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A protein transition for Thai meat producers

A win-win for Thailand's climate goals and the companies' net profits and value

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About this report

This report has been commissioned by Madre Brava.

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Authorship

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Summary

A shift by four leading meat companies in Thailand from chicken and pork to plant-based protein can lead to significant savings in greenhouse gas emissions and land use. To produce the same amount of protein, a mixture of pulses, tofu, fermentation and mycoprotein-based products produce half the CO_2e emissions on two-thirds of the land of chicken. For pork, it's over five times less CO_2e emissions and over half the land. Through a plant-based transition, the companies can support Thailand's Nationally Determined Contribution (NDC) reduction targets, and reduce pressure on forests. For the companies, the benefits will exceed the costs, resulting in a 15, 29, or 65% increase in net profits after tax (for the 30, 50 and 100% protein transition scenarios) compared with a 6% loss in maintaining only animal-based production. On top of this, the positive impact on reputation and ESG rating could further enhance the value of the companies.

This report highlights an alternative business case for four leading and influential animal-based protein companies in Thailand: Charoen Pokphand Foods (CPF), Betagro, Saha Farms, and Cargill Meats TH (Cargill's Thai activities and meat exports). The report focuses on their large-scale chicken and pork operations, including animal feed and end products for food retailers and markets, both domestically and for export. The four companies produced 52% of Thailand's chicken meat and 68% of its pork (2023). Three of the four companies have alternative protein initiatives and plant-based protein brands (except for Saha Farms), but none provide details on their still-small activities.

Emissions and land use in the context of Thailand

Of the four companies' chicken & pork emissions in Thailand, only 15.9% are for export, and 84.1% are for domestic sales. While CPF's and Betagro's emissions are mainly for sales on the domestic market, Saha and Cargill Meats TH emissions are mostly for export. This means any material reduction in CO_2e emissions and land use should come from a protein transition in Thailand and much less from a transition outside Thailand.

The four companies produce 2.5% of Thailand's total GHG emissions - 59% of Thailand's GHG emissions from chicken and pork production in 2023, and account for 12% of Thailand's total agricultural GHG emissions. The companies' chicken and pork supply chain occupies 2.5% of Thailand's total land area and 8.2% of its arable land.

Thailand's emission and land use targets

Thailand's most recent Nationally Determined Contribution (NDC) 3.0 sets a net emissions reduction target of 47% by 2035 compared to 2019. This is a reduction to 152 million tons of CO_2e. In 2024, Thailand's total greenhouse gas (GHG) emissions were 422.4 million tons of CO2e (above the 2019 basis year), with methane accounting for around 23% of the total.

Thailand's National Forest Policy states that the country aims to designate at least 40% of its territory as forest area, with at least 25% as conserved forests and 15% as economic and community forests. In 2023, Thailand's forestry areas accounted for 31%, well below the target.

The protein transition can reduce Thai GHG emissions and land use

Profundo modelled three protein transition scenarios: a change from the current Base scenario (close to 100% animal-based proteins) to 30%, 50% and 100% plant-based proteins by 2050.

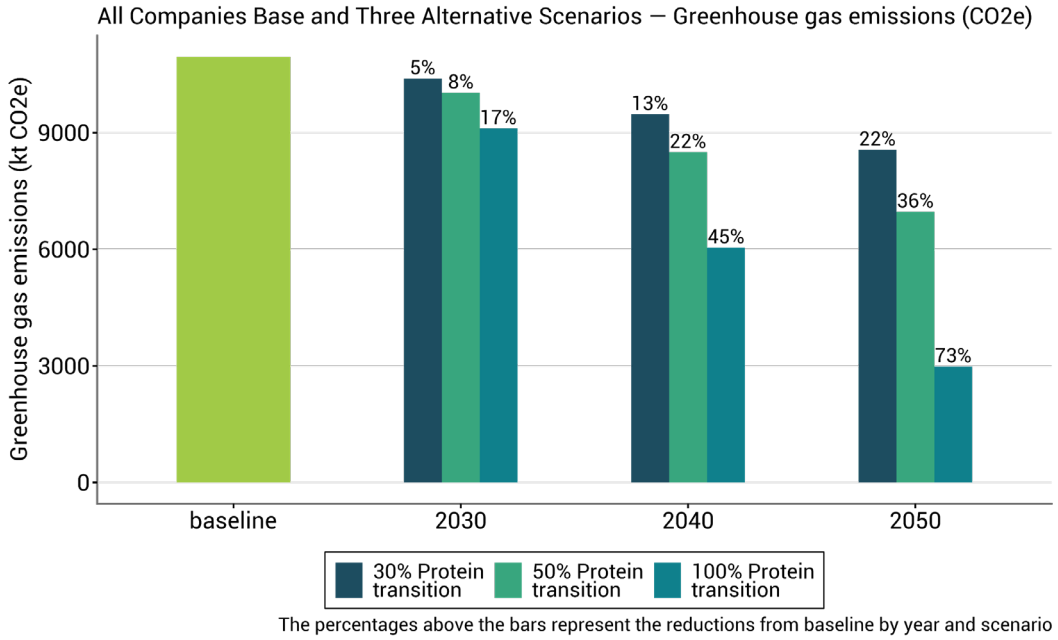
Applying these scenarios to the four companies' operations, while keeping total protein production intact, reduces CO_2e emissions by 22%, 36% and 73%, respectively, compared to the Base scenario. In the context of Thailand, the four companies' GHGs would decline from 2.5% of total GHG to 1.9%, 1.6% and 0.7%, respectively (in the 30%, 50% and 100% transition scenarios).

In the three scenarios (30%, 50% and 100%), land use is reduced by 14%, 23% and 46%, respectively. The land use (including for foreign soy) would decline from being equal to 3.0% (2.5%-point in Thailand, 0.5%-point foreign soy) of Thailand's land area, to 2.6%, 2.3% and 1.6%, respectively. The reduction in land area of 8,375 km^2 in a 100% protein transition scenario is equal to 38 times the area of the Dutch capital Amsterdam.

It is important to consider that emission-reduction measures in the (remaining) animal-based protein activities could reduce emissions in the relevant activities by 16%. This size of reduction would not fit into the climate targets of any government. A transition to plant-based proteins is far more efficient and much more effective.

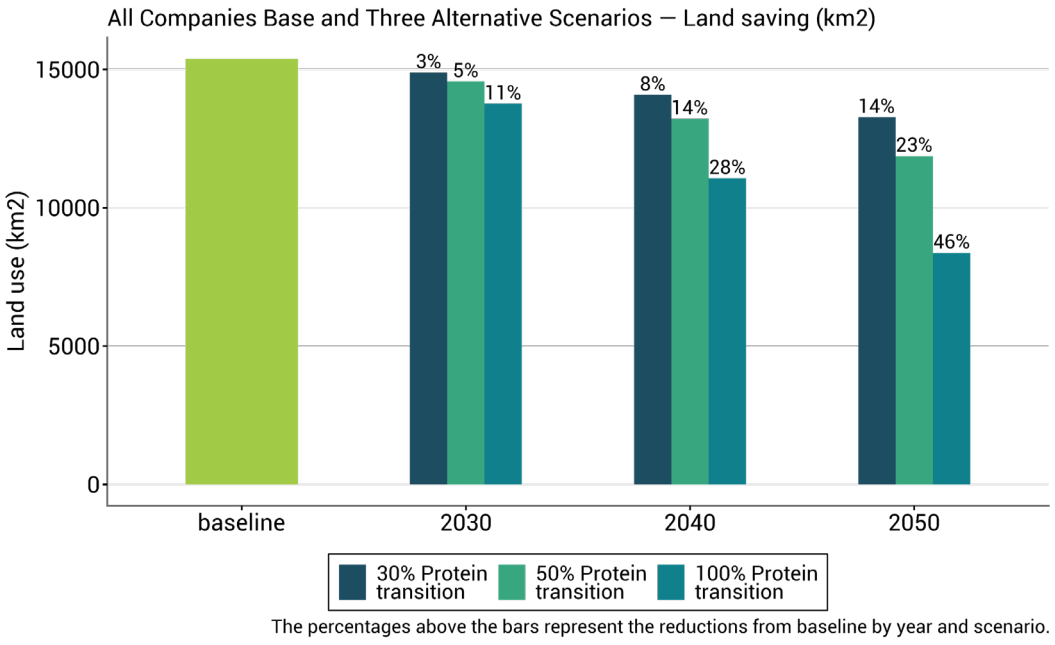
The conclusion is that the three protein scenarios by four companies can significantly contribute to Thailand's national climate targets. The 100% transition scenario results in a 17% GHG reduction in 2030, 45% in 2040, and 73% in 2050, while saving 46% in land use in 2050. The emission reduction percentages for 2030 (17%) and 2040 (45%) are below Thailand's GHG targets (-47% in 2035), but additional on-farm GHG reduction measures and carbon sequestration on freed-up land can partially close the gap.

Figure 1 Greenhouse Gas Emissions (CO_2e) in Thai Chicken & Pork Activities - All four companies



Source: Table 15

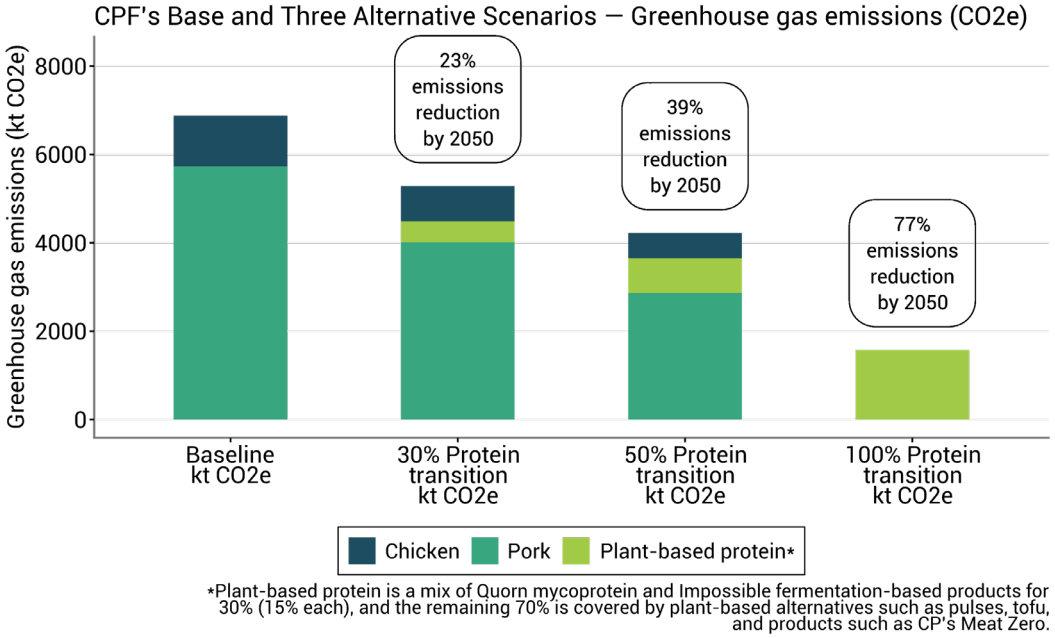
Figure 2 Land savings (km2) in Thai Chicken & Pork Activities - All four companies



Source: Table 16

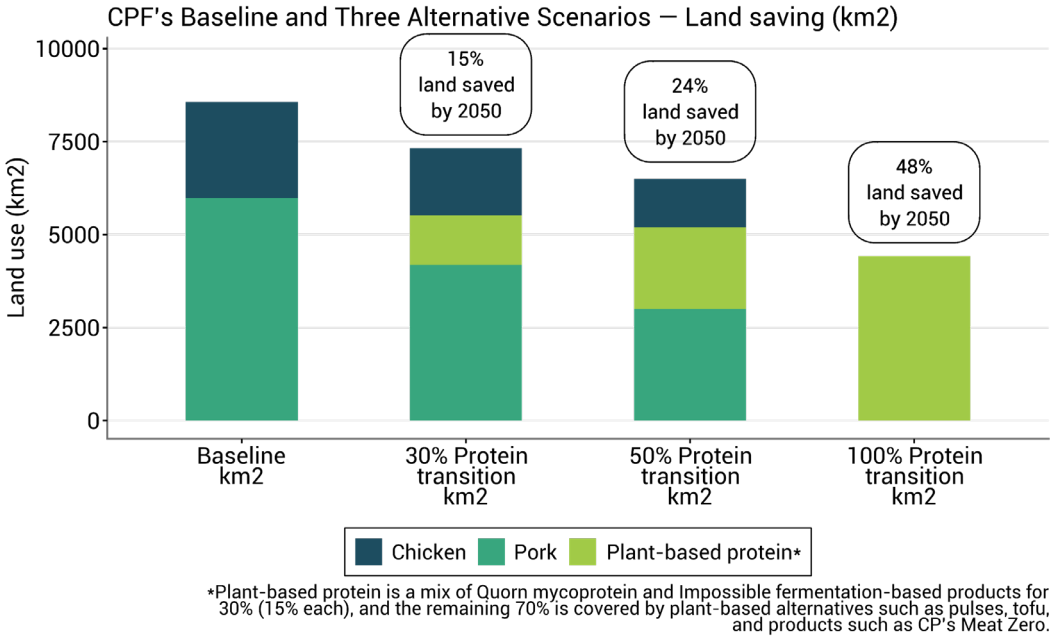
For the leading company, CPF, the CO_2e reduction and land use savings by 2050 are as follows:

Figure 3 CPF - Sources of Greenhouse Gas Emissions (CO_2e) in Thai Chicken & Pork Activities



Source: Table 13

Figure 4 CPF - Land Use and Savings (km2) in Thai Chicken & Pork Activities



Source: Table 13

Costs and benefits of protein transition scenarios for the Thai activities

Costs include construction and financing of new capacity for plant-based protein products, the annual costs of supporting farmers supplying meat in companies' livestock chains, changing their business models, and additional marketing to incentivise a shift in consumer demand. The shift to new production infrastructure not only entails additional costs but also frees up capital. Consider that the meat supply chain, compared to plant-based protein requires much more capital for animal feed, animal farming, and slaughterhouses. Moreover, the costs of additional measures to reduce emissions in the (remaining) livestock business were calculated.

The benefits of the transition to a plant-based protein supply chain include much lower use of raw materials (grains, soy), vitamins, minerals, and additives used in animal feed. Other benefits include potentially lower interest rates on debt, as banks are increasingly willing to issue sustainability-linked loans at preferential rates. Finally, companies' reputations might improve by becoming more sustainable, leading to higher market or enterprise value.

In profit terms, a plant-based transition (in their Thai activities) to 30% of the portfolio might add €90 million (+15%) to the companies' net profit (after tax). In a 50% scenario, this would be €174 million (+29%), and even €389 million in a 100% scenario (+65%). If the companies stick to nearly 100% animal-based protein, they face a net profit reduction of at least €32 million (-6%). These net profit impacts gradually build up in the period to 2050. This means that the effects of the transition are gradual, and the companies' organisations have the opportunity to adapt smoothly.

Finally, further benefits of a protein transition include improved company reputation, as their environmental footprint will positively impact their ESG (Environmental, Social, and Governance) ratings. This could positively impact their valuation multiples, such as the price-to-earnings ratio, on stock exchanges, as high ESG ratings are becoming increasingly relevant to (international) investors and their portfolios. For CPF, the valuation impact could be 31%, 51%, and 104% (in a 30, 50, and 100% scenario) – for a transition in its Thai chicken and pork activities. The potential benefits of carbon sequestration and the societal benefits of CO_2e reduction have not been calculated for the companies, as these will not affect the individual company profits.

Abbreviations

30% (protein) transition	Scenario with 30% plant-based proteins in 2050
50% (protein) scenario/transition	Scenario with 50% plant-based proteins in 2050
100% (protein) scenario/transition	Scenario with 100% plant-based proteins in 2050
CO_2e	Carbon dioxide equivalent
EBITDA	Earnings Before Interest, Tax, Depreciation, and Amortisation
Enterprise Value	Market capitalisation + Net debt
EV/EBITDA	Enterprise Value / EBITDA ratio
Market capitalisation	Number of outstanding shares x share price
Net debt	Gross debt minus Cash
Net debt/EBITDA ratio	Net debt divided by EBITDA
Operating profit	(Operating) revenues minus operating expenses
NA	Not available
NDC	Nationally Determined Contributions
Net profit	Profit after payment of corporate tax
Price / Earnings ratio	Market capitalisation divided by Net profit

Introduction

Madre Brava's mission is to protect people, animals, and the planet by leading a material shift from animal-based foods to more plant-based foods. This research is part of Madre Brava's broader strategy to align the protein industry with a 1.5 °C scenario by reducing livestock's role and scaling up sustainable proteins, including plant-based and other alternative proteins.

The strategy in Thailand includes creating 'private sector champions'. An important factor in Thailand's protein transition is that the largest meat companies need to diversify their investments to increase production of plant-based proteins and reduce animal-based protein production.

The report aims to make an alternative business case for the four leading and influential animal-based protein companies with presence in Thailand: Charoen Pokphand Foods (CPF), Betagro, Saha Farm, and Cargill Meats (Cargill's Thai activities and meat exports). The focus is on their large-scale chicken and pork operations, including animal feed and end products for food retailers and food markets, both domestically and for export. Beef is excluded from the analysis because consumption has remained low for more than a decade, and there is no reason to believe it will increase substantially.

Chapter 1 describes the four companies, their emissions in chicken and pork, and the relative size of domestic and export activities in these two segments. It investigates the climate targets set by the companies and by Thailand through its Nationally Determined Contributions (NDCs). It also calculates the land use for chicken and pork activities. The emissions and the land use of the four companies are shown in the context of the national totals.

The next step (Chapter 2) is to calculate the emission benefit of a transition to plant-based scenarios. Three scenarios have been introduced: a 30%, 50% and 100% transition. The outcomes of these scenarios are compared with the Base scenario. Again, these changes are placed in the national context of Thailand.

Based on the calculated emission footprints in the three scenarios, a gap analysis shows how these scenarios can contribute to Thailand's Nationally Determined Contributions (NDC) to global emissions reduction. The calculation is executed, excluding and including additional measures on livestock farms to reduce emissions. This is done because an argument could be that the additional measures are a good substitute for a protein transition.

The next step (Chapter 3) is to calculate the costs and benefits of the protein transition scenarios for the companies' Thai business. The case study of CPF analyses the costs of setting up new production capacity for plant-based protein products, the annual financial support for farmers who need to change their business models, and the additional marketing and information expenditures required to shift consumer preferences. Also, the cost of additional on-farm measures in the livestock supply chain is calculated, as this option is sometimes brought forward as an alternative to a plant-based protein transition. The CPF case study is extended to the three other companies. Furthermore, this chapter summarises the costs and benefits and analyses their impact on each company's net profit and EBITDA (Earnings Before Interest, Tax, Depreciation and Amortisation). Net profit and Net debt/EBITDA are crucial ratios for investors and creditors.

1

Leaders' climate emissions and land use

This chapter investigates the climate emissions of Thailand's four meat-producing leaders, including carbon dioxide and methane. Emissions from meat production and export are analysed, also in the relative context of Thailand's national climate emissions and its reduction commitments.

1.1 Methodologies to calculate climate emissions and land use

As the analysis focuses on the four companies' emissions and land use from their chicken and pork activities, and the companies do not report on these specifically, Profundo needed to apply widely accepted methodologies. These are explained in this first section.

In Chapter 2, the transition scenarios with plant-based protein alternatives are discussed, and the methodology for estimating their emissions and land use is also included in this section.

1.1.1 GHG emissions

The Global Livestock Environmental Assessment Model (GLEAM), developed by the FAO, quantifies global livestock production and its environmental impacts, particularly greenhouse gas (GHG) emissions. Key emission sources include enteric fermentation, pasture expansion, and feed production. The latest version, GLEAM 3.0 (2022), is based on 2015 FAO livestock data and emission factors aligned with the IPCC Sixth Assessment Report (AR6).[1]

For this analysis, GLEAM 3.0 emission factors for Thailand, and pork and chicken were applied to FAO 2021 production volumes.

Regarding plant-based protein, legumes such as soybeans, peas, and lupines form the basis of most meat substitutes. Life Cycle Assessments (LCAs) show that processing intensity and protein concentration strongly influence their GHG and water footprints.[2]

Because no comprehensive database exists, GHG estimates for meat alternatives (e.g., pulses, soy, fermentation-based products) were compiled from multiple scientific studies and industry LCAs, which may differ in assumptions such as GWP values and system boundaries.

An adequate supply of high-quality protein is a crucial component in the discussion around access to sufficient healthy food and the role of alternative products in reducing meat consumption. Therefore, the estimates presented in this analysis are based on protein values.

1.1.2 Land use

Mean values from Poore and Nemecek (2018) were used to calculate land use by type of meat, pulses, and tofu, while mycoprotein and fermentation-based alternatives rely on land-use estimates reported in product-specific LCAs.

1.1.3 Plant-based alternatives

For the two protein transition scenarios used in this report, a mix of alternative products was used, including pulses, tofu, mycoproteins, and fermentation-based products. Scenarios assume a combined replacement strategy, rather than substitution with a single product.

According to a Boston Consulting Group (2022) survey, alternative proteins could account for 22% of global animal product consumption by 2030.[3] This study adopts a more optimistic assumption of 30% market share, reflecting increased climate awareness. This study uses Quorn mycoprotein and Impossible fermentation-based products for 30% (15% each), and the remaining 70% is covered by plant-based alternatives such as pulses, tofu, and products such as CP's Meat Zero. Mycoprotein and fermentation-based alternatives are not widely consumed in Thailand yet, but these products are being researched in Thailand, and, given expanding market demand, they are likely to become more widely available in the future. For example, "More Meat" plant-based meat is made primarily from split gill mushrooms,[4] "Absolute Plant" introduced mycoprotein burgers in 2022,[5] and CPF described mycoprotein in 2023 as having medium-term (3-5 years) potential.[6]

1.1.4 Data limitations

The calculations in this report draw from a combination of peer-reviewed studies, independent LCAs, and company-published data, which sometimes lack full methodological transparency. Due to the absence of comprehensive, consistent data and company disclosures, multiple sources were combined. This introduces some uncertainty, so the results should be viewed as approximations based on the best available data, rather than precise figures. Key considerations include:

- GHG emissions are based on GLEAM 3.0 GWP100 factors. Differences with other studies may arise from the use of AR6-based GWP revisions or GWP100 versus GWP20 values.
- Land use datasets lack consistent regional breakdowns, and the use of mean values can lead to over- or underestimation.
- Meat volumes were standardised using conversion factors.
- Company production data are rarely disclosed. Estimates are based on production capacity, the distribution of sales revenue by geography, and media articles.
- Thailand's livestock production data is based on FAOSTAT.

1.2 The leading meat-producing and exporting companies

The four leading meat-producing companies of focus are:

- Charoen Pokphand Foods (CPF)
- Betagro
- Saha Farms
- Cargill and its Thai activities (meat exports)

1.2.1 CPF

Charoen Pokphand Group (CP Group), the parent company of CPF, is a diversified conglomerate engaged in industries such as agriculture, telecommunications, marketing, distribution, logistics, international trading, petrochemicals, property and land development, crop integration, insurance, automotive, and pet food. Headquartered in Bangkok, CP Group generates over € 75 billion (US$ 82 billion) in revenue (2024) and employs 452,794 people. Its operations include 330 production plants, 91 research centres, 1,075 livestock and aquaculture farms, 168 Makro branches, 14,630 7-Eleven stores, and 2,605 Lotus stores.[7]

CPF operates integrated agro-industrial and food businesses, including pig, broiler, layer, duck, shrimp, and fish operations.[8] CPF ranks as Thailand's largest producer of broiler chickens in 2024, with 685 million head produced annually.[9] Revenues amounted to € 15.2 billion (TBH 580,747

million) in 2024, with a gross profit margin of 14.6% and net profit of € 484 million (TBH 19,558 million). Of total revenue, 37.4% was generated in Thailand, including export production. Other important production markets are Vietnam and China.[10]

Of revenues in 2024, 88.6% came from Livestock (including feed, farming, and food products), and 11.4% from Aquaculture. In Livestock, revenue from Thai operations accounted for around 37.4%, of which one-sixth (15.5%) was destined for export and 84.5% for domestic sales. The Thai Livestock business had a gross margin of 16.0% in 4Q 2024 and an operating margin of 7.1%.[11]

By product, farm activities (Livestock + Aquaculture) account for 52% of Thai sales, while food accounts for 27% and feed 21%. The majority of Thai exports relate to the food business (77% of Thai exports).[12]

Regarding plant-based and alternative proteins, CP Group states:

"Charoen Pokphand Group adheres to a sustainable production approach, focusing on developing high-quality protein sources at affordable prices, as well as future food that is good for health and environment, such as plant-based proteins and organic farming products. The Group also advocates for developing carbon footprint-certified products or low-carbon products to provide consumers with more options in the collective effort to reduce the climate change impacts."[13]

Furthermore, CPF launched its Meat Zero-branded products in 2022, which are sold at, among other places, 7-Eleven, Lotus's, Makro, and CP Fresh Mart.[14] However, it remains unclear what the brand's size is. In partnership with Future Meat Technologies, a cultivated meat innovator, the company is developing hybrid cultured meat tailored specifically for Asian consumers. Beyond product innovation, CPF invests in the future of alternative proteins by mentoring promising researchers, including students from Chulalongkorn University who won the grand prize at the 2021 ASEAN Food Innovation competition.[15]

1.2.2 Betagro

Betagro is a fully integrated food business, with a focus on animal feed, agro-industrial farming, livestock, and food products for human consumption and pets.[16] Betagro ranks as the fourth largest producer of broiler chickens in Thailand in 2024, with 130 million head produced annually.[17] Total revenues, operating profit, and net profit at year-end December 2024 amounted to € 2,993 million (THB 114,232 million), € 89 million, and € 65 million, respectively.[18] The Group's domestic sales account for around 76%, while 18.5% is exported. The remaining 5% can be attributed to its international business in Cambodia, Laos, and Myanmar.

The Group's consumer food business produces fresh and frozen chicken, pork, eggs, processed meats, and ready-to-eat meals, marketed under the brands BETAGRO, S-Pure, and ITOHAM, as well as emerging brands such as B-FOODS, LA COMIDA, MEATLY, INSPIRED, and ARNIE'S, for the domestic market. In addition, non-packaged meat products are produced for traditional trade channels in Thailand, such as wet markets and industrial channels, and include fresh pork and poultry products in bulk.[19] Furthermore, Betagro's export business focuses on producing and exporting high-quality chicken, pork, eggs, and processed meat products to international markets, including the UK, the European Union, Japan, Singapore, Hong Kong, and China.[20]

Betagro encompasses a wide range of companies, with key poultry subsidiaries including BTG Better Foods Co., B.Foods Product International Co., Ajinomoto Betagro Frozen Foods (Thailand) Co., and BFI Broiler Farm Co. The Group has the capacity to slaughter 300,000 chickens and produce 400 tons of poultry products per day, holding a 9% market share.[21]

Apart from chicken, Betagro also produces and sells live pigs and pork meat. In 2024, pork meat sales accounted for approximately 21% of Group revenue, of which 2% is destined for export. Production capacity at its pork slaughterhouses was 3.1 million heads per year in 2023 and 2024, projected to increase to 3.3 million heads per year in 2025.[22] In the same year, chicken meat sales

accounted for around 20% of Group revenue, excluding processed chicken, which accounted for roughly 10%, of which around 11% was destined for export.[23]

Regarding plant-based and alternative proteins, Betagro integrates them into one of the four pillars of its business strategy: "*Reinforce our business capabilities to find opportunities and enter into new businesses such as alternative proteins, fresh-meat pet food and therapeutic pet food.*"[24]

The company's subsidiary, Betagro Ventures, is involved in developing and investing in the sustainable food industry. For example, it introduced the brand "Meatly!" in 2022, offering various plant-based meat alternatives. The products are sold at department stores and supermarkets like Tops, Lotus, and Gourmet Market, or on Shopee.[25] However, it remains unclear what the brand's size is. Betagro Ventures also co-invests in biotech startups to advance alternative protein innovations. These include Infinite Roots, a mycelium-based protein developer and recipient of Europe's largest funding in the sector; Plantible, a U.S.-based firm specialising in functional plant-based proteins like Rubi Protein; and Meatable, a Dutch pioneer in cultivated meat production.[26] Paid-up capital to Betagro Ventures was € 12.9 million (THB 460 million) as of December 2024.[27]

1.2.3 Saha Farms

Saha Farms is an integrated chicken production company that produces broiler chickens. In 2024, Saha Farms ranked as the third largest producer of broiler chickens in Thailand, with 135 million head produced annually, yielding around 230k tons of chicken.[28]

The company's exports in 2023 reached 170,000 tons, and it aimed for 187,000 in 2024. Key export markets were Japan, South Korea, China, Malaysia, and European countries such as the UK, the Netherlands, and Germany.[29] Indeed, the media reported in 2024 that Saha Farms' primary market is almost 100% international business-to-business, while the company is expanding into the domestic market as part of its strategic plans.[30]

Saha Farms does not publish an annual or sustainability report and does not report on plant protein diversification activities, plans, or investments. A company database reports revenue of €782 million (THB 28,898 million) and net income of € 15.4 million (THB 569 million) for 2023.[31]

1.2.4 Cargill Meats (Thailand)

Cargill Meats (Thailand) (referred to as Cargill Meats TH in this report), a subsidiary of Cargill, is a vertically integrated poultry-processing operation with facilities in Saraburi and Korat, Thailand.[32] The company specialises in producing a diverse selection of fully-cooked, frozen chicken products, over 80% of which are exported to markets including Japan, Europe, Canada, and Hong Kong. In Asia, its customer base consists primarily of major food manufacturers and distributors. To serve Canadian and European markets, Cargill Meats TH supplies other Cargill business units involved in food processing and distribution.[33] Cargill Meats also launched its own chicken consumer brand, Sun Valley, in 2019.[34]

Cargill Inc. had revenues of US$160 billion but does not report its geographic or product splits.[35] According to a company database, Cargill Meats TH had a revenue of 30,290 million TBH and net income of 1,113 million TBH in 2024.[36] The company employs 14,000 people at its two operating facilities in Thailand.[37]

As part of its climate commitments, Cargill states:

"*We are collaborating with customers and suppliers to better enable them to meet their GHG emissions reduction goals through the development of products created from more sustainable raw materials. We are advancing our capabilities by, for example, building out our Life Cycle Assessment (LCA) competencies and developing a carbon footprint screening tool for the research and development of our alternative protein products.*"[38]

However, no details were published on the amount invested, but Cargill is growing its alternative-protein portfolio globally, including in the US[39] and Europe.[40] In 2021, Cargill Meats TH launched a new plant-based protein brand, PlantEver, for Thai consumers. The company states that it expects the country's plant-based protein sector to grow at 10% annually in the coming years.[41] The PlantEver products are sold through Lotus's online and in-store channels,[42] and on the e-commerce platforms Lazada and Shopee.[43] It remains unclear how much of the PlantEver brand is sold.

1.3 The companies in Thailand's context

It is important to consider the size of the companies in the context of Thailand's chicken and pork sector. The top four meat companies in Thailand produce 52% of the country's total chicken meat and 68% of its pork (based on 2023 data). Of the total chicken meat, CPF produces 18%, Cargill Meats Thailand 14%, Saha Farms 10% and Betagro 9%. CPF has a dominant share in pork (51% Thailand's total production), and is also large in chicken production. Betagro produced 17%, while the other two companies are not active in pork production.

Table 1 Thai production volume per meat producer (carcass weight)

Tons	Chicken	% of chicken	Pork	% of pork
CPF	281,763	18%	530,262	51%
Betagro	146,659	9%	179,960	17%
Saha Farms	160,745	10%	0	0%
Cargill Meats TH	214,326	14%	0	0%
Total four companies	803,492	52%	710,222	68%
Thailand (Chicken & Pork)	1,555,742	100%	1,045,516	100%
Four companies as % of Thailand	52%		68%	

Source: Profundo estimates, based on 2023 data.

Note: Estimates for pork production volume are based on reported production capacity and use. Thai production shares for CPF and Betagro are based on revenue split between domestic and international sales for 2024.

1.4 The companies' climate emissions

1.4.1 CPF

Total Scope 1, 2 and 3 emissions amounted to 39.3 million CO_2e in 2024, an increase of 8% compared to 2020 and equal to 2023.

CPF's estimated emissions from the production of chicken and pork are shown in Table 2.

Table 2 CPF – estimated Thai emissions from chicken and pork (tons CO_2e)

Animal	Heads/year (2023, million)	CH_4	CO_2	N^2O	Total annual emissions
Chicken	237	22,541	927,000	197,234	1,146,775
Pork	6	2,423,299	2,805,088	503,749	5,732,136
*Of which exported**		*128,728*	*196,426*	*36,894*	*362,048*
Total		**2,445,840**	**3,732,088**	**700,983**	**6,878,911**

Note: * Rough estimate - Based on share of livestock sales destined for export. Thai production shares for chicken and pork are based on revenue split between domestic and international sales of farming activities for 2024.

Source: WATTPoultry (2024), *Asia Top Broiler Producers*; CPF (2025), *Annual Report 2024*, p.4, 25; *FAO* (2023), "GLEAM v3.0 dashboard",viewed on 6 August 2025.

1.4.2 Betagro

In 2024, Betagro's total scope 1 and 2 emissions amounted to 416,931 (0.42 million) tons of CO_2e (Scope 3 emissions were not reported). Betagro's estimated emissions from the production of chicken and pork are shown in Table 3.

Table 3 Betagro – estimated meat emissions Thailand (tons CO_2e)

Animal	Heads/year million (2023)	CH_4	CO_2	N2O	Total annual emissions
Chicken	123.2	11,733	482,508	102,661	596,902
Pork	2.1*	822,417	951,988	170,962	1,945,366
*Of which exported***		*21,596*	*76,797*	*15,560*	*113,953*
Total		**834,149**	**1,434,495**	**273,623**	**2,542,268**

Note: * Based on 71% annual capacity use, which is the estimated use for chicken. ** Rough estimate - Based on share of sales destined for export. Thai production shares for chicken are based on revenue split between domestic and international sales for 2024.

Source: WATTPoultry (2024), *Asia Top Broiler Producers*; Betagro (2025), *Analyst Meeting 1Q25*, p.33; *FAO* (2023), "GLEAM v3.0 dashboard",viewed on 6 August 2025.

1.4.3 Saha Farms

In 2024, the company did not report its emissions. Saha Farm's estimated emissions from the production of chicken are shown in Table 4.

Table 4 Saha Farms – estimated meat emissions (tons CO_2e)

Animal	Heads/year million (2023)	CH_4	CO_2	N2O	Total annual emissions
Chicken	135	12,860	528,849	112,521	654,230
*Of which exported**		*10,796*	*443,972*	*94,462*	*549,230*
Total		**12,860**	**528,849**	**112,521**	**654,230**

Note: * Rough estimate - Based on estimated share destined for export.

Source: WATTPoultry (2024), *Asia Top Broiler Producers*; EIN Presswire (2024, August), "Saha Farms Reclaims Top Spot in Thai Chicken Exports", online: https://www.einpresswire.com/article/739253285/saha-farms-reclaims-top-spot-in-thai-chicken-exports; *FAO* (2023), "GLEAM v3.0 dashboard",viewed on 6 August 2025.

1.4.4 Cargill Meats (Thailand)

Cargill only reports emissions at the Group level. Cargill Meats TH's estimated emissions from the production of chicken are shown in Table 5.

Table 5 Cargill Meats TH – estimated meat emissions (tons CO_2e)

Animal	Heads/year million (2023)	CH_4	CO_2	N2O	Total annual emissions
Chicken	180	17,146	705,133	150,028	872,307
*Of which exported**		*14,060*	*578,209*	*123,023*	*715,292*
Total		**17,146**	**705,133**	**150,028**	**872,307**

Note: * Rough estimate - Based on estimated share destined for export.

Source: WATTPoultry (2024), *Asia Top Broiler Producers*; *FAO* (2023), "GLEAM v3.0 dashboard",viewed on 6 August 2025.

1.5 Thailand's emissions and targets on reduction and on forests

1.5.1 Emissions

In November 2025, Thailand submitted its Nationally Determined Contribution (NDC) 3.0, which sets a net emissions reduction target of 47% by 2035 compared to 2019 levels, representing a reduction of 135.2 million tons CO_2e to 152 million tons CO_2e in 2035.[44] The implementation period is from 1 January 2032 to 31 December 2035.[45] The NDC 3.0 covers all sectors and categories. As part of its broader climate commitments, the country aims to achieve net-zero emissions by 2050, in line with the 1.5-degree pathways.[46] No specific methane or livestock emissions reduction targets are reported.

NDC 3.0 estimates that around 7.05 billion is needed by 2035 to achieve its required energy transition, which "*hinges critically on securing substantial financial resources and robust international support.*"[47]

In 2024, total greenhouse gas (GHG) emissions for Thailand were 422.4 million tons CO_2e,[48] of which 283.81 million tons CO_2 and an estimated 96 million tons CO_2e methane.[49] As a result, methane accounted for an estimated 23% of Thailand's total GHG emissions in 2024.

Thailand's estimated emissions from the production of chicken and pork are shown in Table 6. The 18.1 million emissions are approximately 19-26%[i] of all emissions from Agriculture[50], including crops.

Table 6 Thailand – estimated meat emissions from chicken & pork (tons CO_2e) -2024

Animal	Heads/year million (2024)	CH_4	CO_2	N2O	Total annual emissions
Chicken	1,340	127,648	5,249,532	1,116,922	6,494,101
Pork	12	4,910,085	5,683,665	1,020,696	11,614,446
*Of which exported**		*545,066*	*2,270,796*	*463,788*	*3,279,650*
Total		**5,037,733**	**10,933,197**	**2,137,618**	**18,108,548**

Note: * Rough estimate - Based on estimated share destined for export.

Source: *FAOSTAT* (2024), "Crops and livestock products", viewed in June 2026; *FAO* (2023), "GLEAM v3.0 dashboard",viewed on 6 August 2025.

For comparison reasons with the 2023 data of the companies, the 2023 emissions for Thailand are as follows. The emissions in all segments have grown from 2023 to 2024:

Table 7 Thailand – estimated meat emissions from chicken & pork (tons CO_2e)

Animal	Heads/year million (2023)	CH_4	CO_2	N2O	Total annual emissions
Chicken	1,307	124,459	5,118,393	1,089,020	6,331,872
Pork	12	4,778,010	5,530,782	993,241	11,302,033
*Of which exported**		*505,197*	*2,183,681*	*446,745*	*3,135,623*
Total		**4,902,470**	**10,649,175**	**2,082,260**	**17,633,905**

Note: * Rough estimate - Based on estimated share destined for export.

Source: *FAOSTAT* (2023), "Crops and livestock products", viewed in August 2025; *(FAO* (2023), "GLEAM v3.0 dashboard",viewed on 6 August 2025.

1.5.2 Forests and emissions

Thailand's National Forest Policy (2019) states that the country aims to designate at least 40% of its territory as forest area, with at least 25% designated as conserved forests and 15% as economic and community forests.[51]

In 2022, Thailand's forestry areas accounted for 31.6%. This share remained fairly stable in the period 2013-2022.[52] According to Carbon Watch, Thailand's forest cover declined to 31.47% in 2023, remaining below the target of 40%.[53]

The IPCC (Intergovernmental Panel on Climate Change) does not set specific forest targets. Instead, forests are featured within broader climate mitigation scenarios and pathways, particularly those that limit global warming to 1.5 °C or 2 °C. For example, the IPCC projects that the land sector, particularly activities such as afforestation and reforestation, could play a key role

[i] Emission data for Agriculture are between 68.9 (IPCC) and 95 million ton CO_2e (European Commission).

in mitigation. IPCC projects that pathways limiting warming to ~1.5 °C (with or without limited overshoot) anticipate an increase in forest cover of about 322 million hectares by 2050 (range: –67 to 890 million ha).[54]

Additionally, in broader terms, the IPCC states that: *"The AFOLU sector offers significant near-term mitigation potential at relatively low cost and can provide 20–30% of the 2050 emissions reduction described in scenarios that limit warming to 2°C (>67%) or lower (high evidence, medium agreement) […] though there are highly variable mitigation strategies for how AFOLU potential can be deployed for achieving climate targets."*[55]

1.6 Emissions and land use of the four companies in Thailand's context

The top four meat companies in Thailand produce 52% of the country's total chicken meat and 68% of its pork. CPF has a dominant share in pork, and is also large in chicken (see also Table 1).

In Thailand's total chicken and pork emissions, the four companies have a high share in CH_4 (methane) emissions (68%), CO_2 emissions (60%), and N2O emissions (59%). CPF and Betagro contribute 39.0% and 14.4% to Thailand's total chicken and pork emissions. When adjusted for emissions associated with soy imported from Brazil, the percentages are slightly lower.

Table 8 Total Thai emissions of the four meat producers

CO_2e (million ton)	Type of meat	CH_4	CO_2	N2O	Total / year	% in Thai total (C&P*)	% in Thai total adjusted** (C&P)
CPF	Chicken & pork	2.45	3.73	0.70	6.88	39.0%	37.4%
Betagro	Chicken & pork	0.83	1.43	0.27	2.54	14.4%	13.8%
Saha Farms	Chicken	0.01	0.53	0.11	0.65	3.7%	3.4%
Cargill Meats TH	Chicken	0.02	0.71	0.15	0.87	4.9%	4.5%
Total four companies	Chicken & pork	3.31	6.40	1.24	10.95	62.1%	59.0%
Thailand	Chicken & pork	4.90	10.65	2.08	17.63	100.0%	100%
Four companies as % of Thailand	Chicken & pork	68%	60%	59%	62%		

Source: Profundo estimates, based on:*FAO* (2023), "GLEAM v3.0 dashboard", viewed on 6 August 2025. *) C&P = Chicken & pork; **) adjusted for soy component Brazil

The estimated land use of pork and chicken production by Thailand as a whole is 1.5 million hectares, of which 1.3 million in Thailand[ii] and 0.24 million in Brazil (soy). The share of CPF in the Thai use of land for chicken and pork is 28.5%, Betagro 11.1%, and the four companies in total 50% (Table 9). The land use by the top-4 companies is 2.5% of the national Thai land use and 8.2% of the arable land.

The number of hectares used by the four companies for chicken & pork can be linked to 242,515 hectares in Brazil (soy).

[ii] Thailand or neighbouring countries.

Table 9 Comparison of land use from chicken & pork production (hectares)

	Type of meat	Land use Thailand (ha)	Share in Thai chicken & pork land use	Share in Thai land use	Share in Thai arable land	Land use in Brazil (hectares)
CPF	Chicken & pork	742,696	28.5%	1.4%	4.7%	113,887
Betagro	Chicken & pork	288,052	11.1%	0.6%	1.8%	49,427
Saha Farms	Chicken	113,379	4.4%	0.2%	0.7%	33,943
Cargill Meats TH	Chicken	151,172	5.8%	0.3%	1.0%	45,257
Total top-4	Chicken & pork	1,295,300	49.7%	2.5%	8.2%	242,515
Thailand total		51,312,000		100%		
Thailand arable land		15,804,096			100.0%	

Source: Calculations by Profundo. Estimates based on Poore, J. and T. Nemecek (2018), "Reducing food's environmental impacts through producers and consumers," Science, Vol. 360: 987–992.

Note: Estimates for pork production volume are based on reported production capacity and use. Thai production shares for CPF and Betagro are based on revenue split between domestic and international sales for 2024.

Thai agricultural land use is 41% of total land, divided in 31% arable (for wheat, maize, rice), 9% permanent crops, and 2% permanent pasture (source: index mundi, Thailand land use 2018)

To finalise the context narrative of the companies, the following conclusions are interesting:

- The Thai activities of the four companies are part of a larger entity. While Saha is active only in Thailand, Cargill Meats TH accounts for just 0.4% of its global business.
- Of the chicken & pork emissions in Thailand of the four companies, only 15.9% is for export (compared to 18% of the Thai sector total), while 84.1% is for domestic sales. While CPF's and Betagro's emissions are mainly for sales on the domestic market, emissions of Saha and Cargill are mostly for the export markets. **This means that any material reduction in CO_2e emissions and land use should come from a protein transition in Thailand and much less from a transition outside Thailand.**
- The four companies' chicken & pork activities produce (or can be linked to) 2.5% of Thailand's total GHG emissions, and 59% of Thailand's total GHG emissions from chicken and pork. The four companies account for 12.2% of total agricultural GHG emissions.
- Through their supply chains, including the cultivation of feed commodities, the four companies use 2.5% of Thailand's land. CPF's chicken and pork activities cover 1.4% (adjusted for soy) of Thailand's land, and Betagro's activities 0.6%. The four companies use 8.2% of Thailand's arable land.

Table 10 The four companies' footprint in chicken and pork in context

	CPF	Betagro	Saha	Cargill Meats TH	Total
Thai activities in context of global activities					
Thai production emissions as % of company's global emissions	17.5%	94.8%	100%	0.4%	
Thai domestic versus export emissions					
% of emissions for export revenues	5.3%	4.5%	84.0%	82.0%	15.9%
% of emissions for domestic (Thailand) revenues	94.7%	95.5%	16.0%	18.0%	84.1%
Thai production emissions in context of Thailand's emissions					
as % of Thailand's GHG emissions	1.5%	0.6%	0.1%	0.2%	2.4%
as % of Thailand's meat GHG emissions	37.4%	13.8%	3.4%	4.5%	59.0%
as % of Agri emissions	7.8%	2.9%	0.7%	0.9%	12.2%
Thai activities' land use in context of Thailand's land area					
as % of Thailand's total land area	1.4%	0.6%	0.2%	0.3%	2.5%
As % of Thailand's arable land	4.7%	1.8%	0.7%	1.0%	8.2%
as % of Thailand's non-forest area	2.1%	0.8%	0.3%	0.4%	3.7%

Source: Profundo estimates

2

Protein transition pathways and footprint

This chapter calculates the four companies' opportunities to reduce CO_2e and land use across three protein transition scenarios.

2.1 Introduction

Chicken, pork, plant-based, and other meat alternatives have very different climate and land-use footprints. The footprint calculations assume that replacing chicken and pork with the alternatives provides the same amount of protein.

Table 11 gives the crucial parameters for the calculation. The numbers show that the CO_2e per 100 grams of protein for pork is significantly higher than for chicken and for the plant-based alternative mix. Also, the land use per 100 grams of protein is the highest for pork.

The methodology for calculating the climate emissions and land use for chicken, pork, and plant-based alternatives is described in the section 1.1.1.

Table 11 Protein, CO_2e, and land use of chicken, pork, and alternatives

	Protein (100 gram) per kg material (carcass for chicken and pork)	CO_2e per 100 gram protein ($kgCO_2e$)	Land use per gram of protein (m^2/100 g)
Chicken	1.43	2.86	6.43
Pork	1.31	8.23	8.59
Average of chosen plant-based alternative mix*	1.27	1.44	4.03

Source: Profundo, based on Poore, J. and T. Nemecek (2018), "Reducing food's environmental impacts through producers and consumers," Science, Vol. 360: 987–992; *FAO* (2023), "GLEAM v3.0 dashboard", viewed on 6 August 2025.

*) Average of chosen plant-based alternative mix: Combined scenario: Pulses-35%, Tofu-35%; Fermentation based (Impossible)-15%, Mycoprotein based (Quorn mince) -15%, see 1.1.3.

2.2 Scenarios

These parameters have been applied to three scenarios: a change from the current Base scenario (100% animal-based proteins) to scenarios of 30%, 50% and 100% plant-based proteins. The calculation is made for the total production of chicken and pork of the four companies in Thailand.

In these scenarios, the protein transition paths in meat have developed as follows, which shows that in the path to, for instance, 50% protein transition to be achieved in 2050, the share of plant-based proteins is 12% in 2030, and 31% in 2040:

Table 12 CPF: Protein transition paths in 2024-2050

% of plant-based proteins	2020	2024	2030	2040	2050
Base scenario	0%	0%	0%	0%	0%
Protein transition 30% plant-based	0%	0%	7%	18%	30%
Protein transition 50% plant-based	0%	0%	12%	31%	50%
Protein transition 100% plant-based	0%	0%	23%	62%	100%

Source: Profundo estimates; % reflects the percentage of proteins generated by plant-based products.

2.2.1 Case study: CPF's Thailand footprint opportunity

This section calculates, for CPF's Thai pork and chicken activities, how the 30%, 50%, and 100% transition scenarios can support Thailand's national climate emissions targets and reduce land use.

Assuming total protein production remains unchanged, the reductions in CO_2e emissions would be 1.6 million, 2.7 million, and 5.3 million, respectively, compared to the Base (no change) scenario. In context, these reductions, to be achieved in 2050, are estimated at 23%, 39% and 77% of CPF's emissions in Thailand in 2024 (see Table 13).

The reduction in land use in Thailand is also significant: 15% in the 30% scenario, 24% in the 50% scenario, and 48% in the 100% plant-based protein scenario. The numbers in square kilometres are impressive, reaching up to 4,141 km² in a 100% scenario, or approximately 0.41 million hectares, equal to 0.81% of Thailand's land area (or 19 times the 219 km^2 area of Amsterdam).

Table 13 CPF's Base and Three Alternative Scenarios — Annual CO_2e Emissions and Land Use

	Base scenario	30% scenario	50% scenario	100% scenario
Division in protein				
Meat	100%	70%	50%	0%
Alternative	0%	30%	50%	100%
Protein production (tons)				
Chicken	40,151	28,106	20,076	0
Pork	69,623	48,736	34,812	0
Total	109,775	76,842	54,887	0
Alternative	0	32,932	54,887	109,775
Tons of equivalent alternative protein products - meat	0	260,086	433,477	866,954
CO_2e emission (ton)				
Chicken	1,146,775	802,743	573,388	0
Pork	5,732,136	4,012,495	2,866,068	0
Total	6,878,911	4,815,238	3,439,456	0
Alternative	0	472,992	788,319	1,576,639
GRAND TOTAL	6,878,911	5,288,229	4,227,775	1,576,639
Reduction versus Base scenario		1,590,682	2,651,136	5,302,273
% reduction		23%	39%	77%
% reduction compared to CPF's 2024 emissions		4%	7%	13%
Land use (km2)				
Chicken	2,582	1,808	1,291	0
Pork	5,983	4,188	2,992	0
Total	8,566	5,996	4,283	0
Alternative		1,328	2,213	4,425
GRAND TOTAL	8,566	7,324	6,495	4,425
Reduction versus Base scenario		1,242	2,070	4,141
% reduction		15%	24%	48%

Source: Profundo estimates

2.2.2 Additional measures in the remaining meat activities are a partial solution

In the preceding report on CPF's global meat and dairy activities[56], it was explained that climate measures in animal-based protein activities could reduce emissions by 16%. This size of reduction (16%) would not be enough to support the climate targets of Thai government. Reducing the production of meat and dairy products is far more efficient.

For CPF's Thai business, additional emission-reduction measures across the remaining meat supply chain would thus yield a maximum 16% reduction compared with 2024. The impact would become smaller, of course, in the protein transition scenarios since meat production is reduced (See Table 14).

Table 14 CPF: Relative context of additional measures in the meat supply chain

CO_2e (tons)	**2024**	**Base scenario (0%)**	**30%**	**50%**	**100%**
Emissions from the product portfolio	6,878,911	6,878,911	5,288,229	4,227,775	1,576,639
Reduction in emissions		0	1,590,682	2,651,136	5,302,273
Reduction of additional measures in the remaining meat activities		1,100,626	770,438	550,313	0
Total reduction		1,100,626	2,361,120	3,201,449	5,302,273
% reduction versus 2024		16%	34%	47%	77%
of which (in %-points):					
Protein transition		0%	23%	39%	77%
Measures in meat activities		16%	11%	8%	0%

Source: Profundo, Table 13 and Table 24

2.3 Footprint reduction opportunities by the four companies

To focus on the impact of the protein transition alone, this section abstracts away from the relatively small impact of measures in the (remaining) meat supply chain.

2.3.1 The GHG reduction by the top 4 through the three protein transition scenarios

As the protein transition (PT) is expected to occur gradually, the 2030 CO_2e reduction gains are relatively small. In the 100% scenario, emissions are reduced by 17% in 2030 and by 73% in 2050. In particular, the 2030 reduction outcome is well below Thailand's emissions-reduction plans, but it provides useful support.

Table 15 Pathways of CO_2e reduction by the top 4 producers

CO_2e emissions (tons)	Base 2024	2030	2040	2050
Scenario 30% PT				
CPF	6,878,911	6,511,831	5,900,030	5,288,229
Betagro	2,542,268	2,410,540	2,190,993	1,971,446
Saha	654,230	631,713	594,186	556,658
Cargill Meats (TH)	872,307	842,285	792,247	742,210
Total	10,947,716	10,396,368	9,477,456	8,558,543
% reduction		5%	13%	22%
Scenario 50% PT				
CPF	6,878,911	6,267,111	5,247,443	4,227,775
Betagro	2,542,268	2,322,721	1,956,809	1,590,898
Saha	654,230	616,702	554,156	491,609
Cargill Meats (TH)	872,307	822,270	738,874	655,479
Total	10,947,716	10,028,803	8,497,282	6,965,761
% reduction		8%	22%	36%
Scenario 100% PT				
CPF	6,878,911	5,655,310	3,615,974	1,576,639
Betagro	2,542,268	2,103,174	1,371,351	639,528
Saha	654,230	579,174	454,082	328,989
Cargill Meats (TH)	872,307	772,233	605,442	438,652
Total	10,947,716	9,109,891	6,046,849	2,983,807
% reduction		17%	45%	73%

Source: Profundo; PT = Protein Transition; excluding additional GHG emission reduction measures in the remaining meat protein activities.

2.3.2 The land use reduction by the top 4 companies through three protein transition scenarios

The reduction in land use is significant: 8,375 km2, or 46%, under a 100% scenario in 2050. The large majority of this is in Thailand. As with emissions reduction, this reduction in square kilometres accumulates over 26 years. Therefore, the impact in 2030 is still limited. The percentage reductions in the 30% and 50% PT scenarios are much lower for 2050 at 14% and 23%, respectively.

Table 16 Pathways of land use reduction by the top 4 producers

Km2	Base 2024	2030	2040	2050
Scenario 30% PT				
CPF	8,566	8,279	7,801	7,324
Betagro	3,375	3,265	3,083	2,901
Saha	1,473	1,435	1,372	1,308
Cargill Meats (TH)	1,964	1,914	1,829	1,744
Total	15,378	14,893	14,085	13,277
% reduction		3%	8%	14%
Scenario 50% PT				
CPF	8,566	8,088	7,292	6,495
Betagro	3,375	3,193	2,889	2,585
Saha	1,473	1,410	1,304	1,198
Cargill Meats (TH)	1,964	1,880	1,739	1,598
Total	15,378	14,570	13,223	11,876
% reduction		5%	14%	23%
Scenario 100% PT				
CPF	8,566	7,610	6,018	4,425
Betagro	3,375	3,010	2,403	1,795
Saha	1,473	1,346	1,135	923
Cargill Meats (TH)	1,964	1,795	1,513	1,231
Total	15,378	13,762	11,068	8,375
% reduction		11%	28%	46%

Source: Profundo; PT = Protein Transition

2.4 Contribution of the protein transition to Thailand's climate goals and land use

The three protein scenarios by the four companies can significantly contribute to Thailand's national climate targets of a 47% reduction in 2035.

The 100% transition pathway results in a 17% GHG reduction in 2030, 45% in 2040, and 73% in 2050, while saving 46% in land use in 2050. The emission reduction percentages for 2030 (17%) and 2040 (45%) are below Thailand's GHG targets (-47% in 2035). Additional on-farm GHG reduction measures, although they are small (see Table 14) and carbon sequestration on freed-up land can help to further close the gap.

The reduction in land use from a 100% protein transition scenario by the top 4 meat companies in Thailand would free up an area equal to 1.6% of Thailand's total land area and would certainly reduce pressure on forest areas. The reduction in land area of 8,375 km^2 is equal to 38 times the area of Amsterdam.

Protein growth assumptions

The current report assumes that, towards 2050, no further growth will occur in the total protein output of the four companies' Thai activities. This assumption is based on the lack of data and projections for the 2026-2050 period of how the companies will position themselves for further growth through capital investments and marketing initiatives.

In the global market, demand for chicken, pork, and dairy products is expected to continue to grow due to population growth and rising per capita protein intake. CPF, Betagro, Cargill Meats Thailand and Saha might also experience further growth if they maintain their market shares.

As a consequence of further growth, the emissions gaps relative to the SBTi targets for 2030 and 2050, as calculated in the next Chapter, will widen.

3

Costs and benefits of a protein transition

This chapter calculates the costs and benefits of the protein transition for CPF and compares them to a Base scenario. The costs include, for instance, the construction of new capacity and the development of new markets, as well as financial support for farmers who need to change their business models. The benefits include, for instance, lower interest rates and potentially higher valuations for more sustainable activities.

3.1 Introduction and methodology

The costs of a protein transition are as follows:

- The investment in new capacity of plant-based proteins and the accelerated depreciation of the capacity of animal-based proteins.
- Marketing costs to change the demand side from meat to plant-based protein products.
- Financial support to suppliers to join the transition.
- Measures on the farms (on-farm measures) to reduce CO_2e emissions of the remaining meat business.

The analysis includes the marginal cost per ton of CO_2e reduction, which could be important if the most efficient/optimal action needs to be chosen. This chapter does not include measures to reduce non-FLAG emissions, including renewable energy. These measures could further reduce emissions at relatively low cost.[57] However, including these would 'dilute' the narrative on the protein transition.

Benefits of a protein transition include:

- Potentially lower interest rates on loans and/or better access to capital.
- Impact on reputation value.
- Impact on ESG rating.
- A higher valuation multiple of the activities (on stock exchanges).

This chapter discusses the most important changes to the CPF's Profit and Loss Accounts and Balance Sheets.

3.1.1 Methodology

In this report, pro forma calculations have been made to assess the various impacts. This means that the 2024 revenues, EBITDA (Earnings Before Interest, Tax and Amortisation), net profit, and debt are the reference financial numbers for the total impact analysis of 30%, 50%, and 100% transitions.

As a consequence, the total annual impact of a 100% transition will be calculated. Although the transition will be finalised in 2050, comparing the impact on 2024 numbers provides a transparent basis for comparison. The calculated impact will be in addition to the organic growth, decline, or stabilisation a company is expected to experience between 2024 and 2025.

After all factors are calculated, the final section estimates the annual additional financial impacts on CPF, as the transition is a gradual process from 2024 to 2050.

3.2 Strategic reasons to make the protein transition

At the moment, a meat company like CPF, which produces chicken and pork, benefits from crucial advantages in its home country, Thailand, and other key regions of Southeast and East Asia. Of CPF revenues, 81% is generated in Southeast and East Asia (of which 32%-point in Thailand), and 14% in Europe and 5% in the Americas:

- Growing demand for protein products through increasing population and rising income per capita in Thailand and in the region.
- The availability of an ample supply of agricultural commodities from domestic production (grains) and imports (soy).
- The availability of a large labour force with relatively low wages (from a Western perspective) creates an export benefit for labour-intensive meat processing.
- A dynamic import and export environment located at the ocean/sea.
- Government-supported business environments and a good education level.

In the transition from animal-based to alternative and plant-based protein products, the automation level could increase, but a large supply of agricultural products is still required. Additionally, the factories may require a large workforce to develop, process, package, and distribute the end products.

For CPF, Thailand is a good starting point, as it has a strong ecosystem and supporting industries for manufacturing food products. The country has a highly skilled labour force and food companies with a reputation for quality and reliability. Food scientists and technologists are readily available. There are numerous Thai universities offering programs in food science and technology. Thailand is a major agricultural country with extensive experience in crop cultivation. Thailand's location in Asian markets is also an advantage.[58]

The Thai agricultural sector is heavily focused on rice. However, sunflower seeds, soybeans, potatoes, and wheat are also produced, which can be used as ingredients for plant-based protein foods, and these areas can be increased or diverted from animal feed production.[59]

This analysis of the competitive edge of the Thai business environment is supported by the intentions of some companies. Due to rising costs caused by the COVID-19 pandemic, plant-based meat alternative companies were looking to relocate their production to lower-cost countries. Thailand, with its abundance of suitable raw materials, has been considered an attractive choice; however, the execution of these considerations has been marginal.

3.3 The opportunity for a transition in South East Asia

A 2023 survey (1500 consumers) showed that while 76% of Thai consumers eat meat, 67% of the population wants to reduce their intake because of health reasons.[60] In 2022, Thailand's meat substitute market reached US$39.1 million and was projected to grow at a CAGR of 14% between 2022 and 2027.[61]

Among survey respondents in Indonesia, Malaysia, Singapore, Thailand, the Philippines, and Vietnam, 42% want to try eating more plant-based meat. Almost half of respondent ranks affordability as one of their top three barriers to consuming more plant-based meat.[62] Survey respondents also indicated that 51% are meat-eaters, 38% are flexitarians, and 2% are vegetarians or vegans. In China, Singapore, South Korea, and Japan, the meat-eating percentage ranges from

60% to 91% in this survey. In Thailand, 47% have consumed plant-based meat and 42% have purchased it.[63]

3.4 The costs of the protein transition

The costs and benefits calculated in this report for the transition in CPF's Thai chicken & pork business will be compared to the 2022-2024 key financial data of CPF (Table 17), which are global data.

Table 17 CPF: key financial data

€ million (Dec)	2022	2023	2024
Revenue	16,662	15,570	15,214
Gross profit	2,221	1,627	2,228
Depreciation and Amortisation	874	883	896
Operating profit	729	142	907
Pre-tax	453	-173	400
Net profit	364	-155	484
EBITDA	1,603	1,025	1,803
Property, plant and equipment (PPE) + biological assets	8,942	8,444	8,942
Net debt	13,590	13,679	14,070
Net debt/EBITDA	8.5	13.3	7.8

Source: Profundo based on FactSet.

3.4.1 Marketing and information costs

Section 3.3 provided input indicating a market opportunity for plant-based proteins; however, the market is small and still needs to grow. Marketing and information expenditures might be needed to change consumer behaviour from animal-based proteins to plant-based protein products.

At the moment, CPF's revenues from its animal-based protein and plant-based alternative protein businesses are close to 100% and 0%, respectively. The consequences of a protein transition for CPF are as follows:

- The 30% and 50% plant-based scenarios mean a substantial reduction in the current animal-based proteins and a very strong growth in plant-based protein products. The 100% plant-based scenario requires an even stronger growth in plant-based protein products.
- The time period is still long, from 2025 to 2050.
- The significant shift in CPF's protein portfolio requires extra marketing and information expenditures to convince consumers.

A marketing rule is to spend 5% to 20% of revenues on marketing, depending on whether you want to sustain or grow the product/category. Generally, 5-10% is enough to sustain growth, but 11-20% is needed for expansion. The marketing expenditures differ by sector. Consumer goods might need 18% of revenue for marketing,[64] as Forbes confirms.[65] These are expenses in the whole chain, to be divided between producers and food retailers.

In 2024, CPF's selling and administrative expenses amounted to 8.7% of sales revenue globally (2023: 8.6%) .[66] Not all of the expenses are marketing costs. In the protein transition, marketing

expenses for animal-based protein products will decline, while expenses for plant-based alternatives will rise.

As a methodology, Table 18 calculates the additional information/marketing expenditure across the whole supply chain, and the additional share that a company such as CPF has to contribute to a protein transition. As the outcome of the analysis is about the change in marketing spending, it is less crucial whether the starting point of the analysis is exactly right:

- A category that needs to remain stable requires 5-10% marketing spend per revenue value. The Base scenario is set at 7.5%. As meat sales are expected to decline, a reduction to 5.3% is assumed in the 30% scenario, to 3.8% in the 50% scenario, and to 0% in the 100% transition scenario.
- A category that needs to grow requires 11-20% marketing spending as a percentage of aspirational revenues. The assumption is 15.5% in the first important phase of 30% penetration for alternatives. At 50% and 100% capacity, economies of scale in marketing may occur. Therefore, the assumptions are 14% and 10%, respectively, in those scenarios.
- Thus, in the 30% scenario, the total annual marketing expenditure for the protein category would increase by € 37 million for CPF and partners (food retail, food service) in the supply chain. In the 100% transition, CPF and its partners would need to pay an additional € 113 million.
- The assumption is that the marketing costs are always shared in the chain with the food retailers and food service companies. The assumption is that a company such as CPF takes up at least 70%.
- This means that CPF would have to pay € 28 million extra per year in the 30% scenario and up to € 84 million extra in a 100% transition scenario.

Table 18 CPF: change in marketing costs due to protein transition (2050)*

€ million	Base scenario	30% scenario	50% scenario	100% scenario
Basis data				
Tons of full product	0	260,086	433,477	866,954
Farm + food products value globally	12,171	12,171	12,171	12,171
Adjustment factor for relevant market**	37%	37%	37%	37%
Farm + food products value Thailand	4,503	4,503	4,503	4,503
Animal-based protein products	4,503	3,152	2,252	4,503
Plant-based protein products	0	1,351	2,252	4,503
% plant-based protein products	0%	30%	50%	100%
Marketing costs				
% on revenues for animal-based products	7.5%	5.3%	3.8%	0.0%
% on revenues for plant-based protein products	15.5%	15.5%	14.0%	10.0%
Marketing costs for animal-based protein products	338	165	84	0
Marketing costs for plant-based protein products	0	209	315	450
Total marketing costs	338	375	400	450
Change in marketing costs		37	62	113
Share for the producer (75%)		**28**	**46**	**84**

Source: Profundo estimates, based on CPF Annual Results and other data and analysis; of CPF current revenues, it is assumed that 80% is consumer facing; more than 20% is animal feed and that is business-to-business; *) Pro forma outcomes of the transition scenarios in 2050 assuming no other changes in CPF; **) share of the activities in Thailand.

3.4.2 The cost of building new capacity on the supply side

Due to the shift toward higher-capacity production of plant-based protein products, CPF must expand its infrastructure in this area. This will mainly involve constructing new processing factories or modifying the setup of existing factories. The financial consequences would include:

- The investments in new capacity or processing machines.
- The accelerated depreciation of existing capacity.

The expenses on a plant-based meat factory include:

- Equipment: specialised food processing machinery, such as extruders, mixers, and packaging lines. This is often the largest single cost component.
- Building and Utilities: The cost of the physical building itself, including infrastructure for power, water, and waste management.
- Indirect Costs: Expenses like planning, engineering, project management, and legal fees.
- Raw Materials: The initial inventory of ingredients like pea protein, soy, wheat, coconut oil, and flavourings.

- Licenses and Permits: Regulatory compliance costs.[67]

The cost to set up a plant-based meat factory, when measured per ton of annual production capacity, can vary significantly depending on whether you are building a new facility from scratch or retrofitting an existing one, and the product that needs to be produced:

- A greenfield/new facility: The capital expenditure or investments for a new plant-based meat factory can range from € 765 to € 2,465 per ton of annual capacity.
- Converting a suitable existing facility to produce plant-based meat is a more cost-effective option. The capital expenditure for this pathway can range from € 85 to € 510 per ton of capacity. This pathway can also be completed in a shorter timeframe than new construction.[68]
- The Good Food Institute also calculates a large-scale plan: 810 factories, each with 30,000 tons of capacity, require € 23 billion in total investments, which is € 944 per ton capacity.[69]

Another example of a large-scale facility, the joint venture between Plant & Bean and Nutra Regenerative Protein Co. (NRPT) established a plant-based meat facility in Ayutthaya with a production capacity of 25,000 tons. The investment was split 51% by NRPT and 49% by Plant & Bean.[70] The factory would manufacture plant-based protein products for Southeast Asia, Australia and New Zealand. It was said to be Thailand's first and largest 100% plant-based food factory.[71] The phase to expand the initial 3,000 tons of capacity to 13,000 tons in 2025-2026 could cost € 0.92 million. The production costs are € 2.30 to € 2.55 per kg, close to the pork price paid in Bangkok.[72] This data shows a low-high range of capital expenditure per ton, from € 314 to € 1,306 (see Table 19).

Table 19 Capital expenditure per ton of capacity in plant-based protein product processing

	Capex/ton Low (€)	Capex/ton High (€)
GFI: Greenfield	765	2,465
GFI: Conversion	85	510
GFI: Global		944
Plant & Bean/NRPT	92	
Average	314	1,306

Source: Profundo estimate based on The Good Foods Institute (GFI) and other data

In the setup, as in Thailand, there will be a combination of greenfield developments, changes to existing factories, and subsequent expansion of the greenfield sites and the existing factories. An average of the low and high ends of the cost range per ton is applied. This leads to an average cost per ton of capacity of € 810.

This is multiplied by the total tons of the product, which contains 12.7% protein. In other words, the tons of protein need to be multiplied by 8 (see Table 20).

The annual costs of capacity consist of interest and depreciation. For interest costs, a 5% interest rate is applied. For the annual depreciation rate, CPF's average depreciation of property, plant and equipment is divided by the relevant fixed assets (2024 annual report with financial statements; approximately 9.8%), multiplied by the new assets.

The existing animal-based protein product capacity will be written down in 25 years. Companies that adjust their business often take one-off charges. The depreciation costs of these 'old' assets in Thailand will no longer be reflected in the future Profit & Loss Accounts. This means € 88 million

lower charges in the 30% scenario in 2050, and up to € 292 million lower annual depreciation costs for the 100% transition scenario.

Combining all the annual cost lines for new capacity in Thailand, a 30% plant-based protein scenario will lead to € 56 million lower annual capacity costs, and a 100% scenario will have € 188 million lower annual expenses. **The explanation for the significantly lower expenses during the protein transition is that plant-based proteins do not require the infrastructure of feed mills, livestock farms, and slaughterhouses.**

Table 20 CPF: Annual additional capacity costs in the three scenarios

€ million	**Factor**	**Base scenario**	**30% scenario**	**50% scenario**	**100% scenario**
Costs (€) per ton - Low	A	314	314	314	314
Costs (€) per ton - High	B	1,306	1,306	1,306	1,306
Average	C = (A+B)/2	810	810	810	810
Tons of equivalent plant-based protein	D	0	32,932	54,887	109,775
Tons of full product	E = D/12.7%	0	260,086	433,477	866,954
Necessary CapEx (€ million)	F = C x E	0	211	351	702
Interest rate	G	5%	5%	5%	5%
Interest costs (€ million)	H = F x G	0	11	18	35
Depreciation costs new capacity (€ million)	I = F x 9.8%	0	21	34	69
Maintenance investment animal-based facilities	J = 0.88 x transition% x Depreciation 2024	0	-88	-146	-292
Total annual additional costs	**K = H + I +J**	**0**	**-56**	**-94**	**-188**

Source: Profundo estimates.

During the protein transition, a significant amount of assets will no longer be used; property, plant, and equipment (PPE) can be sold, and biological assets (livestock) are no longer needed. Still, these assets have a market value.

The value of biological assets assigned to the meat industry will not be discounted when reduced during the protein transition process. This is because animal breeding can be gradually reduced during the transition to 2050.

The property, plant and equipment assets that are abundant can be sold in the market. However, a discount might be needed. In this analysis, a 50% discount is applied.

In total, the protein transition scenarios could free up capital from meat and dairy activities between € 559 million (30% scenario) and € 1,863 million (100% scenario, see Table 21).

Table 21 CPF: Freeing up capital from meat and dairy activities

€ million	Base scenario	30% scenario	50% scenario	100% scenario
Value on the balance sheet				
Property, plant and equipment (PPE) + biological assets - global	8,627	2,588	4,314	8,627
Adjustment for livestock as % of total (livestock + aquaculture)	88%	88%	88%	88%
Adjustment for the relevant market - Thailand	37%	37%	37%	37%
Value livestock assets	2,809	843	1,404	2,809
Of which:				
Biological assets	459	138	229	459
PPE	2,350			
Value in the transition process and accelerated sale				
Biological assets		138	229	459
PPE balance sheet value		843	1,404	2,809
Correction for 'accelerated sale process' or alternative application		50%	50%	50%
Adjusted value of PPE		421	702	1,404
Freeing up capital from old activities through protein transition		559	932	1,863

Source: Profundo estimates, based on CPF's financial statements. These calculations do not include all associates, and including them would elevate the numbers.

3.4.3 The costs to support farmers in switching their business model

The route from the low single-digit (in fact, unknown) contribution of plant-based proteins in CPF's revenues to 30%, 50%, and 100% would mean that CPF will face a material shift in its portfolio from meat to alternatives, and experience changes at various stages of its global supply chain. Consider that CPF is largely vertically integrated in feed, farming and processing, but it also has a contract farming system.[73] Overall, the changes would affect suppliers outside CPF. The impacts could be as follows:

- Suppliers to the feed business, such as grain and soybean farmers, will be affected and might need to change or reduce their activities as fewer raw materials are needed.
- The contract farmers in livestock need to change their business model and become a plant-based protein supplier, cultivating soy and peas instead of livestock.

Suppliers to the feed business already know how to cultivate crops. The main problem is the loss of volume, as plant-based proteins require significantly less crop volume to produce the same amount of protein. A switch in crop knowledge to, for instance, peas, is also required. The transition of a livestock farm to a plant-based farm may involve costs such as purchasing new equipment and buildings, as well as training and education. This may also require financial support to facilitate a smooth, quick transition.

Specific data on the various factors is not available. One example states that the profit per acre for pea farming is US$14.03 higher than for herd farming.[74] Another example for Denmark is that calculations have been made on the cost of protein transition scenarios in the sector:

"[…] the estimates in this study suggest that they will be low compared to the costs of other suggested approaches. At 100% implementation of the PHD (Planetary Health Diet), the deficit relative to the sector's current contribution margin is between € 158.5 and € 217.0 million, depending on assumptions for soy replacement. This does not include expenses related directly to the transition, such as replacement of machinery, but also does not include savings resulting from the replacement of imported soy."[75]

The conclusion is that there is a lack of reports and data providing clear guidance on the costs or necessary investments associated with transitioning from livestock farming to plant-based farming.

A proxy for the operational costs of keeping and raising livestock, as well as the loss of income for crop farmers, is the reduction in the amount of land used. This can indicate the necessary financial support to farmers. This analysis uses yields per hectare, global soybean and corn prices, and an operating margin of 4%.[76] The most important ingredients in animal feed for chicken and pork are corn and soy, with corn accounting for around 50% in chicken feed and 60% in pork feed. Soybean meal is 20-25% of the products. The analysis uses an average of 55% corn and 25% soybean meal. The remaining 20% of animal feed consists of vitamins, minerals, additives, and other products, which are sometimes imported and therefore do not require CPF financial support for the transition.[77]

In the 100% transition scenario, the reduction in land use for CPF's Thai activities is 0.41 million hectares. This would mean a loss of € 231 million in proceeds for crop farmers. Applying a 4% margin, the annual loss in earnings would be € 9.3 million for crop suppliers to CPF and its contract farmers. On top of this, the contract livestock farmers for CPF earn a profit. However, there is insufficient data to extend the calculation.

Of course, not all crop farmers require support. Additionally, farmers can explore alternative crops for cultivation, such as sugarcane, or opt for reforestation projects. Also, the support may be only temporary, for example, during the first phases of transition. Therefore, the assumption is that only 25% of CPF's global suppliers might need support.

Table 22 CPF: Annual support to farmers during the transition phase

	Base scenario	30% scenario	50% scenario	100% scenario
Yields (tons per hectare)				
Soy	1.6			
Corn	4.4			
Price (global, in €, end of June 2025)				
Soy per ton	361			
Corn per ton	170			
Reduction in land use (km2)	0	1,242	2,070	4,141
Reduction in land use (million ha)	0.00	0.12	0.21	0.41
Loss in proceeds (€ million)	0.0	69.4	115.6	231.3
Operating margin farmers (4%)	0.0	2.8	4.6	9.3
Annual potential transition support for local crop farmers (25%)	**0.0**	**0.7**	**1.2**	**2.3**

Source: Profundo estimates based on Indexmundi (prices), USDA (yields).

3.4.4 Additional measures for climate emission reduction in the animal business

In addition to the crucial transition from animal-based proteins to plant-based proteins, the remaining meat activities can also significantly improve their emission footprint. In the three scenarios for plant-based protein products, the three companies still generate substantial revenues from animal-based protein products. Some meat companies claim that reducing animal-protein activities is "a good alternative to, or substitute for, a protein transition."[78]

To keep the analysis transparent, the additional measures to reduce CO_2e emissions are applied only to the supply chain of CPF's meat activities. In that way, the argument of 'low-emission meat production' can be weighed.

A starting point for how to spend money to accelerate CO_2e emission reductions in animal-based protein products is a McKinsey study that lists 28 measures, along with the costs and cost savings per ton of CO_2e.[79] For animal protein production, the study selects four measures that made an above-average contribution to reducing CO_2e emissions, and for crops, five measures. In this context, crops are eaten by animals.

The weighted average of the most important measures for reducing CO_2e in animal protein is a low US$ 5.8 per ton CO_2e, as the expensive measures get a low weight: the first two measures are focused on ruminants, and these create only 8% of CPF's emissions (through dairy activities). For crops, the weighted average is US$ 87.4 per ton CO_2e reduction. The average of the two costs, US$ 45.7 (€ 38.8) per ton, is assumed to be the cost of reducing 1 ton of CO_2e on-farm (see Table 23).

According to McKinsey, a more efficient farm system can only lead to a limited reduction of GHGs. Globally, sustainable food production, including expansion and adoption of practices and technologies that can reduce emissions while meeting food (and feed) requirements, can generate

2.3 billion tons of emissions, for a total of 14.4 billion tons of climate emissions from agriculture.[80] That is 16.0%. McKinsey's abatement database covers 10 sectors across 21 world regions and has a 2030 perspective.[81] For methodological reasons (as indicated above), this report applies the McKinsey analysis only to the animal-based protein chain emissions.

Table 23 Marginal prevention costs for on-farm emissions

	Global emissions (mln ton CO_2e)	Costs per ton CO_2e (US$)	Weight
Animal protein			
Utilise advanced feed additives for livestock	350	99	4%*
Apply nitrogen inhibitors and urease inhibitors to the pasture	214	35	4%*
Improve animal health monitoring and illness prevention	112	0	46%
Employ GHG-focused breeding and genetic selection in livestock*	81	0	46%
A. Weighted average		***5.8***	***100%***
Total global emissions of the four measures of animal protein	757		
Crops			
Reduce the overapplication of fertiliser on fields	131	-146	18%
Apply nitrogen inhibitors and urease inhibitors to crop fields	126	-37	17%
Employ low- or no-till practices on crops	91	123	13%
a- extra due to sequestration on the farm	218	0	30%
Convert from flood to drip/sprinkler irrigation	85	116	12%
Convert to the use of enhanced-efficiency fertilisers	73	904	10%
B. Weighted average		***87.4***	***100%***
Total global emissions of the five measures in crop cultivation	724		
Weighted average of the nine measures (A + B)		***45.7***	
Weighted average of the nine measures (A + B) in Euro		***38.8***	

Source: Profundo based on McKinsey; *) the selection of measures is based on McKinsey analysis and could contain GMO-linked actions; *) In this analysis, these get a lower weight as these two measures apply to ruminants, which are relatively small in CPF's business: dairy creates 8% of CPF's total emissions.

By multiplying the meat emissions by 16% (the share that additional measures can reduce), the potential on-farm emission reduction can be calculated (see Table 24). These amount to 1.1 million tons of emissions in the Base scenario, for instance. If this outcome is multiplied by the prevention costs per ton of CO_2e emissions, the total prevention costs would be, for instance, € 21.4 million in a 50% scenario. Assuming that a minority (25%) of meat production is carried out by

contract farmers, who should cover their own costs, CPF will have to pay 75%, or € 16 million, in a 50% protein scenario (see Table 24).

Table 24 CPF: Additional measures for CO_2e reduction in animal-based protein revenues

	Base scenario	30% scenario	50% scenario	100% scenario
Emissions				
Remaining animal meat emissions (million ton CO_2e)/on-farm emissions	6.9	4.8	3.4	0.0
Part that can be reduced through extra measures (million ton CO_2e)	1.1	0.8	0.6	0.0
Costs				
Prevention costs per ton CO_2e reduction (€)	38.8	38.8	38.8	38.8
Total prevention costs (€ million)	42.8	29.9	21.4	0.0
Share for CPF	75%	75%	75%	75%
Total prevention costs for CPF	32.1	22.4	16.0	0.0

Source: Profundo estimates, based on Table 13 and Table 24

3.4.5 Summary of additional costs

The total annual protein transition and prevention costs would be € 32.1 million in the Base scenario (on-farm measure costs). However, in the 30%, 50% and 100% scenarios, the costs for the new plant-based capacity are dwarfed by the declining cost of the old, much broader, infrastructure for meat production. Consequently, these transition costs are negative (see Table 25).

Table 25 CPF: Summary of transition and prevention costs in three scenarios

€ million	Base scenario	30% scenario	50% scenario	100% scenario
Transition costs				
New capacity costs	0	-56.3	-93.9	-187.7
Annual potential transition support for local crop farmers (25%)	0	0.7	1.2	2.3
Additional marketing costs	0	27.9	46.6	84.4
Prevention costs				
Additional on-farm (crops + livestock) measures	32.1	22.4	16.0	0.0
Total transition and prevention costs	**32.1**	**-5.3**	**-30.2**	**-101.0**

Source: Profundo estimates based on preceding tables

3.5 The benefits of a protein transition

3.5.1 Methodological choices on operating benefits

This report calculates the benefits assuming consumers pay the same price for plant-based proteins as for animal-based proteins. Currently, both economies of scale and price positioning differ significantly between meat production and plant-based protein products. Meat production is a large industry, and the supply and processing chain has become very efficient, leading to relatively low meat prices in a competitive retail environment.

The economies of scale for plant-based alternatives remains relatively small and needs to grow, and food retailers often continue to position the category as a niche market with high prices and margins due to low turnover on supermarket shelves. In this, the category will not be handled much differently from the biological or organic categories. A study showed that organic products in one supermarket were 56% more expensive than conventional products, but based on supply chain costs, this difference should be 16%.[82]

Currently, plant-based meat has an average price premium of 35% over meat in a selection of Southeast Asian markets. However, sausages are 69% more expensive, meatballs 91% and burgers 59%.[83] Other data show that in Thailand, price premiums for plant-based meat alternatives range from 9% to 54%.[84] The higher prices could suggest that the margins on plant-based alternatives are higher than on animal-based proteins. As stated in the paragraph above, food retailers might be responsible for the high pricing of plant-based protein products.

The producers of plant-based protein products have a different business model from the producers of animal-based protein products. Per gram of protein produced, fewer crops and land are required, but probably more advanced factories and processing equipment are needed. Moreover, with fewer economies of scale, plant-based protein producers will need to spend relatively more per gram on marketing and are still on a learning curve.

Another difference in cost items consists of labour costs. In animal-based protein production, slaughter requires large amounts of labour at relatively low wages, whereas in plant-based protein production, less labour is required (more automation in processing), but per-employee costs might be higher due to engineering tasks in factories.

Given that raw materials are a relatively large cost component for food companies, while labour is much smaller, the current analysis of operating cost benefits focuses on differences in raw material costs in the production process. Also, the assumption is that the sales price per gram of protein and the price per kilogram of plant-based protein products will converge to the level of animal-based products.

3.5.2 The raw material cost benefit of the protein transition

While plant-based and alternative proteins require other factories, more automation, and several other additional costs (see section 3.4), the protein transition leads to lower land use because there is less need for agricultural feed materials. This reduces the need for corn and soybeans and for expensive vitamins, minerals, and other additives.

As stated in the section 3.4.3, animal feed consists of 55% corn, 25% soybean meal, and the rest of other products. Vitamins, minerals, and additives might raise production costs by 10%.[85] This means that materials produced by companies like Bayer account for a significant share of the animal feed price.

Table 26 starts with the loss in revenues of crop farmers (from Table 22). Added to this are the extra costs for vitamins, minerals, and additives. The protein transition scenarios result in savings of €76.3 million in a 30% transition and € 254.4 million in a 100% transition in raw material costs.

Table 26 CPF: Farmers' cost of supplies in three scenarios

€ million	Base scenario	30% scenario	50% scenario	100% scenario
Lower sourcing costs from crop farmers	0.0	69.4	115.6	231.3
Lower costs from chemical additives in their animal feed business	0.0	6.9	11.6	23.1
Total of lower costs of supplies	0.0	76.3	127.2	254.4

Source: Profundo estimates based on Table 22 and data on the costs of vitamins, minerals and additives

3.5.3 Lower interest rates on debts

CPF might be able to reduce the interest rates on its debt. Financial institutions seeking to green their loan portfolios could charge lower interest rates on companies' debt, thereby making their businesses more sustainable. Lenders could offer discounted rates for eco-projects, sometimes 0.5% to 2% lower than standard loans.[86] Sustainability-linked loans (SLLs) have a discount of less than 1%-point[87], while green farming in the UK could offer 0.3%-point lower interest rates.[88]

In the CPF example, the company has € 5.2 billion in net debt related to its Thai activities in the Base scenario, and would have € 4.8 billion, € 4.6 billion, and € 4.0 billion in the 30%, 50%, and 100% protein transition scenarios. In 2024, the cost of debt for CPF was 4.30% (2023: 4.34%)[89]. A reduction of 0.125% in a 30% transition, 0.25% in a 50% transition, and 0.50% in a 100% transition would reduce annual interest costs by € 5.3 million, € 10.2 million and € 17.8 million, respectively (see Table 27). The interest rate discounts apply only to the livestock business (88% of the total).

Table 27 CPF: Lower financing cost opportunity

€ million	Base scenario	30% scenario	50% scenario	100% scenario
Additional investments for protein transition (average)		211	351	702
Freeing up of capital from old activities through the protein transition (presented as a negative number)		-559	-932	-1,863
Net debt*	**5,206**	**4,858**	**4,625**	**4,045**
% interest rate advantage for ESG improvement		0.125%	0.25%	0.50%
Share for the Thai livestock and alternative protein business	88.0%	88.0%	88.0%	88.0%
Lower interest costs	**0.0**	**5.3**	**10.2**	**17.8**

Source: Profundo estimates based on preceding tables; *) The global net-debt of € 14,070 million is multiplied by 37%, to adjust the global debt to debt for the Thai activities of CPF.

3.5.4 The reputation and ESG benefits of the protein transition and emission reduction

The valuation of the companies could be an additional argument for a protein transition. A more sustainable profile would be positive for the company's reputation and could raise its stock market valuation, benefiting owners/shareholders.

Companies that reduce their emissions and land use can benefit from improved reputations as their sustainability profiles strengthen. The consequence might be better Environmental, Social and Governance (ESG) ratings at the various rating agencies.

While negative reputation events can harm a company's value by 30%, positive reputation events might give value a positive impact of 20%. In the long term, a positive reputation improves earnings. This positive impact can stem from better client and supply chain relationships, quality personnel, and ultimately enhanced earnings capacity. Companies with stronger reputations tend to see lower costs of capital. The latter will impact the value of the shares. This implies that a company systematically working to improve its reputation (a 100% protein transition) would experience a 20% positive impact on value. If a company systematically damages its own reputation, it would face a 30% decline in value.[90]

This reputation impact will be accounted for in the section on valuation (see section 3.6.3 and Table 30).

3.5.5 The 'opportunity profit' of carbon sequestration from reforestation

Another benefit of the protein transition is the opportunity for idle agricultural land to sequester CO_2 through reforestation, becoming a carbon sink. These benefits are not included in CPF's total benefits. This is because carbon sequestration is a societal profit reaped by the world rather than individual companies like CPF. However, it is interesting to add this calculation in an update of this report.

3.6 Conclusion on costs and benefits for CPF and the other three companies

Table 28 summarises the total transition and prevention costs and benefits for CPF from the protein transition scenarios.

The table shows that the Base scenario has the worst outcome in terms of costs and benefits, with total annual costs of €32.1 million. The protein transition scenarios show negative costs and large benefits. These net benefits of a protein transition range from € 87 million to € 373.2 million, pre-tax.

Table 28 CPF: Annual costs and benefits in protein transition scenarios

€ million	Factor	Base scenario	30% scenario	50% scenario	100% scenario
Costs					
Total transition and prevention costs	A	32.1	-5.3	-30.2	-101.0
Benefits					
Lower costs of supplies	B	0.0	76.3	127.2	254.4
Lower debt costs through ESG enhancement	C	0.0	5.3	10.2	17.8
Balance of benefits and costs of transition	B + C - A	-32.1	87.0	167.6	373.2

Source: Profundo estimates based on preceding tables.

These cost savings from the protein transition scenarios affect key parameters for financiers. **The most important ratios are 1) Net debt to EBITDA and 2) net profit or earnings per share.**

3.6.1 Net debt to EBITDA ratio

Net debt/EBITDA measures the size of gross debt, minus the cash position on the balance sheet, and compares it with the annual gross cash flow, EBITDA (Earnings Before Interest, Tax, Depreciation, and Amortisation). This ratio indicates the number of years it might take to repay the debt from the gross cash flow. A ratio of 2x to 3x is often comfortable for financial markets.

In 2024, CPF had a Net debt/EBITDA ratio of 7.8x (see Table 17). In the Base scenario, which includes the costs of on-farm emission reduction measures, the ratio deteriorates to 7.9 times (Table 29).

The protein transition scenarios would lead to a lower Net debt and a higher EBITDA. As a result, the Net debt/EBITDA ratios would improve across the three transition scenarios, reaching even 5.9x in the 100% scenario, a positive signal of financial strength.

3.6.2 Net profit

The net profit impact would be +13.5% in the 30% scenario, +26% in the 50% scenario, and +58% in the 100% protein scenario (Table 29). These benefits are fully reaped when the transition scenarios are completed in 2050. In the annual steps CPF is taking to shift its course to one of the protein transition scenarios by 2050, the benefits are accumulating to these total annualised numbers for 2050. This means that the annual net profit impacts are smaller: 0.5% in the 2030 scenario, 0.9% in the 50% scenario, and 1.8% in the 100% scenario.

These annual positive impacts through transition can be confronted with the 0.2% annual negative impact in the Base scenario. This means that in a Base scenario, every year, until 2050, CPF will be confronted with a 0.2% pressure on net profit, as, for instance, government climate regulation requires taking more on-farm measures to reduce emissions in the livestock chain; these additional costs would accumulate to a € 32 million pressure on EBITDA in 2050, and € 24 million in net profit in 2050 (pro forma calculated).

Table 29 CPF: Impact of protein transition on P&L and Balance Sheet

€ million	Factor	Base scenario	30% scenario	50% scenario	100% scenario
EBITDA 2024	A	1,803			
Total net-benefits (pre-tax profit impact)	B	-32	87	168	373
of which:					
Higher interest costs from building new capacity	*C*	*0*	*-11*	*-18*	*-35*
Lower interest costs from ESG/sustainability rating	*D*	*0*	*5*	*10*	*18*
EBITDA impact	E = B - D - C	-32	92	175	391
EBITDA	F = A + E	1,771	1,895	1,978	2,194
Net debt change from new capacity	G	0	-348	-581	-1,161
Net debt	H	14,070	13,722	13,489	12,909
Net debt/EBITDA (X)	I = H/F	7.9	7.2	6.8	5.9
Net profit 2024	J	484			
Net profit impact (annual, 25% tax rate)	K = 0.75 x B	-24	65	126	280
Net profit pro forma	L = J + K	460	549	610	764
% impact when transition is completed	M = L/J -1	-5.0%	13.5%	26.0%	57.8%
% annual impact per year in 2025-2050	N = (1+M)^(1/25)-1	-0.2%	0.5%	0.9%	1.8%

Source: Profundo estimates.

3.6.3 Valuation of CPF

The higher net profit and lower net debt in the transition scenarios could materially impact CPF's stock market value. Important valuation ratios are 1) the ratio Enterprise Value (EV) to EBITDA, and 2) the Price/Earnings ratio.

If, in the transition scenarios, these ratios remain aligned with CPF's current EV/EBITDA ratios in the Base scenario, a 30% protein transition could enhance market value by 37.3%. In a 50% and 100% transition, this would be 62.2% and 126.4%, respectively.

Applying this valuation methodology to the Price/Earnings ratio would yield a lower difference. The respective value enhancements in the protein transition scenarios could be 19.4%, 32.6% and 66.1%.

The differences between the Base scenario and the protein transition scenarios would become even larger when the reputation value theory is added. Then, after averaging the implicit EV/EBITDA and Price/Earnings effects and adding the reputation impact, the protein transition scenarios could enhance total market capitalisation by 31% to 104%, while the Base scenario would face a 11% reduction in value.

Table 30 CPF: Valuation impact

€ million	Factor	Base scenario	30% scenario	50% scenario	100% scenario
EV/EBITDA calculation					
Market capitalisation	A	4,408			
Net debt	B	14,070	13,722	13,489	12,909
Enterprise value	C = A + B	18,478			
EBITDA	D	1,771	1,895	1,978	2,194
EV/EBITDA (X)	E = C/D	10.4			
Implicit enterprise value	F = E x D	18,478	19,775	20,639	22,888
Implicit market capitalisation	G = F - B	4,408	6,053	7,149	9,979
% change versus Base scenario	**H = G/A - 1**		**37.3%**	**62.2%**	**126.4%**
P/E calculation					
Market capitalisation	I	4,408			
Net profit	J	460	549	610	764
Price/earnings ratio (X)	K = I/J	9.6			
Implicit market capitalisation	L = J x K	4,408	5,264	5,844	7,321
% change versus Base scenario	**M = L/I -1**		**19.4%**	**32.6%**	**66.1%**
Potential valuation change					
Average change in valuation (%) based on existing valuation multiples	N = (H + M)/2	0.0%	28.4%	47.4%	96.2%
Reputation impact*	O	-11.1%	2.2%	3.7%	7.4%
Total valuation change (%)	P = N + O	-11.1%	30.6%	51.1%	103.6%

Source: Profundo estimates: *) The reputation impacts of -30% and +20% have been adjusted for the relevant market as a share of the total company (37%) and for the scenario percentages.

3.7 The financial impacts on CPF, Betagro, Saha, and Cargill Meats Thailand

This section calculates and summarises the financial impacts of the three scenarios on the net profit of the four Thai meat producers. The costs include the construction and financing costs of new capacity for plant-based protein products, the annual costs of supporting farmers, who are suppliers in meat companies' livestock chains, in changing their business models, and the additional marketing costs to incentivise a shift in consumer demand.

The costs of additional measures to reduce emissions in the (remaining) livestock business have also been calculated. As mentioned in the section 2.2.2, these additional measures to reduce emissions achieve very limited results, which counters the argument of the 'meat' lobby that measures in the meat business could do the job.

There are data limitations for Saha Farms and Cargill Meats (TH). Consequently, the conclusions for the four companies are based on the largest two companies, CPF and Betagro.

The total financial impact, after tax, in the Base scenario (no transition) would be -5.5% compared to the net profit of the last reported year or relevant period. This net profit pressure is due to on-farm measures in the livestock supply chain.

The plant-based protein scenarios would improve net profit. In a 30% transition scenario, net profit would increase by 15.2%. The increase would be 65.2% in a 100% transition scenario. For each of the four companies, the largest benefit would come from much lower animal feed sourcing costs, assuming plant-based protein products sell at the same price as meat products. Another important positive impact is the much lower need for investment: the need to spend more on new soy extrusion plants is much lower than the costs of maintaining the much larger investment base in the animal-based supply chain, including animal feed factories, animal farms, and slaughterhouses.

Table 31 Summary of net profit impact

€ million	Base scenario	30% PT scenario	50% PT scenario	100% PT scenario
CPF	-24.0	65.2	125.7	279.9
Betagro	-8.9	25.5	48.6	109.1
Saha Farms	NA	NA	NA	NA
Cargill Meats (Thailand)	NA	NA	NA	NA
Total	-32.9	90.7	174.3	389.0
Total net profit of the four Thai companies	596.5	596.5	596.5	596.5
% impact	-5.5%	15.2%	29.2%	65.2%

Source: Profundo estimates; NA = Not Available, based on lack of financial data

3.8 Omissions and future additions

A benefit that could be added to the transition scenarios is reduced land use and the potential to reforest these areas. This would lead to sequestration of CO_2e. However, companies cannot integrate this benefit into their financial accounting, as reforestation is a societal benefit. Also, the societal benefits from the CO_2e reductions by the transition scenarios have not been accounted for.

In addition, the model used in this report has not calculated the impact of a combination of lower sourcing costs and, later, lower marketing and information costs at the moment that plant-based protein products have been accepted by the majority of consumers and all companies have adjusted to plant-based capacity. The much smaller infrastructure costs of plant-based proteins (no feed mills, no farms, no slaughterhouses) lead to much lower per-unit protein costs in the long term and under perfect market conditions.

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Appendix 1 Key financials of the four companies

Table 32 CPF: key financial data

€ million (Dec)	2022	2023	2024
Revenue	16,662	15,570	15,214
Gross profit	2,221	1,627	2,228
Depreciation and Amortisation	874	883	896
Operating profit	729	142	907
Pre-tax	453	-173	400
Net profit	364	-155	484
EBITDA	1,603	1,025	1,803
Net debt	13,590	13,679	14,070
Net debt/EBITDA	8.5	13.3	7.8

Source: Profundo based on FactSet.

Table 33 Betagro: key financial data

€ million (Dec)	2022	2023	2024
Revenue	3,055	2,887	2,993
Gross profit	590	288	404
Operating profit	248	-20	89
Net profit	215	-37	65
EBITDA	363	102	220
Net debt	480	610	703
Net debt/EBITDA	1.3	6.0	3.2

Source: Profundo based on FactSet.

Table 34 Saha Farms: key financial data

€ million	2021	2022	2023
Revenues	459.3	707.3	781.9
Net profit	3.8	57.3	15.4

Source: Profundo based on company registers and average foreign exchange rates.

Table 35 Cargill Meats (Thailand): key financial data

€ million	2021	2022	2023
Revenue	593	686	903
Pre-tax	12	-8	77
Net income	15	-10	61
As % of global revenue			0.59%

Source: Profundo based on FactSet.

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