Master's Thesis

From Obligation to Opportunity: Developing an Energy Efficiency Obligation Scheme Policy Proposal to Reduce Energy Poverty in Germany

A thesis submitted
to the TUM School of Life Science
Master's Program Sustainable Resource Management
In partial fulfilment of the requirements for the degree of
Master of Science

Submitted by
Sabrina Hopf
Matriculation Number: 03740503
Contact: Sabrina.hopf@tum.de

Presented to the Supervisor:
Dr.-Ing. Philipp Kuhn
Chair of Renewable and Sustainable Energy Systems
Technical University of Munich

External Supervisors:
Malte Bei der Wieden, Researcher at Öko-Institut e.V.
Dr. Veit Bürger, Head of Department Energy and Climate at Öko-Institut e.V.

Submission date: 05.10.2024

Abstract

In recent years, energy poverty has become a pressing issue in Germany, driven by the sharp rise in energy prices. Although short-term measures, such as energy price caps, have been implemented, a comprehensive policy to sustainable address energy poverty is still lacking. Research suggests that improving energy efficiency can provide a long-term solution to this problem. This thesis proposes an Energy Efficiency Obligation Scheme (EEOS) designed to reduce energy poverty in Germany by incentivizing energy efficiency improvements in energy-poor households, drawing inspiration from the 4th iteration of the UK's Energy Company Obligation (ECO4).

The analysis is conducted in three stages. The first stage involves a descriptive analysis of secondary data, which assesses the feasibility of transferring the British ECO4 to Germany, identifying necessary modifications for a successful implementation in Germany. Secondly, the limitations and shortcomings of the ECO4 are examined to avoid any replication of potential pitfalls. Thirdly, recommendations for a tailored EEOS policy proposal for Germany are developed. Those suggestions are based on the findings of the preceding analyses, a discussion session with two German researchers on the policy proposal, and a review of policy designs from other countries. The latter is only conducted in the absence of recommendations for adjusting limiting or challenging policy features specific to Germany.

The findings reveal significant challenges in directly implementing the British ECO4, particularly regarding the identification and selection of energy-poor households. The analysis indicates that there is no one-size-fits-all solution for addressing energy poverty. This is highlighted by the complexity of targeting vulnerable households while maintaining a cost-effective and straightforward implementation. Further research is required to refine methods for identifying and supporting energy-poor households in a fair and efficient manner.

Table of Contents

List of Figures

List of Tables

List of Acronyms and Abbreviations

BfEE	Bundesstelle für Energieeffizienz
BDEW	Bundesverband der Energie- und Wasserwirtschaft
BEG	Bundesförderung für effiziente Gebäude
BEHG	Brennstoffemissionshandelsgesetz
CO2KostAufG	Kohlendioxidkostenaufteilungsgesetz
DEHSt	Deutsche Emissionshandelsstelle
ECO	Energy Company Obligation
ECO4	Fourth Phase of the Energy Company Obligation
EEG	Erneuerbare-Energien-Gesetz
EEOS	Energy Efficiency Obligation Schemes
EPC	Energy Performance Certificate
EU	European Union
Eurostat	European Statistical Office
GEG	Gebäudeenergiegesetz
HHCRO	Home Heating Cost Reduction Obligation
HTHG	Health to Heat Group
kWh	kilowatt-hour
LA Flex	Local Authority Flexible Eligibility
NECP	National Energy and Climate Plan
NHS	National Health Service
Ofgem	Office of Gas and Electricity Markets
PAS	Publicly Available Specification
PV	photovoltaic
SAP	Standard Assessment Procedure
SGB	Sozialgesetzbuch
SWMR	Solid Wall Minimum Requirement
UK	United Kingdome
WWII	Second world war

1. Introduction

In recent years, energy poverty has become a pressing issue in Germany, exacerbated by the sharp rise in energy prices (Henger & Stockhausen, 2022). This phenomenon is defined as a household's inability to obtain a sufficient quality and standard of domestic energy services - such as space heating and cooling, cooking, appliances, and information technology - to meet its social and material needs (Bouzarovski, 2018, p. 1). It was significantly exacerbated by the war in Ukraine, which increased the housing cost burden for German households from 14.5% in 2021 to 25.2% in May 2022 (Henger & Stockhausen, 2022). In response, the German government earmarked 135 billion euros for relief measures between September 2021 and June 2023 to alleviate this burden (Bruegel, 2023). However as already highlighted by the European Commissioner for Justice, Didier Reynders, "*the rise in energy prices and cost of living has put millions of consumers in a vulnerable situation. Thanks to our collective efforts at EU and national level, the overall situation has improved compared to 12 months ago. However, the reality is that many consumers are still facing difficulties paying their bills"* (European Commission, 2023). The German government has taken these relief packages to mitigate the impact of rising energy costs. However, these measures are largely reactive and temporary. While they provide short-term financial support, they fail to address the underlying issue of energy poverty on a long-term basis.

To address this issue effectively, it is essential to develop policies that reduce energy poverty in a sustainable manner. Energy efficiency, defined as "the ratio of output performance, service, goods, or energy to input of energy" (Directive (EU) 2023/1791, 2012/2023, p. 29), has been acknowledged by scientists as a long-term solution to combat energy poverty (Carfora & Scandurra, 2024, p.15; Rosenow et al., 2013, p. 1199; European Parliament, 2016, p. 21). While financial support must be provided on an ongoing basis, improvements in energy efficiency result in long-term cost savings, even when one-off investments are required (Rosenow et al., 2013, p. 1199).

The European Union recognizes the importance of energy efficiency in addressing energy poverty. The amendment of the Energy Efficiency Directive (EED) urges EU member states to make energy efficiency improvements a priority for vulnerable households, individuals living in social housing, and those experiencing energy poverty (Directive (EU) 2023/1791, 2012/2023, p. 41). One of the EED's principal policies, the Energy Efficiency Obligation Scheme (EEOS), obligates companies to carry out energy efficiency measures. However, member states have the flexibility to implement alternative policies instead of an EEOS (Directive (EU) 2023/1791, 2012/2023, p. 46).

While Germany has opted for alternative energy efficiency policies, 16 European countries (including the UK) have implemented an EEOS (ENSMOV, 2020, p. 3). Notably, five EU Member States and the UK have incorporated provisions for energy-poor households within their EEOS (Sunderland & Thomas, 2021, pp. 4–5). The UK's approach, known as the Energy Company Obligation (ECO), stands out as it focuses entirely on energy poverty alleviation through the implementation of energy efficiency measures in eligible vulnerable households (Bridgen & Robinson, 2023, p. 3). The scheme, first introduced in 2012, has undergone several phases, with the current iteration, ECO4, running from 2022 to 2026 (Ofgem, 2024b).

Despite the benefits of using energy efficiency improvements to alleviate energy poverty, current national measures in Germany, such as the Stromspar-Check initiated by Caritas and supported by the federal government, primarily focuses on low-cost interventions. These include advising households on energy-saving behaviours and funding minor improvements such as energy-efficient lighting (EU Energy Poverty Observatory [EPOV], 2020a, p. 45). While this programme provides valuable support, it lacks the capacity to implement more impactful, long-term energy efficiency measures, such as housing insulation or the installation of heat pumps. Low-income households, already facing significant financial challenges, often lack the resources to invest in these costly measures, despite their relatively short payback periods (Schleich, 2019).

This gap underscores the necessity for more comprehensive policies that empower energy-poor households to receive significant energy efficiency enhancements. While some publications have recommended new measures to address energy poverty in Germany (Strünck, 2017; Cludius et al., 2018; Verbraucherzentrale Nordrhein-Westfalen e.V., 2021), a concrete policy proposal to precisely and sustainably reduce energy poverty through the implementation of energy efficiency improvements in energy-poor households remains absent.

Building on the success of the UK's ECO4, this thesis aims to fill this gap by proposing a new policy instrument for Germany: an EEOS that obligates energy suppliers to implement energy efficiency improvements in energy-poor households. In this regard, the overarching research question to be answered is:

"How can an Energy Efficiency Obligation Scheme for Germany be designed to reduce energy poverty by incentivizing energy efficiency improvements?"

To address this question, this study employs a policy emulation, whereby elements of a policy from one context are adopted and adapted for use in another context, with modifications made to address local conditions and challenges (Rose, 1991, p. 22). Specifically, this thesis develops an EEOS policy proposal for Germany based on an emulation of the British ECO4. Rather than creating a new policy from scratch, this approach leverages the ECO4 as a basis for creating a proposal that is tailored to the German context.

To operationalise the theoretical concept of policy emulation, the study deploys a practical framework derived from the work of Mossberger and Wolman (2003) and Williams and Dzhekova (2014). This includes an assessment of the feasibility of transferring and applying the ECO4 to Germany without modification, as well as the identification of areas where adaptation is crucial. Furthermore, the ECO4's limitations are assessed to avoid replicating any potential drawbacks. Ultimately, the final policy proposal is designed. This is based on the initial findings, a discussion session with two German researchers on the policy proposal, and a review of policy designs from other countries. The latter is conducted in the absence of recommendations for adjusting limiting or challenging policy features specific to Germany. Each stage of the analysis is guided by a subordinate research question:

1. "Is the ECO4 transferable and applicable to Germany?"

2. "Which lessons can be learned from the policy performance of the British ECO?"

3. "Which parts of the policy can be adopted and where do adjustments need to be made to the German context?"

By addressing these research questions, this study aims to develop a comprehensive and tailored policy proposal for implementing an EEOS in Germany, specifically designed to combat energy poverty. The proposal provides a tangible, actionable framework for policymakers and serves as a catalyst for broader discussions on long-term energy poverty reduction strategies. Furthermore, it lays the groundwork for future research and policy development, particularly in the detailed design of EEOS policies targeting energy poverty.

This thesis is structured as follows: The first section provides an overview of energy poverty, energy efficiency and their interrelationship. Moreover, it introduces the EEOS and its application in the UK, as well as literature on policy transfer and emulation. Subsequently, the research design is presented. The following section presents the three-stage analysis. The first step is a descriptive assessment of the ECO4's transferability and applicability to Germany. The second step involves evaluating the results of the expert interviews on the policy performance of the ECO4. The third step entails designing the EEOS policy proposal. Each stage of the analysis concludes with a discussion of its implications and limitations. Finally, the paper summarises the findings and discusses future research directions.

2. State of Knowledge

This section provides an overview of the current state of knowledge regarding key concepts, the EEOS, and the theory on policy transfer and emulation. The first chapter defines energy poverty and provides an overview of its status, as well as the measures taken to address it in Germany. Second, the concept of energy efficiency is explained, and then the use of energy efficiency as a strategy to address energy poverty is investigated. Fourth, the EEOS is examined, including its deployment across Europe and its design features. Fifth, the British approach, the ECO, is described, including its key design features. Finally, the theory on policy transfer is presented.

2.1. Combating Energy Poverty with Energy Efficiency

This chapter familiarizes the reader with the concepts of energy poverty and energy efficiency and how the latter can be leveraged to address the former. Initially, the concept of energy poverty is introduced, and the current state and measures implemented to combat it in Germany are examined. Energy efficiency is then examined, with looking onto its fundamental principles. The chapter concludes by bridging these two concepts, illustrating how energy efficiency strategies can effectively mitigate energy poverty.

2.1.1. Energy Poverty

The concept of energy poverty has evolved significantly over the past few decades. While the terms *energy poverty* and *fuel poverty* are different concepts, they are often used interchangeably by the scientific community, organizations and governments alike (Thomson et al., 2017, p.879; Carfora & Scandurra, 2024, p.1). One of the earliest and most influential definitions resulted from Boardman (1991), who conceptualized energy poverty as "the inability to afford adequate warmth because of the inefficiency of the home" (Boardman, 1991, p. 13). Boardman also introduced the widely used indicator where a household is considered energy-poor if it spends over 10% of its income on basic energy needs (Boardman, 1991, p. 13). Earlier definitions, such as the one of Bouzarovski (2018), include the provision of information technologies and cooling devices used in warmer countries.

More recently, the European Union has introduced its own definition as part of the Fit for 55 package. According to Directive (EU) 2023/1791, 2012/2023 (2012, p. 10), energy poverty is defined as "a household's lack of access to essential energy services, where such services provide basic levels and decent standards of living and health, including adequate heating, hot water, cooling, lighting, and energy to power appliances, in the relevant national context, existing national social policy and other relevant national policies, caused by a combination of factors, including at least non-affordability, insufficient disposable income, high energy expenditure and poor energy efficiency of homes" (Directive (EU) 2023/1791, 2012/2023, p. 10). This definition not only describes the condition but also outlines its causes. Indeed, there is a strong consensus within the scientific community that energy poverty primarily stems from three interrelated factors: high energy prices, low income, and energy-inefficient housing (Boardman, 2012, p. 143; Ürge-Vorsatz & Tirado Herrero, 2012, p. 87; Rogulj et al., 2023, p. 2; Koengkan et al., 2023, p. 4214).

In this thesis it is referred to the aforementioned definition of energy poverty by Bouzarovski (2018). He postulates that "energy poverty occurs when a household is unable to secure a level and quality of domestic energy services - space cooling and heating, cooking, appliances, information technology - sufficient for its social and material needs" (Bouzarovski, 2018, p. 1). Furthermore, as per the consensus of the earlier cited experts, this paper establishes that energy poverty arises from three main causes: high energy prices, low income, and energy inefficient housing. The identification of energy-poor households is carried out in accordance to Boardmans' (1991, p. 13) 10% indicator.

Unlike some other European countries, Germany has yet to establish a formal definition of energy poverty within its national legislation. Consequently, an explicit energy poverty indicator has not been implemented (EPOV, 2020b, p. 33). Heindl and Schuessler (2019, p. 3) highlighted the importance of using self-reported indicators for assessing energy poverty. However, while regular household surveys such as the Mikrozensus or the Socio-Economic Panel include questions on energy consumption and housing conditions, precise data on the extent of energy poverty in Germany is lacking. This also makes it challenging to establish an energy poverty definition in Germany (Strünck, 2017, p. 11). Despite the absence of a formal definition, the German federal government has enacted various policies that address energy poverty both directly and indirectly. These measures, outlined in the 2023 draft of Germany's National Energy and Climate Plan (NECP), encompass a range of approaches to support vulnerable households. These include social security schemes to cover energy costs, housing allowance reforms, energy price caps, and energy efficiency advisory services[1] (Bundesministerium für Wirtschaft und Energie [BMWK], 2023, pp. 55–57). While these initiatives aim to support vulnerable households, recent energy price fluctuations have challenged their effectiveness and highlighted ongoing issues for those consumers.

The surge in energy prices in 2022, triggered by the Ukraine war, has significantly affected German households. In November 2022, the average price increase for electricity, gas, and other fuels was 65% higher compared to November of the previous year. Although prices have since declined, they remain at a substantially higher level in April 2024 compared to pre-war levels, with prices 65% higher than in April 2021 (Eurostat, 2024d). This present elevation in energy costs continues to pose challenges for many households, particularly those in lower income segments (Drescher & Janzen, 2021, p. 13; Heindl & Schuessler, 2019, p. 18). This situation emphasizes the necessity for a more targeted and profound

[1] Chapter 4.1. provides an in-depth overview and description of these policies.

policy to effectively combat energy poverty and ensure equitable access to affordable energy, especially for those most vulnerable.

2.1.2. Energy Efficiency

Energy efficiency has attracted increasing global attention since the oil crisis of the 1970s (Wang & Nie, 2018, p. 498). In recent years, the scientific community has examined energy efficiency from economic, technological, and political perspectives (Pavel et al., 2024; Saunders et al., 2021, p. 137). Despite this extensive research, a universal definition of energy efficiency remains absent (Patterson, 1996, p. 377). Various definitions generally refer to a basic principle: the ratio of useful output to energy input in a given process (Bhattacharyya, 2019, p. 583).

Patterson (1996, p. 377) suggests that to monitor changes in energy efficiency, several indicators can be employed. These include thermodynamic, physical-thermodynamic, economic-thermodynamic, and economic indicators. In this thesis, energy efficiency is conceptualized in accordance with Patterson's (1996, p. 380) description of physical-thermodynamic indicators. This approach modifies the aforementioned ratio by measuring the output in physical units, allowing for the quantification of service delivered per unit of energy input (Patterson, 1996, p. 378). This definition was selected due to its alignment with the European Commission's EED, which defines energy efficiency as "the ratio of output of performance, service, goods or energy, to input of energy" (Directive (EU) 2023/1791, 2023, p. 29).

Building upon this conceptual foundation, it is crucial to explore the practical applications and strategies that can lead to improvements in energy consumption. Energy efficiency improvements encompass a range of strategies and technologies designed to reduce energy consumption in buildings and systems while maintaining or enhancing service quality (Bhattacharyya, 2019, p. 588). These improvements can be categorized into three areas: behavioural changes, technological up-grades, and operational optimizations (Camprubí et al., 2016, p. 305; Papadakis & Katsaprakakis, 2023, p. 2).

Behavioural changes target the modification of energy consumption patterns in households. These may include educational and awareness campaigns, incentive programs, or feedback mechanisms aimed at promoting more energy-conscious behaviour among occupants (Papadakis & Katsaprakakis, 2023, p. 2). Technological interventions focus on optimizing a building's systems and equipment (Papadakis & Katsaprakakis, 2023, pp. 2–3). These include the installation of efficient mechanical equipment for heating, cooling, and hot water systems, as well as improving the insulation of envelope components such as walls, floors, and roofs (Nematchoua et al., 2019, p. 5). Operational interventions focus on modifying the way in which a building is operated. These include the implementation of energy management systems, lighting controls, and occupancy-based systems to optimise energy use based on real-time needs and occupancy patterns (Papadakis & Katsaprakakis, 2023, pp. 2–4).

Energy efficiency policies play a crucial role in driving the adoption of energy efficiency improvements across various sectors. To promote energy efficiency in the residential sector, governments worldwide have implemented a range of policy instruments including regulatory standards, financial incentives, and information campaigns (Harthan et al., 2024, pp. 91–94). However, their impact extends beyond mere energy conservation, intersecting with efforts to combat energy poverty. The relationship between energy efficiency and energy poverty is multifaceted. At its core, energy efficiency policies are designed to reduce energy consumption, which in turn lowers energy costs. This cost reduction is particularly beneficial for low-income households, making energy services more accessible and affordable (Dong et al., 2022, p. 4). Furthermore, these policies play a pivotal role in breaking the vicious cycle of energy poverty, which is perpetuated by the interplay of energy-inefficient buildings, low income, and high energy bills (European Parliament, 2016, p. 20), highlighted in Figure 1.

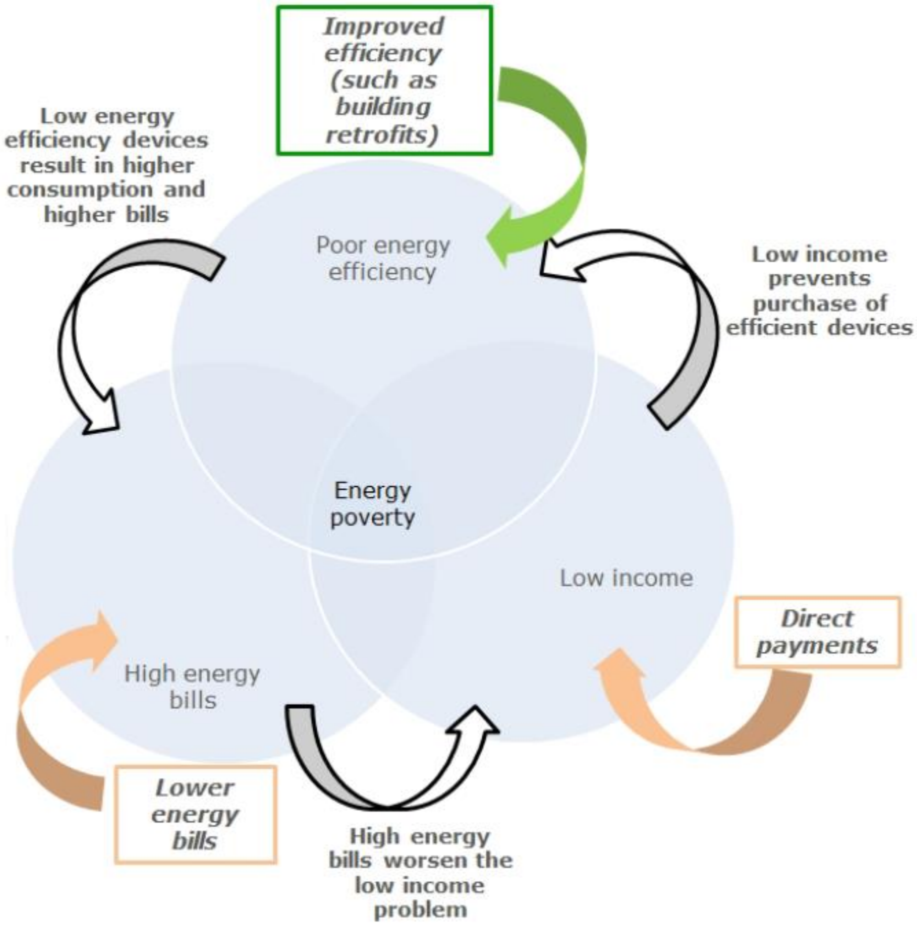

Figure 1: Vicious cycle causing energy poverty with energy efficiency improvements exit option. Figure by European Parliament, 2016.

The defining feature of energy efficiency policies in the context of energy poverty is their long-term impact. In contrast to immediate measures such as direct financial assistance, energy efficiency improvements represent a long-term solution to reducing energy poverty (Carfora & Scandurra, 2024, p.15; Rosenow et al., 2013, p. 1199; European Parliament, 2016, p. 21). This long-term perspective is particularly relevant in countries like Germany, where Bissiri et al. (2019, p. 557) argue that the most effective policy measure to reduce domestic heating consumption and, consequently, energy poverty would be one that focuses on enhancing building envelope performance levels.

Energy efficiency policies aimed at reducing energy poverty encompass a variety of interventions implemented at different governance levels. These interventions, similar to energy efficiency policies in the residential sector, can be categorized into three types: direct financial support, support for energy efficiency measures, and information and guidance schemes, along with other regulatory measures (Cludius et al., 2018, p. 17). The spectrum of these policies ranges from broad measures that indirectly impact energy poverty through general energy savings to targeted interventions specifically designed to alleviate energy poverty (Stojilovska et al., 2022, p. 8). Furthermore, these policies vary in their intensity and depth (Walker et al., 2013, p. 773). This allows for the implementation of tailored solutions that can be adapted to suit different contexts and levels of severity in energy poverty.

2.2. The Energy Efficiency Obligation Scheme Policy

This chapter explores the EEOS and its British equivalent, the ECO. It begins with an overview of the EEOS and its application throughout Europe, including the UK, followed by an outline of the key elements that form the basis of an EEOS. The chapter then provides an in-depth analysis of the ECO, examining its specific design features and operational mechanisms.

2.2.1. Overview and General Design Elements

On 25 October 2012, the European Union adopted Directive 2012/27/EU. This directive introduced a combination of binding measures with the objective of achieving the EU’s 20% energy efficiency target. The aim was to guarantee that energy consumption would not exceed 1,474 million tons of oil equivalent in primary energy or 1,078 million tons of oil equivalent in final energy by 2020 (Directive 2012/27/EU, 2012/2023).

Article 7 of the Directive requires Member States to implement an EEOS at the national level. This policy mandates that energy distributors and/or retail energy sales companies must attain yearly energy savings of 1.5% of their average energy delivered to final customers, excluding energy used for transport. However, it also mentions alternative policies that Member States are allowed to implement instead of an EEOS. As a result, Member States are not strictly required to implement this specific policy, providing some flexibility in how they approach energy efficiency goals. (Directive 2012/27/EU, 2012/2023).

Several European countries have already implemented an EEOS into their national legislation. According to an ENSMOV (2020) report, 16 European countries (including the UK) have incorporated an EEOS, as shown in blue in Figure 2. Among these, four countries exclusively use an EEOS, while the other 12 combine it with alternative measures. An additional 12 Member States rely solely on alternative measures to meet their national energy efficiency target (ENSMOV, 2020). While the basic definition of the EEOS remains consistent, its design varies between countries. As previously mentioned, obligated parties can include energy distributors and/or retail energy sales companies. Furthermore, the obligation can differ in various aspects. These variations include the geographical scale of implementation, the types of energy carrier covered, the economic sectors targeted, and the focus on specific consumer groups. Additionally, countries may set different levels of ambition and use various metrics for measurement (Fawcett et al., 2019). Unlike other European nations, Germany has chosen an alternative strategy to achieve its energy efficiency target (ENSMOV, 2020, p. 3). However, recent studies have put forward a potential design for an EEOS that could align with Germany's unique context and contribute to its energy efficiency goals (Öko-Institut e.V. & Fraunhofer Institut für System- und Innovationsforschung [Fraunhofer ISI], 2012; Schlomann et al., 2021).

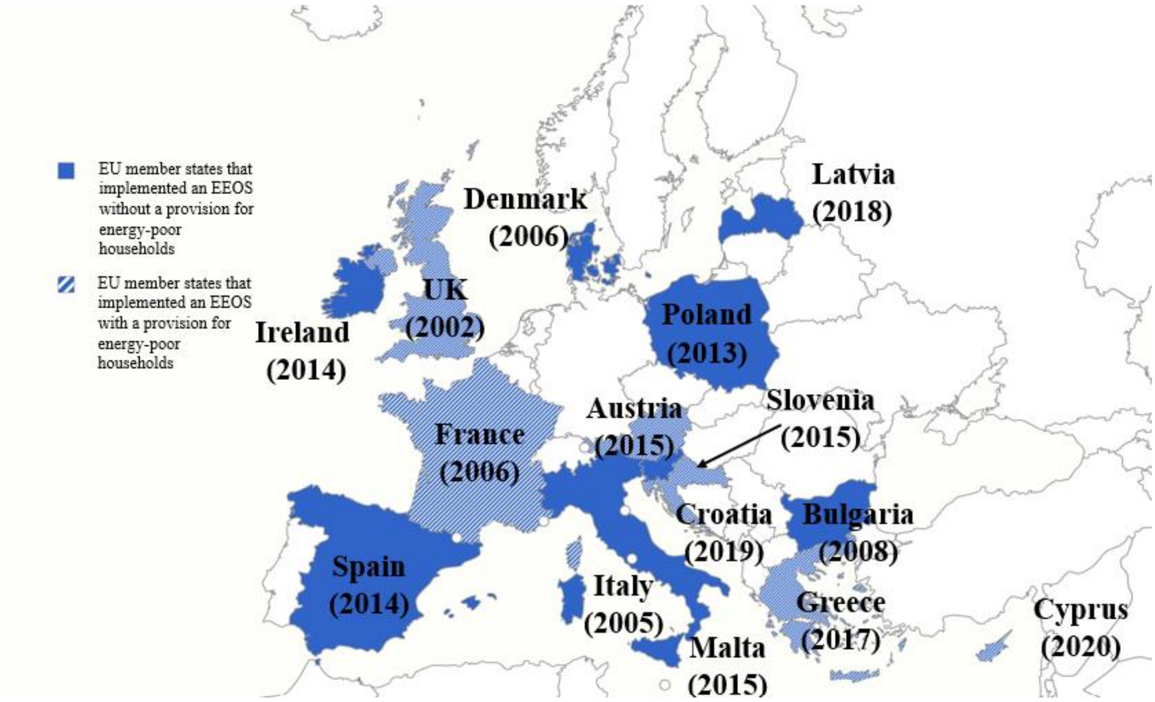

Figure 2: European Member States (including the UK) that implemented an EEOS. Own illustration based on ENSMOV, 2020.

Five EU Member States and the UK have incorporated provisions for energy-poor households within their EEOS framework. Many countries use uplifts to incentivize energy savings in energy-poor households. These uplifts increase the value of energy savings in these households by 10% to 100% more than in other sectors. However, uplifts alone often fall short of achieving desired outcomes. For instance, Austria's uplift system, in place from 2015 to 2020, resulted in only 0.66% of energy savings in energy-poor households (Sunderland & Thomas, 2021, pp. 4–5).

To prioritise energy-poor households, some countries use ring-fencing, which means that a certain proportion of total energy savings must be achieved within this group. Ireland, France and the UK have adopted this approach. Ireland requires 20% of savings to come from the residential sector, with an additional 5% targeted at the most energy-poor households. France combines ring-fencing with uplifts to ensure both minimum delivery and targeted activity at specific households. This dual approach aims to maximise the effectiveness of the EEOS in tackling energy poverty. The UK stands out as a country where the EEOS has evolved over 25 years to focus entirely on tackling energy poverty. This shift was partly motivated by concerns about the negative distributional impacts of their EEOS, also called Energy Company Obligation (ECO), as costs are typically passed on to all energy bill payers through levies, disproportionately affecting low-income households (Sunderland & Thomas, 2021, p. 5).

To understand how an obligation looks in detail, subsequently the key design elements of an EEOS are laid out. The selection of those has been oriented on existing studies addressing the different design features of the policy (Öko-Institut e.V. & Fraunhofer ISI, 2012; Schlomann et al., 2021; Regulatory Assistance Project [RAP], 2012; Energy Saving Policies [ENSPOL], 2016). The most relevant design features addressed in this study are divided into two sections:

1. Obligation Design
2. Eligibility and Accounting of Measures

The following Table 1 contains the design features divided into these sections as well as the associated guiding questions and comments on each design feature to clarify their content.

Table 1: EEOS Design Features and Guiding Questions. Own table based on Öko-Institut e.V. & Fraunhofer ISI, 2012; Schlomann et al., 2021; RAP, 2012; ENSPOL 2016.

Sections	Design Features	Guiding Questions and Comments
Obligation Design	Obligated Energy Carrier	Which energy carrier should be subject to the quota?
	Obligated Parties	Who is obligated under the EEOS? At which company level should the obligation be applied?
	Length of the Obligation Period	Within which period must the obligations be fulfilled? Is this period divided into sub-phases?
	Differentiation of Saving Target	Is there a single obligation, or is it divided into sub-obligations? What do those sub-obligations look like?
	Reference Value of the Savings Target	What is the reference value related to the obligation target?
	Allocation of Costs	Who finances the energy efficiency measures? Is co-financing of energy efficiency improvements by eligible households allowed?
	Flexibility Mechanisms	What mechanisms and levels of flexibility should be implemented (e.g. buy-out[2], banking[3])?
	Admissibility of Certificate Trading	Is trading of obligations allowed? In what form will it be traded (e.g., white certificates, obligations)? Who is allowed to trade certificates (only obligated parties or third-party actors as well)? Who administers the trading process?
	Monitoring and Compliance	Who ensures compliance with the instrument's rules, particularly that quota holders fulfil their savings obligations in terms of quantity? Who is responsible for preventing fraud?
Eligibility and Accounting of Measures	Eligible Measures	Which measures are eligible under the scheme? Are the measures restricted to standardized ones, or are user-defined measures also allowed?
	Selection of Baseline	Creditable savings are calculated relative to a baseline. The baseline represents the current energy efficiency within the reference system, assuming no energy efficiency measures have been implemented. Which baseline is used?
	Determining the Savings	How are savings targets calculated (e.g., through concrete measured savings, technical calculations, or using predetermined expected savings)?
	Double Funding	Is double funding through other political instruments permitted?
	Executing Actors	Which actors are allowed to fulfil the obligation? Only obligated parties or also third parties (e.g., contractors)? How is qualified execution assured?
	Identifying Eligible Consumers	In which target group can the energy efficiency measures be implemented? What are the eligibility characteristics? Who is responsible for identifying the eligible target group?

2.2.2. The British Way: The Energy Company Obligation

I argue that the UK's ECO is the ideal policy for reducing energy poverty by incentivizing energy efficiency measures in Germany. Unlike the French or Irish scheme, the ECO is entirely dedicated to the reduction of energy poverty, aligning with the scientific community's recommendation to implement policies that are fully targeted to energy-poor households. The ECO's long-standing evolution provides

[2] Buy-out is the option of fulfilling the obligation by paying a fixed price or selling certificates at a fixed price.
[3] Banking is the possibility of transferring savings to subsequent trading periods.

valuable experience and data that Germany can learn from, demonstrating adaptability to changing needs and offering insights into how such a policy could be refined over time to best serve vulnerable households in Germany. Subsequently, the evolution and design elements of the ECO are laid out to familiarize the reader with the policy's scope and to provide a reference when proposing it for Germany.

The ECO is the British counterpart to the EEOS and was first introduced in 2013. It is the replacement of two previous schemes, the Carbon Emission Reduction Target and the Community Energy Saving Programme, which were running for several years (Bridgen & Robinson, 2023, p. 3). Like the EEOS, it requires obligated parties, in this case energy suppliers, to carry out energy efficiency measures in households. In contrast to the scheme in other countries, however, its main focus lies on the alleviation of energy poverty by carrying out energy efficiency improvements in energy-poor households (Bridgen & Robinson, 2023, p. 3).

The scheme has undergone four main phases, each building upon the lessons learned from the previous phase (Ofgem, 2024b):

1. **ECO1:** 2013 to 2015
2. **ECO2:** 2015 to 2018 (extended as ECO2t until 2018)
3. **ECO3:** 2018 to 2022
4. **ECO4:** July 2022 to March 2026 (current phase)

When ECO was initially implemented in 2013, it was divided into three sub-obligations (Ofgem, 2015, p. 1):

1. **Carbon Emissions Reduction Obligation:** Aims to provide targeted insulation for hard-to-treat properties.
2. **Carbon Saving Community Obligation:** Focuses on supporting low-income communities, with a sub-target for rural areas.
3. **Home Heating Cost Reduction Obligation (HHCRO)** or Affordable Warmth Group: Dedicated to assisting poorer households, aiming for energy bill lifetime savings.

Since ECO3, initiated in 2018, the obligations are solely build upon the HHCRO (Bridgen & Robinson, 2023, p. 3). This shift has placed a greater emphasis on the alleviation of energy poverty.

Several studies have evaluated the ECO4 program and its predecessors. Dyson (2024) identified several limitations of the current scheme and discussed potential solutions. Bridgen and Robinson (2023) examined the targeting of the ECO by analysing changes in the distribution of energy poverty levels across Local Authorities in England over time. Emden et al. (2024) critiqued the existing ECO scheme, articulating its shortcomings in meeting established targets. Rosenow et al. (2013) provide a critical analysis of an earlier iteration of the ECO, focusing on the criteria used to identify individuals experiencing energy poverty.

In the following chapter, the key design features divided in accordance with the EEOS design features highlighted in Chapter 2.2.1. are delved into.

2.2.2.1. Obligation Design

In this section, the design features related to the "Obligation Design" of ECO4 are described.

Obligated Energy Carrier

Under the ECO4, energy suppliers are obligated if they provide either electricity, gas, or both. As a result, these energy carriers are obligated (Ofgem, 2023c, p. 16).

Obligated Parties

Obligated parties are energy suppliers that meet three conditions (Ofgem, 2023c, p. 16):

1. They provide 300 GWh or more of electricity during the ECO4 qualification year and have 150,000 or more domestic customers for gas or electricity by the end of the qualification year.

2. They provide 700 GWh or more of gas during the ECO4 qualification year and have 150,000 or more domestic customers for gas or electricity by the end of the qualification year.

3. They participated in the preceding phase of ECO4.

Length of the Obligation Period

ECO4 runs from 27 July 2022 to 31 March 2026. It is divided into four phases, each lasting approximately one year. Energy suppliers must meet their obligation by the end of the last phase (Ofgem, 2023c, p. 16).

Differentiation of Saving Target

Similar to ECO3, ECO4 includes the HHCRO as the overarching obligation, with two sub-obligations:

1. **Solid Wall Minimum Requirement (SWMR)**: Requires the installation of solid wall actions, which Ofgem defines as internal or external insulation of the exterior-facing solid walls of uninsulated solid wall premises (Ofgem, 2022, p. 32)
2. **EFG minimum**: Requires suppliers to upgrade a minimum equivalent of 150,000 privately owned homes within energy efficiency bands E, F, and G to a higher standard. Properties initially rated F or G must achieve a band D rating, while those rated E must reach a band C (Ofgem, 2022, p. 33).

Reference Value of the Savings Target

The unit of measurement for the HHCRO and the EFG Minimum is "lifetime bills saved". This relates to the total estimated reduction in energy bills over the lifetime of the energy efficiency improvement installed. The SWMR is measured in "properties treated", which refers to the number of dwellings that received an energy efficiency improvement (Ofgem, 2022, p. 29).

Allocation of Costs

Energy suppliers initially cover the costs of verified savings and later pass them on to customers. They also determine the level of funding for each measure. Ofgem does not control the scope or cost of consumer contributions (Ofgem, 2024c).

Flexibility mechanisms

Suppliers are permitted, under certain conditions, to transfer excess savings from ECO3 to ECO4 and can bank[4] up to 10% of their ECO3 obligation (Ofgem, 2022, pp. 35–36). No buy-out[5] option is applied as no white certificates (see Admissibility of Trading) for trading are produced.

Admissibility of certificate trading

Suppliers may trade all or part of their obligations, but only between obligated suppliers. Trading of obligations means that company A, which generates more savings than it is obligated to, can trade this surplus with company B, which has failed to fulfil its obligation. The trading process is administered by the Office of Gas and Electricity Markets (Ofgem). Unlike some countries that also have implemented an EEOS, no white certificates[6] are created (Ofgem, 2022, p. 40).

Monitoring and Compliance

Ofgem administers the ECO4 scheme, verifies compliance and prevents fraud (Ofgem, 2023c, p. 13). It reserves the right to audit measures notified by suppliers and requires all relevant documentation to be available upon request. A dedicated Counter-Fraud team detects and deters fraud (Ofgem, 2023c, pp. 189–190).

Qualified professionals perform technical monitoring to ensure energy efficiency measures meet established standards, with oversight from Ofgem. Ofgem also conducts score monitoring to confirm that energy savings scores accurately reflect the characteristics of each household (Ofgem, 2023c, p. 189).

[4] Banking is the possibility of transferring savings to subsequent trading periods.
[5] Buy-out is the option of fulfilling the obligation by paying a fixed price or selling certificates at a fixed price.
[6] According to Wirl (2015), "A white certificate is both an accounting tool, which proves that a certain amount of energy has been saved in a specific place and time, and a tradable commodity, which belongs initially to the subject that has induced the savings (implemented a project) or owns the rights to these savings, and then can be traded according to the market rules, always keeping one owner at the time."

2.2.2.2. Eligibility and Accounting of Measures

In this chapter, the design features related to the "Eligibility and Accounting of Measures" of ECO4 are described.

Eligible Measures

ECO4 employs a Whole-House Approach to optimize energy efficiency. This involves the implementation of multiple improvements tailored to the property's needs, treated as a single project. Successful projects are awarded Full Project Scores (FPS) (Ofgem, 2023c, p. 73) when they meet the Standard Assessment Procedure (SAP) improvement criteria. SAP, the UK's national energy performance calculation methodology (GOV.UK, 2024), rates properties from A (most efficient) to G (least efficient) (Ofgem, 2023c, p. 149). Properties rated F or G must improve to at least to band D, and those rated D or E must reach band C. Projects not meeting the minimum standards may receive Partial Project Scores, acknowledging partial progress (Ofgem, 2023c, pp. 148–149).

ECO4 allows the following pre-defined energy efficiency measures (Ofgem, 2023c, pp. 93–141):

- Insulation: cavity wall, external/internal wall, loft, pitched roof, and floor insulation
- Heating systems: upgrades, repairs, and replacements of heating systems or electric storage heaters
- District heating: connection to a district heating system
- First-time central heating installation
- Renewable energy: photovoltaic (pv) panels, especially when combined with other measures like electric heating systems
- Heating controls: smart thermostats, time and temperature zone controls

Before other measures can be installed, specific insulation prerequisites must be met. Suppliers may also apply for innovative measures outside the pre-defined scope, receiving a score uplift. Measures related to information, motivation, or behavioural change are not permitted under ECO4 (Ofgem, 2023c, pp. 93–141).

Selection of Baseline

The baseline for ECO4 is determined by the energy efficiency level of a premise before any measures are implemented, which is called the "status quo ante" (Ofgem, 2023c, pp. 150–151). This is based on the starting SAP rating (Ofgem, 2023c, p. 151).

Saving Determination

Each installed measure or completed project is assigned a project score that reflects its contribution towards a supplier's obligation. Pre-calculated scores can be determined using a published table, which considers the SAP band before and after retrofitting, as well as the floor area category of the dwelling.

These scores represent the annual bill savings of the property following the retrofit (Ofgem, 2023c, pp. 148–149).

Double Funding

Measures funded under ECO4 cannot be combined with funding from other government programs or grants. Any additional non-ECO4 measures installed at the same property must be carried out either before or after ECO4 measures. Importantly, non-ECO4 measures that affect the property's SAP rating cannot be installed between the pre-retrofit and post-retrofit SAP assessments (Ofgem, 2023c, p. 90).

Executing Actors

Although obligated energy suppliers are responsible for meeting the ECO4 targets, they are not required to carry out the energy efficiency measures themselves. Suppliers can delegate the work to approved contractors, who must be accredited under the government-endorsed TrustMark quality scheme (Ofgem, 2024d). This scheme helps consumers to find reputable and trustworthy installers, ensuring that the work carried out under ECO4 meets high standards of quality and customer service (Trustmark, 2024). All retrofitting under ECO4 must comply with the Publicly Available Specification (PAS) 2035:2019, which outlines standards for retrofit assessments, coordination, and installation (Ofgem, 2023c, p. 74).

Identifying Eligible Consumers

Under ECO4 eligible consumers can be identified via two primary routes: the Help to Heat Group (HTHG) and the LA Flex.

1. Help to Heat Group (HTHG):

Households are eligible if they receive certain means-tested benefits, including Jobseekers Allowance, Income-related Employment and Support Allowance, Income Support, Pension Credit Guarantee Credit, Working Tax Credit, Child Tax Credit, Universal Credit, Housing Benefit, or Pension Credit Savings Credit. Additionally, households receiving child benefit qualify if their income falls below a specified threshold, which varies based on the number of children and the household composition. To confirm eligibility, households must provide official documentation issued within the last 12 months (Ofgem, 2023c, pp. 51–52).

2. Local Authority Flex (LA Flex) / ECO4 Flex:

LA Flex provides an additional route for identifying eligible households that may not meet traditional criteria. This scheme allows local authorities to nominate households for energy efficiency improvements and enables suppliers to deliver up to 50% of their ECO4 obligation through this method. Eligibility under LA Flex can be determined by the following four routes: (Ofgem, 2023c, pp. 56–59):

1. Household Income: Households whose total gross income falls below £31,000 are eligible for assistance if they reside in properties rated SAP bands D-G (owner-occupied) or E-G (private rented).

2. Proxy Targeting: Households are eligible if they meet at least two proxies. These proxies include being located in deprived areas, receiving a Council Tax Reduction, being identified as vulnerable to cold homes, receiving free school meals due to low income, receiving referrals from local authorities, receiving referrals from energy suppliers or Citizens Advice for difficulties in paying energy bills, and having energy debt.

3. NHS[7] Referrals: Households may qualify if a member is identified by a health professional as having a severe health condition worsened by living in a cold home.

4. Bespoke Targeting: Local authorities and suppliers can propose alternative methods for identifying low-income or vulnerable households. These innovative approaches must be more effective than the existing criteria and receive approval from the Department for Energy Security and Net Zero (Ofgem, 2023c, pp. 56–59).

2.3. Policy Transfer and Lessons-Learned

According to Dolowitz and Marsh (1996) policy transfer is "a process in which knowledge about policies, administrative arrangements, institutions etc. in one time and/or place is used in the development of policies, administrative arrangements and institutions in another time and/or place" (Dolowitz & Marsh, 1996, p. 343). With this, he stems his definition on the seminal work of Richard Rose (1991) on *lessons-drawing*, which addresses the question: "Under what circumstances and to what extent can a programme that is effective in one place transfer to another?" (Rose, 1991, p. 3). Different types of policy transfer exist. Those include copying, emulation, hybridization, synthesis and inspiration. Rose (1991) emphasizes that in the real world, a program is never expected to transition from one government to another without considering the unique history, culture, and institutions of each. While rejecting the idea of replicating every detail, *emulation* acknowledges that a successful program from abroad can serve as an ideal model for creating legislation domestically. However, it must be adapted to reflect the specific national context (Rose, 1991, p. 21).

Several studies have assessed the transferability of policies to another context. For instance, Warren (2017) investigated the factors influencing the transferability of successful demand-side management and wider energy policies across diverse countries, and evaluated the extent to which these policies can be adapted in other contexts. Steinbacher (2015), evaluated the transferability of a renewable energy policy through the use of semi-structured interviews. Cludius et al. (2018) assessed policies designed to address energy poverty in several European countries. Additionally, they evaluated the applicability and

[7] National Health Service

transferability of these policies to the German context and proposed preliminary conclusions regarding their potential adaptation in other countries.

The final stage of a policy transfer involves the *prospective policy evaluation*. This evaluation assesses the potential outcomes of transferring a programme that has already been implemented in another country to a target setting. This step is of particular importance for policymakers, who require an ex ante analysis to determine whether a policy should be transferred (Rose, 1991, p. 23). Mossberger and Wolman (2003) present a practical framework for evaluating the validity of cross-national policy transfer as a method of prospective policy evaluation, in accordance with Rose's (1991) work. This framework assists policymakers who are considering replicating a foreign policy, or elements of it, in their own regional context.

Building up on this concept, a policy proposal can be formulated. Policy formulation can be defined as "generating options about what to do about a public problem" (Howlett, 2019, p. 29). The literature proposes to utilize policy formulation tools for this purpose. These tools encompass a variety of methods for forecasting and exploring potential future issues through scenario creation, policy option identification and recommendation (using methods such as cost-benefit, cost-effectiveness and multi-criteria analysis), and problem structuring or framing techniques (such as brainstorming, boundary analysis and argumentation mapping) (Jordan & Turnpenny, 2015, p. 4).

3. Research Design

To assess the effect of transferring the latest iteration of ECO, ECO4, before its implementation, this thesis applied the framework of policy transfer as a form of prospective policy evaluation, as proposed by Mossberger and Wolman (2003). I selected this framework for several reasons. Firstly, it is a highly cited and well-established framework within the field of political science. The analytical steps that decision-makers should take to evaluate a policy prospectively are based on the rational policy analysis model, which is well-known and discussed by many seminal political science publications (Rose, 1991; Wolman, 1992). Secondly, in contrast to other scientific publications, it considers the perspective of a policy designer. Many publications focus on the retrospective analysis of a policy transfer. This publication, in contrast, proposes a practical framework for policymakers and those overseeing policy transfers to assess the appropriateness of adapting a policy for implementation in a different country. This framework includes three key stages: *awareness*, *assessment*, and *application* (Mossberger & Wolman, 2003, pp. 430–431).

The *awareness* stage involves determining the scope and quality of information about the policy, as these factors influence the ability to assess its utility. This thesis does not include this stage, as the selection of the ECO4 as the donor policy was already determined through an extensive assessment conducted prior to the thesis design (Mossberger & Wolman, 2003, p. 430).

The policy *assessment* stage, which forms the core of the framework, includes three sub-steps (Mossberger & Wolman, 2003, p. 431):

- *Similarity of Problems and Goals*
- *Differences in Setting*
- *Policy Performance*

Similarity of Problems and Goals assesses whether the problems addressed and goals pursued by the original policy match those of the adopting country. Mossberger and Wolman (2003) highlight that differences in problems and goals are not necessarily exclusion criteria for policy transfer. However, it is crucial to argue why an application might still be desirable. Leaving this step unrecognized could result in unexpected policy failures in the adopting country (Mossberger & Wolman, 2003, p. 431).
Differences in Setting evaluates the extent to which specific variables in the new context diverge from the policy's original context and whether these discrepancies are significant for the implementation or outcomes. The authors list possible variables for inclusion. Those include contextual variables such as political, social, and economic institutions, political climate, public perception, available resources, as well as the presence of other policies that may impact efficacy (Mossberger & Wolman, 2003, p. 431).
Policy Performance involves assessing the policy's performance in the donor country, including evidence of policy effects, advantages and disadvantages.

The final stage involves the *application* of the policy, which can be wholly adopted, modified or even rejected (Mossberger & Wolman, 2003, p. 431).

While Mossberger and Wolman (2003) developed a comprehensive prospective policy evaluation framework, it lacks operationalizing the different evaluation steps. Williams and Dzhekova (2014) filled this gap by building on Mossberger and Wolman's (2003) work. They address how to empirically and quantitatively assess the steps of similarities of problems and goals and differences in setting. Their framework aims to balance between de-contextualizing[8] and over-contextualizing[9] the donor country's policy intended for transfer Williams and Dzhekova (2014, p.8-11).

Drawing on the realist evaluation approach (Pawson & Tilley, 1997), Williams and Dzhekova (2014, p.13) introduced two sets of indicators: *Transferability* and *Applicability*. *Transferability* criteria assess whether the policy can achieve the same outcomes in the target context, while *Applicability* assessment examines the possibility of providing the policy in the local context. This framework aims to assess core aspects of policy measures and identify their suitability for current needs, as well as potential barriers and opportunities in the recipient country. Williams and Dzhekova (2014, p.13) clarify that their framework is not intended to create a comprehensive policy proposal, noting that a more rigorous analysis might be necessary for such an ambition.

This thesis aims to propose a more comprehensive policy design. Therefore, as suggested by Mossberger and Wolman (2003), a detailed analysis of the policy's performance were incorporated into this thesis's framework, in addition to the analysis proposed by Williams and Dzhekova (2014). This incorporation of the policy performance assessment allows for a more complete understanding of the policy, including its success factors and challenges.

As Williams and Dzhekova's (2014) framework partly evolved from Mossberger and Wolman's (2003) work, the former was incorporated into the latter. Specifically:

1. Instead of *Similarities of Problems and Goals* the term *Transferability* was used.
2. Instead of *Differences in Setting* the term *Applicability* was used.

The final modified framework applied in this thesis is visualised in Figure 3.

[8] De-contextualization, in this context, refers to an excessive focus on policy outputs, results, and impacts while neglecting contextual variables.
[9] Over-contextualization makes a policy's success or failure too dependent on its applied context, hindering generalizations about its potential utility in another context.

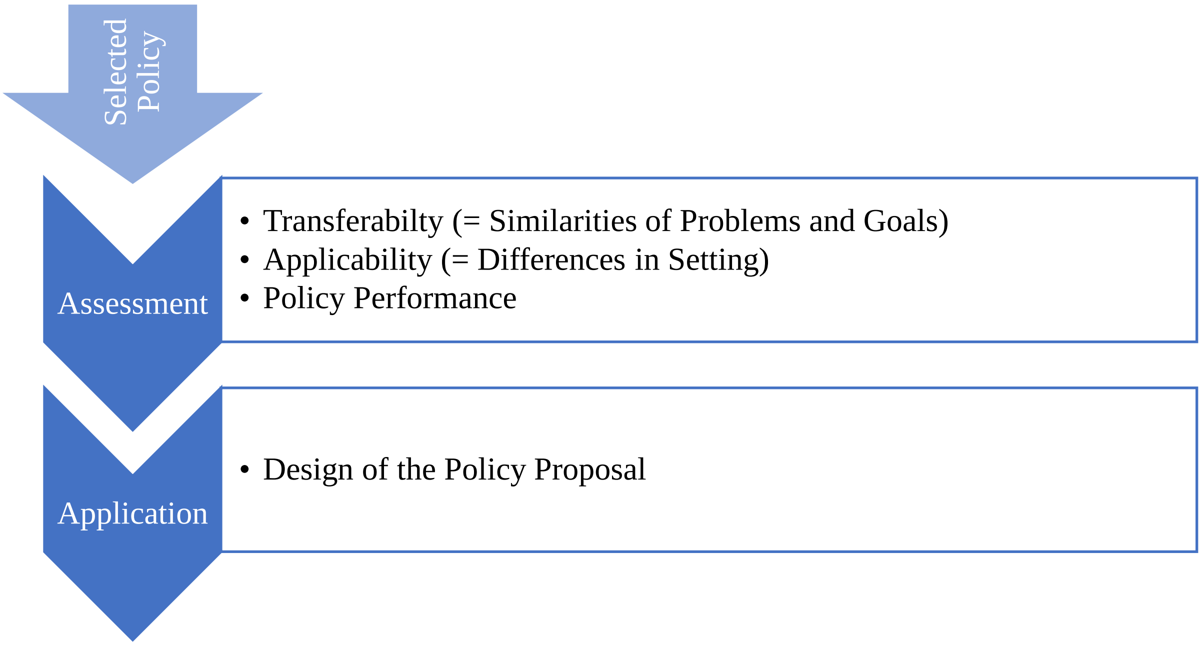

Figure 3: Prospective Policy Evaluation Framework as applied in this thesis. Own figure based on the integration of Mossberger and Wolman (2003) and Williams and Dzhekova (2014) frameworks.

3.1. Assessment of the Applicability and Transferability of the 4th Energy Company Obligation (ECO4) to Germany

The originally by Williams and Dzhekova (2014, p. 12) developed questions were specifically adapted to the purpose of this thesis. In total they proposed 17 questions in their framework. The proposed original set of questions can be found in Appendix A. Due to limitations in time, resources, data availability, and feasibility of answering certain questions, the original list of 17 questions were restricted accordingly. This results in the list of questions adapted to the research question visualized in Table 2.

Table 2: Adapted set of questions for prospectively evaluating the policy transfer. Own figure based on the adaptation of the framework of Williams and Dzhekova, 2014.

Construct	Factors/Criteria	Questions to Ask
Transferability	Magnitude of energy poverty in target context	Is energy poverty already addressed by other policies? What is the prevalence of energy poverty in Germany? What is the difference in the prevalence of energy poverty between the UK and Germany?
	Objective of the intervention	Is the intervention targeting the same priority objective in the UK and Germany?

	Target group characteristics	Are the characteristics of energy-poor households in Germany comparable to those in the UK?
		Are the dwelling stock characteristics in Germany comparable to those in the UK?[10]
		Are the characteristics of the obligated parties in Germany comparable to those in the UK?[11]
Applicability	Impact on other affected interest groups/stakeholders: winners and losers	Does the policy contradict the interests of any key stakeholders/interest groups?
	Existing institutional/policy infrastructure	Is the ECO4's potential impact conflicting/cancelling out/overlapping/synergizing with existing policies?
	Available resources	Human resources required?

To address these questions regarding the assessment of the ECO4 transferability and applicability, a descriptive analytical approach using secondary data sources was employed. This method is well suited to the analysis in this chapter as it allows for a systematic characterisation and comparison of relevant factors between the UK and Germany, without establishing causal relationships or making complex predictions. The analysis draws on a range of existing evidence and information to address the evaluation questions in a comprehensive way. It avoids the need for primary data collection (e.g. interviews, surveys or field observations), which would be resource-intensive and potentially infeasible given the scope of this work.

Secondary data sources included existing indicators, official governmental documents, position papers, statistics from government websites and publications, and grey literature. To ensure comparability, data for each country was derived from the same or comparable sources. For instance, when comparing dwelling stock data, governmental documents were used for both countries. However, it is important to note that there may be variations in data collection and calculation methods between the two countries, which represents a limitation of this thesis.

The analysis entailed a systematic review of secondary sources, extraction of relevant data for each question, and analysis of findings. For questions which compare Germany and the UK, a comparative approach was employed. Conversely, when questions are posed specifically about Germany, the analysis synthesised information to provide a comprehensive picture of the German context. The final synthesis and evaluation of the ECO's overall transferability and applicability, based on the findings from this analysis, were addressed in an interim conclusion and discussion. Detailed definitions of the terms used

[10] Energy poverty is strongly linked to the type and condition of dwellings, and the appropriate energy efficiency measures must be tailored to the specific characteristics of each household. Therefore, this study incorporates the features of the dwellings into the profile of the target group.
[11] Obligated parties, responsible for implementing the energy-saving measures, are also considered a key target group. The design and implementation of the obligation are shaped by the specific characteristics of these obligated entities.

in each of the evaluation questions, together with the specific methods and data sources used, can be found in Appendix B.

3.2. Performance Evaluation of the 4th Energy Company Obligation (ECO4)

For assessing the policy performance, semi-structured expert interviews as the primary data collection source were employed. Semi-structured expert interviews were selected as the primary data source for several reasons. Firstly, as Mossberger and Wolman (2003) recommended, consulting knowledgeable individuals on the policy of the donor country provides valuable insights that may not be easily accessible through other methods. Secondly, compared to field studies, expert interviews offer a high data density, making them an efficient method for gathering rich information in a relatively short timeframe. Thirdly, experts can represent the views of many stakeholders, providing a shortcut to the typically time-consuming observation process. Ultimately, semi-structuring the interviews allows for systematically collecting data while maintaining the flexibility to explore unexpected but valuable information that may arise during the conversation (Bogner et al., 2009).

This thesis used a purposive sampling strategy supplemented by snowball sampling. The initial selection of experts was based on their knowledge and involvement with the ECO4 and its predecessors. Snowball sampling was then used to identify additional participants based on the initial interviewees' networks or recommendations. In total, 17 stakeholders were contacted for interviews. The selection aimed to include diverse perspectives from the scientific community, energy companies, governmental bodies, and non-governmental stakeholders. The final sample consisted of 4 experts from various backgrounds, which are listed in Table 3. It is worth noting that, despite efforts to include governmental perspectives, the Department for Energy Security and Net Zero, as well as the administrative authority Ofgem, declined to participate due to the recent election period and organizational policies.

Table 3: Interviewed Experts with their affiliation and classification. Own table.

Expert	Affiliation	Classification
Jan Rosenow	German Energy Efficiency Scientists and Research Associate at Oxford and Cambridge University, Director, European Programmes at Regulatory Assistance Project	Scientist
William Baker	British Fuel Poverty Scientist	Scientist
George Walters	Chief Home Service Officer at the British Energy Supplier Utilita Energy	Obligated Energy Supplier
Matt Copeland	Head of Policy and Public Affairs at National Energy Action	Fuel Poverty Charity

Interviews were conducted between May 2024 and June 2024. Each interview lasted between 25 and 55 minutes and was conducted in either German or English, depending on the participant’s background. To guarantee the accuracy and reliability of the information provided and to facilitate undivided attention during the interviews, all sessions were audio-recorded with the consent of the participants. The interview guide was developed based on the theoretical framework, focusing on the contextual factors mentioned therein, as well as the Ofgem manual for ECO (Ofgem, 2023c). Questions were tailored to each expert's background and knowledge. The questions primarily addressed the success and challenges of the ECO4, its impact on reducing energy poverty in the UK, eligibility criteria and permitted technical measures, bureaucratic processes, and communication between different stakeholders. The transcripts, letters of consent and interview guides of each expert interview can be found it Appendix C-E. The data collection process was completed when sufficient data had been collected to meet the objectives of this thesis, while adhering to the time constraints.

All audio recordings were transcribed verbatim without word repetitions and filler words to ensure accuracy. An inductive coding approach, based on the methodology proposed by Gioia et al. (2013), was employed for the qualitative content analysis. The process involved first-order coding, where initial codes were generated directly from the data, staying close to participants' own language and concepts. This was followed by second-order coding, where first-order codes were grouped into broader themes. Finally, these themes were further abstracted into three key dimensions: General Obligation Design, Eligibility and Accounting of Measures, and Effectiveness and Applicability to Germany.

3.3. Development of an Energy Efficiency Obligation Scheme Policy Proposal for Germany

The formulation of the EEOS policy proposal was carried out in three steps. Firstly, the policy limitations and transfer challenges. Secondly, an initial policy proposal was developed. Thirdly, two German researchers were consulted on the initial policy proposal, and changes were made accordingly. Finally, the final policy proposal was drafted. This methodological approach was chosen to ensure a systematic translation of prior analyses into a practical policy proposal, while also incorporating expert opinions to enhance its validity and feasibility. Following, each step is described in further detail.

Initially, the policy limitations and transfer challenges through a comprehensive synthesis of the previous analyses for each policy feature, as detailed in Chapter 2.2.1, were assessed. This tailored synthesis was chosen as the most suitable method to clearly identify the specific policy limitations and transfer challenges for each policy feature, providing a nuanced understanding of which aspects required modification based on prior analyses.

Based on the identified policy limitations and transfer challenges, the recommendations for modifying each policy feature were developed. These recommendations were derived from two primary sources: direct expert suggestions for altering the policy features, as gathered in previous phases of the research, and informed modifications based on the assessment of the policy limitations and transfer challenges. In cases where no clear advantageous option emerged, multiple options for consideration were presented. Where transfer challenges were identified but no corresponding design modification was apparent, an additional analysis of EEOS designs from other countries (France, Ireland, Austria, Croatia, and Cyprus) was carried out. Sources included (NOR: DEVR1428328A, 2014/24.03.2022; EEffG, 2004/2024; RAP (2012); ENSMOV, 2020). This approach should help to close the knowledge gap about potential alternative design options. The selection of countries for additional analysis was based on their inclusion of addressing energy poverty focusing on the residential sector, aligning with the goals of the for Germany proposed EEOS.

To mitigate potential bias and enhance the proposal's validity, the policy proposal was discussed in a one-hour discussion session with two researchers from the Öko-Institut e.V., namely Malte Bei der Wieden and Dr. Veit Bürger. Both are familiar with Germany's energy policy landscape and energy sector, as well as the European EEOS and the British ECO. This step tackled the inability to employ more resource-intensive methods, such as cost-benefit analysis or multi-criteria-analysis, as proposed by policy formulation literature (Jordan & Turnpenny, 2015, p. 21), due to time constraints. Furthermore, the consultation of German stakeholders was not feasible due to time constraints. The discussion session with the researchers served as a form of peer review, facilitating the refinement of the proposal based on practical insights. Subsequently, the policy proposal was modified in accordance with the recommendations articulated by the researchers. The recommendations resulting from the discussion with them are highlighted in each policy feature recommendation. Building upon this work, the final policy proposal was crafted.

4. Assessment of the Transferability and Applicability of the 4th Energy Company Obligation (ECO4) to Germany

This chapter presents the results of the assessment of the ECO4's transferability and applicability to Germany. The transferability assessment focused on comparing existing energy poverty policies, the prevalence of energy poverty, and the alignment of ECO4 objectives with Germany's intended goals. It also examined the comparability of energy-poor household characteristics, dwelling stock, and obligated parties between the UK and Germany. The applicability assessment investigated the potential impact on stakeholders, interactions with existing German policies, and the availability of necessary human resources for implementation.

4.1. Existing Energy Poverty Policies in Germany

This chapter assessed the question whether energy poverty is already addressed by other policies. As outlined in the 2023 NECP draft, the German Federal Government has implemented various policies to directly or indirectly address energy poverty (BMWK, 2023). To highlight the absence of policies targeting a particular root cause of energy poverty, policies were categorized based on the root causes they target[12]. These categories are: low income, high energy expenditure and low energy efficiency.

Low Income

The Federal Government provides benefits under the Minimum Social Security Schemes to individuals under the Second and Twelfth Social Code (dt. Sozialgesetzbuch; SGB II for Jobseekers and SGB XII for Social Assistances). These benefits are indirectly addressing energy poverty by covering "standard needs", including energy costs. Also loans are available for energy debts. (BMWK, 2023, pp. 5–6). The Housing Allowance Act (dt. Wohngeldgesetz) indirectly addresses energy poverty by providing subsides for housing costs, which also include a contribution to the household's heating costs (BMWK, 2023, pp. 56–57).

High Energy Expenditures

Introduced in January 2023, the electricity and gas price breaks (dt. Strom- und Gaspreisbremse) aim to alleviate rising energy costs and mitigate energy poverty. By capping household gas prices at 12 cents per kWh, electricity at 40 cents per kWh and district heating at 9,5 cent per kWh, these measures provide

[12] This classification aims to provide a clearer overview of the existing policies. However, the author acknowledges that these policies often address multiple causes as the roots of energy poverty are interconnected. The classification is based on the primary cause that each policy seeks to address.

financial relief for all households (BMWK, 2023, p. 57). The price breaks were in place until the end of Dezember 2023 (Presse- und Informationsamt der Bundesregierung, 2024).

Low Energy Efficiency

The Energy Advice of the Consumer Centre (dt. Energieberatung der Verbraucherzentrale) and the Electricity Saving Check (dt. Stromspar-Check) provide information, advice and assistance on energy efficiency to citizens. In the Electricity Saving Check, former long-term unemployed individuals are working as energy advisors. Their role is to provide advice to low-income households on how to save energy, with the aim of reducing their energy bills. The program also includes practical measures such as the replacement of old, inefficient refrigerators (BMWK, 2023, p. 57).
In the Consumer Centre households receive independent guidance on energy costs, energy savings, energy efficiency improvements and funding opportunities. Advice is provided through face-to-face consultations, telephone or video consultations, online lectures, and on-site visits by energy consultants. While there is a nominal fee of 30€ for these services, low-income households receive them free of charge (BMWK, 2023, p. 57).

Interim Conclusion

In conclusion, the German legislative framework addresses energy poverty through measures targeting low-income households and high energy costs. Federal assistance includes benefits under the Minimum Social Security Scheme and the Housing Allowances Act, indirectly reducing energy expenses. Furthermore, recent reforms and price reductions aim to mitigate rising energy prices. Programmes such as the Electricity Saving Check and the Energy Advice of the Consumer Centre offer advice on energy savings and practical measures to improve the dwelling’s energy efficiency. However, a targeted and profound policy for alleviating energy on a long-term basis is lacking.

4.2. The Prevalence of Energy Poverty in Germany

This chapter assessed the question of the prevalence of energy poverty in Germany. This was done by analysing two European Statistical Office (Eurostat) indicators (Eurostat, 2017; Eurostat, 2022a). Figure 4 visualises the results over time from the beginning of each indicator’s measurement until 2023.

Both indicators show similar trends. The *Population unable to keep home adequately warm* (G1) indicator, calculated since 2005, remained relatively constant until 2013. The introduction of the *Arrears on utility bills* (G2) indicator in 2014 marked the beginning of a steady decline for both indicators until 2019. Following this, G2 began to raise again after 2019, the beginning of the COVID-19-pandemic, peaking at 5.2% in 2023, the year of the energy price crisis. Conversely, G1 exhibits significant fluctuations, spiking to 7% in 2020 before dropping to 2.2% in 2021, and then peaking again at 8.1% in 2023.

In conclusion, both indicators reveal a significant fluctuation in energy poverty trends in Germany, particularly between the COVID-19-pandemic and the energy price crisis.

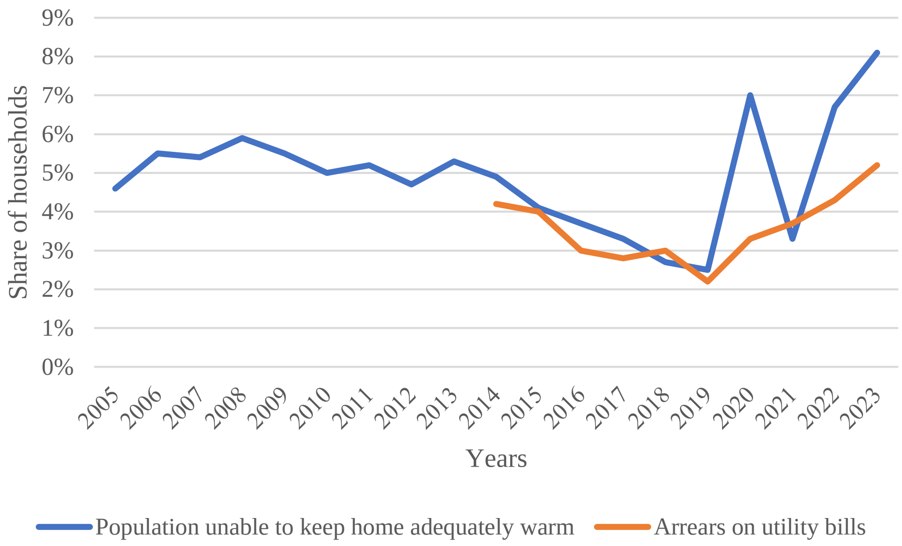

Figure 4: Population unable to keep home adequately warm indicator and the Arrears on utility bills indicator over time for Germany. Own figure based on data from Eurostat, 2024 & Eurostat, 2022.

4.3. Comparability of the Prevalence of Energy Poverty in Germany and the UK

This section assessed the question whether the prevalence pf energy poverty is comparable between Germany and the UK. Same as in Chapter 4.2. the Eurostat *Population unable to keep homes adequately warm* indicator (Eurostat, 2024c) and the *Arrears on utility bills indicator* (Eurostat, 2022a) was utilized as indicators for the prevalence of energy poverty. Figure 5 presents the results over time from the beginning of each indicator's measurement until 2023 for both countries.

The first indicator analysed the *Population unable to keep homes adequately warm*. Before 2008, both countries showed similar trends, with the UK having slightly lower results from 2006 to 2007. However, a divergence began from 2008 onwards. While Germany experienced a consistent decrease in the share of population unable to keep their homes adequately warm from 2008 to 2018, the UK saw an exponential increase during the same period, peaking in 2013 at a level of 5.3 percentage points higher than Germany's. After 2013, the UK's indicator began to decrease, reaching 5.4% in 2018, which is still 2.7 percentage points above Germany's rate.

The second indicator, *Arrears on utility bills*, shows a similar decreasing pattern in both countries until 2018. In the UK, the share decreased from 7.2% in 2014 to 5.4% in 2018. Notably, the UK's rate remained consistently higher than Germany's, with a difference of 3 percentage points in 2018.

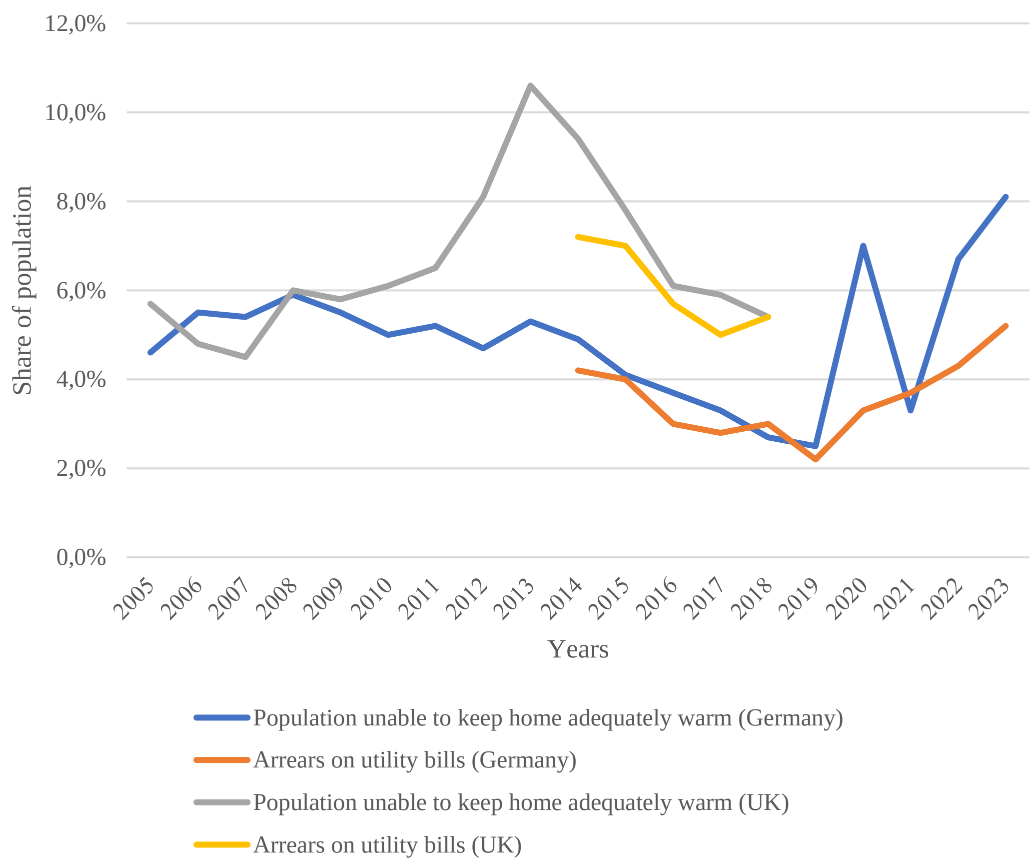

Figure 5: Population unable to keep home adequately warm indicator and the Arrears on utility bills indicator over time for Germany and the UK. Own figure based on data from Eurostat, 2024 and Eurostat, 2022.

In conclusion, Germany has shown steady improvement in energy poverty indicators until 2018, while the UK faced more significant challenges, particularly after 2008. Despite some recovery, the UK's indicators remain consistently higher than Germany's, indicating persistent disparities.

4.4. Objective of the Intervention

This chapter assessed whether the ECO4 and the aimed policy proposal target the same priority objective. As stated by Ofgem, the ECO3 scheme aimed to help low-income and vulnerable households reduce energy costs through energy efficiency improvements (Ofgem, 2023b, p. 2). Since ECO3, ECO4 has focused exclusively on the Home Heating Cost Reduction Obligation (HHCRO), placing greater emphasis on improving the least energy-efficient homes for vulnerable and energy-poor households (Bridgen & Robinson, 2023).

The policy proposal in this thesis aims to reduce energy poverty in Germany by incentivising energy efficiency improvements. To which extent the objective of reducing energy poverty with the proposed policy is achieved depends on how energy poverty is defined for the policy proposal and whether this definition aligns with the definition of eligible households in the ECO4 scheme. This thesis employs the definition of Boardman (1991) who considers a household energy-poor energy if it spends over 10% of income on basic energy needs. The ECO4s' eligibility criteria, however, are based on more general benchmarks, such as living in a dwelling with a low energy efficiency rating and receiving specific social benefits. Thus, it cannot be guaranteed that all households receiving measures are energy-poor as defined by Boardmann (1991) (Ofgem, 2023c, pp. 56–59). It was nevertheless acknowledged that identifying and implementing measures for households that are exclusively energy-poor by definition requires considerable financial and human resources, rendering it an unrealistic proposition. It may therefore be advisable for the German government to consider adopting a similar approach to that taken by the UK. Therefore, this thesis proposes that, despite the awareness of the discrepancy between theory and practice, the ECO4 and the proposed policy are designed to achieve the same objective: the reduction of energy poverty through energy efficiency improvements.

In conclusion, the analysis showed that while the ECO4 and the proposed policy in this thesis share the objective of reducing energy poverty, their approaches differ in defining and targeting eligible households. The ECO4 uses broader criteria, potentially encompassing households not strictly considered energy-poor under Boardman's definition. Despite this discrepancy, both policies aim to achieve similar outcomes by focusing on energy efficiency improvements to alleviate energy poverty.

4.5. Comparability of Energy-Poor Household Characteristics

This section analysed the comparability of the characteristics of energy-poor households between Germany and the UK. For this comparison, the Eurostat indicator *Share of disposable income spent on electricity, gas, and other fuels by income quintiles* (Eurostat, 2024a) was employed. An income quintile is a statistical classification of a population into five equal groups based on income levels, with each quintile representing 20% of the population (Eurostat, 2024b). Figure 6 presents this indicator for the year 2015.

The results demonstrate that in both, Germany and the UK, the proportion of income allocated to energy expenditure declines as household income rises. In both countries, the lowest income quintile (Q1) has the highest proportion of income spent on energy. However, German households consistently spend a larger proportion of their income on energy than UK households across all income quintiles.

A more detailed analysis of Q1, which represents the most vulnerable households, revealed that in Germany, these households spend 10.6% of their disposable income on energy, compared to 9.9% in the UK. The discrepancy between German and UK Q1 households is 0.7 percentage points. This pattern of elevated energy expenditure among German households is evident across all income quintiles, with the discrepancy between German and UK households remaining approximately 1 percentage point for other quintiles.

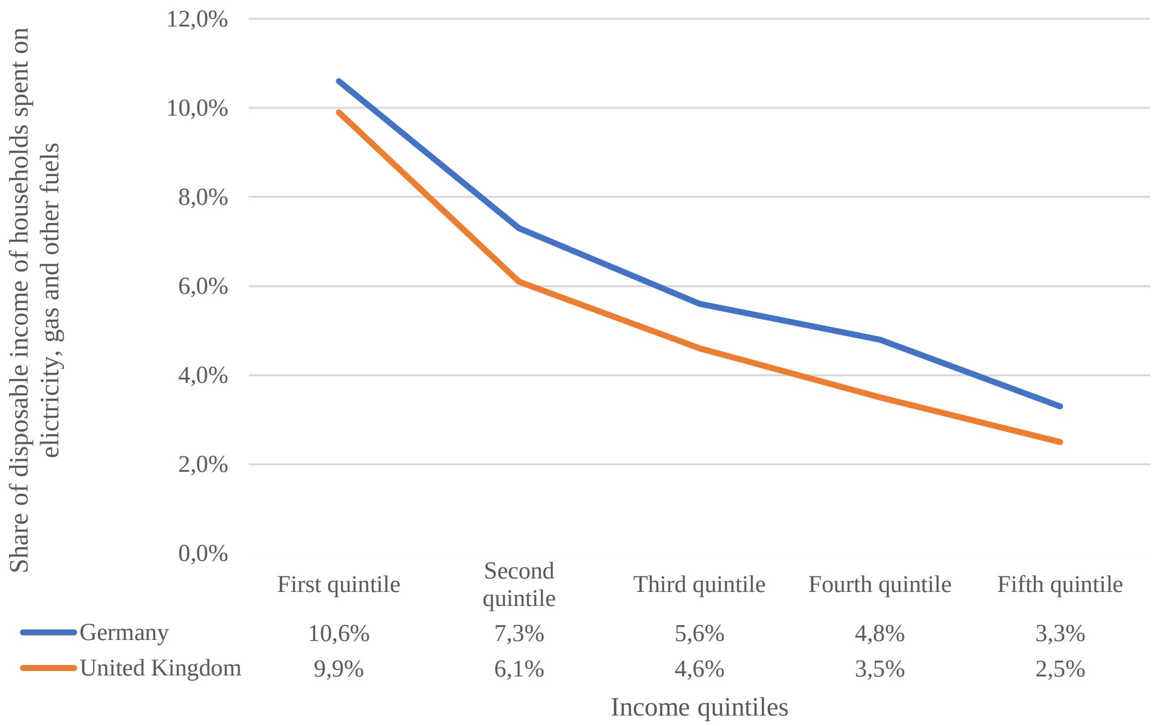

Figure 6: Share of disposable income of households spent on electricity, gas and other fuels by income quintiles for 2015. Own figure based on data from Eurostat, 2024.

In conclusion, both Germany and the UK demonstrate a comparable pattern of the indicator, whereby lower-income households allocate a greater proportion of their income to energy costs. However, German households consistently spend a higher percentage of their disposable income on energy in comparison to their UK counterparts, across all income quintiles. The discrepancy is most evident among the most vulnerable households (Q1), with German households allocating 0.7 percentage points more of their income to energy costs than their UK counterparts.

4.6. Comparability of Dwelling Stock Characteristics

This chapter analysed the question of whether the dwelling stocks of the UK and Germany are comparable. Three key indicators were employed to assess this question: Housing Tenure, Energy Source, and Construction Period.

Housing Tenure

As illustrated in Table 4, there are notable disparities in housing tenure between the UK and Germany. The UK exhibits a higher proportion of home ownership and social housing, whereas Germany has a substantially larger private rental sector.

Table 4: Share of housing tenure in the UK and Germany. Own figure based on data of Destatis, 2024 for Germany and Scottish Government, 2022; Office for National Statistics, 2023b for the UK.

Housing Tenure	UK	Germany
Owner Occupied	63%	42%
Private Rented	20%	55%
Social Housing	18%	3%

Heating Source

An examination of household heating sources reveals significant differences in the heating infrastructure of Great Britain and Germany, as illustrated in Table 5.

The majority of UK households rely on natural gas for heating, while Germany demonstrates a more diversified portfolio. Notably, Germany exhibits a higher usage of oil and renewables compared to the UK. This broader range of heating sources indicates a more varied heating infrastructure in Germany.

Table 5: Share of Energy Source used for heating for the UK and Germany. Own figure based on data of Eurostat, 2022b.

Heating Source[13]	**UK**	**Germany**
Natural Gas	67.7%	34.3%
Oil	12.8%	31.4%
Renewables	11.6%	24.6%
District Heating	0.7%	5.7%
Electricity	5.6%	3.2%
Solids	1.4%	0.8%

Construction Period

The assessment of construction dates for existing building stock in the UK and Germany reveals notable trends across different periods, as shown in Table 6.

A substantial proportion of the housing stock in both countries was constructed prior to the Second World War (WWII), with the UK having a notably higher share. Notably, these buildings typically exhibit the lowest energy efficiency. The period between 1948 and 1978 represents the largest share of existing building stock in Germany and the second largest in the UK. Despite the lack of emphasis on energy efficiency, this period saw improvements in construction practices. The post-1978 era, triggered by the oil crisis (Wang & Nie, 2018, p. 498), marked a turning point in energy-saving awareness with the introduction of the building energy code in in 1976 (Deutscher Bundestag, 2023a). Germany has a higher proportion of buildings from this period compared to the UK. Buildings constructed after 1990, which are likely to be the most energy-efficient due to modern standards, represent a similar proportion in both countries, with Germany slightly ahead.

[13] See appendix B.6.2. for a detailed list of the energy sources that fall under these categories.

Table 6: Share of buildings constructed in different construction periods for the UK and Germany. Own figure based on data of Destatis, 2024 for Germany and Scottish Government, 2024; Office for National Statistics, 2023a; Welsh Government, 2019 für the UK.

Construction Period	UK	Germany
Pre-1948 (Pre-WWII)	38.1%	21.6%
1948-1978	31.1 %	41.0%
1979 – 1990 (Post Oil Crisis & Introduction of building energy code)	9.5%	14.1%
Post 1990	21.2%	23.3%

Interim Conclusion

In conclusion, the analysis revealed that, while there are some similarities, there are also significant disparities between the two countries in terms of their dwelling stock characteristics. The contrasting tenure types illustrate a clear divergence in the characteristics of the dwelling stock. Germany has a significantly higher proportion of rental properties, while the UK has a greater proportion of owner-occupied homes. Furthermore, there are notable differences in heating usage patterns. Germany has a more diverse heating infrastructure, with a higher adoption of oil and renewable sources compared to the UK's predominant reliance on gas. Furthermore, an analysis of the construction period of the dwelling stock indicates that Germany has constructed more between the end of WWII and 1978. Furthermore, the UK constructed numerous dwellings between the end of the WWII and 1978. However, also a significant number was built prior to WWII.

4.7. Comparability of Obligated Party Characteristics

This section assessed the compatibility of obligated party characteristics between the UK and Germany, focusing on the number of electricity and gas suppliers due to the limited availability of comparable data. The results are presented in Table 7.

The analysis reveals a stark contrast between the energy markets of the UK and Germany. While the UK's market is highly concentrated with only a handful of suppliers (Ofgem, 2024a), Germany's landscape is significantly more fragmented and competitive (Bundesnetzagentur & Bundeskartellamt, 2023, pp. 163–257). The difference is striking, with Germany having approximately 65 times more energy suppliers than the UK.

In conclusion, the characteristics of energy suppliers in Germany are markedly different from those in the UK. Germany has approximately 65 times as many energy suppliers as the UK.

Table 7: Number of Electricity and Gas Suppliers in Germany and the UK. Own table based on Bundesnetzagentur & Bundeskartellamt, 2023, pp. 163–257 Ofgem, 2024a for the UK.

Indicator	UK	Germany
Total Energy Suppliers	21	-[14]
Energy Suppliers (or both electricity /gas)	20	1400
Gas Suppliers (or both gas/electricity)	19	1100

4.8. Impact on Other Affected Interest Groups/Stakeholders: Winners and Losers

This chapter assessed if the policy contradicts the interests of any key stakeholders/interest groups. Instead of assessing the contradiction of German stakeholders towards a directly transferred ECO4, the opposition towards the implementation of a general EEOS was assessed. Justifications for this approach can be found in Appendix B.8.

The analysis identified four stakeholders who have published position papers or made public statements regarding the EEOS and its application to Germany between 2016 and 2023. These stakeholders can be categorised into two environmental organisations and two industry associations. The stances taken by these stakeholders illustrate a clear divergence of opinion between EEOS proponents and EEOS opponents of the EEOS. The results are listed accordingly.

EEOS Supporters

Environmental organizations were at the forefront of advocating for an EEOS implementation in Germany. The German Federation for the Environment and Nature Conservation (dt. Bundesverband Umwelt und Naturschutz (BUND)) and Environmental Action Germany (dt. Deutsche Umwelt Hilfe(DUH)) were particularly vocal in their support.

In 2016, the BUND and the DUH lodged a complaint with the European Commission against Germany. Their primary criticism centred on what they perceived as inadequate implementation of the EED. They argued that unlike other EU countries that had already implemented an EEOS, Germany’s alternative measures were excessively vague and failed to adequately address energy efficiency (Bund für Naturschutz und Umwelt in Deutschland [BUND], 2024).

The DUH was critical towards Germany’s existing energy efficiency policies. They contended that the National Action Plan on Energy Efficiency (NAPE) and the Energy Savings Ordinance fall short of harnessing Germany’s full energy efficiency potential. During the 2016 public consultation on the Green Paper on Energy Efficiency, the DUH strongly advocated for the reconsideration of an EEOS in

[14] No data available.

Germany. For that, they cited multiple studies, which demonstrate the policy's effectiveness in fulfilling the requirements of Article 7 of the EED (Deutsche Umwelthilfe [DUH], 2016, p. 3).

EEOS Opponents

Opposition to the EEOS came primarily from industry associations representing energy suppliers and utilities. The German Association of Local Utilities (dt. Verband kommunaler Unternehmen (VKU)) expressed strong opposition against the EEOS, arguing it being impractical. Instead, they advocated for achieving energy efficiency goals through further developing the existing NAPE (Verband kommunaler Unternehmen e.V [VKU], 2024).

The German Association of Energy and Water Industries (dt. Bundesverband der Energie- und Wasserwirtschaft (BDEW)) was even more critical towards the EEOS. In their response to the EU Parliament and Council's 2021 proposal to recast the EED, the BDEW not only criticized the introduction of an EEOS but called for its complete removal. They argued that the EEOS leads to minimal energy savings while creating excessive bureaucracy, questioning its overall efficiency. In terms of cost distribution, they postulated that the system unfairly shifts the financial burden of supporting efficiency measures from member states to obligated entities and ultimately to consumers. The BDEW also expressed concern about the social impact, suggesting that the EEOS could counteract efforts to protect vulnerable consumers by disproportionately distributing costs among the population (Bundesverband der Energie- und Wasserwirtschaft e.V [BDEW], 2021, pp. 9–10).

The BDEW's opposition extends to specific aspects of the proposed EEOS implementation. They particularly objected to the EU Parliament and Council's suggestion to primarily implement energy efficiency measures for groups affected by energy poverty. BDEW argued that such groups, due to their low income, typically consume less energy and thus have limited efficiency potential. They asserted that addressing energy poverty should fall under the purview of European and national social policies, not energy efficiency policies (BDEW, 2021, p. 5).

<u>Interim Conclusion</u>

In conclusion, the analysis revealed a clear divergence of opinion among stakeholders regarding the implementation of an EEOS in Germany. Environmental organisations supported the policy, citing its effectiveness in meeting EU energy efficiency requirements. Industry associations, particularly those representing utilities, opposed it, pointing to increased bureaucracy and unfair cost distribution.

4.9. Interaction with Existing Policies

This chapter examined the potential interactions between existing German policies and an ECO4 directly transferred to Germany. The analysis aimed to identify potential synergies, conflicts, and redundancies in the policy landscape to highlight necessary adaptations of the policy to the German context.

Six policies were identified that may interact with the ECO4. Each policy was assessed based on its potential interaction, which is categorized as follows: *conflicting*, *cancelling out*, *overlapping* and *synergizing*. *Conflicting* means that two policies have opposing or incompatible requirements or outcomes. *Cancelling out* is used when the impact of the EEOS negates the benefits of an existing policy. *Overlapping* refers to the circumstance that the EEOS and an existing policy aims for similar goals with similar measures, which could cause redundancy. If two policies complement each other, it is indicated as *synergy*. Table 8 provides an overview of the assessed policies and their potential interaction with the ECO4.

Table 8: Interaction of an ECO4 directly transferred to Germany with existing German policies. Own table.

Interaction	GEG	BEHG	CO2KostAufG	BEG	Stromspar-Check	EEG
Conflicting	X					
Cancelling Out						
Overlapping	X		X	X		X
Synergizing		X			X	

Subsequently, the reader is initially familiarized with each assessed policy. Then, the potential interaction with the ECO4 directly transferred to Germany is presented.

<u>The Building Energy Act (Gebäudeenergiengesetz (GEG))</u>

The Building Energy Act (dt. Gebäudeenergiengesetz (GEG)) came into force on 1 November 2020, consolidating and replacing several previous energy-related regulations regarding buildings. It has since been amended on 1 January 2023 and 1 January 2024. The GEG specifies minimum energy requirements for new and existing buildings, focusing on heating and other building services, the use of renewable energy, thermal insulation levels, and energy performance certificates (GEG, 2020/16.10.2023). Subsequently, the GEG (GEG, 2020/16.10.2023) was compared to the current ECO4 (Ofgem, 2023c) to assess possible interactions.

Overlapping

The GEG requires insulation upgrades for existing buildings, mandating a minimum thermal insulation standard (Clause §47) and setting heat transfer limits for renovations and first-time installations (Clauses §48, §50) (GEG, 2020/16.10.2023). Compliance with these requirements must be ensured by technical insulation measures such as cavity wall insulation and external/internal/hybrid wall insulation triggered by the ECO4 (Ofgem, 2023c, pp. 94–95).

Conflicting

Both policies especially conflict regarding the type of heating systems allowed. The GEG restricts the operation of older boilers using liquid or gaseous fuels (Clause §72). It also sets deadlines for transitioning to climate-friendly energy in existing and new buildings outside development areas. Moreover, the GEG prohibits the installation of fossil fuel boilers after 2028 (Clause §71) (GEG, 2020/16.10.2023). In contrast, the UK's ECO4 scheme, allows the replacement of old boilers with ones operating on fossil fuels (Ofgem, 2023c, p. 123). This requirement creates a conflict between both policies.

The Fuel Emission Trading Act (Brennstoffemissionshandelgesetz (BEHG))

The Fuel Emissions Trading Act (dt. Brennstoffemissionshandelgesetz (BEHG)) is the carbon pricing scheme mainly for buildings and transport. It requires fuel suppliers and distributors, including those of natural gas, oil and petrol, to purchase emissions certificates from 2021 onwards. The number of certificates needed is calculated based on the fuel-specific CO_2-emissions and the quantity of fuel supplied. The costs incurred by suppliers are then passed on to consumers, including households, as part of the overall energy pricing structure (BEHG, 2019/22.12.2023). Thereafter, a comparison was made between the BEHG (BEHG, 2019/22.12.2023) and the current ECO4 (Ofgem, 2023c) to evaluate potential interactions.

Synergizing

The pricing of CO_2-emissions is a significant factor influencing the rise in energy costs. The installation of new thermal insulation or heat pumps by the ECO4 will result in a reduction in heat consumption by the household. This indicates that energy efficiency improvements via an ECO4 are becoming even more efficient in the future. Especially as the BEHG will be replaced by the EU ETS2[15] (European Commission, 2024a), which is expected to introduce even higher CO_2 prices (Kurmayer, 2023), the risk of energy poverty may increase. An EEOS like the ECO4 may be an effective, targeted tool to counteract this.

The Carbon Dioxide Cost Allocation Act (Kohlendioxidkostenaufteilungsgesetz (CO2KostAufG))

The Carbon Dioxide Cost Allocation Act (dt. Kohlendioxidkostenaufteilungsgesetz (CO2KostAufG)), which came into force in 2023, aims to achieve a fair distribution of CO_2-costs between landlords and tenants. The apportionment of costs is determined by the energy efficiency rating of the building. The

[15] EU ETS2 is an independent emission trading system that will address CO2 emissions from fuel combustion in buildings, road transport, and additional sectors, primarily small industries previously not included in the existing EU ETS (European Commission (2024b).

more energy-efficient a building is, the lower the landlord’s contribution to CO_2-costs, while tenants are required to pay a higher share. The key objectives and mechanisms of this policy include providing incentives for landlords to invest in energy efficiency measures, establishing a fair distribution of CO_2-costs based on building energy efficiency, and encouraging energy-efficient behaviour among tenants (CO2KostAufG, 2022). Following this, possible interactions were assessed by comparing the CO2KostAufG (CO2KostAufG, 2022) with the ECO4 (Ofgem, 2023c).

Overlapping

When installing energy efficiency improvements through the ECO4, it is important to consider the distribution effect on the household’s CO_2 emissions. The extent to which the contractor bears the cost of the energy efficiency improvements determines whether the landlord is liable for the resulting increase in efficiency to some or no extent. As the dwellings’ energy efficiency improves through the ECO4 measures, the landlord’s share of CO_2-costs would decrease under CO2KostAufG. This may result in a situation where landlords benefit from efficiency improvements without having made the investment themselves. As both policies aim to incentivises energy efficiency improvements, the interaction was classified as overlapping. This overlap as well as the cost distribution needs to be tackled when transferring and adapting an ECO4 to Germany.

The Federal Funding for Efficient Buildings (Bundesförderung für effiziente Gebäude (BEG))

The Federal Funding for Efficient Buildings (dt. Bundesförderung für effiziente Gebäude, BEG) was introduced in 2021 as a consolidation of previous funding programmes aimed at promoting energy efficiency and renewable energies in the building sector. This comprehensive programme offers financial support for a wide range of measures, including the installation of new heating systems, the optimization of existing heating systems, improvements to building envelopes, and the implementation of optimized system technology (BEG EM, 2023). Next, the ECO4 (Ofgem, 2023c) was compared with the BEG (BEG EM, 2023) to investigate potential interactions.

Overlapping

There is a degree of overlap between the ECO4 and the BEG, in that a number of technologies are supported by both programmes. For example, the ECO4 and the BEG are both providing subsidies for new heating systems (Ofgem, 2023c, pp. 94–95;(BEG EM, 2023). However, the extent of the overlap also depends on whether both instruments can be utilised simultaneously. If this is permitted, there is a risk of double counting of the energy savings. This overlap needs to be considered when adapting the ECO4 to Germany.

The Electricity Saving Check (Stromspar-Check)

Since 2008, the German Caritas Association and the Federal Association of Energy and Climate Protection Agencies in Germany (Stromspar-Check, 2024e) have been offering low-income households free energy-saving advice as part of a government-funded programme. The advice is provided in a variety of formats, including online, by telephone, at one of the 150 locations, or in people's own homes by long-term unemployed individuals who have been trained as energy experts (Stromspar-Check, 2024a). Furthermore, the Electricity Saving Check (dt. Stromspar-Check) provides complimentary immediate assistance, including small-scale energy efficiency measures (Stromspar-Check, 2024b), as well as a grant of at least 100 euros to replace a fridge or freezer (Stromspar-Check, 2024d).

Synergyzing

While both instruments share the overarching goal of addressing energy expenses for low-income households through energy efficiency measures, they differ significantly in their scope and implementation. The Electricity Saving Check primarily focuses on minor, easily implementable energy efficiency measures and behavioural changes. These include the installation of LED lighting, water-saving devices, and the replacement of small appliances (Stromspar-Check, 2024c). In contrast, the ECO4 mostly targets larger-scale energy efficiency improvements (Ofgem, 2023c, pp. 94–95). The two programmes differ in terms of scale and nature, and thus do not directly overlap in the specific measures they support. However, both programmes may synergize. In fact, the complementary aspects of these programmes could enhance their overall effectiveness in addressing energy poverty and expanding the reach of the EEOS beyond vulnerable households. The close engagement of energy advisers with vulnerable households through the Electricity Saving Check could be particularly advantageous when identifying eligible households under the ECO4.

The German Renewable Energy Act (Erneuerbare-Energien-Gesetz (EEG))

The German Renewable Energy Act (dt. Erneuerbare-Energien-Gesetz (EEG)) establishes a regulatory framework designed to promote the generation and integration of renewable energy into the national electricity grid. A key feature of this legislation is its provision for preferential feed-in of electricity from renewable sources, coupled with guaranteed fixed feed-in tariffs for producers. This system creates a supportive environment for renewable energy adoption, exemplified by the case of household solar panel installations (EEG 2023, 2014/08.06.2024). Subsequently, potential interactions were examined by comparing the EEG (EEG 2023, 2014/08.06.2024) to the ECO4 (Ofgem, 2023c).

Overlapping

The installation of photovoltaic (PV) panels is currently included as an eligible measure under the ECO4 (Ofgem, 2023c, p. 94). Therefore, as the EEG and the ECO4 both support the installation of PV panels, this could potentially result in a situation of double funding. This overlap needs to be considered when adapting the ECO4 to Germany.

Interim Conclusion

In conclusion, a direct transfer of ECO4 to Germany would result in different types of interactions with existing policies. In some areas, the ECO4 and existing policies overlap, such as with the GEG and BEG, where both set standards for building insulation and heating systems. Additionally, the ECO4 and the CO2KostAufG might overlap, highlighting a need for consideration. Regarding PV an overlap with the EEG might occur. Furthermore, there are conflicts, particularly between the ECO4 and the GEG, regarding the types of heating system installations that are allowed. The GEG's stringent requirements for renewable energy in new heating systems directly conflict with the promotion of efficient fossil boilers in ECO4. On the other hand, there is a synergy between the ECO4 and the Energy Saving Check as well as the BEHG.

4.10. Available Human Resources

This section assessed the availability of human resources for carrying out an ECO4-like EEOS in Germany. During the most recent completed ECO period (ECO3), which ran from 1 October 2018 to 31 March 2022, a total of 1.03 million measures were implemented. These included 417,539 insulation installations and 251,741 boiler replacements (Ofgem, 2023a, p. 4). Based on an even distribution across the four six-month phases, approximately 257,500 measures were installed in each period.

It should be noted that the situation in Germany may differ once an ECO4 would be directly transferred to German. This could occur due to external factors such as a different obligation target or a lower impact due to the COVID-19-pandemic during the phase of ECO3. Nevertheless, this data provided an estimation of the quantity of skilled workforces that would be required for the implementation of measures under an ECO4 directly transferred to Germany. Whether there are enough skilled workforces in Germany capable of implementing these measures was subsequently assessed.

A review of grey literature revealed that numerous institutions have analysed the availability of skilled workers in Germany. A 2018 report by the Institut für Arbeitsmarkt und Berufsforschung (IAB) highlighted a significant shortage of skilled workers, with 2.7 million positions sought and 1.65 million unfilled. The vacancy rate, which measures the number of unfilled vacancies as a percentage of the total number of vacancies, is an indicator of the shortage of skilled workers. In 2018, the vacancy rates were 38% in Western Germany and 41% in Eastern Germany (Dettmann et al., 2019, p. 22).

A 2021 study by the Institut der Deutschen Wirtschaft (IW) identified 408 out of 1,300 occupational categories as bottleneck occupations, where demand for labour exceeds supply. The study forecasted that by 2026, the demand will exceed supply in 557 occupational categories, indicating that the shortage of skilled workers will extend to other occupational groups (Burstedde, 2023, p. 59). Furthermore, the IW identified the top 30 occupational categories most affected by labour shortages. Sanitary, Heating, and Air-Conditioning Technology ranked eighth, (Burstedde, 2023, p. 60), a field crucial for the installation and maintenance of heating systems (Bundesagentur für Arbeit, 2021, p. 567). Additionally, the role of roofer, which is vital for insulating rooftops (Bundesagentur für Arbeit, 2021, p. 498), ranked 28th among jobs with the most significant skilled worker shortages (Burstedde, 2023, p. 60). Similarly, a study on the skilled labour shortages in companies highlighted a significant deficit in the Sanitary, Heating, and Air-Conditioning Technology sector, with 14,434 open positions in 2020. This underscores the acute shortage of skilled workers in this area (Schirner et al., 2021, p. 20).

In summary, Germany is facing a shortage of skilled workers, affecting both East and West Germany equally. Currently, almost one-third of all occupational categories are experiencing a shortage of skilled workers, with this trend expected to worsen by 2026. Occupational categories such as Sanitary, Heating, and Air-Conditioning Technology, and roofing, which are essential for implementing the planned energy efficiency measures, are among the most affected by this shortage.

4.11. Interim Conclusion and Discussion

This chapter provides a summary of the key findings to facilitate comprehension. It also addresses the question of whether the ECO4 is transferable and applicable in the German context. Furthermore, it discusses the findings of this chapter, including their integration within the existing literature and the potential limitations of the analysis.

4.11.1. Transferability

The assessment of transferability focused on determining whether the primary mechanisms of the ECO4 could achieve similar outcomes in Germany. This analysis revealed both opportunities and challenges in adapting the UK's policy to the German context.

In terms of policy context, the findings indicate that, while Germany has a number of measures in place to address energy poverty, there is a lack of direct and comprehensive policies specifically targeting the low energy efficiency of residential buildings. Strünck (2017, p. 17) highlights that, in contrast to many other European countries, Germany's approach to improving the energy efficiency of buildings is primarily embedded within climate and environmental policy. There is currently no connection to social policy objectives such as energy poverty. This lack of alignment underscores the necessity for a national policy that addresses energy inefficiency as a primary driver of energy poverty. Nonetheless, Strünck (2017, p. 17) noted that numerous local initiatives are striving to tackle this issue. One such example is the collaboration between municipal utilities, consumer centres and welfare associations. This thesis primarily focuses on national-level policies, recognising that an analysis of local initiatives, while valuable, is beyond the scope of this study. The decision to concentrate on federal strategies is driven by the need for a unified, country-wide approach to effectively combat energy poverty while ensuring equitable outcomes for all citizens, regardless of their geographic location.

The analysis of the prevalence of energy poverty in both countries provided further insights into the potential transferability of ECO4 to Germany. While evidence indicates that energy poverty is more prevalent in the UK, recent global events, such as the pandemic and the energy price crisis, have also significantly impacted German households. This indicates that the introduction of an ECO4-like EEOS may be a necessary step in addressing energy poverty in Germany. To assess energy poverty in both countries, two consensual-based indicators were used. Drescher and Janzen (2021, p. 13) advised that a comprehensive evaluation of energy poverty should incorporate both consensual-based and expenditure-based indicators, as neither alone fully captures the multifaceted nature of the issue. While expenditure-based indicators were considered, they were ultimately excluded as they need to be interpreted in the context of national circumstances. This is due to the fact that energy consumption patterns and costs vary significantly from country to country. This is a result of differences in housing efficiency, social policies and energy pricing. This means that a low expenditure does not necessarily indicate energy poverty. Including such an in-depth analysis was seen as too time intensive for this analysis, which is why expenditure-based indicator were excluded. Moreover, when comparing the prevalence of energy poverty, only Eurostat data until 2018 was available due to Brexit. However, as evidenced by the calculation of the prevalence of energy poverty exclusively for Germany, the energy poverty rate notably increased during the COVIID-19 pandemic and the energy crisis. It is therefore unclear how the two crises may have influenced the prevalence of energy poverty in the UK and to what extent it is comparable between the two countries during this period.

In both countries, households in the lowest income quintile allocate a disproportionately high share of their income to energy costs, indicating a common challenge that could benefit from a similar policy approach. Heindl and Schuessler (2019, p. 18) corroborate this finding for Germany, observing that energy-related deprivation is particularly common among low-income households, especially those in the lowest income decile. However, the nuances of energy poverty in Germany, as explored by Drescher and Janzen (2021), highlight the need for policy adaptation. They identify household composition, educational attainment, employment status, housing characteristics, and the primary energy source as key factors associated with energy poverty in Germany. Notably, one-person households and non-working individuals are at particularly high risk. These findings underscore the importance of tailoring any transferred policy to address Germany's specific demographic and socioeconomic factors. While this study addresses housing characteristics and energy source use, it does not cover all factors highlighted by Drescher and Janzen (2021) due to the unavailability of suitable micro-level data for comparing these characteristics between the UK and Germany. The lack of available data represents a challenge to the transferability of policy, as it limits the ability to make a complete comparison of the characteristics of energy-poor households. To address this limitation and provide a basis for comparison, an existing EUROSTAT indicator was selected, which was available for both countries.

Dwelling characteristics represent another crucial aspect of transferability. Germany's housing stock differs significantly from that of the UK. Germany has a higher proportion of privately rented properties and a greater diversity of heating sources. As Cludius et al. (2018, p. 53) highlighted that these differences require careful consideration when adapting policies like the ECO4. The generally higher energy efficiency of German buildings compared to the UK may result in different renovation requirements and strategies (Cludius et al., 2018, p. 53). Moreover, the prevalence of rental properties in Germany is starkly contrasted with the UK's predominantly owner-occupied housing market. This discrepancy may necessitate distinct strategies for identifying and targeting these households.

In line with these findings on energy-poor households and dwelling characteristics, a comparative study found that British and German households exhibit varying sensitivities to changes in energy use, income, heating prices, and heating needs—all factors linked to energy poverty. This led the authors to conclude that a "one-size-fits-all" approach is unsuitable for addressing energy poverty, as effective policy solutions must consider political, geographical, economic, and social factors unique to each country (Bissiri et al., 2019, p. 566).

The structure of the energy market also plays a crucial role in policy transferability. Germany's energy market is characterized by a greater degree of fragmentation and competition compared to the more concentrated market in the UK. While the higher number of energy suppliers in Germany does not preclude the transferability of the ECO4, it may have a significant impact on market dynamics and equity considerations if the policy is not adapted to these unique conditions. Therefore, designing the EEOS policy proposal requires careful consideration of how to distribute obligations among a larger number of smaller suppliers and ensure fair competition in the implementation of energy efficiency improvements.

Despite these challenges, the potential for implementing an ECO4-like EEOS to the German context remains viable. The long-standing history and adaptability of the ECO in the UK demonstrate its potential for successful adaptation to different national contexts. Moreover, as evidenced by other European countries, an EEOS can be tailored to fit specific national circumstances (RAP, 2012). Therefore, an ECO4-like EEOS could be effectively implemented in Germany, provided it is customized to fit into and address the country's unique context.

4.11.2. Applicability

The applicability analysis of the ECO4 scheme to the German context revealed difficulties in relation to existing policies, stakeholder opinions and available human resources. This examination is crucial for understanding how the policy might function within Germany's unique socio-economic and political context, and where adaptations might be necessary for successful implementation in Germany.

Stakeholder perspectives play a pivotal role in determining the applicability of the ECO4 scheme in Germany. Previously, environmental organisations have expressed support for the introduction of an EEOS in Germany, citing its potential to deliver substantial improvements in energy efficiency and contribute to a reduction in carbon emissions. This support provides a valuable foundation for policy implementation, as these organizations can help push public awareness and political will for the implementation of an EEOS.

However, the stance of key industry stakeholders presents a significant challenge to the scheme's applicability. Major industrial groups, such as BDEW and VKU, which represent a substantial portion of the German energy market, have shown resistance to the introduction of an EEOS. Their influence on shaping energy policies in Germany cannot be underestimated. As Schlomann et al. (2021) noted, at the time of the EU EED's introduction in 2012, the BDEW and several large energy supply companies expressed considerable scepticism about implementing an EEOS in Germany. This resistance underscores the need for a carefully policy creation that addresses the concerns of these influential stakeholders. Despite this resistance, there may be potential for finding common ground. Schlomann et al. (2021) identified potential synergies with existing business models, which could align with EEOS objectives. Engaging these stakeholders in the policy design process and highlighting potential business opportunities within the scheme could be crucial for improving its applicability.

Moreover, Schlomann et al. (2021, p. 41) reported that the debate surrounding the introduction of an EEOS in Germany has been ongoing for nearly two decades, with the most intense discussions occurring between 2006 and 2014. Notably, the stakeholder positions analysed were primarily based on statements and publications from 2016 to 2023, as earlier positions were not readily accessible.

Recognizing stakeholders' concerns, especially on an ECO4-like EEOS focused on the reducing of energy poverty, would have been valuable for this thesis to proactively adapt the scheme by incorporating provisions that minimize negative impacts. Due to time constraints, the interview with German stakeholders was omitted. Thus, the analysis of existing literature and policy documents was prioritized over conducting primary research.

It is also crucial to consider how the ECO4 would interact with existing German policies, to assess its applicability. A direct implementation of the ECO4 in Germany possibly result in conflicts or overlapping with existing policies, such as the GEG, EEG or BEG. It is therefore vital to consider these interactions carefully when adapting the ECO4 to the German context. While this analysis did not undertake a comprehensive investigation of the nature and extent of these interactions, it is evident that a more detailed study would be required to fully understand and mitigate potential policy conflicts. Furthermore, there are potential areas for synergy with existing policies. For example, the Energy Savings Check has the potential to complement an EEOS. There may be potential for synergies in a variety of areas, including information dissemination, comprehensive energy assessments, phased interventions, data sharing and targeting, and combined impact assessment.

Human resource considerations present another significant challenge to the ECO4's applicability in Germany. A key issue is the shortage of skilled labour necessary to implement the energy efficiency measures required under an EEOS. This shortage could result in delays, increased costs, or even failure to meet targets, when installing energy efficiency improvements. The extent of this impact would depend largely on the specific targets set by the German government and the available workforce capacity. Unlike the UK's ECO, which has been in place for several years and allowed energy suppliers to establish strong partnerships with service providers, Germany lacks these established structures. His lack of infrastructure could have a significant impact on the initial rollout and execution of the ECO4. If Germany sets more ambitious targets or provides less financial support than the UK, the strain on the already constrained workforce could be significant. In addition, while the analysis has focused primarily on private sector resources, the availability of resources in the public sector is equally important. It is crucial to ensure adequate staffing within government agencies and local authorities to guarantee effective programme administration, regulatory compliance and monitoring. Any shortcomings in these areas could further complicate the successful adoption and execution of the ECO4-like EEOS in Germany.

4.11.3. Overall Research Approach

This study's approach to examining the transferability and applicability of the ECO4 from the UK to Germany was based on the framework set out by Williams and Dzhekova (2014). The framework was instrumental in structuring the analysis of transferability and applicability. This approach enabled a detailed examination of how the ECO4's mechanisms could operate within the specific socio-economic and political context of Germany. It should be noted, however, that while this framework provided a robust foundation for analysis, alternative approaches to studying policy transferability could offer further insights. For instance, Warren's (2017) work on the transferability of demand-side management and broader energy policies identifies key contextual factors that influence successful policy implementation. While this study aligns with several of Warren's contextual factors, such as market structure and regulatory framework, it did not explicitly consider climate factors. This is particularly relevant when comparing countries on different continents, where heating and cooling needs can significantly differ. However, for this thesis, which focuses on the UK and Germany, climate considerations are less critical. Both countries have similar climatic conditions due to their geographic proximity in Europe.

One further drawback of this analysis is its primary reliance on secondary data sources. This methodological choice was largely driven by the resource and time constraints associated with collecting primary data, such as through interviews or surveys across two different national contexts. While the use of secondary data enabled a comprehensive comparative analysis, it may have constrained the depth and timeliness of insights.

In conclusion, the transferability and applicability analyses underlined the considerable challenges that need to be addressed when directly transferring an ECO4 to Germany. Therefore, tailoring the policy to the specific German context is crucial. The next phase of this study focused on evaluating ECO4's policy performance through expert interviews. These interviews provided a deeper insight into the successes and limitations of the policy in the UK, which served as a further basis for modifying the scheme to ensure successful implementation in Germany. This, together with the transferability and applicability analysis, formed the basis of the subsequent policy proposal.

5. Performance Evaluation of the 4th Energy Company Obligation (ECO4)

The results of the expert interviews were categorized into three dimensions with eight overarching categories that assess the policy performance of the ECO4. Table 9 provides an overview of the dimensions and categories identified in the qualitative content analysis.

Table 9: Dimensions, Themes and Fist-Order Codes identified according to Gioia (2013) in the expert interviews. Own table.

Dimensions	Themes (Second-Order Codes)	First-Order Codes
Obligation Design	General Obligation Design	Supply chain
		Opinions of energy suppliers
		ECO4 part of bigger solution
	Financing	Financing through consumers' bills
		Opposition to consumers' contributions
		Cost for suppliers
		ECO4 independent of public funding
	Monitoring, Compliance and Development	Administration and regulation responsibilities
		Optimization of obligation
		Monitoring the quality of conductors
		Monitoring the quality of installations
Eligibility and Accounting of Measures	Local Authority Flex Eligibility	LA Flex quite bureaucratic
		Lack of capacity for ECO
		Recommendations on LA Flex design
		Challenges in Local Authority interaction
		Skill-building for Local Authorities
		Recommendations for building a consortium of Local Authorities
		Support for LA Flex
	Eligible Measures	Attitudes toward the range of permitted measures
		Innovative measures
		Broader design of the instrument
		Deep retrofit approach
		Recommendations on retrofitting approach
		Recommendations for expanding technical measures
		Recommendations for continuous adjustment
	Identifying Eligible Households	Failures in benefiting all energy-poor households
		Suitability for the private rented sector
		Attitudes on eligibility criteria
		High sourcing costs
		Responsible stakeholders for sourcing
		Data for sourcing
		Attitudes of households
		Recommendations for targeting
		Recommendations for sourcing
	Effectiveness in Reducing Energy Poverty	Effectiveness in reducing energy poverty

Effectiveness and Applicability to Germany		Dependent variables for effectiveness Energy efficiency is not a total solution Alternative approaches
	Applicability to Germany	Applicability of the general design Applicability to dwelling stock Interaction with the German policy landscape Accelerating the upscaling of technologies

5.1. Obligation Design

This chapter summarizes the main output of the expert interviews on the obligation design. The section is structured according to the three themes: General Obligation Design, Financing, and Monitoring, Compliance and Development.

5.1.1. General Obligation Design

The expert interviews highlighted several key limitations and challenges of the ECO4, as well as recommendations on tackling these issues and improving the general design. One of the key challenges identified was the inefficiency of the supply chains, which refers to the series of steps and entities engaged in delivering energy efficiency improvements, such as home retrofitting, from energy suppliers to consumers. This supply chain was seen as overly complex with too many intermediaries. Walters (2024) noted that the supply chain is leveraging energy suppliers being under pressure to fulfil their obligations by increasing their margins at the expense of the overall cost-effectiveness. To address this, he suggested reducing the number of intermediaries and allowing the supply chain to access funding directly. This could foster greater market competition and ensure that a higher proportion of funding is directed towards installing energy efficiency measures in dwellings, rather than being diverted through multiple levels of the supply chain.

Beyond supply chain inefficiencies, the experts also discussed the inherent tensions between energy suppliers' primary obligations under the scheme and their ability to effectively serve energy-poor households. While energy suppliers are frequently expected to prioritize the needs of energy-poor consumers and achieve ambitious outcomes, one expert content that their primary obligation is to fulfil their obligations in a cost-effective manner (Copeland, 2024). Walters (2024) provided support for this position, arguing that the supplier-led scheme, referring to suppliers being primarily responsible for delivering the obligation, is not the most efficient for consumers. He contended that the ECO4 is highly challenging for energy suppliers, and that retrofitting is not within the scope of their core business activities, which contributes to inefficiencies. However, Rosenow (2024) suggested that energy suppliers' historical resistance to such schemes may have been more strategic than genuine. According to Walters (2024), a well-designed policy could better direct and incentivize them towards the desired results.

Looking beyond just the ECO4 scheme itself, the experts emphasized the importance of integrating it with broader, publicly funded energy efficiency programs (Copeland, 2024; Baker, 2024). As Baker (2024) stated: “My preference would be for [the ECO4] as a junior partner within a bigger programme, where the bigger partner is the publicly funded scheme”. This, he argued, could help achieve higher retrofitting rates and deeper energy efficiency upgrades in homes. At the same time, Baker (2024) raised concerns about the complexity of managing multiple overlapping schemes and suggested simplifying the coordination and rules between these various programs.
The need to understand both the strengths and limitations of the scheme was stressed out (Copeland, 2024). For instance, the ECO4 was seen as particularly ill-equipped to effectively target the households with the lowest incomes, often living in smaller homes. Rather than simply increasing funding for the ECO4, implementing additional complementary measures to better address this issue was proposed (Copeland, 2024; Baker, 2024).

5.1.2. Financing

The chapter delves into the evolving perspectives of experts and different stakeholders on the financing mechanisms of the ECO4. Rosenow (2024) reported that initially, the ECO’s funding through consumer energy bills was met with significant criticism from lobbying groups. They argued that the scheme should be publicly financed to avoid burdening households with higher energy costs (Rosenow, 2024). However, as alternative funding mechanisms were removed, these same groups now believe that maintaining the current approach is the best option. However, a significant increase of the ECO resulting in a higher burden on consumers’ bills could increase public concern (Baker, 2024).

The issue of households’ contributions for their implemented energy efficiency measures was a point of discussion. Copeland (2024) recalled cases where households were asked to cover up to 10% of installation costs, which could amount to around 5,000£ on average. He argued that this practice is “entirely unsuitable” for low-income households, often already burdened with debt. The ECO4 scheme no longer requires customer co-funding, but Copeland (2024) believed this should be explicitly prohibited to protect vulnerable households.

There was a divergence of opinion among experts regarding the financial implications for energy suppliers under the ECO4. Over time, energy suppliers became very efficient in delivering their obligations (Copeland, 2024). Baker (2024) argued that over the years, energy suppliers built up supply chains in the energy efficiency industry, which enabled them to deliver their obligations as cheaply as possible. He also asserted that energy suppliers initially overestimate their administration and search costs, subsequently identifying ways to deliver services at a lower cost, thereby capturing the savings. From suppliers’ perspective, the ECO4 is a highly costly and resource-intensive process, with 25 employees dedicated to it in-house. The suppliers face significant challenges in identifying the households, generating lead, modelling, determining the eligibility of the dwelling, installing the system, and submitting the savings. The low conversion rate of generated leads, with only around 1% resulting in successful home upgrades, contributes to substantial demand and administrative costs (Walters, 2024).

Despite the debates over the financing mechanisms, Copeland (2024) emphasized the critical importance of maintaining the ECO scheme due to the UK's poor public finances. In light of the UK's constrained public finances and the necessity to address energy poverty targets, it is crucial to ensure the continuity of the ECO scheme (Copeland, 2024). Baker (2024) highlighted that the current approach of funding the ECO4 through consumer energy bills rather than public funds makes the scheme more secure and less susceptible to political changes. This funding model also avoids any direct impact on taxpayer finances, which was seen as a more stable option than publicly funded programs.

5.1.3. Monitoring, Compliance and Development

A point of discussion during the interviews was the importance of maintaining a clear distinction between the administrative and regulatory authorities involved in monitoring, compliance, and program development. It was emphasized that administrative authorities with strong operational capabilities should be responsible for fine-tuning, reporting, and monitoring activities. In contrast, ministries should be responsible for setting the overarching policy targets (Rosenow, 2024).

Rosenow (2024) also cautioned against making frequent, drastic changes to energy efficiency schemes. It was pointed to the precursors of ECO4, where significant modifications led to perceptions of high complexity and limited success of the scheme. Instead, he suggested to refrain from frequent interventions and instead to incrementally adjust the ECO4 every few years.

Additionally, Rosenow (2024) highlighted the importance of monitoring the quality of conductors. This entails a registry of qualified conductors maintained by Ofgem. If a single conductor causes repeated negative installations, Ofgem conducts quality checks by randomly sampling the one in question. If the sampling results are negative, Ofgem may remove the conductor from the register. Furthermore, Ofgem has requested that obligated companies only work with registered conductors. However, he noted that the extent to which the register-based approach is actually enforced in practice remains an open question.

The combination of the Trustmark[16] and PAS 2035[17] standards was seen as an effective tool to prevent poor-quality installations (Copeland, 2024). Yet, Baker (2024) acknowledged that the standard can be relatively costly. He suggested that the level of project management, oversight, and coordination required by PAS 2035 should be proportional to the scale of the investment. Despite these measures, rare cases of inadequate installations have still occurred (Copeland, 2024). This underscores the need for

[16] TrustMark is a government-endorsed quality scheme in the UK that identifies trustworthy and reliable tradespeople and businesses operating in the home improvement, repair, and maintenance sectors (Trustmark (2024)

[17] PAS 2035 is the British retrofitting standard for dwellings (Moody (2023)

clear accountability mechanisms to address non-compliance (Copeland, 2024; Baker, 2024). This principle is expected to be integrated into the successor of the ECO4, ECO5 (Copeland, 2024).

5.2. Eligibility and Accounting of Measures

This chapter outlines the key findings from the expert interviews on the identification for eligible households and the range of permitted measures. The subsequent section is presented according to the themes: Local Authority Flex, Eligible Measures, and Identifying Eligible Households.

5.2.1. Local Authority Flex

The interviews highlighted the challenges associated with the Local Authority Flex, including its complexity, lack of capacity, and difficulties in targeting. Additionally, the experts provided several recommendations on improving it.

Local Authority Flex Eligibility (LA Flex)[18] was initially designed to potentially address up to 50% of a company's obligations. However, in practice, the impact has been considerably lower, with only 14.5% of targets being achieved (Baker, 2024). This discrepancy can be attributed to several factors.

It was highlighted that ECO4 has become a complex and bureaucratic process (Baker, 2024). Another challenge is the varying capacity of local authorities to engage with the ECO4 (Copeland, 2024; Baker, 2024). While larger urban councils tend to be more involved, this is not a consistent trend across the board. The success of ECO4 implementation often hinges on the ambition of individual council officers tasked with overseeing the programme. This variability is further compounded by the numerous pressing issues that local authorities face, which can result in a diversion of attention and resources from the ECO4 (Baker, 2024).

The inconsistent engagement of local authorities presents challenges in effectively targeting areas with the highest levels of energy poverty, despite recommendations from stakeholders to address this (Baker, 2024). Furthermore, energy suppliers encounter difficulties in engaging with local authorities, which adds to the challenges and limits the overall effectiveness of the scheme (Walters, 2024).

To address these challenges and improve the effectiveness of Local Authority Flex, experts proposed several solutions. First, there is a need to enhance the capabilities of local authorities to implement ECO4 more effectively (Copeland, 2024; Baker, 2024). Another proposed approach was to form consortia of local authorities with specialist teams to oversee collaborations with energy companies. This consortium approach would facilitate communication and enhance efficiency. Examples of such consortia could include the Greater London Authority or metropolitan authorities, which represent larger populations

[18] LA Flex is a household referral system in the ECO4 scheme, enabling local authorities to expand eligibility criteria and adapt energy efficiency programmes to suit their specific area (Ofgem, 2023c, p. 56).

(e.g., 8 million) compared to individual local authorities that typically serve around 100,000 people (Baker, 2024).

Furthermore, experts proposed the implementation of a multi-faceted funding model comparable to the Scottish system. This would include providing all local authorities with baseline funding to ensure widespread implementation, coupled with a competitive element to drive innovation. Copeland (2024) similarly suggested to provide funding directly to local authorities to lead energy poverty reduction efforts, particularly for those in the deepest energy poverty. Furthermore, the establishment of a national programme for households ineligible for local schemes would ensure comprehensive coverage (Baker, 2024).

5.2.2. Eligible Measures

The interviews revealed differing opinions on the eligible measures. Copeland (2024) as the representative of the energy poverty charity, which includes technology companies among its members, broadly approved the current range of eligible measures. Rosenow (2024) also supported the current measures, highlighting his lack of in-depth knowledge on their variety.

One point of differing opinions was the types of eligible measures and their effectiveness. Copeland (2024) questioned the use of heat pumps, batteries, and solar panels, preferring to focus on improving thermal efficiency. He argued that measures such as solar panels may not permanently reduce household costs as much as improved insulation. Rosenow (2024), however, advocated for the use of heat pumps, while Baker (2024) cautioned that heat pumps can be problematic in poorly insulated dwellings, potentially causing bills to skyrocket. In such cases, Baker (2024) suggested that implementing boilers might be more effective in addressing energy poverty. Rosenow (2024) countered this view, arguing that installing gas boilers is counterproductive given the projected increase in gas prices in the coming years.

The Innovation Allowance was viewed positively by Rosenow (2024). He highlighted that studies exist that support its effectiveness. However, Copeland (2024) noted a lack of significant innovations in the range of eligible measures themselves. The importance of designing market-based instruments like ECO4 broadly, allowing for competition between various measures, was also stressed by Rosenow (2024).

Moreover, criticism towards the Whole-House Approach was expressed (Copeland, 2024; Baker, 2024; Walters, 2024). This approach mandates the installation of multiple measures per dwelling, addressing the limitations of previous schemes that oftentimes implemented only a single measure per home. Suppliers can also only install measures in homes if there is a significant improvement in the energy efficiency rating (Baker, 2024). While the current focus on improving the least efficient homes has been a reasonable strategy thus far, Copeland (2024) believed that this target may become very expensive and overly restrictive if more homes reach a higher energy efficiency level in the next five years. Instead, he argued to rethink this approach of only implementing a set of measures that create an intensive energy efficiency improvement, but also allow for single-measure improvements. Baker (2024) had initially posited that ECO4 functions more effectively as a high-volume, lower-cost scheme, which would contravene the prevailing approach. However, he also emphasized the importance of energy-poor households receiving a deep retrofit. Nevertheless, he also acknowledged that this has shifted from high-volume, low-cost measures to fewer, more expensive interventions. The average cost per home has increased dramatically from £3,500 to £33,000, resulting in a much smaller number of energy-poor households being assisted (Baker, 2024; Walter, 2024). Baker (2024) highlighted that this approach has tended to benefit houses in rural areas more. This results in potentially neglecting flats and smaller homes where many fuel-poor households live (Baker, 2024).

To reach more energy-poor households and simultaneously implement deep retrofits, Baker (2024) proposed several enhancements. A systematic street-by-street approach was suggested, targeting entire neighbourhoods regardless of income. This method would offer free improvements to low-income households and subsidized upgrades for higher-income homes, benefiting from economies of scale, particularly in areas with similar housing types. To complement this, an on-demand national scheme was proposed to ensure that energy-poor households in more affluent areas, or those not immediately targeted by the area-based approach, can still access timely improvements. This would reduce the stigma attached to the scheme, thereby increasing its acceptance. People would perceive it as a scheme for everyone, not just those who identify as energy-poor.

Furthermore, Rosenow (2024) recommended supplementary measures such as hydraulic balancing and training programs. Data indicates that training, such as for heat pump installers, can significantly enhance installation efficiency. Regular fine-tuning of the measures and a broad range of eligible measures were also emphasized as crucial (Rosenow, 2024).

5.2.3. Identifying Eligible Households

The ECO4 faces several challenges in identifying and reaching eligible households, stemming from complex eligibility criteria, search costs, and data limitations.

The expert interviews revealed that ECO4 fails to benefit all energy-poor households (Copeland, 2024; Baker, 2024, Walters, 2024; Rosenow, 2024). Identifying appropriate households, especially those with the lowest incomes, is a key challenge (Walters, 2024; Copeland, 2024). Many energy-poor households refrain from claiming means-tested benefits, which is one way eligible households are identified under ECO4. Consequently, these households fail to meet the eligibility criteria and are therefore unable to benefit from the scheme (Baker, 2024). The policy’s eligibility criteria result in its inability to reach single-occupant homes and smaller dwellings. Conversely, it is successful in reaching larger homes in rural areas that are occupied by low-income households (Baker, 2024; Copeland, 2024). This uneven

distribution of benefits exacerbates the problem for those not receiving support, as the scheme is funded through the energy bills of all consumers (Rosenow, 2024).
It was also highlighted that the ECO4 is primarily designed for owner-occupiers rather than social housing or the private rented sector, where energy poverty is most severe in the UK. The scheme has seen little uptake by private landlords, as it requires both tenant eligibility and landlord approval, making the process complex (Baker, 2024).

Besides the ECO4 failing to benefit all energy-poor households, the scheme's eligibility criteria, based on both inhabitant and dwelling characteristics, made it difficult for suppliers to deliver measures to a large number of dwellings (Walters, 2024). Nevertheless, Copeland (2024) argued that the scheme will only be able to assist less than a quarter of energy-poor households over its lifetime. Simply changing the criteria is unlikely to resolve the problems of energy poverty. Helping one group of energy-poor households would mean leaving another equally needy group without support (Copeland, 2024).

Walters (2024) argued that searching for eligible households under ECO4 and its precursors is incredibly expensive. In the predecessor of ECO4, half of the costs of a kilowatt-hour saved were search costs (Rosenow, 2024). This underscores the trade-off between highly targeted eligibility criteria and the associated search costs. The narrower the eligibility criteria, the harder it becomes to find eligible households. This increases the costs of finding those who are eligible (Walters, 2024; Rosenow, 2024).

Various stakeholders are involved in sourcing eligible households, each facing unique challenges. Besides the local authorities also National Health Service (NHS) staff can also refer individuals to the scheme. However, they lack the capacity to engage effectively (Baker, 2024). Energy suppliers and their contractors are the primary stakeholders responsible for sourcing eligible households. Most suppliers outsource this task to contractors, with only one or two exceptions who have their own in-house delivery. This approach makes the scheme less demand-led and potentially less responsive to the needs of energy-poor households (Baker, 2024).

The identification of eligible households is closely tied to data availability and privacy concerns. The easiest way to identify eligible households would be to get information on income, costs, and the energy efficiency of a dwelling. However, such data is difficult to collect as it depends on the households trusting the entities who are asking for it with sensitive data (e.g. information on receiving social benefits) (Copeland, 2024, Rosenow, 2024). There is debate over whether energy suppliers are suitable for this task due to their limited data on low-income households and the sensitivity of requesting information about means-tested benefits (Copeland, 2024; Baker, 2024). However, Baker (2024) noted that some experts argued that energy suppliers do have access to relevant information through smart meters, which provide detailed consumption data and can indicate when consumers are struggling to pay their bills. Additionally, over half of all households have publicly available energy efficiency labels, which can help identify homes with the worst efficiency (Baker, 2024).

The ECO4's impact on households is generally positive, particularly for those who receive benefits (Copeland, 2024; Baker, 2024). Copeland (2024) stressed that when people can access the measures, they are typically satisfied, as the interventions have tangible effects on their lives. This positive sentiment is corroborated by various case studies, as reported by the interviewed fuel poverty charity.

However, there are circumstances where households may have a less favourable view of the ECO4. Firstly, disappointment can arise when households believe they are eligible for measures based on personal circumstances, only to discover they don't qualify. This can occur, for instance, when companies are unable to improve a household's energy efficiency by two bands within a reasonable cost frame, resulting in no measures being installed. Secondly, although less common now, failed installations can lead to extremely negative experiences. This issue was more prevalent in the ECO4's precursor schemes during the 2000s when the programs were larger and involved more installers. Some of these installations resulted in poor insulation, causing damp and mold problems that worsened living conditions. While such incidents have decreased due to improved protections, they still occasionally occur and can severely impact trust in the scheme (Copeland, 2024). Trust issues with energy suppliers also contribute to some consumers questioning the ECO (Baker, 2024). Notably, many energy-poor households never interact with the ECO4 scheme (Copeland, 2024).

To address these challenges, experts proposed several recommendations. Regarding targeting households, Walters (2024) advocated for a balanced approach that meets the scheme's targets without being overly restrictive or excluding potential beneficiaries. To tackle the issue of failed installations, it was recommended to prioritize households that have experienced unsuccessful insulation in the past, as they are currently in the worst state in terms of housing conditions (Copeland, 2024).

For sourcing eligible households, Rosenow (2024) and Copeland (2024) suggested creating a system where energy-poor households can actively report their situation. This could be achieved through vouchers or letters with an access link sent to the households (Rosenow, 2024; Copeland, 2024). However, previous attempts, such as sending letters to low-income households with information on energy poverty reduction assistance, proved ineffective with very low response rates (Rosenow, 2024).

To address the lack of data, experts proposed leveraging the Digital Economy Act, which has been used in other UK schemes. This act provides data-sharing powers that could allow the government to establish agreements between the Department for Work and Pensions and energy suppliers. Such an agreement for the ECO4 would enable suppliers to more easily identify eligible customers and systematically approach those most in need, such as those with the highest energy debt or least ability to pay (Copeland, 2024).

Another suggestion involves combining different data sets. For instance, over 50% of homes have publicly available energy efficiency labels. Integrating this information with other data could help identify households most in need of assistance (Baker, 2024).

5.3. Effectiveness and Applicability to Germany

This chapter describes the key findings on the ECO4's effectiveness in reducing energy poverty and its applicability to Germany. The results are presented according to the following themes: Effectiveness in Reducing Energy Poverty in the UK, and Applicability to Germany.

5.3.1. Effectiveness in Reducing Energy Poverty in the UK

According to the interviewed experts, the ECO4 has shown mixed results in its effectiveness at reducing energy poverty in the UK.

One expert acknowledged that the ECO4 is a quite effective scheme for assisting low-income households that are struggling to pay their energy bills. However, its effectiveness is limited when addressing extreme cases of energy poverty. It was noted that the ECO4 faces challenges in reaching those in the worst circumstances, as identifying and targeting individuals with the lowest incomes requires a precise and expensive approach (Copeland, 2024).

The recent surge in energy prices has further complicated the ECO4's impact. Many beneficiaries of the scheme still struggle to pay their bills due to the significant increase in energy costs. This situation has even raised concerns about whether the additional cost of funding the ECO4 might place an inappropriate burden on consumers (Baker, 2024).

The ECO4's success in addressing energy poverty depends on the extent of support provided to each household. In the past, the scheme has concentrated on installing single measures such as loft insulation, cavity wall insulation and boilers (Baker, 2024). However, Baker (2024) argued that many households require more comprehensive retrofitting to significantly improve their energy efficiency and reduce their energy bills. While the current approach may provide some relief from energy poverty, it often fails to significantly improve their living conditions or generate substantial savings on energy bills. In cases where more comprehensive retrofitting has been carried out, the results have been proven to be highly beneficial. Those who have received energy efficiency measures have been able to heat their entire homes rather than just one room. This has led to improved living conditions and a positive impact on various aspects of their lives (Baker; 2024).

However, Baker (2024) and Copeland (2024) highlighted that while energy efficiency improvements can have a significant impact on energy poverty, they are not the entire solution. Baker (2024) suggested that a more substantial way to improve energy poverty would be to improve energy efficiency in line with the Passive House standard. This would result in minimal energy costs. Nevertheless, he asserted that this would result in significantly higher costs and that current energy efficiency improvements do not reach the passive house level.

5.3.2. Applicability to Germany

The ECO4's applicability to Germany was debated among experts.. While the general architecture of ECO4 was considered solid and transferable, it was made clear that any implementation in Germany would require careful adaptation to the country's specific context (Rosenow, 2024).

One of the key considerations was the structure of Germany's housing market. Unlike the UK, Germany has a high proportion of privately rented housing. The ECO4 mainly focuses on owner occupiers and social housing. A German EEOS would need to be specifically designed to address households in rented flats (Baker, 2024).

However, the integration of a new EEOS into Germany's existing policy landscape presents complex challenges. The country already has a rich array of energy efficiency programs, including the well-established KfW program, which manages significant financial volumes (Rosenow, 2024). Rosenow (2024) questioned whether a new EEOS would add value compared to these existing policies. Instead of overhauling the entire funding structure, he suggested focusing on more targeted measures that could benefit lower-income households (Rosenow, 2024).

Before implementing an EEOS, the importance of careful analysis and design was emphasized. A detailed study could help to identify appropriate measures, their scale, and any cannibalisations with existing policies. This approach would help avoid creating redundant or competing instruments, which could lead to inefficiencies, increased costs, and unnecessary bureaucracy (Rosenow, 2024).

Despite these hurdles, Rosenow (2024) saw significant potential for an EEOS for Germany. He argued that the EEOS is particularly well-suited for scaling up technologies during the rapid growth phase of market adoption. This could make an EEOS a crucial tool in driving forward Germany's heat transition and advancing other sectoral technologies.

Another potential advantage of an EEOS implemented in Germany is its ability to make energy efficiency programs more proactive. While many current programs are passive, waiting for people to seek them out, an EEOS could actively identify and support those interested in implementing energy efficiency measures. This could enhance the effectiveness of existing programs by reaching more customers and ensuring that available funds for climate protection measures are fully utilized (Rosenow, 2024).

5.4. Interim Conclusion and Discussion

This chapter provides a summary of the key results and discusses their significance, emphasizing specifically the limitations of the ECO4. Additionally, it explores how these findings fit into a wider context and identifies any potential limitations in the analysis.

5.4.1. Key Findings and Their Implications

The evaluation of the UK's ECO4 revealed several key findings with implications for its limitations and potential adaptation to the German context. These findings include its retrofitting approach, the identification of eligible households, and the integration with other programs.

The Whole-House Approach, while beneficial for reducing energy poverty in individual households, presents a challenging trade-off between depth and breadth of support. This approach can dramatically improve the circumstances of energy-poor households, aligning with literature suggesting that minor retrofits are unlikely to yield substantial reductions in household energy expenses and thus may not alleviate energy poverty (Walker et al., 2013, p. 773). However, the comprehensive nature of these retrofits comes at a high cost, both financially and in terms of resources. Dyson (2024, p. 4) highlighted a striking 640% increase in average investment per home between ECO3 and ECO4, underscoring the resource intensity of this approach. This raises a crucial question for Germany: should the focus be on providing comprehensive support to fewer households (depth) or basic support to a larger number of households (breadth)? The answer to this question will significantly impact the design and reach of the proposed EEOS.

The challenges in targeting and defining eligibility emerged as another critical finding. The ECO4 scheme has struggled to effectively reach those households suffering most from energy poverty, a finding corroborated by studies from Bridgen and Robinson (2023) and Emden et al. (2024). Paradoxically, energy-poor households are among the least likely to participate in schemes like ECO4, effectively funding these initiatives through their bills without receiving benefits. This issue is particularly acute in rural communities (Emden et al., 2024, p. 28). The high costs associated with identifying and targeting eligible households further compound this problem, diverting funding away from energy efficiency improvements. Moreover, stringent eligibility criteria have been found to exclude approximately 20% of energy-poor households (Dyson, 2024, p. 6), undermining the equity of the scheme. This situation presents a clear paradox of targeting: the more precise the targeting, the higher the sourcing costs, which in turn reduces the funds available for actual energy efficiency measures. For Germany, this highlights the need for a careful balance between precise targeting and operational efficiency in the proposed EEOS.

In response to these targeting challenges, an area-based approach has emerged as a potential solution during the expert interviews. Other studies suggested a similar approach (Bridgen & Robinson, 2023; Dyson, 2024; Walker et al., 2013; Rosenow et al., 2013). Rosenow et al. (2013, p. 1201) highlighted that this approach offers several advantages, including cost-effectiveness and reduced stigma for participating households. By targeting entire areas rather than individual households, it can simplify the identification process and profit from economy of scale. However, as Bridgen and Robinson (2023, p. 13) pointed out, this approach may disadvantage rural areas where deprivation is often tied to individual or household circumstances rather than community-wide factors. The use of Geoinformation Systems for identifying eligible areas, as suggested by Walker et al. (2013, p. 774), could provide a more nuanced implementation of this approach. For Germany, considering its diverse urban and rural landscape, an area-based approach could offer a promising strategy, but it would need careful design to ensure equitable coverage across different types of communities.

Adapting the ECO4 scheme to the German context presents unique challenges, particularly in addressing the private-rented sector, which is especially prevalent in Germany. The ECO4 scheme has been found to inadequately address this sector, which could pose significant difficulties in a German adaptation. Obtaining approval from both tenants and owners for energy efficiency measures could increase administrative burdens and complexities.
Furthermore, the lack of publicly available energy efficiency labels and comprehensive smart meter data in Germany, unlike in the UK, creates a substantial barrier to effectively targeting energy efficiency measures. This data deficit will require Germany to discuss how data under an EEOS could be collected and utilized in the most effective manner.

The role of local authorities in identifying eligible households emerged as a limitation of the policy. The findings indicate a lack of capacity and inconsistent involvement of local authorities in the UK, potentially resulting in a "postcode lottery" where support varies significantly between areas. This disparity could exacerbate regional inequalities, a concern particularly relevant to Germany given its federal structure and varying housing conditions across states and municipalities. The importance of capacity building and forming consortia was highlighted as a crucial improvement for the scheme. Dyson (2024, p. 13) emphasizes the effectiveness of personalized approaches and visits from third-sector and local organizations in engaging vulnerable households. For Germany, ensuring uniform and equitable distribution of resources across different regions will be crucial, necessitating a strong focus on building local authority capacity and involvement.

Finally, the integration of the ECO4 with broader, publicly funded energy efficiency programs was identified as an important consideration. This idea aligned with the argumentation put forward by Dyson (2024, p. 8). He pointed out that the eligibility requirements for ECO4 could be improved to better align with parallel energy efficiency and heat decarbonisation policies, such as local authority-led programmes and heat electrification grants. Aligning ECO4 with other policies would allow authorities and energy suppliers to coordinate efforts and combine funding. However, the importance of maintaining taxpayer funding for the scheme was emphasized by the interviewed experts, as it provides greater security and resilience to political changes. For Germany, this suggests the need for a holistic approach to energy poverty alleviation, integrating any new scheme with existing policies while ensuring stable and sustainable funding mechanisms.

5.4.2. Overall Research Approach

While this study provided valuable insights into the UK's ECO4 scheme and its potential applicability to Germany, it is important to acknowledge the limitations of this analysis' overall research approach.

The study's primary limitation is the relatively small sample size of expert interviews conducted. Given that only four experts were interviewed, the breadth of perspectives captured may be insufficient to provide a fully comprehensive view of the ECO4 scheme's performance and implications. The limited sample size may restrict the diversity of insights and fail to capture the full spectrum of experiences and opinions related to the scheme's implementation and effectiveness. Furthermore, the expert interviews did not include representatives from certain key stakeholder groups. The study included two experts from academia, one from industry, and another from the interface between industry and consumer organisations. However, this composition notably excludes the perspectives of government officials, environmental organisations and direct beneficiaries of the scheme. The lack of these viewpoints may result in an incomplete understanding of the scheme's impacts and challenges, particularly from a policy-making and environmental sustainability standpoint. It is worth noting that efforts were made to include a broader range of perspectives, with approximately twenty stakeholders initially approached for participation. These efforts included attempts to involve government representatives. Unfortunately, due to a lack of responses, these additional viewpoints could not be incorporated into the study.

Another limitation of the analysis is its reliance solely on expert interviews for data collection. While expert interviews provide valuable in-depth insights, the exclusion of other data sources, such as policy reports, quantitative analyses, or surveys, may limit the comprehensiveness of the analysis. For instance, Schlomann's et al. (2021) approach of including reports and other documentation to obtain a more comprehensive picture of policy performance was not replicated in this study due to time and resource constraints.

This chapter provided a comprehensive analysis of the UK's ECO4, offering valuable insights that will inform the subsequent stages of this thesis. The findings regarding the shortcomings and key success factors, along with the recommendations, provided crucial insights for the design of a policy proposal in Germany. As the thesis continues, these insights were instrumental in developing a tailored EEOS for Germany that effectively addresses energy poverty.

6. Development of an Energy Efficiency Obligation Scheme Policy Proposal for Germany

This chapter sets out the policy design proposal for the EEOS in Germany. The initial stage of the analysis involved an assessment of the limitations and transfer challenges associated with a direct transfer of the ECO4 approach to Germany. These conclusions were drawn from the preceding analyses. Based on the aforementioned findings, the recommendations from the expert interviews and those of the consulted researchers, as well as a review of policy designs from other countries (in the absence of recommendations for adjusting limiting or challenging policy features specific to Germany), the EEOS policy proposal was designed. Table 10 provides a precise overview over the EEOS policy proposal for Germany. For a detailed description of the design recommendations, please refer to Chapter 6.1.

Table 10: Final EEOS Policy Proposal. Own table.

Design Features	Design	Justification
Obligated Energy Carrier	All energy carriers (except renewables) delivered to the household sector including gas, (renewable) electricity, heating oil and district heating.	To prevent market distortions and ensure fairness, all energy sources (except from renewables) used in households should be obligated.
Obligated Parties	End energy suppliers (electricity, natural gas and district heating), manufacturers and importers (heating oil). Energy suppliers may form collective structures to jointly meet their obligations.	High consumer proximity is crucial for identifying eligible households, as the households' sharing of eligibility details depends on trust towards the sourcing entity. By utilizing existing data of the electricity and energy tax, energy suppliers are defined, and obligations are determined, which simplifies the process. Following the French model, collective structures help to simplify administration and reduce complexity.
Length of the Obligation Period	3 years with a division into four one-year sub-phases.	This is in accordance with the reporting obligation of the EED.
Differentiation of Saving Target	One overarching obligation (implementation of measures in solely eligible households). No sub-obligations.	To decrease complexity and increase the acceptance of involved stakeholders, no sub-obligation is applied.
Reference Value of the Savings Target	Lifetime bill saving (= total estimated reduction in energy bills over the lifetime of the energy efficiency improvement installed).	This aligns with the British policy feature as no policy limitations and transfer challenge were found in the analyses.
Allocation of Costs	Energy suppliers cover the obligation's costs and can pass on the costs to consumers without restriction. Co-Financing of energy efficiency measures by households is prohibited (depending on households' eligibility criteria this might change).	A consumer-funded scheme ensures independence from government finances, offering stability and protection from political changes. Requiring even small co-financing may burden low-income households.
Flexibility Mechanisms	Banking[19] of access savings to the next obligation phase is allowed. No buy-out[20] is introduced.	This aligns with the British policy feature as no policy limitations and transfer challenge were found. A buy-out is not introduced as no white certificates will be produced and traded.
Admissibility of Certificate Trading	Trading of obligations between the obligated suppliers or a collective of suppliers (bilateral trading). The German Emission Trading Authority (DEHSt) administers the trading.	This aligns with the British policy feature as no policy limitations and transfer challenge were found. DEHSt administers the trading due to their existing experiences in administrating trading systems.
Monitoring and Compliance	The BfEE manages the scheme, ensures compliance, and prevents fraud, with a fraud prevention team in place. Qualified professionals, overseen by BfEE, conduct technical monitoring.	The BfEE's expertise in energy efficiency and its role under the EED enable it to efficiently manage EEOS compliance. Its existing duties provide the knowledge needed, reducing the learning curve and implementation delays.
Eligible Measures	A standardized set of eligible measures is tailored to the needs of German housing and avoids conflicts with existing policies (e.g., fossil fuel	Standardized measures simplify implementation and management, making the scheme more accessible than user-defined measures. Allowing for innovative measures promotes technological

[19] Banking is the possibility of transferring savings to subsequent trading periods.
[20] Buy-out is the option of fulfilling the obligation by paying a fixed price or selling certificates at a fixed price.

	boilers are banned). An innovative measure allowance permits applications for user-defined measures.	innovation. The alignment with existing policies facilitates a smooth integration and prevents conflicts or redundancy.
Selection of Baseline	Standardized values for each measure and building type.	In contrast to the status quo ante, which is used in the UK, standardized values are less complex and simplifying the accounting of measures.
Determining the savings	Saving targets are calculated using predetermined scores from a published table. The table considers the dwelling's energy efficiency rating before and after retrofitting, and its floor area. The scores represent the expected annual bill savings.	This aligns with the British policy feature as no policy limitations and transfer challenge were found in prior analyses.
Double Funding	Double funding is prohibited.	Double funding may increase deadweight losses, harming efficiency and system credibility.
Executing Actors	Obligated parties and third-party contractors are allowed to carry out the energy efficiency measures. Installations should be carried out by a set standard. Contractors should be qualified and registered in a monitoring system under the administration of the BfEE. The contractors are regularly overseen by the BfEE.	To avoid poor installations, regular oversight of the contractors and a set standard for the installations is crucial.
Identifying Eligible Consumers	<u>*Targeting eligible households*</u> *Option 1:* Basing eligibility solely on receiving means-tested benefits and low income, without considering the dwellings' energy efficiency. *Option 2:* An area-based approach targeting entire neighbourhoods, offering free upgrades for low-income households and subsidized improvements for higher-income combined with an on-demand national scheme for those in highest energy poverty. *Option 3:* Maintain focused eligibility criteria, targeting households facing the most severe energy poverty. *Rented-dwelling targeting:* To improve the rented-dwelling targeting, either simplify bureaucracy and provide clear approval guidelines or initially start with owner-occupied dwellings and social housing, expanding to rented-dwellings later.	<u>*Targeting eligible households*</u> *Option 1:* More households will be eligible, and the sourcing may be simplified for energy suppliers lowering also the sourcing costs. However, increases the chance of including non-energy-poor households, while leaving those in the highest energy poverty without support. *Option 2:* This may increase the economy of scale and increase its acceptance beyond consumers. However. highly time-consuming definition of criteria and area selection process. *Option 3:* Resources would be focused solely on reducing energy poverty, directly targeting energy-poor households. However, increase in sourcing cost and energy bills.
	<u>*Sourcing eligible households:*</u> Sourcing through obligated parties, third-party contractors and local authorities. Letters with links to EEOS applications are distributed as a proactive measure to eligible households. Training to strengthen local authorities' capacities is applied, and local authority consortia with EEOS specialist teams are implemented. Synergies with the Electricity Saving Check should be explored, possibly including informing households about the EEOS and identifying eligible households by Electricity Saving Check auditors.	<u>*Sourcing eligible households:*</u> The choice of stakeholders for sourcing aligns with the British policy feature as no policy limitations and transfer challenge were found in prior analyses. Letters may increase the reach of the EEOS and proactively include households. Capacity building is essential for increasing local authority involvement and efficiency. The formation of consortia could facilitate communication and enhance efficiency. Synergies with the Electricity Saving Check could simplify the sourcing of eligible households.

6.1. Policy Limitations, Transfer Challenges and Recommendations for Policy Design

This section examines ECO4's limitations and transfer challenges of each policy feature to Germany and puts forward the design recommendations for each of them. This chapter is structured in accordance with the overview of the general design elements set out in Chapter 2.2.1.

6.1.1. Obligated Energy Carrier

Policy Limitations and Transfer Challenges to Germany

In the UK, the only obligated energy carrier under the ECO4 is gas and electricity (Ofgem, 2023c, p. 16). The previous comparison with Germany revealed that, in addition to electricity, households are served by a broader mix of heating sources, including not only gas but also heating oil, district heating, and renewable energy sources (Statistisches Bundesamt [DESTATIS], 2024). The direct application of the UK's design may result in significant oversight of these alternative energy sources. Such a scenario could lead to unintended market distortions, whereby gas and electricity suppliers are discriminated disproportionately, which could in turn undermine the equitable development of Germany's diverse energy sector.

Design Recommendations

Considering Germany's diverse energy mix, it is recommended that the policy feature be adapted to include all fossil energy carriers as well as electricity delivered to the household sector. In this regard, in addition to gas and electricity, the obligation should encompass heating oil and district heating. This approach is in line with practices observed in other countries, where a wider range of energy carriers is integrated into their obligations (EEffG, 2004/2024, p. 5, ENSPOL, 2016, p. 58, ENSMOV, 2020, p. 23). Given the considerable role other energy carriers play in the energy mix of German households' (DESTATIS, 2024), their inclusion will prevent market distortions and ensure a fair, comprehensive approach. The determination of the obligation was made with reference to the energy and electricity taxation, which is targeted exclusively at fossil fuels and electricity. Consequently, renewable heating sources (such as pellets, biogas, or wood, but not renewable electricity) are excluded from the scope of this proposal. A comprehensive rationale for this methodology can be found in the subsequent chapter.

6.1.2. Obligated Parties

Policy Limitations and Transfer Challenges to Germany

In the UK, energy suppliers are designated as the obligated parties under ECO4. These suppliers are required to either provide a specified amount of electricity or gas and meet a minimum domestic customer threshold (Ofgem, 2023c, p. 16). In Germany, however, besides the provision of electricity, the heating energy mix includes significant proportions of heating oil and district heating (DESTATIS, 2024). Imposing the British model directly would fail to consider a significant proportion of the German energy market, particularly those supplying energy sources beyond electricity and gas.

Furthermore, Germany has approximately 65 times more energy suppliers than the UK (Bundesnetzagentur & Bundeskartellamt, 2023, pp. 163–257; Ofgem, 2024a). This introduces several transfer challenges. The obligation of an excessive number of energy suppliers may result in inefficiencies within the administrative process and the potential for market distortions. The exclusion of a significant number of suppliers may lead to an inadequate coverage of the market.

Design Recommendation

Given the unique characteristics of the German energy market, adopting a direct replication of British policy feature may not be practical. The expert interviews revealed that the ability to identify eligible households depends on the trust of households in providing sensitive data to the sourcing entities (Copeland, 2024; Rosenow, 2024). Therefore, it is concluded that a high level of customer proximity of the obligated parties is crucial. Thus, energy suppliers are identified as the most appropriate obligated party for the purpose of the proposed policy. This is in line with other European countries having a sub-obligation of targeting energy poverty in their EEOS (ENSMOV, 2020, pp. 5–23). It was even explicitly highlighted that the French system chose energy suppliers as obligated parties due to their direct relationships to consumers (ENSPOL, 2016, p. 58).

The sole point of contention is the definition of an energy supplier and the threshold determining when they are obligated. The consulted researchers recommended that existing systems, such as the energy and electricity tax (Energie- und Stromsteuer), be employed for the determination of the obligation of the energy suppliers. Furthermore, they proposed to define the energy suppliers in accordance with the tax debtor of the electricity- and energy tax. In the case of natural gas, and electricity, the tax debtor is the end energy supplier. For heating oil, the tax debtor is the owner of the tax warehouse or importer (EnergieStG, 2006/27.03.2024; StromStG, 1999/22.12.2023). The definition and obligation determination according to the energy and electricity tax allows for leveraging existing systems, which may reduce administrative costs and hurdles. While district heating is not included in this tax, it is recommended to obligated the end energy supplier, which is the operator of the district heating network.

Drawing from practices in other countries, such as France, where in the 2nd period of the scheme around 2,000 suppliers were obligated (ENSPOL, 2016, p. 58), a more flexible model may be suitable. Precisely, it is recommended that the proposed EEOS should allow for collective obligations in accordance with the French scheme. In this model, energy suppliers can join to meet their collective obligation. By transferring their individual obligations to a collective entity, they can share the responsibility, thereby mitigating administrative burdens and enhancing scheme compliance. This approach would accommodate a large number of suppliers in Germany, facilitate smaller suppliers' participation, and reduce overall complexity (ENSPOL, 2016, p. 75).

6.1.3. Length of the Obligation Period

Policy Limitations and Transfer Challenges to Germany

No policy limitations and transfer challenges were identified in the previous analyses.

Recommendation

Despite the lack of identified policy limitations and transfer challenges in the previous analyses, the researchers recommended amending the obligation period length in accordance with the reporting obligation on Germany's energy efficiency as outlined in the EED. This obligation is to be fulfilled every three years (Bundesamt für Wirtschaft und Ausfuhrkontrolle [BAFA], 2024c). While this policy does not directly target the enhancement of Germany's energy efficiency, the observed change in energy efficiency may still be attributed to the country's overall energy efficiency improvement.

6.1.4. Differentiation of Saving Target

Policy Limitations and Transfer Challenges to Germany

The overarching obligation is divided into the following sub-obligations: Solid Wall Minimum Requirements and the EFG Minimum Requirements (Ofgem, 2022, pp. 32–33). The Solid Wall Minimum Requirement has been generally well-received by the interviewed experts. However, the EFG Minimum Requirement's dual-band retrofitting strategy has faced criticism, particularly regarding ECO's Whole-House Approach (Copeland, 2024; Baker, 2024; Walters, 2024), which will be explored in more detail later. This criticism also applies to the EFG Minimum Requirement, as both obligations share similarities. Like the Whole-House Approach, the EFG Minimum Requirement aims to significantly improve a dwelling's energy efficiency by raising its rating by two energy efficiency levels, especially for homes with the lowest energy ratings. While this approach undoubtedly enhances the living conditions of those households (Baker, 2024), it was considered to be excessively costly and complex (Copeland, 2024; Baker, 2024; Walters, 2024). These issues are further compounded by concerns from German industry interest groups regarding the complex implementation of a similar EEOS in Germany (BDEW, 2021; VKU, 2024), as identified in Chapter 4.8.

Design Recommendations

To avoid unnecessary complexity, it is concluded that the proposed EEOS should not adopt a similar sub-obligation. The incorporation of such sub-obligations may result in a more complex system and a reduction in acceptance among obligated energy suppliers due to this complexity. As a result, it is recommended that only an overarching obligation be established, in which the obligated parties are required to implement energy efficiency improvements in only eligible households. This approach ensures comprehensive coverage and efficiency without introducing unnecessary complexity. Nevertheless, it is critical to monitor the developments on an ongoing basis and consider the introduction of additional sub-obligations should the overarching one prove ineffective in achieving the desired outcomes.

6.1.5. Reference Value of the Savings Target

Policy Limitations and Transfer Challenges to Germany

No policy limitations and transfer challenges were found in previous analyses.

Design Recommendations

The adoption of the reference value of the saving target in "lifetimes bill savings" is transferred to Germany. This refers to the total estimated reduction in energy bills over the lifetime of the energy efficiency improvement installed.

6.1.6. Allocation of Costs

Policy Limitations and Transfer Challenges to Germany

In the UK, energy suppliers bear the initial financial burden of the ECO4 scheme, with the subsequent costs passed on to consumers through their energy bills. This approach has previously been criticized, with consumer organizations initially arguing for public financing to avoid the burden of higher energy costs on households. However, following the removal of alternative funding mechanisms, these groups now support the current approach as the optimal available option. Nevertheless, public concern could increase again in the UK, if there is a substantial rise in ECO costs resulting in higher consumer bills (Rosenow, 2024; Baker, 2024).

The previous analyses highlighted that German industry interest groups are concerned that the EEOS may result in an unfair financial burden transfer from member states budgets to obligated entities and ultimately to consumers. These groups argued that tackling energy poverty should fall under European and national social policies, rather than energy efficiency policies (BDEW, 2021). Furthermore, Copeland (2024) highlighted the inappropriateness of requiring household co-financing, arguing that even a 10% contribution towards installation costs could be too burdensome for low-income households. However, from the interviewed suppliers' perspective, there is also concern about the scheme's high costs, which could have an adverse effect on their operational viability and profitability (Walters, 2024).

Design Recommendations

Considering the transfer challenges and policy limitations, it is proposed that a consumer-based funding approach be adopted, whereby costs are distributed across all energy consumers. This approach preserves the scheme's independence from public financing, thereby enhancing stability and resilience to political changes, as emphasised by an interviewed expert (Baker, 2024). Secondly, in accordance with the recommendation put forth by Copeland (2024), it is advised that the requirement for energy-poor households to co-finance energy efficiency improvements be prohibited. This addresses the concern that even minor contributions could prove burdensome for low-income households (Copeland, 2024).

6.1.7. Flexibility Mechanisms

Policy Limitations and Transfer Challenges to Germany

No policy limitations and transfer challenges were found in prior analyses.

Design Recommendation

The policy feature of banking[21] surplus savings to the next obligation phase is transferred to Germany. It is decided not to implement a buy-out[22], as no white certificates are intended to be produced and traded (see Chapter 6.1.8.).

6.1.8. Admissibility of Certificate Trading

Policy Limitations and Transfer Challenges to Germany

No policy limitations and transfer challenges were found in previous analyses.

Design Recommendation

The trading of obligations between the obligated suppliers or collective of suppliers (as discussed in Chapter 6.1.2) is implemented into the proposed EEOS. Trading of obligations means that company A, which generates more savings than it is obligated to, can trade this surplus with company B, which has failed to fulfil its obligation. The researchers recommended that the German Emission Trading Authority (dt. Deutsche Emissionshandelsstelle (DEHSt)) may oversee the operation of a platform for the trading of these obligations. This authority is perceived as suitable for this task, as it has already gained expertise in the administration of the emission trading system. Therefore, existing expertise can be leveraged, and the learning curve can be reduced.

6.1.9. Monitoring and Compliance

Policy Limitations and Transfer Challenges to Germany

No policy limitations and transfer challenges were found in previous analyses.

[21] Banking is the possibility of transferring savings to subsequent trading periods.
[22] Buy-out is the option of fulfilling the obligation by paying a fixed price or selling certificates at a fixed price.

Design Recommendations

Rosenow (2024) highlighted the importance of a clear distinction between administrative and regulatory roles to enhance the effectiveness of monitoring, compliance, and program development. In accordance with his recommendations, it is proposed that the administrative authority focuses on operational tasks such as reporting, data collection, and compliance tracking, while the regulatory authority, which is most likely the responsible ministry, sets the policy objectives.

The Bundesstelle für Energieeffizienz (BfEE) is recommended to act as the administrative authority. Its responsibilities include monitoring, compliance and fraud prevention. This choice is based on the BfEE's expertise in energy efficiency and its existing role in monitoring under the EED (BAFA, 2024b). The BfEE's current monitoring and reporting responsibilities provide it with the institutional knowledge necessary to efficiently manage the compliance requirements of the EEOS. This alignment of responsibilities leverages existing expertise and reduces the learning curve and risk of implementation delays.

In line with ECO4 (Ofgem, 2023c, pp. 189–190), it is recommended that qualified professionals, under the supervision of the BfEE, should be responsible for technical monitoring to ensure that energy efficiency measures meet the standards set. It is also suggested that the BfEE should oversee the monitoring of energy savings scores to ensure that they accurately reflect the characteristics of each household. A dedicated fraud prevention team is proposed in accordance with ECO4 (Ofgem, 2023c, pp. 189–190).

6.1.10. Eligible Measures

Policy Limitations and Transfer Challenges to Germany

Specifically, the Whole-House Approach of the ECO4 faced substantial criticism (Copeland, 2024; Baker, 2024; Walters, 2024). This approach aims to resolve the issue of implementing only a single measure per dwelling by ensuring comprehensive upgrades (Baker, 2024). Baker (2024) suggested that the implementation of only single measures often fall short in significantly improving the dwellings' energy efficiency or generate substantial savings on energy bills. In contrast, comprehensive retrofitting has proven highly effective, enabling households to heat their entire homes, resulting in better living conditions and overall well-being. However, the extensive and costly nature of these deep retrofitting requirements has led to a reduction in the number of households receiving assistance (Baker, 2024). Furthermore, according to the interviewed supplier, these requirements significantly contribute to the resource-intensive and costly nature of their operations, as they focus on fewer, but more complex, leads (Walters, 2024). The high costs and resource demands of this approach tend to benefit rural homes, potentially leaving urban flats and smaller properties, where many fuel-poor households live, inadequately addressed (Baker, 2024). These issues are compounded by concerns from German industry interest groups regarding the implementation of a similar EEOS in Germany (VKU, 2024; BDEW, 2021).

Implementing a similar approach in Germany could cause overlap and cancelling out with existing policies. The GEG prohibits monovalent fossil fuel boilers beyond 2028, creating a conflict with the ECO4's eligibility criteria (GEG, 2020/16.10.2023). Furthermore, overlapping provisions between the ECO4, the GEG, the BEG, and the EEG could lead to duplicative funding and regulatory confusion, as discussed in Chapter 4.9. For example, the GEG's insulation standards and the BEG's heating system supports may overlap with the ECO4's scope (GEG, 2020/16.10.2023; BEG EM, 2023), complicating implementation and potentially causing inefficiencies.

Simultaneously, as outlined in Chapter 4.6. Germany differs from the UK in terms of the variety of dwellings constructed within a specific period, as well as the heating source and, consequently, the heating device used. Thus, a direct adoption of the range of measures eligible under ECO4 would neglect those differences.

Design Recommendation

To enhance the feasibility and effectiveness of the proposed EEOS, several key modifications are recommended. Firstly, it is suggested to eliminate the Whole-House Approach. While this approach aims for comprehensive upgrades, it has proven to be both costly and resource-intensive, often limiting its benefits to rural areas and neglecting urban and smaller properties (Copeland, 2024; Baker, 2024; Walters, 2024). In accordance with the criticism of Baker (2024) and Copeland (2024), shifting to a model that allows single measures is proposed. Through this, the EEOS can broaden its scope of support, ensuring that a greater number of households, including those in urban and smaller dwellings, can benefit from the scheme. This change may also improve the acceptance and participation of obligated energy suppliers.

In terms of eligible measures, the proposed scheme incorporates a broad set of standardized measures tailored to the specific needs of the German dwelling stock. While a user-defined range might offer a more precise fit for the specific needs of different dwelling types, it introduces significant complexity in terms of implementation and administration. A standardized range of measures, on the other hand, simplifies the process, making the scheme easier to manage and more accessible. However, it is crucial to exclude fossil fuel boilers from the list of eligible measures to comply with the GEG. Moreover, in line with the recommendation of Rosenow (2024), innovative measures outside of the scope of the eligible measures, are allowed in the proposed scheme. All sets of proposed measures and their preconditions should be thoroughly evaluated to ensure they do not overlap with existing provisions under the GEG, the BEG, CO2KostAufG and the EEG.

To prevent double funding, careful coordination with existing policies is necessary. This issue is addressed in detail in Chapter 6.1.13. Additionally, in line with Rosenow's (2024) suggestions, hydraulic equalization to make the heating system more efficient. However, measures focused on motivational and informational activities are excluded. This is due to challenges in quantifying the "lifetime bill savings" of such measures.

6.1.11. Selection of Baseline

Policy Limitations and Transfer Challenges to Germany

No policy limitations and transfer challenges were found in previous analyses.

Design Recommendations

While no policy limitations and transfer challenges were identified, the researchers highlighted that using the specific current consumption of the concerned building (before implementing the energy efficiency improvements) as the baseline is extremely complex. Instead, they proposed to use a list of standardized values with which the increase in energy efficiency for each type of building can be determined. This simplifies the accounting of measures.

6.1.12. Saving Determination

Policy Limitations and Transfer Challenges to Germany

No policy limitations and transfer challenges were found in prior analyses.

Design Recommendations

It is recommended in accordance with the ECO4 (Ofgem, 2023c, pp. 148–149) to determine saving targets using pre-calculated scores. These scores are obtained from a published table that considers the change in energy efficiency, as well as the floor area category. The scores represent the anticipated "lifetime bill savings" for the property. The researchers emphasised that, in addition to including these pre-calculated scores, this published table should be combined with the list of standardised values, which enables the calculation of the increase in energy efficiency for each type of building as described in Chapter 6.1.11.

6.1.13. Double Funding

Policy Limitations and Transfer Challenges to Germany

In ECO4, double funding is strictly prohibited. While the interviewed experts did not criticize this restriction, they noted that the ECO4 could achieve greater effectiveness if it were designed to synergize with existing policies (Baker, 2024). As outlined in Chapter 4.9., a key concern in transferring the policy to Germany is the potential overlap of the proposed EEOS with other policies, like the BEG or GEG, which could result in unintentional double funding and cannibalization if such overlaps are not carefully managed.

Design Recommendations

Based on these challenges, it is recommended that the proposed EEOS should maintain a strict prohibition on double funding. Double funding could significantly increase deadweight losses, reducing the overall efficiency and credibility of the system. The potential for overlap with existing policies, such as the BEG or GEG, increases the likelihood of such inefficiencies, underscoring the need for careful coordination.

6.1.14. Executing Actors

Policy Limitations and Transfer Challenges to Germany

The allowance for obligated parties and third-party contractors to carry out energy efficiency measures was not criticized. However, previous experience of the ECO's predecessors indicated shortcomings in the quality of the installation. Poor installation practices resulted in damp and mould problems in dwellings. Recent protections, such as the Trustmark and PAS 2035:2019 standards, have significantly reduced the occurrence of this issue. It was nevertheless observed that a small number of poor installations still occur (Copeland, 2024). Notably, while these standards are effective in preventing poor-quality installations, carrying out installations under these standards is costly, particularly in terms of project management and oversight (Baker, 2024).

A further challenge for the transfer of this policy to Germany is the severe shortage of skilled workers in critical sectors, such as sanitary, heating, and air-conditioning technology, and roofing (Burstedde, 2023, p. 60). These sectors are pivotal for implementing the planned energy efficiency measures under an EEOS (Bundesagentur für Arbeit, 2021, p. 498-567), which may potentially result in the non-fulfilment or delay of the proposed EEOS.

Design Recommendations

In accordance with ECO4, obligated parties and third-party contractors are allowed to carry out the energy efficiency measures for the proposed EEOS. To mitigate the risks associated with poor-quality installations and adapt the ECO to the German context, it is essential to implement a robust system for monitoring and regulating contractor quality. Rosenow (2024) emphasised the necessity of maintaining a register of qualified contractors, with periodic audits and the removal of those who consistently fail to perform adequately. Accordingly, a comparable monitoring system with administrative authority empowered to enforce rigorous quality standards and promptly address recurring issues is recommended.

Furthermore, the implementation of a comparable standard, such as PAS 2035:2019, tailored to the German context is proposed. In view of the considerable costs involved in compliance, it is proposed in accordance with Baker (2024) that the level of supervision should be aligned with the scale and complexity of the project. This tiered approach would facilitate the viability of smaller projects while maintaining rigorous standards for larger and more complex retrofits without placing an excessive administrative burden on smaller businesses.

Ultimately, the success of this policy transfer depends on addressing Germany's shortage of skilled workers. The issue of a shortage of skilled workforces is a topic of ongoing discussion in Germany (Spitzenverband der Gebäudetechnik [VdZ], 2018; BDEW, 2024; Bundesministerium für Wirtschaft und Klimaschutz [BMWK], 2024). The objective of this paper is not to propose solutions for closing this gap. It is nevertheless strongly recommended that this issue be urgently addressed, to ensure the smooth implementation of the EEOS.

6.1.15. Identifying Eligible Consumers

Policy Limitations and Transfer Challenges to Germany

The policy encounters several obstacles in identifying and supporting eligible households, particularly those with the lowest incomes. One significant challenge is that a considerable number of households experiencing high energy costs, but not claiming means-tested benefits, are not eligible for assistance under the ECO4 (Walters, 2024; Copeland, 2024). The policy encounters difficulties in assisting single-occupant homes and smaller dwellings; however, it is more effective in reaching larger homes in rural areas with low-income occupants (Baker, 2024; Copeland, 2024). The unequal distribution of benefits gives rise to further complications, as the scheme is financed through the energy bills of all consumers (Rosenow, 2024).

A significant shortcoming of the policy is its exclusion of the private rented sector, where energy efficiency improvements are challenging due to the necessity of landlord and tenant approval (Baker, 2024). This challenge is further compounded in the German context, where private rented dwellings constitute a substantial proportion of the dwelling stock (DESTATIS, 2024). Furthermore, the process of identifying eligible households is financially burdensome for energy suppliers due to the restrictive eligibility criteria. These costs are transferred to consumers, consequently increasing their energy bills (Walters, 2024).

The Local Authority Flex (LA Flex), designed to assist the identification of eligible households, is facing significant bureaucratic challenges and an inconsistent involvement from local authorities. Larger councils are more frequently involved in the EEOS. However, the level of commitment varies considerably, resulting in uneven efforts to address energy poverty (Copeland, 2024; Baker, 2024). Furthermore, energy suppliers have difficulty communicating with local authorities, which impedes progress. Instead of the anticipated 50% of eligible households identified through LA Flex, only 14.5% were sourced by this approach. Moreover, NHS healthcare professionals lack the capacity to refer individuals having a severe health condition to get an energy efficiency improvement under ECO4 (Baker, 2024).

A further challenge is the difficulty in collecting sensitive household data, such as income and energy usage. While Baker (2024) indicates that the utilisation of smart meters and public energy efficiency labels in the UK may facilitate the identification of eligible households, Germany lacks the widespread implementation of such tools. Since 2014, all energy performance certificates have been required to be registered online. However, the number of registered consumption and demand oriented certificates for residential buildings is relatively low, at 120,000 and 80,000, respectively (Öko-Institut e.V., 2023). Accordingly, utilizing this approach for Germany was deemed ineffective.

Recommendations on Targeting Eligible Households

Several recommendations for modifications are put forth. However, as no single option emerged as the optimal choice, different alternatives are presented for further consideration.

Targeting Option 1: In terms of targeting households, Walters (2024) proposed a balanced approach that would ensure the scheme's targets are met without unduly restricting or excluding potential beneficiaries. For example, France, which also addressed energy poverty, established eligibility criteria based solely on the number of individuals in a household, income level, and geographical location (NOR: DEVR1428328A, 2014/24.03.2022). In Austria, a household is considered eligible when it receives benefits or exemptions under specific federal laws, such as grants, exemptions from fees, equalisation allowances, or support in cases of insolvency or debt settlement proceedings (EEffG, 2004/2024). In light of the aforementioned considerations, it is proposed that the eligibility criteria for the first option be based solely on the receipt of means-tested benefits, low income and health condition, without including a provision on the low energy efficiency of the dwelling. This guarantees that the eligibility criteria are not excessively restrictive, thus making a greater number of households eligible and simplifying the sourcing and reducing the costs for energy suppliers. However, this approach may potentially result in the inclusion of non-energy-poor households, while those experiencing the most severe forms of energy poverty may be left without support. This is because energy suppliers may lack an incentive to seek out such households, given the complex and expensive sourcing process involved.

Targeting Option 2: Another option is according to the recommendation put forward by Baker (2024). He proposed a systematic street-by-street approach, whereby entire neighbourhoods are targeted regardless of income. This method would provide free improvements to low-income households and subsidised upgrades for higher-income homes, thereby benefiting from economies of scale, particularly in areas with similar housing types. To supplement this, an on-demand national scheme was proposed by Baker (2024) to guarantee that households lacking access to energy in more affluent areas or those not immediately targeted by the area-based approach can still obtain timely improvements. This would reduces the stigma attached to the scheme, thereby increasing its acceptance. The researchers highlighted that, in the case of an area-based approach, it would be necessary to determine where these areas are. This would necessitate a catalogue of criteria and a definition process, which would be extremely time-consuming. As a result, it would be reasonable to refer to other institutions or instruments that have already designated such areas for other purposes. Furthermore, the researchers suggested that municipalities could be obliged to designate such areas as an annex to municipal heat planning.

Targeting Option 3: Copeland (2024) posited that a mere alteration of the eligibility criteria would inevitably result in the exclusion of other vulnerable groups from the support system. Based on his comment, a third option is recommended. This entails directly implementing the eligibility criteria set forth in ECO4 to Germany. These criteria are based on receiving means-tested benefits, low income and health condition, as well as on the energy efficiency of the dwelling. This approach would allow for targeting households experiencing the greatest energy poverty. This would ensure that the policy and the resources used for it are specifically oriented towards addressing energy poverty. However, this may result in elevated sourcing costs and thus increased energy bills due to the complexities involved in sourcing those households.

Given the high proportion of rental housing in Germany (see Chapter 4.6.), it is argued that one option would be to reduce the barriers for implementing energy efficiency measures in privately rented properties. To achieve this, it is essential to streamline the approval process. This could entail reducing bureaucratic requirements and providing clear guidelines to facilitate approvals. Alternatively, the EEOS could initially focus on implementing energy efficiency measures exclusively in owner-occupied dwellings and social housing. Following a period of further familiarisation, the scheme could then be extended to the rented sector.

Recommendations on Sourcing Eligible Households

In accordance with ECO4, it is recommended that the sourcing of eligible households is conducted through the obligated parties and their third-party contractors, as well as by local authorities. Additionally, further methods for improving the identification of eligible households are proposed in accordance with expert recommendations (Rosenow, 2024; Copeland, 2024). To identify eligible households, it is suggested to implement a system through which energy-poor households can proactively declare their circumstances. This can be accomplished by distributing vouchers or letters containing an access link to the relevant households.

To improve the efficiency of LA Flex, several solutions were proposed by the interviewed experts (Copeland, 2024; Baker, 2024), which are incorporated into the EEOS policy proposal. Firstly, the capacities of local authorities should be enhanced to facilitate more effective implementation of the EEOS. This ensures that local authorities are actively involved in the EEOS, guaranteeing effective implementation of measures across all regions of Germany. Furthermore, the formation of local authorities' consortia, including EEOS specialist teams, should be encouraged to facilitate collaboration with energy companies. This could make it easier for smaller authorities with limited resources to participate in the scheme. Furthermore, the establishment of a specialist team within these consortia could support more efficient communication with suppliers.

Moreover, it was recommended to explore opportunities for synergies, as outlined in Chapter 4.9. and highlighted by Baker (2024). A cooperation between the EEOS and the Energy Saving Check is recommended. This synergy could maximize the reach and impact of the scheme. Energy advisers from Caritas, who work with low-income households through the Energy Saving Check, should play a vital role in raising awareness of larger-scale energy efficiency improvements offered by the EEOS. They should educate eligible households on both immediate, low-cost energy savings and how to gain more substantial, long-term interventions. Additionally, in-home visits for the Energy Saving Check should be enhanced to incorporate preliminary energy efficiency assessments of the dwelling, thereby streamlining the process for identifying eligible households. It is therefore recommended that the energy consultants undergo further training in order to ensure that they are adequately prepared for this new role.

Finally, according to expert recommendations, data should be used more effectively while adhering to data protection measures (Rosenow, 2024; Copeland, 2024). As a result, the Energy Saving Check's insights on household types and energy consumption patterns should inform the deployment of EEOS measures, ensuring that assistance reaches those who need it most while avoiding redundancy and inefficiencies.

6.2. Discussion on the Energy Efficiency Obligation Scheme Policy Proposal

The following chapter discusses the main findings and beds them into existing literature. Moreover, the potential limitations of the analysis are highlighted.

6.2.1. Policy Design Features

The results of this study revealed that the design of an EEOS for Germany requires careful adaptation to the national context, supporting the notion that a “one-size-fits-all” approach is unsuitable for addressing energy poverty. This finding aligns with previous research suggesting that effective policy solutions must consider political, geographical, economic, and social factors unique to each country (Bissiri et al., 2019, p. 566). It also aligns with recommendations of the European Parliament (2016), which highlighted that social policies tailored to each member state should be evaluated individually, considering factors such as the country’s housing tenure systems, variations in national social security frameworks, and other relevant aspects. This is deemed particularly crucial in the initial phases, where energy efficiency measures have yet to significantly impact the existing building stock inhabited by those in energy poverty. The recommendation also stressed that broader definition of energy poverty at the EU level, adaptable at the local level, would be beneficial for effectively monitoring and developing the right mix of social and energy efficiency policies (European Parliament, 2016, pp. 70–76). While this energy poverty definition has already been implemented on the European level in the meantime, there is a lack of an EU-wide definition across all member states. Cludius et al. (2018, p. 58) underscored the importance of defining such a concept and its associated indicator to facilitate the identification and targeting of a comprehensive cross-country evaluation.

This proposal aligned in several design features with the recommendation from previous studies focused on proposing an EEOS targeted on energy efficiency for Germany (Schlomann et al., 2021; Öko-Institut e.V. and Fraunhofer Institut für System- und Innovationsforschung, 2012). Those include for instance the obligation of energy suppliers due to the consumer proximity or the prohibition of double funding. However, this proposal also puts forward diverging recommendations on the design of several policy features. While this thesis proposed allowing the trading of obligations without producing certificates, other studies, such as Schlomann et al. (2021), recommended introducing white certificates. Both approaches aim to encourage the growth of the market for energy efficiency solutions, with a focus on the market-based nature of this instrument. This discrepancy in design illustrates the complexity involved in developing an effective EEOS and demonstrates that several viable approaches can coexist, each with its own benefits and challenges. A notable distinction of this proposal is the use of lifetime bill savings as the reference value for the savings target. This approach differs from previous studies that suggest using final energy consumption as the benchmark (Schlomann et al., 2021; Öko-Institut e.V. and Fraunhofer Institut für System- und Innovationsforschung, 2012). This thesis's choice reflects a clear focus on reducing energy poverty, rather than solely increasing energy efficiency. By using lifetime bill saving as the reference value, the impact on vulnerable households' energy bills is given greater emphasis, thus directly addressing the financial aspect of energy poverty.

The design of eligibility criteria is another critical aspect of this EEOS proposal. The ECO4 analysis revealed several limitations to the current eligibility criteria. While this thesis did not identify a definitive best approach, it highlighted the potential of area-based targeting as a promising strategy for identifying eligible households. This approach, supported by several publications (Bridgen & Robinson, 2023; James Dyson, 2024; Walker et al., 2013; Rosenow et al., 2013), offers a way to efficiently target energy poverty at a community level. However, as noted by the researchers during the discussion session, implementing an area-based approach may require intensive analytical work to design a comprehensive catalogue of criteria and a robust definition process. This suggests that it is challenging to identify an optimal approach that is both fair and effective in targeting eligible households while also ensuring that the sourcing process is straightforward and cost-effective.

6.2.2. Overall Research Approach

While this study provides valuable insights into the design of an EEOS for Germany, it is crucial to acknowledge the limitations of this analysis's research approach.

One limitation is the methodology employed for designing the policy proposal. While the policy proposal was built on the conclusions from the expert interview, the descriptive analysis, a discussion session with German researchers and the review of design features in other countries, this study lacked more rigorous and systematic methodologies that could have enhanced the reliability and validity of the findings. While the policy formulation literature proposes methodologies such as the multi-criteria-analysis or cost-benefit analysis for designing policies (Jordan & Turnpenny, 2015, p. 21), this approach was not considered due to time constraints.

Furthermore, the thesis fails to address how to implement and communicate the proposed policy, which are essential for successful policy adoption. The implementation of an EEOS divided into a series of phases. These include legislative procedures, engagement with stakeholders, and the creation of monitoring and enforcement mechanisms. These aspects were not addressed sufficiently in this thesis. For instance, there was no detailed discussion on the legal enforcement of the obligation, the penalties that could be imposed for non-compliance, or the work of the regulatory body responsible for overseeing the scheme. Furthermore, a communication strategy is critical for the EEOS's acceptance and effectiveness. This thesis does not provide guidance on how to frame the policy in a way that will gain support from various political actors, interest groups and the public. The lack of a defined communication strategy may result in confusion regarding the policy's objectives and mechanisms, which could ultimately impede its effectiveness.

7. Conclusion and Outlook

This thesis aims to address the pressing issue of energy poverty in Germany, a problem exacerbated by recent sharp rises in energy prices. While short-term measures such as energy price reductions have been implemented, Germany lacks a comprehensive, long-term policy to sustainably reduce energy poverty. While some publications recommended new measures to address energy poverty in Germany, a concrete policy proposal targeting energy-poor households through implementing energy efficiency improvements in a targeted and sustainable way is still lacking. To fill this gap, this thesis developed a policy proposal for an Energy Efficiency Obligation Scheme (EEOS). This proposal aims at alleviating energy poverty in Germany by incentivising energy efficiency improvements in eligible households, building on the emulation of the British Energy Company Obligation (ECO).

To assess the feasibility of transferring the ECO to Germany and identify the necessary adaptations, the study applied a framework based on the work of Mossberger and Wollman (2013) and William and Dzhekova (2015). This framework also included an assessment of the limitations of the ECO to avoid replicating any potential drawbacks. Based on these findings, a discussion with two German researchers on the policy proposal and the policy designs from other countries (in the absence of recommendations for adjusting limiting or challenging policy features specific to Germany), the final policy proposal was designed. The results provide a sound basis for developing a sustainable, long-term policy to alleviate energy poverty in Germany by incentivising targeted energy efficiency improvements.

The findings of the study highlight the challenges in directly applying the UK's ECO4 to Germany and emphasize the need for a tailored approach when developing an EEOS for Germany. This challenges the notion of universal solutions for addressing energy poverty. The findings align with previous research that stresses the importance of considering country-specific political, geographical, economic, and social factors when designing effective policies. Our proposed EEOS for Germany includes several key adjustments to reflect these national characteristics. Notably, housing stock, energy supplier structures, and existing legislation have been identified as critical reasons for adapting the policy to the German context. For the latter, adjustments are needed to avoid potential overlaps or conflicts with existing legislation.

Additionally, limitations in the ECO4's design were identified, that should be avoided in Germany. Specifically, the policy is ineffective in reaching all energy-poor households, especially those with the most severe form. A paradox also emerged: the more precisely the policy targets eligible households, the higher the sourcing costs, which reduces the funds available for energy efficiency improvements. Moreover, ECO4 overlooks the private rental sector, which is a significant challenge in Germany, where a substantial proportion of dwellings are rented. While several options for adjusting the eligibility criteria have been proposed, each carries its own set of advantages and disadvantages, making it difficult to determine the optimal solution.

There are several potential avenues for future research. Further consideration should be given to the evaluation criteria used to assess the transferability and applicability of the ECO4 to Germany. Future research could encompass a wider range of characteristics, as recommended by William and Dzhekova (2014), and potentially beyond. The additional criteria could encompass financial resources, social acceptability and political feasibility. By widening the scope of the evaluation, researchers would be able to obtain a more comprehensive insight into the hurdles and opportunities associated with adapting the ECO4 to the German context.

Another crucial area that requires deeper investigation is the potential interplay between the proposed EEOS and the existing German policies. The current study acknowledges a gap in this area, which future research could address by conducting a comprehensive analysis of how the proposed EEOS would need to be adapted to prevent any negative interactions with the current German policy landscape. Furthermore, potential synergies with the Electricity Saving Check could be explored, which could include gaining a deeper understanding of the challenges and opportunities presented by this existing instrument, as well as developing a plan for how such a synergy could be implemented.

A further avenue for future research would be to determine how Germany could define energy poverty, and which indicator would be most suitable for measuring it. Currently, there is no official definition or indicator for energy poverty in place in Germany, which makes it challenging to effectively identify and address energy poverty on a national scale. This could facilitate German policymakers to establish a clear energy poverty definition and indicator. Such an implementation would provide a national-wide blueprint for identifying energy-poor households, allowing for more targeted policy interventions, and ensure the more efficient distribution of resources to address energy poverty across different regions.

The limited number of expert interviews regarding the performance of ECO4 in the thesis also provides an opportunity for expansion. Future research could benefit from engaging with a wider range of experts. This could involve interviewing additional stakeholders in the UK to gain a more nuanced understanding of the ECO4's successes factors and limitations. By incorporating a wider range of expert opinions, researchers could gain a more nuanced understanding of the policy's performance to ensure a more successful implementation in Germany.

Furthermore, future research could utilize more available information sources on ECO4 to better understand its performance. As an example, researchers could analyse feedback forms submitted by energy suppliers at the conclusion of each obligation period. These forms, which are publicly available online, could offer valuable insights into the industry's perception of the design and implementation of the instrument. By incorporating these additional sources, future studies could present a more complete picture of the factors contributing to the success of the ECO4, as well as any potential limitations.

Stakeholder engagement is another avenue for future research. This thesis lacks up-to-date stakeholder views on the EEOS's potential to address energy poverty. It would be beneficial for future studies to conduct interviews with a wide range of German stakeholders on the proposed EEOS, including environmental organisations, industry representatives, policymakers, and consumer advocacy groups. These interviews could yield valuable insights into the diverse viewpoints on the proposed policy, which could inform modifications to the policy proposal design or highlight strategies for more effective stakeholder involvement in the implementation process.

Moreover, future research should concentrate on optimising the proposed EEOS. A comprehensive cost-benefit analysis should be conducted to determine the most effective eligibility criteria. This would guarantee that the policy targets the most vulnerable households while ensuring the most cost-effective outcome. Moreover, a scenario analysis could forecast the potential outcomes of the proposed EEOS under different economic conditions and benchmark it against alternative policy options to ascertain its suitability for Germany. This will allow the policy proposal to be refined to make it more robust, tailored and appealing to German policymakers, thus facilitating the discussion on alleviating energy poverty in Germany.

8. References

Bhattacharyya, S. C. (2019). *Energy economics: Concepts, issues, markets and governance* (2nd ed. 2019). *Springer eBook Collection*. Springer. https://doi.org/10.1007/978-1-4471-7468-4

Bissiri, M., Reis, I. F., Figueiredo, N. C., & Da Pereira Silva, P. (2019). An econometric analysis of the drivers for residential heating consumption in the UK and Germany. *Journal of Cleaner Production*, *228*, 557–569. https://doi.org/10.1016/j.jclepro.2019.04.178

Boardman, B. (1991). *Fuel poverty: From cold homes to affordable warmth* (1. publ). Belhaven Press.

Boardman, B. (2012). Fuel poverty synthesis: Lessons learnt, actions needed. *Energy Policy*, *49*, 143–148. https://doi.org/10.1016/j.enpol.2012.02.035

Bogner, A., Littig, B., & Menz, W. (Eds.). (2009). *Experteninterviews: Theorien, Methoden, Anwendungsfelder* (3., grundlegend überarbeitete Auflage). VS Verlag für Sozialwissenschaften.

Bouzarovski, S. (2018). *Energy Poverty: (Dis)Assembling Europe's Infrastructural Divide*. *SpringerLink Bücher*. Springer International Publishing. https://doi.org/10.1007/978-3-319-69299-9

Bridgen, P., & Robinson, C. (2023). A decade of fuel poverty in England: A spatio-temporal analysis of needs-based targeting of domestic energy efficiency obligations. *Energy Research & Social Science*, *101*, 103139. https://doi.org/10.1016/j.erss.2023.103139

Bruegel. (2023). *National fiscal policy responses to the energy crisis: Germany*. https://www.bruegel.org/system/files/2023-07/Methodology%20Figure%201%20-%20with%20split_31%20July%2023.xlsx

Bund für Naturschutz und Umwelt in Deutschland. (2024, July 15). *Energieeffizienzpolitik in der Sackgasse: BUND und DUH reichen Beschwerde ein*. https://www.bund.net/themen/aktuelles/detail-aktuelles/news/energieeffizienzpolitik-in-der-sackgasse-bund-und-duh-reichen-beschwerde-ein/

Bundesagentur für Arbeit. (November 2021). *Klassifikation der Berufe 2010 – überarbeitete Fassung 2020 Band 2: Definitorischer und beschreibender Teil*. 16.07.2024

Bundesamt für Wirtschaft und Ausfuhrkontrolle. (2024a). *Bundesförderung für effiziente Gebäude*. https://www.bafa.de/DE/Energie/Effiziente_Gebaeude/Sanierung_Wohngebaeude/sanierung_wohngebaeude_node.html

Bundesamt für Wirtschaft und Ausfuhrkontrolle. (2024b, September 15). *Aktivitäten*. https://www.bfee-online.de/BfEE/DE/BfEE/Aktivitaeten/aktivitaeten_node.html

Bundesamt für Wirtschaft und Ausfuhrkontrolle. (2024c, September 15). *Monitoring und Berichte auf EU-Ebene*. https://www.bfee-online.de/BfEE/DE/Monitoring/MonitoringBerichte/monitoringberichte_node.html

Stromsteuergesetz, March 24, 1999. https://www.gesetze-im-internet.de/stromstg/BJNR037810999.html

Energiesteuergesetz, July 15, 2006. https://www.gesetze-im-internet.de/energiestg/BJNR153410006.html

Gesetz für den Ausbau erneuerbarer Energien, July 21, 2014. https://www.gesetze-im-internet.de/eeg_2014/BJNR106610014.html

Gesetz über einen nationalen Zertifikatehandel für Brennstoffemissionen, December 12, 2019. https://www.gesetze-im-internet.de/behg/BJNR272800019.html

Gesetz zur Einsparung von Energie und zur Nutzung erneuerbarer Energien zur Wärme- und Kälteerzeugung in Gebäuden, August 8, 2020. https://www.gesetze-im-internet.de/geg/

Gesetz zur Aufteilung der Kohlendioxidkosten (Kohlendioxidkostenaufteilungsgesetz), December 5, 2022. https://www.gesetze-im-internet.de/co2kostaufg/BJNR215400022.html

Bundesgesetz über die Verbesserung der Energieeffizienz bei Haushalten, Unternehmen und dem Bund sowie Energieverbrauchserfassung und Monitoring, 2004. https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=20008914&Fassung

Richtlinie für die Bundesförderung für effiziente Gebäude, 2023. https://www.bafa.de/SharedDocs/Downloads/DE/Energie/beg_richtline_beg_em_20231221_PDF.pdf?__blob=publicationFile&v=2

Bundesministerium für Wirtschaft und Energie. (2023). *Update of the integrated national Energy and climate plan: Draft*. https://www.bmwk.de/Redaktion/EN/Downloads/M-O/necp-draft-2023.pdf?__blob=publicationFile&v=1

Bundesministerium für Wirtschaft und Klimaschutz. (2024). *Fachkräfte für Deutschland*. https://www.bmwk.de/Redaktion/DE/Dossier/fachkraeftesicherung.html

Bundesnetzagentur, & Bundeskartellamt. (2023). *Monitoringbericht 2023*. https://data.bundesnetzagentur.de/Bundesnetzagentur/SharedDocs/Mediathek/Monitoringberichte/MonitoringberichtEnergie2023.pdf

Bundesverband der Energie- und Wasserwirtschaft e.V. (2021). *Stellungnahme zum Vorschlag der Europäischen Kommission einer Richtlinie zur Energie-effizienz vom 14.07.2021*. https://www.google.com/url?sa=t&source=web&rct=j&opi=89978449&url=https://www.bdew.de/media/documents/BDEW_Stellungnahme_zu_EED2021_final_online.pdf&ved=2ahUKEwiI-ff8i6mHAxWx0gIHHeSYDeYQFnoECBQQAQ&usg=AOvVaw17OoDvb-AGgY-GIisGsWEu

Bundesverband der Energie- und Wasserwirtschaft e.V. (2024). *Fachkräfte sichern. Energiewende antreiben*. https://www.bdew.de/energie/dossier-fachkraeftesicherung/

Burstedde, A. (2023). *Die IW-Arbeitsmarktfortschreibung: Wo stehen Beschäftigung und Fachkräftemangel in den 1.300 Berufsgattungen in fünf Jahren? Methodenbericht.* Institut der deutschen Wirtschaft Köln e. V. https://www.iwkoeln.de/fileadmin/user_upload/Studien/Report/PDF/2023/IW-Report_2023-Arbeitsmarktfortschreibung.pdf

Camprubí, L., Malmusi, D., Mehdipanah, R., Palència, L., Molnar, A., Muntaner, C., & Borrell, C. (2016). Façade insulation retrofitting policy implementation process and its effects on health equity determinants: A realist review. *Energy Policy*, *91*, 304–314. https://doi.org/10.1016/j.enpol.2016.01.016

Carfora, A., & Scandurra, G. (2024). Boosting green energy transition to tackle energy poverty in Europe. *Energy Research & Social Science*, *110*, 103451. https://doi.org/10.1016/j.erss.2024.103451

Cludius, J., Hünecke, K., Noka, V., Schumacher, K., Förster, H., Kunert, D., & Fries, T. (2018). *Policy instruments and measures to alleviate energy poverty in Germany - learning from good practices in other European countries.* Öko-Institut e.V. https://www.google.com/url?sa=t&source=web&rct=j&opi=89978449&url=https://www.oeko.de/fileadmin/oekodoc/WP-Energy-Poverty-2018.pdf&ved=2ahUKEwj007n7l8-IAxWicPED-HUZYAQcQFnoECBYQAQ&usg=AOvVaw1Ktyj_LTZW952ieucep9jo

Copeland, M. (2024, June 19). Interview by S. Hopf.

Dettmann, E., Fackler, D., Müller, S., Neuschäffer, G., Slavtchev, V., Leber, U., & Schwengler, B. (2019). *Fehlende Fachkräfte in Deutschland -Unterschiede in den Betrieben und mögliche Erklärungsfaktoren: Ergebnisse aus dem IAB-Betriebspanel 2018: IAB-Forschungsbericht, No. 10/2019.* Institut für Arbeitsmarkt- und. https://hdl.handle.net/10419/204776

Deutsche Umwelthilfe. (2016). *Stellungnahme: Zum Grünbuch Energieeffizienz - Diskussionspapier des Bundesministeriums für Wirtschaft und Energie*. https://www.duh.de/fileadmin/user_upload/download/Projektinformation/Energieeffizienz/161031_DUH_Stellungnahme-Gruenbuch-Energieeffizienz.pdf

Deutscher Bundestag. (2023a). *1976: Als die Einsparung von Energie in Gebäuden Gesetz wurde*. https://www.bundestag.de/dokumente/textarchiv/2023/kw26-gebaeude-energie-955702

Deutscher Bundestag. (2023b). *Deutschland hat noch etwa 1,09 Millionen Sozialwohnungen*. https://www.bundestag.de/presse/hib/kurzmeldungen-967750

Directorate-General for Communication. (2023). *Update of the integrated national Energy and climate plan: Draft*. https://commission.europa.eu/document/download/c589deb5-9494-4984-9ef5-8e2ee711aaf2_en?filename=GERMANY-%20DRAFT%20UPDATED%20NECP%202021-2030%20EN.pdf

Dolowitz, D., & Marsh, D. (1996). Who Learns What from Whom: A Review of the Policy Transfer Literature. *Political Studies*, *44*(2), 343–357. https://doi.org/10.1111/j.1467-9248.1996.tb00334.x

Dong, K., Dou, Y., & Jiang, Q. (2022). Income inequality, energy poverty, and energy efficiency: Who cause who and how? *Technological Forecasting and Social Change*, *179*, 121622. https://doi.org/10.1016/j.techfore.2022.121622

Drescher, K., & Janzen, B. (2021). Determinants, persistence, and dynamics of energy poverty: An empirical assessment using German household survey data. *Energy Economics*, *102*, 105433. https://doi.org/10.1016/j.eneco.2021.105433

Dyson, J. (2024). *The Future of the Energy Company Obligation: Boosting delivery to tackle fuel poverty and upgrade homes*. E3G. https://www.e3g.org/wp-content/uploads/The-future-of-ECO.pdf

Emden, J., Murphy, L., & Lloyd, H. (2024, September 25). *Evaluating the Energy Company Obligation* (BEYOND ECO). Institute for Public Policy Research (IPPR). http://www.jstor.org/stable/resrep53587.8

Energy Saving Policies. (2016). *Energy Saving Policies and Energy Efficiency Obligation Scheme: D2.1.1: Report on existing and planned EEOs in the EU – Part II: Description of planned schemes*. https://energypedia.info/images/8/88/ENSPOL_Report_on_existing_EEOs_outside_the_EU.pdf

ENSMOV. (2020). *Snapshot of Energy Efficiency Obligation Schemes in Europe (as of end 2019)*. https://ensmov.eu/wp-content/uploads/2020/06/ENSMOV_Snapshot_EEOS_provisional.pdf

EU Energy Poverty Observatory. (2020a). *Member State Reports on Energy Poverty 2019*. https://op.europa.eu/en/publication-detail/-/publication/b9a25ba4-9ef6-11ea-9d2d-01aa75ed71a1/language-en

EU Energy Poverty Observatory. (2020b). *Towards an inclusive energy transition in the European Union: Confronting energy poverty amidst a global crisis*. Publications Office of the European Union. https://doi.org/10.2833/103649

European Commission. (2023, October 23). *Commission publishes recommendations to tackle energy poverty across the EU*. https://energy.ec.europa.eu/news/commission-publishes-recommendations-tackle-energy-poverty-across-eu-2023-10-23_en

European Commission. (2024a). *ETS2: buildings, road transport and additional sectors*. https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/ets2-buildings-road-transport-and-additional-sectors_en

European Commission. (2024b). *ETS2: buildings, road transport and additional sectors*. https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/ets2-buildings-road-transport-and-additional-sectors_en

European Parliament. (2016). *Energy Efficiency and Low-Income Households*. https://www.europarl.europa.eu/RegData/etudes/STUD/2016/595339/IPOL_STU(2016)595339_EN.pdf

Directive 2012/27/EU of the European Parliament and of the Council of October 2021 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC, 2012. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012L0027

Directive (EU) 2023/1791 of the European Parliament and of the Council of 13 September 2023 on energy efficiency and amending Regulation (EU) 2023/955 (recast), 2012. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32023L1791

Directive (EU) 2023/1791 of the European Parliament and of the Council of 13 September 2023 on energy efficiency and amending Regulation (EU) 2023/955 (recast), Official Journal of the European Union (2023). https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32023L1791

Eurostat. (2017). *Glossary: Household - social statistics*. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Household_-_social_statistics

Eurostat. (2022a). *Arrears on utility bills - EU-SILC survey.* https://doi.org/10.2908/ILC_MDES07

Eurostat. (2022b). *Disaggregated final energy consumption in households - quantities.* https://doi.org/10.2908/NRG_D_HHQ

Eurostat. (2024a). *Disposable income of households (with expenditure greater than zero) spent on essential goods and services by household composition - experimental statistics.* https://doi.org/10.2908/ICW_AFF_04

Eurostat. (2024b). *Glossary:Income quintile group*. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Income_quintile_group

Eurostat. (2024c). *Inability to keep home adequately warm by level of disability (activity limitation), sex and age.* https://doi.org/10.2908/HLTH_DHC140

Eurostat. (2024d, June 6). *Harmonised index of consumer prices (HICP) (prc_hicp)*. https://ec.europa.eu/eurostat/cache/metadata/EN/prc_hicp_esmshi_de.htm

Fawcett, T., Rosenow, J., & Bertoldi, P. (2019). Energy efficiency obligation schemes: Their future in the EU. *Energy Efficiency*, *12*(1), 57–71. https://doi.org/10.1007/s12053-018-9657-1

Fizaine, F., & Kahouli, S. (2019). On the power of indicators: how the choice of fuel poverty indicator affects the identification of the target population. *Applied Economics*, *51*(11), 1081–1110. https://doi.org/10.1080/00036846.2018.1524975

Gioia, D. A., Corley, K. G., & Hamilton, A. L. (2013). Seeking Qualitative Rigor in Inductive Research. *Organizational Research Methods*, *16*(1), 15–31. https://doi.org/10.1177/1094428112452151

GOV.UK. (2024, June 26). *Standard Assessment Procedure*. https://www.gov.uk/guidance/standard-assessment-procedure

Harthan, R. O., Förster, H., Braungardt, S., Görz, W. K., Jansen, L. L., Jörß, W., Kasten, P., Loreck, C., Ludig, S., Scheffler, M., Bei der Wieden, M., Brugger, H., Fleiter, T., Mandel, T., Rehfeldt, M., Deurer, J., & Osterburg, B. (2024). *Treibhausgas-Projektionen für Deutschland.* Umweltbundesamt. https://www.umweltbundesamt.de/sites/default/files/medien/11850/publikationen/projektionsbericht_2024_instrumentenpapier.pdf

Heindl, P., & Schuessler, R. (2019). *A Deprivation-Based Assessment of Energy Poverty: Conceptual Problems and Application to Germany.* https://doi.org/10.2139/ssrn.3454425

Henger, R., & Stockhausen, M. (2022). *Gefahr der Energiearmut wächst.* Institut der deutshen Wirtschaft (iW). https://www.iwkoeln.de/fileadmin/user_upload/Studien/Kurzberichte/PDF/2022/IW-Kurzbericht_2022-Energiearmut.pdf

Howlett, M. (2019). *Designing public policies: Principles and instruments* (Second edition). *Routledge textbooks in policy studies*. Routledge Taylor & Francis Group. https://doi.org/10.4324/9781315232003

Jordan, A. J., & Turnpenny, J. R. (Eds.). (2015). *New horizons in public policy series*. *The tools of policy formulation: Actors, capacities, venues and effects*. Edward Elgar Publishing. http://hdl.handle.net/10419/182379

Koengkan, M., Fuinhas, J. A., Auza, A., & Ursavaş, U. (2023). The Impact of Energy Efficiency Regulations on Energy Poverty in Residential Dwellings in the Lisbon Metropolitan Area: An Empirical Investigation. *Sustainability*, *15*(5), 4214. https://doi.org/10.3390/su15054214

Kurmayer, N. J. (2023, October 23). Berlin warned of €200 EU carbon price shock on fuel, heating bills. https://www.euractiv.com/section/emissions-trading-scheme/news/eu-wide-carbon-price-from-2027-berlin-warned-of-e200-price-shock/

Moody, E. (2023). *PAS 2035*. https://retrofitacademy.org/knowledge/pas-2035/

Mossberger, K., & Wolman, H. (2003). Policy Transfer as a Form of Prospective Policy Evaluation: Challenges and Recommendations. *Public Administration Review*, *63*(4), 428–440. https://doi.org/10.1111/1540-6210.00306

National Records of Scotland. (2022). *Mid-2021 Population Estimates, Scotland*. https://www.nrscotland.gov.uk/files/statistics/population-estimates/mid-21/mid-year-pop-est-21-report.pdf

Nematchoua, M. K., Yvon, A., Roy, S. E. J., Ralijaona, C. G., Mamiharijaona, R., Razafinjaka, J. N., & Tefy, R. (2019). A review on energy consumption in the residential and commercial buildings located in tropical regions of Indian Ocean: A case of Madagascar island. *Journal of Energy Storage*, *24*, 100748. https://doi.org/10.1016/j.est.2019.04.022

OECD. (2024a). *OECD Affordable Housing Database - indicator HM1.3 Housing tenures*. https://www.oecd.org/content/dam/oecd/en/data/datasets/affordable-housing-database/hm1-3-housing-tenures.pdf

OECD. (2024b). *OECD Affordable Housing Database - indicator HM1.5. Residential stock by dwelling type*. https://webfs.oecd.org/Els-com/Affordable_Housing_Database/HM1-5-Housing-stock-by-dwelling-type.pdf

Ofgem. (2015, September 30). *Energy Company Obligation Final Report*. https://www.ofgem.gov.uk/sites/default/files/docs/2015/09/eco_final_report_0.pdf

Ofgem. (2022, October 19). *ECO4 Guidance: Supplier Administration*. https://www.google.com/url?sa=t&source=web&rct=j&opi=89978449&url=https://www.ofgem.gov.uk/sites/default/files/2022-

07/ECO4_SupplierAdministration_GuidanceV0.1.pdf&ved=2ahUKEwjm3JawnNiGAxWF-SPEDHYdtCm0QFnoECBUQAQ&usg=AOvVaw3RbaLOnjLJIhssDLW5QBBh

Ofgem. (2023a). *Energy Company Obligation (ECO3): Final Determination Report*. https://www.ofgem.gov.uk/sites/default/files/2023-02/ECO3%20-%20Final%20Determination%20Report.pdf

Ofgem. (2023b). *Energy Company Obligation (ECO3): Final Determination Report*. https://www.ofgem.gov.uk/sites/default/files/2023-02/ECO3%20-%20Final%20Determination%20Report.pdf

Ofgem. (2023c, August 14). *Energy Company Obligation (ECO4) Guidance: Delivery V2.0*. https://www.google.com/url?sa=t&source=web&rct=j&opi=89978449&url=https://www.ofgem.gov.uk/sites/default/files/2023-08/ECO4%2520Delivery%2520Guidance%2520v2.0_0.pdf&ved=2ahUKEwiWoNPOkdiGAxUoX_EDHcW-BTAQFnoECA4QAQ&usg=AOvVaw1TdvcQQ6o6AgLAVZKRyAtj

Ofgem. (2024a). *Number of active domestic suppliers by fuel type (GB)*.

Ofgem. (2024b, June 12). *Energy Company Obligation (ECO)*. https://www.ofgem.gov.uk/environmental-and-social-schemes/energy-company-obligation-eco

Ofgem. (2024c, June 14). *Energy Company Obligation (ECO) - Homeowners and tenants*. https://www.ofgem.gov.uk/environmental-and-social-schemes/energy-company-obligation-eco/energy-company-obligation-eco-homeowners-and-tenants

Ofgem. (2024d, June 14). *Energy Company Obligation (ECO) - Supply Chain*. https://www.ofgem.gov.uk/environmental-and-social-schemes/energy-company-obligation-eco/energy-company-obligation-eco-supply-chain

Öko-Institut e.V. (2023). *Wie viel Energie verbrauchen unsere Wohngebäude?* https://www.oeko.de/blog/wie-viel-energie-verbrauchen-unsere-wohngebaeude/

Öko-Institut e.V., & Fraunhofer Institut für System- und Innovationsforschung. (2012). *Energieeinsparquote für Deutschland? Bewertung des Instruments der Energieeinsparquote (Weiße Zertifikate) auf seine Eignung als Klimaschutzinstrument für Deutschland*. https://www.researchgate.net/publication/257412493_Energieeinsparquote_fur_Deutschland_Bewertung_des_Instruments_der_Energieeinsparquote_Weisse_Zertifikate_auf_seine_Eignung_als_Klimaschutzinstrument_fur_Deutschland#fullTextFileContent

Papadakis, N., & Katsaprakakis, D. A. (2023). A Review of Energy Efficiency Interventions in Public Buildings. *Energies*, *16*(17), 6329. https://doi.org/10.3390/en16176329

Patterson, M. G. (1996). What is energy efficiency? *Energy Policy*, *24*(5), 377–390. https://doi.org/10.1016/0301-4215(96)00017-1

Pavel, T., Polina, S., & Liubov, N. (2024). The research of the impact of energy efficiency on mitigating greenhouse gas emissions at the national level. *Energy Conversion and Management*, *314*, 118671. https://doi.org/10.1016/j.enconman.2024.118671

Pawson, R., & Tilley, N. (1997). *Realistic Evaluation*. SAGE Publications. https://www.torrossa.com/en/resources/an/5409538

Presse- und Informationsamt der Bundesregierung. (2024). *Fragen und Antworten zu den Energiepreisbremsen*. https://www.bundesregierung.de/breg-de/schwerpunkte/entlastung-fuer-deutschland/strompreisbremse-2125002

Regulatory Assistance Project. (2012). *Best Practices in Designing and Implementing Energy Efficiency Obligation Schemes*. https://www.raponline.org/wp-content/uploads/2023/09/rap-ie-adsm-bestpracticesindesigningandimplementingenergyefficiencyobligationschemes-2012-may.pdf

Arrêté du 29 décembre 2014 relatif aux modalités d'application du dispositif des certificats d'économies d'énergie - Légifrance, December 31, 2014.

Rogulj, I., Peretto, M., Oikonomou, V., Ebrahimigharehbaghi, S., & Tourkolias, C. (2023). Decarbonisation Policies in the Residential Sector and Energy Poverty: Mitigation Strategies and Impacts in Central and Southern Eastern Europe. *Energies*, *16*(14), 5443. https://doi.org/10.3390/en16145443

Rose, R. (1991). What is Lesson-Drawing? *Journal of Public Policy*, *11*(1), 3–30. https://doi.org/10.1017/S0143814X00004918

Rosenow, J. (2024, May 2). Interview by S. Hopf.

Rosenow, J., Platt, R., & Flanagan, B. (2013). Fuel poverty and energy efficiency obligations – A critical assessment of the supplier obligation in the UK. *Energy Policy, 62*, 1194–1203. https://doi.org/10.1016/j.enpol.2013.07.103

Saunders, H. D., Roy, J., Azevedo, I. M., Chakravarty, D., Dasgupta, S., La Rue Can, S. de, Druckman, A., Fouquet, R., Grubb, M., Lin, B., Lowe, R., Madlener, R., McCoy, D. M., Mundaca, L., Oreszczyn, T., Sorrell, S., Stern, D., Tanaka, K., & Wei, T. (2021). Energy Efficiency: What Has Research Delivered in the Last 40 Years? *Annual Review of Environment and Resources*, *46*(1), 135–165. https://doi.org/10.1146/annurev-environ-012320-084937

Schirner, S., Hickmann, H., Werner, D., & Dr. Malin, L. (2021). *Fachkräfteengpässe in Unternehmen - Fachkräftemangel und Nachwuchsqualifizierung im Handwerk.* Institut der deutschen Wirtschaft Köln e. V. https://hdl.handle.net/10419/233865

Schlomann, B., Rohde, C., & Bentele, S. (2021). *Mögliche Ausgestaltung eines Energieeinsparverpflichtungssystems für Deutschland: Abschlussbericht.* Umweltbundesamt. https://www.umweltbundesamt.de/sites/default/files/medien/5750/publikationen/2021-02-26_cc_11-2021_energieeinsparverpflichtungssystem.pdf

Spitzenverband der Gebäudetechnik. (2018). *Fachkräftebedarf für die Energiewende in Gebäuden*. https://www.vdzev.de/wp-content/uploads/2021/01/VdZ_Prognos_Kurzstudie.pdf

Steinbacher, K. (2015). Drawing Lessons When Objectives Differ? Assessing Renewable Energy Policy Transfer from Germany to Morocco. *Politics and Governance*, *3*(2), 34–50. https://www.cogitatiopress.com/politicsandgovernance/article/view/192/165

Stojilovska, A., Guyet, R., Mahoney, K., Gouveia, J. P., Castaño-Rosa, R., Živčič, L., Barbosa, R., & Tkalec, T. (2022). Energy poverty and emerging debates: Beyond the traditional triangle of energy poverty drivers. *Energy Policy, 169*, 113181. https://doi.org/10.1016/j.enpol.2022.113181

Stromspar-Check. (2024a). *Beratung*. https://www.stromspar-check.de/stromspar-check/beratung

Stromspar-Check. (2024b). *Kostenfreie Soforthilfen im Stromspar-Check*. https://www.stromspar-check.de/stromspar-check/soforthilfen

Stromspar-Check. (2024c). *Kostenfreie Soforthilfen im Stromspar-Check*. https://www.stromspar-check.de/stromspar-check/soforthilfen

Stromspar-Check. (2024d). *Kühlgerätetausch*. https://www.stromspar-check.de/stromspar-check/kuehlgeraetetausch

Stromspar-Check. (2024e). *Verbundpartner*. https://www.stromspar-check.de/wir-ueber-uns/verbundpartner

Strünck, C. (2017). *Energiearmut bekämpfen – Instrumente, Maßnahmen und Erfolge in Europa.* Friedrich-Ebert-Stiftung. https://www.google.com/url?sa=t&source=web&rct=j&opi=89978449&url=https://library.fes.de/pdf-files/wiso/13273-20170403.pdf&ved=2ahUKEwioyMPXjdyIAxVzSfED-HeyFLE8QFnoECBcQAQ&usg=AOvVaw2XITNVHHe59Wi-QiyugOSe

Sunderland, L., & Thomas, S. (2021). *EU Policy Guide: The Energy Efficiency Directive Energy Savings Obligation and Energy Poverty Alleviation*. https://socialwatt.eu/sites/default/files/news/Policy%20Brief%20EP%20and%20EEOSs%20ENSMOV.pdf

Thema, J., & Vondung, F. (2020). *EPOV Indicator Dashboard: Methodology Guidebook.* Wuppertal Institut für Klima, Umwelt, Energie GmbH.

Thomson, H., Bouzarovski, S., & Snell, C. (2017). Rethinking the measurement of energy poverty in Europe: A critical analysis of indicators and data. *Indoor + Built Environment : The Journal of the International Society of the Built Environment*, *26*(7), 879–901. https://doi.org/10.1177/1420326X17699260

Trustmark. (2024, June 14). *Who is Trustmark?* https://www.trustmark.org.uk/about/who-is-trustmark

Ürge-Vorsatz, D., & Tirado Herrero, S. (2012). Building synergies between climate change mitigation and energy poverty alleviation. *Energy Policy*, *49*, 83–90. https://doi.org/10.1016/j.enpol.2011.11.093

Verband kommunaler Unternehmen e.V. (2024, July 15). *Energieeffizienzgesetz: Ersteinschätzung zum Referentenentwurf: VKU*. https://www.vku.de/presse/pressemitteilungen/energieeffizienzgesetz-ersteinschaetzung-zum-referentenentwurf/

Verbraucherzentrale Nordrhein-Westfalen e.V. (2021). *Energiearmut - Nein Danke! Ideen und Hilfestellungen für die praktische Arbeit vor Ort*. https://www.verbraucherzentrale.nrw/sites/default/files/2022-02/vznrw_praxisleitfaden_energiearmut-nein_danke_2022_interaktiv.pdf

Walker, R., Liddell, C., McKenzie, P., & Morris, C. (2013). Evaluating fuel poverty policy in Northern Ireland using a geographic approach. *Energy Policy*, *63*, 765–774. https://doi.org/10.1016/j.enpol.2013.08.047

Walters, G. (2024, May 23). Interview by S. Hopf.

Wang, C., & Nie, P. (2018). How rebound effects of efficiency improvement and price jump of energy influence energy consumption? *Journal of Cleaner Production*, *202*, 497–503. https://doi.org/10.1016/j.jclepro.2018.08.169

Warren, P. (2017). Transferability of demand-side policies between countries. *Energy Policy*, *109*, 757–766. https://doi.org/10.1016/j.enpol.2017.07.032

(2019).

Welsh Government. (2024, September 9). *Dwelling stock estimates by year and tenure*. https://statswales.gov.wales/Catalogue/Housing/Dwelling-Stock-Estimates/dwellingstockestimates-by-year-tenure

Williams, C. C., & Dzhekova, R. (2014). Evaluating the Cross-National Transferability of Policies: A Conceptual Framework. *Journal of Developmental Entrepreneurship*, *19*(04), 1450022. https://doi.org/10.1142/S1084946714500228

Wirl, F. (2015). White certificates — Energy efficiency programs under private information of consumers. *Energy Economics*, *49*, 507–515. https://doi.org/10.1016/j.eneco.2015.03.026

Wolman, H. (1992). Understanding Cross National Policy Transfers: The Case of Britain and the US. *Governance*, *5*(1), 27–45. https://doi.org/10.1111/j.1468-0491.1992.tb00027.x

9. Appendices

Appendix A: Original Set of Questions according to Williams & Dzekova (2014)

Table 11: Framework for evaluating transferability and applicability of policies. Own table based on William & Dzekova, 2014.

Construct	Factors/Criteria	Questions to Ask
Transferability	Magnitude of issue in target context	Does the need exist? Is it already addressed by other policies?
		What is the prevalence of the issue in the local context?
		What is the difference in the risk status/issue prevalence between the donor and target setting?
	Objective of the intervention	Is the measure targeting the same priority objective in the donor and target context?
	Magnitude of "reach" vs. cost effectiveness of the measure	Will the intervention broadly "cover" the target group? Is it proportionate to the costs involved?
	Target group characteristics	Are they comparable to the country of origin?
		Will any differences in characteristic affect implementation in the target setting?
Applicability	Political acceptability	Does the objective of the measure match with political priorities?
		What are the government's indicators for success of the measure?
		Is there political opposition in the current climate?
	Social acceptability	Will the target population be interested in the intervention?
	Impact on other affected interest groups/stakeholders: winners and losers	Does the measure contradict the interests of any important stakeholders/interest groups? (trade unions, etc.)
	Existing institutional/policy infrastructure	Is the measure's potential impact contradicting/cancelling out/overlapping with existing policies? Is the institutional and legislative infrastructure in place?
	Available resources	Financial, human resources, training required?
		Administrative/enforcement capacity in place?
	Other local barriers and implementation risks (structural constrains)	Risk of deformities in implementation due to other structural/cultural constraining factors, inefficient institutions, immaturity of the economic/financial system, political volatility.

Appendix B: Methodologies for Transferability and Applicability Assessment

Appendix B.1: Methodology on Existing Energy Policies in Germany

This section aims to analyse the question: *"Is energy poverty already addressed by other policies?"*. "Energy poverty" occurs when a "household is unable to secure a level and quality of domestic energy services - space cooling and heating, cooking, appliances, information technology - sufficient for its social and material needs" (Bouzarovski, 2018, p. 1). "Other policies" include all relevant national-level policies targeting energy poverty, with a particular emphasis on those outlined in Germany's 2023 NECP (Directorate-General for Communication, 2023).

This thesis employed a document analysis to systematically assess the policies implemented by the federal government to address energy poverty. The analysis used predefined categories derived from the three main drivers of energy poverty, as identified in the literature (Boardman, 2012, p. 143; Ürge-Vorsatz & Tirado Herrero, 2012, p. 87).: low income, high energy expenditures, and low energy efficiency. The categories were used to classify policies, but it should be noted that they are not intended to strictly isolate one cause from another, as these factors often overlap in practice. The categories rather aim to guide the extraction and analysis.

The 2023 draft of Germany's NECP (Directorate-General for Communication, 2023) was selected as the primary source due to its comprehensive and authoritative account of national measures to combat energy poverty. Other relevant documents were also considered, but the NECP was found to be a reliable source, providing a proper overview of instruments alleviating energy poverty in Germany.

The document analysis was conducted using an inductive coding approach based on the methodology set out by Gioia et al. (2013). The initial stage of the analysis involved first-order coding, whereby codes were developed from the text and kept close to the original wording. These were then grouped into broader second-order themes, which were abstracted into three main dimensions: low-income, high energy expenditure, and low energy efficiency.

Appendix B.2: Methodology on the Prevalence of Energy Poverty in Germany

This chapter aims to analyse the question: "*What is the prevalence of energy poverty in Germany?"* by utilizing available datasets. The definition of energy poverty remains consistent with that described in Appendix B.1. The term "prevalence" refers to the proportion of households or individuals within a population that experience energy poverty at a given time.

Given the limited timeframe of this thesis, a secondary data analysis using existing datasets for Germany was conducted. This analysis focused on the visualization and qualitative discussion of those energy poverty indicators. The primary consensual indicators from the EU Energy Poverty Observatory (EPOV) were selected because of their comprehensiveness, methodological rigor, and relevance to studying energy poverty in Germany. These indicators were chosen over alternative methods because of their consistency in measurement across EU countries and over time, which is relevant in the comparison of the prevalence of energy poverty of Germany and the UK.

EPOV applied two primary consensual energy poverty indicators. Those were drawn from self-reported experiences of restricted access to energy services (Thema & Vondung, 2020). These indicators focus on self-reported data concerning energy access and affordability. They include (Thema & Vondung, 2020, p. 11):

1. *Population Unable to Keep Home Adequately Warm*: Households were questioned if they can afford to keep their home adequately warm.
2. *Arrears on Utility Bills*: Households were asked whether they had been in arrears with their utility bills (heating, electricity, gas, water, etc.) in the past twelve months due to financial difficulties.

The percentage of population in energy poverty is calculated using the proportion of households that responded "yes" to these questions.

The results for the consensus-based indicators were compiled from the start of each indicator until the most recent update in 2023, using micro-data from the EU-SILC survey (Eurostat, 2024c; Eurostat, 2022a). The results for both indicators were then presented in graphical form over time to show certain trends. This graphical presentation was followed by a qualitative discussion, focusing on patterns, anomalies, and implications of energy poverty in Germany.

Appendix B.3: Methodology on the Comparison of Prevalence of Energy Poverty in Germany and the UK

This section aims to analyse the question: "*What is the difference in the prevalence of energy poverty between the UK and Germany?"* by utilizing available datasets. The conceptualization of "energy poverty" and "prevalence" remained consistent with the definitions established in Appendices B.1 and B.2.

In accordance with the methodology set out in Appendix B.2, this analysis employed the EU-SILC survey data provided by Eurostat for the UK (Eurostat, 2024c; Eurostat, 2022a). The data were then compared with the findings from Germany. Please refer to Appendix B.2 for further details on the indicators used.

The data collection method was in accordance with the description provided in Appendix B.2. Please note that, due to Brexit, the data from the consensual-based indicators are only available up until 2018. Consequently, the data comparison for the two countries was limited to the period during which data was available for both (up to 2018). This represents a limitation of the study, as it precludes a direct comparison of more recent trends in energy poverty in the UK and Germany beyond 2018.

The data from both countries were presented in graphical form to illustrate the trends in energy poverty indicators over time. The visualisations enabled a comparative analysis of the prevalence of energy poverty in the UK and Germany. The results were then discussed qualitatively, with particular attention paid to the key differences and similarities in energy poverty trends between the two countries.

Appendix B.4: Methodology on Objective of the Intervention

This section aims to analyse the question: "*Is the intervention targeting the same priority objective in the UK and Germany?".* In this thesis, "intervention" is defined as the Energy Efficiency Obligation Scheme, currently implemented in the UK as the ECO4 and proposed to be transferred to Germany. The "priority objective" refers to the specific aim intended to be achieved through the policy's implementation.

To assess alignment between the priority objectives in both countries, the objective targeted by the policy proposal for Germany was laid out and systematically compared to the priority objective of the ECO4 in the UK. The comparison was carried out by examining thematic similarities and differences between the two policy objectives. Data on the priority objective in the UK was collected by reviewing official documents from Ofgem, with two primary sources (Ofgem, 2023a; Ofgem, 2023c) selected due to their reliability as they directly source from the regulator Ofgem.

Appendix B.5: Methodology on Comparability of energy-poor household characteristics

This section aimed to analyse the question: "*Are the characteristics of energy-poor households in Germany comparable to those in the UK?*". For this analysis, the definition of a "household" followed the EU-SILC definition where a household is "a housekeeping unit or, operationally, a social unit with common arrangements, sharing household expenses or daily needs in a shared common residence" (Eurostat, 2017). In this thesis an "energy-poor household" is one that is impacted by energy poverty. Energy poverty occurs "when a household is unable to secure a level and quality of domestic energy services - space cooling and heating, cooking, appliances, information technology - sufficient for its social and material needs" (Bouzarovski, 2018, p. 1).

A review of the literature on energy poverty drivers by Fizaine and Kahouli (2019) identified the variables that best describe a typical profile of an energy-poor household. A holistic approach would be to use the aforementioned characteristics to determine the differences of energy-poor household characteristics between the two countries. However, differences in data collection methodologies for the variables in question between the UK and Germany, along with limitations in access to data on these variables, precluded their use for this analysis. Instead, the comparison focused on the *disposable income of households (with expenditures greater than zero) spent on essential goods and services by income quantiles* indictor (Eurostat, 2024a). Data for 2015 were selected due to the unavailability of comparable data after Brexit. The comparison used household expenditures on electricity, gas, and other fuels as the key indicator.

Appendix B.6: Methodology on Comparability of Dwelling Stock Characteristics

This section aims to analyse the question: "*Are the dwelling stock characteristics in Germany comparable to those in the UK?*". According to the OECD, "dwelling stock" refers to the total number of occupied dwellings in a country. They further defined dwelling as a "a room or suite of rooms and its accessories in a permanent building or structurally separated part thereof which by the way it has been built, rebuilt, converted, etc., is intended for private habitation. It should have a separate access to a street (direct or via a garden or grounds) or to a common space within the building (staircase, passage, gallery, etc.)" (OECD, 2024b, p. 1). In this context, the characteristics of dwellings are those which are linked to energy poverty or the implementation of the policy in discussion. The earlier discussed studies on drivers influencing energy poverty also addressed the dwelling characteristics (Fizaine & Kahouli, 2019). Characteristics like the housing tenure, heating source and construction period are listed in their publication. Following the methodology is presented for each characteristic.

Appendix B.6.1: Methodology on Comparability of Dwelling Stock Characteristics – Housing Tenure

The term "housing tenure" refers to the legal or financial agreements that regulate the use of a property by an individual or household. It defines the relationship between the tenant and the property in terms of ownership, rights and responsibilities (OECD, 2024a). This thesis divided housing tenure in accordance with the consulted sources (Office for National Statistics, 2023b; Scottish Government, 2022; DESTATIS, 2024) into three categories: owner-occupied, private rented, and social housing.

To assess the comparability of housing tenure between Germany and the UK, secondary data was employed. For Germany, data from the Mikrozensus 2022 (DESTATIS, 2024) was used. For the UK, data from Scotland and data from England and Wales were merged. Specifically, data from the 2021 Housing statistics (Scottish Government, 2022) was used for Scotland, and Census 2021 (Office for National Statistics, 2023b) for England and Wales.

The merging of data from Scotland and from England and Wales was necessary to provide a comprehensive picture of heating sources across the UK. The merging process involved aligning the categories from both datasets to ensure consistency. In Scotland, the division between private rented and social housing is not clearly defined. For this study, private rented housing includes the categories "Total number of dwellings rented privately or with a job/business" and "Total number of vacant private dwellings and second homes," while social housing includes the categories "Total number of dwellings from housing associations" and "Total number of dwellings from local authorities, New Towns, and Scottish Homes" as named in the housing statistics (Scottish Government, 2022).

The total number of dwellings for each category in England, Wales, and Scotland was then summarized, and their respective shares were calculated. The German data was treated similarly. The DESTATIS dataset (2024) lacked an overview of social housing, which is likely included in the private rented category. Accordingly, the number for social housing (1.09 million) as reported by the German government (Deutscher Bundestag, 2023b) was incorporated into the analysis, with the result subtracted from the figure for private rented housing. The final shares for the UK and Germany were presented in a table and qualitatively discussed, considering the different shares between the two regions.

This analysis compared data from 2022 for Germany and 2021 for the UK, due to the unavailability of more recent data for the UK and the absence of German data for 2021. While it is acknowledged that there may have been some shifts in housing tenure shares in the UK between 2021 and 2022, it is assumed that these changes are minimal and do not significantly affect the overall comparability of the datasets.

Appendix B.6.2: Methodology on Comparability of Dwelling Stock Characteristics – Heating Source

"Heating sources" refer to those used for heating, cooling and water heating in a household, which is in accordance with the indicator used here. To assess the comparability of heating sources between Germany and the UK, secondary data was employed. For both countries, the disaggregated final energy consumption in households by Eurostat was employed (Eurostat, 2022b). Due to Brexit, the data from 2018 was compared.

In this thesis, heating sources were categorized based on the following groups: Gas, Oil, Renewables, District Heating, Electricity and Solids. Gas includes natural gas and liquified natural gas. Oil includes oil and petroleum products, liquefied petroleum gases, other kerosene, gas oil and diesel oil. Renewables include renewables and biofuels, solar thermal, ambient heat (heat pumps), primary solid biofuels and biogases. District heating only includes district heating. Electricity only includes electricity and solids include solid fossil fuels, peat, peat products, oil shale and oil sands (Eurostat, 2022b).

The final shares of energy sources for the UK and Germany were presented in a table and discussed qualitatively. The qualitative analysis considered the differences in energy source distribution across the two regions.

Appendix B.6.3: Methodology on Comparability of Dwelling Stock Characteristics – Construction Period

The term "Construction Period" refers to the timeframe during which a dwelling was built. For this analysis, the following timeframes were applied in accordance with the categories provided in the selected data: Pre-1948, 1948-1978 (Post-WWII), 1979-1990, and Post-1990.

To assess the comparability of construction periods between Germany and the UK, secondary data was employed. For Germany, the analysis employed data from the 2022 Mikrozensus (DESTATIS, 2024). For UK, data from Scotland, England and Wales were combined. In particular, data from the 2022 Scottish Housing Conditions Survey (Scottish Government, 2024) for Scotland, the 2021 Census (Office for National Statistics, 2023a) for England and the Welsh Housing Condition Survey 2017 (Welsh Government, 2019) for Wales were combined to create a unified dataset.

Considering the significant regional disparities, it was imperative to merge the data from Scotland, England, and Wales to gain a comprehensive understanding of the construction periods across the UK. This process involved aligning the categories of each dataset to ensure consistency. For Scotland and Wales, only data in percentages for specific years (2019 and 2017, respectively) were available. To standardise the data, the number of dwellings for Scotland (2,528,823 in 2021 (National Records of Scotland, 2022)) and Wales (1,467,200 in 2021 (Welsh Government, 2024)) were employed to calculate the number of dwellings in each construction period based on the percentages.

The discrepancy in the classification of dwellings between Germany and the UK presents a further challenge. To address this issue, the construction periods in question were reclassified according to the following categories: Pre-1948, 1945-1978 (Post-WWII), 1979-1990, and Post-1990. To ensure comparability, the data was then adjusted using a linear distribution assumption for dwelling construction over time. Precisely, if the Scottish dataset indicates that 1.2 million houses were constructed between 1979 and 1993, but the requisite data pertains to the 1979-1990 period, the first step was to calculate the number of years within the specified period (15 years). This was followed by dividing the number of dwellings by the number of years (1.2 million ÷ 15), which yields 80,000 houses per year. To adjust the data to the 1979-1990 period, the number of houses built after 1990 (80,000 per year) must be subtracted from the total. This results in an adjusted total of 1.12 million houses. Where necessary, this methodology was applied in a consistent manner across both countries. To make these adjustments, it was assumed that the distribution of house construction over time within each period is linear. This assumption was necessary due to the unavailability of more granular data and was based on the reasonable expectation that construction rates remained constant over short periods. However, this assumption may not fully capture fluctuations in construction trends, and the resulting figures should therefore be interpreted with caution.

Importantly, the datasets for the UK cover different timeframes: 2017 for Wales, 2019 for Scotland, and 2021 for England, while the German data is from 2022. This temporal misalignment may introduce some biases, particularly in the post-1990 category, where the representation of newer constructions is underrepresented for Wales and Scotland. Furthermore, data from Scotland and Wales were presented as percentages, which requires conversion based on the number of dwellings. These factors have the potential to impact the precision of the final dataset.

The final comparison of construction periods between Germany and the UK was presented in a table that outlines the distribution of dwellings by construction period for each region. A qualitative discussion followed, analysing the similarities and differences between the two countries' dwelling stock characteristics.

Appendix B.7: Methodology on Comparability of Obligated Party Characteristics

This section aims to analyse the question: "*Are the characteristics of the obligated parties in Germany comparable to those in the UK?*". In the context of the ECO4, obligated parties were defined as energy suppliers subject to the ECO4 scheme. According to Ofgem, obligated parties are energy suppliers, with obligations based on the volume of energy supplied and the number of customers (Ofgem, 2023c, p. 16). These factors were deemed critical for this analysis. However, due to the unavailability of comparable data on energy supply and customer numbers between Germany and the UK, these characteristics could not be fully integrated into this analysis. Instead, this analysis focused on the number of energy suppliers in both countries, which can serve as a proxy for understanding the obligated parties' market structure. The share of each party's obligation is influenced by both the total number of suppliers and their respective obligations.

Data for both, Germany and the UK, were collected from respective government sources, including Bundesnetzagentur and Bundeskartellamt (2023) and Ofgem (2024a), and were presented in a table. The obligated party characteristics of the two countries were then qualitatively discussed.

Appendix B.8: Methodology on Impact on other affected Interest Groups/Stakeholder

This section aimed to analyse the question: "*Does the policy contradict the interests of any stakeholders/interest groups?*". The term "policy" refers to the EEOS proposed by the European Commission as part of its EED. This conceptualisation was selected due to the streamlined methodology it offers. In 2012, the European Commission proposed the EEOS, which was subsequently discussed among relevant stakeholders in Germany. While these discussions did not focus explicitly on reducing energy poverty, the core mechanism - the requirement for obligated parties to implement energy efficiency measures - is consistent with the mechanisms proposed in this thesis. Therefore, it was assumed that stakeholder opinions toward the EEOS proposed in this thesis will be similar to those previously discussed.

The term "interests" is defined in relation to the EEOS and its key stakeholders. These encompass financial interests (costs and revenues), regulatory interests (compliance with laws), environmental interests (impact on CO2-emissions), and social interests (public opinion and responsibility).

"Key stakeholders/interest groups" are defined as those directly or indirectly affected by an EEOS. These include energy suppliers, industrial interest groups, consumer protection organisations, government and regulatory bodies, and environmental protection organisations. The stakeholders were identified in accordance with the guidance set out in the ECO4 Guidance (Ofgem, 2023c). Specific organisations within these groups are representative of the broader stakeholder community.

This thesis employed a document analysis for comprehensively assessing the attitudes of key stakeholders towards the EEOS within the EED. Given the timeframe of this thesis, document analysis was identified as the most feasible approach. To identify relevant documents from key stakeholders, including position papers and statements on the EEOS, the Advanced Search Tool on Google was used. The search string used was as follows:

(Energieeinsparverpflichtungen OR Energieeffizienzeinsparverpflichtungssystem OR EEOS OR Energy Efficiency Obligation Schemes OR (Artikel 7 AND EED) OR (Artikel 7 AND Energieeffizienzrichtline) OR (Artikel 7 AND Energy Efficiency Directive)) OR (Energieeffizienz-Richtline AND Artikel 7)

Documents were limited to English and German, with no restrictions on publication date, allowing for a wide range of relevant material to be included. Priority was given to position papers and statements based on their origin (e.g. well-established stakeholders) and relevance to the EEOS. Documents that were considered to be irrelevant were excluded manually following a review of their content to ensure alignment with the stakeholders' views on the EEOS. While there are advantages to using public documents, there are also limitations. It is possible that not all stakeholder groups have published clear or up-to-date statements, which could result in gaps in the analysis.

The analysis was conducted using an inductive coding approach based on the methodology developed by (Gioia et al., 2013). The coding process started with first-order coding, whereby codes were derived directly from the text and were closely aligned to the original wording. The codes were then grouped into broader second-order themes, which were ultimately abstracted into the main categories: Pro-EEOS and Anti-EEOS. This approach provided a clear and structured framework for identifying the key patterns in stakeholder positions.

Appendix B.9: Methodology on Interaction with Existing Policies

This section aimed to analyse the question: "*Is the ECO's potential impact contradicting/cancelling out/overlapping with existing policies?*". The "ECO's potential impact" refers to the reduction of energy poverty through the implementation of energy efficiency measures in energy-poor households. "Existing policies" are those already implemented at the national level that either target the same objective as the potential EEOS or implement similar measures at the household level.

In this context, "Conflicting" means that two policies have opposing or incompatible requirements or outcomes. "Cancelling out" refers to the stance in which the impact of the ECO4 negate the benefits of existing policies. "Overlapping" implies that the ECO4 and an existing policy aims for similar goals with similar measures, which could cause redundancy. If two policies complement each other, it is indicated as "Synergizing".

The initial stage involved identifying existing policies and assessing their potential to interact with the ECO4 in case of a direct transfer to Germany. The selection of policies was discussed with an researchers from Öko-Institut e.V. Additional policies were included based on the researchers' recommendations to ensure comprehensive coverage. The selected policies included the GEG (GEG, 2020/16.10.2023), the BEHG (BEHG, 2019/22.12.2023), the CO2KostAufG (CO2KostAufG, 2022), the BEG (BAFA, 2024a), the Electricity Saving Check (Stromspar-Check, 2024c) and the EEG (EEG 2023, 2014/08.06.2024). A systematic review of the primary policy documents and legislation was conducted to identify any potential interactions with the ECO4. The screening process entailed the application of specific criteria, including an assessment of policy objectives, target groups, and key measures implemented at the household level. Each policy was reviewed to identify any areas where it might interact with the ECO4. In instances where policy descriptions were not available in legal texts (such as for the Stromspar-Check), official programme descriptions were used instead.

Once potential interactions were identified, they were categorised according to one of four relationship types: synergizing, conflicting, cancelling out, or overlapping. Following this categorisation, the relationship between the ECO4 and each existing policy was described in detail.

Appendix B.10: Methodology on Available Human Resources

This section aims to analyse the question: "*Human resources required?*". The term "human resources" refers primarily to the skilled labour required to implement the energy efficiency measures. To estimate the number of skilled workers required in the UK, the number of measures implemented under ECO3 was analysed. Although the number of measures implemented in Germany may be different, it was assumed that the scale will be similar. Given the limited timeframe and scope of this thesis's, an in-depth analysis of the availability of these skilled workers was not possible. Instead, an overview of the labour market was provided by reviewing relevant studies. To obtain information on the availability of human resources, grey literature was considered appropriate due to its practical insights and the limited academic studies on this topic. Google's Advanced Search Tool was used to identify relevant documents using the following search string:

(("Fachkräftemangel" OR "Fachkräftesituation" OR "Mangel an Fachpersonal" OR "Facharbeitermangel") AND ("Deutschland") AND ("Energie" OR "Energiesektor" OR "Gebäudesanierung" OR "Bauwesen" OR "Gebäude" OR "Immobilien"))

No publication date restrictions were applied to ensure comprehensive coverage. Documents were selected based on their credibility, with priority given to those from well-established stakeholders and industry position papers. The search results were then filtered manually according to their relevance in relation to the guiding question of the analysis. Given the limited number of relevant publications identified, a formal coding approach was not deemed necessary. Instead, the key themes were extracted manually from the literature.

Appendix E: Interview Questions

Appendix E.1: Interview Questions – Jan Rosenow

Hintergrund und Erfahrungen

1. Was ist Ihre Erfahrung und Ihr Wissen zur Energy Company Obligation (ECO) oder ähnlichen Instrumenten in anderen Kontexten?

Bewertung der Energy Company Obligation

2. Wie würden Sie die ECO in Bezug auf die Reduktion der Energiearmut in Großbritannien bewerten?

3. Wie würden Sie die Eignungskriterien der Haushalte im Hinblick auf die Reduktion der Energiearmut in Großbritannien bewerten?

4. Wie würden Sie die zulässigen Maßnahmen der ECO im Hinblick auf die Reduktion der Energiearmut in Großbritannien bewerten?

5. Gibt es Ihrer Meinung nach Elemente der ECO (z.B. in der Gestaltung, Umsetzung oder Überwachung), die Sie für besonders gut halten, und wenn ja, welche und warum?

6. Gibt es Ihrer Meinung nach Elemente der ECO (z.B. in der Gestaltung, Umsetzung oder Überwachung), die Sie für besonders schlecht halten, und wenn ja, welche und warum?

7. Was sind die Einstellungen verschiedener Stakeholder (z.B. von Energieunternehmen, Verbraucherverbänden oder Forscher*innen) gegenüber der ECO?

Anwendbarkeit auf Deutschland

8. Glauben Sie, dass die ECO auf Deutschland anwendbar ist? Bitte begründen Sie ihre Einschätzung.

9. Gibt es Elemente der ECO, die für den deutschen Kontext besonders gut geeignet sind?

10. Gibt es Elemente der ECO, die für den deutschen Kontext nicht geeignet sind?

Abschließende Bemerkungen

11. Könnten Sie mir bitte weitere Stakeholder (z.B. von Ofgem oder verpflichtenden Energieunternehmen) empfehlen, die ich für dieses Projekt interviewen könnte?

12. Möchten Sie noch Dinge hinzufügen, die wir noch nicht im Interview besprochen haben?

Appendix E.2: Interview Questions – William Baker

Background and Experience

1. What is your experience and knowledge of the Energy Company Obligation (ECO) or similar policies in other contexts?

Evaluation of Energy Company Obligation

2. How would you evaluate the ECO's effectiveness in reducing energy poverty in Great Britain?

3. Do you think the ECO is suitable for reducing Great Britain’s energy poverty? Please explain your answer.

4. How effective has the ECO been in accurately targeting and reaching the most energy-poor households? Are there gaps in the policy's reach or implementation?

5. If so, do you have recommendations on how the ECO could effectively target energy-poor households?

6. How would you assess the permitted energy efficiency measures of the ECO concerning reducing energy poverty in Great Britain?

7. What are the attitudes of different Stakeholders (e.g., energy-poor households, consumer associations, and scientists) towards the ECO?

8. What are the ECO's most significant challenges or limitations in addressing energy poverty?

9. What improvements would you recommend for the ECO to enhance its effectiveness in reducing energy poverty?

Concluding Remarks

10. Are there any things you would like to add that we have not yet discussed in the interview?

Appendix E.3: Interview Questions – George Walters

Background and Experience

1. How long has your company been obligated under the ECO, and how many measures have you implemented? Please briefly describe them.

Evaluation of Energy Company Obligation

2. How does your company identify and verify households eligible for the ECO? What are the key challenges, and what improvements would you recommend?

3. How would you evaluate the implementation process of the ECO (e.g. general process, eligible technical measures, monitoring, and auditing procedures)? What improvements would you recommend?

4. How many employees of your company are involved in implementing the ECO obligation?

5. How do you evaluate the bureaucratic processes and interactions with regulatory bodies and local authorities? What improvements would you recommend?

6. What are the most significant challenges in fulfilling your obligations under the ECO?

Further Questions

7. Do you have additional recommendations for improving the ECO?

8. Based on your experience, how effective has the ECO been in reducing energy poverty among your customer base?

Appendix E.4: Interview Questions – Matt Copeland

Background and Experience

1. When and why was your organization founded, and what is your organization's connection to energy poverty?

2. What is your experience with the Energy Company Obligation (ECO)?

Evaluation of Energy Company Obligation

3. How would you evaluate the ECO's effectiveness in reducing energy poverty in Great Britain?

4. Do you think the ECO is suitable for reducing Great Britain's energy poverty? Please explain your answer.

5. How effective has the ECO been in accurately targeting and reaching the most energy-poor households? Are there gaps in the policy's reach or implementation?

6. If so, do you have recommendations on how the ECO could effectively target energy-poor households?

7. How would you assess the permitted energy efficiency measures of the ECO concerning reducing energy poverty in Great Britain?

8. What are the attitudes of energy-poor households towards the ECO?

9. What are the ECO's most significant challenges or limitations in addressing energy poverty?

10. What improvements would you recommend for the ECO to enhance its effectiveness in reducing energy poverty?

Concluding Remarks

11. Do you want to add anything that we have not yet discussed in the interview?