

VESTLANDSBANEN FEASIBILITY STUDY - DELIVERY 1

Deliverable 7.1: Passenger Transport Model

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EXECUTIVE SUMMARY

Introduction

Vestlandsbanen over Haukeli is a proposed high-speed railway network for long-distance, regional and freight services connecting Bergen, Haugesund and Stavanger in western Norway with Oslo and Skien in the east. The network comprises 30 stations and 650 km of new double-track railway designed for operating speeds of 250 km/h or higher. Vestlandsbanen will provide seven interconnections with the existing railway network and includes a new independently aligned route between Oslo Central Station and Drammen via Majorstua, with connections to the existing railway.

The average travel time between Oslo and Bergen is estimated at 2 hours and 20 minutes, including 9 to 10 intermediate station stops selected from a total of 17 stations along the 411 km route, following an alternating and regular stopping pattern. For services between Oslo and Stavanger, the average travel time is estimated at 2 hours and 27 minutes, including 8 to 9 intermediate stops selected from a total of 17 stations along the 431 km route. Very short travel times have also been calculated for all other travel movements within the Vestlandsbanen network, reflecting the fact that all passenger services will be operated exclusively by long-distance trains.

Vestlandsbanen has been conceived as an integral component of an efficient and resilient national transport system, strengthening connectivity both within Norway and with neighbouring countries. The scheme is expected to deliver significant economic and environmental benefits at a national level.

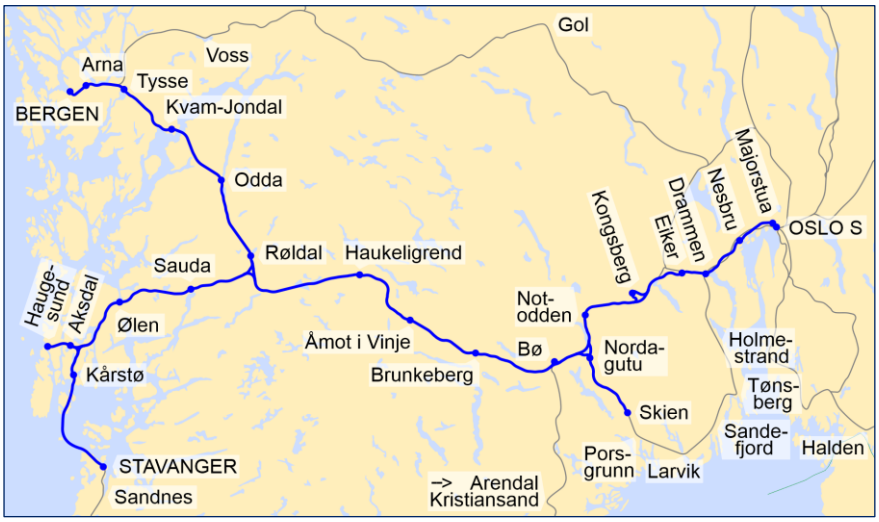

Figure A: Vestlandsbanen alignment, station locations (blue dots), and interconnections with the existing railway network.

This document is the seventh report in Sener's Vestlandsbanen Feasibility Study series. It provides a comprehensive description of the passenger transport model developed by Sener to assess the impacts of introducing high-speed rail services within the corridor and to forecast future modal shift and induced travel demand.

Key findings

The passenger demand forecasts for the Vestlandsbanen model network, defined as demand on Vestlandsbanen together with the additional demand generated on Vestfoldbanen and the Bø-Kristiansand section of Sørlandsbanen, for the opening year (set to 2035 for this study) have been developed using a cautious forecasting approach, high geographical resolution and conservative assumptions throughout the modelling process. The results are as follows:

- Approximately 119,400 rail passengers per day.
- An annual passenger transport work of 6.043 billion passenger-km.

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- An annual fare revenue of NOK 13.248 billion, equivalent to NOK 2.19 per passenger-km.
- An average passenger line load of 21,600 passengers per day on Vestlandsbanen. The line load is defined as the total number of passengers travelling on a railway section between two consecutive stations, and the average value is calculated as the weighted average across all such sections. Figure B below presents the estimated line load for the various sections of the Vestlandsbanen model network.



Figure B: Estimated daily passenger line load on the different sections of the Vestlandsbanen model network in 2035.

The demand forecasts presented above are exceptionally high, not only in relation to Norway's population but also when benchmarked against other relevant indicators. This is illustrated by the following examples:

- The forecast passenger transport work on the Vestlandsbanen model network in 2035 is more than 50% higher than the passenger transport work recorded across the entire Norwegian railway network in 2025.
- The forecast average line load on Vestlandsbanen in 2035 is significantly lower than the average line load on the French high-speed rail network, slightly lower than that of Germany, and higher than that of Spain. It should be noted that the continued expansion of the European high-speed rail network has generated substantial socio-economic benefits over recent decades and has been accompanied by sustained growth in passenger demand. The forecasts for Vestlandsbanen relate to the commencement of operations and can therefore reasonably be expected to increase further over time.

Nevertheless, the strong demand forecasts are consistent with the specific characteristics of the Vestlandsbanen corridor:

- Norwegians undertake a high volume of travel, particularly over longer distances.

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- Challenging topography and demanding winter driving conditions, which contribute to Norway having by far the highest level of domestic air travel per capita in Europe, also indicate strong demand for fast, reliable rail services.
- The relatively short distances between Oslo and the principal population centres along the western coast allow rail services to offer shorter end-to-end journey times than air travel, while simultaneously serving a dense station network.
- The Vestlandsbanen network concept enables travel demand from multiple corridors and directions to be consolidated, thereby improving both network competitiveness and the relationship between demand and infrastructure investment costs.

These factors collectively underpin the high passenger demand forecasts. In addition, the corridor is characterised by strong freight transport demand, favourable conditions for efficient railway operation, and generally favourable geological conditions for tunnel construction. Together, these factors support the strong economic performance and expected profitability of the Vestlandsbanen project.

Origin of demand and regional demand patterns

Table A below presents the proportion of total demand expected to arise from modal shift from air travel, private car use and existing public transport services, together with the proportion attributable to induced demand. Figure C on the following page illustrates travel demand between twelve station groups defined by Sener to support the analysis of regional travel patterns within the Vestlandsbanen model network.

Origin of HSR demand	Journeys per day	HSR transport work, million pkm per year	HSR ticket revenues, million NOK per year	Share of total transport work, %	Share of total ticket revenues, %
From air, total	13,696	1,940.1	4,155.5	32.1	31.4
From air, OD trips only	10,769	1,526.7	3,277.0	25.3	24.7
From air, transfer trips	2,927	413.3	878.5	6.8	6.6
From private cars	64,733	2,094.5	4,652.5	34.7	35.1
From public transport	9,788	338.2	805.0	5.6	6.1
Induced demand	31,155	1,669.9	3,634.7	27.6	27.4
Total demand	**119,372**	**6,042.7**	**13,247.7**	**100.0**	**100.0**

Table A: Origin of passenger transport demand within the Vestlandsbanen model network.

The results presented in Table A indicate that modal shift from air travel and modal shift from private car each account for approximately one-third of total demand. The remaining demand is generated through a combination of modal shift from existing public transport services and induced travel demand.

Figure C shows that rail journeys between Stavanger, Bergen, Arna, Nesbru, Majorstua and Oslo S, representing the three largest urban regions in Norway, account for 43.5% of the total Vestlandsbanen market. However, the numerous lower-volume travel markets collectively contribute 56.5% of total passenger transport work, highlighting the importance of the wider regional market served by the Vestlandsbanen network.

A detailed analysis of the forecasts indicates that overall air passenger demand within the Vestlandsbanen model network is expected to decrease by 74.2%, increasing to 77.0% when air services to and from Sandefjord and Kristiansand are excluded. At the same time, the network is forecast to attract a substantial number of travellers from private car across almost the full range of travel distances, from approximately 20 km to more than 500 km.

These findings demonstrate that Vestlandsbanen should not be regarded solely as a mode for long-distance travel, a market currently dominated by air transport. Rather, the network is expected to serve a broad spectrum of travel markets and to exert a significant influence on Norway's wider transport system.

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For example, a major reduction in road congestion and environmental impacts is expected for E18 near Oslo, as the number of road travellers east of Drammen is estimated to decline by about 11,000 to 14,000 per day. This may also allow future highway investments driven solely by capacity constraints to be deferred or avoided altogether. Similar applies to airport investments solely motivated by such constraints.

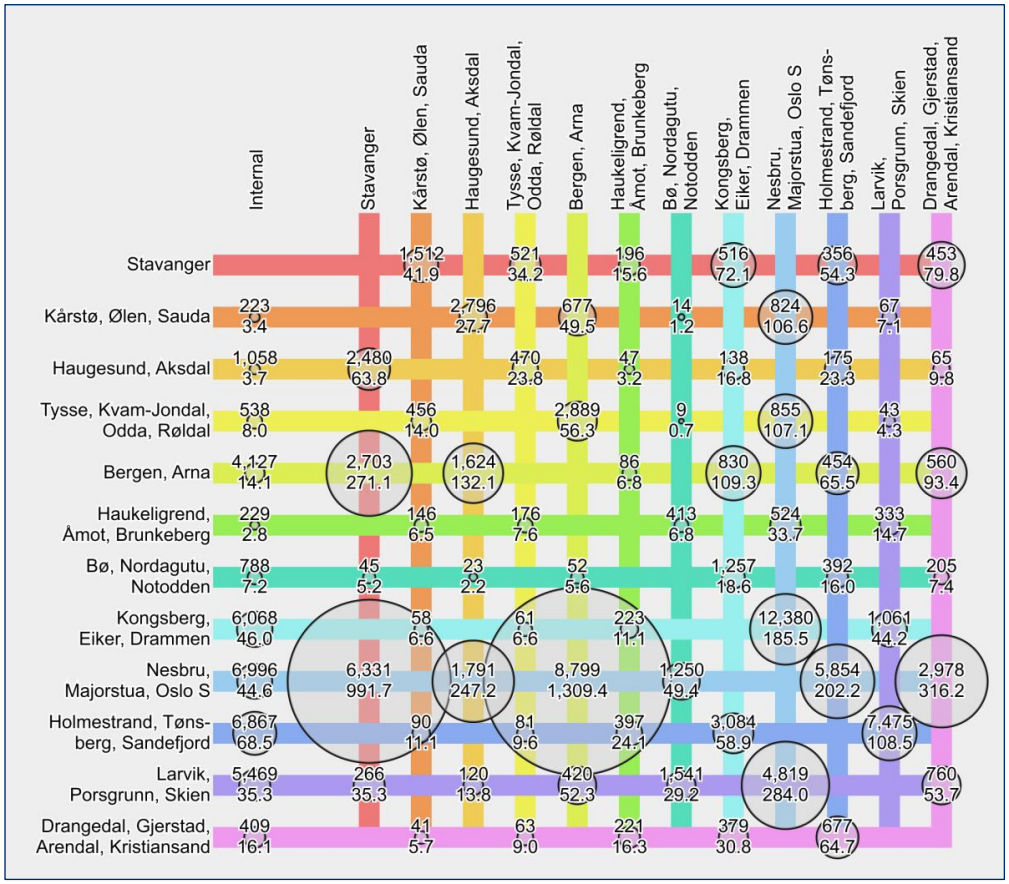

Figure C: Estimated passenger demand between twelve station groups in 2035, showing daily passenger volumes (upper value) and corresponding annual passenger transport work (lower value). The area of each circle is proportional to the transport work.

The modelling methodology

Following an assessment of a range of potential approaches, Sener elected to develop its passenger transport model using the Norwegian Institute of Transport Economics' (TØI) National and Regional Transport Models (NTM6 and RTM), combined with the core structure of the Norwegian High-Speed Rail Demand Model (NHSRDM) developed by Atkins in 2010 and 2011. The NHSRDM incorporated a Stated Preference survey, providing insight into the factors influencing travellers' choice between different, existing or prospective transport modes.

This approach provided access to the most up-to-date data on travel demand, journey distances, travel times and travel costs across all transport modes for every origin-destination pair within the Vestlandsbanen area of influence, comprising 1,075 model zones. Sener incorporated forecasts of population growth, economic development and future transport network enhancements in Norway. In addition, a series of adjustments were applied both to the demand data and to the behavioural parameters derived from the Stated Preference survey in order to improve model consistency and performance. Several of these parameters would otherwise have contributed to significant inaccuracies in the forecast results.

The methodology is founded on the application of mathematical logit functions to estimate both modal shift and induced demand. The underlying principle is that travellers generally perceive travel as a disutility, as journeys involve both monetary costs and time expenditure. It is further assumed that the various components contributing

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to the overall inconvenience of a journey can be separately evaluated, weighted according to their relative importance, and aggregated into a single composite measure. This measure, referred to as 'utility', enables direct comparison between alternative travel options and facilitates the estimation of their respective market shares. A similar approach is applied in the estimation of induced demand.

The utility calculation incorporates a broad range of journey attributes, including access and egress times and costs to and from stations or airports, pre-boarding time, in-vehicle travel time and cost, service frequency, and interchange requirements. These components are weighted using differentiated parameters for work and non-work travel, as well as for journeys where air services are either available or unavailable. Accordingly, considerable effort has been made to define the characteristics of each transport mode as accurately and consistently as possible.

In addition, Sener has developed a dedicated and deliberately conservative methodology for forecasting demand associated with journeys of less than 100 km. A similarly cautious approach has been adopted for estimating modal shift from air passengers making transit or transfer journeys.

Characteristics of the high-speed rail services

Sener developed the proposed train operating plan for Vestlandsbanen, Vestfoldbanen and the Bø–Kristiansand section of Sørlandsbanen through a structured, iterative process comprising:

- Calculation of train running times, taking account of local Norwegian weather conditions.
- Consideration of minimum service frequency requirements at individual stations.
- Assessment of train capacity utilisation across the various routes.
- Development of an operating plan and its progressive refinement in response to the demand forecasting results.

Figure D presents the final service concept resulting from this process. Solid lines represent one train service per hour in each direction, while dotted lines represent one service every two hours. Solid black circles indicate the station is served by every train, half-black/half-white circles indicate that the station is served by every second train, and white circles indicate the station is not served by the route concerned.

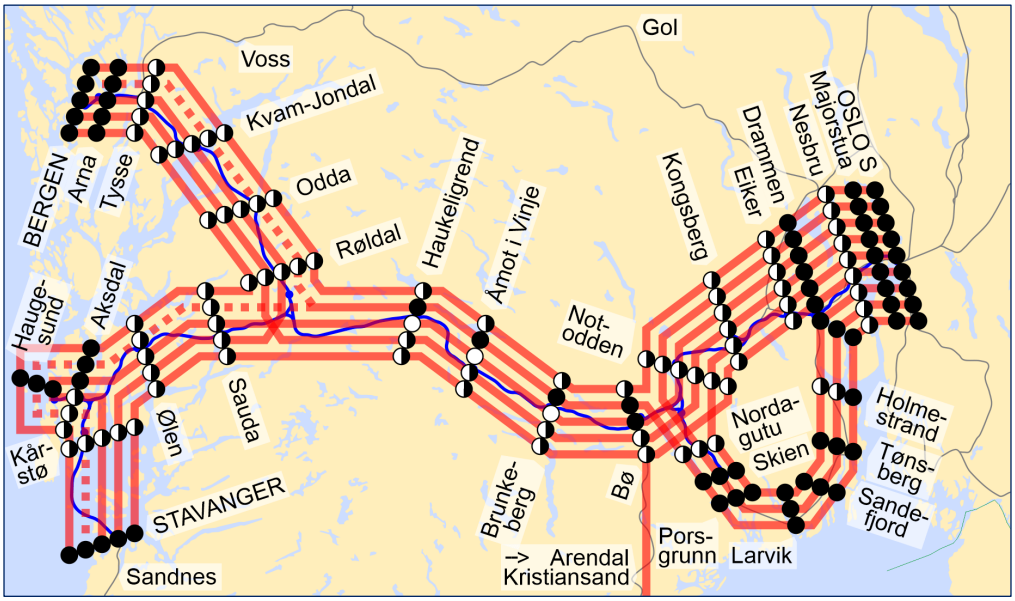

Figure D: Schematic representation of direct train services and service frequencies within the Vestlandsbanen model network. It should be noted that trains will serve additional stations beyond those shown in the diagram.

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For demand forecasting purposes, Sener defined a model network comprising all Vestlandsbanen stations, together with four stations on Sørlandsbanen south of Bø and five stations on Vestfoldbanen, as shown in Figure D. However, the travel time calculations take into account stops at the same frequency at all stations currently served on Vestfoldbanen and Sørlandsbanen.

In addition, Sener established a ticket pricing model to calculate average fares. Under this approach, a journey of 400 km generates an average fare of NOK 1,080 for work journeys and NOK 648 for non-work journeys. For a journey distance of 100 km, the corresponding average fares are NOK 330 and NOK 198 respectively. Detailed information on average ticket fares and travel times for each station-to-station pair can be found in Appendix 3.

Sener also assessed both travel-time and fare elasticities, measuring the sensitivity of demand to variations in travel time and ticket price. The travel-time elasticity analysis did not identify a compelling case for further reducing the travel times of the fastest services, for example through the removal of intermediate stops. Instead, the findings suggest that greater benefits may be achieved through measures that enhance network accessibility, operational flexibility and regional connectivity.

With regard to fare elasticity, the analysis produced values greater than −1 across all journey distances and for demand transferred from all competing transport modes. This indicates that, while higher fares would reduce passenger demand, the percentage reduction in demand would be smaller than the corresponding percentage increase in fares. Consequently, total fare revenue would increase. This is an important consideration for future cost-benefit assessments and financial evaluations of the scheme.

Finally, the report describes the measures adopted by Sener to identify, manage and mitigate the various sources of uncertainty inherent within the forecasting process. Overall, the assessment concludes that the methodology, assumptions and calibration approach adopted provide a robust and reliable basis for the forecast results, including under scenarios involving less favourable economic and demographic development than is currently anticipated for Norway.

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1 OBJECTIVE

As part of the Vestlandsbanen Feasibility Study – Delivery 1, Sener has developed a new Passenger Transport Model to analyse the impact of introducing a High-Speed Rail (HSR) service in the Vestlandsbanen corridor. The model is designed to estimate future modal share shifts and induced demand across all zones within a defined network, incorporating multiple transport modes – air, car, and public transport – as well as different travel purposes (work and non-work).

The model developed under Delivery 1 serves as a mathematical representation of numerous network characteristics, including population size, average income, and both current and projected travel times, costs, and quality parameters across all transport modes.

The model simulates traffic variations driven by changes in transportation services, population trends, economic conditions, and similar factors. It also illustrates the relationship between demand and changes in transportation services, such as the impact of a significant reduction in flight departures – initially due to many air travellers shifting to high-speed rail, and subsequently as a factor that amplifies this effect. Moreover, new railway lines can influence settlement patterns and industrial production; however, the transport-related consequences of these changes cannot be captured by the model. These limitations are considered in the uncertainty analysis.

This Deliverable also provides a comprehensive overview of the methodological framework adopted to ensure robust and reliable demand forecasts. Specifically, it addresses:

1. **Input Data and Adjustments**: The initial travel matrices, the rationale behind their selection, and the adjustments applied to ensure consistency.
2. **Zoning**: The definition of zones within the Vestlandsbanen study area.
3. **Growth Factors**: The calculation of growth rates at the zone level and their application in demand forecasting.
4. **Model Formulation**: The hierarchical logit structure and parameter estimation process.
5. **Results**: The outcomes obtained after applying the model to future scenarios with and without Vestlandsbanen.

2 LIST OF ACRONYMS

Acronym	Description
SSB	Statistisk Sentralbyrå (Statistics Norway)
NTM6	National Transport Model, version 6
RTM	Regional Transport Model
TØI	Transportøkonomisk Institutt (Transport Economics Institute)
HSR	High-Speed Rail
CBA	Cost Benefit Analysis
OD	Origin-Destination
LoS	Level of Service

3 INTRODUCTION

Considering the specific objectives of this study and the challenges encountered during its development, an evaluation was carried out to identify the most suitable methodological approaches for estimating future demand for the new High-Speed Rail (HSR) mode in the Vestlandsbanen corridor.

Initially, the plan was to acquire and use mobile phone data from recent years to inform the passenger transport model. However, due to challenges in obtaining reliable travel matrices from mobile phone data and the lack of

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accuracy in the data provided, it was decided to rely on existing passenger transportation models in Norway – specifically the national transport model (NTM6) and the regional transport models East, South, and West (RTM). These models were developed by Transportøkonomisk institutt (TØI) and made available to Sener by Statens Vegvesen.

Sener utilised initial matrices covering travel volumes, travel times, travel distances, and direct travel costs for car trips (including road tolls and ferry costs) in recent years, for various travel purposes and transport modes. These data provide a comprehensive view of mobility within the country.

No Stated Preference or Revealed Preference surveys were conducted during this phase of the study. Such surveys allow travellers to indicate which combinations of factors influence their choice among different existing or future transport modes. However, in 2012, as part of the Norway High Speed Rail Assessment Study – which Jernbaneverket (the Norwegian Rail Administration at that time) was commissioned to conduct – a mode choice model for High-Speed Rail (*Norwegian High Speed Rail Demand Model, NHSRDM*) was developed by Atkins.[1] They estimated a model based on Stated Preference surveys conducted in December 2010 and January 2011.

In light of this situation, Sener decided to use data from NTM6 and RTM as a starting point, combined with the basic formulation of the Norwegian High-Speed Rail Demand Model (NHSRDM) developed by Atkins. This approach provides the most recent demand and level-of-service (LoS) data – covering travel distances, times, and costs for all transport modes, various travel purposes, and all origin-destination zone pairs – while also offering valuable insights into user preferences for HSR.

On this initial model, adjustments were applied to both the matrices and the parameters governing the model's functionality. The matrices were aligned with values collected from official statistical sources for different transport modes, while the parameters were refined through an iterative process based on international experience and the specific conditions of the Vestlandsbanen corridor.

These adjusted matrices and the refined demand model were then used to simulate traffic across different transport modes for two future scenarios: one without Vestlandsbanen and one with Vestlandsbanen. In both cases, projections of Norway's population, economy, and transport network development were taken into account. Additionally, the model provided key input data for the cost-benefit analysis (see Deliverable 8 of Sener's study), including time savings for travellers shifting to HSR from other transport modes.

4 EXISTING NORWEGIAN PASSENGER TRANSPORT MODELS

The main characteristics of the existing NTM6 and RTM matrices, along with the assumptions made during the development of Sener's new model, are presented in the following sections.

4.1 Input travel data: National Transport Model (NTM6)

The existing National Transport Model (NTM6) covers domestic journeys longer than 70 km one way, made by residents in Norway, age 13 or older. This means that the NTM6 data does not include journeys made by foreign tourists or business travellers to, from or within Norway, nor does it cover journeys made by Norwegians to other countries – not even those parts of such trips that take place on Norwegian territory.

The NTM6 model comprises 1,553 zones in Norway, and travel demand and level-of-service (LoS) matrices for all possible pairs of origin and destination zones. The matrices are differentiated for car traffic (specified for both fossil fuel and electric cars, car drivers and car passengers), air traffic and public transport (bus, boat and existing train services, but without any distinction between those three modes of public transportation).

[1] "Norway High Speed Rail Assessment Study - Phase III: Model Development Report, Final Report", Atkins 25.01.2012, https://banenor.brage.unit.no/banenor-xmlui/handle/11250/155084

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With very few exceptions, these 1,553 zones correspond to the areas labelled “delområde” by SSB. They represent parts of municipalities, with the number of “delområder” per municipality varying significantly. For example, Oslo consists of 60 “delområder”, while several smaller municipalities have only one “delområde”. Sener has focused the development of its transport model on the 1,075 zones located south of Trøndelag and Møre og Romsdal, as these are most relevant to the Vestlandsbanen corridor.

The NTM6 matrices extracted (version 1.48.11) were estimated for the year 2020, assuming a “normal” situation prior to the COVID-19 impact that began in March. However, 2020 was atypical in terms of mobility due to pandemic-related restrictions. Therefore, 2019 data was used when comparing the matrices extracted from the NTM6 model with official mobility data for air travel, car trips, and public transport. This explains why, in this study, the NTM6 matrices are also referred to as 2019 matrices.

The NTM6 matrices have been defined for:

- Two (2) types of trips based on the distance:
  - Medium (MD): 70–200 km one way
  - Long (LD): over 200 km one way
- Five (5) trip purposes:
  - to/from working place,
  - leisure,
  - private,
  - business/duty and
  - visit.

Sener has grouped them into:

- “Work” (to/from working place and business/duty) and,
- “Non-Work” (leisure, private and visit).

It should be noted that when a trip involves multiple modes of transport, the main mode determines whether it is classified in the NTM6 matrices as an air, car, or public transport trip. For example, a trip from Skien to a location near Tromsø, using a car from Skien to Gardermoen (Oslo Airport), a flight from Gardermoen to Langnes (Tromsø Airport), and a bus for the final leg, is classified as an air trip. Consequently, the car segment from Skien to Gardermoen and the bus segment from Langnes (even if longer than 70 km) are not recorded in the NTM6 transport matrices.

The limitations listed above – including the absence of cross-border trips, trips by children aged 12 or younger, trips by foreign citizens to, from and within Norway, and trip legs not classified as the main mode of transport – require adjustments to the data provided by NTM6. With few exceptions, Sener applied such adjustments to all transport modes and to both long-distance (LD) and medium-distance (MD) trips, as these limitations affect them all. During its investigation to collect official data, Sener also received verbal confirmation that the NTM6 travel matrices had been calibrated in previous years against traffic counts on roads and airports. This suggests that the necessary adjustments may be less extensive than the definition of the NTM6 travel matrices would initially indicate. Nevertheless, they are by no means insignificant.

4.2 Input travel data: Regional Transportation Model (RTM)

The existing Regional Transport Models (RTM) consist of five regional models: East, South, West, Middle, and North. For the Vestlandsbanen study, the relevant regions are East, South, and West, which cover the following counties:

- East: Oslo, Akershus, Østfold, Buskerud and Innlandet
- South: Vestfold, Telemark and Agder
- West: Rogaland and Vestland

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The regional transport models cover trips of less than 70 km one way. Each of the five regional models includes matrices for trips within the region as well as to and from a peripheral zone extending approximately 30 km. This peripheral zone is essential because it ensures that cross-border trips – for example, between RTM East and RTM South – are captured in the model. Without these peripheral zones, trips that start in one region and end in another would be excluded, leading to an incomplete representation of travel patterns and potentially inaccurate demand forecasts.

The travel matrices for the three study regions (West, South, and East) were estimated for the same period as the NTM6 matrices (year 2020, assuming pre-COVID-19 conditions). They cover car traffic – differentiated by fossil fuel and electric vehicles, as well as car drivers and passengers – and public transport. The matrices distinguish up to six trip purposes: commuting to/from the workplace, business/duty, leisure, pick-up/delivery, private, and workplace-based trips. For modelling purposes, Sener grouped these into two categories: “Work” (commuting, business/duty, and workplace-based) and “Non-Work” (leisure, private, and pick-up/delivery).

Compared to the NTM6 model, the number of zones embedded in the RTM models is much higher. RTM West covers 3,800 zones, RTM South 5,469 zones, and RTM East 5,773 zones. Sener has merged the RTM zones to the corresponding NTM6 zones.

Unlike NTM6 data, the RTM data also include trips crossing the border into Sweden. However, there are virtually no trips to or from Sweden shorter than 70 km that are relevant for the Vestlandsbanen corridor, located west of Oslo. Therefore, Sener has not used these travel matrices.

There are also matrices available for school trips. However, the matrices for school trips by car contain a complete set of information only for the RTM East model. The car matrices for the other regional transport models (South and West) contain no or only tiny amounts of information. To maintain consistency, Sener has therefore excluded school trip matrices by car and public transport for all regions.

The RTM models also provide matrices for car trips to and from the nearest airport. While some of these trips could be relevant for the Vestlandsbanen study – as illustrated in the previous chapter with the first leg of a Skien–Tromsø trip – others are not. For example, a car trip from Ølen (Vindafjord municipality) to Haugesund Airport as the first leg of a trip to Oslo would not contribute to Vestlandsbanen’s traffic potential, since a high-speed train would connect Ølen directly to Oslo without increasing demand between Ølen and Haugesund. Consequently, Sener has not used these trips from the RTM data.

4.3 Input data: Level of Service (LoS)

Sener has used Level of Service (LoS) matrices for travel distances, travel times, and direct costs (such as road tolls and ferry charges) for car trips. These matrices were available for all pairs of NTM6 zones, for three different travel purposes (to/from work, duty/business and leisure), and for the same period as the travel matrices (2020, assuming pre-COVID-19 conditions). For other car trip costs, which depend on driving distances, estimates from external sources were applied. The same approach was used for travel times and costs for air trips.

On the other hand, Sener has not attempted to estimate corresponding figures for public transport, primarily due to uncertainties regarding the market shares of buses and existing rail services. This limitation increased the complexity of the model calculations, as described in Chapters 8.2.1 and 8.2.2.

A comparison of the Level of Service (LoS) data for car travel distances with external sources such as Google Maps and GuleSider/kart indicates a high degree of correlation. However, for car travel times, the LoS matrices frequently report significantly shorter durations than those provided by other sources. For example, the average speed derived from LoS data for a car trip from Sandvika in Bærum municipality, via Oslo city, to Oslo Airport Gardermoen is 88.2 km/h – a speed achievable only under conditions of zero traffic congestion.

A similar pattern is observed for long-distance trips. According to Google Maps, the estimated driving time for a car journey from Sandvika in Bærum to Norheimsund in Kvam, retrieved in summer 2025, is approximately six hours. In contrast, the LoS matrices suggest that the 373 km route via Rv 7 across Hardangervidda can be completed in 5 hours and 20 minutes – 40 minutes faster.

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These and other comparisons indicate that the car travel times in the LoS matrices are theoretically achievable, but only under optimal conditions. These conditions include:

- No delays due to traffic congestion
- No delays due to snow and ice on road
- No delays due to convoy driving on high mountain sections
- No delays or additional cost due to closed roads and long detours in winter
- No delays due to road works
- No delays due to necessary breaks for the car driver on long-distance trips.

Overall, this results in a notable discrepancy between the car travel times reported in the LoS matrices and the actual travel times typically experienced on an average day. Nevertheless, the LoS matrices provided as part of the NTM6 model remain the most comprehensive and accurate non-commercial network dataset available in Norway, representing a highly valuable resource for Sener's development of a new passenger transport model.

It is also important to note that the Norwegian road network is continuously being upgraded and shortened. As a result, the difference between the travel times indicated in the LoS matrices and those realistically achievable in future years is expected to gradually diminish. This has been taken into account in the model development, as described in Chapter 6.2.

4.4 Zoning for the Vestlandsbanen study area

Sener's development of a new passenger transport model for the Vestlandsbanen corridor has focused on 1,075 zones located across the counties of Vestland, Rogaland, Agder, Vestfold, Telemark, Buskerud, Akershus, Oslo, Østfold, and Innlandet. This area is highlighted in purple in the figure below.

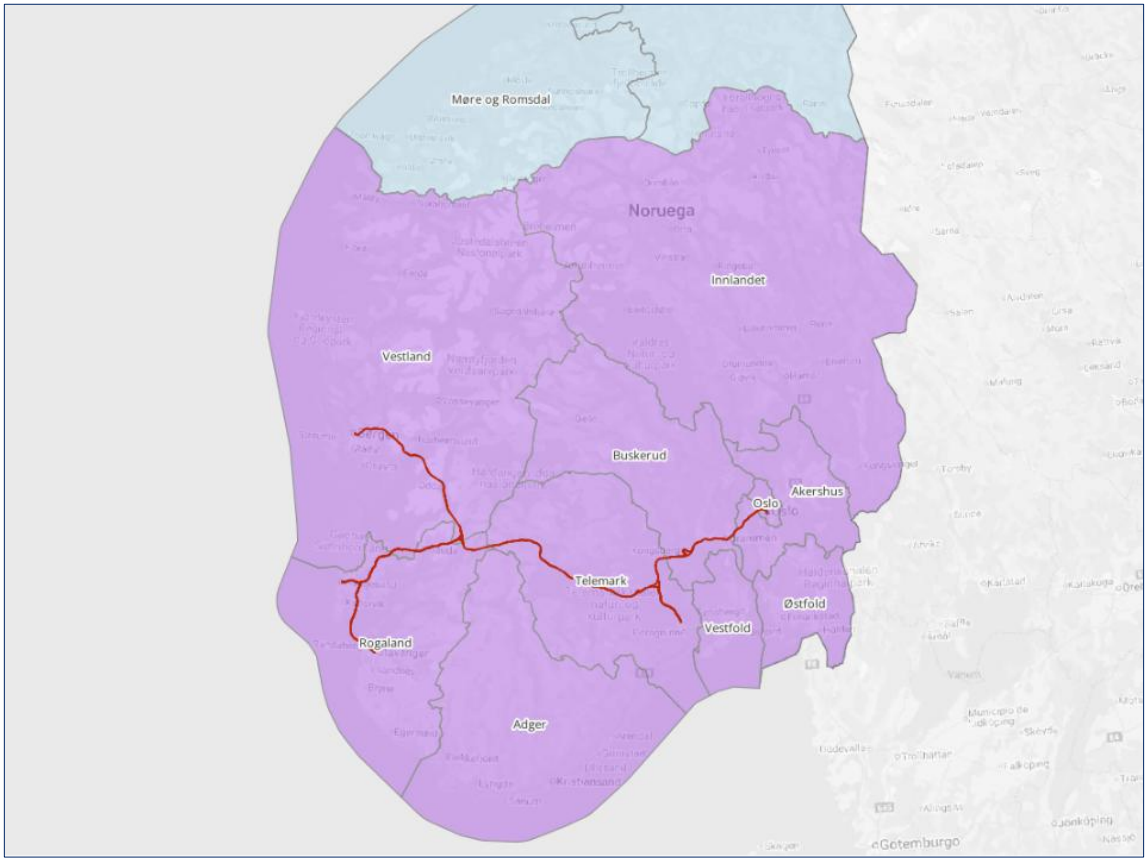

Figure 1: The counties in the Vestlandsbanen Study Area

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However, this does not mean that trips to and from Trøndelag, Møre og Romsdal, and Northern Norway are excluded from the new model. For example, air passengers traveling from Haugesund to Bodø are included because they first fly to Oslo and then transfer to another flight from Oslo Airport Gardermoen to Bodø. As a result, they are recorded as transfer passengers on the Haugesund–Oslo route.

In addition, some long-distance car traffic to and from regions outside the Vestlandsbanen study area is included due to road traffic adjustments, as explained in Chapter 5 on input travel data adjustments.

However, a significant transport potential remains unaccounted for – particularly if other high-speed rail sections, such as between Oslo and Trondheim – are completed alongside or shortly after Vestlandsbanen. These potential impacts are addressed in the uncertainty analysis.

For this study, Sener has also developed a zoning system called “Micro regions.” This corresponds to the same zoning described in Deliverable 2.2 (*Current Demand for Freight Transport* report) and included in Appendix 1 of this report. In total, there are 36 Micro regions within the 10 counties covered by the Vestlandsbanen study area.

5 INPUT TRAVEL DATA ADJUSTMENTS

As outlined in the previous chapter, certain modifications to the input travel matrices were necessary to ensure consistency and accuracy in the model. These adjustments address discrepancies in the original datasets and incorporate refinements to better reflect observed travel patterns. The specific adjustments applied are detailed in the following subsections.

5.1 Air travel matrices

An important prerequisite for further analyses is obtaining data on pure origin-destination (OD) traffic between airports in Norway. This data can be directly compared with NTM6 to determine adjustment factors for air traffic.

Pure OD traffic refers to air travellers who arrive at the departure airport by bus, train, car, or other land transport modes and leave the destination airport using similar means. It can be assumed these passengers are travelling between areas near the airports. In addition to this, there are other air passengers classified as transit or transfer passengers:

- Transit Passenger: Passengers who arrive at an intermediate airport by plane, make a brief stop and continue by the same plane to their destination airport. They do not leave the plane during their stop.
- Transfer Passenger: Passengers who arrive at an intermediate airport by plane and change there to another plane before continuing to their destination airport. They may need to pass through security or collect their luggage, depending on the airport or airline requirements.

Data on pure origin-destination (OD) traffic between airports in Norway is not directly available but can be derived from various sources. The methodology for this calculation is illustrated using the Stavanger–Oslo air route as an example.

As listed in SSB table 08510,[2] the total number of passengers in 2019 on the Stavanger–Oslo route was 1,681,389, both directions together. 842,477 passengers flew from Stavanger to Oslo and 838,912 from Oslo to Stavanger. The table tells us that 256,327 of the 838,912 westbound passengers were arriving in Oslo airport Gardermoen by plane (256,273 transfer passengers and 54 transit passengers). And 13,322 of the 842,477 eastbound passengers were arriving in Stavanger airport Sola by plane.

[2] https://www.ssb.no/statbank/table/08510

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Origin airport	Destination airport	Passenger group	Passengers
Stavanger Sola	Oslo Gardermoen	Passengers on board at departure	842,477
		Passengers on board at departure changing flights (Transfer)	13,169
		Passengers on board at departure in transit	153
Oslo Gardermoen	Stavanger Sola	Passengers on board at departure	838,912
		Passengers on board at departure changing flights (Transfer)	256,273
		Passengers on board at departure in transit	54

Table 1: Passengers between Oslo and Stavanger in 2019. Source: table 08510, SSB

However, there is no available information on the number of transit or transfer passengers travelling in the opposite direction, that is, passengers who continued their journey by air either after arriving at Stavanger airport on a westbound flight from Oslo or after arriving at Oslo airport on an eastbound flight from Stavanger.

To address this data gap, Sener assumed a balance between inbound and outbound transfer flows. Specifically, the number of passengers arriving at Oslo airport by plane before departing westbound to Stavanger was considered approximately equal to the number of passengers departing from Oslo airport by plane after arriving on an eastbound flight from Stavanger. Similarly, the number of passengers arriving at Stavanger airport by plane before departing eastbound to Oslo was assumed to be roughly equivalent to the number of passengers departing from Stavanger airport by plane after arriving on a westbound flight from Oslo.

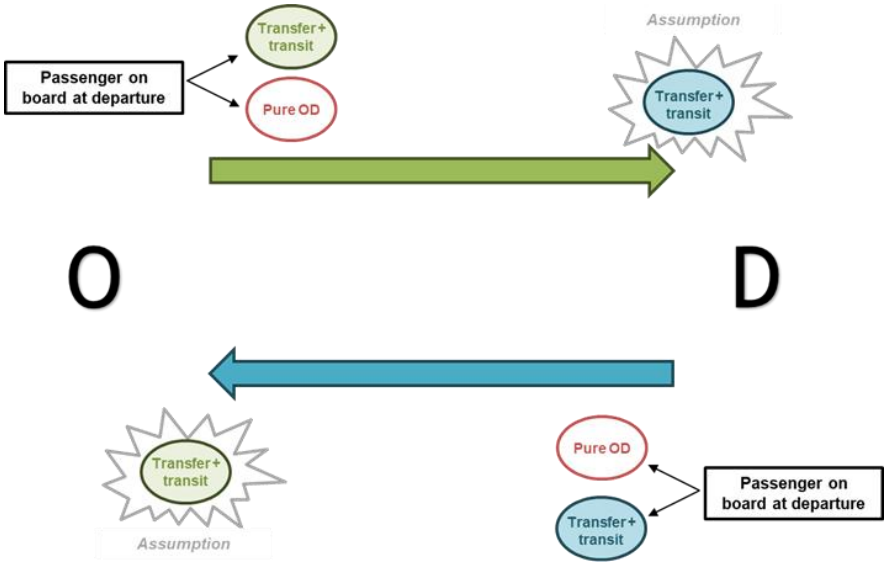

Figure 2: Assumption about transfer and transit behaviour

Under these assumptions, it is possible to calculate the share of pure OD passengers. At Oslo Airport, 256,327 out of 838,912 westbound passengers, approximately 30.55%, were transfer or transit passengers, while the remaining 69.45% can initially be regarded as pure OD passengers. However, some of these westbound passengers arriving in Stavanger continued their journey by air to another destination. This share is likely similar to the proportion of passengers who arrived at Stavanger Airport by plane and continued to Oslo, which is 13,322 out of 842,477, or 1.58%. Therefore, the total share of pure OD passengers is calculated as 68.35% (69.45% × 98.42%). Based on these percentages, the number of pure OD passengers between Oslo and Stavanger in 2019 was approximately 1,149,182.

The same procedure can be applied to all air routes of interest within the study area. The results of these calculations are presented in the table below:

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Airport to airport route	Pure OD passengers	Transfer+transit pass.	Total air passengers
Bergen/Stord-Oslo	1,543,285	499,176	2,042,461
Stavanger-Oslo	1,149,182	532,207	1,681,389
Bergen-Stavanger	412,179	165,993	578,172
Haugesund-Oslo	270,428	202,723	473,151
Kristiansand-Oslo	262,807	247,270	510,077
Bergen-Sandefjord	134,370	24,283	158,653
Bergen-Kristiansand	122,377	27,325	149,702
Stavanger-Sandefjord	75,711	4,047	79,758
Total	**3,970,339**	**1,703,024**	**5,673,363**

Table 2: Air passengers between airports, 2019. Source: SSB, table 08510.

Considering both directions of the air routes and based on Table 08510 from Statistics Norway (SSB) for 2019, a total of 5.67 million air passengers were registered on relevant routes within the Vestlandsbanen area of influence (including routes to and from Sandefjord and Kristiansand). Of these, approximately 3.97 million passengers (70%) were pure OD travellers, while 1.70 million passengers (30%) were transfer or transit passengers. In addition, several other air services – such as Bergen–Haugesund, Oslo–Sandefjord, and Kristiansand–Stavanger – were operated as charter flights with very few passengers and have therefore not been considered in this study.

Comparison of SSB data and NTM6 travel matrices

The figures in the table above have been cross-referenced with the corresponding matrix data extracted from the National Transport Model (NTM6). This process involves defining the catchment areas of various airports, which, by nature, can only be estimated approximately. Many travellers have access to more than one airport in their vicinity and make their choice based on factors such as flight availability, convenience, total travel time, and cost. For this study, for example, Sener has set the boundary between the catchment area of Oslo Airport Gardermoen and that of Sandefjord Airport Torp at the administrative border between Buskerud and Vestfold counties. Consequently, all flights to and from Vestfold were considered as routed via Torp, while those to and from Buskerud were assigned to Gardermoen. In practice, of course, alternative routing options exist, with travellers crossing the Buskerud–Vestfold border in both directions.

This allocation of air routes to different regions is detailed in Table 3 below. The numbers in brackets indicate the zone codes of the “Micro Regions” referenced in Chapter 4.4 and Appendix 1.

Air route	Connections between regions assigned to different air routes
Bergen/Stord-Oslo	Former Hordaland County (30-34) - Major parts of south-eastern Norway (1-21, not 17-19)
Stavanger-Oslo	Southern Rogaland (25-27) - Major parts of south-eastern Norway (1-21, not 17-19)
Bergen-Stavanger	Former Hordaland County (30-34) - Southern Rogaland (25-27)
Haugesund-Oslo	Northern Rogaland (28-29)[3] - South-eastern Norway (1-21)
Kristiansand-Oslo	Agder (22-24) - South-eastern Norway, except Vestfold and Telemark (1-16)
Bergen-Sandefjord	Former Hordaland County (30-34) - Vestfold and southern Telemark (17-19)
Bergen-Kristiansand	Former Hordaland County (30-34) - Agder (22-24)
Stavanger-Sandefjord	Southern Rogaland (25-27) - Vestfold and southern Telemark (17-19)

Table 3: Different air routes and connections between regions assigned to these routes.

In this assignment, air traffic to and from the four airports in the former Sogn og Fjordane County (“Micro Regions” 35 and 36) is not considered relevant for the Vestlandsbanen corridor. For trips between these airports and Oslo Airport Gardermoen, high-speed rail on Vestlandsbanen would only be a marginally competitive

[3] For the comparison with the NTM6 figures, Sveio and Etne municipalities in Vestland county have been included in Northern Rogaland, the catchment area of Haugesund airport Karmøy, and consequently been removed from the catchment area of Bergen airport Flesland.

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alternative, as it would require an additional two to six hours by car or boat to reach the nearest station on the western section of the line. For air trips between Sogn og Fjordane and destinations south or southeast of Bergen in the former Hordaland or Rogaland counties, the volume of relevant air traffic is negligible. However, flights to and from Southern Rogaland may form part of transfer traffic on the Bergen–Stavanger route and are accounted for in that context, but not as origin-destination traffic combined with car, bus, train, or boat legs north of Bergen.

Air traffic to and from Stord Airport Sørstokken has not been assigned its own catchment area because, as indicated by RTM data, many travellers to and from the Stord region prefer to use Bergen Airport Flesland. Consequently, the Stord region has been included in Flesland's catchment area, and all air traffic to and from Stord has been treated as routed via Flesland. This introduces only minor inaccuracies, as the Stord–Oslo route represents just 2% of the Bergen–Oslo air traffic volume.

The table below presents the results of comparing SSB data with NTM6 data. Adjustment factors were calculated by dividing the values obtained from SSB by those from the model. On average, SSB values are 8.3% higher than NTM6 values, and many adjustment factors are close to 1. However, some factors exceed 2 or fall below 0.7, making it impractical to apply a single average adjustment factor across all air routes. Therefore, Sener has opted to apply individual adjustment factors for each route, as detailed in the table below.

The significant variation among some of the adjustment factors can be attributed to several causes, but inaccuracies in the NTM6 model are likely the most important. It is worth noting that Atkins, in 2012, during the development of the Norwegian High-Speed Rail Demand Model (NHSRDM), identified very similar discrepancies when comparing actual air traffic figures with data from the NTM5 model – the predecessor of NTM6 – particularly for the Bergen–Stavanger and Oslo-Kristiansand routes.[4]

Airport to airport route	Pure OD passengers, SSB	Pure OD passengers, NTM6	Adjustment factor
Bergen/Stord-Oslo	1,543,285	1,397,507	1.104
Stavanger-Oslo	1,149,182	1,072,968	1.071
Bergen-Stavanger	412,179	178,520	2.309
Haugesund-Oslo	270,428	292,003	0.926
Kristiansand-Oslo	262,807	378,728	0.694
Bergen-Sandefjord	134,370	146,428	0.918
Bergen-Kristiansand	122,377	105,800	1.157
Stavanger-Sandefjord	75,711	95,690	0.791
Total	**3,970,339**	**3,667,644**	**1.083**

Table 4: Comparison between SSB and NTM6 data on pure OD air passengers, and adjustment factors.

5.2 Car travel matrices

A TØI report from 2022 states that, in 2019, passenger car transport work (including rental cars) across the entire Norwegian road network amounted to 66.757 billion passenger-kilometres (pkm). This figure is presented in Chapter 7.1 of "Deliverable 2.1: *Current Demand for Passenger Transport*" and was also available on the SSB website until autumn 2023 as StatBank table 03982.

According to the same TØI-report, the total driving distance of passenger cars across the entire Norwegian road network was 35.867 billion km in 2019, corresponding to an average occupancy rate of 1.86 persons per car.[5]

In autumn 2023, a decision has been made to retroactively reduce the transport work figures for passenger car traffic over several years. According to the new SSB figures for 2019, the total transport work in passenger car

[4] "Norway High Speed Rail Assessment Study - Phase III: Model Development Report, Final Report", Atkins 25.01.2012, Table 2 in chapter 4.1.4.1, page 18, https://banenor.brage.unit.no/banenor-xmlui/handle/11250/155084
[5] Bjørg L. Flotve and Eivind Farstad: "Transportytelser i Norge 1946–2021", TØI-rapport 1929/2022, Table 2 on p. 49 and Table 11 on p. 59, https://www.toi.no/getfile.php?mmfileid=74610.

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traffic in Norway was revised to 57.640 billion passenger-km, while the total driving distance of passenger cars was kept unchanged.[6] As a result, the average occupancy rate was reduced to 1.61 persons per car.

This revision was based on the "Reisevaneundersøkelsen 2018/2019" survey, which presents some limitations, particularly regarding long- and medium-distance trips.[7] These limitations may have influenced the estimated average car occupancy rate. Nevertheless, Sener has adopted a conservative approach and applied an average car occupancy rate of 1.61 for 2019 in the subsequent calculations.

On the other hand, there are also considerably greater uncertainties that need to be addressed. These arise from comparing the national transport work figures mentioned above with the corresponding figures from the NTM6 and RTM models.

The table below shows the NTM6 figures for transport work by car drivers and car passengers respectively, specified for Long-Distance (LD) trips (more than 200 km one way) and Medium-Distance (MD) trips (70-200 km one way), and work and non-work purposes. The table also distinguishes between national figures, calculated for the entire Norwegian road network (in italics), and the corresponding figures for the Vestlandsbanen study area only. The figures are obtained by multiplying the NTM6 travel data (see Chapter 4.1) by the LoS data for trip distances between the centre points of the various NTM6 model zones (see Chapter 4.3).

Range	Purpose	Car drivers, mill. pkm/year		Car passengers, mill. pkm/year		Average car occupancy rate	
		Norway	Study area	*Norway*	Study area	*Norway*	Study area
LD	Work	*244.6*	156.7	*76.1*	47.9	*1.311*	1.306
LD	Non-work	*2,161.9*	1,320.5	*1,667.1*	1,019.4	*1.771*	1.772
MD	Work	*1,035.4*	777.3	*166.5*	128.1	*1.161*	1.165
MD	Non-work	*4,079.8*	3,043.0	*2,163.0*	1,651.0	*1.530*	1.543
LD	All	*2,406.4*	1,477.2	*1,743.1*	1,067.3	*1.724*	1.723
MD	All	*5,115.2*	3,820.3	*2,329.5*	1,779.1	*1.455*	1.466
LD+MD	**All**	***7,521.7***	**5,297.5**	***4,072.6***	**2,846.4**	***1.541***	**1.537**

Table 5: Transport work in 2019 for Long-Distance and Medium-Distance car trips according to NTM6.

The NTM6 transport work figures for 2019 shown in the table above cannot be directly compared with the national figures for transport work (57.640 billion passenger-km) or the total car driving distance (35.867 billion car-km, equivalent to transport work by car drivers only). This is primarily due to differences in methodology, scope, and data definitions between the NTM6 model and the official national statistics.

For instance, the NTM6 figures do not comprise car trips when the car is not the main mean of transport. This is illustrated in Chapter 4.1 by the first leg of a Skien–Tromsø trip when the traveller uses a car from Skien to Gardermoen airport. However, among all car trips in Norway longer than 70 km one way, the share of trips to or from an airport is quite small.

There are also other reasons that could be mentioned. Nevertheless, a comparison of the total transport work by car drivers of 35.9 billion passenger-km with about 7.5 billion passenger-km covered by the NTM6 model, indicates about 28 billion passenger-km by car drivers on trips less than 70 km long.

Furthermore, a comparison of the total transport work by both car drivers and car passengers of 57.6 billion passenger-km with about 11.6 (7.5 + 4.1) billion passenger-km covered by the NTM6 model, indicates about 46 billion passenger-km by car drivers and passengers on trips less than 70 km long. This corresponds to an average

[6] https://www.ssb.no/statbank/table/03982.
[7] https://www.toi.no/getfile.php?mmfileid=71405, chapter 6.2.

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occupancy rate in the Norwegian short-distance car traffic (trips shorter than 70 km one way) of more than 1.6 (46 divided by 28).

However, such an average car occupancy rate for short-distance trips differs greatly from the ratio between the number of all car trips (both car driver trips and car passenger trips) and the number of car driver trips only, covered by the relevant RTM models for the Vestlandsbanen study area (West, South and East). This ratio of 1.15 (the weighted average of 1.067 for work trips and 1.192 for non-work trips) corresponds – with some reservations – to an average car occupancy rate of 1.15, far below 1.6.

Admittedly, a trip ratio is not equivalent to a transport work ratio, as the average car occupancy rate for shorter trips may be lower than that for longer trips within the short-distance category. Furthermore, the RTM average car occupancy rates relevant to the Vestlandsbanen study area are not necessarily identical to the RTM rates for the entire country, despite the very similar occupancy rates for long- and medium-distance trips shown in the two columns on the far right of Table 5.

Nevertheless, the margin of error introduced by these assumptions is relatively small, which highlights the need to adjust the NTM6 and RTM figures, either for car driver transport work, car occupancy rates across the three distance ranges, or all these factors.

Comparison of road traffic counts with NTM6 and RTM travel data

To determine these adjustment factors, it is useful to begin by comparing NTM6 and RTM car traffic data with actual traffic counts from 2019. For this purpose, Sener selected several count points on high-mountain road sections between eastern and western Norway, as well as a count point on the E39 near the Fedafjorden bridge in western Agder. These traffic flows include minimal local traffic and, unlike counts in the greater Oslo area or near the Western Coast, can be accurately allocated to specific origin-destination pairs.

The list below shows the selected traffic count points and the average daily number of passenger cars passing these points in 2019, according to data from Statens Vegvesen.[8] These figures include all vehicles up to 7.5 meters in length to account for motorhomes. However, this approach also includes vans, which are not relevant for this analysis, while excluding passenger cars towing camping trailers, as their total length typically exceeds 7.5 meters.

Road Count Points	Cars/Day
E39 Teistedalstunnelen	5,133
E134 Vågslidtunnelen	1,469
E16 Filefjellstunnelen[9]	727
Rv52 Bjøberg	1,100
Fv50 Geiteryggtunnelen	259
Rv7 Lappestein	1,177
Sum of the four northern roads	**3,263**
Sum of all roads listed above	**9,865**

Table 6: Average daily passenger car counts (vehicle length ≤7.5 m) on selected Norwegian roads, 2019.

These figures have been compared with the NTM6 and RTM travel data. Table 7 on the following page presents the same count points and traffic volumes as listed above, along with the origin and destination areas considered for these flows. It also includes the NTM6 and RTM estimates for car drivers and passengers passing these points on an average day, as well as the corresponding average car occupancy rate. The numbers in brackets behind the origin and destination areas indicate the zone codes for the 'Micro regions' referenced in Chapter 4.4 and Appendix 1.

[8] https://trafikkdata.atlas.vegvesen.no/kart.
[9] The traffic figure includes also passenger cars on the previous E16, outside and parallel with the recently built tunnel (opened 2017).

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		Range	Car driver	Car passn.	Occupancy
E39 Teistedalstunnelen	Southern Rogaland[10] (25-27) – South-eastern Norway (1-21)	LD	1,063.5	796.3	1.749
		MD	5.8	2.5	1.437
		RTM	0.2	0.0	1.005
	Southern Rogaland[11] (25-27) – Southern parts of Agder County[12] (22-23)	LD	408.5	283.7	1.695
		MD	2,377.0	1,005.6	1.423
		RTM	1,722.3	268.7	1.156
	Haugalandet, Ryfylke, Sunnhordland, Bergensområdet and Nordhordland (28-30,32,34) - Southern parts of Agder County[12] (22-23)	LD	218.5	159.5	1.730
		MD	0.4	0.2	1.516
		RTM	0.0	0.0	--
	All traffic flows above	LD	1,690.5	1,239.5	1.733
		MD	2,383.2	1,008.3	1.423
		RTM	1,722.5	268.7	1.156
	Road traffic count: 5,133 or 88.6% of	→	**5,796.2**	**2,516.6**	**1.434**
E134 Vågslidtunnelen	Haugalandet, Ryfylke and Sunnhordland (28-30) – South-eastern Norway (1-21)	LD	859.3	598.9	1.697
		MD	37.0	16.2	1.437
		RTM	106.6	1.5	1.014
	Southern part of Hardanger[13] (31) – South-eastern Norway (1-21)	LD	68.6	47.6	1.694
		MD	35.8	16.5	1.461
		RTM	118.1	2.5	1.021
	Eastern parts of former Hordaland County (31,33) - Agder (22-24)	LD	56.6	39.6	1.700
		MD	8.8	3.9	1.441
		RTM	30.7	0.5	1.017
	Bergensområdet and northern parts of former Hordaland County (32-34) - Telemark (19-21)	LD	102.5	80.0	1.780
		MD	0.3	0.1	1.477
		RTM	0.1	0.0	1.000
	All traffic flows above	LD	1,087.0	766.1	1.705
		MD	81.9	36.7	1.448
		RTM	255.6	4.6	1.018
	Road traffic count: 1,469 or 103.1% of	→	**1,424.5**	**807.4**	**1.567**
E16 Filefjellsstunnelen, Rv52 Bjøberg, Fv50 Geiterygg-tunnelen and Rv7 Lappestein	Former Sogn og Fjordane County[14] (35-36) - Major parts of south-eastern Norway and Agder (1-24, not 13 and 16)	LD	739.1	500.4	1.677
		MD	184.7	78.6	1.426
		RTM	450.5	12.4	1.027
	Bergensområdet and northern parts of former Hordaland County (32-34) - South-eastern Norway, except Telemark (1-18)	LD	1,049.5	834.5	1.795
		MD	77.2	33.2	1.430
		RTM	4.0	0.0	1.012
	Northern part of Hardanger[15] (31) – South-eastern Norway (1-21)	LD	174.0	128.4	1.738
		MD	66.5	28.5	1.429
		RTM	17.0	0.3	1.018
	All traffic flows above	LD	1,962.6	1,463.3	1.746
		MD	328.4	140.3	1.427
		RTM	471.4	12.7	1.027
	Road traffic counts: 3,263 or 118.1% of	→	**2,762.4**	**1,616.4**	**1.585**
All	**Road traffic counts: 9,865 or 98.8% of**	→	**9,983.1**	**4,940.4**	**1.495**

Table 7: Traffic flows on selected roads in 2019, according to NTM6 and RTM models, and corresponding road counts.

[10] Trips from and to the inner parts of Kvinesdal municipality (NTM6 zones 784-786) are not included, as a route via Fv461 probably would be preferred to a route via the E39 bridge over the Fedafjorden.
[11] Trips from and to the inner parts of Kvinesdal municipality are not included, as a route via Fv4090 or Fv461 probably would be preferred.
[12] Trips from and to Hægebostad municipality and the northern parts of Agder County (NTM6 zones 781-782 in 'Micro region' 23 and the entire 'Micro region' 24) are not included, as a route via Fv465, Fv4184 and/or Fv42 probably would be preferred to a route via E39.
[13] The figures include all trips from and to areas in Ullensvang municipality on Folgefonnhalvøya, near Tyssedal and south of Tyssedal (NTM6 zones 952-958).
[14] Trips from and to Årdal municipality (NTM6 zones 1043-1044) are not included, unless the destination or origin is in western Buskerud, eastern Telemark or western Telemark ('Micro regions' 9, 20 or 21). In these cases, trips from or to areas on the northern side of the Nord-fjorden (NTM6 zones 1060-1068 and 1072-1075) are not included either, as a route via Rv15 and Strynefjellet probably would be preferred.
[15] The figures include all trips from and to Kvam, Ulvik and Eidfjord municipalities, as well as trips from and to the Kinsarvik area in Ullensvang municipality (NTM6 zones 959-962 and 973-976).

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The comparisons in Table 7 should be interpreted with caution. Route choices made by individual drivers depend on factors such as roadworks, detours, weather conditions, and personal preferences, and therefore cannot be determined with complete accuracy. As a result, the allocation of traffic flows to specific roads involves a non-negligible margin of error. In addition, the model data may contain minor inaccuracies, for example in the representation of passenger car trips to and from abroad or those made by foreign tourists and business travellers, which are not included in the NTM6 dataset.

The very small difference of only 1.2% between the 9,865 passenger cars recorded at all selected traffic count points on an average day in 2019 and the total of 9,983 car driver trips according to NTM6 and RTM data indicates that no adjustment to the number of car driver trips is necessary.

However, when comparing individual traffic count points or groups of points with the corresponding NTM6 and RTM data, deviations of up to 18% are observed. Attempts to correct these discrepancies, for example, by increasing the number of long-distance trips and reducing short-distance (RTM) trips – would not improve the alignment between traffic counts and model data. Therefore, Sener has decided to keep the car driver trip data unchanged and limit adjustments to the average car occupancy rates.

Adjustment of average car occupancy rates

In this study, Sener has considered various adjustment factors and concluded that a factor of 1.3 should be applied to long-distance, medium-distance (NTM6), and short-distance (RTM) travel data. This adjustment increases the transport work for long- and medium-distance trips across the entire Norwegian road network from 11.6 billion passenger-km to 15.1 billion passenger-km, raising their share from 20% to 26% of the total passenger car transport work of 57.640 billion passenger-km.

At the same time, the average car occupancy rate of long-distance trips will increase from 1.724 to 2.24 (compare Table 5, third last row) and from 1.455 to 1.89 for medium-distance trips (compare the second last row). These values are considered plausible given the high proportion of non-work trips at these distance ranges.

Furthermore, the average car occupancy rate in short-distance traffic will increase from 1.15 to 1.495, corresponding to a transport work of almost 42 billion passenger-km (28 × 1.495, based on unchanged car driver trip data). Including about 15 billion passenger-km for long-distance and medium-distance trips, the total transport work then will amount to 57 billion passenger-km, close to the reference value of 57.640 billion passenger-km.

5.3 Public transport matrices

When comparing the NTM6 and RTM public transport matrices with figures from other sources, challenges arise due to the limited level of detail in most publicly available data. During this study, Sener submitted several requests for passenger traffic information, restricted to roughly aggregated figures for a period five to six years ago, but all were rejected – even such approximate data was considered confidential business information.

Nevertheless, it was possible to obtain some sufficiently detailed information to indicate discrepancies between actual traffic volumes and the corresponding NTM6 and RTM trip matrices. In several cases, this information suggests that real traffic levels in 2019 were higher than those reflected in the NTM6 and RTM matrices.

One example is the number of train passengers on Vestfoldbanen between Skien or Porsgrunn and destinations in other parts of southeastern Norway, excluding Telemark County. A new report published in August 2025 on the Jernbanedirektoratet website[16] provides relevant figures, as shown in the graphic below.

[16] https://www.jernbanedirektoratet.no/content/uploads/2025/10/Nasjonal-potensialanalyse_Passasjertallanalyse.pdf, page 21

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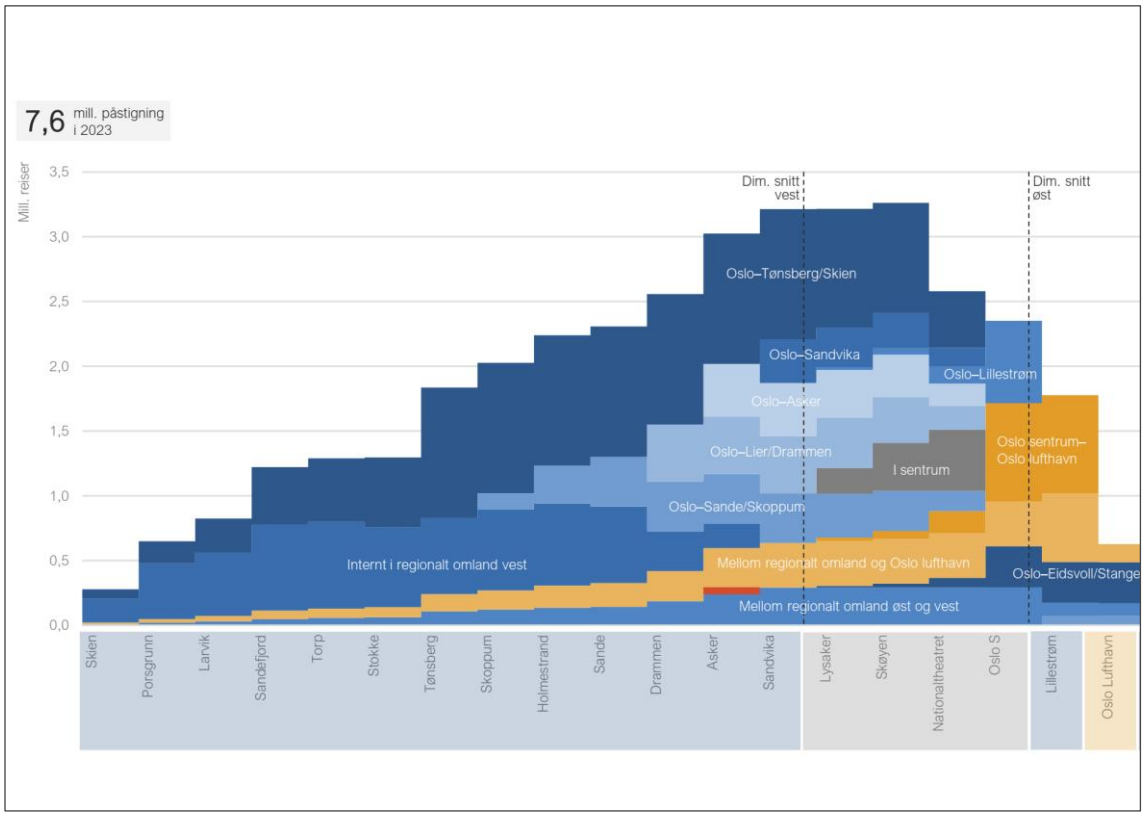

Figure 3: Passenger trips on Vestfoldbanen in 2023. Source: Jernbanedirektoratet.

This graphic shows that approximately 650,000 train passengers travelled between Skien or Porsgrunn and Larvik, Sandefjord, or other stations in southeastern Norway in 2023, in both directions. According to Statistics Norway (SSB) website,[17] the number of passengers on Vestfoldbanen increased from 2019 to 2023 by 5.0%, while transport work grew by 16.6%. This indicates particularly strong growth for the longest trips on Vestfoldbanen, such as those to and from Skien or Porsgrunn. However, it seems unlikely that the number of train passengers traveling on Vestfoldbanen from or to Skien or Porsgrunn in 2019 was significantly lower than 550,000, which corresponds to an average of about 1,500 passengers per day.

In comparison, the NTM6 and RTM figures indicate approximately 787 travellers per day between southern Telemark (including the municipalities of Skien, Porsgrunn, Siljan, Bamble, and Kragerø) and all other zones in southeastern Norway, excluding Telemark County. This figure appears far too low, particularly as it includes all bus travellers between the selected areas.

One possible explanation may be that the NTM6 and RTM figures are not derived from observed traffic counts for 2019, but instead from model-based extrapolations using data from earlier years. The commissioning of the new double-track Porsgrunn–Farriseidet high-speed line in September 2018 resulted in a substantial increase in rail demand along this corridor. It may therefore be the case that this traffic growth is not yet fully reflected in the NTM6 and RTM matrices.

However, several other comparisons conducted by Sener did not reveal such significant discrepancies between the NTM6 and RTM figures and the best possible estimates of actual traffic levels. Therefore, Sener has decided to use the NTM6 and RTM public transport matrices without any adjustments at this study phase.

[17] https://www.ssb.no/statbank/table/10484

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6 DEMAND DEVELOPMENT FROM 2019 TO 2035 AND BEYOND

The methodology described in the previous chapters enables the establishment of travel matrices for different existing transport modes, based on NTM6 and RTM data combined with the recommended adjustment factors. These matrices represent travel demand for the base year 2019.

However, forecasting future demand – both for high-speed rail on Vestlandsbanen and for all other transport modes – requires developing travel matrices for the period from the start of Vestlandsbanen operations through the final year considered in the cost-benefit analysis (40 years later). To achieve this, it has been necessary to make assumptions regarding the key drivers of future traffic development, including population growth, transport network evolution, and economic trends.

For the purposes of this study, the opening of Vestlandsbanen has been set to the year 2035. This assumption does not reflect any consideration of the time required for further planning processes, political decisions, approvals, funding arrangements, or railway construction activities. Rather, it represents an assumed, technically feasible opening year adopted solely for demand forecasting purposes. Any opening year beyond 2035 would be expected to result in higher demand levels, given the anticipated growth in both population and economic activity in Norway over time.

6.1 Population development

Based on Table 13600 from SSB,[18] population projections have been obtained for the "Main alternative (MMMM)" of development, specified for each Norwegian municipality within the Vestlandsbanen area of influence (as defined in 2020), three different groups of age (0-19 years old, 20-64 years old and 65 years old or older), and the years 2020,[19] 2035, 2040, 2045 and 2050.

Projections for the population aged 20–64 were used to estimate the development of work-related trips, while projections for the total population were applied to non-work trips. These projections are not identical, and therefore the differing growth patterns for work and non-work travel were explicitly taken into account in the demand forecasts.

Unfortunately, there is no information available that is specified for each Norwegian municipality and the years after 2050. However, projections of the population development in the whole country can be obtained from SSB Table 14282.[20] They show a decline of almost 5% in the population aged 20-64 from 2050 to 2075, but an increase in the other parts of the population of more than 10 % in this period, and an increase of the total population of about 2%. People aged 20-64 travel more than other people, and the development of this age group must be weighted stronger than the development of other age groups. Therefore, Sener has assumed that the overall effect of the expected population changes from 2050 to 2075 will be negligible small and set the population growth in this period in all municipalities to zero.

The next challenge was determining how to calculate the evolution of work and non-work trips for all origin–destination zone pairs. Sener estimated the growth factors for each pair using the following formula:

$$\mathrm{GrowthFactorOriginDestinationPair} = \sqrt[2]{\mathrm{GrowthFactorOrigin} * \mathrm{GrowthFactorDestination}}$$

This approach generally produces slightly lower values compared to using arithmetic means.

[18] https://www.ssb.no/statbank/table/13600
[19] Figures for 2019 with the same spatial resolution were not available. This is caused by the many changes in the number and size of the Norwegian counties and municipalities between 2019 and 2020, making it difficult to obtain figures for the population in 2019 within the areas defined as municipalities in 2020. Therefore, figures for 2019 have been calculated by figures for 2020 and a growth factor of 1.009 – corresponding to the national, average growth from 2019 to 2020 – for all age groups and selected municipalities within the Vestlandsbanen area of influence.
[20] https://www.ssb.no/statbank/table/14282

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6.2 Development of the transport system

As will become evident in the following chapters, developing a new transport model for the Vestlandsbanen study area requires comprehensive information on both the volumes of different transport modes and their characteristics (e.g., travel times, costs, etc.). These data must reflect conditions expected at the time HSR operations commence, set to 2035 for this study. Meeting this requirement presents several methodological challenges.

As shown in chapter 4.3, the travel times by car given as part of the LoS data for 2019, in most cases are too short. Among other things, traffic congestion and winter problems are not or insufficiently taken into account. These travel times will also be too short in 2035, and most likely even in many years after 2035, despite a constant improvement of the Norwegian road network.

This raises the question of how figures for 2035 could be calculated. One possible approach is to apply an adjustment factor to the LoS data on car travel times in 2019, and to stipulate a slight degression of these travel times during the years from 2019 to 2035 and beyond. Next, it would be necessary to estimate the growth in car traffic that is resulting from a slightly increased competitiveness against other modes of transport in this period, and induced traffic. All these estimations would be based on assumptions with a large margin of error.

Sener has decided not to adopt this approach. Instead, except for one specific case noted below, the car travel times provided as Level of Service (LoS) data for 2019 have been retained as the car travel times for 2035, without any adjustment. Furthermore, it is assumed that changes in car travel times between 2019 and 2035 will not have a significant impact on the share of car traffic relative to other existing modes.

This latter assumption positively influences high-speed rail traffic volumes, as attracting car travellers to switch to high-speed rail is generally more challenging than attracting air or bus travellers. Conversely, the first assumption – maintaining car travel times without adjustment – results in an overestimated attractiveness of car trips, both in 2035 and in subsequent years. This overestimation has a substantially greater negative impact on projected high-speed rail traffic volumes than the modest positive effect of assuming no increase in car modal share.

This outcome is further reinforced by the fact that traffic volumes during the initial years of Vestlandsbanen's operation carry significantly more weight in cost-benefit analyses than volumes in later decades, when actual car travel times will likely converge with the 2019 LoS data. Therefore, the assumption applied can be considered conservative.

Other assumptions about the development of passenger transport in Norway

Sener assumes that the share of electric vehicles among passenger cars on Norwegian roads will continue to increase. While the operating costs of electric cars are generally lower than those of conventional vehicles, their purchase and maintenance costs remain higher, partly due to factors such as increased weight and larger tires. At the same time, Norway's current favourable regulations – such as reduced taxes and lower road tolls for electric cars – are expected to be phased out gradually. Consequently, there is no reason to anticipate a significant reduction in the overall cost of passenger car trips in the future as a result of the growing share of electric vehicles.

As noted above, Norway continues to upgrade its national road network, resulting in a gradual reduction in car travel times. However, such improvements are often accompanied by substantial road tolls, which increase overall driving costs – even in cases where driving times are significantly reduced.[21] Conversely, several previously completed road projects will see toll collection phased out in the coming years or decades, once full project financing has been achieved. Taken together, these factors suggest that infrastructure improvements will not lead to major changes in the overall cost of passenger car travel in the future.

Regarding the current railway network, further improvements near Oslo, Bergen, Stavanger, and Trondheim can be expected. However, according to the National Transport Plan, no major investments are planned for the existing main lines connecting different regions of the country. These lines will remain single-track with limited

[21] One possible example is E39 Svegatjørn–Rådal near Bergen. This new road reduced the driving time by about 10 minutes, but each passenger car must pay a road toll of NOK 63 (valid after 14.5.2025), while the reduction of the driving distance was less than 2.5 km.

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capacity and numerous sections vulnerable to landslides or built on poor foundations, resulting in a high risk of operational disruptions. This risk will not be significantly reduced by rail investments near the largest cities, even when such projects include minor segments of Norway's main lines.

For example, future rail projects such as Arna–Stanghelle and Sandnes–Bryne will have a substantial positive impact on local and regional rail traffic along the western sections of Bergensbanen and Sørlandsbanen. However, their effect on long-distance traffic on these main lines appears too small to be considered in this study. The same applies to the potential increase in traffic in adjacent sections of Vestlandsbanen. For instance, reduced travel times on Bergensbanen between Arna and Stanghelle will improve rail competitiveness on routes such as Voss–Stavanger and indirectly benefit Vestlandsbanen. Nevertheless, these traffic gains will be marginal compared to the overall traffic potential of Vestlandsbanen.

New rail line Drammen-Tønsberg and Rogfast

Conversely, Sener has decided to include the ongoing investments in Vestfoldbanen between Drammen and Tønsberg in the Vestlandsbanen study. These projects, expected to be completed by 2027, will create a continuous double-track line designed for speeds of 200-250 km/h, reducing the rail distance between Drammen and Tønsberg to 58 km. This new railway line will be essential for enabling direct train services such as Bergen/Stavanger–Skien–Tønsberg–Oslo and Oslo–Kongsberg–Skien–Tønsberg–Oslo once Vestlandsbanen becomes operational.

To account for the effects of these investments, Sener has simulated the future train services for two scenarios: one including only the new Drammen–Tønsberg line, and another including both the new line and Vestlandsbanen. The incremental benefit of Vestlandsbanen has then been calculated based on the differences between these two scenarios.

The same calculation approach has been applied to the 26.7 km Rogfast subsea tunnel currently under construction beneath Boknafjorden. Upon its expected completion in 2033, this tunnel will reduce car travel times between southern and northern Rogaland by approximately one hour. However, the road toll per passenger car will be as high as NOK 336.50 (included discount, 2024 prices). Further details will be provided in Chapter 7.4.3.

6.3 Economic development

In addition to population growth and transport system development, Norway's economic performance is one of the key drivers influencing future transport demand. To estimate the effect of this driver, Sener has conducted an analysis based on the development of the Gross Domestic Product per capita (GDPpc) at constant prices. The historical development of this economy indicator can be obtained from SSB,[22] and there are several projections for the future provided by the Norwegian government. The latest projection – an increase of 0.5% per year from 2024 to 2060 – can be found in "Perspektivmeldingen 2024"[23] and is more conservative than the previous ones. For example, in "Perspektivmeldingen 2021", an increase of 0.9% per year was expected for almost the same period.

The next step in the calculation was to analyse the historical evolution of Norwegian transport volumes per capita and relate it to the development of GDP per capita (GDPpc) over the same period. For this purpose, Sener examined the trend in domestic air travel between 2010 and 2019 (see rows C and D in Table 8 below) and the evolution of transport work for all other modes during the same period (see rows E and F in Table 8 below). The latter reflects the development of trips by car and public transport, weighted by trip length.

Sener also considered using the development of trips without weighting. However, more than 90% of car and public transport trips are short-distance journeys, which have limited relevance for this study. Furthermore,

[22] https://www.ssb.no/statbank/table/09842
[23] https://www.regjeringen.no/contentassets/7400c9d08a5543b8912fbf700f3344fd/no/pdfs/stm202320240031000dddpdfs.pdf, Table 5.1.

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transport work per capita increased by 5.11% from 2010 to 2019, while the number of trips per capita grew by 7.36%.[24] Therefore, using transport work figures for cars and public transport helps avoid overestimation.

In contrast, for air traffic, the development of trip numbers is more relevant than transport work, as the latter would disproportionately emphasize the longest air journeys, such as those between northern and southern Norway. For Vestlandsbanen, the medium-distance air trips are the most relevant.

	2010	2019	Growth factor 2010-2019	Elasticity related to GDPpc
A: GDPpc (2015-kr)	587,107	618,621	1.0537	
B: Inhabitants in Norway	4,858,199	5,328,212		
C: Domestic air passengers	13,680,306	16,382,695		
D: C/B (air pass. per capita)	2.816	3.075	1.0919	1.6815
E: Car+public tr. (million pkm)	68,694	79,188		
F: E/B (pkm per capita)	14,140	14,862	1.0511	0.9527

Table 8: Development of GDPpc, domestic air trips and transport work by car and public transport.

Based on the historical development of the GDP per capita, the air passengers per capita and the transport work per capita by car and public transport, Sener has determined the “elasticities” for the two traffic indicators in relation to the GDP per capita, as shown in the column to the far right of Table 8. These elasticities indicate the percentage change in demand per capita in relation to one per cent change in the GDPpc.

Next, Sener has considered how to apply an elasticity that is relevant for estimating the future development of passenger transport in Norway. For the elasticity of air trips and long-distance car trips per capita and in relation to the GDPpc, a combination was assumed that consists of two-thirds of the historical elasticity of air trips and one-third of the historical elasticity of the transport work by car and public transport. However, this combined historical elasticity was reduced by 20% before it was applied to the period 2019-2035. This resulted in an elasticity of 1.151.[25] The same approach was chosen for the period 2035-2050, but after reducing the elasticity by 30%, and for the period 2050-2075, after reducing the elasticity by 50%.

For the elasticity of medium-distance car trips, short-distance car trips (as covered by the RTM travel matrices) and trips by public transport per capita and in relation to the GDPpc, Sener has assumed the historical elasticity of the transport work by car and public transport but reduced it by 20% before it was applied to the period 2019-2035. This resulted in an elasticity of 0.762.[26] Also the elasticities for the periods 2035-2050 and 2050-2075 were calculated analogously to the elasticities for air trips and long-distance car trips.

In combination with the development of the GDPpc from 2019 to 2035 – a growth of 3.85% from 2019 to 2024 according to the historical data[27] and a growth of 5.64% from 2024 to 2035 according to the projections referred to at start of this chapter, totalling 9.71% from 2019 to 2035 – it was possible to estimate the effect of the economic development on different types of trips for different years and periods.

For example, the assumptions described above resulted in an overall growth of trips per capita from 2019 to 2035 by 11.25% for air trips and long-distance car trips, and by 7.32% for medium and short-distance car trips and trips by public transport, due to the expected economic development. The corresponding figures for 2035-2050 are 7.82% and 5.12%, and for 2050-2075 9.38% and 6.12%.[28]

[24] The figures are based on TØI-rapport 1929/2022, table 1 and 2 on p. 48 and 49, https://www.toi.no/getfile.php?mmfileid=74610. Using SSB table 03982 for the 2010 to 2019 period would result in misleading figures, as explained in the beginning of chapter 5.2.
[25] (1.6815 × 2/3 + 0.9527 × 1/3) × 0.8 = 1.151. The corresponding figures based on 30% and 50% reductions are 1.007 and 0.719.
[26] 0.9527 × 0.8 = 0.762. The corresponding figures based on 30% and 50% reductions are 0.667 and 0.476.
[27] NOK 618,621 in 2019 and NOK 642,453 in 2024.
[28] 2019-2035: 1.0971^1.151 = 1.1125 and 1.0971^0.762 = 1.0732. 2035-2050: 1.005^15 = 1.0777. 1.0777^1.007 = 1.0782 and 1.0777^0.667 = 1.0512. 2050-2075: 1.005^25 = 1.1328. 1.1328^0.719 = 1.0938 and 1.1328^0.476 = 1.0612.

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7 CHARACTERISTICS OF VARIOUS MODES OF TRANSPORT

The purpose of this chapter is to describe the characteristics of the transport modes that Sener has used as the basis for estimating future modal shares and induced traffic volumes. These characteristics include quantifiable parameters such as travel times, travel costs, service frequencies, and the potential need for transfers between modes. Additional qualitative attributes – such as comfort, design, safety, and reliability – will be addressed in Chapter 8.

7.1 Travel times by high-speed rail

Travel times on Vestlandsbanen will be influenced by a range of operational and infrastructure-related factors, including track alignment, rolling stock performance, stopping patterns, and other key operational parameters. In the following chapters, the underlying inputs and assumptions for the calculation of travel times are presented in detail.

7.1.1 Selection of track alignment

Between 2008 and 2012, Norsk Bane AS commissioned Deutsche Bahn International (DBI) to undertake an extensive feasibility study on the development of high-speed railways in Norway. As part of this work, DBI produced a detailed alignment proposal for Vestlandsbanen, supported by comprehensive engineering data including curve radii, gradients, speed limits, and tunnel configurations (either two parallel single-track tubes or a single double track tube). The level of detail contained in the DBI study provides a sufficient foundation for simulating future train operations.

As described in the Deliverable 4 – *DBI Alignment Review* report, Sener subsequently carried out a thorough and systematic assessment of the DBI alignment. The review focused on identifying conflicts with recently constructed infrastructure and buildings, as well as examining opportunities to optimise the alignment from an engineering, operational, and constructability perspective. Based on this analysis, Sener proposed several refinements and developed alternative alignment options where improvements appeared feasible.

However, within the scope and timeframe of this phase of the study, it was not possible to replicate the same depth of investigation undertaken by DBI in their original work. Despite this, there is no evidence to suggest that Sener's recommended adjustments would result in longer train running times. On the contrary, most of the proposed refinements are expected to enhance operational performance.

Following discussions with Norsk Bane, and in order to ensure consistency and comparability across all modelling tasks, the DBI alignment has been adopted as the reference basis for calculating future train running times at this stage. This approach ensures that the operational simulations are grounded in a well-defined and technically robust alignment while still acknowledging the potential benefits of the improvements identified by Sener.

7.1.2 Selection of passenger train for the simulation

There are numerous high-speed train models technically suitable for operation on Vestlandsbanen; however, certain configurations are significantly better aligned with the corridor's specific requirements. In its detailed review of DBI's alignment proposal and associated operational assumptions, Sener placed particular emphasis on safety performance, behaviour under adverse weather conditions, energy efficiency, and traction system redundancy. These criteria are especially relevant for a line such as Vestlandsbanen, where long sections in sparsely populated areas, long tunnels, and challenging winter conditions impose demanding requirements on rolling stock.

From this assessment, several key design features of a train emerge as particularly advantageous. An articulated train architecture with hinged coaches provides improved stability and crashworthiness, offering clear safety benefits in the unlikely event of a derailment. A high proportion of motorised bogies enhances acceleration and adhesion, which is critical for maintaining performance on slippery rails during snow, ice, or heavy rainfall. Distributed traction equipment further increases operational resilience by allowing the train to continue running even if part of the traction system becomes unavailable.

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One of the train families that meets these criteria is the *AGV (Automotrice à Grande Vitesse),* manufactured by Alstom. [29] The AGV platform is available in multiple configurations with 7, 8, 10, 11, or 14 coaches. In addition, a shorter five-coach version – featuring three motorised and three non-motorised bogies – is technically feasible due to the modular nature of the traction system. A train of this size would offer approximately 200 seats, including a restaurant area, and would have an overall length of nearly 100 metres. This compact yet powerful configuration makes it well suited for operations on the Vestlandsbanen high-speed corridor.



Figure 4: A train with hinged coaches, sharing a common bogie. Picture from TGV Réseau. Source: Norsk Bane AS.

As part of this study, Sener has carried out detailed simulations of future train operations based on a five-coach AGV configuration. Operating this unit on Vestlandsbanen, with the option to couple two or more units to form longer trains when demand requires, provides a high degree of operational flexibility. This approach supports a fixed-interval timetable while allowing capacity to be scaled efficiently in response to varying demand levels throughout the day or across seasons. It also ensures that the rolling stock strategy remains adaptable as ridership evolves over time.

Table 9 below summarises the main technical specifications of the selected AGV configuration used in the running-time calculations.

AGV in five-coach configuration - technical data	
Passenger capacity	200 seats
Train mass, 100% occupancy, full water tanks, full supply	204 tonnes
Mass factor	1.06
Traction power	4,500 kW
Maximum operation speed	320 km/h
Running resistance, W in Newton, v in km/h[30]	$W = 1{,}300 + 16 \cdot v + 0.295 \cdot v^2$
Increase in air resistance in single-track tunnels, by[31]	1.6 – 9.6 / (3 + 13·exp (0.8·L))
Increase in air resistance in double-track tunnels, by	1.3 - 0.6 / (1 + exp (1.6·L))

Table 9: Technical data used for train operation simulations, AGV-train with five coaches.

7.1.3 Weather conditions and other operational premises for the simulations

The operational assumptions adopted by Sener for the simulations are designed to ensure reliable and robust running times, even under unfavourable operating conditions. These assumptions intentionally produce travel

[29] AGV Platform and Italo Project for NTV, https://www.schienenfahrzeugtagung.at/download/PDF2013/03_Lacote.pdf.
[30] Sener has derived the running resistance of a 5-coaches train from the Davis formula for an 11-coaches train, https://www.greengauge21.net/wp-content/uploads/SYSTRA-Factors-affecting-HSR-carbon-impacts.pdf, Chapter 2.1, Table 1, and known correlations between the running resistance and the number of coaches, for instance in "Alberto García Álvarez, Ignacio González Franco: Dinámica de los trenes en alta velocidad. Cinemática ferroviaria," https://dialnet.unirioja.es/servlet/libro?codigo=790159, page 23. Sener has also taken into account an average temperature at sea level of 5°C, while Davis formulae usually are provided for a temperature at sea level of 15°C.
[31] Sener has used this (and the next) formula to calculate a factor that indicates the increase of the air resistance when the trains run in a tunnel, depending on the length of the tunnel (L) and the type of tunnel (single-tube tunnel with double-track or twin-tube tunnel with single-tracks in each tube). For the running time calculations, it is assumed that all tunnels longer than 1.2 km will be constructed as twin-tube tunnels with cross-sections of 70.29 m² each, while shorter will be constructed as single-tube tunnels with a cross section of 98.52 m².

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times that are longer than those achievable under normal circumstances, thereby providing a performance margin that can be used to recover from delays, maintain punctuality, or reduce energy consumption.

The key premises are outlined below:

- *A constant headwind of 7.5 m/s (27 km/h)* is applied against the front of the train on all at-grade sections and bridges. This value is nearly twice as high as the wind speeds typically used in running-time calculations for other European railway lines. The assumption reflects the fact that large parts of Vestlandsbanen – particularly in western Norway – are frequently exposed to strong winds. The selected wind speed also implicitly accounts for the presence of snow on the tracks, which increases running resistance in a manner comparable to a strong headwind.
- *Simulations are limited to single-unit train operations.* Running double- or triple-unit sets would result in shorter travel times, as the available traction force increases stronger than the running resistance when multiple units operate together. Restricting simulations to single-unit trains therefore represents a conservative assumption that contributes to timetable robustness.
- *Traction force at start is limited to 150 kN,*[32] decreasing by 0.15% for each km/h increase in speed. This corresponds to a friction coefficient of μ = 0.15 at start and a maximum initial acceleration of 0.69 m/s².[33] On dry rails, more than twice this traction force is technically feasible. Under such conditions, faster acceleration and shorter running times – or reduced energy consumption – could be achieved. The limitation also ensures that acceptable acceleration levels can be maintained even in the event of partial traction-equipment failures.
- *Maximum braking deceleration is limited to –0.5 m/s²,* with gradients taken into account. For example, on a downhill section with a 12.5‰ gradient, the effective braking deceleration is limited to –0.38 m/s².[34] These values correspond to very gentle and comfortable braking. If required, significantly higher deceleration rates could be applied to reduce running times.
- *A dwell time of one minute* is assumed at intermediate stations for passenger alighting, boarding, and train preparation for departure. This value may be increased during peak periods when operating double- or triple-unit trains, which would have slightly shorter running times. To ensure that such short dwell times are consistently achievable, Sener recommends several operational and infrastructure measures, including:
  - two doors per coach on each side,
  - platforms on both sides of the train at the busiest stations (where feasible),
  - mandatory and evenly distributed seat reservations,
  - clear information on tickets and platforms regarding seat location (coach number and nearest door),
  - weather-protected, temperature-controlled waiting areas along the full potential train length of up to 400 metres.
- *An additional performance buffer* is applied, consisting of two components:
  - 5% of the calculated running time, and
  - one second per kilometre of running distance.

  This combination ensures that the largest buffers are applied where trains operate at the highest speeds. For example, the total buffer applied is 10.56% at 200 km/h, 11.94% at 250 km/h, and 13.33% at 300 km/h. This approach ensures that the simulations reflect realistic operational margins and provide a robust basis for timetable planning.

[32] 204 tonnes × 3/6 × 9.81 m/s² × 0.15 = 150 kN.
[33] (150 – 1.3 kN) / 1.06 / 204 tonnes = 0.688 m/s².
[34] 0.5 – 0.0125 × 9.81 = 0.377 m/s².

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7.1.4 Stops at stations

Sener has carried out passenger-train simulations for nearly all feasible combinations of passing stations and stopping at stations along Vestlandsbanen, as well as on relevant sections of adjacent railway lines such as Vestfoldbanen and Sørlandsbanen. These comprehensive simulations constitute an essential basis for analysing how different service patterns and stopping frequencies influence overall travel times and demand.

To maintain a manageable number of scenarios and ensure consistency across the modelling process, several limitations on the number of possible combinations were introduced. These simplifications relate to the following aspects:

- *Constraints arising from "The high-speed rail system definition"* described in Chapter 7.2. This chapter outlines the initial assumptions regarding the Vestlandsbanen model network to which the transport model calculations shall be applied, for example the stations to be served along Vestlandsbanen and adjacent lines, and the routes to be operated as direct services without the need for passengers to change trains.
- *Mandatory stops at key stations.* For the running-time simulations, it has been assumed that all trains will stop at Arna, Drammen, and Majorstua whenever these stations lie along the train's route. These stations are expected to play a central role in the future network.
- *Simplification of interactions between consecutive station stops.* Each stop at a station adds time relative to passing the station at high speed. However, the additional time required for two consecutive stops is often less than the sum of the two additional times needed for each of these stops. This occurs when a train stopping at the first station decelerates again for the next stop before it reaches the same maximum speed as trains that do not stop. Under the specific geometry and station spacing of Vestlandsbanen, this effect can reduce running times by up to two seconds. To limit the number of simulation variants and maintain consistency, Sener has chosen to disregard these marginal time savings.

The following table presents selected results from the passenger-train simulations. As an illustrative example, services between Stavanger and Bergen using the direct route between Kårstø and Ølen (bypassing Haugesund) are shown. A complete overview of all possible routes on Vestlandsbanen, together with the corresponding running times, is provided in *Appendix 2,* which also includes information on inter-station distances and the average speeds of passing trains.

Station	Passing time	Arrival time	Departure time	Total time
Stavanger	0.00	0.00	0.00	0.00
Kårstø	12.86	1.18	2.23	3.54
Ølen	22.84	1.31	2.36	4.01
Sauda	30.50	1.45	2.50	4.22
Røldal	39.08	1.11	2.16	3.60
Odda	47.19	1.57	2.62	4.50
Kvam-Jondal	54.40	1.16	2.21	3.41
Tysse	1:01.21	1.29	2.34	3.62
Arna	1:06.83	0.00	1.05	0.00
Bergen	1:13.07	0.00	0.00	0.00

Table 10: Example of results from passenger train simulations between Stavanger and Bergen, in minutes

The second column, titled "Passing time", presents the running times for a train operating without intermediate stops, except for mandatory halts – specifically at Arna, in addition to the terminal stations Stavanger and Bergen. Under these conditions, the full Stavanger–Bergen journey (276 km) is completed in approximately 1:13 hours.

To calculate the running time for the same route including stops at selected stations the values in the fifth column, titled "Total time", must be added. For example, if the train stops at Kårstø, Sauda, Odda, and Tysse, the sum of the additional travel times is:

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$$3.54 + 4.22 + 4.50 + 3.62 = 15.88 \text{ minutes}$$

When added to the non-stop “Passing” time of 73.07 minutes, the total journey time increases to 88.95 minutes, or about 1:29 hours.

To calculate the running time between two stations, for instance, from Stavanger to Kårstø, the arrival time is obtained by adding the “Arrival time” value from the third column to the passing time. A train stopping at Kårstø will therefore arrive:

$$12.86 + 1.18 = 14.04 \text{ minutes}$$

after departure from Stavanger – i.e., 1.18 minutes later than a non-stopping train will pass Kårstø station at high speed.

The departure time from Kårstø is then calculated by adding the “Departure” value from the fourth column. This includes the dwell time plus the 5% operational buffer (as described in the previous subsection). Thus, the train will depart Kårstø:

$$12.86 + 2.23 = 15.09 \text{ minutes}$$

after leaving Stavanger.

Assuming the train proceeds directly to Sauda without stopping at Ølen, the passing time at Ølen becomes:

$$22.84 + 3.54 = 26.38 \text{ minutes}$$

after departure from Stavanger, where 3.54 minutes is the additional time spent for a stop at Kårstø station. Similarly, the arrival time at Sauda is calculated as:

$$30.50 + 3.54 + 1.45 = 35.48 \text{ minutes}$$

after departure from Stavanger, combining the passing time (30.50 minutes), the additional time for a stop at Kårstø (3.54 minutes), and the Sauda arrival add-on (1.45 minutes).

In general, all running times along the Vestlandsbanen alignment – covering any combination of passing and stopping patterns – can be derived using this method. This provides a consistent and transparent framework for evaluating timetable scenarios, service concepts, and operational strategies.

When it comes to train running times on adjacent railway lines, they are presented in the following chapter.

7.2 The high-speed rail system definition

The purpose of this chapter is to define the Vestlandsbanen model network to which the transport model calculations shall be applied. This task has already been largely completed. The NTM6 and RTM datasets define a network comprising 1,075 zones and provide comprehensive information on travel times, distances and costs for almost 1.2 million[35] possible origin–destination zone pairs within the network. Further details of these datasets are provided in Chapter 4.

In addition, it is necessary to specify the stations along Vestlandsbanen and adjacent railway lines to be incorporated into the model, the routes to be operated as direct services without interchange, and the service frequencies to be offered. Some of these specifications are determined within this chapter, while others are introduced as initial assumptions that provide a basis for the subsequent optimisation of the high-speed rail system. Overall, this constitutes a comprehensive task.

[35] 1,075 × 1,074 = 1,154,550.

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7.2.1 Stations, train services and insufficient information on public transport

One of the principal challenges in defining the Vestlandsbanen model network relates to the limited availability of Level of Service (LoS) data for public transport. Within the NTM6 and RTM datasets, LoS information – covering travel times, distances and travel costs – is provided exclusively for car and air transport. There is no corresponding dataset for public transport, nor is there a modal breakdown between bus, boat and conventional rail services (see Chapters 4.1 and 4.3).

This limitation raises the question of whether the Vestlandsbanen model network should represent public transport services beyond the high-speed rail services operating between Vestlandsbanen stations. From a modelling perspective, the inclusion of conventional rail services on adjacent lines, and potentially parallel bus and boat services, could improve network realism and behavioural representation, provided that additional data can be assembled and processed. Furthermore, for each public service that is *not* explicitly represented, it must implicitly be assumed that the travel times and costs are broadly comparable to those of car travel, as no alternative LoS data source with full network coverage is available.

However, the representation of public transport services requires more than the specification of travel times, fares and service frequencies. It also necessitates the inclusion of qualitative service attributes – such as comfort, capacity, reliability and interchange penalties – in order to reflect differences in perceived quality and to allow the model to distinguish between premium services, such as high-speed rail, and conventional public transport alternatives. The collection of such information, and its translation into consistent and robust modelling parameters, is technically demanding and subject to a significant risk of inconsistency and uncertainty.

Given these constraints, there is no assurance that extending the model network to include a wider range of public transport services would result in a more reliable model outcome. On the contrary, a more complex representation based on weak or incomplete data may introduce additional sources of error. For this reason, a simplified model structure – focusing on high-speed rail services and relying on transparent assumptions for other modes – is considered an appropriate approach.

34 stations selected for the model network

Sener has assessed a range of options and decided to implement 34 railway stations and the rail services between them in the Vestlandsbanen model network, without including any bus or boat routes. The selection comprises all 25 planned stations along Vestlandsbanen (including Oslo S, Bergen, Stavanger and other existing stations), five stations on Vestfoldbanen, and four stations on Sørlandsbanen and Arendalsbanen between Bø in Telemark and Arendal and Kristiansand (including Arendal and Kristiansand). These stations are listed in the left-hand part of Table 11 on the following page.

These stations have been selected because it is important to investigate demand for direct train services (i.e., without interchange) both between Agder and eastern Norway and between western Norway and the Grenland, Vestfold and Agder regions via Bø in Telemark. This is particularly relevant given that increasing sections of Vestfoldbanen are being built as high-speed double-track railway, which is expected to materially improve journey times, capacity and service attractiveness.

Sener also considered including stations on Jærbanen south of Stavanger, Bergensbanen north-east of Arna, and Dovrebanen, Kongsvingerbanen and Østfoldbanen to the north, east and south of Oslo. However, it proved difficult to determine how many additional stations should be included and how far from the Vestlandsbanen corridor the model network should reasonably extend. There are also significant uncertainties regarding the extent of modern double-track sections that will be delivered on these lines in the coming years and, consequently, regarding the future service specifications to be assumed. For these reasons, Sener decided not to include these railway lines in the Vestlandsbanen model network.

Conversely, Sener has also included other train services in the model network than the services between the 34 stations listed in the left-hand part of Table 11. This applies to services to and from 15 additional stations, listed in the right-hand part of Table 11.

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These services include, among others, services to and from the most heavily used stations on Drammen- and Askerbanen (the existing double-track railway lines between Oslo Central Station and Drammen): Nationaltheatret, Skøyen, Lysaker, Sandvika and Asker. Vestlandsbanen is planned to run broadly parallel to these lines on a separate alignment, with a connection to Askerbanen between Lysaker and Sandvika.

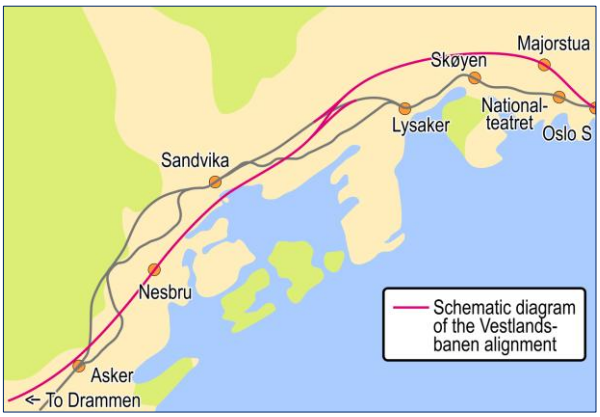

Figure 5: Schematic diagram of existing railway lines and planned Vestlandsbanen west of Oslo central station.

This combination of two connected double-track lines will not only enable a comprehensive renewal of the existing railway (see Chapter 2.2 in Deliverable 1 – Study Area Characterisation), improve operational reliability in the corridor, double capacity and significantly reduce travel times; it will also allow variation in train routes and stopping patterns between Oslo S and Drammen. Table 12 presents the alternative routes and stopping patterns selected by Sener for this area within the Vestlandsbanen model network, together with the corresponding calculated travel times.

However, Sener has not implemented the five stations mentioned above in the Vestlandsbanen model network. This is partly because adding stations (and processing the associated service information for each station) increases the model complexity – particularly due to many possible train routes on two parallel, connected railway lines. The complexity that can be accommodated is constrained by the scope and resources of the current study.

In addition, representing the five stations on the existing railway between Oslo S and Drammen would often add limited value. This is due to the short distances between these stations and the Vestlandsbanen stations. For example, the straight-line distance from the planned Majorstua station to Nationaltheatret and Skøyen is approximately 2 km. A transport model with 1,075 zones distributed across a large part of southern Norway does not provide sufficient spatial resolution to estimate reliably how demand for high-speed rail trips would be distributed among three stations located so close together – even if the zone structure in Oslo is denser than in most other municipalities. In such cases, assigning all demand to a single station is not expected to result in any material loss of accuracy.

Stations implemented in the Vestlandsbanen model network	Stations served by implemented train services
Oslo-Drammen	
Oslo S	Oslo S
Majorstua	Majorstua Nationaltheatret Skøyen Lysaker
Nesbru	Nesbru Sandvika Asker
Drammen	Drammen
Drammen-Skien via Vestfold	
Drammen	Drammen
Holmestrand	Sande Holmestrand Horten
Tønsberg	Tønsberg
Sandefjord	Stokke Torp Sandefjord
Larvik	Larvik
Porsgrunn	Porsgrunn
Skien	Skien

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Bø-Arendal/Kristiansand	
Bø	Bø Lunde
Drangedal	Drangedal Neslandsvatn
Gjerstad	Gjerstad Vegårshei
Arendal	Nelaug Blakstad Arendal
Kristiansand	Vennesla Kristiansand

Table 11: Stations implemented in the Vestlandsbanen model network, and stations served by implemented train services.

Risk for underestimating the high-speed rail demand

Conversely, representing only Majorstua and Nesbru as intermediate stations between Oslo S and Drammen in the Vestlandsbanen model network – while nevertheless accounting for the additional running time associated with more intermediate stops – creates a material risk of underestimating high-speed rail (HSR) demand in this corridor.

This effect can be illustrated using a trip that starts in Sandvika (close to Sandvika station) and ends in central Oslo. When assessing the competitiveness of HSR relative to car, bus and conventional rail, the model will assign the trip to the nearest HSR station included in the model network and then compute station access time and cost, waiting time, travel time in high-speed train, ticket costs and other, associated time and cost components of the trip – based on that station. Under the current network definition (implemented stations and services), the nearest HSR station from Sandvika is Nesbru, even though frequent HSR services would be available at Sandvika station.

The issue is that Nesbru is located approximately 4 km from Sandvika in the opposite direction to Oslo. Accordingly, the model will impose an unnecessary access detour and associated time/cost and thereby reducing the modelled propensity to choose HSR. The resulting demand for HSR is therefore likely to be materially lower than would be obtained under an identical service plan in which Sandvika is explicitly represented as a station in the Vestlandsbanen model network.

Similar effects may occur for the estimation of HSR demand on existing lines connected to Vestlandsbanen, like Vestfoldbanen, Sørlandsbanen and Arendalsbanen. In these corridors, frequent services to and from all currently served stations have been implemented in the model network, but only around every second station is included as a model station, as shown in Table 11. As a result, some trips are assigned to a model station that is not the most appropriate access point in reality, with corresponding impacts on modelled access/egress times and HSR travel times.

At the same time, including all stations along these existing lines would not necessarily eliminate problems and could introduce other inaccuracies. For example, very short inter-station spacing (such as between Torp and Sandefjord) may not be meaningfully distinguishable within a model of 1,075 zones, and there may be cases where a station is located at a large distance from the centroid of the nearest model zone (e.g., Nelaug), leading to unreliable access/egress representation. In such circumstances, increasing station granularity does not automatically improve accuracy and can, in some cases, reduce the robustness and interpretability of model results.

Finally, it should be noted that the risk of underestimating HSR demand is not confined to existing railway lines connected to Vestlandsbanen. A similar risk may also arise on Vestlandsbanen itself, for comparable reasons related to station representation, access/egress modelling and zoning resolution, as discussed in Chapter 7.2.3.

7.2.2 Travel times on existing railways for train services included in model network

In the previous subchapters, a set of stations and train services has been defined as part of the Vestlandsbanen model network. This provides the basis for completing the running-time calculations and extending the results to those rail services that will operate partly on railway lines adjacent to Vestlandsbanen.

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These calculations were based on the same assumptions regarding train performance and operations as those used for the running-time calculations on Vestlandsbanen alone, as described in Chapter 7.1. However, unlike the latter, these calculations could not be based on highly detailed track alignment data, as the necessary information is not available from public sources. This applies both to projects commissioned several decades ago and to projects currently under construction, such as Drammen–Kobbervikdalen and Nykirke–Barkåker, both on Vestfoldbanen.

However, by combining other project information — including design speeds and tunnel cross-sections — with topographic maps (used to estimate elevations and curve radii) and, where available, working timetables[36] for existing train operations, it was possible to produce realistic running-time estimates.

For Oslo S–Drammen, Sener has calculated running times for four different stopping patterns, assuming that passenger trains will operate these patterns in a regular, repeating cycle. When this calculation was made, it was not known how many trains would run between Oslo S and Drammen, but it seemed clear at an early stage of the investigations that there would be sufficient trains to ensure frequent services for each of the four stopping patterns.

Table 12 presents the calculated travel times for the four selected stopping patterns. The average travel time is about 20 minutes, 15 minutes faster than the shortest travel time achievable on the existing railway line. This will also greatly increase the benefits of recent investments in high-speed, double-track sections on Vestfoldbanen.

Results for stopping patterns that involve train operations on other sections than Vestlandsbanen only, have first been calculated as running times relative to the fastest stopping pattern (Oslo S–Majorstua–Drammen, marked “A”), then been rounded up to the nearest quarter of a minute, and finally been added to the running time for the fastest stopping pattern, pattern A. All figures in Table 12 are average values for both directions.

	Stopping patterns Oslo S-Drammen	Running time in minutes
A	Oslo S-Majorstua-Drammen[37]	16.22
B	Oslo S-Majorstua-Nesbru-Drammen	19.78
C	Oslo S-Majorstua-Sandvika-Asker-Drammen	23.72
D	Oslo S-Nationaltheatret-Skøyen-Lysaker-Drammen	21.22
	Average[38]	20.23

Table 12: Running times for selected stopping patterns between Oslo S and Drammen.

The running times for stopping pattern C (Oslo S–Majorstua–Sandvika–Asker–Drammen) assume that the speed limits will be increased from the current 160 km/h to 200 km/h between Sandvika and Asker (on Askerbanen), and from 160 km/h to 180 km/h in the two curves within the Lieråsen tunnel. The curve radii are sufficient to allow this. Further reductions in running time, of at least one minute, together with increased capacity and operational flexibility, would be achievable through the construction of a connection between Vestlandsbanen and the western end of Asker station, as envisaged in the Vestlandsbanen alignment proposal in the vicinity of Asker station.

It should also be noted that other trains will operate on parts of the Vestlandsbanen section between Oslo S and Drammen for existing rail travellers. Most of these travellers will not be included in the demand figures for Vestlandsbanen, but their presence will make it possible to operate additional trains between Oslo S and Drammen. It is assumed that some of these trains will follow the stopping pattern Oslo S–Nationaltheatret–Skøyen–Lysaker–Nesbru–Drammen, which is not included among stopping patterns A to D.

[36] https://www.banenor.no/for-deg-i-bransjen/togselskap/kapasitetsfordeling/grafiske-togruter/
[37] The figures for westbound and eastbound trains can be found in Appendix 2.
[38] In order to reflect the differences between the two directions, the average running time has been calculated as the running time of stopping pattern B, plus 0.5 minutes. This results in an average figure of 20.28 minutes, slightly more than 20.23 minutes calculated in Table 12.

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Train running times on the northern part of Vestfoldbanen

The passenger train running times Drammen–Tønsberg have been calculated for the situation where the new high-speed sections "Drammen–Kobbervikdalen" and "Nykirke–Barkåker" (currently under construction) are in operation. Sener has used the same calculation procedure as described in the previous subchapter. The results in minutes, rounded to the nearest 0.05 minute and calculated as the average value for both directions, are presented in Table 13. Assuming that all trains on Vestfoldbanen Drammen–Skien will serve both Sande, Holmestrand and Horten on one half of the departures and pass them non-stop on the other half, the average running time Drammen–Tønsberg will be 24.75 minutes (mean of 29.9 and 19.6 minutes).

AGV-train Drammen-Tønsberg	Train stopping at all stations	Non-stop train Drammen-Tønsberg
	Minutes	Minutes
From Drammen	0.00	0.00
To Sande	9.00	|
From Sande	10.05	|
To Holmestrand	15.75	|
From Holmestrand	16.80	|
To Horten	23.20	|
From Horten	24.25	|
To Tønsberg	29.90	19.60

Table 13: Running times for an AGV-train Drammen-Tønsberg.

When these figures are added to the running time for Oslo S–Drammen, the fastest journey time between Oslo S and Tønsberg is 37 minutes, while the average journey time is 46 minutes. This is approximately 20 minutes faster than would be achievable in 2035 without Vestlandsbanen. The main reasons for this are the Vestlandsbanen section between Oslo S and Drammen, and the use of a train capable of taking advantage of Vestfoldbanen's design speed of 250 km/h.

Train running times on the southern part of Vestfoldbanen

On the southern part of Vestfoldbanen, the main constraint on train running times is track capacity. Despite major progress in the construction of new double-track high-speed sections in Vestfold and southern Telemark, Vestfoldbanen between Tønsberg station and the eastern end of Kleivertunnelen (currently incomplete), almost 3 km west of Larvik, remains – and will probably still be in 2035 – a single-track railway. The same applies to the section between the western end of the recently completed high-speed double-track section Porsgrunn–Farriseidet, approximately 1.3 km south-east of Porsgrunn station, and Skien station.

On such single-track sections, a more powerful train than those currently in service may save a few seconds of running time on certain stretches, but it would then have to wait correspondingly longer at the next passing loop for a train coming from the opposite direction. The overall running times would therefore remain unchanged.

At present, there are at most two passenger trains per hour in each direction operating on the Tønsberg–Skien section of Vestfoldbanen. This frequency is most likely too low, given the role that Vestfoldbanen could play in a network incorporating Vestlandsbanen. The connection of Vestlandsbanen to Vestfoldbanen at both Drammen and Skien will enable fast train services from Vestfold and Grenland to Vestland, Rogaland, inner Telemark, Agder, Buskerud, and the greater Oslo area, as well as a "ring service" Oslo–Drammen–Vestfold–Porsgrunn–Skien–Notodden–Kongsberg–Drammen–Oslo, and vice versa.

Sener has therefore examined the possibility of increasing the number of passenger trains from two to three per hour in each direction, even though this would result in a slight increase in travel times. The results, rounded to the nearest half-minute, are presented in Table 14 for both a train travelling from Skien to Tønsberg and a train travelling from Tønsberg to Skien. As is clearly shown in the table, train crossings are proposed to take place at Skien station, on the double-track section near Pasa (2 km east of Porsgrunn station), at Larvik station, at Lauve (two parallel tracks, 559 metres long), at Sandefjord station, Stokke station, and at Tønsberg station. This crossing pattern can be repeated at 20-minute intervals.

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Passenger train Skien-Tønsberg and vice versa	Skien-Tønsberg	Tønsberg-Skien
	Minutes	Minutes
From (to) Skien	0.5	59.5
To (from) Porsgrunn	7.0	53.0
From (to) Porsgrunn	8.0	52.0
Double-track section near Pasa	10.0	50.0
To (from) Larvik	19.5	40.5
From (to) Larvik	22.5	37.5
Lauve, crossing tracks	30.0	30.0
To (from) Sandefjord	37.5	22.5
From (to) Sandefjord	40.5	19.5
To (from) Torp	44.0	16.0
From (to) Torp	45.0	15.0
To (from) Stokke	49.5	10.5
From (to) Stokke	50.5	9.5
To (from) Tønsberg	59.5	0.5

Table 14: Running times for a passenger train Skien-Tønsberg and vice versa. The words in brackets refer to the column to the right.

The table above indicates a shorter operational running time between Skien and Porsgrunn than under the current network configuration. This reduction is attributable to the Vestlandsbanen alignment proposal, which includes a new underground station in central Skien, replacing the existing station located near the northern part of the urban area. Consequently, the rail alignment distance between Porsgrunn and Skien would be reduced from 9.59 km to 7.89 km, resulting in a corresponding decrease in sectional running time.

The passenger train running times presented above, together with service robustness, timetable resilience, and the scope for higher service frequencies, would be substantially improved once the remaining single-track sections of Vestfoldbanen are replaced by high-speed double-track infrastructure. This is expected to occur some years after 2035. Consequently, rail demand on both Vestfoldbanen and Vestlandsbanen is likely to increase more strongly than the general demand growth assumed for the Vestlandsbanen project, as set out in Chapter 6.

It should, however, be emphasised that operation of through services on both Vestlandsbanen and the full extent of Vestfoldbanen would require a comprehensive assessment of infrastructure condition and, where necessary, renewal of critical assets on Vestfoldbanen, particularly on the remaining single-track sections. Without such interventions, the risk of operational disturbance and knock-on effects on adjacent lines would remain unacceptably high.

Train running times on Sørlandsbanen Bø–Arendal/Kristiansand

Sener has calculated passenger-train running times for the single-track section of Sørlandsbanen between Bø in Telemark and Arendal/Kristiansand using the same methodological approach as applied to the southern section of Vestfoldbanen. At present, the 202 km section between Bø and Kristiansand is served by, at best, one passenger train every two hours, with a corresponding service frequency on the 36 km branch line between Nelaug and Arendal.

This level of service is likely to be insufficient when considered against the substantially reduced journey times that Vestlandsbanen would provide from Bø to large parts of southern Norway. For example, a rail journey from Arendal to Stavanger via Bø and Vestlandsbanen would reduce end-to-end travel time by at least one hour compared with the existing route via Kristiansand.

Sener has therefore examined an operating pattern based on hourly passenger services between Bø and Kristiansand in both directions. The resulting timetable is presented in Table 15 on the following page for both northbound and southbound services. At stations where opposing trains are scheduled to cross, both arrival and departure times are shown. At intermediate stations without planned crossings, a single representative time is provided, approximately midway between arrival and departure. All running times have been rounded to the nearest half-minute.

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Passenger trains Bø-Arendal/Kristiansand and vice versa	Bø-Arendal/Krs.	Krs./Arendal-Bø
	Minutes	Minutes
From (to) Bø	0.5	2:59.5
Lunde	10.5	2:49.5
To (from) Drangedal	29.5	2:30.5
From (to) Drangedal	30.5	2:29.5
Neslandsvatn	42.5	2:17.5
To (from) Gjerstad	54.5	2:05.5
From (to) Gjerstad	1:00.5	1:59.5
Vegårshei	1:16.5	1:43.5
To (from) Nelaug	1:29.5	1:30.5
From (to) Nelaug to (from) Kristiansand	1:30.5	1:29.5
From (to) Nelaug to (from) Arendal	1:38.0	1:22.0
Blakstad	2:00.0	1:00.0
To (from) Arendal	2:15.0	45.0
Oggevatn	2:00.0	1:00.0
Vennesla	2:17.0	42.5
To (from) Kristiansand	2:29.5	30.5

Table 15: Running times for passenger trains Bø-Arendal/Kristiansand and vice versa.

For Sener, the development of an operating pattern capable of maintaining hourly services to and from all stations currently served was a key objective. This objective is achievable, but it requires limited infrastructure interventions, particularly on the most operationally constrained section, the 44 km stretch between Gjerstad and Nelaug. To support hourly services with a minimum level of timetable robustness, a sectional running time of 29 minutes is required. At present, however, the running time on this section is 30 minutes for Kristiansand-bound services and 31 minutes in the opposite direction, in both cases including an intermediate stop at Vegårshei.

The ongoing renewal of the catenary and power supply system[39] dating from 1939, is expected to contribute to a reduction in these running times. In addition, it appears advisable to replace the turnout at the southern end of Gjerstad station and the two turnouts at the eastern end of Nelaug station with turnouts for higher speeds in the diverting tracks, in order to reduce time losses associated with turnout speed restrictions.

Further optimisation could be achieved through minor increases in line speed on sections with sufficiently large curve radii. Modern passenger rolling stock has high traction performance and can therefore benefit from speed increases even on relatively short sections. One example is the 1.85 km section at Skorstøl, where the alignment is either straight or includes curve radii consistent with speeds of at least 120 km/h, while the current speed limit is only 100 km/h. Although an increase to 120 km/h on this section alone would save less than 10 seconds, several similar opportunities exist northeast of Nelaug, and their cumulative effect could be operationally significant.

If the combined effect of these measures proves insufficient, it may be necessary to consider omitting the stop at Vegårshei on every second service. This would reduce the service frequency at that station to its current level, but it could help lower the average sectional running time to the level required for a robust hourly timetable.

A further investment required to support hourly services – given the need for train-crossing opportunities at intervals corresponding to approximately 30 minutes of running time – relates to Blakstad station on Arendalsbanen. The journey time between Nelaug and Arendal is 37 minutes, but none of the seven stations currently served on this branch line has more than one track. However, several of these stations had crossing loops in earlier decades, and the associated foundations remain in place. One such location is the former Blakstad station, where the installation of two turnouts and an additional parallel track of approximately 200 metres would make hourly services feasible. Without such an intervention, the service frequency on Arendalsbanen would need to remain at its current level of one train every two hours.

[39] https://www.banenor.no/nyheter-og-aktuelt/nyheter/2025/et-historisk-loft-for-sorlandsbanen/

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7.2.3 Access and egress times and costs to and from stations, and preboarding times

The calculation of travel times between stations in the Vestlandsbanen model network is described in Chapters 7.1 and 7.2.2. This chapter addresses the remaining components of the total journey time – and the associated costs – incurred by travellers using high-speed rail. These components comprise:

- access time from the trip origin to the departure station,
- waiting time prior to boarding, and
- egress time from the arrival station to the final destination.

The trip origin is located within one of the 1,075 NTM6 zones covering the Vestlandsbanen area of influence, while the destination is located within another of these 1,075 zones. The calculations described in this chapter therefore establish the link between the NTM6 zoning system within the Vestlandsbanen area of influence and the 34 stations included in the Vestlandsbanen model network (see Chapter 7.2.1).

Within the NTM6 zoning system, there are almost 1.2 million possible origin–destination movements, corresponding to trips from each of the 1,075 zones to each of the other 1,074 zones. However, it is not necessary to analyse all such movements. For the purposes of the Vestlandsbanen study, it is sufficient to consider only those trips that may include a rail journey between one of the 34 departure stations in the Vestlandsbanen model network and one of the other 33 possible arrival stations.

This allows the calculation of station access and egress times and costs in three steps:

- **Step 1:** Identify the NTM6 zones associated with each of the 34 stations included in the Vestlandsbanen model network. As described below, this *assignment* of zones to stations is not always straightforward.
- **Step 2:** For each of the 34 stations, calculate the access and egress times and costs between the station and each associated zone.
- **Step 3:** Generate a matrix comprising all 34 × 33 = 1,122 possible pairs of departure and arrival stations, together with all feasible combinations of zones associated with each station pair.

The following sections describe these three steps in detail.

Assigning NTM6 zones to stations

Zones located close to a particular station, but relatively distant from other stations, can be assigned to that station unambiguously. However, this is not always the case. For example, the travel time from NTM6 zone 901: Vats, situated in the western part of Vindafjord municipality in Rogaland, to Aksdal station is approximately the same as to Ølen station. In such cases, assigning zone 901 exclusively to either Aksdal or Ølen station would lead the model to produce misleading results.

To address this, Sener established two separate assignments for this zone: one to Aksdal station for trips to and from zones near Haugesund, Kårstø and Stavanger stations; and one to Ølen station for trips to and from zones near all other stations in the Vestlandsbanen model network.

A similar approach has been applied to a number of other zones. In addition, Sener has assigned certain zones to stations depending on the direction of travel for other modelling purposes. For example, most zones in Vaksdal, Modalen and Voss municipalities (north-east of Bergen) have been assigned to Arna station, but only where the trip origin or destination is not located in zones near Bergen station. This ensures that trips on the Bergensbanen are excluded from the Vestlandsbanen demand calculation.

Calculating access and egress times and costs for each of the 34 stations

A valuable resource for calculating access and egress times and costs to and from each station is the Level of Service (LoS) dataset provided for Sener's work on the Vestlandsbanen study; see Chapter 4.3. For each possible pair of NTM6 zones, this dataset contains information on travel distances, travel times, and direct costs (such as road tolls and ferry charges) for car trips between the centroids of the two NTM6 zones.

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Compared with car travel, public transport is generally less expensive and less time-consuming in large urban areas, but slower in less densely populated regions. However, no equivalent LoS dataset for public transport is available for the entire Vestlandsbanen corridor; see Chapter 7.2.1. It was therefore necessary to use car trip data for the calculation of access and egress times and costs, while accepting the associated inaccuracies.

In many cases, the 34 stations selected for the Vestlandsbanen model network are located close to the centroid of an NTM6 zone. For example, Ølen station is located less than 300 metres from the centroid of NTM6 zone 905: Ølen. In such cases, Sener has calculated access and egress times in two steps:

- **First,** the travel time from the centroid of the trip origin zone (for example, from the centroid of zone 901: Vats) to the centroid of the zone nearest to the departure station (for example, the centroid of zone 905: Ølen) is retrieved from the LoS dataset.
- **Second,** the travel time from the centroid of the zone nearest to the station (for example, from the centroid of zone 905) to the departure station (for example, Ølen station) is calculated using web services such as Google Maps and Gule Sider,[40] and is then added to the LoS-based travel time.

With regard to travel costs, Sener has multiplied the length of the two trip legs by NOK 3.90 per car-km and added the direct costs provided by the LoS dataset. This value and calculation procedure are the same as those used for all car trips, including those analysed as an alternative to a high-speed rail (HSR) trip; see Chapter 7.4.

It should be noted that a trip will often start at a location other than the centroid of an NTM6 zone. Consequently, the distance from the actual trip origin to the departure station may be either longer or shorter than the distance from the zone centroid. Likewise, the average distance of all possible car trips originating within a zone may be either longer or shorter than the centroid-based distance.

Sener has therefore adopted a conservative approach and calculated access and egress times as described above, including in cases where the distance between the station and the centroid of the nearest NTM6 zone is significantly greater than 300 metres and the method results in a non-negligible detour on the access trip to the station.

However, this procedure also has limitations. For example, there is no NTM6 zone centroid located close to Brunkeberg station. The nearest is the centroid of zone 686: Kviteseid, which is 7 km away. Using this centroid to determine access and egress times and costs for zones located east of Brunkeberg station would result in a 14 km detour being included in the calculation, since all such trips would follow the E134 and pass the station. Sener therefore decided to use two different centroids: the centroid of zone 686: Kviteseid for access and egress trips west of Brunkeberg station, and the centroid of zone 683: Seljord, 10 km away, for access and egress trips east of Brunkeberg station.

Unfortunately, not all challenges can be resolved in this way, particularly in areas with large NTM6 zones and correspondingly long distances between centroids. For example, the only zone that can be assigned to Nordagutu station is zone 677: Sauherad. All other zones in the area belong either to Bø, Skien or Notodden.

The issue is that the centroid of zone 677 is located near Hjuksebø, approximately 8 km and 10 minutes by car north of Nordagutu station, and only around 10 minutes by car south of Notodden town centre. Consequently, when the procedure described above is applied, the rail travel time between zone 677 and one of the zones in Notodden will be calculated as the sum of a 10-minute southbound access trip to Nordagutu station, the pre-boarding time, the in-vehicle time on a northbound train travelling almost 19 km to Notodden station, and the egress time from Notodden station to Notodden town centre. By contrast, the equivalent journey by car would take only around 10 minutes. This leads the passenger transport model to estimate an unrealistically low rail demand.

[40] https://www.google.no/maps and https://www.gulesider.no/kart

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Conversely, if a zone centroid were located closer to Nordagutu station, the station access time would be considerably shorter, the car travel time to Notodden would be longer, and the resulting rail demand would be more realistic.

A similar issue arises at Haukeligrend station in Vinje municipality, Vest-Telemark. The nearest – and indeed the only – centroid that can be assigned to this station is the centroid of zone 730: Bykle, located near Hovden in the northern part of Agder County, approximately 30 minutes by car from Haukeligrend station. At the same time, trips to and from the area surrounding Haukeligrend station are included within trips to and from zone 690: Vinje, whose centroid is located close to Åmot station. As a result, the modelled rail demand to and from Åmot station will be slightly overstated, whereas the modelled demand to and from Haukeligrend station will be understated. This limitation cannot be resolved within the scope of the present study and should therefore receive greater attention in the next phase of the Vestlandsbanen investigations.

Generating a table consisting of all relevant combinations of NTM6-zones

Using a dedicated coding procedure, Sener has consolidated the 34 stations included in the Vestlandsbanen model network, all assigned zones, and the various calculation procedures described above into a single table. This table incorporates zone-to-station assignments, including cases where the assignment depends on the direction of travel, as well as time and cost calculations based on either one centroid or multiple centroids, as appropriate.

On this basis, all possible combinations were generated for the 34 departure stations and 33 arrival stations, together with all possible combinations of NTM6 zones associated with each station pair. This resulted in a total of 937,888 combinations.

The preboarding time

Rail passengers typically arrive at the station a few minutes before their train departs. This pre-boarding time depends both on the type of traveller and on the nature of the journey. For long-distance trips, pre-boarding time is generally longer than for short-distance trips. At the same time, commuters and business travellers are usually more familiar with rail travel and therefore tend to arrive later at the station than passengers travelling for private purposes. Sener has therefore defined the average pre-boarding time as:

$$7.5 + 0.04 * T \quad \text{for work trips, and}$$

$$10 + 0.05 * T \quad \text{for non-work trips}$$

In these expressions, T represents the in-vehicle travel time on board the high-speed train, measured in minutes, and the resulting pre-boarding time is also expressed in minutes. This corresponds to a pre-boarding time of 12.3 minutes for a work trip involving two hours on board the train, and 16.0 minutes for a non-work trip of the same duration. For trips involving 30 minutes on board the train, the corresponding values are 8.7 minutes and 11.5 minutes, respectively.

In addition, a high-speed rail journey includes other forms of waiting time, such as the waiting time until the next available departure. This aspect is addressed in the following subchapter.

7.2.4 Train routes without interchange, and service frequencies

The purpose of this chapter is to define the train service patterns to be operated as direct (i.e. without interchange) services, as well as the service frequencies to be provided at the various stations. This definition cannot be achieved in a single step; rather, it constitutes an iterative optimisation process, starting from a set of initial assumptions which are subsequently refined.

For example, demand for high-speed rail on a given corridor is, inter alia, dependent on the number of daily departures. Conversely, the level of service that can be sustained is largely a function of demand. This interdependency necessitates the adoption of initial assumptions, followed by successive adjustments based on the demand outcomes derived.

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In addition, the determination of service frequencies is influenced by broader project objectives. As outlined in Deliverable 0 – High-Level Goals, the primary objectives of the Vestlandsbanen project include enhancing national connectivity, thereby supporting increased economic productivity and competitiveness, improving environmental performance, and enhancing transport safety, among other benefits.

These objectives can only be realised if sufficiently frequent services are provided at each station. As a general principle, the interval between consecutive departures should not exceed the end-to-end journey time by car; otherwise, the improvement in connectivity would be limited. While this criterion cannot be strictly met in all cases – particularly over shorter distances – it provides an important guideline for establishing the initial service assumptions.

Sener has initiated the development of direct service patterns and frequencies with the Bergen–Oslo and Stavanger–Oslo corridors. Based on current air and road traffic volumes, together with the achievable rail journey times, it became evident at an early stage that a high-frequency service with regular intermediate stops and a unified operating concept – serving both long-distance and regional passengers with the same trains – would be both feasible and advantageous. The rationale for this approach is set out below:

- On Vestlandsbanen, non-stop journey times Bergen–Oslo and Stavanger–Oslo are expected to be approximately 1 hour 45 minutes.[41] However, a high-speed rail journey time of around 2 hours 30 minutes would remain highly competitive with air travel. This provides sufficient allowance for a significant number of intermediate stops, each adding approximately 4 to 4½ minutes to the overall journey time.[42] Sener has also assessed limited-stop service patterns with substantially shorter journey times, targeting potential long-distance markets such as Stavanger–Trondheim or Bergen–Stockholm. However, these markets exhibit comparatively lower demand potential than the cumulative benefits associated with serving multiple intermediate stations along Vestlandsbanen.

- Operating a single service pattern that accommodates both regional and long-distance passengers offers several advantages. A high number of well-served intermediate stations, integrated with connecting public transport services, enhances rail competitiveness relative to private car travel, particularly given the more dispersed origins and destinations of road-based trips. Furthermore, the aggregation of regional and long-distance demand improves rolling stock utilisation – benefiting from temporal variation in demand peaks – enables higher service frequencies and reduces the need for passenger interchanges.

- Sener has also considered a segregated operating model, with distinct services for regional and long-distance markets, particularly in the absence of a parallel conventional railway capable of delivering competitive regional services. However, such a model would reduce the attractiveness and increase the cost of high-speed rail, due to the requirement for interchanges, lower off-peak utilisation of regional services, and increased operational complexity. This complexity arises from the need to manage overtaking movements (fast long-distance trains passing slower regional services) and to ensure reliable connections between different service types.

- The feasibility of operating fast freight services between passenger services during daytime hours is largely dependent on the differential between average passenger and freight train speeds. Increasing the number of intermediate stops reduces the average speed of passenger services, thereby facilitating timetable integration with freight operations. Moreover, the relatively high number of stations planned along Vestlandsbanen – compared to typical high-speed rail systems internationally – provides multiple overtaking opportunities for freight services. All stations are therefore planned with four-track layouts, also reflecting safety and operational requirements.

Based on the above considerations, Sener has defined the initial assumptions for the optimisation process on the Bergen–Oslo and Stavanger–Oslo corridors as two trains per hour per direction, with each service calling, on

[41] Appendix 2 shows a travel time of 1:51 hours from Oslo S to Bergen, including stops at Majorstua, Drammen and Arna. Removing these stops would save at least 6 minutes. From Oslo S to Stavanger would take a few minutes more.
[42] See Appendix 2 and the figures in the column titled “Total time”.

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average, at every second station on each departure, in addition to mandatory stops at Majorstua and Drammen (and Arna for services to/from Bergen).

Table 16 below indicates a journey time of approximately 2 hours 20 minutes between both Bergen and Oslo S, and Stavanger and Oslo S, in both directions. It also provides the corresponding arrival times at intermediate stations, based on the proposed stopping pattern.[43] These values incorporate the average running times derived from four selected stopping patterns between Oslo S and Drammen, as outlined in the first part of Chapter 7.2.2.

Bergen-Oslo S	h:min	Oslo S-Bergen	h:min	Stavanger-Oslo S	h:min	Oslo S-Stavanger	h:min
Bergen	0.00	Oslo S	0.00	Stavanger	0.00	Oslo S	0.00
Arna	5.22	Majorstua	2.58	Kårstø	14.04	Majorstua	2.58
Tysse	13.34	Nesbru	10.53	Ølen	25.93	Nesbru	10.53
Kvam-Jondal	21.99	Drammen	20.16	Sauda	35.71	Drammen	20.16
Odda	31.57	Eiker	26.23	Haukeligrend	57.16	Eiker	26.23
Røldal	42.17	Kongsberg	35.36	Åmot	1:07.07	Kongsberg	35.36
Haukeligrend	58.22	Notodden	44.22	Brunkeberg	1:16.97	Notodden	44.22
Åmot	1:08.13	Bø	53.05	Bø	1:27.52	Bø	53.05
Brunkeberg	1:18.03	Brunkeberg	1:03.76	Notodden	1:36.06	Brunkeberg	1:03.76
Bø	1:28.58	Åmot	1:13.81	Kongsberg	1:46.12	Åmot	1:13.81
Notodden	1:37.12	Haukeligrend	1:23.71	Eiker	1:53.58	Haukeligrend	1:23.71
Kongsberg	1:47.18	Røldal	1:39.16	Drammen	1:57.91	Sauda	1:44.10
Eiker	1:54.64	Odda	1:49.20	Nesbru	2:07.60	Ølen	1:53.84
Drammen	1:58.97	Kvam-Jondal	1:58.25	Majorstua	2:15.50	Kårstø	2:05.52
Nesbru	2:08.66	Tysse	2:06.89	Oslo S	2:19.35	Stavanger	2:18.57
Majorstua	2:16.56	Arna	2:13.04				
Oslo S	2:20.41	Bergen	2:19.27				

Table 16: Arrival times for passenger trains Bergen-Oslo S, Stavanger-Oslo S and vice versa, stopping in average on every second station.

Haugesund, Aksdal, Grenland and Vestfold

A key outstanding issue concerns how high-speed services should serve Haugesund and Aksdal stations. Sener has assessed several options, including the introduction of additional dedicated services between Haugesund and Oslo S. However, demand estimations indicate that such services would likely sustain only one train per direction every two hours. This relatively low frequency would be suboptimal, particularly considering that, in order to minimise pathing conflicts with other services, these additional trains would adopt stopping patterns broadly similar to the Bergen–Oslo and Stavanger–Oslo services, calling at approximately every second station. Consequently, this would limit the number of direct connections between Haugesund/Aksdal and intermediate stations – such as Notodden, Kongsberg and Eiker – to approximately four services per day in each direction.

An alternative approach would be to split the assumed two trains per hour per direction between Stavanger and Oslo, routing one service via the direct alignment between Kårstø and Ølen, and the other via Haugesund. This would effectively double the service frequency to and from Haugesund. However, it would also result in increased journey times for passengers travelling between Stavanger/Kårstø and Oslo when using services routed via Haugesund, rather than the fastest direct option.

The magnitude of this additional travel time can be illustrated by comparing alternative routings for a journey between Sauda and Stavanger. Based on service patterns with stops at approximately every second station, the fastest direct services are expected to achieve a journey time of around 35 minutes. By contrast, the route via Haugesund comprises approximately 24 minutes from Sauda to Haugesund and a further 24 minutes from

[43] It should be noted that the table cannot be used to calculate travel times between two intermediate stations, because the difference between the arrival times to the two stations only reflects half of the time it takes for a stop at the first station, except for Majorstua, Drammen and Arna.

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Haugesund to Stavanger. Allowing an additional 5 minutes for reversal at Haugesund – consistent with current operational practice, although potentially reducible in the future – the total journey time via Haugesund would be approximately 53 minutes, representing an increase of 18 minutes compared to the direct route.

Conversely, modest reductions in the number of intermediate stops east of Sauda could yield a slight reduction in journey times between Haugesund and Oslo. This optimisation is supported by demand estimations for high-speed services between Rogaland and the former Hordaland counties in the west, and Grenland and Vestfold in the east. The demand appears sufficient to support one train every two hours from Stavanger (via Haugesund) and one train every two hours from Bergen, resulting in an effective hourly service east of Sauda and Røldal.

For these services, it is essential to maintain stops at Haukeligrend, Åmot, Brunkeberg and Bø. Without these stops, the service frequency between the stations in Vest- and Midt-Telemark and the principal urban centres of Skien and Porsgrunn would fall below one train per hour per direction, which would be inadequate.

At the same time, high-speed services operating every two hours between Stavanger and Grenland/Vestfold via Haugesund – with all departures calling at stations in Vest-Telemark – would allow Stavanger–Oslo services via Haugesund to run non-stop through Vest-Telemark. This would reduce journey times by approximately six minutes compared to a pattern with stops at every second station. Nevertheless, services to and from Oslo should retain a stop at Bø in order to ensure robust interchange with services to Kristiansand and Arendal via south-western Telemark and inner Agder. Given that demand is expected to support hourly services on these connecting routes, it is appropriate for all Stavanger–Oslo services via Haugesund to call at Bø.

In addition, an hourly service should be provided at Aksdal station. This is important not only for Tysvær municipality but also for connectivity to significant parts of the Sunnhordland region.

Under this operating concept, the end-to-end journey time between Stavanger and Oslo S via Haugesund would be approximately 2 hours 35 minutes, compared to around 2 hours 19 minutes via the shortest alignment. This results in an average journey time of approximately 2 hours 27 minutes between Stavanger and Oslo S.

Stavanger–Bergen and the "ring service"

Similar considerations support the provision of two trains per hour per direction between Bergen and Stavanger, as well as two trains per hour on the "ring service" (Oslo–Kongsberg–Skien–Tønsberg–Oslo). In all cases, services are assumed to call, on average, at every second station. An exception is made for the single-track section between Skien and Tønsberg, where trains are assumed to call at all stations, as omitting stops would not yield any meaningful reduction in journey time due to infrastructure constraints.

Demand estimations for the ring service – taking into account the current extent of single-track sections – indicate slightly lower demand than on the Bergen–Oslo and Stavanger–Oslo corridors, but still sufficient to justify an initial assumption of two trains per hour per direction. It is also considered essential to provide at least hourly direct connections between Kongsberg, Notodden, Grenland and southern Vestfold, and the industry centroids in these areas. This level of connectivity would not be achievable with only one train per hour per direction combined with a stopping pattern serving, on average, every second station.

By contrast, with two trains per hour per direction, stations such as Notodden, Kongsberg and Eiker can benefit from three departures per hour to Drammen and Oslo, out of a total of six trains operating over the Notodden–Drammen section of Vestlandsbanen.

A similar rationale applies to the Bergen–Stavanger corridor. A symmetrical operating pattern – comprising two trains per hour from both Bergen and Stavanger to Oslo, together with two trains per hour between Bergen and Stavanger – provides the most robust framework for a regular and evenly distributed stopping pattern across stations in Vestland and Rogaland counties.

As with the east–west corridors to and from Stavanger, it is assumed that, for the north–south services, one of the two trains per hour per direction would operate via the shortest alignment, while the other would serve Haugesund and Aksdal. In this case, however, no additional stations would be omitted from the stopping pattern. This operating concept results in a fastest journey time of approximately 1 hour 27 minutes between Bergen and Stavanger via the direct route, and approximately 1 hour 47 minutes for services routed via Haugesund.

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Kristiansand/Arendal–Bø

Demand on the Sørlandsbanen corridor between Kristiansand/Arendal and Bø appears sufficient to support one train per hour per direction. The majority of this demand is expected to be oriented towards the greater Oslo area. This supports the case for providing hourly through services between Oslo S and Kristiansand without interchange at Bø, either by means of high-speed rolling stock or by conventional trains with lower maximum operating speeds, similar to those currently in operation on the Sørlandsbanen. While the former option would entail higher capital costs, the latter would result in increased journey times north-east of Bø, although journey times south of Bø would remain largely unaffected.

However, each additional service operating between Oslo S and Bø would increase the complexity of timetable planning and reduce operational robustness, in particular northeast of the junction located approximately 10 km south of Notodden. This is particularly critical given that this section of Vestlandsbanen is already expected to accommodate up to six passenger services and one or two fast freight paths per hour per direction.

Furthermore, the existing single-track section of Sørlandsbanen between Bø and Kristiansand – constructed between 1925 and 1938 – is inherently more susceptible to operational disruption than a modern double-track railway such as Vestlandsbanen. This remains the case even following comprehensive condition assessments and targeted renewal of critical assets.

On this basis, Sener has, for the purposes of this study, assumed that passengers travelling between areas served by Vestlandsbanen and those located south of Bø on Sørlandsbanen would be required to interchange at Bø. This assumption may be revisited in subsequent phases of the Vestlandsbanen development, depending on factors such as the final alignment of the branch via Kongsberg and the implementation of additional capacity-enhancing measures.

One such measure could include the provision of a new connection between Vestlandsbanen and Sørlandsbanen in the vicinity of Vestfossen (between Eiker and Kongsberg), as outlined in Deliverable 4 – DBI Alignment Review Report. However, these considerations should be evaluated in conjunction with the potential development of a new double-track railway along the Skagerrak coast between Grenland and Kristiansand, conceived as a logical extension of the Vestlandsbanen and Vestfoldbanen high-speed rail network.

Other direct rail services

Sener has also assessed the potential for additional direct services, for example between Notodden, Kongsberg and Eiker, and stations along Vestfoldbanen south of Drammen. At present, demand for such connections appears to be limited and insufficient to justify direct services.

In addition, capacity constraints at Drammen station – particularly in relation to turnaround and reversal operations – further restrict the feasibility of introducing such services.

Summary

The initial assumptions adopted by Sener for the direct routes in the Vestlandsbanen model network are outlined below. The selected service frequencies are illustrated in Table 17 and Figure 6.

In Figure 6, solid lines represent one train departure per hour in each direction, while dotted lines indicate a service frequency of one train every two hours.

Station stopping patterns are denoted using circle symbols:

- **Solid black circles** indicate that trains stop at the station on every departure (approximately 16 times per day on average, considering weekdays and annual operation).
- **Half black / half white circles** indicate that trains stop at the station on every second departure (around 8 times per day).
- **White circles** indicate that trains do not stop at the station.

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Train route	Number of services in each direction
Bergen-Oslo	2 trains an hour
Stavanger-Oslo (shortest route)	1 train an hour
Stavanger-Oslo via Haugesund	1 train an hour
Bergen-Stavanger (shortest route)	1 train an hour
Bergen-Stavanger via Haugesund	1 train an hour
Bergen-Skien-Tønsberg-Oslo	1 train every second hour
Stavanger-Haugesund-Skien-Tønsberg-Oslo	1 train every second hour
Oslo-Kongsberg-Skien-Tønsberg-Oslo	2 trains an hour
Bø-Arendal/Kristiansand	1 train an hour

Table 17: Initial assumptions for direct routes and service frequencies in the Vestlandsbanen model network.

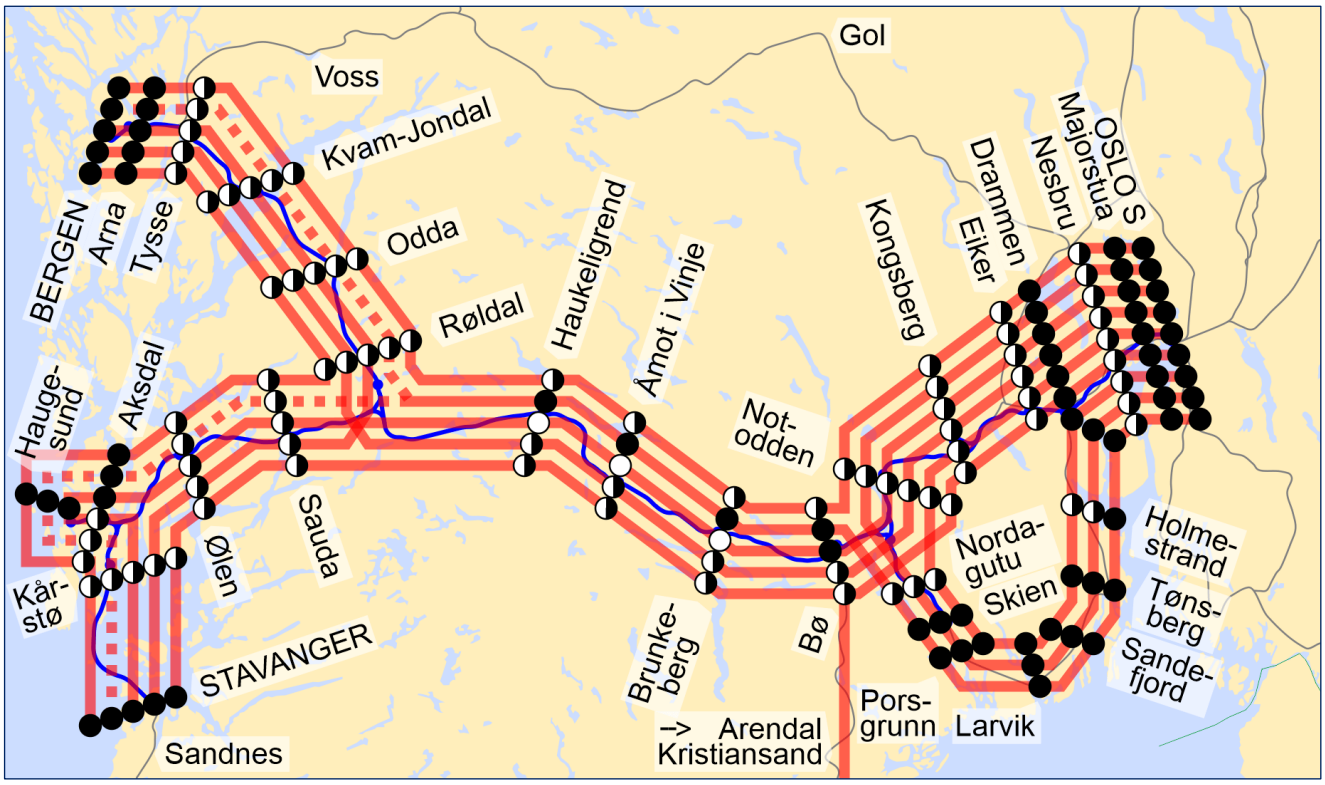

Figure 6: Schematic diagram of the direct train routes and service frequencies selected as initial assumptions for the Vestlandsbanen model network. It should be noted that the trains will serve more stations than shown here, see Table 11.

7.2.5 High-speed rail ticket costs

A review of the pricing and discount policies adopted by various high-speed rail operators indicates a significant diversity of approaches. Typically, discounted fares are offered to specific passenger groups, including children, students, military personnel, pensioners, families, and organised groups. In addition, frequent travellers may benefit from a range of loyalty schemes. Travel outside peak periods is generally incentivised through reduced fares, while differentiated pricing across rolling stock classes reflects varying passenger requirements in terms of comfort and onboard working facilities.

With the exception of a limited number of high-level recommendations (outlined below), it is not considered appropriate for Sener to define a detailed pricing and discount framework for operators on the Vestlandsbanen corridor. Such policies are most effectively developed by the operating companies themselves, drawing on their detailed understanding of the Norwegian travel market and through close dialogue with the relevant national

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authorities. Consequently, Sener has not made assumptions regarding absolute fare levels, discount structures, or the distribution of demand across different ticket categories.

Instead, Sener has estimated the *average* ticket prices, differentiated between work-related and non-work-related trips. It is anticipated that average fares for work-related travel will be significantly higher than those for non-work travel, driven by several factors:

- A higher proportion of non-work travellers benefit from discounted fare categories (e.g. children, pensioners, families, and group travel) compared to work-related travellers.
- Business and duty travellers typically place greater value on comfort and productivity and are therefore more willing to pay a premium for enhanced onboard conditions and facilities.
- A significant share of commuters and business travellers travel during peak periods; unlike leisure travellers, they generally exhibit limited sensitivity to price incentives aimed at shifting demand to off-peak times.

However, there is currently an additional factor contributing to higher average travel costs for business travellers compared to other user groups: passengers who purchase tickets shortly before departure are often required to pay significantly higher fares than those who book several weeks in advance. While this pricing approach is common in the aviation sector, it is not considered appropriate for the Vestlandsbanen corridor and is therefore not recommended.

As highlighted in Chapter 5, which analyses current demand patterns, there is substantial potential for modal shift from both air and road to rail, particularly when considering a combination of long-distance and regional journeys. For rail to compete effectively with private car usage, it must not only offer high-speed, high-frequency services supported by a well-distributed network of stations but also remain competitive in terms of cost and flexibility.

Flexibility, in this context, encompasses the ability for passengers to make travel decisions at short notice and to modify departure times without incurring significant financial penalties. This principle does not preclude the implementation of time-of-day pricing variations; however, any such differentiation should be transparent, communicated well in advance, and consistently available to passengers. In parallel, it is essential to ensure sufficient rolling stock capacity so that passengers can change to their intended service without facing constraints due to fully booked trains.

Taking these considerations into account, Sener has adopted a conservative approach to fare assumptions within the passenger demand model, applying relatively moderate average ticket prices as a baseline for subsequent optimisation. This optimisation process will further examine the potential generation of operating surpluses and the extent to which these may contribute to the financing of the high-speed rail infrastructure. Nevertheless, it is considered fundamental that average rail fares remain significantly lower than those for air travel, even though high-speed rail services will offer faster door-to-door journey times for most users, combined with a higher overall quality of travel experience.

The following formulae define the average ticket prices (expressed in NOK at 2024 price levels) applied in the initial transport model, as a function of travel distance D, measured in kilometres and rounded up to the nearest whole kilometre.

$$40 + 3 * D - 0.001 * D^2 \quad \text{for work trips, and}$$

$$24 + 1.8 * D - 0.0006 * D^2 \quad \text{for non-work trips}$$

These formulations yield, for instance, an average ticket cost of NOK 1,080 for a work-related trip and NOK 648 for a non-work trip over a distance of 400 km. For a journey of 100 km, the corresponding average fares are NOK 330 and NOK 198, respectively.

Sener does not have access to benchmark data regarding current average rail fares in Norway. However, it is reasonable to assume that these are not significantly lower than the fare levels assumed for the Vestlandsbanen analysis, despite notable differences such as longer journey times on existing services. This can be attributed, at least in part, to the shorter and more direct alignments planned for Vestlandsbanen, which makes it possible to offer highly competitive ticket prices even with a slightly higher price per travel distance.

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7.2.6 Times and costs for rail travellers – summary

Chapter 7.2 presents the definition of the high-speed rail system. It includes a comprehensive set of calculations and assumptions relating to rail travel, with associated journey times and costs detailed across several subchapters. This encompasses:

- Travel times by high-speed trains between stations along Vestlandsbanen and adjacent railway lines,
- Stopping pattern and service frequencies for all train routes and stations, and resulting travel times and interchanges (where necessary),
- Access and egress costs to and from stations, and preboarding times, and
- Ticket costs.

Except for access and egress costs and pre-boarding times, all relevant data are compiled in Appendix 3, providing a comprehensive matrix of origin–destination pairs across all stations within the study area.

The content of Appendix 3

As outlined in Chapter 7.2.1, 34 stations have been selected for the Vestlandsbanen model network. For all possible journeys between these stations, except for Arendal–Kristiansand and vice versa, Appendix 3 show:

- The travel time in hours, minutes and hundredths of a minute, based on the stopping pattern illustrated in Figure 6 in Chapter 7.2.4 and described in the preceding sections of Chapter 7.2;
- The average ticket revenue per journey for work purposes, in NOK (2024 prices);
- The average ticket revenue per journey for non-work purposes, in NOK (2024 prices);
- The number of departures per average day and direction; and
- The number of interchanges on each journey, based on the reported number of departures.

7.3 Times and costs for air travellers

The purpose of this chapter is to define the key characteristics of air travel, forming a core input to the passenger transport model and underpinning the estimation of future modal split and induced demand.

7.3.1 Flight times and service frequencies

Eight air routes have been identified as relevant within the Vestlandsbanen area of influence (refer to Chapter 5.1). Table 18 presents the corresponding flight times (in minutes), together with the number of daily services per direction, as adopted in the transport model.

Flight durations have been derived from airline timetable data, while service frequencies represent projections for the year 2035, based on observed schedules in 2024 and 2025. No material increases or reductions in service frequency have been assumed over this period.

Sener has not incorporated explicit allowances for average delays in the modelling assumptions, despite strong indications that a calculation of such allowances would result in non-negligible figures.

Air route	Flight time	Flights/day
Bergen/Stord-Oslo	55	24
Stavanger-Oslo	55	20
Bergen-Stavanger	40	11
Haugesund-Oslo	55	7
Kristiansand-Oslo	50	7
Bergen-Sandefjord	55	5
Bergen-Kristiansand	55	5
Stavanger-Sandefjord	50	4

Table 18: Assumed flight times and number of flights per day and direction.

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Following the commissioning of Vestlandsbanen, a significant reduction in air passenger demand is anticipated. This is expected to translate into corresponding adjustments in service frequencies and input parameters within the transport model, applied through an iterative modelling process.

For the purpose of the analysis, Sener has assumed that the reduction in flight frequencies will be less pronounced than the decline in passenger demand, with services maintained at a defined minimum level. This approach reflects the likelihood that a baseline level of air connectivity will be preserved for operational, strategic, and regional accessibility reasons, even where load factors may be relatively low. Accordingly, a minimum service level has been established at 35% of pre-Vestlandsbanen flight frequencies, irrespective of whether the modelled reduction in air travel demand exceeds 65%.

7.3.2 Airport access and egress, and dwell times in airports

Access and egress times and costs to and from the six airports – Flesland (Bergen), Karmøy (Haugesund), Sola (Stavanger), Kjevik (Kristiansand), Torp (Sandefjord), and Gardermoen (Oslo) – have been estimated using the same methodological approach as that applied to station access and egress, as described in Chapter 7.2.3.

In contrast to the station-based analysis, no significant challenges were encountered in assigning NTM6 zones to airports, as these are generally located within areas characterised by a relatively dense and fine-grained zoning structure.

One specific case required a differentiated zoning assignment depending on the direction of travel. This applies to zones in the vicinity of Sandefjord Airport Torp. For journeys to or from Bergen or Stavanger, these zones are assigned to Torp Airport. However, for journeys to or from Haugesund, the same zones are instead assigned to Oslo Airport Gardermoen, reflecting the absence of regular direct air services between Sandefjord and Haugesund. Journeys via Stord Airport Sørstokken have been assigned to Bergen Airport Flesland; see Chapter 5.1.

Dwell times in airports

In a similar manner to pre-boarding times at railway stations, Sener has defined dwell times at airports, both prior to departure and following arrival. These dwell time components account for activities such as baggage check-in and reclaim, as well as passenger circulation within the terminal, including movement to departure gates and exit from arrival areas.

The following average values have been adopted, reflecting the assumption that non-work travellers typically spend longer within airport facilities than work-related travellers:

- **Work-related trips:** 55 minutes prior to departure and 5 minutes following arrival;
- **Non-work trips:** 65 minutes prior to departure and 15 minutes following arrival.

There is no evidence to suggest that these dwell times will vary materially in response to changes in air travel demand or foreseeable technological developments (for example, those related to security procedures or cabin baggage regulations).

7.3.3 Air ticket costs

Sener has undertaken an analysis of air fares across the eight selected routes over a multi-year period, spanning 2024 to early 2026. The findings highlight a high degree of variability in ticket pricing, driven by a range of factors:

- Airlines frequently offer substantially reduced fares during promotional campaigns compared to standard pricing periods, with one-way tickets occasionally available from as low as NOK 349 when booked several weeks in advance.
- Ticket prices vary significantly depending on the booking horizon. Fares can exceed NOK 3,500 for one-way travel booked less than one week prior to departure and may surpass NOK 4,500 for premium seating purchased only a few days in advance.
- No clear correlation is observed between fare levels and flight distance. For example, fares on the Bergen–Stavanger route may exceed those on Bergen–Oslo, despite the latter being approximately twice the distance.

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- Prices are also influenced by aircraft size and the level of competition on a given route. Routes operated with smaller aircraft tend to exhibit higher average fares, while increased airline competition generally leads to lower prices.
- A wide range of discounts is available through loyalty programmes, organisational memberships, and bundled products such as credit cards or insurance packages.

Under these conditions, any attempt to derive a statistically robust average fare would be subject to an unacceptably high margin of uncertainty. Instead, Sener has adopted a pragmatic approach, defining representative average fare levels that are not considered excessive, thereby supporting a conservative estimation of future air travel demand.

On this basis, the following average ticket costs have been applied uniformly across all eight routes within the passenger transport model:

- **NOK 1,400** for work-related trips;
- **NOK 840** for non-work trips.

These assumed air fares are approximately 25% higher than the corresponding high-speed rail ticket costs for comparable distances, with the exception of the significantly shorter Bergen–Stavanger route.

7.4 Times and costs for car travellers

Similar to Chapter 7.3, this chapter outlines the characteristics of car travel, as applied within the passenger transport model.

7.4.1 Car travel times

As described in Chapter 4.3, car travel times are derived directly from the Level of Service (LoS) datasets, covering all origin–destination pairs between NTM6 zones. The only adjustment applied to these baseline travel times relates to the inclusion of the Rogfast subsea tunnel project, as discussed in Chapter 7.4.3.

7.4.2 Car travel costs per car-kilometre

The costs associated with car travel – excluding road tolls and ferry charges – are reported in a range of sources, with significant variation in the resulting estimates. For example, a handbook by Statens vegvesen[44] reports a cost of NOK 2.52 per car-kilometre (2020 price level). This value appears understated, as key cost components such as insurance premiums and public charges are not included.

Conversely, an analysis by the Opplysningsrådet for veitrafikken (OFV)[45] indicates costs ranging between NOK 5.39 and NOK 9.05 per car-kilometre (2024 price level) for different types of passenger vehicles within the two lowest cost categories. These relatively high values are derived despite an annual mileage of 15,000 km – approximately 30% above the national average.[46] Within these estimates, vehicle depreciation alone accounts for approximately one-third to one-half of the total cost.

A key consideration in interpreting these values is that car ownership is, for many households in Norway, a necessity rather than a discretionary choice. Limited availability of public transport in many areas and directions means that private vehicles remain essential for daily mobility. As a result, when comparing travel options, users often consider only the marginal cost of an additional journey (e.g. fuel/electricity, variable maintenance, and tolls), rather than the full ownership cost, as fixed expenses such as purchase, taxes, and a substantial share of insurance costs are already incurred.

[44] https://www.vegvesen.no/globalassets/fag/handboker/hb-v712-konsekvensanalyser-2021.pdf, Table 5.3.
[45] https://ofv.no/aktuelt/2024/stadig-dyrere-å-ha-bil
[46] https://www.ssb.no/transport-og-reiseliv/landtransport/statistikk/kjorelengder

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By contrast, the provision of a high-quality public transport system – comprising high-speed rail as the backbone, complemented by local modes such as frequent bus services, car-sharing schemes, and micromobility options – has the potential to reduce car dependency. In such scenarios, households may be able to reduce car ownership (e.g. from two cars to one), and the full cost of car ownership becomes more relevant in mode choice decisions.

In order to reconcile these differing perspectives, Sener has considered alternative reference points for estimating representative car travel costs. One such source is the standard reimbursement rates that Norwegian employers may pay employees for the use of private vehicles for work purposes, without incurring tax liability.[47] These rates are assumed to reflect a broadly accepted approximation of actual per-kilometre costs, noting that any additional reimbursement is subject to taxation.

Since 2017, the tax-free reimbursement rate has been NOK 3.50 per car-kilometre. In addition, taxable supplementary allowances have increased from NOK 0.60 in 2017 to NOK 1.40 in 2024. A further allowance of NOK 1.00 per additional passenger (excluding the driver) is also applied. Assuming an average vehicle occupancy of 1.61 persons (see Chapter 5.2), this corresponds to an effective tax-free rate of NOK 4.11 per car-kilometre.

On this basis, Sener has adopted an average car travel cost of NOK 3.90 per car-kilometre (2024 price level), excluding tolls and ferry charges. This value is slightly below the derived benchmark of NOK 4.11, reflecting the possibility that passenger-related allowances are partly designed to incentivise higher vehicle occupancy. At the same time, no explicit adjustment has been made to reflect inflationary effects on reimbursement rates since 2017, thereby maintaining a conservative assumption within the modelling framework.

7.4.3 Adjustments of car travel times and costs due to the Rogfast road tunnel

The planned Rogfast subsea road tunnel is expected to reduce car travel times by approximately 60 minutes for journeys between areas located on the northern and southern sides of the Boknafjord, and vice versa. These time savings have been incorporated into the model for the majority of relevant journeys. However, they have not been applied in cases where an alternative route – although slightly longer in distance – avoids the relatively high toll charge associated with the Rogfast tunnel. One such example is journeys between Vestland County and areas in Agder County located east of Kvinesdal.

The toll levels for the Rogfast tunnel are defined in the financing framework of the Norwegian Ministry of Transport.[48] For passenger vehicles, the stated toll per direction is NOK 394 (2020 price level), or NOK 353 when applicable subsidies are taken into account. Sener has adopted the subsidised value, extrapolated it to 2024 prices, and applied an assumed average discount of 20%, resulting in an effective toll of NOK 336.50 per journey.

For comparison, the 2024 fare for the existing ferry service is NOK 188, based on NTM6 data for ferry and toll charges. The Rogfast tunnel therefore implies a net increase in user cost of NOK 148.50 per journey, which has been consistently applied in the subsequent model calculations.

7.4.4 Car travel costs per traveller and km, also to and from stations or airports

For the purpose of subsequent calculations and comparison with alternative modes, travel costs are required on a per passenger-kilometre (pkm) basis rather than per vehicle-kilometre. As described in Chapter 5.2, a comprehensive dataset is available on car occupancy rates for each of the approximately 1.2 million origin–destination pairs within the NTM6 zoning system. Accordingly, the cost per passenger-kilometre is derived by adding the estimated car cost per vehicle-kilometre to applicable road tolls and ferry charges, and dividing the result by the corresponding vehicle occupancy rate.

Car-based cost assumptions are also applied in the estimation of access and egress trips to and from railway stations and airports. As noted in Chapters 7.2.3 and 7.3.2, this does not imply that all such journeys are undertaken by private car; rather, it reflects the modelling assumption that the cost of access and egress trips is represented by equivalent car travel costs.

[47] https://www.skatteetaten.no/satser/bilgodtgjorelse-kilometergodtgjorelse
[48] https://www.regjeringen.no/contentassets/8e5b283f2fd34f7b8559705ad9d2502b/nn-no/pdfs/prp202020210054000dddpdfs.pdf, page 4.

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The derivation of these costs requires assumptions regarding average vehicle occupancy for access and egress trips. For airport access and egress, an assumption of one passenger per car has been adopted.

For railway station access and egress, a composite approach has been applied. The full journey – from origin to final destination – has been considered, and the respective modal shares of car and air travel in existing demand have been used to derive a weighted occupancy rate. Specifically, the average car occupancy is weighted by the current share of car travel, while an occupancy rate of 1.0 is assumed for air travel and weighted by its corresponding modal share. The sum of these weighted values is then applied as the representative occupancy rate for access and egress trips to and from railway stations.

7.5 Times and costs for travellers by public transport

As outlined in Chapters 4.1 and 7.2.1, the available datasets for public transport do not differentiate between journeys undertaken by bus, maritime services, or existing rail services. As a result, it is not feasible to define the characteristics of public transport through single representative values for travel time, cost, service frequency, or other key parameters.

As discussed in Chapter 8.2.2, this limitation can be addressed within the modelling framework when estimating modal demand following the commissioning of Vestlandsbanen. Nevertheless, it remains important to quantify the expected changes in public transport performance and characteristics where sufficient information is available to support robust assumptions.

In general, demand for long-distance public transport services operating in parallel with Vestlandsbanen is expected to decrease, whereas demand for public transport services serving stations along Vestlandsbanen is expected to increase. The latter includes rail services such as Egersund–Stavanger, Voss–Arna and Halden–Oslo. However, a detailed assessment of these effects – including the influence of new road infrastructure, with or without tolling, wider economic development, and alternative operating models for existing rail services – falls outside the scope of this study. Consequently, for the purposes of demand forecasting, Sener has assumed that the introduction of Vestlandsbanen will not result in any changes to existing public transport services.

One important exception, however, is the planned improvements to rail services on Vestfoldbanen, which are expected to be implemented by 2027. Chapters 7.2.2 and 7.2.4 describe the journey times and service frequencies anticipated on Vestfoldbanen following the commissioning of Vestlandsbanen, which is set to 2035 for this study. However, corresponding data are also required for a 2035 scenario without Vestlandsbanen, as outlined in the final part of Chapter 6.2.

For this, Sener has incorporated an average reduction in travel time of 9 minutes for journeys along the new infrastructure between Drammen and Tønsberg, reflecting a range of savings between 4 and 14 minutes depending on service patterns (i.e. stopping at all stations versus non-stopping services). These improvements are applied consistently across all relevant origin–destination pairs, including longer-distance public transport users whose journeys include sections on Vestfoldbanen, such as passengers travelling between Bergen and Sandefjord. The corresponding reductions implemented for shorter relations are 1 minute between Drammen and Holmestrand and 3 minutes between Holmestrand and Tønsberg.

Sener also examined whether the forecast increase in demand arising from these journey time reductions would be sufficient to warrant higher train service frequencies. However, the modelling results indicate that demand would increase by less than 10 per cent, even after allowing for induced rail demand.

Furthermore, the reductions in rail journey times cannot be assumed to apply to all public transport users. A significant proportion of travellers will continue to rely on regional and long-distance bus services, for example to and from stops such as Kopstadkrysset near Horten and Fokserød near Sandefjord, as well as on shorter journeys where the origin or destination is located some distance from the nearest railway station. This further supports a cautious approach when estimating the benefits associated with reduced rail journey times on Vestfoldbanen, including any additional benefits that might arise from an increase in service frequency.

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8 THE DEMAND CALCULATION METHODOLOGY

This chapter sets out the methodology developed for the passenger transport model to estimate demand across the different transport modes. The application of this methodology and the resulting calculations are presented in Chapter 9.

8.1 The determination of utilities

8.1.1 The concept of utilities and utility parameters

“Utility” is a fundamental concept underpinning the theoretical framework of transport modelling. It reflects the principle that travellers generally perceive travel as a disbenefit, as it incurs both monetary costs and time expenditures, which cannot be otherwise utilised and therefore represent a loss of value. For this reason, utility is typically expressed as a negative quantity, and the term “disutility” is often used in practice.

The utility concept further assumes that the various components contributing to the overall inconvenience of a journey can be individually assessed, weighted, and aggregated into a single composite measure. This total utility provides a unified indicator that captures all relevant journey characteristics, enabling direct comparison between alternative travel options. The relative attractiveness of each option, expressed through its utility, determines its share of overall demand within the model.

The weighting of individual journey components is achieved through the application of utility *parameters*. These parameters quantify the relative importance of different attributes, such as travel time, cost, or the need to interchange between modes. For example, in the case of private travel, Sener has applied a utility parameter of approximately –0.01 per minute for access and egress time to and from stations, whereas a parameter of approximately –0.2 has been assigned to each interchange. The ratio between these parameters implies that, on average, an additional 20 minutes of travel time is perceived as equally disadvantageous as one additional interchange.

Similarly, distinct parameters are applied to in-vehicle travel time depending on the mode of transport. While both car and air travel times are associated with negative utility values, the parameter assigned to car travel time is less negative than that for air travel, reflecting the assumption that an additional minute spent driving is perceived as less onerous than an equivalent increase in flight time.

Differences are also introduced between user groups. For instance, lower (i.e. less negative) utility parameters are assigned to travel costs for business travellers compared to private travellers, reflecting their lower sensitivity to price. In addition to these negative components, positive utility contributions may also be incorporated, representing attributes such as comfort, reliability, and service quality – particularly relevant for modern high-speed rail systems.

By combining these parameters with the corresponding journey characteristics, individual utility components are calculated and aggregated into total utilities for each mode and trip purpose (e.g. work-related or private). These total utilities then determine the allocation of demand across modes. Modes associated with higher (i.e. less negative) utilities are more attractive and therefore capture a larger share of demand, whereas those with lower (more negative) utilities attract a smaller share.

The size of these shares depends on the differences between the total utilities of different journeys. The higher this difference, the more sharply the transport model reacts. If, for example, a utility of –0.7 is calculated for a flight and a utility of –1.1 for a car journey, a demand distribution of 60: 40 for flight: car journey may result under certain conditions. The same demand distribution will result under the same conditions, if utilities of –1.7 are calculated for air travel and –2.1 for car travel. If, on the other hand, utilities of –1.7 are calculated for air travel and –3.7 for car travel, this will result in a demand distribution of 88: 12. The absolute magnitude of the utility parameters therefore also plays an important role, not just their relative magnitude in comparison with other parameters.

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8.1.2 Retrieving utility parameters

One of the most challenging aspects in developing the passenger transport model has been the identification of robust and appropriate sources for the derivation of utility parameters. While numerous Norwegian studies exist that analyse the preferences of air and car travellers, there is a notable lack of empirical evidence specifically addressing the introduction of a new high-speed rail system.

The principal exception is the stated preference survey undertaken as part of the Norway High Speed Rail Assessment Study, commissioned by Jernbaneverket and published in 2012. This survey was designed to capture the key factors influencing travellers' choices between different, existing and potential future transport modes. The relevant findings are documented in two principal reports:

- Norway High Speed Rail Assessment Study: Phase III – Model Development Report, Final Report, 25 January 2012, Atkins[49] and
- Norwegian High Speed Railway Assessment Project – Contract 5: Market Analysis – Subjects 2 and 3: Expected Revenue and Passenger Choices, Final Report, 18 February 2011, Atkins in association with RAND Europe.[50]

The latter report, hereinafter referred to as the 'Rand report', is cited in the former as the basis for the development of a mode choice model known as the 'Norwegian High Speed Rail Demand Model' (NHSRDM), which is described in the former report, hereinafter referred to as the 'Atkins report'. This demand model was limited to trips longer than 100 km, as Atkins relied solely on data from NTM5 – the national transport model in use at the time – which only covered journeys of this length. In addition, Atkins developed a so-called 'gravity model' for trips shorter than 100 km, but this gravity model did not make use of the stated preference survey.

The Rand report includes a description of the survey and the derivation of utility parameters based on respondents' answers. These utility parameters were subsequently revised during Atkins' development of the demand model. This explains many of the differences between the Rand report and the Atkins report; however, some discrepancies cannot be accounted for solely in this way.

8.1.3 Evaluation of the utility parameters used in the NHSRDM

Sener has undertaken a detailed review of the utility parameters established by Rand and Atkins. It is evident that considerable effort has been devoted to capturing the various benefits and disadvantages associated with travel. In the estimation of travel time utility, for example, a clear distinction is drawn between access and egress times to and from stations or airports, pre-boarding time, and in-vehicle time for both rail and air modes. Furthermore, differentiated utility parameters are applied for work and non-work trips, as well as for journeys where air services are either available or unavailable.

In general, the majority of the utility parameters presented in the Atkins report appear reasonable and broadly consistent with established practice. However, certain parameters warrant further scrutiny.

Utility parameters applied to the logarithm of travel cost

A particularly relevant issue concerns the specification of the utility parameter for travel cost. Consistent with the approach adopted by Atkins, Sener considers that the relationship between travel cost and perceived utility should not be represented as purely linear. The inclusion of both a linear cost term and a logarithmic cost term is therefore considered methodologically appropriate, as it offers a more precise approach for determining the relationship between the travel cost and the utility of travel cost.

However, the parameter applied in the Atkins report to the logarithm of travel cost appears to be materially overstated. The implications of this parameter can be demonstrated through a simplified example involving a car

[49] "Norway High Speed Rail Assessment Study - Phase III: Model Development Report, Final Report", Atkins 25.01.2012, https://banenor.brage.unit.no/banenor-xmlui/handle/11250/155084
[50] The report is not published on the internet, but can be ordered from the library of Bane NOR.

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journey with two alternative routes. If both routes are assumed to be 100 km in length, the base travel cost is NOK 270, applying a vehicle operating cost of NOK 2.70 per vehicle-kilometre in 2011 prices, equivalent to approximately NOK 3.90 in 2024 prices. If one of the two routes is subject to an additional toll charge of NOK 50, the total cost of that route increases to NOK 320.

The relevant behavioural question is then the amount of travel time that would need to be saved for the higher-cost route to be perceived as equivalent to the lower-cost alternative by an average traveller. Applying the non-work trip parameters reported by Atkins, the resulting time saving exceeds four hours.[51] This implied trade-off is clearly implausible and suggests that the logarithmic cost parameter has an excessive influence on the overall utility calculation relative to the other utility components.

This issue is further reinforced by comparison with the Rand parameter set. The logarithmic cost parameters reported by Atkins for both work and non-work trips are approximately six times higher than those presented by Rand.[52] By contrast, the corresponding linear cost parameters, together with the parameters for many other utility components, are broadly similar across the two sources. This divergence suggests that the discrepancy is specific to the logarithmic cost term rather than being the result of a wider difference in model calibration or parameter scaling.

On this basis, Sener has replaced the logarithmic cost parameters reported by Atkins with those presented in the Rand study. Under this revised specification, the time saving required to offset a NOK 50 toll charge, expressed in 2011 prices, is reduced to approximately 77 minutes for non-work trips. While this represents a substantial improvement relative to the Atkins specification, the resulting value remains relatively high from a behavioural perspective. Sener therefore considers that further calibration or sensitivity testing would be advisable to confirm the robustness of the logarithmic cost parameter.

The utility parameters for travel times

An alternative approach to obtaining more realistic time–cost trade-offs is to increase the utility parameter applied to car travel time. A comparison with the corresponding parameters for rail and air modes supports this adjustment.

In the Atkins specification, the utility parameters for air and high-speed rail travel time are approximately twice those for car travel time in the case of work trips. However, for non-work trips, this difference increases significantly, with air and rail parameters being approximately five to six times greater than those for car travel time, depending on the relative share of access, pre-boarding, and egress components.[53]

This implies implausible behavioural outcomes. For example, a three-hour air journey – where access, egress, and airport processes represent a substantial proportion of the total travel time – would be perceived as equivalent to approximately 18 hours of car travel. This is not considered credible.

Sener has therefore doubled the utility parameter for car travel time for non-work trips, while retaining the parameters for work trips. This adjustment reduces the time saving required to offset a NOK 50 toll (2011 prices) on a 100 km car journey to approximately 38.6 minutes for non-work trips and 15.4 minutes[54] for work trips, which are considered more realistic.

Sener has also introduced similar, though generally more limited, adjustments to other utility parameters listed in the Atkins report, as described after Table 19 on the next page.

[51] –1.02 × (ln(320) – ln(270)) – 0.00077 × 50 = –0.2118 = –0.000882 × 240.13. See Table 19, rows A1, B1 and C1.
[52] Compare the parameters on page 68 and 69 (–0.092 and –0.174) in the Rand report with the figures on the right-hand side of the table on page 28 in the Atkins report (–0.583 and –1.02).
[53] See rows C1, C2, D2, E1, E2, F1, F2, G1 and G2 in Table 19.
[54] –0.174 × (ln(320) – ln(270)) – 0.000770 × 50 = –0.06806 = –0.001764 × 38.58 and –0.092 × (ln(320) – ln(270)) – 0.000575 × 50 = –0.04438 = –0.00288 × 15.41.

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	Utility	Work Atkins	Non-work Atkins	Work Sener	Non-work Sener
	No air service available				
A1	Travel cost, all modes (NOK)	-0.000575	-0.000770	-0.000402	-0.000538
B1	Logarithm of travel cost, all modes (NOK)	-0.583000	-1.020000	-0.092000	-0.174000
C1	Travel time in a car (minutes)	-0.002880	-0.000882	-0.002880	-0.001764
E1	Travel time in a high-speed train (minutes)	-0.005840	-0.003700	-0.005840	-0.003700
F1	Access and egress times, high-speed rail (minutes)	-0.006940	-0.007020	-0.005840	-0.007020
G1	Preboarding time, high-speed rail (minutes)	-0.007060	-0.005060	-0.005840	-0.005060
H1	Service frequency, high-speed rail (departures per day)	-0.768000	-0.553000	-0.768000	-0.553000
I1	Interchanges, high-speed rail (number of interchanges)	-0.321000	-0.267000	-0.160500	-0.133500
J1	Return in one day, all modes (from 0% to 100% bonus)	0.219000	0.256000	0.219000	0.256000
K1	Alternative specific constant, high-speed rail compared to car	-	-	-	-
	Utility	**Work Atkins**	**Non-work Atkins**	**Work Sener**	**Non-work Sener**
	Air service available				
A2	Travel cost, all modes (NOK)	-0.000891	-0.001140	-0.000622	-0.000796
B2	Logarithm of travel cost, all modes (NOK)	-0.904000	-1.510000	-0.092000	-0.174000
C2	Travel time in a car (minutes)	-0.004470	-0.001300	-0.004470	-0.002600
D2	Travel time on board of an airplane (minutes)	-0.007950	-0.007110	-0.009050	-0.007110
E2	Travel time in a high-speed train (minutes)	-0.009050	-0.005480	-0.009050	-0.005480
F2	Access and egress times, air and high-speed rail (minutes)	-0.010800	-0.010400	-0.009050	-0.010400
G2	Preboarding time, air and high-speed rail (minutes)	-0.010900	-0.007480	-0.009050	-0.007480
H2	Service frequency, air and high-speed rail (departures per day)	-1.190000	-0.817000	-1.190000	-0.817000
I2	Interchanges, air and high-speed rail (number of interchanges)	-0.497000	-0.396000	-0.248500	-0.198000
J2	Return in one day, all modes (from 0% to 100% bonus)	0.339000	0.378000	0.339000	0.378000
K2	Alternative specific constant, high-speed rail compared to car	-	-	-	-
L2	Alternative specific constant, high-speed rail compared to air	1.090000	0.201000	1.590000	1.202000

Table 19: The utility parameters listed in the Atkins report and the parameters Sener has selected for the passenger transport model.

Below are some notes on the various utility parameters listed in Table 19:

- ***A1, A2, travel costs, all modes**:* No substantive modifications have been introduced. Differences between the Atkins and Sener parameter values are solely attributable to the conversion from 2011 to 2024 price levels.[55]
- ***B1, B2, logarithm of travel cost, all modes**:* Adjustments have been implemented as described above. No inflation adjustment has been applied to the logarithmic term, as any such transformation would introduce a

[55] https://www.ssb.no/priser-og-prisindekser/konsumpriser/statistikk/konsumprisindeksen, Table 3, development from December 2010 to the year average figure 2024, 67.8 to 97.1.

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uniform add-on in utility across all modes, which would cancel out in comparative utility calculations (refer to Chapter 8.1.1).

- ***C1, C2, travel time in a car:*** Parameter values for work-related trips have been retained. For non-work trips, the parameters have been increased in order to correct the imbalance identified in the relative valuation of time across modes, as described above.

- ***D2, travel time on board of an airplane:*** According to the Atkins report, travellers on a work trip find the time spent on board an airplane 12% less burdensome than the time spent on a high-speed train. Given the wider seats and greater legroom on high-speed trains – even compared to seats in an airplane's business class – the turbulence-free glide along a well-aligned slab track railway, and the far better facilities for working – including the use of phones and access to conference compartments – the ratio of these parameters, as indicated by the survey, seems little plausible.

  On the other hand, this survey probably also reflects, to some extent, the perception of the quality of the existing railway system as a whole. This should not be overlooked. Sener has therefore only set the travel time parameter for flights equal to that for train journeys, rather than increasing it further. When it comes to non-work trips, no adjustment has been made to the parameter for the travel time for flights, as the figure in the Atkins report is 30% higher than for the travel time in a high-speed train.

- ***E1, E2, travel time in a high-speed train:*** No adjustments have been applied.

- ***F1, F2, access and egress times, air and high-speed rail:*** No adjustment of the parameters for non-work trips has been applied. For work trips, however, Sener has set the parameters for the access and egress times (and the preboarding times) equal to those for the travel times on board an airplane or a high-speed train. This simplification is reasonable, as the parameters in the Atkins report for the access and egress times and for the preboarding time are very similar to those for the travel time on board an airplane or a high-speed train. Furthermore, the Rand report shows the same alignment for flights, although this is presented ambiguously in the Atkins report.[56]

- ***G1, G2, preboarding time, air and high-speed rail:*** Consistent with the approach adopted for access and egress time, no changes have been made for non-work trips, while parameters for work trips have been aligned with in-vehicle travel time, please see *'F1, F2, access and egress times.'*

- ***H1, H2, service frequency, air and high-speed rail:*** Parameter values remain unchanged. However, Sener calculated this utility of the service frequency by dividing the utility parameter by the number of daily departures plus one, rather than by the number of departures alone, as Atkins did. While this has negligible impact for high-frequency services, it materially reduces the negative utility associated with very low frequencies, particularly relevant for air services following the commissioning of Vestlandsbanen. This adjustment avoids overestimating the rail demand resulting from reduced flight frequencies.

- ***I1, I2, interchanges, air and high-speed rail:*** These utility parameters reflect both the inconvenience associated with interchanging between transport services and the uncertainty linked to the risk of missing a planned connection in the event of delays. For Vestlandsbanen, these inconveniences and uncertainties are expected to be kept at a very low level. In most cases, passengers will not be required to change platforms when transferring between trains, and a range of operational measures is planned to minimise both the occurrence and impact of delays.[57]

[56] Regarding the parameter for the travel time on board an airplane, the Atkins Report states that this applies to the 'door-to-door travel time', i.e. including access and egress times to and from the airports and the time spent there. Nevertheless, different parameters are listed for the two latter components of the travel time, even for air travel. This contradiction does not exist in the Rand Report, as it is explicitly stated that the parameters for the access and egress times and for the preboarding time do not apply to air travel.

[57] See for example Chapter 7.1 about the running time calculations, the timetable example in the Deliverable 7.2 report, and the calculation of operation costs in the Deliverable 8 report, including a major reserve of additional passenger trains.

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Against this background, Sener has reduced the interchange parameters reported in the Atkins report by 50%. Under this revised specification, an interchange is assumed to impose a disadvantage equivalent to an increase in travel time of approximately 27.5 minutes for work trips and 36 minutes for non-work trips.[58] By comparison, application of the original Atkins parameters would imply equivalent penalties of 55 and 72 minutes, respectively, which are considered less representative of the inconvenience of interchanging between transport services and the anticipated operating conditions for Vestlandsbanen.

- ***J1, J2, return in one day, all modes:*** In the Atkins report, a positive utility parameter (i.e. a bonus) is applied across all modes of transport where a round trip can be completed within six hours. Sener has retained the same utility parameters but introduced a smoother transition between non-bonus and bonus conditions. Whereas Atkins applies no bonus for round trips of up to 5 hours and 59 minutes and the full bonus from 6 hours onwards, Sener adopts a more gradual approach. Under this specification, a small positive utility is applied to round trips of less than 7 hours, with the full bonus reached for round trips of 5 hours or less.

- ***K1, K2, alternative specific constant, high-speed rail compared to car:*** An alternative specific constant captures the residual advantages and disadvantages of a transport mode that are not explicitly represented through travel cost and travel time components. These may include, for example, the high degree of flexibility offered by private car use relative to scheduled transport services, the higher safety levels associated with high-speed rail compared to car travel, and the greater resilience of rail operations to adverse weather conditions such as snow, wind and fog, compared to both cars and airplanes.

  The latter is of particular importance when comparing the conditions for road traffic – which have deteriorated as a result of climate change and the increased occurrence of landslides, flooding and similar consequences of extreme weather conditions – with those for rail operations on a new high-speed line designed in accordance with the latest scientific knowledge.

  In the comparison between car travel and high-speed rail, Sener – consistent with the approach adopted in the Atkins report – has not applied an explicit alternative specific constant. However, unlike Atkins, Sener has incorporated the negative utility associated with two interchanges for all rail and air journeys (at the origin and destination stations or airports), even in cases where some travellers may access or egress rail services on foot or by bicycle. This modelling assumption results in an implicit preference for car travel, which is intentional. It reflects the objective of avoiding an underestimation of the value travellers place on the flexibility and convenience associated with private car use.

- ***L2, alternative specific constant, high-speed rail compared to air:*** The Atkins report provides alternative specific constants for the comparison between air and high-speed rail travel. However, these constants appear to be comparatively low and significantly below the corresponding values reported in the Rand report. This discrepancy can be partly attributed to the relatively high parameter assigned to the logarithm of travel cost in the Atkins specification (see B2).

  Given that air travel can be assumed to be approximately 25% more expensive than high-speed rail (see Chapter 7.3.3), the inflated logarithmic cost parameter introduces a substantial negative utility for air travel within the model. Once this parameter is corrected, the associated cost-related disadvantage for air travel is removed. Consequently, a compensatory adjustment to the alternative specific constant is required. On this basis, Sener has increased the alternative specific constant for high-speed rail relative to air by 0.181 for work trips and 0.298 for non-work trips.[59]

  Sener incorporated this increase into the calculations and subsequently assessed the performance of the transport model. The results indicated that, despite applying all parameters listed on the right-hand side of

[58] Work trips: –0.00584 × 27.483 = –0.1605 and –0.00905 × 27.459 = –0.2485. Non-work trips: –0.0037 × 36.081 = –0.1335 and –0.00548 × 36.131 = –0.198.
[59] (0.904 – 0.092) × ln (1.25) = 0.181 and (1.51 – 0.174) × ln (1.25) = 0.298.

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Table 19 and the adjusted alternative specific constants, the model continued to produce a relatively low and implausible share of demand for high-speed rail compared to air travel.

On this basis, Sener introduced a further, cautious increase in the alternative specific constant. For work trips, the constant has been aligned with the value specified in the Rand report (1.59), without further adjustment.

For non-work trips, Sener has adopted an alternative specific constant that is significantly higher than the value presented in the Rand study (1.202 compared to 0.622), while remaining below the corresponding value for work trips. In most cases, this constant also remains proportionally lower when considered relative to the utility parameters associated with in-vehicle travel time for air transport and other related components.[60]

The primary justification for selecting a relatively high alternative specific constant for non-work trips is to ensure that the resulting modal share for high-speed rail adequately reflects the specific characteristics of the Vestlandsbanen corridor. These characteristics are not fully captured by the survey underpinning the Rand report, which considered not only corridors between Oslo and Bergen, Haugesund and Stavanger, but also connections to Trondheim, Stockholm and Gothenburg.

The latter corridors differ significantly in their operating context. Although winter conditions affect travel times on all routes, they do not impose the same level of difficulty, duration variability, and operational uncertainty as car journeys crossing the high mountain regions between western and eastern Norway during the extended snow and ice season, which typically lasts from October to May. During these periods, both road and conventional rail journeys are subject to considerable reliability constraints, unlike routes such as Oslo–Stockholm, where conditions are comparatively more stable.

As a result, travellers between western and eastern Norway are more likely to rely on air transport and less likely to use private cars or conventional public transport than travellers on other corridors in southern Norway or between Norway and Sweden, despite the fact that air services are also significantly affected by adverse weather conditions. This reflects the relative unattractiveness of the available alternatives.

However, the introduction of Vestlandsbanen and its associated step change in reliability and journey time performance is expected to materially alter this balance. In particular, a stronger modal shift from air to rail is anticipated compared to other high-speed rail schemes in southern Scandinavia. This provides a clear rationale for adopting a higher alternative specific constant for Vestlandsbanen than the average value derived from the Rand report.

Based on the full set of parameters and constants derived from the Atkins and Rand reports, together with the adjustments described above, Sener calculated the overall utilities of journeys by high-speed rail, air and car for each of the 937,888 possible origin–destination pairs within the NTM6 zoning system (please see the penultimate section of Chapter 7.2.3).

These calculations were performed separately for work and non-work trips and further distinguished between journeys with and without the availability of air services.

In addition, pairs for which the total number of air and car users was zero were excluded from the datasets. This affected 6,837 origin–destination pairs for work trips and 1,066 pairs for non-work trips, while resulting in a negligible loss of demand, equivalent to approximately 0.27 public transport journeys per day.

Following this filtering process, the resulting datasets comprised 415,864 origin–destination pairs with air travel availability and 515,187 without for work trips. For non-work trips, the corresponding figures were 326,050 pairs with air travel availability and 610,772 pairs without.

[60] The selected, alternative specific constant for non-work trips (1.202) accounts for 75.6% of the selected constant for work trips (1.59). In comparison, the utility parameters for the travel time on board of an aircraft are –0.00711 and –0.00905, where the former accounts for 78.6% of the latter. The corresponding figures are 115% for the access and egress times (–0.0104 / –0.00905), 82.7% for the preboarding time (–0.00748 / –0.00905), 68.7% for the service frequency (–0.817 / –1.19) and 79.7% for the number of interchanges (–0.198 / –0.2485).

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8.2 The model demand formulation

To estimate demand across the different modes of transport and newly induced demand following the commissioning of Vestlandsbanen, Sener has used the standard formulae employed in so-called logit models. The term 'logit model' refers to the type of mathematical functions that are used for such calculations. More details are outlined below.

The same standard formulae have been used by Atkins in the 'Norwegian High Speed Rail Demand Model' as part of their study for Jernbaneverket, published in 2012. However, for some calculations, Sener has adopted a different approach to that of Atkins. This applies to journeys shorter than 100 km, see Chapter 8.3, and to the potential demand for high-speed rail from transit and transfer air passengers, see Chapter 8.4.

8.2.1 The pivot application and the direct application

Within logit models, the two most important tools for calculating the distribution of demand across different modes of transport are denoted as

- the 'incremental' or 'pivot application', and
- the 'direct application'.

Both applications process figures for the reference scenario – the situation without Vestlandsbanen – and for the project scenario – the situation after commissioning of Vestlandsbanen.

The pivot application

The pivot application uses the market shares of various modes of transport in the reference scenario and the *changes* of the utilities of these transport modes – i.e. the differences between the utilities in the project scenario and the utilities in the reference scenario – to determine the distribution of demand in the project scenario. The utilities themselves, on the other hand, are not taken into account.

This is evident from the following formulae, which can be used, for example, to calculate the distribution of the future demand following various developments of the existing transport modes, such as those resulting from a new section of road or an increased number of flights.

The formulae are valid for developments that will affect journeys by both air, car and public transport (PT). They are denoted as a *multinominal*, pivot application, since they incorporate more than two different modes of transport. P_{Air}, P_{Car} and P_{PT} represent the **p**robabilities for the project scenario that an average traveller will choose a certain mode of transport, while P^0_{Air}, P^0_{Car} and P^0_{PT} are the corresponding probabilities for the reference scenario. These probabilities are the same as the estimated or observed market shares of the different modes of transport.

Furthermore, ΔU_{Air}, ΔU_{Car} and ΔU_{PT} represent the changes in the utilities of the different modes of transport – i.e. $\Delta U_{Air} = U_{Air} - U^0_{Air}$ and corresponding for car and public transport – while θ (the Greek letter theta) is a parameter that determines the extent to which changes in utility affect the distribution of the future demand.

$$P_{Air} = \frac{P^0_{Air} \cdot e^{\theta \cdot \Delta U_{Air}}}{P^0_{Air} \cdot e^{\theta \cdot \Delta U_{Air}} + P^0_{Car} \cdot e^{\theta \cdot \Delta U_{Car}} + P^0_{PT} \cdot e^{\theta \cdot \Delta U_{PT}}}$$

$$P_{Car} = \frac{P^0_{Car} \cdot e^{\theta \cdot \Delta U_{Car}}}{P^0_{Air} \cdot e^{\theta \cdot \Delta U_{Air}} + P^0_{Car} \cdot e^{\theta \cdot \Delta U_{Car}} + P^0_{PT} \cdot e^{\theta \cdot \Delta U_{PT}}}$$

$$P_{PT} = \frac{P^0_{PT} \cdot e^{\theta \cdot \Delta U_{PT}}}{P^0_{Air} \cdot e^{\theta \cdot \Delta U_{Air}} + P^0_{Car} \cdot e^{\theta \cdot \Delta U_{Car}} + P^0_{PT} \cdot e^{\theta \cdot \Delta U_{PT}}}$$

However, such formulae cannot be used directly – for example, after inserting an additional term for high-speed rail – to calculate the distribution of demand following the commissioning of Vestlandsbanen. The market share of high-speed rail in the reference scenario (P^0_{HSR}) is zero, and the change in utility (ΔU_{HSR}) would be infinitely high, as high-speed rail would be a non-existent mode of transport in the reference scenario and would have an infinitely high negative utility. Such figures cannot be processed by the pivot application.

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The direct application

Another option is to consider the 'direct application'. This application determines the distribution of demand solely from the utilities of various modes of transport, not from market shares or changes in utilities. The direct application can be used both for the project and the reference scenario.

The formulae for the direct application are shown below, again for developments that will affect journeys by both air, car and public transport. U_{Air}, U_{Car} and U_{PT} represent the utilities of these modes of transport:

$$P_{Air} = \frac{e^{\theta \cdot U_{Air}}}{e^{\theta \cdot U_{Air}} + e^{\theta \cdot U_{Car}} + e^{\theta \cdot U_{PT}}}$$

$$P_{Car} = \frac{e^{\theta \cdot U_{Car}}}{e^{\theta \cdot U_{Air}} + e^{\theta \cdot U_{Car}} + e^{\theta \cdot U_{PT}}}$$

$$P_{PT} = \frac{e^{\theta \cdot U_{PT}}}{e^{\theta \cdot U_{Air}} + e^{\theta \cdot U_{Car}} + e^{\theta \cdot U_{PT}}}$$

However, also the direct application cannot be used directly to calculate the distribution of demand following the commissioning of Vestlandsbanen. Opposite to the pivot application, the direct application requires numbers for the utility of public transport, not just for the changes in this utility. However, the basic data sets currently available for the Vestlandsbanen study does not comprise information that could allow the estimation of such absolute utilities, as outlined in Chapter 7.5.

8.2.2 The nested logit transport model

A common technique to overcome the challenges described in the previous sub-chapter, is to introduce a sub-set (or nest) consisting of two similar modes of transport. This can be done in different ways, depending on whether an air service is available or not. This also explains why utility parameters have been determined for these two alternatives in the first place.

Air service available

Where an air service is available, the air and high-speed rail modes can be combined into a nest denoted 'fast modes.' This creates a hierarchical structure within the model. Air and high-speed rail then form the bottom level of the hierarchical structure, while the upper level comprises 'fast modes', car, and public transport.

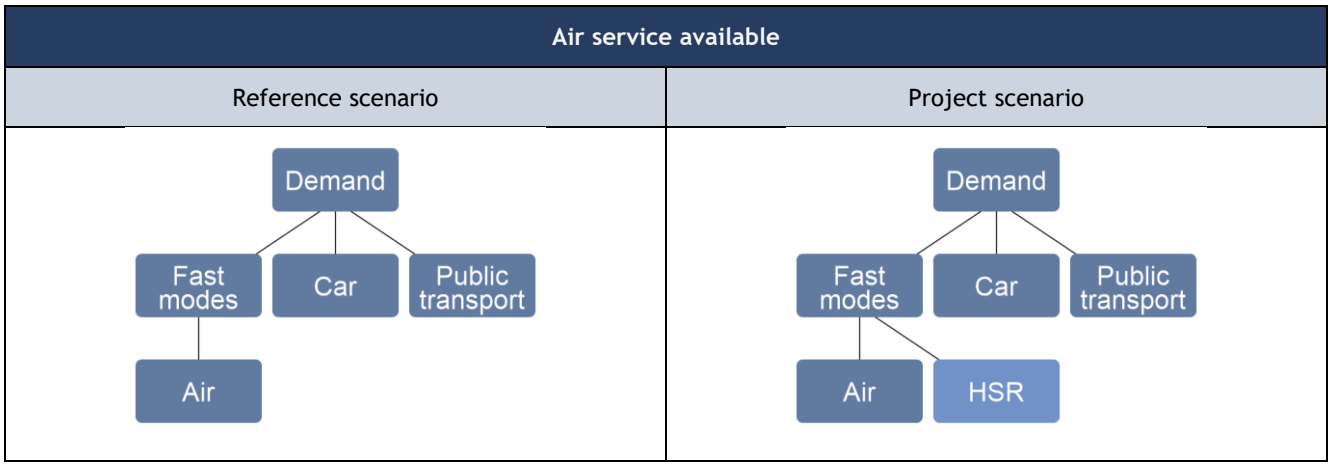

Figure 7: The hierarchical structure of a nested logit model, where an air service is available.

Sener has adopted this approach. The idea behind this is that it makes it possible to use the pivot application for calculating the demand for high-speed rail and other modes of transport. This is because the introduction of 'fast modes' eliminates the unmanageable, infinitely large change in utility.

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Now, the change in utility is a non-infinite number. In the reference scenario, the utility of the 'fast modes' is identical to that of the air mode ($U^0_{FM} = U^0_{Air}$), as there is no high-speed rail in this scenario. In the project scenario, the composite utility of 'fast modes' can be calculated from the utilities of air and high-speed rail as follows:

$$U_{FM} = \ln(e^{U_{Air}} + e^{U_{HSR}})$$

Consequently, the change in the utility of 'fast modes' results in $\Delta U_{FM} = U_{FM} - U^0_{FM}$, which is a finite number and an important part of the pivot application formulae.

Furthermore, in the reference scenario, the market share or the probability to choose 'fast modes' is the same as the market share of the air mode: $P^0_{FM} = P^0_{Air}$, as there is no high-speed rail in this scenario.

In addition, Sener has used the same figures for θ as listed in the Atkins report. These are 0.645 for work trips and 0.676 for non-work trips. Thus, all necessary figures for the pivot application are available:

$$P_{FM} = \frac{P^0_{FM} \cdot e^{\theta \cdot \Delta U_{FM}}}{P^0_{FM} \cdot e^{\theta \cdot \Delta U_{FM}} + P^0_{Car} \cdot e^{\theta \cdot \Delta U_{Car}} + P^0_{PT} \cdot e^{\theta \cdot \Delta U_{PT}}}$$

$$P_{Car} = \frac{P^0_{Car} \cdot e^{\theta \cdot \Delta U_{Car}}}{P^0_{FM} \cdot e^{\theta \cdot \Delta U_{FM}} + P^0_{Car} \cdot e^{\theta \cdot \Delta U_{Car}} + P^0_{PT} \cdot e^{\theta \cdot \Delta U_{PT}}}$$

$$P_{PT} = \frac{P^0_{PT} \cdot e^{\theta \cdot \Delta U_{PT}}}{P^0_{FM} \cdot e^{\theta \cdot \Delta U_{FM}} + P^0_{Car} \cdot e^{\theta \cdot \Delta U_{Car}} + P^0_{PT} \cdot e^{\theta \cdot \Delta U_{PT}}}$$

However, there is still one final step. The calculated probability of choosing 'fast modes' in the project scenario must be broken down into the probabilities of choosing high-speed rail versus choosing air travel. This can be done by applying the direct application.

First, the direct application calculates the probability of choosing between air and high-speed rail travel as a proportion of 'fast modes.' These probabilities are then multiplied by the probability of choosing 'fast modes' to obtain the probabilities of choosing air or high-speed rail travel as a proportion of all modes of transport. In the following formulae, θ is assumed to equal 1 – and is thus eliminated – as usual for the bottom level of the model hierarchy.[61]

$$P_{HSR} = P_{FM} \cdot \frac{e^{U_{HSR}}}{e^{U_{HSR}} + e^{U_{Air}}}$$

$$P_{Air} = P_{FM} \cdot \frac{e^{U_{Air}}}{e^{U_{HSR}} + e^{U_{Air}}}$$

Air service unavailable

Where no air service is available, the nest denoted 'fast modes' can consist of the car and high-speed rail modes. In this case, the hierarchical structure of the model looks as shown in Figure 8 on the next page. Car and high-speed rail form the bottom level, while the upper level comprises 'fast modes' and public transport only.

This also simplifies the use of the pivot application. In the reference scenario, the utility of the 'fast modes' is identical to that of the car mode ($U^0_{FM} = U^0_{Car}$), as there is no high-speed rail in this scenario. In the project scenario, the composite utility of 'fast modes' can be calculated from the utilities of car and high-speed rail accordingly to the calculation in the previous section for journeys with air services available:

$$U_{FM} = \ln(e^{U_{Car}} + e^{U_{HSR}})$$

[61] https://assets.publishing.service.gov.uk/media/69a034423e672177d0bc7710/tag-unit-m21-variable-demand-modelling.pdf, App. D.1.2.

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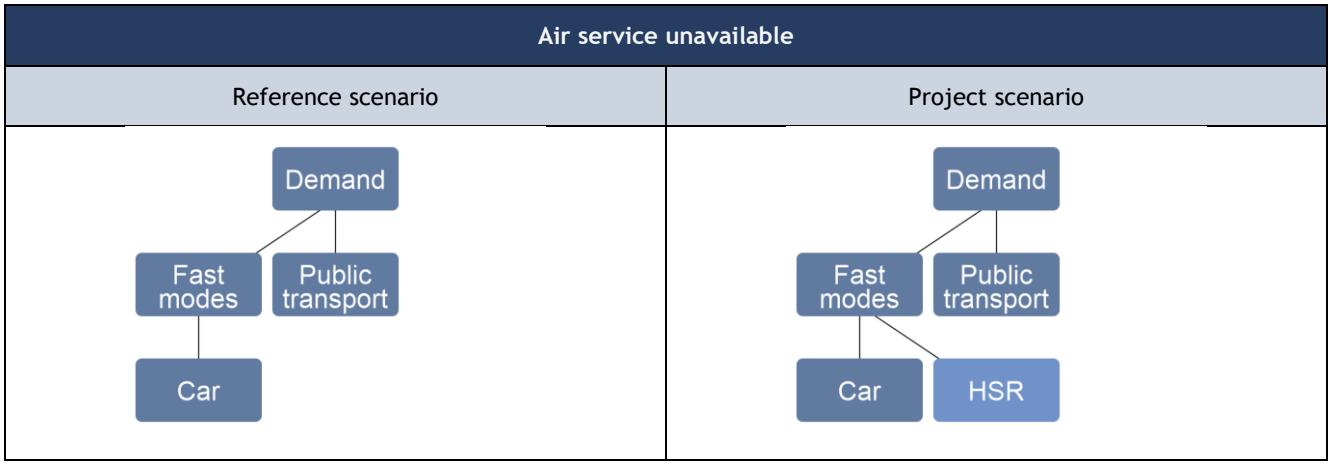

Figure 8: The hierarchical structure of a nested logit model, where no air service is available.

Furthermore, as $\Delta U_{FM} = U_{FM} - U_{FM}^0$ and $\theta = 1$, the following formulae of the pivot application can be applied:

$$P_{FM} = \frac{P_{FM}^0 \cdot e^{\Delta U_{FM}}}{P_{FM}^0 \cdot e^{\Delta U_{FM}} + P_{PT}^0 \cdot e^{\Delta U_{PT}}}$$

$$P_{PT} = \frac{P_{PT}^0 \cdot e^{\Delta U_{PT}}}{P_{FM}^0 \cdot e^{\Delta U_{FM}} + P_{PT}^0 \cdot e^{\Delta U_{PT}}}$$

And finally, using the direct application:

$$P_{HSR} = P_{FM} \cdot \frac{e^{U_{HSR}}}{e^{U_{HSR}} + e^{U_{Car}}}$$

$$P_{Car} = P_{FM} \cdot \frac{e^{U_{Car}}}{e^{U_{HSR}} + e^{U_{Car}}}$$

From applications to results

With the exception of induced demand (see Chapter 8.2.6) and demand for high-speed rail from transit and transfer air passengers (see Chapter 8.4), the methodologies presented in this and the preceding chapter enable a comprehensive range of outputs to be derived. These outputs can be grouped into three categories:

- The number of travellers using high-speed rail and other transport modes following the commissioning of Vestlandsbanen (see Chapter 8.2.3).
- The number of travellers expected to switch from other transport modes to high-speed rail (see Chapter 8.2.4). These results **cannot** be derived directly from the modal demand forecasts described above.
- High-speed rail ticket revenues, together with a range of input parameters required for the cost-benefit analysis (see Chapter 8.2.5).

All of the above calculations require the reference scenario and project scenario to be defined in sufficient detail. The specific assumptions and definitions adopted will vary according to the purpose of each calculation.

8.2.3 The number of travellers by HSR and other modes of transport

To estimate the number of travellers using high-speed rail and competing transport modes, the project scenario must incorporate not only the introduction of Vestlandsbanen services but also all other developments expected to occur by 2035 and beyond, either independently of the project or as a consequence of its implementation. These developments include overall growth in travel demand driven by population and economic growth (see Chapter 6), the impacts of the two complementary infrastructure schemes considered in this study, namely the

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Rogfast road tunnel and the ongoing investments in Vestfoldbanen, as well as the anticipated reduction in air service frequencies on corridors where air connections currently exist.

The reference scenario should also reflect projected demand growth resulting from demographic and economic trends. However, it should exclude Vestlandsbanen, the Rogfast road tunnel, improvements to Vestfoldbanen, and any resulting changes to air service provision. This is because available data on travel by air, car and public transport relate to conditions in 2019 (see Chapter 4.1), when none of these interventions were in operation.

The use of 2019 travel demand data, together with its projection to 2035 and subsequent forecast years, forms the basis for deriving the key inputs required by the nested pivot application. In particular, it enables the calculation of baseline market shares by transport mode within the reference scenario, P^0_{Air}, P^0_{Car} and P^0_{PT}. Furthermore, the changes in utility between the reference and project scenarios, ΔU_{Air}, ΔU_{Car} and ΔU_{PT}, can be readily derived from:

- The expected reduction in air service frequencies following the commissioning of Vestlandsbanen (see Chapters 7.3.1 and 8.1.3, section H2), where air services are available.
- Changes in travel time and travel costs associated with the Rogfast road tunnel for affected journeys (see Chapters 7.4.3 and 8.1.3, sections A1/A2, B1/B2 and C1/C2).
- Travel time savings resulting from the current investments in Vestfoldbanen (see Chapters 7.5 and 8.1.3, sections E1/E2).

The nested pivot application then calculates the market shares for each transport mode under the project scenario, P_{HSR}, P_{Air}, P_{Car} and P_{PT}. These market shares are subsequently multiplied by the overall number of travellers in the reference scenario in order to obtain the number of travellers using high-speed rail and other transport modes following the commissioning of Vestlandsbanen.

8.2.4 The number of travellers who will choose HSR over other modes

The number of travellers choosing high-speed rail instead of alternative modes of transport represents a direct measure of the impact of Vestlandsbanen. This impact is quantified by comparing travel demand by mode under two distinct scenarios:

- **Scenario A**: the situation following the commissioning of Vestlandsbanen. This scenario is defined in the same manner as the project scenario described in Chapter 8.2.3 and includes projected overall demand growth, the introduction of Vestlandsbanen, the Rogfast road tunnel, investments in Vestfoldbanen, and the anticipated reduction in air service frequencies.
- **Scenario B**: the situation in 2035 and beyond without Vestlandsbanen. This scenario incorporates the same background developments as Scenario A, including overall demand growth, the Rogfast road tunnel and investments in Vestfoldbanen, but excludes both Vestlandsbanen and any associated reduction in air service frequencies.

The methodology for calculating travel demand by mode in Scenario A is presented in Chapter 8.2.3. Determining the corresponding demand levels for Scenario B is less straightforward, as this scenario requires the effects of all background developments to be represented while isolating and excluding the specific impacts attributable to Vestlandsbanen.

Sener derived the number of travellers by transport mode for **Scenario B** through a separate calculation based on the following scenarios:

- A reference scenario defined in the same way as in Chapter 8.2.3, incorporating overall demand growth but excluding Vestlandsbanen, the Rogfast road tunnel and the Vestfoldbanen improvements.
- A project scenario that is identical to the reference scenario but additionally includes the Rogfast road tunnel and the Vestfoldbanen improvements. This project scenario is equivalent to **Scenario B** as defined above.

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As neither scenario for this separate calculation includes a new mode of transport such as high-speed rail, the standard pivot application presented in Chapter 8.2.1 can be applied directly, without the need for the nested structure. Furthermore, the market shares of the existing transport modes in the reference scenario, P^0_{Air}, P^0_{Car} and P^0_{PT}, can be derived directly from the baseline travel demand data for air, car and public transport, as these data relate to the same situation as the reference scenario – without Vestlandsbanen, the Rogfast road tunnel or the Vestfoldbanen improvements.

A similar approach applies to the calculation of utility changes between the reference and the project scenarios, ΔU_{Air}, ΔU_{Car} and ΔU_{PT}. Since neither the Rogfast tunnel nor the Vestfoldbanen investments are assumed to affect air service frequencies, ΔU_{Air} is zero for all journeys. The remaining utility changes, ΔU_{Car} and ΔU_{PT}, can be calculated as described in the final part of Chapter 8.2.3, reflecting the impacts of the Rogfast and Vestfoldbanen schemes on travel times and costs.

Once the modal market shares for Scenario B, P_{Air}, P_{Car} and P_{PT}, have been calculated using the non-nested pivot application, Sener has multiplied them by the total number of travellers in the reference scenario to obtain the corresponding number of travellers by mode.

Finally, the number of travellers by each existing transport mode (air, car and public transport, but not high-speed rail) calculated for Scenario A has been subtracted from the corresponding number calculated for Scenario B. The resulting difference represents the number of travellers who switch from existing transport modes to high-speed rail following the introduction of Vestlandsbanen.

This methodology ensures that the demand forecasts capture not only the direct effects of the proposed high-speed railway, but also the wider transport network enhancements and market conditions expected to prevail over the forecast period.

8.2.5 Ticket revenues from HSR services and input data to the CBA

The calculation methods described in the preceding sections provide not only the basis for the market share and demand forecasts presented in Chapter 9, but also the foundation for a range of subsequent calculations required to evaluate the performance and benefits of the proposed high-speed rail network.

One such application is the estimation of ticket revenues from high-speed rail services. These revenues are calculated by multiplying the average ticket costs for work and non-work trips (see Chapter 7.2.5) by the corresponding calculated number of high-speed rail passengers. The resulting revenue forecasts are presented in Chapter 9, too.

The demand and mode-shift forecasts are also used as key inputs to a number of wider economic and financial assessments. These include, among others, the estimation of railway operating costs and the quantification of benefits arising from reductions in emissions, accident costs, travel costs and travel times as travellers shift from other transport modes to high-speed rail.

For some of these estimations, such as the calculation of travel cost savings, sufficient information is available within the scope of the demand modelling to enable direct calculation. However, most require a broader set of assumptions, parameters and analytical inputs that extend beyond the demand forecasting framework.

For this reason, all assumptions and calculations relating to the economic appraisal of the Vestlandsbanen investment have been consolidated within Deliverable 8 – *Cost-Benefit Analysis*. This approach ensures that the demand modelling outputs are integrated appropriately into the wider evaluation of the Vestlandsbanen project and its expected socio-economic impacts.

8.2.6 Induced demand

Following the introduction of Vestlandsbanen, extensive areas located along the new railway corridor, encompassing regions where more than half of Norway's population resides, will benefit from significantly improved accessibility and connectivity. While the principal effect of the scheme will be to redistribute demand between transport modes, the improved level of service is also expected to generate additional travel demand.

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This induced demand represents journeys that would not otherwise have taken place in the absence of Vestlandsbanen.

A wide range of mechanisms may contribute to induced demand, including:

- The creation of new businesses and the expansion of existing enterprises as a result of improved accessibility and reduced travel costs, generating additional trips by employees, customers and suppliers.
- Increased opportunities for students to remain in their hometowns while commuting to educational institutions located elsewhere, rather than relocating to larger urban centres.
- Improved access to employment opportunities, enabling jobseekers to consider positions over a wider geographical area while maintaining acceptable travel times. Similarly, employers may draw from a broader labour market.
- Additional leisure and social travel, such as recreational trips in the mountains, visits to friends and relatives, and attendance at cultural or sporting events that would otherwise be considered too time-consuming or costly.

These examples illustrate the diverse nature of induced demand and the extent to which it is influenced by local conditions, behavioural responses and wider socio-economic factors. Given these uncertainties, a cautious forecasting approach is appropriate. Accordingly, Sener has adopted a set of formulae for estimating induced demand that, particularly in cases involving moderate or minor accessibility improvements, produce relatively conservative levels of induced demand. This conservative approach is reflected in the formulae presented below, as explained in the following sections:

- Where an air service is available:

$$Induced\ demand\ factor = \left(P_{FM}^{0} \cdot e^{\theta \cdot \Delta U_{FM}} + P_{Car}^{0} \cdot e^{\theta \cdot \Delta U_{Car}} + P_{PT}^{0} \cdot e^{\theta \cdot \Delta U_{PT}}\right)^{0.29}$$

- Where no air service is available:

$$Induced\ demand\ factor = (P_{FM}^{0} \cdot e^{\Delta U_{FM}} + P_{PT}^{0} \cdot e^{\Delta U_{PT}})^{0.29}$$

The selected formulae calculate an induced demand factor, representing the proportional increase in total travel demand attributable to the introduction of Vestlandsbanen. For the purposes of this study, all induced demand is assigned exclusively to high-speed rail. No induced demand is assumed for competing transport modes.

The formulae are derived from the nested pivot application described in Chapter 8.2.2. The key principle is the calculation of the composite utility of the 'fast modes' nest and the corresponding change in utility between the reference and project scenarios. In the reference scenario, the 'fast modes' nest comprises either air travel or private car travel. In the project scenario, it comprises high-speed rail together with either air or private car travel.

Where the introduction of high-speed rail provides only a modest additional benefit to travellers, the change in the utility of the 'fast modes' nest, $\Delta U_{FM} = U_{FM} - U_{FM}^{0}$, is correspondingly small. As a result, only a limited amount of induced demand is generated, as $e^{\theta \cdot \Delta U_{FM}}$ only slightly exceeds 1, and both ΔU_{Car} (where an air service is available) and ΔU_{PT} are zero in most cases (except for journeys influenced by the Rogfast road tunnel or the Vestfoldbanen improvements).

Furthermore, the calculated induced demand is reduced even more where public transport already has a high market share. This is commonly observed for work-related travel within the Oslo metropolitan area, where frequent conventional rail services and connected bus services provide a high level of accessibility, even though journey times are longer than those offered by high-speed rail.

In this area, the market share of public transport in the reference scenario, P_{PT}^{0}, can be as high as 70% or more. Consequently, the market share of 'fast modes' in the reference scenario, i.e. the market share of car travel, P_{FM}^{0}, can be as low as 30% or less. In these cases, the size of the term $P_{FM}^{0} \cdot e^{\Delta U_{FM}}$ – and thus the entire induced demand factor – is limited accordingly, as ΔU_{PT} is zero in most cases.

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However, significant induced demand is also calculated within parts of the Oslo metropolitan area, not least because Vestlandsbanen will offer unprecedented short travel times, high service frequencies and several new stations in very attractive locations, such as Majorstua and Nesbru.

For other parts of the Vestlandsbanen corridor, in particular where towns and settlements currently are difficult to access and the new high-speed railway will bring huge benefits to travellers, businesses and communities, the selected formulae yield in some cases even higher levels of induced demand than in parts of the Oslo metropolitan area. However, Sener has chosen to ignore all calculated induced demand that exceeds 60% of the total, existing travel demand, in order to avoid a potential overestimation of the demand for high-speed rail.

It is also worth noting that the adopted methodology is closely aligned with that used by Atkins in the *Norway High Speed Rail Assessment Study – Phase III: Model Development Report* (2012). However, Atkins applied an exponent of **0.33**, based on international experience, whereas Sener has adopted a more conservative exponent of **0.29**, resulting in lower estimates of induced demand and a correspondingly more cautious forecasting approach.[62]

8.3 The short-distance problem

The formulae presented in Chapter 8.2 have been widely applied internationally. However, they are not without limitations.

When estimating demand for high-speed rail on relatively short-distance journeys, the resulting forecasts can often appear unrealistically high. This is a well-recognised characteristic of nested logit models when a new transport mode, such as high-speed rail, is introduced in a market where there is no prior experience of its use. The purpose of this chapter is to explain the reasons for this model behaviour and to describe the approach adopted by Sener to address the issue.

8.3.1 The reasons for the short-distance problem and some considered approaches

The short-distance problem can be explained by two key factors:

- The nested pivot application may appear like a set of formulae that involve a significant number of market shares and utilities of various modes of transport. The fact is, however, that the utilities of the two modes that constitute the 'fast modes' nest – on short distances, that is car and high-speed rail, since air is not available – do not influence the results independently of one another. The only variables that ultimately determine the outcome are the market shares in the reference scenario and the difference between the utility of travelling by car and the utility of travelling by high-speed rail. This can be demonstrated through a mathematical transformation of the key formulae.[63]

- For short-distance journeys, both travel times and travel costs are relatively low for travel by car and by high-speed rail. Consequently, the corresponding utility values, calculated from these travel times and costs, multiplied by the parameters presented in Table 19 of Chapter 8.1.3, are also relatively small. The difference between those utility values is smaller still.

  For very short journeys, typically less than approximately 20 km, the utility difference may be as low as 0.4, or even lower where road traffic conditions are generally unconstrained. When applying the modelling framework described in Chapter 8.2, a utility difference of 0.4 results in an approximate demand split of 40:60 between high-speed rail and car. Where the utility difference falls below 0.4, the model predicts an even

[62] "Norway High Speed Rail Assessment Study - Phase III: Model Development Report, Final Report", Atkins 25.01.2012, Chapters 4.3.3 and 4.3.4, https://banenor.brage.unit.no/banenor-xmlui/handle/11250/155084

[63] In the nested pivot application, ΔU_{PT} is always zero, except for journeys benefiting from the Vestfoldbanen investments. This means that the key term is ΔU_{FM}. It can be transformed as follows, using $\Delta U_{Car} = U_{Car} - U^0_{Car}$, which also is zero, except for journeys affected by the Rogfast tunnel: $\Delta U_{FM} = U_{FM} - U^0_{FM} = \ln(e^{U_{Car}} + e^{U_{HSR}}) - U^0_{Car} = \ln(e^{U_{Car}} + e^{U_{HSR}}) - \ln(e^{U_{Car}}) + \Delta U_{Car} = \ln(1 + e^{U_{HSR} - U_{Car}}) + \Delta U_{Car}$. Furthermore, applying the direct application: $P_{HSR} = P_{FM} \cdot e^{U_{HSR}}/(e^{U_{HSR}} + e^{U_{Car}}) = P_{FM}/(1 + e^{U_{Car} - U_{HSR}})$. This proves that U_{Car} and U_{HSR} always occur as $U_{Car} - U_{HSR}$, the difference between them only, and never independently from one another.

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greater share for high-speed rail. Examples illustrating this behaviour are presented in the following sub-chapter.

In addition, the model generates a certain level of induced demand for high-speed rail, increasing its market share further to approximately 45%. Such market shares appear implausibly high for non-work trips undertaken by high-speed rail over very short distances.

A commonly adopted method for addressing this issue is to segment the demand model by distance band. To some extent, this approach has already been implemented, as Sener's methodology distinguishes between journeys where air travel is a viable option (typically journeys of approximately 250 km or more) and journeys where air travel is not relevant (generally below 250 km).

However, any further subdivision of the latter distance range would be problematic because there are no available data from which to derive utility parameters for journeys shorter than 100 km. The stated preference survey undertaken by Rand in 2010 and 2011, which remains the only available survey examining the factors influencing Norwegian travellers' potential use of high-speed rail, was not designed to assess journeys below this threshold, as discussed in Chapter 8.1.2.

Similarly, no other studies exist that would enable the estimation of the utility parameters required for short-distance travel in Norway. This limitation also applies to other parts of the Norway High Speed Rail Assessment Study published by Jernbaneverket in 2012. Within that study, demand modelling was restricted to a limited number of stations along Vestlandsbanen, namely the terminal stations together with Odda, Kongsberg and Drammen. Consequently, only a small number of journeys shorter than 100 km were considered. For these movements, a simplified gravity model was considered adequate. This approach did not rely on observed traffic volumes or stated preference data but was primarily based on population statistics.

Given the extensive market analysis undertaken by Sener and the comprehensive baseline dataset available regarding travel demand and the characteristics of competing transport modes, such an approach is not considered appropriate for the present study.

8.3.2 Modifying utilities by applying additional functions

Following an assessment of various alternatives, Sener elected to develop a set of supplementary functions to adjust the utilities of the available transport modes. The objective is to retain the use of the extensive transport and market data compiled for the study while producing more realistic forecasts of high-speed rail demand than would otherwise be achieved.

These functions are not intended to provide highly accurate demand estimates. Such precision is not currently achievable due to the absence of empirical data required to calibrate the functions. Instead, they should be regarded as modelling assumptions designed to produce conservative outcomes under all circumstances. More refined forecasting approaches should be developed as part of future investigations of Vestlandsbanen.

The development of these functions followed three key principles:

- Identify the principal drivers of the declining competitiveness of high-speed rail and formulate adjustment functions such that low values of those drivers produce high function values. In all cases, the function values shall be greater than one.
- For each journey, multiply the utilities of all available transport modes by the corresponding adjustment factor. This approach preserves the internal structure of the utility difference between car and high-speed rail, maintaining the relative influence of travel time, travel cost and other utility components, while increasing the overall separation between the two modes. Increasing the utility difference results in a clearer distinction between their respective market shares. As discussed previously, very small utility differences tend to generate similar levels of demand for car and high-speed rail, which is unlikely to be representative of traveller behaviour on most short-distance journeys.
- Undertake extensive testing and refine the adjustment functions to ensure: (i) conservative forecast outcomes; (ii) a gradual convergence towards the original model behaviour for journeys exceeding 100 km, where the

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underlying model is expected to perform satisfactorily without adjustment; and (iii) consistency of results across different explanatory variables, including travel times and costs by car and high-speed rail, access and egress times, service frequencies and related factors.

The key drivers of decreasing competitiveness of high-speed rail

At the outset, several potential parameters could be considered as the primary driver of the declining competitiveness of high-speed rail. Such a parameter might, for example, be the travel distance or travel time by high-speed rail, or alternatively the travel distance or travel time by car.

Sener has chosen travel time by car as the principal driver, as this appears to be a more decisive factor in competition with high-speed rail than travel distance and the associated costs. Travel times and distances by high-speed rail are of limited relevance in this context, since very short rail journey times tend to enhance competitiveness. However, the driver sought here is one that produces precisely the opposite effect.

Another important factor is the relationship between access and egress times to and from railway stations and the travel time by car for the entire journey. Travellers who would spend nearly as much time accessing and leaving railway stations as they would driving directly to their destination are unlikely to be persuaded to switch to high-speed rail.

The formulation of the adjustment formulae

After examining the effects of a wide range of potential functional formulations, Sener selected the formulae set out below. In these expressions, T represents the travel time by car, while R represents the ratio of access and egress times to and from the railway stations to the travel time by car.

$$f(T,R) = 1 + \frac{2.5 \cdot (1+R^2)}{e^{0.04 \cdot T \cdot (1-R)}} \text{ for work trips}$$

$$f(T,R) = 1 + \frac{4 \cdot (1+R^2)}{e^{0.04 \cdot T \cdot (1-R)}} \text{ for non-work trips}$$

For long car journeys (where T is large) and short access and egress times to and from the stations (where R is close to zero), these formulae produce, as intended, values only slightly greater than one. However, as T decreases, the application of the selected formulae has a significant impact on the demand calculation.

This is evident from the 16 calculation examples presented on the next pages. They illustrate how the adjustment formulae respond under different conditions for journeys by car and high-speed rail, including varying journey distances and different locations of the trip origins and destinations relative to the departure and arrival stations.

The key input data for each calculation example is presented both in tables and accompanying diagrams. In addition, the calculations are based on the following assumptions:

- The travel time by car is calculated using an average speed of 37.5 km/h for the first and last 1.5 km sections of the journey, and 75 km/h for the remaining section. It is assumed that the travel distance by car is 10% longer than the corresponding distance by high-speed rail, reflecting the typically more direct alignment of the railway.
- The travel cost by car is based on an assumed cost of NOK 3.90 per vehicle-kilometre (see Chapter 7.4.2) and a car occupancy rate that varies according to journey length: 1.75 for a 90 km high-speed rail journey, 1.6 for 60 km, 1.5 for 40 km, 1.4 for 20 km, and 1.3 for 10 km. No road tolls or ferry charges are assumed.
- High-speed rail travel times are average values derived from the journey times presented in Appendix 3. For example, the journey time for a 90 km trip is assumed to be 30 minutes. By comparison, Stavanger–Ølen (89.1 km) is expected to take less than 26 minutes, whereas Drammen–Bø (89.2 km) is expected to take almost 32 minutes.
- Pre-boarding times and high-speed rail ticket costs, differentiated between work and non-work trips, are applied as described in Chapters 7.2.3 and 7.2.5.

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- Access and egress times to and from railway stations, together with the associated costs, are calculated in the same manner as travel times and costs by car. However, only travel times and costs directly influence the calculation results; access and egress distances do not. The latter serve solely as inputs for calculating the first two variables (see Chapter 7.4.4). Consequently, the results apply equally to a 2.5 km car journey to a station, taking four minutes and costing NOK 7.50, as they do to a much shorter bicycle journey requiring the same amount of time and incurring the same cost.
- Service frequency is assumed to be 16 departures per day for a 90 km high-speed rail journey, 24 departures for 60 km, 32 for 40 km, 48 for 20 km, and 64 departures per day for a 10 km journey.

In the diagrams below, car journeys are shown in blue and high-speed rail journeys in red. Railway stations are represented by yellow circles. The tables present the results calculated for both work and non-work trips, using the parameters described in Chapter 8.1.3 and the methodology set out in Chapter 8.2. These results comprise:

- The difference between the utility of a car journey and that of a high-speed rail journey prior to any adjustment. This is referred to as the original utility difference.
- The corresponding market share of high-speed rail within the combined market share of car and high-speed rail. This measure provides a more precise representation of the effects of the adjustment functions than the share of total demand, which would require an assumption regarding the market share of public transport.
- The difference between the utility of a car journey and that of a high-speed rail journey after all utility values have been multiplied by the adjustment factor.
- The corresponding market share of high-speed rail within the combined market share of car and high-speed rail after application of the adjustment factor.
- Induced demand, assuming a 15% market share for public transport in the reference scenario. If public transport accounts for a larger market share, the induced demand will be correspondingly lower.

The 16 examples make it possible to deduce several key features of the adjustment functions. Admittedly, some differences between the examples for different travel distances by high-speed rail can partly arise from car occupancy rates or high-speed rail service frequencies. However, there are three features that clearly stand out:

High sensitivity for decreasing travel times by car

The adjustment functions respond strongly to decreasing travel times by car. In Example 1, which relates to a 90 km journey by high-speed rail, the calculation already shows a noticeable increase in the difference between the utilities of car travel and high-speed rail: 13% for work trips and 21% for non-work trips, leading to a reduction in the market share of high-speed rail of 3.6% and 4.5%, respectively.[64]

This suggests that the adjustment functions continue to exert some influence even on journeys exceeding 100 km, despite the fact that no adjustment is actually required for trips of this length. However, if the travel time by car is 160 minutes and the access and egress times remain as assumed in Example 1 (four minutes each only), the resulting increase in the utility difference is just 0.6% for work trips and 0.9% for non-work trips.[65] Such values have a negligible impact on the calculated market shares for high-speed rail.

For shorter distances, however, the effects of the adjustment functions become increasingly pronounced. As shown in Example 16, for a 10 km journey by high-speed rail, the increase in the utility difference can reach 800%,[66] corresponding to a 95% reduction in the market share of high-speed rail compared with that calculated without any adjustment. While this reduction may appear substantial, it is not implausible and seems necessary to avoid overestimating demand.

[64] From 0.4443 to 0.5033, and 39.07% to 37.68% for work-trips, and from 0.3633 to 0.4405, and 41.02% to 39.16% for non-work trips.
[65] $2.5 \cdot (1 + 0.05 \cdot 0.05)/e^{0.04 \cdot 160 \cdot 0.95} = 0.0057$ and $4 \cdot (1 + 0.05 \cdot 0.05)/e^{0.04 \cdot 160 \cdot 0.95} = 0.0092$.
[66] The figure applies to non-work trips and an increase of the utility difference from 0.4246 to 3.8215.

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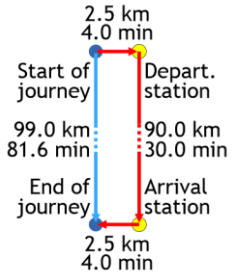
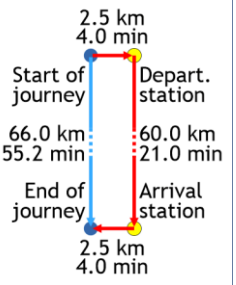
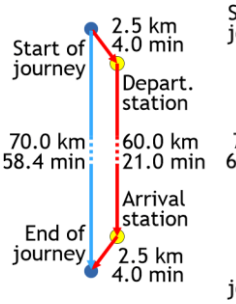
	Input data and results	Example 1	Example 2	Example 3	Example 4
					
Input data	Car travel distance	99.00	66.00	70.00	74.00
	Car travel time	81.60	55.20	58.40	61.60
	HSR travel distance	90.00	60.00	60.00	60.00
	HSR travel time	30.00	21.00	21.00	21.00
	HSR access & egress time	8.00	8.00	8.00	12.80
Work trips	Original utility difference	0.4443	0.4413	0.4276	0.4473
	Original HSR share	39.07 %	39.14 %	39.47 %	39.00 %
	Adjusted utility difference	0.5033	0.6118	0.5726	0.6130
	Adjusted HSR share	37.68 %	35.17 %	36.06 %	35.14 %
	Induced HSR demand, adj.	12.78 %	11.62 %	12.03 %	11.61 %
N.-w. trips	Original utility difference	0.3633	0.3692	0.3573	0.3871
	Original HSR share	41.02 %	40.87 %	41.16 %	40.44 %
	Adjusted utility difference	0.4405	0.5975	0.5512	0.6165
	Adjusted HSR share	39.16 %	35.49 %	36.56 %	35.06 %
	Induced HSR demand, adj.	13.49 %	11.77 %	12.26 %	11.57 %

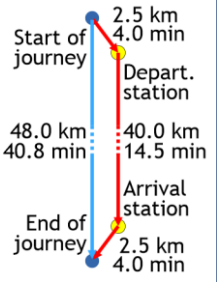
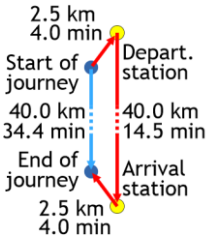
	Input data and results	Example 5	Example 6	Example 7	Example 8
					
Input data	Car travel distance	44.00	48.00	52.00	40.00
	Car travel time	37.60	40.80	44.00	34.40
	HSR travel distance	40.00	40.00	40.00	40.00
	HSR travel time	14.50	14.50	14.50	14.50
	HSR access & egress time	8.00	8.00	12.80	8.00
Work trips	Original utility difference	0.4412	0.4270	0.4468	0.4555
	Original HSR share	39.15 %	39.48 %	39.01 %	38.81 %
	Adjusted utility difference	0.7941	0.7255	0.7946	0.8730
	Adjusted HSR share	31.13 %	32.62 %	31.12 %	29.46 %
	Induced HSR demand, adj.	9.89 %	10.51 %	9.88 %	9.21 %
N.-w. trips	Original utility difference	0.3771	0.3643	0.3944	0.3900
	Original HSR share	40.68 %	40.99 %	40.27 %	40.37 %
	Adjusted utility difference	0.8596	0.7719	0.8856	0.9620
	Adjusted HSR share	29.74 %	31.61 %	29.20 %	27.65 %
	Induced HSR demand, adj.	9.32 %	10.09 %	9.11 %	8.50 %

Table 20a and b: Examples illustrating the effects of adjustment functions selected for demand calculations on short distances.

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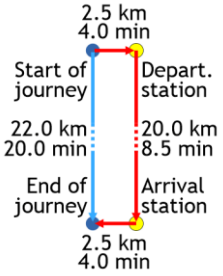
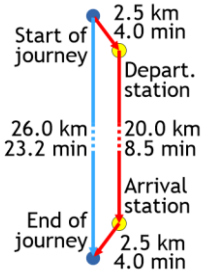
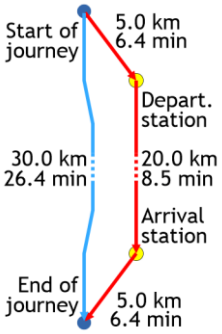
	Input data and results	Example 9	Example 10	Example 11	Example 12
					
Input data	Car travel distance	22.00	26.00	30.00	18.00
	Car travel time	20.00	23.20	26.40	16.80
	HSR travel distance	20.00	20.00	20.00	20.00
	HSR travel time	8.50	8.50	8.50	8.50
	HSR access & egress time	8.00	8.00	12.80	8.00
Work trips	Original utility difference	0.4479	0.4327	0.4523	0.4634
	Original HSR share	38.99 %	39.35 %	38.88 %	38.62 %
	Adjusted utility difference	1.2516	1.0916	1.2630	1.4630
	Adjusted HSR share	22.24 %	25.13 %	22.05 %	18.80 %
	Induced HSR demand, adj.	6.51 %	7.55 %	6.45 %	5.35 %
N.-w. trips	Original utility difference	0.3932	0.3787	0.4088	0.4084
	Original HSR share	40.29 %	40.64 %	39.92 %	39.93 %
	Adjusted utility difference	1.5223	1.3015	1.5809	1.8177
	Adjusted HSR share	17.91 %	21.39 %	17.07 %	13.97 %
	Induced HSR demand, adj.	5.06 %	6.22 %	4.79 %	3.82 %

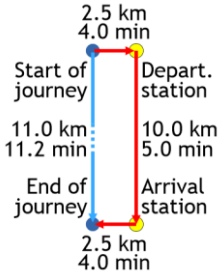
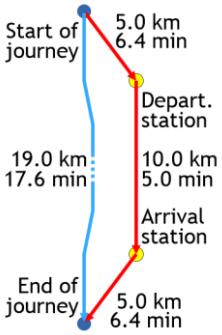
	Input data and results	Example 13	Example 14	Example 15	Example 16
					
Input data	Car travel distance	11.00	15.00	19.00	7.00
	Car travel time	11.20	14.40	17.60	8.00
	HSR travel distance	10.00	10.00	10.00	10.00
	HSR travel time	5.00	5.00	5.00	5.00
	HSR access & egress time	8.00	8.00	12.80	8.00
Work trips	Original utility difference	0.4510	0.4341	0.4535	0.4692
	Original HSR share	38.91 %	39.31 %	38.85 %	38.48 %
	Adjusted utility difference	1.9492	1.5336	1.8839	2.8152
	Adjusted HSR share	12.46 %	17.75 %	13.19 %	5.65 %
	Induced HSR demand, adj.	3.37 %	5.00 %	3.59 %	1.45 %
N.-w. trips	Original utility difference	0.4046	0.3871	0.4168	0.4246
	Original HSR share	40.02 %	40.44 %	39.73 %	39.54 %
	Adjusted utility difference	2.5554	1.9560	2.5203	3.8215
	Adjusted HSR share	7.21 %	12.39 %	7.44 %	2.14 %
	Induced HSR demand, adj.	1.87 %	3.35 %	1.94 %	0.54 %

Table 20c and d: Examples illustrating the effects of adjustment functions selected for demand calculations on short distances.

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High sensitivity to reduced railway station accessibility

When comparing the various examples for identical rail travel distances, the influence of station location becomes readily apparent. In most examples, access and egress times to and from the stations are identical. However, in Examples 3, 6, 10 and 14, the origins and destinations of the journeys are positioned such that the direct travel distance by car is 4 km greater than in Examples 2, 5, 9 and 13. As expected, this increase in car travel distance results in a corresponding increase in demand for high-speed rail.

In Examples 4, 7, 11 and 15, however, access times to the stations are 60% longer than in the other examples. At the same time, the direct travel distance by car is 8 km greater than in Examples 2, 5, 9 and 13. While the longer car journey would normally increase the attractiveness and demand for high-speed rail, the reduced accessibility of the railway stations exerts a strong opposing effect. As a result, demand for high-speed rail remains broadly comparable to that observed in Examples 2, 5, 9 and 13.

The substantial influence of station accessibility is further demonstrated in Examples 8, 12 and 16, where demand for high-speed rail is significantly lower than in the other examples. This is attributable to the less favourable location of the railway stations, which results in shorter direct travel times by car. The effect is particularly pronounced for the shortest high-speed rail journey distances.

Stronger impact on non-work trips than on work trips

As journey distances decrease, the adjustment functions generate a greater reduction in demand for non-work trips than for work-related trips. This reflects observed travel behaviour, whereby public transport is generally used less frequently for private journeys than for commuting or work-related travel, particularly over shorter distances.

Other examinations

In addition to the 16 examples presented here, and many other examples not included in this report, Sener has examined a substantial number of cases derived from the extensive set of journeys to be assessed for Vestlandsbanen. These analyses also included the calculation of elasticities, which quantify how the estimated market share of high-speed rail responds to marginal changes in the input variables, such as travel time by car or the ratio between station access and egress times and corresponding road travel times.

Overall, the results demonstrate that the selected adjustment functions perform robustly and provide a highly effective representation of the underlying travel behaviour.

8.4 Transit- and transfer air passengers

This chapter describes the approach adopted by Sener to estimate the number of transit and transfer air passengers[67] who may potentially switch to Vestlandsbanen. The analysis focuses on air passengers whose journey comprises at least two flight segments, with one flight operating within the Vestlandsbanen corridor and at least one other flight originating or terminating outside the corridor. Such journeys are not captured as trips between two zones within the Vestlandsbanen corridor, as described in Chapter 5.1, and therefore require a separate assessment.

For the purposes of this analysis, it is necessary to distinguish between transit and transfer air passengers. Transit passengers may remain on board the aircraft during an intermediate stop and typically experience only a short dwell time, generally in the order of 20 to 30 minutes, before continuing their journey to the final destination. Unless a high-speed rail alternative offers a significantly shorter overall journey time, such passengers have little incentive to interrupt their air journey and transfer to rail.

Transfer passengers, by contrast, are required to disembark from the aircraft and complete all or part of the airport transfer process. For international arrivals, this may include immigration and customs procedures, baggage

[67] See Chapter 5.1 for a definition of OD, transit and transfer air passengers.

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collection, re-checking luggage where required, and passing through security screening before boarding the subsequent flight. In addition, transfer passengers generally experience substantially longer connection times than transit passengers. This effect may be further amplified if flight frequencies are reduced as a consequence of a significant share of OD air passengers switching to Vestlandsbanen. Under these circumstances, transfer passengers may regard high-speed rail as a viable alternative to part of their air journey.

For the reasons outlined above, and given the relatively low number of transit passengers on routes within the Vestlandsbanen corridor, with the exception of the Bergen–Stavanger route (approximately 65,000 passengers in 2019), Sener has decided not to include transit passengers in the assessment and to restrict the analysis to transfer passengers only.

8.4.1 Sener's approach to demand forecasting

The methodology adopted by Sener to estimate the number of transfer air passengers expected to switch to high-speed rail can be illustrated through the following example.

Following the commissioning of Vestlandsbanen, air passengers arriving at Oslo Airport Gardermoen from an airport outside the Vestlandsbanen corridor and travelling onwards to Tysse in the municipality of Samnanger (approximately 50 km east of Bergen Airport Flesland) will have at least two alternative travel options:

1) continue their journey by air, taking a connecting flight to Bergen Airport Flesland and travelling onwards from the airport to their final destination; or
2) transfer to rail at Gardermoen Airport railway station, travel to Oslo S and continue by Vestlandsbanen to Tysse station.

These options are broadly comparable to those available to travellers whose journey originates in the immediate vicinity of Gardermoen Airport, for example at a hotel located 50 metres from the terminal, and whose destination is also Tysse.

Although certain differences exist between transfer passengers and travellers whose journey originates at Gardermoen, these differences can be accounted for within the analysis. Once the relevant adjustments have been made, the proportion of transfer passengers arriving at Gardermoen who subsequently switch to rail can be estimated from the proportion of locally originating travellers who choose rail rather than a flight departing from the adjacent airport.

This latter proportion can be calculated using the demand forecasting applications described in Chapter 8.2, not only for journeys to Tysse but also for all other destinations for which a flight between Gardermoen and Bergen Airport Flesland constitutes a recorded alternative. The same principle applies to journeys in the opposite direction and, consequently, to the total volume of transfer air passengers on the Oslo–Bergen air route who change aircraft at Gardermoen.

8.4.2 Current transfer air passenger volumes

Table 21 on the next page presents the number of transfer passengers on the principal air routes within the Vestlandsbanen corridor in 2019. The calculation was undertaken in accordance with the methodology described in Chapter 5.1 and produces results broadly consistent with those presented in Table 2 of that chapter. The key difference is that transit passengers have been excluded from the figures shown in Table 21.

The table also identifies the number of transfer passengers changing aircraft at both the most frequently used and the less frequently used transfer airport for each route. In most cases, the principal transfer airport is Oslo Airport Gardermoen. For the Bergen–Stavanger and Bergen–Kristiansand routes, the principal transfer airport is Bergen Airport Flesland, whereas for the Stavanger–Sandefjord route it is Stavanger Airport Sola. According to Statistics Norway (SSB), no transfer passengers were recorded as changing aircraft at Sandefjord Airport Torp or Haugesund Airport Karmøy.

Table 21 demonstrates that the analysis is required for a total of 13 distinct passenger flows. For five of the eight airport-to-airport routes, transfer movements via both airports must be assessed. For the Haugesund–Oslo, Bergen–Sandefjord and Stavanger–Sandefjord routes, however, only a single transfer airport requires consideration.

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Airport to airport route	Total transfer passengers	Transfer passengers, most used airport	Transfer passengers, less used airport
Bergen/Stord-Oslo	498,315	473,052	25,263
Stavanger-Oslo	531,841	509,565	22,276
Bergen-Stavanger	101,219	86,253	14,966
Haugesund-Oslo	202,617	202,617	0
Kristiansand-Oslo	247,270	245,864	1,406
Bergen-Sandefjord	24,053	24,053	0
Bergen-Kristiansand	27,325	25,307	2,018
Stavanger-Sandefjord	4,047	4,047	0
Total	**1,636,686**	**1,570,758**	**65,928**

Table 21: Transfer air passengers between airports, 2019. Source: SSB, table 08510.

Further development of the number of transfer passenger demand

As no detailed information is available regarding the composition of transfer air passengers, Sener has assumed that the number of transfer passengers will grow to 2035 and subsequent forecast years at the same rate as that applied to OD passengers on the corresponding routes. The methodology adopted for this projection is described in Chapter 6. For the same reason, Sener has also assumed that the proportion of work and non-work journeys among transfer air passengers is consistent with that obtained for OD passengers on the same routes.

Both assumptions introduce a degree of uncertainty. However, it is difficult to identify a more robust basis for forecasting in the absence of more detailed data. Furthermore, transfer passengers account for only 29% of all air travellers within the Vestlandsbanen corridor, and the proportion expected to transfer to high-speed rail is smaller still. Consequently, the uncertainty associated with these assumptions is expected to have only a limited influence on the overall forecasting results.

8.4.3 Assumptions adopted for utility and market share calculations

In accordance with the methodology described in the preceding chapters, Sener has calculated utilities for the two travel options available to passengers whose journey originates at an airport and who subsequently reach their final destination either by rail or by air, as well as for journeys undertaken in the opposite direction. These utility calculations are based on the same assumptions applied to other journey types; however, they are subject to a number of specific adjustments reflecting the particular characteristics of transfer passengers:

- **For air passengers**, the time spent at the airport is assumed to be 10 minutes shorter than that applied to OD air passengers (see Chapter 7.3.2). This adjustment reflects the fact that a significant proportion of transfer passengers arrive from airports within Norway and are therefore not required to pass through security screening at the transfer airport. Consequently, they are generally able to reach the departure gate for their connecting flight more quickly. However, the minimum connection time between two flights is typically at least 45 minutes.[68]

- **For air passengers**, the fare associated with the connecting flight is assumed to be 30% lower than the equivalent OD fare. In many cases, this assumption may favour air travel more than actual market conditions would suggest. Nevertheless, given the complexity of airline pricing structures (see Chapter 7.3.3), it is difficult to establish a more reliable estimate.

- **For air passengers**, the utility calculation includes only a single interchange, namely at the airport nearest to the final destination. **For high-speed rail passengers**, by contrast, three interchanges are assumed:

[68] 45 minutes is a very low and conservative figure. For example, the airline 'Norwegian' recommends at least 120 minutes between two consecutive flights, see https://www.norwegian.com/no/booking/bestillingsinformasjon/videreforbindelser/

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1) a transfer from the arriving aircraft to a bus or rail service providing access to the nearest Vestlandsbanen station;
2) a transfer from that feeder service to a Vestlandsbanen high-speed train; and
3) a final interchange at the destination station.

The same number of interchanges is assumed for journeys undertaken in the opposite direction.

This assumption may prove conservative, as many Vestlandsbanen services may not terminate at Oslo Central Station but continue to, or originate from, Oslo Airport Gardermoen, Hamar, Trondheim, or other stations north of Gardermoen, depending on the future development of the Norwegian high-speed rail network.

Conversely, the expansion of the Norwegian network, together with potential developments in Sweden, could also enable a number of Vestlandsbanen services to continue to Gothenburg or Stockholm and therefore not serve Gardermoen Airport. Given these uncertainties, it is difficult to define a more precise assumption.

- **For high-speed rail passengers**, it is assumed that travel between the airport and the nearest Vestlandsbanen station is undertaken by public transport. At several airports, travellers can choose between multiple public transport options. For example, passengers travelling to or from Bergen Airport Flesland may use either bus services or the Bybanen light rail system. Sener has therefore derived average travel times and costs for these access and egress journeys. The resulting assumptions are presented in Table 22.

Airport	Travel time (min)	Travel cost (NOK)
Oslo airport Gardermoen	30	200
Bergen airport Flesland	30	100
Stavanger airport Sola	30	140
Kristiansand airport Kjevik	35	40

Table 22: Average travel times and costs assumed for journeys between airports and nearest railway station.

From utilities to market shares and passenger volumes

The next stage of the analysis concerns the geographical distribution of transfer air passengers' final destinations. For example, among passengers arriving from an airport outside the Vestlandsbanen corridor, landing at Oslo Airport Gardermoen and continuing towards Bergen Airport Flesland, some may be travelling to Tysse, while others may be destined for Bergen city centre or locations in the vicinity of Flesland Airport. For the latter group in particular, air travel remains an attractive option compared with alternative modes.

Accordingly, Sener derived the destination distribution of transfer air passengers from the distribution of OD air passengers travelling from the NTM6 zones located closest to the respective transfer airports: Gardermoen, Flesland, Sola and Kjevik.[69] These zones were selected because they also represent favourable origins for air travel. Furthermore, no alternative zone, or combination of zones, was identified as being more representative of transfer passenger travel patterns.

In practical terms, Sener applied the following sequence of calculations for each of the four NTM6 zones located in the vicinity of an airport:

- **First**, Sener identified the number of OD air passengers travelling to destinations located within the catchment areas of the other airports, and vice versa.

[69] This concerns NTM6 zone 200 for Oslo airport Gardermoen, zone 922 for Bergen airport Flesland, zone 862 for Stavanger airport Sola and zone 745 for Kristiansand airport Kjevik. The distances between these NTM6 zones and the respective airports are usually a few kilometres only and always less than 6 km.

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- **Second**, for each destination airport and for each destination zone within its catchment area, Sener calculated the utilities associated with travel by air and by high-speed rail.
- **Third**, these utility values were used within the direct application of the logit model (see Chapter 8.2.1) to estimate the market share of high-speed rail. Then, Sener calculated interim results by multiplying the estimated market shares by the number of air travellers for each pair of origin and destination zones.
- **Finally**, the interim results were multiplied by the ratio between the number of transfer passengers on the relevant air route and the total number of OD air passengers travelling between the zone close to the transfer airport and all destination zones within the catchment area of the corresponding destination airport.

This approach enabled Sener to estimate the number of transfer air passengers expected to switch to high-speed rail, disaggregated by individual origin-destination zone pairs.

Sener also considered including an estimate of induced demand. However, this was ultimately excluded from the analysis, as such an assessment would require a robust understanding of the relative importance of Vestlandsbanen within the context of the passenger's overall air-and-rail journey. No suitable data is available to support such an assessment.

8.5 Forecasts for the years beyond 2035

As outlined in Chapter 6.1, projected population growth, and the corresponding evolution of travel demand, has been assessed for each municipality in Norway. Accordingly, the demand forecasts for the years beyond 2035, which are presented in Deliverable 8 – *Cost-Benefit-Analysis*, are not based on simple extrapolation techniques; rather, they explicitly incorporate these demographic and travel demand developments into the forecasting methodology.

8.6 Assumptions regarding demand distribution across a day

For several calculations, such as determining the train operating plan required to meet demand (see Chapter 9.7.1), it is necessary to make assumptions regarding the distribution of demand across the various time periods throughout the day.

For hourly train services on a working day, Sener has assumed that the first departure will be scheduled in the early morning, for example at around 5:00 a.m., and the last departure (at least for trains commencing long-distance journeys) at around 10:00 p.m., i.e. 17 hours later. This results in 18 departures per day in each direction.

On Saturdays, Sundays, and public holidays, the number of departures is expected to be lower, resulting in an average of 16 departures per day for hourly train services and a total capacity of 3,200 seats per day and per direction, assuming that trains consist of a single unit providing 200 seats (see Chapter 7.1.2). For higher or lower service frequencies, the average number of trains operated per day and the overall passenger capacity would vary accordingly.

Furthermore, Sener expects that demand will not be evenly distributed throughout the day, despite the availability of reduced off-peak fares. Instead, it is assumed that half of the daily demand is concentrated within three hours in the morning peak period and three hours in the afternoon peak period, while the remaining half is distributed across the other ten hours of the day. This corresponds to demand during peak hours being approximately 33% higher than the average hourly demand, while demand during off-peak hours is approximately 20% lower than the average hourly demand.

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9 DEMAND CALCULATION AND DISCUSSION OF RESULTS

The purpose of this chapter is to present and discuss the results of the passenger transport demand forecasts for the Vestlandsbanen model network, using the methodologies described in the preceding chapters.

Chapter 9.1 presents the key results and compares them with performance indicators from other relevant projects. Chapters 9.2 to 9.6 provide detailed background information on the forecast results and their implications for the socio-economic analysis. Chapter 9.7 examines potential optimisation measures for the Vestlandsbanen transport system and assesses their implications for passenger demand. Finally, Chapter 9.8 presents the uncertainty analysis and recommendations for further development of the Vestlandsbanen passenger transport model.

9.1 Key results and performance indicators

The passenger demand forecasts have yielded the following key results for Vestlandsbanen and the other parts of the Vestlandsbanen model network (including Vestfoldbanen and the Bø–Kristiansand section of Sørlandsbanen; see Chapter 7.2):

- Daily ridership across Vestlandsbanen, Vestfoldbanen, and Sørlandsbanen (Bø–Kristiansand) is estimated to reach almost 119,400 passengers by 2035. Notably, 91.8% of these passengers are expected to be new users of public transport rather than passengers diverted from existing public transport services (bus, boat, and conventional rail). When passenger volumes are weighted by distance travelled, this proportion increases to 94.4%.

- The average rail journey within the Vestlandsbanen model network is expected to be 138.7 km. This corresponds to an annual passenger transport work (passengers multiplied by the distance travelled) of 6.043 billion passenger-km in 2035. Of this total, 5.176 billion passenger-km (86%) is estimated for Vestlandsbanen, 486 million passenger-km (8%) for Vestfoldbanen, and 380 million passenger-km (6%) for the Bø–Kristiansand section of Sørlandsbanen.

- The ticket fares assumed for the Vestlandsbanen model network (see Chapter 7.2.5), combined with the expected proportion of work and non-work travel and the variation in journey lengths, result in average ticket revenue of NOK 2.19 per passenger-km. This corresponds to total annual ticket revenue of NOK 13.248 billion in 2035.

- The average line load on Vestlandsbanen in 2035 is estimated at almost 21,600 passengers per day. This important performance indicator is is defined as the total number of passengers travelling on a railway section between two consecutive stations, and the average value is calculated as the weighted average across all such sections.[70]

  Figure 9 on the following page shows an estimated passenger line load of approximately 18,000 passengers per day in Rogaland and Vestland counties. The figure increases to more than 24,000 in Vest-Telemark, reaches approximately 33,000 near Notodden, and exceeds 45,000 in the approaches to Oslo. By contrast, the triangular junctions near Aksdal, Røldal, and Nordagutu, as well as the parallel branches via Bø and Kongsberg, are expected to carry lower passenger volumes than other sections of Vestlandsbanen. As a result, the average line load is lower than the peak values quoted above might suggest.

- The interconnections between Vestlandsbanen and Vestfoldbanen at Drammen and Skien are expected to generate a substantial increase in demand on Vestfoldbanen. North of Sande, the additional demand is esti-

[70] The total length of double-track sections used by passenger trains on Vestlandsbanen, including Bergen–Arna (already constructed as part of Bergensbanen) is 658 km. 5.176 billion pkm per year on 658 km corresponds to a line load of 21,550 passengers per day. When including high-speed rail demand between Majorstua and Oslo S – which is not included in the present demand calculation as the travel distance of 3.52 km is considered as too short for applying the forecast model – the average line load will reach about 21,600 per day.

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Figure 9: The estimated passenger line load per day on different sections of Vestlandsbanen in 2035.

mated to be equivalent to approximately 140% of the 2023 demand level, rising to 250% or more west of Sandefjord. A similar trend is expected for Oslo–Drammen. West of Lysaker (7 km from Oslo S), the additional demand in 2035 is estimated to be at least equal to the entire demand recorded in 2023.[71]

Very high demand forecasts

The demand and line load figures presented above are exceptionally high, not only when compared with the population of Norway and that of the Vestlandsbanen corridor (see Chapter 3 in Deliverable 1 – *Study Area Characterisation*), but also when benchmarked against other relevant transport indicators. This can be illustrated by the following examples:

[71] See https://www.jernbanedirektoratet.no/content/uploads/2025/10/Nasjonal-potensialanalyse_Passasjertallanalyse.pdf, page 14–44. The report includes the figure rendered as Figure 3 in Chapter 5.3, together with many other interesting figures. They make it possible to estimate the maximum passenger line load between Lysaker and Drammen in 2023 at almost 35,000 passengers per day. For comparison, the introduction of Vestlandsbanen is forecast to generate approximately 40,000 additional rail passenger journeys per day on the Drammen-Oslo corridor (see Figures 9 and 12).

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- The estimated passenger transport work on the Vestlandsbanen model network in 2035 is more than 50% higher than the passenger transport work recorded across the entire Norwegian railway network in 2025.[72]
- The estimated average line load on Vestlandsbanen in 2035 is significantly lower than the average line load on the high-speed rail network in France, slightly lower than that in Germany, but higher than that in Spain.

With regard to the latter comparison, it should be noted that the first sections of Europe's high-speed rail network entered service 35 to 45 years ago. For example, the Paris–Lyon high-speed line was commissioned in 1981, Hannover–Würzburg in 1991, and Madrid–Seville in 1992. These projects, together with the subsequent expansion of the network to many thousands of kilometres of high-speed rail infrastructure across Europe, have had a profound impact on socio-economic development over recent decades.

The demand figures for Vestlandsbanen, on the other hand, apply to the start of operations. They are likely to increase substantially over time. Against this backdrop, the comparison between the projected figures for Vestlandsbanen in 2035 and the average figures for high-speed rail networks in selected European countries in 2024, as presented in Table 23 below, is particularly noteworthy.

Table 23 presents the length of high-speed railway lines[73] and the total passenger transport work undertaken by high-speed rail services in France, Germany, and Spain.[74] In France and Germany, however, these services operate not only on dedicated high-speed infrastructure but also extensively on conventional railway lines and, in some cases, across international routes. Consequently, the proportion of transport work attributable solely to dedicated high-speed lines is significantly lower.[75]

	High-speed rail network length	Total HSR transport work, in billion pkm	Relevant share of transport work	Average line load, passengers per day
Vestlandsbanen, Norway	658 km	5.176 (2035)	100%	21,600
High-speed lines in France	2,655 km	66.690 (2024)	60%	41,000
High-speed lines in Germany	1,159 km	38.241 (2024)	30%	27,000
High-speed lines in Spain	3,363 km	18.468 (2024)	100%	15.000

Table 23: Average passenger line loads of high-speed railway lines in various countries.

On the other hand, these results are not surprising, given the specific conditions in the Vestlandsbanen corridor:

- Norwegians undertake a high volume of long-distance travel, a market segment in which high-speed rail services are generally more competitive than shorter-distance services, particularly outside the urban cores of major cities.
- Challenging topography and demanding winter driving conditions, which contribute to Norway having by far the highest level of domestic air travel per capita in Europe, also indicate strong demand for fast, reliable rail services.

[72] According to https://www.ssb.no/en/statbank/table/10484, the total passenger transport work on the Norwegian railway network in 2025 was 3.968 billion pkm, on a network extending over 3,962 km. See also https://www.jernbanedirektoratet.no/jernbanen-i-norge/tall-og-fakta-om-jernbanen/ for the network length.
[73] The figures apply to 2024 and are obtained from the IRG (Independent Regulators Group) website, https://irg-rail.eu/download/5/1577/IRG-Rail14thMMReport-WorkingDocument-260902.pdf, page 12.
[74] For France: https://www.statistiques.developpement-durable.gouv.fr/media/8868/download?inline#page=169
For Germany: https://ir.deutschebahn.com/fileadmin/Deutsch/2025/DB_DuF_d_2024.pdf, page 20.
For Spain: https://otle.transportes.gob.es/datos-graficos-mapas/datos-recientes-mensualestrimestrales/movilidad/2038, Gráficos anuales.
[75] In Germany, the length of high-speed railway lines, i.e. railway lines specially built to allow trains to travel at speeds of 250 km/h or more, was just 1,159 km in 2024. However, the length of the network served by high-speed trains was 6,600 km, thereof about 2,800 km for speeds of 200 km/h or more.

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- The relatively short distances between Oslo and the main population centres along Norway's western coast enable rail services to offer journey times that are faster than air travel, while simultaneously serving a dense network of intermediate stations.
- The proposed alignment of Vestlandsbanen and the network concept enable fast and direct journeys between a large number of cities and towns, while also making it possible to consolidate travel demand from different directions. This increases service frequency, improves competitiveness relative to car travel, and provides substantial benefits for connecting conventional railway services.

All these factors contribute to the high demand forecast. In addition, there is strong demand for freight transport, favourable conditions for efficient railway operations, lower land acquisition costs than in more densely populated countries, and generally favourable geological conditions for tunnel construction. Together, these factors support the strong economic performance and expected profitability of the Vestlandsbanen project.

Main figures for the origin of demand

Table 24 below presents the proportions of overall demand expected to arise from modal shifts from air travel, private car use, and public transport, as well as the proportion attributable to induced demand, i.e. journeys that would not occur in the absence of Vestlandsbanen.

Origin of HSR demand	Journeys per day	Average travel distance, km	HSR transport work, million pkm per year	HSR ticket revenues, million NOK per year	HSR ticket revenues, NOK per pkm	Share of total transport work, %	Share of total ticket revenues, %
From air, total	13,696	388.1	1,940.1	4,155.5	2.14	32.1	31.4
From air, OD trips only	10,769	388.4	1,526.7	3,277.0	2.15	25.3	24.7
From air, transfer trips	2,927	386.9	413.3	878.5	2.13	6.8	6.6
From private cars	64,733	88.6	2,094.5	4,652.5	2.22	34.7	35.1
From public transport	9,788	94.7	338.2	805.0	2.38	5.6	6.1
Induced demand	31,155	146.9	1,669.9	3,634.7	2.18	27.6	27.4
Total demand	**119,372**	**138.7**	**6,042.7**	**13,247.7**	**2.19**	**100.0**	**100.0**

Table 24: Key figures for the origin of passenger transport demand in the Vestlandsbanen model network. It should be noted that ticket revenue is not always directly proportional to the distance travelled.[76]

The table indicates that mode shift from air travel and mode shift from private car each account for approximately one-third of total demand within the Vestlandsbanen model network. The remaining demand is attributable to mode shift from existing public transport services and newly generated travel demand.

Together with the demand patterns by transport mode and journey length presented in the following chapters, these results demonstrate that Vestlandsbanen should not be viewed solely as a new mode for long-distance travel, a market currently dominated by air transport. Rather, it is expected to play a significant role across a broad range of travel markets and to have substantial implications for Norway's wider transport system.

[76] Ticket revenue is calculated on the basis of the shortest available route, whereas transport work is calculated using the fastest route or the route most likely to be chosen by passengers. For example, under the current configuration of the Vestfoldbanen, a journey between Drammen and Larvik is faster via Skien, although this route is approximately 40 km longer than the alternative via Tønsberg. Consequently, ticket revenue is allocated to the shorter route via Tønsberg, while transport work is assigned to the route via Skien. This and similar cases explain the seemingly anomalous average ticket revenue per passenger-kilometre.

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9.2 Air-to-rail modal shift

For each section of the Vestlandsbanen model network, Figure 10 presents the estimated daily passenger line load in 2035 attributable to passengers switching from air transport to high-speed rail.

In the central section of the Vestlandsbanen network, between Bø and the triangular junction west of Haukeligrend, the diverted air passenger line load is forecast to reach approximately 11,400 passengers per day, representing almost half (47%) of the total passenger line load (see Figure 9 in the previous chapter). By contrast, the proportion of demand derived from air transport is significantly lower towards the termini of the network.

Conversely, the passenger line load generated by travellers switching from private car to high-speed rail (see Figure 11 in the following chapter) exhibits the opposite pattern. The highest line loads are expected near the network termini, while only relatively modest volumes are forecast on the central section. As a result, demand diverted from air and private car travel is expected to complement each other spatially, thereby contributing to a more balanced utilisation of train capacity across the network.



Figure 10: The estimated passenger line load diverted from air, per day in 2035.
The lines representing the passenger line load are drawn three times thicker than in Figure 9.

Table 25 on the following page provides a detailed breakdown of all eight air routes influenced by Vestlandsbanen. For each route, it presents the forecast daily air passenger demand in 2035 under the reference scenario (i.e. without Vestlandsbanen), as well as the number and percentage of passengers projected to switch from air transport to high-speed rail.

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Air routes and journey types	Air travellers per day 2035, reference	Estimated number of HSR travellers	Decline in the number of air travellers	Air travellers per day 2035, reference	Estimated number of HSR travellers	Decline in the number of air travellers	Air travellers per day 2035, reference	Estimated number of HSR travellers	Decline in the number of air travellers
Bergen/Stord-Oslo	Work journeys			Non-work journeys			All journeys		
Origin-destination only	2,245.1	1,942.7	86.5 %	2,850.9	2,399.2	84.2 %	5,096.0	4,341.9	85.2 %
Transfer journeys	724.9	415.0	57.2 %	921.9	555.4	60.2 %	1,646.8	970.4	58.9 %
All journeys	2,970.0	2,357.7	79.4 %	3,772.8	2,954.6	78.3 %	6,742.8	5,312.2	78.8 %
Stavanger-Oslo	Work journeys			Non-work journeys			All journeys		
Origin-destination only	1,668.4	1,383.1	82.9 %	2,141.9	1,749.8	81.7 %	3,810.4	3,132.9	82.2 %
Transfer journeys	772.2	373.3	48.3 %	991.3	502.2	50.7 %	1,763.4	875.5	49.6 %
All journeys	2,440.6	1,756.5	72.0 %	3,133.2	2,252.0	71.9 %	5,573.8	4,008.4	71.9 %
Bergen-Stavanger	Work journeys			Non-work journeys			All journeys		
Origin-destination only	1,017.0	928.6	91.3 %	309.7	269.6	87.0 %	1,326.7	1,198.2	90.3 %
Transfer journeys	250.9	180.9	72.1 %	77.4	52.4	67.8 %	328.3	233.4	71.1 %
All journeys	1,267.9	1,109.6	87.5 %	387.0	321.9	83.2 %	1,655.0	1,431.6	86.5 %
Haugesund-Oslo	Work journeys			Non-work journeys			All journeys		
Origin-destination only	406.0	364.2	89.7 %	467.0	396.7	84.9 %	873.0	760.9	87.2 %
Transfer journeys	304.2	198.2	65.2 %	348.6	226.9	65.1 %	652.8	425.1	65.1 %
All journeys	710.2	562.4	79.2 %	815.6	623.6	76.5 %	1,525.8	1,186.0	77.7 %
All air routes in core area	Work journeys			Non-work journeys			All journeys		
Origin-destination only	5,336.5	4,618.7	86.5 %	5,769.6	4,815.3	83.5 %	11,106	9,434	84.9 %
Transfer journeys	2,052.2	1,167.4	56.9 %	2,339.1	1,336.8	57.2 %	4,391	2,504	57.0 %
All journeys	7,388.7	5,786.1	78.3 %	8,108.7	6,152.1	75.9 %	15,497	11,938	77.0 %
Kristiansand-Oslo	Work journeys			Non-work journeys			All journeys		
Origin-destination only	483.2	306.1	63.3 %	391.1	216.7	55.4 %	874.2	522.8	59.8 %
Transfer journeys	454.6	166.3	36.6 %	367.9	166.2	45.2 %	822.6	332.5	40.4 %
All journeys	937.8	472.4	50.4 %	759.0	382.9	50.4 %	1,696.8	855.3	50.4 %
Bergen-Sandefjord	Work journeys			Non-work journeys			All journeys		
Origin-destination only	175.4	153.5	87.5 %	261.3	218.5	83.6 %	436.7	372.0	85.2 %
Transfer journeys	31.4	19.3	61.5 %	46.8	30.5	65.0 %	78.2	49.8	63.6 %
All journeys	206.8	172.8	83.5 %	308.1	249.0	80.8 %	514.9	421.8	81.9 %
Bergen-Kristiansand	Work journeys			Non-work journeys			All journeys		
Origin-destination only	172.6	108.5	62.9 %	229.2	149.2	65.1 %	401.8	257.8	64.1 %
Transfer journeys	38.5	11.2	29.1 %	51.2	21.7	42.5 %	89.7	32.9	36.7 %
All journeys	211.2	119.7	56.7 %	280.3	171.0	61.0 %	491.5	290.7	59.1 %
Stavanger-Sandefjord	Work journeys			Non-work journeys			All journeys		
Origin-destination only	110.9	88.8	80.0 %	136.5	93.6	68.6 %	247.5	182.4	73.7 %
Transfer journeys	5.9	3.4	57.8 %	7.3	4.3	59.4 %	13.2	7.8	58.6 %
All journeys	116.9	92.2	78.9 %	143.8	98.0	68.1 %	260.7	190.2	72.9 %
All air routes	Work journeys			Non-work journeys			All journeys		
Origin-destination only	6,278.7	5,275.5	84.0 %	6,787.6	5,493.4	80.9 %	13,066	10,769	82.4 %
Transfer journeys	2,582.7	1,367.7	53.0 %	2,812.4	1,559.5	55.5 %	5,395	2,927	54.3 %
All journeys	**8,861.4**	**6,643.2**	**75.0 %**	**9,600.0**	**7,052.9**	**73.5 %**	**18,461**	**13,696**	**74.2 %**

Table 25: The reference number of air travellers per day in 2035 (without Vestlandsbanen) and the number and percentage of travellers that are expected to shift to high-speed rail.

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The overall reduction in air passenger demand is estimated at almost 13,700 passengers per day, corresponding to an average decrease of 74.2%. This includes a reduction of nearly 5,700 departing passengers per day at Oslo Airport Gardermoen, approximately 3,700 passengers at Bergen Airport Flesland, and a combined reduction of around 3,400 passengers at Stavanger Airport Sola and Haugesund Airport Karmøy.

When compared with the total number of departing air passengers in 2025 across both domestic and international services, approximately 36,000 passengers per day at Gardermoen, 8,700 at Flesland, and 5,500 at Sola and Karmøy[77] the scale of the impact becomes evident. The introduction of Vestlandsbanen could enable airport investments driven solely by capacity constraints to be deferred by many years, and potentially by decades.

As would be expected, the average reduction in air passenger demand increases when only routes within the core Vestlandsbanen corridor are considered, excluding services to and from Sandefjord and Kristiansand. Under this assumption, the average reduction rises to 77.0%.

However, notable differences exist between the four principal air routes. The smallest reduction, 71.9%, is forecast for the Oslo-Stavanger market, whereas 78.8% is forecast for the Bergen/Stord-Oslo market. This difference can be explained in part by journey times, as the high-speed rail travel time between Oslo and Bergen is approximately seven minutes shorter than between Oslo and Stavanger.

The principal factor, however, relates to the respective airport catchment areas. The catchment area of Sola Airport lies predominantly around and south of Stavanger and therefore, from the perspective of travel to and from Oslo, is located close to or beyond Stavanger itself. The main exception is the northern part of Ryfylke, where the proposed high-speed rail stations at Sauda and Røldal would offer the most convenient access.

In contrast, substantial parts of the catchment area served by Flesland Airport are located closer to Oslo than Bergen itself. This includes the regions of Hardanger and Sunnhordland, where several stations are proposed along the Vestlandsbanen corridor. The proposed station at Aksdal is also relevant in this regard. Although located on the Rogaland section of Vestlandsbanen, it is approximately 37 km closer to Oslo than Bergen station and is expected to provide the most convenient rail access for residents of the Stord and Bømlo municipalities.

These differences in catchment area characteristics are particularly evident in the forecasts for transfer passengers and therefore have a corresponding influence on the overall demand forecasts.

At the same time, the analysis highlights the potential benefits of extending the Vestlandsbanen network into the densely populated areas south of Stavanger. A new high-speed alignment connecting Stavanger with Sandnes, for example via Forus (a major employment centre) and continuing further south, would be expected to generate additional demand across the rail network and further strengthen the overall business case for the scheme.

9.3 Car-to-rail modal shift

For each section of the Vestlandsbanen model network, Figure 11 on the following page presents the estimated daily passenger line load in 2035 attributable to travellers switching from private car to high-speed rail.

This diverted car passenger line load represents the aggregate reduction in car travel across several parallel road corridors. For example, on the central section of the Vestlandsbanen network, between Bø and the triangular junction west of Haukeligrend, the line load includes travellers transferring from road corridors extending from the E18/E39 via Kristiansand in the south to the E16 via Filefjell in the north.

Closer to Oslo, however, the diverted car passenger line load largely corresponds to the forecast reduction in traffic on the E18. Alternative routes, such as the Moss–Horten ferry connection, the E134 via the Oslofjord Tunnel, the E16/Rv350 via Jevnaker and Hønefoss, and the more northerly road corridors, are advantageous for only a limited proportion of travellers within the Vestlandsbanen catchment area.

[77] https://www.ssb.no/statbank1/table/08507/. It should be noted that transfer passengers are counted twice.

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Consequently, east of Drammen, a reduction of about 11,000 to 14,000 road travellers per day can be expected on the E18. Depending on the assumptions adopted regarding vehicle occupancy, this equates to approximately 15–20% of current car traffic volumes.[78] Vestlandsbanen is therefore expected to make a significant contribution to reducing road congestion and environmental impacts and may allow future highway investments driven solely by capacity constraints to be deferred or avoided altogether.



Figure 11: The estimated passenger line load diverted from private cars, per day in 2035. The lines representing the passenger line load are drawn in the same scale as in Figure 10, but three times thicker than in Figure 9.

Table 26 on the following page summarises the forecast modal shift from private car to high-speed rail across different journey distance ranges. For each distance band, the table presents the reference demand in 2035 (without Vestlandsbanen), the number and proportion of car travellers expected to transfer to high-speed rail, the resulting transport work undertaken by high-speed rail, the average high-speed rail journey length, and the share of total rail passenger-kilometres attributable to demand diverted from private car travel.

[78] https://trafikkdata.atlas.vegvesen.no/kart. For example, the average number of vehicles at Drengsrud near Liahagen bridge (between Asker and Drammen) was 55,878 in 2025. Almost 50,000 of them were passenger cars. This corresponds to 70–75,000 car travellers when assuming 1.4–1.5 travellers per car.

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Car travel distance ranges and journey types	Car travellers per day 2035, reference	Estimated number of HSR travellers	Decline in the number of car travellers	HSR transport work, million pkm per year	Average travel distance by HSR train	Proportion of HSR transport work from car
Less than 20 km						
Work journeys	116,755.8	3,238.0	2.8%	17.4	14.7	4.2%
Non-work journeys	263,870.6	3,401.8	1.3%	17.8	14.4	1.1%
All journeys	380,626.4	6,639.9	1.7%	35.2	14.5	1.7%
20-40 km						
Work journeys	107,662.0	8,805.1	8.2%	75.1	23.4	18.0%
Non-work journeys	181,939.8	11,230.8	6.2%	96.8	23.6	5.8%
All journeys	289,601.7	20,035.8	6.9%	172.0	23.5	8.2%
40-70 km						
Work journeys	49,759.1	5,144.3	10.3%	79.7	42.4	19.1%
Non-work journeys	59,865.4	6,267.1	10.5%	108.0	47.2	6.4%
All journeys	109,624.5	11,411.4	10.4%	187.7	45.1	9.0%
70-100 km						
Work journeys	10,369.1	1,598.2	15.4%	40.7	69.8	9.7%
Non-work journeys	26,262.7	4,429.9	16.9%	132.5	82.0	7.9%
All journeys	36,631.8	6,028.0	16.5%	173.3	78.7	8.3%
100-150 km						
Work journeys	9,088.3	1,586.7	17.5%	69.3	119.6	16.6%
Non-work journeys	35,963.5	6,898.3	19.2%	315.2	125.2	18.8%
All journeys	45,051.8	8,485.0	18.8%	384.5	124.1	18.4%
150-200 km						
Work journeys	4,924.3	784.6	15.9%	47.0	164.2	11.2%
Non-work journeys	29,217.2	4,467.1	15.3%	275.9	169.2	16.5%
All journeys	34,141.5	5,251.7	15.4%	322.9	168.5	15.4%
200-250 km						
Work journeys	861.8	145.5	16.9%	9.9	186.3	2.4%
Non-work journeys	8,382.0	1,203.1	14.4%	93.5	212.8	5.6%
All journeys	9,243.8	1,348.6	14.6%	103.4	210.0	4.9%
250-320 km						
Work journeys	528.8	127.1	24.0%	12.6	270.6	3.0%
Non-work journeys	5,942.2	918.5	15.5%	90.8	270.9	5.4%
All journeys	6,471.0	1,045.6	16.2%	103.4	270.8	4.9%
320-400 km						
Work journeys	478.4	174.2	36.4%	21.0	330.5	5.0%
Non-work journeys	5,338.1	1,161.8	21.8%	140.1	330.5	8.4%
All journeys	5,816.4	1,335.9	23.0%	161.1	330.5	7.7%
400-500 km						
Work journeys	537.1	260.2	48.4%	36.7	386.5	8.8%
Non-work journeys	6,446.1	2,307.2	35.8%	328.4	389.9	19.6%
All journeys	6,983.2	2,567.4	36.8%	365.1	389.6	17.4%
More than 500 km						
Work journeys	137.9	57.9	42.0%	8.6	408.3	2.1%
Non-work journeys	1,643.5	525.6	32.0%	77.4	403.4	4.6%
All journeys	1,781.4	583.5	32.8%	86.0	403.9	4.1%
All travel distances						
Work journeys	301,102.6	21,921.8	7.3%	418.0	52.2	100.0%
Non-work journeys	624,870.9	42,811.1	6.9%	1,676.5	107.3	100.0%
All journeys	**925,973.5**	**64,733.0**	**7.0%**	**2,094.5**	**88.6**	**100.0%**

Table 26: The reference number of car travellers per day in 2035, the number and percentage of travellers expected to shift to HSR, the average travel distance by HSR and the proportion of the total transport work by HSR diverted from private cars.

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Two points should be noted when interpreting the results presented in Table 26. Firstly, Table 26 does not represent all car journeys within the Vestlandsbanen area of influence. The figures relate exclusively to journeys between pairs of the 1,075 NTM6 zones located within the study area, where each zone is associated with a different railway station catchment area. In addition, a number of journeys assessed as having limited relevance to the objectives of the analysis were excluded during the early stages of model development (see Chapter 7.2.3).

As a consequence, significant components of overall car travel are not represented in the table. This includes, for example, journeys between two zones served by the same railway station, as well as journeys undertaken entirely within a single NTM6 zone.

Secondly, the distribution of car journeys across the various distance bands is strongly influenced by the spatial configuration of the NTM6 zoning system. As discussed in Chapter 7.2.3, some parts of the study area contain a relatively large number of closely spaced zones, whereas other areas contain comparatively few zones, even where population densities are broadly similar. As a result, the distribution of demand between distance bands may, in some instances, appear counterintuitive.

Nevertheless, Table 26 clearly demonstrates that the proposed Vestlandsbanen services are expected to attract a substantial number of travellers from private car across almost all of the journey distance ranges considered.

9.4 Public-transport-to-rail modal shift

For each section of the Vestlandsbanen network, Figure 12 below presents the estimated daily passenger line load in 2035 attributable to travellers transferring from existing public transport services to high-speed rail.

Unfortunately, it is not possible to determine whether these modal shifts originate from bus services or conventional rail services, as the input data used in the modelling does not distinguish between individual public transport modes (see Chapter 4.1).

However, it is possible to identify at least one significant component of this modal shift. The diverted demand between Bergen, Arna and Tysse in the west and stations within the Oslo metropolitan area in the east, including southern Buskerud and northern Vestfold, is estimated at approximately 750 passengers per day in 2035. Given the limited provision of long-distance coach services on this corridor, approximately 700 of these passengers are likely to be diverted from long-distance services on the Bergensbanen.

Whilst this represents less than 2% of total demand on Vestlandsbanen, the impact on Bergensbanen would be more noticeable. At the same time, Vestlandsbanen is expected to generate additional demand on sections of Bergensbanen by enabling competitive rail journey times for movements such as Geilo–Arna–Stavanger and Gol–Drammen–Skien.

These positive effects cannot be quantified within the scope of the present study, owing to insufficient data to distinguish between private car, bus and conventional rail modes for access and egress trips associated with stations such as Arna and Drammen.

Nevertheless, it appears unlikely that the combined effect of demand abstraction and induced demand would result in an overall reduction in Bergensbanen patronage exceeding 25%. This is particularly the case given that regional travel accounts for a substantial proportion of total passenger demand on Bergensbanen.[79]

Such a reduction would be unlikely to necessitate any significant reduction in service provision. Trains operating on Bergensbanen and Flåmsbanen currently record the highest passenger loads per train on the Norwegian rail

[79] According to https://www.ssb.no/statbank/table/10484, the transport work on Bergensbanen in 2025 was 376.3 million pkm (local services Bergen–Voss–Myrdal not included). Based on a line length of 483 km, this corresponds to an average line load of 2,135 passengers per day. Assuming a 15% growth from 2025 to 2035, this results in an average line load of 2,450 passengers per day in 2035 and a proportion of 28.6% for the diverted 700 passengers per day. If the positive effects of Vestlandsbanen on Bergensbanen are estimated to an increase in demand of at least 3.6%, the overall loss will be less than 25%.

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network.[80] Even with a reduction of 25% in passenger demand, average train occupancy would remain approximately 50% higher than the current national rail average.

For other public-transport modal shifts, the underlying source is considerably more difficult to identify. However, it is likely that a substantial proportion of the relatively high diverted demand forecast in the Oslo area originates from bus services. One contributing factor is the proposed station at Nesbru, which is located in a densely populated part of Asker municipality where access to existing railway stations is relatively poor, and rail services are currently limited to stopping trains serving all intermediate stations. As a result, high-speed rail services from Nesbru are expected to offer a significantly more attractive alternative to existing public transport options.



Figure 12: The estimated passenger line load diverted from public transport, per day in 2035. The lines representing the passenger line load are drawn in the same scale as in Figures 10 and 11, but three times thicker than in Figure 9.

Table 27 on the following page summarises the forecast modal shift from public transport to high-speed rail across different journey distance bands. As data on journey distances by individual public transport modes is not available (see Chapter 4.1), the distance bands are based on road travel distances.

[80] According to https://www.ssb.no/statbank/table/10484, the average number of passengers per train on Bergensbanen was 188.5 in 2025, down from 235 passengers in 2019. The average number for the entire Norwegian rail network was 94.4 passengers per train in 2025.

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Travel distance ranges by car and journey types	PT-travellers per day 2035, reference	Estimated number of HSR travellers	Decline in the number of PT travellers, %	HSR transport work, million pkm per year	Average travel distance by HSR train	Proportion of HSR transport work from PT
Less than 20 km						
Work journeys	35,521.8	819.6	2.3%	4.7	15.6	4.0%
Non-work journeys	20,765.7	407.6	2.0%	2.1	14.3	1.0%
All journeys	56,287.5	1,227.2	2.2%	6.8	15.2	2.0%
20-40 km						
Work journeys	37,031.4	2,028.2	5.5%	14.7	19.9	12.5%
Non-work journeys	13,281.1	794.4	6.0%	5.7	19.5	2.6%
All journeys	50,312.5	2,822.6	5.6%	20.4	19.8	6.0%
40-70 km						
Work journeys	21,929.2	1,529.1	7.0%	23.0	41.1	19.4%
Non-work journeys	4,799.5	650.0	13.5%	12.2	51.6	5.6%
All journeys	26,728.7	2,179.0	8.2%	35.2	44.2	10.4%
70-100 km						
Work journeys	3,848.9	485.2	12.6%	12.6	71.1	10.7%
Non-work journeys	2,650.1	480.0	18.1%	14.7	84.1	6.7%
All journeys	6,499.0	965.2	14.9%	27.3	77.6	8.1%
100-150 km						
Work journeys	2,580.7	410.5	15.9%	18.1	120.9	15.3%
Non-work journeys	2,664.4	590.6	22.2%	26.2	121.3	11.9%
All journeys	5,245.1	1,001.1	19.1%	44.3	121.2	13.1%
150-200 km						
Work journeys	499.0	71.6	14.4%	4.1	155.0	3.4%
Non-work journeys	1,034.6	149.9	14.5%	9.6	174.8	4.3%
All journeys	1,533.6	221.5	14.4%	13.6	168.4	4.0%
200-250 km						
Work journeys	217.2	14.3	6.6%	1.3	256.3	1.1%
Non-work journeys	1,179.8	68.2	5.8%	7.8	311.3	3.5%
All journeys	1,397.0	82.5	5.9%	9.1	301.7	2.7%
250-320 km						
Work journeys	131.0	29.8	22.7%	3.3	301.5	2.8%
Non-work journeys	939.4	68.4	7.3%	7.6	303.3	3.4%
All journeys	1,070.4	98.2	9.2%	10.8	302.8	3.2%
320-400 km						
Work journeys	190.6	78.3	41.1%	10.1	352.2	8.5%
Non-work journeys	699.7	178.2	25.5%	23.0	354.0	10.5%
All journeys	890.3	256.6	28.8%	33.1	353.5	9.8%
400-500 km						
Work journeys	240.7	163.8	68.1%	24.1	403.3	20.4%
Non-work journeys	1,155.0	687.7	59.5%	101.1	402.6	45.9%
All journeys	1,395.7	851.5	61.0%	125.2	402.7	37.0%
More than 500 km						
Work journeys	22.6	14.5	64.1%	2.2	419.2	1.9%
Non-work journeys	123.4	68.0	55.1%	10.2	411.3	4.6%
All journeys	146.0	82.5	56.5%	12.4	412.7	3.7%
All travel distances						
Work journeys	102,213.1	5,644.8	5.5%	118.1	57.3	100.0%
Non-work journeys	49,292.6	4,142.9	8.4%	220.1	145.5	100.0%
All journeys	**151,505.7**	**9,787.8**	**6.5%**	**338.2**	**94.7**	**100.0%**

Table 27: The reference number of public transport travellers per day in 2035, the number and percentage of travellers expected to shift to HSR, the average travel distance by HSR and the proportion of the total transport work by HSR diverted from public transport.

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The table presents the forecast public transport demand in 2035 under the reference scenario (without Vestlandsbanen), together with the number and proportion of passengers expected to shift to high-speed rail, the associated transport work, the average high-speed rail travel length, and the contribution of each distance band to total passenger-km generated by demand diverted from public transport. The observations and caveats relating to journey distance distributions presented in the previous chapter for Table 26 are equally applicable to Table 27.

Similar to Table 26, Table 27 demonstrates that Vestlandsbanen is expected to attract a significant number of travellers from existing public transport services across many journey distance bands. Nevertheless, demand abstraction from public transport is forecast to be relatively modest for journeys longer than approximately 150 km. The principal exception is the 400–500 km distance band, which contributes around 37% of the total passenger-kilometres diverted from public transport. This demand, corresponding to approximately 850 passengers per day, is derived predominantly from the Bergensbanen corridor.

9.5 Induced demand effects

For each section of the Vestlandsbanen model network, Figure 13 below presents the estimated daily passenger line load in 2035 attributable to induced demand. Compared with the total demand and corresponding passenger line load shown in Figure 9 (Chapter 9.1), the spatial distribution of induced demand follows a broadly similar pattern, with the exception of parts of eastern Norway.



Figure 13: The estimated passenger line load generated as induced demand, per day in 2035. The lines representing the passenger line load are drawn in the same scale as in Figures 10, 11 and 12, but three times thicker than in Figure 9.

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Travel distance ranges by car, journey types	Estimated number of new HSR travellers	HSR transport work, million pkm per year	Average travel distance by HSR train	Proportion of induced HSR transport work
Less than 20 km				
Work journeys	1,260.2	6.9	15.0	1.2 %
Non-work journeys	1,170.2	6.2	14.5	0.6 %
All journeys	2,430.3	13.1	14.8	0.8 %
20-40 km				
Work journeys	3,486.6	29.1	22.9	5.3 %
Non-work journeys	3,870.3	33.2	23.5	3.0 %
All journeys	7,356.9	62.3	23.2	3.7 %
40-70 km				
Work journeys	2,212.5	34.2	42.4	6.2 %
Non-work journeys	2,355.9	41.2	47.9	3.7 %
All journeys	4,568.4	75.4	45.2	4.5 %
70-100 km				
Work journeys	747.4	19.2	70.5	3.5 %
Non-work journeys	1,779.2	53.2	81.9	4.8 %
All journeys	2,526.7	72.4	78.5	4.3 %
100-150 km				
Work journeys	747.8	32.6	119.4	5.9 %
Non-work journeys	2,814.5	128.1	124.7	11.5 %
All journeys	3,562.3	160.7	123.6	9.6 %
150-200 km				
Work journeys	650.6	52.4	220.6	9.5 %
Non-work journeys	1,790.2	111.5	170.6	10.0 %
All journeys	2,440.9	163.9	183.9	9.8 %
200-250 km				
Work journeys	225.4	20.7	251.9	3.7 %
Non-work journeys	540.5	43.9	222.7	3.9 %
All journeys	765.9	64.7	231.3	3.9 %
250-320 km				
Work journeys	127.6	12.9	277.6	2.3 %
Non-work journeys	367.1	36.3	270.9	3.3 %
All journeys	494.8	49.2	272.6	2.9 %
320-400 km				
Work journeys	269.8	33.7	341.9	6.1 %
Non-work journeys	681.6	84.7	340.6	7.6 %
All journeys	951.4	118.4	341.0	7.1 %
400-500 km				
Work journeys	1,569.1	229.5	400.7	41.4 %
Non-work journeys	3,158.7	460.0	398.9	41.2 %
All journeys	4,727.8	689.5	399.5	41.3 %
More than 500 km				
Work journeys	542.9	83.1	419.1	15.0 %
Non-work journeys	786.7	117.4	408.8	10.5 %
All journeys	1,329.5	200.4	413.0	12.0 %
All travel distances				
Work journeys	11,839.8	554.4	128.3	100.0 %
Non-work journeys	19,314.9	1,115.6	158.2	100.0 %
All journeys	**31,154.7**	**1,669.9**	**146.9**	**100.0 %**

Table 28: The estimated number of new high-speed rail travellers, the average travel distance by HSR and the proportion of the total induced transport work.

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This difference arises because the transport model generates only limited levels of induced demand where improvements in accessibility are relatively modest. Such conditions are typically found in areas where public transport already commands a substantial market share, notably within the Oslo metropolitan area (see Chapter 8.2.6).

Consequently, as shown in Table 28 on the previous page, both the volume of induced demand associated with shorter journeys and the contribution of these journeys to total induced demand are relatively low. This reflects the fact that the greatest increases in accessibility, and therefore the strongest induced demand effects, occur on longer-distance travel markets where Vestlandsbanen delivers the most significant reductions in journey time.

Furthermore, Table 28 shows that more than half of the induced demand, measured in passenger-kilometres, is generated by journeys exceeding 400 km in length.[81] These journeys are primarily associated with travel between the greater Oslo, Bergen and Stavanger regions, where a fast and convenient rail alternative to air travel is expected not only to attract substantial mode shift but also to generate significant levels of new travel demand.

At the same time, Figure 13 demonstrates that the spatial distribution of induced demand exhibits characteristics similar to those of demand diverted from air transport. As a result, it complements the high levels of demand diverted from private car in the most densely populated areas, thereby contributing to a more balanced utilisation of train capacity across the network.

9.6 Regional demand patterns

Figure 14 on the following page illustrates demand between twelve station groups defined by Sener to facilitate the analysis of regional demand patterns.

For example, the stations at Bø, Nordagutu and Notodden are included in the seventh group from the top (or from the left) of the diagram and are represented by a turquoise line. At each intersection with a line of another colour, a circle indicates the estimated number of passengers per day in 2035 (upper value) and the corresponding annual transport work in million passenger-kilometres (lower value) between the two station groups. For instance, demand between the station group comprising Bø, Nordagutu and Notodden and that comprising Larvik, Porsgrunn and Skien is estimated at 1,541 passengers per day, generating 29.2 million passenger-kilometres per year. The area of each circle is proportional to the transport work.

Internal demand, defined as journeys between stations within the same group, is shown on the left-hand side of the diagram under the heading “Internal”. No value is shown for Stavanger, as Stavanger is the sole station included in the first station group.

The largest circle in the diagram represents travel between Bergen and Arna on the one hand and Nesbru, Majorstua and Oslo S on the other. This flow is forecast to generate 8,799 high-speed rail passengers per day, corresponding to 1,309.4 million passenger-kilometres per year, or 21.7% of the total transport work estimated for the Vestlandsbanen model network.

The second-largest flow represents travel between Stavanger and Nesbru, Majorstua and Oslo S. This market is estimated to generate 6,331 passengers per day and 991.7 million passenger-kilometres per year, equivalent to 16.4% of total transport work.

When all journeys between and within these three station groups are combined, total demand amounts to 28,956 high-speed rail passengers per day and 2,630.8 million passenger-kilometres per year, representing 43.5% of the total transport work estimated for the Vestlandsbanen model network. These results demonstrate that, whilst demand between Norway's three largest urban areas[82] constitutes a key component of the Vestlandsbanen market, the combined contribution of the numerous lower-volume travel markets is even greater. Taken together, these other connections account for 56.5% of total transport work, underscoring the importance of the wider regional market served by the network.

[81] 689.5 + 200.4 million pkm per year out of 1,669.9 million pkm.
[82] https://www.ssb.no/befolkning/folketall/artikler/de-storste-byene-og-tettstedene-i-norge

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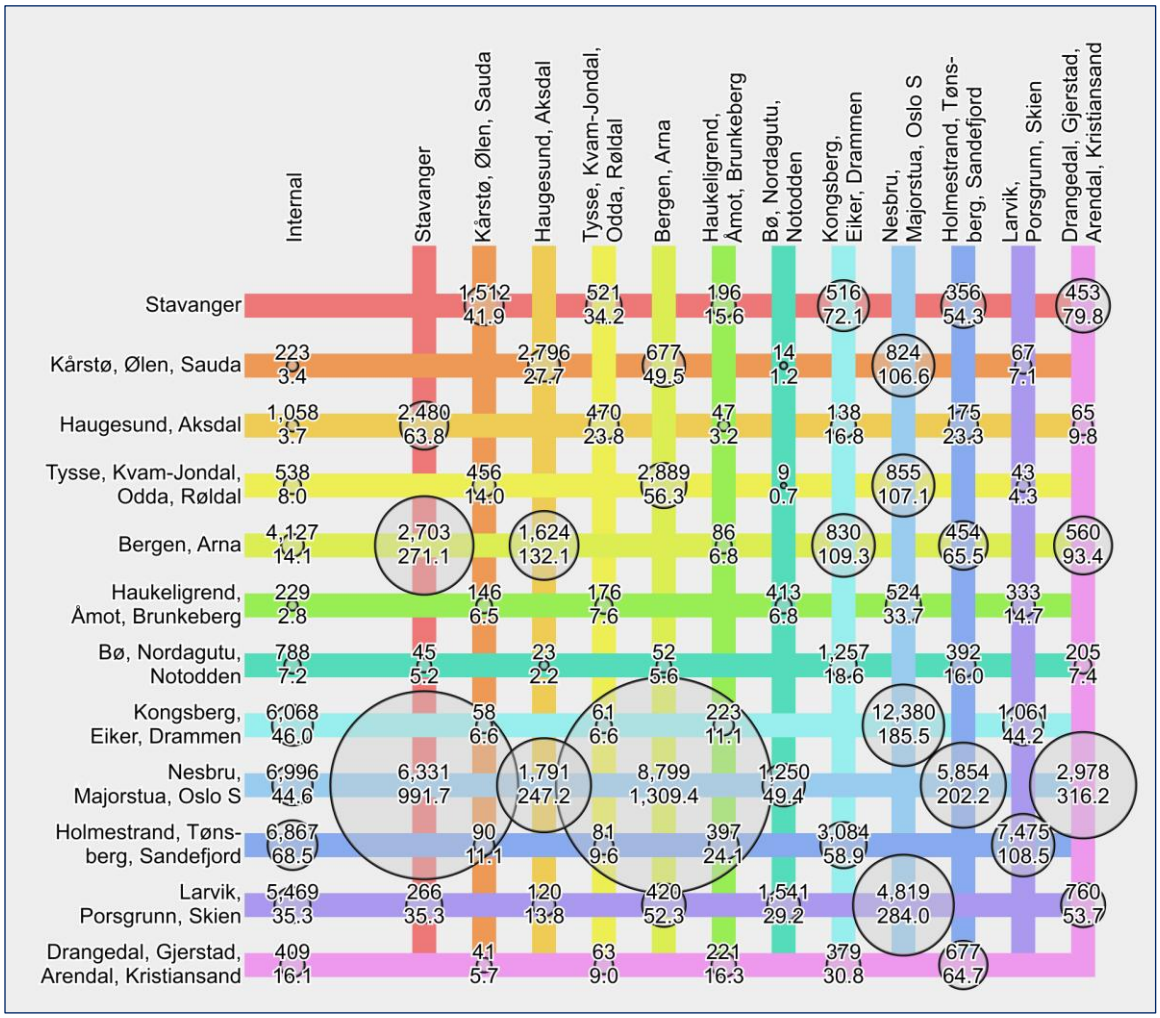

Figure 14: Circles displaying the estimated number of passengers per day (upper value) and the corresponding transport work (lower value) in 2035 for all possible pairs of twelve groups of stations.

Content of Appendix 4

Appendix 4 provides a more detailed breakdown of regional demand patterns. For each station-to-station movement, the number of high-speed rail passengers is presented together with the origin of demand, distinguishing between passengers diverted from air transport, private car, existing public transport services, and induced demand.

In several cases, significant differences can be observed between the two travel directions. This is particularly evident for journeys to and from Bergen. The Level of Service (LoS) data (see Chapter 4.3) reflects the impact of Bergen's one-way street system on road travel times, as well as the urban tolling scheme, under which charges apply when travelling into the city but not when travelling in the opposite direction. These factors result in directional differences in travel times and costs, which in turn lead to different utility values and demand forecasts for each travel direction.

9.7 Optimisation of Vestlandsbanen transportation system

The results presented in the previous chapters depend, among other factors, on the service frequencies assumed for the various train routes within the Vestlandsbanen network. These frequencies were discussed in Chapter 7.2.4, taking into account the minimum service levels required to ensure competitiveness and preliminary estimates of potential demand. However, they remain planning assumptions rather than the outcome of a detailed iterative planning and optimisation process.

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The same applies to the number of stations, fare levels and the stopping patterns of the various train services. The following chapters therefore assess whether the proposed train operating plan is appropriately aligned with forecast demand and whether any modifications to the operating plan or other elements of the Vestlandsbanen transport system are warranted.

9.7.1 Train capacity utilisation

The assessment of the train capacity utilisation on different sections of the Vestlandsbanen network during both peak and off-peak periods is based on the assumptions described in Chapter 8.6.

Where capacity utilisation is very high, passengers may be unable to secure a seat on their preferred departure, thereby reducing the attractiveness and convenience of high-speed rail services. Conversely, low capacity utilisation results in an inefficient use of rolling stock and infrastructure. An appropriate balance must therefore be achieved between passenger convenience and operational efficiency. For this reason, average capacity utilisation rates in the range of approximately 60% to 80% are generally considered desirable.

Determining an appropriate train operation program

To determine an appropriate train operating plan, Sener compared the service frequencies set out in Chapter 7.2.4 (reproduced below) with the estimated passenger line loads for 2035, as presented in Figure 9 in Chapter 9.1. This comparison demonstrates that the assumed service frequencies are not excessive.

In fact, the opposite is true. On several sections of Vestlandsbanen, particularly between Bø and Oslo, peak-hour demand would exceed the available train capacity if each service were operated by a single train unit providing 200 seats. This becomes evident from the train capacity utilisation figures presented in Table 30 on the following page. Consequently, at least one of the principal train services must be operated as a double-set during peak periods, providing a total capacity of 400 seats per train.

Several options are available for providing the required capacity. However, the most efficient solution appears to be operating the Bergen–Oslo and Stavanger–Oslo services as double-sets during peak periods, as shown in Table 29 below. Otherwise, capacity utilisation on substantial sections of Vestlandsbanen in Rogaland and Vestland counties would exceed 84% during peak hours.[83]

Train route	Number of services in each direction
Bergen-Oslo	2 trains an hour, 2 units (peak) and 1 unit (off-peak)
Stavanger-Oslo (shortest route)	1 train an hour, 2 units (peak) and 1 unit (off-peak)
Stavanger-Oslo via Haugesund	1 train an hour, 2 units (peak) and 1 unit (off-peak)
Bergen-Stavanger (shortest route)	1 train an hour, 1 unit (both peak and off-peak)
Bergen-Stavanger via Haugesund	1 train an hour, 1 unit (both peak and off-peak)
Bergen-Skien-Tønsberg-Oslo	1 train every second hour, 1 unit (both peak and off-peak)
Stavanger-Haugesund-Skien-Tønsberg-Oslo	1 train every second hour, 1 unit (both peak and off-peak)
Oslo-Kongsberg-Skien-Tønsberg-Oslo	2 trains an hour, 1 unit (both peak and off-peak)
Bø-Arendal/Kristiansand	1 train an hour, 2 units (peak) and 1 unit (off-peak)

Table 29: Proposed direct train routes and operating plan for the Vestlandsbanen model network.

However, there are still several aspects of the proposed train operating plan that warrant further consideration. These can be identified from Table 30, which presents the train capacity utilisation rates during peak and off-peak periods (highlighted in the table using a darker shade of grey) for selected sections of the Vestlandsbanen model

[83] On major parts of Vestlandsbanen in Rogaland and Vestland counties, the estimated line load is about 18,200 passengers per day. In peak hours, this would correspond to 758 passengers per hour and direction, or 84.2%, if the available train capacity would be limited to 900 seats.

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Vestlandsbanen section	Total demand per day, both directions	Demand per peak hour and direction	Demand per off-peak hour and direction	Total capacity per peak hour and direction	Total capacity per off-peak hour and direction	Utilisation rate, peak hours, per cent	Utilisation rate, off-peak hours, per cent	Bergen-Oslo, peak	Bergen-Oslo, off-peak	Bergen-Stavg., peak	Bergen-Stavg., off-peak	Bergen-Skien, peak	Bergen-Skien, off-peak	Stavanger-Oslo, peak	Stavanger-Oslo, off-peak	Stavang.-Skien, peak	Stavang.-Skien, off-peak	"Ring-service", peak	"Ring-service", off-peak
Vestland section max	20,049	835.4	501.2	1,300	900	64.3	55.7	800	400	400	400	100	100						
Vestland section min	18,188	757.8	454.7	1,300	900	58.3	50.5	800	400	400	400	100	100						
Røldal-Sauda connec.	6,451	268.8	161.3	400	400	67.2	40.3			400	400								
Rogaland section max	18,592	774.6	464.8	1,300	900	59.6	51.6			400	400			800	400	100	100		
Rogaland section min	15,379	640.8	384.5	1,300	900	49.3	42.7			400	400			800	400	100	100		
Aksdal-Ølen connect.	5,302	220.9	132.5	600	400	36.8	33.1			200	200			400	200				
Aksdal-Kårstø conn.	4,427	184.5	110.7	600	400	30.7	27.7			200	200			400	200				
Kårstø-Ølen connect.	13,290	553.7	332.2	600	400	92.3	83.1			200	200			400	200				
Telemark sect. max	31,159	1298.3	779.0	1,800	1,000	72.1	77.9	800	400			100	100	800	400	100	100		
Telemark sect. min	24,251	1010.4	606.3	1,800	1,000	56.1	60.6	800	400			100	100	800	400	100	100		
Bø-Nordagutu conn.	4,703	195.9	117.6	200	200	98.0	58.8					100	100			100	100		
Bø-Notodden connec.	26,457	1102.4	661.4	1,600	800	68.9	82.7	800	400					800	400				
Notod.-N.gutu conn.	6,448	268.6	161.2	400	400	67.2	40.3											400	400
Buskerud section max	41,025	1709.4	1025.6	2,000	1,200	85.5	85.5	800	400					800	400			400	400
Buskerud section min	32,904	1371.0	822.6	2,000	1,200	68.6	68.6	800	400					800	400			400	400
Vestfoldbanen max	13,259	552.5	331.5	600	600	92.1	55.2					100	100			100	100	400	400
Vestfoldbanen min	8,923	371.8	223.1	600	600	62.0	37.2					100	100			100	100	400	400
Drammen-Oslo max	46,405	1933.6	1160.1	2,600	1,800	74.4	64.5	800	400			100	100	800	400	100	100	800	800
Drammen-Oslo min	45,701	1904.2	1142.5	2,600	1,800	73.2	63.5	800	400			100	100	800	400	100	100	800	800
Sørlandsbanen max	6,402	266.8	160.1	400	200	66.7	80.0												
Sørlandsbanen min	3,601	150.0	90.0	400	200	37.5	45.0												

Table 30: High-speed rail demand per day in 2035, proposed train capacity and resulting train capacity utilisation on various sections of the Vestlandsbanen model network.

network.[84] The utilisation rates are derived from the proposed operating plan, as defined by the seating capacity allocated to each train service (shown on the right-hand side of the table) and the resulting total train capacity available on each section (shown to the left of the utilisation rates).

- The calculated capacity utilisation rates on the Aksdal–Ølen and Aksdal–Kårstø connections are relatively low, ranging from approximately 28% to 37%. However, in Table 30 and Figures 9 to 13, all Vestlandsbanen passengers travelling between Stavanger or Kårstø and destinations beyond Aksdal and Haugesund (i.e. Ølen, Sauda, and stations further north or east) are assigned exclusively to the Kårstø-Ølen connection.

  In practice, however, many of these passengers would also be expected to use services via Haugesund. Although these trains involve an additional journey time of 16 to 20 minutes (see Chapter 7.2.4), passengers may often reach their final destination more quickly than if they were required to wait for the next direct service.

[84] In the table, “Vestland section” stands for the sections between Bergen and the junction south of Røldal, “Rogaland section” for the section between Stavanger and the junction east of Sauda, “Telemark section” for the section between the junction west of Haukeligrend and the junction east of Bø, and “Buskerud section” stands for the section between the junction south of Notodden and Drammen.

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Consequently, the actual utilisation rates on the Aksdal–Ølen and Aksdal–Kårstø connections (and on the sections immediately east and west of Aksdal shown in Figures 9 to 13) are likely to be higher than those indicated in Table 30, while utilisation on the Kårstø–Ølen connection is likely to be correspondingly lower. This would be beneficial, given that the utilisation rates currently estimated for the Kårstø–Ølen connection range from 83% to 92%.

- The train capacity utilisation rate on the Bø–Nordagutu connection is estimated to reach 98% during peak periods. This suggests that additional capacity should be provided during peak hours, although not necessarily by doubling the capacity of all services. For example, it would be sufficient to add one additional train unit to one morning service and one afternoon service. This would reduce the average peak-period utilisation rate from 98% to 73%. At the same time, the utilisation rate on the Skien–Porsgrunn section would decrease from 92% to 83%.

  Such additional train units could easily be reallocated from the Bergen–Oslo and Stavanger–Oslo services, which operate with significantly greater capacity than the services via Skien. Furthermore, the forecast capacity utilisation on the Bergen–Oslo and Stavanger–Oslo services during peak periods remains well below the recommended maximum level.

  It should also be noted that all calculations presented above are based on simplified assumptions regarding the temporal distribution of demand by time of day, day of week and season. A robust assessment of demand patterns at this level of detail would require a substantially different analytical approach and lies beyond the scope of the present study. Consequently, the full extent of the potential for service optimisation cannot yet be assessed.

  For example, it is reasonable to assume that services departing from Stavanger and Bergen at 5:00 a.m. would initially operate with below-average passenger loads. This could be advantageous when these trains reach the central parts of eastern Norway at around 6:30 a.m., a time when demand for train capacity is likely to be significantly higher. Such operational efficiencies cannot, however, be captured within the scope of the current analysis.

- The forecast increase in demand on Vestfoldbanen is expected to arise almost entirely (see Chapter 9.4) in addition to existing demand and train services. This raises important questions regarding the extent to which existing passengers on Vestfoldbanen may transfer to services operating on the Vestlandsbanen network, how the different services should be coordinated, and what implications this may have for capacity utilisation.

  These questions cannot be answered at this stage, not least because of the lack of detailed data on existing rail demand. As discussed in Chapters 4.1 and 7.2.1, the available public transport datasets do not distinguish between journeys made by bus and those made using existing rail services.

Summary

The analyses presented above support the following conclusions:

- The proposed service frequencies on the various train routes can be considered proportionate to the estimated traffic volumes.

- The proposed train operating plan, as set out in Table 29, is well suited to accommodating the forecast demand. Nevertheless, there remains scope for further optimisation, particularly with regard to the allocation of rolling stock and the temporal distribution of services. The extent of this optimisation potential cannot be fully assessed within the scope of the present study.

- It is noteworthy that the forecast demand across the entire Vestlandsbanen network can be accommodated using long-distance train services alone. While the “Ring Service” (Oslo–Kongsberg–Skien–Tønsberg–Oslo) increases both service frequency and available seating capacity in the central parts of eastern Norway, it does not exhibit the progressive decline in passenger volumes typically observed on regional rail services with increasing distance from the capital (see Figure 3 in Chapter 5.3). This has a significant positive impact on the operating economics of the proposed rail network.

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9.7.2 Train station usage

Compared with many high-speed rail networks in Europe, Vestlandsbanen is planned to include a relatively large number of stations. There are several reasons for this, including:

- On most sections of Vestlandsbanen, there is no parallel conventional railway capable of providing competitive passenger services.
- All stations, equipped with four-track layouts, play an important operational role by enabling faster passenger services to overtake freight trains.
- The stations provide valuable operational flexibility and serve as strategic assets for emergency response and network resilience. Their staff, facilities and equipment constitute important resources from both preparedness and security perspectives.

Nevertheless, the question arises as to whether a reduction in the number of stations would be beneficial, for example by enabling shorter journey times for a large proportion of passengers. To address this question, Sener has analysed a series of key performance indicators for each of the 34 stations included in the Vestlandsbanen model network (see Chapter 7.2.1 and Table 11). The results of this analysis are presented in Table 31 below.

Station	Passengers per day	Average travel distance, km	Annual transport work, million pkm	Annual ticket revenues, million NOK
Bergen	10,025	248.1	907.7	1,920.2
Arna	3,649	136.7	182.1	390.0
Tysse	732	73.9	19.7	48.0
Kvam-Jondal	855	142.9	44.6	94.9
Odda	1,115	141.5	57.6	123.5
Røldal	648	95.8	22.6	54.9
Sauda	504	140.7	25.9	56.5
Ølen	1,142	115.3	48.1	107.3
Aksdal	2,436	128.4	114.2	244.0
Haugesund	3,487	134.7	171.4	377.6
Kårstø	1,918	97.8	68.4	156.1
Stavanger	7,689	296.6	832.5	1,729.4
Haukeligrend	222	160.3	13.0	26.5
Åmot	619	137.6	31.1	65.2
Brunkeberg	769	113.9	32.0	68.0
Bø	1,515	68.0	37.6	95.2
Nordagutu	352	44.9	5.8	16.1
Skien	3,522	59.6	76.6	199.4
Notodden	1,522	63.0	35.0	88.4
Kongsberg	3,367	61.6	75.6	184.5
Eiker	4,233	51.9	80.2	211.2
Drammen	8,461	55.2	170.4	449.6
Nesbru	7,348	71.5	191.7	463.5
Majorstua[85]	5,683	153.7	318.9	714.7
Oslo S	17,168	231.5	1,450.5	3,000.4
Holmestrand	3,681	67.2	90.2	234.5
Tønsberg	6,560	70.1	167.9	417.5
Sandefjord	6,143	57.7	129.5	340.0
Larvik	5,263	72.0	138.3	315.2
Porsgrunn	5,136	76.8	144.0	346.1
Drangedal	355	112.2	14.6	33.1
Gjerstad	683	175.3	43.7	88.2
Arendal	771	278.7	78.5	154.3
Kristiansand	1,800	338.9	222.7	433.8
All stations	**119,372**	**138.7**	**6,042.7**	**13,247.7**

Table 31: Key demand figures for the 34 stations implemented in the Vestlandsbanen model network.

Table 31 presents the following information for each station:

[85] It should be noted that high-speed rail demand between Majorstua and Oslo S is not included in the present demand calculation, since the travel distance of 3.52 km is considered as too short for applying the forecast model.

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- The number of passengers per day, expressed as the average of boarding and alighting passengers, as these values are not necessarily identical.
- The average rail journey distance associated with passengers boarding or alighting at each station.
- The annual passenger transport work generated by high-speed rail services, allocated equally between boarding and alighting passenger movements.
- The annual ticket revenue generated for train operators, allocated equally between boarding and alighting passenger movements.

These indicators demonstrate substantial levels of rail demand at all stations, with the exception of Haukeligrend and Nordagutu. However, as explained in Chapter 7.2.3, the geographical resolution of the zoning system used as input to the transport model is insufficient in certain areas. In the cases of Haukeligrend and Nordagutu, the nearest NTM6 zone centroids are located at a considerable distance from the stations, resulting in a significant underestimation of passenger demand to and from these locations.

For all other stations along Vestlandsbanen, the forecasts indicate annual transport work of approximately 20 million passenger-km or more and annual ticket revenues of at least NOK 48 million. These values are sufficiently high to support a strong business case for serving all stations included in the proposed operating plan. Consequently, there appears to be limited justification for removing any of these stations.

However, station usage is only one of several factors that should be taken into account. Another important consideration is the effect of journey time changes on passenger demand, for example those resulting from a reduction in the number of intermediate stops. This issue is examined in the following chapter.

9.7.3 Effects of changes in high-speed rail travel times

Tables 32 and 33 below present the relationship between relatively small changes in in-vehicle high-speed rail travel times and the corresponding changes in passenger demand.

Air routes and journey types	HSR time elasticities work journeys	HSR time elasticities non-work journeys	HSR time elasticities all journeys
Bergen/Stord-Oslo			
Origin-destination only	-0.160	-0.107	-0.131
Transfer journeys	-0.767	-0.534	-0.634
All journeys	-0.267	-0.187	-0.222
Stavanger-Oslo			
Origin-destination only	-0.217	-0.135	-0.171
Transfer journeys	-0.965	-0.677	-0.800
All journeys	-0.376	-0.256	-0.309
Bergen-Stavanger			
Origin-destination only	-0.075	-0.065	-0.073
Transfer journeys	-0.318	-0.344	-0.324
All journeys	-0.115	-0.111	-0.114
Haugesund-Oslo			
Origin-destination only	-0.112	-0.090	-0.100
Transfer journeys	-0.609	-0.470	-0.535
All journeys	-0.287	-0.228	-0.256
Kristiansand-Oslo			
Origin-destination only	-0.609	-0.388	-0.517
Transfer journeys	-1.153	-0.612	-0.882
All journeys	-0.801	-0.485	-0.659
Bergen-Sandefjord			
Origin-destination only	-0.160	-0.114	-0.133
Transfer journeys	-0.707	-0.433	-0.539
All journeys	-0.221	-0.153	-0.181
Bergen-Kristiansand			
Origin-destination only	-0.770	-0.390	-0.550
Transfer journeys	-1.520	-0.737	-1.004
All journeys	-0.840	-0.434	-0.601
Stavanger-Sandefjord			
Origin-destination only	-0.256	-0.207	-0.231
Transfer journeys	-0.731	-0.455	-0.577
All journeys	-0.273	-0.218	-0.245
All air routes			
Origin-destination only	-0.197	-0.133	-0.164
Transfer journeys	-0.791	-0.573	-0.675
All journeys	**-0.319**	**-0.231**	**-0.274**

Table 32: HSR travel time elasticities for the eight air routes within the Vestlandsbanen model network.

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These relationships are expressed in terms of travel time elasticities, which measure the percentage change in demand resulting from a one per cent change in travel time.

For example, a travel time elasticity of −0.3 implies a 0.6% reduction in demand resulting from a 2% increase in in-vehicle high-speed rail travel time. This does not, however, imply that a 10% increase in travel time would lead to a proportional 3% reduction in demand, as the relationship between high-speed rail travel time and demand is non-linear. Nevertheless, the resulting reduction in demand would be expected to be of a broadly similar magnitude.

Table 32 presents the estimated travel time elasticities for high-speed rail journeys diverted from air transport. In general, elasticities are higher for work journeys than for non-work journeys, reflecting the greater sensitivity of business travellers and commuters to changes in journey time.

Similarly, elasticities tend to be higher for longer high-speed rail journeys, such as Bergen–Kristiansand, than for shorter journeys such as Bergen–Stavanger. On the latter corridor, high-speed rail is highly competitive with air transport, and the forecast rail mode share (of the combined air and HSR market) already exceeds 85%. As a result, further changes in journey time have a relatively limited effect on demand. For similar reasons, the estimated elasticities for transfer passengers are generally higher than those for end-to-end origin-destination (OD) passengers.

Table 33 below presents the travel time elasticities for high-speed rail (HSR) journeys diverted from private car and public transport, together with induced HSR demand. In general, these elasticities are lowest for shorter journeys.

Travel distance ranges by car and journey types	HSR travel time elasticit. car journeys	HSR travel time elasticit. PT journeys	HSR travel time elasticit. Induced dem.
Less than 20 km			
Work journeys	-0.180	-0.183	-0.189
Non-work journeys	-0.153	-0.158	-0.160
All journeys	-0.166	-0.174	-0.175
20-40 km			
Work journeys	-0.189	-0.187	-0.204
Non-work journeys	-0.155	-0.157	-0.168
All journeys	-0.170	-0.179	-0.185
40-70 km			
Work journeys	-0.242	-0.229	-0.261
Non-work journeys	-0.184	-0.160	-0.203
All journeys	-0.210	-0.208	-0.231
70-100 km			
Work journeys	-0.238	-0.241	-0.259
Non-work journeys	-0.176	-0.159	-0.198
All journeys	-0.192	-0.200	-0.216
100-150 km			
Work journeys	-0.269	-0.309	-0.310
Non-work journeys	-0.185	-0.186	-0.220
All journeys	-0.201	-0.237	-0.239
150-200 km			
Work journeys	-0.389	-0.346	-0.422
Non-work journeys	-0.257	-0.249	-0.289
All journeys	-0.277	-0.281	-0.325
200-250 km			
Work journeys	-0.431	-0.642	-0.391
Non-work journeys	-0.318	-0.504	-0.355
All journeys	-0.330	-0.528	-0.366
250-320 km			
Work journeys	-0.720	-0.877	-0.769
Non-work journeys	-0.434	-0.514	-0.490
All journeys	-0.469	-0.624	-0.562
320-400 km			
Work journeys	-0.631	-0.723	-0.663
Non-work journeys	-0.405	-0.446	-0.451
All journeys	-0.434	-0.530	-0.511
400-500 km			
Work journeys	-0.438	-0.294	-0.623
Non-work journeys	-0.298	-0.213	-0.407
All journeys	-0.312	-0.229	-0.479
More than 500 km			
Work journeys	-0.463	-0.338	-0.720
Non-work journeys	-0.295	-0.229	-0.424
All journeys	-0.312	-0.248	-0.545

Table 33: HSR travel time elasticities for high-speed rail passengers diverted from car and public transport (PT), as well as for new HSR travellers (induced demand) for various distance ranges.

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One reason is that, for short-distance trips, in-vehicle rail travel time constitutes only a relatively small proportion of total journey time, which also includes access and egress times, as well as station waiting time. Consequently, changes in in-vehicle travel time tend to have a relatively limited effect on demand for shorter journeys.

An interesting example: journeys to and from Stavanger and Kårstø

A useful illustration of the application of these elasticities, and of the sensitivity of the transport model to different modelling assumptions, is provided by journeys between Stavanger or Kårstø and destinations elsewhere on the Vestlandsbanen model network.

According to the preferred operating concept discussed in Chapter 7.2.4, two of the four trains per hour in each direction between Stavanger and both Oslo and Bergen will operate via the direct alignment between Kårstø and Ølen, while the remaining two services will operate via Haugesund. Services routed via Haugesund will require approximately 20 minutes longer than those using the direct alignment.

In addition, it is proposed that the Stavanger–Oslo services operating via Haugesund will pass several stations in Vest-Telemark without stopping, thereby reducing their running time by approximately four minutes. As a result, these services will be only 16 minutes slower than those operating via the direct Kårstø–Ølen alignment – which, together with other trains via Haugesund, will also serve stations in Vest-Telemark, thereby ensuring connectivity between Stavanger, Haugesund and Vest-Telemark.

This raises an important question for the demand forecast: to what extent will passengers travelling between Stavanger or Kårstø and destinations beyond Aksdal and Haugesund, including Ølen, Sauda and stations further north and east, choose services via Haugesund as opposed to those operating on the direct route?

For the analysis presented in Chapter 9.7.1, which examined the alignment between train services and forecast demand, it was assumed that all passengers travelling between Stavanger or Kårstø and destinations beyond Aksdal and Haugesund would use only the direct route. From the perspective of that analysis, this represents the most demanding assumption.

Conversely, when calculating average journey times and associated demand forecasts, it was assumed that 50% of passengers would use services via Haugesund and 50% would use the direct route. This assumption produces an average journey time that lies midway between the two alternatives and therefore provides a conservative basis for demand estimation.

At present, however, it is not possible to determine the most likely distribution of passengers between the two route options. Passenger choice will depend heavily on the detailed timetable and the attractiveness of individual departure times. Consequently, the allocation of passengers between the two routes must currently remain an assumption.

Nevertheless, it appears plausible that a well-designed timetable could result in approximately two-thirds of passengers travelling via the direct route and one-third via Haugesund. Under such a scenario, the average journey time between Stavanger or Kårstø and destinations beyond Haugesund and Aksdal would be approximately 3.3 minutes[86] shorter than the value currently used in the demand forecasts. This corresponds to a reduction of around 2.3% in journey time for Stavanger–Oslo trips and a slightly larger percentage reduction for shorter journeys.[87]

This makes it possible to estimate, for example, the impact on the Stavanger–Oslo air travel market. Applying the travel time elasticity presented in Table 32 (−0.309), a reduction of 3.3 minutes in average rail travel time would

[86] If half of the passengers between Stavanger or Kårstø and stations beyond Aksdal and Haugesund will travel via Haugesund, the average travel time is 20 / 2 = 10 minutes longer than on the direct route. If only one third will travel via Haugesund, the average travel time is 20 / 3 = 6.67 minutes longer than on the direct route. The difference is 3.33 minutes.

[87] The estimated travel time Stavanger–Oslo is 147 minutes (the average for both directions), see Appendix 3. Another relevant example is Stavanger–Drammen, which will take 125.65 minutes. There, a travel time reduction of 3.33 minutes corresponds to 2.65%.

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be expected to increase HSR demand diverted from air transport by approximately 0.75%, equivalent to around 30 additional passengers per day.[88]

Additional demand would also be generated through increased mode shift from private car and public transport, as well as through induced demand. These effects would occur not only on trips between Stavanger or Kårstø and the Oslo area, but also on journeys to destinations throughout the Vestlandsbanen area of influence located north and east of Haugesund and Aksdal. Using the travel time elasticities calculated by Sener for all relevant station pairs, the overall impact can be estimated at slightly more than 110 additional HSR passengers per day, approximately 14 million additional passenger-kilometres per year, and almost NOK 30 million in additional annual ticket revenue.

Although these increases are relatively modest when compared with the overall forecast of 6.043 billion passenger-kilometres and annual ticket revenues of NOK 13.248 billion, they demonstrate that even minor changes in modelling assumptions, without any alteration to the proposed operating plan itself, can produce measurable differences in forecast demand.

More broadly, this example highlights the sensitivity of demand forecasts to changes in HSR journey times. Future amendments to the proposed alignment, whether resulting in shorter or longer travel times, may therefore have a non-negligible impact on demand.

At the same time, the question remains as to whether journey times could be reduced through modifications to service stopping patterns, particularly through the omission of selected intermediate station stops. This question was left open in the previous chapter and is examined in the following section.

Train services Bergen–Skien–Vestfold with modified stopping pattern in Åmot in Vest-Telemark

To assess the demand impacts of changes to the proposed operating plan, Sener has examined a scenario in which the Bergen–Oslo services operating via Grenland and Vestfold call at Åmot in Vest-Telemark only on every second service (four times a day), and compared it with another scenario in which the trains call at Åmot on each service (eight times a day) as currently proposed.

Such an amendment would result in an average travel time reduction of 2.06 minutes for passengers between stations west of Åmot and stations in Grenland and Vestfold.[89] Conversely, the service frequency available at Åmot would be reduced in both directions, towards Bergen and towards Grenland and Vestfold.

Using the utility parameters described in Chapter 8.1.3, reductions in service frequency can be expressed as equivalent increases in travel time,[90] and, through the application of the travel time elasticities presented in this chapter, translated into corresponding changes in demand. The results of this assessment are presented in Table 34 on the following page.

As expected, Table 34 indicate only modest differences between the two scenarios. On balance, they suggest that passing through Åmot on every second service would yield a slight net benefit for the Bergen–Skien–Vestfold services, at least when assessed in terms of passenger transport work.

[88] The average reduction in HSR travel time for all relevant pairs of stations is assumed to be about 2.45%. Multiplied by -0.309 and the expected number of travellers shifting to HSR from air (4,008.4 per day, see Table 25 in Chapter 9.2), this results in slightly more than 30 additional HSR travellers per day.

[89] According to Appendix 2, column “Total time”, the additional time required for a stop at Åmot station is 4.19 minutes for eastbound trains and 4.04 minutes for westbound trains. Time savings for passengers between stations west of Åmot and several stations further east, such as Brunkeberg, Bø and Holmestrand, are not considered relevant, as other trains will provide shorter travel times. Also, Haukeligrend has not been taken into account, due to demand forecast uncertainties.

[90] As evident from Table 19 in Chapter 8.1.3, the ratio between the utility parameters for the service frequency and the utility parameters for the travel time by high-speed train is almost exactly the same, no matter whether an air service is available or not. However, there are minor differences between this ratio for work and non-work trips, see H1, H2 ratio to E1, E2 for work trips: 0.768/0.00584 ≈ 1.19/0.00905 ≈ 131.5 and H1, H2 ratio to E1, E2 for non-work trips: 0.553/0.0037 ≈ 0.817/0.00548 ≈ 149. Sener has adapted these ratios to the distribution between work and non-work trips for each station-to-station pair.

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Between stations	and stations	Change in number of daily departures	Travel time reduction or equivalent increase, minutes	Change in HSR passenger numbers per day	Change in HSR transport work, million pkm/year	Change in HSR ticket revenue, million NOK/year
Bergen, Arna, Tysse, Kvam-Jondal, Odda, Røldal	Nordagutu, Skien, Porsgrunn, Larvik, Sandefjord, Tønsberg	-	-2,06	3,87	0,506	0,994
Åmot	Nordagutu, Skien, Porsgrunn, Larvik, Sandefjord, Tønsberg	From 16 to 12	2,62	-2,17	-0,119	-0,235
Åmot	Bergen, Arna	From 24 to 20	1,10	-0,11	-0,009	-0,016
Åmot	Tysse, Kvam-Jondal, Odda, Røldal	From 12 to 10	1,96	-0,89	-0,040	-0,104
Åmot	Brunkeberg, Bø	From 28 to 24	0,77	-1,56	-0,020	-0,065
Åmot	All relevant stations			-4,73	-0,187	-0,421
Sum increase and decline				-0,86	0,318	0,573

Table 34: Changes in HSR demand in response to reduced service frequency at Åmot station and reduced travel times for trains Bergen-Skien-Vestfold.

However, the conclusions derived from Table 34 should be treated with caution. The results are highly sensitive to the valuation of service frequency relative to journey time, as represented by the utility parameters presented in Table 19 (Chapter 8.1.3). These parameters were adopted from the Norwegian High Speed Rail Demand Model (NHSRDM) and imply, for example, that passengers perceive a reduction in service frequency from one train per hour to one train every two hours as equivalent to an increase in journey time of only 7–8 minutes.[91]

This assumption was not discussed in detail in Chapter 8.1.3, primarily because service frequencies on most train routes on Vestlandsbanen will be sufficiently high to have only a limited influence on forecast demand, particularly when alternative journey opportunities involving interchange are also considered.

Nevertheless, a traveller wishing to return home after a meeting or cultural event, for example, and having just missed a train, may perceive a reduction from hourly to two-hourly departures as inconvenient as an additional travel time of one hour, not of just a few minutes.

Whilst the average perceived inconvenience would naturally be substantially lower than this maximum value, it is reasonable to argue that it could exceed the equivalent 7–8 minute penalty implied by the NHSRDM parameters. Indeed, if the equivalent increase in travel time associated with the service frequency reduction were assumed to be only 20 minutes, the outcome of the analysis would be reversed. Under such an assumption, overall demand would be higher if the Bergen–Skien–Vestfold services continued to call at Åmot on each service, as proposed in the operating plan.

Furthermore, demand levels alone do not provide a sufficient basis for selecting between alternative service patterns. A range of wider considerations must also be taken into account, including the following:

- Many of the smaller communities along the Vestlandsbanen corridor are experiencing population decline, a trend that is, in some cases, compounded by reductions in public services such as secondary education, healthcare provision and public transport. Conversely, other communities are investing heavily to accommodate population growth through the development of new housing, roads, sports facilities and other infra-

[91] See previous footnote. 131.5 × (1/9 – 1/17) = 6.88 minutes for work trips and 149 × (1/9 – 1/17) = 7.79 minutes for non-work trips.

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structure. By providing fast, reliable passenger and freight services, Vestlandsbanen has the potential to support a more balanced pattern of regional development. Realising this potential, however, requires a dense station network and frequent train services.

- The environmental benefits of modal shift from car to rail are often greatest where car traffic occurs within major urban areas. However, many of these journeys originate or terminate in more rural areas. At the same time, it is generally easier to encourage long-distance motorists to transfer to rail than travellers undertaking short local car journeys, at least when providing frequent train services.

- From an economic perspective, increasing rail demand at less heavily used stations may prove more beneficial than attracting additional passengers at stations such as Oslo, Bergen or Stavanger, where further growth would place additional demands on station facilities, staffing and associated infrastructure.

- In many cases, the benefits of Vestlandsbanen are determined not only by the quality of the train service itself but also by its integration with connecting public transport services. However, the feasibility of providing such feeder services depends, to a large extent, on the level of demand and the resulting capacity utilisation. For example, a bus service connecting a nearby town with a railway station should ideally carry passengers in both directions, rather than returning empty after dropping off rail users. This is only viable if train arrivals and departures are sufficiently frequent to generate demand in both directions. Consequently, the frequency of train services calling at a station can have a significant influence on the viability and effectiveness of integrated public transport connections.

- The ability to operate fast passenger services and slower freight services on the same infrastructure during daytime hours depends to a significant extent on the speed differential between the two service types. Passenger services making regular intermediate stops are often particularly compatible with such operating arrangements.

Against this background, it may be more appropriate to explore opportunities to increase the overall societal benefits of Vestlandsbanen through service enhancements rather than through further reductions in journey times. Within the scope of the present study, Sener is not in a position to make specific recommendations, as the analysis required would be considerably more extensive than that undertaken here. Nevertheless, a number of topics can be identified for further investigation during subsequent phases of the Vestlandsbanen studies:

- Enhanced service frequencies for selected stations and train services, even where this may result in marginally longer journey times for some passengers.

- A parallel line branching from Vestlandsbanen near Vestfossen and Daler, serving at least Hokksund and Mjøndalen, with the objective of improving connectivity for the municipalities of Øvre Eiker, Modum and Sigdal, while also increasing capacity and overtaking opportunities on the approximately 30 km Kongsberg–Drammen corridor. Deliverable 4, DBI Alignment Review, includes a proposal for such a scheme.

- An additional station near Skare in Ullensvang municipality. The 36 km section between Odda and Røldal is longer than most distances between consecutive stations (see Appendix 2, "Distance" column) and is designed with an average gradient of 7.94‰. An intermediate station could improve both regional accessibility and operational flexibility for freight services.

- An additional station near Skjold in Vindafjord municipality. The 40 km distance between Kårstø and Ølen is also longer than most distances between consecutive stations. Under normal operating conditions this presents little challenge, as many passenger services will operate via Haugesund. However, during periods of disruption, the ability to overtake freight trains between Kårstø and Ølen could prove valuable. Such a station could also improve accessibility for a significant number of passengers.

Further examples could be identified. The key point is that the travel time elasticities presented in this chapter do not indicate a compelling case for making the fastest services any faster. Rather, they suggest that there may be greater value in exploring measures that enhance network accessibility, operational flexibility and regional connectivity.

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9.7.4 Effects of changes in HSR ticket fares

Analogous to the previous chapter, Tables 35 and 36 present the fare elasticities of demand, expressed as the percentage change in demand resulting from a one per cent change in high-speed rail ticket prices.

Table 35 presents the estimated fare elasticities for high-speed rail journeys diverted from air transport. The highest elasticities are observed on corridors characterised by relatively long high-speed rail journey times, such as Oslo–Kristiansand and Bergen–Kristiansand. By contrast, fare elasticities are lower on routes where high-speed rail offers shorter journey times and a stronger competitive position relative to air transport. This suggests that journey time is generally a more important determinant of traveller behaviour than ticket price.

Air routes and journey types	HSR cost elasticities work journeys	HSR cost elasticities non-work journeys	HSR cost elasticities all journeys
Bergen/Stord-Oslo			
Origin-destination only	-0.098	-0.094	-0.096
Transfer journeys	-0.310	-0.244	-0.272
All journeys	-0.135	-0.122	-0.128
Stavanger-Oslo			
Origin-destination only	-0.130	-0.115	-0.121
Transfer journeys	-0.404	-0.328	-0.361
All journeys	-0.188	-0.162	-0.174
Bergen-Stavanger			
Origin-destination only	-0.049	-0.064	-0.052
Transfer journeys	-0.157	-0.158	-0.158
All journeys	-0.067	-0.079	-0.070
Haugesund-Oslo			
Origin-destination only	-0.070	-0.082	-0.077
Transfer journeys	-0.239	-0.203	-0.220
All journeys	-0.130	-0.126	-0.128
Kristiansand-Oslo			
Origin-destination only	-0.207	-0.194	-0.202
Transfer journeys	-0.383	-0.291	-0.337
All journeys	-0.269	-0.236	-0.254
Bergen-Sandefjord			
Origin-destination only	-0.088	-0.093	-0.091
Transfer journeys	-0.270	-0.215	-0.236
All journeys	-0.108	-0.108	-0.108
Bergen-Kristiansand			
Origin-destination only	-0.293	-0.215	-0.248
Transfer journeys	-0.577	-0.397	-0.458
All journeys	-0.319	-0.238	-0.271
Stavanger-Sandefjord			
Origin-destination only	-0.138	-0.165	-0.152
Transfer journeys	-0.306	-0.261	-0.281
All journeys	-0.144	-0.169	-0.157
All air routes			
Origin-destination only	-0.106	-0.107	-0.107
Transfer journeys	-0.316	-0.269	-0.291
All journeys	**-0.150**	**-0.142**	**-0.146**

Table 35: HSR ticket cost elasticities for the eight air routes within the Vestlandsbanen model network.

Table 36 on the following page presents the estimated fare elasticities for high-speed rail journeys diverted from private car and public transport, as well as for induced high-speed rail demand. In general, these elasticities are highest for short-distance journeys, particularly for non-work journeys, reflecting the greater sensitivity of leisure travellers to changes in travel costs.

A further explanation is that the fare structure assumed for Vestlandsbanen does not increase linearly with distance. On a per-kilometre basis, fares for longer journeys are assumed to be significantly lower than those for shorter journeys. At the same time, the transport model assumes that car operating costs are broadly proportional to distance travelled. Together, these factors reinforce the relatively conservative estimate of demand for shorter-distance rail travel, as outlined in Chapter 8.3 about the short-distance problem.

The most significant finding from the elasticity analysis, however, is that the fare elasticities for all modal shifts, including those from air transport (see Table 35), are greater than −1 across all journey distance bands. This indicates that, although higher fares would reduce demand, the percentage reduction in demand would be smaller than the percentage increase in fares. As a result, total ticket revenue would increase.

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This is an important finding for subsequent cost-benefit assessments. At the same time, it is evident that higher fares and lower passenger demand would reduce the overall societal benefits of Vestlandsbanen and would represent a less favourable outcome from an environmental perspective. These issues are examined further in Deliverable 8 – *Cost-Benefit Analysis*.

Travel distance ranges by car and journey types	HSR travel cost elasticit. car journeys	HSR travel cost elasticit. PT journeys	HSR travel cost elasticit. Induced dem.
Less than 20 km			
Work journeys	-0.384	-0.414	-0.407
Non-work journeys	-0.765	-0.816	-0.801
All journeys	-0.579	-0.548	-0.597
20-40 km			
Work journeys	-0.303	-0.339	-0.335
Non-work journeys	-0.561	-0.641	-0.614
All journeys	-0.447	-0.424	-0.481
40-70 km			
Work journeys	-0.250	-0.274	-0.281
Non-work journeys	-0.389	-0.400	-0.440
All journeys	-0.326	-0.312	-0.363
70-100 km			
Work journeys	-0.201	-0.219	-0.225
Non-work journeys	-0.263	-0.268	-0.308
All journeys	-0.247	-0.243	-0.283
100-150 km			
Work journeys	-0.196	-0.224	-0.230
Non-work journeys	-0.230	-0.250	-0.280
All journeys	-0.223	-0.239	-0.270
150-200 km			
Work journeys	-0.219	-0.212	-0.265
Non-work journeys	-0.240	-0.240	-0.286
All journeys	-0.237	-0.231	-0.281
200-250 km			
Work journeys	-0.224	-0.302	-0.239
Non-work journeys	-0.254	-0.346	-0.302
All journeys	-0.250	-0.339	-0.283
250-320 km			
Work journeys	-0.281	-0.328	-0.309
Non-work journeys	-0.302	-0.341	-0.354
All journeys	-0.300	-0.337	-0.342
320-400 km			
Work journeys	-0.256	-0.287	-0.281
Non-work journeys	-0.290	-0.294	-0.341
All journeys	-0.285	-0.292	-0.324
400-500 km			
Work journeys	-0.228	-0.173	-0.369
Non-work journeys	-0.237	-0.184	-0.350
All journeys	-0.236	-0.182	-0.356
More than 500 km			
Work journeys	-0.253	-0.198	-0.428
Non-work journeys	-0.230	-0.189	-0.352
All journeys	-0.233	-0.191	-0.383

Table 36: HSR ticket cost elasticities for high-speed rail passengers diverted from car and public transport (PT), as well as for new HSR travellers (induced demand) for various distance ranges.

9.8 The uncertainty analysis

Forecasting the transport impacts of a future 650 km high-speed rail network in Norway is inherently subject to significant uncertainty. The following sections describe in greater detail how Sener has addressed these uncertainties and balanced competing considerations throughout the forecasting process.

On the one hand, it was essential to adopt assumptions and input parameters that remain robust under less favourable future scenarios. The objective was to avoid overstating the traffic volumes and associated benefits that could be achieved by Vestlandsbanen and to ensure that the forecasts presented are based on a prudent and credible assessment.

On the other hand, an excessively conservative approach may lead to a substantial underestimation of the scheme's potential. Forecasting demand for a high-speed rail network involves a large number of analytical steps, each affected by its own uncertainties and assumptions. If highly conservative assumptions are systematically applied at every stage of the modelling process, the cumulative effect may result in forecasts that are not only below the most likely outcome, but significantly below a realistic range of expected demand. Such an outcome

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could lead to an undervaluation of the project's benefits and potentially influence the prioritisation of future studies and development activities. This should also be avoided.

The methodology developed by Sener seeks to strike an appropriate balance between these two extremes, providing forecasts that are both prudent and representative of the most likely future conditions.

In broad terms, the study addresses three fundamental questions, each of which is associated with a degree of uncertainty:

- What is the current level of travel demand across the various transport modes?
- How is this demand expected to evolve up to the opening year of the high-speed railway and during subsequent years of operation?
- How will travellers respond to the introduction of the new railway and allocate their journeys among the available transport options?

The volume of existing travel

There are numerous traffic counting stations across the Norwegian road network. While these provide reliable information on vehicle flows, they do not capture vehicle occupancy levels or the origins and destinations of individual trips. Sener initially investigated the use of mobile phone data to supplement this information. However, the available datasets were found to be insufficient in terms of quality and geographical resolution for the purposes of the Vestlandsbanen study.

As an alternative, Sener utilised the NTM6 and RTM transport models developed by the Norwegian transport authorities and research communities. Although these models do not represent observed traffic counts, they constitute the most comprehensive and widely accepted basis currently available for strategic transport planning in Norway. Having been developed and continuously refined over more than two decades, they provide a robust foundation for demand analysis.

Nevertheless, a number of adjustments were considered necessary, primarily because the NTM6 and RTM datasets do not capture all categories of travel demand. In particular, trips undertaken by persons under the age of 13 and journeys with an international origin or destination are excluded from the available model outputs.

As part of this adjustment process, Sener increased the number of car passengers, defined as vehicle occupants other than the driver, by 30%. This improved consistency with other available data sources, although it inevitably introduced some uncertainty regarding the distribution of additional demand across different journey lengths. Conversely, and as discussed in Chapter 5.2, Sener adopted without modification the retrospective reduction in average car occupancy introduced by Statistics Norway (SSB) in autumn 2023. While this assumption may be conservative, its adoption ensured consistency with the official statistical baseline. The revision reduced reported car travel in Norway by more than 9 billion passenger-kilometres per year.

Furthermore, Sener elected not to apply corresponding upward adjustments to public transport demand, despite evidence suggesting that actual public transport usage may be higher than indicated by the model outputs. The available evidence was not considered sufficiently robust to determine the appropriate magnitude of any such adjustment. As a result, the public transport demand figures used in the analysis should be regarded as a prudent representation of current travel patterns.

The development of travel in the years ahead

As described in Chapter 6, future demand growth has been estimated using, among other inputs, the Norwegian Ministry of Finance's forecasts of economic growth per capita and the medium-growth scenario from Statistics Norway (SSB)'s population projections. Sener has also applied empirically observed Norwegian relationships between economic growth and travel demand growth, albeit using significantly moderated elasticity values.

Whilst all such forecasts are inherently uncertain, a number of assumptions and methodological choices have been adopted to ensure that the resulting demand forecasts remain robust and do not overstate the potential demand for Vestlandsbanen:

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- **Road transport competitiveness**

  As discussed in Chapter 6.2, the Level of Service (LoS) data used for road travel in 2019 generally underestimate actual journey times. This situation is expected to persist for many years, despite ongoing improvements to the Norwegian road network.

  In principle, the baseline road travel times should have been corrected, and the impact of future highway investments on journey times and induced demand should have been modelled year by year. However, sufficiently reliable and geographically detailed information regarding future road infrastructure investments is not currently available.

  Consequently, Sener has retained the original road travel times throughout the assessment period. As a result, the competitive position of private car travel relative to Vestlandsbanen is likely to be overstated over much of the analysis period. At the same time, future growth in overall travel demand has been forecast using deliberately moderated empirical relationships between economic growth and travel demand.

- **Wider economic and demographic effects**

  International experience demonstrates that major railway investments, particularly high-speed rail systems offering attractive passenger and freight services, can stimulate additional population growth and economic activity in the areas they serve. The magnitude and geographic distribution of such effects depend on local conditions and cannot be reliably represented within conventional transport demand models.

  Nevertheless, for a project of the scale of Vestlandsbanen, which would significantly improve connectivity across large parts of Norway, it is reasonable to expect positive wider economic and demographic effects at a national level. Although these effects cannot be allocated with confidence to individual stations or corridors, they provide an important source of resilience against potential deviations between assumed and actual developments in population, economic activity and travel demand.

- **Future railway network development**

  Due to the absence of sufficiently reliable information regarding future infrastructure programmes, Sener has not assumed any major additions to the railway network connected to Vestlandsbanen over the assessment period to 2075, with the exception of the two sections of Vestfoldbanen between Drammen and Tønsberg currently under construction.

  This assumption is unlikely to reflect the long-term development of the Norwegian rail network. It is reasonable to expect that Norway, in common with its European partners, will continue to invest substantially in railway infrastructure over the coming decades. Such investments would support additional rail demand both on newly constructed sections and across the wider network.

  Consequently, improvements on corridors connecting to Vestlandsbanen, including routes serving Gjøvik, Hamar, Kongsvinger, Askim, Fredrikstad, Larvik, Kristiansand, Egersund and Voss, would be expected to generate additional demand on Vestlandsbanen itself. Likewise, Vestlandsbanen would strengthen demand on these connecting routes. Although it is not currently possible to quantify the geographic distribution of these effects with precision, the overall impact can reasonably be expected to be positive and material.

Travellers' choice between different modes of transport

Despite a number of adjustments introduced to improve consistency, the demand model developed by Sener relies substantially on the utility parameters derived from the Stated Preference (SP) survey undertaken in 2010 and 2011 during the development of the Norwegian High-Speed Rail Demand Model (NHSRDM). This remains the only dedicated study of its kind undertaken in Norway.

All stated preference surveys are subject to inherent uncertainties, including questions regarding the representativeness of the sample and the stability of traveller preferences over time. In the present case, an additional source of uncertainty arises from the age of the survey, which was conducted more than fifteen years ago, and from the fact that respondents had little or no direct experience of modern high-speed rail services.

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This may have influenced respondents' perceptions of future rail services. In particular, experiences of the conventional Norwegian rail network, including perceptions regarding reliability and punctuality, may have affected expectations of future high-speed services and contributed to a cautious valuation of rail travel.

Furthermore, sustained growth in real incomes over recent years is likely to have reduced overall price sensitivity while increasing travellers' preference for fast, reliable and high-quality transport services. It is therefore reasonable to expect that a comparable survey undertaken today could generate utility parameters associated with a stronger preference for high-speed rail.

At the same time, new uncertainties have emerged since the original survey was conducted. Domestic air travel provides a useful example. Passenger volumes remain broadly comparable with pre-pandemic levels and lower than might otherwise be expected based on demographic and economic growth alone. This may reflect a combination of factors, including continued investment in the Norwegian road network, behavioural changes following the Covid-19 pandemic, and increases in airline operating costs resulting from geopolitical instability and higher fuel prices.

While not all of these factors are directly relevant to Vestlandsbanen, they illustrate the broader uncertainties affecting long-term travel demand forecasting. To address such uncertainties, Sener has adopted a number of deliberately prudent assumptions throughout the demand modelling process. These assumptions generally act to reduce the forecast demand for high-speed rail and include the following:

- Relatively conservative assumptions regarding average air fares and private car operating costs, as described in Chapters 7.3.3 and 7.4.2.
- The assumption that all high-speed rail journeys involve at least two interchanges, although in many cases direct access to stations or destinations would reduce the need for such transfers (Chapter 8.1.3).
- The application of a conservative induced-demand methodology that generates lower demand responses than those typically adopted in comparable high-speed rail studies (Chapter 8.2.6).
- The use of a dedicated methodology for trips below 100 km that intentionally produces conservative demand estimates (Chapter 8.3).
- Conservative assumptions regarding journey times between Stavanger or Kårstø and destinations north or east of Haugesund and Aksdal. Alternative assumptions of equal technical credibility would produce journey times more than three minutes shorter (Chapter 9.7.3).
- No allowance for the potential competitive advantage arising from the substantially lower energy consumption of high-speed rail relative to competing transport modes.
- No allowance for the likely future increase in carbon pricing and other environmental charges that may increase the operating costs of competing modes and improve the relative attractiveness of rail.

In addition to these intentionally conservative assumptions, a number of limitations in the available datasets also contribute to reduced demand estimates for Vestlandsbanen:

- The spatial relationship between proposed stations and the centroids of the nearest NTM6 zones leads to an underrepresentation of demand at Nordagutu and Haukeligrend, and to a lesser, but still significant extent at Aksdal, Kårstø, Røldal and Kvam-Jondal (Chapter 7.2.3).
- Although journey time calculations incorporate stopping patterns at 49 stations, demand is explicitly represented at only 34 stations within the Vestlandsbanen model network. Demand associated with the remaining stations is therefore partially suppressed, as travellers are effectively assumed to access the network through alternative stations (Chapter 7.2.1).
- The available public transport datasets do not distinguish between bus, boat and conventional rail services. This limitation restricts the assessment of traffic growth on connecting rail corridors and is likely to understate both passenger demand and wider network benefits associated with Vestlandsbanen.

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Taken together, these assumptions and modelling limitations provide a substantial counterbalance to the uncertainties inherent in long-term travel demand forecasting. Overall, the methodology adopted by Sener is considered sufficiently conservative to ensure that the resulting demand forecasts remain prudent and robust, while still providing a realistic indication of the likely market potential of Vestlandsbanen.

Recommendations for further studies

The following recommendations are therefore proposed for subsequent phases of study:

- **Enhancement of public transport datasets**. Future studies should seek to disaggregate the available public transport demand data by mode, distinguishing between bus, boat and conventional rail services. Corresponding Level of Service (LoS) datasets should also be developed for each mode. This would address a number of the limitations identified in the current study and provide a stronger basis for demand model calibration and validation.
- **Representation of future transport networks**. Further consideration should be given to how the long-term evolution of the Norwegian road and rail networks can be represented more effectively within the forecasting framework. Although the precise scope and timing of future infrastructure investments remain uncertain, the development of realistic network scenarios would provide a more robust basis for assessing long-term demand and network impacts.
- **Updated Stated Preference research**. A new Stated Preference (SP) survey should be undertaken to reflect current travel behaviour, socio-economic conditions and attitudes towards high-speed rail. Given the importance of the utility parameters derived from such surveys, particular attention should be paid to survey design, sample representativeness and the treatment of uncertainty. Consideration should also be given to incorporating respondents' greater familiarity with modern high-speed rail systems and evolving preferences regarding travel time, reliability, comfort and sustainability.

More broadly, future research should seek to reduce the principal sources of uncertainty identified in this study and further refine the understanding of long-term travel demand in Norway. This would support progressively more detailed assessments of the traffic, economic and societal benefits associated with Vestlandsbanen.

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Appendix 1

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Micro region	Municipalities
Micro region 1	3001 Halden
	3002 Moss
	3003 Sarpsborg
	3004 Fredrikstad
	3011 Hvaler
	3017 Råde
Micro region 2	3012 Aremark
	3013 Marker
	3014 Indre Østfold
	3015 Skiptvet
	3016 Rakkestad
	3018 Våler (Viken)
Micro region 3	3019 Vestby
	3020 Nordre Follo
	3021 Ås
	3022 Frogn
	3023 Nesodden
	3028 Enebakk
Micro region 4	3024 Bærum
	3025 Asker
Micro region 5	3026 Aurskog-Høland
	3027 Rælingen
	3029 Lørenskog
	3030 Lillestrøm
	3034 Nes
Micro region 6	3031 Nittedal
	3032 Gjerdrum
	3033 Ullensaker
	3035 Eidsvoll
	3036 Nannestad
	3037 Hurdal
	3053 Jevnaker
	3054 Lunner
Micro region 7	3005 Drammen
	3006 Kongsberg
	3047 Modum

Micro region	Municipalities
	3048 Øvre Eiker
	3049 Lier
	3050 Flesberg
	3051 Rollag
	3052 Nore og Uvdal
Micro region 8	3007 Ringerike
	3038 Hole
	3045 Sigdal
	3046 Krødsherad
Micro region 9	3039 Flå
	3040 Nesbyen
	3041 Gol
	3042 Hemsedal
	3043 Ål
	3044 Hol
Micro reg. 10	0301 Oslo kommune
Micro region 11	3401 Kongsvinger
	3414 Nord-Odal
	3415 Sør-Odal
	3416 Eidskog
	3417 Grue
	3418 Åsnes
	3419 Våler (Innlandet)
Micro region 12	3403 Hamar
	3411 Ringsaker
	3412 Løten
	3413 Stange
	3420 Elverum
Micro region 13	3421 Trysil
	3422 Åmot
	3423 Stor-Elvdal
	3424 Rendalen
	3425 Engerdal
	3426 Tolga
	3427 Tynset
	3428 Alvdal

Micro region	Municipalities
	3429 Folldal
	3430 Os
Micro region 14	3405 Lillehammer
	3407 Gjøvik
	3440 Øyer
	3441 Gausdal
	3442 Østre Toten
	3443 Vestre Toten
	3446 Gran
Micro region 15	3447 Søndre Land
	3448 Nordre Land
	3449 Sør-Aurdal
	3450 Etnedal
	3451 Nord-Aurdal
	3452 Vestre Slidre
	3453 Øystre Slidre
	3454 Vang
Micro region 16	3431 Dovre
	3432 Lesja
	3433 Skjåk
	3434 Lom
	3435 Vågå
	3436 Nord-Fron
	3437 Sel
	3438 Sør-Fron
	3439 Ringebu
Micro region 17	3801 Horten
	3802 Holmestrand
	3803 Tønsberg
	3811 Færder
Micro region 18	3804 Sandefjord
	3805 Larvik
Micro region 19	3806 Porsgrunn
	3807 Skien
	3812 Siljan
	3813 Bamble

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Micro region	Municipalities
	3814 Kragerø
Micro region 20	3808 Notodden
	3815 Drangedal
	3816 Nome
	3817 Midt-Telemark
	3818 Tinn
	3819 Hjartdal
Micro region 21	3820 Seljord
	3821 Kviteseid
	3822 Nissedal
	3823 Fyresdal
	3824 Tokke
	3825 Vinje
Micro region 22	4201 Risør
	4202 Grimstad
	4203 Arendal
	4211 Gjerstad
	4212 Vegårshei
	4213 Tvedestrand
	4214 Froland
	4217 Åmli
Micro region 23	4204 Kristiansand
	4205 Lindesnes
	4206 Farsund
	4215 Lillesand
	4216 Birkenes
	4218 Iveland
	4223 Vennesla
	4225 Lyngdal
	4226 Hægebostad
Micro region 24	4219 Evje og Hornnes
	4220 Bygland
	4221 Valle
	4222 Bykle
	4224 Åseral
Micro region 25	1101 Eigersund

Micro region	Municipalities
	1111 Sokndal
	1112 Lund
	4207 Flekkefjord
	4227 Kvinesdal
	4228 Sirdal
Micro region 26	1114 Bjerkreim
	1119 Hå
	1120 Klepp
	1121 Time
	1122 Gjesdal
Micro region 27	1103 Stavanger
	1108 Sandnes
	1124 Sola
	1127 Randaberg
	1130 Strand
Micro region 28	1106 Haugesund
	1144 Kvitsøy
	1145 Bokn
	1146 Tysvær
	1149 Karmøy
	1151 Utsira
Micro region 29	1133 Hjelmeland
	1134 Suldal
	1135 Sauda
	1160 Vindafjord
Micro region 30	4611 Etne
	4612 Sveio
	4613 Bømlo
	4614 Stord
	4615 Fitjar
	4616 Tysnes
	4617 Kvinnherad
Micro region 31	4618 Ullensvang
	4619 Eidfjord
	4620 Ulvik
	4622 Kvam

Micro region	Municipalities
Micro region 32	4601 Bergen
	4623 Samnanger
	4624 Bjørnafjorden
	4625 Austevoll
	4626 Øygarden
	4627 Askøy
Micro region 33	4621 Voss
	4628 Vaksdal
	4629 Modalen
	4630 Osterøy
Micro region 34	4631 Alver
	4632 Austrheim
	4633 Fedje
	4634 Masfjorden
	4635 Gulen
Micro region 35	4636 Solund
	4637 Hyllestad
	4638 Høyanger
	4639 Vik
	4640 Sogndal
	4641 Aurland
	4642 Lærdal
	4643 Årdal
	4644 Luster
Micro region 36	4602 Kinn
	4645 Askvoll
	4646 Fjaler
	4647 Sunnfjord
	4648 Bremanger
	4649 Stad
	4650 Gloppen
	4651 Stryn

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Appendix 2

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	Passing time	Arrival time	Depart. time	Total time	Distance	Average Speed
Bergen-Oslo						
Bergen	0.00	0.00	0.00	0.00	0.0000	
Arna	5.22	0.00	1.05	0.00	9.3500	107.43
Tysse	12.23	1.11	2.16	3.56	26.9260	176.96
Kvam-Jondal	19.01	1.20	2.25	3.65	54.3420	242.51
Odda	26.42	1.54	2.59	4.67	85.5960	253.29
Røldal	34.86	1.36	2.41	4.22	121.4260	254.59
Haukeligrend	48.52	1.65	2.70	4.27	179.8040	256.39
Åmot	56.59	1.35	2.40	4.19	213.1780	248.25
Brunkeberg	1:04.21	1.53	2.58	4.10	245.8100	256.86
Bø	1:12.36	1.88	2.93	5.01	281.4270	262.32
Notodden	1:19.13	1.15	2.20	4.06	310.7700	259.93
Kongsberg	1:25.58	2.73	3.78	6.68	338.2622	255.80
Eiker	1:31.12	1.31	2.36	3.46	360.6080	242.00
Drammen	1:35.03	0.00	1.05	0.00	370.5000	151.66
Nesbru	1:43.36	1.36	2.41	3.54	392.5100	181.46
Majorstua	1:48.59	0.00	1.05	0.00	407.8100	175.69
Oslo S	1:52.44	0.00	0.00	0.00	411.3300	75.26
Oslo-Bergen						
Oslo S	0.00	0.00	0.00	0.00	0.0000	
Majorstua	2.58	0.00	1.05	0.00	3.5200	81.90
Nesbru	8.87	1.16	2.21	3.59	18.8200	175.05
Drammen	16.07	0.00	1.05	0.00	40.8300	183.45
Eiker	20.98	1.16	2.21	3.48	50.7220	153.73
Kongsberg	26.82	2.71	3.76	6.50	72.9400	228.24
Notodden	33.45	1.69	2.74	3.95	100.5600	250.06
Bø	40.18	1.81	2.86	5.19	129.7486	260.21
Brunkeberg	48.67	1.44	2.49	4.47	165.5200	252.84
Åmot	56.27	1.66	2.71	4.04	198.1520	257.74
Haukeligrend	1:04.34	1.46	2.51	4.53	231.5760	248.51
Røldal	1:17.47	1.52	2.57	4.26	289.9040	266.55
Odda	1:25.33	1.57	2.62	4.50	325.7340	273.34
Kvam-Jondal	1:32.54	1.16	2.21	3.41	356.9880	260.17
Tysse	1:39.34	1.29	2.34	3.62	384.4040	241.69
Arna	1:44.97	0.00	1.05	0.00	401.9800	187.47
Bergen	1:51.20	0.00	0.00	0.00	411.3300	108.19
Haugesund-Oslo						
Haugesund	0.00	0.00	0.00	0.00	0.0000	
Aksdal	3.84	1.18	2.23	3.78	9.6800	151.39
Ølen	11.49	1.31	2.36	4.01	41.9700	253.19
Sauda	19.14	1.45	2.50	4.22	74.1600	252.40
Haukeligrend	38.28	1.65	2.70	4.27	152.4976	245.62
Åmot	46.34	1.35	2.40	4.19	185.9216	248.62
Brunkeberg	53.97	1.53	2.58	4.10	218.5536	256.86
Bø	1:02.11	1.88	2.93	5.01	254.1706	262.32
Notodden	1:08.89	1.15	2.20	4.06	283.5136	259.93
Kongsberg	1:15.33	2.73	3.78	6.68	311.0058	255.80
Eiker	1:20.87	1.31	2.36	3.46	333.3516	242.00
Drammen	1:24.79	0.00	1.05	0.00	343.2436	151.66
Nesbru	1:33.12	1.36	2.41	3.54	365.2536	181.46
Majorstua	1:38.34	0.00	1.05	0.00	380.5536	175.69
Oslo S	1:42.20	0.00	0.00	0.00	384.0736	75.26

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	Passing time	Arrival time	Depart. time	Total time	Distance	Average Speed
Oslo-Haugesund						
Oslo S	0.00	0.00	0.00	0.00	0.0000	
Majorstua	2.58	0.00	1.05	0.00	3.5200	81.90
Nesbru	8.87	1.16	2.21	3.59	18.8200	175.05
Drammen	16.07	0.00	1.05	0.00	40.8300	183.45
Eiker	20.98	1.16	2.21	3.48	50.7220	153.73
Kongsberg	26.82	2.71	3.76	6.50	72.9400	228.24
Notodden	33.45	1.69	2.74	3.95	100.5600	250.06
Bø	40.18	1.81	2.86	5.19	129.7486	260.21
Brunkeberg	48.67	1.44	2.49	4.47	165.5200	252.84
Åmot	56.27	1.66	2.71	4.04	198.1520	257.74
Haukeligrend	1:04.34	1.46	2.51	4.53	231.5760	248.51
Sauda	1:22.55	1.38	2.43	4.05	309.9160	258.01
Ølen	1:30.13	1.51	2.56	4.01	342.1060	254.85
Aksdal	1:37.69	1.53	2.58	3.85	374.3960	256.30
Haugesund	1:41.43	0.00	0.00	0.00	384.0760	155.22
Stavanger-Oslo						
Stavanger	0.00	0.00	0.00	0.00	0.0000	
Kårstø	12.86	1.18	2.23	3.54	49.1200	229.26
Ølen	22.84	1.31	2.36	4.01	89.1104	240.21
Sauda	30.50	1.45	2.50	4.22	121.3004	252.40
Haukeligrend	49.63	1.65	2.70	4.27	199.6380	245.62
Åmot	57.70	1.35	2.40	4.19	233.0620	248.62
Brunkeberg	1:05.32	1.53	2.58	4.10	265.6940	256.86
Bø	1:13.47	1.88	2.93	5.01	301.3110	262.32
Notodden	1:20.24	1.15	2.20	4.06	330.6540	259.93
Kongsberg	1:26.69	2.73	3.78	6.68	358.1462	255.80
Eiker	1:32.23	1.31	2.36	3.46	380.4920	242.00
Drammen	1:36.14	0.00	1.05	0.00	390.3840	151.66
Nesbru	1:44.47	1.36	2.41	3.54	412.3940	181.46
Majorstua	1:49.70	0.00	1.05	0.00	427.6940	175.69
Oslo S	1:53.55	0.00	0.00	0.00	431.2140	75.26
Oslo-Stavanger						
Oslo S	0.00	0.00	0.00	0.00	0.0000	
Majorstua	2.58	0.00	1.05	0.00	3.5200	81.90
Nesbru	8.87	1.16	2.21	3.59	18.8200	175.05
Drammen	16.07	0.00	1.05	0.00	40.8300	183.45
Eiker	20.98	1.16	2.21	3.48	50.7220	153.73
Kongsberg	26.82	2.71	3.76	6.50	72.9400	228.24
Notodd	33.45	1.69	2.74	3.95	100.5600	250.06
Bø	40.18	1.81	2.86	5.19	129.7486	260.21
Brunkeberg	48.67	1.44	2.49	4.47	165.5200	252.84
Åmot	56.27	1.66	2.71	4.04	198.1520	257.74
Haukeligrend	1:04.34	1.46	2.51	4.53	231.5760	248.51
Sauda	1:22.55	1.38	2.43	4.05	309.9160	258.01
Ølen	1:30.13	1.51	2.56	4.01	342.1060	254.85
Kårstø	1:40.07	1.25	2.30	3.72	382.1000	241.59
Stavanger	1:52.51	0.00	0.00	0.00	431.2200	236.81
Stavanger-Haugesund						
Stavanger	0.00	0.00	0.00	0.00	0.0000	
Kårstø	12.86	1.18	2.23	3.53	49.1200	229.26
Aksdal	16.99	1.09	2.14	3.19	63.9898	215.60
Haugesund	20.95	0.00	0.00	0.00	73.6698	146.97

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	Passing time	Arrival time	Depart. time	Total time	Distance	Average Speed
Haugesund-Stavanger						
Haugesund	0.00	0.00	0.00	0.00	0.0000	
Aksdal	3.84	1.18	2.23	3.25	9.6800	151.33
Kårstø	7.99	1.24	2.29	3.71	24.5318	214.45
Stavanger	20.44	0.00	0.00	0.00	73.6518	236.81
Bergen-Haugesund						
Bergen	0.00	0.00	0.00	0.00	0.0000	
Arna	5.22	0.00	1.05	0.00	9.3500	107.43
Tysse	12.23	1.11	2.16	3.56	26.9260	176.96
Kvam-Jondal	19.01	1.20	2.25	3.65	54.3420	242.51
Odda	26.42	1.54	2.59	4.67	85.5960	253.29
Røldal	34.87	1.35	2.40	3.44	121.4260	254.48
Sauda	43.24	1.38	2.43	4.05	154.6690	238.26
Ølen	50.82	1.51	2.56	4.01	186.8590	254.85
Aksdal	58.37	1.53	2.58	3.85	219.1490	256.30
Haugesund	1:02.12	0.00	0.00	0.00	228.8290	155.22
Haugesund-Bergen						
Haugesund	0.00	0.00	0.00	0.00	0.0000	
Aksdal	3.84	1.18	2.23	3.78	9.6800	151.39
Ølen	11.49	1.31	2.36	4.01	41.9700	253.19
Sauda	19.14	1.45	2.50	4.22	74.1600	252.40
Røldal	27.72	1.11	2.16	3.60	107.4156	232.52
Odda	35.84	1.57	2.62	4.50	143.2456	264.91
Kvam-Jondal	43.04	1.16	2.21	3.41	174.4996	260.17
Tysse	49.85	1.29	2.34	3.62	201.9156	241.69
Arna	55.48	0.00	1.05	0.00	219.4916	187.47

	Passing time	Arrival time	Depart. time	Total time	Distance	Average Speed
Bergen	1:01.71	0.00	0.00	0.00	228.8416	108.19
Bergen-Stavanger						
Bergen	0.00	0.00	0.00	0.00	0.0000	
Arna	5.22	0.00	1.05	0.00	9.3500	107.43
Tysse	12.23	1.11	2.16	3.56	26.9260	176.96
Kvam-Jondal	19.01	1.20	2.25	3.65	54.3420	242.51
Odda	26.42	1.54	2.59	4.67	85.5960	253.29
Røldal	34.87	1.35	2.40	3.44	121.4260	254.48
Sauda	43.24	1.38	2.43	4.05	154.6690	238.26
Ølen	50.82	1.51	2.56	4.01	186.8590	254.85
Kårstø	1:00.75	1.25	2.30	3.72	226.8530	241.59
Stavanger	1:13.19	0.00	0.00	0.00	275.9730	236.81
Stavanger-Bergen						
Stavanger	0.00	0.00	0.00	0.00	0.0000	
Kårstø	12.86	1.18	2.23	3.54	49.1200	229.26
Ølen	22.84	1.31	2.36	4.01	89.1104	240.21
Sauda	30.50	1.45	2.50	4.22	121.3004	252.40
Røldal	39.08	1.11	2.16	3.60	154.5560	232.52
Odda	47.19	1.57	2.62	4.50	190.3860	264.91
Kvam-Jondal	54.40	1.16	2.21	3.41	221.6400	260.17
Tysse	1:01.21	1.29	2.34	3.62	249.0560	241.69
Arna	1:06.83	0.00	1.05	0.00	266.6320	187.47
Bergen	1:13.07	0.00	0.00	0.00	275.9820	108.19

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	Passing time	Arrival time	Depart. time	Total time	Distance	Average Speed
Skien-Oslo						
Skien	0.00	0.00	0.00	0.00	0.0000	
Nordagutu	8.91	1.67	2.72	3.98	30.4300	204.98
Notodden	13.84	1.05	2.10	3.83	48.9688	225.27
Kongsberg	20.42	2.73	3.78	6.68	76.4610	250.70
Eiker	25.96	1.31	2.36	3.46	98.8068	242.00
Drammen	29.88	0.00	1.05	0.00	108.6988	151.66
Nesbru	38.21	1.36	2.41	3.54	130.7088	181.46
Majorstua	43.43	0.00	1.05	0.00	146.0088	175.69
Oslo S	47.29	0.00	0.00	0.00	149.5288	75.26
Oslo-Skien						
Oslo S	0.00	0.00	0.00	0.00	0.0000	
Majorstua	2.58	0.00	1.05	0.00	3.5200	81.90
Nesbru	8.87	1.16	2.21	3.59	18.8200	175.05
Drammen	16.07	0.00	1.05	0.00	40.8300	183.45
Eiker	20.98	1.16	2.21	3.48	50.7220	153.73
Kongsberg	26.82	2.71	3.76	6.50	72.9400	228.24
Notodden	33.45	1.69	2.74	3.95	100.5600	250.06
Nordagutu	38.23	1.29	2.34	3.99	119.1080	232.72
Skien	46.92	0.00	0.00	0.00	149.5380	210.27
Skien-Bergen						
Skien	0.00	0.00	0.00	0.00	0.0000	
Nordagutu	9.34	1.24	2.29	2.82	30.4300	195.57
Bø	14.42	1.74	2.79	5.05	47.3152	199.43
Brunkeberg	22.97	1.44	2.49	4.47	83.0866	250.93
Åmot	30.57	1.66	2.71	4.04	115.7186	257.74

	Passing time	Arrival time	Depart. time	Total time	Distance	Average Speed
Haukeligrend	38.64	1.46	2.51	4.53	149.1426	248.51
Røldal	51.76	1.52	2.57	4.26	207.4706	266.55
Odda	59.63	1.57	2.62	4.50	243.3006	273.34
Kvam-Jondal	1:06.84	1.16	2.21	3.41	274.5546	260.17
Tysse	1:13.64	1.29	2.34	3.62	301.9706	241.69
Arna	1:19.27	0.00	1.05	0.00	319.5466	187.47
Bergen	1:25.50	0.00	0.00	0.00	328.8966	108.19
Bergen-Skien						
Bergen	0.00	0.00	0.00	0.00	0.0000	
Arna	5.22	0.00	1.05	0.00	9.3500	107.43
Tysse	12.23	1.11	2.16	3.56	26.9260	176.96
Kvam-Jondal	19.01	1.20	2.25	3.65	54.3420	242.51
Odda	26.42	1.54	2.59	4.67	85.5960	253.29
Røldal	34.86	1.36	2.41	4.22	121.4260	254.59
Haukeligrend	48.52	1.65	2.70	4.27	179.7540	256.17
Åmot	56.59	1.35	2.40	4.19	213.1780	248.62
Brunkeberg	1:04.21	1.53	2.58	4.10	245.8100	256.86
Bø	1:12.36	1.88	2.93	4.76	281.4270	262.32
Nordagutu	1:17.25	0.65	1.70	2.68	298.4040	208.20
Skien	1:26.60	0.00	0.00	0.00	328.8340	195.35
Skien-Haugesund						
Skien	0.00	0.00	0.00	0.00	0.0000	
Nordagutu	9.34	1.24	2.29	2.82	30.4300	195.57
Bø	14.42	1.74	2.79	5.05	47.3152	199.43
Brunkeberg	22.97	1.44	2.49	4.47	83.0866	250.93
Åmot	30.57	1.66	2.71	4.04	115.7186	257.74

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	Passing time	Arrival time	Depart. time	Total time	Distance	Average Speed
Haukeligrend	38.64	1.46	2.51	4.53	149.1426	248.51
Sauda	56.85	1.38	2.43	4.05	227.4826	258.01
Ølen	1:04.43	1.51	2.56	4.01	259.6726	254.85
Aksdal	1:11.99	1.53	2.58	3.85	291.9626	256.30
Haugesund	1:15.73	0.00	0.00	0.00	301.6426	155.22
Haugesund-Skien						
Haugesund	0.00	0.00	0.00	0.00	0.0000	
Aksdal	3.84	1.18	2.23	3.78	9.6800	151.39
Ølen	11.49	1.31	2.36	4.01	41.9700	253.19
Sauda	19.14	1.45	2.50	4.22	74.1600	252.40
Haukeligrend	38.28	1.65	2.70	4.27	152.4976	245.62
Åmot	46.34	1.35	2.40	4.19	185.9216	248.62
Brunkeberg	53.97	1.53	2.58	4.10	218.5536	256.86
Bø	1:02.11	1.88	2.93	4.76	254.1706	262.32
Nordagutu	1:07.00	0.65	1.70	2.68	271.1476	208.20
Skien	1:16.35	0.00	0.00	0.00	301.5776	195.35
Skien-Stavanger						
Skien	0.00	0.00	0.00	0.00	0.0000	
Nordagutu	9.34	1.24	2.29	2.82	30.4300	195.57
Bø	14.42	1.74	2.79	5.05	47.3152	199.43
Brunkeberg	22.97	1.44	2.49	4.47	83.0866	250.93
Åmot	30.57	1.66	2.71	4.04	115.7186	257.74
Haukeligrend	38.64	1.46	2.51	4.53	149.1426	248.51
Sauda	56.85	1.38	2.43	4.05	227.4826	258.01
Ølen	1:04.43	1.51	2.56	4.01	259.6726	254.85
Kårstø	1:14.36	1.25	2.30	3.72	299.6666	241.59

	Passing time	Arrival time	Depart. time	Total time	Distance	Average Speed
Stavanger	1:26.81	0.00	0.00	0.00	348.7866	236.81
Stavanger-Skien						
Stavanger	0.00	0.00	0.00	0.00	0.0000	
Kårstø	12.86	1.18	2.23	3.54	49.1200	229.26
Ølen	22.84	1.31	2.36	4.01	89.1104	240.21
Sauda	30.50	1.45	2.50	4.22	121.3004	252.40
Haukeligrend	49.63	1.65	2.70	4.27	199.6380	245.62
Åmot	57.70	1.35	2.40	4.19	233.0620	248.62
Brunkeberg	1:05.32	1.53	2.58	4.10	265.6940	256.86
Bø	1:13.47	1.88	2.93	4.76	301.3110	262.32
Nordagutu	1:18.36	0.65	1.70	2.68	318.2880	208.20
Skien	1:27.71	0.00	0.00	0.00	348.7180	195.35

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Appendix 3

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From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Bergen	Arna	5.22	69.90	41.94	72	
Bergen	Tysse	13.34	120.27	72.16	36	
Bergen	Kvam-Jondal	21.99	201.98	121.19	36	
Bergen	Odda	31.57	290.60	174.36	36	
Bergen	Røldal	42.17	391.12	234.67	36	
Bergen	Sauda	52.28	480.98	288.59	16	
Bergen	Ølen	1:02.02	566.03	339.62	16	
Bergen	Aksdal	1:11.60	651.60	390.96	16	
Bergen	Haugesund	1:17.66	674.56	404.74	16	
Bergen	Kårstø	1:23.61	669.47	401.68	16	
Bergen	Stavanger	1:36.66	791.82	475.09	32	
Bergen	Haukeligrend	58.22	547.60	328.56	24	
Bergen	Åmot	1:08.13	636.20	381.72	24	
Bergen	Brunkeberg	1:18.03	717.48	430.49	24	
Bergen	Bø	1:28.58	806.48	483.89	24	
Bergen	Nordagutu	1:44.64	847.60	508.56	8	0.50
Bergen	Skien	1:54.68	918.76	551.26	16	0.50
Bergen	Notodden	1:37.12	876.28	525.77	16	
Bergen	Kongsberg	1:47.18	942.08	565.25	16	
Bergen	Eiker	1:54.64	992.68	595.61	16	
Bergen	Drammen	1:58.97	1015.36	609.22	32	
Bergen	Nesbru	2:13.66	1064.55	638.73	32	0.50
Bergen	Majorstua	2:16.56	1097.54	658.52	32	
Bergen	Oslo S	2:20.41	1106.26	663.75	32	
Bergen	Holmestrand	2:24.72	1086.59	651.95	32	1.00
Bergen	Tønsberg	2:42.99	1095.35	657.21	32	0.50
Bergen	Sandefjord	2:32.73	1037.84	622.70	16	0.50
Bergen	Larvik	2:14.73	994.96	596.97	16	0.50
Bergen	Porsgrunn	2:02.23	937.43	562.46	16	0.50
Bergen	Drangedal	2:12.58	907.02	544.21	16	1.00
Bergen	Gjerstad	2:37.58	981.26	588.76	16	1.00
Bergen	Arendal	3:57.58	1160.03	696.02	16	1.00
Bergen	Kristiansand	4:12.58	1259.78	755.87	16	1.00
Arna	Bergen	5.19	69.90	41.94	72	
Arna	Tysse	7.07	93.68	56.21	36	
Arna	Kvam-Jondal	15.72	172.98	103.79	36	
Arna	Odda	25.29	265.07	159.04	36	
Arna	Røldal	35.89	366.23	219.74	36	
Arna	Sauda	46.01	456.68	274.01	16	
Arna	Ølen	55.74	542.32	325.39	16	
Arna	Aksdal	1:05.33	625.90	375.54	16	
Arna	Haugesund	1:11.39	651.60	390.96	16	
Arna	Kårstø	1:17.34	646.48	387.89	16	
Arna	Stavanger	1:30.39	769.71	461.83	32	
Arna	Haukeligrend	51.95	523.76	314.26	24	
Arna	Åmot	1:01.86	610.38	366.23	24	
Arna	Brunkeberg	1:11.76	694.83	416.90	24	
Arna	Bø	1:22.31	784.47	470.68	24	
Arna	Nordagutu	1:38.37	825.90	495.54	8	0.50
Arna	Skien	1:48.40	897.60	538.56	16	0.50
Arna	Notodden	1:30.85	854.80	512.88	16	
Arna	Kongsberg	1:40.90	918.76	551.26	16	
Arna	Eiker	1:48.37	972.10	583.26	16	
Arna	Drammen	1:52.70	994.96	596.97	32	
Arna	Nesbru	2:07.39	1044.54	626.73	32	0.50
Arna	Majorstua	2:10.29	1077.80	646.68	32	
Arna	Oslo S	2:14.14	1084.40	650.64	32	
Arna	Holmestrand	2:18.45	1066.76	640.06	32	1.00
Arna	Tønsberg	2:36.72	1073.39	644.03	32	0.50
Arna	Sandefjord	2:26.45	1017.62	610.57	16	0.50
Arna	Larvik	2:08.45	974.39	584.63	16	0.50
Arna	Porsgrunn	1:55.95	916.42	549.85	16	0.50
Arna	Drangedal	2:06.31	885.78	531.47	16	1.00
Arna	Gjerstad	2:31.31	960.59	576.35	16	1.00
Arna	Arendal	3:51.31	1140.82	684.49	16	1.00
Arna	Kristiansand	4:06.31	1239.38	743.63	16	1.00
Tysse	Bergen	13.15	120.27	72.16	36	
Tysse	Arna	6.91	93.68	56.21	36	
Tysse	Kvam-Jondal	9.38	123.22	73.93	18	
Tysse	Odda	18.95	213.52	128.11	18	
Tysse	Røldal	29.55	315.98	189.59	18	
Tysse	Sauda	39.66	407.62	244.57	8	
Tysse	Ølen	49.40	494.40	296.64	8	
Tysse	Aksdal	58.99	581.75	349.05	8	
Tysse	Haugesund	1:05.05	605.20	363.12	8	
Tysse	Kårstø	1:11.00	600.00	360.00	8	
Tysse	Stavanger	1:24.05	727.50	436.50	16	
Tysse	Haukeligrend	45.61	475.59	285.35	12	
Tysse	Åmot	55.52	566.03	339.62	12	
Tysse	Brunkeberg	1:05.42	649.04	389.42	12	
Tysse	Bø	1:15.96	739.98	443.99	12	
Tysse	Nordagutu	1:32.70	782.02	469.21	8	0.75
Tysse	Skien	1:42.06	854.80	512.88	12	0.50
Tysse	Notodden	1:24.51	811.34	486.81	8	
Tysse	Kongsberg	1:34.56	878.66	527.19	8	
Tysse	Eiker	1:42.03	930.44	558.27	8	
Tysse	Drammen	1:46.36	953.66	572.20	16	

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From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Tysse	Nesbru	2:01.05	1004.04	602.43	16	0.50
Tysse	Majorstua	2:03.94	1037.84	622.70	16	
Tysse	Oslo S	2:07.80	1046.78	628.07	16	
Tysse	Holmestrand	2:12.11	1026.62	615.97	16	1.00
Tysse	Tønsberg	2:30.38	1035.60	621.36	16	0.50
Tysse	Sandefjord	2:20.11	976.68	586.01	12	0.50
Tysse	Larvik	2:02.11	932.78	559.67	12	0.50
Tysse	Porsgrunn	1:49.61	873.90	524.34	12	0.50
Tysse	Drangedal	1:59.96	842.79	505.67	8	1.00
Tysse	Gjerstad	2:24.96	918.76	551.26	8	1.00
Tysse	Arendal	3:44.96	1101.90	661.14	8	1.00
Tysse	Kristiansand	3:59.96	1204.24	722.54	8	1.00
Kvam-Jondal	Bergen	21.68	201.98	121.19	36	
Kvam-Jondal	Arna	15.45	172.98	103.79	36	
Kvam-Jondal	Tysse	9.30	123.22	73.93	18	
Kvam-Jondal	Odda	10.35	134.98	80.99	18	
Kvam-Jondal	Røldal	20.95	239.38	143.63	18	
Kvam-Jondal	Sauda	31.06	332.80	199.68	8	
Kvam-Jondal	Ølen	40.80	421.31	252.79	8	
Kvam-Jondal	Aksdal	50.39	507.78	304.67	8	
Kvam-Jondal	Haugesund	56.45	534.38	320.63	8	
Kvam-Jondal	Kårstø	1:02.40	529.07	317.44	8	
Kvam-Jondal	Stavanger	1:15.45	656.72	394.03	16	
Kvam-Jondal	Haukeligrend	37.01	402.12	241.27	12	
Kvam-Jondal	Åmot	46.92	491.72	295.03	12	
Kvam-Jondal	Brunkeberg	56.82	579.14	347.48	12	
Kvam-Jondal	Bø	1:07.36	672.02	403.21	12	
Kvam-Jondal	Nordagutu	1:24.10	714.98	428.99	8	0.75
Kvam-Jondal	Skien	1:33.46	789.38	473.63	12	0.50

From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Kvam-Jondal	Notodden	1:15.90	744.95	446.97	8	
Kvam-Jondal	Kongsberg	1:25.96	811.34	486.81	8	
Kvam-Jondal	Eiker	1:33.43	866.75	520.05	8	
Kvam-Jondal	Drammen	1:37.76	890.51	534.31	16	
Kvam-Jondal	Nesbru	1:52.45	942.08	565.25	16	0.50
Kvam-Jondal	Majorstua	1:55.34	976.68	586.01	16	
Kvam-Jondal	Oslo S	1:59.20	983.55	590.13	16	
Kvam-Jondal	Holmestrand	2:03.51	965.20	579.12	16	1.00
Kvam-Jondal	Tønsberg	2:21.78	972.10	583.26	16	0.50
Kvam-Jondal	Sandefjord	2:11.51	914.07	548.44	12	0.50
Kvam-Jondal	Larvik	1:53.51	869.14	521.48	12	0.50
Kvam-Jondal	Porsgrunn	1:41.01	808.91	485.35	12	0.50
Kvam-Jondal	Drangedal	1:51.36	777.10	466.26	8	1.00
Kvam-Jondal	Gjerstad	2:16.36	854.80	512.88	8	1.00
Kvam-Jondal	Arendal	3:36.36	1042.31	625.39	8	1.00
Kvam-Jondal	Kristiansand	3:51.36	1145.10	687.06	8	1.00
Odda	Bergen	31.27	290.60	174.36	36	
Odda	Arna	25.04	265.07	159.04	36	
Odda	Tysse	18.89	213.52	128.11	18	
Odda	Kvam-Jondal	10.25	134.98	80.99	18	
Odda	Røldal	11.89	146.70	88.02	18	
Odda	Sauda	22.00	245.10	147.06	8	
Odda	Ølen	31.74	335.60	201.36	8	
Odda	Aksdal	41.32	424.04	254.43	8	
Odda	Haugesund	47.38	451.26	270.76	8	
Odda	Kårstø	53.33	445.84	267.50	8	
Odda	Stavanger	1:06.38	576.52	345.91	16	
Odda	Haukeligrend	27.94	315.98	189.59	12	
Odda	Åmot	37.85	407.62	244.57	12	

From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Odda	Brunkeberg	47.75	497.08	298.25	12	
Odda	Bø	58.30	589.58	353.75	12	
Odda	Nordagutu	1:15.04	633.63	380.18	8	0.75
Odda	Skien	1:24.40	712.46	427.48	12	0.50
Odda	Notodden	1:06.84	666.92	400.15	8	
Odda	Kongsberg	1:16.90	734.99	440.99	8	
Odda	Eiker	1:24.36	791.82	475.09	8	
Odda	Drammen	1:28.69	813.78	488.27	16	
Odda	Nesbru	1:43.38	866.75	520.05	16	0.50
Odda	Majorstua	1:46.28	904.67	542.80	16	
Odda	Oslo S	1:50.14	911.72	547.03	16	
Odda	Holmestrand	1:54.44	890.51	534.31	16	1.00
Odda	Tønsberg	2:12.71	899.96	539.98	16	0.50
Odda	Sandefjord	2:02.45	840.38	504.23	12	0.50
Odda	Larvik	1:44.45	791.82	475.09	12	0.50
Odda	Porsgrunn	1:31.95	732.50	439.50	12	0.50
Odda	Drangedal	1:42.30	699.88	419.93	8	1.00
Odda	Gjerstad	2:07.30	779.56	467.74	8	1.00
Odda	Arendal	3:27.30	969.80	581.88	8	1.00
Odda	Kristiansand	3:42.30	1077.80	646.68	8	1.00
Røldal	Bergen	41.19	391.12	234.67	36	
Røldal	Arna	34.96	366.23	219.74	36	
Røldal	Tysse	28.81	315.98	189.59	18	
Røldal	Kvam-Jondal	20.17	239.38	143.63	18	
Røldal	Odda	11.12	146.70	88.02	18	
Røldal	Sauda	10.78	140.84	84.51	8	
Røldal	Ølen	20.52	233.64	140.19	8	
Røldal	Aksdal	30.11	324.40	194.64	8	
Røldal	Haugesund	36.16	352.34	211.40	8	

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From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Røldal	Kårstø	42.12	346.76	208.06	8	
Røldal	Stavanger	55.17	480.98	288.59	16	
Røldal	Haukeligrend	17.12	213.52	128.11	12	
Røldal	Åmot	27.03	307.54	184.52	12	
Røldal	Brunkeberg	36.93	399.38	239.63	12	
Røldal	Bø	47.47	497.08	298.25	12	
Røldal	Nordagutu	1:04.21	539.67	323.80	8	0.75
Røldal	Skien	1:13.57	620.74	372.44	12	0.50
Røldal	Notodden	56.01	573.90	344.34	8	
Røldal	Kongsberg	1:06.07	643.91	386.35	8	
Røldal	Eiker	1:13.53	702.40	421.44	8	
Røldal	Drammen	1:17.86	727.50	436.50	16	
Røldal	Nesbru	1:32.56	782.02	469.21	16	0.50
Røldal	Majorstua	1:35.45	818.63	491.18	16	
Røldal	Oslo S	1:39.31	825.90	495.54	16	
Røldal	Holmestrand	1:43.61	804.04	482.42	16	1.00
Røldal	Tønsberg	2:01.89	813.78	488.27	16	0.50
Røldal	Sandefjord	1:51.62	752.40	451.44	12	0.50
Røldal	Larvik	1:33.62	704.92	422.95	12	0.50
Røldal	Porsgrunn	1:21.12	641.34	384.81	12	0.50
Røldal	Drangedal	1:31.47	607.79	364.67	8	1.00
Røldal	Gjerstad	1:56.47	689.78	413.87	8	1.00
Røldal	Arendal	3:16.47	885.78	531.47	8	1.00
Røldal	Kristiansand	3:31.47	997.23	598.34	8	1.00
Sauda	Bergen	51.86	480.98	288.59	16	
Sauda	Arna	45.62	456.68	274.01	16	
Sauda	Tysse	39.48	407.62	244.57	8	
Sauda	Kvam-Jondal	30.84	332.80	199.68	8	
Sauda	Odda	21.78	245.10	147.06	8	

From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Sauda	Røldal	11.41	140.84	84.51	8	
Sauda	Ølen	10.71	137.91	82.75	18	
Sauda	Aksdal	20.30	230.78	138.47	20	
Sauda	Haugesund	26.36	259.38	155.63	20	
Sauda	Kårstø	32.31	253.67	152.20	18	
Sauda	Stavanger	45.36	391.12	234.67	36	
Sauda	Haukeligrend	22.51	270.76	162.46	8	
Sauda	Åmot	34.55	363.46	218.07	8	
Sauda	Brunkeberg	46.55	453.98	272.39	8	
Sauda	Bø	49.72	550.24	330.14	12	
Sauda	Nordagutu	1:04.98	592.19	355.31	8	0.75
Sauda	Skien	1:15.88	672.02	403.21	12	0.50
Sauda	Notodden	59.52	625.90	375.54	8	
Sauda	Kongsberg	1:09.57	694.83	416.90	8	
Sauda	Eiker	1:17.04	752.40	451.44	8	
Sauda	Drammen	1:21.37	777.10	466.26	16	
Sauda	Nesbru	1:36.06	830.74	498.44	16	0.50
Sauda	Majorstua	1:38.96	866.75	520.05	16	
Sauda	Oslo S	1:42.81	873.90	524.34	16	
Sauda	Holmestrand	1:47.12	852.40	511.44	16	1.00
Sauda	Tønsberg	2:05.39	861.98	517.19	16	0.50
Sauda	Sandefjord	1:53.93	801.60	480.96	12	0.50
Sauda	Larvik	1:35.93	754.88	452.93	12	0.50
Sauda	Porsgrunn	1:23.43	692.30	415.38	12	0.50
Sauda	Drangedal	1:33.72	659.27	395.56	8	1.00
Sauda	Gjerstad	1:58.72	739.98	443.99	8	1.00
Sauda	Arendal	3:18.72	932.78	559.67	8	1.00
Sauda	Kristiansand	3:33.72	1042.31	625.39	8	1.00
Ølen	Bergen	1:01.54	566.03	339.62	16	

From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Ølen	Arna	55.31	542.32	325.39	16	
Ølen	Tysse	49.16	494.40	296.64	8	
Ølen	Kvam-Jondal	40.52	421.31	252.79	8	
Ølen	Odda	31.47	335.60	201.36	8	
Ølen	Røldal	21.10	233.64	140.19	8	
Ølen	Sauda	10.74	137.91	82.75	18	
Ølen	Aksdal	10.54	137.91	82.75	20	
Ølen	Haugesund	16.60	164.24	98.54	20	
Ølen	Kårstø	22.55	158.40	95.04	18	
Ølen	Stavanger	35.60	301.90	181.14	36	
Ølen	Haukeligrend	32.19	360.68	216.41	8	
Ølen	Åmot	44.23	451.26	270.76	8	
Ølen	Brunkeberg	56.23	539.67	323.80	8	
Ølen	Bø	59.40	633.63	380.18	12	
Ølen	Nordagutu	1:14.67	677.10	406.26	8	0.75
Ølen	Skien	1:25.56	752.40	451.44	12	0.50
Ølen	Notodden	1:09.20	707.44	424.46	8	
Ølen	Kongsberg	1:19.26	777.10	466.26	8	
Ølen	Eiker	1:26.72	830.74	498.44	8	
Ølen	Drammen	1:31.05	854.80	512.88	16	
Ølen	Nesbru	1:45.74	907.02	544.21	16	0.50
Ølen	Majorstua	1:48.64	942.08	565.25	16	
Ølen	Oslo S	1:52.49	951.35	570.81	16	
Ølen	Holmestrand	1:56.80	930.44	558.27	16	1.00
Ølen	Tønsberg	2:15.07	937.43	562.46	16	0.50
Ølen	Sandefjord	2:03.61	878.66	527.19	12	0.50
Ølen	Larvik	1:45.61	833.15	499.89	12	0.50
Ølen	Porsgrunn	1:33.11	772.18	463.31	12	0.50
Ølen	Drangedal	1:43.40	739.98	443.99	8	1.00

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From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Ølen	Gjerstad	2:08.40	818.63	491.18	8	1.00
Ølen	Arendal	3:28.40	1008.58	605.15	8	1.00
Ølen	Kristiansand	3:43.40	1112.78	667.67	8	1.00
Aksdal	Bergen	1:11.10	651.60	390.96	16	
Aksdal	Arna	1:04.87	625.90	375.54	16	
Aksdal	Tysse	58.72	581.75	349.05	8	
Aksdal	Kvam-Jondal	50.08	507.78	304.67	8	
Aksdal	Odda	41.03	424.04	254.43	8	
Aksdal	Røldal	30.65	324.40	194.64	8	
Aksdal	Sauda	20.30	230.78	138.47	20	
Aksdal	Ølen	10.51	137.91	82.75	20	
Aksdal	Haugesund	5.01	69.90	41.94	60	
Aksdal	Kårstø	6.42	84.78	50.87	10	
Aksdal	Stavanger	19.47	227.90	136.74	20	
Aksdal	Haukeligrend	41.75	448.55	269.13	8	
Aksdal	Åmot	53.79	539.67	323.80	8	
Aksdal	Brunkeberg	1:05.79	623.32	373.99	8	
Aksdal	Bø	1:05.82	714.98	428.99	16	
Aksdal	Nordagutu	1:25.08	757.36	454.41	8	0.50
Aksdal	Skien	1:35.12	830.74	498.44	16	0.50
Aksdal	Notodden	1:16.87	786.92	472.15	8	
Aksdal	Kongsberg	1:26.92	854.80	512.88	8	
Aksdal	Eiker	1:34.39	907.02	544.21	8	
Aksdal	Drammen	1:38.72	930.44	558.27	16	
Aksdal	Nesbru	1:53.41	981.26	588.76	16	0.50
Aksdal	Majorstua	1:56.31	1015.36	609.22	16	
Aksdal	Oslo S	2:00.16	1024.38	614.63	16	
Aksdal	Holmestrand	2:04.47	1004.04	602.43	16	1.00
Aksdal	Tønsberg	2:24.63	1013.10	607.86	16	0.50

From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Aksdal	Sandefjord	2:13.17	953.66	572.20	16	0.50
Aksdal	Larvik	1:55.17	909.38	545.63	16	0.50
Aksdal	Porsgrunn	1:42.67	850.00	510.00	16	0.50
Aksdal	Drangedal	1:49.82	818.63	491.18	16	1.00
Aksdal	Gjerstad	2:14.82	895.24	537.14	16	1.00
Aksdal	Arendal	3:34.82	1080.00	648.00	16	1.00
Aksdal	Kristiansand	3:49.82	1183.30	709.98	16	1.00
Haugesund	Bergen	1:17.17	674.56	404.74	16	
Haugesund	Arna	1:10.94	651.60	390.96	16	
Haugesund	Tysse	1:04.79	605.20	363.12	8	
Haugesund	Kvam-Jondal	56.15	534.38	320.63	8	
Haugesund	Odda	47.10	451.26	270.76	8	
Haugesund	Røldal	36.73	352.34	211.40	8	
Haugesund	Sauda	26.37	259.38	155.63	20	
Haugesund	Ølen	16.58	164.24	98.54	20	
Haugesund	Aksdal	5.02	69.90	41.94	60	
Haugesund	Kårstø	10.86	114.38	68.63	20	
Haugesund	Stavanger	23.92	256.52	153.91	40	
Haugesund	Haukeligrend	47.82	475.59	285.35	8	
Haugesund	Åmot	59.86	563.40	338.04	8	
Haugesund	Brunkeberg	1:11.86	649.04	389.42	8	
Haugesund	Bø	1:11.89	739.98	443.99	16	
Haugesund	Nordagutu	1:31.15	782.02	469.21	8	0.50
Haugesund	Skien	1:41.19	854.80	512.88	16	0.50
Haugesund	Notodden	1:22.94	811.34	486.81	8	
Haugesund	Kongsberg	1:33.00	878.66	527.19	8	
Haugesund	Eiker	1:40.46	930.44	558.27	8	
Haugesund	Drammen	1:44.79	953.66	572.20	16	
Haugesund	Nesbru	1:59.48	1004.04	602.43	16	0.50

From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Haugesund	Majorstua	2:02.38	1037.84	622.70	16	
Haugesund	Oslo S	2:06.23	1046.78	628.07	16	
Haugesund	Holmestrand	2:10.54	1026.62	615.97	16	1.00
Haugesund	Tønsberg	2:30.70	1033.36	620.02	16	0.50
Haugesund	Sandefjord	2:19.24	976.68	586.01	16	0.50
Haugesund	Larvik	2:01.24	932.78	559.67	16	0.50
Haugesund	Porsgrunn	1:48.74	873.90	524.34	16	0.50
Haugesund	Drangedal	1:55.89	842.79	505.67	16	1.00
Haugesund	Gjerstad	2:20.89	918.76	551.26	16	1.00
Haugesund	Arendal	3:40.89	1101.90	661.14	16	1.00
Haugesund	Kristiansand	3:55.89	1202.15	721.29	16	1.00
Kårstø	Bergen	1:23.18	669.47	401.68	16	
Kårstø	Arna	1:16.95	646.48	387.89	16	
Kårstø	Tysse	1:10.80	600.00	360.00	8	
Kårstø	Kvam-Jondal	1:02.16	529.07	317.44	8	
Kårstø	Odda	53.11	445.84	267.50	8	
Kårstø	Røldal	42.73	346.76	208.06	8	
Kårstø	Sauda	32.38	253.67	152.20	18	
Kårstø	Ølen	22.59	158.40	95.04	18	
Kårstø	Aksdal	6.53	84.78	50.87	10	
Kårstø	Haugesund	10.99	114.38	68.63	20	
Kårstø	Stavanger	13.86	187.50	112.50	36	
Kårstø	Haukeligrend	53.83	470.20	282.12	8	
Kårstø	Åmot	1:04.80	558.14	334.89	8	
Kårstø	Brunkeberg	1:15.75	643.91	386.35	8	
Kårstø	Bø	1:21.04	734.99	440.99	12	
Kårstø	Nordagutu	1:31.31	777.10	466.26	8	0.75
Kårstø	Skien	1:50.28	850.00	510.00	12	0.50
Kårstø	Notodden	1:30.83	806.48	483.89	8	

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From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Kårstø	Kongsberg	1:40.89	873.90	524.34	8	
Kårstø	Eiker	1:48.35	925.78	555.47	8	
Kårstø	Drammen	1:52.69	949.04	569.42	16	
Kårstø	Nesbru	2:07.38	999.50	599.70	16	0.50
Kårstø	Majorstua	2:10.27	1033.36	620.02	16	
Kårstø	Oslo S	2:14.13	1042.31	625.39	16	
Kårstø	Holmestrand	2:18.44	1022.12	613.27	16	1.00
Kårstø	Tønsberg	2:36.71	1028.87	617.32	16	0.50
Kårstø	Sandefjord	2:28.33	972.10	583.26	12	0.50
Kårstø	Larvik	2:10.33	928.11	556.87	12	0.50
Kårstø	Porsgrunn	1:57.83	869.14	521.48	12	0.50
Kårstø	Drangedal	2:05.04	837.98	502.79	8	1.00
Kårstø	Gjerstad	2:30.04	914.07	548.44	8	1.00
Kårstø	Arendal	3:50.04	1097.54	658.52	8	1.00
Kårstø	Kristiansand	4:05.04	1197.98	718.79	8	1.00
Stavanger	Bergen	1:36.50	791.82	475.09	32	
Stavanger	Arna	1:30.26	769.71	461.83	32	
Stavanger	Tysse	1:24.11	727.50	436.50	16	
Stavanger	Kvam-Jondal	1:15.47	656.72	394.03	16	
Stavanger	Odda	1:06.42	576.52	345.91	16	
Stavanger	Røldal	56.05	480.98	288.59	16	
Stavanger	Sauda	45.70	391.12	234.67	36	
Stavanger	Ølen	35.91	301.90	181.14	36	
Stavanger	Aksdal	19.84	227.90	136.74	20	
Stavanger	Haugesund	24.31	256.52	153.91	40	
Stavanger	Kårstø	14.04	187.50	112.50	36	
Stavanger	Haukeligrend	1:07.14	600.00	360.00	16	
Stavanger	Åmot	1:18.12	687.24	412.35	16	
Stavanger	Brunkeberg	1:29.07	767.24	460.35	16	

From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Stavanger	Bø	1:34.36	854.80	512.88	24	
Stavanger	Nordagutu	1:53.56	895.24	537.14	8	0.50
Stavanger	Skien	2:03.60	965.20	579.12	16	0.50
Stavanger	Notodden	1:44.15	923.44	554.06	16	
Stavanger	Kongsberg	1:54.21	988.12	592.87	16	
Stavanger	Eiker	2:01.67	1037.84	622.70	16	
Stavanger	Drammen	2:06.00	1060.12	636.07	32	
Stavanger	Nesbru	2:20.69	1108.43	665.06	32	0.50
Stavanger	Majorstua	2:23.59	1140.82	684.49	32	
Stavanger	Oslo S	2:27.45	1149.38	689.63	32	
Stavanger	Holmestrand	2:31.75	1130.07	678.04	32	1.00
Stavanger	Tønsberg	2:50.03	1136.52	681.91	16	0.50
Stavanger	Sandefjord	2:41.65	1082.20	649.32	16	0.50
Stavanger	Larvik	2:23.65	1040.08	624.05	16	0.50
Stavanger	Porsgrunn	2:11.15	983.55	590.13	16	0.50
Stavanger	Drangedal	2:18.36	953.66	572.20	16	1.00
Stavanger	Gjerstad	2:43.36	1026.62	615.97	16	1.00
Stavanger	Arendal	4:03.36	1202.15	721.29	16	1.00
Stavanger	Kristiansand	4:18.36	1297.98	778.79	16	1.00
Haukeligrend	Bergen	56.78	547.60	328.56	24	
Haukeligrend	Arna	50.54	523.76	314.26	24	
Haukeligrend	Tysse	44.39	475.59	285.35	12	
Haukeligrend	Kvam-Jondal	35.76	402.12	241.27	12	
Haukeligrend	Odda	26.70	315.98	189.59	12	
Haukeligrend	Røldal	16.66	213.52	128.11	12	
Haukeligrend	Sauda	21.61	270.76	162.46	8	
Haukeligrend	Ølen	31.35	360.68	216.41	8	
Haukeligrend	Aksdal	40.93	448.55	269.13	8	
Haukeligrend	Haugesund	46.99	475.59	285.35	8	

From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Haukeligrend	Kårstø	52.94	470.20	282.12	8	
Haukeligrend	Stavanger	1:05.99	600.00	360.00	16	
Haukeligrend	Åmot	10.99	140.84	84.51	28	
Haukeligrend	Brunkeberg	20.89	236.51	141.91	28	
Haukeligrend	Bø	31.44	335.60	201.36	28	
Haukeligrend	Nordagutu	44.00	382.84	229.70	8	
Haukeligrend	Skien	54.04	467.50	280.50	16	
Haukeligrend	Notodden	39.98	415.84	249.50	12	
Haukeligrend	Kongsberg	50.04	491.72	295.03	12	
Haukeligrend	Eiker	57.50	550.24	330.14	12	
Haukeligrend	Drammen	1:01.83	576.52	345.91	24	
Haukeligrend	Nesbru	1:16.52	633.63	380.18	24	0.50
Haukeligrend	Majorstua	1:19.42	674.56	404.74	24	
Haukeligrend	Oslo S	1:23.28	682.18	409.31	24	
Haukeligrend	Holmestrand	1:27.58	659.27	395.56	24	1.00
Haukeligrend	Tønsberg	1:47.57	669.47	401.68	16	
Haukeligrend	Sandefjord	1:25.57	602.60	361.56	16	
Haukeligrend	Larvik	1:07.57	552.88	331.73	16	
Haukeligrend	Porsgrunn	55.07	486.35	291.81	16	
Haukeligrend	Drangedal	1:17.51	451.26	270.76	16	1.00
Haukeligrend	Gjerstad	1:42.51	539.67	323.80	16	1.00
Haukeligrend	Arendal	3:02.51	744.95	446.97	16	1.00
Haukeligrend	Kristiansand	3:17.51	861.98	517.19	16	1.00
Åmot	Bergen	1:06.43	636.20	381.72	24	
Åmot	Arna	1:00.20	610.38	366.23	24	
Åmot	Tysse	54.05	566.03	339.62	12	
Åmot	Kvam-Jondal	45.41	491.72	295.03	12	
Åmot	Odda	36.36	407.62	244.57	12	
Åmot	Røldal	26.32	307.54	184.52	12	

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From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Åmot	Sauda	33.53	363.46	218.07	8	
Åmot	Ølen	43.26	451.26	270.76	8	
Åmot	Aksdal	52.85	539.67	323.80	8	
Åmot	Haugesund	58.91	563.40	338.04	8	
Åmot	Kårstø	1:03.73	558.14	334.89	8	
Åmot	Stavanger	1:16.78	687.24	412.35	16	
Åmot	Haukeligrend	10.87	140.84	84.51	28	
Åmot	Brunkeberg	10.94	137.91	82.75	28	
Åmot	Bø	21.49	242.24	145.34	28	
Åmot	Nordagutu	31.96	290.60	174.36	8	
Åmot	Skien	42.00	374.54	224.73	16	
Åmot	Notodden	30.03	324.40	194.64	12	
Åmot	Kongsberg	40.09	402.12	241.27	12	
Åmot	Eiker	47.55	462.10	277.26	12	
Åmot	Drammen	51.88	489.04	293.42	24	
Åmot	Nesbru	1:06.57	547.60	328.56	24	0.50
Åmot	Majorstua	1:09.47	586.98	352.19	24	
Åmot	Oslo S	1:13.33	597.40	358.44	24	
Åmot	Holmestrand	1:17.63	573.90	344.34	24	1.00
Åmot	Tønsberg	1:37.62	581.75	349.05	16	
Åmot	Sandefjord	1:15.62	515.78	309.47	16	
Åmot	Larvik	57.62	464.80	278.88	16	
Åmot	Porsgrunn	45.12	396.62	237.97	16	
Åmot	Drangedal	1:06.51	360.68	216.41	16	1.00
Åmot	Gjerstad	1:31.51	448.55	269.13	16	1.00
Åmot	Arendal	2:51.51	661.82	397.09	16	1.00
Åmot	Kristiansand	3:06.51	779.56	467.74	16	1.00
Brunkeberg	Bergen	1:16.70	717.48	430.49	24	
Brunkeberg	Arna	1:10.46	694.83	416.90	24	

From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Brunkeberg	Tysse	1:04.31	649.04	389.42	12	
Brunkeberg	Kvam-Jondal	55.67	579.14	347.48	12	
Brunkeberg	Odda	46.62	497.08	298.25	12	
Brunkeberg	Røldal	36.58	399.38	239.63	12	
Brunkeberg	Sauda	45.81	453.98	272.39	8	
Brunkeberg	Ølen	55.55	539.67	323.80	8	
Brunkeberg	Aksdal	1:05.14	623.32	373.99	8	
Brunkeberg	Haugesund	1:11.20	649.04	389.42	8	
Brunkeberg	Kårstø	1:15.00	643.91	386.35	8	
Brunkeberg	Stavanger	1:28.05	767.24	460.35	16	
Brunkeberg	Haukeligrend	21.13	236.51	141.91	28	
Brunkeberg	Åmot	11.24	137.91	82.75	28	
Brunkeberg	Bø	11.55	146.70	88.02	28	
Brunkeberg	Nordagutu	19.97	196.19	117.71	8	
Brunkeberg	Skien	30.00	284.94	170.97	16	
Brunkeberg	Notodden	20.09	230.78	138.47	12	
Brunkeberg	Kongsberg	30.14	310.35	186.21	12	
Brunkeberg	Eiker	37.61	371.78	223.07	12	
Brunkeberg	Drammen	41.94	399.38	239.63	24	
Brunkeberg	Nesbru	56.63	459.39	275.63	24	0.50
Brunkeberg	Majorstua	59.53	499.76	299.85	24	
Brunkeberg	Oslo S	1:03.38	510.44	306.27	24	
Brunkeberg	Holmestrand	1:07.69	486.35	291.81	24	1.00
Brunkeberg	Tønsberg	1:27.67	497.08	298.25	16	
Brunkeberg	Sandefjord	1:05.67	426.78	256.07	16	
Brunkeberg	Larvik	47.67	374.54	224.73	16	
Brunkeberg	Porsgrunn	35.17	304.72	182.83	16	
Brunkeberg	Drangedal	55.55	267.92	160.75	16	1.00
Brunkeberg	Gjerstad	1:20.55	360.68	216.41	16	1.00

From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Brunkeberg	Arendal	2:40.55	576.52	345.91	16	1.00
Brunkeberg	Kristiansand	2:55.55	699.88	419.93	16	1.00
Bø	Bergen	1:27.77	806.48	483.89	24	
Bø	Arna	1:21.53	784.47	470.68	24	
Bø	Tysse	1:15.38	739.98	443.99	12	
Bø	Kvam-Jondal	1:06.74	672.02	403.21	12	
Bø	Odda	57.69	589.58	353.75	12	
Bø	Røldal	47.65	497.08	298.25	12	
Bø	Sauda	49.34	550.24	330.14	12	
Bø	Ølen	59.07	633.63	380.18	12	
Bø	Aksdal	1:05.40	714.98	428.99	16	
Bø	Haugesund	1:11.46	739.98	443.99	16	
Bø	Kårstø	1:20.67	734.99	440.99	12	
Bø	Stavanger	1:33.72	854.80	512.88	24	
Bø	Haukeligrend	32.20	335.60	201.36	28	
Bø	Åmot	22.31	242.24	145.34	28	
Bø	Brunkeberg	12.26	146.70	88.02	28	
Bø	Nordagutu	7.37	90.71	54.43	8	
Bø	Skien	17.41	181.70	109.02	16	
Bø	Notodden	9.99	129.10	77.46	20	
Bø	Kongsberg	20.05	207.75	124.65	20	
Bø	Eiker	27.51	273.60	164.16	20	
Bø	Drammen	31.85	301.90	181.14	40	
Bø	Nesbru	46.54	363.46	218.07	40	0.50
Bø	Majorstua	49.43	404.87	242.92	40	
Bø	Oslo S	53.29	413.10	247.86	40	
Bø	Holmestrand	57.60	388.36	233.02	32	1.00
Bø	Tønsberg	1:17.46	399.38	239.63	16	
Bø	Sandefjord	55.46	330.00	198.00	16	

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From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Bø	Larvik	37.46	276.44	165.86	16	
Bø	Porsgrunn	24.96	204.86	122.92	16	
Bø	Drangedal	29.00	164.24	98.54	16	
Bø	Gjerstad	54.00	256.52	153.91	16	
Bø	Arendal	2:14.00	480.98	288.59	16	
Bø	Kristiansand	2:29.00	605.20	363.12	16	
Nordagutu	Bergen	1:43.93	847.60	508.56	8	0.50
Nordagutu	Arna	1:37.70	825.90	495.54	8	0.50
Nordagutu	Tysse	1:32.17	782.02	469.21	8	0.75
Nordagutu	Kvam-Jondal	1:23.53	714.98	428.99	8	0.75
Nordagutu	Odda	1:14.48	633.63	380.18	8	0.75
Nordagutu	Røldal	1:04.43	542.32	325.39	8	0.75
Nordagutu	Sauda	1:04.54	594.80	356.88	8	0.75
Nordagutu	Ølen	1:14.28	677.10	406.26	8	0.75
Nordagutu	Aksdal	1:24.86	757.36	454.41	8	0.50
Nordagutu	Haugesund	1:30.92	782.02	469.21	8	0.50
Nordagutu	Kårstø	1:30.92	777.10	466.26	8	0.75
Nordagutu	Stavanger	1:53.15	895.24	537.14	8	0.50
Nordagutu	Haukeligrend	44.86	382.84	229.70	8	
Nordagutu	Åmot	32.95	290.60	174.36	8	
Nordagutu	Brunkeberg	20.66	196.19	117.71	8	
Nordagutu	Bø	7.35	90.71	54.43	8	
Nordagutu	Skien	10.33	132.04	79.22	24	
Nordagutu	Notodden	7.25	96.64	57.98	8	
Nordagutu	Kongsberg	17.42	178.79	107.27	8	
Nordagutu	Eiker	24.89	242.24	145.34	8	
Nordagutu	Drammen	29.22	270.76	162.46	16	
Nordagutu	Nesbru	43.91	332.80	199.68	16	0.50
Nordagutu	Majorstua	46.80	374.54	224.73	16	

From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Nordagutu	Oslo S	50.66	385.60	231.36	16	
Nordagutu	Holmestrand	54.97	360.68	216.41	16	1.00
Nordagutu	Tønsberg	1:10.38	352.34	211.40	24	
Nordagutu	Sandefjord	48.38	282.11	169.27	24	
Nordagutu	Larvik	30.38	227.90	136.74	24	
Nordagutu	Porsgrunn	17.88	155.48	93.29	24	
Nordagutu	Drangedal	51.35	213.52	128.11	8	1.00
Nordagutu	Gjerstad	1:16.35	304.72	182.83	8	1.00
Nordagutu	Arendal	2:36.35	526.42	315.85	8	1.00
Nordagutu	Kristiansand	2:51.35	649.04	389.42	8	1.00
Skien	Bergen	1:54.14	918.76	551.26	16	0.50
Skien	Arna	1:47.91	897.60	538.56	16	0.50
Skien	Tysse	1:41.76	854.80	512.88	12	0.50
Skien	Kvam-Jondal	1:33.12	789.38	473.63	12	0.50
Skien	Odda	1:24.07	712.46	427.48	12	0.50
Skien	Røldal	1:14.03	620.74	372.44	12	0.50
Skien	Sauda	1:15.75	672.02	403.21	12	0.50
Skien	Ølen	1:25.48	752.40	451.44	12	0.50
Skien	Aksdal	1:35.07	830.74	498.44	16	0.50
Skien	Haugesund	1:41.13	854.80	512.88	16	0.50
Skien	Kårstø	1:50.31	850.00	510.00	12	0.50
Skien	Stavanger	2:03.36	965.20	579.12	16	0.50
Skien	Haukeligrend	55.07	467.50	280.50	16	
Skien	Åmot	43.16	374.54	224.73	16	
Skien	Brunkeberg	30.87	284.94	170.97	16	
Skien	Bø	17.56	181.70	109.02	16	
Skien	Nordagutu	10.57	132.04	79.22	24	
Skien	Notodden	16.88	184.60	110.76	16	
Skien	Kongsberg	27.06	265.07	159.04	16	

From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Skien	Eiker	34.52	327.20	196.32	16	
Skien	Drammen	38.85	355.12	213.07	32	
Skien	Nesbru	53.54	415.84	249.50	32	0.50
Skien	Majorstua	56.44	459.39	275.63	32	
Skien	Oslo S	1:00.30	467.50	280.50	32	
Skien	Holmestrand	1:13.15	341.18	204.71	32	
Skien	Tønsberg	59.00	267.92	160.75	48	
Skien	Sandefjord	37.00	193.30	115.98	48	
Skien	Larvik	19.00	137.91	82.75	48	
Skien	Porsgrunn	6.50	63.94	38.36	48	
Skien	Drangedal	1:01.56	301.90	181.14	16	1.00
Skien	Gjerstad	1:26.56	391.12	234.67	16	1.00
Skien	Arendal	2:46.56	605.20	363.12	16	1.00
Skien	Kristiansand	3:01.56	727.50	436.50	16	1.00
Notodden	Bergen	1:35.98	876.28	525.77	16	
Notodden	Arna	1:29.74	854.80	512.88	16	
Notodden	Tysse	1:23.59	811.34	486.81	8	
Notodden	Kvam-Jondal	1:14.95	744.95	446.97	8	
Notodden	Odda	1:05.90	666.92	400.15	8	
Notodden	Røldal	55.86	573.90	344.34	8	
Notodden	Sauda	58.84	625.90	375.54	8	
Notodden	Ølen	1:08.58	707.44	424.46	8	
Notodden	Aksdal	1:16.20	786.92	472.15	8	
Notodden	Haugesund	1:22.26	811.34	486.81	8	
Notodden	Kårstø	1:30.18	806.48	483.89	8	
Notodden	Stavanger	1:43.23	923.44	554.06	16	
Notodden	Haukeligrend	40.41	418.58	251.15	12	
Notodden	Åmot	30.52	324.40	194.64	12	
Notodden	Brunkeberg	20.47	230.78	138.47	12	

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From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Notodden	Bø	9.75	129.10	77.46	20	
Notodden	Nordagutu	7.28	96.64	57.98	8	
Notodden	Skien	16.67	184.60	110.76	16	
Notodden	Kongsberg	11.04	123.22	73.93	24	
Notodden	Eiker	18.50	187.50	112.50	24	
Notodden	Drammen	22.83	216.40	129.84	48	
Notodden	Nesbru	37.52	279.28	167.57	48	0.50
Notodden	Majorstua	40.42	324.40	194.64	48	
Notodden	Oslo S	44.28	332.80	199.68	48	
Notodden	Holmestrand	48.58	307.54	184.52	32	1.00
Notodden	Tønsberg	57.58	380.08	228.05	48	1.00
Notodden	Sandefjord	54.72	332.80	199.68	16	
Notodden	Larvik	36.72	279.28	167.57	16	
Notodden	Porsgrunn	24.22	207.75	124.65	16	
Notodden	Drangedal	48.75	247.96	148.78	16	1.00
Notodden	Gjerstad	1:13.75	341.18	204.71	16	1.00
Notodden	Arendal	2:33.75	558.14	334.89	16	1.00
Notodden	Kristiansand	2:48.75	682.18	409.31	16	1.00
Kongsberg	Bergen	1:46.12	942.08	565.25	16	
Kongsberg	Arna	1:39.88	921.10	552.66	16	
Kongsberg	Tysse	1:33.73	878.66	527.19	8	
Kongsberg	Kvam-Jondal	1:25.09	813.78	488.27	8	
Kongsberg	Odda	1:16.04	734.99	440.99	8	
Kongsberg	Røldal	1:06.00	643.91	386.35	8	
Kongsberg	Sauda	1:08.98	694.83	416.90	8	
Kongsberg	Ølen	1:18.72	777.10	466.26	8	
Kongsberg	Aksdal	1:26.34	854.80	512.88	8	
Kongsberg	Haugesund	1:32.40	878.66	527.19	8	
Kongsberg	Kårstø	1:40.32	873.90	524.34	8	

From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Kongsberg	Stavanger	1:53.37	988.12	592.87	16	
Kongsberg	Haukeligrend	50.55	491.72	295.03	12	
Kongsberg	Åmot	40.65	402.12	241.27	12	
Kongsberg	Brunkeberg	30.61	310.35	186.21	12	
Kongsberg	Bø	19.89	207.75	124.65	20	
Kongsberg	Nordagutu	17.42	178.79	107.27	8	
Kongsberg	Skien	26.81	265.07	159.04	16	
Kongsberg	Notodden	11.07	123.22	73.93	24	
Kongsberg	Eiker	9.75	108.47	65.08	24	
Kongsberg	Drammen	14.08	137.91	82.75	48	
Kongsberg	Nesbru	28.77	201.98	121.19	48	0.50
Kongsberg	Majorstua	31.67	245.10	147.06	48	
Kongsberg	Oslo S	35.53	256.52	153.91	48	
Kongsberg	Holmestrand	39.83	230.78	138.47	32	1.00
Kongsberg	Tønsberg	48.83	304.72	182.83	48	1.00
Kongsberg	Sandefjord	1:08.88	374.54	224.73	48	1.00
Kongsberg	Larvik	46.86	357.90	214.74	16	
Kongsberg	Porsgrunn	34.36	287.78	172.67	16	
Kongsberg	Drangedal	58.89	327.20	196.32	16	1.00
Kongsberg	Gjerstad	1:23.89	415.84	249.50	16	1.00
Kongsberg	Arendal	2:43.89	631.06	378.63	16	1.00
Kongsberg	Kristiansand	2:58.89	749.92	449.95	16	1.00
Eiker	Bergen	1:53.73	992.68	595.61	16	
Eiker	Arna	1:47.50	972.10	583.26	16	
Eiker	Tysse	1:41.35	930.44	558.27	8	
Eiker	Kvam-Jondal	1:32.71	866.75	520.05	8	
Eiker	Odda	1:23.66	791.82	475.09	8	
Eiker	Røldal	1:13.62	702.40	421.44	8	
Eiker	Sauda	1:16.60	752.40	451.44	8	

From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Eiker	Ølen	1:26.34	830.74	498.44	8	
Eiker	Aksdal	1:33.96	907.02	544.21	8	
Eiker	Haugesund	1:40.02	930.44	558.27	8	
Eiker	Kårstø	1:47.93	925.78	555.47	8	
Eiker	Stavanger	2:00.98	1037.84	622.70	16	
Eiker	Haukeligrend	58.17	550.24	330.14	12	
Eiker	Åmot	48.27	462.10	277.26	12	
Eiker	Brunkeberg	38.22	371.78	223.07	12	
Eiker	Bø	27.51	273.60	164.16	20	
Eiker	Nordagutu	25.04	242.24	145.34	8	
Eiker	Skien	34.43	327.20	196.32	16	
Eiker	Notodden	18.68	187.50	112.50	24	
Eiker	Kongsberg	9.82	108.47	65.08	24	
Eiker	Drammen	5.01	69.90	41.94	48	
Eiker	Nesbru	19.70	134.98	80.99	48	0.50
Eiker	Majorstua	22.60	181.70	109.02	48	
Eiker	Oslo S	26.46	190.40	114.24	48	
Eiker	Holmestrand	30.76	164.24	98.54	32	1.00
Eiker	Tønsberg	39.76	239.38	143.63	48	1.00
Eiker	Sandefjord	59.81	313.16	187.90	48	1.00
Eiker	Larvik	54.48	366.23	219.74	16	
Eiker	Porsgrunn	41.98	349.55	209.73	16	
Eiker	Drangedal	1:06.51	388.36	233.02	16	1.00
Eiker	Gjerstad	1:31.51	475.59	285.35	16	1.00
Eiker	Arendal	2:51.51	687.24	412.35	16	1.00
Eiker	Kristiansand	3:06.51	806.48	483.89	16	1.00
Drammen	Bergen	1:58.06	1015.36	609.22	32	
Drammen	Arna	1:51.83	994.96	596.97	32	
Drammen	Tysse	1:45.68	953.66	572.20	16	

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From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Drammen	Kvam-Jondal	1:37.04	890.51	534.31	16	
Drammen	Odda	1:27.99	813.78	488.27	16	
Drammen	Røldal	1:17.94	727.50	436.50	16	
Drammen	Sauda	1:20.93	777.10	466.26	16	
Drammen	Ølen	1:30.66	854.80	512.88	16	
Drammen	Aksdal	1:38.29	930.44	558.27	16	
Drammen	Haugesund	1:44.35	953.66	572.20	16	
Drammen	Kårstø	1:52.26	949.04	569.42	16	
Drammen	Stavanger	2:05.31	1060.12	636.07	32	
Drammen	Haukeligrend	1:02.50	576.52	345.91	24	
Drammen	Åmot	52.60	489.04	293.42	24	
Drammen	Brunkeberg	42.55	399.38	239.63	24	
Drammen	Bø	31.84	299.08	179.45	40	
Drammen	Nordagutu	29.37	270.76	162.46	16	
Drammen	Skien	38.75	355.12	213.07	32	
Drammen	Notodden	23.01	216.40	129.84	48	
Drammen	Kongsberg	14.15	137.91	82.75	48	
Drammen	Eiker	5.02	69.90	41.94	48	
Drammen	Nesbru	8.64	108.47	65.08	72	
Drammen	Majorstua	16.54	152.56	91.53	144	
Drammen	Oslo S	20.39	161.32	96.79	144	
Drammen	Holmestrand	15.75	134.98	80.99	32	
Drammen	Tønsberg	24.75	210.64	126.38	48	
Drammen	Sandefjord	44.80	284.94	170.97	48	
Drammen	Larvik	58.80	338.39	203.03	32	
Drammen	Porsgrunn	46.30	377.31	226.39	32	
Drammen	Drangedal	1:10.84	415.84	249.50	16	1.00
Drammen	Gjerstad	1:35.84	502.43	301.46	16	1.00
Drammen	Arendal	2:55.84	712.46	427.48	16	1.00

From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Drammen	Kristiansand	3:10.84	830.74	498.44	16	1.00
Nesbru	Bergen	2:12.69	1064.55	638.73	32	0.50
Nesbru	Arna	2:06.46	1044.54	626.73	32	0.50
Nesbru	Tysse	2:00.31	1004.04	602.43	16	0.50
Nesbru	Kvam-Jondal	1:51.67	942.08	565.25	16	0.50
Nesbru	Odda	1:42.62	866.75	520.05	16	0.50
Nesbru	Røldal	1:32.58	782.02	469.21	16	0.50
Nesbru	Sauda	1:35.56	830.74	498.44	16	0.50
Nesbru	Ølen	1:45.30	907.02	544.21	16	0.50
Nesbru	Aksdal	1:52.92	981.26	588.76	16	0.50
Nesbru	Haugesund	1:58.98	1004.04	602.43	16	0.50
Nesbru	Kårstø	2:06.89	999.50	599.70	16	0.50
Nesbru	Stavanger	2:19.94	1108.43	665.06	32	0.50
Nesbru	Haukeligrend	1:17.13	633.63	380.18	24	0.50
Nesbru	Åmot	1:07.23	547.60	328.56	24	0.50
Nesbru	Brunkeberg	57.18	459.39	275.63	24	0.50
Nesbru	Bø	46.47	360.68	216.41	40	0.50
Nesbru	Nordagutu	44.00	332.80	199.68	16	0.50
Nesbru	Skien	53.39	415.84	249.50	32	0.50
Nesbru	Notodden	37.64	279.28	167.57	48	0.50
Nesbru	Kongsberg	28.78	201.98	121.19	48	0.50
Nesbru	Eiker	19.65	134.98	80.99	48	0.50
Nesbru	Drammen	8.58	108.47	65.08	72	
Nesbru	Majorstua	6.85	87.74	52.65	72	
Nesbru	Oslo S	10.70	96.64	57.98	72	
Nesbru	Holmestrand	30.38	199.08	119.45	32	0.50
Nesbru	Tønsberg	39.38	273.60	164.16	48	0.50
Nesbru	Sandefjord	59.43	346.76	208.06	48	0.50
Nesbru	Larvik	1:13.44	399.38	239.63	32	0.50

From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Nesbru	Porsgrunn	1:00.94	437.68	262.61	32	0.50
Nesbru	Drangedal	1:20.47	475.59	285.35	16	1.00
Nesbru	Gjerstad	1:45.47	560.78	336.47	16	1.00
Nesbru	Arendal	3:05.47	767.24	460.35	16	1.00
Nesbru	Kristiansand	3:20.47	883.40	530.04	16	1.00
Majorstua	Bergen	2:15.65	1097.54	658.52	32	
Majorstua	Arna	2:09.41	1077.80	646.68	32	
Majorstua	Tysse	2:03.26	1037.84	622.70	16	
Majorstua	Kvam-Jondal	1:54.62	976.68	586.01	16	
Majorstua	Odda	1:45.57	904.67	542.80	16	
Majorstua	Røldal	1:35.53	818.63	491.18	16	
Majorstua	Sauda	1:38.51	866.75	520.05	16	
Majorstua	Ølen	1:48.25	942.08	565.25	16	
Majorstua	Aksdal	1:55.87	1015.36	609.22	16	
Majorstua	Haugesund	2:01.93	1037.84	622.70	16	
Majorstua	Kårstø	2:09.85	1033.36	620.02	16	
Majorstua	Stavanger	2:22.90	1140.82	684.49	32	
Majorstua	Haukeligrend	1:20.08	674.56	404.74	24	
Majorstua	Åmot	1:10.18	586.98	352.19	24	
Majorstua	Brunkeberg	1:00.14	499.76	299.85	24	
Majorstua	Bø	49.42	404.87	242.92	40	
Majorstua	Nordagutu	46.95	374.54	224.73	16	
Majorstua	Skien	56.34	459.39	275.63	32	
Majorstua	Notodden	40.60	324.40	194.64	48	
Majorstua	Kongsberg	31.73	245.10	147.06	48	
Majorstua	Eiker	22.60	181.70	109.02	48	
Majorstua	Drammen	16.53	152.56	91.53	144	
Majorstua	Nesbru	6.90	87.74	52.65	72	
Majorstua	Oslo S	2.81	51.98	31.19	144	

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From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Majorstua	Holmestrand	33.33	245.10	147.06	32	
Majorstua	Tønsberg	42.33	318.78	191.27	48	
Majorstua	Sandefjord	1:02.38	388.36	233.02	48	
Majorstua	Larvik	1:16.39	440.40	264.24	32	
Majorstua	Porsgrunn	1:03.89	478.28	286.97	32	
Majorstua	Drangedal	1:28.42	515.78	309.47	16	1.00
Majorstua	Gjerstad	1:53.42	602.60	361.56	16	1.00
Majorstua	Arendal	3:13.42	804.04	482.42	16	1.00
Majorstua	Kristiansand	3:28.42	918.76	551.26	16	1.00
Oslo S	Bergen	2:19.27	1106.26	663.75	32	
Oslo S	Arna	2:13.04	1084.40	650.64	32	
Oslo S	Tysse	2:06.89	1046.78	628.07	16	
Oslo S	Kvam-Jondal	1:58.25	983.55	590.13	16	
Oslo S	Odda	1:49.20	911.72	547.03	16	
Oslo S	Røldal	1:39.16	825.90	495.54	16	
Oslo S	Sauda	1:42.14	873.90	524.34	16	
Oslo S	Ølen	1:51.88	951.35	570.81	16	
Oslo S	Aksdal	1:59.50	1024.38	614.63	16	
Oslo S	Haugesund	2:05.56	1046.78	628.07	16	
Oslo S	Kårstø	2:13.47	1042.31	625.39	16	
Oslo S	Stavanger	2:26.53	1149.38	689.63	32	
Oslo S	Haukeligrend	1:23.71	682.18	409.31	24	
Oslo S	Åmot	1:13.81	597.40	358.44	24	
Oslo S	Brunkeberg	1:03.76	510.44	306.27	24	
Oslo S	Bø	53.05	413.10	247.86	40	
Oslo S	Nordagutu	50.58	385.60	231.36	16	
Oslo S	Skien	59.97	467.50	280.50	32	
Oslo S	Notodden	44.22	332.80	199.68	48	
Oslo S	Kongsberg	35.36	253.67	152.20	48	

From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Oslo S	Eiker	26.23	190.40	114.24	48	
Oslo S	Drammen	20.16	161.32	96.79	144	
Oslo S	Nesbru	10.53	96.64	57.98	72	
Oslo S	Majorstua	2.58	51.98	31.19	144	
Oslo S	Holmestrand	36.96	253.67	152.20	32	
Oslo S	Tønsberg	45.96	327.20	196.32	48	
Oslo S	Sandefjord	1:06.01	396.62	237.97	48	
Oslo S	Larvik	1:20.02	451.26	270.76	32	
Oslo S	Porsgrunn	1:07.52	489.04	293.42	32	
Oslo S	Drangedal	1:32.05	526.42	315.85	16	1.00
Oslo S	Gjerstad	1:57.05	610.38	366.23	16	1.00
Oslo S	Arendal	3:17.05	813.78	488.27	16	1.00
Oslo S	Kristiansand	3:32.05	925.78	555.47	16	1.00
Holmestrand	Bergen	2:23.81	1086.59	651.95	32	1.00
Holmestrand	Arna	2:17.58	1066.76	640.06	32	1.00
Holmestrand	Tysse	2:11.43	1026.62	615.97	16	1.00
Holmestrand	Kvam-Jondal	2:02.79	965.20	579.12	16	1.00
Holmestrand	Odda	1:53.74	890.51	534.31	16	1.00
Holmestrand	Røldal	1:43.69	804.04	482.42	16	1.00
Holmestrand	Sauda	1:46.68	852.40	511.44	16	1.00
Holmestrand	Ølen	1:56.41	930.44	558.27	16	1.00
Holmestrand	Aksdal	2:04.04	1004.04	602.43	16	1.00
Holmestrand	Haugesund	2:10.10	1026.62	615.97	16	1.00
Holmestrand	Kårstø	2:18.01	1022.12	613.27	16	1.00
Holmestrand	Stavanger	2:31.06	1130.07	678.04	32	1.00
Holmestrand	Haukeligrend	1:28.25	659.27	395.56	24	1.00
Holmestrand	Åmot	1:18.35	573.90	344.34	24	1.00
Holmestrand	Brunkeberg	1:08.30	486.35	291.81	24	1.00
Holmestrand	Bø	57.59	388.36	233.02	32	1.00

From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Holmestrand	Nordagutu	55.12	360.68	216.41	16	1.00
Holmestrand	Skien	1:13.15	341.18	204.71	32	
Holmestrand	Notodden	48.76	307.54	184.52	32	1.00
Holmestrand	Kongsberg	39.90	230.78	138.47	32	1.00
Holmestrand	Eiker	30.77	164.24	98.54	32	1.00
Holmestrand	Drammen	15.75	134.98	80.99	32	
Holmestrand	Nesbru	30.44	199.08	119.45	32	0.50
Holmestrand	Majorstua	33.34	245.10	147.06	32	
Holmestrand	Oslo S	37.19	253.67	152.20	32	
Holmestrand	Tønsberg	13.10	117.32	70.39	32	
Holmestrand	Sandefjord	33.15	193.30	115.98	32	
Holmestrand	Larvik	51.15	247.96	148.78	32	
Holmestrand	Porsgrunn	1:05.65	318.78	191.27	32	
Holmestrand	Drangedal	1:36.59	502.43	301.46	16	2.00
Holmestrand	Gjerstad	2:01.59	586.98	352.19	16	2.00
Holmestrand	Arendal	3:21.59	791.82	475.09	16	2.00
Holmestrand	Kristiansand	3:36.59	904.67	542.80	16	2.00
Tønsberg	Bergen	2:42.33	1095.35	657.21	32	0.50
Tønsberg	Arna	2:36.10	1073.39	644.03	32	0.50
Tønsberg	Tysse	2:29.95	1035.60	621.36	16	0.50
Tønsberg	Kvam-Jondal	2:21.31	972.10	583.26	16	0.50
Tønsberg	Odda	2:12.26	899.96	539.98	16	0.50
Tønsberg	Røldal	2:02.22	813.78	488.27	16	0.50
Tønsberg	Sauda	2:05.20	861.98	517.19	16	0.50
Tønsberg	Ølen	2:14.94	937.43	562.46	16	0.50
Tønsberg	Aksdal	2:24.52	1013.10	607.86	16	0.50
Tønsberg	Haugesund	2:30.58	1033.36	620.02	16	0.50
Tønsberg	Kårstø	2:36.53	1028.87	617.32	16	0.50
Tønsberg	Stavanger	2:49.58	1136.52	681.91	16	0.50

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From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Tønsberg	Haukeligrend	1:48.34	669.47	401.68	16	
Tønsberg	Åmot	1:38.45	581.75	349.05	16	
Tønsberg	Brunkeberg	1:28.40	497.08	298.25	16	
Tønsberg	Bø	1:17.61	399.38	239.63	16	
Tønsberg	Nordagutu	1:10.62	352.34	211.40	24	
Tønsberg	Skien	59.00	267.92	160.75	48	
Tønsberg	Notodden	57.76	380.08	228.05	48	1.00
Tønsberg	Kongsberg	48.90	301.90	181.14	48	1.00
Tønsberg	Eiker	39.77	239.38	143.63	48	1.00
Tønsberg	Drammen	24.75	210.64	126.38	48	
Tønsberg	Nesbru	39.44	273.60	164.16	48	0.50
Tønsberg	Majorstua	42.34	318.78	191.27	48	
Tønsberg	Oslo S	46.19	327.20	196.32	48	
Tønsberg	Holmestrand	13.10	117.32	70.39	32	
Tønsberg	Sandefjord	19.00	117.32	70.39	48	
Tønsberg	Larvik	37.00	172.98	103.79	48	
Tønsberg	Porsgrunn	51.50	245.10	147.06	48	
Tønsberg	Drangedal	2:01.61	513.11	307.87	16	1.00
Tønsberg	Gjerstad	2:26.61	597.40	358.44	16	1.00
Tønsberg	Arendal	3:46.61	799.16	479.50	16	1.00
Tønsberg	Kristiansand	4:01.61	914.07	548.44	16	1.00
Sandefjord	Bergen	2:32.19	1037.84	622.70	16	0.50
Sandefjord	Arna	2:25.96	1017.62	610.57	16	0.50
Sandefjord	Tysse	2:19.81	976.68	586.01	12	0.50
Sandefjord	Kvam-Jondal	2:11.17	914.07	548.44	12	0.50
Sandefjord	Odda	2:02.12	840.38	504.23	12	0.50
Sandefjord	Røldal	1:52.08	752.40	451.44	12	0.50
Sandefjord	Sauda	1:53.80	801.60	480.96	12	0.50
Sandefjord	Ølen	2:03.53	878.66	527.19	12	0.50

From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Sandefjord	Aksdal	2:13.12	953.66	572.20	16	0.50
Sandefjord	Haugesund	2:19.18	976.68	586.01	16	0.50
Sandefjord	Kårstø	2:28.36	972.10	583.26	12	0.50
Sandefjord	Stavanger	2:41.41	1082.20	649.32	16	0.50
Sandefjord	Haukeligrend	1:26.34	605.20	363.12	16	
Sandefjord	Åmot	1:16.45	515.78	309.47	16	
Sandefjord	Brunkeberg	1:06.40	426.78	256.07	16	
Sandefjord	Bø	55.61	330.00	198.00	16	
Sandefjord	Nordagutu	48.62	282.11	169.27	24	
Sandefjord	Skien	37.00	193.30	115.98	48	
Sandefjord	Notodden	54.93	332.80	199.68	16	
Sandefjord	Kongsberg	1:08.95	374.54	224.73	48	1.00
Sandefjord	Eiker	59.82	313.16	187.90	48	1.00
Sandefjord	Drammen	44.80	284.94	170.97	48	
Sandefjord	Nesbru	59.49	346.76	208.06	48	0.50
Sandefjord	Majorstua	1:02.39	388.36	233.02	48	
Sandefjord	Oslo S	1:06.24	396.62	237.97	48	
Sandefjord	Holmestrand	33.15	193.30	115.98	32	
Sandefjord	Tønsberg	19.00	117.32	70.39	48	
Sandefjord	Larvik	15.00	99.60	59.76	48	
Sandefjord	Porsgrunn	29.50	170.06	102.04	48	
Sandefjord	Drangedal	1:39.61	443.12	265.87	16	1.00
Sandefjord	Gjerstad	2:04.61	531.72	319.03	16	1.00
Sandefjord	Arendal	3:24.61	737.48	442.49	16	1.00
Sandefjord	Kristiansand	3:39.61	854.80	512.88	16	1.00
Larvik	Bergen	2:14.19	994.96	596.97	16	0.50
Larvik	Arna	2:07.96	974.39	584.63	16	0.50
Larvik	Tysse	2:01.81	932.78	559.67	12	0.50
Larvik	Kvam-Jondal	1:53.17	869.14	521.48	12	0.50

From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Larvik	Odda	1:44.12	794.27	476.56	12	0.50
Larvik	Røldal	1:34.08	704.92	422.95	12	0.50
Larvik	Sauda	1:35.80	754.88	452.93	12	0.50
Larvik	Ølen	1:45.53	833.15	499.89	12	0.50
Larvik	Aksdal	1:55.12	909.38	545.63	16	0.50
Larvik	Haugesund	2:01.18	932.78	559.67	16	0.50
Larvik	Kårstø	2:10.36	928.11	556.87	12	0.50
Larvik	Stavanger	2:23.41	1040.08	624.05	16	0.50
Larvik	Haukeligrend	1:08.34	552.88	331.73	16	
Larvik	Åmot	58.45	464.80	278.88	16	
Larvik	Brunkeberg	48.40	374.54	224.73	16	
Larvik	Bø	37.61	276.44	165.86	16	
Larvik	Nordagutu	30.62	227.90	136.74	24	
Larvik	Skien	19.00	137.91	82.75	48	
Larvik	Notodden	36.93	279.28	167.57	16	
Larvik	Kongsberg	47.11	357.90	214.74	16	
Larvik	Eiker	54.57	366.23	219.74	16	
Larvik	Drammen	58.90	338.39	203.03	32	
Larvik	Nesbru	1:13.59	399.38	239.63	32	0.50
Larvik	Majorstua	1:16.49	440.40	264.24	32	
Larvik	Oslo S	1:20.35	451.26	270.76	32	
Larvik	Holmestrand	51.15	247.96	148.78	32	
Larvik	Tønsberg	37.00	172.98	103.79	48	
Larvik	Sandefjord	15.00	99.60	59.76	48	
Larvik	Porsgrunn	11.50	114.38	68.63	48	
Larvik	Drangedal	1:21.61	391.12	234.67	16	1.00
Larvik	Gjerstad	1:46.61	478.28	286.97	16	1.00
Larvik	Arendal	3:06.61	689.78	413.87	16	1.00
Larvik	Kristiansand	3:21.61	808.91	485.35	16	1.00

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From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Porsgrunn	Bergen	2:01.69	937.43	562.46	16	0.50
Porsgrunn	Arna	1:55.46	916.42	549.85	16	0.50
Porsgrunn	Tysse	1:49.31	873.90	524.34	12	0.50
Porsgrunn	Kvam-Jondal	1:40.67	808.91	485.35	12	0.50
Porsgrunn	Odda	1:31.62	732.50	439.50	12	0.50
Porsgrunn	Røldal	1:21.58	641.34	384.81	12	0.50
Porsgrunn	Sauda	1:23.30	692.30	415.38	12	0.50
Porsgrunn	Ølen	1:33.03	772.18	463.31	12	0.50
Porsgrunn	Aksdal	1:42.62	850.00	510.00	16	0.50
Porsgrunn	Haugesund	1:48.68	873.90	524.34	16	0.50
Porsgrunn	Kårstø	1:57.86	869.14	521.48	12	0.50
Porsgrunn	Stavanger	2:10.91	983.55	590.13	16	0.50
Porsgrunn	Haukeligrend	55.84	489.04	293.42	16	
Porsgrunn	Åmot	45.95	396.62	237.97	16	
Porsgrunn	Brunkeberg	35.90	304.72	182.83	16	
Porsgrunn	Bø	25.11	204.86	122.92	16	
Porsgrunn	Nordagutu	18.12	155.48	93.29	24	
Porsgrunn	Skien	6.50	63.94	38.36	48	
Porsgrunn	Notodden	24.43	207.75	124.65	16	
Porsgrunn	Kongsberg	34.61	287.78	172.67	16	
Porsgrunn	Eiker	42.07	349.55	209.73	16	
Porsgrunn	Drammen	46.40	377.31	226.39	32	
Porsgrunn	Nesbru	1:01.09	437.68	262.61	32	0.50
Porsgrunn	Majorstua	1:03.99	478.28	286.97	32	
Porsgrunn	Oslo S	1:07.85	489.04	293.42	32	
Porsgrunn	Holmestrand	1:05.65	318.78	191.27	32	
Porsgrunn	Tønsberg	51.50	245.10	147.06	48	
Porsgrunn	Sandefjord	29.50	170.06	102.04	48	
Porsgrunn	Larvik	11.50	114.38	68.63	48	

From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Porsgrunn	Drangedal	1:09.11	321.59	192.95	16	1.00
Porsgrunn	Gjerstad	1:34.11	413.10	247.86	16	1.00
Porsgrunn	Arendal	2:54.11	625.90	375.54	16	1.00
Porsgrunn	Kristiansand	3:09.11	747.44	448.46	16	1.00
Drangedal	Bergen	2:11.77	907.02	544.21	16	1.00
Drangedal	Arna	2:05.53	885.78	531.47	16	1.00
Drangedal	Tysse	1:59.38	842.79	505.67	8	1.00
Drangedal	Kvam-Jondal	1:50.74	777.10	466.26	8	1.00
Drangedal	Odda	1:41.69	699.88	419.93	8	1.00
Drangedal	Røldal	1:31.65	607.79	364.67	8	1.00
Drangedal	Sauda	1:33.34	659.27	395.56	8	1.00
Drangedal	Ølen	1:43.07	739.98	443.99	8	1.00
Drangedal	Aksdal	1:49.40	818.63	491.18	16	1.00
Drangedal	Haugesund	1:55.46	842.79	505.67	16	1.00
Drangedal	Kårstø	2:04.67	837.98	502.79	8	1.00
Drangedal	Stavanger	2:17.72	953.66	572.20	16	1.00
Drangedal	Haukeligrend	1:18.33	451.26	270.76	16	1.00
Drangedal	Åmot	1:07.43	360.68	216.41	16	1.00
Drangedal	Brunkeberg	56.26	267.92	160.75	16	1.00
Drangedal	Bø	29.00	164.24	98.54	16	
Drangedal	Nordagutu	51.37	213.52	128.11	8	1.00
Drangedal	Skien	1:01.41	301.90	181.14	16	1.00
Drangedal	Notodden	48.99	247.96	148.78	16	1.00
Drangedal	Kongsberg	59.05	327.20	196.32	16	1.00
Drangedal	Eiker	1:06.51	388.36	233.02	16	1.00
Drangedal	Drammen	1:10.85	415.84	249.50	16	1.00
Drangedal	Nesbru	1:20.54	475.59	285.35	16	1.00
Drangedal	Majorstua	1:28.43	515.78	309.47	16	1.00
Drangedal	Oslo S	1:32.29	526.42	315.85	16	1.00

From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Drangedal	Holmestrand	1:36.60	502.43	301.46	16	2.00
Drangedal	Tønsberg	2:01.46	513.11	307.87	16	1.00
Drangedal	Sandefjord	1:39.46	443.12	265.87	16	1.00
Drangedal	Larvik	1:21.46	391.12	234.67	16	1.00
Drangedal	Porsgrunn	1:08.96	321.59	192.95	16	1.00
Drangedal	Gjerstad	24.00	137.91	82.75	16	
Drangedal	Arendal	1:44.00	366.23	219.74	16	
Drangedal	Kristiansand	1:59.00	497.08	298.25	16	
Gjerstad	Bergen	2:36.77	981.26	588.76	16	1.00
Gjerstad	Arna	2:30.53	960.59	576.35	16	1.00
Gjerstad	Tysse	2:24.38	918.76	551.26	8	1.00
Gjerstad	Kvam-Jondal	2:15.74	854.80	512.88	8	1.00
Gjerstad	Odda	2:06.69	779.56	467.74	8	1.00
Gjerstad	Røldal	1:56.65	689.78	413.87	8	1.00
Gjerstad	Sauda	1:58.34	739.98	443.99	8	1.00
Gjerstad	Ølen	2:08.07	818.63	491.18	8	1.00
Gjerstad	Aksdal	2:14.40	895.24	537.14	16	1.00
Gjerstad	Haugesund	2:20.46	918.76	551.26	16	1.00
Gjerstad	Kårstø	2:29.67	914.07	548.44	8	1.00
Gjerstad	Stavanger	2:42.72	1026.62	615.97	16	1.00
Gjerstad	Haukeligrend	1:43.33	539.67	323.80	16	1.00
Gjerstad	Åmot	1:32.43	448.55	269.13	16	1.00
Gjerstad	Brunkeberg	1:21.26	357.90	214.74	16	1.00
Gjerstad	Bø	54.00	256.52	153.91	16	
Gjerstad	Nordagutu	1:16.37	304.72	182.83	8	1.00
Gjerstad	Skien	1:26.41	391.12	234.67	16	1.00
Gjerstad	Notodden	1:13.99	341.18	204.71	16	1.00
Gjerstad	Kongsberg	1:24.05	415.84	249.50	16	1.00
Gjerstad	Eiker	1:31.51	475.59	285.35	16	1.00

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From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Gjerstad	Drammen	1:35.85	502.43	301.46	16	1.00
Gjerstad	Nesbru	1:45.54	560.78	336.47	16	1.00
Gjerstad	Majorstua	1:53.43	602.60	361.56	16	1.00
Gjerstad	Oslo S	1:57.29	610.38	366.23	16	1.00
Gjerstad	Holmestrand	2:01.60	586.98	352.19	16	2.00
Gjerstad	Tønsberg	2:26.46	597.40	358.44	16	1.00
Gjerstad	Sandefjord	2:04.46	529.07	317.44	16	1.00
Gjerstad	Larvik	1:46.46	478.28	286.97	16	1.00
Gjerstad	Porsgrunn	1:33.96	410.36	246.22	16	1.00
Gjerstad	Drangedal	24.00	137.91	82.75	16	
Gjerstad	Arendal	1:14.00	276.44	165.86	16	
Gjerstad	Kristiansand	1:29.00	410.36	246.22	16	
Arendal	Bergen	3:56.77	1160.03	696.02	16	1.00
Arendal	Arna	3:50.53	1140.82	684.49	16	1.00
Arendal	Tysse	3:44.38	1101.90	661.14	8	1.00
Arendal	Kvam-Jondal	3:35.74	1042.31	625.39	8	1.00
Arendal	Odda	3:26.69	969.80	581.88	8	1.00
Arendal	Røldal	3:16.65	885.78	531.47	8	1.00
Arendal	Sauda	3:18.34	932.78	559.67	8	1.00
Arendal	Ølen	3:28.07	1008.58	605.15	8	1.00
Arendal	Aksdal	3:34.40	1080.00	648.00	16	1.00
Arendal	Haugesund	3:40.46	1101.90	661.14	16	1.00
Arendal	Kårstø	3:49.67	1097.54	658.52	8	1.00
Arendal	Stavanger	4:02.72	1202.15	721.29	16	1.00
Arendal	Haukeligrend	3:03.33	744.95	446.97	16	1.00
Arendal	Åmot	2:52.43	661.82	397.09	16	1.00

From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Arendal	Brunkeberg	2:41.26	576.52	345.91	16	1.00
Arendal	Bø	2:14.00	480.98	288.59	16	
Arendal	Nordagutu	2:36.37	526.42	315.85	8	1.00
Arendal	Skien	2:46.41	605.20	363.12	16	1.00
Arendal	Notodden	2:33.99	558.14	334.89	16	1.00
Arendal	Kongsberg	2:44.05	631.06	378.63	16	1.00
Arendal	Eiker	2:51.51	687.24	412.35	16	1.00
Arendal	Drammen	2:55.85	712.46	427.48	16	1.00
Arendal	Nesbru	3:05.54	767.24	460.35	16	1.00
Arendal	Majorstua	3:13.43	804.04	482.42	16	1.00
Arendal	Oslo S	3:17.29	813.78	488.27	16	1.00
Arendal	Holmestrand	3:21.60	791.82	475.09	16	2.00
Arendal	Tønsberg	3:46.46	799.16	479.50	16	1.00
Arendal	Sandefjord	3:24.46	737.48	442.49	16	1.00
Arendal	Larvik	3:06.46	689.78	413.87	16	1.00
Arendal	Porsgrunn	2:53.96	625.90	375.54	16	1.00
Arendal	Drangedal	1:44.00	366.23	219.74	16	
Arendal	Gjerstad	1:14.00	276.44	165.86	16	
Kristiansand	Bergen	4:11.77	1259.78	755.87	16	1.00
Kristiansand	Arna	4:05.53	1239.38	743.63	16	1.00
Kristiansand	Tysse	3:59.38	1204.24	722.54	8	1.00
Kristiansand	Kvam-Jondal	3:50.74	1145.10	687.06	8	1.00
Kristiansand	Odda	3:41.69	1077.80	646.68	8	1.00
Kristiansand	Røldal	3:31.65	997.23	598.34	8	1.00
Kristiansand	Sauda	3:33.34	1042.31	625.39	8	1.00
Kristiansand	Ølen	3:43.07	1112.78	667.67	8	1.00

From station	To station	Time h:min	Ticket work	Ticket non-w	Dep /day	Int. chg.
Kristiansand	Aksdal	3:49.40	1183.30	709.98	16	1.00
Kristiansand	Haugesund	3:55.46	1202.15	721.29	16	1.00
Kristiansand	Kårstø	4:04.67	1197.98	718.79	8	1.00
Kristiansand	Stavanger	4:17.72	1297.98	778.79	16	1.00
Kristiansand	Haukeligrend	3:18.33	861.98	517.19	16	1.00
Kristiansand	Åmot	3:07.43	779.56	467.74	16	1.00
Kristiansand	Brunkeberg	2:56.26	699.88	419.93	16	1.00
Kristiansand	Bø	2:29.00	605.20	363.12	16	
Kristiansand	Nordagutu	2:51.37	649.04	389.42	8	1.00
Kristiansand	Skien	3:01.41	727.50	436.50	16	1.00
Kristiansand	Notodden	2:48.99	682.18	409.31	16	1.00
Kristiansand	Kongsberg	2:59.05	749.92	449.95	16	1.00
Kristiansand	Eiker	3:06.51	806.48	483.89	16	1.00
Kristiansand	Drammen	3:10.85	830.74	498.44	16	1.00
Kristiansand	Nesbru	3:20.54	883.40	530.04	16	1.00
Kristiansand	Majorstua	3:28.43	918.76	551.26	16	1.00
Kristiansand	Oslo S	3:32.29	925.78	555.47	16	1.00
Kristiansand	Holmestrand	3:36.60	904.67	542.80	16	2.00
Kristiansand	Tønsberg	4:01.46	914.07	548.44	16	1.00
Kristiansand	Sandefjord	3:39.46	854.80	512.88	16	1.00
Kristiansand	Larvik	3:21.46	808.91	485.35	16	1.00
Kristiansand	Porsgrunn	3:08.96	747.44	448.46	16	1.00
Kristiansand	Drangedal	1:59.00	497.08	298.25	16	
Kristiansand	Gjerstad	1:29.00	410.36	246.22	16	

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Appendix 4

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From station	To station	HSR trips	From air	From car	From PT	Induc. dem.
Bergen	Arna	1538.4	0.0	897.8	272.6	367.9
Bergen	Tysse	369.5	0.0	234.5	43.0	92.0
Bergen	Kvam-Jondal	348.7	0.0	221.4	36.9	90.4
Bergen	Odda	328.6	0.0	212.4	25.3	90.8
Bergen	Røldal	55.1	0.0	37.6	0.4	17.2
Bergen	Sauda	22.8	0.0	15.6	0.2	6.9
Bergen	Ølen	138.2	0.0	92.9	5.1	40.2
Bergen	Aksdal	319.2	0.0	184.6	52.5	82.0
Bergen	Haugesund	364.1	0.0	231.7	30.2	102.1
Bergen	Kårstø	130.2	0.0	86.2	7.6	36.4
Bergen	Stavanger	1167.3	633.2	149.3	15.7	369.2
Bergen	Haukeligrend	6.1	0.3	3.7	0.2	1.9
Bergen	Åmot	16.0	0.1	10.9	0.2	4.8
Bergen	Brunkeberg	10.8	0.6	6.6	0.2	3.4
Bergen	Bø	13.0	2.9	5.2	0.2	4.6
Bergen	Nordagutu	1.7	0.3	0.7	0.0	0.6
Bergen	Skien	47.5	19.1	11.0	1.2	16.2
Bergen	Notodden	6.6	1.3	2.8	0.1	2.3
Bergen	Kongsberg	56.1	14.3	15.5	4.6	21.7
Bergen	Eiker	103.2	31.4	16.8	17.2	37.8
Bergen	Drammen	183.2	64.1	27.8	22.2	69.0
Bergen	Nesbru	268.0	116.0	46.6	15.3	90.0
Bergen	Majorstua	567.0	263.0	45.8	65.8	192.5
Bergen	Oslo S	2735.3	1521.1	293.9	170.6	749.7
Bergen	Holmestrand	52.3	27.6	7.5	2.2	15.0
Bergen	Tønsberg	74.3	44.8	6.9	2.0	20.5
Bergen	Sandefjord	57.5	28.0	14.5	0.7	14.3
Bergen	Larvik	56.2	24.5	15.4	1.0	15.3
Bergen	Porsgrunn	64.8	28.0	14.8	1.3	20.7
Bergen	Drangedal	3.6	0.7	1.8	0.0	1.1
Bergen	Gjerstad	21.2	9.3	5.1	0.6	6.3
Bergen	Arendal	55.3	30.8	8.8	2.6	13.1
Bergen	Kristiansand	145.7	81.4	30.5	6.1	27.7
Arna	Bergen	2588.8	0.0	1543.9	411.3	633.6
Arna	Tysse	148.1	0.0	108.7	3.3	36.1
Arna	Kvam-Jondal	49.7	0.0	34.8	2.1	12.7
Arna	Odda	49.4	0.0	34.1	1.8	13.6
Arna	Røldal	10.8	0.0	7.6	0.0	3.2
Arna	Sauda	6.5	0.0	4.6	0.1	1.9
Arna	Ølen	21.3	0.0	14.8	0.4	6.1
Arna	Aksdal	63.6	0.0	42.2	4.8	16.6
Arna	Haugesund	53.4	0.0	36.0	2.2	15.2
Arna	Kårstø	16.4	0.0	11.2	0.6	4.6
Arna	Stavanger	176.1	73.9	35.3	3.2	63.7
Arna	Haukeligrend	1.6	0.0	1.1	0.0	0.5
Arna	Åmot	4.6	0.0	3.3	0.0	1.3
Arna	Brunkeberg	3.4	0.0	2.3	0.1	1.0
Arna	Bø	2.9	0.2	1.7	0.1	0.9
Arna	Nordagutu	0.3	0.0	0.2	0.0	0.1
Arna	Skien	10.2	2.1	4.3	0.4	3.5
Arna	Notodden	1.7	0.1	1.0	0.0	0.5
Arna	Kongsberg	10.9	1.6	4.7	0.8	3.8
Arna	Eiker	19.2	3.7	5.9	2.9	6.7
Arna	Drammen	38.8	8.6	12.2	4.4	13.6
Arna	Nesbru	51.8	15.9	15.8	2.7	17.4
Arna	Majorstua	124.7	42.9	22.0	16.7	43.1
Arna	Oslo S	599.3	260.1	125.5	42.9	170.9
Arna	Holmestrand	10.8	3.2	3.8	0.5	3.3
Arna	Tønsberg	15.3	5.8	4.1	0.6	4.8
Arna	Sandefjord	13.4	3.6	5.8	0.3	3.7
Arna	Larvik	14.3	2.9	7.1	0.3	4.0
Arna	Porsgrunn	14.2	3.1	6.1	0.4	4.6
Arna	Drangedal	0.9	0.0	0.6	0.0	0.2
Arna	Gjerstad	4.5	1.0	2.0	0.1	1.4
Arna	Arendal	10.6	3.9	3.2	0.5	2.9
Arna	Kristiansand	33.9	11.5	14.0	0.8	7.7
Tysse	Bergen	464.1	0.0	295.6	50.7	117.8
Tysse	Arna	150.5	0.0	110.4	3.5	36.7
Tysse	Kvam-Jondal	30.3	0.0	22.5	0.4	7.3
Tysse	Odda	8.4	0.0	6.0	0.2	2.2
Tysse	Røldal	5.0	0.0	3.5	0.0	1.5
Tysse	Sauda	1.9	0.0	1.3	0.0	0.6
Tysse	Ølen	3.6	0.0	2.5	0.0	1.1
Tysse	Aksdal	10.1	0.0	7.2	0.2	2.6
Tysse	Haugesund	11.7	0.0	8.3	0.1	3.3
Tysse	Kårstø	4.8	0.0	3.4	0.0	1.4
Tysse	Stavanger	11.0	3.3	3.8	0.1	3.8
Tysse	Haukeligrend	1.0	0.0	0.7	0.0	0.3
Tysse	Åmot	0.4	0.0	0.3	0.0	0.1
Tysse	Brunkeberg	0.3	0.0	0.2	0.0	0.1
Tysse	Bø	0.2	0.0	0.1	0.0	0.1
Tysse	Nordagutu	0.0	0.0	0.0	0.0	0.0
Tysse	Skien	0.6	0.1	0.3	0.0	0.2
Tysse	Notodden	0.1	0.0	0.1	0.0	0.0
Tysse	Kongsberg	0.5	0.0	0.3	0.0	0.2
Tysse	Eiker	1.6	0.4	0.5	0.2	0.6
Tysse	Drammen	3.0	0.9	0.7	0.2	1.2

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From station	To station	HSR trips	From air	From car	From PT	Induc. dem.
Tysse	Nesbru	4.6	1.6	1.2	0.1	1.7
Tysse	Majorstua	8.8	3.6	1.3	0.4	3.5
Tysse	Oslo S	46.7	22.9	7.6	1.2	14.9
Tysse	Holmestrand	1.0	0.3	0.3	0.0	0.3
Tysse	Tønsberg	2.4	0.5	1.3	0.0	0.6
Tysse	Sandefjord	1.3	0.3	0.6	0.0	0.4
Tysse	Larvik	1.3	0.3	0.6	0.0	0.4
Tysse	Porsgrunn	0.9	0.2	0.4	0.0	0.3
Tysse	Drangedal	0.2	0.0	0.1	0.0	0.1
Tysse	Gjerstad	0.3	0.0	0.2	0.0	0.1
Tysse	Arendal	1.0	0.4	0.3	0.0	0.3
Tysse	Kristiansand	2.8	0.9	1.2	0.0	0.7
Kvam-Jondal	Bergen	397.5	0.0	251.2	42.0	104.2
Kvam-Jondal	Arna	50.6	0.0	35.4	2.2	13.0
Kvam-Jondal	Tysse	30.4	0.0	22.5	0.5	7.4
Kvam-Jondal	Odda	42.6	0.0	31.4	0.3	11.0
Kvam-Jondal	Røldal	39.6	0.0	28.5	0.0	11.1
Kvam-Jondal	Sauda	4.1	0.0	2.9	0.0	1.2
Kvam-Jondal	Ølen	6.8	0.0	4.9	0.1	1.9
Kvam-Jondal	Aksdal	19.3	0.0	13.8	0.4	5.2
Kvam-Jondal	Haugesund	25.2	0.0	17.9	0.2	7.1
Kvam-Jondal	Kårstø	7.4	0.0	5.3	0.0	2.1
Kvam-Jondal	Stavanger	29.7	3.7	15.8	0.4	9.8
Kvam-Jondal	Haukeligrend	1.9	0.0	1.3	0.0	0.6
Kvam-Jondal	Åmot	4.8	0.0	3.4	0.0	1.4
Kvam-Jondal	Brunkeberg	0.6	0.0	0.4	0.0	0.2
Kvam-Jondal	Bø	0.5	0.0	0.4	0.0	0.2
Kvam-Jondal	Nordagutu	0.1	0.0	0.1	0.0	0.0
Kvam-Jondal	Skien	1.1	0.1	0.7	0.0	0.3
Kvam-Jondal	Notodden	0.4	0.0	0.3	0.0	0.1
Kvam-Jondal	Kongsberg	1.9	0.0	1.2	0.1	0.6
Kvam-Jondal	Eiker	3.5	0.2	1.9	0.3	1.1
Kvam-Jondal	Drammen	6.9	1.0	3.2	0.4	2.3
Kvam-Jondal	Nesbru	14.8	2.9	6.6	0.3	5.0
Kvam-Jondal	Majorstua	27.3	7.4	8.7	1.1	10.1
Kvam-Jondal	Oslo S	133.9	47.4	40.9	3.1	42.5
Kvam-Jondal	Holmestrand	2.8	0.4	1.5	0.0	0.8
Kvam-Jondal	Tønsberg	6.0	1.0	3.2	0.1	1.7
Kvam-Jondal	Sandefjord	3.5	0.6	1.8	0.0	1.1
Kvam-Jondal	Larvik	3.3	0.4	1.8	0.0	1.0
Kvam-Jondal	Porsgrunn	1.5	0.1	0.9	0.0	0.5
Kvam-Jondal	Drangedal	0.2	0.0	0.1	0.0	0.1
Kvam-Jondal	Gjerstad	0.5	0.0	0.4	0.0	0.1
Kvam-Jondal	Arendal	1.5	0.4	0.6	0.0	0.5
Kvam-Jondal	Kristiansand	7.8	1.8	3.9	0.1	2.0
Odda	Bergen	347.5	0.0	224.3	26.4	96.8
Odda	Arna	49.6	0.0	34.2	1.8	13.6
Odda	Tysse	8.4	0.0	6.0	0.2	2.2
Odda	Kvam-Jondal	43.8	0.0	32.3	0.3	11.3
Odda	Røldal	140.2	0.0	104.1	0.0	36.0
Odda	Sauda	12.4	0.0	9.0	0.0	3.3
Odda	Ølen	21.6	0.0	16.0	0.1	5.6
Odda	Aksdal	24.9	0.0	18.0	0.4	6.5
Odda	Haugesund	58.3	0.0	42.0	0.5	15.8
Odda	Kårstø	22.7	0.0	16.5	0.1	6.1
Odda	Stavanger	100.8	0.0	66.2	0.7	33.9
Odda	Haukeligrend	14.4	0.0	10.4	0.0	4.0
Odda	Åmot	45.4	0.0	32.7	0.0	12.7
Odda	Brunkeberg	2.3	0.0	1.6	0.0	0.7
Odda	Bø	1.1	0.0	0.8	0.0	0.3
Odda	Nordagutu	0.1	0.0	0.1	0.0	0.0
Odda	Skien	2.3	0.0	1.6	0.0	0.7
Odda	Notodden	0.7	0.0	0.5	0.0	0.2
Odda	Kongsberg	2.0	0.0	1.3	0.1	0.6
Odda	Eiker	3.2	0.1	1.9	0.2	0.9
Odda	Drammen	5.6	0.5	3.1	0.3	1.7
Odda	Nesbru	15.7	2.4	7.9	0.2	5.2
Odda	Majorstua	23.5	6.9	7.3	0.8	8.4
Odda	Oslo S	133.8	49.5	39.8	2.2	42.2
Odda	Holmestrand	2.5	0.3	1.4	0.0	0.8
Odda	Tønsberg	10.5	0.8	6.3	0.0	3.2
Odda	Sandefjord	6.0	0.5	3.5	0.0	1.9
Odda	Larvik	4.6	0.2	3.0	0.0	1.4
Odda	Porsgrunn	2.9	0.1	1.9	0.0	0.8
Odda	Drangedal	0.3	0.0	0.2	0.0	0.1
Odda	Gjerstad	0.8	0.0	0.5	0.0	0.2
Odda	Arendal	1.7	0.2	0.9	0.0	0.5
Odda	Kristiansand	11.2	1.3	6.8	0.2	3.0
Røldal	Bergen	57.3	0.0	38.9	0.4	18.0
Røldal	Arna	11.5	0.0	8.0	0.0	3.4
Røldal	Tysse	5.0	0.0	3.5	0.0	1.5
Røldal	Kvam-Jondal	39.0	0.0	28.0	0.0	11.0
Røldal	Odda	145.2	0.0	107.7	0.0	37.5
Røldal	Sauda	50.2	0.0	36.7	0.0	13.5
Røldal	Ølen	74.0	0.0	53.6	0.1	20.3
Røldal	Aksdal	24.3	0.0	17.4	0.1	6.9
Røldal	Haugesund	62.2	0.0	44.2	0.2	17.9

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From station	To station	HSR trips	From air	From car	From PT	Induc. dem.
Røldal	Kårstø	18.7	0.0	13.4	0.0	5.3
Røldal	Stavanger	120.0	0.0	80.9	0.3	38.7
Røldal	Haukeligrend	3.5	0.0	2.6	0.0	1.0
Røldal	Åmot	10.7	0.0	7.7	0.0	3.0
Røldal	Brunkeberg	2.1	0.0	1.5	0.0	0.6
Røldal	Bø	0.8	0.0	0.6	0.0	0.2
Røldal	Nordagutu	0.0	0.0	0.0	0.0	0.0
Røldal	Skien	0.9	0.0	0.6	0.0	0.3
Røldal	Notodden	0.4	0.0	0.3	0.0	0.1
Røldal	Kongsberg	0.4	0.0	0.3	0.0	0.1
Røldal	Eiker	0.6	0.0	0.4	0.0	0.2
Røldal	Drammen	1.0	0.0	0.7	0.1	0.3
Røldal	Nesbru	1.5	0.0	1.0	0.0	0.4
Røldal	Majorstua	2.1	0.2	1.1	0.2	0.7
Røldal	Oslo S	13.8	4.2	5.4	0.5	3.8
Røldal	Holmestrand	0.5	0.0	0.3	0.0	0.1
Røldal	Tønsberg	2.5	0.0	1.8	0.0	0.7
Røldal	Sandefjord	1.2	0.0	0.9	0.0	0.4
Røldal	Larvik	1.2	0.0	0.8	0.0	0.3
Røldal	Porsgrunn	0.9	0.0	0.6	0.0	0.3
Røldal	Drangedal	0.1	0.0	0.1	0.0	0.0
Røldal	Gjerstad	0.2	0.0	0.2	0.0	0.1
Røldal	Arendal	0.4	0.0	0.3	0.0	0.1
Røldal	Kristiansand	2.2	0.0	1.6	0.0	0.6
Sauda	Bergen	23.4	0.0	16.0	0.2	7.2
Sauda	Arna	6.5	0.0	4.6	0.1	1.9
Sauda	Tysse	1.9	0.0	1.3	0.0	0.6
Sauda	Kvam-Jondal	4.1	0.0	2.9	0.0	1.2
Sauda	Odda	12.4	0.0	9.1	0.0	3.3
Sauda	Røldal	49.7	0.0	36.3	0.0	13.4
Sauda	Ølen	28.4	0.0	20.6	0.1	7.7
Sauda	Aksdal	13.0	0.0	9.3	0.1	3.5
Sauda	Haugesund	35.5	0.0	25.4	0.1	9.9
Sauda	Kårstø	12.5	0.0	9.1	0.0	3.4
Sauda	Stavanger	158.2	0.0	110.6	2.5	45.1
Sauda	Haukeligrend	10.0	0.0	7.2	0.0	2.8
Sauda	Åmot	33.7	0.0	24.0	0.1	9.7
Sauda	Brunkeberg	2.4	0.0	1.7	0.1	0.7
Sauda	Bø	0.8	0.0	0.5	0.0	0.2
Sauda	Nordagutu	0.1	0.0	0.1	0.0	0.0
Sauda	Skien	1.6	0.0	1.1	0.1	0.5
Sauda	Notodden	0.5	0.0	0.4	0.0	0.2
Sauda	Kongsberg	0.9	0.0	0.6	0.0	0.3
Sauda	Eiker	1.1	0.0	0.7	0.1	0.3
Sauda	Drammen	2.1	0.1	1.2	0.1	0.7
Sauda	Nesbru	4.7	0.8	2.4	0.0	1.5
Sauda	Majorstua	9.2	2.9	2.7	0.2	3.4
Sauda	Oslo S	67.8	33.5	14.8	0.8	18.6
Sauda	Holmestrand	0.8	0.1	0.5	0.0	0.3
Sauda	Tønsberg	6.5	0.2	4.4	0.0	2.0
Sauda	Sandefjord	3.4	0.1	2.2	0.0	1.1
Sauda	Larvik	2.9	0.0	1.9	0.0	0.9
Sauda	Porsgrunn	2.1	0.0	1.4	0.1	0.6
Sauda	Drangedal	0.3	0.0	0.2	0.0	0.1
Sauda	Gjerstad	0.6	0.0	0.4	0.0	0.2
Sauda	Arendal	1.1	0.0	0.8	0.0	0.3
Sauda	Kristiansand	5.0	0.0	3.6	0.2	1.3
Ølen	Bergen	140.9	0.0	94.5	5.2	41.2
Ølen	Arna	21.3	0.0	14.8	0.4	6.1
Ølen	Tysse	3.6	0.0	2.5	0.0	1.1
Ølen	Kvam-Jondal	6.9	0.0	4.9	0.1	1.9
Ølen	Odda	22.5	0.0	16.6	0.1	5.8
Ølen	Røldal	73.4	0.0	53.2	0.1	20.1
Ølen	Sauda	29.8	0.0	21.5	0.2	8.1
Ølen	Aksdal	118.0	0.0	85.7	1.9	30.5
Ølen	Haugesund	258.6	0.0	187.6	2.8	68.2
Ølen	Kårstø	70.4	0.0	51.7	0.2	18.5
Ølen	Stavanger	225.8	0.0	147.7	2.6	75.4
Ølen	Haukeligrend	6.0	0.0	4.2	0.1	1.7
Ølen	Åmot	12.7	0.0	9.0	0.1	3.6
Ølen	Brunkeberg	1.3	0.0	0.9	0.1	0.4
Ølen	Bø	1.1	0.0	0.7	0.0	0.3
Ølen	Nordagutu	0.1	0.0	0.1	0.0	0.0
Ølen	Skien	2.0	0.0	1.3	0.1	0.6
Ølen	Notodden	0.8	0.0	0.5	0.0	0.2
Ølen	Kongsberg	1.1	0.0	0.7	0.1	0.3
Ølen	Eiker	1.9	0.1	1.0	0.2	0.6
Ølen	Drammen	3.5	0.4	1.6	0.3	1.1
Ølen	Nesbru	8.1	1.8	3.5	0.2	2.7
Ølen	Majorstua	16.7	5.3	3.9	1.1	6.4
Ølen	Oslo S	92.2	45.1	18.6	3.1	25.4
Ølen	Holmestrand	1.4	0.1	0.8	0.0	0.5
Ølen	Tønsberg	7.6	0.5	4.9	0.0	2.2
Ølen	Sandefjord	4.4	0.3	2.6	0.0	1.4
Ølen	Larvik	4.2	0.1	2.8	0.0	1.3
Ølen	Porsgrunn	3.2	0.0	2.1	0.1	1.0
Ølen	Drangedal	0.4	0.0	0.3	0.0	0.1

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From station	To station	HSR trips	From air	From car	From PT	Induc. dem.
Ølen	Gjerstad	0.9	0.0	0.6	0.0	0.2
Ølen	Arendal	1.5	0.0	1.1	0.0	0.4
Ølen	Kristiansand	5.4	0.0	3.8	0.2	1.4
Aksdal	Bergen	333.6	0.0	192.8	54.8	86.1
Aksdal	Arna	63.5	0.0	42.1	4.8	16.6
Aksdal	Tysse	9.9	0.0	7.1	0.2	2.6
Aksdal	Kvam-Jondal	19.5	0.0	13.9	0.4	5.2
Aksdal	Odda	25.3	0.0	18.3	0.4	6.7
Aksdal	Røldal	24.2	0.0	17.3	0.1	6.9
Aksdal	Sauda	13.1	0.0	9.5	0.1	3.6
Aksdal	Ølen	117.8	0.0	85.5	2.0	30.4
Aksdal	Haugesund	502.3	0.0	368.7	15.4	118.3
Aksdal	Kårstø	423.2	0.0	317.9	0.6	104.7
Aksdal	Stavanger	405.5	0.0	262.0	14.5	129.0
Aksdal	Haukeligrend	1.4	0.0	1.0	0.0	0.4
Aksdal	Åmot	3.9	0.0	2.8	0.1	1.1
Aksdal	Brunkeberg	2.8	0.0	1.9	0.1	0.8
Aksdal	Bø	2.2	0.0	1.5	0.0	0.6
Aksdal	Nordagutu	0.2	0.0	0.2	0.0	0.1
Aksdal	Skien	4.8	0.3	2.9	0.1	1.5
Aksdal	Notodden	1.3	0.0	0.9	0.0	0.4
Aksdal	Kongsberg	2.8	0.2	1.5	0.2	0.9
Aksdal	Eiker	6.8	1.3	2.5	0.5	2.5
Aksdal	Drammen	15.0	3.8	4.7	0.8	5.7
Aksdal	Nesbru	29.0	8.9	8.7	0.8	10.6
Aksdal	Majorstua	50.8	20.6	8.7	1.9	19.5
Aksdal	Oslo S	291.3	145.7	48.1	6.1	91.3
Aksdal	Holmestrand	6.1	1.6	2.2	0.1	2.3
Aksdal	Tønsberg	18.0	2.8	9.5	0.1	5.6

From station	To station	HSR trips	From air	From car	From PT	Induc. dem.
Aksdal	Sandefjord	11.0	1.9	5.5	0.1	3.6
Aksdal	Larvik	10.0	1.3	5.4	0.1	3.3
Aksdal	Porsgrunn	6.1	0.4	3.7	0.1	1.9
Aksdal	Drangedal	0.5	0.0	0.3	0.0	0.1
Aksdal	Gjerstad	1.7	0.1	1.1	0.0	0.5
Aksdal	Arendal	5.6	1.0	2.5	0.3	1.7
Aksdal	Kristiansand	9.8	2.8	2.9	1.3	2.8
Haugesund	Bergen	373.2	0.0	237.0	31.0	105.2
Haugesund	Arna	53.4	0.0	35.9	2.2	15.2
Haugesund	Tysse	11.8	0.0	8.3	0.1	3.4
Haugesund	Kvam-Jondal	25.5	0.0	18.2	0.2	7.2
Haugesund	Odda	59.2	0.0	42.6	0.5	16.0
Haugesund	Røldal	58.3	0.0	41.4	0.2	16.7
Haugesund	Sauda	36.1	0.0	25.9	0.1	10.1
Haugesund	Ølen	256.4	0.0	186.0	2.7	67.7
Haugesund	Aksdal	555.9	0.0	407.7	16.8	131.4
Haugesund	Kårstø	558.4	0.0	417.4	1.9	139.2
Haugesund	Stavanger	848.2	0.0	505.0	87.7	255.4
Haugesund	Haukeligrend	2.6	0.0	1.9	0.0	0.8
Haugesund	Åmot	7.9	0.0	5.4	0.2	2.3
Haugesund	Brunkeberg	4.9	0.0	3.2	0.2	1.5
Haugesund	Bø	4.2	0.0	2.7	0.2	1.3
Haugesund	Nordagutu	0.6	0.0	0.4	0.0	0.2
Haugesund	Skien	9.8	0.4	5.8	0.4	3.1
Haugesund	Notodden	2.9	0.1	1.8	0.1	0.9
Haugesund	Kongsberg	6.1	0.7	3.2	0.3	2.0
Haugesund	Eiker	13.4	3.1	5.0	0.6	4.7
Haugesund	Drammen	25.0	6.6	8.4	0.9	9.1
Haugesund	Nesbru	43.2	12.8	16.0	0.5	13.9

From station	To station	HSR trips	From air	From car	From PT	Induc. dem.
Haugesund	Majorstua	73.4	31.3	13.9	2.1	26.1
Haugesund	Oslo S	409.0	240.5	64.1	6.7	97.7
Haugesund	Holmestrand	9.5	2.4	3.7	0.1	3.2
Haugesund	Tønsberg	25.2	3.5	14.5	0.1	7.1
Haugesund	Sandefjord	17.3	2.5	9.3	0.1	5.4
Haugesund	Larvik	16.5	2.0	9.0	0.1	5.4
Haugesund	Porsgrunn	12.9	0.7	7.6	0.4	4.1
Haugesund	Drangedal	1.3	0.0	0.9	0.0	0.4
Haugesund	Gjerstad	2.6	0.1	1.7	0.1	0.7
Haugesund	Arendal	4.2	0.0	2.9	0.2	1.1
Haugesund	Kristiansand	6.9	0.0	3.8	1.3	1.7
Kårstø	Bergen	133.4	0.0	88.1	7.8	37.5
Kårstø	Arna	16.4	0.0	11.2	0.6	4.6
Kårstø	Tysse	4.8	0.0	3.4	0.0	1.4
Kårstø	Kvam-Jondal	7.5	0.0	5.4	0.0	2.1
Kårstø	Odda	23.0	0.0	16.7	0.1	6.2
Kårstø	Røldal	18.2	0.0	13.0	0.0	5.2
Kårstø	Sauda	12.7	0.0	9.2	0.0	3.5
Kårstø	Ølen	69.4	0.0	50.9	0.2	18.3
Kårstø	Aksdal	423.8	0.0	318.4	0.6	104.8
Kårstø	Haugesund	541.8	0.0	405.2	1.9	134.7
Kårstø	Stavanger	377.4	0.0	229.7	35.6	112.1
Kårstø	Haukeligrend	1.2	0.0	0.8	0.0	0.3
Kårstø	Åmot	3.5	0.0	2.4	0.0	1.0
Kårstø	Brunkeberg	2.2	0.0	1.5	0.1	0.6
Kårstø	Bø	2.0	0.0	1.3	0.0	0.6
Kårstø	Nordagutu	0.3	0.0	0.2	0.0	0.1
Kårstø	Skien	4.1	0.2	2.5	0.1	1.3
Kårstø	Notodden	1.4	0.0	0.9	0.0	0.4

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From station	To station	HSR trips	From air	From car	From PT	Induc. dem.
Kårstø	Kongsberg	3.1	0.4	1.6	0.1	1.0
Kårstø	Eiker	5.3	1.3	2.1	0.1	1.8
Kårstø	Drammen	9.9	2.7	3.5	0.2	3.5
Kårstø	Nesbru	17.5	5.3	6.8	0.2	5.3
Kårstø	Majorstua	30.0	13.6	5.9	0.5	10.0
Kårstø	Oslo S	166.5	101.8	26.7	1.8	36.2
Kårstø	Holmestrand	3.9	1.0	1.5	0.1	1.2
Kårstø	Tønsberg	9.8	1.6	5.4	0.1	2.7
Kårstø	Sandefjord	7.0	1.1	3.8	0.0	2.1
Kårstø	Larvik	7.1	0.9	4.0	0.0	2.2
Kårstø	Porsgrunn	6.1	0.4	3.6	0.1	1.9
Kårstø	Drangedal	0.6	0.0	0.4	0.0	0.2
Kårstø	Gjerstad	1.2	0.0	0.8	0.0	0.3
Kårstø	Arendal	1.1	0.0	0.7	0.1	0.3
Kårstø	Kristiansand	2.7	0.0	1.5	0.6	0.6
Stavanger	Bergen	1184.0	636.7	151.7	16.0	379.6
Stavanger	Arna	175.4	73.8	35.0	3.2	63.4
Stavanger	Tysse	10.9	3.3	3.7	0.1	3.8
Stavanger	Kvam-Jondal	29.6	3.7	15.7	0.4	9.7
Stavanger	Odda	100.1	0.0	65.8	0.7	33.6
Stavanger	Røldal	118.8	0.0	80.2	0.3	38.2
Stavanger	Sauda	156.9	0.0	109.8	2.5	44.6
Stavanger	Ølen	222.1	0.0	145.6	2.6	73.9
Stavanger	Aksdal	398.3	0.0	257.6	14.4	126.3
Stavanger	Haugesund	828.0	0.0	493.7	86.2	248.2
Stavanger	Kårstø	371.6	0.0	226.5	35.1	109.9
Stavanger	Haukeligrend	60.2	0.0	44.1	0.0	16.1
Stavanger	Åmot	21.7	0.0	15.1	0.3	6.2
Stavanger	Brunkeberg	15.5	0.1	10.4	0.5	4.5
Stavanger	Bø	13.1	0.8	7.1	1.2	4.0
Stavanger	Nordagutu	1.7	0.1	0.9	0.1	0.5
Stavanger	Skien	33.3	5.8	15.2	2.3	9.9
Stavanger	Notodden	7.8	0.8	4.2	0.3	2.5
Stavanger	Kongsberg	37.6	11.0	9.8	2.7	14.1
Stavanger	Eiker	72.7	28.9	13.9	2.7	27.2
Stavanger	Drammen	147.0	59.3	25.9	7.0	54.8
Stavanger	Nesbru	264.7	119.8	57.0	3.5	84.4
Stavanger	Majorstua	466.3	249.3	42.6	18.3	156.1
Stavanger	Oslo S	2430.4	1555.8	207.9	54.2	612.5
Stavanger	Holmestrand	48.4	17.4	18.3	0.6	12.2
Stavanger	Tønsberg	82.0	26.3	36.7	0.3	18.6
Stavanger	Sandefjord	46.5	17.7	17.7	0.2	10.8
Stavanger	Larvik	47.8	15.3	20.1	0.3	12.1
Stavanger	Porsgrunn	51.5	13.5	20.7	2.8	14.5
Stavanger	Drangedal	4.4	0.1	2.8	0.3	1.2
Stavanger	Gjerstad	18.7	0.5	12.9	0.4	4.8
Stavanger	Arendal	38.5	0.0	27.5	1.5	9.4
Stavanger	Kristiansand	164.6	0.0	109.0	17.1	38.5
Haukeligrend	Bergen	6.3	0.3	3.8	0.2	1.9
Haukeligrend	Arna	1.6	0.0	1.1	0.0	0.5
Haukeligrend	Tysse	1.0	0.0	0.7	0.0	0.3
Haukeligrend	Kvam-Jondal	2.0	0.0	1.4	0.0	0.6
Haukeligrend	Odda	14.8	0.0	10.7	0.0	4.1
Haukeligrend	Røldal	3.5	0.0	2.6	0.0	1.0
Haukeligrend	Sauda	10.2	0.0	7.3	0.0	2.9
Haukeligrend	Ølen	6.0	0.0	4.2	0.1	1.7
Haukeligrend	Aksdal	1.4	0.0	1.0	0.0	0.4
Haukeligrend	Haugesund	2.7	0.0	1.9	0.0	0.8
Haukeligrend	Kårstø	1.2	0.0	0.8	0.0	0.3
Haukeligrend	Stavanger	61.6	0.0	45.0	0.0	16.5
Haukeligrend	Åmot	29.0	0.0	21.4	0.0	7.6
Haukeligrend	Brunkeberg	3.0	0.0	2.1	0.0	0.8
Haukeligrend	Bø	3.5	0.0	2.5	0.0	1.0
Haukeligrend	Nordagutu	0.4	0.0	0.3	0.0	0.1
Haukeligrend	Skien	7.8	0.0	5.5	0.1	2.2
Haukeligrend	Notodden	2.2	0.0	1.6	0.0	0.6
Haukeligrend	Kongsberg	3.4	0.0	2.2	0.2	1.0
Haukeligrend	Eiker	1.2	0.0	0.8	0.0	0.3
Haukeligrend	Drammen	2.2	0.0	1.5	0.1	0.6
Haukeligrend	Nesbru	2.7	0.0	1.9	0.0	0.7
Haukeligrend	Majorstua	3.4	0.0	2.3	0.1	1.0
Haukeligrend	Oslo S	15.3	1.1	9.9	0.2	4.0
Haukeligrend	Holmestrand	0.9	0.0	0.7	0.0	0.3
Haukeligrend	Tønsberg	6.7	0.0	4.8	0.0	1.9
Haukeligrend	Sandefjord	3.3	0.0	2.4	0.0	0.9
Haukeligrend	Larvik	3.0	0.0	2.1	0.0	0.9
Haukeligrend	Porsgrunn	5.9	0.0	4.2	0.0	1.6
Haukeligrend	Drangedal	0.8	0.0	0.6	0.0	0.2
Haukeligrend	Gjerstad	0.8	0.0	0.6	0.0	0.2
Haukeligrend	Arendal	5.1	0.0	3.9	0.0	1.2
Haukeligrend	Kristiansand	11.7	0.0	8.9	0.0	2.8
Åmot	Bergen	16.5	0.1	11.2	0.2	5.0
Åmot	Arna	4.7	0.0	3.4	0.0	1.3
Åmot	Tysse	0.4	0.0	0.3	0.0	0.1
Åmot	Kvam-Jondal	4.8	0.0	3.4	0.0	1.4
Åmot	Odda	46.0	0.0	33.1	0.0	12.9
Åmot	Røldal	11.1	0.0	8.0	0.0	3.1

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From station	To station	HSR trips	From air	From car	From PT	Induc. dem.
Åmot	Sauda	33.8	0.0	24.0	0.1	9.7
Åmot	Ølen	12.7	0.0	9.0	0.1	3.6
Åmot	Aksdal	4.0	0.0	2.8	0.1	1.1
Åmot	Haugesund	8.0	0.0	5.5	0.2	2.3
Åmot	Kårstø	3.5	0.0	2.4	0.0	1.0
Åmot	Stavanger	21.8	0.0	15.2	0.3	6.2
Åmot	Haukeligrend	28.5	0.0	21.0	0.0	7.5
Åmot	Brunkeberg	80.8	0.0	60.6	0.1	20.1
Åmot	Bø	12.5	0.0	9.1	0.1	3.4
Åmot	Nordagutu	1.1	0.0	0.8	0.0	0.3
Åmot	Skien	20.7	0.0	14.8	0.1	5.7
Åmot	Notodden	5.3	0.0	3.9	0.0	1.4
Åmot	Kongsberg	10.7	0.0	7.5	0.2	2.9
Åmot	Eiker	15.5	0.0	11.0	0.2	4.2
Åmot	Drammen	32.4	0.0	22.8	0.5	9.1
Åmot	Nesbru	21.5	0.0	15.1	0.4	6.0
Åmot	Majorstua	10.4	0.0	6.5	1.0	2.9
Åmot	Oslo S	43.9	0.0	29.1	2.8	12.0
Åmot	Holmestrand	11.9	0.0	8.6	0.1	3.2
Åmot	Tønsberg	24.9	0.0	17.8	0.1	7.0
Åmot	Sandefjord	37.9	0.0	27.1	0.1	10.6
Åmot	Larvik	35.8	0.0	25.6	0.1	10.1
Åmot	Porsgrunn	25.5	0.0	18.3	0.1	7.0
Åmot	Drangedal	2.8	0.0	2.1	0.0	0.7
Åmot	Gjerstad	4.9	0.0	3.7	0.0	1.3
Åmot	Arendal	12.2	0.0	9.1	0.0	3.1
Åmot	Kristiansand	12.0	0.0	9.0	0.1	2.9
Brunkeberg	Bergen	11.1	0.6	6.7	0.2	3.5
Brunkeberg	Arna	3.4	0.0	2.3	0.1	1.0

From station	To station	HSR trips	From air	From car	From PT	Induc. dem.
Brunkeberg	Tysse	0.3	0.0	0.2	0.0	0.1
Brunkeberg	Kvam-Jondal	0.6	0.0	0.4	0.0	0.2
Brunkeberg	Odda	2.3	0.0	1.7	0.0	0.7
Brunkeberg	Røldal	2.0	0.0	1.4	0.0	0.6
Brunkeberg	Sauda	2.4	0.0	1.7	0.1	0.7
Brunkeberg	Ølen	1.3	0.0	0.9	0.1	0.4
Brunkeberg	Aksdal	2.8	0.0	1.9	0.1	0.8
Brunkeberg	Haugesund	4.9	0.0	3.2	0.2	1.5
Brunkeberg	Kårstø	2.2	0.0	1.5	0.1	0.6
Brunkeberg	Stavanger	15.5	0.1	10.4	0.5	4.5
Brunkeberg	Haukeligrend	3.0	0.0	2.1	0.0	0.8
Brunkeberg	Åmot	84.9	0.0	63.6	0.1	21.1
Brunkeberg	Bø	159.6	0.0	116.4	3.0	40.2
Brunkeberg	Nordagutu	8.4	0.0	6.1	0.0	2.2
Brunkeberg	Skien	18.4	0.0	13.0	0.4	5.1
Brunkeberg	Notodden	14.8	0.0	11.0	0.1	3.7
Brunkeberg	Kongsberg	8.8	0.0	6.3	0.2	2.4
Brunkeberg	Eiker	12.2	0.0	8.7	0.2	3.3
Brunkeberg	Drammen	25.2	0.0	17.8	0.5	7.0
Brunkeberg	Nesbru	22.5	0.0	16.0	0.4	6.2
Brunkeberg	Majorstua	32.1	0.0	21.6	1.6	8.9
Brunkeberg	Oslo S	110.7	0.0	76.2	4.1	30.5
Brunkeberg	Holmestrand	13.2	0.0	9.8	0.1	3.4
Brunkeberg	Tønsberg	67.5	0.0	49.0	0.1	18.3
Brunkeberg	Sandefjord	32.0	0.0	23.1	0.1	8.8
Brunkeberg	Larvik	29.1	0.0	21.0	0.1	8.0
Brunkeberg	Porsgrunn	20.7	0.0	14.7	0.2	5.7
Brunkeberg	Drangedal	19.7	0.0	14.9	0.0	4.9
Brunkeberg	Gjerstad	3.7	0.0	2.7	0.0	0.9

From station	To station	HSR trips	From air	From car	From PT	Induc. dem.
Brunkeberg	Arendal	11.5	0.0	8.6	0.0	2.9
Brunkeberg	Kristiansand	25.6	0.0	18.9	0.3	6.4
Bø	Bergen	13.1	2.9	5.3	0.2	4.7
Bø	Arna	2.9	0.2	1.7	0.1	0.9
Bø	Tysse	0.2	0.0	0.1	0.0	0.1
Bø	Kvam-Jondal	0.5	0.0	0.4	0.0	0.2
Bø	Odda	1.1	0.0	0.8	0.0	0.3
Bø	Røldal	0.8	0.0	0.6	0.0	0.2
Bø	Sauda	0.8	0.0	0.5	0.0	0.2
Bø	Ølen	1.1	0.0	0.7	0.0	0.3
Bø	Aksdal	2.2	0.0	1.5	0.0	0.6
Bø	Haugesund	4.2	0.0	2.7	0.2	1.3
Bø	Kårstø	2.0	0.0	1.3	0.0	0.6
Bø	Stavanger	13.1	0.8	7.1	1.2	4.0
Bø	Haukeligrend	3.4	0.0	2.4	0.0	0.9
Bø	Åmot	12.5	0.0	9.1	0.1	3.4
Bø	Brunkeberg	157.7	0.0	115.1	2.9	39.7
Bø	Nordagutu	143.9	0.0	108.0	1.4	34.6
Bø	Skien	223.4	0.0	152.8	12.8	57.8
Bø	Notodden	252.7	0.0	186.5	3.1	63.2
Bø	Kongsberg	29.4	0.0	21.1	0.3	8.0
Bø	Eiker	12.3	0.0	8.8	0.2	3.4
Bø	Drammen	25.3	0.0	17.6	0.7	7.1
Bø	Nesbru	24.8	0.0	17.5	0.5	6.8
Bø	Majorstua	36.6	0.0	21.2	5.4	9.9
Bø	Oslo S	140.1	0.0	90.2	11.8	38.1
Bø	Holmestrand	14.8	0.0	10.8	0.2	3.8
Bø	Tønsberg	76.2	0.0	55.2	0.4	20.6
Bø	Sandefjord	35.6	0.0	25.5	0.5	9.6

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From station	To station	HSR trips	From air	From car	From PT	Induc. dem.
Bø	Larvik	41.5	0.0	30.0	0.4	11.2
Bø	Porsgrunn	175.8	0.0	123.7	7.1	45.0
Bø	Drangedal	51.3	0.0	37.4	0.5	13.3
Bø	Gjerstad	4.6	0.0	3.4	0.0	1.2
Bø	Arendal	10.8	0.0	7.8	0.1	2.8
Bø	Kristiansand	10.3	0.0	7.0	0.7	2.6
Nordagutu	Bergen	1.7	0.3	0.7	0.0	0.6
Nordagutu	Arna	0.3	0.0	0.2	0.0	0.1
Nordagutu	Tysse	0.0	0.0	0.0	0.0	0.0
Nordagutu	Kvam-Jondal	0.1	0.0	0.1	0.0	0.0
Nordagutu	Odda	0.1	0.0	0.1	0.0	0.0
Nordagutu	Røldal	0.0	0.0	0.0	0.0	0.0
Nordagutu	Sauda	0.1	0.0	0.1	0.0	0.0
Nordagutu	Ølen	0.1	0.0	0.1	0.0	0.0
Nordagutu	Aksdal	0.2	0.0	0.2	0.0	0.1
Nordagutu	Haugesund	0.6	0.0	0.4	0.0	0.2
Nordagutu	Kårstø	0.3	0.0	0.2	0.0	0.1
Nordagutu	Stavanger	1.7	0.1	0.9	0.1	0.5
Nordagutu	Haukeligrend	0.4	0.0	0.3	0.0	0.1
Nordagutu	Åmot	1.1	0.0	0.8	0.0	0.3
Nordagutu	Brunkeberg	8.1	0.0	5.9	0.0	2.1
Nordagutu	Bø	142.8	0.0	107.1	1.4	34.3
Nordagutu	Skien	77.5	0.0	55.3	1.4	20.8
Nordagutu	Notodden	0.8	0.0	0.6	0.0	0.2
Nordagutu	Kongsberg	7.2	0.0	5.3	0.1	1.8
Nordagutu	Eiker	1.6	0.0	1.2	0.0	0.4
Nordagutu	Drammen	4.7	0.0	3.4	0.1	1.3
Nordagutu	Nesbru	4.7	0.0	3.4	0.1	1.3
Nordagutu	Majorstua	7.3	0.0	5.0	0.3	2.0

From station	To station	HSR trips	From air	From car	From PT	Induc. dem.
Nordagutu	Oslo S	27.1	0.0	19.2	0.6	7.3
Nordagutu	Holmestrand	1.5	0.0	1.1	0.0	0.4
Nordagutu	Tønsberg	2.7	0.0	1.9	0.0	0.7
Nordagutu	Sandefjord	6.1	0.0	4.4	0.0	1.7
Nordagutu	Larvik	7.8	0.0	5.6	0.0	2.2
Nordagutu	Porsgrunn	38.7	0.0	27.5	0.8	10.4
Nordagutu	Drangedal	1.8	0.0	1.3	0.0	0.5
Nordagutu	Gjerstad	0.6	0.0	0.4	0.0	0.1
Nordagutu	Arendal	1.3	0.0	1.0	0.0	0.3
Nordagutu	Kristiansand	0.6	0.0	0.4	0.1	0.1
Skien	Bergen	48.6	19.3	11.2	1.2	16.9
Skien	Arna	10.2	2.1	4.3	0.4	3.5
Skien	Tysse	0.6	0.1	0.3	0.0	0.2
Skien	Kvam-Jondal	1.1	0.1	0.7	0.0	0.3
Skien	Odda	2.3	0.0	1.6	0.0	0.7
Skien	Røldal	0.9	0.0	0.6	0.0	0.3
Skien	Sauda	1.6	0.0	1.1	0.1	0.5
Skien	Ølen	2.0	0.0	1.3	0.1	0.6
Skien	Aksdal	4.8	0.3	2.9	0.1	1.5
Skien	Haugesund	9.7	0.4	5.7	0.4	3.1
Skien	Kårstø	4.1	0.2	2.5	0.1	1.3
Skien	Stavanger	33.3	5.8	15.2	2.3	10.0
Skien	Haukeligrend	7.6	0.0	5.4	0.1	2.1
Skien	Åmot	20.5	0.0	14.7	0.1	5.7
Skien	Brunkeberg	18.2	0.0	12.8	0.3	5.0
Skien	Bø	213.6	0.0	146.1	12.3	55.2
Skien	Nordagutu	78.8	0.0	56.4	1.3	21.1
Skien	Notodden	101.9	0.0	72.9	1.1	27.9
Skien	Kongsberg	31.0	0.0	22.0	0.4	8.6

From station	To station	HSR trips	From air	From car	From PT	Induc. dem.
Skien	Eiker	31.5	0.0	22.2	0.7	8.6
Skien	Drammen	44.0	0.0	28.7	3.4	11.9
Skien	Nesbru	42.8	0.0	28.5	2.8	11.4
Skien	Majorstua	62.9	0.0	41.5	4.2	17.3
Skien	Oslo S	303.8	0.0	209.9	12.3	81.6
Skien	Holmestrand	53.5	0.0	38.8	1.2	13.5
Skien	Tønsberg	233.4	0.0	167.1	4.7	61.6
Skien	Sandefjord	200.8	0.0	145.4	3.0	52.4
Skien	Larvik	476.1	0.0	343.3	9.7	123.2
Skien	Porsgrunn	1234.6	0.0	824.4	121.3	289.0
Skien	Drangedal	43.8	0.0	32.7	0.2	10.9
Skien	Gjerstad	14.3	0.0	10.8	0.1	3.4
Skien	Arendal	15.0	0.0	11.0	0.4	3.7
Skien	Kristiansand	37.3	0.0	26.8	1.4	9.2
Notodden	Bergen	6.7	1.3	2.8	0.1	2.3
Notodden	Arna	1.7	0.1	1.0	0.0	0.5
Notodden	Tysse	0.1	0.0	0.1	0.0	0.0
Notodden	Kvam-Jondal	0.4	0.0	0.3	0.0	0.1
Notodden	Odda	0.7	0.0	0.5	0.0	0.2
Notodden	Røldal	0.4	0.0	0.3	0.0	0.1
Notodden	Sauda	0.5	0.0	0.4	0.0	0.2
Notodden	Ølen	0.8	0.0	0.5	0.0	0.2
Notodden	Aksdal	1.3	0.0	0.9	0.0	0.4
Notodden	Haugesund	2.9	0.1	1.8	0.1	0.9
Notodden	Kårstø	1.4	0.0	0.9	0.0	0.4
Notodden	Stavanger	7.8	0.8	4.2	0.3	2.5
Notodden	Haukeligrend	2.2	0.0	1.6	0.0	0.6
Notodden	Åmot	5.3	0.0	3.9	0.0	1.4
Notodden	Brunkeberg	14.8	0.0	11.0	0.1	3.7

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From station	To station	HSR trips	From air	From car	From PT	Induc. dem.
Notodden	Bø	247.1	0.0	182.4	3.0	61.7
Notodden	Nordagutu	0.8	0.0	0.6	0.0	0.2
Notodden	Skien	104.0	0.0	74.3	1.2	28.5
Notodden	Kongsberg	391.3	0.0	286.5	5.3	99.5
Notodden	Eiker	73.9	0.0	53.9	0.7	19.3
Notodden	Drammen	86.3	0.0	61.8	1.2	23.3
Notodden	Nesbru	44.6	0.0	32.5	0.5	11.6
Notodden	Majorstua	78.4	0.0	55.2	2.2	21.0
Notodden	Oslo S	261.4	0.0	186.6	5.4	69.5
Notodden	Holmestrand	18.1	0.0	13.5	0.1	4.5
Notodden	Tønsberg	24.0	0.0	17.6	0.2	6.3
Notodden	Sandefjord	18.1	0.0	13.0	0.1	4.9
Notodden	Larvik	43.5	0.0	31.4	0.1	11.9
Notodden	Porsgrunn	64.4	0.0	46.3	0.7	17.5
Notodden	Drangedal	3.0	0.0	2.2	0.0	0.8
Notodden	Gjerstad	4.2	0.0	3.1	0.0	1.1
Notodden	Arendal	7.3	0.0	5.4	0.1	1.9
Notodden	Kristiansand	6.2	0.0	4.4	0.3	1.6
Kongsberg	Bergen	56.9	14.3	15.8	4.7	22.1
Kongsberg	Arna	10.9	1.6	4.7	0.8	3.8
Kongsberg	Tysse	0.5	0.0	0.3	0.0	0.2
Kongsberg	Kvam-Jondal	1.9	0.0	1.2	0.1	0.6
Kongsberg	Odda	2.0	0.0	1.4	0.1	0.6
Kongsberg	Røldal	0.4	0.0	0.3	0.0	0.1
Kongsberg	Sauda	0.9	0.0	0.6	0.0	0.3
Kongsberg	Ølen	1.1	0.0	0.7	0.1	0.3
Kongsberg	Aksdal	2.8	0.2	1.5	0.2	0.9
Kongsberg	Haugesund	6.1	0.7	3.2	0.3	2.0
Kongsberg	Kårstø	3.1	0.4	1.6	0.1	1.0

From station	To station	HSR trips	From air	From car	From PT	Induc. dem.
Kongsberg	Stavanger	37.6	11.0	9.8	2.7	14.1
Kongsberg	Haukeligrend	3.4	0.0	2.2	0.2	0.9
Kongsberg	Åmot	10.6	0.0	7.5	0.2	2.9
Kongsberg	Brunkeberg	8.8	0.0	6.3	0.2	2.4
Kongsberg	Bø	28.6	0.0	20.5	0.3	7.8
Kongsberg	Nordagutu	7.0	0.0	5.2	0.1	1.8
Kongsberg	Skien	31.1	0.0	22.0	0.4	8.6
Kongsberg	Notodden	386.1	0.0	282.8	5.2	98.1
Kongsberg	Eiker	743.7	0.0	549.6	11.7	182.4
Kongsberg	Drammen	761.8	0.0	534.8	27.4	199.6
Kongsberg	Nesbru	146.7	0.0	97.7	11.2	37.8
Kongsberg	Majorstua	211.9	0.0	126.0	30.5	55.4
Kongsberg	Oslo S	610.8	0.0	394.8	56.8	159.2
Kongsberg	Holmestrand	89.9	0.0	66.7	0.9	22.2
Kongsberg	Tønsberg	66.6	0.0	48.0	1.3	17.4
Kongsberg	Sandefjord	33.5	0.0	24.2	0.6	8.7
Kongsberg	Larvik	36.4	0.0	26.0	0.6	9.8
Kongsberg	Porsgrunn	40.6	0.0	29.0	0.4	11.2
Kongsberg	Drangedal	1.8	0.0	1.3	0.1	0.5
Kongsberg	Gjerstad	6.4	0.0	4.5	0.3	1.7
Kongsberg	Arendal	4.9	0.0	3.2	0.5	1.2
Kongsberg	Kristiansand	8.3	0.2	4.1	1.9	2.1
Eiker	Bergen	105.7	31.7	17.1	17.6	39.4
Eiker	Arna	19.3	3.8	5.9	2.9	6.7
Eiker	Tysse	1.6	0.4	0.5	0.2	0.6
Eiker	Kvam-Jondal	3.5	0.2	1.9	0.3	1.1
Eiker	Odda	3.2	0.1	2.0	0.2	0.9
Eiker	Røldal	0.6	0.0	0.4	0.0	0.2
Eiker	Sauda	1.1	0.0	0.7	0.1	0.3

From station	To station	HSR trips	From air	From car	From PT	Induc. dem.
Eiker	Ølen	1.9	0.1	1.0	0.2	0.6
Eiker	Aksdal	6.8	1.3	2.5	0.5	2.5
Eiker	Haugesund	13.4	3.1	5.0	0.6	4.7
Eiker	Kårstø	5.3	1.3	2.1	0.1	1.8
Eiker	Stavanger	73.1	29.0	14.0	2.7	27.4
Eiker	Haukeligrend	1.2	0.0	0.8	0.0	0.3
Eiker	Åmot	15.5	0.0	11.0	0.2	4.3
Eiker	Brunkeberg	12.2	0.0	8.7	0.2	3.3
Eiker	Bø	12.2	0.0	8.7	0.2	3.3
Eiker	Nordagutu	1.7	0.0	1.2	0.0	0.4
Eiker	Skien	31.7	0.0	22.3	0.7	8.6
Eiker	Notodden	72.9	0.0	53.1	0.7	19.1
Eiker	Kongsberg	754.5	0.0	557.1	12.1	185.3
Eiker	Drammen	1553.7	0.0	1061.5	126.6	365.5
Eiker	Nesbru	358.6	0.0	238.9	33.7	86.0
Eiker	Majorstua	327.5	0.0	162.1	85.6	79.9
Eiker	Oslo S	583.4	0.0	327.8	112.7	142.9
Eiker	Holmestrand	81.6	0.0	61.1	0.9	19.7
Eiker	Tønsberg	55.9	0.0	39.2	2.4	14.3
Eiker	Sandefjord	37.7	0.0	26.8	1.3	9.7
Eiker	Larvik	43.1	0.0	30.4	1.3	11.4
Eiker	Porsgrunn	63.0	0.0	45.1	0.8	17.1
Eiker	Drangedal	3.1	0.0	2.2	0.1	0.8
Eiker	Gjerstad	14.6	0.0	10.6	0.2	3.8
Eiker	Arendal	8.0	0.0	5.0	1.0	2.0
Eiker	Kristiansand	20.1	1.5	11.4	2.2	5.0
Drammen	Bergen	187.0	64.6	28.3	22.6	71.5
Drammen	Arna	38.9	8.6	12.3	4.4	13.7
Drammen	Tysse	3.0	0.9	0.7	0.2	1.2

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From station	To station	HSR trips	From air	From car	From PT	Induc. dem.
Drammen	Kvam-Jondal	7.0	1.0	3.2	0.4	2.3
Drammen	Odda	5.6	0.5	3.1	0.3	1.7
Drammen	Røldal	1.0	0.0	0.7	0.1	0.3
Drammen	Sauda	2.1	0.1	1.2	0.1	0.7
Drammen	Ølen	3.5	0.4	1.6	0.3	1.2
Drammen	Aksdal	15.1	3.8	4.7	0.8	5.7
Drammen	Haugesund	25.0	6.6	8.4	0.9	9.0
Drammen	Kårstø	9.9	2.7	3.5	0.2	3.5
Drammen	Stavanger	147.5	59.4	26.0	7.1	55.1
Drammen	Haukeligrend	2.1	0.0	1.5	0.1	0.6
Drammen	Åmot	32.4	0.0	22.8	0.5	9.1
Drammen	Brunkeberg	25.2	0.0	17.7	0.5	7.0
Drammen	Bø	25.3	0.0	17.6	0.7	7.1
Drammen	Nordagutu	4.7	0.0	3.4	0.1	1.3
Drammen	Skien	43.8	0.0	28.6	3.3	11.9
Drammen	Notodden	85.8	0.0	61.5	1.2	23.2
Drammen	Kongsberg	760.1	0.0	533.9	26.7	199.5
Drammen	Eiker	1494.0	0.0	1021.8	120.9	351.4
Drammen	Nesbru	1682.3	0.0	1140.1	140.2	402.0
Drammen	Majorstua	1025.5	0.0	492.5	286.4	246.6
Drammen	Oslo S	1325.2	0.0	610.5	394.5	320.1
Drammen	Holmestrand	696.8	0.0	506.7	18.0	172.0
Drammen	Tønsberg	358.4	0.0	251.9	12.3	94.2
Drammen	Sandefjord	130.2	0.0	78.0	17.7	34.5
Drammen	Larvik	96.0	0.0	60.7	10.1	25.2
Drammen	Porsgrunn	144.4	0.0	102.3	3.5	38.7
Drammen	Drangedal	7.1	0.0	5.0	0.2	1.9
Drammen	Gjerstad	43.1	0.0	31.2	0.8	11.1
Drammen	Arendal	21.2	0.0	13.4	2.5	5.2
Drammen	Kristiansand	51.2	3.0	29.8	5.7	12.7
Nesbru	Bergen	276.8	117.5	48.3	15.9	95.1
Nesbru	Arna	52.1	16.0	15.9	2.7	17.5
Nesbru	Tysse	4.7	1.6	1.2	0.1	1.7
Nesbru	Kvam-Jondal	14.9	2.9	6.7	0.3	5.1
Nesbru	Odda	15.9	2.4	8.0	0.2	5.2
Nesbru	Røldal	1.5	0.0	1.0	0.0	0.4
Nesbru	Sauda	4.7	0.8	2.4	0.0	1.5
Nesbru	Ølen	8.2	1.8	3.5	0.2	2.7
Nesbru	Aksdal	29.0	8.9	8.8	0.8	10.6
Nesbru	Haugesund	43.2	12.8	16.0	0.5	13.9
Nesbru	Kårstø	17.6	5.3	6.8	0.2	5.3
Nesbru	Stavanger	266.9	120.3	57.5	3.5	85.6
Nesbru	Haukeligrend	2.7	0.0	1.9	0.0	0.7
Nesbru	Åmot	21.5	0.0	15.2	0.4	6.0
Nesbru	Brunkeberg	22.6	0.0	16.0	0.4	6.2
Nesbru	Bø	24.9	0.0	17.5	0.5	6.8
Nesbru	Nordagutu	4.8	0.0	3.4	0.1	1.3
Nesbru	Skien	42.9	0.0	28.6	2.8	11.5
Nesbru	Notodden	45.1	0.0	32.9	0.5	11.8
Nesbru	Kongsberg	144.9	0.0	96.6	11.0	37.4
Nesbru	Eiker	354.5	0.0	236.4	33.0	85.1
Nesbru	Drammen	1691.4	0.0	1142.4	144.5	404.5
Nesbru	Majorstua	1509.4	0.0	758.7	398.5	352.3
Nesbru	Oslo S	2307.0	0.0	1070.4	701.4	535.2
Nesbru	Holmestrand	176.2	0.0	121.1	11.8	43.3
Nesbru	Tønsberg	113.0	0.0	60.0	22.5	30.5
Nesbru	Sandefjord	101.2	0.0	61.4	13.2	26.6
Nesbru	Larvik	91.8	0.0	59.6	8.2	24.0
Nesbru	Porsgrunn	140.7	0.0	100.1	3.3	37.3
Nesbru	Drangedal	6.9	0.0	4.9	0.2	1.9
Nesbru	Gjerstad	38.0	0.0	27.9	0.3	9.8
Nesbru	Arendal	26.0	1.0	17.5	1.1	6.5
Nesbru	Kristiansand	75.1	15.1	38.7	3.7	17.5
Majorstua	Bergen	581.7	265.8	46.9	67.3	201.8
Majorstua	Arna	124.6	42.9	21.9	16.7	43.0
Majorstua	Tysse	8.8	3.6	1.3	0.4	3.5
Majorstua	Kvam-Jondal	27.3	7.4	8.8	1.1	10.1
Majorstua	Odda	23.5	6.9	7.3	0.8	8.4
Majorstua	Røldal	2.1	0.2	1.1	0.2	0.7
Majorstua	Sauda	9.2	2.9	2.7	0.2	3.4
Majorstua	Ølen	16.6	5.3	3.9	1.1	6.4
Majorstua	Aksdal	50.8	20.6	8.7	1.9	19.5
Majorstua	Haugesund	73.1	31.2	13.9	2.1	25.9
Majorstua	Kårstø	29.9	13.6	5.9	0.5	9.9
Majorstua	Stavanger	467.6	249.7	42.6	18.3	157.0
Majorstua	Haukeligrend	3.3	0.0	2.3	0.1	1.0
Majorstua	Åmot	10.3	0.0	6.4	1.0	2.8
Majorstua	Brunkeberg	31.8	0.0	21.4	1.6	8.8
Majorstua	Bø	36.2	0.0	21.0	5.4	9.8
Majorstua	Nordagutu	7.2	0.0	4.9	0.3	2.0
Majorstua	Skien	62.3	0.0	41.1	4.1	17.1
Majorstua	Notodden	77.8	0.0	54.9	2.2	20.8
Majorstua	Kongsberg	207.3	0.0	123.4	29.7	54.1
Majorstua	Eiker	306.7	0.0	150.5	81.7	74.5
Majorstua	Drammen	937.8	0.0	442.0	271.5	224.3
Majorstua	Nesbru	1179.8	0.0	579.4	326.1	274.3
Majorstua	Oslo S	0.0	0.0	0.0	0.0	0.0

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From station	To station	HSR trips	From air	From car	From PT	Induc. dem.
Majorstua	Holmestrand	214.1	0.0	113.8	46.8	53.5
Majorstua	Tønsberg	192.0	0.0	84.6	54.2	53.2
Majorstua	Sandefjord	174.5	0.0	96.1	31.4	46.9
Majorstua	Larvik	151.6	0.0	96.1	15.0	40.5
Majorstua	Porsgrunn	210.3	0.0	146.1	7.1	57.0
Majorstua	Drangedal	9.1	0.0	5.9	0.8	2.4
Majorstua	Gjerstad	45.9	0.2	32.8	1.2	11.8
Majorstua	Arendal	44.0	6.1	24.5	2.4	11.0
Majorstua	Kristiansand	143.1	43.0	48.4	19.9	31.9
Oslo S	Bergen	2816.4	1547.4	304.6	175.2	789.2
Oslo S	Arna	600.9	259.4	126.9	43.0	171.6
Oslo S	Tysse	46.9	23.0	7.7	1.2	15.0
Oslo S	Kvam-Jondal	134.7	47.4	41.3	3.1	42.9
Oslo S	Odda	134.3	49.5	40.1	2.2	42.4
Oslo S	Røldal	13.8	4.2	5.4	0.5	3.8
Oslo S	Sauda	67.8	33.5	14.9	0.8	18.6
Oslo S	Ølen	92.1	44.9	18.7	3.1	25.4
Oslo S	Aksdal	291.7	145.6	48.4	6.1	91.6
Oslo S	Haugesund	407.0	238.7	64.2	6.6	97.4
Oslo S	Kårstø	165.5	100.8	26.8	1.8	36.1
Oslo S	Stavanger	2435.6	1554.3	209.3	54.3	617.7
Oslo S	Haukeligrend	15.2	1.1	9.9	0.2	4.0
Oslo S	Åmot	43.8	0.0	29.1	2.8	12.0
Oslo S	Brunkeberg	110.4	0.0	76.0	4.1	30.3
Oslo S	Bø	139.7	0.0	90.0	11.8	37.9
Oslo S	Nordagutu	27.0	0.0	19.1	0.6	7.3
Oslo S	Skien	303.6	0.0	209.8	12.3	81.5
Oslo S	Notodden	262.1	0.0	187.1	5.4	69.6
Oslo S	Kongsberg	614.1	0.0	397.5	56.6	160.0

From station	To station	HSR trips	From air	From car	From PT	Induc. dem.
Oslo S	Eiker	574.9	0.0	323.3	111.1	140.5
Oslo S	Drammen	1276.9	0.0	586.5	383.4	307.0
Oslo S	Nesbru	1999.5	0.0	923.5	613.4	462.6
Oslo S	Majorstua	0.0	0.0	0.0	0.0	0.0
Oslo S	Holmestrand	571.2	0.0	332.5	97.2	141.5
Oslo S	Tønsberg	771.1	0.0	430.7	134.4	205.9
Oslo S	Sandefjord	612.9	0.0	380.0	70.5	162.5
Oslo S	Larvik	548.8	0.0	363.4	40.7	144.7
Oslo S	Porsgrunn	847.9	0.0	602.1	18.9	226.9
Oslo S	Drangedal	37.6	0.0	25.8	1.9	9.9
Oslo S	Gjerstad	187.7	6.4	132.0	2.9	46.4
Oslo S	Arendal	229.4	71.6	105.9	7.3	44.6
Oslo S	Kristiansand	645.0	277.3	206.7	46.2	114.8
Holmestrand	Bergen	54.0	28.1	7.7	2.3	15.9
Holmestrand	Arna	10.9	3.2	3.8	0.5	3.3
Holmestrand	Tysse	1.0	0.3	0.3	0.0	0.4
Holmestrand	Kvam-Jondal	2.8	0.4	1.5	0.0	0.9
Holmestrand	Odda	2.5	0.3	1.5	0.0	0.8
Holmestrand	Røldal	0.5	0.0	0.3	0.0	0.1
Holmestrand	Sauda	0.8	0.1	0.5	0.0	0.3
Holmestrand	Ølen	1.4	0.1	0.8	0.0	0.5
Holmestrand	Aksdal	6.2	1.6	2.2	0.1	2.3
Holmestrand	Haugesund	9.5	2.4	3.7	0.1	3.2
Holmestrand	Kårstø	3.9	1.0	1.5	0.1	1.2
Holmestrand	Stavanger	49.0	17.5	18.5	0.6	12.4
Holmestrand	Haukeligrend	0.9	0.0	0.7	0.0	0.3
Holmestrand	Åmot	11.9	0.0	8.6	0.1	3.2
Holmestrand	Brunkeberg	13.4	0.0	9.9	0.1	3.4
Holmestrand	Bø	14.5	0.0	10.6	0.2	3.7

From station	To station	HSR trips	From air	From car	From PT	Induc. dem.
Holmestrand	Nordagutu	1.5	0.0	1.1	0.0	0.4
Holmestrand	Skien	53.7	0.0	38.9	1.2	13.6
Holmestrand	Notodden	17.6	0.0	13.2	0.1	4.4
Holmestrand	Kongsberg	86.8	0.0	64.4	0.9	21.5
Holmestrand	Eiker	77.9	0.0	58.3	0.9	18.8
Holmestrand	Drammen	681.5	0.0	495.2	18.1	168.1
Holmestrand	Nesbru	173.1	0.0	118.7	11.8	42.5
Holmestrand	Majorstua	220.2	0.0	117.3	47.8	55.1
Holmestrand	Oslo S	570.9	0.0	331.5	97.8	141.6
Holmestrand	Tønsberg	1118.7	0.0	820.8	11.8	286.1
Holmestrand	Sandefjord	245.5	0.0	180.8	3.9	60.8
Holmestrand	Larvik	99.9	0.0	72.7	2.6	24.6
Holmestrand	Porsgrunn	88.9	0.0	65.5	1.3	22.1
Holmestrand	Drangedal	8.8	0.0	6.5	0.0	2.2
Holmestrand	Gjerstad	15.8	0.0	11.9	0.1	3.8
Holmestrand	Arendal	37.3	0.0	28.0	0.3	9.0
Holmestrand	Kristiansand	27.5	0.0	20.1	0.7	6.7
Tønsberg	Bergen	76.9	45.6	7.2	2.1	21.9
Tønsberg	Arna	15.4	5.8	4.1	0.6	4.9
Tønsberg	Tysse	2.5	0.5	1.3	0.0	0.7
Tønsberg	Kvam-Jondal	6.1	1.0	3.2	0.1	1.8
Tønsberg	Odda	10.6	0.8	6.4	0.0	3.3
Tønsberg	Røldal	2.5	0.0	1.8	0.0	0.7
Tønsberg	Sauda	6.6	0.2	4.4	0.0	2.0
Tønsberg	Ølen	7.6	0.5	4.8	0.0	2.2
Tønsberg	Aksdal	18.2	2.8	9.6	0.1	5.7
Tønsberg	Haugesund	25.1	3.5	14.4	0.1	7.1
Tønsberg	Kårstø	9.8	1.6	5.4	0.1	2.7
Tønsberg	Stavanger	83.2	26.6	37.3	0.3	19.0

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From station	To station	HSR trips	From air	From car	From PT	Induc. dem.
Tønsberg	Haukeligrend	6.6	0.0	4.8	0.0	1.8
Tønsberg	Åmot	24.9	0.0	17.8	0.1	7.0
Tønsberg	Brunkeberg	67.9	0.0	49.3	0.1	18.4
Tønsberg	Bø	75.6	0.0	54.8	0.4	20.4
Tønsberg	Nordagutu	2.7	0.0	1.9	0.0	0.7
Tønsberg	Skien	233.3	0.0	167.0	4.7	61.7
Tønsberg	Notodden	24.1	0.0	17.7	0.2	6.3
Tønsberg	Kongsberg	66.5	0.0	47.9	1.3	17.3
Tønsberg	Eiker	57.0	0.0	40.2	2.3	14.5
Tønsberg	Drammen	363.4	0.0	255.8	12.3	95.4
Tønsberg	Nesbru	113.2	0.0	60.2	22.4	30.5
Tønsberg	Majorstua	193.7	0.0	85.3	54.7	53.7
Tønsberg	Oslo S	768.9	0.0	432.4	134.7	201.7
Tønsberg	Holmestrand	1054.4	0.0	769.0	22.0	263.4
Tønsberg	Sandefjord	2183.6	0.0	1559.9	84.1	539.6
Tønsberg	Larvik	694.9	0.0	499.2	24.2	171.5
Tønsberg	Porsgrunn	244.2	0.0	178.3	4.0	61.9
Tønsberg	Drangedal	19.9	0.0	14.7	0.0	5.1
Tønsberg	Gjerstad	26.4	0.0	20.0	0.1	6.3
Tønsberg	Arendal	78.9	0.0	59.1	0.8	19.1
Tønsberg	Kristiansand	45.0	0.0	33.1	0.9	11.0
Sandefjord	Bergen	59.6	28.5	15.2	0.7	15.2
Sandefjord	Arna	13.4	3.6	5.8	0.3	3.7
Sandefjord	Tysse	1.3	0.3	0.6	0.0	0.4
Sandefjord	Kvam-Jondal	3.6	0.6	1.8	0.0	1.1
Sandefjord	Odda	6.0	0.5	3.5	0.0	1.9
Sandefjord	Røldal	1.2	0.0	0.9	0.0	0.4
Sandefjord	Sauda	3.4	0.1	2.2	0.0	1.1
Sandefjord	Ølen	4.4	0.3	2.6	0.0	1.4

From station	To station	HSR trips	From air	From car	From PT	Induc. dem.
Sandefjord	Aksdal	11.1	1.9	5.6	0.1	3.6
Sandefjord	Haugesund	17.3	2.5	9.3	0.1	5.4
Sandefjord	Kårstø	7.0	1.1	3.8	0.0	2.1
Sandefjord	Stavanger	46.7	17.7	17.8	0.2	10.9
Sandefjord	Haukeligrend	3.3	0.0	2.3	0.0	0.9
Sandefjord	Åmot	37.6	0.0	26.9	0.1	10.5
Sandefjord	Brunkeberg	32.0	0.0	23.1	0.1	8.7
Sandefjord	Bø	34.8	0.0	24.9	0.5	9.3
Sandefjord	Nordagutu	6.1	0.0	4.4	0.0	1.7
Sandefjord	Skien	198.2	0.0	143.6	3.0	51.7
Sandefjord	Notodden	18.1	0.0	13.1	0.1	4.9
Sandefjord	Kongsberg	33.0	0.0	23.9	0.6	8.5
Sandefjord	Eiker	37.0	0.0	26.3	1.3	9.4
Sandefjord	Drammen	130.2	0.0	79.0	17.6	33.6
Sandefjord	Nesbru	100.0	0.0	61.2	13.0	25.8
Sandefjord	Majorstua	175.6	0.0	97.9	31.5	46.2
Sandefjord	Oslo S	612.2	0.0	381.8	70.1	160.3
Sandefjord	Holmestrand	231.5	0.0	170.7	3.7	57.1
Sandefjord	Tønsberg	2033.1	0.0	1454.6	77.8	500.7
Sandefjord	Larvik	1618.9	0.0	1163.1	70.4	385.4
Sandefjord	Porsgrunn	416.0	0.0	305.6	6.3	104.2
Sandefjord	Drangedal	8.2	0.0	6.1	0.0	2.1
Sandefjord	Gjerstad	9.5	0.0	7.2	0.1	2.3
Sandefjord	Arendal	34.0	0.0	25.3	0.5	8.2
Sandefjord	Kristiansand	29.1	0.0	21.4	0.6	7.1
Larvik	Bergen	58.2	24.9	16.1	1.0	16.2
Larvik	Arna	14.3	2.9	7.1	0.3	4.0
Larvik	Tysse	1.3	0.3	0.6	0.0	0.4
Larvik	Kvam-Jondal	3.3	0.4	1.8	0.0	1.0

From station	To station	HSR trips	From air	From car	From PT	Induc. dem.
Larvik	Odda	4.6	0.2	3.0	0.0	1.4
Larvik	Røldal	1.2	0.0	0.8	0.0	0.3
Larvik	Sauda	2.9	0.0	1.9	0.0	0.9
Larvik	Ølen	4.2	0.1	2.8	0.0	1.3
Larvik	Aksdal	10.0	1.3	5.4	0.1	3.3
Larvik	Haugesund	16.4	2.0	9.0	0.1	5.4
Larvik	Kårstø	7.1	0.9	4.0	0.0	2.2
Larvik	Stavanger	48.1	15.4	20.2	0.3	12.1
Larvik	Haukeligrend	2.9	0.0	2.1	0.0	0.8
Larvik	Åmot	35.5	0.0	25.5	0.1	10.0
Larvik	Brunkeberg	28.9	0.0	20.9	0.1	8.0
Larvik	Bø	39.9	0.0	28.8	0.4	10.7
Larvik	Nordagutu	8.0	0.0	5.7	0.0	2.2
Larvik	Skien	465.4	0.0	335.7	9.5	120.2
Larvik	Notodden	43.4	0.0	31.3	0.1	11.9
Larvik	Kongsberg	35.3	0.0	25.2	0.6	9.5
Larvik	Eiker	42.7	0.0	30.2	1.3	11.2
Larvik	Drammen	95.2	0.0	60.6	10.0	24.6
Larvik	Nesbru	91.4	0.0	59.6	8.2	23.6
Larvik	Majorstua	153.4	0.0	97.8	15.0	40.6
Larvik	Oslo S	549.9	0.0	365.4	40.4	144.1
Larvik	Holmestrand	102.0	0.0	74.3	2.6	25.1
Larvik	Tønsberg	688.5	0.0	494.5	23.9	170.1
Larvik	Sandefjord	1767.4	0.0	1270.3	74.0	423.2
Larvik	Porsgrunn	847.8	0.0	620.8	17.4	209.6
Larvik	Drangedal	9.4	0.0	7.0	0.0	2.4
Larvik	Gjerstad	8.6	0.0	6.5	0.0	2.0
Larvik	Arendal	32.4	0.0	24.2	0.4	7.8
Larvik	Kristiansand	67.0	0.0	49.2	1.5	16.4

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From station	To station	HSR trips	From air	From car	From PT	Induc. dem.
Porsgrunn	Bergen	66.9	28.3	15.2	1.4	21.9
Porsgrunn	Arna	14.3	3.1	6.1	0.4	4.7
Porsgrunn	Tysse	0.9	0.2	0.4	0.0	0.3
Porsgrunn	Kvam-Jondal	1.5	0.1	0.9	0.0	0.5
Porsgrunn	Odda	2.9	0.1	1.9	0.0	0.9
Porsgrunn	Røldal	0.9	0.0	0.6	0.0	0.3
Porsgrunn	Sauda	2.1	0.0	1.4	0.1	0.6
Porsgrunn	Ølen	3.2	0.0	2.1	0.1	1.0
Porsgrunn	Aksdal	6.1	0.4	3.7	0.1	1.9
Porsgrunn	Haugesund	12.9	0.7	7.6	0.4	4.2
Porsgrunn	Kårstø	6.1	0.4	3.6	0.1	1.9
Porsgrunn	Stavanger	52.0	13.5	20.9	2.8	14.7
Porsgrunn	Haukeligrend	5.8	0.0	4.2	0.0	1.6
Porsgrunn	Åmot	25.6	0.0	18.4	0.1	7.1
Porsgrunn	Brunkeberg	20.8	0.0	14.9	0.2	5.7
Porsgrunn	Bø	174.1	0.0	122.6	6.9	44.6
Porsgrunn	Nordagutu	40.3	0.0	28.7	0.8	10.8
Porsgrunn	Skien	1511.0	0.0	1010.0	145.9	355.1
Porsgrunn	Notodden	64.4	0.0	46.3	0.6	17.5
Porsgrunn	Kongsberg	40.9	0.0	29.2	0.4	11.3
Porsgrunn	Eiker	63.5	0.0	45.5	0.7	17.2
Porsgrunn	Drammen	147.0	0.0	104.1	3.5	39.4
Porsgrunn	Nesbru	142.4	0.0	101.4	3.3	37.8
Porsgrunn	Majorstua	214.6	0.0	149.2	7.1	58.3
Porsgrunn	Oslo S	858.0	0.0	609.4	18.8	229.8
Porsgrunn	Holmestrand	92.0	0.0	67.8	1.3	22.9
Porsgrunn	Tønsberg	249.7	0.0	182.2	4.1	63.4
Porsgrunn	Sandefjord	439.5	0.0	322.6	6.5	110.4
Porsgrunn	Larvik	934.1	0.0	683.4	18.7	232.0

From station	To station	HSR trips	From air	From car	From PT	Induc. dem.
Porsgrunn	Drangedal	57.2	0.0	43.1	0.1	14.0
Porsgrunn	Gjerstad	18.1	0.0	13.8	0.0	4.3
Porsgrunn	Arendal	17.3	0.0	12.7	0.5	4.1
Porsgrunn	Kristiansand	58.7	0.0	42.4	2.0	14.2
Drangedal	Bergen	3.7	0.7	1.8	0.0	1.1
Drangedal	Arna	0.9	0.0	0.6	0.0	0.2
Drangedal	Tysse	0.2	0.0	0.1	0.0	0.1
Drangedal	Kvam-Jondal	0.2	0.0	0.1	0.0	0.1
Drangedal	Odda	0.3	0.0	0.2	0.0	0.1
Drangedal	Røldal	0.1	0.0	0.1	0.0	0.0
Drangedal	Sauda	0.3	0.0	0.2	0.0	0.1
Drangedal	Ølen	0.4	0.0	0.3	0.0	0.1
Drangedal	Aksdal	0.5	0.0	0.3	0.0	0.1
Drangedal	Haugesund	1.3	0.0	0.9	0.0	0.4
Drangedal	Kårstø	0.6	0.0	0.4	0.0	0.2
Drangedal	Stavanger	4.5	0.1	2.8	0.3	1.2
Drangedal	Haukeligrend	0.8	0.0	0.6	0.0	0.2
Drangedal	Åmot	2.8	0.0	2.1	0.0	0.7
Drangedal	Brunkeberg	19.3	0.0	14.5	0.0	4.8
Drangedal	Bø	52.2	0.0	38.1	0.5	13.6
Drangedal	Nordagutu	1.9	0.0	1.4	0.0	0.5
Drangedal	Skien	44.4	0.0	33.1	0.2	11.1
Drangedal	Notodden	3.0	0.0	2.2	0.0	0.8
Drangedal	Kongsberg	1.8	0.0	1.3	0.1	0.5
Drangedal	Eiker	3.1	0.0	2.2	0.1	0.8
Drangedal	Drammen	7.2	0.0	5.0	0.2	1.9
Drangedal	Nesbru	6.9	0.0	4.9	0.2	1.9
Drangedal	Majorstua	9.3	0.0	6.0	0.8	2.5
Drangedal	Oslo S	37.8	0.0	26.0	1.9	10.0

From station	To station	HSR trips	From air	From car	From PT	Induc. dem.
Drangedal	Holmestrand	8.8	0.0	6.5	0.0	2.2
Drangedal	Tønsberg	19.9	0.0	14.8	0.0	5.1
Drangedal	Sandefjord	8.3	0.0	6.1	0.0	2.1
Drangedal	Larvik	9.6	0.0	7.2	0.0	2.4
Drangedal	Porsgrunn	57.3	0.0	43.1	0.2	14.0
Drangedal	Gjerstad	24.8	0.0	18.3	0.1	6.3
Drangedal	Arendal	6.4	0.0	4.7	0.1	1.6
Drangedal	Kristiansand	17.3	0.0	12.0	0.7	4.5
Gjerstad	Bergen	21.7	9.4	5.2	0.6	6.6
Gjerstad	Arna	4.5	1.0	2.0	0.1	1.4
Gjerstad	Tysse	0.3	0.0	0.2	0.0	0.1
Gjerstad	Kvam-Jondal	0.5	0.0	0.4	0.0	0.2
Gjerstad	Odda	0.8	0.0	0.6	0.0	0.2
Gjerstad	Røldal	0.2	0.0	0.2	0.0	0.1
Gjerstad	Sauda	0.6	0.0	0.4	0.0	0.2
Gjerstad	Ølen	0.9	0.0	0.7	0.0	0.2
Gjerstad	Aksdal	1.7	0.1	1.1	0.0	0.5
Gjerstad	Haugesund	2.6	0.1	1.7	0.1	0.7
Gjerstad	Kårstø	1.2	0.0	0.8	0.0	0.3
Gjerstad	Stavanger	18.9	0.5	13.0	0.4	4.9
Gjerstad	Haukeligrend	0.8	0.0	0.6	0.0	0.2
Gjerstad	Åmot	4.9	0.0	3.7	0.0	1.3
Gjerstad	Brunkeberg	3.7	0.0	2.8	0.0	0.9
Gjerstad	Bø	4.5	0.0	3.3	0.0	1.2
Gjerstad	Nordagutu	0.6	0.0	0.4	0.0	0.1
Gjerstad	Skien	16.0	0.0	12.1	0.1	3.8
Gjerstad	Notodden	4.2	0.0	3.1	0.0	1.1
Gjerstad	Kongsberg	6.5	0.0	4.5	0.3	1.7
Gjerstad	Eiker	14.6	0.0	10.6	0.2	3.8

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From station	To station	HSR trips	From air	From car	From PT	Induc. dem.
Gjerstad	Drammen	43.2	0.0	31.3	0.8	11.1
Gjerstad	Nesbru	37.9	0.0	27.9	0.3	9.8
Gjerstad	Majorstua	46.4	0.2	33.1	1.2	11.9
Gjerstad	Oslo S	188.1	6.4	132.3	2.9	46.5
Gjerstad	Holmestrand	15.7	0.0	11.8	0.1	3.8
Gjerstad	Tønsberg	26.0	0.0	19.7	0.1	6.2
Gjerstad	Sandefjord	9.5	0.0	7.2	0.1	2.3
Gjerstad	Larvik	8.8	0.0	6.7	0.0	2.1
Gjerstad	Porsgrunn	18.4	0.0	14.0	0.0	4.4
Gjerstad	Drangedal	25.8	0.0	19.1	0.1	6.6
Gjerstad	Arendal	47.3	0.0	35.7	0.2	11.3
Gjerstad	Kristiansand	110.7	0.0	82.2	1.0	27.6
Arendal	Bergen	57.0	31.4	9.1	2.7	13.9
Arendal	Arna	10.6	3.9	3.2	0.5	2.9
Arendal	Tysse	1.0	0.4	0.3	0.0	0.3
Arendal	Kvam-Jondal	1.5	0.4	0.6	0.0	0.5
Arendal	Odda	1.7	0.2	1.0	0.0	0.5
Arendal	Røldal	0.4	0.0	0.3	0.0	0.1
Arendal	Sauda	1.1	0.0	0.8	0.0	0.3
Arendal	Ølen	1.5	0.0	1.1	0.0	0.4
Arendal	Aksdal	5.6	1.0	2.5	0.3	1.7
Arendal	Haugesund	4.2	0.0	2.9	0.2	1.1
Arendal	Kårstø	1.1	0.0	0.7	0.1	0.3
Arendal	Stavanger	38.6	0.0	27.6	1.6	9.5
Arendal	Haukeligrend	4.9	0.0	3.7	0.0	1.2
Arendal	Åmot	12.2	0.0	9.1	0.0	3.1
Arendal	Brunkeberg	11.5	0.0	8.5	0.0	2.9
Arendal	Bø	10.7	0.0	7.8	0.1	2.8
Arendal	Nordagutu	1.3	0.0	1.0	0.0	0.3

From station	To station	HSR trips	From air	From car	From PT	Induc. dem.
Arendal	Skien	15.3	0.0	11.2	0.4	3.7
Arendal	Notodden	7.3	0.0	5.4	0.1	1.9
Arendal	Kongsberg	4.9	0.0	3.2	0.5	1.2
Arendal	Eiker	7.9	0.0	4.9	1.0	2.0
Arendal	Drammen	20.9	0.0	13.2	2.5	5.1
Arendal	Nesbru	25.9	1.0	17.4	1.1	6.4
Arendal	Majorstua	44.0	6.1	24.5	2.4	11.0
Arendal	Oslo S	229.7	72.3	105.6	7.3	44.5
Arendal	Holmestrand	36.9	0.0	27.7	0.3	8.9
Arendal	Tønsberg	78.0	0.0	58.4	0.8	18.8
Arendal	Sandefjord	33.6	0.0	25.1	0.5	8.1
Arendal	Larvik	32.2	0.0	24.1	0.4	7.8
Arendal	Porsgrunn	17.0	0.0	12.5	0.5	4.0
Arendal	Drangedal	6.2	0.0	4.6	0.1	1.6
Arendal	Gjerstad	45.3	0.0	34.2	0.2	10.8
Kristiansand	Bergen	151.8	83.7	32.2	6.4	29.5
Kristiansand	Arna	33.9	11.4	14.0	0.8	7.7
Kristiansand	Tysse	2.9	0.9	1.2	0.0	0.7
Kristiansand	Kvam-Jondal	7.9	1.8	3.9	0.1	2.0
Kristiansand	Odda	11.2	1.3	6.8	0.2	3.0
Kristiansand	Røldal	2.2	0.0	1.6	0.0	0.6
Kristiansand	Sauda	5.0	0.0	3.6	0.2	1.3
Kristiansand	Ølen	5.3	0.0	3.8	0.2	1.4
Kristiansand	Aksdal	9.8	2.8	2.9	1.3	2.8
Kristiansand	Haugesund	6.9	0.0	3.8	1.3	1.7
Kristiansand	Kårstø	2.6	0.0	1.4	0.6	0.6
Kristiansand	Stavanger	164.9	0.0	109.2	17.1	38.6
Kristiansand	Haukeligrend	11.1	0.0	8.5	0.0	2.7
Kristiansand	Åmot	12.0	0.0	9.0	0.1	2.9

From station	To station	HSR trips	From air	From car	From PT	Induc. dem.
Kristiansand	Brunkeberg	25.7	0.0	19.0	0.3	6.4
Kristiansand	Bø	10.3	0.0	7.0	0.7	2.6
Kristiansand	Nordagutu	0.6	0.0	0.4	0.1	0.1
Kristiansand	Skien	37.7	0.0	27.0	1.4	9.3
Kristiansand	Notodden	6.2	0.0	4.4	0.3	1.5
Kristiansand	Kongsberg	8.2	0.2	4.1	1.9	2.1
Kristiansand	Eiker	20.0	1.5	11.3	2.2	5.0
Kristiansand	Drammen	50.8	3.0	29.6	5.6	12.6
Kristiansand	Nesbru	74.4	15.0	38.4	3.7	17.3
Kristiansand	Majorstua	143.3	42.9	48.5	19.9	32.0
Kristiansand	Oslo S	646.6	279.1	206.4	46.3	114.7
Kristiansand	Holmestrand	27.2	0.0	19.9	0.6	6.6
Kristiansand	Tønsberg	44.5	0.0	32.7	0.9	10.8
Kristiansand	Sandefjord	28.8	0.0	21.2	0.6	7.0
Kristiansand	Larvik	66.5	0.0	48.8	1.4	16.2
Kristiansand	Porsgrunn	57.7	0.0	41.7	2.0	14.0
Kristiansand	Drangedal	17.2	0.0	11.9	0.7	4.5
Kristiansand	Gjerstad	107.8	0.0	80.1	1.0	26.8

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