MEMOIRE

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Feasible Pathways for Phasing Out Fossil Fuel Subsidies

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Summary

For decades, in Belgium as in many countries around the world, fossil fuels have been subsidised. In 2021, these amounted to over EUR 21.5 billion in Belgium, equivalent to 4.3% of its GDP (SPF Finances, 2024). At a time when many targets have been set at global, European and Belgian levels for a more sustainable energy future, these subsidies create distorted price signals that do not reflect the true cost of fossil fuel consumption and are in complete contradiction with the climate and social urgency (Solarin, 2022; COP26, 2021; National Bank of Belgium, 2023).

My analysis identifies several types of subsidies in Belgium. Direct subsidies include direct transfers (mainly aimed at protecting vulnerable households in energy poverty), income tax benefits (linked to fuel cards), reduced VAT rates applied to certain fossil fuels and excise duties (excise rate differentials between products, specific rates for the same product and subsidies on intermediate consumption). It also identifies subsidies to maritime and international air transport and indirect subsidies (company cars and VAT exemptions on airline tickets).

The largest share of these subsidies is allocated to natural gas (over EUR 7 billion), which is mainly used for residential and industrial heating (SPF Finances, 2024). While my analysis of fossil fuel subsidies in Belgium covers all subsidies, I propose pathways with a focus on subsidies for natural gas for residential use. This choice is highly relevant given that 39% of Belgian final residential energy consumption consisted of natural gas in 2022 (Eurostat, 2024).

I have identified three main components of the subsidies for domestic natural gas consumption in 2021, with a total value of almost 1.6 billion euros (SPF Finances, 2024). The first is the social tariff, introduced to tackle fuel poverty. Despite its intentions, many households in energy poverty are not eligible for this social tariff. The second component is the CPAS fund, which works in conjunction with the social tariff to ensure access to energy for low-income and highly indebted households. The third component consists of subsidies from differential excise rates between natural gas for household consumption and other products, which represent the largest share of residential natural gas subsidies (83%). In addition, the energy crisis of 2022 led to a reform of the taxation of natural gas consumed by households, which reduced the VAT, abolished federal contributions and introduced a special excise duty, followed by an extra special excise duty CREG (2023).

To answer the research question *"How to phase out the use of fossil fuel subsidies for natural gas consumed by households in Belgium?"*, I propose a series of recommendations, termed 'feasible pathways', for the gradual elimination of these subsidies, taking into account the environmental and socio-political realities.

The feasible pathways I propose consist of a gradual annual reduction of each subsidy from 2025 to 2050, with the aim of complete elimination by 2050. For the social tariff and the CPAS fund, this reduction will take place in three phases (2025, 2030 and 2035) to give vulnerable households time to anticipate and adjust their behaviour. The subsidy for the tariff differential will be phased out with an annual reduction over the whole period. The lowering of the social tariff subsidy and the CPAS fund are relatively straightforward to implement. Meanwhile, a new excise tax on residential natural gas consumption will be used as an instrument to reduce the tariff differential. This new excise duty takes into account the VAT reduction and the subsidy through the tariff differential and is positively linked to consumption. Its weighted average is calculated using forecasted prices and consumption. The distribution of the new excise duty is progressively linked to three tiers of average consumption of households.

The pathways also include the introduction of a new Fund, the Subsidy for Renovation or Renovated Housing, accompanied by a redefinition of eligibility criteria and administrative support. This Fund will support households in energy poverty by providing resources to either renovate their housing if they are homeowners, or to increase their budget to rent more energy-efficient housing. While a significant initial investment in this Fund will be needed, it is designed not to exceed the avoided costs of the social tariff and the CPAS fund over 25 years.

The direct effects of these pathways will be increased tax revenues due to the new excise duty, although they are expected to decline in the future as consumption diminishes, and increased prices. Indirect effects of these pathways are expected to include changes in household behaviour. These may consist of opting for energy-efficient renovations, moving to more energy-efficient housing or switching to alternative heating systems. Such changes could stimulate demand and technological progress in the energy efficiency sector. Overall, residential consumption of natural gas is expected to decrease.

I have used seven dimensions as evaluation criteria to assess the feasibility and potential impact of the proposed pathways; efficiency, redistribution, political feasibility, accountability and fiscal sustainability, administrative realism, transition and dynamic costs. Efficiency is achieved through redirected subsidies and a progressive consumption duty that promotes energy efficiency and social welfare. Redistribution efforts protect vulnerable and low-consumption households while providing incentives to reduce consumption. Political feasibility is supported by the urgency of climate action and existing political momentum. Accountability and fiscal sustainability are ensured through clear communication and increased tax revenues. Administrative realism is maintained through practical implementation strategies. Finally, transition and dynamic costs are managed through initial investments and regular policy reviews.

Using current price and consumption data from the CREG (2024) dashboards, long-term price elasticity from Burke & Yang (2016), and three different future scenarios from the International Energy Agency (2023b) *World Energy Outlook 2023*, I have forecasted future prices and consumption of residential natural gas to determine the new excise duty. The new excise duty is calculated on a trimestrial basis and its distribution is based on the level of consumption of a household. Finally, its estimated impact on the forecasted prices is consistent with the objective of discouraging household consumption of natural gas.

After assessing the direct and indirect effects, the evaluation criteria and the price effects, it can be concluded that the phasing out of subsidies for natural gas for household use is likely to increase prices and change consumer behaviour. It is expected that households will switch to more energy-efficient heating systems or renovate or move to more energy-efficient housing. This should ultimately reduce natural gas consumption in the residential sector, in line with the objective of phasing out fossil fuel subsidies for natural gas.

Overall, the proposed pathways provide a balanced approach to phasing out natural gas subsidies for residential consumption, promoting environmental sustainability, social equity and economic efficiency. With the implementation of these strategies by policymakers, Belgium can move towards a more sustainable and equitable energy future.

Feasible Pathways for Phasing Out Fossil Fuel Subsidies *

Anaïs Couronné

2023-2024

Abstract

The aim of this thesis is twofold. The first objective is to provide a comprehensive analysis of all fossil fuel subsidies in Belgium. This involves delving into their origins and mechanisms, as well as their potential environmental impacts. Secondly, and of key importance, the thesis proposes a series of recommendations, termed 'feasible pathways', for the gradual elimination of these subsidies, with a particular focus on natural gas for residential consumption. This will be achieved while taking into account the socio-political factors that influence their existence, thereby ensuring a balanced approach that considers both environmental concerns and socio-political realities. This thesis puts forward a number of feasible pathways. The social tariff will be gradually phased out and compensated for by a Fund for Renovation and Renovated Housing. In contrast, the rate differential subsidy will be phased out by implementing a new excise duty scheme that is reformed in such a way that it is progressive and includes the rate differentials with other energy products, as well as accounting for the reduced VAT rate. The pathways are discussed in terms of their direct and indirect effects, evaluated in accordance with seven distinct policy evaluation criteria, and analysed in three different forecasted scenarios.

*This thesis has been written under supervision of Professor Estelle Cantillon.

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1 Introduction

It is known that the use of fossil fuels has negative externalities as it contributes to climate change through global warming and air pollution, leading to health problems and various socio-economic effects. As a result, the social costs associated with fossil fuels exceed the private costs. It is therefore essential to address these negative externalities, for example by imposing taxes. This is already the case for fossil fuels, which should lead to a reduction in the externality. According to this reasoning, taxes on fossil fuels are a constructive approach to reducing this negative externality, and subsidies should be discouraged.

Nevertheless, in Belgium, as in most countries around the world, fossil fuels are subsidised, despite the well-documented negative consequences for the environment. Fossil fuel subsidies are problematic because they do not reflect the real cost of harmful energy sources, and thus encourage their consumption and enhance their negative consequences. The fossil fuel subsidies also intensify income inequalities (Solarin, 2022). The SPF Finances (2024)[1] documents these subsidies by making an inventory. In Belgium, according to the SPF Finances (2024), the total of all fossil fuel subsidies amount to 4.3% of the GDP in 2021 (direct subsidies amount to EUR 12 billion, or 2.4% of the GDP). According to the OECD (2022), subsidised fossil fuels accounted for 1.3% of Belgian emissions in 2021, an increase from 0.6% in 2018.

For many years, policy discussions have focused on strategies to reduce greenhouse gas emissions through taxes, permits and other regulatory or legal limits. Yet fossil fuel markets around the world remain littered with government programmes that subsidise these emissions. These subsidies are large and act as a negative tax on carbon, slowing the transition to cleaner fuels, weakening the impact of carbon constraints, and absorbing a significant portion of government revenues in many countries (Koplow, 2018).

In 2023, the Belgian Government (2023) submitted a draft update of the National

[1]The SPF Finances is Belgium's Federal Public Service in charge of financial matters. Responsible for taxation, budgeting, public accounting and financial regulation, it makes an important contribution to managing the country's finances and ensuring fiscal transparency and stability.

Energy and Climate Plan (NECP)[2] to the European Commission. While this NECP mentions the need to phase out fossil fuel subsidies, it lacks a clear trajectory for their gradual elimination. The aim of this thesis is therefore twofold: firstly, to provide a comprehensive analysis of all fossil fuel subsidies in Belgium, looking at their origins and mechanisms, as well as their potential environmental impacts. Secondly, and of key importance, it seeks to propose a range of recommendations, termed feasible pathways, for phasing out of the use of these subsidies. This will be done while taking into account the socio-political factors that influence their existence, ensuring a balanced approach that considers both environmental concerns and socio-political realities.

In Belgium, according to the SPF Finances (2024), the largest amount of fossil fuel subsidies goes to natural gas. In 2021, 54% of direct fossil fuel subsidies went to natural gas through the social tariff, the CPAS energy access fund[3], the extended social tariff, the tariff differential between products and special tariffs for some products. In total, 34% of fossil fuel subsidies are allocated to natural gas, amounting to almost EUR 7.4 billion (or 1.5% of GDP). As this is, by far, the largest fossil fuel subsidy - the second largest being company cars, which amounts to EUR 2.5 billion in 2021 - it is therefore relevant that this thesis focuses on natural gas when seeking to propose feasible pathways towards moving this subsidy. The research question for this thesis is consequently the following: *How to phase out the use of fossil fuel subsidies for natural gas consumed by households in Belgium?*

This research question will be answered with the following structure. In Section 2 I will set the context for this thesis and motivate the research question by discussing the Belgian and EU climate objectives regarding the use of fossil fuels and the abolition of their subsidies. Next, in Section 3, I will respond to the first objective of this thesis, which is the analysis of all fossil fuel subsidies in Belgium, with a particular interest in natural gas, as this will be the main focus of this thesis. This

[2] The National Energy and Climate Plans (NECPs) were introduced by the EU's Regulation on Energy Union and Climate Action (EU)2018/1999, part of the Clean Energy for All Europeans package adopted in 2019. NECPs outline EU countries' strategies for decarbonisation, energy efficiency, security, market integration, and innovation, fostering coordinated planning and investment (European Commission, 2023b).

[3] The CPAS (Public Centre for Social Welfare) energy access fund provides financial assistance to low-income households to help cover their energy expenses.

section quantifies these subsidies and explains the reasons as to why they exist.

In Section 4, I will describe the approach and methodology used to address the research question. This includes the analysis of current prices, the proposed pathways and the evaluation framework. Section 5 will present the available data that is used to estimate future prices and consumption, and Section 6 will respond to the second aim of this thesis, consisting of the results and policy design. In this section, I will propose feasible pathways for phasing out natural gas subsidies. In Section 7 I will use evaluation criteria to ensure the feasibility of the proposed pathways. Finally, I will conclude in Section 8.

2 Context

The research question of this thesis is the following: "*How to phase out the use of fossil fuel subsidies for natural gas consumed by households in Belgium?*". To establish this research question, I will set the context of the current state of the world regarding fossil fuel subsidies.

Fossil fuels have powered economies for more than 150 years and currently provide around 80% of the world's energy (Environmental and Energy Study Institute, 2021). Despite their benefits, they have significant environmental and health impacts, including air and water pollution, greenhouse gas emissions and climate change (Perera, 2017; Siddik et al., 2021; Wuebbles & Jain, 2001). Recognising these harms, many institutions and governments are seeking to end dependence on fossil fuels. They are working towards a cleaner, more sustainable energy future by reducing subsidies, implementing policies to promote renewable energy and setting ambitious targets to phase out fossil fuel use altogether.

Globally, climate objectives are focused on the Paris Agreement[4], which aims to limit global warming to well below 2 degrees Celsius, and preferably to 1.5 degrees. Countries all over the world are committed to reducing greenhouse gas emissions, increasing the deployment of renewable energy, and improving energy

[4]The Paris Agreement is a legally binding international agreement on climate change. It was adopted by 196 parties (including Belgium) at the UN Climate Change Conference (COP21) in Paris, France, on 12 December 2015. https://unfccc.int/process-and-meetings/the-paris-agreement

efficiency. The Paris Agreement does not explicitly mention fossil fuel subsidies, but it encourages countries to take action to reduce greenhouse gas emissions and increase climate resilience. Moreover, at COP26, 39 countries, including Belgium, committed to ending new direct public support for the international fossil fuel energy sector by the end of 2022 (COP26, 2021).

Within the European Union (EU), the European Green Deal[5] sets ambitious targets, including reducing net greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels and achieving climate neutrality by 2050. The EU is implementing various policies and regulations to drive this transition, such as the Emissions Trading System[6] and the Renewable Energy Directive[7]. While fossil fuel subsidies are not directly addressed in its core documents, the EU has recognised the contradiction between supporting the transition to clean energy and continuing to subsidise fossil fuels. The EU is committed to reviewing and reforming energy taxation and subsidies to support the transition to renewable energy and energy efficiency (European Parliament, 2023).

As an EU member state, Belgium has aligned its climate targets with the EU framework. Nonetheless, it faces challenges in meeting its targets, partly due to continuing to subsidise fossil fuels. Belgium also aims to be climate-neutral by 2050. The Belgian Government (2023) states in its draft National Energy and Climate Plan (NECP)[8] that there is a need to phase out fossil fuel subsidies. The NECP states that the federal state of Belgium has set a greenhouse gas reduction target of 47% by 2030 compared to 2005. It also sets several other targets and objectives but does not provide a clear pathway for the phasing out of subsidies for fossil fuels (Belgian Government, 2023).

Thus, despite significant efforts to shift away from fossil fuels and their subsidies,

[5] More information can be found on the European Commission's official website: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

[6] The EU Emissions Trading System works on the 'cap and trade' principle. More information can be found on: https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets_en.

[7] The Renewable Energy Directive is the legal framework for the development of clean energy across all sectors of the EU economy. More information can be found on: https://energy.ec.europa.eu/topics/renewable-energy/renewable-energy-directive-targets-and-rules/renewable-energy-directive_en

[8] The National Energy and Climate Plan (NECP) guides Belgium's efforts to meet EU climate targets. More information can be found on: https://www.nationalenergyclimateplan.be/en

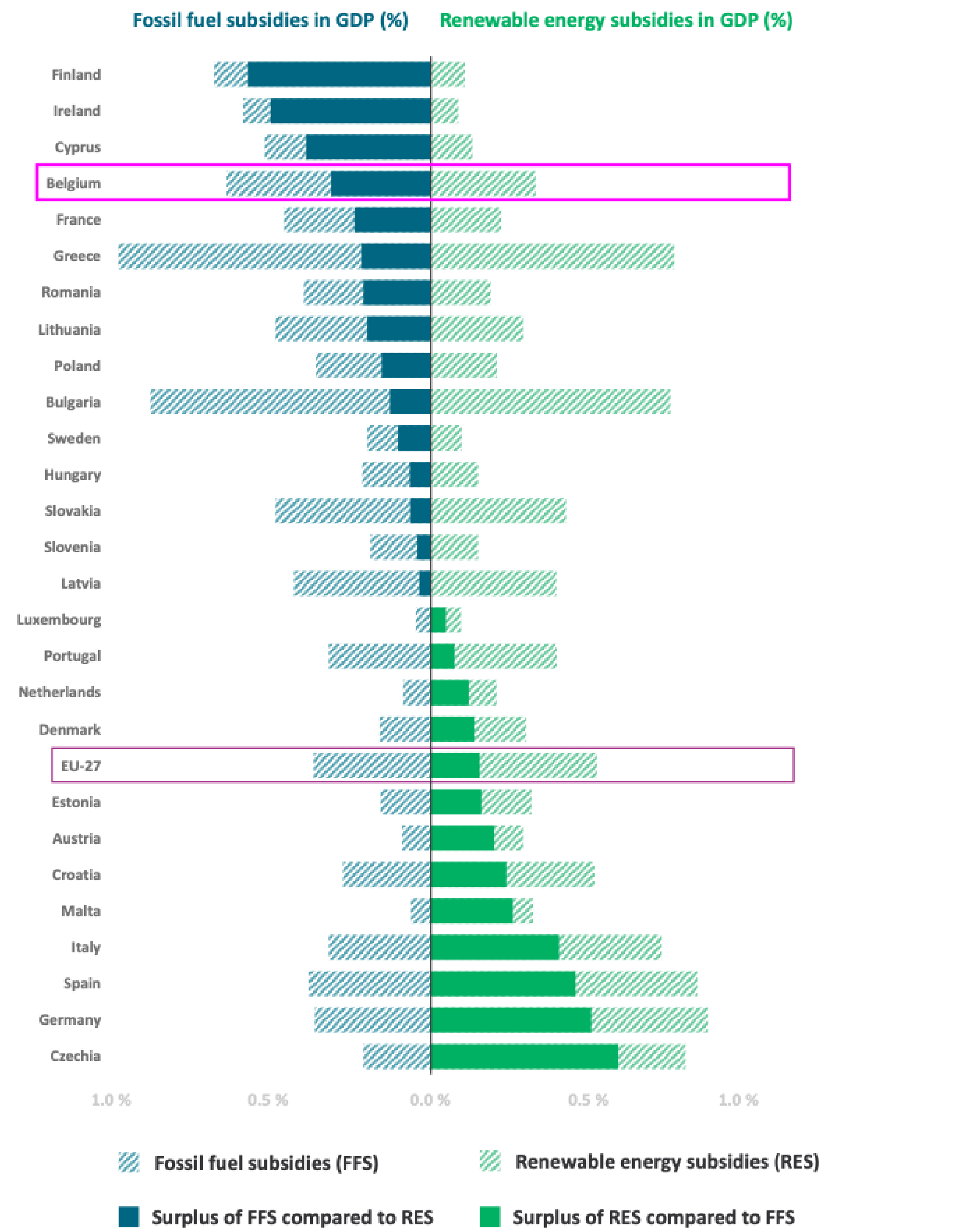
the transition is far from complete. For example, as shown in Figure 1, Belgium still allocates more subsidies to fossil fuels than to green energy initiatives (European Court of Auditors, 2022). The figure compares fossil fuel subsidies as a percentage of GDP with renewable energy subsidies as a percentage of GDP, by country, and shows the surplus. In the case of Belgium, which is framed in pink, this surplus is on the side of fossil fuel subsidies. This imbalance highlights the ongoing challenges of reducing dependence on fossil fuels and their subsidies. It can also be seen that Belgium is among the countries with the largest surplus for fossil fuel subsidies as a percentage of GDP. The European Union average has a positive surplus, meaning that the share of GDP allocated to renewable energy subsidies is larger than that allocated to fossil fuel subsidies. This again shows the urgency for Belgium to take action to phase out fossil fuel subsidies. The results in Figure 2 are even more alarming, as this shows the fossil fuel subsidies per capita in the EU27 and G20 countries in 2018, where Belgium is remarkably higher than the rest. Financial incentives continue to support fossil energy sources, slowing progress towards a greener, more sustainable future. To meet ambitious fossil fuel phase-out targets, countries like Belgium need to redirect investment towards renewable energy and implement stronger policies to discourage the use of fossil fuels.

Belgium also has an increasing budget deficit (National Bank of Belgium, 2023). Reducing government spending or foregone tax revenue by phasing out fossil fuel subsidies can help to solve or mitigate this deficit.

There is also the social aspect. Fossil fuel subsidies often increase income inequality. According to United Nations Development Programme (2021), the richest quintile receives more than six times the benefit from fossil fuel subsidies as the bottom quintile, and this disparity is reproduced across developing regions. The regressivity of these subsidies is even more pronounced when one considers that high-income households not only consume more energy but also own more energy-intensive goods. It is well known that the European Union strives to reduce income inequalities (see for example the European Pillar of Social Rights[9]). However, it does not mention the increased income inequality as a consequence of fossil fuel subsidies, despite the existing literature, such as Solarin (2022).

[9]More information available at: https://ec.europa.eu/social/main.jsp?catId=1593&langId=en

Figure 1: Level of Fossil Fuel Subsidies compared to Renewable Energy Subsidies, 2022

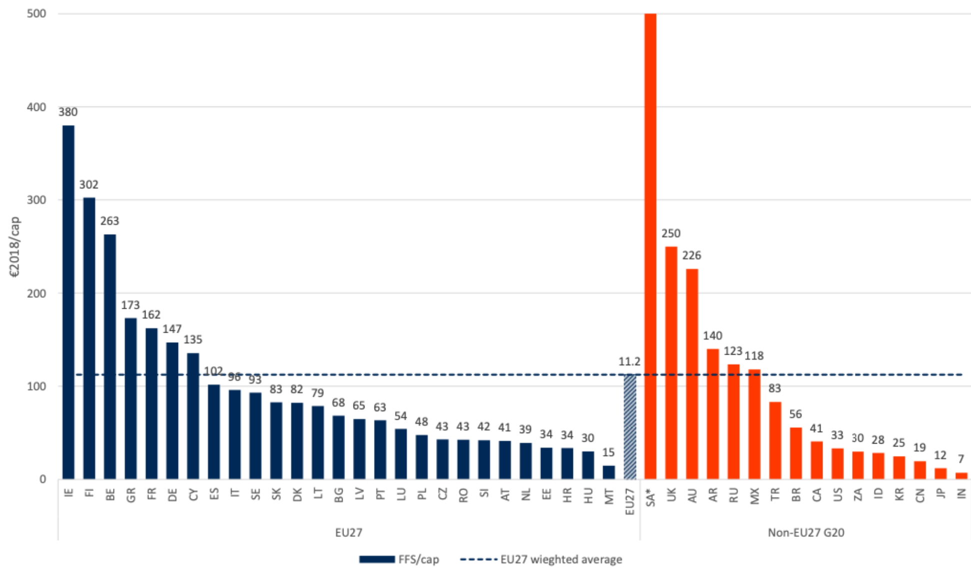


Source: European Court of Auditors (2022)

While much research[10] has been done on the use of fossil fuels, various institutions

[10]See for example Soeder & Soeder (2021); Halkos & Gkampoura (2023).

Figure 2: Fossil fuel subsidies per capita in EU27 and G20 countries, 2018



Source: European Commission (2020)

and governments have tried to measure fossil fuel subsidies[11], and some politicians or economists have even tried to suggest sustainable ways to eliminate some of them[12], to my knowledge of the literature, this thesis is the first to investigate policies to phase out of natural gas subsidies in Belgium, using the most recent available data and focusing on current targets and subsidies. For this reason, in this thesis, it seems highly relevant to document the existing fossil fuel subsidies, with a special focus on natural gas, and to propose feasible pathways. This research aims to analyse fossil fuel subsidies and to recommend pathways to gradually but significantly reduce the consumption of fossil fuels, notably natural gas, in Belgium. In this way, the climate targets for 2030 and especially 2050 can be achieved.

3 Analysis of fossil fuel subsidies

In order to provide feasible pathways for phasing out fossil fuel subsidies, it is first necessary to clarify terminology and methodology, as definitions and approaches can vary in the literature. To obtain a basis for the analysis and recommendations

[11]See for example SPF Finances (2024); International Energy Agency (2024b); OECD (2023).
[12]See for example Böhl Gutierrez et al. (2024); McCulloch (2023).

presented, this section first explains the concept of fossil fuel subsidies and compares three different approaches to assessing them.

The second part of this section analyses the types of fossil fuel subsidies that exist in Belgium, the reasons for their introduction and the rationale (if any) for their continued use. This structured analysis will provide a comprehensive understanding of the complexities involved.

3.1 Clarification of terminology

According to Eurostat (2023), *fossil fuels* include non-renewable energy sources such as coal, coal products, natural gas, derived gas, crude oil, petroleum products and non-renewable wastes. These sources come from ancient plant and animal material formed in geological ages. Moreover, fossil fuels can also be made through industrial processes that use other fossil fuels. Fossil fuel energy can thus be understood as the energy generated by burning coal, oil or natural gas. These carbon-rich resources result from the transformation of organic material deposited underground over millions of years (SPF Finances, 2023).

Even though the term *subsidy* is commonly used in economics, there are multiple approaches to defining a subsidy, reflecting the different methods by which it can be characterised. Most international organisations have however adopted a subsidy definition developed by the World Trade Organization (WTO), under the Agreement of Subsidies and Countervailing Measures (ASCM). A subsidy, as defined by the World Trade Organization (1995) ASCM, encompasses various forms of financial assistance or support provided by governments or public entities. This includes (i) direct transfers of funds, (ii) forgone government revenue, (iii) provision of goods or services, and (iv) payments to funding mechanisms, or entrusting private entities with governmental functions. Additionally, subsidies include income or price support, resulting in a conferred benefit. This definition encompasses the necessary complexity required to track the various policies involved in providing subsidies. In the context of fossil fuel subsidies, points (i) and (ii) apply most. In other words, as summarized by Daneshzand et al. (2022), any policy or measure that keeps the price lower than its market price can be considered a type of subsidy (OECD, 1997). Since they distort price signals and lead to inefficient distribution of goods and services, many studies suggest that there should be a strong and essential reason why to grant subsidies (Daneshzand et al., 2022). However, in the context of fossil fuel subsidies, these subsidies are not justified (as will be discussed in this Section).

3.2 Approaches to Measure Fossil Fuel Subsidies

Several approaches exist and are used by different institutions to define and measure fossil fuel subsidies. Globally, the most comprehensive published estimates for global fossil fuel subsidies are; the OECD[13] Inventory of Support Measures for Fossil Fuels, the IEA[14] Energy subsidies database and the IMF[15] Fossil Fuel Subsidies database. Estimates from these three organisations are based on different approaches, which provide complementary information.

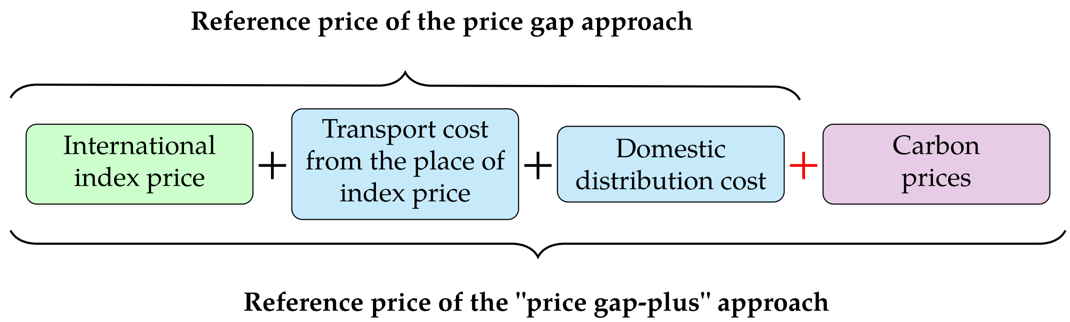
The IEA and IMF analyses of energy subsidies compare the end-use prices paid by fuel consumers with reference prices (such as import-parity prices). The IMF also includes production subsidies for selected countries as well as "implicit" subsidies to fossil fuels. The OECD Inventory covers measures that provide support (either absolute or relative) to fossil fuels, but it does not attempt to assess the impact on prices or quantities of the measures considered (Global Subsidies Initiative, 2024).
I will discuss (i) the International Energy Agency (IEA), which uses a price gap-plus approach; (ii) the International Monetary Fund (IMF), which uses the so-called comprehensive approach; (iii) the Organisation for Economic Co-operation and Development (OECD), which uses an inventory approach; and (iv) the SPF Finances (2024), which uses the bottom-up approach.

[13]The Organisation for Economic Co-operation and Development (OECD) is an international organisation established in 1961 to promote economic growth, stability and improvements in living standards among its member countries.

[14]The International Energy Agency (IEA) is an intergovernmental organisation established in 1974 to promote energy security through policy cooperation, information exchange, research and statistics.

[15]The International Monetary Fund (IMF) is an international organization established in 1944 to promote global monetary cooperation, exchange rate stability, and economic growth.

Figure 3: The Price Gap-plus Approach



Note: Reference prices include VAT where applicable. *Source:* International Energy Agency (2023a)

3.2.1 The Price Gap-plus Approach

The IEA's *price gap approach* begins by establishing a market reference price, which is derived from the international market prices of fossil fuels. This reference price includes adjustments for international transport costs and domestic distribution costs to ensure that it accurately reflects what consumers would pay in the absence of government intervention. End-user prices, which are the prices paid by consumers, are then compared to this market reference price. If the end-user price is lower than the market reference price, the difference is considered a subsidy. This straightforward method allows for clear identification of direct subsidies that reduce the cost of fossil fuels for consumers, it captures direct subsidies that result in consumers paying less than the market value for fossil fuels (International Energy Agency, 2023a).

However, according to the International Energy Agency (2023a), the price gap approach has limitations, notably that it does not take into account the externalities associated with fossil fuel consumption, such as environmental damage and health impacts. To address this issue, the IEA proposes a *price gap-plus approach*, which seeks to incorporate environmental aspects into the calculation of fossil fuel subsidies. This enhanced methodology adds a carbon price to the reference price, providing a more comprehensive view of the true cost of fossil fuels (see Figure 3).

The *price gap-plus approach* is an enhanced methodology that provides a more comprehensive view of the social cost of fossil fuel subsidies. As can be seen in

Figure 3, it is achieved by adding a carbon price to the market reference price. The carbon price represents the cost of carbon emissions associated with fossil fuel consumption. The chosen carbon price can vary widely, but for this methodology, a standard or average carbon price is determined based on global or regional carbon pricing initiatives. This carbon price is then added to the market reference price to generate an adjusted reference price. The end-user prices are compared to the adjusted reference price, which includes the carbon price. If the end-user price is still lower than the adjusted reference price, the difference is considered a subsidy that now also reflects environmental costs (International Energy Agency, 2023a).

It should be noted that the International Energy Agency (2024b) yearly publishes a time series of fossil fuel consumption subsidy estimates from 2010, by country and fuel. This file also separates the country-by-country estimates for subsidies to the transport sector. Unfortunately, there is no data available on Belgium.

3.2.2 The Comprehensive Approach

The International Monetary Fund's (IMF) methodology for assessing fossil fuel subsidies distinguishes explicit subsidies — where fossil fuels are sold below their supply costs — and implicit subsidies, which fail to internalize environmental costs and foregone tax revenues in retail prices. The *comprehensive approach* adopted by the IMF calculates the total fossil fuel subsidy by quantifying the gap between current retail prices and efficient prices, encompassing supply, environmental, and other associated costs (International Monetary Fund, 2024a; Black et al., 2023). This approach is similar to the price-gap method.

Explicit subsidies are quantified by subtracting the fuel user price from the sectoral unit supply cost, multiplied by sectoral fuel consumption. These subsidies directly impact government budgets through expenditure on subsidies or revenue losses from discounted pricing mechanisms.

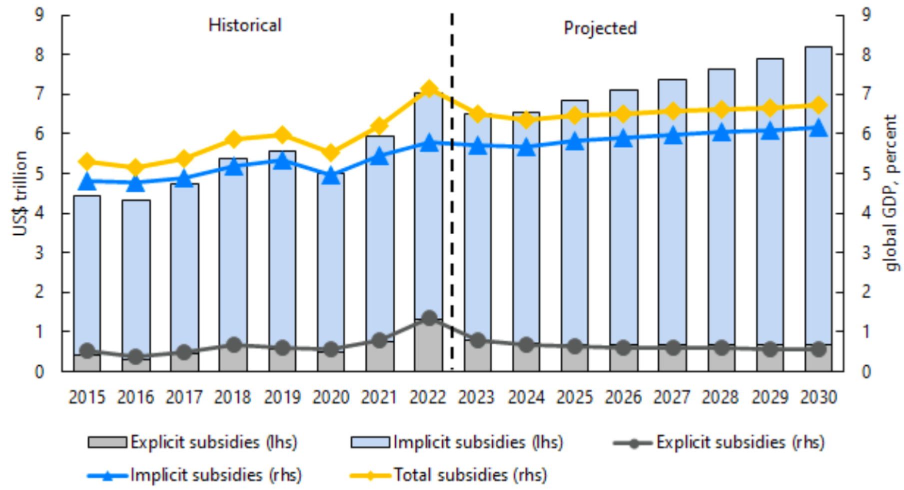
Implicit subsidies are equally crucial, encompassing undercharges in fuel prices relative to efficient levels that incorporate environmental externalities and forgone consumption tax revenues. Environmental externalities include climate change impacts and local air pollution, while forgone consumption tax revenues account for undercharges like value-added taxes. The IMF calculates these subsidies by assessing the difference between sectoral efficient fuel prices and actual user prices, multiplied by sectoral fuel consumption (International Monetary Fund, 2024a).

Data sources include national statistical agencies, energy market reports, and international databases that provide inputs on supply costs, user prices, and sector-specific consumption patterns. Assumptions about economic conditions, policy impacts, and price elasticities further refine the estimates. This meticulous approach ensures robust calculations that capture the true economic and environmental costs associated with fossil fuel consumption across sectors such as power generation, industry, transportation, and residential use.

The approach used by the International Monetary Fund (2024a) highlights a significant disparity between efficient and prevailing fossil fuel prices, exacerbated by the substantial societal costs linked to climate change impacts and the alarming toll of premature deaths attributed to fossil fuel-related air pollution. This systematic underpricing not only deprives governments of vital revenue streams but also undermines efforts towards equitable distribution and poverty alleviation (Black et al., 2023). This approach underscores the imperative to recalibrate energy pricing mechanisms to reflect true societal costs, enhance fiscal sustainability, and redirect fiscal resources towards more equitable and sustainable development pathways.

According to the International Monetary Fund (2024b), global fossil fuel subsidies amounted to USD 7 trillion (approximately EUR 6.16 trillion), or 7.1% of global GDP, in 2022 (see Figure 4). This represents a USD 2 trillion (approximately EUR 1.76 trillion) increase since 2020, largely driven by government interventions to support surging energy prices. While these subsidies are anticipated to decline in the near term as energy price support policies are rolled back and international prices fall, they are projected to rise again, reaching USD 8.2 trillion (approximately EUR 7.216 trillion) by 2030. This increase is expected, as the share of fuel consumption in emerging markets, where price gaps are generally larger, continues to grow. In 2022, 18% of these subsidies were due to undercharging supply costs (explicit subsidies), while 82% were due to undercharging environmental costs and forgone consumption taxes (implicit subsidies). By 2030, the share of explicit subsidies is projected to fall to 8%, highlighting a shift in the composition of these financial supports.

Figure 4: IMF Estimation and Forecast of Fossil Fuel Subsidies, 2015 to 2030



Source: International Monetary Fund (2024b).

3.2.3 The Inventory Approach

The inventory approach, also known as the programme-specific approach, involves quantifying the value of government programmes aimed at specific industries and consolidating them to determine the overall support level. It covers various forms of support, including reductions in mandatory payments, such as tax breaks, as well as the transfer of operational risks to the public sector, which goes beyond cash transfers. In addition, mandatory purchase requirements are usually included in this method, although only qualitatively. By tracking individual subsidies, the inventory approach helps to identify key political and economic leverage points for reform. It also increases transparency by compiling programme-specific data on government support for fossil fuels (Koplow, 2018; SPF Finances, 2023).

However, the inventory approach also has limitations. It does not inherently address questions on energy price impacts or pricing distortions without additional analysis, and discrepancies in policy coverage between inventories may emerge due to definitional disputes or data access challenges. Sensitivity to decisions on which programmes to include, reliance on programme-level data, and complications arising from differential baselines across political jurisdictions further underscore its complexity. Despite these challenges, the inventory approach remains a critical tool for identifying leverage points for reform and understanding the landscape of government support across various industries (Koplow & Dernbach, 2001; Kojima & Koplow, 2015)

The Total Support Estimate Approach

Subsidy inventories meticulously collect specific programme data on government support for fossil fuels, which can then be aggregated to enhance transparency. The Organisation for Economic Co-operation and Development (OECD) uses its Total Support Estimate (TSE), which includes both price distortions (net market transfers) and transfers that do not influence final market prices (net budgetary transfers), effectively consolidating price gap and inventory estimates (Elgouacem, 2020).

The OECD (2023) uses a detailed bottom-up methodology, collecting comprehensive data directly from official government sources such as budget reports. This approach focuses on individual support measures for fossil fuels, including both direct budget transfers and fiscal expenditures resulting from provisions that favour fossil fuel production or consumption over alternative sources.

The TSE provides a methodical approach to aggregating transfers and market support for specific sectors, monitoring individual policies on both the producer and consumer sides of the market. This allows their interactions to be assessed. The OECD adopts this bottom-up approach, listing direct subsidies and tax incentives for the production and use of fossil fuels and providing estimates of the amount of support provided by these measures (Kojima & Koplow, 2015; Koplow, 2018).

While this approach integrates transfers with market support into a comprehensive measure of support and separates effects on producer and consumer markets, it has limitations. OECD member countries determine the amounts and subsidies they report, leading to under-reporting of government support through the financial system. In addition, there is limited information on the calculations behind the estimates, and empirical data on producer and consumer subsidy equivalents (PSE and CSE) in fossil fuel markets remain scarce, although improving for OECD and selected other countries. In addition, the methodology does not take into account Pigouvian taxes (i.e. taxes on activities causing negative externalities) as such, and the classification of support measures does not take into account their original implementation objectives or their environmental and economic effects (Elgouacem, 2020; SPF Finances, 2023).

As for Belgium, this inventory includes direct subsidies (such as the fuel oil fund, social tariffs for natural gas and electricity, and the CPAS energy access support fund[16]) and tax expenditures on excise taxes applied to energy products, from the perspective of being included in the federal inventory of tax expenditures. However, no exact data is available on the Belgian level.

The OECD data show that the fiscal and opportunity costs of global support for fossil fuels almost doubled to more than USD 1.4 trillion (EUR 1.19 trillion) in 2022, up from EUR 653.65 billion in 2021 (OECD, 2023).

3.2.4 Federal Inventory of Subsidies for Fossil Fuels

As highlighted above, there exists a variety of approaches to quantifying fossil fuel subsidies, each with its own set of advantages and disadvantages. Differences in coverage and the exclusion of certain types of policies from quantitative estimates are common across institutions. Such exclusions may be due to methodological differences or divergent analytical objectives. Often, however, resource or data constraints prevent the systematic evaluation of more complex interventions.

For the purpose of this paper, I have decided to adopt the approach used by SPF Finances (2024), which has conducted a report as a response to the requirement from the National Energy and Climate Plan (NECP)[17] of drawing up and evaluating a list of existing fossil fuel subsidies at the federal level. The choice for the Belgian *Inventaire Fédéral des Subventions aux Énergies Fossiles* (Federal Inventory of Subsidies for Fossil Fuels) is driven by several elements tailored to the specific needs and objectives of this thesis.

Firstly, this thesis focuses exclusively on Belgium and therefore requires a data source that provides comprehensive insights into the country's fossil fuel subsidy

[16] See footnote 3.
[17] See footnote 2

landscape. By using the inventory compiled by SPF Finances, which specifically targets federal subsidies within Belgium, the research ensures relevance and accuracy in its analysis of the national energy transition context.

Secondly, the approach is in line with the methodology of the inventory approach above. Both methods involve quantifying the value of government programmes targeted at specific industries. These are then consolidated to determine the overall level of support. Similarly, both approaches provide comprehensive coverage of different forms of support, including direct subsidies and fiscal expenditures. This provides a total picture of government support to the fossil fuel sector. By using similar principles and methodologies, the SPF Finances (2024) approach is consistent with established approaches to assessing government support for fossil fuels.

Furthermore, the approach adopted by SPF Finances (2024) covers a wide range of subsidy types, including direct financial contributions and fiscal expenditure, providing a broader picture of government support for fossil fuels in Belgium. This comprehensive coverage is essential for a full understanding of the extent of subsidies and their impact on the energy sector and the economy as a whole. By including different forms of financial support, the inventory allows for a nuanced analysis of the subsidies in place, facilitating informed decisions and policy making.

In addition, the transparency and accessibility of the data provided by SPF Finances (2023) enhances the reliability and credibility of the research findings. Access to detailed information on specific subsidy programmes enables in-depth analysis and meaningful conclusions to be drawn. This transparency fosters trust among stakeholders and facilitates cooperation between researchers, policy makers and other relevant actors to further advance the transition towards a greener energy future in Belgium.

However, despite its strengths, a potential limitation of relying solely on the inventory compiled by SPF Finances (2024) is the inherent risk of under-reporting or misrepresentation of subsidy data. While the inventory aims to provide a comprehensive overview of government fossil fuel subsidies, there may be cases where certain subsidies or their impacts are not fully captured or accurately reported.

Moreover, a report on Belgian subsidies, authored by Belgian authorities, may not fully disclose all relevant details, potentially leading to underreporting.

Finally, the decision to adopt this approach is based on its alignment with the research objectives, its comprehensive coverage of the Belgian fossil fuel subsidy landscape and the transparency of the data. While acknowledging potential limitations, such as the risk of under-reporting, this thesis utilises the strengths of the SPF Finances (2024) inventory to offer valuable insights into Belgium's energy transition pathway. The data and methodologies explained in this thesis are derived from both SPF Finances (2023) and its updated version, SPF Finances (2024), published in May 2024. Although both reports use very similar methodologies, SPF Finances (2023) provides more detailed explanations, while SPF Finances (2024) tends to include more recent data.

Thus, SPF Finances (2024) relies mainly on the Inventory Approach. Some subsidies are *direct*; directly linked to the use of fossil fuel. Others are *indirect*; they encourage the consumption of a good or service that involves the use of fossil fuels. The Inventory lists subsidies by classifying them according to the nature of the instrument used. The consolidation of all these fossil fuel subsidies in Belgium, according to the SPF Finances (2023); SPF Finances (2024), from 2015 to 2021 can be found in Table 5. This table brings together all the subsidies that will be discussed in more detail in the rest of this section.

Figure 5: Subsidies on Energy Products: Reduced Rates and Exemptions, EUR millions, 2015 to 2021

	2015	2016	2017	2018	2019	2020	2021
Direct Subsidies	***13029.19***	***12111.95***	**12379.8**	**11676.2**	**11475**	**11378.6**	**12096**
As % of GDP	***3.10%***	***2.80%***	**2.80%**	**2.50%**	**2.40%**	**2.50%**	**2.40%**
Transfers - permanent measures	**141.9**	**143.9**	**152.1**	**156.7**	**178.2**	**165.6**	**173.1**
Social tariff, natural gas	59	65	70	74	89	79	95.3
Social tariff, electricity*	30.3	31	32.8	33.8	36.7	35.2	28
CPAS**, natural gas	22	22	22	22	25	25.1	25.2
CPAS**, electricity*	12.7	9.8	10	10	10.9	11.7	10.8
Fuel Oil Fund	17.9	16.1	17.3	16.9	16.6	14.6	13.8
Transfers - temporary measures	**0**	**0**	**0**	**0**	**0**	**0**	**215.8**
Extended social tariff, natural gas (BIM)							154.8
Extended social tariff, electricity* (BIM)							38.3
One-off bonus of EUR 80*							22.7
Income tax	**348.4**	**327.4**	**411.4**	**520.8**	**534.5**	**553.2**	**667.1**
Fuel cards	348.4	327.4	411.4	520.8	534.5	553.2	667.1
VAT	**1.9**	**1.9**	**3.7**	**3.6**	**2.9**	**2.4**	**2.4**
Reduced rate on coal	1.9	1.9	3.7	3.6	2.9	2.4	2.4
Excise Duties	**12086.99**	**11211.95**	**11812.6**	**10995.1**	**10759.4**	**10657.4**	**11037.6**
Rate differential across products	***7594.71***	***6275.66***	***5971.7***	***5587.4***	***5234.8***	***4854.5***	***5534***
Diesel	1637.96	1441.81	1049.9	696	410.4	257.4	382.9
Kerosene							
Heavy fuel oil	5.3	26.1	27.3	26	20.1	52.8	16.9
LPG	9.3	5.9	9.3	6.7	5.4	6	9.7
Natural gas	5610.05	4706.55	4884.9	4848.1	4741.5	4538	5124.3
Coal and coke	332.1	95.3	0.3	10.6	57.4	0.3	0.2
Specific rates for the same product	***3901.06***	***4376.82***	***5098.4***	***4732.6***	***4742.1***	***5067.5***	***4737.5***
Heating oil	2586.46	2385.62	2534.6	2266	2129.8	2263.3	2096.5
Gas oil, industrial and commercial use	370.7	361.6	428.6	386.3	415.6	383.7	375
Reimbursement diesel, professional use	812.3	692.7	702.9	668.2	958.8	1215.9	891.5
Kerosene, used as fuel	33.3	32.3	36.9	37	34.9	32.5	41.5
Kerosene, used as engine fuel	3.7	3.9	5.7	4.6	3.4	2.3	2.4
LPG, used as fuel	94.6	99.4	119	120.3	108.6	138.7	140
Natural gas at reduced rate	0	801.3	1270.7	1250.2	1091	1031.1	1190.6
Subsidies on intermediate consumption	***591.22***	***559.47***	***742.5***	***675.1***	***782.5***	***735.4***	***766.1***
Ships and aircraf[1]	27.24	24.48	33.4	28.8	36.9	22.6	22.7
Rail transport	6.12	5.21	18	23	17.7	15.6	16
Inland navigation	36.81	29.41	94.6	93.1	86.6	84.3	86.1
Dredging activities	82.53	85.09	78.9	70.3	75	53.9	59.1
Agricultural and horicultural work,...[2]	438.52	415.28	517.6	459.9	566.3	559	582.2
Maritime and international air transport subsidies			913.71	1027.04	989.63	711.97	893.66
As % of GDP			**0.20%**	**0.20%**	**0.20%**	**0.20%**	**0.20%**
Aviation kersosene exemption	450	426.8	627.86	672.95	676.99	471.8	594.17
Excise duty exemption for heavy fuel oil[3]			245.39	304.3	268.07	188.09	241.92
Excise duty exemption for diesel[3]			40.46	49.79	44.57	52.08	57.57
Indirect subsidies	**1743.13**	**1864.15**	**2177.28**	**2307**	**2476.61**	**2466.07**	**2609.32**
As % of GDP	**0.40%**	**0.40%**	**0.50%**	**0.50%**	**0.50%**	**0.50%**	**0.50%**
Company cars	1541.13	1670.05	1963.48	2084.8	2248.31	2404.17	2522.52
VAT, exemption for airline tickets	202	194.1	213.8	222.2	228.3	61.9	86.8
Subsidies on products for non-energy us	**0**	**0**	**6007.2**	**6249.4**	**5723**	**5604.1**	**5941.1**
As % of GDP			**1.30%**	**1.40%**	**1.20%**	**1.20%**	**1.20%**
Coal tar			198.6	210	203.7	192.1	168.9
LPG			1091.5	1641.9	1705.1	1577.8	1645.8
Nafta			2478.2	2427.1	1999.5	2037.5	2310.8
Heavy fuel oil			11.9	13.9	14.3	14.2	14.2
White spirit and cooking gasoline			9.5	6.3	3.5	5.2	3.3
Lubricants			68.4	64.5	60.9	42.5	46.4
Bitumen			234	238.9	219.4	194.9	227.4
Petroleum coking			13.6	14.6	14.8	17.9	18.1
Paraffin waxes			13.5	12.5	12.9	12.7	12.9
Other oil products			1019.4	780.7	685.3	606.9	685.6
Natural gas			868.6	839	803.6	902.4	807.7
TOTAL (EUR millions)	**14772.32**	**13976.1**	**21477.99**	**21259.64**	**20664.24**	**20160.74**	**21540.08**
As % of GDP	**3.50%**	**3.20%**	**4.80%**	**4.60%**	**4.30%**	**4.40%**	**4.30%**

Note: * = for electricity, the production mix is taken into account; ** = Public Centre for Social Welfare (CPAS-OCMW); [1] = Manufacturing, development, testing and maintenance of aircraft and ships; [2] = Agricultural and horticultural work, fish farming and forestry; [3] = Excise duty exemption for heavy fuel oil and for diesel, for international maritime transport.

For 2015 and 2016, slightly different methodology has been used; the paraffin excise duty exemption (aviation) is included in direct subsidies. Exemptions from excise duty on heavy fuel oil and diesel (international shipping), as well as subsidies on products for non-energy use (feedstocks), are not included either.

Source: SPF Finances (2023); SPF Finances (2024).

3.3 Analysis of Direct Fossil Fuel Subsidies in Belgium

In this Section, I will discuss the *direct* fossil fuel subsidies granted in Belgium. Direct subsidies are subsidies that are directly linked to the use of fossil fuels. In 2021, direct fossil fuel subsidies accounted for EUR 12,096.2 million, which is the equivalent of 2.4% of the Belgian GDP (SPF Finances, 2024). Following the structure of Table 5, used by SPF Finances (2024), I will first discuss budget expenditure, followed by tax expenditure on income tax and VAT, and, lastly, excise duty.

3.3.1 Budget Expenditure

Budget expenditure on fossil fuels amounts to EUR 388.9 million in 2021 (SPF Finances, 2024). In 2021, it consisted of the social tariff (EUR 28 million for electricity and EUR 95.3 million for natural gas), the CPAS (EUR 10.8 million for electricity and EUR 25.2 million for natural gas - both through its Energy Access Fund) and EUR 13.8 million for heating oil and other eligible fuels through the Social Fund for Heating. In addition, it is also consistent in transfers that are part of temporary measures, which reach a total of EUR 215.8 million in 2021 (SPF Finances, 2024).

To better understand the origin of the budgetary expenditure in Belgium, I will first trace the history of the energy market. The evolution of the energy market in the European Union has been shaped by a series of legislative directives, starting with the first package in 1996. These directives, aimed at liberalising the energy sector, began the process of dismantling monopolies in the production and supply of electricity, thus clearing the way for increased competition and market access for all stakeholders. Subsequent packages, introduced in 2003, 2009 and 2019, refined and extended these efforts, with a focus on promoting competition, improving network infrastructure and setting ambitious energy and climate targets for Member States (El Guendi & Thierry, 2023; Eberlein, 2008).

These directives aim to create a more competitive and efficient energy market. However, their implementation has been influenced by the different energy policies and priorities of individual Member States. This has resulted in a complex regulatory landscape characterised by different degrees of market liberalisation and regulatory intervention in different jurisdictions.

Despite the potential benefits of increased competition, concerns have been raised about the impact of liberalisation on electricity prices and consumer protection. The intensification of competition may lead suppliers to prioritise cost-cutting measures, potentially compromising service quality and consumer welfare. Furthermore, the liberalisation process has highlighted the need for a robust regulatory framework to ensure fair competition, protect vulnerable consumers and promote sustainable energy development.

In Belgium, the liberalisation of the energy market has increased consumer choice. However, although the incumbents' market share has fallen, they remain the dominant players in the energy market. This situation raises questions about the primary objective of market liberalisation, which was to promote competition and lower prices for consumers. It is therefore arguable whether consumers are really benefiting from lower prices as a result of competition in the energy market.

This leads to an important concept; energy poverty. The issue of energy poverty has become increasingly relevant. The concept of energy poverty, although not formally defined until recent decades, has historical roots dating back centuries. Throughout history, certain social groups, such as the farming community in the Middle Ages, faced challenges accessing energy resources, exemplified by their limited access to wood from the estates. However, it was not until the 1990s that the term *Fuel Poverty* was first conceptualised in academic literature in the UK. Before this, academics like Bradshaw & Hutton (1983) had alluded to the concept in a broader sense. This early notion primarily focused on households struggling to adequately heat their homes, with an emphasis on heating methods. It was Brenda Boardman's seminal work *Fuel poverty: from cold houses to affordable heat* that, in 1991, provided a specific definition of fuel poverty, bringing attention to the issue and laying the groundwork for further research and policy development (Boardman, 1991; El Guendi & Thierry, 2023).

According to the European Union, energy poverty occurs when a household must reduce its energy consumption to a degree that negatively impacts the inhabitants' health and well-being. Therefore, the European Commission's message is clear: energy poverty must be tackled by addressing its root causes through structural and targeted measures, and in particular through energy efficiency (European Commission, 2023a). Meanwhile, there is no unanimous definition of fuel poverty within the European Union. Although some official European documents recognise that *energy is essential for all Europeans* (European Commission, 2007), there is no common definition across the Member States. Some countries, such as France, have precise criteria, such as *a household is in a situation of fuel poverty when its energy expenditure in its dwelling exceeds 8% of its income, and its income per consumption unit (CU) is below the 3rd decile of income per consumption unit* (Charlier et al., 2015), while others remain fairly vague about the concept of fuel poverty. In 2020, the European Commission proposed new recommendations as part of its *renovation wave* strategy, highlighting the need for Member States to define fuel poverty (Andrijauskiene et al., 2021).

In Belgium, the concept of energy poverty is not explicitly mentioned in legal texts, although Belgian authorities have long been concerned about this phenomenon. According to the Belgian SPF Economie (Federal Public Service for Economy), one could assert that a household in energy poverty is one that cannot meet its energy needs without making sacrifices or foregoing other commonly consumed goods (Bonnard et al., 2014). There is also mention of minimal comfort, which is, once again, a relatively subjective concept that is difficult to quantify.

Within the energy sector, the Belgian legislation uses the term *protected customer* to refer to *an individual in a financially or socially vulnerable situation, meeting certain conditions in terms of income, disability, family situation, etc., and benefiting from specific social protection in the context of electricity and gas supply compared to an unprotected customer*. Protected customers are entitled to a social tariff lower than market prices for electricity and gas from each supplier. The definition of a *protected customer* is not identical at federal and regional levels in Belgium. The federal level is primarily responsible for tariff setting, while the regional level addresses issues related to the protection of the protected customers - the Brussels and Walloon Region extend the concept of protected customers to a larger group (SPF Finances, 2023).

The Fondation Roi Baudouin (2024) uses the energy poverty barometer, which assesses three dimensions: measured energy poverty (PEm) for households spending too much on energy in comparison to their income after housing costs, hidden energy poverty (PEc) for those limiting basic needs due to low energy bills, and perceived energy poverty (PEr) reflecting subjective and declarative experiences. According to the Fondation Roi Baudouin (2024), 21.8% of households faced at least one of the three forms of fuel poverty, an increase of 6.9% compared with 2021. Over 62.9% of households at risk of poverty - i.e. with an income below 60% of the national median equivalent income - suffer from at least one form of fuel poverty, and social tenants appear to be more vulnerable to fuel poverty.

Social Tariff

As discussed above, access to affordable energy is essential for individual and household wellbeing and socio-economic development. However, vulnerable households often face challenges in meeting their energy needs. This is often due to financial constraints or social exclusion. In response to these challenges, governments around the world have introduced social tariffs as a policy mechanism to reduce the burden of energy costs for disadvantaged groups. In 2021, this subsidy amounts to EUR 95 million for natural gas and EUR 89 million for electricity (SPF Finances, 2024).

The introduction of social tariffs for electricity and gas in Belgium in 2003 was a milestone in the country's efforts to tackle energy poverty. These tariffs are administered by the Commission for Electricity and Gas Regulation (CREG)[18], and target individuals or households in precarious situations and offer preferential pricing for essential energy services. Eligibility criteria include recipients of social assistance, some beneficiaries of pension services and those receiving social integration support. While the federal government oversees the administration of social tariffs, there are regional differences in terms of additional eligibility criteria and support measures.

In Belgium, the social tariff structure includes different types of measurement, including single, two-hourly or exclusive night meters for electricity, while a uniform approach is taken for natural gas and heat (CREG, 2021). Periodic reviews by the CREG ensure that tariffs remain responsive to market dynamics and accessible to eligible beneficiaries. However, limitations such as the exclusion of fixed charges and subscription fees pose challenges for some households, particularly those with

[18]The Commission for Electricity and Gas Regulation (CREG) is the regulatory body in charge of the supervision and regulation of the electricity and natural gas markets in Belgium.

budget meters.

Despite their good intentions, social tariffs face challenges in fully addressing the needs of vulnerable households. Limited coverage of ancillary services and potential disincentives to energy conservation are barriers to maximising the effectiveness of social tariffs (King Baudouin Foundation, 2020). In addition, disparities in regional implementation and coverage highlight the need for greater coordination and cooperation between federal and regional authorities (SPF Finances, 2024).

The social tariff is identical for all energy suppliers and distribution network operators. People who are entitled to it are also exempt from paying for the rental of their electricity or natural gas meter. Moreover, the tariff has been extended to collective boilers located in social buildings of the Public Centre for Social Welfare (CPAS)[19], housing funds and social property agencies. In addition, the government has agreed to the possibility of extending the target group to all those who are entitled to increased intervention, following the European regulations (SPF Economy, 2019).

CREG calculates and publishes the social tariff every three months, based on the lowest commercial tariffs of electricity and gas suppliers - before July 2020 it was every six months. The tariff includes the energy component, transmission and distribution network tariffs. It does not include VAT and the federal contribution on electricity and gas, nor the connection fee to the network in Wallonia or the contribution to the energy fund in Flanders. Since the social tariff is not only the lowest commercial tariff, but also includes the most favourable distribution tariff, regardless of the consumer's location, and a capping mechanism that limits the impact of electricity and gas price increases, the isolation of the subsidy component is complex. Therefore, Table 1 compares the average price and the social tariff, the difference is considered as the subsidy (SPF Finances, 2024). This methodology is also used by OECD (2023).

[19]The Public Centre for Social Welfare (CPAS) is a public institution in Belgium responsible for providing social assistance and welfare services to residents in need. It plays a crucial role in ensuring social protection and promoting the well-being of individuals and families facing financial difficulties or other social challenges.

Table 1: Social Tariff, April 2024

Category	Average Price (EUR/year)	Social Tariff (EUR/year)	Share of social customers
Electricity	1,069.67	724.91	9.89%
Natural gas	1,239.08	786.77	10.41%

Note: The share of social customers is the number of social customers divided by the total number of residential customers.
Source: CREG (2024).

As can be seen in Table 2, these tariffs only account for half of the households in energy poverty. There are two explanations for this; (i) some households may not claim their rights, and (ii) access criteria are linked to people's status[20] rather than their income (SPF Finances, 2023). Furthermore, it can be observed that there exist some disparities in Belgium, as the Walloon and Brussels Region count, proportionately, more households in fuel poverty, than Flanders.

Table 2: Energy Poverty and Social Tariff, 2020

	Brussels	Flanders	Wallonia	**Belgium**
% of households in fuel poverty	26.5 %	15.9 %	29.5 %	**21,5 %**
% of social tariff beneficiaries for electricity	12.74 %	8.41 %	11.90 %	**10.02 %**
% of social tariff beneficiaries for natural gas	13.13 %	8.99 %	13.90 %	**10.95 %**

Note: The % of households in fuel poverty reflects the share of households in at least one of the following categories: measured energy poverty, hidden energy poverty and perceived energy poverty.
Source: SPF Finances (2023).

Nevertheless, it should be noted that these social tariffs change the price signal: they introduce price distortions between the actual cost of fossil energy consumption and do not encourage households to reduce their consumption of fossil fuels, switch to less harmful energy, or invest in energy-efficient housing. They therefore run counter to the objective of integrating external costs. While homeowners could choose a different heating system or carry out insulation work to reduce their energy consumption, tenants do not have this capacity. Therefore the negative consequences of the change in the price signal must be put into perspective.

CPAS

[20]The social tariff is allocated to households that meet certain conditions (Fédération Wallonie-Bruxelles, 2024a).

The *Centre Public d'Action Sociale* (Public Centre for Social Welfare), or the CPAS[21], introduced its **Energy Access Support Fund** in 2002. The CPAS operates in conjunction with social tariffs and the Social Fund for Heating and is part of the wider energy fund landscape. Supported by transfers from the CREG[22], this initiative aims to strengthen the financial capacity of the CPAS to ensure energy access for low-income and highly indebted households. Fund allocations primarily support CPAS debt mediation and budget counselling services, as well as direct interventions to settle outstanding debts. Despite aid provisions to encourage the transition from electric or coal heating to more energy-efficient heating systems, the effectiveness of the initiative remains limited. This is due to its mismatch with the typical housing tenure of the target population, which is mainly composed of people who do not own their own homes. Preventive CPAS initiatives also include the procurement of energy-efficient appliances and the maintenance or upgrading of energy-related infrastructure (SPF Finances, 2023). In contrast to the social tariff, this mechanism does not directly affect prices. In 2021, the subsidy amounted to EUR 25 million for natural gas and EUR 34 million for electricity (SPF Finances, 2024).

In Belgium, since 2004, low-income households also benefited from another direct support mechanism: the **Social Fund for Heating**. Originally established during a period of significant fuel price increases, particularly for heating oil, the fund has been extended to households using propane gas. It operates through cooperation between the public authorities, the CPAS and the oil sector, and provides partial support for heating bills for specific target groups. Beneficiaries include people receiving enhanced assistance from the *Institut National d'Assurance Maladie-Invalidité* (National Institute for Health and Disability Insurance)[23], recipients of income integration benefits and those undergoing debt mediation. Through the CPAS, it provides support for a maximum of 1,500 litres of heating oil or an equivalent amount for other eligible fuels, with a maximum total support of €300 per household per heating season. The amount of the subsidy varies between 14 and 20 cents per litre, depending on the invoiced price per litre including VAT. In addition, in response to the energy crisis, the Fund's allocations have been increased for

[21] The Centre Public d'Action Sociale (CPAS) is a Belgian institution that provides social assistance and welfare services to those in need at the local level.

[22] See footnote 18

[23] The Institut National d'Assurance Maladie-Invalidité (INAMI) is a Belgian institute, responsible for managing the country's health and disability insurance system.

deliveries from July 2022, with the maximum grant per household increasing from EUR 300 to EUR 720 and the maximum amount of fuel supported per household per heating season increasing from 1,500 to 2,000 litres. In total, the subsidy for the Social Fund for Heating amounted to EUR 14 million in 2021 (SPF Finances, 2024).

The provided support consists of the reimbursement of a pre-determined and capped proportion of energy consumption. While it reduces the total amount of the bill, unlike social tariffs, it only affects the marginal cost of energy consumption once it exceeds the intervention threshold. From an environmental perspective, the negative impact is therefore less pronounced. Access to the subsidy is linked to specific fuels, which may be explained by the fact that, as mentioned above, it is linked to an increase in the heating oil price. However, maintaining this link seems unjustified as heating oil is not exclusively used by low-income households. Moreover, this system reduces incentives to switch to alternative energy sources that are less or not at all dependent on fossil fuels.

Temporary Measures

The social tariff system in Belgium has played a crucial role in supporting vulnerable populations, particularly those classified under the *Bénéficiaire de l'Intervention Majorée*(Beneficiary of the Increased Intervention, BIM) category. The extended social tariff has provided significant financial relief to eligible households for both natural gas and electricity consumption. Specifically, the extended social tariff for natural gas amounted to €154.8, while for electricity, it provided a benefit of €38.3. These measures have been instrumental in alleviating energy costs for those in need during the energy crisis of 2022 (Fédération Wallonie-Bruxelles, 2024b; SPF Finances, 2024).

However, it is important to note that as of 1 July 2023, the extended social tariff for the BIM category has been abolished. This measure had been in force since 1 February 2021, providing substantial relief during its period of implementation (Fédération Wallonie-Bruxelles, 2024b). The abolition marks a significant shift in the support framework for energy consumers, necessitating a reassessment of how vulnerable populations will be supported moving forward. The discontinuation of the extended social tariff underscores the ongoing challenges in balancing social welfare with economic and policy considerations in the energy sector.

In addition to the extended social tariffs, a one-off bonus of EUR 80 was also granted to beneficiaries of the social electricity tariff. This bonus was applied to the electricity supply and provided on 30 September 2021. This lump-sum payment further aided households in managing their energy expenses during a time when energy prices were particularly volatile. The combination of these financial supports ensured that the most vulnerable could maintain access to essential energy services without facing undue financial hardship (SPF Finances, 2024).

From an environmental perspective, while the social tariffs provided necessary financial support, they also highlighted the need for mechanisms that mitigate potential negative environmental impacts. Subsidies, while socially justified, can sometimes lead to increased energy consumption, which in turn can exacerbate environmental degradation. Therefore, future policy considerations must strive to balance the dual objectives of social support and environmental sustainability, ensuring that vulnerable populations receive necessary assistance without compromising long-term ecological goals.

Conclusion on Budget Expenditure

The comparison of the different mechanisms described above illustrates the complex interaction between socio-economic needs and environmental objectives in energy policy. Although energy assistance programmes play a crucial role in helping financially vulnerable households cope with high energy costs, they consequently contribute to continued dependence on fossil fuels. This challenges sustainability efforts by continuing environmental damage while addressing immediate social needs.

At its core, the challenge lies in the inherent structure of conventional energy aid mechanisms, which focus primarily on alleviating immediate financial burdens without simultaneously promoting long-term shifts towards cleaner, renewable energy alternatives. By addressing affordability concerns alone, without integrating strategies to improve energy efficiency or promote the uptake of renewable energy, there is a risk of reinforcing entrenched patterns of fossil fuel dependency among marginalised communities. This phenomenon not only perpetuates environmental degradation but also undermines broader initiatives to mitigate climate change and transition to low-carbon energy systems.

A more nuanced approach to energy assistance that balances the twin goals of social equity and environmental sustainability is needed. This means rethinking existing support frameworks to prioritise initiatives that not only alleviate the immediate financial burden of fossil fuels, but also empower vulnerable households to adopt energy-saving measures, adopt renewable energy technologies and improve the energy efficiency of their housing. By aligning social welfare imperatives with broader environmental goals, policymakers can catalyze transformative change towards a more equitable, resilient and sustainable energy landscape that promotes inclusive prosperity while safeguarding the planet for future generations.

Tackling fuel poverty among vulnerable households, particularly renters, requires a multi-faceted approach that balances social welfare imperatives with environmental sustainability goals. One key strategy is to improve rental housing standards to ensure energy efficiency. By requiring landlords to meet strict energy performance criteria before renting out properties, the government can reduce energy-related financial burdens on tenants while reducing overall energy consumption and greenhouse gas emissions. Financial incentives and subsidies will improve the comfort and affordability of rental housing by encouraging landlords to carry out energy-efficient renovations, such as installing insulation or upgrading heating systems.

In Belgium, the energy performance of buildings is assessed through region-specific energy performance certificates (EPCs), each tailored to the regulatory framework of its respective region. In Wallonia, there is the *Certificat de Performance Energétique* (Energy Performance Certificate) [24], which is similar to the one in the Brussels-Capital Region, also called the *Certificat de Performance Energétique*[25],

[24] The Certificat de Performance Energétique (CPE) provides detailed insights into a building's energy efficiency, including consumption data and CO_2 emissions, serving as a mandatory requirement for residential properties on sale or rent

[25] The Certificat de Performance Energétique (CPE) for the Brussels-Capital Region urnishes prospective buyers or tenants with comprehensive information on energy usage and recommendations for enhancing efficiency

and in Flanders, the *Energieprestatiecertificaat* (Energy performance certificate)[26]. While these certificates share the common goal of promoting energy-conscious decisions in the real estate market, their nuances reflect regional variations in regulations and practices, underscoring the importance of localized approaches to sustainable building management.

In Belgium, various government programs offer financial assistance to homeowners and landlords for energy-efficient renovations, including insulation, heating system upgrades, and renewable energy installations. These initiatives play a crucial role in improving the energy efficiency of residential properties, ultimately reducing energy costs for occupants while enhancing overall comfort. For instance, in the Walloon Region, programs like *Primes Renovation* (Renovation Grants)[27] provide homeowners with financial support to undertake energy-saving measures. Similarly, the Brussels-Capital Region offers subsidies through initiatives like the *Primes Renolution* (Renolution Premiums)[28] scheme, aimed at encouraging energy-efficient renovations in residential buildings. Additionally, in Flanders, homeowners and landlords can access grants and loans through schemes such as the Mijn VerbouwPremie (My Renovation Premium)[29], facilitating investments in energy efficiency improvements. By incentivizing and supporting energy renovations, these programs contribute to the country's sustainability goals while promoting the well-being of residents and tenants.

However, targeted support programs specifically designed for low-income tenants are essential, as they cannot choose to improve the energy-efficiency of their current housing, and often do not have the resources to move to more energy-efficient housing. While 14.6% of homeowners (with or without a mortgage) are affected by some form of fuel poverty, 32.3% of private tenants and 46.2% of social tenants are affected by this problem (Fondation Roi Baudouin, 2020). It is therefore crucial to design policies that also aim to support these households.

[26]The Energieprestatiecertificaat (ECP) fulfills the same purpose as both CPEs, ensuring that residential properties adhere to energy efficiency standards during transactions

[27]The *Primes Renovations* are an initiative by the Walloon region aimed at providing financial support for energy-efficient home improvement projects

[28]The *Primes Renolution* are made available to support renovation and energy-saving work. They are reserved for buildings in the Brussels-Capital Region.

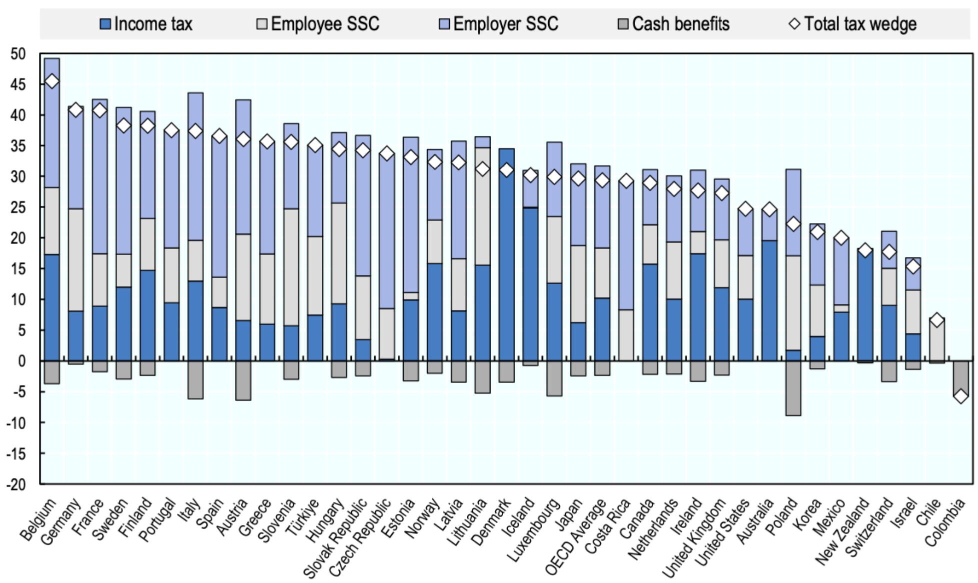
[29]The *Mijn VerbouwPremie* is a premium from the Flemish government for renovation and energy-saving investments

3.3.2 Tax Expenditure on Income Tax

One of the most costly tax schemes in terms of budgetary and environmental impact is the company car, which benefits from favourable tax treatment. In Belgium, company cars have long been a prevalent feature of the transportation landscape, with a significant portion of the workforce relying on them for their daily commute and professional activities. Trends indicate a steady increase in company car ownership over the years, reflecting their importance in employee compensation packages and mobility preferences May (2017); Copenhagen Economics (2010). Understanding the historical context and prevalence of company cars in Belgium is essential for a comprehensive analysis of their tax implications and environmental consequences.

Originally, company cars were introduced as part of extra-legal benefits. They have since become an integral part of many companies' remuneration strategies. The introduction of company cars can be linked to the historically high tax pressure on wages in Belgium. The Belgian labour tax system is the highest in the European Union (EU), with an overall tax burden on labour, as measured by the tax wedge on a single earner on average earnings, of 55.3% (compared to 42.9% on average in the EU in 2015). For a two-earner couple, Belgium also has the highest tax wedge as a percentage of labour costs compared to OECD countries, with 45.5% in 2022, as shown in Figure 6 (OECD, 2023).

Figure 6: Income Tax plus Employee and Employer Social Security Contributions less Cash Benefits, 2022



Note: Two-earner married couple, one at 100% and the other at 67% of the average wage, with two children. Includes payroll taxes where applicable. In 2022, for this household type, the OECD average tax wedge as a percentage of labour costs is 29.4%, in Belgium this is 45.5% (the highest among OECD countries for this household type).
Source: OECD (2023).

As company cars belong to the extralegal benefits category, they are an indirect form of subsidy, while fuel cards are considered to be direct subsidies. Therefore fuel costs will be discussed in this section, while company cars are discussed separately in Section 3.4.1.

Fuel costs

The *fuel card scheme* in Belgium is a direct subsidy that departs from traditional taxation principles regarding vehicle-related expenses. Typically, employees bear the costs associated with private and commuting use, including fuel expenses. However, the current tax framework in Belgium deviates from this norm with regard to the benefit received from employer-provided fuel cards. In particular, this benefit remains exempt from social security contributions, unlike other forms of compensation. Moreover, if the employer pays all or part of the fuel costs for a company car, 40% of the taxable benefit is not deductible for corporate income tax purposes. In addition, the employee receiving the benefit is not taxed, which underlines the subsidy embedded in the fuel card scheme. Thus, the fuel card scheme effectively subsidises fuel expenses related to company cars and serves as a direct financial support mechanism within the broader Belgian company car regime. In 2022, the subsidy amounted to EUR 864.9 million SPF Finances (2024).

Various studies suggest that the vast majority of company car beneficiaries also receive fuel cards, with percentages ranging from 76% to 88% depending on the study (Venneman et al., 2012; SPF Finances, 2024). Unfortunately, administrative records do not provide specific information on the exact number of company car drivers using these fuel cards. CLIMACT (2019) estimates the subsidy related to the provision of fuel cards at EUR 222.4 million for the period 2014-2016. This estimate considered various factors including tax and social security contributions and adjustments for corporation tax. CLIMACT (2019) uses a personal income tax rate of 28%, nominal rates for social security contributions, and assumes 424,557 company cars for employees and 150,000 for directors. The SPF Finances (2024) has updated these calculations by adjusting for changes in the marginal rate, fuel prices, the number of company cars, and tax rates, and thus estimates a higher subsidy (EUR 864.9 million in 2022, as mentioned above). For comparison, SPF Finances (2024) estimates the subsidy at EUR 348.0 million in 2015.

Subsidising fuel cards provides a significant financial incentive that reinforces dependence on fossil fuels and undermines efforts to transition to cleaner energy alternatives. By covering the cost of fuel used for private purposes, employers effectively remove the marginal cost of private mileage, thereby incentivizing the use of company cars for non-business travel. This practice not only contradicts the objectives of energy and vehicle taxation to reduce fuel consumption but also worsens environmental degradation.

It must be noted that, as will be discussed in Section 3.4.1, there will be a rise in the number of electric company cars in the following years, which will also have an impact on the fuel card. Logically, employees owning an electric company card will no longer buy fuel with their fuel card, but will now use the advantage for charging their car. Additionally, many employees will want to install a charging station at home. The tax reduction amount for an individual installing a charging station is a percentage of the total eligible expenses. Since April 1, 2023, the reduction has been 30%, and it will most likely further decrease in the future (SPF Finances, 2024).

Despite the growing popularity of electric vehicles (EVs), May (2017) highlights the misconception that they are entirely environmentally friendly. The manufacturing process of EVs and their batteries consumes more energy than what is needed for traditional vehicles. Moreover, the ecological aspect depends heavily on the energy sources used to power these vehicles, whether it be natural gas, nuclear, or renewable energy. Additionally, like their combustion engine counterparts, EVs emit particulate matter during operation, primarily through tyre and brake wear. May (2017) emphasises that the environmental impact extends beyond the vehicles themselves, as it includes the resources and energy required for expanding electrification infrastructure. It is crucial to acknowledge these complexities when considering the overall environmental footprint of EVs.

3.3.3 VAT

The *Value Added Tax* (VAT) is a general tax levied on the final consumption of goods and services within the territory of a country. It is standardised at a single rate and reduced rates are considered subsidies.

In Belgium, the VAT[30] is a consumption tax borne by the final consumer. It is levied at successive stages, i.e. at each transaction in the production and distribution process. The standard rate being 21%, more advantageous rates of 0%, 6% and 12% also exist, which apply to certain categories of goods and services.

Subsidies related to VAT provisions can be divided into two sections. First, I will consider VAT on energy consumption, then I will analyse VAT on transport services.

VAT on Energy Consumption

Solid fuels

[30]More information is available on https://www.belgium.be/en/economy/business/taxation_and_accounting/tva.

Solid fuels[31], i.e. coal, coke, lignite and similar fuels, benefit from a reduced VAT rate of 12%. Hence, this is a direct subsidy, estimated at EUR 2.4 million for coal in 2021, according to SPF Finances (2023). Solid fuels account for 2.5% of energy consumption, and only 0.3% of tax revenue (European Commission, 2020).

While a reduced VAT rate is intended for goods and services that are considered economically and socially important, it presents a certain contradiction when applied to coal. Despite its economic importance, coal is undoubtedly one of the most polluting fossil fuels available. When burned, it releases large amounts of CO_2 and other pollutants into the atmosphere. This exacerbates climate change and contributes to air pollution. Balat (2007) states that coal is a significant contributor to global greenhouse gas emissions, accounting for 30-40% of global CO_2 emissions from fossil fuels. This underlines the significant environmental impact associated with the use of coal.

Taxing coal at the standard 21% VAT rate would more accurately reflect the true environmental costs of its production and consumption. Such a measure could act as a strong incentive to transition to cleaner and more sustainable energy sources. Not only would it align taxation with environmental objectives, it would also stimulate investment in renewable energy technologies. Ultimately, taxing coal at a higher rate would be a step towards phasing out coal consumption.

Electricity and Natural Gas

In April 2014, the Belgian government reduced the VAT rate on electricity prices from 21% to 6% as a measure to support low-income families. Following a change of government in September 2015, however, this tax reduction was reversed and the VAT rate was restored to 21% (Hindriks & Serse, 2022).

In 2022, energy became a political weapon with the outbreak of Russia's war against Ukraine. This had a significant impact on European energy markets. While most countries were still recovering from the COVID-19 crisis, the energy crisis caused by this war reached its peak in August 2022, when energy prices hit record levels. Households and businesses across Europe, including Belgium, faced exceptionally

[31] Solid fuels are combustible substances that are in a solid state at room temperature and can undergo combustion to release energy.

high energy bills (Council, 2024). In response to this financial burden on households, the Belgian government decided to reduce the VAT rate on electricity and natural gas from 21% to 6%. This measure was implemented on March 1, 2022. Initially scheduled to last until September 30, 2022, it was later extended until March 31, 2023 to provide relief to consumers facing soaring energy costs (Mignolet, 2023).

Subsequently, the government decided to extend the reduced VAT rate indefinitely. This decision is accompanied by a reform of the excise duty system to compensate for the loss of revenue resulting from the VAT reduction. By implementing measures to mitigate the impact of high energy prices on households, the Belgian government shows its commitment to supporting consumers in the midst of the ongoing energy crisis. The CREG (2023)[32] has calculated the estimated impact of the new scheme, with the reduced VAT of 6% combined with the increased excise duty. Using data up to September 2023, the CREG (2023) shows that the new system is more favourable to domestic households than the old system. As a result, federal revenues are reduced by EUR 153.2 million for electricity and EUR 106 million for gas on an annual basis compared to what they would have been under the old system. Thus, this reduced VAT rate combined with the special excise duty, is a subsidy in comparison to the 21% VAT rate. This subsidy is not included in Table 5 (which goes up to 2021), as it only starts in 2022.

VAT on transport services

In the transport sector, a reduced VAT rate is considered an indirect rather than a direct subsidy. The tax expenditure does not directly concern the use of fossil energy, but rather a service whose production inevitably requires an energy source. However, if there is a dependence on fossil energy that is subsidised, there is a competitive advantage for this form of transport, which may lead to an increase in the use of fossil energy. A further distinction needs to be made between passenger and freight transport. Passenger transport typically represents final consumption, whereas freight transport is an intermediate step in the production chain. In the case of freight transport, VAT is deductible for the purchaser of the transport service and the VAT applied at the end of the chain is that applied to the delivery of

[32] See 18.

the transported goods (SPF Finances, 2023). Thus I will only describe passenger transport.

International passenger transport

As can be seen in Figure 3, in Belgium, a VAT of 6% is levied on all forms of domestic passenger transport, whether by air, sea, inland waterway, rail or road (European Commission, 2021). However, this is not the case for international passenger transport, for which neither Belgium nor its neighbouring countries (Germany, France, the Netherlands and Luxembourg[33]) levy VAT on air and sea transport, both using fossil fuels. In fact, all extra-EU and intra-EU air passenger transport in the European Union is zero-rated (ETLA, 2014).

Table 3: VAT on Passenger Transport, Comparison by Country, 2021

	Belgium	**Germany**	**Netherlands**	**France**	**Luxembourg**
Passenger transport (domestic)					
Air	6	19	21	10	3
Sea	6	19 or 7	9	10	N/A
Inland waterway	6	7 or 19	9	10	3
Rail	6	7 or 19	9	10	3
Road	6	7 or 19	9	10	3
Passenger transport (international)					
Air	0	0	0	0	0
Sea	0	0	0	0	N/A
Inland waterway	6	0 or 7	9	10	0
Rail	6	7 or 19	9	0	0
Road	6	7 or 19	9	10	0

Note: Luxembourg: VAT on international passenger transport by sea is not applicable. *Source*: European Commission (2021).

Nonetheless, there are some discrepancies when it comes to inland waterway, rail and road transport. Belgium applies a reduced VAT rate of 6% to these three types of transport (See Figure 3). Luxembourg maintains a VAT rate of 0%. With the exception of the zero rate applied by France to rail transport, Germany, France and the Netherlands apply higher VAT rates to inland waterway, rail and road transport than Belgium (European Commission, 2021).

[33]Luxembourg: VAT on international passenger transport by sea is not applicable.

Two things are worth noting. Firstly, it is remarkable that in Belgium, Germany and the Netherlands, rail transport is taxed at the same rate, if not higher, than other modes of transport, even though this type of transport uses fossil fuels only to a limited extent (European Environment Agency, 2024). This is all the more surprising as all the countries in question apply a zero rate to air transport, which is a highly polluting mode of transport (Borken-Kleefeld et al., 2010; SPF Finances, 2023). Secondly, these different rates are a potential source of distortion of competition. However, this distortion is rather small and it could be argued that the air and rail markets only partially overlap, especially in Belgium (SPF Finances, 2023).

In line with the SPF Finances (2023), since Belgium applies at least a reduced rate to all modes of transport, I only consider the zero rate for air and maritime transport as a subsidy. The number of passengers travelling by sea is very small compared to those travelling by air - 3 million passengers embarking by sea compared to 16 million passengers departing by air (Statbel, 2024a,b). Therefore, I will only focus on the indirect subsidy given to air transport by the zero VAT rate.

Air transport

Although the VAT policy should cover passenger transport by air and sea, EU Member States have historically relied on temporary derogations (some of which date back to their EU accession). These derogations exempt airline tickets for all international flights, including those within the EU, from VAT and refund the tax paid at previous stages[34]. Despite that it was initially introduced as a temporary measure, the VAT exemption for international transport remains in force under Belgian law, as set out in Article 41, §1, 1 of the VAT Code. This provision underlines the permanent application of the exemption, contrary to its initial temporary intention. As a result, international passenger transport by air is subject to a zero VAT rate, while domestic passenger transport by air is not. In comparison with these neighbouring countries, as shown in Figure 3, only Luxembourg (3%) has a lower VAT rate than Belgium (6%). France (10%), Germany (19%) and the Netherlands (21%) apply higher VAT rates.

As shown in Table 4, research by Delft et al. (2019) estimates the effect of an increase

[34]COUNCIL DIRECTIVE 2006/112/EC of 28 November 2006 on the common system of value added tax

of 6% of the VAT tax rate on Belgian airline tickets (see column (3), the other columns will be discussed below). In comparison to the baseline (2018 in this study), the total economic impact on employment and GDP is estimated to be zero. Moreover, tax revenue would be EUR 202 million and CO_2 emissions would be reduced by 6%.

Table 4: Impacts per Taxation Scenario and Change Relative to the Current Situation for Belgium

(1) Impact	**(2) Ticket Tax**	**(3) VAT rate**	**(4) Fuel excise duty**
Average ticket price	+ 4%	+ 6%	+ 16%
Passenger demand	- 4%	- 6%	- 17%
Employment (direct jobs)	- 4%	- 6%	- 17%
Value added	- 4%	- 6%	- 17%
CO_2 emissions	- 4%	- 6%	- 17%
People affected by noise	- 3%	- 4%	- 12%
Total economic impact on employment	0%	0%	0%
Total economic impact on GDP	0%	0%	0%
Fiscal Revenue	EUR 142 million	EUR 202 million	EUR 450 million

Note: These results are compared to the *current situation* of 2018 and report effects relative to values in the base year 2015. The ticket tax is assumed to be introduced with the same structure and level as the German Air Transport Tax. Net-zero demand impulse is assumed.
Source: Delft et al. (2019).

There is no exact data on the share of domestic air passengers in Belgium in comparison to the share of international air passengers, but it is very likely to be very limited. However, considering the size of the country, the number of domestic flights is still remarkable. In 2022, there were more than 1,800 hop-on, hop-off flights in Belgium, and that number is still rising. There were just over 400 flights between Liège and Zaventem airports (85 km), over 270 between Zaventem and Charleroi (55 km) and over 240 between Antwerp and the capital, a distance of just under 32 km[35]. Of all flight operations recorded at Deurne airport in 2022, around 72% were domestic flights[36].

As stated by the High Council of Finance (2020), "*The absence of VAT on the sale of airline tickets cannot be justified in economic or social terms, and certainly not in ecological*

[35]https://www.tijd.be/ondernemen/luchtvaart/gilkinet-dient-verbod-in-op-binnenlandse-vluchten-met-privejets/10514449.html
[36]https://www.demorgen.be/cs-b5ede040/

terms. On the contrary, they constitute a major distortion." However, without a reform of the European framework, an initiative in Belgium alone would make little to no sense.

3.3.4 Excise Duty

According to the definition used by SPF Finances (2023), *excise duties* are *specific duties applied to particular products*. It should be noted that exemptions imposed by European Directives are not considered to be tax expenditures in this thesis, as Belgium cannot change them unilaterally. The methodology used involves converting excise duties into standardised energy units in order to compare different energy sources. This allows for a more balanced assessment of subsidies by highlighting differences in taxation based on *energy equivalent*. Establishing a reference point, in this case, unleaded petrol, highlights historical trends in excise policy and helps to identify fossil fuel subsidies, in particular, the continued subsidisation of diesel despite its higher energy content. This methodology is in line with the *Federal Inventory of Subsidies for Fossil Fuels* by SPF Finances (2023).

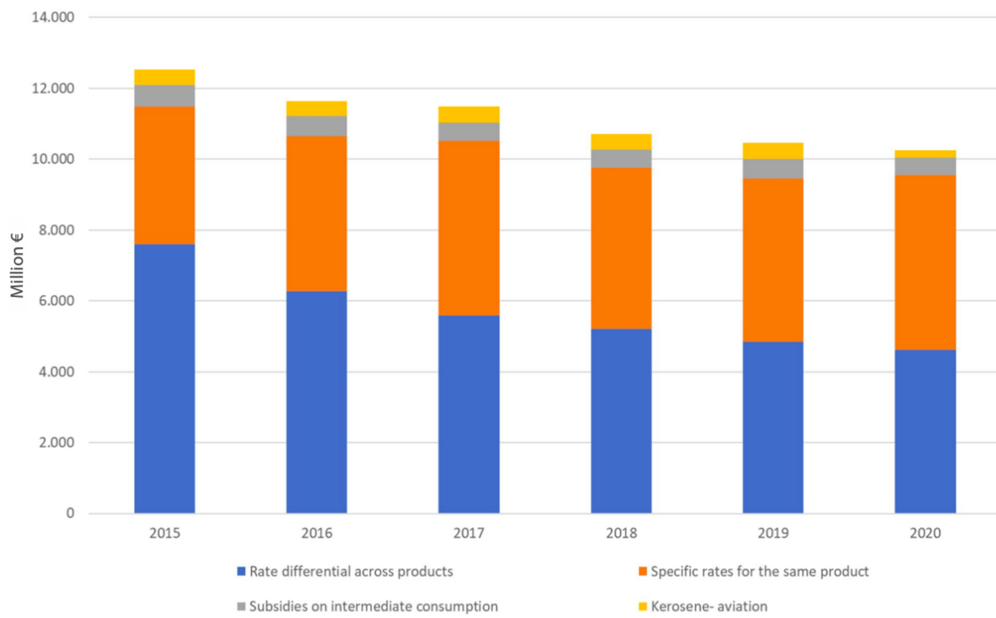
Hence, the excise duty rate on unleaded petrol expressed in terms of Tonne of Oil Equivalent (TOE)[37] will be used as the reference point for calculating subsidies. Generalizing the reference point to all petroleum products and expressing it in TOE allows a distinction between subsidies resulting from differences in rates between products and those arising from differentiations for the same product. Lastly, I will also discuss the exemption from excise duty on paraffin. The evolution of these excise duties, per type of subsidy, can be seen in Figure 7.

Rate Differentials between Products

In 2021, subsidies through differential taxing of energy products totalled EUR 5,534.2 million, around 1% of GDP, primarily due to taxing disparities benefiting low-sulfur diesel and natural gas. The subsidy declined in 2020 due to reduced consumption during the COVID-19 crisis but increased in 2021 with higher gas consumption volumes (SPF Finances, 2023).

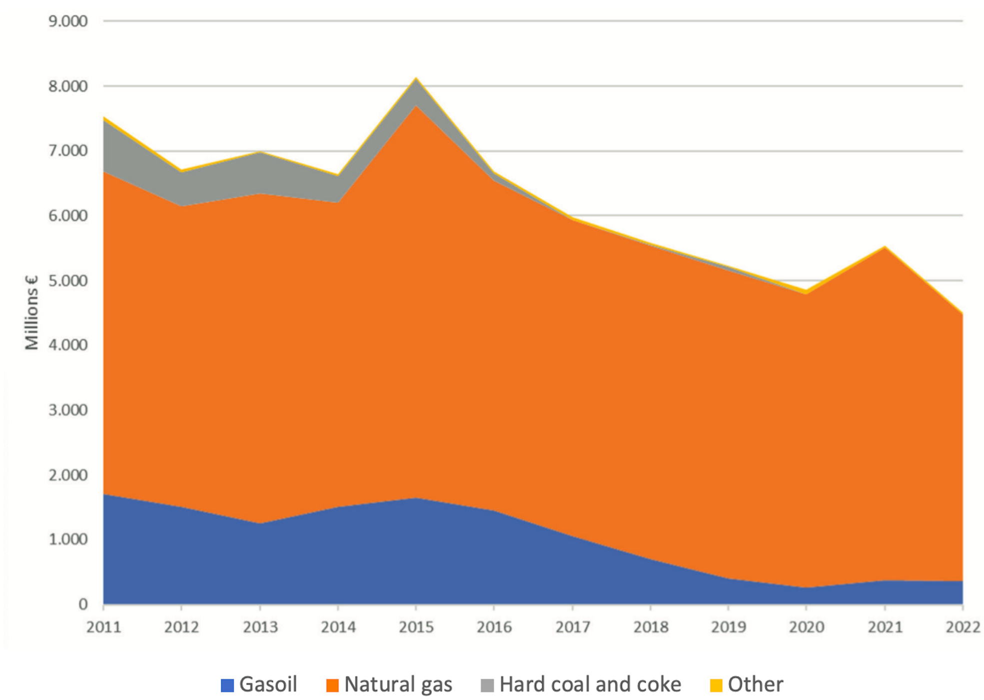
[37] The Tonne of Oil Equivalent (TOE) is a standardized unit for measuring energy, representing the energy released by burning one metric ton of crude oil, facilitating comparisons between different energy sources.

Figure 7: Excise Duties, per Type of Subsidy, 2015 to 2020



Source: *SPF Finances* (*2023*).

Figure 8: Subsidies on energy products - rate differentials between products, 2011 to 2022



Source: SPF Finances (2024).

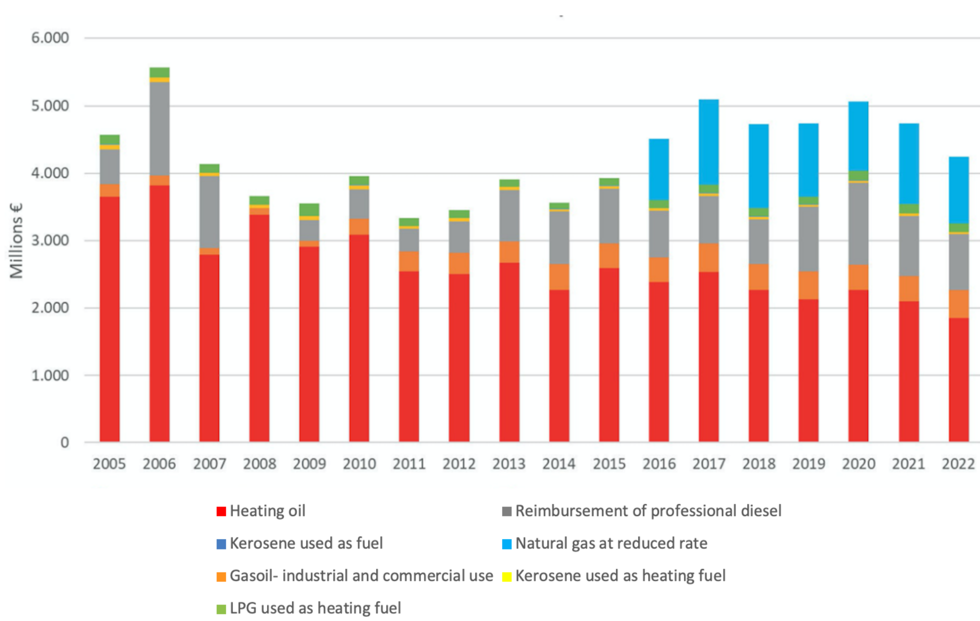
As can be seen in Figure 8, natural gas benefits the most from rate differentials since a decade at least - the subsidy for natural gas amounted to EUR 5,124.3 million in 2021 (SPF Finances, 2024). However, a sharp decline can be observed in 2022. Since then, as a consequence of the energy crisis, the taxation of natural gas has changed.

From January 1, 2022, a *special excise duty* on natural gas and electricity has replaced the public service surcharges and the federal levy and natural gas (and electricity). This reform aims to increase the purchasing power of Belgian consumers by transforming contributions into a special consumption tax. These special excise duties will be discussed in Section 5.

Special Rates for the same Products

Using the same methodology as for the rate differentials between products, the SPF Finances (2023) calculates the special rates for the same products. These amount to approximately EUR 4,737.5 million in 2021. This is a minimum estimate as some tax expenditures are not fully quantified. The results can be seen in Figure 9. Three main components emerge; the reduced rate for heating oil, the reimbursement of professional diesel, and the reduced rate for natural gas. The latter is mainly related to industry, in particular to sectors with sectoral agreements. I will discuss each of these three main components to better understand the main mechanisms.

Figure 9: Subsidies on Energy Products: Reduced Rates and Exemptions, 2005 to 2021



Source: SPF Finances (2024).

Heating Oil

The consumption of heating oil per household has fallen significantly over the past years (SPF Finances, 2023). Several factors have contributed to this decline, including improved home insulation, increased boiler efficiency and the emergence of alternative heating systems such as pellet heating. All of which have combined to reduce household reliance on heating oil.

According to SPF Finances (2023), in 2018, households in the third and fourth quartiles are those heating most with oil (accounting for respectively 31.5 and 30% of households heating with oil). In 2018, 84% of households heating with oil were homeowners (SPF Finances, 2023). Moreover, average expenditure increases with income. In 2022, the average annual expenditure on heating oil per household in the first quartile was EUR 298, compared to EUR 433 for a household in the fourth quartile (Statbel, 2022b). Hence, the highest consumption of heating oil does not correspond to the lowest-income individuals, nor does the highest spending on heating oil. This observation underscores the lack of social justification for subsidizing heating oil.

The exemption from excise duties (except inspection fees and energy taxes) is a major subsidy (EUR 2,096.5 million in 2021, SPF Finances (2024)). From an energy and environmental point of view, it is not justified: heating oil does not have any characteristics that justify preferential treatment, on the contrary. Its exemption is particularly harmful because of its clear impact on price signalling. Furthermore, it also lacks social justification, as there is no concentration of low-income households using heating oil.

Excise duties on heating oil are significantly lower than those on natural gas and electricity, being 5 times lower than gas and 14 times lower than heat pumps for a moderately insulated house. Reducing the tax difference between electricity and both gas and heating oil therefore proves to be an essential measure to promote more ecological heating options (Federal Public Service Finance, 2023).

Addressing the regressive nature of energy taxation requires a comprehensive reform that better aligns environmental and social objectives, which should also consider adjustments to social tariffs and other support mechanisms that have been discussed in Section 3.3.1. However, heating oil is getting banned from Belgium. For instance, as of 2022, it is no longer allowed to install or replace a fuel oil boiler in certain cases in Flanders[38]. Wallonia[39], and Brussels[40] have similar objectives. Should the total ban on heating oil come into effect, the subsidies should also disappear in the coming years.

Commercial Diesel

[38] https://www.vlaanderen.be/en/moving-housing-and-energy/heating-with-fuel-oil-what-is-still-allowed-and-wha

[39] https://www.wallonie.be/fr/actualites/interdiction-des-chaudieres-au-mazout-quelles-sont-les-mesures-prevues

[40] https://www.brusselstimes.com/227886/brussels-gradually-shifts-to-more-sustainable-heating-solutions

The partial reimbursement of the special excise duty on commercial diesel was introduced in 2005 and was aligned with the European minimum excise rate until 2021. The excise duty rate is composed of the basic (or ordinary) excise duty[41], the special excise duty and the energy levy. This refund applies to sectors such as taxis, transport of disabled people, transport of passengers by buses of specific categories, and transport of goods by vehicles weighing more than 7.5 tonnes. In particular, the reimbursement applies to all transport operators on the basis of fuel purchased on Belgian territory - regardless of whether the vehicle is registered in Belgium. However, current estimates do not differentiate between taxis and other uses, such as freight transport. Since 2011, the reimbursement mechanism has maintained a constant rate in nominal euros, despite the decision taken in 2014 to index excise duties as from 2015 and to align excise duties on diesel and petrol between 2015 and 2018. Until 2021, these decisions had a counteracting effect on commercial diesel, leading to corresponding increases in reimbursement rates. From 2005 to 2021, the cumulative increase in excise duties was 71% before refunds and 15.6% after these. In addition, the European Commission's proposal to revise the Directive on the taxation of energy products in July 2021 aims to eliminate the difference in rates between commercial and non-commercial use of diesel fuel. In 2021, the Belgian federal government decided to gradually reduce the reimbursement rate for commercial diesel between 2022 and 2026 (SPF Finances, 2023).

Given the flexibility for operators to choose refuelling locations based on prevailing tariffs, the international transport sector is significant for understanding competitive pricing dynamics. Prior to the abolition of the professional diesel refund, fuel prices in Belgium at the beginning of 2022 were comparable to those in France, Germany and the Netherlands, but higher than those in Luxembourg. In particular, among the neighbouring countries, only France had a similar intervention system, albeit on a smaller scale. Taking into account the refunds for commercial diesel, Belgium offered the most competitive net prices for refuelling, just behind Luxembourg (SPF Finances, 2023).

To understand the rationale for subsidies across different beneficiary categories, a common pattern emerges: subsidies typically distort environmental incentives

[41] The basic excise duty cannot be modified without the agreement of the Grand Duchy of Luxembourg

by lowering price signals, even though prices should ideally be adjusted to reflect external costs. I will now discuss the three main categories of beneficiaries: freight transport, the taxi industry, and the transport of people with disabilities.

Firstly, in the case of *freight transport*, competitiveness arguments are often put forward, but they deserve careful consideration. In the context of international transport, any competitive advantage for Belgian operators is neutralised by the accessibility of diesel refunds for foreign transport hauliers. Instead, the subsidy extends the negative price signal to foreign operators, while the competitiveness of Belgian hauliers compared to their foreign counterparts depends on several factors, in particular wage differentials for drivers of heavy goods vehicles. Restoring conditions of fair competition therefore means first and foremost addressing wage differentials. With regard to cabotage (inland transport), any alleged competitive advantage must be assessed comprehensively based on all the costs involved.

The Bureau Fédéral du Plan (2023) examines the impact on transport demand of abolishing the commercial diesel scheme for lorries. It shows that this change would lead to a slight reduction of 0.5% in the total number of tonne-kilometres travelled by lorries within Belgium by 2040 compared to the baseline scenario, i.e. 2019. International transport would decrease more than national transport, which would remain largely unaffected due to a shift towards vans.

Consequently, the abolition of the professional diesel regime for lorries would lead to an overall decrease in demand for transport by lorries driven on Belgian territory (-1.3% by 2040). Similarly, the impact on direct and unburned emissions by mode of transport follows this trends, with a decrease of 1.3% and an increase for rail, inland waterways and vans (respectively 1.7%, 2.3% and 6.6%). In addition, considering particulate matter ($PM_{2.5}$) emissions[42] as a whole, there would be a slight decrease compared to the baseline scenario (-0.3%).

The Bureau Fédéral du Plan (2023) concludes that abolishing the commercial diesel scheme for lorries would not have a significant impact on road congestion or pollutant emissions. Instead, it would be a budgetary rather than an environmental

[42] $PM_{2.5}$ emissions are fine particles with a diameter of 2.5 micrometers or less, contributing to air pollution and health concerns.

measure, although the net budgetary impact remains uncertain. However, it is important to note the high volatility of diesel prices, which makes it possible to analyse the relationship between fuel costs and the intensity of road freight transport. The data show no clear evidence of a link between fuel costs and road transport intensity. Even with a potential 20% increase in fuel costs for lorries, the price elasticity appears to be zero, as shown in Figure 2 in Appendix (Bureau Fédéral du Plan, 2023).

Secondly, in the case of the *taxi industry*, there is no economic justification for subsidising a sector that has historically been protected from foreign competition, especially in the light of current competitive dynamics where labour costs outweigh diesel prices.

Thirdly, there is similarly no rationale for subsidising the use of fossil fuels for the *transport of disabled people*, as social welfare objectives could be better achieved through fixed subsidies rather than through environmentally damaging mechanisms.

Finally, regardless of the category of beneficiary, there is no compelling argument for maintaining this fossil fuel subsidy. In the case of international freight transport, removing the refund would not necessarily reduce the consumption of fossil fuels, but it would eliminate the excess expenditure on them.

Natural Gas

Between 2016 and 2021, tax measures have been introduced to encourage the use of natural gas as a fuel by companies. These measures include a zero excise duty and a reduction in energy taxes for companies with special environmental agreements issued by the Flemish, Walloon or Brussels-Capital regions. These agreements, which are part of the *branch agreements*, aim to maintain the competitiveness of energy-intensive industries while encouraging improvements in energy efficiency. In return for commitments to reduce CO_2 emissions and improve energy efficiency, participating companies benefit from reduced excise duties on natural gas. To qualify, companies must provide their natural gas supplier with the necessary licence. Under the National Energy-Climate Plan (NECP)[43], government support for companies through energy contracts or industry agreements will continue and be refined until 2030. The aim is to further incentivise the industry's energy efficiency efforts, while ensuring fair competition within the EU and accelerating the phasing out of fossil fuel subsidies, within a framework of continuous improvement and adequate reporting to avoid lock-ins (SPF Finances, 2023).

According to SPF Finances (2023), the subsidy cost of the reduced excise duty on natural gas is EUR 1 billion in 2021, slightly higher than in 2020.

Subsidies on Intermediate Consumption

In 2020, excise duty exemptions on intermediate consumption amounted to EUR 98.37 million, primarily benefiting inland navigation and rail transport due to exemptions on diesel, subject to high excise duty rates. However, subsidies from differences in taxation between products were substantially higher and more diverse in their sectoral distribution, with agriculture receiving the highest subsidy. This disparity is attributed to low excise duty rates on heavy fuel oil and, notably, natural gas. Moreover, the methodology used to estimate these subsidies for intermediate consumption reveals a worrying reliance on low-tax energy sources, in particular diesel and natural gas, which not only distorts market dynamics but also hampers efforts to decarbonise the economy (SPF Finances, 2023).

The continuation of such subsidies is inconsistent with Belgium's environmental objectives, as it undermines the price signal needed for companies to switch to cleaner energy alternatives and reduce their dependence on fossil fuels. While sector-specific support may be justified in certain circumstances, it is imperative to decouple subsidies from energy consumption in order to allow the price signal to play its intended role in driving decarbonisation efforts (SPF Finances, 2023).

Aviation Kerosene Exemption

[43]See footnote 2.

Aviation, responsible for around 2% of global CO_2 emissions in 2022, was the fastest growing source of pollution within the transport sector prior to the Covid-19 pandemic (International Energy Agency (IEA), 2023). This surge in emissions is largely due to the longstanding lack of taxation and regulation of the aviation industry, which has created an environment where sustainable technology investments have been overlooked and air travel has remained artificially cheap, thereby increasing demand. If these favourable tax policies are maintained, the current trend suggests that air traffic will continue to grow, further exacerbating environmental concerns (Transport & Environment, 2023).

In Belgium, there is no tax on kerosene [44]. This represents a huge shortfall of public revenues, which will increase even more if air travel pricing is not improved in a more environmentally and socially equitable way, according to Transport & Environment (2023).

Transport & Environment (2023) strongly supports the taxation of kerosene, which should be extended to all flights departing from European airports, with an initial rate of 38 cents per litre proposed by the European Commission. This includes a full legal assessment of existing Air Service Agreements (ASAs) to identify and renegotiate prohibitions on fuel taxation where legally permissible.

Thus, aviation fuel is exempt from excise duty and many countries exempt tickets from VAT or apply a zero VAT rate (as discussed above). There are also other changes that can be made to aviation taxes, either through revenue-neutral tax reform or by changing the total fiscal revenue. Research by Delft et al. (2019) assumes all revenues are recycled (see Table 4). Consequently, a net-zero demand impulse is assumed in the case of a *revenue-neutral tax reform*, since an increase in aviation taxes causes not only a decrease in the demand for aviation activities but also an increase in the demand for other sectors. It should be noted that this is a strong assumption. On the other hand, in the case of a *fiscal revenue reform*, the impact depends on how these changes affect the economy. Either the change can be in public spending; then we could assume a net-zero impulse as well since the change in public spending will change the output of economic sectors, which will

[44] Kerosene, the refined hydrocarbon liquid commonly known as aviation fuel, serves as the primary energy source for jet engines in aircraft.

also have a value-added. Or, the change can be in government deficit or surplus. In this case, the impact is harder to determine, since an increase (decrease) in fiscal revenue will make the government more favourable for lending (borrowing) money, which will cause a decrease (increase) in interest rates and an increase (decrease) in investment. Simultaneously, the fiscal stimulus would result in a lower demand. The balance of these two effects is difficult to determine. However, it can be concluded that a rise in taxation would cause fiscal austerity (Delft et al., 2019).

Delft et al. (2019) estimate economic and environmental impacts of taxes and of tax exemptions on aviation. For Belgium, the results of their estimation are represented in Table 4. Column (2) describes the current situation (noting this estimation is based on the current situation as it was in 2018, and thus uses data from 2018). One should be careful while interpreting these results, as up to 2018 Belgium levied no aviation taxes: neither a passenger ticket tax, nor a VAT on air tickets, nor an excise duty on kerosene. Column (3) describes the impact of introducing a ticket tax. It is assumed to be introduced with the same structure and level as the German Air Transport Tax[45]. With the ticket tax, the average ticket increases by EUR 7.47 tax rate, thus 4% Column (4) describes the estimated impact of introducing a 6% VAT rate. Finally, in Column (5), the impact of fuel excise duty is estimated. Here, an excise duty of 330 EUR/kilolitre is assumed, meaning a rise of 16% of the price.

Table 4 describes that according to Delft et al. (2019), there are no scenarios where the introduction of taxation and regulation would have a (negative) impact on GDP or employment in the overall economy. However, as discussed above, this is due to strong assumptions.

3.4 Analysis of Indirect Fossil Fuel Subsidies in Belgium

In this Section, I will discuss the *indirect* fossil fuel subsidies granted in Belgium. Indirect subsidies apply to the production of services that rely heavily on fossil fuels. In 2021, they amounted to EUR 2,609.35 million, being 0.5% of the GDP (SPF

[45]The German Air Transport Tax is a self-assessed tax levied on air carriers for departures. The revenue from this tax is received by the Federal Government and there is no specific allocation of the revenue. The tax rates are linked to the participation of aviation in greenhouse gas emissions trading, with possible adjustments based on the previous year's revenue.

Finances, 2024). Company cars constitute the largest element, with a subsidy of over EUR 2,500 million in 2021.

3.4.1 Company Cars

Definition of the Company Car

First, it is essential to define the *company car*. According to May (2017), the company car is strictly defined as *a vehicle provided to an employee by their company or employer for both business and personal use*. This excludes vehicles owned by self-employed individuals or service vehicles provided by employers solely for professional use by staff members. May (2017) found that, in 2016, there were approximately between 550,000 and 670,000 company cars in Belgium, which corresponds to 11% of the total vehicle fleet in May 2016. From early 2007 to late 2015, the number of company cars allocated to employees has risen by 56%. For company executives, the increase in company cars is likely significant, although precise figures are challenging to ascertain due to data limitations. Consequently, while definitive numbers on company cars may be elusive, their proliferation has been rapid, with reported figures often underestimating the actual count by excluding executive company cars (May, 2017). Another important finding is the allocation of the use of the company cars. According to Copenhagen Economics (2010), 67% of company car usage is for private use, leaving only 33% for business use. This means that by subsidising company cars, the majority of the subsidy is for private use.

Advantages of the Company Car

Employee Advantages

Let me now delve into the advantages of company cars, for employees as well as for employers. Princen (2017) studies the *Taxation of Company Cars in Belgium*. Firstly, there are several advantages for the employee who is getting the car, since the income tax rules do not differentiate between the usage of the company car for business or private purposes. This is a significant advantage for an employee, since, as discussed above, only one-third of the use of a company car is for business purposes. Secondly, while the calculation of the taxable benefit for private use is fixed in most EU countries, it is variable in Belgium. Here, it is determined as a percentage of the car price, known as the *imputation rate*, which fluctuates based on factors such as the car's carbon dioxide emissions, fuel type, and age.

In 2015, this imputation rate ranged between 3.4% for the least polluting cars to 15.4% for the most polluting ones (Princen, 2017). These numbers are relatively low when compared to the other EU countries, as can be seen in Figure 1 in Appendix. For instance, it is 9% in Portugal and 30% in Italy. Furthermore, the calculation for the imputation rate does not include the fuel costs paid by the employer - which have been discussed in Section 3.3.2 -, nor the private mileage. Princen (2017) assumes an annual private mileage of 10,000km, which is thus covered by the employer.

This results in a total cost of providing a company car that is four times larger than the taxable benefit. In essence, there exists a 25% disparity between the actual cost to the employer and the taxable benefit. Consequently, employees are taxed on a benefit-in-kind that significantly underestimates the true value of using a company car. This implies that company cars are a form of remuneration subject to lower taxation rates compared to other forms of compensation. Furthermore, the benefit-in-kind of using a company car exempts the employee from paying employee social contributions (which stand at 13.07% for other forms of remuneration), despite utilizing the company car for private purposes. Moreover, compared with other elements of the salary package that benefit from special tax regimes, the derogatory regimes applicable to company cars (and fuel cards) have the particularity of being harmful to the environment and, as soon as the motorisation is based on fossil fuels, of being a subsidy to the use of these fuels (Princen, 2017).

Employer Advantages

For employers, company cars offer a significant tax advantage compared to traditional salary-based compensation structures. Unlike salaries, the benefit of using a company car is exempt from the regular system of employers' social security contributions. While social security contributions typically apply to all forms of remuneration, including cash and non-cash benefits, the non-cash benefit of a company car is exempt from these contributions. Instead, employers providing company cars are subject to a solidarity charge, determined by factors such as the car's carbon dioxide emissions and fuel type. This solidarity charge (which is indexed each year[46]) is generally much lower than the social security contributions

[46] For 2024, the CO_2 contribution for company cars is calculated based on emission rates and fuel type, ranging from approximately EUR 20.83 for electric vehicles to varying amounts for petrol, diesel,

that would be incurred on other forms of remuneration, as it is not directly tied to the value of the fringe benefit or the overall remuneration level. Consequently, the attractiveness of offering a company car as part of an employee's compensation package increases with the employee's remuneration level, leading many middle to high-income earners in Belgium to include company cars in their remuneration packages Princen (2017).

Furthermore, under Belgian corporate tax rules, work-related car expenses are deductible. This includes all work-related travel expenses, including commuting expenses, paid or reimbursed by the employer. All car expenses are considered business-related, although the rate of deductibility varies depending on the type of cost. Financing costs are fully deductible, while fuel costs are partially deductible at a rate of 60%. Other car expenses, such as insurance and maintenance costs, are deductible depending on the car's carbon dioxide emissions and fuel type, with deductibility ranging from 120% for electric cars to 50% for high-emission diesel cars. VAT on the purchase of company cars for private use is also partially deductible for companies in Belgium. This deduction is calculated using various methods, such as keeping a logbook or applying semi-lump-sum percentages based on commuting distance, with a maximum deductibility limit of 50% (Princen, 2017).

Harmful Consequences

Having discussed the advantages of company cars, it is interesting to look into the consequences of this tax scheme. Firstly, there is the cost. According to Princen (2017), the favourable tax treatment of company cars and fuel costs in Belgium amounts to approximately EUR 3.75 billion of government revenue foregone annually, which constituted 0.9% of GDP in 2016. Harding (2014) estimated the income tax revenue foregone at EUR 2 billion (0.5% of GDP), while the special social security scheme for company cars is projected to result in a loss of approximately EUR 1.75 billion (0.4% of GDP) in social security revenues (Courbe, 2011).

Secondly, one could wonder who benefits from these advantages. The tax benefits associated with providing company cars tend to favour employees with higher income levels. Research by De Witte et al. (2009) reveals that individuals who are

and LPG vehicles (Social Securty Belgium, 2024).

highly educated, male, under the age of 50, and hold managerial or board positions in companies located in the Flemish region are more likely to have access to company cars. Consequently, the current company car scheme disproportionately benefits high-income earners, thereby posing challenges to the progressive nature of the tax system.

Thirdly, the inclusion of the company car scheme in the Belgian tax system exacerbates its complexity and reduces its overall efficiency. As highlighted in the 2017 Country Report, the Belgian tax framework already contains complexities due to numerous exemptions and deductions, which contribute to the erosion of the tax base European Commission (2017).

Finally, the environmental impact is significant. This tax system encourages higher car ownership and mileage, thereby further worsening environmental degradation. According to Laine & Van Steenbergen (2016), owners of company cars tend to travel, on average, an additional 58.2 kilometres per week, with daily distances for private use increasing by 8.2 kilometres. Therefore, this increase in car use leads to significant annual welfare losses. The study also suggests that abolishing the special tax regime for company cars could reduce the commuting distance of current company car users by about 2,794 kilometres per year. Thus, both the increase in the number of cars and the longer journeys contribute to the overall impact, respectively with an *extensive margin* effect and an *intensive margin* effect.

The Mobility Budget

In response to the preferential treatment of company cars, the Belgian government introduced a *mobility budget*[47] as an alternative means of commuting. Starting from March 1, 2019, the mobility budget was proposed in Belgium whereby employers providing company cars to their staff could replace this practice by granting a mobility budget.

This budget can be divided into three pillars as defined by the employer. The first pillar includes the environmentally friendly company car, which must have zero

[47] https://lebudgetmobilite.be/fr

CO_2 emissions by 1 January 2026, and meet certain standards by then. The second pillar includes sustainable transport options such as cycling, public transport and car sharing. In addition, employees living within 10 kilometres of their workplace can use the mobility budget to finance their rent or mortgage interest and repayments. Any remaining budget not allocated to the first and second pillars can be received in cash, with a special contribution of 38.07% from the employee, which is used for social security benefits such as pension rights.

This budget allows employees to manage their own travel expenses. Unlike social security contributions, the mobility budget is not subject to social charges (except for the third pillar), but special contributions may be applicable depending on the circumstances. The Royal Decree of September 10, 2023, sets out the rules for calculating the expenses within the mobility budget, giving employers the option to choose between actual expense formulas or lump-sum values, with a validity period of three years for the chosen method. This system aims to introduce an alternative to traditional company car usage while providing employees with more sustainable mobility options (Office National de Sécurité Sociale (ONSS), 2024). The initiative allows employees to opt for a transport budget or additional net pay instead of a company car as part of their remuneration package.

All the proposed mobility budget formulas share the objective of ensuring that the employee nor the employer is disadvantaged. The corollary of the mobility budget is that it is fiscally advantageous and therefore represents a considerable budgetary investment (just like the company car) focused on a segment of workers. As many academics and policymakers have pointed out, the implementation of the mobility budget does not address the fundamental issue. Vandenbroucke et al. (2019) argue that the implementation of the mobility budget implicitly represents a political choice to continue to devote significant financial resources to reducing the progressive nature of taxation for certain high-income workers rather than improving the management of the tax system. Since this measure extends favourable tax treatment to other commuting options, it does not substantially reduce the number of employees benefiting from the tax scheme for company cars. Thus, it is not sufficient to phase out fossil fuel subsidies for company cars. By specifying that any change to the scheme must not disadvantage either the employee or the employer compared to the existing company car scheme, the discussion is channelled and the potential for a substantial revision or even abolition of the company car scheme is eliminated from the beginning (Vandenbroucke et al., 2019). Zijlstra & Vanoutrive (2018) also argue that the margin for political manoeuvre is limited because of the special status of the company car in the political discourse, where it is seen as the *reference point* around which 'real solutions' must be built.

In conclusion, while the mobility budget provides a framework for reallocating resources in a more environmentally friendly way, it lacks the transformative power needed to significantly reduce dependency on company cars. It provides alternative options within its structure but does not inherently incentivise a complete shift away from traditional vehicles. Additionally, the plan's effectiveness may be limited by factors such as infrastructure availability, cost considerations and individual preferences. Therefore, while it is a positive step forward, it should be seen as part of a broader strategy that includes additional measures and incentives to truly promote sustainable mobility practices and achieve environmental goals.

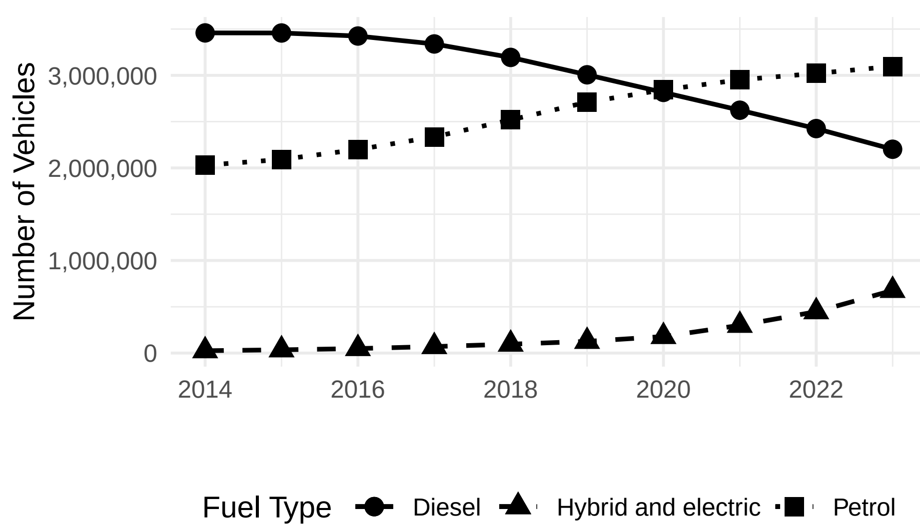
Electric Vehicles

In the previous section, I mentioned the shift from company cars to electric vehicles. These electric vehicles are often described as a completely green mode of transport. The electric car, commonly referred to as the electric vehicle (EV), represents a major shift in the automotive industry. Unlike conventional internal combustion engine vehicles, which rely on petrol or diesel fuel for power, EVs are powered primarily or entirely by electricity stored in rechargeable batteries. At the core of their operation are electric motors that replace traditional engines to drive the wheels. These motors draw power from onboard battery packs, converting electrical energy into mechanical energy to propel the vehicle forward. This move away from reliance on fossil fuels marks a significant step towards sustainable transport and offers numerous environmental benefits, including reduced greenhouse gas emissions and lower running costs. In essence, EVs are considered as the ongoing transition to cleaner and more energy-efficient mobility solutions.

Overall, EVs show superior performance in terms of improved air quality and reduced fossil fuel consumption compared to conventional vehicles. The composition of the energy mix has a significant impact on the Life Cycle Assessment (LCA) emissions of electric vehicles. The integration of renewable energy and clean electricity sources is key to further reducing emissions during the power cycle and battery production. In addition, strategies such as the recycling of vehicles and battery materials serve as effective measures to reduce the emissions associated with the LCA of electric vehicles (Das et al., 2024).

In Belgium, tax benefits for non-electric company cars will gradually decrease from 2023 and disappear completely by 2026. This underlines the urgent need for companies to integrate electric vehicles into their fleets. In 2023, fully electric cars have almost doubled in one year, with a 93.6% increase. There were 71,651 electric cars in 2022; and 138,749 in 2023 (Figure 10). It is important to note that 80.8% of these electric cars are registered by companies. Even though electric cars are becoming increasingly popular in Belgium, only 26,440 cars (19.1%) are owned by individuals and 112,056 by companies (Statbel - Federal Public Service Economy, Belgium, 2023).

Figure 10: Vehicles in Belgium, by Fuel Type, 2014 to 2023



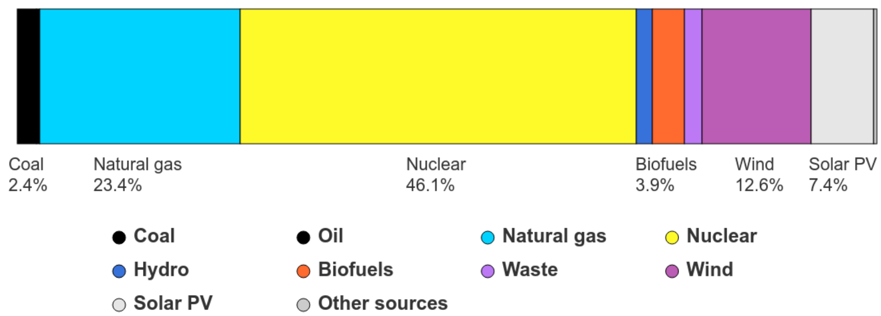
Source: Own calculations, with data from Statbel - Federal Public Service Economy, Belgium (2023).

Subsidies for petrol and diesel company cars are, for obvious reasons, (indirect) subsidies for fossil fuels. As these company cars are being replaced by electric vehicles, it is important to consider their environmental nature. The shift towards electric vehicles (EVs) and away from traditional combustion engine vehicles is a positive step towards reducing carbon emissions and promoting sustainable transport. Nevertheless, it raises critical questions about the total environmental impact of EVs. Despite their green reputation, questions remain about the overall sustainability of EVs, particularly the lifecycle impacts of battery production, resource extraction and end-of-life disposal, as well as the nature of these new support schemes. Therefore, while the transition to electric cars represents progress in reducing dependence on fossil fuels, it also requires careful consideration of the wider environmental impacts to ensure a truly sustainable mobility future.

Boateng & Klopp (2024) found that the growing demand for minerals to meet electric vehicle (EV) production targets presents a sustainability dilemma. Research by Benchmark Minerals Intelligence (2022) found that around 384 new mines for critical minerals such as graphite, lithium, nickel and cobalt will be needed to meet global EV demand by 2035. The extractive industry's track record of environmental degradation, corruption and human rights abuses raises concerns. Despite holding sustainability certifications, mining companies often contribute to large-scale damage. Increased mineral extraction for electric vehicles could exacerbate sustainability risks, biodiversity loss and conflict (Boateng & Klopp, 2024). In other words, although electric vehicles (EVs) are often seen as a completely clean transport option, their materials and production, and in particular that of their batteries, do not entirely correspond to the green ideals that are commonly portrayed. Furthermore, EVs rely on electricity to operate, and in Belgium's case, where only a limited share of electricity is generated from renewable sources (see figure 11), this reliance raises questions about the overall environmental impact of EV adoption.

In conclusion, while a shift towards a *more* - but not entirely - environmentally friendly company car is to be encouraged, Belgium's commitment to maintaining favourable conditions for (electric) company cars is inconsistent with broader sustainability goals and societal well-being. Despite evidence that EV ownership is economically feasible and has environmental benefits, EVs as company cars are unnecessarily expensive for the state, encourage the use of cars for private purposes, and have a negative impact on the social and economic development of the country. Belgium's resistance to removing tax incentives for company cars

Figure 11: Electricity Generation Sources, 2022



Source: International Energy Agency (2024a).

reflects a short-term approach to mobility policy. A reassessment of Belgium's EV support framework is therefore needed, with a gradual reduction of incentives and a shift towards a fairer and more efficient tax system, in line with broader fiscal and environmental objectives.

3.4.2 VAT - Exemption for Airline Tickets

Since April 1, 2022, the Belgian government introduced the *aviation tax*, also called the boarding tax. This tax ranges from 2 to 10 EUR, depending on the flight distance, on passengers departing from Belgian soil. It is highest when travelling below 500km. The tax aims to encourage passengers to consider alternative transportation methods and to raise awareness about the environmental impact of short flights. Its aim is also to generate revenue for the state. It was estimated that the tax would cost approximately EUR 5 million to aviation companies, such as Brussels Airlines, TUI Fly and Ryanair. The tax was implemented in 2022, despite objections from parties such as Ryanair and the Belgian Federation for Aviation. The Constitutional Court aligns with the current Prime Minister Alexander De Croo's reasoning and deems the tax 'fair', striking a balance between business freedom and environmental protection (Soir, 2024; Luchtvaartnieuws, 2023).

According to Belgique (2022), the aviation tax fell short of the projected revenue for 2022, with only EUR 20.5 million collected instead of the anticipated EUR 30 million. Moreover, with the recent 2024 elections, the Flemish Green Party's (Groen) proposal for a differentiated eco-tax on air travel, based on ticket class, aims to share the environmental burden fairly while generating revenue. However, this plan has sparked a debate within the Green parties, highlighting the complexity of balancing environmental concerns with economic and political considerations (The Brussels Times, 2023).

3.5 Closer Look on Subsidies for Natural Gas for Residential Consumption

Natural gas is, by far, the most heavily subsidised fossil fuel discussed in this thesis. According to Table 5, the total subsidies for natural gas in 2021 amount to EUR 7,397.9 million (SPF Finances, 2024). This significant financial support justifies the focus on subsidies for this particular fossil fuel used by households in subsequent sections of the thesis.

Table 5: Natural Gas Subsidies (EUR million)

Subsidy	**2017**	**2018**	**2019**	**2020**	**2021**
Social rate	70.0	74.0	89.0	79.0	95.3
CPAS Energy Access Fund	22.0	22.0	25.0	25.1	25.2
Extended social tariff (BIM)	-	-	-	-	154.8
Excise duty - differences between products	4884.9	4848.1	4741.5	4538.0	5124.3
Excise duty - special rates for same product	1270.7	1250.2	1091.0	1031.1	1190.6
Subsidy for non-energy use	868.6	839.0	803.6	902.4	807.7
Total	**7116.2**	**7033.3**	**6750.1**	**6575.6**	**7397.9**

Note: The social tariff extended to the BIM category was introduced in February 2021 and was in July 2023.
Source: SPF Finances (2024).

When examining the beneficiaries of these subsidies, it is crucial to understand who directly benefits from subsidised natural gas.

In the case of the social tariff, the CPAS Energy Access Fund and the Extended Social Tariff, these subsidies are specifically allocated to the final consumption of natural gas by households and therefore only benefit households.

In terms of subsidies resulting from differences in excise rates between products, the final consumption of natural gas is distributed as follows; 25.8% for residential use, 13.6% for commercial use, 55.6% for industrial use, and 0.5% for transport use (European Environment Agency, 2023). I assume that the subsidy is distributed in the same proportions. Consequently, 25.8% of this subsidy goes to households and this is the share considered in this analysis.

Although not yet included in Table 5, the reduced VAT on natural gas will play a significant role from its introduction in 2022, albeit offset by a special excise tax. The extended social tariff (BIM) expires in 2023 and is therefore not taken into account as it no longer exists.

Differences in excise duty rates between uses of the same product apply to natural gas used as fuel by businesses. Subsidies linked to the non-energy use of fossil fuels, whether for combustion or as a feedstock, are an integral part of the carbon neutrality debate, but do not relate to direct final consumption by households. They are therefore not considered in the following sections of this thesis.

The residential and industrial natural gas markets operate with different dynamics and receive different levels of government support. While subsidies for residential natural gas may not represent the largest share of total subsidies, addressing them can yield significant benefits in terms of equity, environmental impact, fiscal management and public perception. According to International Energy Agency (2024c), heat production accounts for almost half of total final energy consumption and 38% of energy-related CO_2 emissions in 2022. In Belgium, natural gas accounts for 39% of the final energy consumed by households in 2022 Eurostat (2024). The focus on natural gas used by households is therefore highly relevant.

The subsidy for natural gas consumption from 2017 to 2021 by households only is detailed in Table 6. The focus on household consumption is crucial because households are significant beneficiaries of natural gas subsidies. Understanding this allocation helps to clarify the impact on household energy costs and consumption patterns. This focus also provides insights into policy decisions and their impact on energy affordability and sustainability at the household level.

Table 6: Natural Gas Subsidies for Residential Consumption (EUR million)

Subsidy	**2017**	**2018**	**2019**	**2020**	**2021**
Social rate	70.0	74.0	89.0	79.0	95.3
CPAS Energy Access Fund	22.0	22.0	25.0	25.1	25.2
Extended social tariff (BIM)	-	-	-	-	154.8
Excise duty - differences between products	1260.30	1250.81	1170.80	1170.80	1322.07
Total	**1352.30**	**1346.81**	**1284.60**	**1274.91**	**1597.37**

Note: The social tariff extended to the BIM category was in force from February 1st, 2021, to July 1st, 2023.
Source: Own calculations with data from SPF Finances (2024).

4 Conceptual Framework

4.1 Feasible Pathways

Defining clear pathways is crucial when it comes to phasing out fossil fuel subsidies. In this context, a pathway outlines a strategy for the gradual phasing out of subsidies for natural gas in Belgium. These pathways must detail a course towards the complete removal of these financial supports. In line with the climate goals outlined in Section 2, I aim to completely end all subsidies by 2050. To make this feasible, I propose an exponential decay approach, i.e. pathways with fixed annual reductions that are phased in to facilitate adaptation and ensure a smooth transition. This approach involves substantial reductions at the very start, followed by a gradual phase-out that balances the urgency of the transition with its feasibility.

As can be seen in Figure 12, for the social tariff and the CPAS Energy Access Fund, subsidies will be reduced by 10% per year from 2025, then by 15% per year from 2030, and finally by 20% per year from 2035 to 2050. This phased reduction approach is consistent with gradual transitions that allow sufficient time for housing changes and behavioural adjustments. By 2050, these subsidies will be set at exactly zero, ensuring a complete end of the subsidies.

The subsidy due to different excise rates is reduced more aggressively, by 25% per year from 2025 to 2050. This steeper reduction trajectory reflects the need for a faster transition away from subsidies that directly influence market prices and consumer behaviour, thereby accelerating the shift towards energy efficiency. It is also set at exactly zero in 2050.

Thus, the pathways in their explicit form are given by the following;

$$S_t = S_0 \times (1 - r)^t \tag{1}$$

With the recursive form being the following;

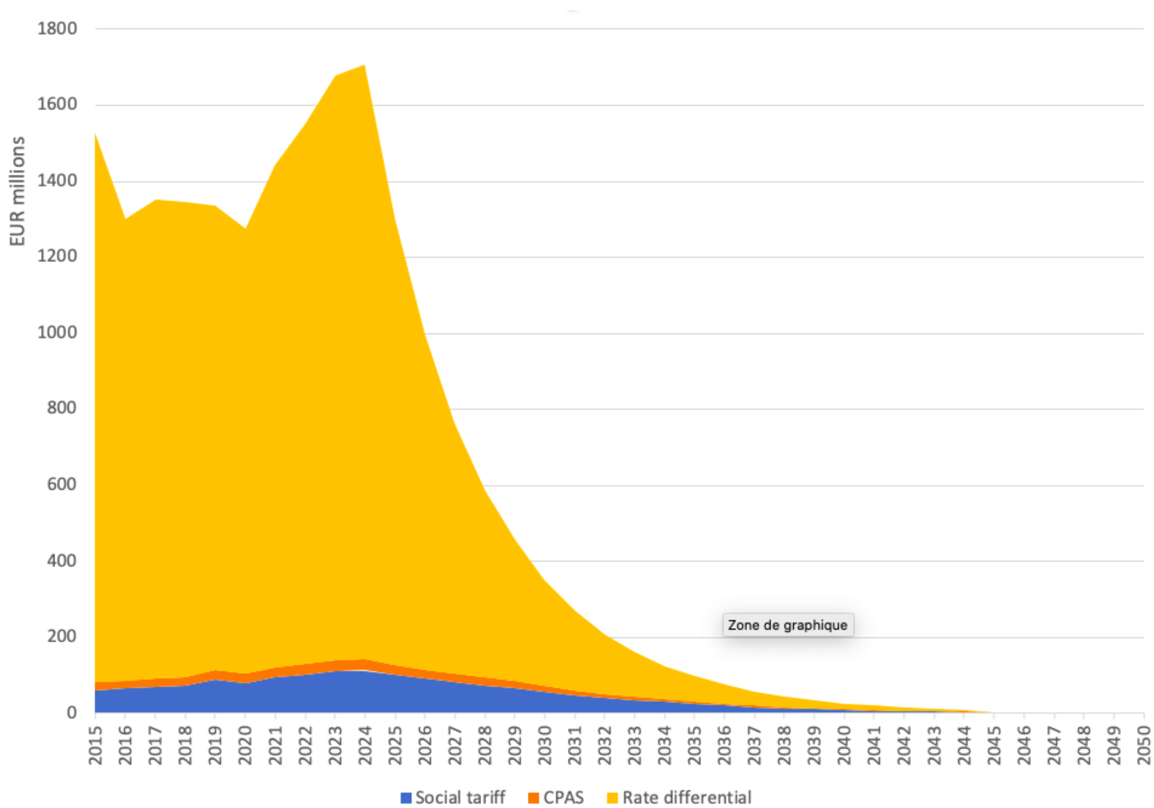
$$S_t = S_{t-1} \times (1 - r) \tag{2}$$

Where S_t is the subsidy in year t and equals the subsidy in the previous year (S_{t-1}) multiplied by 1 minus the annual fixed rate r, which is increasing in three phases for the social tariff and the CPAS fund (10%, 15% and finally 20%), and at 25% for the subsidy through the rate differential. The explicit form for the latter is therefore $S_t = S_{2025} \times (0.75)^t$.
In 2050, the three subsidies will be set at exactly zero, ensuring that they are completely eliminated. Therefore, $S_{2050} = 0$.

The timing, being an annual reduction, is appropriate in a twofold sense. First, the social rate and the excise duties are already recalculated every three months, so it is administratively possible to change them every year. The same applies to the CPAS fund, which is paid out several times a year. Secondly, it gives households time to anticipate future changes in subsidies, so that they can change their behaviour accordingly. As for the increase in the rate of the social tariff and the CPAS fund reduction every five years, vulnerable households have more time to anticipate, prepare or renovate, or switch to a different heating fuel or housing.

The first advantages of the exponential decay pathways are *transparency* and *predictability*. Since it is easy to communicate these annual reductions in subsidies, households can anticipate them and change their behaviour in advance. The second advantage is the *early impact*, with larger initial reductions demonstrating a strong commitment to phasing out subsidies and encouraging early changes in behaviour. However, the gradual increase in the annual reduction for the social tariff and the CPAS fund allows households to prepare and have a smoother transition. By providing a gradual transition, I can mitigate the social and economic impact and

Figure 12: Pathways to Phase Out Natural Gas Subsidies, 2015 to 2050



Source: Own calculations, with data from SPF Finances (2023); SPF Finances (2024).

ensure that the most affected groups have sufficient time and resources to adapt. Third, there is *adaptability*, as the model can keep the reductions proportional to the previous year's amount, but can be adjusted to adapt the rate of reduction in later years if needed, providing flexibility. This could be necessary in the event of a new energy crisis, or in the event of major technological advances in energy efficiency. Lastly, the *manageability* is also a key advantage, as the fixed annual reduction provides a clear and manageable way to track reductions year per year, ensuring the reductions align with the planned schedule and are easy to communicate.

The decision not to simply abolish subsidies from January 2025 is based on the recognition that sudden policy changes can cause significant disruption. Instead, a gradual reduction will ensure a smooth transition and give households time to adjust gradually. This path ensures a predictable and gradual reduction in subsidy levels, allowing for adjustments where necessary, while moving steadily towards the complete phasing out of fossil fuel subsidies. The annual reduction provides a clear path and timetable, facilitating planning and adaptation at both government and societal levels. Each year's reduction will be calculated based on the previous year's adjusted subsidy level, ensuring that the phase-out process remains consistent and transparent throughout.

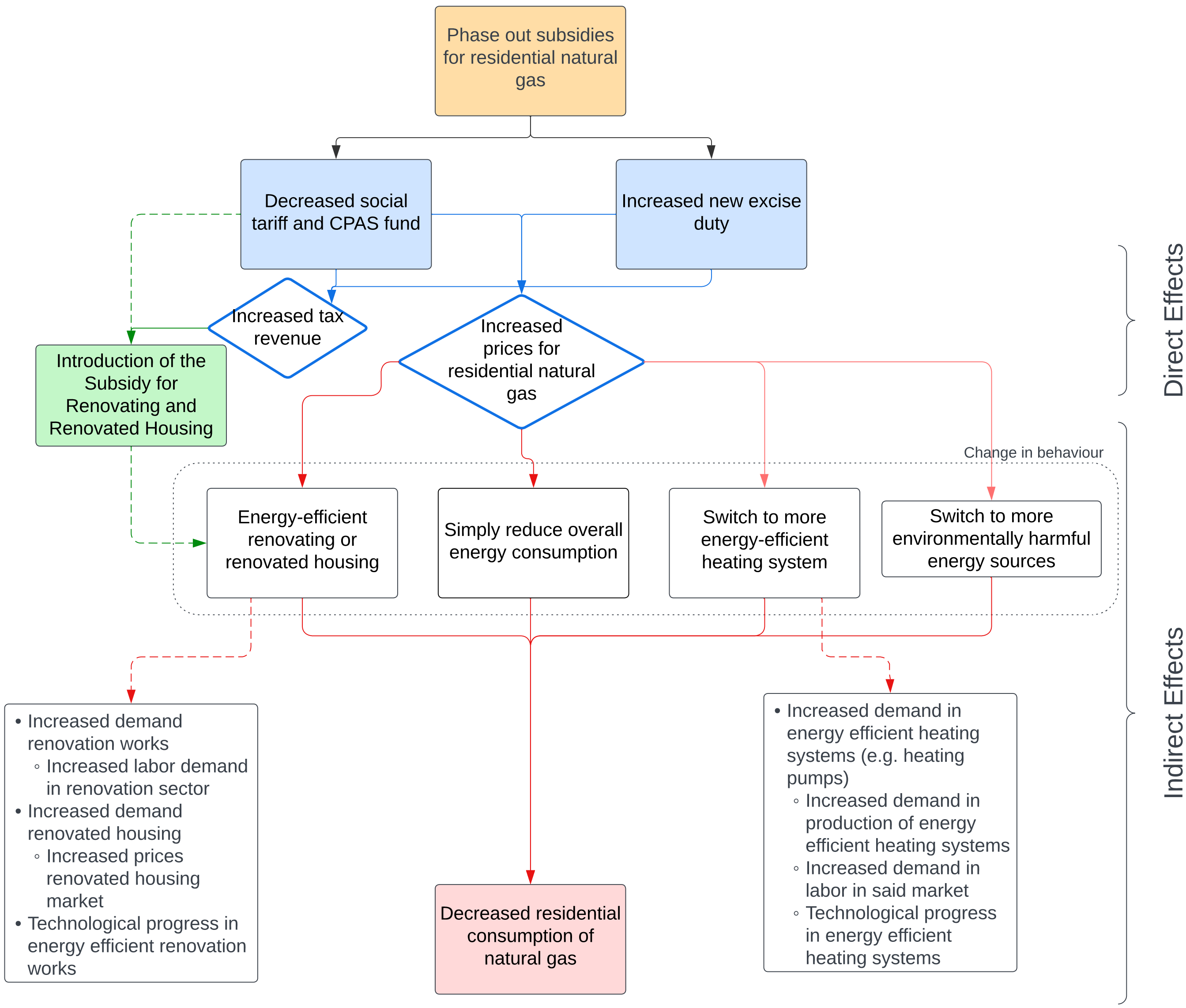
The pathways will be achieved in two manners; (i) the phasing out of the Social Tariff and the CPAS Fund, accompanied by the introduction of the Subsidy for Renovation and Renovated Housing, and (ii) the reform of the taxation of natural gas for residential use, i.e. the introduction of a new (increased) excise duty.

4.2 Direct and Indirect Effects

Once the feasible pathways are established, it is crucial to assess their effects. Phasing out natural gas subsidies for residential consumption will have both direct and indirect impacts. An overview can be seen in Figure 13.

The first *direct effect* of phasing out natural gas subsidies will be **increased tax revenue**, resulting from the reduction in government spending on the social tariff and the CPAS Fund, and increased new excise duty.

Figure 13: Direct and Indirect Effects of the Phase Out of Subsidies for Residential Natural Gas



Note: The blue arrows represent the direct effects, the red arrows represent the indirect effects, and the green arrows represent the effect leading to and from the accompanying Subsidy for Renovation and Renovated Housing.

Secondly, the *direct effect* for households will be **increased prices**, as the social tariff will be phased out and the increased excise duty will have a direct impact on price.

For those currently benefiting from the social tariff and the CPAS fund, the impact will be felt directly and most importantly, as these measures are likely only benefiting households already in energy poverty. Consequently, the cost of natural gas for these vulnerable households will increase significantly. To address the risk of exacerbating energy poverty, I propose introducing a new *Subsidy for Renovation and Renovated Housing*, using the reduced government spending mentioned above. This subsidy is intended to support energy-efficient renovations or to increase the housing budget for more energy-efficient homes. Details of this subsidy will be discussed further in Section 6.

As the price of natural gas for residential use rises, households will face higher costs. Although the increase will be gradual and vulnerable households will benefit from the new subsidy, many households in energy poverty or at risk of poverty will not be covered. Therefore, similar to the suggestions made by Fondation Roi Baudouin (2024), I recommend redefining the eligibility criteria for both the current social tariff and CPAS fund, as well as the new subsidy.

Furthermore, the phase-out of natural gas subsidies can lead to significant *indirect effects*, through the increased prices and the introduction of the Subsidy for Renovated and Renovating Housing. As natural gas prices gradually increase due to the removal of reduced rates for social tariff beneficiaries and the increased taxation due to the removal of product rate differentials, households may **change their behaviour** in response. Although some households may (i) simply reduce their overall energy usage due to high prices, this is less likely as energy is a necessity and past crises have shown that consumption does not decrease proportionally with price increases. More likely responses are (ii) to invest in energy-efficient renovations, such as improved insulation, or to move to renovated housing which is also incentivised by the introduced subsidy), or (iii) to switch to more energy-efficient and sustainable energy sources. Households may even combine these strategies. However, another possible behaviour change could be (iv) a switch to cheaper, but more environmentally damaging energy sources, such as heating oil or coal. This potential outcome underlines the importance of not only phasing out subsidies for natural gas but also taking into account all other harmful alternatives. However, regulations on these fuels are already being implemented. Taken together, the behavioural changes will lead to a **reduction in residential natural gas consumption**. While this reduction in consumption would result in lower tax revenues, the overall shift aligns with broader climate and societal welfare objectives (as mentioned in Section 2). By (indirectly) reducing dependence on natural gas and promoting energy efficiency, the transition supports long-term environmental sustainability and offers significant societal benefits, including reduced greenhouse gas emissions and improved energy resilience.

These indirect effects may also have consequential effects. The possibility for households to opt for renovation works, such as better insulation, etc., or for renovated housing, may have a positive effect on the demand for renovation works - by the homeowners benefiting from the fund, but also by the homeowners renting to the renters benefiting from the fund. This increased demand for renovation work may in turn affect the demand for labour in this sector, as there will be a need for sufficient labour to carry out energy-efficient renovations. The increased demand for renovated dwellings may in turn affect prices in the housing market. In addition, this increase in demand could accelerate technological progress in energy-efficient housing.

The possibility for households to switch to more energy-efficient heating systems may have a positive effect on the demand for energy-efficient heating systems, such as heat pumps. These are effective and arguably the most efficient replacements for gas boilers (Altermatt et al., 2023). This in turn could lead to increased demand for the production of these systems, which in turn could lead to increased demand for labour to produce them. In addition, the increased demand may lead to a significant acceleration in technological progress in energy-efficient heating systems.

4.3 Evaluation Criteria

Having outlined the feasible pathways and discussed their direct and indirect effects, I will now use seven dimensions to evaluate the outcomes and assess the effectiveness of the accompanying policies. These dimensions will provide a comprehensive framework for analysing the results and identifying the opportunities offered by the supporting strategies. This approach will allow a thorough assessment of how well the pathways and measures are achieving their intended goals, and provide insights into potential improvements or adjustments needed for successful implementation.

The seven key dimensions of evaluation are: (1) efficiency, (2) redistribution, (3) political feasibility, (4) accountability, (5) fiscal sustainability, (6) administrative realism, and (7) transition and dynamic considerations. While numerous other evaluation criteria could be applied, I focus on these seven due to their critical importance in policy analysis.

4.3.1 Efficiency

Efficiency is crucial in the evaluation of a policy. Firstly, the *productive efficiency* makes sure the desired outcome is achieved with the least amount of resources. Secondly, the *allocative efficiency* makes sure the resources used are allocated in a way that maximizes societal welfare, where the marginal cost equals the marginal benefit.

On the one hand, the *productive efficiency* is met in two ways; (i) replacing the social tariff with the Fund encourages homeowners to invest in energy-efficient improvement - this shift promotes productive efficiency by reducing energy consumption and associated costs -, and (ii) the progressive excise duty makes natural gas prices reflect its true cost, aligning consumption with the actual resource costs.

On the other hand, *allocative efficiency* is met in two similar ways; (i) the investment in energy-efficient housing is more valuable to society in the long term, and (ii) the progressive excise duty adjusts the price of natural gas based on consumption, encouraging households to consume less, which aligns supply with actual demand and maximizes social benefit.

For policymakers and other organisations to verify this efficiency, several indicators could be used for the evaluation of the policy.

Residential consumption of natural gas

The first and most obvious way to assess the impact of the pathways is to look at consumption. This is very straightforward as the CREG (2024) publishes consumption data every month. Although it should be noted that consumption varies according to the season, on an annual basis the impact will be measurable. If household consumption of natural gas decreases significantly, this could be a positive indirect effect of the pathways and could mean that households have changed their behaviour. However, to verify the latter, other aspects could be looked at;

Demand for energy-efficient heating alternatives

Behavioural change could also be assessed by looking at the demand for energy-efficient heating alternatives. Since heat pumps are likely to be the most popular alternative due to their high energy efficiency (Altermatt et al., 2023), their demand could be analysed. Comparing the reduction in natural gas consumption and the increase in the use of heating pumps, one could already conclude the efficiency of the pathways.

Demand for energy efficient renovation works

Demand for energy-efficient renovations could serve as an indicator of the efficiency of the proposed pathways. While major renovations often require permits, which could be easily tracked, and contractors, who could report on the number of services completed, smaller works could be done by homeowners themselves or through informal arrangements. Another method could be to estimate this demand through the purchase of materials for renovation. To only track the number of renovations carried out as a result of the fund would greatly underestimate efficiency, as I expect the effect to also lead to renovations by landlords renting to households benefiting from the fund and by homeowners seeking to avoid high natural gas consumption.

Demand for energy-efficient renovated housing

Increased demand for energy-efficient renovated housing would also be a good indicator. This could be easily assessed by looking at the demand for housing with a certain level of energy performance. If the demand itself isn't directly observable, the price increase could also be used as an indicator.

Tax revenue and expense
Finally, efficiency would be relatively easy to measure in terms of tax revenues and expenditures. In theory, the fund should be a major expense in the early years of the phase-out, as it is intended to benefit vulnerable households and provide them with an incentive to change their behaviour. Therefore, if the fund is heavily used in the early years, this could be an indicator of the efficiency of the subsidy. In addition, the new excise duty should increase tax revenues in the short term and decrease in the long term if households change their behaviour, which would also be easy to verify.

It should be noted that these pathways are neither the first nor the last policy measures aimed at reducing fossil fuel consumption. Therefore, all discussed indicators should be considered with caution, as none of them, except the last one, is exclusively dependent on the implementation of the proposed pathways.

4.3.2 Redistribution

The *redistribution* criteria assesses how the pathways affect different groups within society, including how they redistribute resources and affect equity between different stakeholders.

The Fund should benefit those in energy poverty. However, as discussed in Section 3, not all households in energy poverty currently benefit from the social tariff. Raising awareness of the new fund among those eligible could be one solution, while a review of the eligibility criteria to benefit from it could also address the issue - as suggested by the Fondation Roi Baudouin (2020). This will allow all households in energy poverty to benefit from better housing, potentially improving their living conditions and reducing their energy costs. However, wealthier households could benefit disproportionately if they can afford renovations and therefore have lower consumption, or if they spend a smaller share of their income on natural gas even with higher consumption and therefore higher prices. The progressive excise duty could therefore become regressive if it falls disproportionately on lower-income households. To address this, the Fund ensures the protection of the most vulnerable households.

The distribution criteria can therefore be assessed by looking at the share of households living in energy poverty. The ideal scenario would be for the share to be zero by 2050, but it will be very useful to recalculate the share regularly to know whether the redistributive aspect of the pathways is effective. Of course, if the criteria for energy poverty change, one should be careful when comparing different time periods.

As household consumption of natural gas is expected to decrease due to behavioural changes, the supply side of natural gas to households in Belgium could be affected. International suppliers such as Norway and the Netherlands could reduce their exports to Belgium (Energuide, 2024). In addition, distribution networks, including GRD and Fluxys, will also be affected and may face lower revenues and operational adjustments (CREG, 2024).

4.3.3 Political Feasibility

The political feasibility is crucial. It should be noted that the Belgian federal government is currently not formed yet, but that most parties integrated the phase-out of fossil fuel subsidies in their programmes during the 2024 elections. Moreover, a reform of the excise duty scheme for natural gas already took place in 2022, proving the possibility of reforming the taxation of this good once again. Thus, the political feasibility can be evaluated easily by simply seeing if the policy is implemented. The only drawback is the need for the federal government to be formed soon enough to have time to implement these pathways correctly and timely.
The political feasibility of the policy is crucial, as it evaluates the likelihood that the policy will be accepted and supported by policymakers, thus politicians and public opinion. To evaluate the political feasibility, I will discuss the winners and losers of these pathways.

The *winners* are multiple. Firstly, there are the households in energy poverty that benefit from the current social tariff that are homeowners. These households will benefit from additional resources to improve their housing conditions and lower energy bills. This can be evaluated by looking at the number of beneficiaries of the Fund for renovation works. Similarly, households in the same case, but renting housing, will also have increased resources to afford more energy-efficient housing, improving their housing conditions and lowering their energy bill. This can be evaluated by looking at the demand for more energy-efficient housing, as discussed above.

Moreover, environmentally conscious voters and future-aware generations will also likely support these policies for their long-term benefits. Additionally, those in the renovation sector will also benefit from this policy, and thus be more likely to be in favor of this policy. Lastly, voters with a preference for less governmental spending will also be in favour of the policy, as it phases out the rate differential subsidy completely, and thus increases tax revenue. To evaluate these effects, one can conduct surveys, monitor public opinion over time using social media analysis, news sentiment analysis, and regular opinion polls, or look at voting behaviour during the next elections (even though the latter will most likely be related to many other aspects as well).

On the other hand, *losers* will likely be the high-consumption households which do not plan on switching fuels or renovating or moving to more energy-efficient housing. These households will see their spending on natural gas increase with this new policy. Natural gas producers may also be opposed to the policy, as the demand is expected to decrease in the long term. Again, this can be evaluated by conducting surveys, monitoring public opinion or looking at voting behaviour, but also by tracking residential consumption data on natural gas.

However, as discussed in Section 2, there is an urgency to address climate change, and several agreements and treaties have been concluded to adopt a transition. Policies framed as steps towards a greener economy are thus essential. By communicating effectively about the long-term benefits and the advantages of these pathways, support for this policy is thus highly likely.

It should be noted that the Belgian federal government is currently not formed yet, but most parties integrated the phase-out of fossil fuel subsidies in their programs during the 2024 elections. Moreover, a reform of the excise duty scheme for natural gas already took place in 2022, proving the possibility of reforming the taxation of this good once again. Thus, the political feasibility can be evaluated easily by simply seeing if the policy is implemented. The only drawback is the need for the federal government to be formed soon enough to have time to implement these pathways correctly and timely.

4.3.4 Accountability

The *accountability* criteria ensures that pathways are consistent with existing rights and responsibilities and that they are coordinated with related policies to maximise impact and effectiveness.

As discussed in Section 3, there are already several subsidies for renovation work in Belgium. However, the difference lies in the beneficiaries. The proposed Fund targets households in energy poverty. The Fund can therefore be seen as an additional support for the most vulnerable rather than a superfluous one. Coordination can be relatively smooth as these beneficiaries already receive support in the form of the current social tariff, so they are already identified. Moreover, 97% of the beneficiaries are federal social beneficiaries, which reduces the need for extensive coordination with regional authorities, although this could be made possible.

As the excise tax has recently been changed, it is known that such a change is possible and is done at the federal level. Therefore, the proposed pathways can also be implemented at the federal level. In addition, I am proposing a policy starting in January 2025, which will allow sufficient time for analysis and announcement before implementation.

The pathways are straightforward and can be communicated. Strict and timely enforcement will allow for good understanding and anticipation by households wishing to reduce their consumption by switching fuels, renovating or moving to more energy-efficient housing.

Several indicators can be used to assess the accountability of these pathways.

Alignment with existing rights and responsibilities
By carrying out regular reviews to ensure that pathways are consistent with existing legislation and policies, and by monitoring changes in legislation and updating pathways accordingly, alignment can be assessed and ensured.

Beneficiary data accuracy
This can be done by first redefining households in energy poverty and then regularly updating and verifying data on the recipients of the fund and the proportion of households in energy poverty. This data could be used not only to assess accountability but also to improve the Fund to ensure accurate targeting.

4.3.5 Fiscal Sustainability

The *fiscal sustainability* criteria ensure that the pathways are financially viable in the long term, without imposing excessive burdens on the federal budget or the economy. Evaluating fiscal sustainability involves assessing both the costs and the benefits of the proposed pathways and their impact on government revenues and expenditures.

The gradual phase-out of subsidies and the introduction of new support measures for energy-efficient housing must be balanced to maintain fiscal health. The proposed pathways involve significant initial investments but aim to generate long-term savings and revenue increases through reduced energy consumption and higher tax revenues.

Cost-Benefit Analysis
Performing a cost-benefit analysis is a good indicator of the fiscal sustainability of the pathways. By tracking the government's expenditure on the new Fund and other support measures that will be described below, one could estimate the initial investment costs. These can then be compared to the estimated savings in the short term (increased tax revenue) and in the long term, resulting from reduced natural gas consumption (and thus also health benefits) and lower subsidy payouts. This involves modelling energy consumption trends and comparing them to baseline scenarios without the new pathways. This way, the fiscal sustainability of the pathways can be evaluated.

To evaluate the fiscal sustainability of these pathways, several indicators can be employed:

Revenue Generation

The tracking of revenue generation can also work as a good indicator. By monitoring changes in tax revenues from natural gas as consumption decreases, one can assess the impact of higher excise duties on federal revenue. Moreover, potential new revenue streams generated by increased demand for energy-efficient technologies and related economic activities can also be used as an indicator of fiscal sustainability.

By employing these evaluation indicators, the fiscal sustainability of the proposed pathways can be rigorously assessed in the future. This ensures that the pathways remain financially viable, balancing initial costs with long-term benefits to achieve the desired economic and environmental outcomes.

4.3.6 Administrative realism

Through the *administrative realism* criteria it is possible to examine the feasibility of implementing and managing the policy, including the costs, risks, and effectiveness of the enforcement.

The Fund will involve significant administrative efforts to process applications, assess eligibility, and manage funds. While there already exist eligibility criteria for the beneficiaries of the social tariff and the CPAS fund, these can certainly be reviewed to include all households in energy poverty. Moreover, once the eligible households are chosen, there should be a distinction between those being homeowners and those renting their housing. For homeowners, there should be an application for enrollment in the Fund such that it can be verified that they do plan on using the money to renovate their housing for more energy efficiency. For renters, there should be a verification for the money being used to move to more energy-efficient housing. While there already exist certificates and other rankings, such as the EPB certificate (Energy Performance of Buildings), it will still take effort to verify that households follow the required criteria. The enforcement of this Fund will thus require strong regulation. Not only will all these accompanying measures have a cost (that will have to be included in the costs discussed in the *fiscal sustainability*), but they also raise questions about administrative realism. To evaluate this, several indicators can be used.

Administrative costs

By estimating the total costs associated with changing the eligibility criteria, and implementing and managing the policy, realism could be evaluated. This cost would include staffing, training, and technology expenses. Tracking these costs against initial estimates and comparing them to similar policies or past experiences will allow for a comprehensive evaluation.

Processing time

To assess administrative realism, it is essential to evaluate the time required to process applications for the Renovation and Renovated Housing Fund. This involves tracking how long it takes to review, approve, and disburse funds. Monitoring trends over time and comparing processing times to benchmarks or similar programs can highlight administrative efficiency or delays.

Eligibility verification

Examining the efficiency and accuracy of the process can also be used for verifying eligibility. Measure the success rate of applications versus rejections and assess the time needed for verification. Evaluate how well the criteria target the intended beneficiaries, and determine if the verification process is streamlined and effective.

Error rates

Monitor the frequency and types of errors encountered during administration, such as incorrect eligibility determinations or fund misallocations. A lower error rate indicates better administrative control and accuracy. Analyzing the nature of errors can also help in refining processes to minimize future issues.

Administrative burden on beneficiaries

Measure the burden placed on beneficiaries, including paperwork, application complexity, and interactions with administrative bodies. A reduced burden reflects a more user-friendly process and can be evaluated through beneficiary feedback and the time required to complete administrative tasks.

4.3.7 Transition and Dynamic Considerations

The *transition considerations* focus on the challenges and expenses associated with shifting from the current system to the new policy framework. The transition from the social tariff to the Fund will necessitate substantial administrative changes. This includes setting up new administrative systems to manage the Fund, training personnel, and effectively communicating the changes to the public. Key resources such as time, money, knowledge, and workforce will be required for these tasks. Key indicators for evaluating these transition considerations include:

Administrative costs
As discussed above, the initial administrative costs will be important and can be assessed by measuring the total costs associated with setting up and managing the new Fund. By tracking costs, staffing levels and process efficiency, the transition criteria can thus be evaluated.

Market disruptions
Market disruptions can also be used to evaluate the success of the transition to the pathways. These can be assessed in several ways. First, by looking at service availability, by monitoring the capacity and availability of renovation service providers in response to increased demand. The number of service providers and their capacity utilization or the availability of renovation services and waiting times can be good indicators. Second, by looking at price changes in the cost of renovation services and materials, and third, by surveying stakeholders (e.g. contractors, suppliers, but also beneficiaries of the social tariff first, and later the Fund).

Legal adjustments
By examining the complexity and speed of legal adjustments needed to implement the policy, one could estimate the regulatory changes needed, which can be used to evaluate the transition considerations. This can be done by tracking the required time to complete legal and regulatory changes and the number and type of legal adjustments made. Moreover, measuring the time taken to implement the regulatory changes can also be used for evaluating the transition criteria.

The *dynamic considerations* address the ongoing costs and challenges associated with maintaining, adapting, and refining the policy over time. This involves the ability to update the policy based on new information, evolving circumstances, and technological advancements. Key aspects include:

Policy adaptability
Tracking how often the policy is reviewed and updated can be a good indicator for evaluating dynamic considerations. This can be done by looking at the number of policy reviews conducted per year or the frequency of updates based on new information. Measuring how quickly the policy adapts to new data or changing circumstances can also be a good indicator.

Compliance and evasion
Evaluating dynamic considerations can also be done by looking at compliance rates or detecting evasion. The first can be estimated by looking at the percentage of entities or individuals in compliance, for instance taking the number of compliance audits conducted and their outcomes. The latter can be estimated by tracking instances of evasion and the effectiveness of enforcement actions. In this case, the number of cases of evasion detected and the effectiveness of enforcement actions (e.g., penalties imposed) can be used.

4.4 Methodology

As mentioned above, the suggested pathways will be achieved by introducing a subsidy (the Fund) and by changing the taxation of natural gas for residential consumption through a new excise duty. In order to calculate this new excise duty, that will be levied in the future, I need to estimate future prices and consumption of natural gas. I will use data from CREG (2024) on current prices and consumption of natural gas by households in Belgium (see Section 5). To forecast future prices and consumption, I will need to proceed in three steps. Firstly, I will need the price elasticity for the residential demand for natural gas. Secondly, to predict future prices, I will base my estimates on the International Energy Agency (2023b), which lays out three different scenarios for the forecasting of natural gas prices. I opt for these three different scenarios because the future is uncertain - the energy crisis of 2022 is a perfect example of how much energy prices fluctuate. Using these three different estimations will allow me to evaluate the feasibility of my suggested pathways in different scenarios, which will make them more robust. Thirdly, I will also estimate future consumption, by using the price elasticity and the forecasted prices in the three scenarios.

4.4.1 Price Elasticity

The price elasticity plays an important role in the evaluation of direct effects (the tax incidence) of the new excise duty. The more it is elastic, the more consumption will vary when prices change. Thus, if the price goes up because of the new excise duty, consumers will be impacted and will be more likely to change their behaviour (i.e. opt for other energy sources or more energy-efficient solutions).
To estimate the price elasticity of natural gas consumption by households in Belgium, I need long-term data on the residential demand in Belgium. Unfortunately, I do not have this data. In Appendix 9, I describe how I try to estimate the price elasticity with price and consumption data for a relatively short period. This estimation of natural gas consumption concerning the price of natural gas ($Price$) leads to a value of -0.10310. However, since this is done with a price-quantity time series, I cannot use this for the estimation of future consumption and I need to use the existing literature on elasticity for residential natural gas.

According to the literature, the price elasticity for natural gas residential demand is negative. Auffhammer & Rubin (2018) found a price elasticity of demand for residential natural gas ranging from -0.23 to -0.17 in California. Burke & Yang (2016) use a data set covering 44 countries (of which Belgium) over the period 1978 – 2011 and found a long-run price elasticity of natural gas demand by households of -1.43. Since the latter study is relatively recent, covers a long-term period, calculates the elasticity specifically for household demand and takes into account 44 countries (of which Belgium), I choose to use this price elasticity to estimate Belgian consumption. I therefore assume that this elasticity applies to Belgian households' future demand for natural gas. This is a strong assumption, as it is likely that this elasticity will change in the future, given major advances in the regulation of natural gas, but also in the accessibility of energy-efficient heating alternatives and the improved quality of insulated housing.

4.4.2 Price Estimation of Natural Gas

To estimate future natural gas prices, I use a data-driven approach combined with the literature. I use data from the CREG (2024) on historical natural gas prices in Belgium and combine it with estimates from the International Energy Agency (2023b) on future prices. Future prices are uncertain, therefore I choose three different scenarios to get a more comprehensive and accurate understanding of the future.

The International Energy Agency (2023b) report on the *World Energy Outlook* presents three scenarios that I will use in this thesis: (i) the Stated Policies Scenario (STEPS), (ii) the Announced Pledges Scenario (APS), and (iii) the Net Zero Emissions by 2050 Scenario (NZE). This *Outlook* provides a robust evidence base for guiding energy decision-makers in achieving transitions that are rapid, secure, affordable, and inclusive. Instead of presenting a single future vision, the report explores different scenarios that reflect real-world conditions and starting points. The STEPS scenario offers an outlook based on the latest policy settings, including energy, climate, and related industrial policies. The APS scenario assumes full and timely implementation of all national energy and climate targets set by governments. Nonetheless, substantial additional efforts are necessary to meet the NZE scenario's objectives, which aim to limit global warming to 1.5 °C. The three scenarios are thus distinct from one another. By examining all three, it is possible to gain a more comprehensive understanding of the likely trajectory of natural gas prices.

These scenarios are based on data for 2010 and 2022 and are forecasts for 2030 and 2050, expressed in USD/MBtu (US dollars per million British thermal units) for the European Union. To adapt these to Belgian prices, I focus on the predicted changes in natural gas prices, rather than their absolute values. This is because the scenarios are based on EU-wide data, rather than data specific to Belgium. It is reasonable to assume that these changes apply to Belgium, given the interconnected nature of the European energy market and the similar trends in natural gas prices across EU countries.

In the outlook by International Energy Agency (2023b), a 2010 reference is provided. However, as the data from CREG (2024) does not include prices for natural gas in

Belgium before 2013, it is necessary to first estimate the prices in 2013 by calculating the growth rate between 2010 and 2030. Thus, I examine the percentage changes in gas prices between 2013 and 2030, as well as between 2030 and 2050, for each of the three scenarios.
To compute the price growth rate r_{s2030} from 2013 to 2030 for scenario s, I use the following reasoning;

$$\begin{aligned} P_{s2013} * (1+r)^m &= P_{s2030} \\ (1+r_{s2030})^m &= \frac{P_{s2030}}{P_{s2013}} \\ m * ln(1+r_{s2030}) &= ln\frac{P_{s2030}}{P_{s2013}} \\ ln(1+r_{s2030}) &= \frac{ln\frac{P_{s2030}}{P_{s2013}}}{m} \\ 1+r_{s2030} &= e^{(\frac{ln\frac{P_{s2030}}{P_{s2013}}}{m})} \\ r_{s2030} &= e^{(\frac{ln\frac{P_{s2030}}{P_{s2013}}}{m})} - 1 \end{aligned} \tag{3}$$

Where P_{s2013} is the residential price of natural gas in 2013 for scenario s, P_{s2030} is the residential price of natural gas in 2030 for scenario s, r_s is the growth rate of price per month for scenario s between 2013 and 2030, and m is the number of months between January 2013 and December 2029 (m = 204).

Thus, to find P_{2013} according to the International Energy Agency (2023b) scenarios, I have to first calculate the annual price growth for each scenario s between 2010 and 2030, and have then used this price growth rate to calculate P_{2013}.

$$r_{sannual} = e^{(\frac{ln\frac{P_{2030}}{P_{2013}}}{20})} - 1 \tag{4}$$

such that

$$P_{2013} = P_{2010}(1 - r_{sannual})^3 \tag{5}$$

For the monthly price growth rate between 2030 and 2050, the following holds;

$$r_{s2050} = e^{(\frac{ln\frac{P_{s2050}}{P_{s2030}}}{m2050})} - 1 \quad (6)$$

Where m_{2050} is the number of months between January 2030 and December 2050 (m=252).

Since the three scenarios predict different growth rates, and since there are two different price growth rates for each scenario (one between 2013 and 2030, and one between 2030 and 2050), the following holds;

$$r_{sk} = e^{(\frac{ln\frac{P_{sk}}{P_t}}{m_k})} - 1 \quad (7)$$

Where r_{sk} is the growth rate of prices in scenario $s = \{\text{STEPS}, \text{APS}, \text{NZE}\}$, until year $k = \{2030, 2050\}$, P_{sk} is the price of natural gas in scenario $s = \{\text{STEPS}, \text{APS}, \text{NZE}\}$, until year $k = \{2030, 2050\}$, P_t is the price of natural gas in month t, and m_k is the number of months between t and k.

I can now estimate future prices, using my most recent data (thus taking the average of prices for natural gas from January to April 2024, i.e. $P_{Avg2024}$). For prices until 2030, I use the following reasoning;

$$P_{st} = P_{Avg2024} * (1 + r_{s2030})^{m_{2030}} \quad (8)$$

For instance, for prices in scenario s in February 2025, the following holds;

$$P_{sFebr2025} = P_{Avg2024} * (1 + r_{s2030})^{59} \quad (9)$$

For instance, for prices in scenario s in June 2043, the following holds;

$$P_{sJune2043} = P_{sJan2030} * (1 + r_{s2050})^{91} \quad (10)$$

4.4.3 Consumption Estimation of Natural Gas

In order to estimate future consumption of natural gas, I use the price elasticity and the forecasted prices found with the methodologies described above.

The use of historical price elasticity to estimate future consumption is not optimal due to changing market conditions and evolving consumer behaviour. While the report by International Energy Agency (2023b) does not provide specific projections for residential natural gas consumption under the three scenarios, this forecast is essential for the calculation of the new excise duty. In the absence of future data, consumption estimates have to be derived from past and current trends, and forecasts.

Once the excise duty is implemented, ideally in January 2025, it will be crucial to use updated price-elasticity estimations and consumption data to ensure accuracy. Specifically, data up to November or December 2024 will be used for the initial calculation of the excise duty for January 2025. Thereafter, consumption data will be updated every three months to reflect actual consumption (and prices) and the excise duty will be adjusted accordingly. This iterative approach will improve the responsiveness and accuracy of the excise duty, bringing it more in line with actual consumption patterns.

Therefore, for the forecasting of consumption, using the price elasticity, I have;

$$\begin{aligned} \eta &= -\frac{\Delta Q}{Q} * \frac{P}{\Delta P} \\ \frac{\Delta Q}{Q} &= -\eta \frac{\Delta P}{P} \end{aligned} \tag{11}$$

Where η is the price elasticity of natural gas for residential consumption, P is the price of natural gas for households (including costs and taxes), and Q is the consumed quantity of natural gas.
Since $\frac{\Delta P}{P}$ is the growth rate of price, it is equal to r_{sk}. Therefore, I define $g_{sk} = \frac{\Delta Q}{Q}$ as the growth rate of consumption.

Thus, the growth rate of consumption g_{sk} is the following;

$$g_{sk} = -\eta * r_{sk} \tag{12}$$

Where η = 1.43 (Burke & Yang, 2016), and r_{sk} is the price growth rate in scenario s for time period k.

Similarly, as for the price estimations, I use the most recent consumption data to forecast future consumption.
Thus, for consumption until 2030, I use the following reasoning;

$$Q_{st} = Q_{Avg2024} * (1 + g_{s2030})^{m_{2030}} \tag{13}$$

For instance, for consumption in scenario s in February 2025, the following holds;

$$Q_{sFebr2025} = Q_{Avg2024} * (1 + g_{s2030})^{59} \tag{14}$$

For instance, for consumption in scenario s in June 2043, the following holds;

$$Q_{sJune2043} = Q_{sJan2030} * (1 + g_{s2030})^{91} \tag{15}$$

5 Data

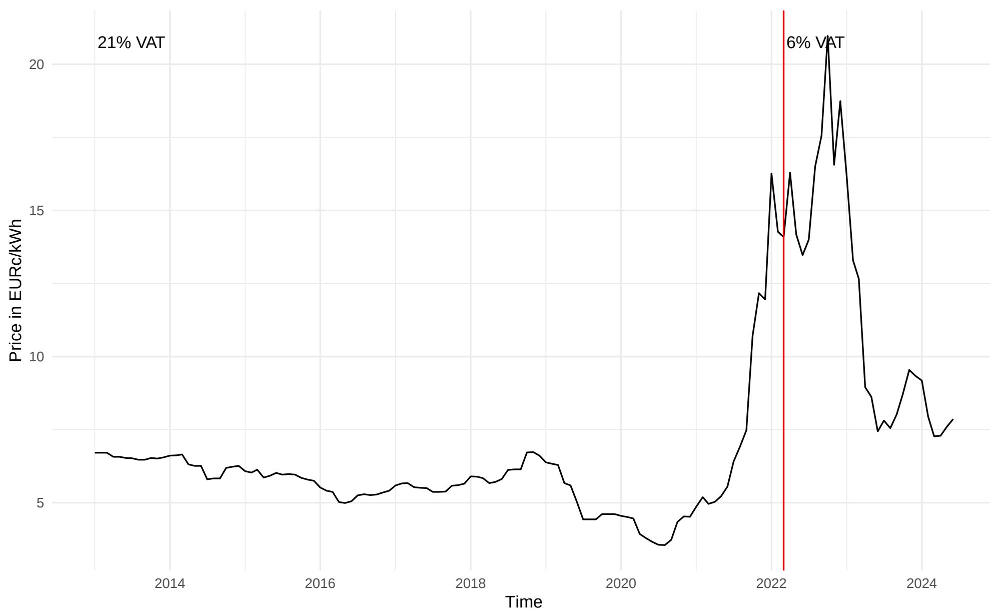
5.1 Data on Natural Gas Prices

Regarding natural gas prices, I have monthly data from CREG (2024) for average households. This data includes the average prices and the social tariff (price and number of social customers). It also includes the components of the total price such as energy, distribution and transport, VAT and taxes.

The evolution of natural gas prices for households can be observed in Figure 14. It can be seen that natural gas prices peaked in 2022, this was due to a confluence of factors that culminated in a significant energy crisis. The main driver was the geopolitical tension arising from the Russia-Ukraine war. Russia, a major supplier of natural gas to Europe, faced sanctions and supply disruptions that severely limited the availability of natural gas on the global market. In addition, the recovery from the COVID-19 pandemic led to a sharp increase in energy demand as industries ramped up production and economic activity resumed at a rapid pace. This surge in demand, coupled with limited supply, created a perfect setting for price surges (Xing et al., 2023).

The evolution of the social tariff for natural gas, which is more stable than the fluctuating average price, can be observed in Figure 4 in the Appendix. Although the social tariff has not experienced peaks like the average household price, it has been rising steadily over time.

Figure 14: Evolution of Natural Gas Prices for Households, 2013/01 to 2024/06

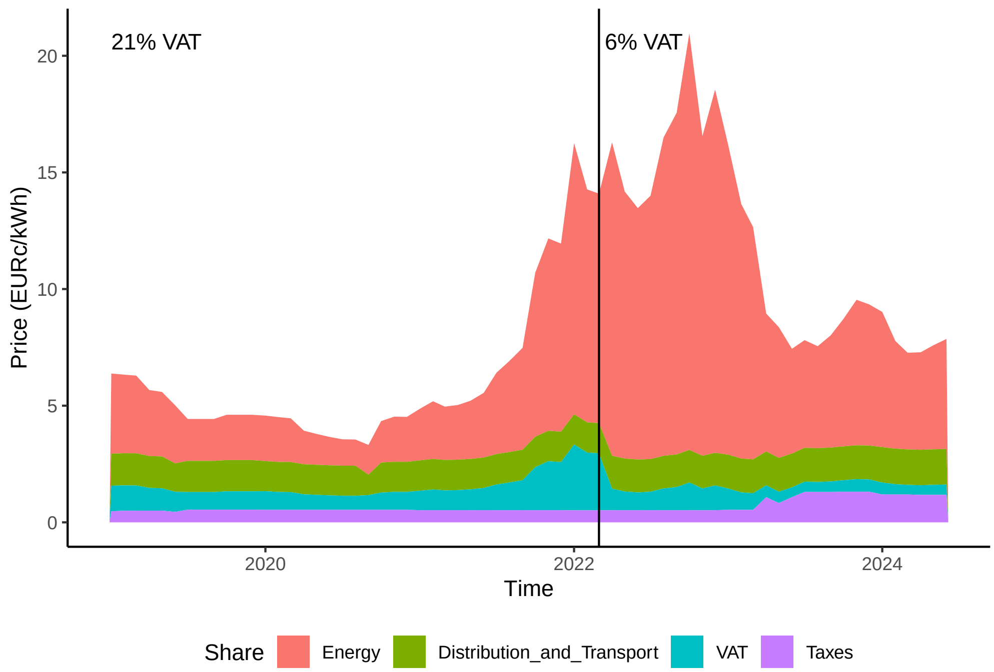


Note: This is the natural gas price (including VAT) in c€/kWh for Belgian households with an average consumption profile (i.e. 23,260 KWh/year before April 2022, and 17,000 KWh/year afterwards). The vertical red line indicates the change in the VAT rate.
Source: Own calculations, with data from CREG (2024).

Furthermore, it is also important to look into the components of natural gas prices. The price is composed of four different shares: (i) energy, the price of the natural gas itself, (ii) the distribution and transport costs, (iii) the VAT, and (iv) the taxes (other than VAT). The evolution of the distribution of these can be observed in Figure 15. It can be seen that a VAT of 21% has been imposed on natural gas from 2013 up to 2022.

From the end of 2021 onward there was a sharp increase in prices due to the energy crisis and the VAT was reduced. As the VAT rate decreased in March 2022 from 21% to 6%, the change can also be observed in the distribution of the price components.

Figure 15: Evolution of Distribution of Price Components of Natural Gas for Households, 2019/01 to 2024/06



Note: Natural gas price (including VAT) in c€/kWh for Belgian households with an average consumption profile (i.e. 23,260 KWh/year before April 2022, and 17,000 KWh/year afterwards). The vertical line indicates the change in the VAT rate.

Source: Own calculations, with data from CREG (2024).

This VAT reduction has been accompanied by an increase in excise duties. Until 2021, consumers paid federal contributions (included in the prices above) on their electricity and natural gas consumption. The Programme Act of 27 December 2021 abolishes these federal levies and replaces them with a special excise duty. Thus, since 1 January 2022, special excise duties were introduced for natural gas (as well as for electricity, on which the VAT has also been reduced from 21% to 6%). These are tariffs per consumption interval calculated on a trimestrial basis. In April 2023, the federal government introduced an extra special excise duty - extra, because the one implemented in 2022 remains. These figures are described in Table 7, which shows the breakdown of excise duties for households with average consumption. The change in the share of *Taxes* as a price component can also be observed in Figure 15.

The new mechanism works as follows:
In April 2023, the extra special excise duty amounts to 33.88 EUR/MWh for electricity and 7.69 EUR/MWh for natural gas for households with an average consumption. The average Belgian household consumption is 3500 KWh for electricity and 17000 KWh for natural gas, i.e. 291.67 KWh/month and 1417 KWh/month respectively. As can be seen in Table 7, this corresponds to a total monthly cost of the new special excise duty for an average household of EUR 21 for electricity and natural gas combined, in April 2023. For simplicity, when mentioning the sum of the first and the extra special excise duty that is currently in place, I will refer to the 'existing special excise duty'.

Table 7: Excise Duty on Electricity and Natural Gas for an Average Household, April 2023

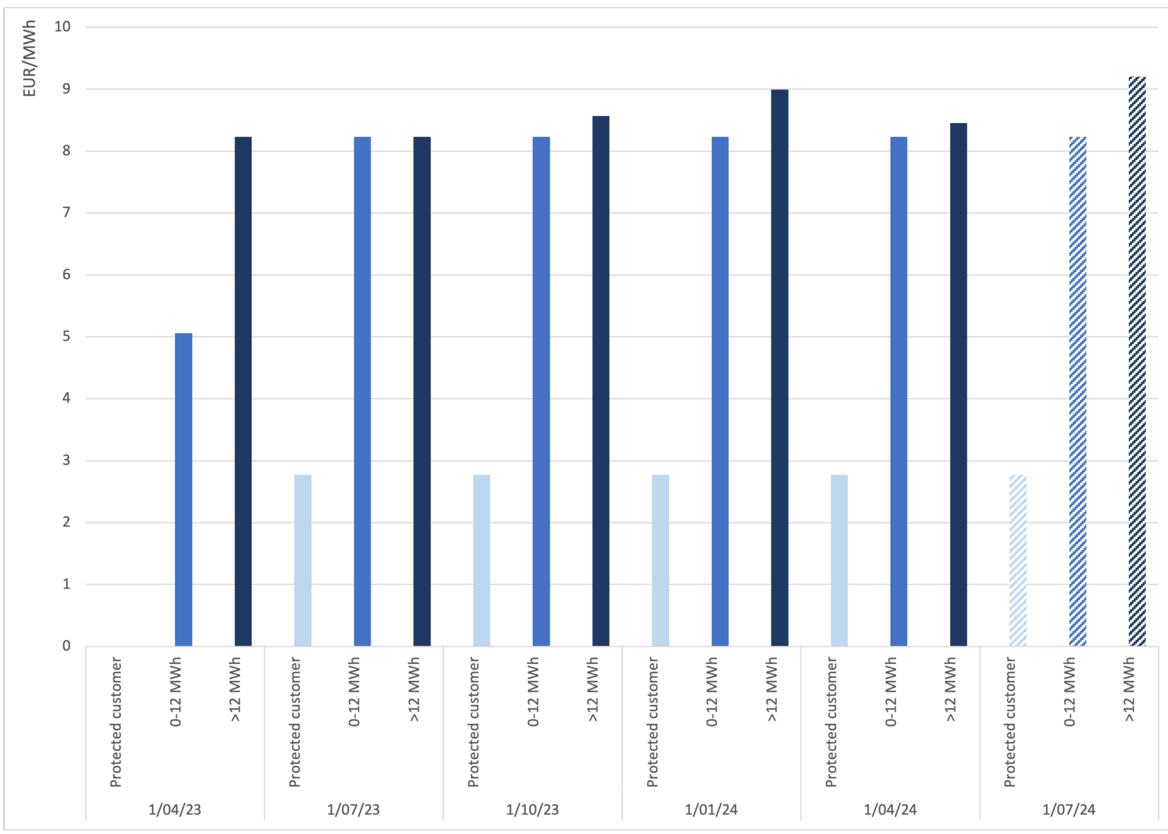
Average household	**Electricity**	**Natural Gas**
Yearly consumption (kWh/year)	3500	17000
Monthly consumption (kWh/month)	291.67	1417
First special excise duty (since January 2022) (EUR/MWh)	13.60	0.54
Extra special excise duty (for April 2023)(EUR/MWh)	33.88	7.69
Total average special excise duty (EUR/month)	9.88	10.91
Total monthly extra excise duty for average household	EUR 21	
Total monthly special excise duty for average household	**EUR 35**	

Note: Special excise duties, expressed in EUR/MWh. The total monthly excise duty combines the special excise duties of electricity and natural gas.
Source: Own calculations, with data from SPF Finance (2024).

Several aspects need to be taken into account. Firstly, the excise duties are very flexible as they are recalculated every 3 months, based on the recalculated energy prices. The evolution of the special excise duties, per consumption interval, can be observed in Figure 16 for natural gas (and in Figure 3 in Appendix for electricity).

Secondly, if electricity and natural gas prices exceed a certain threshold (i.e. more than 250 EUR/MWh for electricity and more than 100 EUR/MWh for gas), the excise duties are reduced such that an average household pays a maximum of EUR 16 per month. Thirdly, this reduction only applies to *basic consumption*, which is set at 3000 KWh/year for electricity and 12000 KWh/year for natural gas, i.e. below average consumption. If households consume more than this basic consumption, they have to pay the full excise duty for all consumed KWh above the threshold. Lastly, if natural gas prices fall below EUR 45, excise duties on additional consumption will be increased above the maximum threshold of EUR 21 (SPF Finance, 2024).

Figure 16: Special Excise Duties for Natural Gas (for Non-Professional Consumption), 2023/04 to 2024/07



Note: Special excise duties in EUR/MWh. The shaded bars are estimated by SPF Finance (2024) as of July 2024.
source: Own calculations, with data from SPF Finance (2024).

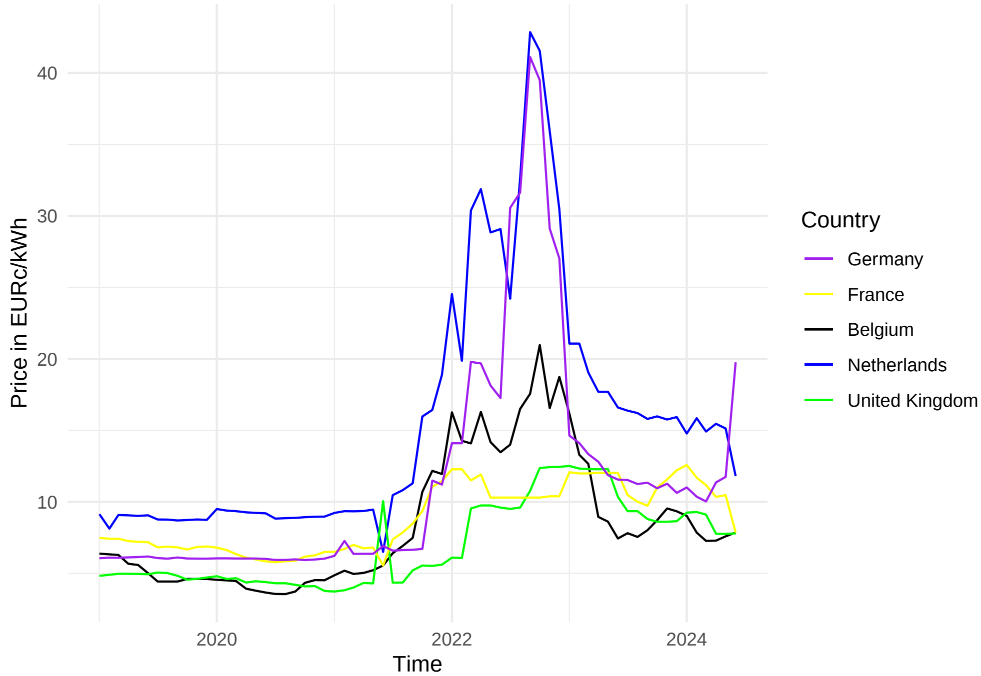
The introduction of special excise duties is compensation for the reduced VAT rate. It is therefore worth comparing the two scenarios. When electricity and natural gas prices are low, the increased excise duties, despite the reduced VAT rate, are more expensive for households than the situation with 21% VAT - hence this scenario generates more government revenue. By the same reasoning, when prices are high, the combination of high excise duties and low VAT generates less government revenue and is therefore more beneficial for households. This can be explained by the fact that the VAT is a percentage and therefore rises with prices, whereas excise duties are linked to consumption and are additionally reduced with high prices.

With the data available on CREG (2024), it is also possible to compare Belgian prices with those of neighbouring countries (see figure 17 in Appendix). It can be seen that the prices in the Netherlands and Germany are generally higher than in Belgium. The prices in the United Kingdom were similar to those in Belgium before the energy crisis, while prices in France used to be higher. During the energy crisis, prices in the UK and France did not peak as much as in Belgium, but since the recovery from the crisis, prices in France have not fallen as much as in Belgium. Looking at the distribution of these prices by country (see Figure 5), it can be seen that the share of energy and network costs is higher in France than in any other country observed. Belgium and Germany have the lowest share of energy costs, while the Netherlands has the highest share of surcharges.

5.2 Data on Natural Gas Consumption

Regarding the consumption of natural gas, Figure 18 shows that household consumption has decreased over the last five years. However, it can be seen that this consumption fluctuates strongly with the seasons. Looking at the degree-days data (see Figure 19), it can be confirmed that this is strongly related to the weather. Degree-days are calculated by comparing the average daily temperature with a base temperature, which in this case is 16.5°C in Uccle. They are computed by adding up when the average daily temperature falls below this base temperature, reflecting the need for heating. For example, if the average temperature on a given day is 10°C, the degree days for that day would be 6.5, indicating a significant need for heating. In the context of this study, a monthly total of 231 degree days represents the cumulative temperature difference below 16.5°C during the month, highlighting the level of heating required to maintain comfortable indoor conditions.

Figure 17: Evolution of Natural Gas Prices for Households, Comparison by Country, 2019/01 to 2024/06

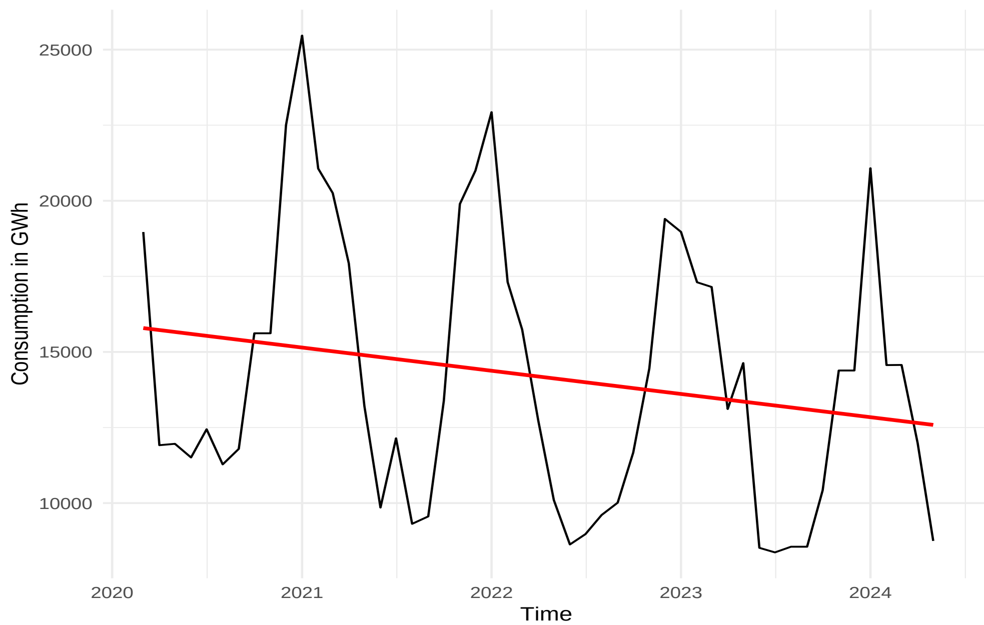


Note: These represent the average commercial price based on the active supply on the market during the month in question.
Source: Own calculations, with data from CREG (2024).

6 Policy Design of the Pathways

As explained above, the pathways to phasing out natural gas subsidies for residential consumption are to reduce these subsidies gradually until they are completely eliminated in 2050. To achieve this, I suggest two reforms; (i) the abolition of the social tariff and the CPAS fund, while introducing the Subsidy for Renovation and Renovated Housing, and (ii) the reform of the excise duty scheme, while taking into account the new current reform, the reduced VAT rate and the differential rates between products.

Figure 18: Evolution of Natural Gas Consumption by Households, 2020/03 to 2024/05



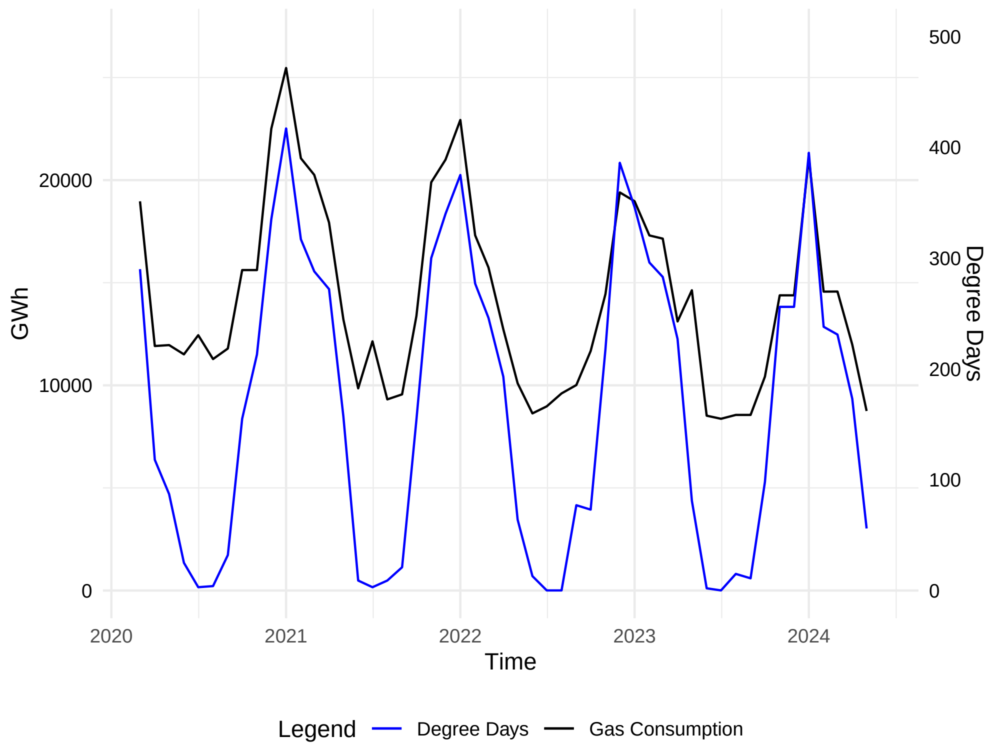
Note: Natural gas consumption by households, data extracted from GRD and Fluxys, is measured in GWh. The red line depicts the trend.
Source: Own calculations, with data from CREG (2024).

6.1 Phasing Out Social Tariff and CPAS Fund with a Subsidy for Renovation and Renovated Housing

Energy poverty is a significant issue and therefore the social tariff and CPAS fund are socially justified; however, these are not sustainable long-term solutions. Thus, these should be phased out with caution. To this end, I propose a gradual elimination of the Social Tariff and CPAS Fund for natural gas, to be replaced with a new *Subsidy for Renovation or Renovated Housing*. This strategic policy shift aims to address both environmental and social challenges.

The gradual phase-out of the Social Tariff and CPAS Fund represents a thoughtful approach to transitioning away from fossil fuel dependence. Historically, these subsidies have been crucial in alleviating energy costs for low-income households. However, they also perpetuate reliance on fossil fuels, which undermines climate objectives. The planned reduction, from EUR 120 million in 2021 to zero by 2050, ensures a structured timeline for moving away from fossil fuel subsidies while

Figure 19: Evolution of Natural Gas Consumption by Households, 2020/03 to 2024/05



Note: Natural gas consumption by households, data extracted from GRD and Fluxys, is measured in GWh. Number of degree days = difference between 16.5°C and the average temperature in Uccle.
Source: Own calculations, with data from CREG (2024).

minimizing economic disruption.

As discussed in Section 4 and as can be seen in Figure 12, subsidies will be reduced by 10% per year from 2025, then by 15% per year from 2030, and finally by 20% per year from 2035 to 2050. This phased reduction approach is consistent with gradual transitions that allow sufficient time for housing changes and behavioural adjustments. By 2050, these subsidies are set at exactly zero, ensuring a complete end of the subsidies.

To address the challenges that this transition poses for affected households, the new *Subsidy for Renovation or Renovated Housing* will be introduced in 2025 (I will refer to this as 'the Fund'). This subsidy is designed to support energy-efficient renovations in two crucial ways: it can be used either to renovate one's own home or to increase the budget available for renting more energy-efficient, i.e. renovated, housing. This dual-purpose subsidy mitigates the impact of phasing out fossil fuel subsidies and promotes sustainable housing practices. Moreover, unlike the CPAS fund, it benefits both homeowners and tenants and is not linked to the use of natural gas.

The introduction of this subsidy is essential in Belgium, where extensive renovations are needed to meet energy efficiency standards and environmental targets. By complementing existing renovation programmes and funds, the additional funding will contribute to achieving these objectives, with a particular focus on the most vulnerable households. The initial high value of the grant provides an incentive for immediate renovations, while its gradual decrease is consistent with the assumption that renovations or relocations will take place relatively quickly. For tenants, it facilitates access to energy-efficient housing, reducing heating costs and potentially encouraging homeowners to upgrade their properties in response to increased demand for renovated rental options.

The Subsidy for Renovation or Renovated Housing addresses several key objectives:

- Environmental impact: The primary goal is to enhance energy efficiency and sustainability in housing. By funding renovations, the policy promotes upgrades to modern energy standards, reducing fossil fuel consumption and greenhouse gas emissions.

- Social equity: The subsidy supports vulnerable households to transition from fossil fuel subsidies, providing substantial initial aid for extensive renovations and improving living conditions. Its gradual decrease ensures ongoing support during the transition.

- Economic transition: By stimulating the construction and renovation sectors, the subsidy creates jobs and drives economic growth, balancing the reduction of fossil fuel subsidies with economic benefits. These indirect effects are discussed in more detail in Section 4.

To ensure financial equilibrium, the total value of the Renovation or Renovated Housing Subsidy between 2025 and 2050 is aligned with the phased reduction of the Social Tariff and CPAS Fund. I thus make sure the following equation holds;

$$\sum_{i=2025}^{2050} F_i = \sum_{i=2025}^{2050} \bar{S}_i \tag{16}$$

Where $\sum_{i=2025}^{2050} F_i$ represents the sum of the Renovation or Renovated Housing Fund values from the year 2025 to 2050, and $\sum_{i=2025}^{2050} \bar{S}_i$ represents the sum reduced government expense to the Social tariff and CPAS fund values from the year 2025 to 2050. As the social tariff and the CPAS fund are reduced, the government has less government expenditure to invest in the fund. I have chosen to assume that these two subsidies would have remained at their 2024 levels, and take the difference between the 2024 subsidy and the pathway subsidy. It should be noted that this assumption is likely to underestimate government savings, as it is likely that these subsidies would have increased in the absence of reform. Therefore, it is highly likely that the amount allocated to the fund can be increased by using the rest of the reduced government expenditure and also the revenue from the new excise duty, which will be discussed below.

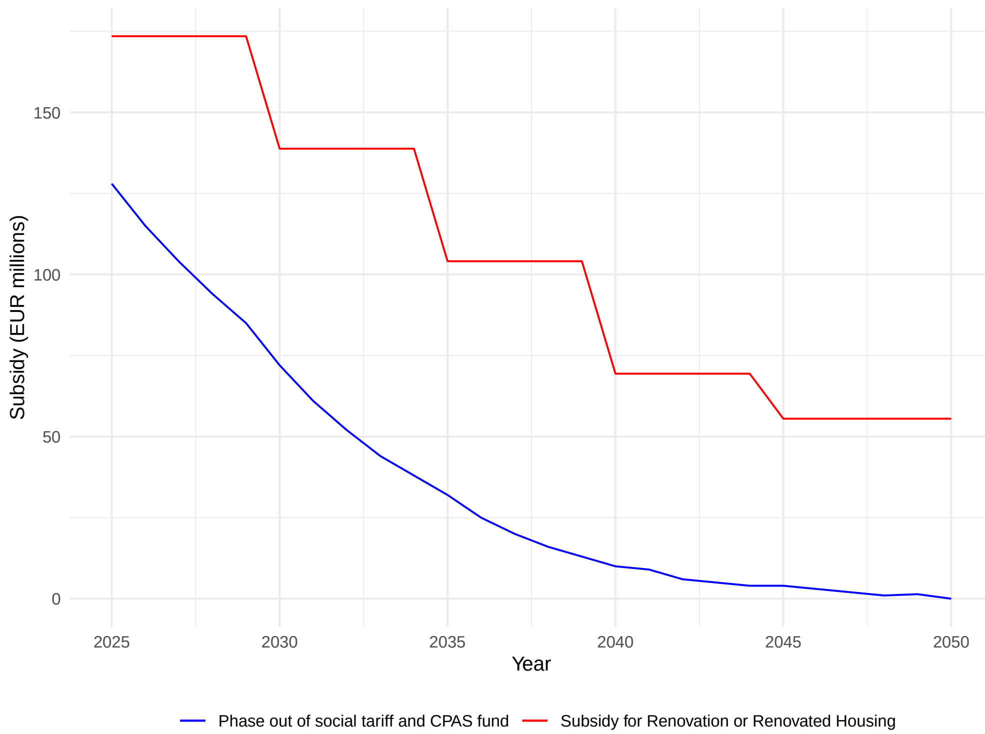
This phase-out of the existing subsidies through the annual gradual reduction of the social tariff and the CPAS fund and the introduction and then five-yearly reduction of the subsidy for renovation or renovated housing can be seen in figure 20

In addition to improving individual living conditions by funding energy-efficient upgrades, the Renovation or Renovated Housing Subsidy supports climate goals by reducing energy consumption and greenhouse gas emissions. It also addresses housing inequality by providing access to high-quality rental properties for those unable to renovate their own homes.

6.2 Phasing Out Rate Differentials with a New Excise Duty

As mentioned above, there have been several changes in the taxation of natural gas for residential consumption in recent years. VAT has been reduced from 21% to 6% and special excise duties have been introduced. In the context of this thesis, the most relevant question is whether or not these excise duties remove the fossil fuel subsidy created by the reduced VAT. CREG (2023) has published an opinion comparing the different scenarios. It has calculated the estimated impact of the new scheme, with the reduced VAT of 6% combined with the increased excise duty. Using data up to

Figure 20: Phase-out of the Social Tariff and CPAS Fund



September 2023, the CREG (2023) shows that the new system is more favourable to households than the old system. As a result, federal revenues for natural gas are reduced by EUR 106 million on an annual basis compared to what they would have been under the old system. Thus, the new system does not reduce subsidies for natural gas for residential consumption, on the contrary. Nevertheless, excise duties have the advantage of being directly proportional to consumption. They are also more stable during energy crises. Therefore, if well designed, they could be very efficient in discouraging consumption without being a subsidy for fossil energy.

Excise duties could provide an incentive to reduce consumption, as the cost increases with consumption. By setting a different excise duty for each range of annual consumption, lower excise duties could be applied to those with lower consumption. However, if excise duties are to be used to discourage consumption, they should not be reduced when prices are higher. By reducing them, the government is sending a signal that it wants to protect consumption rather than discourage it. Therefore, it could be argued that the current special excise taxes will not lead to a shift towards more climate-friendly forms of energy (Pauwels, 2023).

Taking all these aspects into account, the VAT rate can be kept at 6% because it is directly linked to prices and not to consumption. Excise duties on consumption are an effective incentive to reduce consumption and phase out the natural gas subsidy. However, several aspects of the current system could be improved. For these reasons, I am proposing a reform of excise duties: a *new excise duty*;

1. Currently, excise duties are reduced when prices are too high. This is inconsistent with the argument of reducing consumption. Instead, it gives a signal that consumption is to be protected. The new excise duty is therefore not reduced in case of high prices.

2. Excise duties for social tariff beneficiaries are lower, which is inconsistent with the negative impact of fossil fuel subsidies. As explained above, social tariff and CPAS fund beneficiaries now benefit from the fund and therefore no longer benefit from a reduced excise duty.

3. The total revenue to the government from the combination of the 6% rate and the special excise duties is lower than it would have been if the 21% VAT rate

had been maintained. This makes the new mechanism a subsidy compared to the 21% VAT scenario. The new excise duty takes this into account.

4. The key aspect of the introduction of the new excise duty is that it aims to gradually remove the subsidy provided by the rate differential. This subsidy is therefore taken into account in the calculation of the new excise duty.

In order to phase out the subsidy to natural gas for household consumption, I thus take into account the recently reduced VAT rate, the new excise duty and the existing subsidy through differential rates between products.

Firstly, since I am maintaining the reduced VAT rate of 6% for natural gas, this new scenario should not be a subsidy compared to the previous scenario where the VAT rate was 21%. I am opting for this scheme because excise duty is linked to consumption rather than price and is therefore more likely to discourage high consumption of natural gas. Secondly, I want this new system to have no subsidy in the form of rate differentials between products.

Thus, the total government revenue of the new scenario must respect the following;

$$TotalRevenue_{\text{new scenario}} \geq TotalRevenue_{\text{VAT=21\%}} + Subsidy_{\text{Rate Differentials}} \tag{17}$$

Where, $Subsidy_{\text{Rate Differentialsø}}$ is the difference in the subsidy due to excise rate differentials between products and the phasing out of this subsidy, as discussed in Section 3.

The new excise duty will be proportionate to the consumption of households, thus I will use the weighted average for this modelisation. Since the VAT is levied on the price including the excise duty, the total revenue of the new scenario will be the following;

$$TR_{\text{new scenario}} = 0.06(P' + ED^*)Q + ED^*Q \tag{18}$$

Where P' is the average natural gas price for households without VAT, ED^* is the weighted average of the new excise duties that will be levied in the function of the consumption, and Q is the monthly residential consumption.

To find this new excise duty, I do the following;

$$
\begin{aligned}
TR_{\text{new scenario}} &= TR_{\text{VAT=21\%}} + Subsidy_{\text{Rate Differentials}} \\
0.06(P' + ED^*)Q + ED^*Q &= 0.21P'Q + S_{RD} \\
1.06ED^*Q + 0.06P'Q &= 0.21P'Q + S_{RD} \\
1.06ED^* &= (0.21 - 0.06)P' + \frac{S_{RD}}{Q} \\
1.06ED^* &= 0.15P' + \frac{S_{RD}}{Q} \\
ED^* &= \left(\frac{0.15}{1.06}\right)P' + \frac{1}{1.06}\frac{S_{RD}}{Q} \\
ED^* &= 0.1415P' + \frac{S_{RD}}{1.06Q}
\end{aligned}
\tag{19}
$$

Since the new excise duty will change over time, the following holds;

$$
ED_t^* = 0.1415\bar{P}_t' + \frac{S_{RD_t}}{1.06\bar{Q}_t} \tag{20}
$$

Where ED_t^* is the new excise duty in month t. $\bar{P}_t'$ is the average price of the three scenarios STEPS, APS and NZE in month t, S_{RD} is the current fossil fuel subsidy for natural gas consumption, and $\bar{Q}_t$ is the average consumption of the three scenarios in month t. S_{RD_t} is the difference in the current subsidy and the phased-out subsidy in month t.

The new excise duty will be calculated per trimester T because the excise duties are recalculated every three months, such that they stay constant over a trimester (= 3 months). Thus, the following holds;

$$
ED_T^* = \frac{1}{3}\sum_{i=1}^{3} ED_{\text{month}_i} \tag{21}
$$

To account for future uncertainties, I will calculate an excise duty based on the average price and average consumption from the three forecasted scenarios. Since it is impractical to propose different excise duties for each scenario — due to the uncertainty about which scenario will occur — using an average provides a more practical and logical approach. This method ensures a single, robust excise duty that can be applied consistently across all possible future scenarios.

In order to forecast ED^*_t, I thus need future $\bar{P}'_t$, $\bar{Q}_t$, and S_{RD}. I can then calculate ED^*_T for each trimester T.

6.2.1 Forecasted Subsidy through Rate Differentials

As has been discussed in Section 4, and can be observed in Figure 12, the subsidy through excise rate differentials between products will be phased out through the pathways, with an annual 25% decrease. Hence, to account for this gradual reduction, similar to the social tariff and the CPAS fund, I take the difference between the phased-out subsidy and the subsidy in 2024, until 2050. This will give me S_{RD}. This evolution can be seen in Figure 6 in Appendix.

6.2.2 Forecasted Natural Gas Prices for Households

P' is price P without VAT (which is 6% from March 2022). I then take the average P'_t in scenarios STEPS, APS, and NZE. This gives me one $\bar{P}'_t$ per month. Thus, I first need to find P.

In order to estimate a future database, I yield a comprehensive dataset of historical and forecasted natural gas prices from 2013 to 2050, using price data for Belgium and three different scenarios. I thus find six different monthly growth rates, as there is one for each scenario from 2013 to 2030 (i.e. $k = 2030$) and from 2030 to 2050 (i.e. $k = 2050$). These can be observed in Table 8.

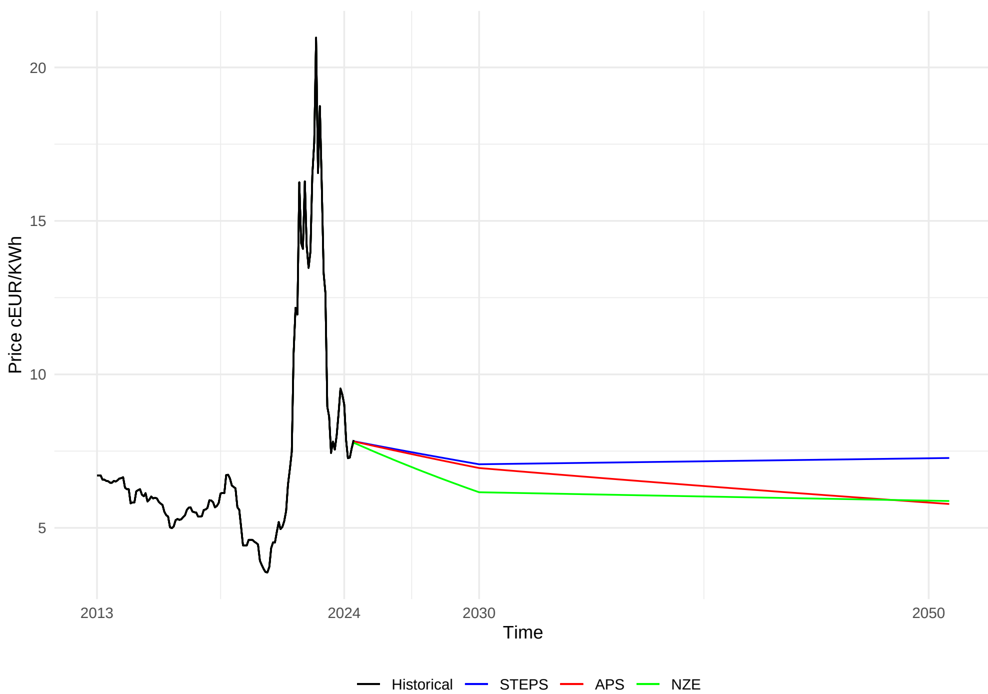
Table 8: Monthly Price Growth Rates

	STEPS	APS	NZE
2013 to 2030	-0.150%	-0.175%	-0.347%
2030 to 2050	0.011%	-0.074%	-0.019%

Note: These monthly price growth rates represent the r_{sk}, in scenario s = {STEPS, APS, NZE}, for time periods k = {2030, 2050}.

The forecasted prices can be observed in Figure 21. The figure highlights the differences in the predicted price trajectories between the three scenarios. The historical prices are depicted in black, while the forecasted prices are shown in blue, red and green for STEPS, APS, and NZE, respectively. The historical prices describe the real prices as reported by the CREG (2024). The three scenarios estimate an overall decrease in prices compared to current prices. Due to the different growth rates between the two periods, different trajectories can be observed. Prices in the STEPS scenarios remain the highest throughout the period. Prices in the NZE scenario are the lowest until 2048 and are slightly higher than in the APS scenario in the last 3 years. Prices decrease in all periods and all scenarios, except for the STEPS scenario over the period 2030 to 2050, where there is a slight increase (due to the positive monthly growth rate shown in Table 8).

Figure 21: Historical and Forecasted Natural Gas Prices, 2013/01 to 2050/12



Note: The historical price is the natural gas price (including VAT) in c€/kWh for Belgian households with an average consumption profile (i.e. 23,260 KWh/year before April 2022, and 17,000 KWh/year afterwards). The STEPS price is the price forecast according to estimations of the Stated Policies Scenarios. The APS price is the price forecast according to the Announced Pledges Scenario, and the NZE price is the price forecast according to the Net Zero Emissions by 2050 scenario

Source: Own calculations, with data from CREG (2024) and International Energy Agency (2023b).

Thus, I now take these monthly forecasted natural gas prices until 2050 and exclude the VAT of 6%. I then take the monthly average of the three scenarios to get a $\bar{P}_t'$ for each month t, from January 2025 to December 2050.

6.2.3 Forecasted Natural Gas Residential Consumption

To find $\bar{Q}_t$, I take the average of the monthly consumption in each scenario. This gives me one $\bar{Q}_t$ per month. Thus, I need to find the forecasted residential natural gas consumption.

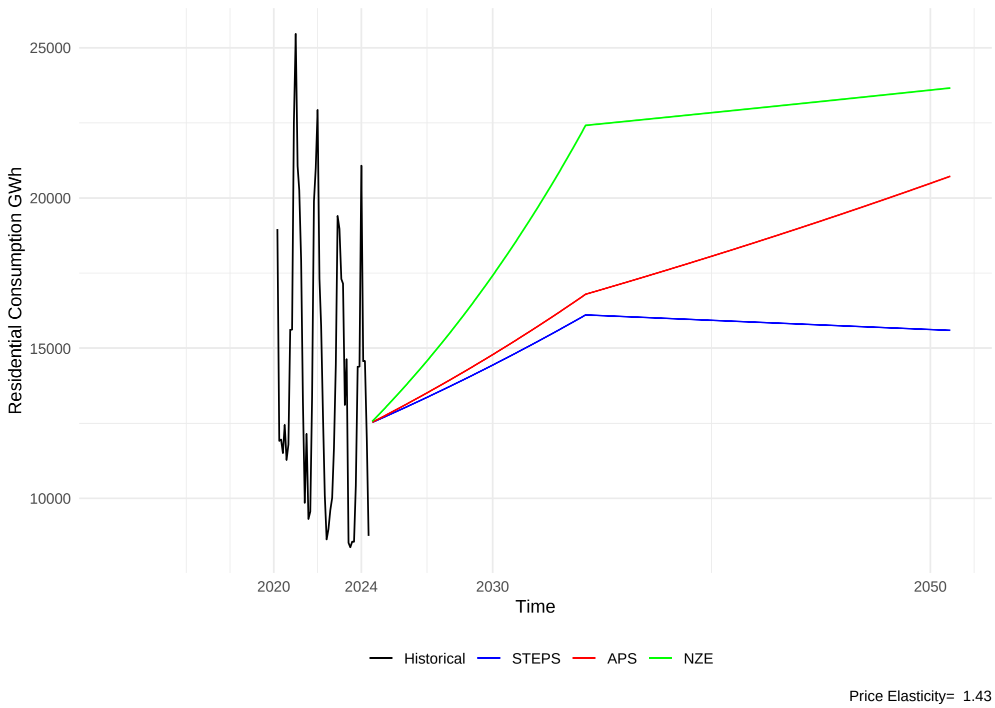
Using the price elasticity estimated by Burke & Yang (2016) and the forecasted prices in each scenario, calculated above, I now estimate future consumption.

The monthly consumption can be seen in the figure 22. The historical consumption, in black, shows the real consumption with data from CREG (2024). As mentioned in Section 5, consumption fluctuates greatly over the seasons. The predicted consumption does not vary between seasons in either scenario. This is because the forecast consumption is linked to the price growth rate and the price elasticity, and I do not take into account degree days. Although this approach may be less representative in terms of specific seasons, I have chosen to maintain this estimate so that the new excise duty does not vary by season either. Consumption increases in the three scenarios, which is consistent with the negative price elasticity combined with the decreasing forecasted prices described above. In line with these two elements, the NZE scenario predicts the highest consumption, as it predicts the lowest prices, and vice versa for the STEPS scenario.

6.2.4 Calculation of New Excise Duty

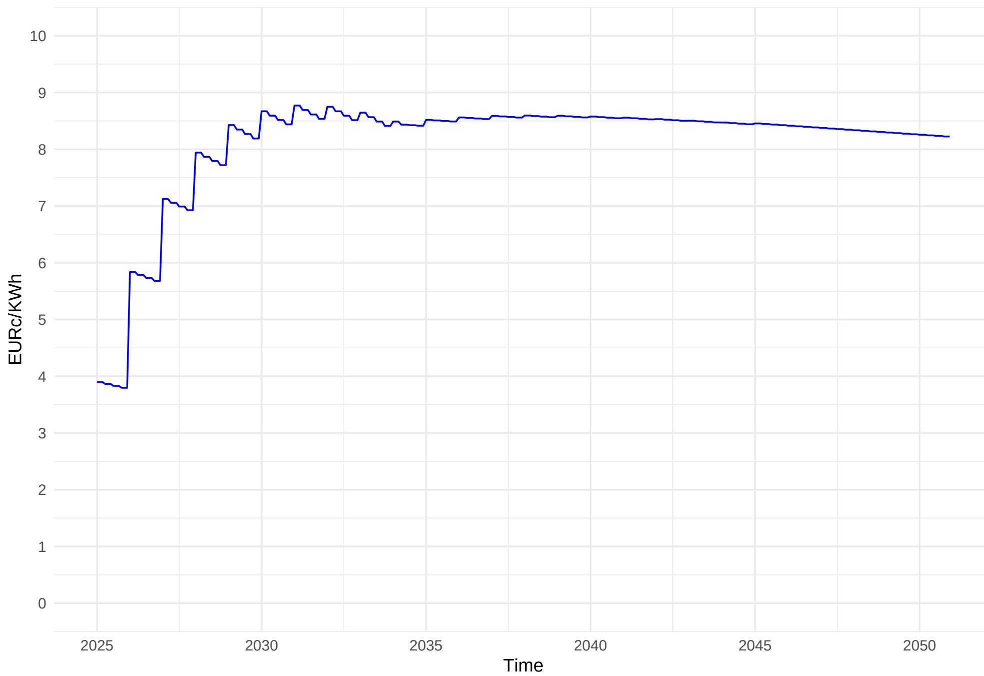
The evolution of this new excise duty ED_T^*, per trimester, can be seen in Figure 23. It can be seen that this new excise duty increases each year, which is due to the subsidy for the rate differential, which is phased out with an annual reduction (see figure 6 in Appendix). It then stabilises, which can also be explained by the fact that the subsidy is almost phased out by 2035 before it is set to zero in 2050.
Finally, it is essential to estimate the effect of this new excise duty on the forecasted prices in each scenario. For each scenario, the following holds;

Figure 22: Historical and Forecasted Natural Gas Consumption, per Month, 2020/03 to 2050/12



Note: The historical consumption is the total monthly natural gas consumption in GWh for Belgian households. The STEPS, APS and NZE scenarios are explained in Section 4. This figure shows the average monthly consumption of natural gas, in GWh, according to each scenario.
Source: Own calculations, with data from CREG (2024) and International Energy Agency (2023b).

Figure 23: New Excise Duty, 2025 to 2050



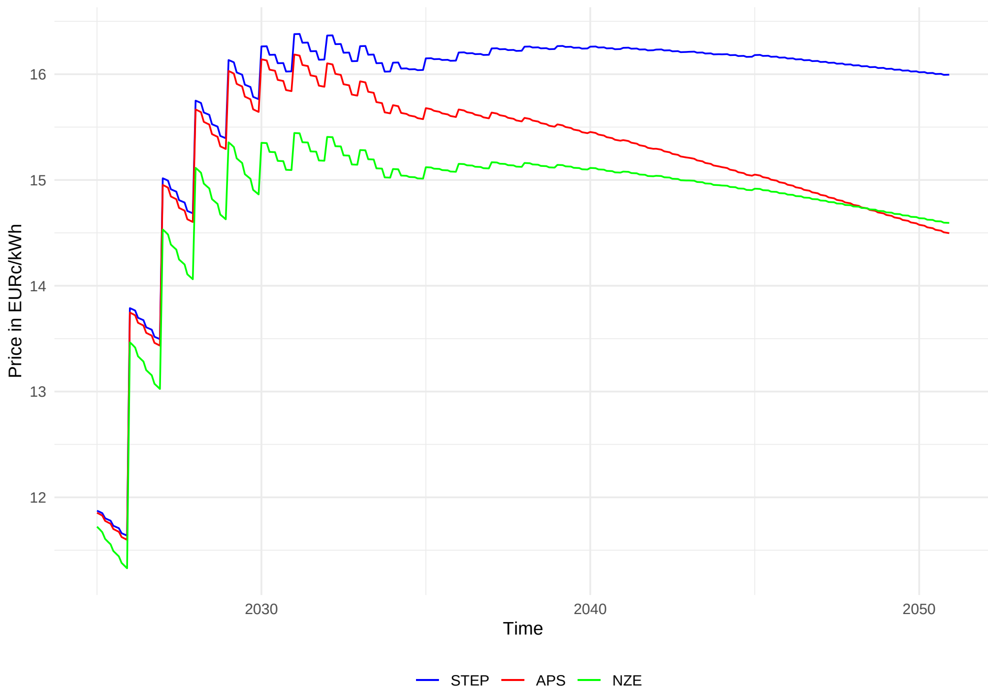
Source: Own calculations.

$$P_{st}^{*} = 1.06 * (P_{s}^{\prime}t + ED_{T}^{*}) \tag{22}$$

In other words, the price P_{st} in scenario s in month t is equal to the sum of the price $P_{st}^{\prime}$ in scenario s in month t without VAT and the new excise duty ED_{T}^{*} of that trimester T, multiplied by the VAT (6%). The results can be observed in Figure 24.

In Figure 25, both the new prices and the previously forecasted prices of natural gas, including VAT, are shown. Prices until 2024 are those as published by CREG (2024). The new prices P_{st}^{*} are constructed as explained above (full lines). The prices without the new excise duty (dashed lines) are the previously forecasted prices (see Figure 21. In line with the previous results, prices are highest in the STEPS scenario and lowest in the NZE scenario (until 2048 for the latter). As can be seen in the figure, the new excise duty will increase prices significantly. However, several aspects need to be taken into account. Firstly, this is the weighted average of the excise duty, which

Figure 24: Evolution of New Prices, 2025 to 2050



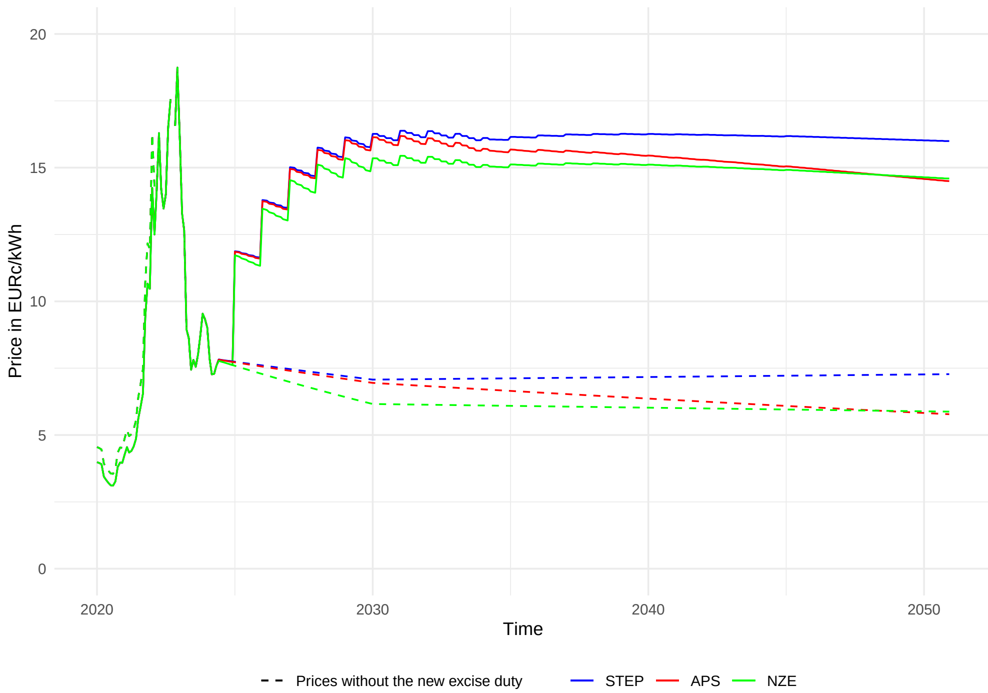
Source: Own calculations.

means that, as will be discussed below, households with low natural gas consumption will not pay as much as the prices shown in the graph. Secondly, these prices ensure that there is no subsidy for this fossil fuel. They therefore reflect a more complete picture of social costs. While natural gas is still used by many households, the excise duty, which is levied per KWh consumed and rises with higher consumption, is intended to discourage unnecessary consumption in order to phase out the use of fossil fuels such as natural gas. Thirdly, this new excise duty is to be implemented in January 2025 and, as can be seen in the chart, the excise duty (and therefore prices) will increase gradually over time. Households therefore have time to anticipate the measure and change their behaviour accordingly.

6.2.5 Distribution of the Progressive Excise Duty

Having calculated the weighted average of the excise duty, I now decide to apply a different excise duty for three types of natural gas consumption. For the moment, as described in Section 5, there are only two tiers; (1) households with an annual average consumption of 0 to 12 MWh per month and (2) households with an annual

Figure 25: Comparison New Prices and Previous Prices, 2020 to 2050



Source: Own calculations.

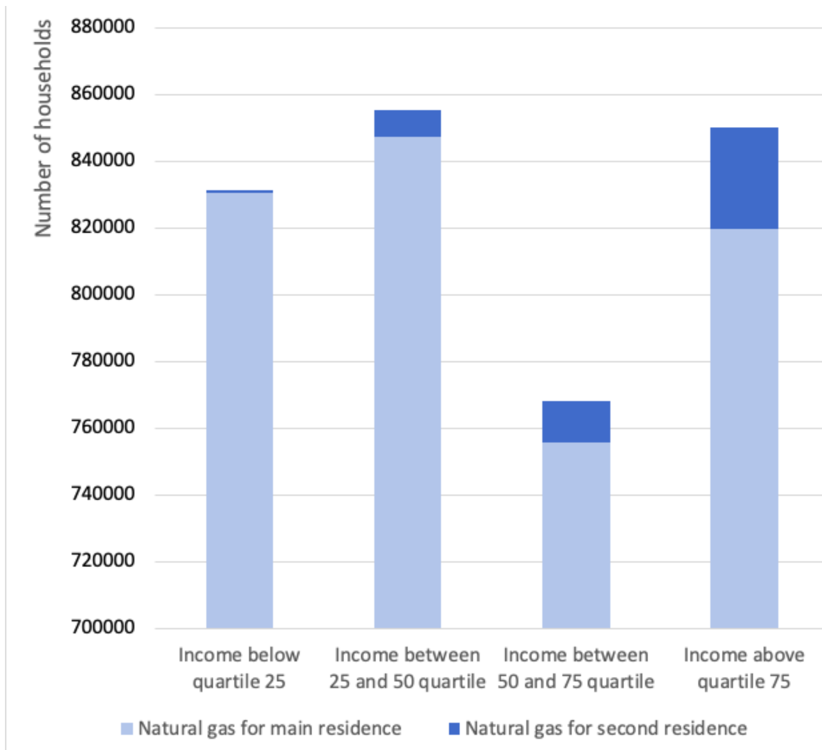
average consumption of more than 12 MWh per month.

According to a recent survey conducted by CREG (2024), the average annual consumption of a Belgian household is 17,000 kWh. As can be seen in Figure 26, it is not necessarily those with the lowest income who are the most numerous consumers of natural gas. Moreover, the only reason why those with the highest incomes are more numerous than the latter is because of their second homes.

Figure 27 shows that households with the highest income spend the most on natural gas compared to other households. As this is the average expenditure per household, this implies that high-income households consume more natural gas, on average, than low-income households. It is therefore not only environmentally but also socially justified to increase the excise duty on high consumption and to encourage and reward lower consumption.

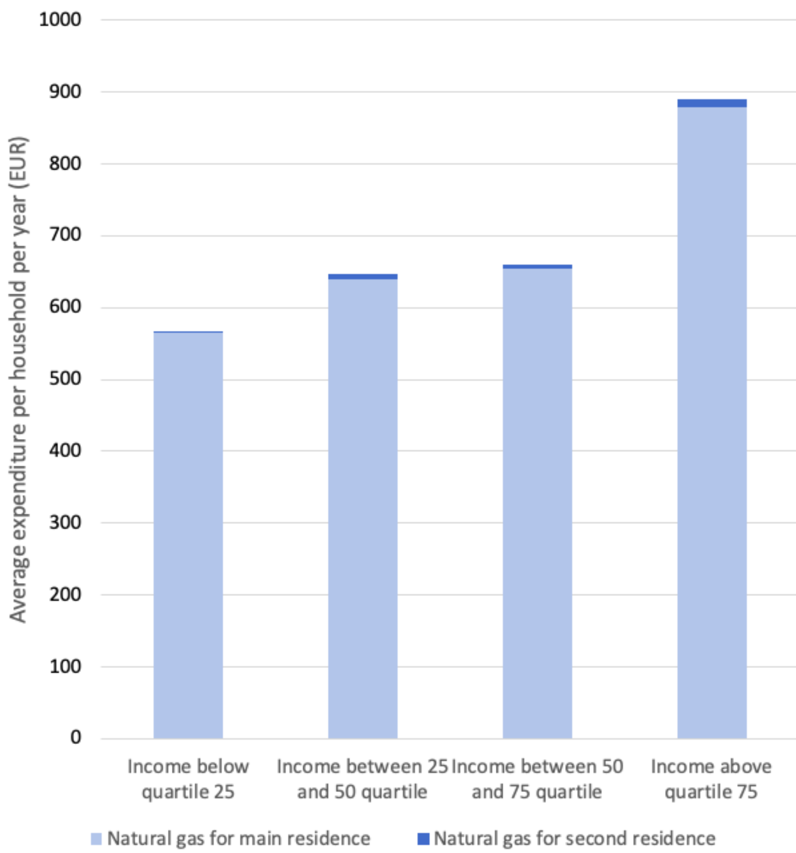
I suggest adding a third tier - so that lower consumption is more incentivised and

Figure 26: Number of Households spending Income on Natural Gas, per Income Quartile, 2022



Source: Statbel (2022a).

Figure 27: Average expenditure per Household per Year on Natural Gas, per Income Quartile, 2022



Source: Statbel (2022a).

rewarded with a lower excise duty.
Thus, the following holds;

$$ED^* = \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 \tag{23}$$

Where $\alpha_1 + \alpha_2 + \alpha_3 = 1$
α_1, α_2, and α_3 are the proportions of households paying, respectively, excise duties X_1, X_2, and X_3. To make sure this measure is not regressive, I want $X_1 \leq X_2 \leq X_3$. Unfortunately, no data is available on the proportion of households' consumption. Therefore, I decided to take the tiers 0-9 MWh/month, 9-12 MWh/month, and over 12 MWh/month. This choice is made in order to incentivise low consumption and to reward those consuming less. Now, to suggest the distribution of the excise duty for the first trimester of 2025, I choose to take the weighted average of the new excise duty for the second tier. This way, I can decrease the excise duty for households with low consumption and increase it for those with higher consumption. The reasoning behind this is the incentivising of lower consumption.

Thus, since I have set $ED^* = X_2$, and I have $1 = \alpha_1 + \alpha_2 + \alpha_3$, from Equation 23 follows;

$$\begin{aligned}
ED^* &= \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 \\
ED^* &= \alpha_1 X_1 + \alpha_2 ED^* + \alpha_3 X_3 \\
ED^*(1 - \alpha_2) &= \alpha_1 X_1 + \alpha_3 X_3 \\
ED^*(\alpha_1 + \alpha_2 + \alpha_3 - \alpha_2) &= \alpha_1 X_1 + \alpha_3 X_3 \\
ED^* &= \frac{\alpha_1 X_1 + \alpha_3 X_3}{\alpha_1 + \alpha_3} \\
ED^* &= \frac{X_1}{\alpha_1 + \alpha_3} + \frac{X_3}{\alpha_1 + \alpha_3}
\end{aligned} \tag{24}$$

Thus, this gives the following excise duties;

$$\begin{aligned}
X_1 &= (\alpha_1 + \alpha_3) * ED^* - X_3 \\
X_3 &= (\alpha_1 + \alpha_3) * ED^* - X_1
\end{aligned} \tag{25}$$

Such that $X_1 < X_3$, since these need to be strictly progressive excise duties. An overview of this distribution can be observed in Table 9.

Table 9: Distribution of New Excise Duty on Natural Gas Consumption

Annual Average Consumption	**New Excise Duty**	**Distribution of Households**
0 – 9 MWh/month	$X_1 = (\alpha_1 + \alpha_3) * ED^* - X_3$	α_1
9 – 12 MWh/month	$X_2 = ED^*$	α_2
> 12 MWh/month	$X_3 = (\alpha_1 + \alpha_3) * ED^* - X_1$	α_3

Further research, or more available data, is thus needed in order to define the distribution of the households, and thus find the exact new excise duty for every trimester, starting from January 2025. However, with the weighted average, it is already possible to find the excise duty for the households consuming 9 to 12 MWh/month on an annual average, as can be seen in Table 10.

Table 10: Distribution of the New Excise Duty on Natural Gas Consumption, January 2025

Tier (MWh/month)	**New Excise Duty** (cEUR/KWh)	**New Price (cEUR/KWh)** STEPS	APS	NZE
0 – 9	$X_1 = 3.899(\alpha_1 + \alpha_3) - X_3$	$1.06(7.302 + X_1)$	$1.06(7.284 + X_1)$	$1.06(7.160 + X_1)$
9 – 12	3.899	11.873	11.854	11.722
> 12	$X_3 = 3.899(\alpha_1 + \alpha_3) - X_1$	$1.06(7.302 + X_3)$	$1.06(7.284 + X_3)$	$1.06(7.160 + X_3)$

7 Evaluation of the Policy Design

To provide a clear and concise assessment of the proposed pathways for phasing out natural gas subsidies, I have used a scoring system across the seven key dimensions discussed in Section 4. This scoring system helps to quantify the feasibility and impact of each policy aspect, allowing for a better understanding of the strengths and weaknesses. Each dimension is scored on a scale of 1 to 5, with 1 indicating very low feasibility or impact and 5 indicating very high feasibility or impact. Below I present the scores for each dimension, together with a brief explanation of the score assigned, which is based on what has been discussed above and the current assumptions and information available. It is clear, however, that these scores will need to be adjusted in the future so that policy design and implementation can be reviewed and improved regularly, and so that its success can be measured in the future.

Efficiency (Score: 5)
The proposed pathways should achieve high efficiency by (i) redirecting subsidies from natural gas to the Renovation and Renovated Housing Fund, which promotes energy-efficient housing improvements, (i) reflecting the true cost of natural gas consumption in the price through the new excise duty, which should disincentivise (high) residential consumption. This should reduce fossil fuel consumption and associated costs and increase energy efficiency, thereby increasing productive and allocative efficiency.

Redistribution (Score: 4)
Redistribution is well addressed as the Fund targets households in energy poverty, ensuring that vulnerable groups benefit from improved housing conditions and reduced energy costs. However, there is a potential risk that wealthier households will benefit more if they can afford renovations and energy-efficient housing and therefore have lower consumption. Moreover, even with high consumption, high-income households may spend a lower proportion of their income on natural gas consumption than low-income households with low consumption. It should also be noted that the eligibility criteria for the fund need to be redefined to include all vulnerable households.

Political Feasibility (Score: 4)
The political feasibility is strong due to the urgency of tackling climate change and the existing political momentum to reduce fossil fuel subsidies. The policy benefits multiple stakeholders, including households in fuel poverty and the renovation sector, although there may be opposition from high-consumption households and natural gas producers.

Accountability (Score: 4)
Accountability is expected to be well met as pathways are consistent with existing rights and responsibilities and effectively coordinated with related policies. The Fund specifically targets households in fuel poverty and provides additional support, and the implementation of the new excise duty is straightforward.

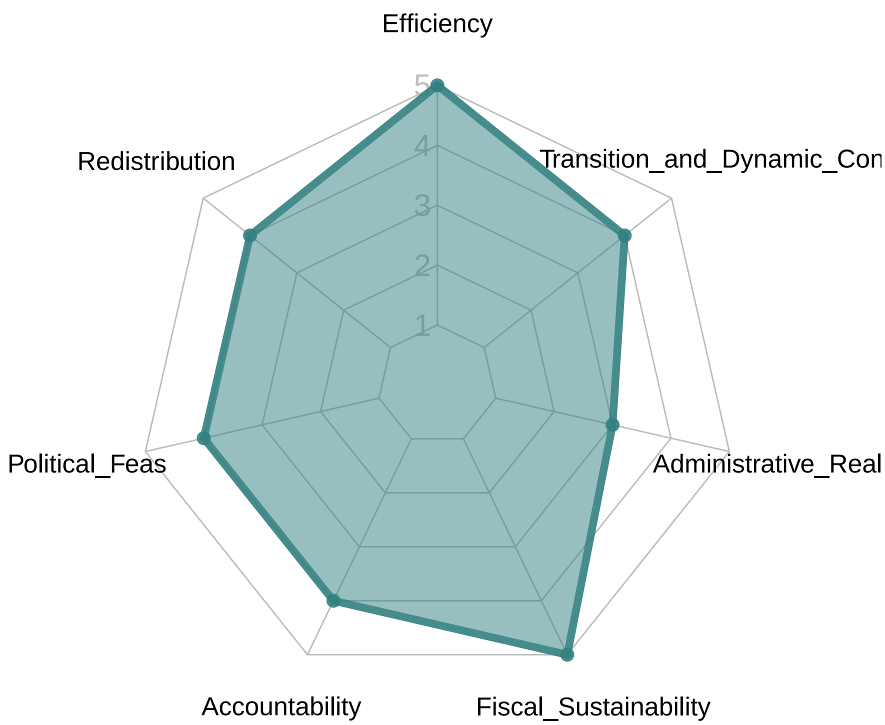
Fiscal Sustainability (Score: 5)
Fiscal sustainability is high, as the removal of subsidies and the introduction of the new excise duty will increase tax revenues. Although the fund requires an initial investment, it will be supported by excise duty revenues and the gradual phasing out of the social tariff, with long-term benefits for the state budget and social welfare. It should be noted, however, that as consumption is expected to fall, tax revenues from excise duties will follow the same trend. Nevertheless, these revenues are not the main objective of the pathways and are still higher than in the baseline scenario.

Administrative Realism (Score: 3)
Administrative realism scores moderately due to the significant effort required to administer the Fund, including staffing, training, redefining eligibility criteria, processing applications and verifying the use of the funding. However, the implementation of the excise duty and the reduction of the social tariff do not pose major challenges, with effective regulation being crucial for success.

Transition and Dynamic Considerations (Score: 4)
The transition requires significant initial investment in setting up administrative systems and communicating changes. Despite the potential for initial market disruption in the renovation and energy efficiency sectors, these investments will be outweighed by the long-term benefits. Regular reviews and adjustments will be necessary to ensure that the Fund and the excise duty remain effective and adaptable to changing circumstances.

Scorecard
As can be seen in Figure 28, the scoring system indicates a balanced assessment of the feasibility and evaluation criteria of the proposed gas subsidy removal pathways. High scores for efficiency and fiscal sustainability highlight the strengths of the policy design, while a moderate score for administrative realism acknowledges the challenges of implementation. Overall, the proposed pathways offer a promising approach to promoting environmental sustainability, social equity and economic efficiency.

Figure 28: Scorecard for the Evaluation of the Policy Design



8 Conclusion

In Belgium, fossil fuel subsidies totalled over EUR 21.5 billion in 2021, of which EUR 1.6 billion were subsidies to natural gas for residential consumption. In order to move out of the use of these fossil fuel subsidies for natural gas consumed by households in Belgium, I have suggested several feasible pathways. These can be divided into two segments.

First, the gradual phasing out of the social tariff and the CPAS fund for natural gas will reduce the subsidy to zero in 2050. This phase-out is accompanied by a Subsidy for Renovating or Renovated Housing, which will allow vulnerable households to benefit from support in their transition to more energy-efficient housing. It also requires accompanying measures. These include research to redefine the eligibility criteria for the fund (the current social tariff and the CPAS fund do not succeed in including all households in energy poverty), sufficient administrative resources to have the necessary staff, and training, as well as preparations for processing applications and verifying the use of funds.

Secondly, the phasing out of the excise rate differential will be achieved by including it in the calculation of a new excise duty. This new excise duty will take into account not only the rate differential but also the reduced VAT rate. Using three different forecasting scenarios I estimate negative growth rates for the natural gas prices. Combining these with a long-term negative price elasticity, the forecasted consumption increases. This leads to a relatively large new excise duty, which increases prices significantly. However, this pathway requires a trimestrial update of the excise duty calculation based on the latest available data. The distribution of the new excise duty is progressively linked to three tiers of average consumption, and its estimated impact on forecasted prices is consistent with the aim of disincentivising household consumption of natural gas.

After considering both direct and indirect effects, assessing the evaluation criteria and looking at the impact on prices, it can be concluded that the phasing out of subsidies for natural gas for residential use through these pathways is likely to lead to an increase in prices and a behaviour change. Households are therefore likely to switch to more energy-efficient heating systems or to renovate or move to renovated housing. Consequently, this should lead to a decrease in the consumption of natural gas in the residential sector, which is the ultimate idea behind the phasing out of the natural gas subsidy.

In conclusion, these pathways are feasible and can be evaluated through various indicators and assessments, which can also lead to their improvement or adaptation. If calculated and implemented in a timely and correct manner, and updated regularly, they will successfully phase out subsidies on natural gas for residential use. In addition, but no less importantly, they also contribute to the transition to more energy-efficient housing and heating systems, while supporting vulnerable households, thus contributing to environmental and social sustainability.

9 Limitations and Further Recommendations

When addressing fossil fuel subsidies in Belgium and proposing phase-out pathways, it is crucial to acknowledge the underlying assumptions, constraints and limitations of the analysis. In addition, it is important to provide further recommendations on how to address and improve these shortcomings.

Firstly, the analysis of fossil fuel subsidies in Belgium is primarily based on the methodology of the SPF Finances (2024), which is indeed solid but would benefit from comparison with other methodologies. Although various inventories and reports on fossil fuel subsidies exist, detailed and recent data for Belgium are lacking, making methodological comparisons difficult. In addition, self-reporting by countries carries a risk of under-reporting, cross-country comparisons are difficult due to different reporting standards, and the two-year data lag limits the availability of recent information, especially in the case of phenomena such as the energy crisis in 2022.

Second, there are limitations to the proposed pathways and their feasibility. The pathways are designed to be implemented in 2025 and to end in 2050. However, as the current federal government has yet to be formed, it is increasingly unlikely that it will be able to discuss, review, adopt, communicate and implement these pathways by January 2025. Effective implementation will also require administrative feasibility, which depends on the available time to prepare for staffing, training, eligibility criteria, and the preparation of processes and assessments. While a delay in implementation should not cause major problems and any subsequent adjustment in policy design should be manageable, it is crucial to communicate the pathways in advance. This will allow households to anticipate and adjust their behaviour accordingly.

Third, in estimating the avoided subsidy to the social tariff, the CPAS fund and the rate differential, the difference between the phased-out subsidy and the subsidy in 2024 is taken. This is likely to be an underestimation of the real 'avoided' tax expenditure, as it could be assumed that the subsidy would have continued to increase from 2024 to 2050 if these pathways had not been introduced. Further research on these subsidy projections may therefore provide more accurate estimates.

Finally, there are also constraints on the calculation of the new excise duty. Regarding projected prices, these are based on three scenarios presented by the International Energy Agency (2023b). These scenarios are built on assumptions and are therefore uncertain. Regarding the elasticity, I use the long-term price elasticity for residential natural gas consumption estimated by Burke & Yang (2016). While this elasticity is useful, it does not represent future changes in behaviour as it is based on the past. To get around this limitation, it might be useful to model, for example, the switch from natural gas to heat pumps to see the long-term effects. Other potential changes in behaviour could also be modelled to provide a more comprehensive forecast of future consumption. While the forecasted consumption is assumed to remain relatively high, it is expected that households will change their behaviour and therefore reduce their consumption of natural gas. It is therefore not optimal to forecast consumption based on past consumption and elasticity before the implementation of the pathways. Consumption is likely to fall as a result of the proposed trajectories, but also as a result of global warming, other implemented or planned regulations, improved quality of house insulation and increased accessibility of more energy-efficient heating systems. Furthermore, future research is needed to identify the distribution of residential natural gas consumption. This information is crucial for the calculation of the distribution of the new excise duty, for it to be progressive and to be positively linked to average consumption, thus incentivising low consumption.

Nevertheless, the calculation of the new excise duty in this thesis is based on data up to the second quarter of 2024, while the new excise duty is to be levied in January 2025. As the new excise duty should be recalculated every three months based on the most recent data on prices and consumption, it is logical that these data and forecasts will be more accurate in December 2024 than they are now.

I therefore consider it feasible that future policymakers and regulators will obtain the most recent data available by working with CREG (2024). Therefore, the methodology presented in this thesis will allow them to calculate the correct new excise duty every three months and therefore to implement the suggested pathways.

In conclusion, while it is both relevant and urgent to phase out subsidies for residential natural gas consumption, it is also critical to address all the other subsidies discussed in this thesis, as they also lack sufficient justification. Further research is therefore essential to comprehensively phase out all fossil fuel subsidies and thereby set the path for a more sustainable and equitable energy future.

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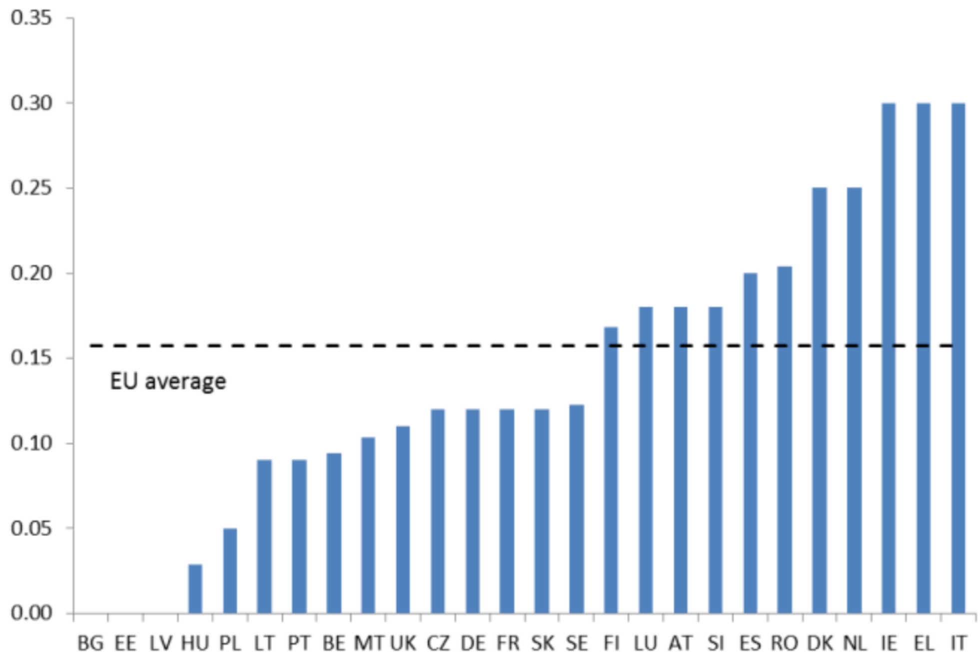
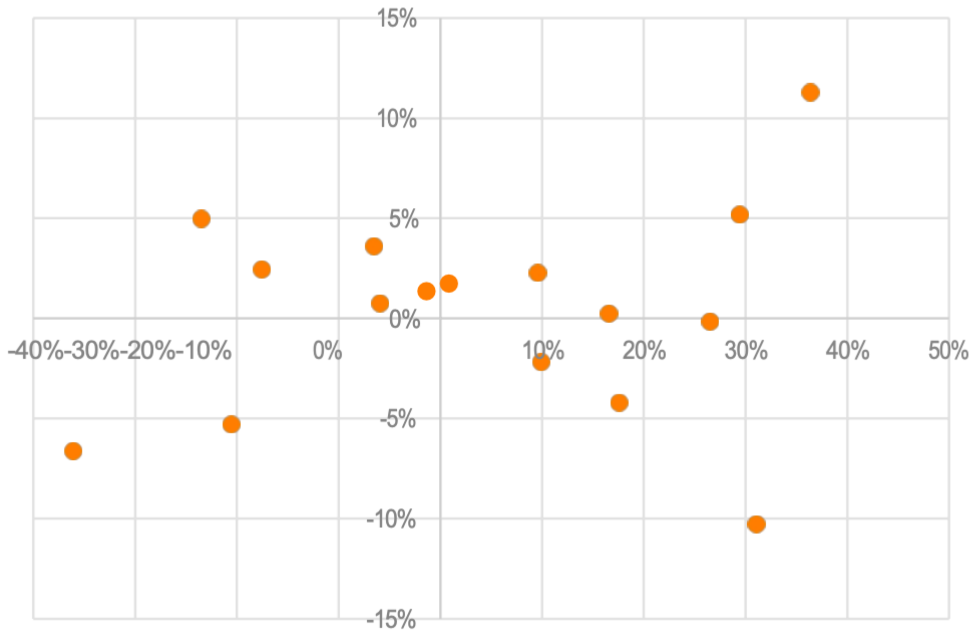
Appendix

Figure 1: Imputation rate used to compute the taxable benefit-in-kind, 2014



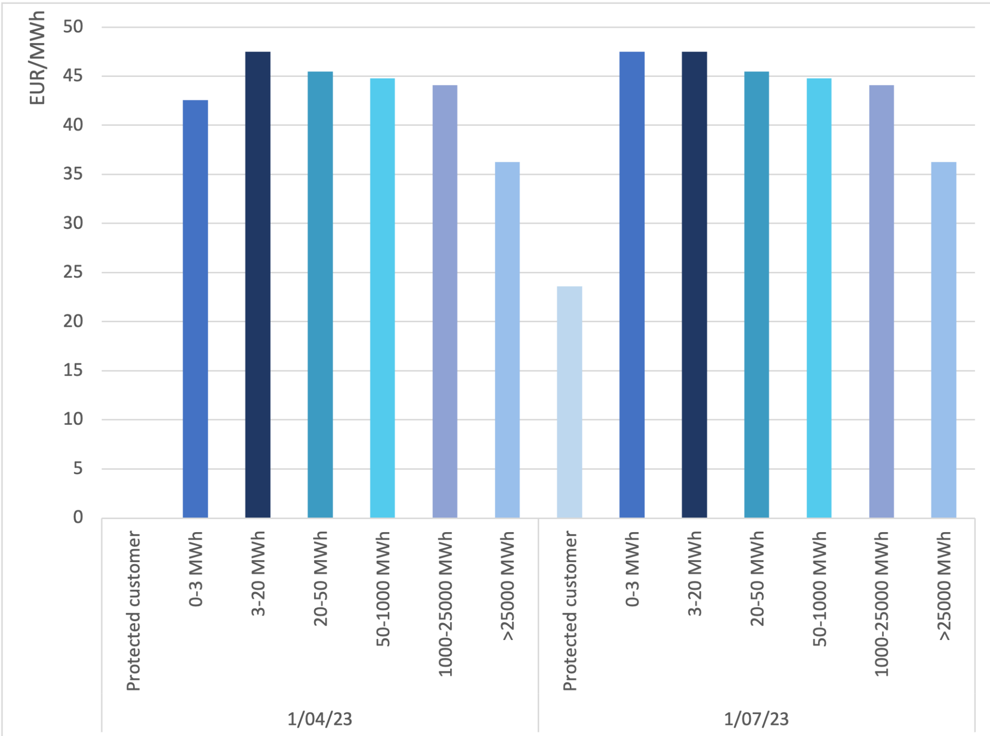
Source: Princen (2017)

Figure 2: Correlation tonne-kilometers travelled by lorries (y-axis) as a function of growth in the price of diesel (x-axis), 2005 to 2021



Note: This graph shows that for annual increases in prices, excluding VAT, the number of tonne-kilometres transported by lorry in France has changed both for the better and for the worse.
Source: Bureau Fédéral du Plan (2023).

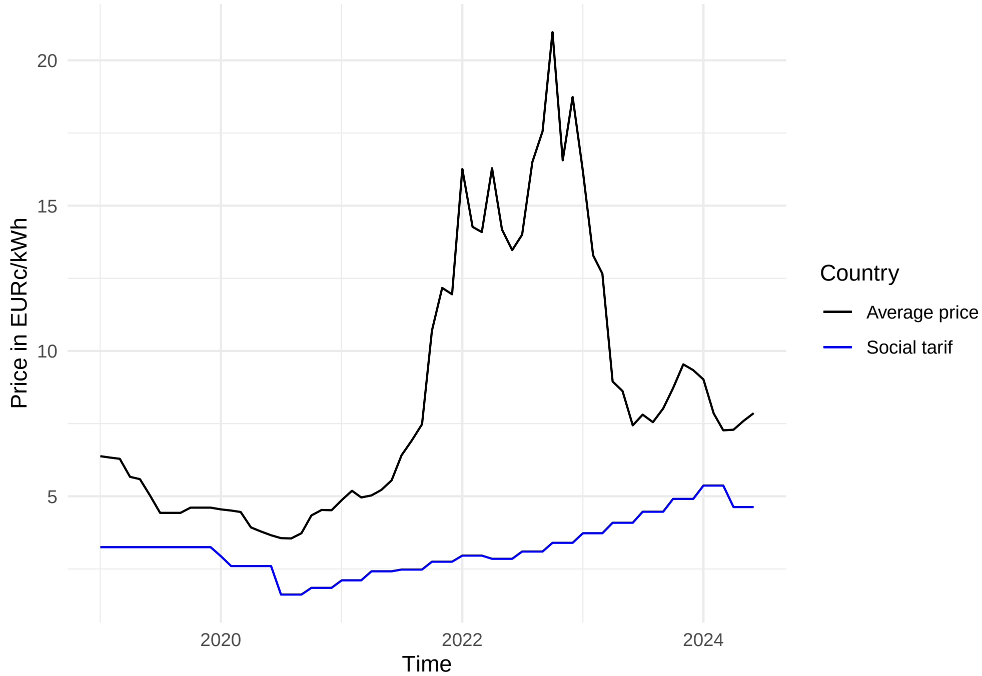
Figure 3: Special Excise Duties for Electricity (for Non-Professional Consumption)



Note: Special excise duties, expressed in EUR/MWh.

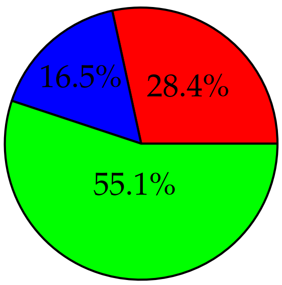
Source: Own calculations, with data from SPF Finance (2024).

Figure 4: Evolution of Natural Gas Prices for Households, 2013/01 to 2024/06

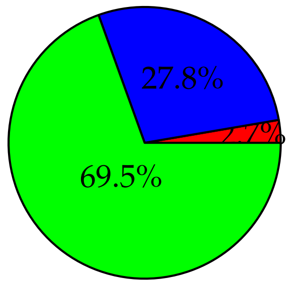


Note: The average price is the natural gas price (including VAT) in c€/kWh for Belgian households with an average consumption profile (i.e. 23,260 KWh/year before April 2022, and 17,000 KWh/year afterwards).
Source: Own calculations, with data from CREG (2024).

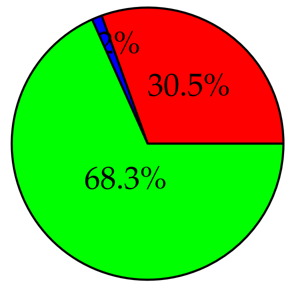
Figure 5: Tax Shares in April 2024



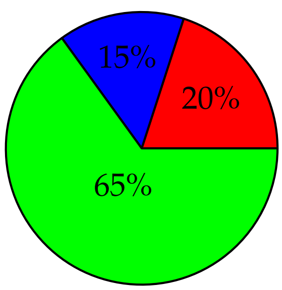
(a) Belgium



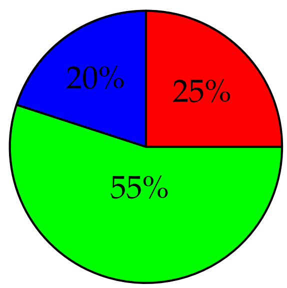
(b) France



(c) Netherlands



(d) United Kingdom



(e) Germany

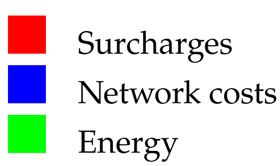
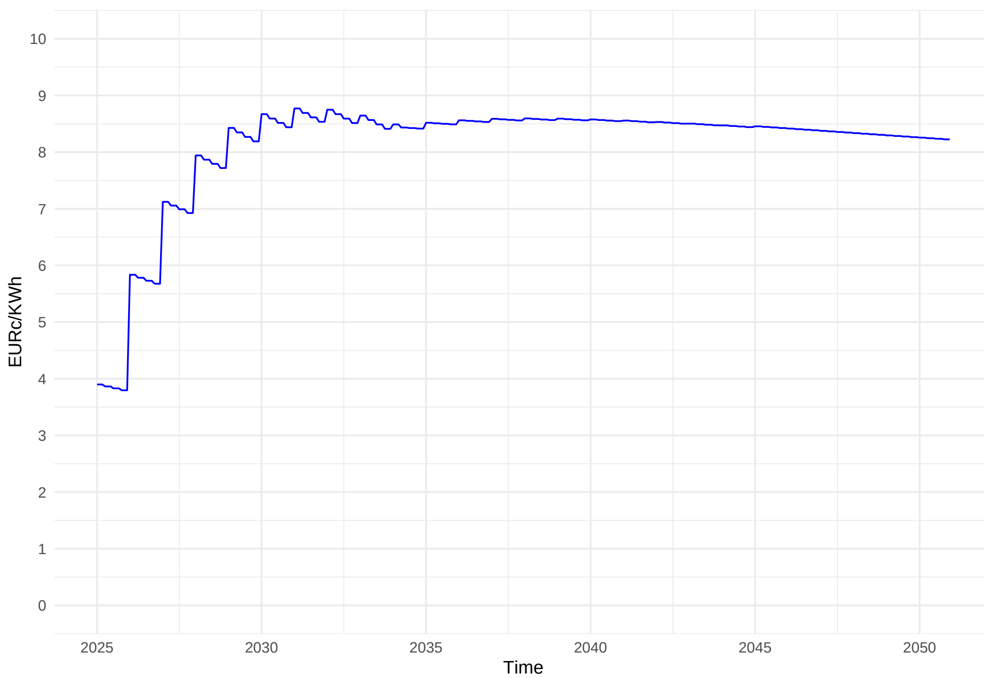


Figure 6: Difference in Subsidy through Excise Rate Differentials between Products, 2025 to 2050



Source: This difference in subsidy (S_{RD} increases annually due to the annual phase out of 25% of the subsidy through excise rate differentials.

Price Elasticity Estimation with Consumption

I employ a multiple linear regression analysis to examine the relationship between natural gas consumption and its determinants, price in particular. The dependent variable is the logarithm of natural gas consumption, while the independent variables include the logarithm of price, degree days, and months. The logarithmic transformation allows for the direct estimation and interpretation of the elasticity.

$$\log(\text{Consumption}) = \beta_0 + \beta_1 \log(\text{Price}) + \beta_2 \text{Degree\_day} + \beta_3 \text{Month} + \epsilon \tag{26}$$

$Consumption$ represents the natural gas consumption in GWh in Belgium, $Price$ denotes the price of natural gas in cEUR/KWh including all costs, $Degree\_day$ captures the cumulative temperature difference below 16.5°C during the month in °C, and $Month$ denotes the month. The coefficients β_0, β_1, β_2, and β_3 are estimated parameters, and ϵ represents the error term accounting for unobserved factors influencing consumption.

β_1 represents the price elasticity, since;

$$\begin{aligned}\log(\text{Consumption}) = \beta_0 + \beta_1 \log(\text{Price}) + \beta_2 \log(\text{Degree\_day}) + \beta_3 \text{Month} + \epsilon \\ \log(Q) = \beta_0 + \beta_1 log(P) + \beta_2 \log(\text{D\_d}) + \beta_3 \text{Month} + \varepsilon \\ Q = e^{\beta_0 + \beta_1 log(P) + \beta_2 \log(\text{D\_d}) + \beta_3 \text{Month} + \varepsilon}\end{aligned} \tag{27}$$

Taking the derivative of Q with respect to P, I have;

$$\begin{aligned}\frac{\partial Q}{\partial P} = \frac{\partial(\beta_0 + \beta_1 log(P) + \beta_2 \log(\text{D\_d}) + \beta_3 \text{Month} + \varepsilon)}{\partial P} e^{\beta_0 + \beta_1 log(P) + \beta_2 \log(\text{D\_d}) + \beta_3 \text{Month} + \varepsilon} \\ \frac{\partial Q}{\partial P} = \beta_1 \frac{1}{P} e^{\beta_0 + \beta_1 log(P) + \beta_2 \log(\text{D\_d}) + \beta_3 \text{Month} + \varepsilon}\end{aligned} \tag{28}$$

Since $e^{\beta_0 + \beta_1 log(P) + \beta_2 \log(\text{D\_d}) + \beta_3 \text{Month} + \varepsilon} = Q$, I have;

$$\beta_1 = \frac{\partial Q}{\partial P} \frac{P}{Q} = \frac{\Delta Q}{\Delta P} \frac{P}{Q} \tag{29}$$

P is the price of natural gas for households (including costs and taxes), and Q is the consumed quantity of natural gas.

The model's goodness of fit is evaluated using the R-squared and F-statistic. The coefficients of the independent variables are estimated using ordinary least squares (OLS) and their significance is tested using t-tests. The p-values associated with each coefficient are used to determine the statistical significance of each variable.

The results of the multiple linear regression analysis are presented in Table 11.

Table 11: Regression Results

Variable	Estimate	Std. Error	t value	p value
Intercept	9.94646	0.21670	45.900	$< 2e$-16 $***$
log(Price)	-0.10310	0.04222	-2.442	0.01949 $*$

Note: Significance levels are indicated by $***\ p < 0.001$; $**\ p < 0.01$; $*\ p < 0.05$.

The fit of the model is assessed using the R-squared and the F-statistic. The R-squared value is 0.8463, indicating that the model explains approximately 84.63% of the variation in natural gas consumption. The F-statistic is 15.67, with a p-value of $2.95e{-}11$, indicating that the overall model is statistically significant at the 3% level.

The price coefficient is estimated to be -0.10310. However, as explained in Section 4, this can not be used to estimate price-elasticity for residential natural gas demand.