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ENSURING THE SUSTAINABILITY OF CLEAN COOKING PROGRAMS

Identifying good practices in subsidy provision

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Final Report

CLEAN COOKING CONSULTING

Pengwern Associates

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Abbreviations

GDP	Gross domestic product
GHG	Greenhouse gas
ICS	Improved (biomass) cookstove
IFI	International Financial Institution
LPG	Liquefied petroleum gas
KOSAP	Kenya Off-grid Solar Access Product
NDC	Nationally determined contributions
PMUY	Pradhan Mantri Ujjwala Yojana
RBF	Results-based finance/financing
SDG	Sustainable Development Goal
VAT	Value-added tax
WHO	World Health Organization

Executive Summary

Addressing the global clean cooking challenge remains an urgent priority. Roughly 2.1 billion people, one-third of the world's population, still rely on polluting fuels for cooking, contributing to an estimated 3.2 million premature deaths annually.[1] Despite notable advances, in more than 130 countries worldwide some proportion of the population regularly rely on polluting fuels for their cooking needs.[2] Clean cooking access remains deeply linked with economic development, health outcomes, and climate goals.

This report investigates the socio-economic development dynamics and potential subsidy mechanisms that can support clean cooking transitions. Two questions guide the analysis: (i) What is the relationship between economic development and clean cooking adoption? (ii) Given that part of the analysis for question (i) suggests that subsidies are important in sustaining clean cooking adoption, what types of subsidy models are most promising for accelerating effective transitions?

Economic development is associated with cleaner cooking, but progress is non-linear. No country with a Gross Domestic Product (GDP) per capita above $40,000 (all income values measured in 2021 international dollars) continues to have households that use polluting fuels for cooking. Below this threshold, progress is more mixed. The average (median) country passes through the threshold when fewer than 50% of its households are using polluting fuels when its GDP per capita is around $7,000; the 20% threshold at $11,500; the 10% threshold around $12,500; and the 5% threshold at approximately $13,500 and the 1% threshold at just under $15,000. Countries with higher fossil fuel subsidies tend to pass through many of these thresholds at lower GDP per capita levels than countries with lower or no fossil fuel subsidies.

The final elimination of polluting fuels appears to also correlate with increasing median and lowest decile household consumption levels. The median country that passes the 1% threshold has a median household consumption of roughly $3,000 per year, and a lowest decile consumption of approximately $1,500 per year. These levels are significantly higher than those observed when countries pass earlier thresholds, suggestive of the importance of broad-based economic empowerment - not just national income averages - in completing the clean cooking transitions.

Subsidies remain essential tools throughout the transition, even in high-income settings. A high-level review of countries with full clean cooking access shows that many continue to provide energy subsidies for low-income households. These are typically means-tested and remain in place until household incomes exceed $20,000–$30,000 (2021 international dollars). This indicates that subsidy support often endures well beyond the point of universal clean cooking adoption, reflecting the role of subsidies in maintaining energy equity and affordability. Efficient and financially sustainable subsidies can play an important role in guaranteeing that lowest income groups can access clean cooking services.

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[1] WHO (2024) Household air pollution
[2] WHO data available from the Global Health Observatory

This report provides policymakers with a broad taxonomy of different clean cooking subsidy models to allow them to understand their advantages and disadvantages and contextual relevance. Adopting a wide definition of subsidies - as any intervention that lowers the cost of supplying clean cooking solutions, increases the returns to providers of clean cooking solutions, or reduces the income that consumers must allocate to adopt clean cooking solutions - the report assesses 17 distinct subsidy models, categorized by whether they target supply or demand, and whether they focus on appliances, fuels, or infrastructure. These models are analyzed against a range of criteria including cost-effectiveness, predictability, likelihood of market distortion, ability to mobilize private capital, and alignment with net-zero objectives. These subsidies might be delivered through a range of mechanisms, including administrative changes in prices, financial transfers, tax incentives, and the monetization of carbon credits.[3]

In nascent markets, supply-side subsidies are often prioritized. Early-stage markets for clean cooking often suffer from thin supply chains, high upfront costs, and limited product availability. Supply-side subsidies, including capital cost grants and results-based financing, can help build manufacturing capacity, expand distribution, and reduce consumer prices. These interventions lay the groundwork for later market development and enable the broader uptake of clean cooking solutions.

Of the three main ways to provide supply side subsidies - capital subsidies, operating cost subsidies and results-based financing (RBF) models - capital subsidies or RBF tend to score better against the assessment criteria than operating cost subsidies. Capital subsidies support long-term investment and scale, while RBF directly ties disbursements to measurable results such as adoption or usage. These models are more likely to be effective and efficient than operating cost subsidies, which can be administratively complex, fiscally unsustainable, and, relative to RBF, less easily targeted.

Usage-linked subsidies are attractive for providing incentives for the sustained adoption of clean cooking solutions. Many households continue to use traditional cooking methods alongside new clean solutions — a phenomenon known as "stacking". Subsidy models that reward ongoing usage of appliances and/or fuels, rather than merely their purchase, help address this challenge. These can include pay-for-performance schemes based on verified usage data, which can take advantage of advances in digital technology to generate more accurate usage data at lower cost than traditional survey-based approaches. The ATEC "cook-to-earn" program,[4] funded by carbon credits, and based on digital monitoring, demonstrates how such models can promote sustained behavioral change.

Infrastructure-related subsidies have attractive characteristics, so long as the provision of the infrastructure itself is cost-effective. The attractiveness of using subsidies to support

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[3] The inclusion of carbon credits as a source of subsidy reflects that this study adopts a financial perspective to the definition of a subsidy, focusing on the transfer of financial resources to encourage clean cooking. From an economic perspective, the monetization of carbon credits is a means of pricing (some of) the external costs associated with GHG emissions so would be seen as correcting a distortion rather than the provision of a subsidy.
[4] ATEC (2023) Cook to Earn; ATEC (2024) ATEC's Cook to Earn Phase 2; Modern Energy Cooking Services (2023)

access to civil infrastructure derives from the greater likelihood that subsidies can be provided on a one-off basis (and/or that remaining subsidy needs can be met through price discrimination among customers), the relative ease of geographically targeting subsidies to those who need them most, and the relatively low risk of market distortion. However, infrastructure solutions should ideally be adopted only after applying least cost modelling analysis to confirm it is a cost-effective solution. Without this, there is a risk that infrastructure-related subsidies will be (cost) ineffective.

Where infrastructure subsidies are not viable or appropriate, any choice between appliance- and fuel-based support requires careful trade-offs. Appliance subsidies offer greater predictability and may avoid entrenching expectations, while fuel-based subsidies more closely target the health and climate benefits that clean cooking offers. However, fuel subsidies - especially on the demand side - face risks from price volatility (particularly for fuels such as LPG that are priced in hard currency), budget unpredictability, and political resistance to withdrawal if consumer expectations are established.

Demand-side subsidies are more likely to be important as markets mature; in most cases it will be preferable for any subsidies to be targeted. As the supply environment improves, the key barriers become acceptability and affordability - particularly for lower-income households. Well-targeted demand-side subsidies (e.g., conditional cash transfers and vouchers) are more likely to be cost-effective and less distortive to further market development than untargeted approaches.

High-integrity carbon crediting is an attractive source of funding clean cooking subsidies. When structured through long-term, fixed-price agreements, carbon crediting may provide greater revenue certainty than many public subsidy mechanisms, with the added flexibility to scale if adoption exceeds expectations. It is also a funding source that aligns well with some of the most effective subsidy models identified in this report - those tied to verified, ongoing use of clean cooking solutions. Recent efforts to strengthen carbon market integrity, including the adoption of the Core Carbon Principles, are expected to enhance the value of high-quality credits and further increase the viability of usage-linked models, while placing necessary scrutiny on weaker methodologies and approaches.

Further action is required to unlock the full potential of high-integrity carbon crediting as a clean cooking subsidy source. This includes strengthening the confidence of local banks in treating carbon credit offtake agreements as bankable commitments – an area where private sector–oriented international finance institutions (DFIs) might play a critical demonstration role. Additionally, it is essential to ensure that revenues from high-integrity carbon credits are accessible to a broad range of companies. Achieving this will require ongoing efforts to simplify crediting methodologies while maintaining environmental integrity, increased use of programmatic crediting approaches, and sustained capacity-building support.

1. Introduction

1.1. Context

There is an urgent need to advance the clean cooking transition. Around 2.1 billion people worldwide, approximately one-third of the global population, still cook using open fires or inefficient stoves fueled by biomass (such as wood, animal dung, and crop waste), kerosene, and coal. These practices generate harmful household air pollution, which was responsible for an estimated 3.2 million deaths in 2020, including over 237,000 deaths among children under the age of five.[5]

The experience of some countries can provide insights into what it might take to achieve a clean cooking transition. As of the latest World Health Organization (WHO) data, sixty-one countries have made a full transition to clean cooking,[6] with 134 countries still in transition.

Subsidies often play a critical component in the transition towards clean cooking. Countries working toward universal access to clean cooking - and those that have already made significant progress - often rely on subsidies. Subsidies may even persist even when all households have adopted clean cooking solutions. However, the design and effectiveness of subsidy models can vary widely, and different subsidy models may be more or less appropriate at different stages of market development.

1.2. Aims of the study

This report focuses on two key questions:

1. What is the empirical relationship between economic development – and conventional metrics for measuring this development - and the use of clean cooking solutions? (Section 2)

2. Section 2 suggests that there is likely to be an ongoing need for subsidies to support and sustain the adoption of clean cooking solutions. Therefore, section 3 asks, as development partners and countries look to accelerate the trend towards permanent use of clean cooking solutions, what are the different subsidy models they can use, and which are the most attractive? (Section 3)

Throughout this report, the term 'clean cooking' is used. The term is based on the WHO's definition, i.e., household energy systems that use clean fuels and technologies to prepare food, boil water and heat homes, and that do not produce harmful air pollutants. Clean fuels include electricity, liquefied petroleum gas (LPG), biogas, natural gas, pellets, briquettes, alcohol fuels (ethanol or methanol), and solar energy. The data analysis presented in section 2 relies entirely on statistics prepared using this definition. The analysis of subsidies (section 3) is also relevant for improved cookstoves, which do not significantly reduce or eliminate emissions

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[5] World Health Organization, Household Air Pollution, data for 2022
[6] WHO data from the Global Health Observatory

of health-damaging pollutants but can burn biomass fuels more efficiently, even though such improved cookstoves would not be considered 'clean' according to WHO Standards.

Often the adoption of clean cooking solutions and improved cookstoves will also reduce greenhouse gas (GHG) emissions. For example, the use of solar energy or alcohol fuels will result in fewer GHG emissions than deriving the same energy output from wood or other forms of biomass. However, this is not always the case. For example, the adoption of e-Cooking using electricity would meet this study’s definition of clean cooking but may not reduce GHG emissions if the electricity is derived from coal-fired power generation.

2. Exploring the relationship between income, consumption, and clean cooking

2.1. Introduction

This section provides an initial assessment of the relationship between the adoption of the clean cooking solutions at the country level and various aggregate measures of economic development (linked to income or consumption). The analysis complements existing studies that have focused on drivers of the adoption of clean cooking at the household level (see Box 1) with an additional perspective exploring relationships at the national level. It looks both across countries and over time.

It examines whether there are typical thresholds of average income or consumption at which progress along the clean cooking transition becomes "locked in" - that is, where country-level variables are associated with the widespread adoption of clean cooking solutions. Identifying such thresholds can, for example, help guide the strategic allocation of international public support for clean cooking initiatives. It is important to emphasize, however, that this analysis does not suggest countries can simply rely on surpassing specific income or consumption levels to achieve widespread clean cooking adoption. In many cases, countries that have reached or exceeded thresholds will be making use of targeted policy interventions and support measures to sustain the use of clean cooking solutions. The analysis also demonstrates that there are many countries that have been able to achieve much more widespread adoption of clean cooking solutions than might be expected given their underlying socio-economic development variables.

Box 1 Existing literature on the adoption of clean cooking solutions

A wide number of studies have sought to explain the role and importance of different factors in shaping household decisions on cooking methods. Two systematic reviews are particularly helpful in summarizing this literature:

- Puzzolo et al (2016) look at seven key groups of factors that can act as barriers or enablers of clean cooking solutions, focusing specifically on LPG, biogas, solar cooking and alcohol fuels. These seven factors are: fuel and technology characteristics; household and setting characteristics; knowledge and perceptions; financial, tax and subsidy aspects; market development regulation, legislation and standards; and programmatic and policy mechanisms. The authors conclude that while *'there is not a generalisable set of minimum criteria to guarantee clean fuel uptake, some factors are certainly critical.'* Some of the factors specifically listed by the authors include the ability of the clean cooking solution to meet cooking needs; higher [household] income levels – such that households can pay for the stove and fuel; ensuring that the clean cooking solution delivers fuel savings; the availability of fuels; the existence of appropriate financing and government support arrangements; and providing confidence that the solution can be used safely.
- Ocen et al (2024) undertake a systematic review focused around six groups of factors: characteristics of household and head; economic and market factors; personal preferences; structural factors; technology-related factors; and others. Although the authors do not identify which factors may be more or less important, their commentary reinforces the conclusion from Puzzolo et al that a wide range of different factors are likely to shape cooking preferences at the household level.

The purpose of this study is to complement these household-level assessments with a more macroeconomic perspective.

Source: Puzzolo, E. et al (2016) Clean fuels for resource-poor settings: a systematic review of barrier and enablers to adoption and sustained use, Environmental Research, and Ocen, S. et al (2024) Unveiling factors influencing choice of clean cooking solutions among households: a systematic review of literature, Frontiers in Sustainability,

Three analyses were undertaken:

1. An initial cross-sectional **'static' analysis** comparing the percentage of people using polluting fuels for cooking and GDP per capita across different countries.
2. A more detailed **'dynamic' analysis** looking at the value of key economic variables at the point that various thresholds related to the use of polluting fuels are crossed.
3. A **review of subsidy policies** for household energy use[7] in countries that have completed the clean cooking transition, to understand the household income levels when policymakers in these countries tend to withdraw means-tested subsidies.

[7] Very few policies isolated household cooking within countries that had completed their transition to clean cooking, so household energy consumption was used as a (broader) proxy.

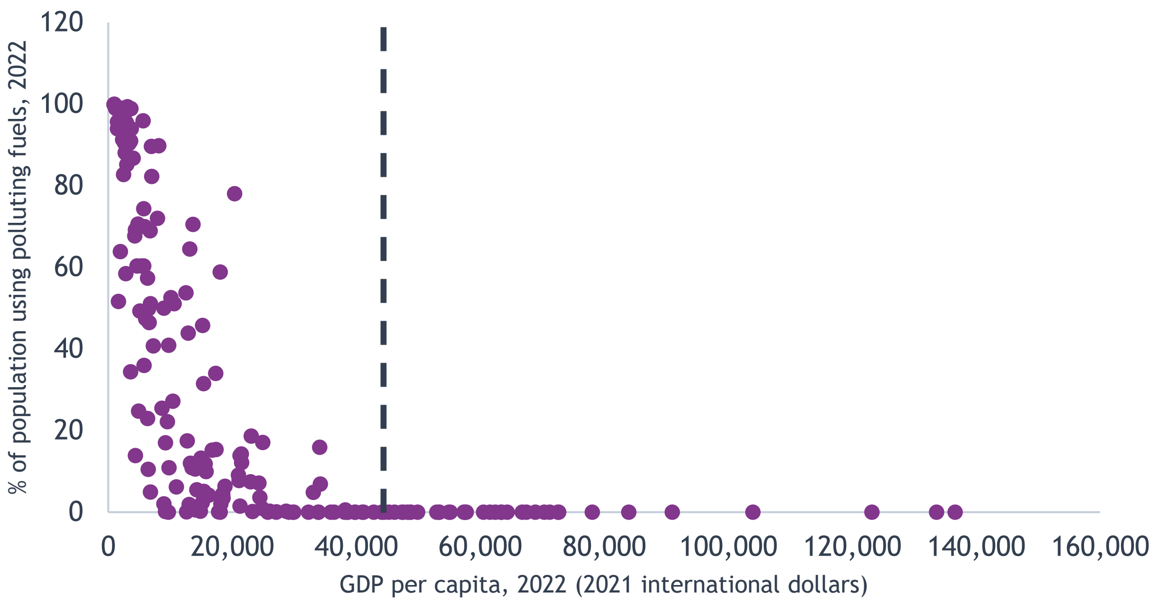
This is an initial analysis based on simple data manipulation. A more detailed econometric analysis that could help quantify the magnitude of certain effects or determine statistical significance would be a useful next step. All economic variables are reported in 2021 international dollars.

2.2. 'Static' analysis

All countries with a GDP per capita of more than $40k have completed the clean cooking transition (Figure 1). Indeed, there are only three outlying countries (Türkiye, Malaysia and Kazakhstan) with a GDP per capita of greater than $30k that have not (all but) made a full transition to clean cooking.

Below the $40k GDP per capita threshold, there is a negative relationship between income and polluting fuel use. This aligns with earlier analyses by Bonjour et al (2013).[8] However, Figure 2 shows that there are some notable outliers, with many countries having a significantly 'better' or 'worse' use of dirty fuels than might expected given their GDP per capita. A number – but not all – of the countries with worse clean cooking performance than would be expected given GDP per capita are countries with high levels of inequality associated with fossil fuel extraction with limited rent redistribution, e.g., Djibouti, Equatorial Guinea, and Sao Tome. Bonjour et al (2013) also identify that the availability of different energy sources and the degree of urbanization as two further factors that can mediate the relationship between national income and clean cooking use.

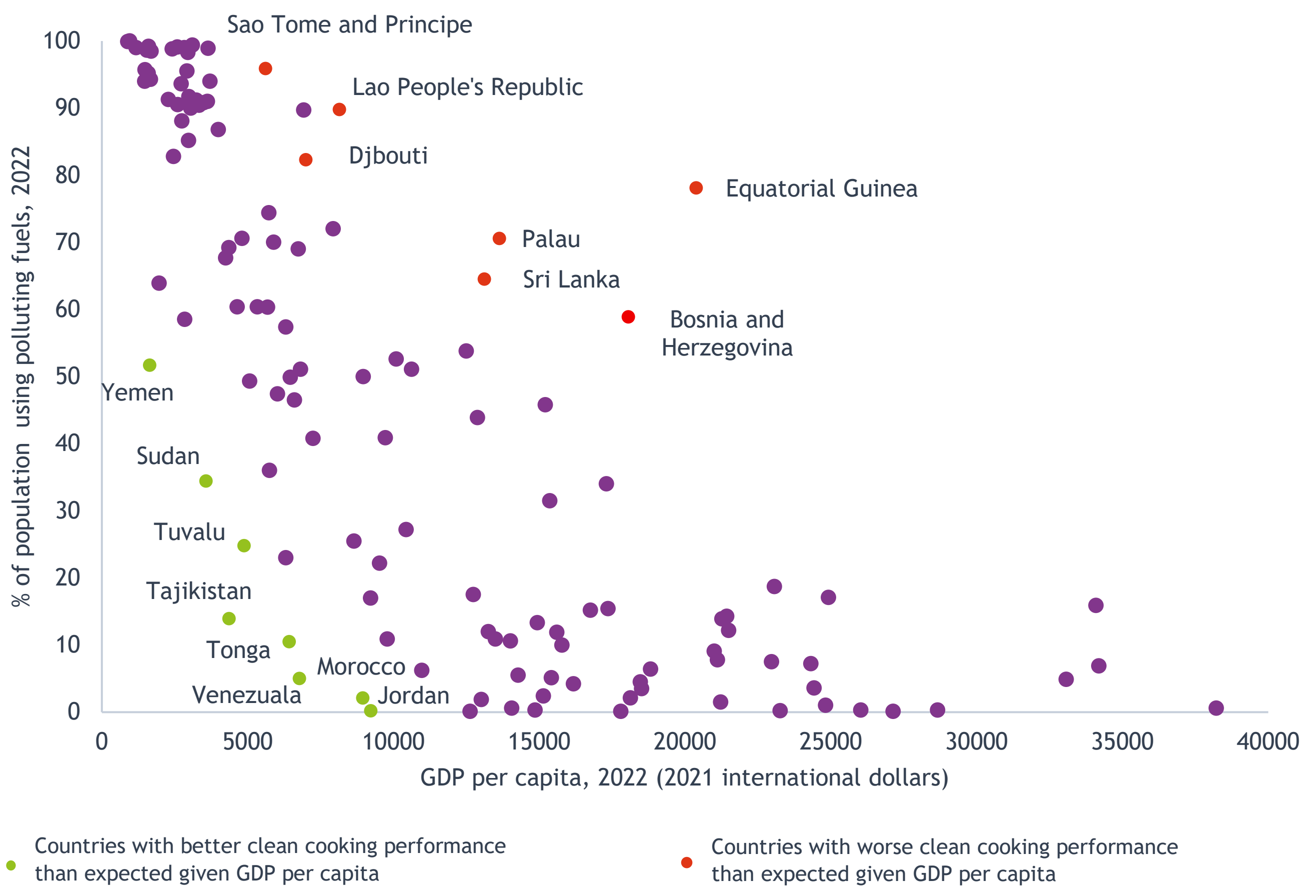
Figure 1 Countries with a GDP per capita greater than $40k have completed the clean cooking transition



Sources: WHO and International Monetary Fund (IMF)

[8] Bonjour, S et al (2013) Solid Fuel Use for Household Cooking: Country and Regional Estimates for 1980-2010, Environmental Health Perspectives 121:7,

Figure 2 Below the $40k threshold, there is a negative relationship between income and polluting fuel use



Sources: WHO and IMF

2.3. 'Dynamic' analysis

The dynamic analysis tracks clean cooking performance and economic variables over time. It considers the income levels at which different thresholds for using polluting fuels are passed. This analysis provides insights into the threshold values that these countries may need to surpass to reduce their dependence on polluting fuels for cooking.

Table 1 shows the number of countries that permanently passed one of five different thresholds for use of polluting fuels for cooking in the period between 1990 and 2022. Over this period, there are 130 instances of countries passing through the different thresholds, with some countries passing through more than one threshold.

Table 1 Number of countries caught by different thresholds

Threshold of polluting fuel use	50%	20%	10%	5%	1%
Number of countries passing through threshold, 1990-2022	37	39	27	18	9

Source: WHO

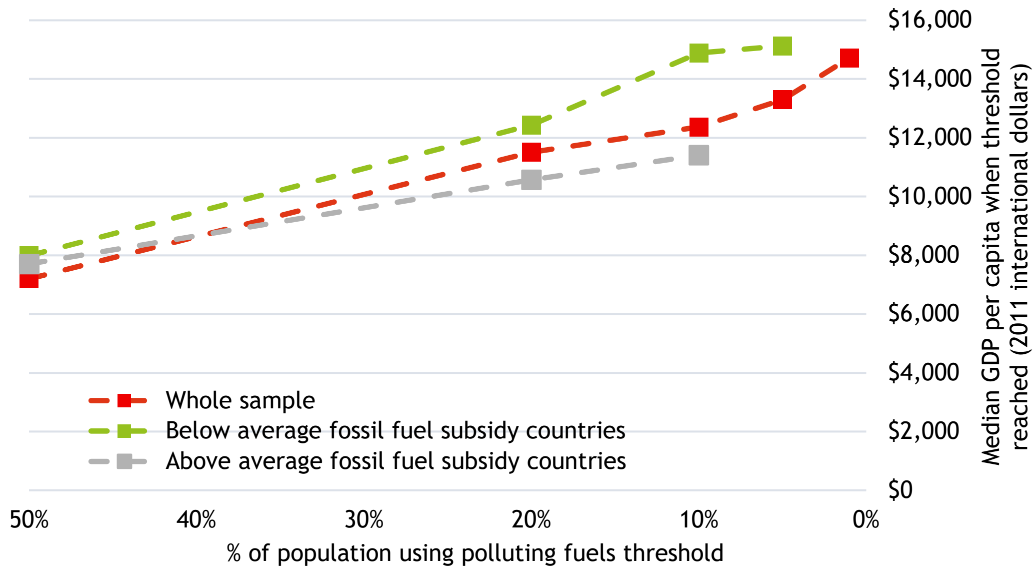
The analysis identifies, in the year that any country permanently passes through any of the thresholds, that country's:

- GDP per capita;
- Median household consumption and/or income level;
- Consumption and/or income level[9] of the lowest decile.

The analysis also considers the role of fossil fuel subsidies. The analysis was undertaken for both the total sample of countries and for countries which had, in the year that the polluting fuels threshold was passed (or, because of data availability limitations, 2010 if later), higher or lower than the average value for fossil fuel subsidies as a proportion of GDP between 2010-2021.[10] However, as discussed below, challenges with sample size and data availability meant that this breakdown could not always be used reliably.

Countries tend to reduce their reliance on polluting fuels for cooking as GDP per capita increases. As expected, the percentage of households that use polluting fuels falls as countries reach higher levels of GDP per capita, as shown in Figure 3.

Figure 3 GDP per capita for median countries passing through different thresholds of dirty cooking fuel use



Sources: WHO, IMF and Our World in Data

[9] This data was taken from Our World in Data (sourced from the World Bank Poverty and Inequality Platform) with data interpolated for those countries and years for which no data was available. While both income and consumption data were collated, the results are only presented for consumption due to better data availability.
[10] Fossil fuel subsidy data taken from Our World in Data, drawing on date from the International Energy Agency, Organisation for Economic Co-operation and Development and International Monetary Fund via the United Nations Global SDG Database.

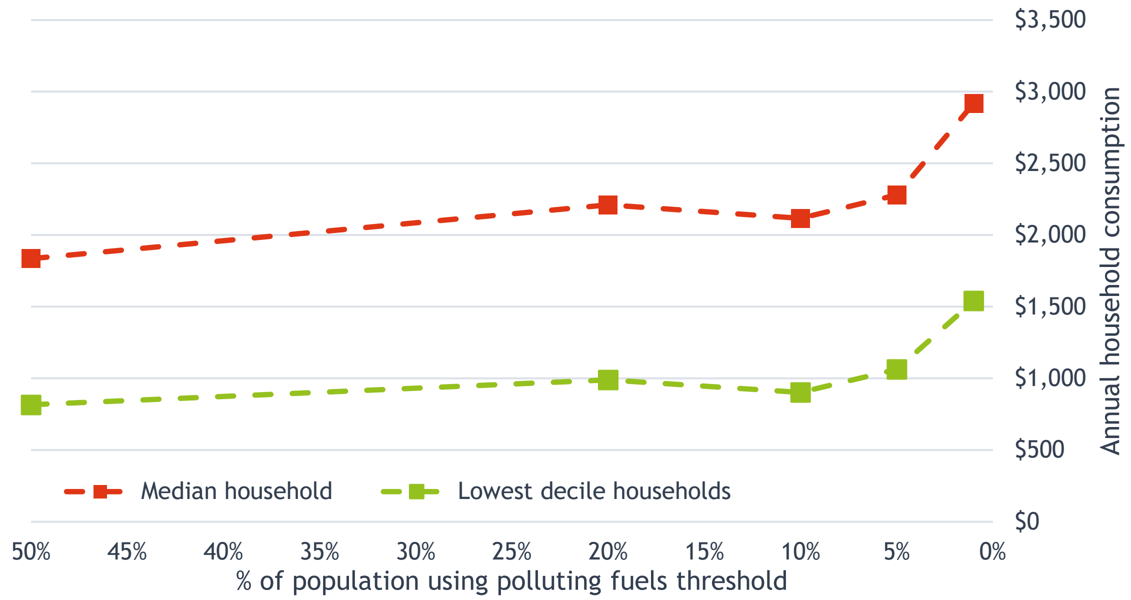
The median country requires a GDP per capita of just under $8,000 to have fewer than 50% households using polluting fuels. This rises to $11,500 for fewer than 20% households using polluting fuels; to around $12,500 to pass the 10% threshold; and to around $13,000 and $15,000 to pass through the 5% and 1% thresholds respectively.

Countries with above average fossil fuel subsidies tend to achieve clean cooking adoption at lower income levels. As shown by the grey markers in Figure 3, these countries pass through the 20% and 10% thresholds at GDP levels 75-85% lower than those countries with below average fossil fuel subsidies. However, fossil fuel subsidy provision makes little difference to the income level at which countries cross the 50% threshold. One possible explanation for this is that fuel prices are not the biggest barrier to clean cooking adoption in countries in the earlier stages of their clean cooking transition. The analysis only includes countries where more than five countries fall into the category which is why no data is presented for above average fossil fuel subsidy countries beyond the 5% threshold and below average fossil fuel countries for the 1% threshold.

However, to pass through the 1% threshold, increasing GDP per capita alone may be insufficient; median and lower decile consumption levels may also need to increase. Figure 5 shows that the median country only moves to fewer than 1% of households using polluting fuels for cooking when median annual household consumption reaches $3,000 and when the consumption of the lowest decile exceeds $1,500. This is notably higher than when countries pass through the less demanding thresholds (i.e., where higher proportions of populations cook with polluting fuels); all of which are exceeded by the median country when median household consumption reaches approximately $2,250 and when household consumption of the lowest decile reaches around $1,000.

In combination, this analysis has important policy implications. The preliminary evidence from Figures 3 and 4 suggests that overall improvements in economic development (as measured by GDP per capita) are associated with reductions in the use of polluting fuels for cooking. However, they appear to need to be complemented by rising income or consumption levels among median households and those in the lowest decile in order to achieve the final phase-out of polluting fuels.

Figure 4 Countries only appear to move towards the elimination of polluting fuels when median/lowest decline consumption levels increase



Sources: WHO, IMF and Our World in Data (in turn sourced from World Bank Poverty and Inequality Platform)

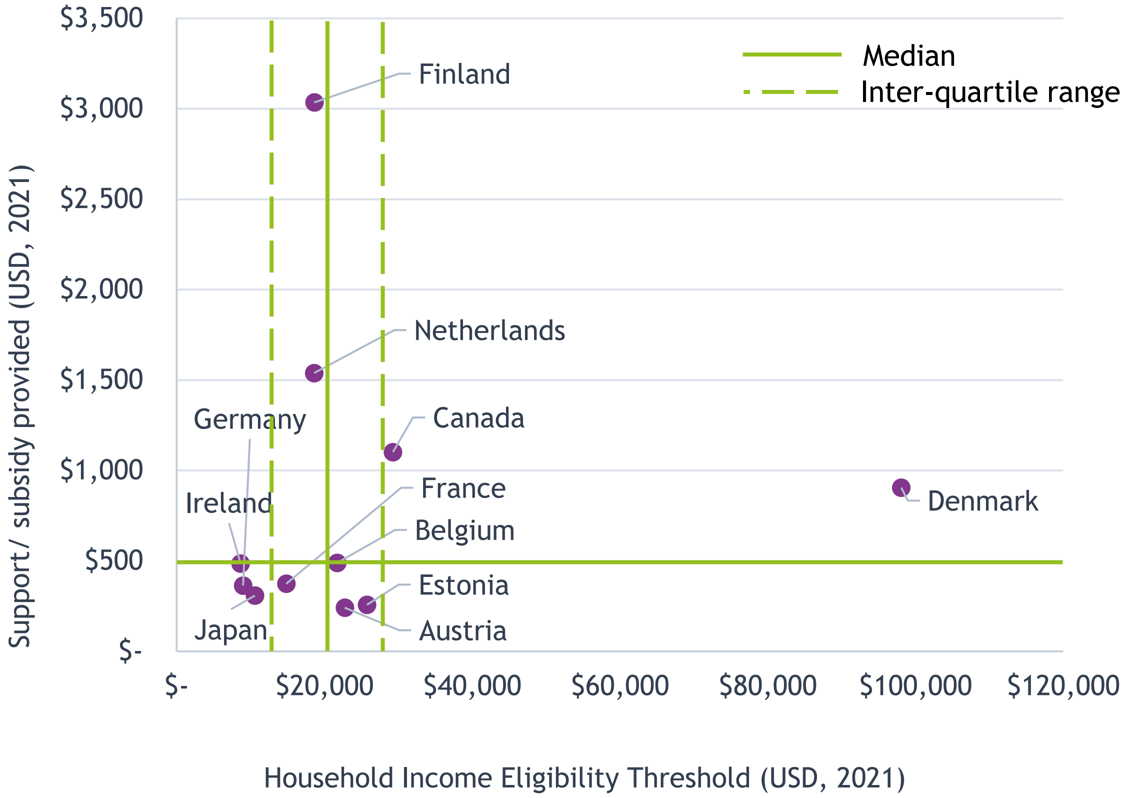
See Annex 2 for more details about the data analysis.

2.4. Use of subsidies within countries that have completed the clean cooking transition

This final subsection provides an initial, preliminary exploration of the extent to which countries that have completed the clean cooking transition continue to provide subsidies to support low-income households within their jurisdiction. Starting with the set of sixty-two countries that had already reached 0% polluting fuels use for cooking in 1990, all the principalities and small island states were removed, leaving a subsample of forty-nine countries. Of these, analysis focused on a selection of 25 countries, of which 12 were found to have recent policies with means-tested fixed payment support for domestic energy bills.

As Figure 5 shows, most countries offer means-tested energy subsidies use at household income eligibility threshold of between $10-30k (in 2021 intl. dollars). In none of the countries reviewed was there a household income eligibility threshold of below $8.5k, while, except for Denmark, no country continues to offer means tested subsidies for households when household income rises above $31.5k. Six countries set eligibility for subsidy support within the inter-quartile range of a $14k-$27k (2021 intl. dollars). Figure 6 also shows that most countries tend to provide support of $200-$500 per year (2021 intl. dollars), although a few are more generous.

Figure 5 Sample of countries with 100% clean cooking access and means-tested household energy subsidies



Sources: Social Watt (2023) - Austria; The Brussels Times (2022)- Belgium; The Local (2023) - Denmark; European Commission (2022) - Estonia; Finland Ministry of Social Affairs and Health (2022) - Finland; SECCA (undated) - France; Social Watt (2023) - Germany; Social Watt (2023) - Italy; Japan Times (2024) - Japan; Secretariat of the European Social Charter (2023) - The Netherlands; Social Watt (2023) - various.

The analysis suggests that subsidy provision to support household energy consumption - and ensure access to modern energy services - is commonplace, even among countries that achieved 100% clean cooking use many years ago. Often these subsidies continue to be provided until household income exceeds $20,000 (2021 international dollar) a high threshold by international standards. However, the income thresholds from this analysis are difficult to compare with the country threshold analysis, not least because data availability means that earlier analysis is focused on cooking, and this covers all domestic energy uses of energy.

This initial review has several caveats. First, the analysis does not take account of differences in the retail price of energy across countries which may drive consideration of when and how much means-tested subsidy might be provided. Second, in almost all cases, the subsides are, or were, provided to ensure that people have access to energy (i.e., gas, electricity) for all uses; not specifically for cooking. Third, the analysis only considers means-tested subsidy payments. In some cases, governments commonly may apply a cap to the maximum price that a utility can charge for a unit of electricity or gas, but this is applied to every household. These are excluded from the analysis.

2.5. Summary

- No country with a GDP per capita greater than $40,000 (2021 international dollars) has households using polluting fuels for cooking. For countries below this income threshold, clean cooking performance is more mixed; some of the countries with the highest levels of income inequality often have lower levels of clean cooking penetration than would be expected given their income levels.
- The median country permanently reaches fewer than half of households using polluting fuels when its GDP per capita is around $6,000; passes the 20% threshold at a GDP per capita of around $7,500; the 10% threshold when GDP per capita is $10,000; and passes through the 5% threshold at around $11,000.
- Countries with above average fossil fuel subsidy provision pass through the 20% and 10% thresholds at GDP levels 70-75% lower than those countries with below average fossil fuel subsidies, but fossil fuel subsidies appear to have little impact on the income level at which the 50% threshold is passed.
- Rising GDP per capita seems to be less important in explaining when countries breach the 1% threshold. Instead, median annual household consumption and lowest decile annual household consumption appear to need to increase to around $3,000 and $1,000, respectively.
- Many countries that have completed the transition to 100% clean cooking continue to provide additional subsidies to support energy consumption by lower-income households, with subsidies often available until household income exceeds $20k ($14-$27k) per year.

3. A review of different subsidy models to promote clean cooking

A broad suite of interventions is required to improve access and use of clean cooking solutions. There are a range of barriers that must be overcome to both ensure that clean cooking fuels and technologies are available and to encourage households to make use of them. A suite of interventions, covering political prioritization, financing, knowledge creation, partnerships, and better understanding consumer behavior, are all needed to simultaneously drive the supply of, and demand for, clean cooking solutions.[11]

Subsidies are a key part of the policy toolkit. The findings of section 2 suggest that they continue to play a significant role even in high-income countries where access to clean cooking is universal. Their importance is likely to be even greater in low- and middle-income countries, where full adoption remains a challenge. Considering their critical role, the remainder of this report examines various subsidy delivery models that could be employed to accelerate clean cooking progress. It is important to underscore, however, that subsidies represent only one element within a broader set of coherent policy measures required to achieve universal access to clean cooking, and that on their own, subsidies are unlikely to support the expansion of commercial markets into non-commercial areas.[12]

The report adopts an expansive definition of a subsidy. For the purposes of this report, a subsidy is defined as any intervention that lowers the cost of supplying clean cooking solutions, increases the returns to providers of clean cooking solutions, or reduces the income that consumers must allocate to adopt clean cooking solutions. Subsidies can be delivered through several channels including administrative changes in prices, financial transfers, tax incentives, and the monetization of carbon credits.[13]

This section covers three main issues:

- Section 3.1 explains the taxonomy of subsidy models explored in the report;
- Section 3.2 discusses the criteria that underpin the detailed assessment of each subsidy model; and
- Section 3.3 describes some of the key cross-cutting insights derived from the assessment of the subsidy models.

3.1. Taxonomy of subsidy instruments for clean cooking

One way to try and support clean cooking solutions would be through a lump-sum transfer

[11] Lighting Global/ESMAP (2024) Designing Responsible End-User Subsidies for Energy Access
[12] Hivos and iied (2020) Energy for All: Better Use of Subsidies to Achieve Impact
[13] The inclusion of carbon credits as a source of subsidy reflects that this study adopts a financial perspective to the definition of a subsidy, focusing on the transfer of financial resources to encourage clean cooking. From an economic perspective, the monetization of carbon credits is a means of pricing (some of) the external costs associated with GHG emissions so would be seen as correcting a distortion rather than the provision of a subsidy.

i.e., the provision of an unconditional fixed monetary payment made to eligible individuals or households, independent of their behavior, income, or consumption choices. Lump-sum transfers are typically the least distortionary approach to providing subsidies because they allow prices to reflect costs and provide flexibility for households to spend the transfer in the way that they consider will be most suitable.

However, while lump sum transfers can play an important role in mitigating the social impacts of energy reforms, they do not directly incentivize the adoption of clean cooking solutions. There are several compelling reasons why policymakers may choose to target clean cooking adoption more specifically. These include the long-term health impacts of traditional cooking methods, which - due to information asymmetry, gendered power dynamics within households or 'present behavior bias'[14] - may not be fully factored into household decision-making; persistent market barriers that limit household access to a diverse range of clean cooking technologies; and the significant greenhouse gas emissions and other externalities (e.g. deforestation) associated with polluting cooking practices.[15] The global policy focus on clean cooking is reflected in international commitments such as Sustainable Development Goal (SDG) 7, which calls for universal access to clean cooking by 2030. It is also reflected in national policy frameworks - as of December 2023, over 60 countries made explicit clean cooking measures in their Nationally Determined Contributions (NDCs).[16] As such, the subsidies analyzed in this report are subsidies specifically targeting clean cooking adoption. At the same time, where analyzing the desirability of different subsidy models, these are compared with the outcome that might be expected from lump-sum transfers, where relevant and appropriate.

Figure 6 shows that the subsidy taxonomy distinguishes between both the 'effect' of the subsidy and the 'solution category' to which it applies. In terms of subsidy effect, the taxonomy first distinguishes between supply-side and demand-side (or producer versus consumer subsidies):

- Supply-side subsidies are channeled through companies involved in the supply of clean cooking solutions to raise the incremental profitability of supplying the market. In turn, supply side subsidies can be distinguished between those that reduce the costs of supplying solutions (by reducing capital or operating costs), and those that increase company revenue. Often, subsidies that increase revenues will be provided on a results-basis, with the company receiving additional subsidies according to the results achieved. These results might either be defined in terms of the number of customers who have access to the clean cooking solution, or the extent to which a given number of customers make use of the clean cooking solution.
- Demand-side subsidies reduce the proportion of pre-subsidy household income that households must allocate to access clean cooking solutions. They can be distinguished between subsidies that directly reduce the prices that consumers pay for the clean

[14] Present (behavior) bias refers to a situation where people prioritize immediate rewards over future payoffs, even if that decision benefits them less overall. See Hitchcock (2025) Present Bias - Everything You Need to Know
[15] As discussed in the introduction, while clean cooking solutions as defined by the WHO will often address GHG emission externalities, this need not always be the case.
[16] Clean Cooking Alliance (2024) Nationally Determined Contributions and Clean Cooking

cooking solution, and those that increase consumers' purchasing power i.e., using vouchers/conditional cash transfers.

There can be spillovers between demand and supply subsidies. For example, a subsidy scheme might provide extra revenues to suppliers of clean cooking solutions but mandate that some of this additional revenue be passed through to consumers through price reductions. This indirect channel is shown by the dark dashed arrows in Figure 6.

The taxonomy considers three solution categories; cooking appliances, fuels, and civil infrastructure. Appliances are devices that facilitate clean cooking e.g., improved cookstoves, e-cookers, biodigesters. Fuels are energy sources that facilitate clean cooking e.g., LPG, electricity, ethanol, pellets. Civil infrastructure concerns the infrastructure required for the provision of some energy sources e.g., gas and electricity connections. In the case of electricity connections, these may either be provided by the centralized grid or through a mini-grid. These three solutions can be intertwined e.g., e-Cooking appliances like rice cookers depend on there being electrical infrastructure in place, and many 'tool and fuel' business models can effectively cross-subsidize the provision of heavily discounted appliances through subsidies linked to continued usage of the relevant fuel.

There are two further features of this taxonomy and its use that are important to stress.

- In general, the taxonomy does not identify the source of the subsidy. Most subsidy models could be implemented using subsidies provided nationally (from taxpayers), internationally (from development partners) or through the monetization of carbon credits. However, where a particular subsidy model is highly likely or can only be implemented using one source, this is identified.
- While the taxonomy and this report examines each of these models separately, it is important to note that, in practice, policymakers may – and do – choose to apply more than one subsidy model at the same time.

Figure 6 Taxonomy of subsidy instruments for clean cooking

3.2. Criteria used to assess the subsidy models

The different subsidy models have been analyzed according to eight criteria. Table 2 presents these different criteria and how they have been interpreted, including reference to Figure 7 below on subsidy sustainability. The full application of these criteria to each subsidy model is provided in Annex 1, while the discussion in section 4 summarizes the key strengths and weaknesses associated with each model.

Figure 7 The relative importance of different subsidy funding sources within a market will likely change over time

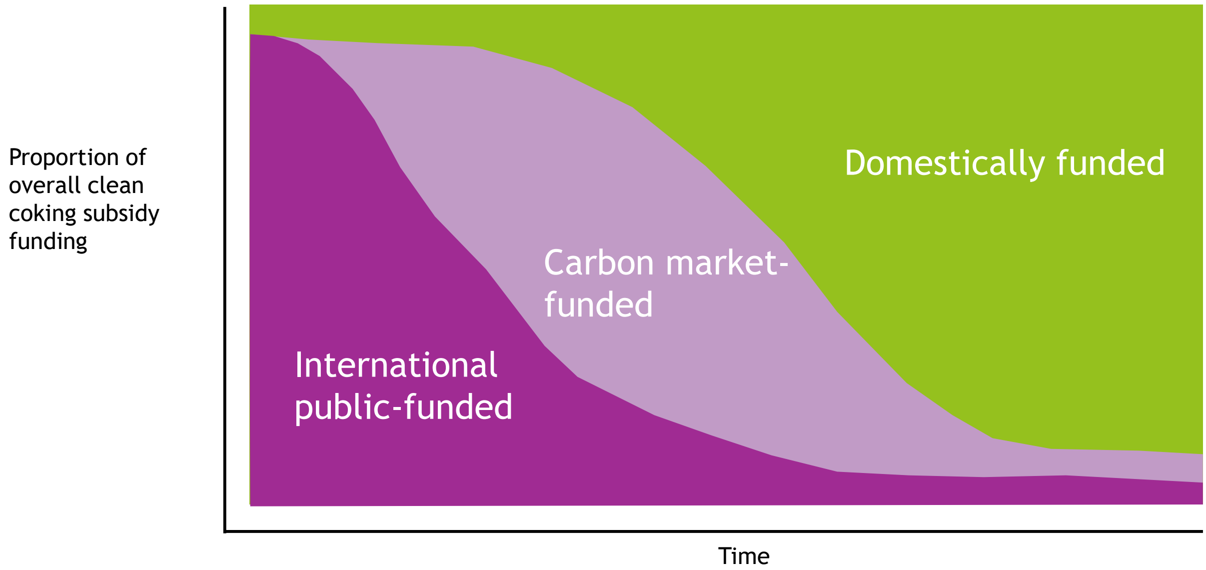


Table 2 Criteria for assessing different clean cooking subsidy models

Criterion	*How has this criterion been interpreted?*
Effectiveness	*Will the subsidy model increase the number/proportion of households using clean cooking solutions while it is in operation (and, if so, in what circumstances)?* This considers whether the model addresses key barriers to adoption and whether it is scalable and easy to verify. It abstracts from the generosity of the subsidy, which will vary by context.
Cost-effectiveness	*Is the model likely to achieve a significant increase in the adoption of clean cooking solutions while it is in operation, per $ of subsidy provided?* Cost-effectiveness depends on solving adoption barriers, targeting those in need (minimizing inclusion errors), and keeping transaction costs low.
Predictability	*Can stakeholders have confidence regarding the existence and design stability of the subsidy model for its intended duration?* Predictability improves when the subsidy is affordable and draws from a reliable source. Unpredictable schemes are less effective over the medium to long term.
Market distortion	*Does the subsidy mechanism facilitate fair and effective competition between different cooking solution providers, including both existing suppliers and potential new entrants?* Market distortion is minimized when all providers, across different technologies, are treated equally. Subsidies will be more distorting if the subsidy allocation mechanism focuses on certain technologies or companies. Lump sum transfers typically cause minimal distortion.
Support transition to sustainability	*Does the subsidy model support a change in market conditions that will help transition the source of, and reduce/eliminate, the need for subsidies?* Figure 8 shows a theoretical subsidy transition path, beginning with international support and gradually shifting to domestic government funding before eventually being phased out. In some cases, international support shifts from development aid to carbon finance. This criterion evaluates whether the model enables a transition from external to domestic funding, with subsidies decreasing over time.
Ability to mobilize private capital	*Does the model support mobilization of private finance?* Within the transition to sustainability, it is important to facilitate clean cooking solution providers (and potentially consumers) to access private capital to support sustainable scale-up.
Ability to reach marginalized groups	*Does the subsidy model account for and address any circumstances that can make it particularly challenging for marginalized groups i.e. women-led households, elderly, households in rural communities to adopt clean cooking solutions?* Models that can account for the differences associated with reaching these groups, and that can incorporate explicit communication and feedback channels, are more likely to be successful.
Consistent with Net Zero goals	*Does the subsidy model support emission reductions that will support the delivery of the temperature goals of the Paris Agreement?* Subsidy models that can be tied to delivery of emission reductions will help countries meet their NDCs.

3.3. Summary of findings from the review of clean cooking subsidy models

Building on the assessment of each of the individual models - Section 4 and Annex 1 - the analysis suggests five overarching findings.

1. **In nascent markets, priority will often be given to supply-side subsidies to build foundations.**

Early-stage markets require support for suppliers to scale manufacturing and distribution of both appliances and fuels.

Supply-side subsidies should be aligned with the clean cooking solution(s) expected to be most likely to succeed in the local context, as determined by local government. This may mean that, while intra-technology neutrality is desirable i.e., companies offering the same solution should have equal opportunity to access the subsidy, inter-technology distortions may be unavoidable due to cost heterogeneity and supply chain availability across solutions and geographies.[17]

2. **Within the family of supply-side models, capital subsidies and results-based financing serve distinct, complementary functions - and are preferable to operating cost subsidies.**

Results-based subsidies are often attractive as they provide stronger performance incentives and better targeting. They also typically require households to demonstrate some willingness to pay for the solution which helps to reduce concerns about market distortion. However, RBF requires both credible yet flexible funding mechanisms that can accommodate delivery (and payout) uncertainties.

Capital cost subsidies are appropriate where access to finance constrains scale, as the subsidy can then enable long-term cost reductions. They also offer relative administrative simplicity.

In contrast to each, operating cost subsidies are less attractive, combining the targeting challenges of capital subsidies with the need for a long-term predictable subsidy source of results-based approaches.

3. **Supply-side subsidies tied to ongoing use are particularly attractive.**

Appliance or fuel stacking is a pervasive risk and a challenge to maximizing the continued use of clean cooking solutions. Subsidies that are tied to ongoing use can be effective in addressing this challenge. Across many criteria, approaches that incentivize suppliers or providers based

[17] A related challenge that policymakers may need to address is when the preferred technologies identified vary in the extent of their subsidy needs in the local market. The least distortive approach would be to only provide a quantum of subsidy equal to the estimate of the subsidy needs of the most competitive technology. However, if policymakers value the availability of a portfolio of different technologies, or expect that relatively higher cost technologies today have the potential to be lower cost tomorrow, then they may prefer to provide technology specific subsidy amounts. Policymakers have also considered these issues in relation to subsidies for different renewable power technologies. See, for example, Ringel (2006) Fostering the use of renewable energies in the European Union: the race between feed-in tariffs and green certificates, Renewable Energy 31:1,

on actual household usage perform particularly well.

These are often structured as hybrid models that provide additional revenues to suppliers, but mandate that a portion of that revenue is passed through to consumers as lower prices as use is demonstrated. These models rely on technologies that minimize transaction costs and need to be supported by predictable funding sources.

High-integrity carbon crediting presents a promising source for this subsidy model: contracting arrangements can ensure that it is a reliable funding source that can easily scale as ongoing use is demonstrated, while offering increasingly standardized monitoring protocols.

4. **Subsidies targeting civil infrastructure – either on the demand or supply side – are often attractive, so long as infrastructure provision itself is cost effective**

This aligns with the experience of countries that have already achieved universal access, where large-scale infrastructure expansion - often supported by subsidies to reach rural areas - was central to progress. The attractiveness of using subsidies to support access to civil infrastructure derives from the greater likelihood that subsidies can be provided on a one-off basis (and/or that remaining subsidy needs can be met through price discrimination among customers), the relative ease of geographically targeting subsidies to those who need them most, and the relatively low risk of market distortion. It reflects the importance of integrating clean cooking within broader energy system planning, rather than treating it as a separate challenge.

However, infrastructure expansion will be a costly approach to expanding access in many contexts and that, even after expansion, households will only be able to make gradual use of the infrastructure services offered. There is a risk that infrastructure expansion will be preferred to other more cost-effective solutions, meaning that it may either generate larger demands for subsidy, and/or, that it may be ineffective at reaching the more marginalized customer groups.

5. **Choosing between appliance and fuel subsidies is a complex trade-off.**

Although subsidies for civil infrastructure are often attractive, there will be market contexts where they are inappropriate, like remote rural settings. These markets are also hard for fuel-dependent models to serve. In these cases, policymakers may need to choose how to funnel scarce resources between a slower but longer-term approach; focusing on strengthening fuel supply chains, or in quicker but shorter-term approaches; focusing on the roll-out of improved cookstoves appliances.

Fuel-based subsidies more directly target the health and GHG emission reduction benefits that clean cooking solutions offer. However, in many cases, this needs to be traded off against the risks that fuel price volatility may either undermine the effectiveness of the subsidy or render it too generous; potentially making the budget needed for the subsidy unpredictable. This is a particular risk for fuels such as LPG priced in hard currency. A further concern with fuel-based subsidies, particularly demand-side subsidies, is that the frequent purchase of fuel means it is more likely that price expectations become entrenched, making subsidy removal more challenging.

6. **Demand-side subsidies are likely to grow in importance as markets mature; but, in most cases, they should be targeted.**

Experience from high-income countries suggests that demand side subsidies are needed to achieve and sustain universal adoption of clean cooking solutions.

Universal demand-side subsidies, i.e., price reductions, are unlikely to be cost-effective and may be politically difficult to withdraw, especially when applied to fuel. By contrast, targeted mechanisms - for example, linking to social protection systems or voucher-based schemes - potentially offer a more sustainable path.

4. Assessment of subsidy models

This section explores each of the seventeen different subsidy models covered in the report. In each case it describes how the model works, a relevant example and key advantages and disadvantages, drawing on the more detailed assessment against criteria provided in Annex 1. In a selection of cases, more detailed case studies are provided.

The first sub-section looks at appliance-based models (numbered A1-A6); the second sub-section looks at fuel-based models (F1-F6); and the final sub-section looks at civil infrastructure-based models (I1-I6).

4.1. Clean Cooking Appliance-based Models

4.1.1. Model A1: Lowering the capital costs of manufacturing clean cooking appliances

How the model works
A supply-side subsidy instrument such as a grant or concessional loan that reduces the capital costs incurred in manufacturing or supplying clean cooking appliances, compared with commercially available instruments. This model is most likely to be applied when appliances are being manufactured in the local vicinity to where they will be deployed.

Examples include
BURN leveraged a $500,000 grant from the Clean Cooking Alliance in 2013 (and subsequently closed multi-million-dollar investments).[18]

Positives associated with this model, relative to other models

- **Can support a pathway to subsidy sustainability**: Capital cost subsidies can help manufacturers scale production and reduce long-term unit costs, creating conditions for eventual independence from public funding.
- **Ability to attract private capital**: Well-designed capital subsidies can improve a company's visibility and creditworthiness, which help to mobilize private investment.

Negatives associated with this model, relative to other models

- **Limited ability to target marginalized groups**: Directing capital subsidies exclusively to low-income users is almost impossible (without placing restrictive conditions on manufacturers that could undermine commercial viability and scalability).
- **Weak alignment with usage-based impact**: The model is disconnected from the activity that drives health benefits and emissions reductions, since the subsidy supports production rather than actual usage. The absence of incentives for sustaining clean cooking adoption may mean these health and climate benefits are not achieved.
- **Potential for market distortion**: This subsidy model may favor larger, more established companies with stronger relationship networks and greater capacity to navigate subsidy application processes. This risk will be magnified if those not able to access the subsidy would otherwise have a relatively more competitive offering than those companies that do access the subsidy. There may also be a risk, especially in the future, that the subsidy ends up supporting production that is commercially viable.

Overall assessment
It can be effective when there is confidence that users will want to continue to use appliances once they are available. Moreover, the focus on facilitating economies of scale offers a pathway to sustainability. However, it is unlikely to be effective if ongoing use of the appliance is uncertain.

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[18] Clean Cooking Alliance (2022) Spark+ Invests US $4 Million in BURN's Multi-Country Expansion Across Africa

4.1.2. Model A2: Lowering the operating costs of manufacturing clean cooking appliances

How the model works
A supply-side subsidy instrument that reduces the operating costs involved in manufacturing/ supplying clean cooking appliances, compared to similar consumer goods. This could be delivered through, for example, value-added tax (VAT) exemptions, reduced excise duties on components for stove manufacturers or biodigester manufacturers or reducing import tariffs for clean cooking appliances.

Examples include
The Government of Kenya offered VAT exemptions for Improved Cookstoves from 2016-2020.[19]

Positives associated with this model, relative to other models

- **Easy to implement with low transaction costs:** This subsidy model is often implemented by governments, typically through some sort of reduction in taxes paid by appliance manufacturers or suppliers.
- **Can be provided on a comprehensive basis.** The instrument can, in principle, be applied without favoring individual suppliers.

Negatives associated with this model, relative to other models

- **Challenging to reach marginalized groups**: Effective targeting is difficult without imposing restrictive eligibility rules or distorting manufacturers' business models.
- **Unclear cost-effectiveness**: While administrative costs are relatively low, the inability to target users, the lack of incentivization for use, and the difficulty in verifying whether subsidies are passed on to consumers may raise concerns about the cost effectiveness of the instrument.
- **Concerns over predictability**: This subsidy needs to be provided on a long-term basis to be effective which, if implemented through fiscal systems, may be difficult to secure.

Overall assessment
Relatively easy to implement through national tax policies, with modest transaction costs. However, it does not ensure appliance use and cannot be easily targeted to those most in need. Effectiveness is difficult to verify, and annual budget cycles may make it unpredictable. While it can be applied broadly without selecting specific suppliers, it may favor business models that maximize subsidy access, potentially distorting competition — particularly if local manufacturers gain an advantage over importers (although this may be seen as a positive to the government if it translates to more local jobs). There may be a higher risk of subsidy dependency compared to capital cost subsidies, as the model may be less likely to deliver economies of scale. While it may improve manufacturer profitability, the lack of direct financial sector engagement may make it challenging to mobilize financial sector action.

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[19] Duke Nicholas Institute (2022) The Role of Taxes and Subsidies in the Clean Cooking Transition

4.1.3. Model A3: Increasing revenues from supplying clean cooking appliances (by increasing customer numbers)

How the model works
A supply-side, RBF instrument that increases the revenues received by an appliance manufacturer for successfully introducing the appliance into a household's cooking stack e.g. an addition to revenues from the sale of appliances. Some proportion of the subsidy may be mandated to be passed on to customers.

Examples include
EnDev funded Practical Action to deploy 14,055 improved cookstoves through an RBF in Nepal between 2014 and 2019.[20] The Kenya Off-grid Solar Access Project (KOSAP) is predominantly a solar project, but also contains a clean cooking component. It is funded by the World Bank and implemented by the Ministry of Energy and Petroleum, Kenya Power and Lighting Company and Rural Electrification and Renewable Energy Corporation. Specific to clean cooking, it seeks to provide 150,000 households across 14 Kenyan counties access to clean cooking solutions between July 2017 and May 2025. As of December 2022, the program had incentivized the sale of 9,002 clean cooking solutions.[21]

Positives associated with this model, relative to other models

- **Strong incentive for suppliers to expand access**: Results-based subsidies tied to verified sales drive performance and reduce market distortion by ensuring demand.
- **Offers ability to target support for marginalized groups**: The ability to adjust the subsidy amount by region or customer profile improve equity, though adds complexity.

Negatives associated with this model, relative to other models

- **Subsidy remains removed from usage**: Focusing on sales, not use, may limit sustained appliance use and GHG reduction impact.
- **Relies on appliance manufacturers/suppliers being able to access finance:** Ex-post subsidies means that companies may continue to face challenges in accessing finance, although the expectation of increased profitability may help address this.
- **Subsidy amounts can be difficult to predict.** Variable disbursements complicate planning; fixed funding caps help control risk but may lead to some companies missing subsidies to which they expected to be entitled.

Overall assessment
An attractive subsidy model that provides strong incentives for market expansion, supporting cost efficiency. However, it neither ensures appliance use nor guarantees recipients can access the capital needed for expansion, and it requires careful implementation due to uncertainty around how much subsidy may be claimed.

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[20] Energizing Development (2021) EnDev Results-based Financing Facility, Nepal
[21] KOSAP (2023) Quarterly Newsletter, January

4.1.4. Model A4: Increasing revenues from supplying clean cooking appliances (by increasing customer usage)

How the model works
A supply-side subsidy instrument that increases the revenue a company receives from each customer that is verified as an active user of their cooking appliance, typically independently verified or by an appropriate sample of stove use monitors.

Examples include
ATEC paid customers in Bangladesh and Cambodia 0.05$ paid for each kWh cooked, using real time e-cooking usage data, funded by a $25/ton carbon credit price achieved by ATEC (Box 2).

Positives associated with this model, relative to other models

- **Potential for high effectiveness/cost effectiveness**: by linking subsidy disbursement to verified usage, this model increases effectiveness compared to instruments tied only to distribution. The data also enables monitoring and adaptive program design.
- **Demonstrated ability to mobilize private capital**: By strengthening revenue predictability and demonstrating monetizable impact, the model enhances creditworthiness and can attract commercial investment.

Negatives associated with this model, relative to other models

- **Non-digital usage verification is more error prone**: If this model is implemented using survey-based methods of usage verification then it carries high risks of subsidies being allocated inappropriately (and over-crediting if funded through carbon credits).
- **Higher risks of market distortion**: High verification costs and customer-tracking requirements may hinder entry for smaller manufacturers or those lacking household-level monitoring capacity, concentrating advantages among better-resourced firms. The risk grows if the excluded companies would have offered more competitive products than those receiving subsidies. Additionally, some distributors may give away appliances entirely through carbon credit funding, potentially undermining future sales in these areas.[22]
- **Predictability challenges**: As with similar models, the subsidy obligation is uncertain, which may complicate planning depending on the funding source.
- **Some appliances rely on customers having access to compatible cookware:** Schemes may require subsidy beneficiaries to buy (or access) compatible cookware.

Overall assessment
This model is expected to be effective because it requires appliance usage verification. Verification and registration costs may restrict access to larger manufacturers, and not all distributors can track customers effectively. The subsidy may help scale operations by increasing profitability and capital access for appliance manufacturers. Since it incentivizes continued appliance use, it supports verifiable emission reductions, aligning with climate goals. Predictability may remain a challenge – depending on the subsidy source - as total subsidy

[22] Clean Cooking Alliance (2024) A Call to Action: Delivering Responsible Carbon Finance

claims are unknown in advance.

Box 2 Using carbon crediting to fund subsidies for use of clean cooking appliances

Context

ATEC, a project developer, implemented the cook-to-earn concept in their project in Bangladesh and Cambodia, enabling households access to clean cooking solutions while generating income through their cooking practices.

ATEC's ability to detect real-time usage allowed them to make direct micropayments to users to reward usage; incentivizing sustained adoption of electric cooking. ATEC used the Gold Standard's Metered & Measured methodology alongside their Internet-of-Things enabled e-Cooking appliances in their "Cook-to-Earn" pilots.

Under the Metered & Measured methodology, increases in customer appliance usage directly translate to the issuance of larger carbon credit volumes. These credits are used to fund the micropayments. In the first pilot, ATEC achieved $25 per ton of avoided emission, which was shared directly with the users via a mobile money payment in 0.05$ increments for each kWh cooked. The pay-out was capped at 70% of the carbon credit's value.

In 2024, one report indicated that traditional field-based Monitoring, Reporting, and Verification methods for cookstove projects could be overestimating carbon credit issuances by 6.3 times. However, the Gold Standard's Metered & Measured methodology was found to generate credit issuances within 10% of the study's estimates.

What Worked Well

Effectiveness

Digital verification has emerged as a pivotal enabler for scaling cookstove carbon markets with greater transparency and integrity. By capturing real-time user data, ATEC can validate emission reductions more quickly and accurately, facilitating the generation of higher integrity carbon credits at scale. This approach allows providers like ATEC to offset stove costs through carbon revenue, accelerating uptake and supporting broader adoption.

The impact of performance-based incentives was also notable. Offering payments to new customers led to a 38–56% increase in stove usage, while incentivizing existing customers resulted in usage gains ranging from 1% to 21%. However, usage responses varied significantly - some customers halved their usage after being paid, while others more than doubled it - highlighting the complexity of understanding user behavior in response to financial incentives.

Cost effectiveness

By enabling the collection, reporting, and application of real-time usage data from individual metered products, D-MRV ensures high integrity in carbon emission reduction claims and reduces the need for costly and resource-intensive field-based verification activities.

Predictability

ATEC reports that it can consistently exceed a 2 kWh/day usage threshold - a self-reported benchmark for the viability of carbon-financed e-Cooking projects - by approximately 20%. This strengthens the credibility and financial predictability of the model. Further reinforcing this confidence, ENGIE's Global Energy Management & Sales division - the energy trading arm of the ENGIE Group - has signed a long-term agreement to purchase up to 11.5 million tons of carbon credits generated from ATEC's e-Cooking devices. This commitment reflects strong demand from carbon credit buyers and provides confidence in the model.

Ability to mobilize private capital

As noted above, ENGIE has agreed to buy 11.5 million carbon credits from ATEC. In the first pilot, ATEC achieved $25 per ton of avoided emission; approximately five times the levels seen in the market for other cookstove projects in 2025, due to the perceptions of higher quality from buyers. As such, these kinds of projects are now attracting $100s of millions of private investment. Another project using the Metered & Measured methodology sold its first issuance of credits at $35 per ton.

'Positive' Market Distortion

Suppliers offering alternative technologies without digital monitoring capabilities may struggle to demonstrate equivalency to the real-time usage data generated by dMRV-enabled projects. This could reinforce buyer preferences for data-rich solutions, driving the development of a 'premium' carbon credit market for digitally verified projects, while relegating others to a lower-value tier — potentially entrenching disparities in access to carbon revenues.

Issues Raised

Ability to reach marginalized groups

Access to e-cooking appliances remains out of reach for some marginalized households, with users required to pay $5–$10 per month over a 27-month installment plan — an amount that may be prohibitive for lower-income families.

Additionally, the model of directly compensating users with carbon credits for their cooking behavior reframes cooking from a consumptive expense to a potential income-generating activity. This shift demands a significant psychological adjustment and may not be intuitive for all users. Effectively communicating this concept will likely require targeted education efforts, potentially adding costs for outreach, advertising, and behavior change campaigns.

Support transition to subsidy sustainability

ATEC describes its "flywheel" model as being where financial incentives are integrated with the eCook induction stove, creating a self-reinforcing cycle that fosters greater adoption and momentum in the market. However, it is not clear whether any funding sources will be needed after the crediting periods end, and where this funding might come from.

'Negative' Market Distortion

The emergence of digitally monitored carbon projects could create an uneven playing field in the clean cooking sector. Smaller, local suppliers of improved cookstoves may find the high costs associated with carbon project registration and ongoing verification prohibitive, effectively excluding them from participating in carbon markets.

Sources: Gill-Wiehl, A., Kammen, D. and Haya, B. (2024) Pervasive over-crediting from cookstove offset methodologies, Nature Sustainability; ATEC (2023) Cook to Earn; ATEC (2024) ATEC's Cook to Earn Phase 2; Modern Energy Cooking Services (2023) Paying People Carbon Credits based on Usage Data; Clean Cooking Alliance (2025) Buyer's Guide to High Quality Cookstove Carbon Credits; Clean Cooking Alliance (undated) Sector Data; Carbon Herald (2023) Engie to Buy 11.5m Tons of Carbon Credits from ATEC

4.1.5. Model A5: Increasing consumer purchasing power for clean cooking appliances

How the model works
A demand-side instrument that increases a customer's ability to pay for a clean cooking appliance. This might be through, for example, vouchers, or the use of blended finance to underwrite microfinance loans to customers to buy appliances

Examples include
Spark+, a blended finance fund, provided $2 million to Sumac Microfinance Bank in 2022 to grow its clean cooking portfolio in Kenya.[23] Sumac offers its energy-focused Kawi Loan product which can be used to finance the purchase of improved cookstoves from BURN Manufacturing, and biogas digesters from Sistema.bio.

Positives associated with this model, relative to other models

- **Strong potential to reach marginalized groups:** The ability to select recipients makes this model particularly suitable for targeting underserved populations, including in humanitarian contexts, provided supply chains can meet demand, although delivery mechanisms vary in their risk of inclusion errors and transaction costs.
- **Limited market distortion:** Depending on the detailed design, this mechanism can share many similarities with a lump-sum transfer, providing flexibility for households to decide how they wish to use their extra purchasing power without distorting costs/prices of supply. However, this benefit will be lost if the detailed design provides support for only certain appliance types.

Negatives associated with this model, relative to other models

- **Targets appliance acquisition rather than use:** As with most appliance-based subsidies, a lack of assurance on long-term adoption and usage may limit the cost-effectiveness of this instrument.
- **Unclear contributions to net zero:** Linked to the lack of targeting on use, this subsidy is only indirectly related to emissions outcomes.

Overall assessment
This model addresses upfront affordability barriers but does not ensure long-term appliance use. Consumer-targeted subsidies tend to be less distortive, offer the prospect of good targeting to those in need but this may increase transaction costs. While subsidies may encourage long-term adoption, they may also reduce consumers' willingness to pay the full price in the future. Because the subsidy focuses on purchase rather than continued use, its impact on emissions reduction is uncertain.

[23] Spark+ (2022) Spark+ provides USD 2 million to Sumac Microfinance Bank

4.1.6. Model A6: Reducing the price of clean cooking appliances

How the model works
An instrument that reduces the price of a clean cooking appliance compared to the unsubsidized market price by fixing an appliance's retail price below the cost of the manufacture and supply of the appliance, with the subsidy instrument compensating suppliers for the difference ('capped prices').

Examples include
Solar electric cookers were installed free of charge to sixty-one households in the Dzaleka Refugee Camp, Malawi, as part of a three-year pilot project run by the World Food Programme.[24]

Positives associated with this model, relative to other models

- **Immediately addresses appliance affordability**: Helps to overcome a key barrier, particularly in settings associated with low ability or willingness to pay for clean or improved cooking solutions, or where there is free availability of wood fuels.

Negatives associated with this model, relative to other models

- **Targets appliance acquisition rather than use:** As with most appliance-based subsidies, a lack of assurance on long-term adoption and usage may limit the cost-effectiveness of this instrument.
- **High risks of market distortion:** Reducing prices is distortive especially if, to streamline implementation, subsidies are tied to specific appliance types or technologies. Conversely, the selective application of subsidies to certain appliance types or technologies may lead to these being perceived as being of lower quality, potentially making it more difficult for these appliances or technologies to achieve widespread adoption.
- **Challenging to deliver long-term subsidy sustainability:** Linked to the market distortion, while initial support may encourage uptake, prolonged exposure to subsidized pricing can erode willingness to pay; potentially creating a sense of dependency that undermines market self-reliance.

Overall assessment
The model addresses a major affordability barrier but does not ensure continued use. Depending on the setting, it may be difficult to limit price caps to specific households, which could lead to high inclusion errors. Subsidies are typically restricted to qualified appliances, which will distort competition and free giveaways are highly distortionary. That said, a stable subsidy could drive sales growth (for those not giving away for free) and might help to mobilize private capital into the manufacturer.

[24] Modern Energy Cooking Services (2024) Solar Electric Cooking in Displacement Settings: Lessons from Dzaleka Refugee Camp

4.1.7. Summary of subsidy models for appliances

Table 3 summarizes some of the key advantages and disadvantages associated with the six subsidy models focused on appliances, highlighting those models which score well against the criteria and those that are judged to be less attractive (see also Annex A).

Table 3 Key advantages and disadvantages of different appliance-based subsidy models

Model	*Key attractions*	*Key challenges*
A1: Lowering the capital cost of manufacturing clean cooking appliances	• Can support a pathway to subsidy sustainability • Some ability to attract private capital	• Unclear cost-effectiveness, in part due to targeting appliance production rather than use, also implying contribution to GHG emission reductions is uncertain • Limited ability to target marginalized groups • May distort competition towards manufacturers that are best able to navigate subsidy application process
A2: Lowering the operating costs of manufacturing clean cooking appliances	• Easy to implement with low transaction costs • Can be provided on a comprehensive basis, limiting distortion across those suppliers that qualify for the subsidy	• Challenging to reach marginalized groups • Unclear cost-effectiveness, in part due to target appliance production rather than use, also implying contribution to GHG emission reductions is uncertain • Concerns over predictability
A3: Increasing revenues from supplying clean cooking appliances (by increasing customer numbers)	• Strong incentive for suppliers to expand access • Offers ability to target support for marginalized groups	• Targets appliance acquisition rather than use, also implying contribution to GHG emission reductions is uncertain • Relies on appliance manufacturer/supplier being able to access finance • Subsidy amounts can be difficult to predict

A4: Increasing revenues from supplying clean cooking appliances (by increasing customer usage	• Potential for high effectiveness/cost effectiveness • Demonstrated ability to mobilize private capital	• Non-digital usage verification is more error prone • Risks of market distortion • Subsidy amounts can be difficult to predict
A5: Increasing consumer purchasing power for clean cooking appliances	• Strong potential to reach marginalized groups • Limited market distortion	• Targets appliance acquisition rather than use, also implying contribution to GHG emission reductions is uncertain • Some appliances rely on customers having access to compatible cookware
A6: Reducing the price of clean cooking appliance	• Immediately addresses appliance affordability	• Targets appliance acquisition rather than use, also implying contribution to GHG emission reductions is uncertain • High risks of market distortion • Challenging to deliver long-term subsidy sustainability

Note: Rows shaded in green are subsidy models that perform particularly well; those in red perform less well.

4.2. Clean Cooking Fuel-based Models

4.2.1. Model F1: Lowering the capital costs of producing clean cooking fuels

How the model works
A supply-side subsidy instrument that reduces the capital costs involved in manufacturing or distributing clean cooking fuels compared to similar consumer goods.

Example includes
Circle Gas received a $1.5 million interest free loan in 2019 and went on to raise $34.8 million of credit notes from a Kenyan bank in 2024. The funding was partly used to increase cylinder stocks.[25]

Positives associated with this model, relative to other models

- **Can support a pathway to subsidy sustainability**: Capital cost subsidies can help manufacturers scale production and reduce long-term unit costs, creating conditions for eventual independence from public funding.
- **Can signal credibility to manufacturers and attract private capital**: Well-designed capital subsidies can improve a company's visibility and creditworthiness, sending strong market signals that help mobilize private investment.
- **More consistent with net zero ambitions**: Support for clean fuels is directly linked with climate benefits at the point of use (compared with the use of charcoal-based cooking systems), though the scale of benefit varies by fuel type and national context.

Negatives associated with this model, relative to other models

- **Limited ability to target marginalized groups**: Directing capital subsidies exclusively to low-income users is almost impossible (without placing restrictive conditions on fuel providers that could undermine commercial viability and scalability).
- **The impact depends on households having appliance access**: The subsidy only drives adoption if households have compatible appliances; without them, uptake will not happen, and cost-effectiveness is compromised.
- **Risk of market distortion**: administrative allocation of grants may favor incumbent, well-connected market actors. This risk will be magnified if those not able to access the subsidy would otherwise have a relatively more competitive offering than those that are able to access the subsidy.

Overall assessment
While it can help reduce costs of fuel supply, it may not ensure use of that fuel, as households need compatible appliances. The risk of market distortion depends on design - but may favor incumbents. Predictability may be challenging given risks associated with global price fluctuations and supply chain issues. However, one-off investments in production facilities can provide lasting benefits if they successfully expand market supply.

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[25] Circle Gas (Company number 11588906) Annual Filings to Companies House in 2020 and 2023

4.2.2. Model F2: Lowering the operating costs of supplying clean cooking fuels

How the model works
A supply-side subsidy instrument that reduces the operating costs involved with supplying clean cooking fuel such as VAT exemptions or reduced excise duties for importing relevant fuels.

Examples include
KOKO Networks secured exemptions on VAT and duties in 2021 for imported ethanol cooking fuels in Kenya,[26] as part of the Ethanol Cooking Fuel Masterplan.[27] Box 3 below also discusses the approach taken by the Government of Kenya in relation to the application of VAT on LPG.

Positives associated with this model, relative to other models

- **Easy to implement with low transaction costs:** This subsidy model is often used by governments given it is easy to implement through the tax system.
- **Historic records demonstrate that it can be effective.** The Kenya case study (Box 3) was successful at reaching many households, including low-income households.
- **Can be provided on a relatively non-distortionary basis:** In principle it can be designed so that many/all suppliers benefit from the subsidy.
- **Moderate links to achieving net-zero outcomes**: The specific focus on fuels aligns the subsidy more closely with the sources of household cooking emissions.

Negatives associated with this model, relative to other models

- **Potential limitations on cost-effectiveness**: While administrative costs are low, the inability to target users and the difficulty in verifying whether subsidies are passed on to consumers raise concerns about the instrument's cost effectiveness.
- **Risk of lack of predictability.** If implemented through the tax system then subsidy is subject to the annual budget cycle (see Box 3), which will be problematic for subsidy recipients. Alternatively, fuel price volatility – a particular risk for fuels such as LPG priced in hard currency - may demand frequent changes in subsidy amounts to ensure effectiveness, which will be challenging for subsidy providers.
- **Difficult in moving towards subsidy sustainability.** May be difficult to realize economies of scale that allows subsidy to be successfully withdrawn.

Overall assessment
Easy to implement through tax systems, with modest transaction costs. However, fuel adoption requires households to have compatible appliances and targeting specific consumers is normally difficult. Market distortion within a given fuel type is low, but significant inter-technology imbalances may arise if only some fuels are subsidized. Predictability can be challenging if the subsidy is provided from annual budget cycles. While the subsidy may improve supplier profitability, financial markets are less likely to be mobilized by these subsidies.

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[26] KOKO Networks (2022) 200,000 Nairobi subscribers
[27] South to South (2020) Kenya's Ethanol Cooking Fuel Masterplan (2020)

Box 3 The Government of Kenya has provided VAT exemptions to support the supply of LPG

Context

The Government of Kenya intends to expand percentage of households using LPG for cooking from 19% in 2022 to 35% by 2030.

Within a broader package of policy support, the government made five VAT-related changes to LPG between 2012 and 2024. A 16% VAT was first introduced in 2013, before being removed in 2016. In 2021, it was re-established at 16%, following an IMF recommendation to increase all fuel taxes (alongside general government cuts to spending) as part of a $2.3bn Covid-19 recovery loan, although the planned reintroduction was delayed by a year. In 2022, VAT was halved to 8% to try to enhance affordability during international petroleum price surges. In 2023, the supply of LPG was zero-rated again, with the 3.5% Import Declaration Fee and the 2% Railway development Levy also removed.

Prices for an average 13kg cylinder in Kenya have fluctuated over this 12-year period, with VAT playing a role in price determination, alongside market demand and global supply issues.

What worked well

Effectiveness

One modelling study suggested the removal of VAT for LPG in Kenya could have been expected to result in the avoidance of 30,000 premature deaths between 2023–2030 by decreasing national household air pollution related mortality by 20%. The same study also estimated an expected net reduction in CO2e emissions of 7 megatons. Likewise, research conducted by a consortium of Kenyan and UK Universities after the re-introduction of VAT highlighted a decline in use of LPG of clean cooking amongst half of the urban households studied, with LPG being substituted by health-damaging fuels such as charcoal and wood.

Ability to reach marginalized groups

The ability of the VAT reduction to reach marginalized groups can be seen in the impacts following its reintroduction. Surveys conducted after July 2021 in Langas informal settlement (815 households) and Kisumu (32 households) found that 43% and 56% of households, respectively, used less LPG for cooking each month than they had previously. This was directly attributed to the price hike occasioned by the imposition VAT on the fuel. Three quarters of these households reported cooking more frequently with polluting biomass alternatives such as charcoal and wood. In Langas, households with the lowest incomes were more likely to reduce their use of LPG for cooking than those with higher incomes.

Issues Raised

Market distortion

There was a lack of policy coordination across different fuel types: levies on kerosene, a more polluting fuel, matched or were less than LPG between 2021 and 2022, distorting prices and buying behaviors. In 2021, the VAT charged on LPG was double that for kerosene (16% versus 8%).

Predictability

The regular changes in VAT rates may have added confusion and uncertainty in the Kenyan market, potentially discouraging the capital investment needed to scale up commercial production of cleaner cooking solutions.

Reduced effectiveness in recent years

As can be seen in Figure 8 below, the VAT rating has had less impact on Kenyan LPG prices since 2023. This indicates the relative bluntness of the instrument, with the impact on costs, and hence prices, and ultimately demand, being influenced by many factors beyond the control of the instrument.

Figure 8 The relationship between VAT rate and LPG prices has broken down in recent years

Sources: Gould et al (2024) In Praise of Cooking Gas Subsidies: Transitional Fuels to Advance Health and Equity. Environmental Research Letters; Clean Cooking Alliance (2021) Value-added Tax on Cleaner Cooking Solutions in Kenya, Business Daily (2024) State Exempts Cooking Gas Meters from Value-added Tax; Argus (2021) Kenya's LPG Tax to Gain IMF Loan Threatens Growth; Republic of Kenya Ministry of Energy and Petroleum (2024) Kenya National Cooking Transition Strategy 2024-28; Bowmans (2023) Analysis of the Finance Act, 2023; CLEAN-Air *(Africa) et al (2021) COP26 and SDG7 Goals Under Threat: 16% VAT on LPG Reverses Progress Made in Clean Cooking Adoption in Kenya, Das, I. et al (2022) Taxes and Subsidies and the Transition to Clean Cooking: A Review of Relevant Theoretical and Empirical Insights*

4.2.3. Model F3: Increasing revenue from supplying clean cooking fuels (by increasing customer numbers)

How the model works
A supply-side subsidy instrument that increases the revenue received by a company for each household to which it successfully introduces its fuel. The subsidy scheme design may mandate that some of the subsidies are passed on to consumers.

Examples include
USAID's Alternatives to Charcoal program provided PayGas with RBF incentives to enter Zambian urban markets with their decentralized LPG refilling model. After six months, PayGas had enlisted over 1,500 customers and sold 17.7 tons of LPG.[28]

Positives associated with this model, relative to other models

- **Stronger incentives for suppliers to expand access**: Results-based subsidies tied to verified sales drive performance and have lower market distortion than other models.
- **Can target support for marginalized groups**: Subsidies can be adjusted by region or customer profile to better reach low-income or underserved households, improving equity and inclusiveness, though with some increase in complexity.
- **Greater potential for consistency with net zero**: A focus on subsidies linked to fuel purchases has the potential to more directly target emission reductions compared to subsidies for appliances. However, the scale of the emission reductions, and long-term compatibility with net zero will depend on which fuel source is subsidized.

Negatives associated with this model, relative to other models

- **Relies on fuel suppliers being able to access finance:** Ex-post subsidies mean that companies may continue to face challenges in accessing finance, although the expectation of increased profitability may help address this.
- **Subsidy amounts are difficult to predict upfront.** Variable disbursements complicate planning; fixed funding caps help control risk but may lead to some companies missing subsidies to which they expected to be entitled.
- **Fuel price volatility** may undermine the effectiveness or cost-effectiveness of the model and/or reduce predictability for subsidy providers. This is a particular risk for fuels such as LPG priced in hard currency.

Overall assessment
A performance-based subsidy for clean cooking fuels incentivizes sales, which can make it more effective than capital cost subsidies. There is regular data generated by end users which can enable course correction and increases the likelihood of effectiveness. However, the focus on customer numbers means that risks of fuel stacking remain. Targeting marginalized customers is feasible, but stricter qualification criteria increase transaction costs. Environmental benefits depend on the fuel type supported.

[28] PayGas (2024) LinkedIn update

4.2.4. Model F4: Increasing revenues from supplying clean cooking fuels (by increasing customer usage)

How the model works
A supply-side subsidy instrument that enhances a company's revenue per unit of fuel supplied to customers. Verification may be through fuel metering via the cooking device (e.g., an IoT-enabled valve on an LPG cannister) or through an independent verifier (e.g., a field survey).

Examples include
BioMassters issued carbon credits from Rwandan pellet users under the Gold Standard's "Metered & Measured" clean cooking carbon methodology.[29]

Positives associated with this model, relative to other models

- **High potential for effectiveness and cost-effectiveness:** By linking payments to verified fuel use, the model enhances effectiveness relative to other models. Digital approaches can have lower transaction costs than survey-based methods.
- **Ability to mobilize private capital**: By strengthening revenue predictability, the model enhances creditworthiness and can attract commercial investment. It can harness the growing trend for capital flows into fuel providers.[30]
- **Greater potential for consistency with net zero.** A focus on subsidies linked to fuel use has the potential to more directly target emission reductions than subsidies for appliances. However, this will depend on which fuel source is subsidized.

Negatives associated with this model, relative to other models

- **Fuel price volatility**: Most likely to arise for fuels such as LPG priced in hard currency, fuel-price volatility may undermine cost-effectiveness, long-term subsidy sustainability, and/or reduce predictability for subsidy providers.
- **Non-digital usage verification is more error prone**: Survey-based methods of usage verification carry higher risks of inclusion error and, in cases where subsidy is provided through carbon market revenues, can be linked with significant over-crediting.
- **Higher risks of market distortion**: High verification costs and customer-tracking requirements may create barriers to entry for smaller manufacturers, potentially concentrating market advantages among larger, better-resourced players. This risk will be magnified if those without access to the subsidy have a more competitive offering.

Overall assessment
A usage-based fuel subsidy improves effectiveness by requiring ongoing real-time monitoring via metered fuels, with digital technologies having fewer biases than surveys. Fuel price volatility may impact subsidy effectiveness and predictability. Registration and verification costs may exclude smaller or early-stage providers; limiting participation to suppliers with direct consumer relationships. This model enhances fuel suppliers' profitability and attractiveness to investors, with monetizable impacts that could serve as collateral for private financing. It can also support verifiable emission reductions.

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[29] Fair Climate Fund and BioMassters (2022) Clean cooking with pellets in Rwanda
[30] Clean Cooking Alliance (2021) 2021 Industry Snapshot Report

4.2.5. Model F5: Increasing consumer purchasing power for clean cooking fuels

How the model works
A demand side instrument that increases a customer's ability to pay for clean cooking fuel through conditional vouchers, reimbursements for purchases, or through blended finance underwriting microfinance loans.

Examples include
India's Pradhan Mantri Ujjwala Yojana (PMUY) scheme where consumers pay market rates for LPG cylinder refills, with the government reimbursing eligible consumers' bank accounts for up to twelve 14.2kg cylinders each year. See Box 4.

Positives associated with this model, relative to other models

- **Strong potential to reach marginalized groups:** The ability to select recipients makes this model particularly suitable for targeting underserved populations, provided supply chains can meet demand.
- **Limited market distortion:** By allowing consumers to make decisions over how much of the subsidized fuel they will purchase and from which supplier, as well as through restricting the access to the subsidy to certain consumers and up to a certain threshold of consumption, the model reduces market distortion. However, this is offset by a typical need to focus on only certain fuels.
- **Potentially more aligned with net zero**: A focus on the sale of the fuel could boost sales of lower-carbon fuels. This could have emission saving benefits, depending on which fuel source is subsidized.

Negatives associated with this model, relative to other models

- **Challenges for long-term subsidy sustainability:** Frequent, ongoing subsidies to enhance consumer purchasing power for fuels may, over time, erode consumer willingness to pay for clean fuels; entrenching expectations of continued support, increasing lifetime programmatic costs and complicating eventual phase-out.
- **Fuel price volatility** can make it difficult to calibrate the amount of subsidy that the scheme will require (or could render a scheme ineffective or too generous). As for other models affected by fuel price volatility, this is a particular risk for fuels such as LPG priced in hard currency
- **Clean cooking fuel use is not assured:** as the PMUY scheme illustrates, these mechanisms may not necessarily ensure that the subsidized fuel is used.

Overall assessment
Success depends on fuel suppliers finding the market attractive, the subsidy scale being well calibrated to relative fuel prices, and households already owning compatible appliances. Competitive neutrality is feasible within the same fuel type but hard to achieve across fuels. The additional purchasing power may distort (implicit) price perceptions, making households reliant on ongoing support. Unlike appliance subsidies, which are periodic, fuel subsidies involve continuous transactions, making phase-out more difficult.

Box 4 The Pradhan Mantri Ujjwala Yojana (PMUY) scheme has boosted household purchasing power for LPG

Context

The Pradhan Mantri Ujjwala Yojana (PMUY) was launched in 2016 by the Government of India to promote access to clean cooking fuel. The PMUY scheme intends to reduce the use of biomass-based cooking fuels, which contribute to indoor air pollution and poor health. One of the main aspects of PMUY is to increase consumer purchasing power for LPG. The subsidy mechanism involves a Direct Benefit Transfer, where consumers pay market rates for refills, with the government reimbursing eligible consumers' bank accounts for up to twelve 14.2kg cylinders each year. The amount paid back by the government for each cylinder is capped, with the subsidy cap having changed over time.

In 2019, the effective price for LPG was about 45% of the market price (cylinders were subsidized up to ₹550; a subsidy of ~$0.33/kg). The subsidy program was reformed in 2021 to rationalize LPG subsidy leakages and reduce the scheme's fiscal burden. In 2023 the subsidy amount per 14.2kg cylinder for poorer households was enhanced to ₹300.

In addition, the PMUY also provides assistance to households for their initial LPG setup. In May 2016, a subsidy of ₹1,600 (c.$22) was given to women from below-poverty-line households - identified via the 2011 Socio-Economic & Caste Census - to cover LPG connection costs, including the cylinder deposit, regulator fee, and setup charges. Beneficiaries were required to provide an address, bank account, and social security number. A ₹1,500 (c.$20) loan was also offered for a stove and first cylinder refill.

What worked well

Effectiveness in increasing access

More than 500 million people now live in households that have acquired an LPG stove through these efforts, including 100 million LPG connections specifically targeted at poor households. As a result, India has achieved 95% access to clean cooking, marking a significant shift in household energy use.

Subsidies played a crucial role in this transformation. Without them, rural households would have had to spend approximately 7% of their monthly income on LPG — around 40% more than the cost of traditional fuels. The impact of these subsidies goes beyond access: one study estimates that by 2030, the program could avert 330,000 premature deaths and avoid 120–340 megatons of CO_2-equivalent emissions. The health and climate benefits, valued between $72 billion and $223 billion, vastly outweigh the projected subsidy cost of $0.6–4.8 billion over the same period.

Ability to reach marginalized groups

The adjustments to the program's targeting mechanisms were found to have increased the likelihood of eligible below-poverty-line (BPL) households obtaining an LPG connection by 3–4%, improving outreach to those most in need. A distinctive and empowering feature of the scheme is that LPG connections are registered in the names of adult women in the household. This approach enhances women's agency and decision-making power within the home. Furthermore, the program directs reimbursements through direct transfers to the bank accounts of female members in BPL households, reinforcing their financial independence and making women central actors in the transition to clean cooking.

Issues Raised

Limited effectiveness in increasing consumption

Government data show that only about one-quarter of beneficiaries purchased five or more refills annually - indicating regular use - while another quarter did not purchase a single refill in the first year. In Karnataka, PMUY households consumed an average of 2.3 cylinders per year, compared to 4.7 cylinders among general customers. Similarly, below-poverty-line households, despite receiving a 30% subsidy, have been found to consume 7.4 kg less LPG annually than their above-poverty-line counterparts.

Nationwide, nearly 40% of households still rely primarily on biomass for cooking, and more than one-third of LPG recipients continue to 'stack' traditional fuels alongside clean options.

These patterns underscore the gap between access and sustained, near-exclusive use of clean cooking fuels. Research highlights that factors such as ease of access to free biomass, irregular income, and limited rural infrastructure can discourage regular LPG use. Village-level saturation of LPG adoption and longer experience with the fuel are both linked to greater sustained use, implying that the integration of clean cooking policies with broader rural development strategies will help bring success.

Cost effectiveness

An income threshold was introduced to determine eligibility for subsidized LPG. To ensure better targeting and reduce misuse, India introduced several subsidy reforms, including the "Give It Up" campaign, which encouraged wealthier households to voluntarily forgo subsidies, with over 10 million households participating.

Predictability

Subsidy rates have fluctuated over the course of the scheme, with fiscal pressures causing significant reduction in the 2022 budget for subsidy provision.

Sources: Gould et al (2024) In Praise of Cooking Gas Subsidies: Transitional Fuels to Advance Health and Equity. Environmental Research Letters; Mani, S. et al (2020) The Drivers of Sustained Use of Liquified Petroleum Gas in India, Nature Energy; Gill-Wiehl, A. et al (2021) Is Clean Cooking Affordable? A Review, Renewable and Sustainable Energy Reviews; Sharma, A et al (2019) Transition to LPG for Cooking: A Case Study from Two States in India, Energy for Sustainable Development; OPEC Fund (2024) Overcoming Barriers to Clean Cooking; Gill-Wiehl, A. et al (2022) The Need to Prioritize Consumption: A Difference-in-Differences Approach to Analyze the Total Effect of India's below-the-poverty line policies on LPG use, Energy Policy

4.2.6. Model F6: Reducing the price of clean cooking fuels

How the model works
An instrument that reduces the price of clean cooking fuel compared to the unsubsidized market price; increasing a customer's willingness to pay for fuel. This might include, for example, lifeline tariffs, e-cooking tariffs, and utility bill price caps for gas or electricity.

Examples include
The Government of Uganda introduced an eCooking Tariff in 2021, a discounted electricity rate for monthly consumption between 81 and 150 kilowatt-hours.[31]

Positives associated with this model, relative to other models

- **Effective at increasing access:** Directly enhances affordability by making clean fuels more price competitive.
- **Potentially more aligned with net zero**: Subsidies targets on the sale price of fuels can, depending on the design, directly target GHG emission reductions.

Negatives associated with this model, relative to other models

- **Difficulty to transition away from the subsidy**: Frequent purchases reinforce price expectations which can make phase-out difficult (regardless of whether the subsidy source is international or domestic). One option to mitigate this challenge is to move towards customer-funded cross-subsidies, though this is a long-term objective in most low-access contexts.
- **Relatively low predictability**: Variable fuel prices (most likely for LPG or other fuels priced in hard currency), fuel availability issues, and uncertain demand all contribute to a relatively low degree of predictability around this subsidy model, resulting in the subsidy being either too generous or ineffective and/or leading to high amounts of uncertainty about the amount of budget that needs to be allocated to the subsidy.

Overall assessment
This model is more likely to be sustainable in cases where it is possible to target specific consumer groups, as generalized fuel subsidies often benefit higher-income consumers who use more fuel. Even in these cases, there is a risk that repeated fuel purchases may create long-term subsidy dependence, unlike appliance subsidies with infrequent purchases. A self-sustaining model with cross-subsidies could reduce long-term donor or government dependence, although this has not yet been achieved in rural African settings.

[31] Government of Uganda (2021) Electricity Regulatory Authority

4.2.7. Summary of subsidy models for fuels

Table 4 summarizes some of the key advantages and disadvantages associated with the six subsidy models focused on fuel production or use, highlighting those models which score well against the criteria and those that are judged to be less attractive (see also Annex A).

Table 4 Key advantages and disadvantages of different fuel-based subsidy models

Model	*Key attractions*	*Key challenges*
F1: Lowering the capital cost of producing clean cooking fuels	• Can support a pathway to subsidy sustainability • Ability to attract private capital • Potential for alignment with net zero goals	• Limited ability to target marginalized groups • Impact depends on households having appliance access • Risk of market distortion if subsidy is allocated administratively. May distort competition towards fuel suppliers that are best able to navigate subsidy application process
F2: Lowering the operating costs of supplying clean cooking fuels	• Easy to implement with low transaction costs • Historic records show it can be effective • Can be provided on a comprehensive basis • Potential for alignment with net zero goals	• Unclear cost-effectiveness, in part due to inability to target users as well as challenges with fuel price volatility • Risk of lack of predictability for subsidy recipients • Difficulty in moving towards subsidy sustainability
F3: Increasing revenues from supplying clean cooking fuels (by increasing customer numbers)	• Strong incentive for suppliers to expand access • Can target support for marginalized groups • Potential for alignment with net zero goals	• Relies on appliance manufacturer/supplier being able to access finance • Subsidy amounts are difficult to predict upfront • Fuel price volatility may undermine (cost-) effectiveness or reduce predictability for subsidy providers
F4: Increasing revenues from supplying clean cooking fuels (by increasing customer usage	• Potential for high effectiveness/cost effectiveness • Demonstrated ability to mobilize private capital	• Fuel price volatility may undermine (cost-) effectiveness or reduce predictability for subsidy providers

	• Potential for alignment with net zero goals	• Non-digital usage verification can be error prone • High risks of market distortion
F5: Increasing consumer purchasing power for clean cooking fuels	• Strong potential to reach marginalized groups • Limited market distortion • Potential for alignment with net zero goals	• Challenging to achieve long-term subsidy sustainability • Fuel price volatility may undermine (cost-) effectiveness or reduce predictability for subsidy providers • Clean cooking fuel use is not assured
F6: Reducing the price of clean cooking fuels	• Effective at increasing access • Potential for alignment with net zero goals	• Challenging to achieve long-term subsidy sustainability • High risks of market distortion • Fuel price volatility may undermine (cost-) effectiveness or reduce predictability for subsidy providers

Note: (1) Models that are susceptible to challenges around fuel price volatility will be particularly vulnerable when applied to fuels such as LPG priced in hard currency.

(2) Rows shaded in green are subsidy models that perform particularly well; those in red perform less well. Challenges with fuel

4.3. Connecting Clean Cooking Civil Infrastructure to Households

4.3.1. Model I1: Lowering the capital costs for the build out of clean cooking civil infrastructure

How the model works
A supply-side subsidy instrument that reduces the capital costs incurred by a utility company or mini-grid developer when expanding civil infrastructure that can facilitate clean cooking use. This might be in the form of concessional loans, grants, or other form of blended finance.

Examples include
The International Finance Corporation (IFC) provided concessional loans to several private gas utilities in Colombia to extend the national gas network for 35,000 low-income households.[32]

Positives associated with this model, relative to other models

- **Effectiveness in enabling infrastructure scale-up**: Grants and concessional finance can be a (cost-) effective way to help expand capital-intensive infrastructure. The capital intensity of the network expansion means that the subsidy model may be more appropriate in this than for subsidizing activities that have a lower capital intensity.
- **High potential for sustainability:** Often it will only be necessary to provide a one-off subsidy to support increased access, with household customers often willing/able to pay the cost associated with the ongoing supply of electricity or gas. This also means that subsidy predictability is less of a concern.
- **Ability to mobilize private capital:** Depending on the market context, well-designed capital subsidies can help to mobilize private investment.

Negatives associated with this model, relative to other models

- **Limited ability to reach marginalized groups**: While infrastructure expansion can be targeted to underserved areas, rural coverage of infrastructure solutions often remains expensive and difficult to deliver cost-effectively. Even after the network arrives, households may only be gradually able to afford to use the energy it provides.[33]
- **Potential for market distortion:** subsidies may be allocated administratively, favoring certain producers, and political economy considerations may lead to infrastructure solutions being disproportionately supported compared to other solution options.

Overall assessment
As a capital-intensive business, instruments that lower capital costs should be effective at supporting network expansion. However, these models do not ensure ongoing household energy use, and maintenance concerns may arise. Market distortion is not a primary concern, though large infrastructure solutions may be inappropriately favored over alternatives.

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[32] IFC (2006) Natural Gas Distribution for Low Income Families in the Caribbean Coast
[33] See Dinkelman, T. (2025) Understanding the gradual adoption of electricity in rural South Africa, International Growth Centre blog.

4.3.2. Model I3[34]: Increasing revenues from growing connections to clean cooking civil infrastructure

How the model works
A supply-side subsidy instrument that increases the revenue received by a utility company for increasing the number of household connections in a defined market boundary. The instrument incentivizes the utility to serve the market of interest.

Examples include
The Universal Energy Facility's mini-grid program was launched in 2020 and focuses on mini-grid deployment in Benin, Madagascar, Sierra Leone, and the Democratic Republic of Congo. The program is expected to deliver over 20,000 electricity connections, with over 5,000 verified connections to date. The facility disburses grant payments to approved mini-grid projects based on a results-based incentive of $592 per connection.[35]

Positives associated with this model, relative to other models

- **Potential for cost-effectiveness**: When financing conditions are favorable, results-based approaches can deliver capital efficiency and value for money.
- **Ability to mobilize private capital**: Results-based infrastructure subsidies can often attract private investment by offering predictable, performance-linked payments.
- **High potential for sustainability:** It may only be necessary to provide a one-off subsidy to support increased access, if household customers are willing/able to pay the cost associated with the ongoing supply of electricity or gas.

Negatives associated with this model, relative to other models

- **Cost limitations for infrastructure expansion:** The model can target underserved populations in principle, but high infrastructure costs may nonetheless make it difficult to reach rural or dispersed households in a cost-effective way, even with subsidies. There is a risk that this model may be used to prioritize infrastructure solutions even when they are not the most cost effective. Moreover, even after network expansion, households' ability to use the connection may only gradually increase over time.
- **Risk of unpredictability**: Most programs operate within capped funding pools linked to defined connection targets, but this may exclude some utilities that expected to benefit.

Overall assessment
A connection-based subsidy provides strong incentives for utilities to expand infrastructure, with cost-effectiveness depending on financing costs. The instrument does not ensure households will use the connection. Political economy factors may lead to inefficient infrastructure prioritization. Market distortion is possible between infrastructure and alternative solutions. Infrastructure expansion becomes more expensive in less dense areas. Targeting marginalized groups is possible, but rural expansion remains costly.

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[34] Note that an I2 model, focused on reducing the operating costs associated with civil infrastructure, is not assessed due to the low proportion of operating costs in these activities.
[35] Sustainable Energy for All (2025) Universal Energy Facility

4.3.3. Model I4: Increasing revenues from growing household usage of clean cooking civil infrastructure connections

How the model works
A supply-side subsidy instrument, channeled through a utility company, which encourages the use of the connection it provides; thereby increasing lifetime customer value.

Examples include
Supported by the Green Climate Fund, the Nepalese government has, since 2021, been identifying households eligible for purchasing subsidized electric cooking appliances and coordinating household installations.[36]

Positives associated with this model, relative to other models

- **Supportive of pathway to sustainable subsidy transition:** Once the subsidy is provided, and customers experience the benefit of improved energy services, ongoing subsidy may not be needed for those households (or the amount of subsidy needed may be more fiscally sustainable for a domestic government). This is reinforced by the potential for cross-subsidization between different customer groups connected to the grid.
- **Opportunity to leverage consumer financing:** This model may be able to engage local banks to support the take up of the technologies that will increase the use of the connection.

Negatives associated with this model, relative to other models

- **Risk of ineffectiveness in delivering new connections:** The model is likely to be most effective at increasing energy use among households with existing connections. The extent to which it can increase demand by enough to change investment decisions around network expansion is unclear, although in many contexts this may be unlikely.
- **Low ability to reach marginalized groups.** As a result of the difficulty in encouraging new investment, it is unlikely to be effective at extensive services to remote and marginalized customers (although marginalized among those who are connected to the infrastructure can be targeted).

Overall assessment
This model effectively increases energy use among households with existing connections. If customers experience improved energy services, sustained use is likely, reducing future subsidy needs. Long-term sustainability is possible in the form of cross-subsidization from customers served by the utility. Targeting marginalized groups is feasible but adds transaction costs, particularly if cooking equipment needs to be initially purchased for each household by the utility. The model is unlikely to be a feasible model for supporting infrastructure expansion.

[36] Green Climate Fund (2022) Project FP172

4.3.4. Model I5: Increasing consumer purchasing power for clean cooking civil infrastructure connections

How the model works
An instrument that equips households with the financial means to select a local utility provider to connect their household to the technology that best fits their household energy needs (including clean cooking). The most likely means of achieving this would be through giving vouchers to households for them to select the Distributed Energy Service Company that best meets their needs. The selected company installs the new connection and redeems the voucher for compensation

Examples include
Although this option has been discussed on occasion, it has not been possible to find any real-world examples of this model in operation.

Positives associated with this model, relative to other models

- **Provides consumer agency:** By giving households the option to choose between different providers, the model emulates some of the features of a lump-sum transfer and the limited distortion associated with this model.
- **Potential for increasing reach to marginalized groups**: In principle the subsidy (provision of vouchers) can be targeted to support network expansion towards marginalized groups.

Negatives associated with this model, relative to other models

- **Limited relevance in many contexts:** The model has greatest relevance where there are multiple local utilities that the subsidy (voucher) recipient can choose between. However, in many locations, infrastructure provision will exhibit natural monopoly characteristics and the choice available to households will be limited.
- **Cost limitations for infrastructure expansion**: Expanding civil infrastructure to enable clean cooking in lower-density or remote areas increases costs, implying greater future subsidy requirements as coverage grows.

Overall assessment
In principle, this model addresses a key barrier, is simple to operate, and can be targeted based on location and demographics. Moreover, if households value and use the connection, a transition to financial sustainability is possible. However, to realize its full potential, the model relies on the presence of multiple competing providers. This is particularly unlikely in remote areas, potentially limiting the effectiveness of the model in reaching marginalized groups.

4.3.5. Model I6: Reducing the price of connections to clean cooking civil infrastructure

How the model works
An instrument that reduces or eliminates the connection charge faced by a household for gaining access to civil infrastructure for domestic energy.

Examples include
A cap on the price for a connection, with the subsidy provider covering the residual costs of the utility. E.g., The Stima Loan: a Kenya Power initiative to connect low-income families to pay connection fees in instalments made via the utility's billing system. A revolving fund was launched in 2010 and seeded with €6 million by the French Development Agency. The project disbursed loans to 232,015 customers and connected 228,040 new customers.[37]

Positives associated with this model, relative to other models

- **High potential for effectiveness and cost effectiveness:** By addressing the upfront connection cost – often a key barrier to access – the subsidy has a reasonable likelihood of being effective. It is also relatively straightforward to implement and can be targeted by location or household characteristics.
- **High predictability**: The one-off nature of the subsidy per connection improves predictability at this level. Program-wide predictability will depend on the funding source and demonstrated impact.
- **Supports sustainable subsidy transition**: Assuming households value the connection and can afford ongoing energy costs, the subsidy supports a transition to sustainability.

Negatives associated with this model, relative to other models

- **Limited ability to reach marginalized groups**: as with all subsidy schemes focused on civil infrastructure, there may be cases where the high cost of infrastructure solutions makes it ineffective in reaching marginalized, remote consumers. Application in these contexts would distort competition compared to non-infrastructure solutions.
- **Risk of ineffective or poorly targeted subsidy:** The model relies on finding households who are unable to meet the price of the connection but can then meet the ongoing cost of energy purchases. If these cannot be accurately identified, then there is a risk of inclusion or exclusion error.

Overall assessment
This model directly reduces the upfront connection cost, addressing a key affordability barrier, although without guaranteeing continued energy use. It is simple to administer and can be targeted based on household characteristics like location and demographics. However, if connections are underutilized, cost-effectiveness may be compromised. At the household level, the one-time nature of the subsidy ensures predictability, but overall program sustainability depends on funding sources and program-wide cost-effectiveness.

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[37] Modern Energy Cooking Services (2023) Driving Kenya's eCooking and eMobility revolutions with digital utility-enabled financing

4.3.6. Summary of subsidy models for civil infrastructure connections

Table 5 summarizes some of the key advantages and disadvantages associated with the five subsidy models focused on supporting civil infrastructure, highlighting those models which score well against the criteria and those that are judged to be less attractive (see also Annex A).

Table 5 Key advantages and disadvantages of different subsidy models for civil infrastructure

Model	*Key attractions*	*Key challenges*
I1: Lowering the capital costs for the build out of clean cooking civil infrastructure	• Potential to be highly cost effective • Supportive of pathway to sustainable subsidy transition • Can address access to finance constraints and mobilize private capital	• High cost of infrastructure solutions can limit ability to reach marginalized groups • Potential for market distortion if subsidies are allocated administratively or infrastructure solutions inappropriate preferred to alternatives
I3: Increasing revenues from growing connections to clean cooking civil infrastructure	• Potential to be highly cost effective (when financing is available) • Ability to mobilize private capital • Supportive of pathway to sustainable subsidy transition	• High cost of infrastructure solutions can limit the ability to reach marginalized groups (or ability of those groups to pay for energy after the connection has been provided) • Risk of subsidy unpredictability
I4: Increasing revenues from growing household usage of clean cooking civil infrastructure connections	• Supportive of pathway to sustainable subsidy transition • May provide opportunity to leverage consumer financing	• Risk of ineffectiveness in delivering new connections • High cost of infrastructure solutions can limit ability to reach marginalized groups
I5: Increasing consumer purchasing power for clean cooking civil infrastructure connections	• Provides consumer agency • Some potential for targeting marginalized groups	• Limited relevance in many contexts • High cost of infrastructure solutions can limit the ability to reach marginalized groups (or the ability of those groups to pay for energy after the connection has been provided)

I6: Reducing the price of connections to clean cooking civil infrastructure	• High potential for effectiveness and cost-effectiveness • High predictability • Supportive of pathway to sustainable subsidy transition	• High cost of infrastructure solutions can limit ability to reach marginalized groups • Risk of poor targeting

Note: Rows shaded in green are subsidy models that perform particularly well; those in red perform less well

5. Implications for carbon crediting

While this analysis of subsidy models has been undertaken without a particular focus on the source of subsidy, it does also provide some insights relevant to the role of carbon finance as a source of clean cooking subsidy. Four observations stand out.

Carbon finance is a strong subsidy source for clean cooking
A common challenge faced by many clean cooking subsidy models, especially those provided on an ongoing basis, is that they can be very difficult to 'future-proof'. For example, operating cost subsidies provided through the fiscal system can be subject to frequent changes, threatening market stability, as the case study of Kenya's LPG subsidy demonstrate (Box 3). A similar problem is that RBF schemes often find it difficult to manage the uncertainty as to how many results will be delivered: a typical solution is to cap the total subsidy that is available but this may lead to those who expected to receive a subsidy payment missing out, if the cap is reached.

In this context, engagements with the carbon market, if managed well, can be attractive. Depending on how they are structured, fixed-price credit offtake agreements can provide certainty concerning the floor or total revenue that might be available to subsidize clean cooking activities. At the same time, assuming that buyers for any carbon credits can be found, carbon crediting can allow the subsidy payments to scale if results exceed expectations in a way that government-based subsidy models often find challenging.

In 2023, 96% of the investment tracked into clean cooking companies went into those with active or planned access to carbon credits (and 90% of this came from private sources of funding).[38]

Carbon finance aligns well with attractive subsidy models
This study finds that some of the most attractive subsidy models are those that tie subsidy payments to ongoing use of a clean cooking appliance (subsidy model A4) and/or of a clean fuel (subsidy model F4). The continuous incentive for use provided by these models implies a high potential for effectiveness and cost-effectiveness and recent market experiences demonstrate that these subsidy models have a high potential to mobilize private capital.

Carbon crediting is a particularly well-suited source of funding for these subsidy models; indeed, to a large extent, it has been responsible for driving their innovation and adoption. A selection of significant cookstove carbon projects harnessing subsidy models A4 and F4 are shown in Tables 6 and 7.. The tables show that the use of carbon revenues to underpin these subsidy models has widespread geographic application and that, for fuels (model F4), it has been applied to several different fuel types (LPG, pellets, ethanol). It is notable that the size of projects appearing in the top ten for model A4 are an order of magnitude larger than the top ten largest programs under subsidy model F4. However, as discussed below, there have been concerns that some older carbon crediting methodologies may have been associated with systematic over-crediting, especially for those methodologies associated with subsidy model

[38] Clean Cooking Alliance (2025) Annual Report

A4.[39]

Table 6 Examples where carbon credit revenues have underpinned subsidy model A4

Type	Project Developer	Program of Activity (PoA)	Estimated No. Units	Estimated Annual ERs
Improved (biomass) cookstoves (ICS)	BURN Manufacturing (under ECOA Climate)	VCS3884: Installation of high efficiency cookstoves in Sub Saharan Africa by BURN	7,503,102	22,702,023
ICS	Sustainability Investment Promotion and Development	VCS2925: Grouped Projects for Cambodia Improved Cookstove	800,000	7,172,213
ICS	ETG Climate Solutions	GS13188: ETG Live Better Improved Cookstove	1,000,000	5,600,000
ICS	Removall	VCS2960: Changing Lives via Improved Cooking Initiative - India	1,500,000	3,972,774
ICS	Econexus	VCS3954: Sustainable Charcoal and Improved Cookstove Initiative in India	550,000	3,206,158
ICS	Infinite Environmental Solutions	GS12201: Improved Cookstoves for Sustainable Rural Development in India	100,000	2,802,970
ICS	Value Network Venture Advisory	GS11570: Improved cookstove program in Bangladesh supported by the Republic of Korea	Not stated	2,708,779
e-Cooking	ATEC	GS11815: Electric Cooking Program by ATEC	5,798	53,263

[39] Gill-Wiehl, A., Kammen, D.M. & Haya, B.K. Pervasive over-crediting from cookstove offset methodologies. Nature Sustainability, 191–202 (2024).

Ethanol	Green Development AS	GS11574: PoA for the Reduction of emissions from non-renewable fuel from cooking at household level	3,000,000	5,000,000

Source for Table 6 and Table 7: Voluntary Registry Offsets Database v2025-02, Berkeley Carbon Trading Project, University of California, Berkeley. Analysis: Technology assessed by authors, based on voluntary carbon market projects that are registered, listed or certified

Table 7 Examples where carbon credit revenues have underpinned subsidy model F4

Type	Project Developer	Program of Activity	Estimated No. Units	Estimated Annual ERs
Ethanol	EcoLinks	GS12940: PoA Ecolinks Ghana Bioethanol Cooking Program	700,000	659,295
LPG	Rashal Energies	GS12591: Clean cooking: Fuel switching to avoid deforestation	100,000	587,387
LPG	Bidhaa Sasa	GS12577: Clean Cooking Programme by Bidhaa Sasa	Not stated	420,000
Ethanol	KOKO Networks	GS10884: KOKO Kenya - Ethanol Cookstoves Program	39,568	156,063
LPG	PayGo Energy	GS11725: Deployment of LPG Cookstoves in Kenya POA	360,000	119,281
LPG	Climate Impact Partners	GS11330: Circle Gas LPG Smart Meter Program	1,928,113	80,000
LPG	Envirofit International	GS12888: Commercial LPG Stoves for Ghana	Not stated	70,000
Ethanol	Project Gaia	GS4121: Project Gaia Cook Stove Programme of Activities	640,000	50,000
LPG	Entrepreneurs du Monde	GS10712: MIVO Energie - Enabling LPG access for cooking in Togo	45,500	28,127
Pellets	MyClimate Foundation	GS1062: Energy-efficient biomass cookstoves and biomass fuel pellets for communal kitchens in India	7,500	27,671
Pellets	FairClimate Fund (with BioMassters)	GS11506: Fair Climate Programme for Advanced Biomass Cooking Solutions	10,800	8,436

Source: As for Table 6.

Market efforts to ensure carbon credits deliver high integrity will strengthen the power of subsidy models that can be tied to the delivery of high-quality emission reductions

Carbon crediting has been subject to significant scrutiny in recent years with concerns often expressed (and research sometimes identifying) that some crediting methodologies used historically may have led to systematic over-crediting. This includes methodologies that have been used to support clean cooking adoption.[40] These challenges are now being addressed through, for example, the development and application of the Core Carbon Principles of the Integrity Council for the Voluntary Carbon Market, and the Principles for Responsible Carbon Finance in Clean Cooking of the Clean Cooking Alliance.

These developments are likely to lead to a clear price distinction between credits generated using methodologies, and harnessing technologies, that can demonstrate they are of high integrity and those that cannot. In turn, this will strengthen the effectiveness of subsidy models that use high-integrity carbon credits as their subsidy source. Conversely, subsidy models looking to leverage crediting methodologies and technologies that do not meet these integrity standards (e.g., those tied to the distribution of appliances using survey-based methods to assess usage), may eventually find it more difficult to use carbon markets as their subsidy source.

The long-term sustainability of clean cooking carbon projects also relies on refinements to carbon crediting methodologies to address the other challenges that have been identified as potentially undermining the integrity of carbon credits, such as determining the fraction of non-renewable biomass, and the adoption of more rigorous methods for determining baseline fuel use. Work continues in this area, with VERRA's VM0050 Energy Efficiency and Fuel-Switch Measures in Cookstoves methodology replacing their older cookstove methodologies (VMR0006, v1.2 and VMR0011, v1.0).[41] Since 2022, the Clean Cooking and Climate Consortium, led by the Clean Cooking Alliance, has developed a new methodology called CLEAR for crediting emissions reductions from cookstove projects. The CLEAR methodology incorporates the latest science on key parameters, and mandates direct in-home measurement of fuel consumption.[42]

Further action is required to unlock the full potential of high-integrity carbon crediting as a subsidy source

Two actions stand out. First, at present, securing financing from local banks based on a carbon offtake agreement remains uncommon. This is because banks frequently lack comprehensive data to assess the risks and returns associated with these projects. They may also lack information about effective market entry strategies, growth-oriented business models, risk management, and prudent portfolio construction practices.[43] A transition to market conditions such that a carbon offtake agreement had the same ability as a power-purchase agreement to secure debt financing would significantly enhance the potential for carbon revenue to play an important and highly cost effective role as a subsidy source for clean cooking. Delivering this change will require ongoing dialogue between the sector and the investor community and suggests that there could be a critical role for private-sector focused IFIs in providing proof points that would provide assurance to others.

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[40] Gill-Wiehl, A., Kammen, D.M. & Haya, B.K. Pervasive over-crediting from cookstove offset methodologies. Nature Sustainability 7, 191–202 (2024)
[41] VERRA (2024) VM0050 Energy Efficiency and Fuel-Switch Measures in Cookstoves, v1.0
[42] Clean Cooking Alliance (2024) CLEAR Methodology
[43] African Guarantee Fund (2023) AGF,CCA challenge banking industry to invest in carbon markets

Second, as discussed in section 4, there is a risk that only well-resourced and highly capacitated, predominantly international, companies can make use of carbon credits as a clean cooking subsidy source. Overcoming this challenge requires ongoing efforts to keep crediting methodologies and protocols as simple as possible (while meeting integrity thresholds), greater use of programmatic crediting approaches (to keep transaction costs low), and more capacity building support from development partners (to increase financier engagement from across the capital stack).

Annex 1: Detailed assessment of different subsidy models to promote clean cooking

Clean Cooking Appliances

Model A1: Lowering the capital costs of manufacturing clean cooking appliances

Ideal Market Context

- Where scale-up towards mass-market adoption is possible
- Where access to finance for the manufacturer is a particular challenge

Frequency of Use
Very common (>50 examples)

Scorecard

Effective-ness	Cost effective-ness	Predict-ability	Market Distortion	Support transition to subsidy sustainability	Ability to mobilize private capital	Ability to reach marginalized groups	Consistent with net zero

Effectiveness
The primary barrier addressed by this instrument is the affordability of clean cooking appliances – for example, a 2022 study in Kenya found that despite $237 in potential fuel savings, households were willing to pay only $12 for an improved biomass stove.[44] Instruments that enable manufacturers to achieve economies of scale can help align retail prices with consumer willingness to pay. For example, some Kenyan manufacturers are now producing approximately 600,000 units per month, a scale made possible by concessional loans used to expand production facilities.[45] However, the effect of such instruments on actual appliance use remains uncertain, as usage is not typically tracked. Subsidies may indirectly support usage by enabling manufacturers to offer better warranties or reduce maintenance issues through improved input quality.

Cost Effectiveness
While capital subsidies can reduce fuel appliance costs, they offer limited scope for targeting those most in need. The effectiveness of this instrument depends on the extent to which the subsidy reduces prices. If uptake remains low, cost-effectiveness diminishes. Given that this instrument will be influencing transactions of large value, there will need to be significant due diligence before projects are sanctioned, suggesting high transaction costs, although with

[44] Berkouwer & Dean (2022) Credit, Attention, and Externalities in the Adoption of Energy Efficient Technologies by Low-Income Households, American Economic Review
[45] FSD Africa (2024) BURN Issues $10m Green Bond to Support Clean Cooking In Sub-Saharan Africa

limited direct engagement with end users thereafter.

Predictability

The one-off nature of the investment limits concerns around long-term predictability. If capital is used to expand manufacturing capacity and improve efficiency, the resulting benefits may be durable. However, there is a risk that increased revenues may not be sufficient to cover both capital expenditures and higher operational costs. This risk is mitigated as the size of the subsidy grows. At the programmatic level, the number and size of investments will depend on funding availability. If cost-effectiveness cannot be clearly demonstrated, continued support may be at risk.

Market Distortion

This will depend largely on instrument design: Competitive calls for proposals can attract diverse manufacturers and technologies, but such mechanisms often favor larger firms with better resources, networks, and risk profiles. To help manage transaction costs, the scheme can introduce eligibility criteria, but this may further increase the risk of market distortion. There is also a risk that the subsidy ends up being allocated at firms that can already commercially manufacture the appliance.

Support Transition to Subsidy Sustainability

Capital cost subsidies that support scale-up can contribute to long-term cost reductions that can facilitate a transition from international to domestically sourced subsidies, and eventual subsidy reduction and removal. Several international manufacturers are progressing on this transition. For instance, SSM in China has a production capacity of 150 million stoves annually, while BURN Manufacturing in Kenya and Nigeria can produce 7.2 million units per year.[46]

Ability to Mobilize Private Capital

To crowd in private capital, the instrument must improve manufacturers' unit economics through higher sales and scale efficiencies. Success also depends on external factors such as product appeal, after-sales service, consumer affordability, and competitive alternatives. Nonetheless, the instrument can provide positive signals to investors and enhance the manufacturer's visibility and creditworthiness. For example, Acumen's equity investments in stove manufacturers delivered a multiple on invested capital three times higher than its portfolio average.[47]

Ability to Reach Marginalized Groups

Targeting the subsidy solely to low-income users is not feasible without imposing stringent and potentially unworkable restrictions on manufacturers' business models.

Consistent with Net Zero

Depends on the appliance supported. Because the subsidy focuses on production rather than use, it is disconnected from the activity that drives emissions reductions. As manufacturers scale up, they may face increasing pressure to reduce their own emissions.

[46] SSM website (accessed in April 2025)
[47] Acumen (2023) Recipe for Success, Lessons from Acumen's Cookstove Investments

Model A2: Lowering the operating costs of manufacturing clean cooking appliances

Ideal Market Context

- Where the market is nascent and broad market stimulation is the priority (over precise targeting of specific consumer groups)
- Where supporting local manufacturing is a stated policy objective

Frequency of Use

Less common (≤10 examples)

Scorecard

Effective-ness	Cost effective-ness	Predict-ability	Market Distortion	Support transition to subsidy sustainability	Ability to mobilize private capital	Ability to reach marginalized groups	Consistent with net zero

Effectiveness

This instrument faces the same limitations as capital cost subsidies: reducing appliance prices does not ensure usage. While the subsidy value tends to scale with fuel volume, typical implementation through tax reductions is a blunt tool that cannot be easily tailored to specific market conditions.

Cost Effectiveness

Targeting is not feasible, and while transaction costs are generally modest, the opportunity cost of deploying the instrument may be unclear. Verifying the extent to which subsidies are passed on to consumers is difficult and may involve high administrative effort.

Predictability

Sustainability is uncertain, particularly when delivered via tax incentives subject to annual budget cycles, which may limit long-term commitment.

Market Distortion

The instrument can, in principle, be applied without favoring individual suppliers, but may incentivize business models designed to maximize subsidy capture. It may also distort intra-technology competition; for instance, domestic manufacturers may benefit from exemptions not available to importers. If provided asymmetrically, operating cost subsidies will tend to distort competitive market dynamics more than capital subsidies.

Support Transition to Subsidy Sustainability

The instrument will tend to be implemented by national governments. However, models that support operating cost reductions may have a greater risk of subsidy dependency than models that look to address the upfront capital costs, where the potential for realizing economies of scale are greater.

Ability to Mobilize Private Capital

While increased profitability may improve access to financing, the lack of direct financial sector engagement and limited visibility into revenue growth may reduce attractiveness to investors, especially if there are behavioral biases that favor top-line growth over cost savings.

Ability to Reach Marginalized Groups
Effective targeting is not possible without placing restrictive conditions on eligibility or interfering with manufacturers' business models.

Consistent with Net Zero
Climate impact depends on which type of appliances benefit. Since the instrument targets appliances rather than their operation, it is removed from direct emissions outcomes.

Model A3: Increasing revenues from supplying clean cooking appliances by increasing customer numbers

Ideal Market Context

- When looking to strengthen incentives for producers to target under-served markets
- Where manufacturers have reasonable access to finance
- Where there can be confidence that there is strong adoption of clean cooking appliances

Frequency of Use

Common (>10 examples)

Scorecard

Effective-ness	Cost effective-ness	Predict-ability	Market Distortion	Support transition to subsidy sustainability	Ability to mobilize private capital	Ability to reach marginalized groups	Consistent with net zero

Effectiveness

Results-based subsidies provide stronger incentives for appliance distribution than cost-based models and enable performance monitoring through verified sales. However, as the subsidy ends at the point of sale, it does not ensure continued fuel use, especially given the diversity of household cooking fuels that are often used.[48] Additional revenue may enable suppliers to strengthen customer support, potentially improving sustained adoption.

Cost Effectiveness

By linking payment to sales, the model encourages efficiency and performance, improving cost-effectiveness. Geographic or demographic targeting is feasible, but this form of more granular targeting increase transaction costs.

Predictability

The total subsidy disbursed may be uncertain, posing challenges for medium-term planning. Capping disbursements through fixed funding pools helps manage risk but may lead to some companies missing subsidies to which they expected to be entitled.

Market Distortion

It depends on the design of the scheme. However, to be confident that the scale of the subsidy provision is appropriate, there may be a preference for focusing on companies offering comparable appliances using similar business models. Within this group of suppliers, market distortion is limited if subsidies are competitively allocated. A further advantage of this model which limits market distortion is that the subsidy will only be paid when a customer has chosen to purchase an appliance, i.e., it relies on a market signal.

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[48] Perros & Puzzolo (2025) Understanding drivers of fuel stacking among pay-as-you-go LPG customers in Nairobi, Kenya, World Development Perspectives, Volume 35

Support Transition to Subsidy Sustainability
The model can support scale and cost reduction but carries a risk of supplier dependence if not time-limited or phased out strategically.

Ability to Mobilize Private Capital
Improved profitability can enhance access to finance, though the model does not directly engage with the financial sector. Demonstrated market traction may help attract future investment.

Ability to Reach Marginalized Groups
Subsidies can be tailored by customer type or geography to reach underserved populations, though more targeted approaches raise transaction costs.

Consistent with Net Zero
A focus on the sale of the appliance, rather than on the use of appliance means that the instrument is distant from the activity that is responsible for emissions/emission reductions.

Model A4: Increasing revenues from supplying clean cooking appliances by increasing customer usage

Ideal Market Context

- When looking to strengthen incentives for producers to target under-served markets
- Where - without the subsidy - there is a concern that ongoing appliance usage cannot be assured
- Where costs from traditional monitoring efforts are prohibitive but novel monitoring efforts are feasible

Frequency of Use

Very common (>50 examples)

Scorecard

Effective-ness	Cost effective-ness	Predict-ability	Market Distortion	Support transition to subsidy sustainability	Ability to mobilize private capital	Ability to reach marginalized groups	Consistent with net zero

Effectiveness

By linking subsidy disbursement to verified appliance usage, this model increases effectiveness compared to instruments tied only to distribution. The resulting data enables ongoing monitoring and adaptive program design. Models that use digital verification might not only prove usage, but be used to drive increased usage, as shown in the ATEC case study (Box 2).

Cost Effectiveness

Incentivizing continued use improves overall cost-effectiveness and allows for targeting specific user groups. Transaction costs depend on the monitoring approach, though metered technologies like e-cookers significantly reduce this burden by enabling real-time, appliance-level data collection, as part of the device, as can be seen in the ATEC case study.

Predictability

As with other performance-based models, the total subsidy obligation is not known in advance, which may pose challenges for planning, depending on the source of the subsidy. Projects that can guarantee a minimum level of usage will be less susceptible to concerns around predictability, as shown overleaf by ATEC's confidence in overcoming minimum usage levels.

Market Distortion

High verification and customer-tracking requirements may limit participation by smaller manufacturers and exclude business models not equipped to monitor household-level usage, potentially concentrating market benefits among larger, or more established, firms. These risks will be magnified if those not able to access the subsidy would otherwise have a relatively more competitive offering than those companies that are able to access the subsidy. This could become less of an issue if technology development continues to lower the cost of acquiring the necessary technology and/or if the model is deployed programmatically and this delivers economies of scale in accessing and using the technology.

Support Transition to Subsidy Sustainability

The instrument supports scale-up and cost reduction – and hence a shift from international to domestic funding of the subsidy, before its eventual reduction – but may also lead to subsidy dependence if firms rely on this model to sustain operations or fund growth.

Ability to Mobilize Private Capital
By strengthening revenue predictability and demonstrating monetizable impact, the model enhances creditworthiness and can attract commercial investment.

Ability to Reach Marginalized Groups
The model can be designed to promote adoption among marginalized households, enabling access to, and promoting use of, clean cooking technologies for populations otherwise excluded from the market. However, when customers are required to access the appliance by a multi-year lease-to-own model, as with the ATEC case study, the accessibility of the solution to the poorest is diminished.

Consistent with Net Zero
Although in principle this depends on the clean cooking appliances supported, it has tended to be developed using carbon revenues, targeting low-emission technologies and paired to appropriate methodologies. In this context, the model supports verifiable and sustained emissions reductions, aligning well with emission reduction objectives. Whether it is net-zero consistent will depend on the clean cooking solution being supported. As per the ATEC case study, the methodologies used with these models are viewed by ratings agencies as tending to score higher on integrity assessments than other carbon crediting methodologies used in the cookstoves sector.

Model A5: Increasing consumer purchasing power for clean cooking appliances

Ideal Market Context

- Where ability to pay is very low and where there is good accessibility to improved appliances
- Where there are no plans to bring civil infrastructure to the market

Frequency of Use

Common (> 10 examples)

Scorecard

Effective-ness	Cost effective-ness	Predict-ability	Market Distortion	Support transition to subsidy sustainability	Ability to mobilize private capital	Ability to reach marginalized groups	Consistent with net zero

Effectiveness

Addresses consumer affordability, a key adoption barrier, but does not guarantee sustained use post-purchase. It can support market development if it increases manufacturer interest and demand visibility.

Cost Effectiveness

Consumer-targeted subsidies allow for better targeting of those most in need, though delivery mechanisms vary in their risk of inclusion errors and transaction costs. Lack of assurance on long-term use may reduce cost-effectiveness.

Predictability

Upfront budgeting for vouchers or underwritten loans enhances short-term predictability. In the medium term, sustainability depends on funding sources and demonstrable value for money. Macroeconomic pressures and fiscal concerns can trigger reform of generalized demand side subsidies, including those delivered through increases in purchasing power.[49]

Market Distortion

By not directly influencing prices, the model shares some similarities with a lump-sum transfer and within a given technology class, the instrument can maintain competitive neutrality across suppliers. However, neutrality across technologies with differing cost structures - such as biodigesters versus improved stoves - may be harder to maintain.

Support Transition to Subsidy Sustainability

If users experience tangible benefits - such as reduced smoke and fuel savings - they may be more willing to invest in future appliances without subsidy. However, exposure to mechanisms

[49] ESMAP (2024) From Ambition to Action: Practical Insights on Energy Subsidy Reforms. Energy Subsidy Reform in Action Series

that bolster purchasing power may reduce long-term willingness to pay.[50]

Ability to Mobilize Private Capital
End-user subsidies can support consumer financing mechanisms and expand market size, but do not directly address supplier-level financing constraints or increase manufacturer attractiveness to investors.

Ability to Reach Marginalized Groups
In principle, the choice of who to provide vouchers makes it easy to target marginalized groups, so long as supply to those users is assured. This helps explain their common use in humanitarian settings. Nonetheless, in many cases it can still be challenging to identify and implement the appropriate criteria for who should receive support. For example, strict income-based eligibility can still result in exclusion errors, if, for example, people working in informal jobs lack documentation to prove income eligibility.[51]

Consistent with Net Zero
Climate alignment depends on the appliances supported. As the subsidy targets appliance acquisition rather than use, it is only indirectly related to emissions outcomes and long-term clean cooking adoption.

[50] World Bank: End User Subsidies for Energy Access: A Toolkit (2024)
[51] ESMAP: From Ambition to Action: Practical Insights on Energy Subsidy Reforms. Energy Subsidy Reform in Action Series (2024)

Model A6: Reduce the price of clean cooking appliances

Ideal Market Context

- Where ability to pay is very low and where there is good accessibility to improved appliances
- Where there are no plans to bring civil infrastructure to the market

Frequency of Use
Common (> 10 examples)

Scorecard

Effective-ness	Cost effective-ness	Predict-ability	Market Distortion	Support transition to subsidy sustainability	Ability to mobilize private capital	Ability to reach marginalized groups	Consistent with net zero

Effectiveness
Addresses appliance affordability - a key barrier - but does not guarantee continued use. Effectiveness depends on whether the subsidized appliance is adopted and consistently used by households.

Cost Effectiveness
Difficulties in targeting capped prices to specific households within a particular region increases inclusion error (although this depends on the setting). Unused appliances, with no direct data loop offering feedback on usage undermines cost-effectiveness. Challenges with accurately estimating supply costs heightens the risk of overcompensation.

Predictability
Subsidy outlay is often difficult to forecast, especially if uptake exceeds expectations. Sustained implementation depends on a reliable funding source and careful cost control.

Market Distortion
As it is likely to reduce the prices paid by most or all consumers, it can be highly distortive at the macroeconomic level. Moreover, to simplify implementation, the subsidy may be limited to certain appliance classes, distorting competition across technology types.

Support Transition to Subsidy Sustainability
Users who experience meaningful benefits may invest in future appliances without subsidy, but persistent exposure to subsidized prices may diminish long-term willingness to pay and reinforce subsidy expectations (although the less frequent purchase of appliances than fuels somewhat mitigates this impact).[52]

[52] Lighting Global/ESMAP (2024) Designing Responsible End-User Subsidies for Energy Access

Ability to Mobilize Private Capital
Private finance depends on confidence in subsidy continuity. If perceived as stable, the instrument can boost appliance sales and improve financing conditions, though it does not directly address other investment risks.

Ability to Reach Marginalized Groups
Geographic targeting may be feasible, but more precise targeting is likely to significantly increase program complexity and administrative costs

Consistent with Net Zero
This will depend on which types of appliance manufacturers are eligible for the scheme. Focus on the appliance rather than operation means subsidy is distant from the usage behaviors that are responsible for driving emission reductions.

Clean Cooking Fuels

Model F1: Lowering capital costs of producing clean cooking fuels

Ideal Market Context

- Where high capital expenditure can significantly shorten local fuel value chains
- Where the cost of fuel is a key determinant of overall clean cooking affordability
- Where clean cooking fuels can be cost competitive with dirtier fuels, such as charcoal

Frequency of Use
Common (>10 examples)

Scorecard

Effective-ness	Cost effective-ness	Predict-ability	Market Distortion	Support transition to subsidy sustainability	Ability to mobilize private capital	Ability to reach marginalized groups	Consistent with net zero

Effectiveness
Many clean cooking fuel supply chains are capital-intensive. This instrument helps reduce the costs of fuel provision, thereby improving access. However, household uptake depends on concurrent access to compatible appliances. The relative cost of appliances versus ongoing fuel costs varies widely by technology, country, and business model. This instrument can be particularly relevant for establishing local biomass fuel manufacturing facilities, which can significantly reduce prices by shortening supply chains and reducing reliance on imports.[53]

Cost Effectiveness
While capital subsidies can reduce fuel supply costs, they offer limited scope for targeting those most in need. Moreover, to have any impact on adoption, the instrument will need to be designed in a way to ensure that target households can also gain access to the necessary cooking appliance. Without this, uptake will not be possible, and the instrument is unlikely to be cost effective. Given that this instrument will be influencing transactions of large value, there will need to be significant due diligence before projects are sanctioned, suggesting a high transaction cost, although with limited direct engagement with end users thereafter.

Predictability
The predictability of support is less of a concern due to the one-off nature of investments. If capital is used to build local production or distribution capacity, the intervention is likely to have a high degree of permanence. However, projects reliant on international fuel imports remain vulnerable to global price fluctuations and supply chain disruptions. Sustainability may also be at risk if increased revenues are insufficient to cover remaining loan obligations or operational costs, though this risk decreases as the subsidy increases. At a programmatic level, the number and scale of projects will depend on available funding. If cost-effectiveness cannot

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[53] CCA and Greencroft Economics (2024) Unit Economics Toolkit and Report

be demonstrated, long-term support may be jeopardized.

Market Distortion
This will depend largely on instrument design: competitive calls for proposals can attract diverse manufacturers and technologies, but may favor larger firms with better resources, networks, and risk profiles. To manage transaction costs, the scheme can introduce eligibility criteria, but this may further increase the risk of market distortion.

Support Transition to Subsidy Sustainability
Capital cost subsidies that support scale-up can contribute to long-term cost reductions that can facilitate a transition from international to domestically sourced subsidies, and eventual subsidy reduction and removal.

Ability to Mobilize Private Capital
Capital subsidies that enable scale-up and iterative learning can help build investor confidence. By 2023, both KOKO Networks and Circle Gas had secured deals with local and international banks, indicating increased market readiness for commercial financing.[54] [55]

Ability to Reach Marginalized Groups
Targeting the subsidy solely to low-income users is not feasible without imposing stringent and potentially unworkable restrictions on manufacturers' business models.

Consistent with Net Zero
Transitions away from charcoal-based cooking systems yield clear climate benefits, though the extent varies by fuel type. Only some clean fuels are fully aligned with net-zero pathways. In the case of electric cooking, climate gains depend on grid emissions intensity and the trajectory of energy sector decarbonization. However, the specific focus on fuels aligns the subsidy more closely with the source of emissions than appliance-based subsidies.

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[54] RMB (2023) RMB invests in leading climate tech company Koko as part of carbon business growth
[55] Padoan (2023) Circle Gas turnover soars but expansive ambitions yet to materialise

Model F2: Lowering the operating costs of supplying clean cooking fuels

Ideal Market Context

- Where households already own or can easily acquire compatible appliances
- Where the cost of fuel is a key determinant of overall clean cooking affordability

Frequency of Use

Common (>10 examples)

Scorecard

Effective-ness	Cost effective-ness	Predict-ability	Market Distortion	Support transition to subsidy sustainability	Ability to mobilize private capital	Ability to reach marginalized groups	Consistent with net zero

Effectiveness

An operating cost subsidy may be expected to have a more direct impact on the price of clean cooking fuels than a subsidy focused on the capital cost of supplying fuels. The case study in Kenya demonstrates how this model can be effective in supporting household adoption. However, the model still suffers from the challenge that it will only be effective if consumers have an appliance that can use clean cooking fuels. Like lowering capital costs, the absolute subsidy value will scale with the size of the fuel supplier's volumes. However, the typical means of implementation, tax reductions, are quite blunt instruments that may be difficult to calibrate to market needs, especially when fuel prices are volatile (most likely in cases where fuel prices are denominated in hard currency).

Cost Effectiveness

Targeting is difficult, and while transaction costs are modest, the opportunity cost of deploying the instrument may be unclear. Verifying the extent to which subsidies are passed on to consumers is difficult and may involve high administrative effort.

Predictability

Sustainability is uncertain, particularly when delivered via tax incentives subject to annual budget cycles, which may limit long-term commitment. In the Kenyan LPG VAT example (see Box 3) five changes to the applicable VAT rate were made over a 12-year window, highlighting the low predictability that can be associated with this instrument.

Market Distortion

In principle this instrument should score well for market distortion as the typical mode is for all suppliers of a given fuel technology to benefit equally from the instrument. However, there is likely to be significant distortion at the inter-technology level, depending on which technologies benefit from the instrument and which do not. Policy incoherence can create undesirable incentives for dirtier fuels relative to cleaner fuels, as shown by the Kenyan LPG and kerosene VAT rates in the case study. If applied to some technologies and not others, subsidizing operating costs through these instruments is considered more distortive of competition than subsidizing capital costs (assuming prices are set at the margin).

Support Transition to Subsidy Sustainability
The instrument will tend to be implemented by national governments. However, models that support operating cost reductions may have a greater risk of subsidy dependency than models that look to address the upfront capital costs, where the potential for realizing economies of scale are greater.

Ability to Mobilize Private Capital
While increased profitability may improve access to financing, the lack of direct financial sector engagement and limited visibility into revenue growth may reduce attractiveness to investors, especially if there are behavioral biases that favor top-line growth over cost savings.

Ability to Reach Marginalized Groups
Effective targeting is not possible without placing restrictive conditions on eligibility or interfering with manufacturers' business models. However, while direct targeting may be challenging, low-income households are likely to be sensitive to price changes following cost reductions. For example, the evidence of user behaviors following increases to Kenyan LPG VAT duties suggested that increases in VAT for LPG disproportionately impacted poorer households (implying a reduction in VAT duties would disproportionately benefit these households).

Consistent with Net Zero
Transitions away from charcoal-based cooking systems yield clear climate benefits, though the extent varies by fuel type. Only some clean fuels are fully aligned with net-zero pathways. However, the specific focus on fuels aligns the subsidy more closely with the source of emissions. As noted in the Kenyan case study, VAT exemptions for LPG can be associated with significant net reduction in GHG emissions.

Model F3: Increasing revenues from supplying clean cooking fuels by increasing customer numbers

Ideal Market Context

- When looking to strengthen incentives for suppliers to target under-served markets
- Where suppliers have good access to finance
- Where there can be confidence that there is strong adoption of the subsidized fuel
- Where households have the right appliance, or it is easy to obtain

Frequency of Use

Uncommon (<10 examples)

Scorecard

Effective-ness	Cost effective-ness	Predict-ability	Market Distortion	Support transition to subsidy sustainability	Ability to mobilize private capital	Ability to reach marginalized groups	Consistent with net zero

Effectiveness

Results-based subsidies tied to verified fuel sales provide stronger incentives for distribution than capital subsidies and create feedback loops that support adaptive design. However, as the subsidy ends at the point of sale, it does not ensure continued fuel use, especially given the diversity of household cooking fuels that are often used.[56] Additional revenue may enable suppliers to strengthen customer support, potentially improving sustained adoption. This model helps to make new fuels accessible to customers that they would otherwise not be able to use effectively in their existing cooking appliances, e.g., pellets, or ethanol.

Cost Effectiveness

Linking subsidies to sales improves efficiency relative to capital-based models. Targeting by geography or customer type is feasible, but deeper household-level targeting increases administrative complexity and transaction costs.

Predictability

The total subsidy disbursed may be uncertain, posing challenges for medium-term planning. Capping disbursements through fixed funding pools helps manage risk but may lead to some companies missing subsidies to which they expected to be entitled.

Market Distortion

It depends on the design of the scheme. However, to be confident that the scale of the subsidy provision is appropriate, there may be a preference for focusing on companies offering one specific fuel, potentially distorting inter fuel competition. Within this group of suppliers,

[56] Perros & Puzzolo (2025) Understanding drivers of fuel stacking among pay-as-you-go LPG customers in Nairobi, Kenya, World Development Perspectives, Volume 35

market distortion is limited if subsidies are competitively allocated. A further advantage of this model which limits market distortion is that the subsidy will only be paid when a customer has chosen to purchase the fuel, i.e., the mechanism retains a market signal.

Support Transition to Subsidy Sustainability
The model can support scale and cost reduction but carries a risk of supplier dependence if not time-limited or phased out strategically. This risk is greatest in untested markets or where customer service or supply logistics are weak.

Ability to Mobilize Private Capital
Improved profitability can enhance access to finance, though the model does not directly engage with the financial sector. Demonstrated market traction may help attract future investment.

Ability to Reach Marginalized Groups
Subsidies can be tailored by customer type or geography to reach underserved populations, though more targeted approaches raise transaction costs.

Consistent with Net Zero
It depends on which fuel source is subsidized. In principle a subsidy targeted at boosting sales of a particular fuel could target lower-carbon fuels. The GHG emission benefits will also depend on the baseline fuels being used, which could be part of the customer qualification screening required by the instrument.

Model F4: Increasing revenues from supplying clean cooking fuels by increasing customer usage

Ideal Market Context

- Where metered fuel distribution is already in place or can be easily rolled out
- Where there is high availability of quality fuel
- When looking to strengthen incentives for producers to target under-served markets

Frequency of Use

Common (> 10 examples)

Scorecard

Effective-ness	Cost effective-ness	Predictability	Market Distortion	Support transition to subsidy sustainability	Ability to mobilize private capital	Ability to reach marginalized groups	Consistent with net zero

Effectiveness

By linking payments to verified fuel use, the instrument enhances effectiveness relative to models based solely on fuel sales. Real-time usage data enables course correction. However, sustained effectiveness may be undermined by fuel price volatility, which is a particular risk for fuels such as LPG priced in hard currency.

Cost Effectiveness

Incentivizing continued fuel use can enhance cost-effectiveness, particularly with metered fuels, which allow unobtrusive, real-time monitoring. The transaction costs of this modality are typically lower and data quality higher than survey-based methods.[57,58] However, fuel price fluctuations may reduce effectiveness, and hence cost effectiveness.

Predictability

Subsidy costs are demand-driven and tied to verified usage data, making investment in robust monitoring systems essential. As with other performance-based models, the total subsidy obligation is not known in advance, which may pose challenges for planning, depending on the source of the subsidy. Predictability might be challenged if the viability of the fuel supplier is negatively impacted by volatile fuel prices.

Market Distortion

Although open in principle to all clean fuel providers, the administrative and verification burdens may exclude smaller or early-stage firms. The model requires customer-level tracking, limiting participation for business models without direct end-user engagement. This could become less of an issue if technology development continues to lower the cost of acquiring the necessary technology and/or if the model is deployed programmatically and this delivers

[57] Clean Cooking Alliance (2025) Buyer's Guide to High-Quality Cookstove Carbon Credits
[58] Simons, A. et al (2017) Using unobtrusive sensors to measure and minimize Hawthorne effects: Evidence from cookstoves, Journal of Environmental Economics and Management

economies of scale in accessing and using the technology.

Support Transition to Subsidy Sustainability
The model should support scale and cost reductions but carries a high risk of long-term dependence, particularly where business models are not yet mature, or where fuel supply logistics are unproven.

Ability to Mobilize Private Capital
Stronger revenue models improve access to finance, and monetizable outcomes can attract private investment. There is a trend for more capital to go into fuel providers; LPG, ethanol, pellet, and electric received 55% of the new investment recorded between 2017-2019 (the latest years for which this technology breakdown is available).

Ability to Reach Marginalized Groups
The instrument can be designed to target fuel access among marginalized populations, helping overcome affordability and access barriers. However, when customers are required to access the appliance via a multi-year lease-to-own model, the accessibility of the solution to the poorest is diminished.

Consistent with Net Zero
Although in principle this depends on the clean cooking appliances supported, it has tended to be developed using carbon revenues, targeting low-emission fuels and paired to appropriate methodologies. In this context, the model supports verifiable and sustained emissions reductions, aligning well with emission reduction objectives. Whether it is net-zero consistent will depend on the clean cooking solution being supported.

Model F5: Increasing consumer purchasing power for clean cooking fuels

Ideal Market Context

- Where supply chains can ensure high availability of quality fuel
- Where fuel costs are a significant barrier to adoption, as seen in the PMUY case study overleaf

Frequency of Use
Common (> 10 examples)

Scorecard

Effective-ness	Cost effective-ness	Predict-ability	Market Distortion	Support transition to subsidy sustainability	Ability to mobilize private capital	Ability to reach marginalized groups	Consistent with net zero

Effectiveness
Subsidizing fuel affordability improves competitiveness of cleaner fuels and creates incentives for continued use, particularly where users already own compatible appliances, or, as seen in the case of the PMUY case study, where the scheme also subsidizes equipment access costs. Effectiveness is higher when fuel costs represent a significant share of total cooking expenses (as noted in the case study overleaf), and where suppliers find the market attractive enough to ensure consistent availability. However, as the case study on the PMUY scheme illustrates, promoting greater access to fuel does not ensure their use.

Cost Effectiveness
Targeted delivery to low-income households - for example, through cash transfers - can enhance cost-effectiveness, but limits scalability. By contrast, generalized increases in purchasing power to support fuel purchase can be scaled quickly, but will tend to disproportionately benefit higher-consuming, wealthier households.[59] India grappled with this dynamic with its PMUY scheme with revisions made to make the scheme more cost effective by tailoring subsidy support to households living below the poverty line.

Predictability
Upfront budgeting for vouchers or underwritten loans enhances short-term predictability. In the medium term, sustainability depends on funding sources and demonstrable value for money. Macroeconomic pressures and fiscal concerns can trigger reform of generalized demand side subsidies, including those delivered through increases in purchasing power, as seen in the PMUY case study.

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[59] ESMAP (2024) From Ambition to Action: Practical Insights on Energy Subsidy Reforms. Energy Subsidy Reform in Action Series

Market Distortion
By allowing consumers to make decisions over how much of the subsidized fuel they will purchase and from which supplier, as well as through restricting the access to the subsidy to certain consumers and up to a certain threshold of consumption, the model reduces market distortion. However, this is offset by a typical need to focus on only certain fuels. Neutrality across different fuel types is harder to ensure. It would be hard for India, for example, to switch away from the current focus LPG within its PMUY scheme.

Support Transition to Subsidy Sustainability
Fuel subsidies – even those delivered through increasing purchasing power - may reduce (implied) willingness to pay over time, as frequent transactions reinforce expectation of support. This makes phase-out more difficult than with appliance subsidies, which occur less frequently. Nonetheless, the PMUY scheme used advertising campaigns to encourage over eleven million subsidy users to voluntarily give up benefitting from the subsidy, suggesting these large-scale transitions away from subsidy are possible as household wealth increases.

Ability to Mobilize Private Capital
Consumer-focused instruments can support financing solutions, such as underwritten loans, but do not directly address structural financing barriers faced by fuel suppliers.

Ability to Reach Marginalized Groups
In principle, the choice of who to provide vouchers to makes it relatively easy to target marginalized groups, so long as supply to those users is assured. This helps explain their common use in humanitarian settings. Nonetheless, in many cases it can still be challenging to identify and implement the appropriate criteria for who should receive support. For example, strict income-based eligibility can still result in exclusion errors, given that people working informal jobs can lack documentation to prove income eligibility.[60] The PMUY scheme targets women through its reimbursement process, encouraging their financial independence.

Consistent with Net Zero
The model can directly support emissions reductions if applied to low-carbon fuels, with effectiveness dependent on the specific energy solution being subsidized. In the case of PMUY, significant GHG savings were modelled based on transitioning from biomass to LPG.

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[60] ESMAP (2024) From Ambition to Action: Practical Insights on Energy Subsidy Reforms. Energy Subsidy Reform in Action Series

Model F6: Reducing the price of clean cooking fuels

Ideal Market Context

- Where supply chains can ensure high availability of quality fuel
- Where the margin made from supplying fuel to consumers is unlikely to yield commercial success for the fuel supplier into the medium term, but cross subsidization may be possible
- Where it is possible to accurately isolate customer groups

Frequency of Use
Very common (> 50 examples)

Scorecard

Effective-ness	Cost effective-ness	Predict-ability	Market Distortion	Support transition to subsidy sustainability	Ability to mobilize private capital	Ability to reach marginalized groups	Consistent with net zero

Effectiveness
Improves affordability by making clean fuels more price competitive. Sustained use depends on household access to compatible appliances and suppliers' confidence in the market opportunity.

Cost Effectiveness
It can be cost-effective where price is a binding constraint and targeting is feasible, e.g., via lifeline tariffs. However, generalized subsidies risk favoring higher-consuming, often wealthier households which reduces cost effectiveness.[61]

Predictability
It is difficult to forecast total subsidy costs, especially with variable fuel prices and demand. This may lead to subsidy amounts becoming unpredictable.

Market Distortion
Generalized reductions in prices are highly distortive at a macroeconomic level. The subsidy is typically applied to a single fuel, which may disadvantage alternative clean fuels not covered by the subsidy.

Support Transition to Subsidy Sustainability
Frequent purchases reinforce price expectations, making phase-out difficult (regardless of whether the subsidy is funded from international or domestic sources). A transition to customer-funded cross-subsidies may help reduce long-term dependency, though this is a long-

[61] ESMAP (2024) From Ambition to Action: Practical Insights on Energy Subsidy Reforms. Energy Subsidy Reform in Action Series

term objective in most low-access contexts.[62]

Ability to Mobilize Private Capital
It depends on the perceived reliability of the subsidy. Stable support can drive fuel sales and improve bankability but does not directly address investor risk perceptions.

Ability to Reach Marginalized Groups
There is often some potential for instruments to focus by geography or by fuel consumption, but these will be imperfect in reaching some marginalized groups.

Consistent with Net Zero
It can be aligned with GHG reduction goals if applied to low-carbon fuels. Impact depends on the fuel type supported and baseline usage displaced.

[62] Tearfund (2020) Designing sustainable subsidies to accelerate universal energy access

Clean Cooking civil infrastructure

Model I1: Lowering the capital costs for the build out of clean cooking civil infrastructure

Ideal Market Context

- Where infrastructure solutions can be commercially sustainable - potentially through customer cross-subsidization - if the high capital costs are addressed
- Where access to finance for the utility company is a particular challenge
- Where civil infrastructure expansion is a stated policy objective

Frequency of Use
Very common (>50 examples)

Scorecard

Effective-ness	Cost effective-ness	Predict-ability	Market Distortion	Support transition to subsidy sustainability	Ability to mobilize private capital	Ability to reach marginalized groups	Consistent with net zero

Effectiveness
Due to the capital-intensive nature of civil infrastructure, grants and concessional loans can be effective in supporting expansion. However, such subsidies do not guarantee that households will connect to the infrastructure or use the energy it supplies, which will depend on the ability to pay of the relevant customers. There are also concerns regarding whether capital subsidies alone will ensure adequate maintenance over time.

Cost Effectiveness
Reducing financing costs for infrastructure development can be a cost-effective approach (more cost effective than for activities that are less capital intensive), depending on the financial performance of the utility. Given the maturity of subsidy instruments in this area, transaction costs can be minimized, particularly if support is structured programmatically. While subsidies are not specifically targeted toward cooking - or even household connection policies can partially address this. Nevertheless, political economy dynamics may skew decisions toward large-scale infrastructure investments over potentially more cost-effective alternatives.

Predictability
At the investment level, the one-off nature of capital support means predictability is not a major concern. At the programmatic level, however, predictability will depend on the subsidy source.

Market Distortion
Support tends to be provided for individual projects or assets (determined administratively) which may raise concerns about market distortion, especially between infrastructure and alternative solutions. However, this concern is normally set aside given the expected difference in service provision provided by infrastructure solutions.

Support Transition to Subsidy Sustainability
For a specific infrastructure asset and household connection, it will often only be necessary to provide a one-off subsidy to support increased access, with household customers typically willing/able to pay the cost associated with the ongoing supply of electricity or gas. At the programmatic level – in other words if support is provided to multiple infrastructure providers - infrastructure investments may exhibit slower learning rates than modular technologies, potentially limiting cost reductions over time.

Ability to Mobilize Private Capital
Where support is channeled through local or international investors, the expectation is that familiarity with infrastructure providers will grow, increasing the likelihood of future capital provision with reduced or no subsidy.

Ability to Reach Marginalized Groups
Geographic targeting is possible by prioritizing expansion plans that reach marginalized groups. During project design, subsidy providers may influence where infrastructure is developed, potentially aligning investments with geographic priorities such as rural or humanitarian areas. However, reaching rural households cost-effectively remains a challenge. Even with subsidized capital costs, many lower-income households may still struggle to afford connection or standing charges without additional support.

Consistent with Net Zero
The climate impact of infrastructure investments depends on the energy source. For electricity infrastructure, the emissions profile will be determined by current and future generation mixes. For gas, climate outcomes are influenced by processing and transport, though, ultimately, gas infrastructure is not aligned with long-term net zero objectives.

Model I3: Increasing revenues from growing household connections to clean cooking civil infrastructure

Ideal Market Context

- Where high population density improves the cost-effectiveness of infrastructure deployment
- Where demand for a connection is high
- Where neighborhoods can pay for their consumption
- Where policies support network expansion

Frequency of Use
Common (>10 examples)

Scorecard

Effective-ness	Cost effective-ness	Predict-ability	Market Distortion	Support transition to subsidy sustainability	Ability to mobilize private capital	Ability to reach marginalized groups	Consistent with net zero

Effectiveness
The model provides strong incentives for utilities to expand connections, though its effectiveness depends on the utility's ability to access finance and respond to demand. It does not ensure household use of energy – which will depend on whether the subsidy is targeted towards network expansion where households have ability to pay for ongoing energy use, and which, in any case, may only increase gradually over time.[63] It may not adequately incentivize long-term infrastructure maintenance.

Cost Effectiveness
Cost-effectiveness depends on financing conditions and the capital intensity of expansion. Results-based models may be more cost effective when financing costs are low, while direct capital subsidies may be preferable when they are high. Political preferences for infrastructure can lead to subsidies that crowd out more cost-effective alternatives.

Predictability
Total subsidy requirements may be uncertain, which can complicate medium-term sustainability. Most programs operate within capped funding pools linked to defined connection targets, but this may exclude some utilities that expected to benefit.

Market Distortion
Distortion may arise when subsidies are tied to specific utilities or solutions, limiting competition with non-infrastructure alternatives. However, this is often considered acceptable due to the broader service benefits infrastructure provides

[63] Dinkelman, T. (2025) Understanding the gradual adoption of electricity in rural South Africa, International Growth Centre blog.

Support Transition to Subsidy Sustainability

Once connections are delivered, ongoing subsidy support may not be needed for those households (or the amounts needed may be lower, facilitating a gradual transition to domestic sources). However, expanding infrastructure to lower-density or remote areas increases costs, implying greater future subsidy requirements as coverage grows.[64]

Ability to Mobilize Private Capital

The prospect of performance-based payments can help mobilize finance, particularly where capital markets are functional and familiar with infrastructure risk. Success depends on the financial credibility of the implementing utility or developer.

Ability to Reach Marginalized Groups

The model can target underserved populations in principle, but high infrastructure costs make it difficult to reach rural or dispersed households in a cost-effective way, even with subsidies.

Consistent with Net Zero

This depends on whether the infrastructure transmits gas or electricity. If electricity, the current and future generation sources will be important factors. If gas, the processing and transportation steps will be important factors (and gas is not consistent with long-term net zero goals).

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[64] ESMAP (2021) Utility Performance and Behavior in Africa Today

Model I4: Increasing revenues from growing customer usage of clean cooking civil infrastructure

Ideal Market Context

- Where reliability of the existing connection is high
- Where upfront costs for cooking appliances or cookware (e.g., magnetic induction pans) can be a barrier for low-income households

Frequency of Use

Very uncommon (<5 examples)

Scorecard

Effective-ness	Cost effective-ness	Predict-ability	Market Distortion	Support transition to subsidy sustainability	Ability to mobilize private capital	Ability to reach marginalized groups	Consistent with net zero

Effectiveness

The model is effective at increasing energy use among households with existing connections but is less suited for driving large-scale infrastructure expansion due to limited evidence on resulting demand or revenue. There are few real-world applications.

Cost Effectiveness

The instrument may be cost-effective where infrastructure exists, particularly in supporting electric cooking uptake by reducing appliance-related barriers such as the cost of induction-compatible cookware. Targeting low-income households is feasible but increases transaction costs. It is unlikely to generate sufficient revenue to justify future infrastructure investment.

Predictability

Subsidy demand is uncertain and depends on uptake. Most programs manage this risk by capping the total subsidy pool. Rapid scaling could still challenge medium-term sustainability.

Market Distortion

The model may limit competition by favoring specific utilities or technologies, but such distortion is often accepted given the differentiated nature of infrastructure-based services.

Support Transition to Subsidy Sustainability

Once customers experience the benefits of improved energy services, sustained use is likely, reducing future subsidy needs, facilitating a transition from international to domestic sources. Utilities may also cross-subsidize within their customer base, and pilot programs can help de-risk scale-up. However, the high costs involved in serving rural customers may place limits on the ability to cross-subsidize.

Ability to Mobilize Private Capital

The model has high potential to support consumer financing but is unlikely to mobilize significant upstream investment for infrastructure expansion.

Ability to Reach Marginalized Groups

The approach can target disadvantaged customers connected to the existing infrastructure, though this will incur transaction costs. It is likely to be less effective for extending services to unconnected, remote households.

Consistent with Net Zero

Climate alignment depends on the energy source. Electrification outcomes are tied to the emissions profile of current and future generation; gas-based systems are less compatible with net zero targets due to lifecycle emissions.

Model I5: Increasing consumer purchasing power for clean cooking civil infrastructure

Ideal Market Context

- Where the reliability of the connection is high
- Where financial sustainability of network services is a viable long-term outcome

Frequency of Use

Very uncommon (< 10 examples)

Scorecard

Effective-ness	Cost effective-ness	Predict-ability	Market Distortion	Support transition to subsidy sustainability	Ability to mobilize private capital	Ability to reach marginalized groups	Consistent with net zero

Effectiveness

By addressing the up-front cost of connection, the instrument tackles a key affordability barrier and empowers households to initiate service use. While real-world applications are limited, providing consumer agency may increase the likelihood of sustained usage. Effectiveness will depend on identifying households who can afford to use the connection, after the subsidy has been provided.

Cost Effectiveness

The instrument is simple to implement and can be targeted by geography or demographics. However, if it fails to drive regular energy use, overall cost-effectiveness may be compromised.

Predictability

Subsidy amounts can be defined upfront through vouchers or underwritten loans, improving fiscal predictability. Longer-term sustainability depends on funding sources and the instrument's ability to demonstrate impact.

Market Distortion

Typically constrained to a limited number of infrastructure providers, the model may disadvantage non-infrastructure alternatives.

Support Transition to Subsidy Sustainability

If households value and use the connection, the subsidy may only be needed once. However, expanding infrastructure to lower-density or remote areas increases costs, implying greater future subsidy requirements as coverage grows.[65] Long-term sustainability depends on consistent use and the perceived value of service.

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[65] ESMAP (2021) Utility Performance and Behavior in Africa Today

Ability to Mobilize Private Capital
Capital mobilization depends on investor confidence in the utility's financial viability and continued subsidy support, particularly in serving low-income or remote households with weak payment histories.

Ability to Reach Marginalized Groups
In principle the subsidy can be targeted to support network expansion towards marginalized groups. However, it may be difficult for this subsidy to be contextually relevant for marginalized groups in remote locations as it is predicated on the existence of multiple utility providers competing for household connection.

Consistent with Net Zero
Net zero alignment depends on the energy source. Electrification outcomes are tied to the emissions profile of current and future generation; gas-based systems are less compatible with net zero targets due to lifecycle emissions.

Model I6: Reducing the price of connections to clean cooking civil infrastructure

Ideal Market Context

- Where infrastructure expansion aligns with national electrification or energy access goals
- Where household energy demand is expected to mean that serving the connection will be commercially sustainable.

Frequency of Use
Common (> 10 examples)

Scorecard

Effectiv-eness	Cost effective-ness	Predict-ability	Market Distortion	Support transition to subsidy sustainability	Ability to mobilize private capital	Ability to reach marginalized groups	Consistent with net zero

Effectiveness
Addresses the upfront connection cost, a key barrier to access, though it does not guarantee continued energy use. Effectiveness improves when targeted to households with a high likelihood of being able to pay for ongoing consumption.

Cost Effectiveness
The instrument is straightforward to implement and can be targeted by location or household characteristics. However, poor targeting or low post-connection usage will reduce cost-effectiveness.

Predictability
The one-off nature of the subsidy per connection improves predictability at this level. Program-wide predictability depends on the funding source and demonstrated impact.

Market Distortion
Subsidies tied to specific utilities or infrastructure solutions may limit competition with non-infrastructure alternatives. This is typically accepted due to the higher level of service such infrastructure provides.

Support Transition to Subsidy Sustainability
In principle, it should support a transition to sustainability if households value the connection and make use of it. However, expanding infrastructure to lower-density or remote areas increases costs, implying greater future subsidy requirements as coverage grows.[66]

Ability to Mobilize Private Capital

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[66] ESMAP (2021) Utility Performance and Behavior in Africa Today

Financing depends on utility cost recovery prospects and the perceived reliability of the subsidy. If these are strong, the instrument can support infrastructure investment, although it does not directly engage with the financial sector or seek to address financing barriers.

Ability to Reach Marginalized Groups

In principle the subsidy can be targeted towards support network expansion towards marginalized groups. However, it may be difficult for this subsidy to reach more rural households in a cost-effective way as the high cost of solution may mean that the subsidy amounts required would be prohibitive. Marginalized groups may not be able to afford energy use even after they have benefited from the connection subsidy.

Consistent with Net Zero

This depends on whether the infrastructure transmits gas or electricity. If electricity, the current and future generation sources will be important factors. If gas, the processing and transportation steps will be important factors (and gas will not be consistent with long-term net zero goals).

Annex 2 Further details on the relationship between socio-economic development variables and the extent of use of polluting fuels

Each of the charts below provides more detail on the distribution in the socio-economic development variables of interest as countries pass through various thresholds for clean/polluting cooking use. In each chart, the point at the bottom of the 'whisker' shows the lowest observed value at which a country permanently passed the stated threshold for the use of polluting fuels, the grey box represents the range between the 1st quartile and the median, the green box the range between the median and the 3rd quartile and the highest point on the top 'whisker' is the highest value reported. The numbers in the boxes refer to the number of countries in each sample.

Figure 10 Relationship between GDP per capita and extent of household polluting fuel use

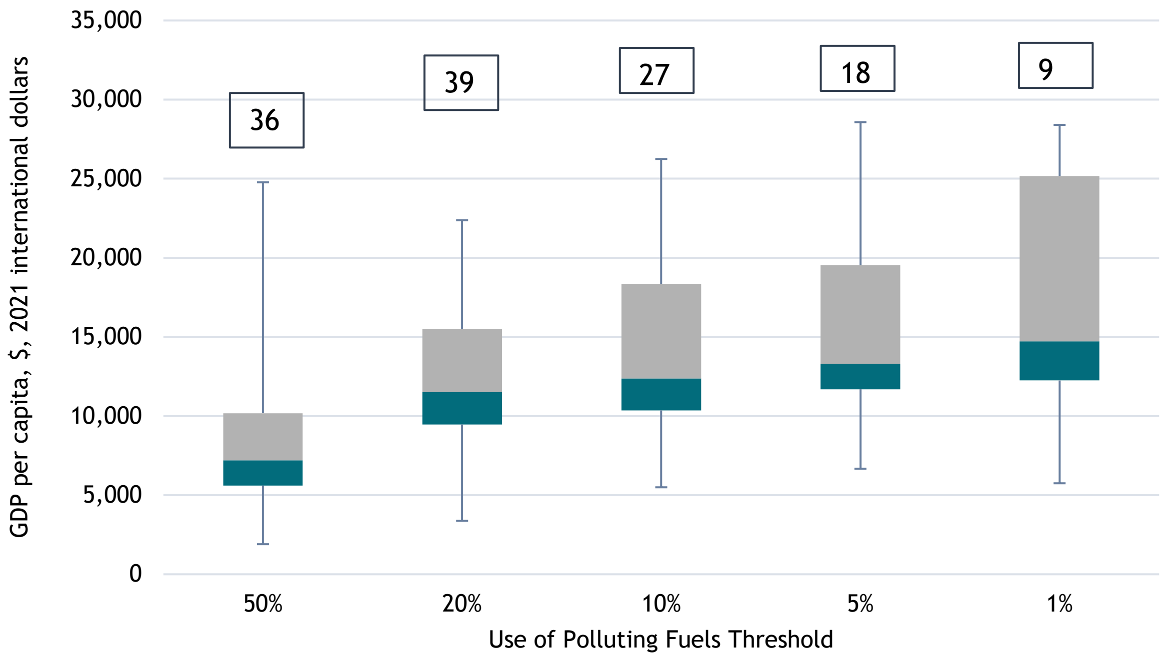


Figure 11 Relationship between median household consumption and extent of household polluting fuel use

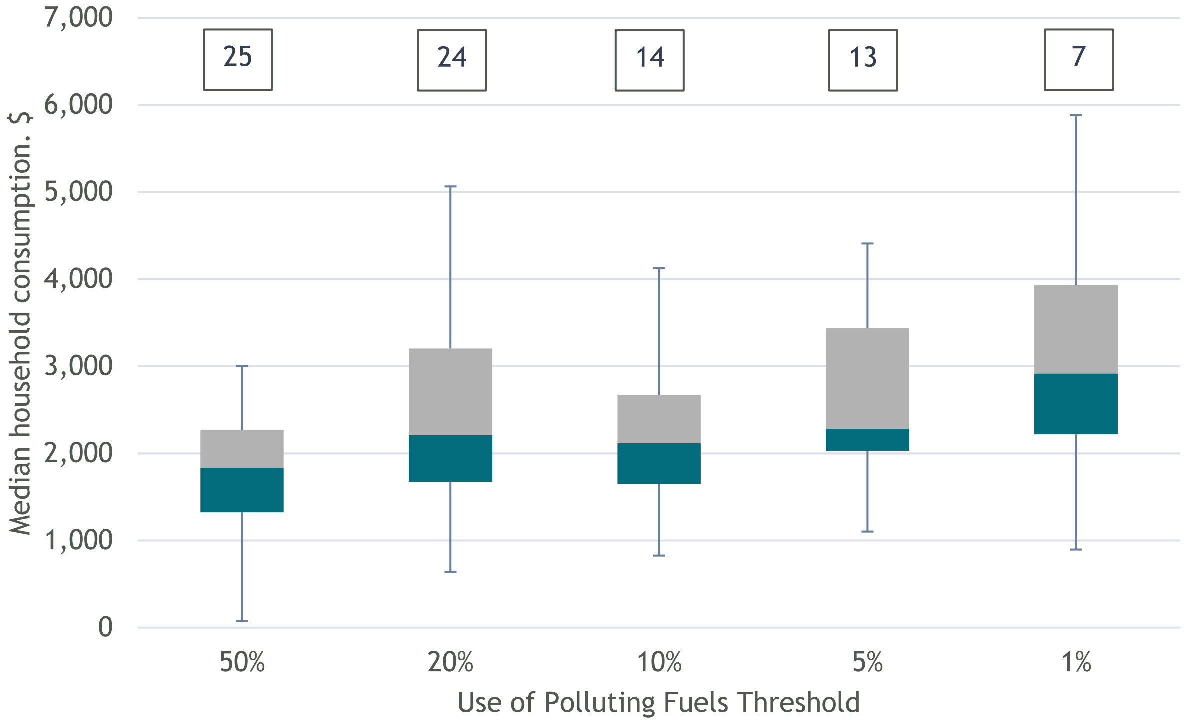
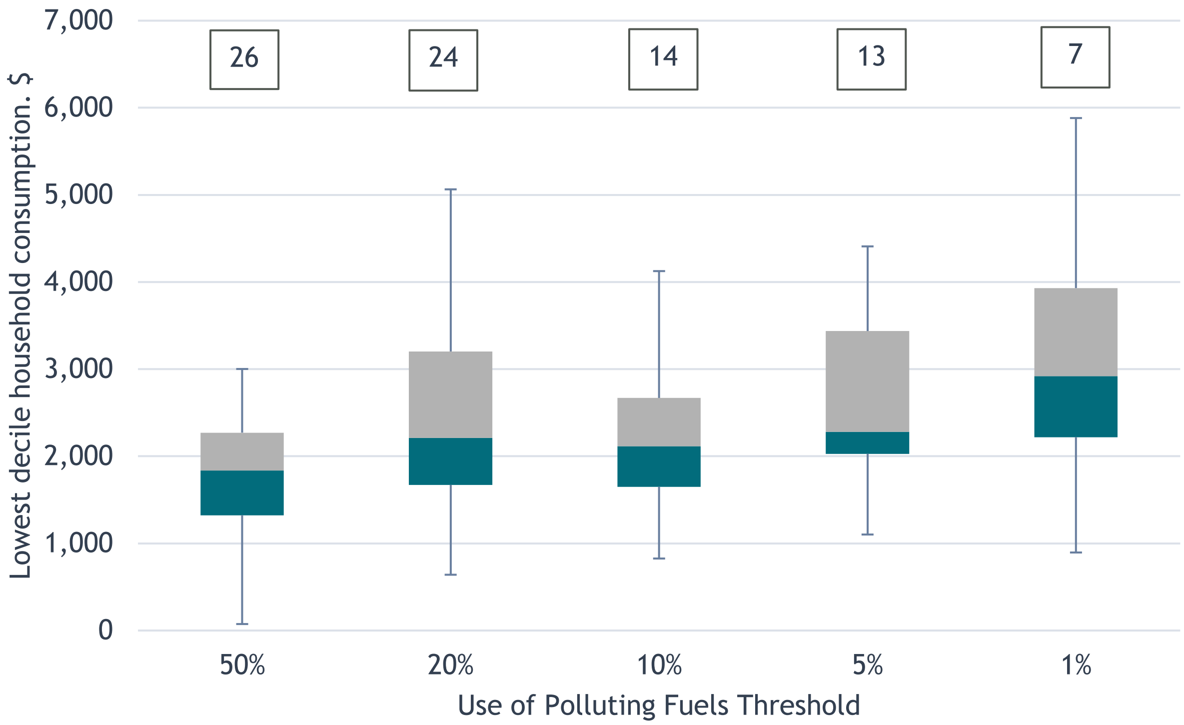


Figure 12 Relationship between household consumption in lowest decile and extent of household polluting fuel use



About Us

Pengwern Associates is a UK-based consultancy specialising in the economics of climate change, the environment, international development and the linkages between them. Across these areas, it provides advice to support strategy development, decision-making and implementation, drawing on both quantitative and qualitative analysis.

John founded Pengwern Associates in 2018, as a lean and flexible consultancy through which he could collaborate with like-minded individuals across the world to address some of today's most intractable environmental and social problems.

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