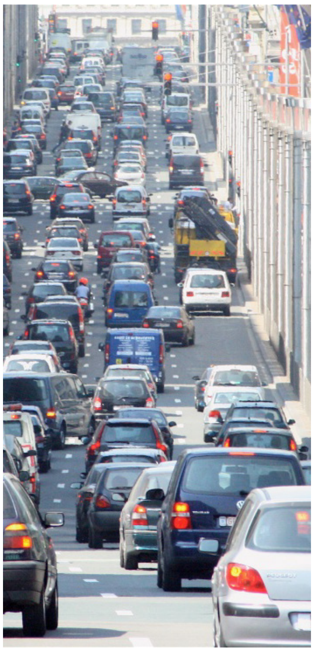
Contribution of the information reported under the MMR to the evaluation of national PaMs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Front page picture: *windmill - energy source with limited to no greenhouse gas emissions; intensive traffic – source of high greenhouse gas emissions; cattle breeding – source of high greenhouse gas emission*

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List of abbreviations

ADEME	Agence De l'Environnement et de la Maîtrise de l'Energie
BCIAT	Biomasse Chaleur Industrie Agriculture Tertiaire
BR	Biennial Report.
CFC	Chlorofluorocarbon.
DAC	Development Assistance Committee.
EEA	European Environment Agency.
EED	Energy Efficiency Directive - Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC.
ESD	Effort Sharing Decision - Decision No 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020.
ETC/ACM	European Topic Centre / Air pollution and Climate change Mitigation.
EU ETS	European Union Emissions Trading System – Directive No 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the community and amending council directive 96/61/EC.
F-gas	Fluorinated greenhouse gas, i.e. HFCs, PFCs and SF6.
F-gas regulation	Regulation (EU) No 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006.
GHG	Greenhouse Gas.
IEA	International Energy Agency.
LCDS	Low Carbon Development Strategies.
MMR	Monitoring Mechanism Regulation - Regulation (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC.
NC	National Communication.
NEEAP	National Energy Efficiency Action Plans.
NREAP	National Renewable Energy Action Plans.
OECD	Organisation for Economic Co-operation and Development.
PaMs	Policies and Measures.
RED	Renewable Energy Directive – Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC
toe	Tonnes of oil equivalents
UNFCCC	United Nations Framework Convention Climate Change

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Executive summary

Main messages

Policy evaluation is an important part of the policy cycle. In addition to assessing how effective or efficient adopted policies or measures have been, it also helps improving the definition of future policies and measures. Evaluation of policies and measures draws upon evidence from different sources and methodologies. Databases on policies and measures represent an important knowledge to support these evaluations by:

- providing an overview of actions taken by countries to reduce greenhouse gas emissions in different sectors;
- showing if some policies and measures have been particularly successful in reducing greenhouse gas emissions;
- providing detailed information on each policy or measure and directing to other resources and references for further details, to support policy evaluation.

In this context, the database on climate mitigation policies and measures maintained and regularly updated by the EEA, based on information reported by European Union Member States under EU reporting regulation (the EU 'Monitoring Mechanism Regulation') provides an extensive knowledge base able to contribute to the evaluation of national climate mitigation policies in the EU. This source of information can be usefully complemented by additional resources. Furthermore, room for improvement exists in the current reporting system, order to enhance and better support policy evaluation in the EU.

Introduction

A key contribution to Europe's transition towards a low carbon society by 2050 consists in the lessons learned from the implementation of existing policies and measures: how do policies work, under what conditions do they work best and, ultimately, which policies have been the most effective to achieve their objectives? The answers to these questions can help identifying the type of interventions and technological developments that are needed to meet the EU's long-term goals.

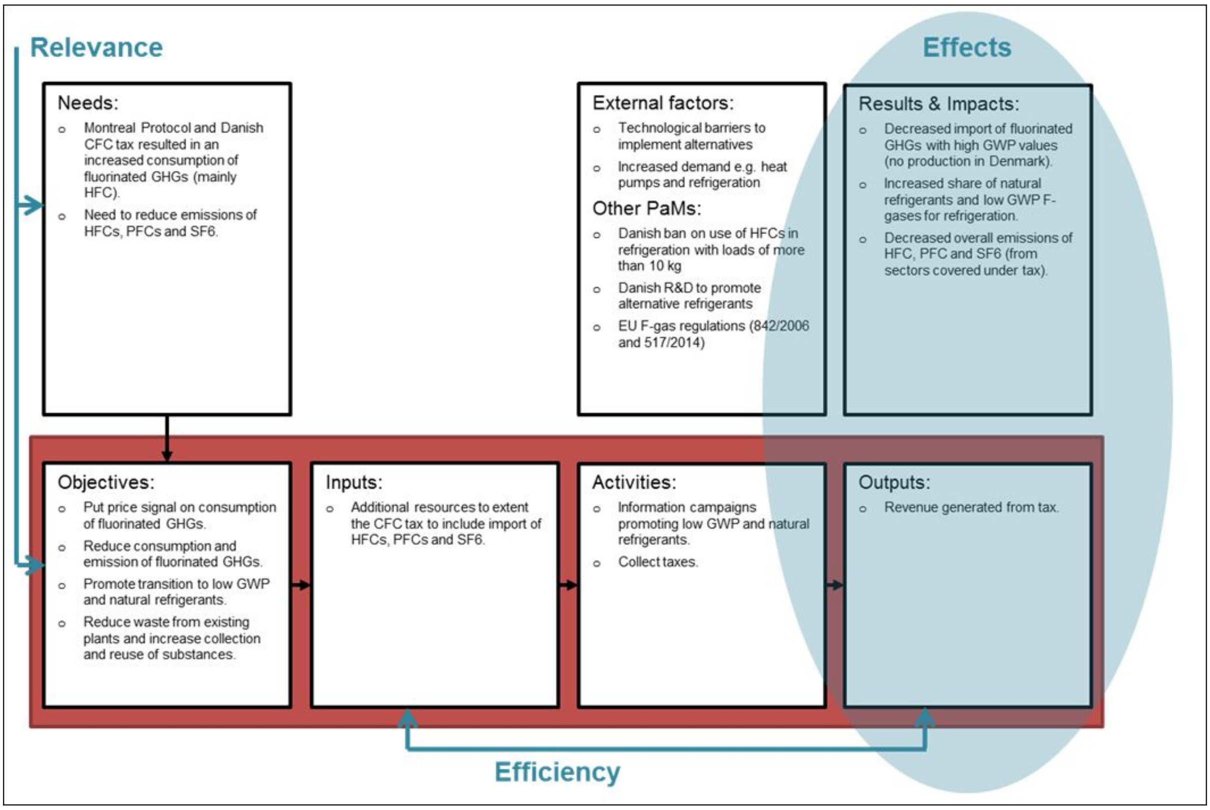
Strong and well-established conceptual and methodological frameworks to perform policy evaluation. However, the availability of relevant and comprehensive information to underpin these analyses is often an issue, as a robust evaluation may require an important amount of supporting evidence. A potential source for such information consists in 'databases' which collect and disseminate the relevant information on national policies and measures. In the EU, a database on national climate mitigation policies and measures is regularly fed by Member States themselves, under a well-established reporting system covering both quantitative data and qualitative information, called the EU 'Monitoring Mechanism'. The information on national policies and measures reported by Member States is collected, checked and aggregated by the European Environment Agency (EEA), and made publicly available online[1]. This 'Policies and measures database' (PaM database) represents an extensive information sources on climate mitigation polices at national level – although it is not the only one. This study aimed to identify, based on the selection and analysis of 11 policies and measures included in the EEA's PaM database, if a policy database such as the EEA's can adequately support policy evaluation and to what extent it requires to be supplemented by additional information, either from other similar databases and national reports, a wider literature review or interviews with national experts.

[1] http://pam.apps.eea.europa.eu

Approach

A set of 11 existing policies and measures were selected from the EEA's PaMs database on the basis of criteria aiming to ensure a representative sample in terms of countries ([2]), sectors, instrument types, and targeted greenhouse gases. An emphasis was made on policies and measures affecting greenhouse gas emissions falling specifically under the Effort Sharing Decision (which targets all emissions not covered by the EU Emissions Trading System). These 11 policies and measures acted as case studies. For each of them, an intervention logic model was identified in order to describe the main characteristics of the intervention, and in particular how the action was intended to operate in order to achieve its objectives. Figure 1 presents an example of intervention logic for the tax on fluorinated gases in Denmark. The intervention logic was then used to evaluate each policy or measures against one or several of the four following criteria: relevance (investigating the relationship between the societal needs and objectives of the policy or measure); coherence (analysing the relationship with other policies and measures); effectiveness (assessing if the policy or measure is achieving the defined objectives) and efficiency (assessing if the implementation cost is justifiable compared to the outcome).

Figure 1 Example of intervention logic: the tax on fluorinated gases in Denmark.



Note: the case study on the tax on fluorinated gases in Denmark focused on the three criteria of relevance, effectiveness and efficiency. See further details in Annex 1, p. 58.
Source: ETC/ACM, 2016.

[2] The countries concerned by the selected PaMs are Belgium, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Ireland, the Netherlands, Spain and the United Kingdom.

Results and conclusions

The evaluation of 11 PaMs selected from the EEA's PaMs database showed that in all cases, the EEA PaM database was a valuable starting point, either to provide information that is directly useful or by referencing to other resources were information could be found. This source of information was however not sufficient in itself and was supplemented with information from other 'databases', mostly the National Energy Efficiency Action Plans, the National Renewable Energy Action Plans, the Odyssee/Mure databases and the National Communication and Biennial Report to the UNFCCC. Reports, websites and (scientific) papers identified via literature search were also important in all aspects of collecting data for evaluation. Interviewing national experts also proved extremely valuable in identifying additional resources and providing insight on relevance, coherence, effectiveness and efficiency of the selected policies and measures.

Policy evaluation draws upon evidence from multiple information sources and methodologies in order to have a balanced and unbiased outcome. As a result, policy databases can only play a limited role in any evaluation of either a single policy or measure or a group of measures. Nevertheless, policy databases have the potential to provide critical information for evaluation purposes. Policy databases, such as the EEA's, often provide specific quantitative information on the results and impacts of policies and measures, on for instance greenhouse gas emissions. Policy databases may also provide references and links to other information sources, with more in-depth material useful for policy evaluation.

An additional strength of policy databases lies in the fact that an overview is provided of climate policies. This makes evaluations of multiple instruments within one sector, country or even across countries possible. An example is the recent evaluation of the Effort Sharing Decision by the European Commission that was partly based on the EEA policies and measures database to assess to what extent EU countries had implemented new policies to achieve 2020 emission reduction targets.

This could also make it possible to benchmark a specific policy to other policies in the country or to policies with a similar objective. To perform this function to the fullest, completeness and consistency across policies and measures is important. This particularly applies to the methodological approaches to estimate the ex post and ex ante impacts and costs of policies and measures. For instance, the scope and underlying assumptions regarding the counterfactual scenario (the scenario without intervention) have a very significant impact on the results. Interaction between instruments further complicates calculations on effectiveness and cost. Apart from consistent and harmonized approaches, transparency on how impacts and costs have been assessed therefore remains important. The MMR specifically requests technical information underpinning the evaluation of their policies and measures and, in differing degrees, this is provided by most European countries.

Apart from specific information on climate policies and measures, quantitative data are also relevant for evaluation purposes. These data are used, among other things, for the development of a comprehensive set of indicators in the area of climate change, energy, transport, and waste. Linking data on policies and measures with indicators and quantitative data opens interesting additional perspectives. Under the Monitoring Mechanism Regulation, the EEA collects, aggregates and publishes data on greenhouse gas emissions and projections which can usefully inform evaluators.

Interviews in the context of the case studies and a dedicated workshop on policy evaluation organised by the EEA showed that climate policy evaluation practices differ across domains and countries and are often done on an ad hoc basis. Because evaluations are now mainly driven by self-reporting of countries in the context of EU or international reporting obligations, there is heavy emphasis on compliance. This explains why information on the impact of policies and measures on greenhouse gas emissions is reported relatively frequently in the EEA policy and measures database, although often focused on expected impacts in future rather than on estimated impacts in the past. Exchange of experiences in policy evaluations or guidelines building on already existing methodological frameworks could help in identifying and adopting good practices by countries.

1 Introduction

1.1 Background

The prominence of climate change on the political agenda at the international, European and national levels compared to many other environmental issues has resulted in an increased pace of policy development in Europe since the second half of the 1990s. Huitema et al. [1] showed that the increase in climate policy making also resulted in an increase in climate policy evaluation. Although the evaluation of environmental policy in general has developed more slowly than in other policy domains [2], the evaluation of environmental and climate policies is today a well-established discipline with robust approaches for the investigation of which, how and under what conditions climate policies work best [3], [4].

Policy evaluations have a key role in the policy cycle. Not only to understand whether the existing measures have achieved their objectives, in a cost-efficient way, whether they are still relevant and coherent with other existing PaMs [5], but also as a knowledge base for the development of new policies and measures (PaMs) to mitigate climate change. Policy evaluation is therefore not only an assessment of what has happened; it should also consider the mechanisms at work behind the policy intervention and, if possible, how much has changed as a consequence. It should look at the wider perspective and provide an independent and objective judgement of the situation based on the evidence available [6].

Policy evaluations can differ in their approach, evidence collection and analytical methods. They often combine data and information from different sources, both quantitative and qualitative. For obtaining information on national climate mitigation policies and measures in Europe, the information reported by Member States under the European Monitoring Mechanism Regulation (MMR, Regulation (EU) No 525/2013) is among the most comprehensive sources of quantitative and qualitative information on climate action in the EU. The MMR is a mechanism for monitoring and reporting of greenhouse gas (GHG) emissions and reporting of other information at national and Union level relevant to climate change. It includes a regular mandatory reporting by Member States of their climate mitigation PaMs. This reporting consists, for each policy or measure, in a description of its main elements (e.g. instrument type, objective and targeted sectors), its impacts on emission savings (ex ante and ex post), and its cost and benefits. In 2015, over 1300 individual PaMs were reported, most of which were implemented between 2004 and 2015 [7]. Most Member States reported on ex ante (expected) emission savings, although not necessarily for each PaM. Only a few Member States reported information on costs and benefits and almost no ex post (achieved) impacts were reported. This underlines the conclusion of Hilden et al. [8] that the development of monitoring and evaluation of the policy measures that are expected to contribute to required emission reductions has progressed more slowly than the more technical development of the monitoring of GHG emissions. There are several potential reasons for this as ex post evaluation is more resource intensive than ex-ante evaluation; a consistent approach across PaMs within and among Member States is difficult because of the differences in the nature of the PaMs and lack of harmonised methodologies on quantitative data; and, ex post evaluation, especially on costs, is perceived as political sensitive.

1.2 Objectives

This study aims to identify the main needs in information and data in order to perform an evaluation of policies and measures, and to assess the usefulness of different data sources for policy evaluation. To achieve this objective, a set of 11 PaMs selected from the EEA PaM's database were evaluated, following a methodology in line with best practices as defined in relevant evaluation literature and on the basis of available information and data sources. The approach to evaluate PaMs presented in this paper builds on an inventory of methodologies for evaluating PaMs contributing to achieving quantified GHG emission targets [9]; on a literature review of evaluations of the EU Emission Trading System (EU ETS; [10]), on previous work by the ETC/ACM on PaMs [7] and on other available information sources, such as existing EU [6] and OECD guidelines on evaluation methodologies. The principal data source is the information reported by Member States under the MMR, but is supplemented with additional data and information sources.

On the basis of these 11 case studies, the study also identifies where information constraints affected the outcome of the evaluations and discusses the relative utility of different information sources. Finally, the study provides some recommendations on how the performance of a PaM database could be optimized to better support evaluations, in particular through improvements to the existing reporting system on policies and measures.

2 Methodology

2.1 Existing frameworks for evaluating PaMs

An extensive literature on how to evaluate climate PaMs exists. This section provides a non-exhaustive overview of relevant studies and guidelines for performing PaM evaluations.

In 2013, Ecorys prepared for the EEA an overview and assessment of **methodologies for evaluating effectiveness and cost effectiveness/economic efficiency of environmental and climate policies** [9]. Effectiveness was defined as achieving quantified emission reductions. The methodologies used were screened based on main indicators of assessing effectiveness, efficiency, and coverage of impacts. The methodologies that are used can be categorized as econometric/other modelling, literature reviews, multi-criteria analysis, or spreadsheet calculation tools. The underlying data and methods can differ substantially depending on the policy and policy type under scrutiny. Costs of PaMs have rarely been covered and if so, often in very straightforward ways and without paying attention to comparability of types of costs.

In 2014, a study of the "**Performance of a literature review of greenhouse gas emission trading policy evaluations**" was done for the EEA [10]. The first part of the study focused on reviewing the existing literature, which evaluates the performance of the EU ETS on five evaluation criteria (effectiveness, efficiency, coherence, EU added value and relevance). The second part of the study focused on identifying gaps in the literature evaluating the EU ETS.

The **OECD Development Assistance Committee** (DAC) has supported the DAC Evaluation Network for more than 30 years. Although not intended for environmental or climate related evaluations, the OECD guidelines for project and programme evaluation [11] give valuable insights. Also, the glossary of key terms in evaluation and results based management gives clear definitions [12].

Within the EU Regional Policy, **Evalsed** is an online resource providing guidance on the evaluation of socio-economic development [13]. Evalsed source book has a specific focus on evaluation in EU cohesion policy and describes a wide range of methods and techniques that can be applied in the evaluation of socio-economic development. The methods and techniques described are: beneficiary surveys, case studies, cost benefit analysis, cost effectiveness analysis, delphi survey, expert panels, focus groups, impact evaluation, interviews, models, multi-criteria analysis, observation techniques, priority evaluation method, regression analysis and SWOT analysis.

Within the EU, Better Regulation is about designing EU policies and laws so that they achieve their objectives at minimum cost (EC, 2015b). It ensures that policy is prepared, implemented and reviewed in an open, transparent manner, informed by the best available evidence and backed up by involving stakeholders. The European Commission's **Better Regulation Guidelines and Toolbox** explain what Better Regulation is and how it should be applied when preparing new initiatives or managing existing policies and legislation. They cover the whole policy cycle, from policy preparation and adoption to implementation and application, to evaluation and revision of EU law. For each of these phases there are principles, objectives, tools and procedures that relate to planning, impact assessment, stakeholder consultation, implementation and evaluation.

The Better Regulation Guidelines define evaluation as an evidence-based judgement of the extent to which an intervention has been effective and efficient; relevant given the needs and its objectives; coherent both internally and with other EU policy interventions and EU added-value. Additional evaluation criteria beyond these five can also be included.

2.2 Overview of methodological approach

The methodology that is followed is presented in Table 2.1and includes six steps, from the selection of 11 PaMs to the preparation of the final report.

Table 2.1 Overview methodological approach.

Step 1	**Selection of PaMs** • Longlist of 30 PaMs • Shortlist of 11 PaMs
Step 2	**Intervention logic** • Prepare intervention logic, including the identification of needs, objectives, actions, expected results and impacts, and external effects
Step 3	**Evaluation criteria / questions** • Specify the evaluation criteria / questions, with a focus on effectiveness, efficiency, relevance and coherence
Step 4	**Data collection** • Review literature based on collected data from PaM databases and literature search • Consult stakeholders (1 representative per Member State)
Step 5	**Consolidating findings** • Aggregate and synthesize information from the different data sources
Step 6	**Synthesise and present results** • Contribute to workshop at Copenhagen on policy evaluation on 6 and 7 September • Preparation of the final report

2.3 Selection of PaMs

A set of 11 national PaMs were selected as case studies. The criteria that were used to select these PaMs were as follows:

- Availability of information on the PaM in the EEA PaM database.
- The PaM focuses primarily on sectors covered by the Effort Sharing Decision (ESD).
- The PaM is not the implementation of an EU legislation, but a specific national PaM. PaMs are chosen that may exist in a similar way in other Member States.
- The PaM, although specific to a Member State, should in principle be replicable in other Member States.
- As it is not certain that the information contained in the PaM databases were sufficient to address all evaluation criteria and questions, it was checked if previous (national) evaluations of the PaM existed against clear evaluation criteria, in particular: relevance, efficiency, effectiveness and coherence.
- The PaMs were selected so they represent a mix of different types of policy instruments (e.g. economic; fiscal; voluntary/negotiated agreements; regulatory; information; education; research; planning; other), target sectors, objectives and Member States.

The selection of PaMs was done in two steps: a first list of 30 PaMs was selected, based on the availability of information in the EEA PaM database. This long list was then narrowed down to 11 PaMs (Table 2.2), in consultation with EEA, taking into account all the criteria above.

Table 2.2 List of selected PaMs.

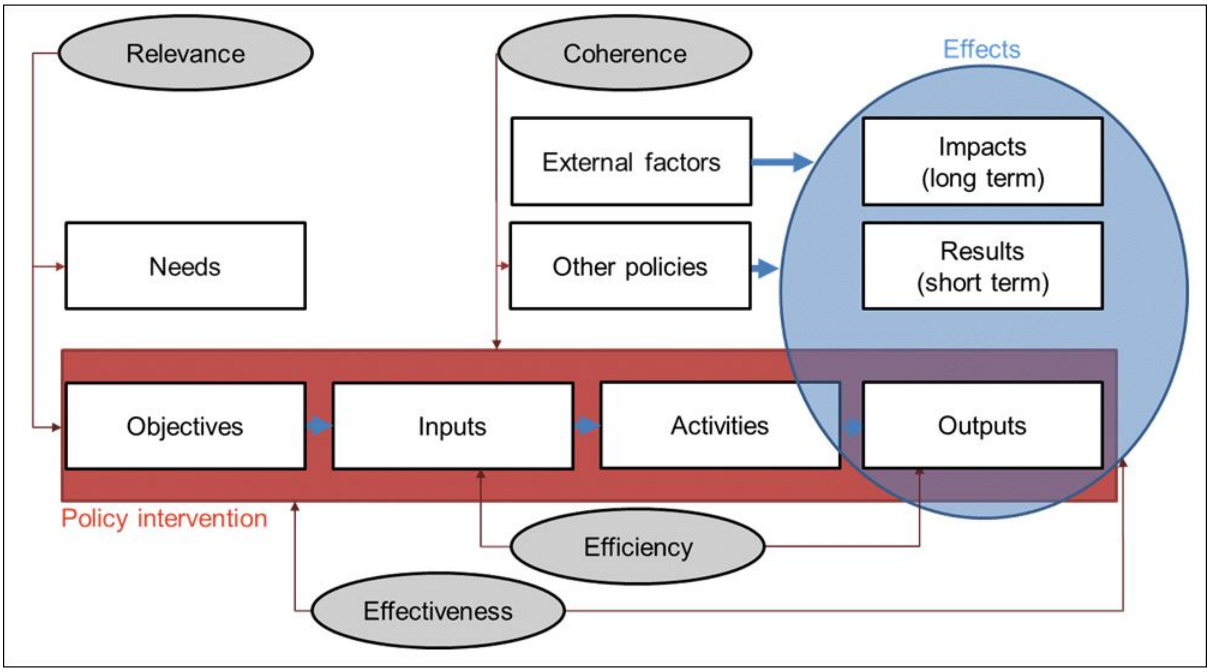
PaM name	Member States	Instrument type (1)	Sector
Promotion of car-pooling	Belgium	Economic	Transport
Support to fund housing modernization using the building saving	Czech Republic	Economic	Energy consumption
Tax on HFCs, PFCs and SF_6 - equivalent to the CO_2 tax	Denmark	Fiscal	Industrial processes
Energy efficiency improvement in public buildings	Estonia	Economic	Energy consumption
Energy Efficiency Agreements 2008-2016 and the expected extension until 2035 (Voluntary energy efficiency agreements)	Finland	Planning	Energy consumption
Heat Fund	France	Economic	Energy consumption
Landfill aeriation	Germany	Economic	Waste
Carbon tax	Ireland	Fiscal	Cross-sectoral
Covenant Clean & Efficient Agro-sectors	Netherlands	Voluntary agreement	Agriculture
Cursos de conducción eficiente en el transporte por carretera	Spain	Education	Transport
Energy company obligation & Domestic Green Deal	United Kingdom	Economic	Energy consumption

Note: (1) Definition of instrument types and sector based on MMR.

2.4 Intervention logic model

One of the approaches often used in policy evaluation is the logical framework [3], that uses an intervention logic model to depict how a policy was intended to operate in order to achieve the objectives. Intervention logic models describe the relationship between an intervention's inputs, activities, results and impacts (Figure 2.1 and Table 2.3). They specify and seek to explain how linkages work between the different elements of the logical framework [14]. An effective intervention logic model therefore is a representation of the causal theory underlying the impact and any associated intervention, and underpins why something occurred and how the intervention works.

Figure 2.1 Intervention logic model and its link to the evaluation criteria.



Source: [3]

Table 2.3 Definitions of the terms used in the intervention logic.

Term	Definition	Example
Needs	The specific needs the PaM is addressing.	Avoid climate change, energy security.
Objective	The specific objective of the PaM (and subsections of the PaM).	Reduce energy consumption of buildings, creation of jobs in renewable energy sector, reduce energy cost.
Actions	This includes all actions by public sector, and is divided into:	
Inputs	Public sector resources dedicated to the design and implementation of the PaM required to achieve the policy objectives.	State subsidy to private investors, additional personnel to collect tax.
Activities	What is delivered on behalf of the public sector to the recipient(s).	Provision of seminars, training events, subsidy.
Outputs	The tangible actions taken by the addressees of a measure.	Number of completed training courses, number of applications for a subsidy.
Results and impacts	The effect of the policy produced by the addressees in short and long term and the wider economic and social effects.	Number of new installations, GHG emission reductions.
External factors	External factors (not directly related to the policy) that has had an impact on the results and impacts of the policy. The impact can be both positive and negative.	Economic activity, fossil fuel prices, heating demand, economic restructuring.

Term	Definition	Example
Other PaMs	Other policies (at national and EU level) that have a positive or negative impact on the results of the policy under evaluation. The impact can be both positive and negative.	EU legislation that set certain targets to Member States (e.g. Effort Sharing Decision, Renewable Energy Directive) or have direct impact on GHG emissions (e.g. F-gas regulation, eco-design), national legislation that directly and indirectly interferes with mitigation PaM.

The first step for each PaM was to set-up the intervention logic and specify the needs the PaM addresses, the objectives of the PaM, the expected results and the impact of the PaM. In addition external factors that have had an influence on the impact were specified. The intervention logic was completed as much as possible based on available data sources.

The intervention logic is used to identify the relevant evaluation questions for the four evaluation criteria (relevance, effectiveness, efficiency and coherence, see section below).

2.5 Evaluation criteria and questions

Although the principal objective of the PaMs in the EEA PaM database could be very diverse, for example an increased share of renewable energy or a reduction of landfilled waste, all PaMs in the EEA PaM database are noteworthy for their expected impact on GHG emissions. The desired result or impact of most PaMs is thus a GHG reduction with a justifiable cost (**effective and efficient**), that is **relevant** for the Member State and its citizens and contributes to the overall EU objectives on climate, is **coherent** and does not contradict with other legislation (at Member State or EU level).

To assess this, the evaluation criteria are translated in a set of evaluation questions that comprehensively address all four criteria. In the sections below, examples of evaluation questions are given for each evaluation criteria. These evaluation questions are however very generic and were further adapted to the PaM being evaluated and its intervention logic.

2.5.1 Effectiveness

Effectiveness analysis considers how successful an action has been in achieving or progressing towards its objectives. The evaluation should form an opinion on the progress made to date and the role of the action in delivering the observed changes. If the objectives have not been achieved, an assessment should be made on the *extent* to which progress has fallen short of the target and what factors have influenced *why* something has not been successful or *why* it has not yet been achieved. Consideration should also be given to whether the objectives can still be achieved on time or with what delay. The analysis should also try to identify if any *unexpected* or *unintended* effects have occurred [6].

Example questions:

- To what extent have the objectives been achieved?
- To what extent (quantification) have GHGs been reduced?
- How is the GHG reduction calculated (method, assumptions, underlying counterfactual scenario)? The counterfactual scenario has a particularly important impact on the calculated GHG reduction;
- To what extent can the GHG reduction be credited to this PaM? Are there (direct) overlapping effects from other PaMs?
- What other external factors or PaMs (indirectly) influenced the achievements observed?

2.5.2 Efficiency

Efficiency assesses the relationship between the resources used and the changes generated by the intervention (which may be positive or negative). Typical efficiency analysis includes analysis of administrative and regulatory costs and benefits, and look at aspects of simplification. Evaluation findings should pin-point areas where there is potential to reduce inefficiencies and simplify the intervention. The costs can be associated to different aspects of an intervention and judged against the benefits achieved. It is important to note that efficiency analysis should always look closely at both the costs and benefits of the intervention as they accrue to different stakeholders [15].

Example questions:

- What costs are involved in implementing the PaM (for the government, for private investors, etc.)
- How are these costs determined?
- How shall other benefits (increase of value of existing stock, independence of fuel supply, increase of employment etc.) be quantified?)
- How are costs/effects of the possibility that nothing is done quantified?
- To what extent are the costs proportionate to the benefits achieved? (What is the underlying assumption for the cost per unit CO2-eq. reduced?
- How affordable were the total costs in question, given the benefits they received?
- Can the cost effectiveness be compared to other PaMs? To what extent has the intervention been cost effective compared to other PaMs in the same country or similar PaMs in other Member States?

2.5.3 Relevance

Relevance looks at the relationship between the needs and problems in society and that triggered the intervention. It requires the identification of the problem and its main underlying causes or drivers and their translation into policy objectives. Examples of issues with relevance are that the wrong drivers may have been identified during the impact assessment; incorrect assumptions may have been made about cause and effect relationships; circumstances may have changed and the needs/problems now are not the same as the ones looked at when the intervention was designed [6].

Example questions:

- To what extent is the intervention (still) relevant, is/are the driver(s) still existing?
- How well do the (original) objectives (still) correspond to the needs within the Member State?
- How well adapted is the PaM to technological or scientific advances? (i.e subsidies to a certain technology that has improved much)?

2.5.4 Coherence

The evaluation of coherence involves looking at how well or not different actions work together. Checking "internal" coherence means looking at how the various internal components of an intervention operate together to achieve its objectives e.g. the different articles of a piece of legislation, different actions under an action plan, etc. Similar checks can be conducted in relation to other ("external") interventions, at different levels: for example, between interventions within the same policy field or in areas which may have to work together (e.g. agriculture policy and climate policy). At its widest, external coherence can look at compliance with EU and international commitments. The focus on coherence may vary depending on the type of evaluation [6].

Example questions:

- To what extent is this PaM coherent with other PaMs of the Member State, which have similar objectives?
- To what extent is the PaM coherent internally?
- To what extent is the PaM coherent with EU policy (and international objectives)?

2.5.5 Selection of evaluation criteria and questions

Considering the number of PaMs and the potential number of evaluation criteria and questions, the evaluation questions for each PaM were prioritized in order to assess each evaluation criteria in an equal share, but not necessarily for each PaM. The criteria (effectiveness, efficiency, relevance and/or coherence) per PaM are listed in Table 2.4.

Table 2.4 Selected evaluation criteria and questions per PaM.

PaM name	MS	Evaluation criteria	Evaluation questions
Promotion of car-pooling	Belgium	Effectiveness	• How effective is the measure at increasing the modal share of car poolers?
		Coherence	• How does the promotion of car-pooling policy fit with other transport management policies?
Support to fund housing modernization using the building saving	Czech Republic	Effectiveness	• What effects can directly be linked to the PaM (e.g. number of renovations, energy savings, GHG emission reductions)? • To what extent, does the *building savings scheme* contribute to the observed energy savings?
		Relevance	• To what extent other PAMs and external effects had an impact on the effectiveness of the PaM?
Tax on HFCs, PFCs and SF_6 - equivalent to the CO_2 tax	Denmark	Effectiveness	• To what extent did the PaM result in a reduction of the import and consumption of HFCs, PFCs and SF_6? • To what extent did the PaM result in a reduction of the emission of HFCs, PFCs and SF_6 and what other factors contributed to this? • Did the PaM result in an increased share of alternative refrigerants?
		Efficiency	• To what extent has the policy generated benefits and costs for different stakeholders (e.g. national administrations, importers, manufacturers, industry)? • Has the intervention been cost

PaM name	MS	Evaluation criteria	Evaluation questions
		Relevance	effective compared to other PaMs? • To what extent is reducing HFC, PFC and SF_6 emissions relevant?
Energy efficiency improvement in public buildings	Estonia	Effectiveness Efficiency	• To what extent did the PAM result in increased renovation of public buildings? • To what extent did the PAM result in decreased energy consumption of public buildings? • To what extent did the PAM result in decreased GHG emissions? • To what extent has the policy generated benefits and costs for government? • Has the PAM been cost effective?
Energy Efficiency Agreements 2008-2016 and the expected extension until 2035 (Voluntary energy efficiency agreements)	Finland	Coherence	• To what extent can energy savings and GHG reductions be credited to the Energy Efficiency Agreements? • Is this PaM coherent with other PaMs of the Member State, which have similar objectives? • To what extent is the PaM coherent with the Energy Efficiency Directive?
Heat Fund	France	Effectiveness Efficiency	• To what extent has the Heat Fund been effective in promoting renewable heat? • To what extent has the Heat Fund been effective in reducing GHG emissions? • To what extent can the effects be attributed to the Heat Fund? • To what extent has the policy generated costs and benefits for different stakeholders? • To what extent has the intervention been cost effective compared to other PaMs?
Landfill aeriation	Germany	Efficiency	• How affordable were the total costs in question, given the benefits over the entire lifetime? • How effective is this PaM in reducing GHG emissions? • To what extend is the PaM still relevant in terms of GHG emissions?
Carbon tax	Ireland	Relevance	• To what extent is the intervention still relevant? • How well adapted is the PaM to technological or scientific advances? • To what extent have GHGs been reduced? • To what extent have the objectives (apart from GHG reductions) been achieved? • What other external factors influenced the achievements observed? • To what extent has the policy

PaM name	MS	Evaluation criteria	Evaluation questions
			generated benefits and/or costs for different stakeholders?
Covenant Clean & Efficient Agro-sectors	Netherlands	Relevance	• To what extent is reducing GHG emissions (for CO2 and non-CO2 GHGs) still relevant in the agrosectors? • Are the quantified objectives of the covenant still relevant? • To what extent will reducing GHG emissions (for CO2 and non-CO2 GHGs) continue to be relevant in the agrosectors?
Cursos de conducción eficiente en el transporte por carretera	Spain	Effectiveness Coherence	• How effective are the eco-efficient driving courses at reducing emissions from cars? • To what extent is the eco-driving policy coherent with other transport management policies?
Energy company obligation & Domestic Green Deal	United Kingdom	Effectiveness	• Have the Green Deal and ECO met their objectives? • To what extent have the Green Deal and ECO been effective at delivering energy-saving improvements

2.6 Data collection

For each evaluation question, the most appropriate methodology for data collection could be different, either based on literature review, independent data collection, stakeholder consultation, case studies, or modelling.

2.6.1 Data sources

The principal data source for the evaluation of the PaMs in this exercise was the EEA PaM database. Based upon the content of the EEA database however, it was impossible to answer the evaluation questions exhaustively. Therefore other data sources that have been identified in the scoping paper "Benchmark of the EEA's PaM database"[3] were used as well. This was complemented with national data sources where these are readily available and a literature search. Other methods for data collection, such as independent data collection and extensive stakeholder consultation (for instance stakeholder interviews, online questionnaires…) falls outside the scope of this study, although bilateral consultation with one representative of the Member State was included.

Input from Member States was asked for addressing the specific evaluation questions, which was used in combination with evidence from the databases and literature search. Establishing what is already known about the PaMs can be challenging. Systematic review is a tool that can help in this respect. Considering that the evaluation questions are very specific, full systematic review of the literature is not relevant because the amount of evidence per PaM per evaluation question was limited [16]. Nevertheless traditional review of the literature can be improved by applying the most contextually

[3] IEA and IRENA, OECD, MURE, EurObserv'ER, EurLex, National Communications, NREAPS, NEEAPS, RES-legal, FAOLEX and National LCDS.

appropriate activities for increasing transparency, objectivity and repeatability of the findings [17]. This includes:

- Use of defined search strings applied to different sources of information, such as scientific databases, organizational web searches, web search engines, bibliographic checking and references from stakeholders. For this assessment, information sources for each PaM were searched on Google and Google Scholar, on websites of relevant organizations were checked (e.g. ADEME in the case of the Heat Fund), in citations of reports and by consulting national experts.

- Screening of the search results on relevance. Search results that were not relevant to address the evaluation question were not considered.

- Appraisal of the quality of the different data sources. The benchmark of PaM databases could be used to this end as this also includes a scoring on the reliability of the information in the database. In most cases, information came from official or national reports though.

Using this approach (also called "Rapid Evidence Assessment") the available literature to address the evaluation questions was searched. In cases evidence was missing to address the evaluation questions, this was identified as a data gap.

2.6.2 Bias

The collection of information could result in two kinds of bias:

- *Selection bias*: the evaluation is based on literature review of publicly available statistics. This literature is for a large part conducted or commissioned by public institutions and deals with quantitative effectiveness measurements [7]. Evaluations that are truly independent are not always available. This is partly a consequence of the restriction to literature review. Inclusion of other data collection methodologies, such as stakeholder consultation, could partly resolve this bias. In this study full stakeholder consultation was not possible. Only one interview was foreseen with a representative of the each Member State, which does not necessarily cover the view of all concerned stakeholders concerned.

- *Publication bias*: for a comprehensive and systematic review it is important that all evidence is readily available. However, statistical data and reports important for policy and measure evaluation might be confidential and not published. In peer reviewed research it is well established that studies finding a positive result have a higher chance of publication than papers without positive result.

Although it is possible to overcome bias partly by carefully designing the evaluation, it is important to always take this into account. In this study, both official and non-official data sources were considered, although the majority of information that we could find were reports from or commissioned by national governments.

2.7 Triangulation of evidence

The evidence from the data collection was aggregated and synthesised quantitatively and/or qualitatively. Synthesis of information requires transparency of the process and identification and extraction of evidence from studies included in the evaluation [18]. Not all sources of evidence are equally robust and therefore consideration should be given as to the reliability of the data source (e.g. as assessed in the benchmarking study) and the relevance of the evidence vis-à-vis the evaluation question [6].

Where possible, evidence from different sources (*i.e.* from literature review and stakeholder consultation) was combined (triangulation). The utility of the different sources is discussed in the section 'Conclusions and recommendations'.

2.8 Workshop

A workshop was organised on 6 and 7 September 2016 in Copenhagen on policy evaluation. The workshop focused on PaM reporting for the MMR and PaM evaluation practices. A report on the outcome of this workshop is given in Annex 2: Eionet workshop: 'Evaluation and reporting of climate mitigation policies and measures.

3 Results

This chapter highlights the main findings from the evaluation of the 11 selected PaMs in relation to the availability of data and information for policy evaluation and the usefulness of different sources. The outcome of the evaluation of each selected PaM is presented in Annex 1: Evaluation of selected PaMs.

3.1 Data and information needs for policy evaluation

3.1.1 Effectiveness

As was discussed in chapter 3.4, effectiveness is the evaluation of how the PaM influenced the activities of the targeted sector and actors and how this resulted in short- and long-term impacts. To evaluate effectiveness, quantitative and/or qualitative data is needed on these different levels of results spurred on by the PaM. In the evaluations, following quantitative information was found and used to evaluate effectiveness:

- Number of investments (Estonia)
- Number of loans (Czech Republic)
- Number of applications for subsidy (Estonia, France)
- Number of Green Deal assessments, plans and investments (UK)
- Number of signatories to the Energy Efficiency Agreement and audits (Finland)
- Import and consumption of F-gases (Denmark)
- Number of projects (Germany)
- Modal splits for commuting (Belgium)
- Share of non-HFC refrigerators (Denmark)
- Energy savings (Czech Republic, Estonia, Finland, Spain, UK)
- Production of renewable energy (France)
- Impact assessment of the PaM on GHG emissions (Belgium, Czech Republic, Denmark, Estonia, Finland, France, Spain, UK)

This also includes a quantitative or qualitative assessment to what extent the observed effects can be attributed to the PaM under investigation or to what extent this is caused by external effects or other PaMs (Belgium, France).

Apart from quantitative data on activity variables and GHG emissions, information on the used methodology is equally important. Impact evaluations try to quantify the effect of a PaM by comparing it against a counterfactual scenarios without this intervention [3]. The outcome of any impact evaluation depends heavily on this counterfactual scenario. Understanding the effectiveness of PaMs, therefore also means understanding underlying methodologies and assumptions in this scenario. This is particularly relevant when comparing the impacts of PaMs.

3.1.2 Efficiency

Efficiency looks at the inputs that were needed to implement and execute the PaM and the output and results. Information on output and results is largely the same as for effectiveness, so we focus here on information on the costs associated with the PaM. For the evaluations of the 11 PaMs, following quantitative information was found/used to evaluate efficiency:

- Administrative costs (Estonia)
- Amount of subsidy provided (France, Germany)
- Amount invested in energy efficiency improvements (Estonia, Finland)
- Amount invested in renewable energy (France)
- Tax revenu (Denmark)
- Shadow price (Denmark)
- Compliance cost (Denmark)
- Socio-economic costs/benefits – employment (France)
- Qualitative information on administrative costs (Denmark, France), compliance costs (Denmark) and socio-economic costs/benefits (Estonia).

3.1.3 Relevance

While evaluating relevance is mostly based on a qualitative appraisal of evidence, quantitative information can be useful to underscore the need for action and the appropriateness of the objectives of the PaM. Information used in out evaluations were:

- Historic GHG emissions (Germany, Denmark, Netherlands)
- Economic importance of the sector (Netherlands)

3.1.4 Coherence

Coherence evaluation is usually based on qualitative data, and needs to take into account the policy-making process, communication and cooperation between authorities, and direct and in-direct effects of related policies. Quantitative data on GHG emission reductions from related policies can be used to judge the magnitude of impact and overlap between policies, although for the selected PaMs this was not available. Evaluations were mainly based on qualitative information (Belgium, Czech Republic, Finland).

3.2 Usefulness of different data sources for policy evaluation and information gaps

In our evaluation of 11 PaMs, the information came from several sources, as identified in the benchmark study. Depending on the sector and instrument type, the EEA PaM database, the NEEAP, the NC6 and the information on Odyssee/MURE was used most often. Databases covering renewable energy policies were not used often because the selected policies focused on non-ETS sectors.

Table 3.1 Use of data sources for the evaluation of the selected PaMs

	Promotion of car-pooling	Support to fund housing modernization using the building saving	Energy efficiency improvement in public buildings	Tax on HFCs, PFCs and SF6 - equivalent to the CO2 tax	Carbon tax	Landfill aeriation	Heat Fund	Covenant Clean & Efficient Agro-sectors	Energy Efficiency Agreements 2008-2016 (Voluntary energy efficiency agreements)	Cursos de conducción eficiente en el transporte por carretera	Energy company obligation & Domestic Green Deal
	BE	**CZ**	**EE**	**DK**	**IE**	**DE**	**FR**	**NL**	**FI**	**ES**	**UK**
EEA PaM database	X	X	X	X	X	X	X	X	X	X	X
OECD	X			X							
IEA policy databases					X		X		X	X	X
EurObserv'ER							X				
NREAP							X	X	X		
NEEAP	X	X	X		X		X	X	X	X	X
RES legal							X				
Odyssee/MURE		X	X				X	X	X	X	X
NC6 and BR2	X	X	X	X	X	X	X	X	X	X	X
LCDS								X	X		
Literature search		X	X	X	X	X	X	X	X		X
Interview	X	X	X	X	X	X	X		X	X	X

Note: X means the data source was used.

For many of the PaMs considered in this report, the **EEA PaM database** is a useful base to gather descriptive and quantitative information. The consistent structure of reporting across countries allows easy comparison between PaMs. Hildén et al. [8] suggested that the information reported by countries under the MMR could be used to show that GHG emission reductions are achieved by actions that are contributing effectively to international commitments, irrespective of other factors such as industrial restructuring and fuel switching not induced by PaMs.

Other PaM databases and information sources also contributed to the policy evaluations. Three databases and information sources were particularly useful and often complementary in this respect: the OECD database (e.g. for information on tax revenues from Denmark), Odyssee/MURE and national energy efficiency action plans (NEEAPs) for more extensive descriptions of PaMs and quantitative information on the impact (such as energy savings). The low carbon development strategies (LCDS) were useful in evaluating relevance of two PaMs. For instance, in the case of the Netherlands, the LCDS provided insight in how the covenant continues to be relevant in future in the context of short and long term GHG reduction targets.

This analysis reveals that climate policy evaluation depends heavily on other sources found via **literature searches**. Availability of these 'external' sources differed among the selected PaMs, from very limited (for Estonia and Ireland) to relatively extensive (for United Kingdom and France), which reflects both Member States' capacity and the relative importance of the selected PaM for these countries. The source of the information was mostly government related or organisations linked to government (ADEME in France, RKAS in Estonia). There were relatively few independent evaluations[4] of single national PaMs, although this also differed among the Member States (e.g. there were several for the Energy Company Obligation and Domestic Green Deal in the UK).

Although the evaluations focussed on the availability of written resources, one **interview** with the Member State took place. The interview was important for gathering additional evidence to the literature review, which helped in understanding the functioning of the PaM (intervention logic) and the evaluation of the PaM. This was particularly the case for relevance and coherence, but also for effectiveness and efficiency the interview provided additional qualitative information. Interviews mostly corroborated the findings of literature but in certain cases also resulted in new insights. For instance in the case of Estonia, the interview was particularly helpful to understand the interplay between different actors involved in the PaM (Ministry, the RKAS and local authorities) and how this affected the effectiveness and efficiency of the PaM. Also for Spain, the interview helped understand the cooperation between different Ministries in the implementation of the PaM that was not apparent from available literature.

Data sources used per topic/evaluation criteria

Description. Following the MMR guidelines, the description in the EEA PaM database is often short. At best, it helps understand the action of the PaM but the level of detail is insufficient to fully grasp all the details of the PaM. If a technical report is included, this sometimes provides more detailed descriptions. More detailed descriptions of the PaM were found in the NEEAP (e.g. Estonia), the NREAP (e.g. France) and the NC6/BR2. Information from literature review also contributed to a more in depth understanding of the PaM. This was particularly the case for the Covenant Clean and Efficient Agrosectors (Netherlands), which is a broad policy with many interventions by numerous stakeholders.

Intervention logic. The EEA PaM database is a suitable starting point to identify needs, objectives, activities (input, actions and outputs), results and impacts and external factors. However the level of detail of the description is often too limited to come up with a comprehensive intervention logic, especially relating to issues that are not directly linked to GHG emission reductions. This applies to all elements of the intervention logic (from the needs and objectives to the external factors). For instance on coherence, the EEA PaM database provides a basis to identify other national and EU climate policies that affect the results and impacts of the PaM under evaluation, but not for policies that fall outside the climate policy domain which affect the effectiveness of the PaM. This is the case for the Belgian PaM promoting carpooling, where effectiveness of the PaM is affected by policies incentivizing company cars in Belgium.

Effectiveness. The EEA database was to some extent useful in this respect, especially concerning the impact on GHG emissions. Reporting is very incomplete though, especially on ex post effects. Typically there is also little information reported on the calculations and assumptions behind the GHG reductions. However, the references to assessments and underpinning technical reports do make the database a useful starting point to find more detailed quantitative data and evaluations. Information on other short or long term results and impacts are generally missing. More extensive information could be found in other resources, either other PaM databases or from other published studies.

[4] Evaluations not commissioned by the national government.

Table 3.2 Use of data sources for the description, intervention logic and evaluation of the selected criteria

	Description	Intervention logic	Relevance	Coherence	Effectiveness	Efficiency
EEA PaM database	X	X		X	X	X
OECD						X
IEA policy databases	X	X				
EurObserv'ER	X	X			X	
NREAP	X	X	X	X	X	
NEEAP	X	X	X	X	X	
RES legal	X	X				
Odyssee/MURE	X	X		X	X	X
NC6 and BR2	X	X	X	X	X	X
LCDS			X			
Literature search	X	X	X	X	X	X
Interview	X	X	X	X	X	X

Note: X means the data source was used.

Efficiency. The EEA PaM database shows projected and realised costs and benefits of the policies, in EUR and EUR/t CO2-eq., which gives a useful indication on the efficiency of the PaM in delivering GHG reductions. Unfortunately this information is not reported for many PaMs by countries, which limits the usefulness of the database. For information that has been reported on costs and benefits, either in the questionnaire or in the technical report (e.g. for Denmark and Estonia), information on how costs or benefits have been calculated is usually missing. This information is very important to be able to interpret reported costs and benefits. The fact that there is no harmonised methodology[5] to assess costs for MMR reporting also means that reported values cannot be compared. To evaluate efficiency evidence came from the OECD database (e.g. Denmark on tax revenue) and, more importantly, the literature review.

Relevance. The link between the objectives of the national PaM and the needs it addresses are largely missing. The need to reduce GHG emissions to avoid climate change is a common denominator for all PaMs, but more specific needs the PaM addresses are often more difficult to identify, which makes evaluation incomplete. Information from EEA PaM database is missing to make this qualitative evaluation, as it is in most PaM databases or information sources. The NC or the NEEAP do sometimes provide information on the national circumstances that helps understand the relevance of certain PaMs in the national context. For the Netherlands the LCDS was useful to evaluate the relevance of the PaM in the future. Existing evaluations of relevance of a national PaM were not found.

Coherence. There is no section in the EEA PaM database where countries can list other policies which are related or interact with the PaM. As such the database is not as useful as it could be for assessing coherence between policies. However, as the EEA PaM database provides an exhaustive list of national climate-related PaMs, it is possible that interacting or overlapping PaMs could be deduced. The link between the national PaM and Union legislation is explicitly included, although only when the national PaM was implemented in response to the Union policy (and not if there is only interaction).

[5] The lack of harmonised methodologies and the fact that this information is often political sensitive, means that Member States might not include this information in the MMR submission.

Jordan et al. [19] argued that climate policy evaluation is now mainly driven by self-reporting of countries to the UNFCCC or the MMR. This implies a heavy emphasis on broad compliance exercises and therefore ex post policy evaluations focus on effectiveness and, to a lesser extent, efficiency [19]. Our evaluation of 11 PaMs also show that information on effectiveness is more readily available than information on efficiency. Evaluations on relevance or coherence of national PaMs was largely missing, although information is available.

Box 1. Quantifying ex post emission savings: the impact of the selected methodology.

The result of assessing the impact of a PaM in terms of ex post GHG emission reductions depends to a large extent on the chosen methodology, where two elements are of particular importance:

The boundary of the assessment

- In-country and/or international effects: In most cases, the impact of the PaM on domestic GHG emissions is determined. In a globalized economy however, domestic policies impact emissions in other countries, within and outside the EU, as well.

- Direct and/or indirect effects: Climate PaMs can have implications on a chain of events that could have a small or large positive or negative effect on GHG emissions. Indirect effects include for instance rebound effects in energy efficiency measures, where the full potential of energy/emission savings are not met because users adjust their behaviour when they purchase a more efficient device. Rebound effects can be direct (usage of energy efficient device increases), indirect (monetary savings from energy efficiency is used for other purchases) or macro-economic (energy efficiency affects fuel prices which has economic implications). Another example is the emission factor from using biomass. In most cases this is considered zero, but in the case of France, a lifecycle approach was used and the emission factor for biomass was not zero.

The counterfactual or reference scenario

The impact of a PaM is often measured against a counterfactual scenario, where the influence of the PaM is excluded. Defining this counterfactual scenario has important implications on the final estimated emission savings. For instance in the case of car pooling in Belgium, the counterfactual is based on the underlying assumption that there would not be any car pooling without supporting policies. In the case of subsidies or premiums (for instance in Estonia and the UK), the impact of the PaM is often based on the number of applications. This ignores the fact that there could be a significant free-rider effect (e.g. a subsidy was requested, but the investment would have occurred also without the subsidy) or multiplier effect (e.g. an investment was triggered by a subsidy scheme, but the subsidy was not requested). These effects are very difficult to quantify and therefore mostly not accounted for.

The fact that methodological choices have such important effects on the outcome of an ex post impact assessment has two implications. Firstly, the impacts of different PaMs in a PaM database (such as the EEA PaMs database, where there are multiple reporters) cannot be compared without understanding the underlying methodological differences. Secondly, Member States might be reluctant to report ex post results because results might be misinterpreted, without this methodological background.

4 Conclusions and recommendations

4.1 Consolidating information of PaMs to support policy evaluations

Policy evaluation typically draws upon different approaches, methodologies and data sources to come to well-funded and unbiased results. As the 11 case studies show, PaM databases could be useful resources in evaluations, either for the evaluation of single PaMs or, for the evaluation of a group of PaMs, for instance from one country or in one sector. Databases are useful because they provide information to evaluators or direct them to additional resources (e.g. reports, government websites, etc.).

In order to best support policy evaluation, the information of a PaM database should address the following aspects:

- **Description**: A PaM database should provide a description of a PaM that helps understand or build the intervention logic of the PaM. A description should therefore include the specific objective(s) even if these do not relate to GHG emission reductions, a description of the PaM, the input (qualitative or quantitative, see also efficiency), activities and output (see also effectiveness) of the intervention and expected results and impacts. For most PaM databases, this information is already partially available, either explicit or implicit.

- **Relevance**: To evaluate the relevance of a PaM, it is important to understand the needs the PaM is addressing and whether the objectives are still appropriate to address these needs. It is difficult for a PaM database to provide this information and more useful resources to evaluate relevance or reports, such as the NEEAPs. Assessing relevance also requires understanding the motivation as to why a specific PaM was implemented and assessing if these motives still apply. These motivations can lie partially outside of the climate policy domain, e.g. a carbon tax could fit in a more general fiscal policy to shift taxation on labour to taxation on consumption. In most cases, climate PaM databases only include objectives directly related to GHG emission reductions. Include ulterior motives as to why PaMs were implemented could be insightful.

- **Coherence**: Climate policy is a typical example of multi-level and multi-actor governance, especially in the EU where the EU has developed a multitude of often highly effective roles for itself in climate governance. To evaluate policies, interactivity of policy measures is therefore very important. This is intensified in the new EU Energy Union policy framework which has 5 closely related dimensions, and where actions in one dimension could have implications in another. A good overview of how national and EU PaMs are interlinked is therefore important. A good example is the EURLex and NLex website, which makes it possible to identify national legislation in each of the 28 Member States that transposes a specific EU legislation.

- **Effectiveness**: Evaluating effectiveness requires information on how the PaM has resulted in expected changes. Results and impacts are assessed and compared to the objectives of the PaM. In PaM databases, results are mostly expressed in only one dimension, either energy savings, renewable energy production or GHG emission savings (depending on the principal scope of the database). As is the case for the EEA PaM database, this could be supplemented with additional information on key indicators, although this information is often not reported by Member States. However, as climate PaMs could have multiple policy objectives it is important from an evaluation perspective that PaM databases have (quantitative) information on indicators that cover all policy objectives of the PaM (even if these fall outside the climate policy domain). If the objective is quantified, indicators help to assess progress and distance to target.

    - **Quantitative data** on PaMs is often the most the most sought after information in PaM databases, but, as is the case in the EEA PaM database is often very incomplete and results between PaMs should be compared cautiously. Quantitative information in PaM databases, should therefore strive for:

  - **Consistency of methodologies**: Box 1 illustrates how methodological differences can have profound impacts on the outcome of ex post GHG emission savings (and costs). A common approach would therefore increase consistency and comparability of the results.
  - **Transparency**: Even if a common approach is used, transparency on methodology and assumptions is imperative to put quantitative data in proper light. Links to technical reports that discloses this information should therefore be provided.

- **Efficiency**: In the context of the MMR Member States are requested to report information on the costs and benefits of their climate PaMs, if available. Few Member States have includes this information, for which there are several reasons. One reason is that this information is (perceived as) political sensitive. This is exacerbated by the fact that costs and benefits are not clearly defined, making interpretation difficult without additional information. For the OECD database, information that is relevant to evaluating efficiency, such as amount of subsidy provided, generated tax revenue, … appear more readily available. One of the explanations could be that this is clearly delineated. In evaluation, efficiency is often expressed in terms of governmental costs in implementing the PaM and this information is missing in many Member States.

4.2 Improvements in reporting systems to enhance policy evaluations

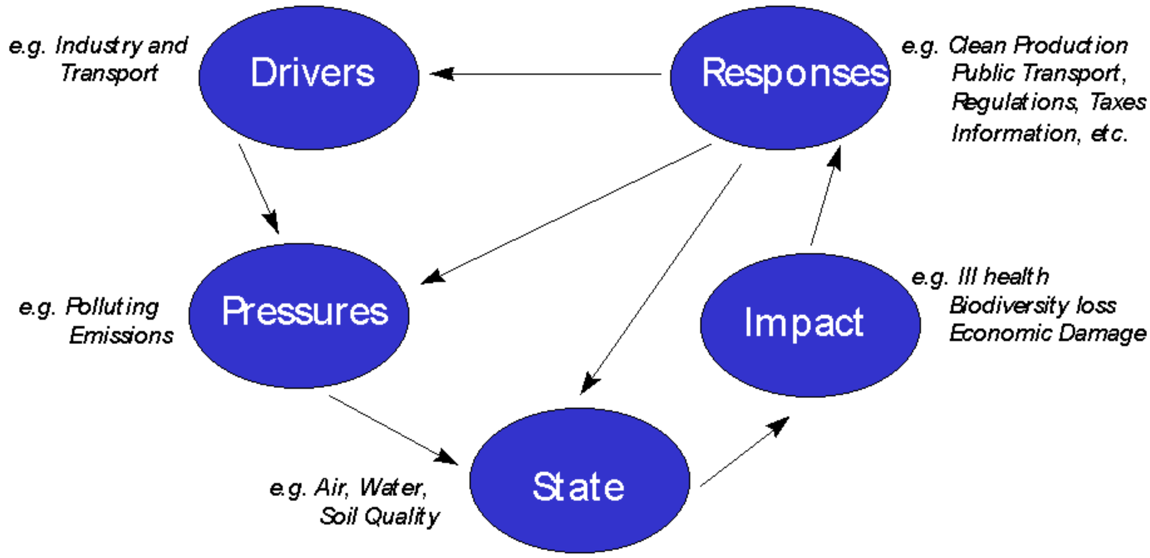
The evaluations carried out in the context of this study show that there could be improvements in the reporting system to enhance policy evaluation. Actions at different levels could be beneficial.

4.2.1 Recommendations for EEA

The MMR reporting on PaMs does not allow for a complete and in-depth evaluation of national PaMs, nor should it be the aim, as this is not the objective of this reporting requirement under the MMR. But as shown by the evaluations performed, the MMR reporting could nevertheless contribute by providing a starting point with basic information on the PaMs, its effectiveness and efficiency. There are also numerous opportunities for Member States in the questionnaire to cite or link to technical reports and other information sources that give more in-depth information on the PaM.

The EEA collects, aggregates and publishes data that is also particularly relevant when evaluating PaMs for effectiveness, efficiency, relevance and coherence at individual PaM level or aggregate level (for a specific sector or Member State). The EEA's Indicator Management System (IMS) contains 127 indicators, covering 22 environmental topics, including climate state, energy, transport (TERM) and waste, that could be particularly interesting to link to information on PaMs. To structure thinking about the interplay between the environment and socio-economic activities, the EEA developed the DPSIR (driving force, pressure, state, impact, and response) framework. Indicators on all parts of the DPSIR chain could be relevant from a policy evaluation perspective [20]. Linking information on PaMs to indicators and other data sources could already assist in policy evaluation. Although it is not necessarily feasible to consolidate all information sources on PaMs in a single database, linking data between PaMs and inventory and projections data would contribute to directly assessing the relationship between PaMs and GHG emission trends.

Figure 4.1 The DPSIR (Drivers, Pressures, State, Impact and Response) framework.



Source: [21].

Additionally it would be interesting to be able to select, for each country, all data reported to EEA.

The importance of the EEA PaM database in policy evaluation could also be found in cases of larger evaluations over multiple or all climate policies in a Member State or in case of evaluations over different Member States (e.g. in the case of the evaluation of Union policies). Of the different databases and information sources considered in the benchmark study, the EEA PaM database is the only comprehensive database on climate PaMs, with the exception of the NC6 and BR reporting to the UNFCCC[6]. The EEA PaM database covers all EU countries across sectors, GHGs and instrument types. It is also the only database that makes a link between national and Union policies. Cross comparison of PaMs across countries with respect to effectiveness, efficiency and other evaluation criteria will become increasingly important, as Auld et al. [22] illustrated in a systematic review of the effectiveness of PaMs. These reviews help to identify and understand what makes policy successful. GHG emissions need to be reduced further in the transition to a low carbon society, and innovative policies will need to be implemented that support this [1]. The inclusion of the outcome of more comprehensive evaluations in the PaM database could help identify these policy innovations [8]. To facilitate such assessments and evaluations, consistent and complete reporting across Member States is needed.

There could be several barriers at this moment that affect more complete, transparent and consistent reporting under the MMR by Member States. There are considerable overlaps in reporting requirements under different Union legislation (mostly evident with the EED and the RED) and also with international reporting requirements (with the NC and BR). In some case(s) information from different sources had different quantitative statistics relevant for effectiveness and efficiency. This was the case for instance for France, Finland, Spain and Belgium. This is not always avoidable, as

[6] Although the IEA has a separate climate PaM database, in practice it only includes PaMs related to energy efficiency and renewable energy. The OECD policy database covers also climate policies but does not include all instrument types.

reporting occurs at different moments in time, but makes it difficult to assess which is correct or most correct. A further **harmonisation of reporting streams** could ensure a higher consistency of the reported information. It could also reduce administrative burden and result in more comprehensive, consistent and less fragmented reporting by the Member States. According to the different reporting obligations it is not possible to prepare the additional data in all of the required allocations.

Reporting GHG inventory data and projections is relatively well defined with extensive reporting manuals and guidelines. This is largely missing in the reporting on PaMs, which results in more heterogeneous, and potentially less complete, reporting. Especially relating to the impact and cost of PaMs, different methodological approaches make it difficult to compare quantitative results. For the Energy Services Directive, methodological guidelines were prepared to assist Member States in quantifying the impact of their PaMs either bottom-up or top-down, in a harmonised way. Although the methodology could be criticized [23], this does make it easier, albeit not perfect, to compare the effectiveness of actions across Member States. In 2009 [24] and 2012 [25], methodological frameworks were developed to evaluate the ex post impact on GHG emissions and the costs of EU climate policies that could form a basis for such **methodological guidelines**.

4.2.2 Recommendations for Member States

The current reporting on PaMs by Member States is clearly defined in the MMR and the implementing act. The reporting requirements and information that is requested by the MMR could already be a good basis for starting policy evaluation, especially if reporting by Member States could be made more complete, transparent and consistent.

In order to facilitate policy evaluations (either of individual or a group of PaMs), *completeness* of the reporting on PaMs, especially concerning non-mandatory reporting requirements, could be improved. Quantitative information on ex post data of both GHG emission reductions and indicators is largely missing in the report. The technical reports that accompany the submission of many Member States includes in some cases more relevant information for policy evaluation than the questionnaire (even when there were opportunities for the data to be included in the questionnaire). Member States also have reporting requirements under other Union legislation that is directly or indirectly related to climate mitigation, e.g. reporting under the MMR, the Energy Efficiency Directive (EED) and the Renewable Energy Directive (RED). This often includes quantitative information that could be included as indicator.

Lack of ex post data is evident at different levels. In a review of five policy databases, [26] the lack of information of ex post data for measuring performance of cooperative initiatives was highlighted. Although the scope was different, the same applies for national policy databases.

In cases where quantitative information is reported, transparency on how impacts, indicators, costs and benefits have been assessed is in some cases missing. This could be resolved by including more references or links to external resources, if publically available. In order to put quantitative information into the correct context, information on the methodology and assumptions is imperative.

Policy evaluation is crucial in policy process, but policy evaluation practices differ significantly within (e.g. from one policy domain to another) and across Member States. At EU level, evaluation (ex post) and impact assessment (ex ante) have been integrated in the policy process via the Better Regulation guidelines. In Member States policy evaluation is often done on an ad hoc basis, which emphasises heavily on effectiveness and efficiency. Exchange of experiences in policy evaluation practices between Member States would help in identifying and adopting good practices.

At the moment, there is little incentive for Member States to put more effort in reporting on their climate PaMs. On the contrary, including information on the impact and costs could be politically sensitive, especially if the information to put quantitative data into context is largely missing.

5 References

[1] D. Huitema, A. Jordan, E. Massey, T. Rayner, H. van Asselt, C. Haug, R. Hildingsson, S. Monni and J. Stripple, "The evaluation of climate policy: theory and emerging practice in Europe," *Policy Sciences,* vol. 44, no. 2, pp. 179-198, 2011.

[2] M. Birnbaum and P. Mickwitz, *New directions for evaluation. Special Issue: Environmental Program and Policy Evaluation: Addressing Methodological Challenges.,* no. 122, pp. 1-112, 2009.

[3] European Environment Agency, "Environment and climate policy evaluation," EEA, Copenhagen, 2016.

[4] C. Haug, T. Rayner, A. Jordan, R. Hildingsson, J. Stripple, S. Monni, D. Huitema, E. Massey, H. Van Asselt and F. Berkhout, "Navigating the dilemmas of climate policy in Europe: evidence from policy evaluation studies.," *Climatic Change,* vol. 101, no. 3-4, pp. 427-445, 2010.

[5] H. Mela and M. Hildén, "Evaluation of climate policies and measures in EU member states – examples and experiences from four sectors," The Finnish Environment, Helsinki, 2012.

[6] European Commission, "Commission staff working document. Better Regulation Guidelines," Strasbourg, 2015.

[7] European Environment Agency, "Overview of reported national policies and measures on climate change mitigation in Europe in 2015," Copenhagen, 2015.

[8] M. Hildén, A. Jordan and T. Rayner, "Climate policy innovation: developing an evaluation perspective," *Environmental Politics,* vol. 23, no. 5, pp. 884-905, 2014.

[9] Briene, Michel; von Schickfus, Marie-Theres ; Ah Tchou, Stéphanie ; Mikkola, Nella ; Klaassens, Erik, "Support to establish and assess an inventory of methodologies for evaluating effectiveness and cost-effectiveness/ economic efficiency of environment and climate policies," Ecorys, Rotterdam, 2013.

[10] Healy, Sean; Schumacher, Katja ; Slingerland, Stephan; Stroia, Anamaria, "Performance of a literature review of greenhouse gas emission trading policy evaluations," TripleE, Öko-institut, REC, Rotterdam, 2014.

[11] OECD, "DAC Principles for the Evaluation of Development Assistance," OECD, Paris, France, 1991.

[12] OECD, "Glossary of Key Terms in Evaluation and Results Based Management," OECD, Paris, France, 2002.

[13] European Commission, "Evalsed Sourcebook: Method and Techniques," Brussels, 2013.

[14] HM Treasury, The Magenta book. Guidance for evaluation., London, 2011.

[15] European Commission, *Commission Staf Working Document: Better regulation guidelines,* Strasbourg, 2015.

[16] Collaboration for Environmental Evidence, "Guidelines for Systematic Review and Evidence Synthesis in Environmental Management," Bangor University, Bangor, UK, 2013.

[17] Haddaway, NR; Woodcock, P; Macura, B; Collins, A, "Making literature reviews more reliable through application of lessons from systematic reviews," *Conservation*

Biology, vol. 29, no. 6, pp. 1596-1605, 2015.

[18] Higgins, Julian P.T.; Green, Sally, Cochrane Handbook for Systematic Reviews of Interventions, Version 5.1.0 ed., Chichester, UK: John Wiley & Sons Ltd, 2011.

[19] A. J. Jordan, D. Huitema, M. Hildén, H. Van Asselt, T. J. Rayner, J. J. Schoenefeld, J. Tosum, J. Forster and E. L. Boasson, “Emergence of polycentric climate governance and its future prospects,” *Nature Climate Change,* vol. 5, pp. 977-982, 2015.

[20] European Environment Agency, “Digest of EEA indicators 2014,” EEA Technical Report, Copenhagen, Denmark, 2014.

[21] European Environment Agency, “DPSIR framework,” 20 April 2016. [Online]. Available: http://www.eea.europa.eu/publications/92-9167-059-6-sum/page002.html.

[22] G. Auld, A. Mallett, B. Burlica, F. Nolan-Poupart and R. Slater, “Evaluating the effects of policy innovations: Lessons from a systematic review of policies promoting low-carbon technology,” *Global Environmental Change,* vol. 29, p. 444–458, 2014.

[23] P. Bertoldi and C. Cahill, “The role of NEEAPs, measurement methods and national targets to achieve the EU 2020 energy svaing goal,” in *Proceedings of the 2013 eceee Summer Study, June 3-8*, Belambra Presqu'île de Giens, 2013.

[24] AEAT, Ecofys, Fraunhofer, ISI, NTUA, “Quantification of the effects on greenhouse gas emissions of policies and measures,” 2009.

[25] Öko-institut, Cambridge Econometrics, AMEC, Harmelink Consulting, TNO, “Ex-post quantification of the effects and costs of policies and measures,” 2012.

[26] O. Widerberg and J. Stripple, “The expanding field of cooperative initiatives for decarbonization: a review of five databases,” *WIREs Climate Change,* vol. 4, no. 486-500, p. 7, 2016.

[27] National Climate Commission of Belgium, “Belgium's 6th National Communication on Climate Change Under the United Nations Framework Convention on Climate Change,” FPD Health, Food Chain Safety and Environment, Brussels, 2013.

[28] SPF Mobilité et Transports, “Diagnostic des déplacements domicile - lieu de travail 2014,” 2016.

[29] OECD, “Economic Surveys, Belgium 2013,” 2013.

[30] VITO and ECONOTEC , “Evaluation of the impact of policy instruments and measures implemented in the context of the Federal climate policy.,” 2015.

[31] T. Vanoutrive, E. Van de Vijver, L. Van Malderen, B. Jourquin, I. Thomas, A. Verhetsel and F. Witlox, “What determines carpooling to workplaces in Belgium: location, organisation, or promotion,” *Journal of Transport Geography,* vol. 22, no. 1, pp. 77-86, 2012.

[32] Transport & Environment, “Push to end Belgium’s’company car paradise,” 2015. [Online]. Available: https://www.transportenvironment.org/news/company-cars%E2%80%99-paradise-%E2%80%98if-it-seems-absurd-it%E2%80%99s-because-it-is%E2%80%99. [Accessed 19 10 2016].

[33] ACSS, “Building savings 2015,” Association of Czech Building Savings Banks, Prague, 2016.

[34] Ministry of Regional Development of the CR, “Housing in the Czech Republic in figures,” 2015.

[35] Czech Ministry of Industry and Trade, “National Energy Efficiency Action Plan of the Czech Republic,” 2014.

[36] Ministry of Industry and Trade, “National Energy Efficiency Action Plan of the

Czech Republic," 2014.
[37] ACSS, "Bausparsystem data in Czech 2000-2015," [Online]. Available: http://www.acss.cz/en/statistics/. [Accessed 27 05 2016].
[38] Denmark , "Denmark's Sixth National Communication on Climate Change Under the United Nations Framework Convention on Climate Change and the Kyoto Protocol and Denmark's First Biennial Report Under the United Nations Framework Convention on Climate Cha," 2013.
[39] D. Brack, "National Legislation on Hydrofluorocarbons.," 2015.
[40] The Danish Environmental Protection Agency, "Danish consumption and emission of F-gases. Environmental Project No. 1842," Copenhagen, 2016.
[41] S. Gulliver, "Evidence on Alternative Synthetic Greenhouse Gas Policies.," 2011.
[42] Danish Centre for Environment and Energy, "Denmark's National Inventory Report 2016," Aarhus University, Aarhus, 2016.
[43] Denmark, "Going Natural. The Danish road to natural refrigerants," nn.
[44] EIA, "Availability of low GWP alternatives to HFCs. Feasibility of an early phase-out of HFCs by 2020," 2012.
[45] Danish Ministry of Finance, 2014. [Online]. Available: http://www.skm.dk/love/lovforslag/tidligere-aar/2008-09/l204. [Accessed 2014].
[46] Denmark, "Biennial report," 2016.
[47] Danish Energy Agency , "Memorandum Denmark's intermediate update on the low-carbon development strategy, climate policies and measures and greenhouse gas projections.," 2016.
[48] K. Madson, "Life after HFCs,–The Danish Experience," Proceedings of the Institute of Refrigeration , 2009.
[49] Shecco, 2012. [Online]. Available: https://issuu.com/shecco/docs/guide_2012_nr_final/52.
[50] OECD, "Tax Administration Database," [Online]. Available: http://www.oecd.org/site/ctpfta/taxadministrationdatabase.htm. [Accessed 09 05 2016].
[51] Sweden, "Skatt på fluorerade växthusgaser (in Swedish)," 2009.
[52] Sorensen and M.A., "Lessons learned from phasing out HFCs in Denmark.," 2012.
[53] Denmark, "Danmarks udledning af CO2-indsatsen i perioden 1990-2001 og omkostningerne herved.," 2005.
[54] OECD , "Revenues raised by environmentally related taxes for selected countries," 2016. [Online]. Available: http://www2.oecd.org/ecoinst/queries/QueryResult_3.aspx?Key=def2f857-766b-4d58-aa02-903e6bf4e684&QryCtx=2&QryFlag=3 . [Accessed 03 05 2016].
[55] ICF, "HFC Policy Analysis Report.," in *Submission by parties on the implementation of decision XIX/6' (UNEP/OzL.Pro.WG.1/34/INF/4/Add.1, 30 June 2014).*, 2014.
[56] Danish Ministry of Finance, "Dødvægtstab ved miljø- og energiafgifter," 21 12 2004. [Online]. Available: http://www.skm.dk/skattetal/analyser-og-rapporter/ska%CF%84/2004/december/ska%CF%84-december-2004/doedvaegtstab-ved-miljoe-og-energiafgifter. [Accessed 02 06 2016].
[57] Estonia, "Renovating historical buildings using funds gained by selling CO2 emission quota," in *Presentation at "Cultural Heritage and the EU 2020 strategy – towards an*

integrated approach", 2013.
[58] Tallinn University of Technology , “Energy Efficiency Policies and Measures in Estonia. Odyssee-MURE 2010.,” 2012.
[59] RKAS, 2016. [Online]. Available: www.rkas.ee. [Accessed 15 5 2016].
[60] Energy Efficiency Watch , “Energy Efficiency in Europe. Assessment of Energy Efficiency Action Plans and Policies in EU Member States.,” 2013.
[61] RKAS, “Consolidated Annual Report,” 2013.
[62] Ecologic, “Assessment of climate change policies in the context of the European Semester.,” 2013.
[63] Motiva, Ministry of Employment and the Economy, “Finland- Energy Efficiency Agreement 2008-2016,” Helsinki, 2016.
[64] Energiatehokkuussopimukset, 2016. [Online]. Available: http://www.energiatehokkuussopimukset.fi/en/activities_and_results/ . [Accessed 08 06 2016].
[65] Motiva, “Energy Efficiency Agreements in Finland - Results 2008-2014,” Helsinki, 2013.
[66] Finland, “Finland’s National Energy Efficiency Action Plan - NEEAP-3,” 2014.
[67] France, “Rapport de la France en application de l’article 13.1 du règlement 525/2013 relatif à un mécanisme pour la surveillance et la déclaration des émissions de gaz à effet de serre. Actualisation 2015 (in French),” 2015.
[68] ADEME, “Fonds Chaleur. Bilan 2009-2014, relance et nouvelle dynamique,” 2015.
[69] ADEME, [Online]. Available: http://bilans-ges.ademe.fr. [Accessed 20 5 2016].
[70] ADEME, “Contrat d’objectifs 2009-2012 entre l’État et l’ADEME,” 2009.
[71] Ministère de l'écologie, du développement durable et de l'énergie, “Programmation pluriannuelle de l'énergie Premières orientations et actions 2016-2023,” 2015.
[72] France, “Report on progress in the promotion and use of energy from renewable sources,” 2015.
[73] ADEME, “Evaluation de l’impact des projets soutenus dans le cadre du fonds chaleur BCIAT sur les acteurs de la filiere en matiere d’emploi et de chiffre d’affaires,” 2014.
[74] France, “Report on progress in the promotion and use of energy from renewable sources,” 2013.
[75] France, “Report on progress in the promotion and use of energy from renewable sources,” 2015.
[76] ADEME, “Bilan Bois Energie au 01/01/2013. Presentation.,” 2013. [Online]. Available: http://www.ofme.org/bois-energie/documents/Energie/20130116_bilan_FC
[77] Ministère de l'environnement, de l'énergie et de la mer, “Le coût du soutien aux énergies renouvelables (in French),” 22 08 2014. [Online]. Available: http://www.developpement-durable.gouv.fr/Le-cout-du-soutien-aux-energies.html. [Accessed 20 5 2016].
[78] R. Stegmann , K. U. Heyer and K. Hupe , “Landfill aeration as a measure for climate protection,” IFAS - Consultants for Waste Management, Hamburg, 2016.
[79] Umweltbundesamt, “National Inventory Report for the German Greenhouse Gas Inventory 1990 - 2014,” 2016.
[80] IEA, “Ireland Carbon Tax,” 2015.

[81] IEEP, "Evaluation of Environmental Tax Reforms: International Experiences," 2013.

[82] Ireland, "Irelands Sixth National Communication under the framework of UNFCCC," 2014.

[83] PWC, "Tax Facts 2015, The essential guide to Irish tax," 2015.

[84] IEA, "Energy Policies of IEA Countries. Ireland. 2012 Review," 2012.

[85] UNFCCC, "National Inventory Submissions 2016," [Online]. Available: http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/9492.php. [Accessed 20 5 2016].

[86] European Environment Agency, "EU Emissions Trading System (ETS) data viewer[last accessed on 10,06,2016]," 2016. [Online]. Available: http://www.eea.europa.eu/data-and-maps/data/data-viewers/emissions-trading-viewer.

[87] Department of Communications, Energy & Natural Resources , "Ireland's Transition to a Low Carbon Energy Future 2015-2030," 2015.

[88] Ireland, "Ireland's Second Biennial Report 2016," 2016.

[89] European Environment Agency, [Online]. Available: http://cdr.eionet.europa.eu/Converters/run_conversion?file=/ec/mmr/art04-13-14_lcds_pams_projections/colvzkuna/envvzkvxq/IE_MMR_PAM_20150622,xml&conv=524&source=remote#pam7. [Accessed 10 6 2016].

[90] Department of Communications, Energy & Natural Resources, "National Energy Efficiency Action Plan," 2014.

[91] Irish Examiner, "Michael McGrath: Review €385m carbon tax," 2015. [Online]. Available: http://www.irishexaminer.com/business/michael-mcgrath-review-385m-carbon-tax-373366.html. [Accessed 10 06 2016].

[92] Tax Strategy Group, "Energy and Environmental Taxes and Vehicle Registration Tax," 2015.

[93] OECD, "Nominal tax rates of environmentally related taxes for selected countries," [Online]. Available: http://www2.oecd.org/ecoinst/. [Accessed 15 5 2016].

[94] Department of Communications, Energy and Natural Resources, "National Energy Efficiency Action Plan 2014. Ireland," 2014.

[95] F. Convery, "Budget 2013 – Three Cheers For The Carbon Tax," 2012. [Online]. Available: http://www.publicpolicy.ie/budget-2013-three-cheers-for-the-carbon-tax/. [Accessed 06 10 2016].

[96] F. Convery, L. Dunne and D. Joyce, "Ireland's Carbon Tax and the Fiscal Crisis," in *ISSUES IN FISCAL ADJUSTMENT, ENVIRONMENTAL EFFECTIVENESS, COMPETITIVENESS, LEAKAGE AND EQUITY IMPLICATIONS*, 2013.

[97] F. Convery, L. Dunne and D. Joyce, "Ireland's Carbon Tax and the Fiscal Crisis," *ISSUES IN FISCAL ADJUSTMENT, ENVIRONMENTAL EFFECTIVENESS, COMPETITIVENESS, LEAKAGE AND EQUITY IMPLICATIONS,* 2013.

[98] Tax Strategy Group , "Energy & Environmental Taxes," [Online]. Available: http://www.finance.gov.ie/sites/default/files/14.03%20Energy%20%20Environmental%20Taxes.pdf.

[99] M. Hyland and S. Haller, "Firm-Level Estimates of Fuel Substitution: An Application to Carbon Pricing," ESRI Working Paper No., 513, 2015.

[100] Ministerie van Landbouw, Natuur en Voedselkwaliteit, "Convenant Schone en Zuinige agrosectoren (in Dutch)," 2008.

[101] RVO, LEI, “Energie en klimaat in de Agrosectoren (in Dutch),” Rijksdienst voor Ondernemend Nederland, Utrecht, 2014.

[102] Ministry of Infrastructure and the Environment, “Sixth Netherlands National Communication under the United Nations Framework Convention on Climate Change,” 2013.

[103] Odyssee/MURE, “TER-NLD21 - Innovation and Action Programme for Clean and Economical Agro sectors,” 2016.

[104] Netherlands, “Klimaatbrief 2050, Uitdagingen voor Nederland bij het streven naar een concurrerend, klimaatneutraal Europa (in Dutch),” 2011.

[105] Ministry of Industry, Energy and Tourism, “2014-2020 National Energy Efficiency Action Plan,” 2013.

[106] IEA, “Energy Policies of IEA Countries – Spain, 2015 Review,” 2015.

[107] Ofgem, “Energy Companies Obligation Final Report, January ’13 - March ’15,” 2015.

[108] DECC, “Household Energy Efficiency National Statistics, headline release,” 2016.

[109] NAO, “Green Deal and Energy Company Obligation,” 2016.

[110] ECCSC, “Energy and Climate Change Select Committee: Home energy efficiency and remand reduction,” 2016.

[111] Rosenow and N. Eyre, “Re-energising UK Domestic Energy Efficiency,” in *ECEEE Summer Study Proceedings*, 2015.

[112] T. Fransen and C. Cronin, *A critical decade for climate policy: tools and initiatives to track our progress,* Washington, DC: World Resources Institute, 2013.

[113] Athmosphere Europe, “Natural refrigerants. Solutions for Europe.,” 2012.

Annex 1: Evaluation of selected PaMs

Promotion of car-pooling (Belgium)

Description

Sector: Transport

Objective: Demand management/reduction; Improved behaviour

Policy instrument: Fiscal

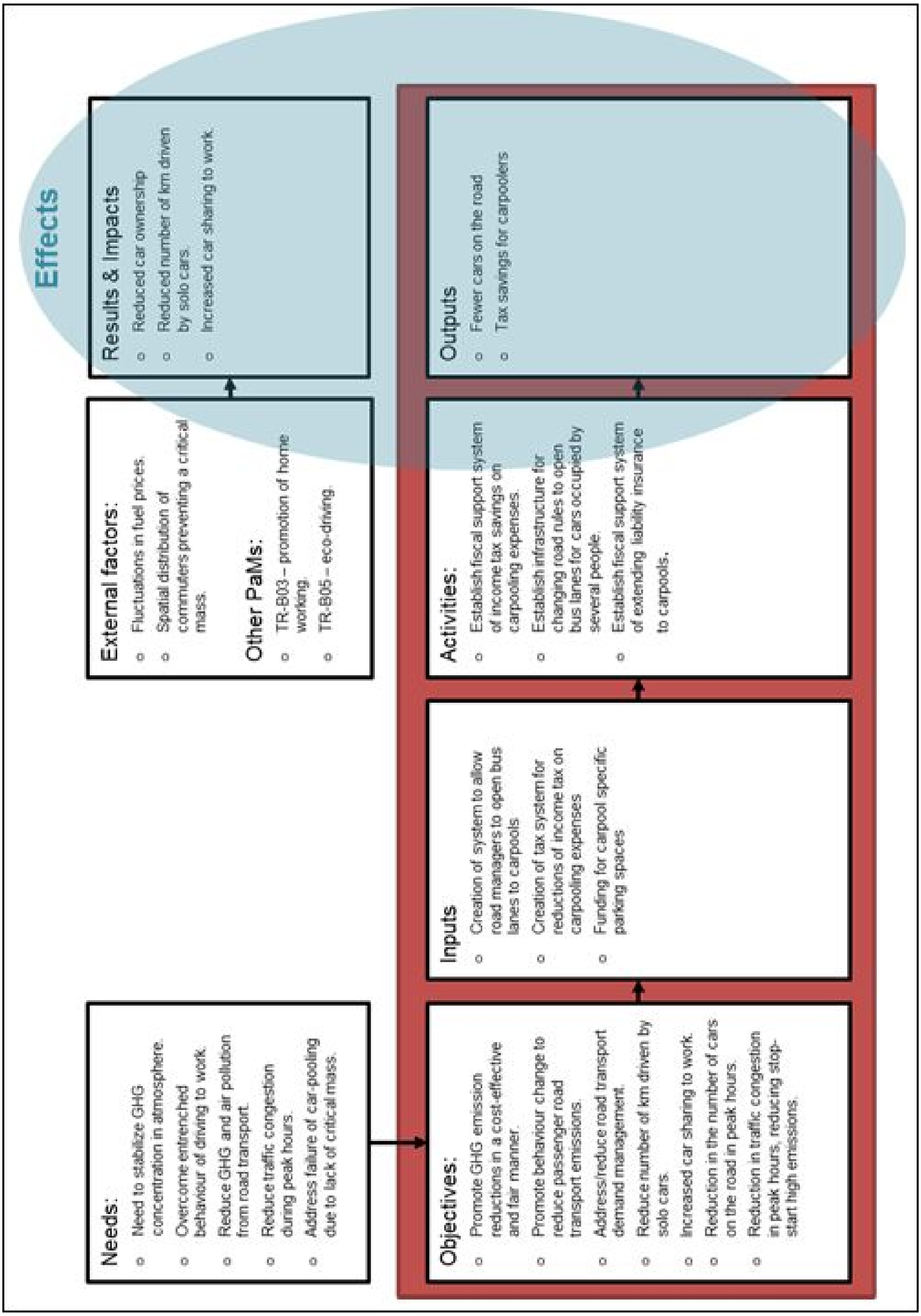
Description: Car-pooling is being supported fiscally. Home-work travel expenses for using car-pooling are deductible at the lump sum rate of 0,15 EUR/km, up to a maximum distance of 25 km (later increased to 50 and 100 km one-way).

Status: Implemented

Start year: 2004

End year: Unknown.

Intervention logic



Evaluation criteria

Effectiveness – ~~Efficiency~~ – ~~Relevance~~ – ~~Coherence~~

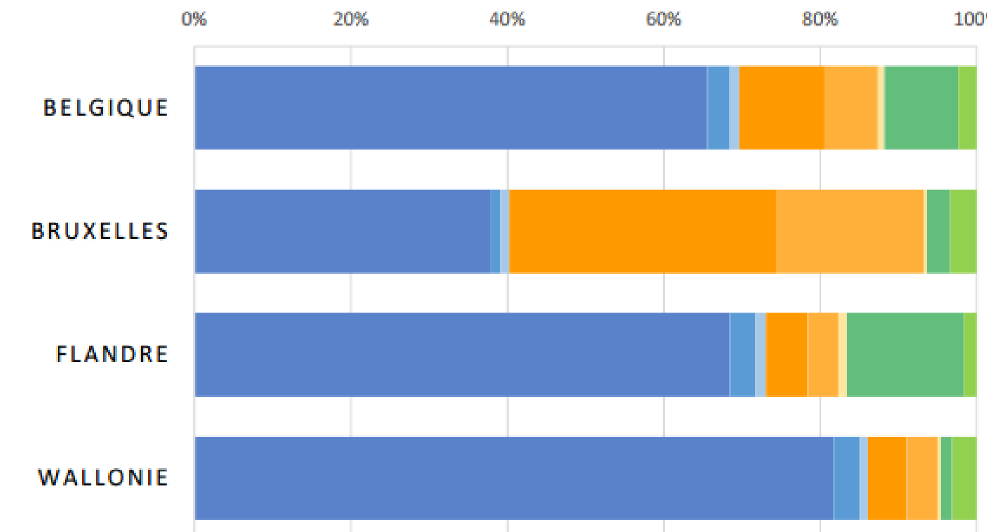
Evaluation

How effective is TR-B01 at increasing the modal share of carpoolers?

TR-B01 incentivises car-pooling through tax savings for drivers of commutes with multiple passengers; the driver's expenses for carpooling are deductible at the rate of 0,15 EUR/km. In addition, carpoolers can sometimes drive in bus lanes to ease congestion, and liability insurance is extended to carpools [27].

Car-pooling remains a small modal share of commuter journeys, at an average of 2,9% in Belgium, lowest in Brussels at 1,2%, as seen in Figure A1.1, according to the latest commuting traffic survey in 2014 [28]. The proportion of people car-pooling to work has decreased on average 38% in Belgium between 2005 and 2014, as shown in Figure A1.1. This may be as a consequence of fewer people commuting to work by car at all, preferring subsidised public transport instead to avoid intense traffic congestion [29].

Figure A1.1 Modal splits for commuting in 2014 (car-pooling = covoiturage).



	Wallonie	Flandre	Bruxelles	Belgique
Voiture (seul)	81,7%	68,5%	37,9%	65,6%
Covoiturage	3,4%	3,3%	1,2%	2,9%
Moto	1,0%	1,3%	1,1%	1,2%
Train	5,0%	5,3%	34,1%	10,9%
Métro, tram, bus	4,0%	3,9%	19,0%	6,9%
TCE*	0,4%	1,1%	0,3%	0,8%
Vélo	1,5%	14,9%	3,0%	9,5%
Marche	3,1%	1,7%	3,4%	2,4%

Source: [28].

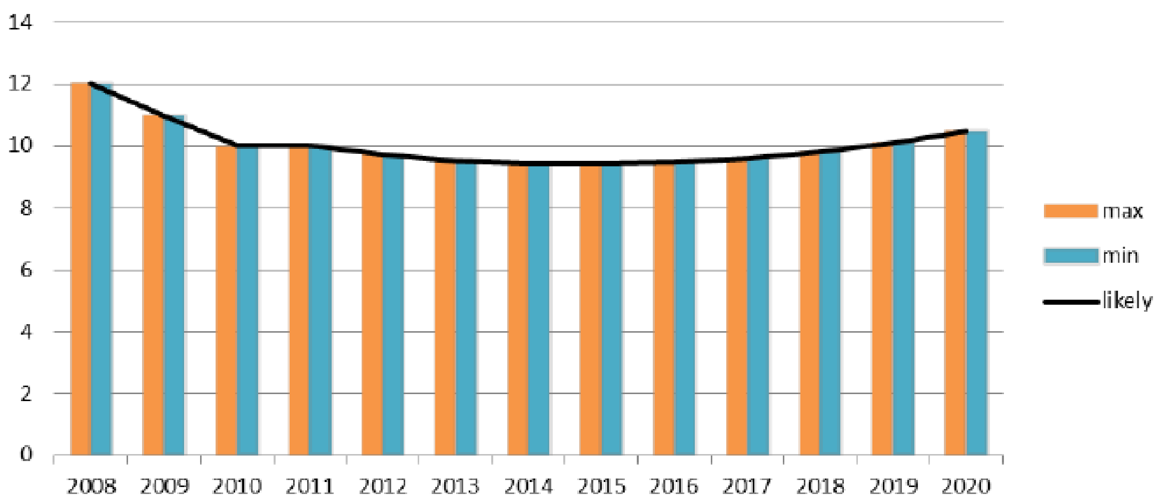
Table A1.1 Change in modal splits for commuting, 2005-2014 (car-pooling = covoiturage).

	BELGIQUE			BRUXELLES			FLANDRE			WALLONIE		
Mode	2005	2014		2005	2014		2005	2014		2005	2014	
Voiture (seul)	66,8%	**65,6%**	- 2%	45,1%	**37,9%**	- 16%	68,7%	**68,5%**	- 0%	80,4%	**81,7%**	+ 2%
Covoiturage	4,7%	**2,9%**	- 38%	2,5%	**1,2%**	- 49%	5,2%	**3,3%**	- 36%	5,2%	**3,4%**	- 35%
Moto	1,7%	**1,2%**	- 33%	0,8%	**1,1%**	+ 38%	2,2%	**1,3%**	- 41%	1,5%	**1,0%**	- 31%
Train	9,5%	**10,9%**	+ 15%	32,2%	**34,1%**	+ 6%	4,1%	**5,3%**	+ 31%	4,4%	**5,0%**	+ 13%
Métro, tram, bus	5,9%	**6,9%**	+ 16%	15,0%	**19,0%**	+ 27%	3,9%	**3,9%**	+ 0%	3,6%	**4,0%**	+ 9%
TCE	1,2%	**0,8%**	- 34%	0,7%	**0,3%**	- 59%	1,6%	**1,1%**	- 31%	0,5%	**0,4%**	- 8%
Vélo	7,8%	**9,5%**	+ 21%	1,2%	**3,0%**	+ 148%	12,3%	**14,9%**	+ 21%	1,3%	**1,5%**	+ 13%
Marche	2,4%	**2,4%**	- 2%	2,6%	**3,4%**	+ 33%	2,1%	**1,7%**	- 19%	3,2%	**3,1%**	- 2%

Source: [28].

A report by VITO and ECONOTEC [30] projected emission reductions due TR-B01 to average 10 kt CO2-eq. per year between 2010 and 2020 (Figure A1.2). This is calculated through extrapolation of the percentage of carpoolers between 2005 and 2008, which may generate higher savings than observed, as the proportion of carpoolers has since decreased.

Figure A1.2 Ex post and ex ante emission reductions by TR-B01 (kt CO2-eq.).



Source: [30].

A proposal to introduce a separate tax code for the car-pooling fiscal incentive to track its uptake was rejected for legal reasons. As such, data on costs saved is not available for evaluation (pers. comm.).

It is likely that the fiscal incentive is not sufficient to persuade commuters to switch transport mode to commuting [31]. The largest successes have been seen in larger companies [28] which offer additional benefits such as reserved parking and a central database to make connections. Strong communication campaigns are also necessary, to increase the critical mass of commuters and increase the efficiency of shared journeys.

How does the promotion of car-pooling policy fit with other transport management policies?

According to Belgium's 6th National Communication [27], Belgium has a three-step prioritisation approach to transport management policies:

1. Reduce mobility needs by encouraging alternatives such as tele-working, video conferences or by reducing distances between home, work and leisure areas;
2. If travel is unavoidable, ensure that it is undertaken with the most environmentally-efficient means of transport: walking or cycling for short journeys, public transport for longer distances;
3. If a road journey is absolutely essential, encourage users to drive efficiently, to purchase efficient vehicles, or to share journeys with other travelers.

As TR-B01 deals with car-pooling, which is in the 3rd priority, policies focusing on aspects in priorities 1 and 2 are going to take precedent, and sometimes conflict, with TR-B01. For example, heavily subsidized public transport and the promotion of remote working have reduced the number of people commuting by cars, which reduces the critical mass of commuters for car-sharing [31]. With flexible working hours also encouraged to alleviate road congestion, there is a smaller pool of people commuting along the same routes at the same time. In Belgium there are strong tax incentives for businesses to provide company cars to their employees, which is in direct conflict with car-pooling, as a benefit of car-pooling is the avoidance of the cost associated with owning a car [32].However, no quantification is possible of the conflicts between such policies.

Policies such as incentivizing electric car uptake, are more coherent with TR-B01, as the more people use electric cars, the lower the emissions from road transport. There is the opportunity for further promotion of carpooling in areas where public transport is not easily accessible, to increase synergies between transport policies. However, there is currently insufficient evidence to draw conclusions on these effects.

Conclusion

Effectiveness: The promotion of car-pooling through TR-B01 does not seem to have been very effective. Between 2005 and 2014, a significant proportion of the active time period of TR-B01, the proportion of people commuting by car-pooling in Belgium has decreased by an average of 38% [28]. One of the explanations for this could be the lack of coherence with other transport management policies, particularly the conflicting subsidies for public transport and tax benefits for company cars.

Support to fund housing modernization using the building savings scheme (Czech Republic)

Description

Sector: Energy consumption.

Objective: Efficiency improvements of buildings.

Policy instrument: Economic.

Description: The building society savings scheme is a financial product which offers a relatively good interest rate. Its appeal is enhanced by the provision of a state subsidy. Building society savings schemes are advantageous in particular, because of the subsequent opportunity to borrow money to invest in housing. These loans have a fixed rate, which at present ranges from 3% to 6%, depending on the building society and amount of the loan selected.

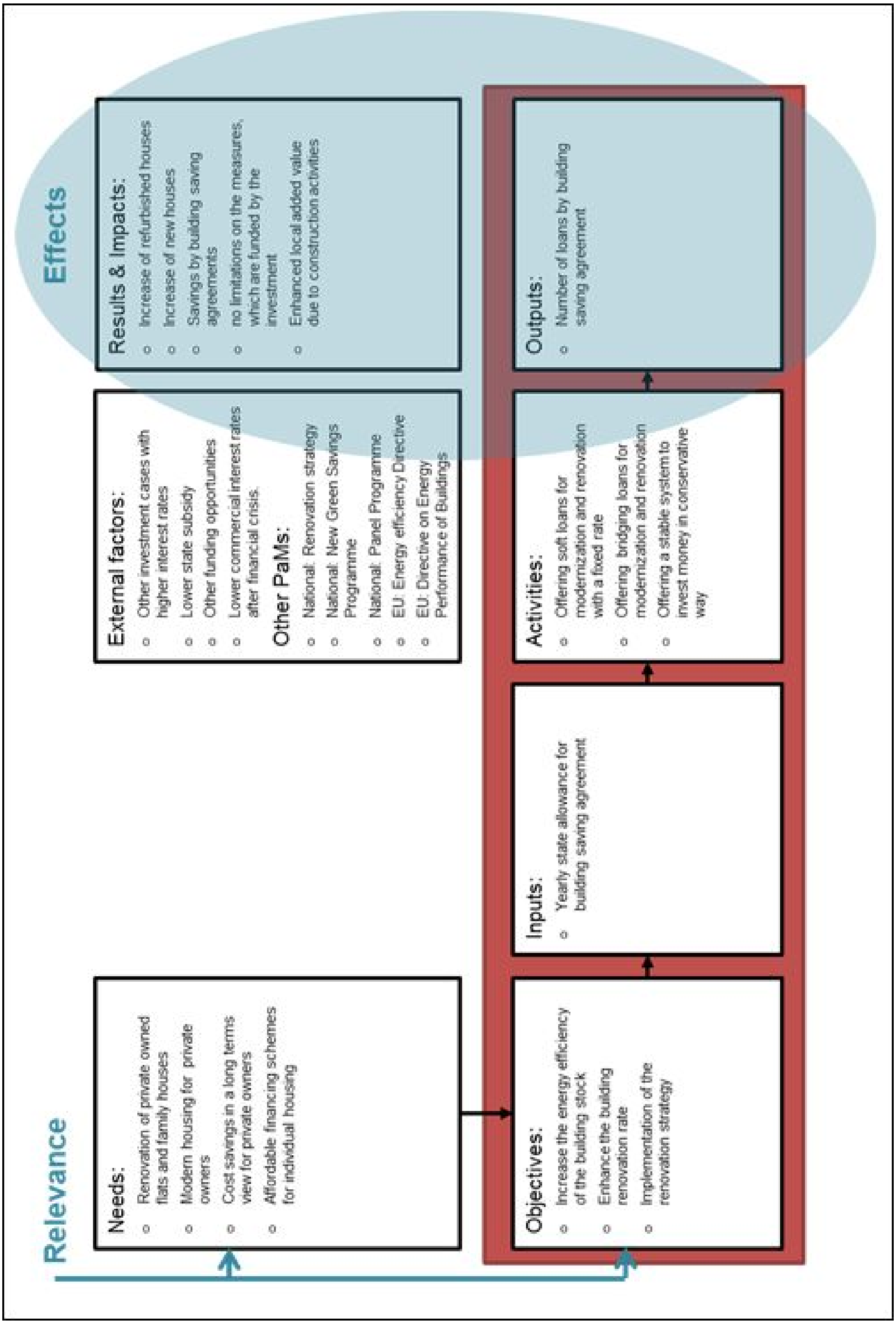
Building society savings schemes are one of the ways of making a large return on resources and a means of accessing some of the most affordable loans for housing. Building society savings schemes include a saving stage and, subsequently, a claim to a loan. Building societies provide further resources in the form of a bridging loan. Although less advantageous, this loan is readily available. It helps those applicants who have not saved enough of their own money but want to finance their housing needs. In the past five years or so, approximately 45% of the loans granted have been used to upgrade and reconstruct flats and single-family buildings.

Status: Implemented.

Start year: 1995.

End year: 2035.

Intervention logic



Evaluation criteria

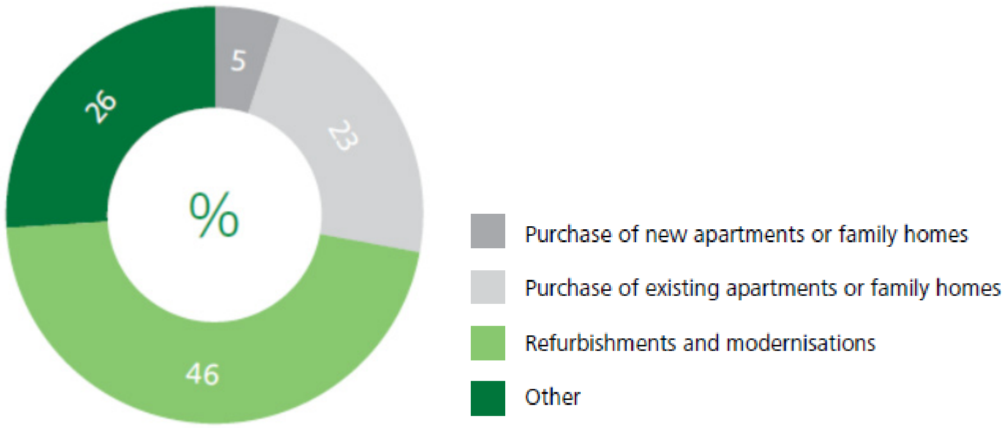
Effectiveness – ~~Efficiency~~ – Relevance – ~~Coherence~~

Evaluation

What effects can directly be linked to the PaM (e.g. number of renovations, energy savings, GHG emission reductions)? To what extent, does the *building savings scheme* contribute to the observed energy savings?

The building savings system in the Czech Republic was originally designed to support the investment of private persons for refurbishment of their property. However, the financial resources of the building savings are not only spent on modernisation or renovation. Based on the dataset in the annual statics of the building savings bank 46% of the new loans in 2015 were used for refurbishment and modernization, see Figure A1.3.

Figure A1.3 New building savings loans in 2015 and their distribution to the different investment case.



Source: [33]

Building savings are generally used for cases with a lower total investment volume. A direct comparison between Table A1.2**Error! Reference source not found.**, where the investment volume is shown and Table A1.3, which provides figures on the new contract per year, serve this purpose. Only 8,7% of the loan volume in 2015 for housing is for building energy savings, but they contribute to 4,26% of contracts. On the opposite 2,57% of the contracts are mortgage loans and they cover 89% of investment volume.

Table A1.2 Loans to households – inhabitants for housing by the end of the corresponding year – total in mCZK.

	Households - inhabitants - loans for housing to inhabitants total	of which			Other households - SVJ[2] - loans
		mortgage loans	building society loans total	other loans on real estates	
2007	510 945	333 901	150 705	26 338	
2014	899 991	796 884	78 069	25 039	51 811

Source: [34]

Table A1.3 Average annual percentage rates of CZK loans provided by banks to inhabitants for housing in the Czech Republic (new business,% p.a.).

	Loans for housing (%)	out of w hich	
		mortgage loans (%)	building society loans (%)
2007	5,27	5,30	4,82
2014	2,85	2,57	4,26

Source: [35].

According to the annual data of the Association of Czech Building Savings Banks (ACSS) the total energy savings were calculated in the NEEAP [36]. Numbers of renovated flats were determined by reference to information on the number and volume of loans provided and the share of loans used for upgrading and reconstruction. Savings were calculated based on the number of renovated flats and the average energy savings per flat. The standards of the refurbished buildings financed by building savings are usually lower, because there are no required minimum savings for receiving the building savings loan. Additionally also reconstruction projects, like the renovation of sanitary spaces, with nearly no energy savings, are aided. For the different types of measures especial building savings schemes are available. Therefore the average savings are calculated with a 15% lower specific energy reduction.

Table A1.4 Energy savings resulting from the *building savings scheme*.

Year	Number of loans	Volume of loans	Average amount ofloan	Reconstruction and upgrade loans		Energy saving per loan	Annual energy savings
	[thousands]	[CZK billions]	[CZK thousands]	number [thousands]	[]	[GJ/year]	[TJ]
2007	162 822	72.5	445	74 800	46.0%	11.3	842
2008	144 907	73.6	508	65 032	45.0%	11.	732
2009	128 54	65.7	511	55 670	43.0%	11.3	626
2010	113 611	57.8	509	5172	44.0%	11.3	564
2011	92 785	48.0	517	41 373	45.0%	11.3	465
2012	77 149	41.7	541	34 717	45.0%	13.5	469
2013	70 000	36.4	520	31 500	45.0%	13.5	425
2014	65 000	33.8	520	29 250	45.0%	13.5	395
2015	60 000	31.2	520	27 000	45.0%	13.5	365
2016	55 000	28.6	520	24 750	45.0%	13.5	334
2017	50 000	26	520	22 500	45.0%	13.5	304
2018	45 000	23.4	520	20 250	45.0%	13.5	273
2019	40 000	20.8	520	18 000	45.0%	13.5	243
2020	35 000	18.2	520	15 750	45.0%	13.5	213

Source: [35].

This calculated energy savings results in GHG emission reductions, which are shown in Figure A1.5. The building savings are included in the WEM scenario of the projections submitted under the MMR. As investments in infrastructure have a long life time the annual savings have an upwards trend until 2025, even if the loans are steadily decreasing. In addition this PaM exists since 1995 and the effects of the former years are included.

Table A1.5 Projected GHG reductions of the *building savings scheme* (in kt CO2-eq. per year).

	2015 non-ETS	2020 non-ETS	2025 total	2030 total
Support to fund housing modernization using the building savings	396	513	607	565

To what extent had other PaMs and external effects an impact on the effectiveness of the PaM?

There is constant decline in the number and amount of loans visible in the ex post and the ex ante trends, see Table A1.4. These reductions are based on the steadily reduction of the state subsidies for building savings, which can be seen in Table A1.6. The state subsidy was reduced by 71% from the peak in 2005 to 2015. Additionally, the conditions to use resources from the building savings scheme were tightening.

Table A1.6 Statistical data from the Building savings bank from 2000 until 2015.

Basic Data of Bauspar System in the Czech Republic	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
New contracts[1] (pcs.)	1 225 964	1 519 996	1 627 211	2 486 507	681 484	792 272	825 951	862 106	1 040 034	886 686	906 143	685 451	580 262	611 404	613 282	458 566
Contracts in savings phase (pcs.)	3 424 580	4 196 408	4 870 620	6 300 831	5 899 300	5 573 874	5 297 522	5 132 595	5 070 510	4 926 183	4 845 319	4 550 468	4 316 999	4 066 684	3 825 367	3 503 349
Deposits (bil. CZK)	110,4	133,3	180,2	236,8	287,1	329,0	359,8	384,9	401,1	415,1	430,1	433,4	435,0	429,1	413,6	384,2
New loans (pcs.)	112 385	111 802	130 777	156 289	163 834	158 735	155 263	162 822	144 907	128 543	113 611	92 785	77 149	72 995	69 172	75 029
New loans (bil. CZK)	14,5	17,1	22,1	32,8	39,8	43,0	51,6	72,5	73,6	65,7	57,8	48,0	41,7	41,3	37,3	45,8
Outstanding loans (pcs.)	373 463	465 824	568 920	685 740	786 483	857 875	900 653	942 944	971 176	988 353	993 357	956 659	894 358	815 160	752 558	695 439
Lent amount (bil. CZK)	31,0	37,0	46,3	63,6	84,2	108,1	135,5	179,3	227,4	267,5	293,4	293,1	282,2	261,4	249,6	242,7
Loan to deposit ratio (%)	10,9%	27,8%	25,7%	26,9%	29,3%	32,8%	37,6%	46,6%	56,7%	64,4%	68,2%	67,6%	64,9%	60,9%	60,4%	63,2%
State subsidy calculation	25% of maximum of 18 000 CZK (up to 4 500 CZK)				new contracts: 15% of maximum of 20 000 CZK (up to 3 000 CZK) earlier contracts under earlier conditions: 25% of maximal 18 000 CZK (up to 4 500 CZK)							10% of maximum of 20 000 CZK (up to 2 000 CZK)				
State subsidy amount (bil. CZK)	7,7	9,3	11,1	13,3	15,3	16,1	15,8	15,0	14,2	13,3	11,7	10,7	5,3	5,0	4,8	4,6

[1] including contracts with additionaly increased contract sum in the year

Source: [37]

There are more attractive funding possibilities for refurbishment available now to Czech homeowners. One of them, the panel program, is especially designed for the retrofitting of multi dwelling buildings (block of flats) and can be granted with up to 90% of the investment. The calculated GHG emission savings in 2020 of the panel program is expected to be 225 kt CO2-eq.

Another overlapping PaM is the green savings scheme, which is financed from the revenue of auctions of emission allowances and focusses on GHG emission savings in buildings. With the green savings a reduction of 274 kt CO2-eq. in 2020 is envisaged to be realized.

Also the implementation of the Directive on Energy Performance of Building has a significant impact on the energy demand and GHG emissions caused by the buildings sector. The projected savings in 2020 associated to this PaM are 406 kt CO2-eq.

Conclusion

Effectiveness. The building savings scheme was originally designed to support investments in refurbishment of private homes. Although the PaM contributes to energy savings and GHG emission reductions, it is not the principal objective but rather a side-effect of increasing building stock renovation. As such, the PaM is not as effective as it does not include minimum requirements regarding energy savings. Nevertheless, it is estimated that on average 13,5 GJ per year of energy are saved per loan. The effectiveness of the PaM is moreover decreasing as less and less loans are requested, because of state aid reductions and more stringent eligibility criteria.

Relevance. While refurbishment and energy efficiency improvements of buildings remains as important, the PaM has reduced its relevance as additional policies have been implemented that also contribute to this, such as the Energy Performance of Buildings Directive.

Tax on HFCs, PFCs and SF_6 - equivalent to the CO_2 tax (Denmark)

Description

Sector: Industrial Processes.

Objective: Reduction of emissions of fluorinated gases.

Policy instrument: Fiscal.

Description: Based on previous experiences made with a tax on new chlorofluorocarbons (CFCs) from 1989 onwards, Denmark also introduced a tax on F-gases in March 2001 through the "Law on Tax on certain ozone depleting substances and certain industrial greenhouse gases". The tax applies to production and imports (although Denmark does not produce HFCs). The tax is payable whether the substances are imported as pure substances or as part of imported products. If the content in the products is not known, the tax is based on a fixed tariff.

Tax paid on HFCs that are exported, or contained in products that are exported, is refunded. The use of HFC for mobile air conditioning is exempt from the tax.

The tax is payable on a wide range of products, including:

- Refrigerating and freezing plants
- Air-conditioning plants
- PUR foam for cooling plants, district heating pipes, insulated gates and doors, panels for refrigeration and freezer rooms, extruded polystyrene for insulation (XPS foam), jointing foam
- Spray canisters
- Insulation gas

The tax is also payable on services on existing and new installations/products.

The tax on F-gases is based on the Danish CO2-tax per t CO2-eq. which applies to potential emissions. The base tax per t CO2-eq. emitted was increased from 100 to 150 DKK from January 2011 onwards. F-gases and blends with high GWP are hence subject to higher taxation than low GWP gases, with a maximum of 600 DKK per kg [38].

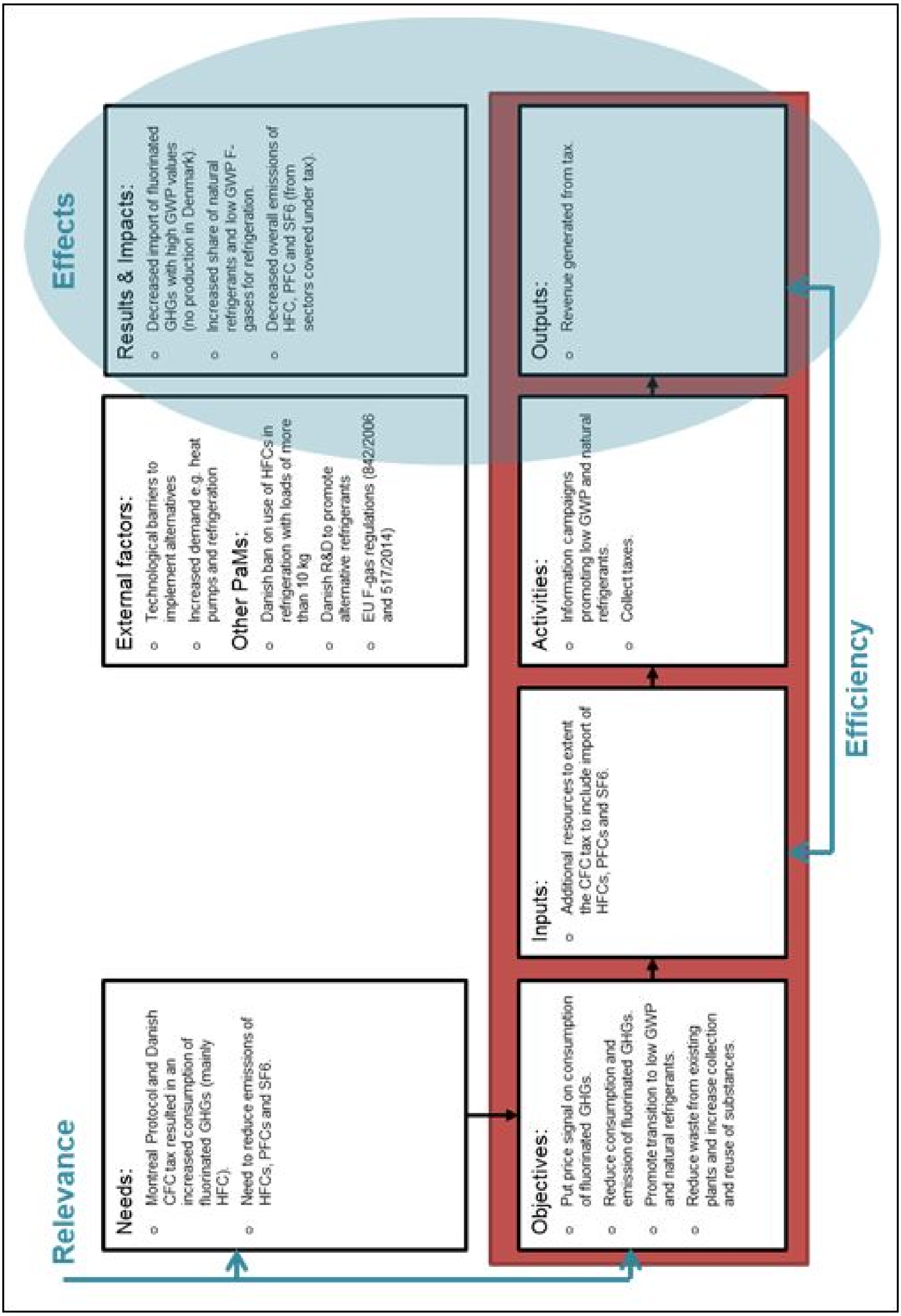
Some of the Danish tax revenue has been invested back into the refrigeration industry through the establishment of the Knowledge Centre for HFC-Free Refrigeration, which offers consultancy services (free up to a limit) for the implementation of alternative technology [39].

Status: Implemented.

Start year: 2001 (the height of the tax was update in 2011)

End year: Unknown.

Intervention logic



Evaluation criteria

Effectiveness – Efficiency – Relevance – ~~Coherence~~

Evaluation

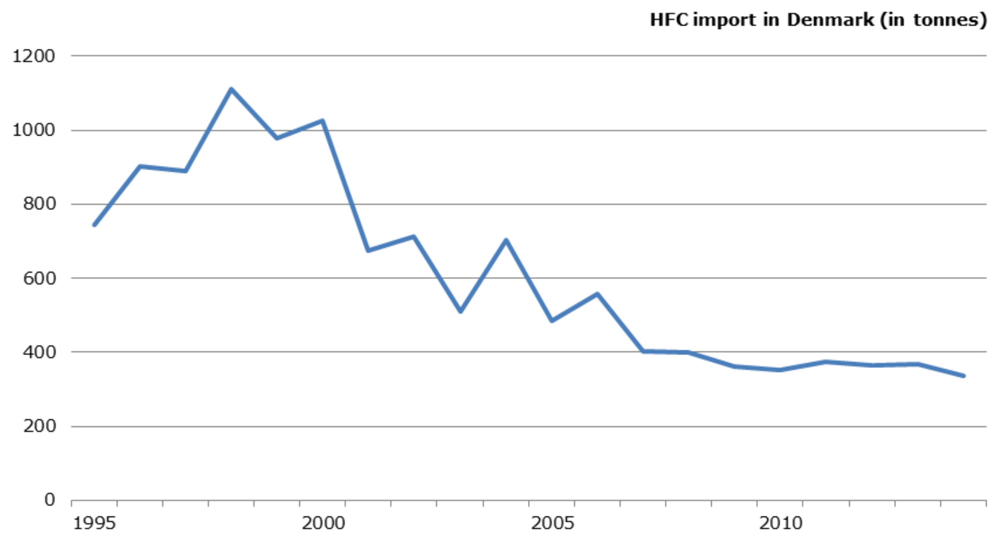
To what extent did the PaM result in a reduction of the import and consumption of HFCs, PFCs and SF6?

The tax covers HFCs, PFCs and SF6, but it is evident that the tax has the greatest influence on HFC import, consumption and emissions as HFCs are the most ubiquitously used F-gases (337,5 t imported in 2014) and have the highest abatement potential. PFCs in Denmark are used only for etching in optics fibre production and as a part of the refrigeration blend R-413A, in 2014 only 0,4 t was imported. SF6 is only imported for use in power switches in high-voltage power systems and in laboratories/optics fibre production. The SF6 import in 2014 was 2,0 t [40].

Data on HFC imports are published by the Danish Environmental Protection Agency (Denmark, 2016). There was a 34% decrease in Danish imports of bulk HFCs after the introduction of the tax in 2001 compared to 2000. Ever since 2001, HFC imports in Denmark have been decreasing with a significant decrease in the period 2001-2007 and slower decrease after 2007 (Figure A1.4). In 2014, the bulk HFC imports were 67% below the 2000 level [40]. Evidence of a link between these taxes and HFC bulk imports is somewhat contradictory, partly because of complicating factors like the Danish ban on the use of F-gases as in certain applications. Therefore, these changes cannot be attributed to the tax alone because the relative influence of complementary policies at EU and national level is unknown [41].

In a previous assessment the effect of the tax on consumption of industrial GHGs amounted to an annual reduction of approximately 5% over the period from 2001 to 2005. On the basis of this assessment, it was estimated that the tax increase in 2011 led to a decrease in consumption of approximately 4% (pers. comm.).

Figure A1.4 Import of HFCs to Denmark.



Source: [40].

The tax was expected not only to have an impact on the import of F-gases. The additional costs of the tax also encourage many users to keep their system tight, especially if the charge is in the order of several hundred kg as for centralized systems in larger supermarkets. The emission factor Denmark uses for their national inventory for commercial refrigeration is 10% for fugitive emissions and 1,5% for refilling [42], which is similar or higher than neighbouring countries (e.g. Germany and the Netherlands). Danish emission factors are based on the IPCC guidelines and adjusted based on own assessment (in 2001/2002, when the tax was just implemented; [42]). So quantitative evidence that the tax resulted in lower fugitive emission factors from commercial installations is missing.

Information does indicate that the tax/ scheme has led to more awareness from owners as well as operators of the equipment. The tax not only increased interest in alternative substances but has also resulted in improved housekeeping of reused gas [43].

Other evidence analysing Norwegian[7] data suggests that the market gets used to these taxes after some time, reducing its effectiveness [44].

Considering that the HFC bulk import quantity and consumption is an important element in the inventory calculation of HFC emissions, a reduction in imports is likely to translate to a reduction in calculated emissions, although not directly ([41]; see below).

To what extent did the PaM result in a reduction of the emission of HFCs, PFCs and SF6 and what other factors contributed to this?

In a first step, an analysis of HFC, PFC and SF6 emissions in the period 1995-2014 was made (Figure A1.5). HFC emissions show an increase from 1993 to 2008 (mainly because of assumptions made about equipment retirement), so the impact of the tax is difficult to detect [41]. The growth rate in emissions of HFC however clearly reduced after the introduction of the tax, but it is only in 2008 that HFC emissions, level of and start to decrease in absolute levels (Figure A1.5). In 2007 Denmark banned new HFC-based refrigerant stationary systems. Again, this could be coincidental, as a ban is not likely to have an immediate effect on emissions.

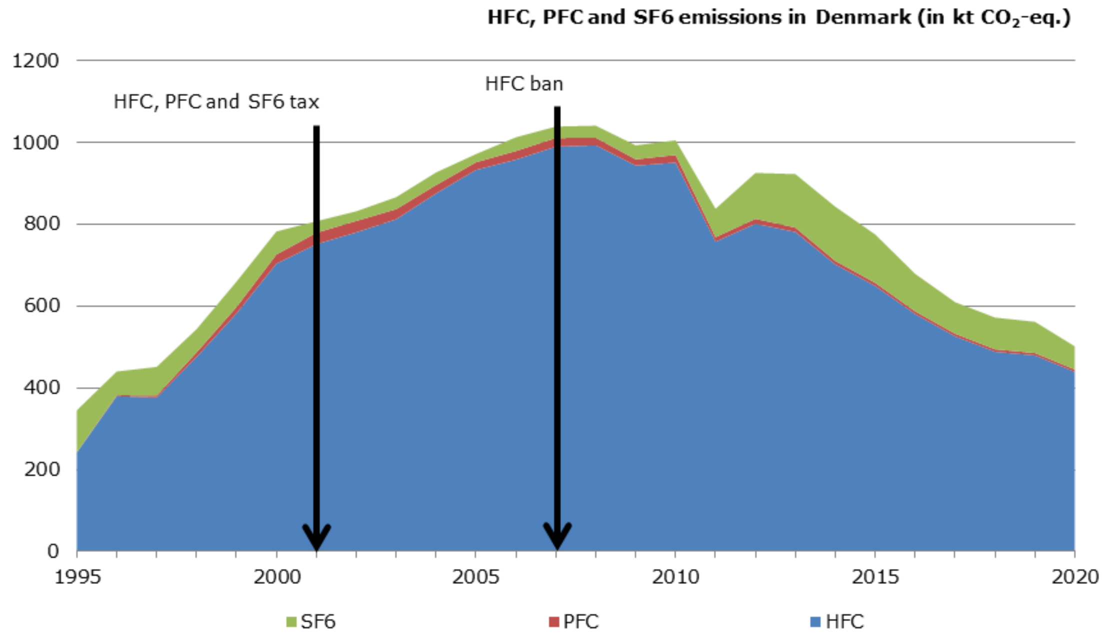
The tax and the ban do not affect all emission sources of F-gases, so the relationship between the PaMs and emissions is blurred. For instance HFC-134a used in mobile air conditioning is exempted from the tax, but is a relatively important emission source (both fugitive and disposal emissions). This is also the case for SF6 emissions from disposal of double glazing and although the tax is an incentive to recuperate F-gases from end-of-life equipment, this is not always possible from technical or economic perspective.

Overall it is estimated that the tax increase resulted in a decrease in the emissions of F-gas emissions of 23 kt CO2-eq. in 2015 (pers. comm. and [45]).

There is also quantified evidence on the ex post impact of the PaM. According to the latest Biennial report of Denmark and the latest technical report submitted in conjunction to the MMR reporting on PaM [46], [47], the impact of the tax was 50 kt CO2-eq. in 2001, 400 kt CO2-eq. in 2010 (the average of the period 2008-2012) and 20 kt CO2-eq. in 2015. This however also includes the impact of the Danish regulation on the use of HFCs, PFCs and SF6. No distinction is made between both PaMs. Additionally the EU F-gas regulation also affected emissions of F-gases across all Member States.

[7] Norway also implemented a tax on F-gases.

Figure A1.5 Emissions of HFCs, PFCs and SF6 in Denmark.



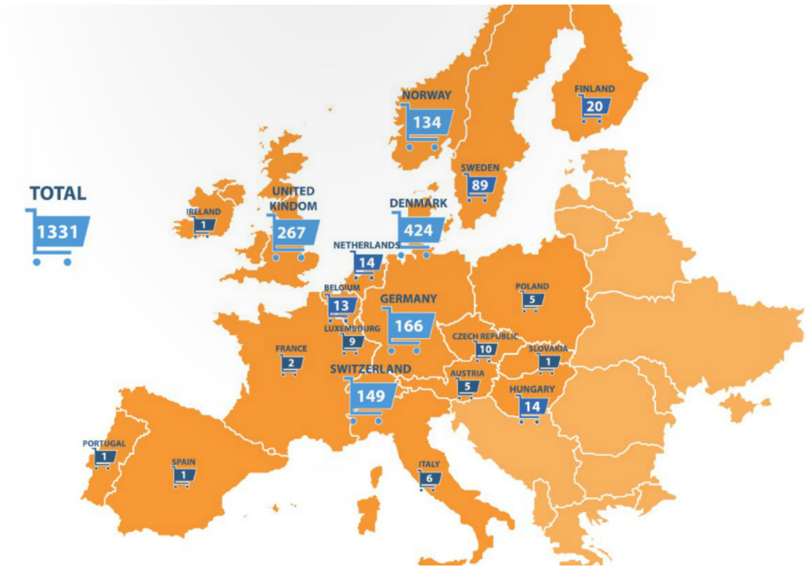
Source: **[40]**.

Did the PaM result in increased share of alternative refrigerants?

One of the important impacts of the PaM that was envisages is a transition (mostly in commercial refrigeration) from HFCs to low-GWP or natural refrigerants (e.g. CO2 or ammonia). For many companies, CO2 is considered the most likely alternative because of its environmental properties, but also due to the improved energy efficiency performance that further reduces the energy bill for end-users [33]. With respect to implementing CO2 transcritical refrigeration, Denmark is clearly leading in Europe (Figure A1.6). Danish legislation was a clear contributor to this [48]; [41].

One information source indicates that the tax scheme has led to an increased interest in alternative substances (HCs, CO2, ammonia or other substances or techniques; [43]), but it was the ban on HFCs in large installations (with load of more than 10 kg) that accelerated this transition. An unintended side effect was a proliferation of small systems operating with HFC refrigerants and with a charge below 10 kg [41], although no quantitative information is available on this effect.

Figure A1.6 Number of CO2 transcritical supermarkets in the EU.



Source: [49].

To what extent has the policy generated benefits and costs for different stakeholders (e.g. national administrations, importers, manufacturers, industry)?

No information is available on the costs of implementing the PaM to government (administrative burden) based on literature review. The tax is administrated by the Danish Customs and Tax Administration, which is an organisation under the Danish Ministry of Taxation. The OECD publishes information on tax administration, which provides information on the overall cost of collection ratios (administrative costs/net revenue) for different OECD and non-OECD countries [50]. For the period 2005 to 2011, the average for Denmark was 0,68%, which would mean that administrative burden would be in the range of 0,3 to 0,5 mDKK per year. In Sweden an impact assessment on the annual administrative cost of a HFC tax was estimated to be 0,55 mSEK (0,4 mDKK), which is in the same range [51].

According to Gulliver [41] no evidence is available on the economic impacts from the taxes on imported F-gases in bulk and in refrigeration and air conditioning equipment. No direct evidence could be found on compliance costs from taxes on imported HFCs in bulk and in refrigeration and air conditioning equipment. Sorensen [52] claimed the HFC legislation did not harm industry, in part because Danish government also supported research and development and consultancy services to industry to support alternative technologies.

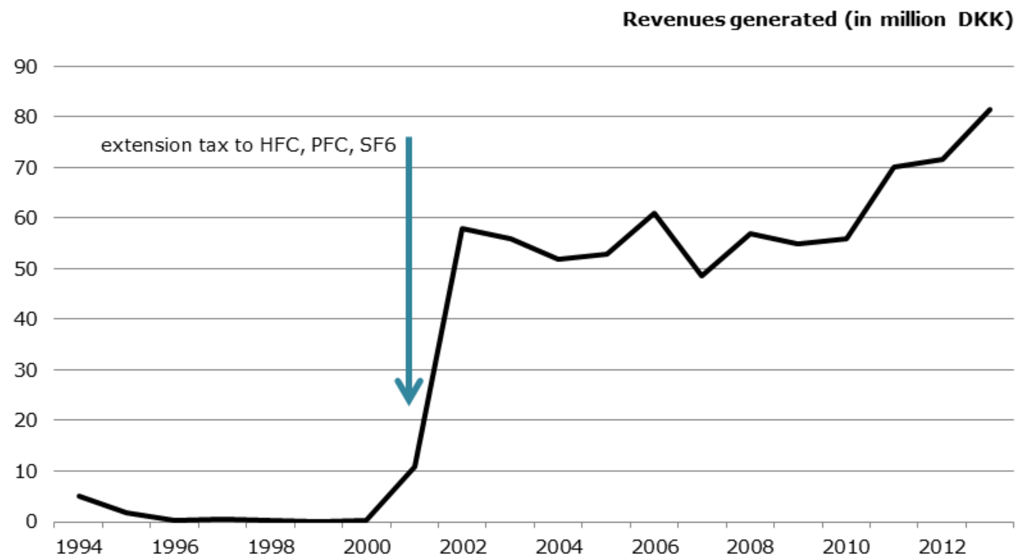
The EEA PaM database does not include information on the costs and benefits of the PaM although information is included in the technical PaM report submitted by Denmark. The technical report refers back to the report of the Environmental Ministry [53]. In this report, the cost of replacing HFC to more environmentally friendly alternatives in industrial refrigeration (which is the most important category of consumers) was represented as the shadow price. This was estimated at 200 DKK_{2002} /t CO2-eq.

Information on the revenue generated from the HFC tax is available on the website of the Danish Ministry of Finance and the OECD policy database [54], [45]. Before the extension of the tax to HFCs, PFCs and SF6, the revenue generated from taxing CFCs almost fell to zero, reflecting the phase-out of CFCs. Inclusion of HFCs, PFCs and SF6 resulted in an increase of 50 – 60 mDKK. In 2011, there was again an increase in the revenue, because of changes in the tax rate.

The Danish HFC tax revenue was partly invested back into the refrigeration and air conditioning industry through the establishment of the Knowledge Centre for HFC-free Refrigeration, which provides free advice and assistance on deciding what kind of refrigeration systems to use. Using revenue generated from the tax, the Research Centre provides tools for calculating refrigerant charges and equivalent warming impact, a systematic collection of Danish and international literature on climate-friendly refrigeration systems, and other free information related to climate-friendly refrigeration systems [55]. A total of 12 mDKK was reserved for the period 2005-2007 for development of alternatives and for subsidies for implementation of the alternatives developed in the previous years.

According to an analysis of the Danish Ministry of Finance [56] the price elasticity of the tax is -0,4 and this results in a deadweight loss of the tax in 2003 of around 27 mDKK in 2003 (or a distortion factor, the relationship between deadweight loss and proceeds, of 0,4 to 0,6).

Figure A1.7 Revenue from HFC tax in Denmark (in mDKK).



Source: [54].

Has the intervention been cost effective compared to other PaMs?

Generally, taxation is considered a cost-effective instrument to reduce consumption of industrial GHGs. Theoretically, the tax ensures that emissions are reduced where it is cheapest as companies are willing to pay reduction costs up to the tax level to reduce their consumption and as companies are the most knowledgeable about their own reduction options, consumption is reduced where it is cheapest for the individual company. In contrast, direct regulation may result in higher socio-economic abatement costs calculated in DKK / t CO2-eq. Nevertheless the introduction of the tax on HFCs, PFCs and SF6 was followed by a ban on using F-gases for certain applications.

To what extent is reducing HFC, PFC and SF6 emissions relevant?

Based on the reported information on emissions of F-gases (Figure A1.5), emissions are still important and reducing the emission levels is still as relevant as in 2001. HFCs continue to be the most important F-gases (with respect to consumption and emissions). The use of HFCs in new applications is increasingly restricted, either in commercial refrigeration (Danish ban), household refrigeration and mobile air conditioning (EU legislation), but there is still a need to assure that quantities contained in existing equipment are handled with care. For some F-gases and applications, for instance the use of SF6 in switch gear or PFCs in semiconductor production, there are no readily available alternatives yet and government intervention continues to be relevant to assure that emissions are limited to a minimum (pers. comm.).

Conclusion

Effectiveness: There is quantitative evidence supporting the claim that the tax has resulted in a slow-down of the growth in imports of F-gases and also emissions. In 2007, Denmark implemented another national PaM that affected the consumption and emissions of HFCs greatly. Both PaMs have had a combined impact on GHG emissions, but it is difficult to discern the impact of each separately. The timing of the decline in absolute HFC emissions (from 2008) seems to suggest that the ban has had a very significant effect, although this needs a caveat that this could also be coincidental (a part of the emissions is caused by decommissioning of equipment containing F-gases, which are not affected directly by the tax or the ban). Part of the revenue generated from the taxes were reinvested in R&D for alternative refrigerants and Denmark is one of the leading countries in the EU when it comes to application of at natural refrigerants in commercial cooling installations.

Efficiency: Generally taxes are considered very cost efficient policy instruments as it allows companies to choose the most cost-efficient solution. There is no information on the administrative costs, but the fact that the PaM was an extension of an already existing tax would suggest that it did not cause additional start-up costs. In most recent years the tax resulted in a revenue of 80 mDKK.

Relevance: The PaM is still relevant as HFC, PFC and SF6 emissions are still around 900 kt CO2-eq. per year and although HFC emissions have reduced, emissions of SF6 have increased in recent years.

Energy efficiency improvement in public buildings (Estonia)

Description

Sector: Energy consumption.

Objective: Efficiency improvements in buildings, demand management/reduction

Policy instrument: Economic.

Description: The international sale of unused national emission quotas in relation to the Kyoto Protocol was initiated in 2010. Arising from the Kyoto Protocol, the Republic of Estonia had the right to sell surplus emission credits (i.e. Assigned Amount Units not needed to offset domestic GHG emissions) on the international market.

The sale of emission credits was carried out by the Green Investment Scheme (GIS), pursuant to which the revenue is used for investments that will result in a further decrease of CO2 emissions as agreed with the buyer of the emission credits. In Estonia, the Green Investment Scheme was used to invest in, among others:

- introduction of efficient and environment benign transport (buses, trams, electric cars);
- replacing street lighting systems with the efficient ones;
- renovation and switching from fossil fuels to biomass of boiler and CHP plants;
- renovation of district heating pipelines;
- construction of wind energy generation parks;
- renovation of buildings in residential buildings;
- renovation of buildings in public sector.

With respect to the latter, the Estonian government ordered the Estonian State Real Estate Ltd (Riigi Kinnisvara AS or RKAS[8]), under the supervision of the Ministry of Finance, to organize these energy efficiency investments in public buildings and more specifically to organize the procurement procedures. Local authorities could submit proposals to the Ministry of Finance for financing the renovation of different public buildings.

The Ministry of Finance used the following selection criteria to rank the projects (which were approved by the Estonian Government):

- CO2 savings – the applications were divided into three groups (A, B and C, equal by volume) according to the expected CO2 emission savings of the investment. The final estimate was based on the data from local governments on costs and CO2 savings. The estimates are conservative and calculated on the basis of general indicators, considering the nature of the work and the CO2 emissions of the used energy source.
- The number of beneficiaries –schools and cultural institutions were divided into three groups (A, B and C, equal by volume) according to the number of beneficiaries per investment. The objective is to direct the resources to as many beneficiaries as possible and thereby ensuring the maximum

[8] RKAS was established in 2001 and since then the Estonian Government has concentrated the development and management of state assets in this company with the objective to guarantee the saving and effective provision of the real estate service to the executors of state authority.

potential increase in the quality of the provision of public services. The data communicated by local governments was used as the basis for the number of beneficiaries.

- Regional limits – 50% was divided equally between 5 regions (NUTS III level) and the other 50% was divided based on the number of residents per region.

These selection criteria only applied for buildings from local authorities. For the renovation of buildings from central government, only the CO2 reduction was taken into account.

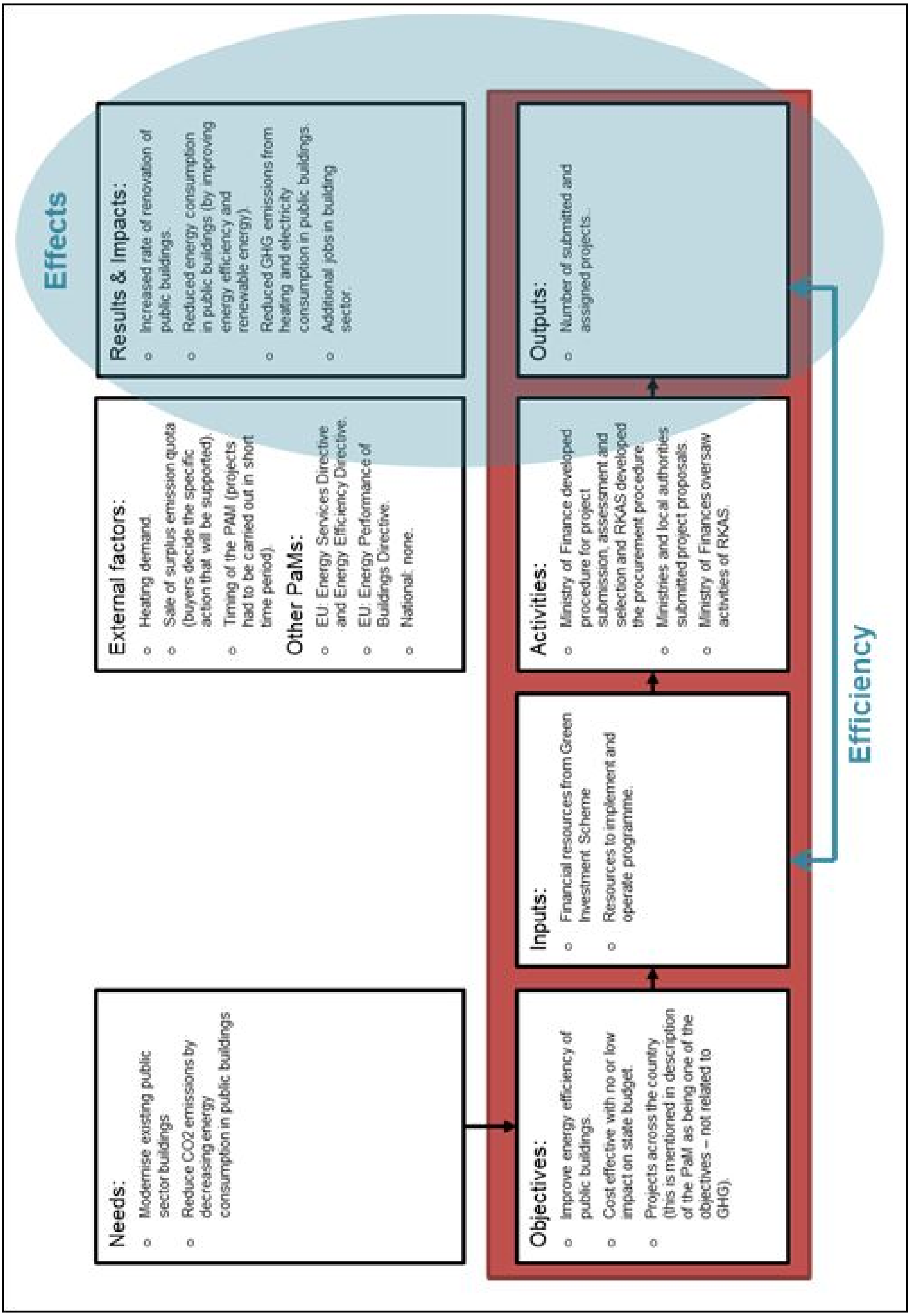
Based on these ranking, projects were either selected or not and a national procurement procedure was started to find a contractor to perform the works at the lowest cost.

Status: Expired

Start year: 2010

End year: 2013

Intervention logic



Evaluation criteria

Effectiveness – Efficiency – ~~Relevance~~ – ~~Coherence~~

Evaluation

To what extent did the PAM result in increased renovation of public buildings?

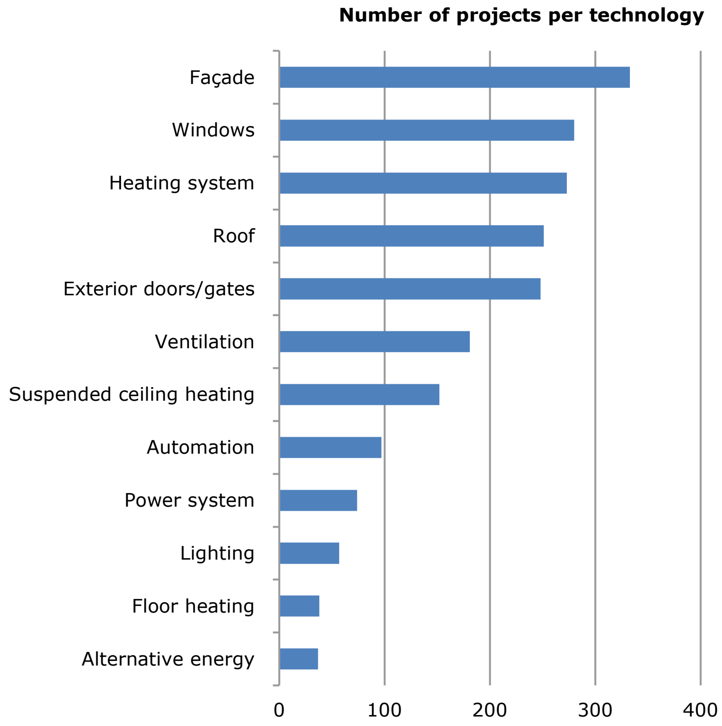
In the sixth National Communication, Estonia [57] reported that applications were received from 201 municipalities (of a total of 226) for the renovation of 862 buildings, of which 63% were schools and kindergartens, 26% were cultural institutions, 7% were social and health care establishments and 4% were other buildings [58]. According to the sixth National Communication, 490 buildings were being renovated, with a total floor area of 1,1 million m² and a total renovation budget of 146,5 mEUR. Due to the efficient use of resources by RKAS the programme could be extend in 2013 and additional buildings were renovated, which meant that a total of 543 buildings were renovated by the end of the programme [59] with a total floor area of 1,3 million m², for a total of 165,67 mEUR. Figure A1.8 gives an overview of the number of investments per technology (the total is higher than the total projects because more than one improvement).

The additionality of this measure is deemed very high, and was also an important consideration of the buyer of the emission credits. It is not likely that the selected buildings would have been renovated in the near future or in the same extent as without the PaM (pers. com.).

This seems corroborated by Energy Efficiency Watch [60], who did a qualitative and quantitative survey with national experts on national energy efficiency policies in 2010 and 2011. Energy Efficiency Watch consulted 11 Estonian experts to assess the level of ambition and quality of the NEEAP. The experts saw a lack of capacity in the public sector and lack of financial and human resources at municipal level as one of the critical issues. Although the PaM was just implemented, the experts saw the increased availability of funds from emission trading as a very positive development, to overcome financial barriers that were deemed very significant because of the general economic conditions in Estonia at that time.

Evidence thus suggests that the use of surplus emission quota to invest in public buildings has resulted in an increased rate of renovations, of which most would not have been done within the same time frame.

Figure A1.8 Number of projects supported by the Estonian Energy efficiency improvement in public buildings PaM per type of technology.



Source: [59]

To what extent did the PAM result in decreased energy consumption of public buildings?

The literature search did not reveal a direct estimate of the energy savings resulting from this PaM. One information source [57], explicitly mentioned that the average heating costs of the renovated buildings decreased by 14%. For protected (historic) buildings the decrease was only about 10%, because insulation of outer walls was impossible. It was not specified in the reference how this was calculated. Data on overall energy savings were also assessed (pers. com.).

To what extent did the PAM result in decreased GHG emissions?

According to the sixth National Communication, the CO2 emission reduction was estimated to be 680 kt CO2-eq. over a 30-year period (at a moment when 490 buildings were renovated, with a total floor area of 1,1 million m^2). This is the data published in the sixth National Communication, but this does not seem to cover all projects (in total 543 projects were funded).

CO2 emission reductions (by energy savings measures) was the principal objective of this PaM and projects were evaluated and ranked based on the emission reductions they could achieve, however there is no continuous monitoring of energy consumption/emission savings of already completed projects. The Ministry of Finance did request for an ex post assessment of the effectiveness. Energy consumption and CO2 emissions were compared between 2009/2010 and 2012. This assessment showed that total CO2 emission savings, which were projected to achieve 27,8 kt CO2-eq. per year was actually 36,3 kt CO2-eq. per year (pers. com.). This included emission savings of both reduced electricity and heat consumption.

To what extent has the policy generated benefits and costs for government?

For RKAS, this programme (called the CO2 project) was the most complex project from 2011 to 2013. In order to implement this project, the structure of RKAS was partly changed and up to 30 additional (temporary) jobs were created in order to achieve the objectives set by the cooperation agreements [61]. According to the RKAS annual report of 2013, the CO2 project was a great challenge for the company, and the entire state. Additional administrative costs were born also by local authorities for preparing and submitting their project proposal. These costs had to be covered by the local authorities themselves, but are probably small considering that the role of local authorities was relatively small. Also the Federal government, and specifically the Ministry of Finance who oversaw the activities of RKAS, had some additional administrative costs which were considered small (pers. com.).

The total budget that was invested in renovations was 165,67 mEUR. The financing came from the sale of surplus emission credits that, according to agreements with buyers, had to be invested in mitigation projects. This budget covered all expenses for the renovations so, apart from administrative burden, this did not result in additional expenses.

The largest benefit is obviously a decreased energy cost for municipalities for heating after renovation. Although some information is available on the amount invested in renovations and the emission reductions that were achieved, no information is available on energy savings and monetary benefits from a reduced heating bill. One information source [57], reported that the average heating costs of the renovated buildings decreased by 14%, but it was not possible to trace back were this information came from.

It was not evaluated to what degree this PaM had positive socio-economic effects. Nevertheless, according to [57] the investments supported by this PaM has been an important support for building sector in period of economic downturn.

An additional benefit was that the buildings after renovation could be used more effectively, although this was not a specific objective of the PaM from the onset.

Has the PAM been cost effective?

The resources allocated to RKAS were used more efficient than anticipated and RKAS was therefore able to extent the programme with an additional year and more buildings being renovated [62].

The CO2 emission reduction was estimated to be 680 kt CO2-eq. over a 30-year period, which corresponds with a cost efficiency of around 215 EUR/t CO2-eq. However, this does not include the benefits of reduced energy expenditure, which over the 30 year life time of the investments could be very significant.

The principal objective of the PaM was a reduction of CO2 emissions (and not energy efficiency or promoting renewable energy) and this was one of the main characteristics for selecting projects. Nevertheless other selection criteria were also included, such as an even regional distribution and the number of beneficiaries that would benefit from a renovation, which means that not necessarily all projects with the largest emission reduction potential were selected.

The project also ran for a very limited time period which means that applications had to be finalised in a short period of time. This could have been a barrier to implement complex and very in-depth renovations. Also for the renovations of historic buildings the duration of the PaM could have been too short, albeit that energy efficiency improvements and CO2 emission reductions could be very significant [57] in these buildings. The projects could only be used for investments that would reduce energy consumption and CO_2 emissions, so this meant that other benefits of renovation were not maximised.

The short time frame and the large number of projects meant a significant boost to activities in the building sector and this had a negative effect on the price (e.g. of construction material, pers. com.).

Conclusion

This PaM was effective in reducing GHG emissions as it overcame two important barriers in reducing energy consumption of public buildings.

The first was that financial resources (from the sale of surplus emission quota) were directed to renovation in a period when there were budgetary constraints because of the economic recession. Up to 543 buildings across Estonia were renovated and made more energy efficient. These renovations would not have occurred (within this time frame) otherwise or as profound.

Secondly, and as identified by Energy Efficiency Watch [60], there was a lack of capacity in the public sector and lack of human resources at municipal level to improve energy efficiency in public buildings. Because the revenue from the sale of surplus emission credits was used to finance the renovations, there was a significant time constraint in which to implement the renovations and to achieve emission reductions. Therefore Estonia opted to centralise the programme as much as possible. The project was run by a single agency, RKAS, which is responsible for all state real estates. RKAS had extensive experience in public procurement procedures, often missing at local level, which assured that the programme could be run more efficiently (and could be supervised by The Ministry of Finance). This imposed additional administrative burden at RKAS, but also avoided costs at the local level.

The short time frame did result in additional costs though because of the significant increase in the demand for renovations. The disadvantage of this approach was also that local authorities did not increase capacity as much as could have been the case.

Energy Efficiency Agreements 2008-2016 and the expected extension until 2035 - Voluntary energy efficiency agreements (Finland)

Description

Sector: Energy consumption, energy supply, industrial processes.

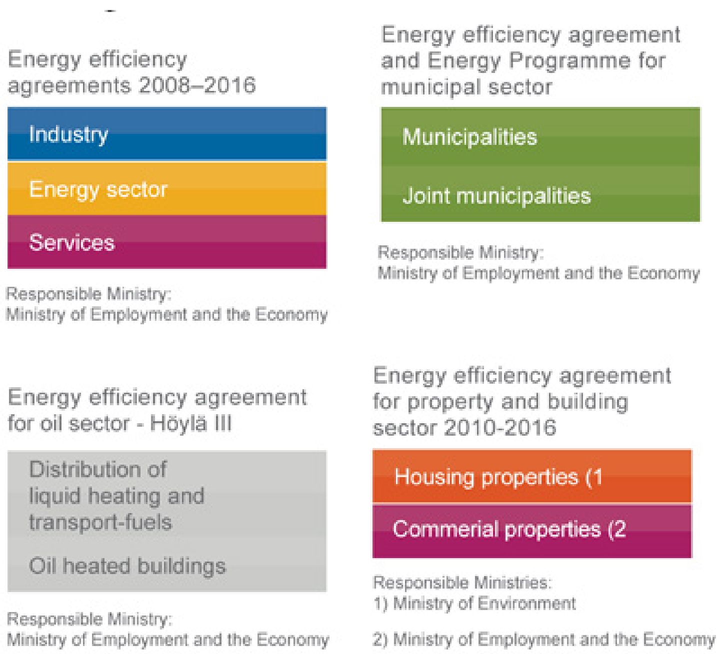
Objective: Efficiency improvements of buildings, efficiency improvement in services/ tertiary sector, efficiency improvement in industrial end-use sectors, reduction of losses, efficiency improvement in the energy and transformation sector.

Policy instrument: Voluntary/negotiated agreements.

Description: Voluntary Energy Efficiency Agreements have since the 1990`s been an important means of furthering energy efficiency in Finland and implement obligations set by the EED and the preceding Energy Services Directive. The agreements play also a central role in the national Climate and Energy Strategy.

From 2008 until 2016 industry, energy sector, municipalities, private services, property and building sector and oil heated buildings were covered by the Energy Efficiency Agreements. The first Energy Efficiency Agreements were originally negotiated for the period until 2005 and then extended until 2007. For the new period 2017–2025, continuing seamless the ongoing period 2008–2016, the agreements were negotiated in 2015-2016 and they will be signed in October 2016. In each agreement period the energy saving targets on participant level are set, related to the common energy savings targets set by e.g. EU directives.

Figure A1.9 Energy Efficiency Agreements and programmes 2008–2016 under the responsibility of the Ministry of Employment and the Economy.



Source: [63].

The Finnish approach on Energy Efficiency Agreements is voluntary. It is seen as a flexible and sensible alternative compared to legislation or other coercive means. In addition energy subsidies granted by the government can be utilized for energy efficiency improvements only by companies and communities, who have joined the agreements. By joining the agreement, the participants commit to energy savings targets and to include continuous improvement in energy efficiency, as part of the existing or planned management systems or operating plans.

The principle of continuous improvement is a key element of all the agreements. The companies and communities that have joined the agreement scheme set their own targets for improving their energy use, implement the measures necessary to reach them, and report annually on the realisation of the energy efficiency measures and other activities aimed at its improvement. The Government supports comprehensive energy audits or analyses and the subsidy is mostly 50% of the approved labour costs of the audit. Due to the EED, since 2015 energy audit subsidy can be granted only to micro and SME businesses and municipalities.

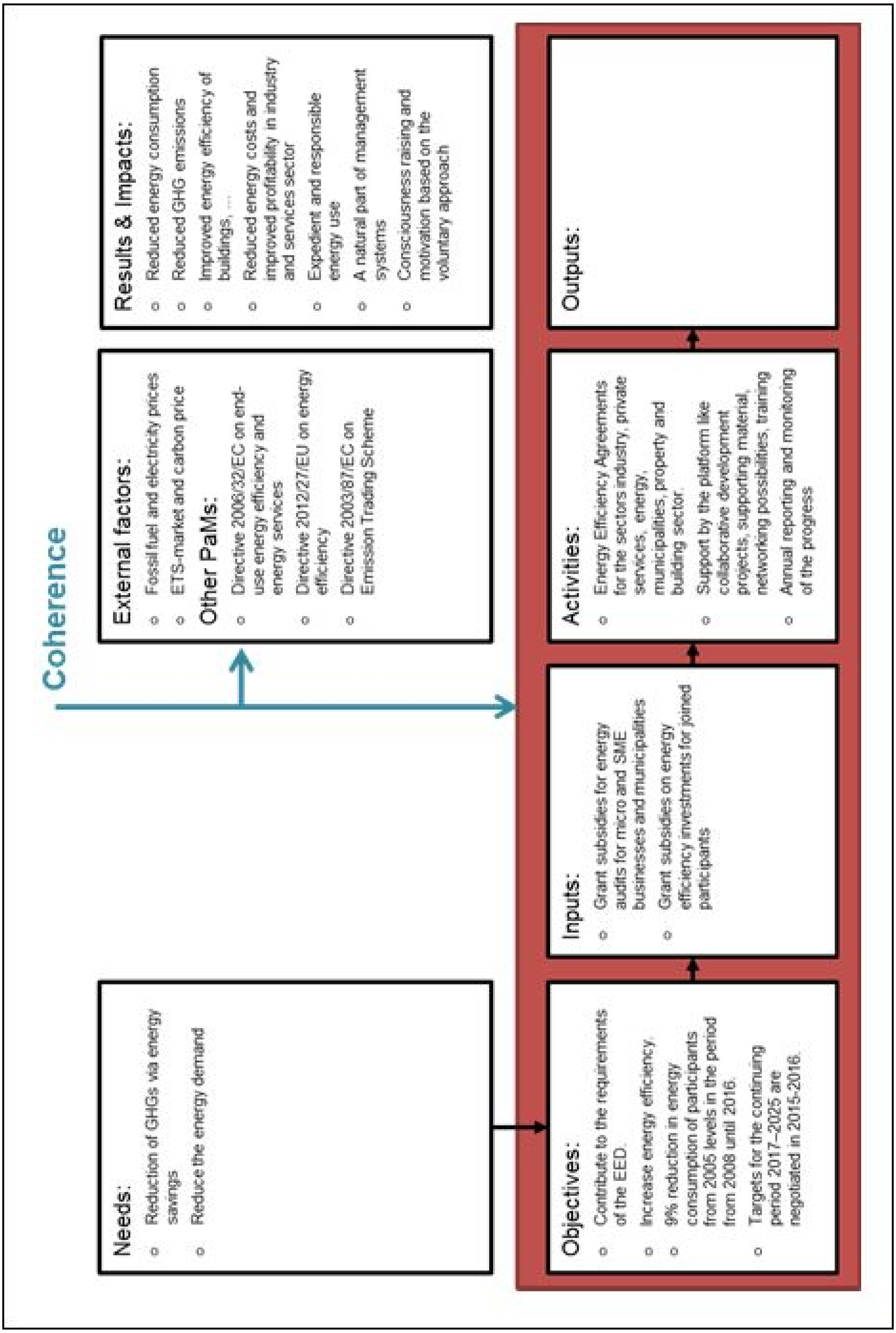
The Finnish Energy Efficiency Agreement scheme includes sectors, which are covered by the EU EED and the EU ETS.

Status: Implemented

Start year: 1997.

End year: An extension is foreseen until 2035.

Intervention logic



Evaluation criteria

~~Effectiveness~~ – ~~Efficiency~~ – ~~Relevance~~ – Coherence

Evaluation

To what extent can energy savings and GHG reductions be credited to the Energy Efficiency Agreements?

There are three main processes responsible for the savings achieved by the Energy Efficiency Agreements. At first, when the agreement is signed, targets are defined for the subsectors. For the period 2008-2016 over 600 Finish companies covering 5000 production sites had signed the agreement in 2014. Additionally, 26 companies responsible for 216 000 rental apartments , 118 municipalities, 204 energy production sites and many other have joined the agreement as well.

The main idea and cornerstone in the agreements is the continuous improvement of energy efficiency throughout the whole agreement period. At first the participant joins and set up their specific energy savings target. After that, they need to identify the possibilities of enhancing the efficiency of energy use which they can carry out for example, by performing an energy audit or analysis for example in accordance with the Ministry's instructions or other similar survey. For audits conducted according to the Ministry's instructions, SME's and municipalities can get a subsidy. Until the end of 2014, 2427 energy audits were subsidised in the framework of the Energy Efficiency Agreements. The outcomes of these energy audits are proposed measures mainly to increase the energy efficiency. As a following step the participants draw up a schedule for the implementation of cost-effective energy efficiency improvement measures. Then the implementation and investment on the measures is taken. Only joined participants of the Energy Efficiency Agreement can utilize Government subsidy on the implementation of the energy efficiency measures.

The whole process from the signing of the agreement until the implementation of the saving measure is monitored annually via an online database. This dataset on the Energy Efficiency Agreements is used for bottom calculations to fulfil the different reporting requirements.

The annual impact of implemented measures at end of 2014 for the period from 2008 until 2014 were 8,76 TWh savings of heating energy and fuels and 3,27 TWh electricity savings. These savings correspond to 3,2% of Finland's total energy consumption and caused reductions of 3,6 Mt CO_2-eq. Based on the implemented energy efficiency measures during 2008–201, joined participants saved at end of 2014 in total 440 mEUR in their annual energy costs [64].

During the period 2008-2014, 792 mEUR have been invested for implementation of savings measures under the Energy Efficiency Agreement scheme by the joined participants. The granted energy audit and investment subsidies therefore were total 84,7 mEUR. 85% of the subsidies were granted for energy-saving investments and 15% on for energy audits [64].

The investment and the calculation of the savings are always based on the lifetime of the measure. Therefore it is not possible to directly link the investment or the subsidies to the savings in order to measure the cost efficiency in this evaluation. A comparison of the savings to the investment shown in Table A1.7, allow to draw conclusions on the realized projects.

In industry usually measures with a short return of investment are implemented. Compared to the high share of investment, in total 21%, the savings in the energy sector are moderate, which indicates investment on infrastructure, like energy transmission and distribution systems. The investment in buildings and municipalities will of course mainly depend on measures with a long lifetime, like the increase of the thermal performance of buildings or saving through improvement of the infrastructure., allow to draw conclusions on the realized projects.

Table A1.7 Saving and investments for the first period split in sectors.

Savings (12 TWh/year) reported for period 2008-2014 at the end of 2014	***Investments (792 mEUR) reported for period 2008-2014***
67% in energy intensive industry	29% in energy intensive industry
21% in energy sector	35% in energy sector
6% in medium sized industry	9% in medium sized industry
3% in property and building sector 2% in municipalities	10% in property and building sector 12% in municipalities
1% in private service sector	4% in private service sector

Source: [64], [65]

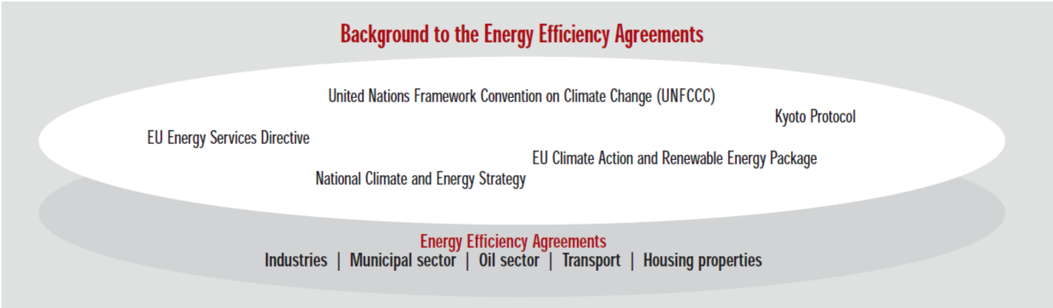
Is this PaM coherent with other PaMs of the Member State, which have similar objectives? To what extent is the PaM coherent with the Energy Efficiency Directive?

Voluntary agreement schemes in terms of energy efficiency have been set up in Finland since the 1990s. These PaMs have been adapted to the needs which are triggered by legislation and regulation on energy efficiency. The Energy Efficiency Agreements have a central role in implementation both the Energy Services Directive and EED.

The Energy Efficiency Agreements are detailed reported in the National Energy Efficiency Action plans for the EED [66]. In the third NEEAP the agreements have a direct impact on three of the eight reported measures. From the period 2009-2013 the contribution of the energy agreement related measures reported in NEEAP was 58% of the savings.

As this PaM contributes to different EU obligations, the required results must be individual structured and calculated for the different reporting. The whole process of the Energy Efficiency Agreements, from the joining until the realizing of the saving measures is documented in the same online database. This circumstance avoids any double counting of savings and is essential for the quality of the provided raw data. Double counting with other energy efficiency policy measures (Energy Audit Programme and investment subsidies for energy efficiency measures) is also tackled.

Figure A1.10 Background of the Energy Efficiency Agreements in Finland.



Source: Ministry of Employment and the Economy (2008)

Furthermore these agreements are also relevant in terms of launching the climate and energy package. For municipalities the action plan of the agreement scheme also includes a feasibility study on renewables, so the scheme has also an influence on the implementation of the RES-Directive.

Also the energy-intensive industry, which is mainly regulated by the EU ETS, is covered by the agreement scheme.

Conclusion

Effectiveness. The Energy Efficiency Agreements contribute significantly to the achievement of Finland's energy efficiency and climate targets. Already since the 1990's voluntary agreements have been established between stakeholders and government. As such, it is well established in and a cornerstone of the Finish energy efficiency policy. At the end of 2014, the Energy Efficiency Agreements resulted in a saving of 3,2% of Finland's total energy consumption, correspond to 3,6 Mt CO2-eq. [64]. This keeps Finland well on track to achieve their 2020 energy efficiency target. The Energy Efficiency Agreements are according to the NEEAP pivotal to this.

Coherence: The majority of measures in the third NEEAP (3 out of 8) are directly impacted by the agreements. Double counting of the impact of the Energy Efficiency Agreements is however avoided by an online database tracking actions.

Fonds Chaleur (France)

Description

Sector: Energy supply, energy consumption

Objective: Increase in renewable energy.

Policy instrument: Economic.

Description: Launched in December 2008, the Heat Fund was implemented in order to support the production of heat from renewable resources and recuperated energy. This system of support for investment is one of the commitments of the Grenelle Environment Forum and is made concrete by Article 19(4) of the Grenelle I law. It had a budget of around one bnEUR for the period 2009-2011. The aim of the Heat Fund is to support, between 2009 and 2020, the production of renewable heat up to 5,5 Mtoe, or more than a quarter of the renewable energy production target set by the Grenelle Environment Forum (an additional 20 Mtoe by 2020).

The Heat Fund mainly supports the development of the use of biomass (forestry, agriculture, production and thermal recovery of biogas, etc.), geothermal energy, heat pumps and solar thermal. The sectors concerned are collective housing, tertiary, agriculture and industry. By encouraging the heating networks to resort to renewable energies, the Heat Fund will also have an important impact in social terms (reduction and stabilisation of heating bills of essentially social housing) and in terms of diversification of energy supply.

The Heat Fund intervention methods are:

- For large scale biomass facilities (production of renewable heat greater than 1 000 toe/year) in the industrial, agricultural and tertiary sectors, annual national calls for projects. This procedure will be annually renewed over at least three years. The first call for projects was launched on 5 December 2008.
- For all other sectors, and for biomass facilities not falling under the calls for projects, the Heat Fund is managed by the ADEME at regional level. It complements aid currently granted in the context of State-Region Project Contracts (CPER).

The amount of support from ADEME is based on an economic assessment of the individual project. This assessment should ensure that the public support makes the investment in renewable heat technologies better than a similar project with conventional fossil fuels. To optimise the level of support following criteria are considered:

- The price of the renewable heat for the user (usually level of support should ensure that the price for renewable heat is 5% lower than for heat generated from conventional fuels)
- The efficient application of public resources (as EUR/toe or EUR/t CO2 emissions).

From 2014 onwards two simplifications have been applied:

- Fixed rate of support for small projects (specified for each technology)
- For larger projects the support needs to be within minimum and maximum level based on an economic assessment.

Support from the Heat Fund cannot be combined with other support schemes such as the energy efficiency certificates and the tax credit. ETS installations (from the third trading period) can apply for funding, but then the benefit from reduced carbon emissions is taken into account.

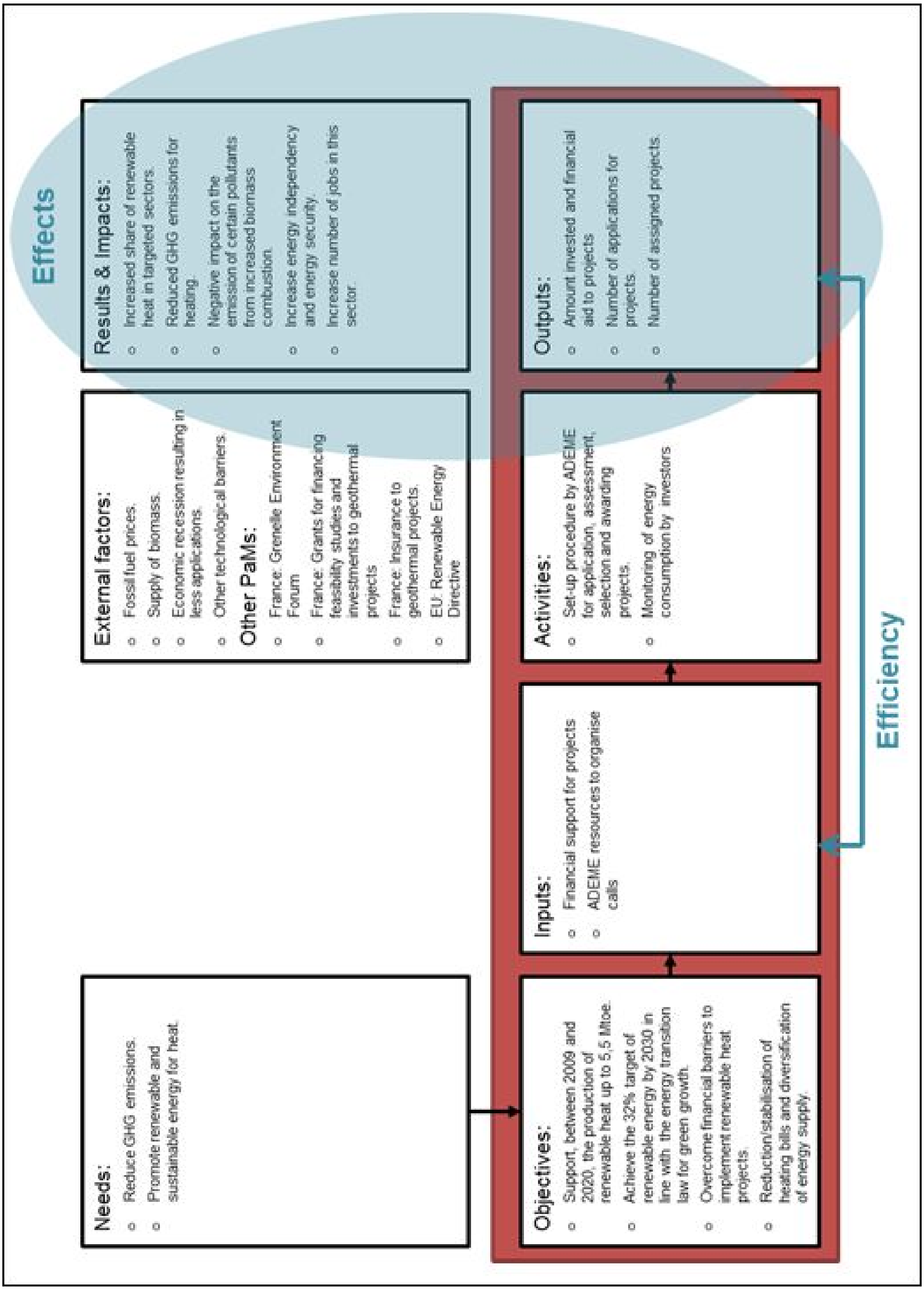
An ex post evaluation of the Heat Fund is foreseen in 2018.

Status: Implemented.

Start year: 2009.

End year: 2020.

Intervention logic



Evaluation criteria

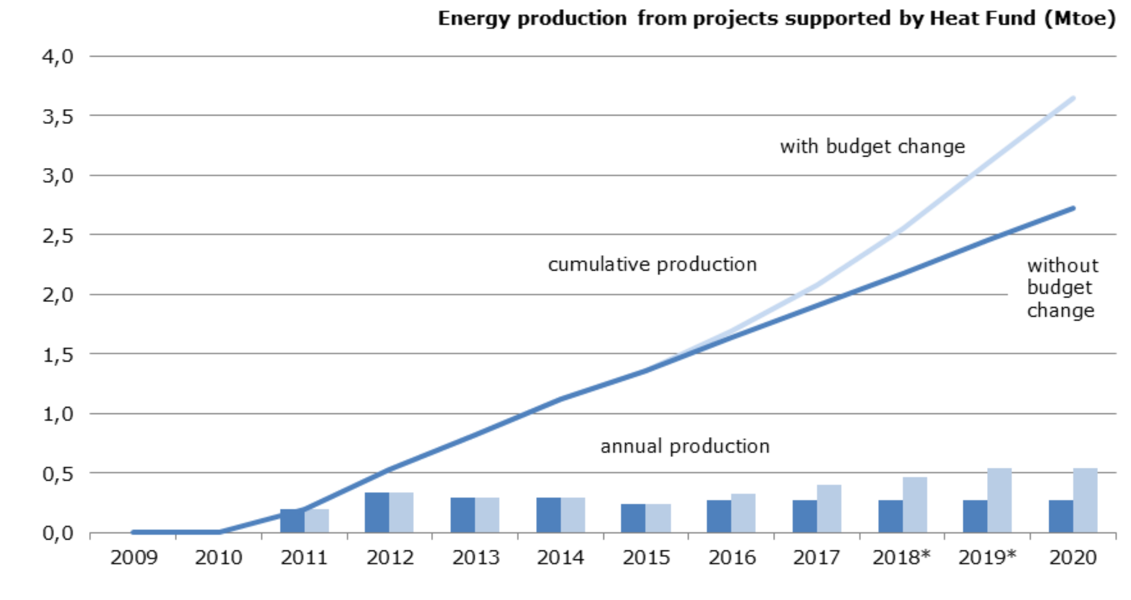
Effectiveness – Efficiency – ~~Relevance~~ – ~~Coherence~~

Evaluation

To what extent has the Heat Fund been effective in promoting renewable heat?

The principal objective of this PaM was to promote renewable energy for heating. The objective is to support the production of renewable heat of up to 5,5 Mtoe between 2009-2020 and in this respect contribute towards the renewable energy production target set by the Grenelle Environment Forum and the target under the Renewable Energy Directive (i.e. 10,3 Mtoe renewable energy for heat). Since the start of the PaM, there has been a clear increase in renewable heating projects that can be attributed to the support scheme in France (Figure A1.11).

Figure A1.11 Energy production from projects supported by the Heat Fund in 2009 to 2013 (ex post) and 2014 to 2020 (projections).



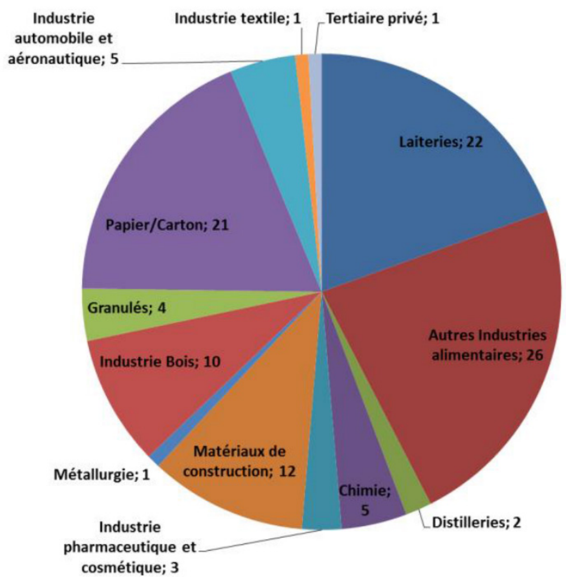
Source: [67] (data for years with * interpolated).

The Heat Fund contributed to 1,5 Mtoe in 2014 and 1,8 Mtoe in 2015, since it started in 2009. Since 2010, the level of support that ADEME is providing is decreasing. The amount of additional energy production (in Mtoe) per year is also decreasing [67]. Based on projections in [67] it is not obvious that the proposed target of 5,5 Mtoe in 2020 will not be within reach (based on an annual support of 223 mEUR,).

The gap between the production of renewable heat in 2015 and the target in 2020 is 3,7 Mtoe[9]. The Heat Fund therefore does not seem to be on track to achieve its target and an increase in the number of investments is therefore necessary. To achieve this the French government decided to increase the annual budget for projects to 420 mEUR to give an additional boost to this sector and to investments in renewable energy [68]. France also decided to extend his support to heat recovery, biogas injection into the network and renewable cooling. If these additional resources are used and due to the new technologies supported, the gap with the target will be reduced, although based on an assessment in France it will difficult to achieve the 5,5 Mtoe target [67]. ADEME (2015), assuming an annual increase with 600 ktoe, expects to achieve the target. "

The measure has been more effective in some sectors than in others. The largest part of the investments were done by industry. Although the PaM intended to promote renewable heat for different end users, only 1% of projects related to the services and private sector (Figure A1.12).

Figure A1.12 Sectors receiving support from the Heat Fund (in %).



Also with respect to the type of installations, the PaM has been more effective for some technologies. Wood biomass is applied most in terms of renewable energy production and amount of aid provided by ADEME. However, both for BCIAT and non-BCIAT wood the level of support that is needed is among the lowest, which explains why this is particularly popular. The Heat Fund has also been particularly effective to support the development of heating networks: 603 heating networks have been supported representing a total length of network of more than 1500 km, a 40% increase compared to 2008 (pers. com.).

Other factors

External factors have an important impact on the effectiveness of the PaM. Low fossil fuel prices mean that renewable energy is a less interesting investment and results in increased subsidy

[9] The increase is compared to 2006, so new installations in-between 2006 and 2009 will also contribute to the achievement of the target (and should be excluded from the gap).

needs. The French carbon tax (in force since 2014) could also help the Heat Fund to reach its objectives (pers. com.).

Biomass from wood is almost 80% of renewable heat production (BCIAT and non-BCIAT). Therefore, security of supply is therefore an important element for investment as well. To assure this the French government has established a call for expressions of interest called “AMI Dynamic Bois”. This was launched in 2015 to promote the biomass supply of the installations. This call has been renewed in 2016 with an envelope of 20 mEUR. This additional support should make it easier to supply biomass to heating installations and have a positive impact on the development of renewable energies.

One of the objectives of the measure was also to decrease the cost of heating for social housing. No quantitative or qualitative information was found on this aspect. Considering that most funding has gone to industry and not to residential sector, it is unlikely that the Heat Fund has affected heating cost markedly.

To what extent has the Heat Fund been effective in reducing GHG emissions?

In the technical report accompanying the submission of France on their climate mitigation PaMs [67], the impact of the Heat Fund has been estimated. An important assumption therefore are the emission factors. ADEME uses a lifecycle approach in calculating these emission factors [69]. GHG emission reductions are achieved because renewable energy is displacing fossil fuels. This means that the emission factor of wood biomass is not zero but 16 g CO2-eq./kWh. On average one kWh produced by renewable energy supported by the Heat Fund reduces emissions with 225 g CO2-eq. or the reduction is 2,61 Mt CO2-eq./Mtoe [67]. In 2013, the avoided GHG emissions was estimated to be 2,15 Mt CO2-eq.

To what extent can the effects be attributed to the Heat Fund?

Considering the additional cost renewable heating imposes compared with fossil fuel **energy**, it is unlikely that the investments would have been made without the policy (pers. com.). There is little overlap with other support schemes of France as combining the Heat Fund with other subsidies is not allowed. There is overlap with the ETS, so here there could be an interacting effect, but the level of support is adjusted taking this into account.

To what extent has the policy generated costs and benefits for different stakeholders?

There is little information on the administrative costs of implementing the Heat Fund (e.g. setting-up application procedure, screening applications, …). For several years ([70], [69]), information is available on the total budget of ADEME and although the budget for the Heat Fund is a significant part of the total ADEME budget, no information is available on the specific administrative costs (e.g. in terms of FTE) of this specific instrument. The administrative cost is estimated to not exceed one FTE per region (pers. comm.).

Screening the different applications on their technical and economic merits is nevertheless likely to impose a considerable administrative burden on ADEME in comparison to other instrument types. It was recognised that the administrative costs could be reduced and in 2014 [71] a simplification of the Heat Fund system was implemented by using standardised rather than project specific support for 75% of the applications.

The most significant cost for government of this policy is the provision of subsidies for renewable heat projects. According to different data sources a total budget was foreseen of 1, 28 bn EUR for the period 2009-2014 [72], although the data sources are not always consistent.

For the period 2009 to 2014 the total amount of subsidy is given in . For the period 2009-2014, 3266 projects were selected and supported. ADEME allocated a total of 1,2 bn EUR subsidy to a total investment of 4,0 bn EUR [72]. The subsidy to investment ratio was 30%. This investment will result in 1554 ktoe renewable heat production per year. According the sixth National Communication, corresponding with a reduction of 2,7 Mt of CO2 emissions in 2015.

In 2014, ADEME published a report on the socio-economic impact of the Heat Fund (although only the section on BCIAT; [73]). This assessment was based on five case studies, i.e. five large scale projects that received funding. The results of these five case studies showed that investment cost were spread over many different posts, of which the heating installation only accounted for 12% of the total investment cost. The operational costs were mainly fuel costs (82%). The study also looked into the impact on employment. During installation a correlation was found with the investment costs. On average investments supported by the Heat Fund resulted in 6,1 FTE per mEUR investment, ranging from 5,5 for medium sized projects to 7,3 FTE for small scale projects. The impact on employment during operation was for 80% linked to the supply of biomass. The effect on employment can thus best be calculated based on fuel consumption. On average 2,66 FTE / ktoe, ranging from 0,8 to 4,3.

Apart from a positive effect on employment, the Heat Fund offers other benefits as well as it lowers the import of fossil fuels, it diversifies energy production and increases energy independence and security (pers.com.).

One of the unintended negative effects of the measure is that it could increase air pollution because of combustion of biomass. Although combustion of biomass is considered to be effective in reducing GHG emissions, other pollutants (such as NOx and dust) are emitted. ADEME therefore implements strict criteria on air quality standards that have been included in the eligibility conditions of the fund (pers. com.). Investors have to install efficient dust removal systems and have to comply with emission limits of existing legislation.

Table A1.8 Support provided from heat fund to renewable energy.

		Non-BCIAT[1] wood	BCIAT wood	Geothermal	Biogas	Solar	Heating networks
2011	EUR/toe	524	368	861	189	10 183	358
	mEUR	58	43,8	26	1,2 [2]	16,2	92,8
2012	EUR/toe	475	389	1207	-	10 408	253
	mEUR	57,1	40,5	14,4	0 [3]	10	100
2013	EUR/toe	531	370	472	194	10 356	2 416
	mEUR	54	27	9	1,6	6,1	96
2014	EUR/toe	667	356	688	204	10 673	1 866
	mEUR	38	26	11,6	3,8	5	50

[1] BCIAT: Biomass Heat – Industry, Agriculture, Services' call for projects

[2] Also covered by Waste Fund in 2011 (+2,3 mEUR).

[3] No thermal upgrading or biogas incorporation project was assisted by the Heat Fund in 2012 but the Heat Fund supported 18 biogas heating transport networks.

Source: [74], [75].

Table A1.9 Review of the Heat Fund including calls for projects and regional aid (2009-2014).

	Number of projects	Amount of eligible investment (mEUR)	ADEME aid (mEUR)	Renewable energy (toe/year)	ADEME aid (EUR/toe)
Non-BCIAT[1] wood	633	1 170	291	482 957	30
BCIAT wood	136	757	286	731 633	19,5
Geothermal	342	413	86,6	94 862	45,6
Biogas	26	43	7,6	35 989	10,5
Solar	1514	145	69	6 314	546
Heating networks	603	1 427	456	202 424	112
Waste heat recovery	12	22	6,4	-	-
Total	3 266	3 977	1 202	1 554 178	38,6

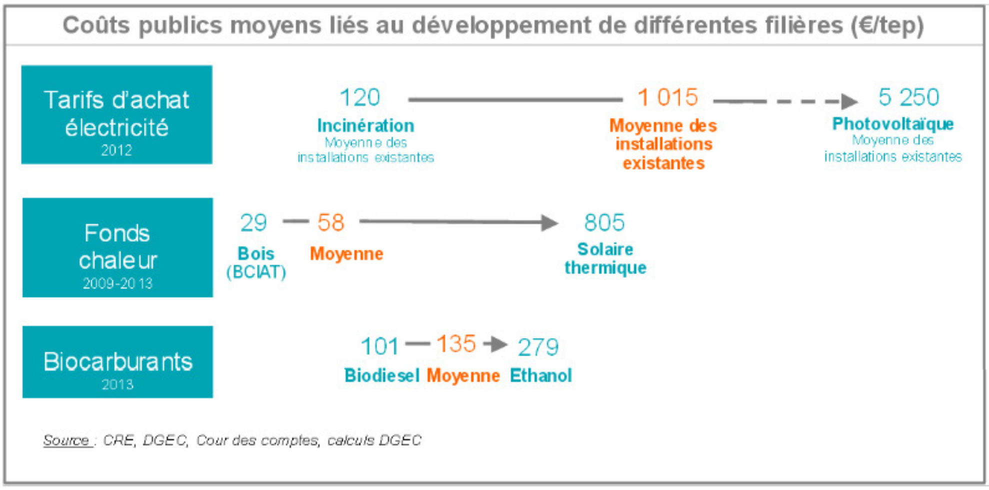
[1] BCIAT: Biomass Heat – Industry, Agriculture, Services' call for projects

Source: [75].

To what extent has the intervention been cost effective compared to other PaMs?

The technical report accompanying the MMR PaM submission [72] mentions that the costs of one t of avoided CO2 emissions increases to 11 EUR over the lifetime of the project. It is not clear how this is calculated or what original source is used. ADEME estimated the cost of avoided CO2 emissions at 16 EUR/t CO2 for the projects in 2009-2011 over the 20 year lifetime of projects [76]. This is well below the shadow price of CO2 emissions set by France, 44 EUR/t CO2 in 2015 and 100 EUR/t CO2 in 2030.

Figure A1.13 Public costs associated with the support of renewable energy with different PaMs in France.



Source: [77]

The Ministry of Environment gives an overview of the public costs to support renewable energy in France [77]. For the Heat Fund the values range from 28 (BCIAT) to 805 (solar thermal) EUR/toe, with an average of 58. This is calculated as the support that is provided via ADEME (in 2013) in relation to the production over the lifetime of the installations. Comparison with other policies that promote renewable energy are clearly in favour of the Heat Fund (Figure A1.13). This can partially be explained by the fact that most projects (in terms of production and funding) has gone to wood biomass, the cheapest technology.

For large scale projects, the level of support is assessed on a project per project basis. This means that the amount of subsidy is tailor made and there is less risk of over-subsidy (pers. com.).

Conclusion

Effectiveness: The Heat Fund is an important policy to France to achieve both targets related to GHG emission reductions (although a part of the achieved emission reductions will affect ETS and not ESD emissions) and renewable energy. The literature shows that the Heat Fund contributed to a production of 1,8 Mtoe of renewable heat in 2015 [67], investments that without the PaM would not have been done (pers. comm.). However, since 2010 the amount of additional energy production per year is decreasing and it is likely that the target of 5,5 Mtoe in 2020 will not be within reach. French government has therefore decided to reinforce the instrument, doubling the annual available funding by 2017. At this moment the Heat Fund has been very successful in certain industrial sectors (i.e. food and wood, paper and pulp industry) and for certain technologies (i.e. biomass), while other sectors and technologies (especially the residential and services sector) are lagging. The high share of biomass for renewable heat could pose problems with supply, for which France has implement supporting policies (AMI dynamic bois).

Efficiency: The PaM is considered efficient. Administrative costs are limited, although large projects need to be screened and assessed by experts and therefore costs are expected to be higher compared to other instrument types. Efforts have been made to reduce administrative burden in 2014, by simplifying the procedure for smaller scale projects. No quantitative information is available on administrative costs. Highest cost for government is providing subsidies, amounting to 1,28 bn EUR for the period 2009-2014. These costs do come with certain benefits (apart from reduced GHG emissions and increased energy dependency) such as the creation of jobs. According to France's own assessment, the PaM is cost efficient as the cost of avoided CO2 emissions is below the shadow price of CO2 emissions. Also compared to support schemes for renewable energy in France, the Heat Fund is more efficient [77].

Landfill aeriation (Germany)

Description

Sector: Waste/waste management.

Objective: Improved landfill management.

Policy instrument: Information, economic.

Description: Using in-situ aerobic stabilisation (landfill aeration), biologically degradable waste undergoes microbial oxidation. Instead of being converted into methane, which is what happens during anaerobic degradation, the biogenic carbon in the waste is converted under aerobic conditions into carbon dioxide (which in this case is greenhouse-neutral because the carbon is biogenic in origin) and the landfill's potential to form methane is correspondingly reduced. The aeration should last for between one and five years, depending on conditions in the landfill. Assuming the measure is successfully implemented, a landfill's potential to form methane would be reduced by 90 %.

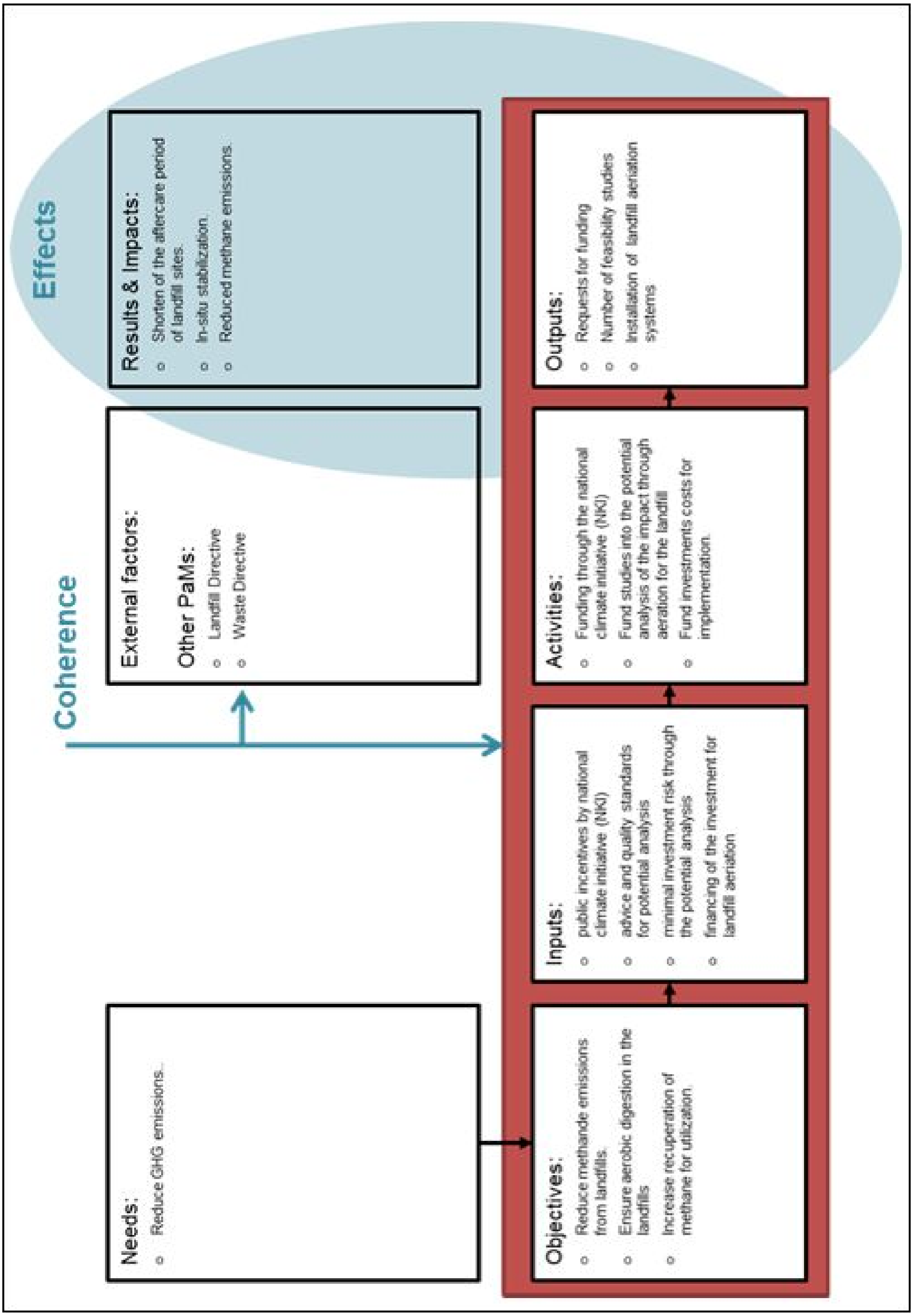
The National Climate Initiative is funding the landfill aeration projects in a two stage approach. The first stage is the funding of a feasibility study and in the second the investment costs for the landfill aeration are funded.

Status: Implemented.

Start year: 2013.

End year: 2023.

Intervention logic



Evaluation criteria

~~Effectiveness~~ – Efficiency – Relevance – ~~Coherence~~

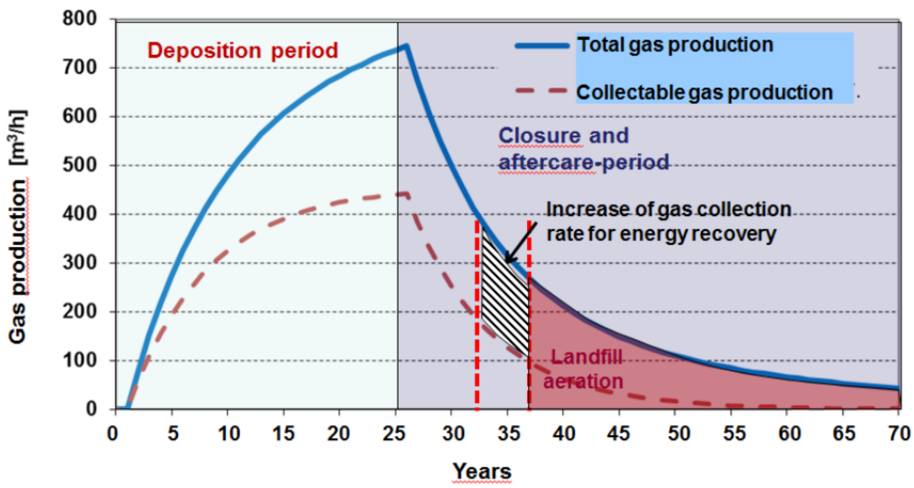
Evaluation

How affordable were the total costs in question, given the benefits over the entire lifetime?

In Germany no municipal solid waste with TOC over 5 m% is deposited in landfills since 2005. Even before this date, hundreds of municipal solid waste landfills were already closed. To mitigate methane emissions from landfills gas production can be collected and used in various ways, including heat and electricity generation. However, when production of methane decreases over time, production could be too low to be extracted and used. Landfill aeration is a method which can be used to increase the gas collection rate so energy production continues to be possible. In

Figure A1.14 the landfill gas-production over the time is shown. The potential for landfill gas collection and use is around 30 years, after which landfills are suitable for aeration to extent the use period. This aeration phase usually lasts 3 to 4 years.

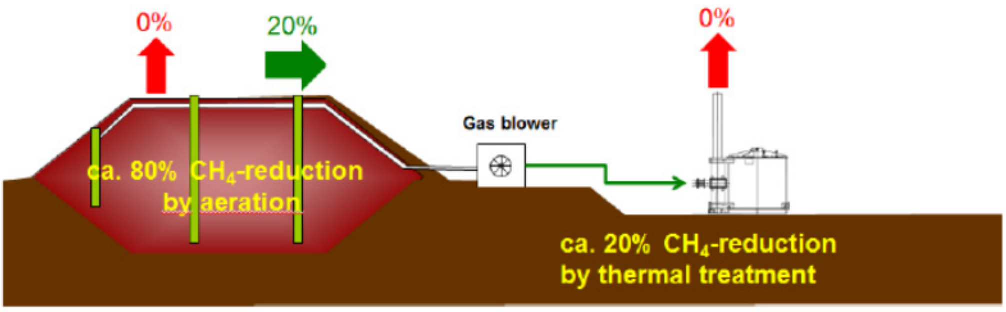
Figure A1.14 Potential for increasing the gas recovery rate with subsequent landfill aeration in the aftercare phase.



Source: [78]

To support landfill aeriation, Germany installed a funding scheme under the National Climate Initiative for feasibility studies and financial support for investment costs. To be eligible for funding, 90% of the possible emissions, calculated via the potential gas formation (organic content in the landfill body), must be mitigated. Figure A1.15 shows the scheme of a landfill aeration system. The extracted air from landfill has to be treated in an afterburner unit, because it still contains 5-10% methane. In a long term view around 400 closed municipal solid waste landfills are suitable for aeration, with 200 to 300 in the short to medium term.

Figure A1.15 Reduction of the methane emissions by means of landfill aeration and high temperature oxidation of the off-gases.



Source: [78]

From 2013 on already 43 concepts studies and 30 investment measures have been carried out by this PaM, see Table A1.10 which also includes the investments.

Table A1.10 Number of landfill aeration projects funded at National Climate Initiative and investment.

	Projects numbers			*Total costs in mEUR*			*Funding in mEUR*		
	Concept study	Investment measure	Sum	Concept study	Investment measure	Sum	Concept study	Investment measure	Sum
2013	10	7	17	~ 0,6	~3,9	~4,5	~0,3	~1,4	~1,7
2014	17	6	23	~0,7			~0,4	~1,4	~1,7
2015	12	3	15						
First half 2016	5	14	19						

In 2015 the average price for emissions certificates EUA was 7,68 EUR. Compared to the mitigation costs of 6,26 EUR for the landfill owner, shown in Table A1.11, could the mitigation measure be seen as economic feasible. Also the aftercare period will be shortened by aeriation.

Table A1.11 Reductions and mitigation costs of landfill aeration in Germany.

Total GHG –Reduction	approximately 385 000 Mg CO2-eq.
Average Reduction per Project	approximately 55 000 Mg CO2-eq.
Mitigation costs per Mg CO2e	approximately 10,00 EUR
Own share landfill operator	approximately 6,26 EUR
Funding	approximately 3,74 EUR

In the German Landfill Ordinance (DepV), landfill aeration is defined as an additional measure. One benefit according to this regulation is that the installation of an aeration system requires only one top layer instead of two. Also the well-defined monitoring of the projects funded by this PaM provides detailed information about the landfill and the mitigated GHG emissions.

How effective is this PaM in reducing GHG emissions?

From 2013 until the end of 2015, 15 “aeration of landfills” projects were funded by the National Climate Initiative. The implementation of which resulted in an emission saving of 0,9 Mt CO2-eq. In 2020, the total GHG emissions from waste will be 8 Mt CO2-eq. in Germany. The potential of GHG mitigation via landfill aeration is 7 to 25 % of the total occurring waste emissions in Germany.

Funding requirements for landfill aeration projects include, among other things, a well-structured monitoring plan. Through a discontinuous measurement of the airflow, the gasflow and the CH4 content of the off gas all parameters to ensure the aerobic conditions that increase CH4 mitigation are monitored.

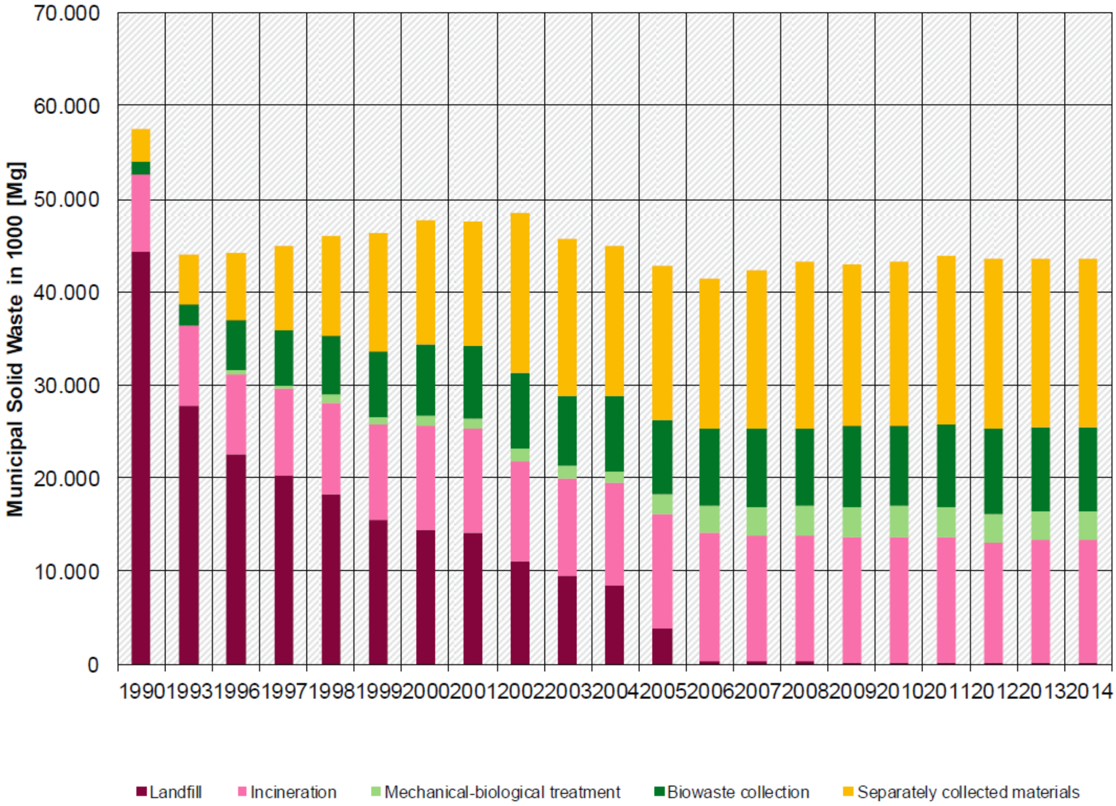
The design of the funding scheme, based on the stage process where there is first a concept study followed by funding investment costs, makes it very effective. Additionally, funding is linked to the reduction target of 90 % of all possible emissions over the entire lifetime of the landfill.

To what extend is the PaM still relevant in terms of GHG emissions?

Considering that 400 landfills are potentially suitable for aeration. Only a small fraction has taken measured to start landfill aeration. The PaM therefore seems as relevant now as from the onset.

Figure A1.16 shows the development of the treatments for municipal solid waste. Landfill aeration is only needed after approximately 30 years. Taking into account the situation in Germany, this would mean that by 2035-2040 all landfills will have to be installed with landfill aeration systems.

Figure A1.16 Changes in pathways for management of settlement waste, 1990 to 2014, with intermediate years.



Source: [79].

Another possible reason for a premature termination of the PaM, before all possible landfill aeration systems are funded, is the inclusion of the waste sector in the ETS. In Germany, the allocation of the CH4 emission from waste to the ETS was under discussion.

Conclusion

Landfill aeration is a technology to increase the recuperation of methane from landfill site for energetic valorisation. In Germany, around 400 municipal solid waste landfills are suitable for landfill aeration in the long term. Without this technology, it is unlikely that these emissions could be avoided. The PaM therefore is very relevant for Germany at the moment. However, it is possible that in future other measures will be implemented to promote landfill aeration (such as the inclusion of the waste sector in the ETS), reducing the need for subsidies. At a reduction cost of approximately 10 EUR/t CO2-eq. emissions can be reduced at relatively low cost, compared to many other mitigation measures in other sectors.

Carbon tax (Ireland)

Description

Sector: Transport, energy consumption, cross cutting.

Objective: Cross-sectoral: tax on fuel used for heating and transport.

Policy instrument: Fiscal.

Description: The aim of the carbon tax is to incorporate a price signal for carbon on the non-ETS sectors, specifically on fuels used for heating and transport. Apart from that, key objectives were promoting the green economy and achieving the EU 2020 goals. With the worldwide financial and economic crisis and an increasing budget deficit the carbon tax was also introduced as part of a package of government measures to respond to this crisis. The policy is directly levied on the carbon content of the fuel. The policy was introduced in Ireland in three phases:

Phase 1, affected petrol, diesel and heating oil, was implemented in December 2009 at a level of 15 EUR/t CO2. This was equivalent to an increase of 0,042 EUR/l petrol and 0,049 EUR/l diesel respectively.

Phase 2, extending the carbon tax to kerosene, marked gas oil (green diesel for agricultural use), liquefied petroleum gas (LPG), fuel oil and natural gas, was implemented in May 2010 at a level of 15 EUR/t CO2. In 2012 this was increased with 33% to 20 EUR/t CO2.

Phase 3, extending the carbon tax to solid fuels (coal and commercial peat) was implemented in May 2013 at a level of 10 EUR/t CO2. In May 2014 this was increased with 10 EUR/t CO2 thus bringing the rate of carbon tax on solid fuels into line with that of the other fossil fuels (pers. comm.), [80], [81].

Department of Finance, 2013: 8; EEA, 2016a; NEAP, 2014:43; Tax Strategy Group, 2014: 1; Tax Strategy Group, 2015: 3;)

A comprehensive overview on tax rates for the different fuel types is presented in the Figure below. Currently there are no plans to adjust the tax rates in the short term, but it is to be expected that the tax will increase in the long term (pers. comm.) and to follow the EU ETS carbon price [82].

Table A1.12 Excise Duty Rates (Revenue - Irish Tax & Customs, 2015).

Goods	Description or Usage	Rate of Duty €
Light Oil (rates shown include carbon charge)	Petrol	587.71 per 1,000 litres
	Aviation gasoline	587.71 per 1,000 litres
Heavy Oil (rates shown include carbon charge)	Used as a propellant	479.02 per 1,000 litres
	Used for air navigation	479.02 per 1,000 litres
	Used for private pleasure navigation	479.02 per 1,000 litres
	Kerosene used other than as a propellant	50.73 per 1,000 litres
	Fuel oil	76.53 per 1,000 litres
	Other heavy oil (including MGO)	102.28 per 1,000 litres
Liquefied Petroleum Gas (rates shown include carbon charge)	Used as a propellant	96.45 per 1,000 litres
	Other liquefied petroleum gas	32.86 per 1,000 litres
Substitute Fuel (rates shown include carbon charge)	Used as a propellant instead of unleaded petrol	587.71 per 1,000 litres
	Used as a propellant instead of diesel	479.02 per 1,000 litres
	Used other than as a propellant	102.28 per 1,000 litres
Natural Gas Carbon Tax	Measured based on net calorific value	4.10 per megawatt hour
	Measured based on gross calorific value	3.70 per megawatt hour
Solid Fuel Carbon Tax	Coal	52.67 per tonne
	Peat Briquettes	36.67 per tonne
	Milled Peat	17.99 per tonne
	Other Peat	27.25 per tonne

There are also reliefs from the carbon tax, although as a matter of principle the reliefs from the carbon tax are limited to ensure as wide an application as possible (Tax Strategy Group, 2014). The reliefs from the carbon tax that currently apply are set out in the Table below.

Reliefs will also be implemented for solid fuels that contain a high biomass content [83] (pers. comm.). Furthermore, due to a commitment in the previous Government's Programme for Government, which stated there would be no increase in the rate of carbon tax on agricultural diesel, when the carbon tax rate increased from 15 to 20 EUR/t a corresponding relief was made available by way of a double income tax relief for farmers. The current Programme for Government makes no such commitment (pers. comm.), [82].

Table A1.13 Reliefs from the carbon tax (Tax Strategy Group, 2014: 1; adapted).

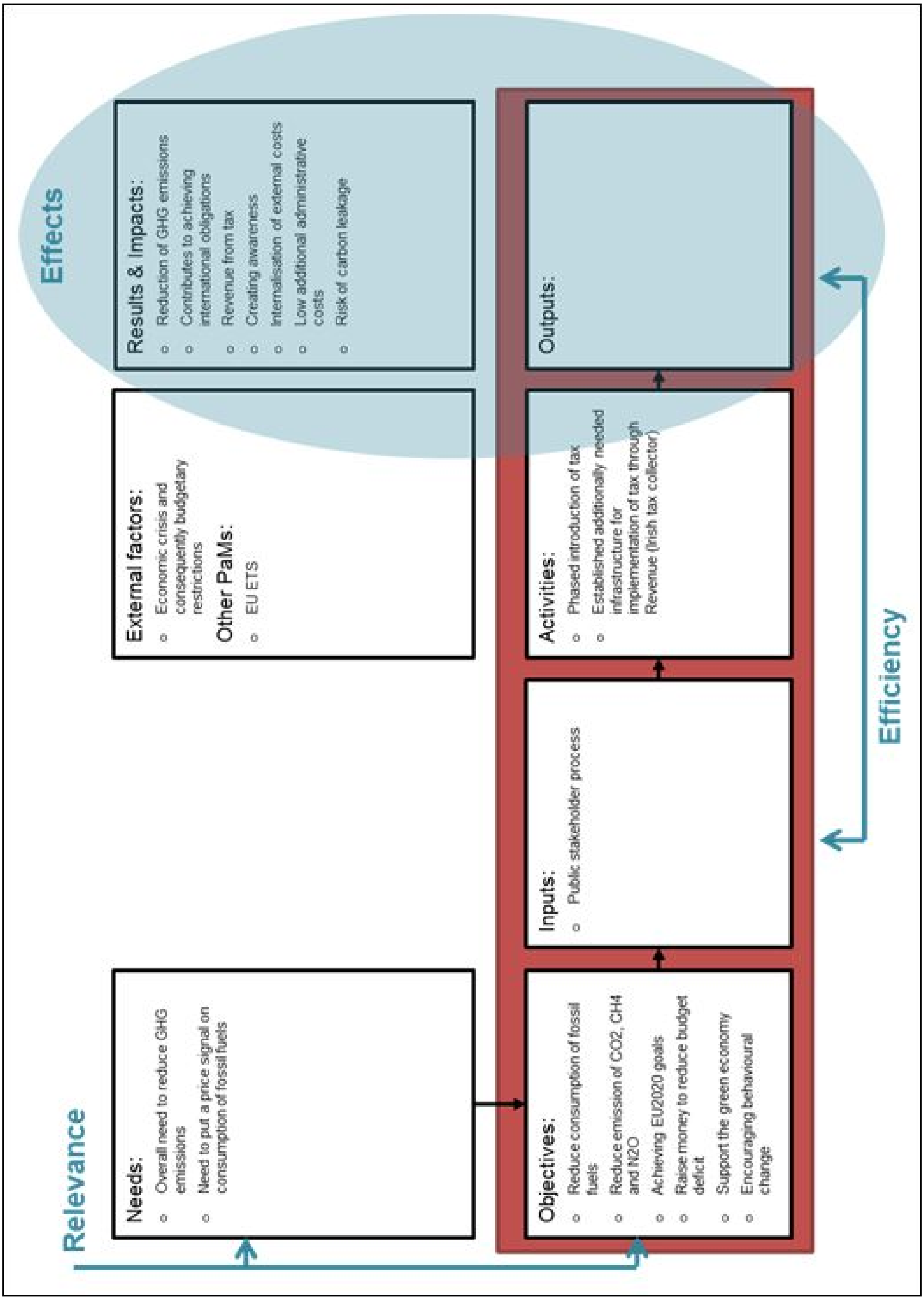
Relief	**Rationale**
Relief for Fuel used for generation of electricity	*Required to comply with EU Energy Tax Directive. Ensures no price increases in electricity arising from carbon tax. Emissions from powergen fall under EU Emission Trading Scheme (ETS)*
Relief for participants in the EU ETS	*The EU ETS is considered the appropriate carbon pricing mechanism for large scale installations. On that basis reliefs apply to ETS participants subject to the EU minimum rates being observed.*
Biofuels	*Exemption intended to promote a higher incidence of biofuel in conventional transport fuel sales.*
Combined Heat and Power (CHP)	*Provides a further incentive for the use of this technology which could lead to a reduction in $CO2$ emissions and other pollutants*

Status: Implemented.

Start year: 2008

End year: Not known.

Intervention logic



Evaluation criteria

Effectiveness – Efficiency – Relevance – ~~Coherence~~

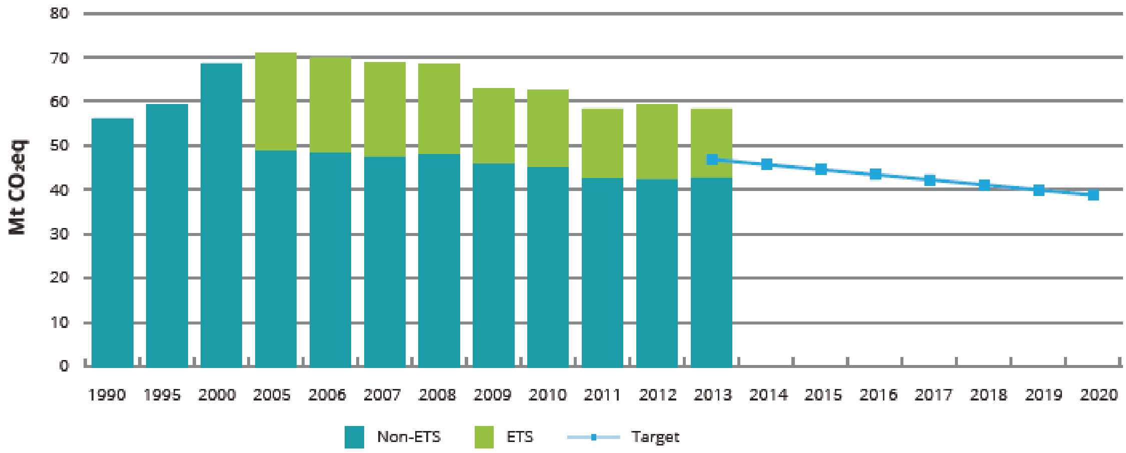
Evaluation

To what extent is the intervention still relevant?

The non-ETS sector represents 58% of total CO2 emissions in 2009 and 72% of total GHG emissions, which is among the highest shares in the EU, with only Luxembourg, France, Lithuania and Latvia having a larger non-ETS sector [84], [85], [86]. Under the EU ESD, Ireland's non-ETS emissions must be reduced by 20% relative to 2005 by 2020 (Figure A1.17). Measures to mitigate emissions in these sectors (i.e. transport, small industry, waste, agriculture and buildings) are therefore of particular importance in Ireland. The high share of non-ETS emissions can be explained by emissions from agriculture (comprising 32% of emissions in 2013, compared to the EU average of 10%). In the absence of emission reductions in agriculture, a greater proportion of the burden sharing falls on other sectors and particularly the non-ETS energy sector in Ireland [87]. These sectors are therefore the primary focus of Government policy and there have been several interventions to reduce emissions and improve energy sustainability. This includes the introduction of the carbon tax, but also rebalancing of Vehicle Registration Tax and motor tax on a CO2 emissions basis, the Biofuels Obligation Scheme, a potential Renewable Heat Incentive, and grants and excise relief for certain low carbon vehicles.

Projections by the EPA indicate that Ireland will not achieve its 2020 emissions target without further measures being put in place [87]. The need for a further decrease of GHG emissions and especially for the carbon tax as policy directly targeting the non-ETS emissions is therefore still very relevant.

Figure A1.17 Total GHG emissions for Ireland from 1990 to 2013.



Note that the blue target line is for non-ETS emissions only.

Source: [87]

How well adapted is the PaM to technological or scientific advances?

The policy can be adapted to technological, scientific advances and societal changes by the government, but, by being an important price signal for the economy as well as the population, the carbon tax can also drive those aforementioned changes. For the carbon tax, the price signal needs to be sufficiently high to drive these changes. If the price signal is too low, it will not have the desired effect on fuel savings and emission reductions. The study on 'Ireland's Transition to a Low Carbon Energy Future 2015-2030', the EPA assumes that carbon prices (per t CO2-eq.) for the ETS and non-ETS sectors will rise from 10 EUR (ETS) and 20 EUR (non-ETS) in 2020 to a common level of 35 EUR in 2030 and 57 EUR in 2035. In a study commissioned by the European Commission, the price to achieve the 2030 and 2050 targets require a price of 40 EUR/t CO2-eq. in 2030 and further increases until 2050. This is in the same range as the EPA reported.

To what extent have GHGs been reduced?

It is estimated that the carbon tax reduces emissions by about 0,3 Mt CO2–eq. per year [88]. According to the ex ante assessment in the EEA PaM database the GHG emission reductions are estimated to remain fairly stable over the upcoming years (Table A1.14).

Table A1.14 GHG emission reductions in kt CO2-eq. per year.

Sector	2020	2025	2030	2035
ESD	325,05	325,07	325,04	324,84

Source: [89]

The national energy forecasts by the Sustainable Energy Authority of Ireland (SEAI) estimates emissions savings due to the PaM in the WEM scenario. In Table A1.15 the predicted effects of the carbon tax in different sectors can be seen. Table A1.16 and Table A1.17 show the projected primary and final energy savings as well as CO2 savings until the year 2020 calculated by Department of Communications, Energy & Natural Resources [88].

Table A1.15 Emissions saving kt CO2-eq. per year.

Sector	2020	2025	2030
Manufacturing Industries and Construction	131,3	131,3	131,3
Transport	23,9	24,0	24,0
Residential	83,2	83,2	83,1
Commercial / Institutional Services	69,5	69,5	69,5
Key assumptions underpinning the energy forecasts Carbon tax:			
2012-2015	2016-2020	2021-2025	2026-2030
20 EUR/t CO2	20 EUR/t CO2	20 EUR/t CO2	35 EUR/t CO2

Source: [88]

Table A1.16 Anticipated energy and CO2 savings achieved and anticipated in 2020.

	Energy savings (GWh, PEE)			CO_2 savings (kt CO_2)		
	2012 (achieved)	2016 (expected)	2020 (expected)	2012 (achieved)	2016 (expected)	2020 (expected)
Public	1,050	2358	3716	238	583	918
Business (Commercial/Industry)	3,257	5,114	7,594	802	1,238	1,813
Buildings	3,778	6,896	10,379	922	1,641	2,459
Transport	1342	2746	4548	342	700	1134
Energy supply	1,710	1,996	4,418	488	362	597
Cross sectoral (carbon tax)	1,200	1,300	1,300	306	330	330
Total	**12,337**	**20,410**	**31,955**	**3,098**	**4,854**	**7,251**

Source: [90]

Table A1.17 Energy saving.

Title of the Energy saving measure		Carbon tax
Energy savings	Method for monitoring/measuring the resulting savings	An estimation is made on the basis of price elasticities for the various fuels impacted. These are applied to demand scenarios that take account of the impact of all other NEEAP measures.
	Savings achieved in 2012	Primary energy 1,200 GWh; final energy 1,090 GWh
	Expected energy savings in 2016	Primary energy 1,300 GWh; final energy 1,180 GWh
	Expected impact on energy savings in 2020	Primary energy 1,300 GWh; final energy 1,180 GWh
	Assumptions	Key assumptions/statistics informing the monitored and projected savings are: • Price elasticities per fuel type • Demand projections by fuel • Current carbon tax €20 per tonne
	Overlaps, multiplication effect, synergy	Estimate applied to demand scenarios where all NEEAP measure impacts have been applied.

Source: [90]

Given the relatively limited time period since the introduction of the carbon tax, the proliferation of other sectoral PaMs in the same sectors, and the fact that its introduction has been sequential rather than immediate it is difficult at this stage to specifically quantify its impact. Ex ante analysis by the Economic and Social Research Institute found that the impact of the tax on emissions and other key variables would be strongly subject to the use of the revenues generated, A 20 EUR/t tax would likely result in drops in emissions of the order of 1,5% and could have a positive impact on aggregate demand if the revenues were used to reduce employment taxes [82].

To what extent have the objectives (apart from GHG reductions) been achieved?

Tax revenue

For 2014, the Revenue Commissioners collected 144,86 mEUR in carbon tax from diesel and 65,69 mEUR in revenues from petrol, kerosene raised 42,28 mEUR; natural gas raised 51,68 mEUR and sales of marked gas oil contributed 54 mEUR [91]. In 2015, the carbon tax raised 419 mEUR and is estimated to raise a further 435 mEUR in the year 2016, which is around 0,9% of overall taxes (pers. comm.) . In Ireland there is no formal earmarking of carbon tax revenues specifically for environmental objectives, but since March 2009 the Better Energy Homes Scheme has paid out almost 194 mEUR in grants. Revenues generated from the carbon tax allow for this system of grants to reduce the costs of retrofitting properties with insulation thereby reducing GHG emissions from the residential sector (pers. comm.).

Increasing the carbon tax rate by 5 EUR would yield an estimated 109 mEUR more in a full year and an increase of 10 EUR in the rate would yield 218 mEUR additional in a full year (pers. comm.). Table A1.19 illustrates the impact increases of 5 EUR and 10 EUR/t CO2 emissions would have on selected individual energy products [92].

Table A1.18 Revenues raised by the carbon tax.

Year	Revenue (mEUR)
2010	223,1
2011	298,2
2012	354,0
2013	388,0
2014	385
2015	419
2016	435 (estimated)

Source: [93]

Table A1.19 Impact of Increases in Carbon Tax (incl. VAT).

	Unit	5 EUR	10 EUR
Petrol	Litre	1,40 c	2,80 c
Diesel	Litre	1,64 c	3,27 c
Coal	40 kg bag	60 c	120 c
Peat briquettes	Bale	13 c	26 c

Source: [92]

Fuel consumption

The impact of this carbon tax in terms of fuel efficiency is difficult to assess, in particular given the complex interaction with vehicle purchasing patterns, other fuel taxation increases, and general economic circumstances impacting on fuel demand. However, it is clear that the carbon tax will have a long term impact on fuel efficiency. Research on the issue suggests that fuel prices are an important aspect in terms of long term fuel demand, with estimated long run elasticities as high as 0,7, and short run elasticities in the region of 0,3 [94].

A study in the year 2012 found a decrease in fuel consumption between 2008 and 2011 [95]. Some of this may have been as a result of the carbon tax, but a drop in consumption was already underway in 2008-2009 before the introduction of the carbon tax and reflects wider economic factors and the general downturn in the economy. Moreover, complementary measure have also played a role in this decline, for example the Vehicle Registration Tax (VRT) and annual motor tax were re-calibrated from July 2008 to be based on open market selling price and CO2 rating and have had a significant impact on the composition of the new car fleet [81].

In terms of pricing, transport fuel prices in Ireland have risen substantially in recent years, reflecting increased fuel excise levels and the introduction of the Carbon Tax in 2010. The Central Statistics Office consumer price index shows that fuel prices have risen with approximately 20% since 2008 [82]. Due to low oil prices both petrol and diesel are still priced at similar levels to those in 2008 (pers. comm.).

According to the country expert, people appear more conscious about what they are investing in and have been moving away from heating their home with oil. But it is difficult to link these behavioural changes directly to the carbon tax. One can certainly see that from the point of introduction of the carbon tax that emissions are going down, but this is part of a broader policy spectrum (pers. comm.).

Public acceptance

Another important factor that contributes to the effectiveness of the carbon tax was the acceptance of the Irish population. The main rationale behind the introduction of a carbon tax was achieving environmental goals and particularly the binding EU2020 targets. According to the country expert, Irish consumers understand the polluter pays principle and the rationale of the carbon tax, and are therefore more willing to accept the PaM (pers. comm.).

The public consultation process prior to the implementation of the tax also meant broader acceptance of this policy by the public. The consultation process happened in the mid-2000s at the first attempt to introduce the carbon tax, but still was used into the design of the tax. It allowed for the development of the phased implementation strategy which had a big impact on the acceptance of the tax when it was introduced (pers. comm.). The broad application of the tax also means that everyone is affected by the tax. As it applies to all fuels, with very limited reliefs, it ensured a fair application based on the carbon content of each fuel. This rationale is logic and broadly accepted. The application of the tax was introduced very high in the supply chain which implies that the carbon tax is included in the end price rather than paying an additional charge on the product (pers. comm.).

What other external factors influenced the achievements observed?

Late 2008, Ireland also felt the impact of the global financial and economic crisis. As a response to the impact this had on the state budget, the Irish government made and agreement in November 2010 with the European Central Bank, the European Commission and the International Monetary Fund. The latter provided substantial financial support, on condition that a number of revenue raising and expenditure reduction targets were met by the Irish government, one of which was the implementation of a carbon tax [96]. Personal communication with a country expert underscored that, the tax was probably introduced earlier than may have been the case otherwise. Another study comes to the conclusion, that the tax was introduced as a mechanism to help address issues of falling tax revenues in other areas [81].

To what extent has the policy generated benefits and/or costs for different stakeholders?

Implementation costs

There is no information is available on the costs of implementing the PaM for the government (administrative burden) based on the literature review as well as the personal interview with a tax policy expert at the Irish Department of Finance. As the tax is applied as high up the chain as possible there are generally only administrative costs (pers. comm.). For example, for petrol and diesel sellers it would be almost no cost, because it only necessitated adjusting existing systems. For solid fuel traders on the other hand, the same system did not exist and the tax collector in Ireland had to develop systems to insure that the tax was implemented. Placing the tax as high up as possible in the supply chain certainly reduced the administrative costs for all concerned.

Distributional Implications

In 2005, it was estimated that 15% of Irish households spent over 10% of their income on energy and this was expected to rise to 19% of households in 2010 (due to energy prices rising faster than incomes). Studies by the Economic and Social Research Institute (ESRI) on the distributional impact of the tax in Ireland were carried out prior to its introduction in 2010. These showed that there were likely to be some regressive impacts, across different income groups, and between urban and rural households, Indeed many submissions to the Commission on Taxation referred to this issue and were concerned about the impact of the tax, particularly for those on lower incomes [97]. A study by ESRI in 2009 estimated that the changes will cost households an average of between 2 and 3 EUR per week, or up to 156 EUR per year.

According to the ESRI, low income households in Ireland usually make more extensive use of cheaper but more carbon intensive fuels, such as coal and turf. The issue of fuel poverty and energy poverty is being addressed by the Energy Affordability Strategy through a combination of institutional supports, investments in improving the energy efficiency of housing stock and wide availability of advice on energy efficiency [98]. For example the retrofit programme 'Better Energy, Warmer Home Scheme' provides retrofits to these particularly vulnerable to fuel poverty free of charge. This results in reduced levels of fuel poverty, improved health and overall better quality of lives, Significant reduction of costs of retrofitting is also available for all other Irish citizens (Conroy, 2016).

According to a study of the University College Dublin the carbon tax avoided (more) increases in income tax which would have further reduced disposable income, increased labour costs and destroyed jobs [97]. The Institute for European Environmental Policy similarly concludes that although the revenues raised from the carbon tax do not allow a major reduction in labour taxes, they do help to prevent (further) increases in labour taxes [81].

Fuel substitution and interrelation to EU ETS

In a study about fuel substitution by companies due to price elasticities, the impact of a 15 EUR/t CO2 carbon tax on average energy-related CO2 emissions was simulated. The carbon tax results in a small reduction in CO2 emissions from oil and gas use, but this reduction is partially offset by an increase in emissions due to increased electricity consumption by some firms [99]. As the carbon tax is not applied to electricity, electricity becomes a relatively less expensive energy source and, therefore, part of the reduction in emissions due to contractions in oil and gas demand is offset by an increase in demand for and emissions from electricity. It is worth noting that the rise in electricity demand, and the associated rise in emissions, would be mitigated if the price of EU ETS permits were to increase as well. In fact, increasing the price of electricity could result in large reductions in industrial CO2 emissions due to a number of factors. Firstly, because electricity is an important fuel source for firms in the Irish manufacturing sector. Secondly, the high carbon intensity of grid-supplied electricity in Ireland means that it is significant source of energy-related CO2 emissions, And, finally, our estimated total elasticities show that electricity demand is highly sensitive to changes in its own price, and thus its demand would contract were its price to rise [99].

Fuel tourism

Ireland shares a land border with the United Kingdom, so if price differences are pronounced between the two jurisdictions, there will be fuel tourism, as vehicle-owners take advantage of the differential to fill up where the fuel is cheaper. For some years, the price differential has favored the Republic of Ireland, so there was considerable movement from Northern Ireland to take advantage of the cheaper petrol and diesel. It was estimated that in 2005 between 5 and 9% of petrol and up to 20% of diesel sold in Ireland was consumed in other jurisdictions (Northern Ireland and Britain). The carbon tax was expected to reduce the extent of fuel tourism linked to people travelling across the border between Ireland and Northern Ireland to avail of cheaper petrol in the Republic, as the tax would increase the price of fuel. The ESRI submission to the Commission on Taxation estimated a decline in fuel tourism would result in a reduction in the yield from excise duties of 26 mEUR. The imposition of the carbon tax at 20 EUR/t CO2 would generate 14 mEUR in revenue for the estimated number of non-residents continuing to buy fuel in the Republic of Ireland. The volume of fuel tourism has declined – fallen by 50% from the peak in 2007 as the differential between prices gets smaller (for example, petrol was approximately 35% cheaper in the Republic of Ireland in 2003, but only 14% cheaper in 2010), but it is clear that the carbon tax has not bridged the gap to the extent of eliminating it. This illustrates that there is scope for further carbon tax increase in the Republic of Ireland, but of course policy in the United Kingdom, and/or changes in the GBP to EUR exchange rate, could alter this [96].

The carbon tax also resulted in fuel tourism in solid fuels. There have been reports that people have been trading solid fuels from North Ireland to South Ireland where reduced rates of VAT on solid fuels in the north and carbon tax in the south result in a price differential. However, higher standards in the South means that coal imported from Northern Ireland may not be sold in the South and is subject to investigation and prosecution by Local Authorities and other agencies charged with enforcing the regulations (Conroy, 2016).

Conclusion

Effectiveness. The carbon tax is estimated to reduce GHG emissions by 0,3 Mt CO2-eq. per year, which is around 8% of ESD emissions in 2013. The impact of the PaM is still difficult to assess because it has been implemented sequentially and has until May 2014 undergone several changes either in scope or tax level. The price signal is effective as it affects all fossil fuels and is levied high in the supply chain, so it affect the price of energy intensive end-products. One element that reduced the effectiveness of the PaM is that currently oil and petrol prices are low, even with the additional carbon tax.

Relevance. The non-ETS sector in Ireland constitutes a significant part of total GHG emissions. This high share can in part be explained by high GHG emissions in the sector agriculture (32% of non-ETS emissions in 2013), a sector where emission reductions are difficult to achieve. This means that to meet the 20% Effort Sharing Decision emission reduction target of Ireland, significant reductions will have to be achieved in the sectors transport, waste, buildings and small industries. The carbon tax targets all these sectors and is thus as relevant as at the start of implementation, especially as Ireland is currently not projected to achieve the 2020 ESD target.

Efficiency. The PaM is efficient as the tax can be levied using existing systems. In total, the tax generated almost 400 mEUR in 2013. Although this revenue is not earmarked for specific purposes, it allowed the Irish government to implement or strengthen some additional measures to reduce GHG emissions, such as the Better Energy Homes Scheme.

Clean and efficient agrosectors (The Netherlands)

Description

Sector: Energy consumption, agriculture.

Objective: Reduction of fertilizer/manure use on cropland, improved livestock management, other energy consumption (efficiency improvement in the agricultural sector).

Policy instrument: Voluntary/negotiated agreements.

Description: The covenant clean and efficient agrosectors is a voluntary negotiated agreement between the Government and ten sector federations representing agriculture, livestock, horticulture, forestry and the agro-industry that was signed in 2008 [100]. The covenant is based on the Clean and Efficient working programme, which was published in 2007.

The overall objective of the covenant is to reduce CO2 emissions with at least 3,5 Mt per year relative to 1990 (and the ambition to achieve a 4,5 Mt CO2 emission reduction per year). For the other GHGs a reduction of 4 to 6 Mt CO2-eq, in 2020 compared to 1990 is put forward, Additionally, in the covenant the government and agrosectors agree to realise around 200 PJ of renewable energy from biomass (in the EEA PaM database this is formulated as 150 PJ of renewable energy) and a doubling of wind energy to 12 PJ in total. The agrosectors also agree to improve energy efficiency with an average of 2% per year over the period 2011-2020.

To achieve these overarching targets, different agreements were made between the government and the sector federations, These include:

- Agro-industry:
    - Improved energy efficiency by 2% annually for the agro industry and Nevedi,
- Horticulture:
    - a total mission reduction of at least 3,3 Mt CO2 per year compared with 1990 (of which 2,3 Mt will be achieved with CHP) and the ambition to achieve an annual emission reduction of 4,3 Mt CO2;
    - an average energy efficiency improvement of 2% per year;
    - an increase in the share of renewable energy from 4% in 2010 to 20% in 2020,
- Agriculture and livestock:
    - reducing energy-related emissions (gas, oil and electricity) with approximately 60% in 2020 compared with 1990;
    - the production of 63 PJ renewable energy in 2020;
    - a reduction of non-CO2 GHG emissions with 25 to 30% in 2020 (compared to 1990), corresponding with 4 to 6 Mt CO2-eq,

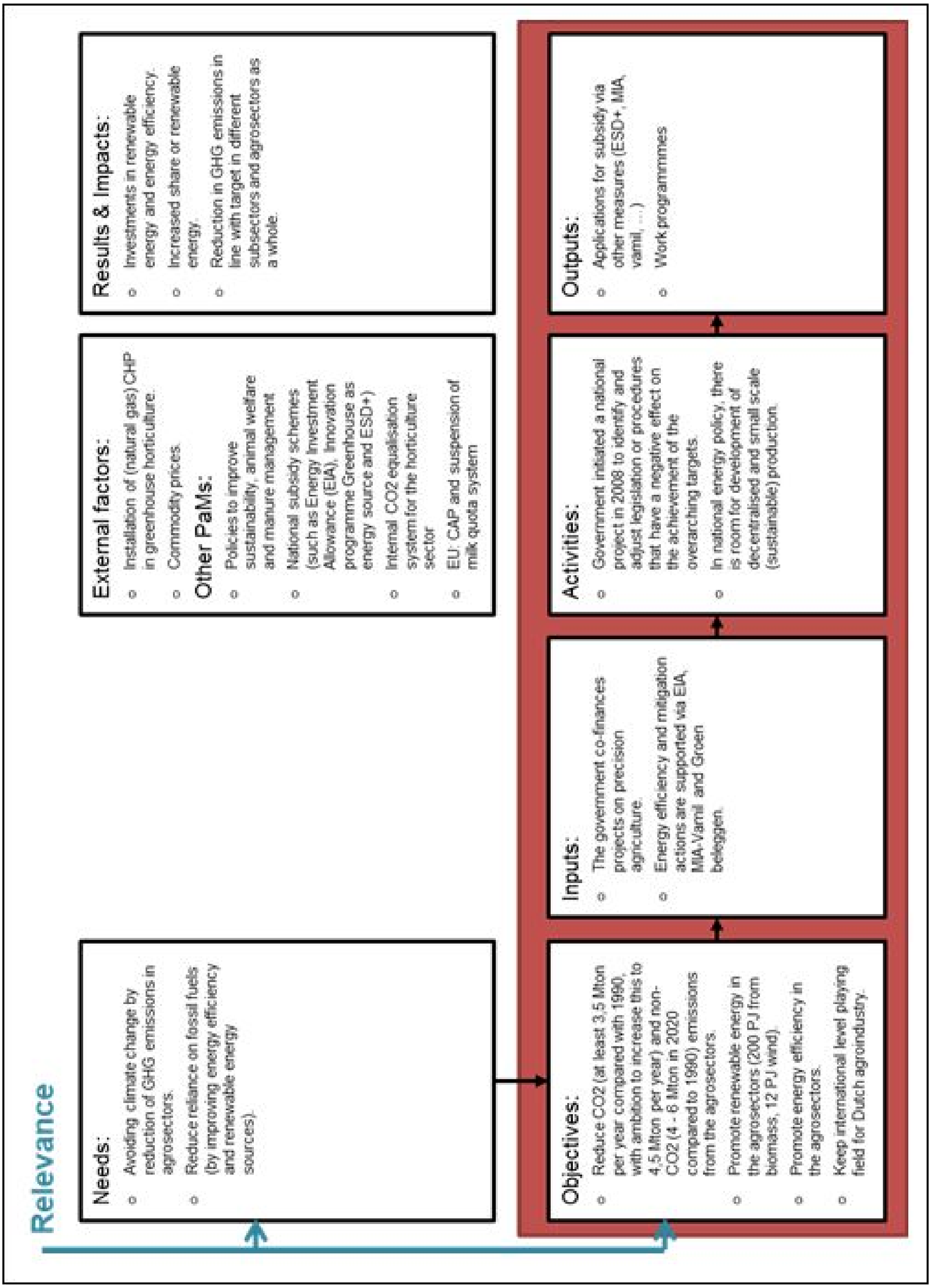
The targets are achieved via actions from government and the sector federations, which are outlined in the covenant and in annual work programmes, agreed between the government and the different sector federations that focus on specific actions that will be undertaking. So while targets are long term, the annual work programmes allow flexibility to select actions that are most appropriate in each agrosector.

Status: Implemented.

Start year: 2008.

End year: 2020.

Intervention logic



Evaluation criteria

~~Effectiveness~~ – ~~Efficiency~~ – Relevance – ~~Coherence~~

Evaluation

To what extent is reducing GHG emissions (for CO2 and non-CO2 GHGs) still relevant in the agrosectors?

To address this question it is important first to evaluate if there continues to be a need to reduce GHG emissions in the Netherlands. Following the latest Trends and Projections report, the Netherlands is on track to (over)achieve their GHG reduction target for ESD sectors. However concerning their renewable energy and energy efficiency target (both domains where the covenant is also contributing towards) the Netherlands is not on track. So actions that contribute towards achieving the 2020 targets continue to be relevant for the Netherlands and, based on projections, would need strengthening.

This specifically applies for the agrosectors in the Netherlands. The agroindustry in the Netherlands is very important, the Netherlands is the second largest exporter of agricultural products in the world and export continues to grow [101]. One of the objectives of the covenant is to implement measures that do not affect the competitiveness of Dutch agrosectors (pers. comm.).

In 2012 there were nearly 69 000 farms and horticultural enterprises in the Netherlands, Of these companies, 25 % relates to dairy farms and 17% relates to arable farms (Netherlands, 2013). With respect to GHG emissions, emissions from agriculture constitute 9,8% of total emissions in 2014 (excluding LULUCF; [85]), which is comparable to the EU average (10,2%), Energy consumption in the agriculture/forestry/fishing corresponds with 5,7% of all energy related emissions in the Netherlands, which is much higher than in most EU countries (in the EU as a whole this is only 2,2%). The amount of fuel consumed by the greenhouse horticultural sector is comparable to fuel consumption in the commercial and public service sector (taking cogeneration into account, Netherlands, 2013). In March 2015, the quota system for milk production came to an end and as a consequence (and in anticipation to this) the number of dairy cows has been slowly increasing since 2008 [102]. This is reflected in GHG emissions from enteric fermentation and manure management that start increasing from 2008.

So agriculture in the Netherlands, which focuses on cattle breeding, crop production and horticulture (of which greenhouse horticulture is the most important sub sector), was and still is an important source of GHG emissions and there continues to be a need for an appropriate instrument to improve energy efficiency, increase the share of renewable energy and reduce GHG emissions in these sectors.

Are the quantified objectives of the covenant still relevant?

The quantified objectives in the covenant are still considered relevant (pers. comm.), and the Dutch agrosectors are in general on track to achieve most of these targets [101]. Some of the targets have been or have almost been met in 2012 (e.g. CO2 and non-CO2 emission reduction), while for other there appears to be need for an increased effort.

Figure A1.18 Targets of the covenant and status in 2012,

Tabel 10. Doelen en resultaten Agroconvenant

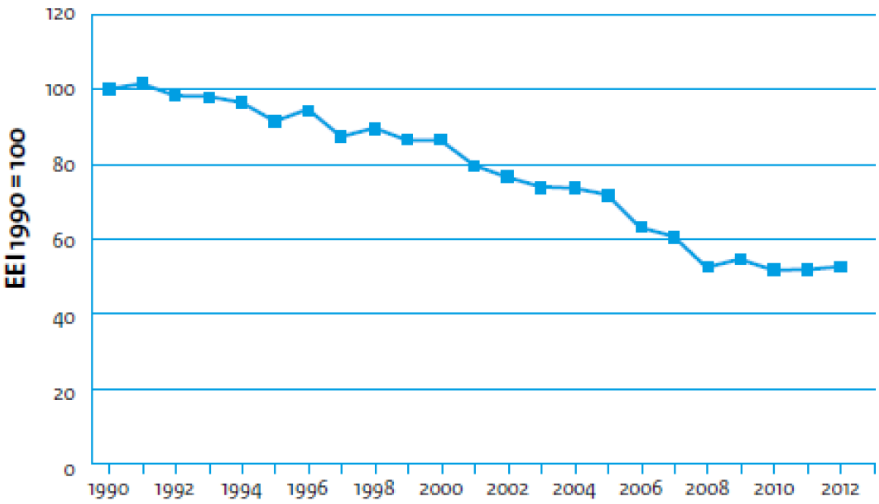
Onderwerp	Doel 2020	Stand van zaken in 2012
1. Energiebesparing 1990-2020		
Alle sectoren	>2% per jaar	2,9% per jaar efficiëntie gerealiseerd
ATV-sectoren*	60% (1990 – 2020)	Totale reductie niet bekend
2. Hernieuwbare energie, doel 2020		
Biomassalevering Agro-industrie	75–125 PJ	11,5 PJ
Biomassalevering Bos- en houtsector	32 PJ	27,4 PJ
Biogaslevering ATV-sectoren*	48 PJ	5,5 PJ
Productie Glastuinbouw	Ca. 25 PJ	1,2 PJ
Productie Pluimveesector	2 PJ	1,3 PJ
3. Windenergie		
Productie ATV-sectoren*	12 PJ	11,2 PJ
4. Broeikasgassen		
CO_2-reductie 1990-2020	Reductie 3,3 Mton	3,3 Mton gerealiseerd (1990-2012)
Glastuinbouw	Max. emissie is 6,2 Mton (2020)**	Huidige emissie is 7,2 Mton (1,2 Mton toename door WKK)
Overige broeikasgassen 1990-2020		
ATV-sectoren *	Reductie 4-6 Mton Max. emissie is dan 16,0 Mton**	5,6 Mton reductie gerealiseerd Huidige emissie is 16,9 Mton

** ATV = Akkerbouw, Tuinbouw open teelten en Veehouderij*

*** I&M, 2012*

Source: [101].

Figure A1.19 Energy efficiency improvements in the sector agriculture,



Source: [103] based on [101].

The covenant is an adaptive policy, where targets are set but the measures to achieve the targets are agreed upon and adjusted by government and the agrosector federations. This allows for flexibility in increasing actions if targets are not within reach with current effort.

To what extent will reducing GHG emissions (for CO2 and non-CO2 GHGs) continue to be relevant in the agrosectors?

Agriculture is considered to be one of the sectors where emission reductions are most difficult and costly to achieve, In their LCDS [104], the Netherlands aim to achieve a climate neutral society in 2050 which is translated in a 80% domestic emission reduction in 2050 [104]. Most of these emission reductions will be achieved in the sectors energy, industry and the built environment, while reductions in transport and agriculture will be harder to achieve. Actions to tackle CO2 emissions from energy consumption (mainly in horticulture) and non-CO2 emissions (CH_4 and N_2O) in livestock and open field agriculture will nevertheless be important to achieve the 2050 objectives.

In their LCDS, the Netherlands emphasise the importance of alternatives for heat production (heat pumps, geothermal energy, solar and residual heat) and demand reduction. To reduce methane emissions from dairy, improvements in productivity of cows will be important. The covenant puts the Netherlands already on track in this respect by emphasising on energy efficiency and renewable energy in horticulture and on emission reductions from dairy cows.

Conclusion

The objectives of the covenant clean and efficient agrosectors are still relevant. There is a continued need to reduce GHG emissions, to improve energy efficiency and to promote renewable energy to mitigate climate change and to increase energy security. Several of the quantified objectives of the covenant have already been met or are almost met. This could mean that further progress could be hampered if objectives are not tightened.

Reducing emissions from agriculture is particularly difficult and therefore there remains a need to reduce GHG emissions in this sector. This is reflected in the LCDS of the Netherlands that emphasised the role of CO2 emission from mainly horticulture and non-CO2 emissions from livestock and open field agriculture.

Cursos de conducción eficiente en el transporte por carretera (Spain)

Description

Sector: Transport.

Objective: Improved behavior.

Policy instrument: Education.

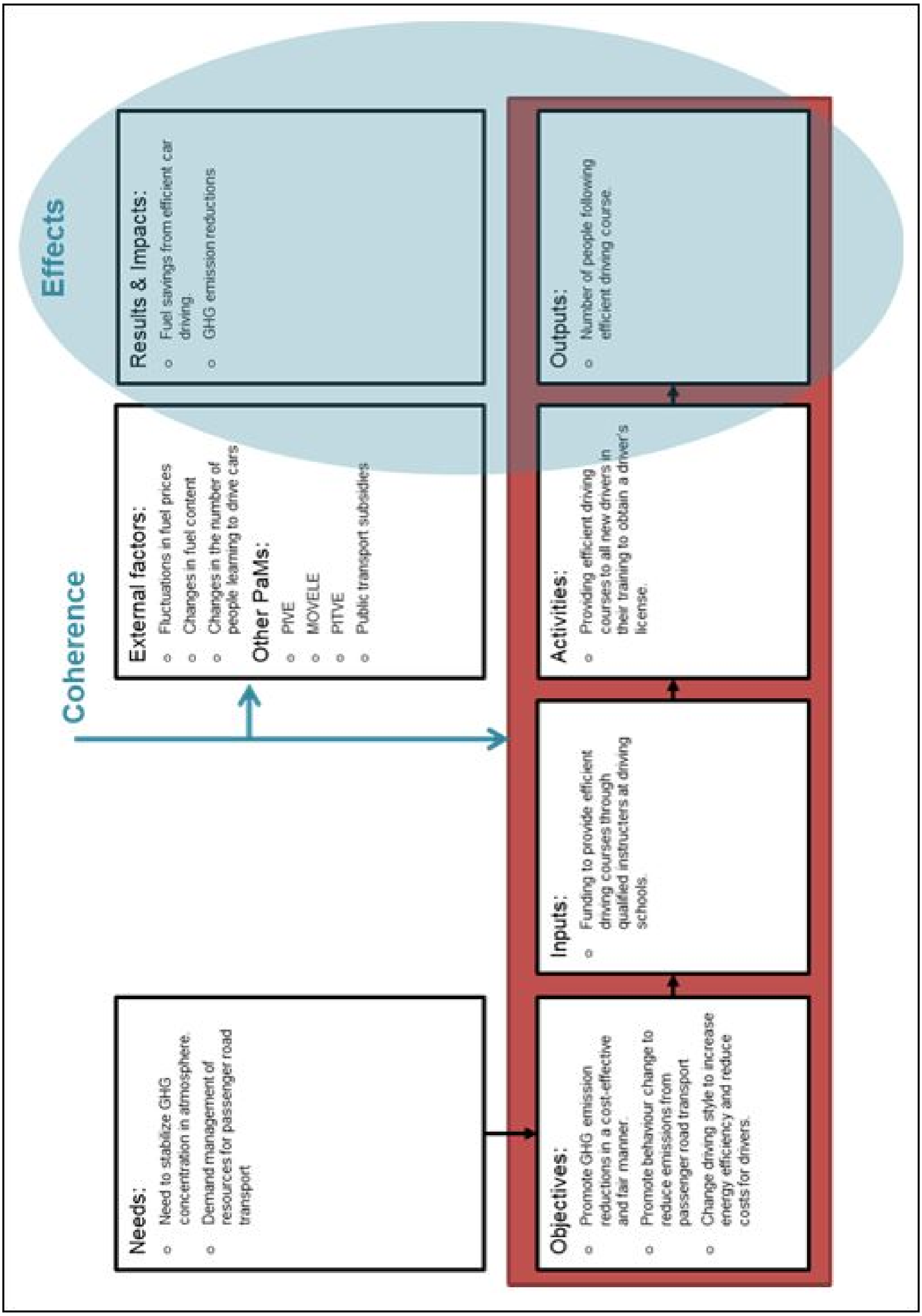
Description: As part of the training required to take a test for a driver's license, candidates receive fuel-efficient driving courses through the network of Spanish driving schools and training centres. Since 2014 this is mandatory training in order to obtain a driver's license. The training focuses on simple, practical, effective behavioural changes designed to reduce fuel consumption. The training courses are overseen by the Institute for the Energy Diversification and Saving (IDAE), and the Directorate-General for Traffic (DGT) is in charge of the implementation of the training.

Status: Adopted.

Start year: 2005.

End year: 2020.

Intervention logic



Evaluation criteria

Effectiveness – ~~Efficiency~~ – ~~Relevance~~ – Coherence

Evaluation

How effective is the PaM in reducing GHG emissions?

The eco-efficient driving courses are mandatory training in order to obtain a driver’s licence since 2014. With an average of 450 000 people obtaining a driver’s licence each year, it is estimated that the training will save 77 ktoe fuel consumption per year and 256 kt CO_2 per year [105].

Figure A1.20 Forecast energy savings 2014-2020 (ktoe) from transport policies (estimated data at the end of 2014)

	CO_2 emissions avoided (ktCO_2)						
	2014	2015	2016	2017	2018	2019	2020
OTHER PROGRAMMES DIRECTLY IMPLEMENTED BY IDAE	252.3	19.6	21.9				
MOVELE Project	3.5						
PIVE 3	10.1						
PIVE 4	48.8						
PIVE 5	145.6						
PAREER plan	10.9	10.9	21.9				
JESSICA fund	12.3	8.7					
MOVELE Balears pilot plan				n.a.			
Electric mobility pilot plan in Isla de la Palma (Canary Islands)				n.a.			
Communication campaigns	21.0						
OTHER PROGRAMMES AND MEASURES	318.6	255.5	255.5	255.5	255.5	255.5	255.5
PIMA Sol	37.2						
PIMA Aire	25.9						
Efficient driving permit	255.5	255.5	255.5	255.5	255.5	255.5	255.5
State incentive plan for rental housing, building renovation and urban regeneration and renovation				n.a.			
TOTAL	570.9	275.1	277.4	255.5	255.5	255.5	255.5

Source: [105].

Figure A1.21 Forecast CO2 emissions savings 2014-2020 (kt CO2) from transport policies (estimated data at the end of 2014)

	Final energy savings (ktoe)						
	2014	2015	2016	2017	2018	2019	2020
OTHER PROGRAMMES DIRECTLY IMPLEMENTED BY IDAE	84.0	3.9	3.7				
MOVELE Project	1.6						
PIVE 3	3.5						
PIVE 4	17.1						
PIVE 5	51.0						
PAREER plan	1.8	1.8	3.7				
JESSICA fund	2.9	2.0					
MOVELE Balears pilot plan	n.a.						
Electric mobility pilot plan in Isla de la Palma (Canary Islands)	n.a.						
Communication campaigns	6.0						
OTHER PROGRAMMES AND MEASURES	93.5	76.9	76.9	76.9	76.9	76.9	76.9
PIMA Sol	8.4						
PIMA Aire	8.2						
Efficient driving permit	76.9	76.9	76.9	76.9	76.9	76.9	76.9
State incentive plan for rental housing, building renovation and urban regeneration and renovation	n.a.						
TOTAL	177.5	80.8	80.6	76.9	76.9	76.9	76.9

Source: [105].

The training focuses on simple changes that can be implemented straight away, and are taught in a practical manner rather than using simulators. Once the behavioural changes to driving style have been established, the co-benefits of cost-effectiveness, reduced stress, and increased safety, are likely to maintain the new efficient driving (pers. comm.). The courses are tightly regulated by the Institute for the Energy Diversification and Saving (IDAE) and are routinely inspected to ensure proper implementation. The delivery of the courses have been effective enough to withstand low fuel prices; even with cheaper petrol, fuel constitutes 30-40% of an organisation's fleet costs, so fuel-efficient driving is still attractive as a measure to save money. Of course, this policy is only relevant for new drivers, not those who already have licenses, so the impact of this policy would depend on the turnover of new drivers.

- **To what extent is the eco-driving policy coherent with other transport management policies?**

  Spain has a three tier approach to energy saving and efficiency in the transport sector:

  - Promoting modal shifts to more environmentally friendly options such as active transport and public transport;
  - Increasing the energy efficiency of vehicles, replacing old vehicles and introducing new technologies;
  - Encouraging behavioural changes to increase energy efficient use of transport such as eco-driving and carpooling.

  The efficient driving courses deliver on the third tier of policies. A major recent transport policy in Spain has focused on replacing inefficient old vehicles through the Efficient-Vehicle Incentive Programme (PIVE) which offers subsidies for scrappage of old and inefficient fleet stock. This is likely to slightly reduce the savings generated from efficient driving, but will not remove their effect [106]. The same can be concluded from interactions with the MOVELE programme which offers incentives for electric and alternative-fuelled vehicles. Only modest uptake is predicted so this will not detract from the efficient driving savings substantially.

In recent years, the efficient driving courses are also taught to bus and truck drivers (those with more than 9 passengers, and vehicles over 3 500kg, respectively), with an estimated 85 000 professional drivers trained so far [106].

Close collaboration between the various competent authorities has ensured few overlaps between current transport policies, and a consistent approach in policy communications.

Conclusion

There is no ex-post data on fuel consumption and CO_2 savings generated from the efficient driving courses policy, but there are signs that it is effective in achieving its aims. It is a simple programme, with few barriers to uptake such as high fees, and has a sensible delivery framework through driving schools. In IDAE's forecasts of energy and CO_2 savings, it is one of the policies with the largest impact. The eco-driving policy is sufficiently coherent with other transport management policies that it is still effective; larger policies such as PIVE may generate greater CO_2 savings, but the eco-driving training can be applied in all road vehicles, and still brings benefits for new, cleaner cars.

Energy Company Obligation & Domestic Green Deal (United Kingdom)

Description

Sector: Energy consumption.

Objective: Efficiency improvements of buildings.

Policy instrument: Regulatory, economic.

Description: The Green Deal programme helps householders make energy-saving improvements to their home and find the best way to pay for them. One way of paying for the upfront costs of the improvements is with Green Deal finance where repayments are made through expected savings on energy bills, though Green Deal finance is just one of the options to pay for the improvements. Other options include the Green Deal Home Improvement Fund which has allowed households, including those on low incomes, to more affordably make energy efficiency improvements, whilst the Green Deal Communities scheme is helping Local Authorities deliver Green Deal energy efficiency measures on a street-by-street basis.

The Energy Company Obligation (ECO) is a statutory obligation on energy suppliers to make reductions in their carbon emissions. It requires large energy suppliers with more than 250,000 customers to deliver energy efficiency measures in order to help the Government achieve desired outcomes. The ECO Programme is delivering domestic energy efficiency measures, such as insulation and heating improvements, to households in fuel poverty or in areas of low income, or homes which are particularly hard to treat with regards to insulation.

The ECO places three obligations on energy suppliers:

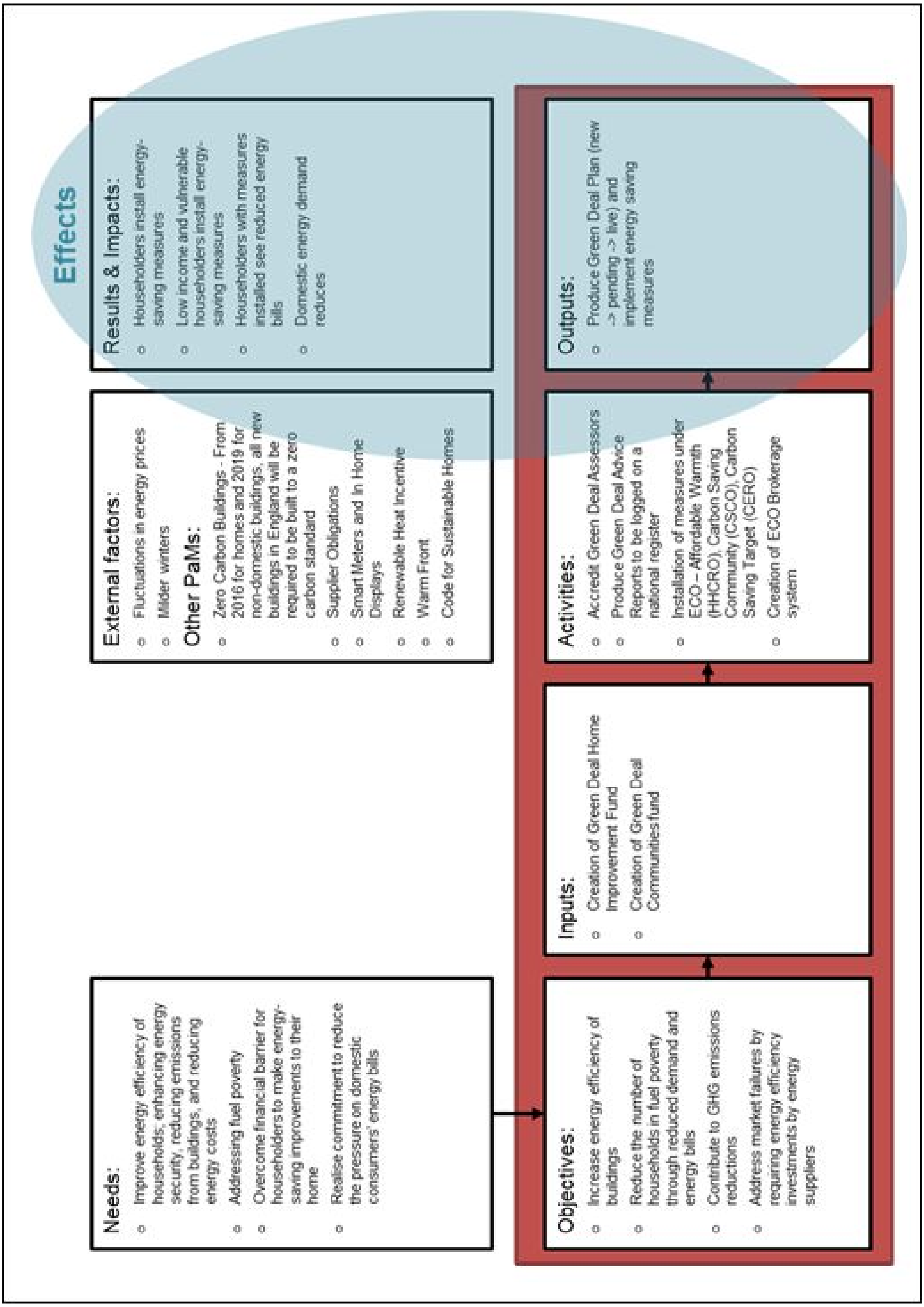
- Carbon Emissions Reduction Obligation (CERO): to deliver total carbon savings of 20,9 Mt CO_2 through the installation of measures like solid wall and hard-to-treat cavity wall insulation.
- Carbon Saving Community Obligation (CSCO): to deliver total carbon savings of 6,8 Mt CO_2 through the installation of insulation measures in specified areas of low income. CSCO contained a “sub-obligation” which required suppliers to deliver a minimum of 15% of this target to low income households in rural areas.
- Home Heating Cost Reduction Obligation (HHCRO, also known as Affordable Warmth): to deliver 4,2 bn GBP savings on energy bills for low income households and households in receipt of particular means-tested benefits.

Status: Implemented.

Start year: 2013.

End year: Not known.

Intervention logic



Evaluation criteria

Effectiveness – ~~Efficiency~~ – ~~Relevance~~ – ~~Coherence~~

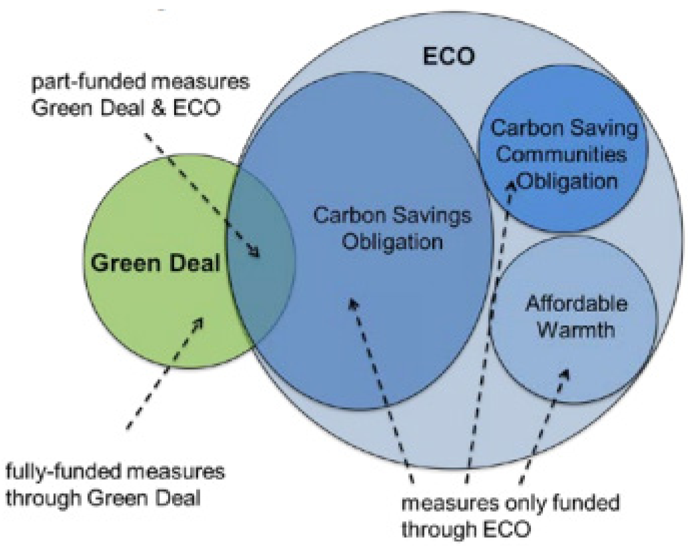
Evaluation

Have the Green Deal and ECO met their objectives?

The Green Deal and the Energy Company Obligation (ECO) aim to reduce GHG emissions and address fuel poverty by delivering energy efficiency measures to residential housing.

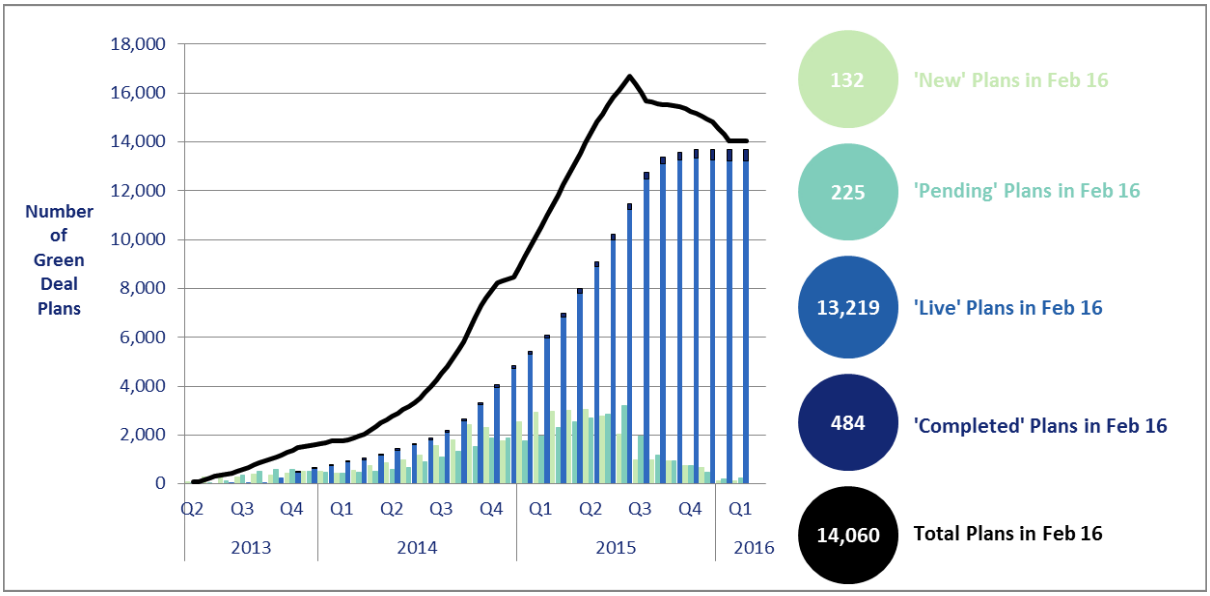
- The Green Deal lets householders pay for the cost of energy-saving improvements through savings on their energy bills, over time.
- ECO was created for extra financial assistance for domestic energy efficiency measures, with a specific focus on measures which are more expensive, and supporting low income households.

Figure A1.22 Interactions between Green Deal and ECO



No objectives were set for the Green Deal due to the novel nature of the scheme, so it is not possible to assess the policy's success against pre-determined targets. A total of 639 965 Green Deal assessments had been performed up to the end of February 2016, with 14 060 total Green Deal Plans, as shown in Figure A1.20. Using Green Deal finance, 20 566 measures were installed. Boiler replacements were the most common (31%), followed by micro-generation (29%) and solid wall insulation (15%).

Figure A1.23 Number of Green Deal Plans by type.



ECO set three obligations for energy companies, which have been met during the first phase from January 2013 to March 2015. These obligations were:

- Carbon Emissions Reductions Obligation (CERO) – initially focused on hard-to-treat properties and measures such as solid wall insulation, all insulation measures are now eligible, including district heating systems. Target of 14 Mt CO_2 lifetime savings (in 2014 this was revised down from the original target of 20,9 Mt CO_2, as part of efforts to reduce the impact of environmental programmes on consumer energy bills (DECC, 2014)).
- Carbon Saving Community Obligation (CSCO) – insulation measures and connections to district heating systems to households in rural and low income areas. Target of 6,8 Mt CO_2 lifetime savings.
- Home Heating Cost Reduction Obligation (HHCRO) – also known as Affordable Warmth, promoting measures which improve the ability of low income households to heat their homes – mostly insulation and heating measures such as replacement boilers. Target of 4,2 bnGBP lifetime notional fuel bill savings.

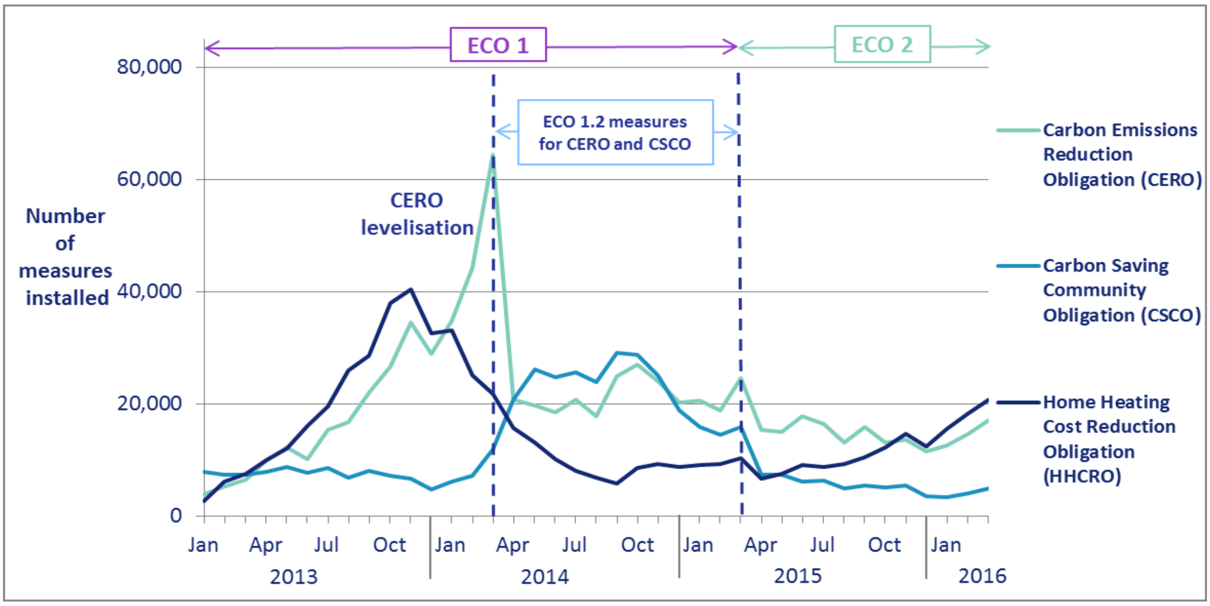
According to Ofgem [107] at the end of ECO phase 1, the lifetime carbon savings achieved were 18,33 Mt CO_2 under CERO (131% of target) and 9,87 Mt CO_2 under CSCO (145% of target). The lifetime bill savings achieved under HHCRO were 5,16 bnGBP (123% of target). Therefore for the first phase, ECO met its objectives. A second phase is currently in place, running from April 2015 to March 2017.

DECC [108] report up to the end of March 2016 a total of 1 794 144 ECO measures had been delivered:

- CERO – 768 621
- CSCO – 446 452
- HHCRO – 579 071

Of all ECO measures installed, 37% were for cavity wall insulation, 25% for loft insulation, 22% for boiler upgrades, and 7% for solid wall insulations. Figure A1.21 presents the measures installed by obligation under ECO. The 524 665 Affordable Warmth ECO measures installed up to the end of December 2015 are estimated to deliver 6,21 bnGBP worth of lifetime bill savings.

Figure A1.24 Number of measures installed under ECO by obligation (up to the end of March 2016).



To what extent have the Green Deal and ECO been effective at delivering energy-saving improvements and GHG reductions?

ECO has delivered millions of energy-saving improvements in homes, and met its objectives. The NAO [109] report estimated that measures installed under ECO up to the end of 2015 generated 24 Mt CO_2 (97 000 MWh) lifetime savings.

However, the CO_2 savings under ECO are approximately 29% of previous schemes (Carbon Emissions Reduction Target, and Community Energy Saving Programme), and delivered on an average of 94 GBP/t of carbon saved, compared to 34 GBP/t of carbon on the predecessor schemes'. This is mainly due to the focus on harder-to-treat homes, which are more expensive to install improvements in. As such, the carbon saving obligations were set lower than before in attempts to keep the costs down.

The uptake of measures under the Green Deal has been significantly lower than expected, with measures financed using Green Deal loans expected to save 0,4 Mt CO_2 (1 000 MWh) lifetime savings. The NAO [109] report suggested that the CO_2 savings under Green Deal might have been achieved anyway without Green Deal finance, under ECO, Home Improvement Fund, or Feed-in-Tariffs. The expected savings have been revised down 80% from original estimates.

Low uptake under the Green Deal seems to be due to several issues [110]:

- The scheme was too complex for households and for the installation industry, which may have been fixed in old business models;
- The scheme was too expensive, and had high interest rates associated with loans;
- Poor communication campaigns to the public;

- Failure to appreciate behavioural barriers to the uptake of energy efficiency measures.

The Green Deal and ECO did not work as synergistically as planned, and according to Rosenow and Eyre [111] and NAO [109] instead often competed with each other, adding to the complexity of the framework. The conversion rate from householders having a Green Deal assessment to having a Green Deal Plan being implemented was approximately 2%. The relatively sudden changes in policy details, such as the revisions of ECO's targets and eligible areas one year into the scheme, are likely to have further disrupted implementation.

Conclusion

It is difficult to draw an overall conclusion on the effectiveness of the Green Deal and ECO as a single policy. Whilst ECO met its objectives in the first phase, and delivered millions of building efficiency improvements, it is clear that it has not been as effective as previous energy efficiency policies. The Green Deal is considered to have been less effective than ECO, even without targets to assess it against. The uptake of measures under the Green Deal, and the lifetime energy consumption and CO_2 savings have been significantly lower than forecast at the onset of the policy. The two policies have not worked together very effectively, and the changing policy details, along with the complexity of the schemes and insufficient communication, have hindered the effectiveness of the Green Deal and ECO.

Annex 2: Eionet workshop: 'Evaluation and reporting of climate mitigation policies and measures'

Date: 6-7 September 2016

Venue: EEA, Copenhagen

Link: http://forum.eionet.europa.eu/eionet-air-climate/library/meetings/reporting-and-evaluation-climate-mitigation-policies-and-measures/presentations_pam-workshop/day1-ex-post-evaluation-climate-mitigation-policies-and-measures

Agenda:

6 September 2016

- Welcome and setting the scene –Paul McAleavey (Head of Air and Climate Change Programme, EEA)
- Policy evaluation at the European Commission and importance of ex-post evaluation at national level – Artur Runge-Metzger (Director, DG CLIMA)

Databases on climate change mitigation policy

- A review of databases on climate change mitigation policy (CARISMA project) - Stefan Bößner (Stockholm Environment Institute)
- Benchmark of the EEA's database on climate mitigation policies and measures (EEA project) – Tom Dauwe (ETC/ACM)
- Discussion
- Contribution of the information reported under the MMR to the evaluation of national PaMs – Justin Goodwin (ETC/ACM)

Policy evaluation in practice: experiences from Member States

- Experience from France: Policy evaluation in practice - Isabelle Cabanne and Marjorie Doudnikoff (Ministry of Environment, Energy and Sea)
- Experience from the Netherlands: Evaluation of policies in the built environment sector - Harry Vreuls (RVO)
- Experience from Finland: Ex-post evaluation of energy policies and measures - Ulla Suomi (Motiva Oy)

Various aspects of policy evaluation: multilevel governance, cost-benefits, time perspectives

- Experiences with evaluation of Covenant of Mayors - Edoardo Croci (Bocconi University)
- Experience with the evaluation of regional vs national policies in Belgium - Marco Orsini (ICEDD)
- Evaluation of energy efficiency measures in the Odyssee/Mure project: from databases to policy evaluations – Barbara Schlomann (Fraunhofer Institute for Systems and Innovation Research)
- Assessing the costs of climate change and local air pollution - Nils Axel Braathen (OECD)
- The need for and use of assessments and evaluations in national climate policy development in Finland - Mikael Hilden (Finnish Environment Institute (SYKE))
- Now for the long term: evaluating climate policies from Paris to 2050 –Jonas Schoenefeld (Tyndall Centre for Climate Change Research)
- Wrap-up – EEA

7 September 2016

- Introduction and setting the scene: Reporting on policies and measures now and in the future – Jürgen Salay (EC, DG CLIMA)
- Overview of the information on PaMs reported in 2015 – Magdalena Jóźwicka (EEA)
- Results of the QA/QC of the reported information on PaMs in 2015 and 2016 – Tom Dauwe (ETC/ACM)
- Reporting on National Systems for PaMs and projections – Tom Dauwe (ETC/ACM)

Reporting of policies and measures: experiences from Member States

- In this session, Member States presented their own experience for reporting on PaMs under the MMR: national system, information source, links with other reporting, etc.
    - Czech Republic - Rostislav Nevečeřal (Czech Hydrometeorological Institute)
    - Germany - Mark Nowakowski (German Federal Environment Agency)
    - Croatia – Tatjana Obučina (Croatian Agency for the Environment and Nature)
    - Ireland – Brian Quirke (Irish Environmental Protection Agency)
- **Guidelines** for reporting on policies and measures and use of Reportnet tools – Elisabeth Kampel (ETC/ACM)
    - Online workflow
    - Web reporting tool
    - Quality assurance procedure
- **Break-out groups**
- Discussion on specific reporting issues and areas of improvements for reporting on PaMs under the MMR, in particular on definitions (policy, measure, groups of policies), transparency, completeness, provision of quantitative information, in particular on effects of PaMs.
- Feedback from break-out groups (plenary)
- Wrap-up – EEA

Scope:

The EEA organised a two-day technical EIONET workshop, aimed at exchanging knowledge and experience concerning the evaluation (in particular ex-post) of climate mitigation policies and measures (PaMs) at national level and the reporting of information on policies and measures under the Monitoring Mechanism Regulation.

The target audience of the workshop constituted of EEA primary contact points for air pollution and climate change mitigation, experts involved in reporting on PaMs under the MMR and relevant experts working in the field of climate policy evaluation.

During the **first day** of the workshop participants shared experiences on national practices concerning ex-post evaluation of climate policies and measures at national level, with the aim to identify gaps to evaluate policies (e.g. data, information, methods, resources, etc.) and improve the relevance and use of the information reported under the MMR to better support policy making.

The EEA highlighted the principal objectives as to how the reporting on climate policies and measures could be improved. The Commission emphasised the importance of policy evaluation. Climate policy is still a relatively young policy field, nevertheless we are at a stage where more emphasis on policy evaluation is needed. Considering that climate policy is expected to be beneficial on multiple levels (e.g. green jobs, circular economy, etc.), climate policy evaluation will have to cover this.

The first day focused on how climate policy databases could contribute to policy evaluation (presentations from the ETC/ACM, SEI and Fraunhofer), national experiences with policy evaluation in France, the Netherlands and Finland and presentations dedicated to policy evaluation of local climate action (Bocconi University and ICEDD) cost benefit analysis in policy evaluation (OECD) and the need and importance of policy evaluation in short and long term (SYKE and Tyndall Centre for Climate Change Research).

The **second day** national experiences on reporting on PaMs under the MMR were shared, and technical aspects discussed related to reporting (e.g. workflow, web tool, quality checks) and concrete actions were identified which would contribute to improve the quality and relevance of the information reported (e.g. transparency, completeness, comparability), in particular to further support evaluation activities.

The Commission highlighted pending studies at the Commission on ex post evaluation of the policies and the streamlining op reporting into Integrated National Energy and Climate Plans under the Energy Union. For PaMs it is foreseen that this includes a description of policies and measures for meeting the targets and objectives for **each dimension of the Energy Union**. The Commission emphasised that a stepwise approach is needed, starting with better understanding of existing data and strengthen information sharing between experts and users in Member States. One forum for this could be case studies, workshops, case studies, other fora and working group 2 under the Climate Change Committee.

The EEA and ETC/ACM presented the results and the outcome of the QA/QC of the information reported by the Member States in 2015. In both presentations it was shown that the information from the PaM database could be a very useful information source for policy makers, stakeholders and experts. However, there are still data issues and there is a need to further improve reporting.

Four Member States presented their experiences in PaM reporting. Croatia, Ireland and the Czech Republic presented their respective National System for reporting on PaMs. Suggestions were also given for EEA and the Commission to help countries in reporting. One is the importance of guidance on assessing impacts and costs of PaMs. For costs this includes for instance the boundary of the cost assessment. An exchange among Member States in approaches for evaluating specific PaMs could be an additional step. Some countries highlighted that direct import of data and automatic checks in the questionnaire could be helpful. Germany also stressed the difficulty in both impact and cost assessment without some guidance defining the boundary and/or the counterfactual scenario, but it remains political sensitive and difficult to do.

The ETC/ACM presented the draft guidelines for reporting policies and measures.

In the final break-out sessions, groups discussed short-, medium- and long-term actions Member States and the EEA could take to improve reporting.

- Many people stressed the importance of **guidelines** and sharing of experiences in policy evaluation. There are already several guidelines available and a link to these will be made available in the reporting guidelines. Further capacity building remains however necessary which could be facilitated via dedicated and expert workshops.

- In medium term, Member States should be able to upload and download information from the questionnaire. EEA already developed an exportation tool to download the information in the template for the Biennial Report for the UNFCCC.