Transformation of a policy instrument for energy renovation of housing

Real case application on the French tax credit for energy transition

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Territorial Collectivities
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I certify that this report is the result of personal work, that it quotes in quotation marks and references all the sources used and that it does not contain passages that have already been used in full in a similar work.
Abstract

The fight against climate change and the reduction of energy precarity are two major challenges of the energy policy of any country. Energy management in the building sector, particularly in the housing sector, is therefore crucial, and the energy renovation of housing makes it possible to reconcile these challenges by reducing households energy expenditure and greenhouse gas emissions in the residential sector.

By focusing on the tax credit for energy transition, a French flagship financial policy instrument for the renovation of private housing in France but criticised for its inefficiency and anti-distributive nature, we show that a major reform of this policy instrument can lead to achieve these energy and social objectives. The new method of calculating public subsidies for energy renovation proposed in this report represents a major step forward compared to the current situation in France, by creating a tailor-made instrument adapted to the financial situation of households and reflecting the energy performance of the renovation works.

We show that it is therefore possible to have an ambitious climate strategy while making a policy aimed at modest households and enhancing the efficiency of public expenditure.

Sammanfattning

Kampen mot klimatförändringarna och minskningen av energiprioriteten är två stora utmaningar i energipolitiken i alla länder. Energihantering inom byggsektorn, särskilt i bostadssektorn, är därför avgörande, och energirenoveringen av bostäder gör det möjligt att förena dessa utmaningar genom att minska hushållens energiförbrukning och växthusgasutsläpp i bostadssektorn.

Genom att fokusera på skattekredit för energiövergång, ett franska flaggskepps finanspolitiska instrument för renovering av privata bostäder i Frankrike men kritiserat för dess ineffektivitet och anti-distribuerande karaktär, visar vi att en större reform av detta politiska instrument kan leda till att uppnå dessa energi och sociala mål. Den nya metoden för att beräkna offentliga subventioner för renovering av energi som föreslås i denna rapport representerar ett stort steg framåt jämfört med den nuvarande situationen i Frankrike, genom att skapa ett skräddarsytt instrument anpassat till hushållens ekonomiska situation och återspeglar renoveringsarbetets energiprestanda.

Vi visar att det därför är möjligt att ha en ambitiös klimatstrategi samtidigt som vi gör en politik riktad mot blygsamma hushåll och effektiviserar de offentliga utgifterna.
Acknowledgements

After several months of work, this master thesis allowed me to confront myself with an enriching experience, both technical and collaborative. By performing my thesis via a real mission for the French ministries, I was thus able to discover a unique environment, the one of the central administration and public policies in favour of the energy renovation of housing in particular, which will be rewarding during my future assignments as a French civil engineer.

I would therefore like to thank the French Directorate of Housing, Urbanism and Landscapes, in particular the Sub-Directorate of Financing and Economics of Housing and Urban Planning, which hosted my thesis and represented by Mrs Cécilia Berthaud.

I would like to thank in particular my colleagues in the office, represented by Mrs Valentine Verzat and Mrs Thuriane Mahé, for their invaluable help and assistance throughout the implementation of this thesis, and without whom my work would not have seen the light of day.

I would also like to express my gratitude to the offices of the other departments of the Ministry, within the Directorate of Housing, Urbanism and Landscapes and also the Directorate General for Energy and Climate, for their close collaboration on the various aspects of this reform, and to the National Housing Agency for its contribution to the implementation of the future mechanism at the heart of this report.

Finally, I would like to thank my academic supervisor at KTH during this master thesis, Mrs Semida Silveira, for her enlightened support in evaluating public policies, which enabled me to carry out original work, as well as the administrations of the École nationale des ponts et chaussées and the AgroParisTech school for the training provided this year.
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## Nomenclature

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<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>ADEME</td>
<td>Environment and energy agency (Agence de l’environnement et de la maîtrise de l’énergie)</td>
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<tr>
<td>ANAH</td>
<td>National Housing Agency (Agence nationale de l’habitat)</td>
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<td>ASP</td>
<td>Agency for services and payment (Agence de services et de paiement)</td>
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<td>BOFiP</td>
<td>Official bulletin of the public finances (Bulletin officiel des finances publiques)</td>
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<td>CEE</td>
<td>White certificates, or energy efficiency certificates (Certificats d’économie d’énergie)</td>
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<tr>
<td>CGEDD</td>
<td>General council for environment and sustainable development (Conseil général pour l’environnement et le développement durable)</td>
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<tr>
<td>CITE</td>
<td>Tax credit for energy transition (Crédit d’impôt pour la transition énergétique)</td>
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<tr>
<td>CNH</td>
<td>National council for housing (Conseil national de l’habitat)</td>
</tr>
<tr>
<td>CSCEE</td>
<td>Superior council for building and energy efficiency (Conseil supérieur de la construction et de l’efficacité énergétique)</td>
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<tr>
<td>CSTB</td>
<td>Scientific and technical centre for building (Centre scientifique et technique du bâtiment)</td>
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<tr>
<td>DGEC</td>
<td>Directorate general for energy and climate (Direction générale de l’énergie et du climat)</td>
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<tr>
<td>DGFiP</td>
<td>Directorate general of public finances (Direction générale des finances publiques)</td>
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<tr>
<td>DHUP</td>
<td>Directorate for housing, urbanism and landscape (Direction de l’habitat, de l’urbanisme et des paysages)</td>
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<tr>
<td>DPE</td>
<td>Energy performance diagnosis (Diagnostic de performance énergétique)</td>
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<tr>
<td>Éco-PTZ</td>
<td>Zero-rate eco-loan (Éco-prêt à taux zéro)</td>
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<tr>
<td>EEH</td>
<td>Energy Efficient Homes, consuming less than 50kWh/m²/year of primary energy. This value can change according to the region and the altitude to which the dwelling is located.</td>
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<tr>
<td>ETP</td>
<td>Full-time equivalent (Équivalent temps plein)</td>
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<tr>
<td>HM</td>
<td>Program ”Living Better” of the National Housing Agency (”Habiter Mieux”)</td>
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<tr>
<td>IGF</td>
<td>General inspection of finances (Inspection générale des finances)</td>
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<tr>
<td>INSEE</td>
<td>National Institute of Statistics and Economic Studies (Institut national de la statistique et des études économiques)</td>
</tr>
<tr>
<td>MACP</td>
<td>Ministry of Public Action and Budget (Ministère de l’Action et des Comptes publics)</td>
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<tr>
<td>MCTRCT</td>
<td>Ministry of Territorial Cohesion and Relation with Territorial Collectivities (Ministère de la Cohésion des territoires et des Relations avec les collectivités territoriales)</td>
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<tr>
<td>MEF</td>
<td>Ministry of Economy and Finances (Ministère de l’Économie et des Finances)</td>
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<tr>
<td>MO</td>
<td>Modest households (Ménages modestes)</td>
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<td>Acronym</td>
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<tr>
<td>MTES</td>
<td>Ministry of Ecology (<em>Ministère de la Transition écologique et solidaire</em>)</td>
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<tr>
<td>MENFIS</td>
<td>Energy-Fiscality Model, developed by the ADEME (<em>Modèle Énergie-Fiscalité</em>)</td>
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<tr>
<td>PREB</td>
<td>Plan for the energy renovation of buildings (<em>Plan de rénovation énergétique des bâtiments</em>)</td>
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<tr>
<td>RT</td>
<td>Thermal regulation (<em>Réglementation thermique</em>)</td>
</tr>
<tr>
<td>SDES</td>
<td>Service for data and statistical studies of the Ministry of Ecology (<em>Service de la donnée et des études statistiques</em>)</td>
</tr>
<tr>
<td>SNBC</td>
<td>National low carbon strategy (<em>Stratégie nationale bas cabone</em>)</td>
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<tr>
<td>TMO</td>
<td>Very modest households (<em>Ménages très modestes</em>)</td>
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1 Context of and objectives of the thesis

Everyone wants to save the planet. Ecology is at the heart of every major challenge and every political debate, and will be the cornerstone of every action undertaken by the generation to come. That being said, what do we keep focusing on? Wind and solar power, check. Electric vehicles, check. Reducing and recycling plastic waste, check. Eating less meat, check. But what about buildings, and the energy they need to function and for us to live comfortably? What about the energy performance and renovation of the building stock? Buildings are everywhere, indispensable, yet rarely the flagship topic when it comes to reducing and decarbonising our energy consumption.

This degree project aims to highlight the necessity of focusing on energy renovation of buildings, by exploring in particular the redesign of a specific policy instrument whose goal is to trigger those renovations. Before going into the heart of this policy design, one must make a short review of the current situation, the legal framework and set the course that will guide this project.

1.1 Energy consumption in housing: a lever to address the climate change issue?

In the European Union, which is where the most reliable data are available on that subject as the energy policy in Europe is becoming stronger and stronger, buildings represent the largest share of energy consumption of the continent.

In the European Commission documentation, based on the collected information from all the Member States, we can find that: [1]

- Buildings represent around 40% of the total energy consumption in the EU
- Buildings account for 36% of CO₂ emissions in the EU
- Nearly 75% of the building stock can be considered as "energy inefficient"
- Around 35% of the buildings in the EU are over 50 years old, when no thermal regulations existed
- Only 0.4 to 1.2% of the building stock is renovated or rebuilt each year, this proportion varying depending on the country.

As a whole, according to the European Commission, energy renovation of existing buildings could help decreasing the total energy consumption of the EU by 5-6% and lower the greenhouse gases emissions by the same proportion. Whether we agree with those estimations or not, focusing on buildings is in every instance one of the main levers available that could help fighting against climate change at the national and European level and playing a key role in energy transition.

Additional benefits of renovations of buildings

Apart from energy consumption and greenhouse gases emissions reduction, strengthening renovations of buildings can lead to other co-benefits, in social, environmental or economic terms. It contributes to the global construction economy (9% or EU’s gross domestic product according to the EU Commission) especially for small companies and craftsmen, improve indoor
climate with benefits on health, or decrease households spending in energy, helping to fight energy precarity – which we will focus about later in the thesis.

1.2 Background: the incentives towards energy renovation of housing in Europe

The objective of this part is not to make an exhaustive review of the situation (energy consumption of the building stock, associated greenhouse gases emissions or life-cycle analysis of buildings) nor of the policies that are implemented all over Europe, but rather to give the reader some hints about what is currently undertaken on that subject in Europe.

1.2.1 Legal frameworks and directives

Two main directives were established in the EU to intensify and put a frame around energy renovation of buildings across all Member States:


The Clean energy for all Europeans package recently amended those directives (in 2018 – 2019), to make them more in line with the new objectives of the EU energy policy: "achieve a highly energy efficient and decarbonised building stock by 2050, create a stable environment for investment decision, and enable consumers and businesses to make more informed choices to save energy and money" [1].

The energy policy in the EU being subsidiary, those directives have then to be transposed in national laws and regulations (1 to 2 years after), each Member State being free to develop its own policies and policy instruments according to this general legislative framework set at a European level.

We are not going to develop the details of those directives, as it is not the objective of this study, but directly go into the subject of the policy instruments that result from them.

1.2.2 Policy instruments implemented in different countries

As stated before, each Member State has to transpose into its national legislative framework the measures and objectives set at the European level. The first two paragraphs of article 10 of the EU Energy Performance of Buildings Directive state the following: [2]

1. In view of the importance of providing appropriate financing and other instruments to catalyse the energy performance of buildings and the transition to nearly zero-energy buildings, Member States shall take appropriate steps to consider the most relevant such instruments in the light of national circumstances.

2. Member States shall draw up […] a list of existing and, if appropriate, proposed measures and instruments including those of a financial nature, other than those required by this Directive, which promote the objectives of this Directive. […] Member States shall update this list every three years.

This leads to a great variety of instruments and measures implemented, some countries being at the cutting edge of incentives towards energy efficiency whereas others struggle to develop a comprehensive energy policy for buildings.
The Odysee-Mure Project [4], co-funded by the Horizon 2020 program of the EU and coordinated by the French Environment and energy agency (ADEME) with support from Enerdata and the Fraunhofer ISI, collects data and proceeds to a comprehensive monitoring of energy efficiency trends and policy evaluation in EU countries.

Without going into details of policies by country, two Policy Briefs published by the Odysee-Mure Project in 2017 and 2018 perform a short review of policies towards energy efficiency in buildings ([5] and [6]).

![Figure 1: Quantity of policy instruments for renovation of buildings across the EU Member States in 2016. Source: Odysee-Mure Project, based on data from the Joint Research Centre of the EU Commission, 2016 [5].](image)

Those analysis mainly show that regulatory and financial instruments are the most used all over Europe (between half and the totality of the implemented measures), even though there exist a huge discrepancy between countries: Austria, Hungary, France, Ireland and the UK show all more than 20 different measures for energy renovation. On the contrary, the majority of countries stands between only 5 and 15 measures, and each time with regulatory and financial incentives as a core basis of the energy policy for buildings.

### 1.2.3 What is a renovation?

Before going into the content of the thesis (which is one specific policy design), one must ask the question of what we call a "renovation". No one has given a clear definition, even at Ministry level in France, where the application of my master thesis took place.

The difficulty of defining a renovation comes from the specificity of the subject it deals with: every buildings, every apartments and every houses are different and consist in a unique object with specific needs and a lot subject to behaviours changes in their utilisation. Not like wind turbines or vehicles, that are mass-produced and reproduced, and whose functioning is quite predictable.
1 Context of and objectives of the thesis

The easiest way to overcome that difficulty is to focus on "renovation actions" only: thermal insulation of elements of the buildings (walls, roof, windows...), energy performance of the heating systems, quantity of renewables sources used as input for those systems, etc. That is why most policy instruments, especially financial incentives, are built on specific actions and not on "global renovations" as a whole.

One could try to define such global renovation with a set of actions, or convert an action into a percentage of a global renovation, but this would systematically forget the specificity of each building and would be useful only to pilot at a very aggregated level the number of renovations performed in a region or country.

Nevertheless, in the EU Energy Performance of Buildings Directive, article 2 paragraph 10, is given a definition of a "major renovation", where: [2]

- "the total cost of the renovation relating to the building envelope or the technical building systems is higher than 25% of the value of the building, excluding the value of the land upon which the building is situated"
- or "more than 25% of the surface of the building envelope undergoes renovation."

It also indicates that the Member States may choose to apply any of those two options. But this definition does not give any indication on what is really renovated, which surface or systems, and with which energy performance in the end.

1.3 Thesis objectives and methodology

1.3.1 Main objectives

The primary goal of this thesis project is to provide an insight on the design of a policy instrument, built in a way to boost energy renovation while addressing the three major challenges of sustainability:

- Environmental: promote and support efficient energy renovation, in order to meet energy and climate goals set by the European Union and by each country
- Social: help to restrain and decrease energy precarity of households, while providing enough financial incentives to make them trigger renovations
- Economic: design a cost-efficient mechanism for public spending.

This degree project therefore intends to investigate the construction and the ex ante evaluation of a policy instrument intended for promoting energy renovation of housing. To do that, we will focus in details on a real case, which is the tax credit for energy transition, in France.

1.3.2 Choice of methodology: real case application

This thesis is indeed based on a concrete mission in the French administration, realised at the heart of policy-making, within the Financial Aid Office of the Directorate for Housing, Urbanism and Landscape, within the French Ministry of Ecology and Ministry of Territorial Cohesion and Relationships with Territorial Collectivities.

The study will thus be built on real data, analysis and scenarios of redesign of the existing policy instrument, scenarios that were actually used for arbitration at Ministers level in order to define the structure and parameters of the future financial instrument for energy renovation of private housing in France from 2020 and after.
This is therefore a technical master thesis, which will describe all the process of designing a new policy instrument, as well as giving some insight on its implementation based on my experience within the French administration.

1.3.3 Delimitations

As a consequence, several subjects will not be tackled in this study, as we will perform an in-depth analysis of the technical aspects of the reform of the French tax credit for energy transition.

The focus will only be on private housing, not social housing, nor public buildings, nor industrial/tertiary buildings. The scenarios and hypothesis that will be explored will be based on the global orientations of the Ministries and the parameters used will be the one given by the specialised services of the French administration.

The final objective will be to propose a new financial mechanism, along with its aggregated impact on the different categories of populations and the associated expected quantities of renovation actions for global policy objectives. At the end, no definitive instrument nor scenario will be settled, as it is not the responsibility of the mission this thesis is based on, but rather the responsibility of the French Ministers that did not arbitrate at the time these words are being written.

Although a short insight on the process of transformation of a policy instrument will be given, this step will arrive after the technical analysis and will not be the core objective of the thesis.
2 Real case application: the tax credit for energy transition in France

2.1 Energy and buildings in France: a sector lagging behind

2.1.1 Overview of the buildings sector: energy consumption and GHG emissions

For several years, the French policy of energy performance of housing has aimed at triggering renovation work in the housing stock, in order to improve the quality of housing, reduce energy expenditure of households, especially low-income households, and to find a solution to the strong challenges of mitigating climate change by reducing greenhouse gas emissions from the building sector.

The challenge remains major. Energy consumption in the building sector, particularly housing, is not reducing much in France, and the production of new energy-efficient homes (or EEH\(^1\)) does not allow to reduce energy consumption drastically, given a very slow renewal rate of the housing stock (around 400 000 dwellings are built per year, i.e. around 1% of the total housing stock [7]).

Controlling energy consumption in buildings is crucial, and echoes the recent social crisis centered on purchasing power and energy consumption for transport (cf. "Yellow vest" movement in France since November 2018). The building sector is very energy intensive, accounting for 45% of final energy consumption of the country [8] (cf. figure 2) and almost 25% of domestic greenhouse gas emissions [9] (cf. figure 3, including the embedded carbon content in electricity production). The issue is also social: 7 million homes are poorly isolated in France, and 3.8 million households have difficulties paying their energy bills or deprive themselves of heating (energy precarity).

![Figure 2: Distribution of the final energy consumption in France by economic sector (left) and distribution by energy source in the residential sector (right).](image)

*Source: Service for data and statistical studies of the French Ministry of Ecology, 2018. [8]*

However, we note that the collective investments (lessors, public entities and especially households) are insufficient to meet the objectives set by the country, in particular through the law

\(^1\)Energy Efficient Homes, consuming less than 50 kWh/m\(^2\)/year of primary energy. This value can change according to the region and the altitude to which the dwelling is located.
2 Real case application: the tax credit for energy transition in France

Figure 3: Distribution of the greenhouse gas emissions in France by economic sector (left) and evolution of emissions in the tertiary residential sector since 1990 (right).

on the energy transition for green growth [10]. These objectives include the reduction of energy consumption of 20% by 2030 and 50% by 2050 compared to 2012, the renovation of the park at the EEH level by 2050, and the eradication of "energy sieves", which are energy-intensive homes classified F and G in the scale of energy performance diagnoses (cf. figure 4).

Figure 4: Presentation of a blank energy performance diagnosis (DPE). The term "energy sieve" refers to the DPE labels F and G.

Various financial aids for renovation exist today, their goal is to reduce energy consumption related to heating and domestic hot water production. Social housing benefits from specific support. In terms of private housing, we can mention the tax credit for energy transition (CITE, Crédit d’impôt pour la transition énergétique in French), the zero-rate eco-loan, energy saving certificates (or white certificates) and aids from the National Housing Agency (ANAH), the latter helping to improve housing both in terms of accessibility and energy improvement for low-income households.

Modest households, belonging to the first four deciles of income, are the most sensitive to the decrease of the "remainder" to finance the energy renovation work (the part not taken in charge by the subsidies). The ANAH helps tens of thousands of households each year, but this figure, although rising, remains below its objectives.
2.1.2 The national Buildings Energy Renovation Plan

2.1.2.1 Description and objectives of the plan

The Buildings Energy Renovation Plan [11] was launched in April 2018 to address these challenges in France. It sets the objectives of an energy and social policy with a horizon of five years, and in particular the objective of eradicating in ten years "energy sieves" occupied by low-income owners.

The Buildings Energy Renovation Plan sets specific objectives of renovations, with a overall goal of 500 000 renovations per year, including:

- 250 000 renovations in modest households
  - 100 000 renovations in the social housing stock
  - 150 000 renovations in the private housing stocks, including 75 000 renovations within the National Housing Agency objectives
- 250 000 in other households: owners or tenants, modest or non modest.

The plan also aims at renovating at least 150 000 energy sieves per year within those 500 000 renovations.

Figure 5: Presentation of the general quantitative objectives of the Buildings Energy Renovation Plan by category of occupants and type of housing stock.

Clarification: the term "renovation" in the sense of the National Low Carbon Strategy (SNBC, Stratégie nationale bas carbone in French) or the Buildings Energy Renovation Plan includes at least two or three "actions" of renovation (insulation of walls, change of heating equipment...). These quantitative objectives are therefore hardly comparable directly with the number of households subsidised or helped via the different public policies that are implemented to meet these objectives. For example, a given public policy aiming at improving the insulation of the roof will count as one action but not necessarily one total renovation (cf. part 1.2.3).
Focus on the tax credit for energy transition (CITE)

This plan announces, in accordance with the commitments of President Emmanuel Macron, the transformation of the existing tax credit for energy transition (CITE, Crédit d'impôt pour la transition énergétique in French) into a premium, in order to simplify procedures and accelerate the financing of energy renovation works for low-income households, also helping to reduce their financial "remainder". This development should also help reduce the waiting period for receiving the tax credit, currently 6–18 months, to a few weeks with the premium. Finally, the orientation towards a "one-stop-service" aims at promoting support for modest households.

From this point of view, it is now envisaged that the existing tax credit for energy transition for low-income households will be paid by the National Housing Agency (ANAH) as a single premium. The technical work between the ministries concerned and the ANAH started in 2018, and should be completed in the coming months for an implementation as early as 2020. This subject will be the heart of the present thesis.

2.1.2.2 Overview of the achievements in 2018

Monitoring renovation dynamics remains extremely difficult in the absence of an observatory dedicated to monitoring actions, and given the multiplicity of the renovations actions and the policy instruments encouraging them. Only a little global data can be reported, as well as the number of housing renovations financed by National Housing Agency (internal sources from the French administration):

- 1.4 million of recipients of the tax credit for energy transition for the renovation works in private dwellings in 2017, representing around 2 billion euros of tax expenditure in 2018
- 100 000 dwellings renovated in the social housing stock, including 15 000 energy sieves
- 62 000 energy renovation actions financed by the ANAH in 2018, for a total budget of 527 M€
- 1.1 billion euros of tax expenditure via reduced VAT at 5.5% for energy renovation works, used by more than 300 000 companies and craftspersons of the sector
- Around 20 000 zero-rate loans distributed in 2018 to finance global energy renovation works
- More than 2 billion euros spent by energy companies to finance energy efficiency actions under a White certificates scheme managed nationally.

To tackle this issue of monitoring the renovation of the housing stock, a specific observatory dedicated to renovations works is under construction (Observatoire de la rénovation énergétique) between the ministries, local governments and concerned agencies and associations. This observatory will enable to have a precise insight on the dynamics of renovations and will help piloting the public policies in consequence.

2.1.2.3 The public action against energy precarity

Beyond aiming at reducing energy consumption in buildings and the associated GHG emissions, the public policies are also strongly engaged in the reduction and elimination of energy precarity, which is a plague harming especially modest households.
The National observatory on energy precarity\textsuperscript{2} provided for 2018 the following data ([12] and internal data from the administration):

– 11.6% of French households spend more than 8% of their revenues to pay the energy bill of their dwelling, and they are among the most modest households of the society

– The total housing stock contains between 7 and 8 million energy sieves, which are dwellings with the worst energetic performances according to the Energy Performance Diagnosis (DPE)\textsuperscript{3}

– Around 3.8 million of these energy sieves are occupied by modest households, and 1.5 million of these households own their dwelling

– Almost 550 000 households suffered from an intervention of an energy provider (reduction of power, contract termination...) because of outstanding debts on their energy bills

– 15% of households declared having suffered from the cold in winter 2017, during at least 24 hours. This was due to a poor insulation in 40% of households.

Figure 6: Results from a survey conducted in 2018 by the National Energy Ombudsman on a sample of 1 500 people.

\textit{Source: National observatory on energy precarity, 2018. [12]}

The energy renovation of buildings is therefore an energy and social policy, which reduces the energy bill thus improving the purchasing power, especially of the most vulnerable citizens, and helps fighting against climate change.

\textsuperscript{2}The National observatory on energy precarity is an observation tool and an instrument for analysing public policies to combat energy precarity at the service of national and territorial actors. \textit{Source: www.onpe.org}

\textsuperscript{3}The term energy sieve is commonly used to refer to dwellings with a conventional consumption superior to 330 kWh of primary energy per square meter and per year for heating and hot water. This diagnosis therefore does not take into account the real consumption due to individual behaviours and actual use of the dwelling.
2.2 State of the art: various policy instruments with questioning efficiency

2.2.1 Overview of the French policies in favour of energy transition in buildings

In this section, we will focus on the policy instruments oriented towards the energy renovation of the private housing stock in France. The public buildings stock and the social housing stock will be therefore excluded from this analysis, as they have their own energy and renovation issues that are being tackled by other policies.

There are seven major national mechanisms encouraging or financing the energy renovation works in the private housing stock, to which one must add the local aids from territorial governments and cities when they exist. The first two policy instruments deal with non economic incentives and obligations, whereas the other instruments focus on the financing of the renovation works.

2.2.1.1 Thermal regulations in buildings

Following the oil shock of 1973, many governments in developed economies established various regulations in order to decrease the dependency of their country to oil and to save energy. The French thermal regulation of 1974 (RT 1974) was therefore set up in France, with a global objective of reducing by 25% the primary energy consumption in new residential buildings [13]. Successive regulations followed throughout the years ([14] and [15]):

- RT 1982, after the second oil shock of 1979, decreasing by 20% the maximum consumption in new buildings
- RT 1988, with an extension to non-residential buildings and including minimal performances for the building envelope and installed heating systems
- RT 2000, decreasing by 20% the maximum consumption in new residential buildings (190 kWh/m²/year) and non-residential buildings (by 40%)
- RT 2005, decreasing by 15% the maximum consumption in new buildings (150 kWh/m²/year)
- RT 2012, very challenging, requiring new homes not to consume more than 50 kWh/m²/year of primary energy. This value changes according to the region and the altitude to which the dwelling is located. This maximum consumption defines the Energy Efficient Home (EEH) label
- RE 2020 (environmental regulation, not only thermal regulation), from which all new buildings will have to be ”energy positive”, i.e. producing in average more energy than they need, and will have to respect objectives in terms of greenhouse gases emissions.

The figure 7 below shows the evolution of energy objectives through successive regulations, with some uncertainties about the first regulations that did not include quantified objectives in terms of kWh/m²/year of primary energy consumed.

2.2.1.2 White certificates (Certificats d’économie d’énergie)

To encourage the reduction of energy consumption and aim for energy efficiency, the government has put in place a mechanism of energy saving certificates (or white certificates): these certificates require energy suppliers to make energy savings with their consumers. This is similar to the principle of emissions trading scheme, such as the one introduced for greenhouse gas emissions.
in the European Union (possibility of financing energy savings or buying certificates from other actors). The objectives of each energy service provider subject to this obligation (the "obligated") are set by the government according to its share in the national energy distribution, as described in figure 8 from the 2016 Annual Report of the French Court of Auditors (Cour des Comptes) [16].

In this context of a state-regulated obligation, certain companies (gas or electricity suppliers, mass-market players with petrol stations, oil companies) offer bonuses, subsidised loans or free diagnosis to help decreasing energy consumption. The renovation works that are undertaken must improve the energy efficiency of the housing and be part of the list of standardised operations. Besides, modest households can benefit from an exceptional bonus to help them finance some energy-saving work under an additional scheme launched in February 2017 and renewed in April 2018 for two more years.

In 2018, the volumes of white certificates issued for renovation works in residential buildings amounted to 215 TWh_{cumac}\footnote{Cumac: French contraction of "cumulative" and "discounted", refering to the total volume of energy savings achieved over the lifetime of the equipment.} or equivalent to about 1.2 billion€ (out of a total of 3 billion€), distributed more or less equally between non modest, modest and very modest households (DGEC internal source).

### 2.2.1.3 Direct subsidies

#### 2.2.1.3.1 The "Living Better" (Habiter Mieux) program of the National Housing Agency
The National Housing Agency (Agence nationale de l’habitat, ANAH) provides subsidies to homeowners whose incomes are below the resource ceilings, to landlords under contract with the ANAH and to co-owners for fragile condominiums. There are two variations of the "Living Better" (Habiter Mieux, or HM) program for homeowners:

- **HM Serenity**: financial assistance to make a complete and coherent set of renovation work capable of bringing at least 25% of energy savings (usually 40% are achieved), coupled to a compulsory technical and social support of the households.

- **HM Agility**: financial assistance for the realisation of one of the following three types of renovation work: change of boiler or heating mode, insulation of the walls from the inside or the outside, or insulation of the attic.

These programs are under constant increase in the last years, as they show very satisfying results, both from energy savings and efficient use of public subsidies (with complete renovations).

### 2.2.1.3.2 The energy check

The energy check is a direct state subsidy that is automatically sent by post to eligible persons. To be eligible, you simply have to report your income to the tax services, even if your income is low or zero. It is also necessary to live in a housing subject to the housing tax (even if the beneficiary is exempt). The check can be used to finance energy efficiency work, even if this
2 Real case application: the tax credit for energy transition in France

<table>
<thead>
<tr>
<th>Category of recipients</th>
<th>Housing units renovated</th>
<th>% of the annual target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homeowners</td>
<td>51 107</td>
<td>88%</td>
</tr>
<tr>
<td>Landlords/lessors</td>
<td>3 664</td>
<td>92%</td>
</tr>
<tr>
<td>Co-owners</td>
<td>7 574</td>
<td>58%</td>
</tr>
<tr>
<td>Total</td>
<td>62 345 (+19% compared to 2017)</td>
<td>83%</td>
</tr>
</tbody>
</table>

Table 1: Balance sheet 2018 of the ”Living Better” program of the National Housing Agency

utilisation is very marginal (0.02% of the energy checks were used for that purpose in 2018). In 2019, around 5.8 million households will be eligible to the energy check, with an average of 200€ per check.

2.2.1.4 Zero-rate loans (Eco PTZ)

The zero-rate eco-loan (Eco-PTZ) is a tool to help finance the remainder after collection of the various possible aids (tax credit, subsidies from the ANAH, white certificates, etc.), by contracting a loan at zero interest rate with a bank that signed an agreement with the State. Historically, the eco-loan was distributed only for renovation works packages, to encourage global renovations. Since March 2019, the condition of work package has been eliminated, which will make it easier to finance the remainder of the cost of household renovation work. Further simplifications came into effect in July 2019, especially to align eligibility conditions on other instruments to improve the readability of the various aids for renovations.

The zero interest rates are financed by the state to the banks via a tax credit on their corporation tax (each eco-loan providing a given remuneration to the bank). In 2018, around 20 000 eco-loans have been granted, for a tax expenditure of 43 M€.

2.2.1.5 Fiscal incentives

2.2.1.5.1 Reduced VAT

For common renovation works of the housing, the VAT rate applied is usually 10% (which is already a reduced rate compared to the standard rate of 20%). However, for renovation works improving the energy performance, this rate has been reduced to 5.5% in 2014.

In 2017, more than 300 000 companies applied the 5.5% reduced rate, for a tax expenditure for the state of 1 200 M€ (or 340 M€ compared to the 10% rate for common renovation works). However, this policy instrument has been criticised for having an inflationary effect on the cost of energy renovation works, like every economic instrument not being directly aimed at households.

2.2.1.5.2 Tax credit

The tax credit for energy transition (CITE, Crédit d’impôt pour la transition énergétique) allows a deduction of 30% from income tax on expenses incurred for most energy efficiency improvement projects. Requested at the time of the tax return the year following the renovation works, it is intended for owner-occupiers, tenants and persons occupying the dwelling free of charge; the dwelling concerned must be the taxpayer’s main residence and must have been built for more than two years (source: Article 200 quater of the General Tax Code [17]).
The CITE is capped over a period of five years at 8,000€ for a single person and 16,000€ for a couple. This limit is increased by 400€ per dependant person. Eligible works include heating and domestic hot water systems, insulation of opaque and glazed walls, as well as other technical or support devices (e.g. energy performance diagnosis).

For households whose incomes are below the ANAH resource ceiling, the tax credit is extended in 2019 to labour costs for the installation of renewable energy heating appliances and the removal of fuel tanks at the rate of 50% (instead of 30%). In 2019, it is also limited to 15% of the cost and capped at 100€ per equipment for the replacement of single-glazed windows by double-glazed windows (source: article 18 bis of Annex 4 of the General Tax Code [18]).

In 2018, for the renovation work carried out in 2017, the CITE benefited to nearly 1.4 million people (only 8% of the first four income deciles) for a total tax expenditure of 2 billion euros.

### 2.2.2 The tax credit for energy transition: the founding but defec
tive instrument for energy renovation of housing

#### 2.2.2.1 A lasting policy in perpetual reform

Since its launch in 2005, the tax credit for energy transition (formerly tax credit for sustainable development, Crédit d’impôt pour le développement durable) has generated on average a tax expenditure of 1.6 billion euros per year and benefited an average of 1.2 million households per year [19].

The historical variations are strongly related to the modalities of the instrument, to the evolution of its eligibility conditions and to the rates of subsidies of the eligible renovation works. As of 2015, the terms and conditions are stable, with a subsidy of materials and equipment totally aligned and fixed at 30%. The increase in spending is related to the growing share of windows replacement.

<table>
<thead>
<tr>
<th>Year of the renovation works</th>
<th>Tax expenditure (M€)</th>
<th>Number of recipients</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>990</td>
<td>990,000</td>
</tr>
<tr>
<td>2006</td>
<td>1,873</td>
<td>1,255,000</td>
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<tr>
<td>2007</td>
<td>2,100</td>
<td>1,323,000</td>
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<tr>
<td>2008</td>
<td>2,778</td>
<td>1,547,000</td>
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<tr>
<td>2009</td>
<td>2,641</td>
<td>1,546,000</td>
</tr>
<tr>
<td>2010</td>
<td>2,042</td>
<td>1,481,000</td>
</tr>
<tr>
<td>2011</td>
<td>1,094</td>
<td>1,269,000</td>
</tr>
<tr>
<td>2012</td>
<td>673</td>
<td>852,000</td>
</tr>
<tr>
<td>2013</td>
<td>619</td>
<td>729,000</td>
</tr>
<tr>
<td>2014</td>
<td>874</td>
<td>661,000</td>
</tr>
<tr>
<td>2015</td>
<td>1,678</td>
<td>1,175,000</td>
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<tr>
<td>2016</td>
<td>1,682</td>
<td>1,246,000</td>
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<tr>
<td>2017</td>
<td>1,953</td>
<td>1,396,000</td>
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</tbody>
</table>

| Total over 2005 – 2017     | 21 billion €         | 15.5 millions*       |
| Total average per year     | 1,615 M€             | 1,190,000            |

Table 2: History of the evolution of expenditure and number of recipients of the tax credit for energy transition. Source: DGFiP and annexed documents to laws of finance.

*NB: overestimation, the same recipients can have declared various renovation works over the years.
Figure 9: History of the evolution of expenditure (red on the left scale in million euros) and number of recipients (grey on the right scale in thousands) of the tax credit for energy transition.


Around one third of the tax expenditure is allocated to windows replacement (more than 600 M€) which is raising lots of questions in the ministries in charge of the budget and the energy. Indeed, technical studies by public agencies (ADEME\(^5\) and CSTB\(^6\), [20]) demonstrated that windows replacement was the least efficient type of renovation work, in terms of MWh of energy saved per euro invested (and therefore per euro of public money invested). That is why the government decided for 2018 to reduce drastically the subsidies for windows (down to 15% for six months and then 0%): the resulting tax expenditure for 2019 is estimated at 900 M€, which is less than half of the year before.

### 2.2.2.2 The choice of simplicity to the detriment of energetic performance

The following table gives an overview of the evolution of the rates at which renovation works can receive a tax credit: the percentage of the eligible cost (mainly equipment and materials) is deducted from the annual taxes the year following the works. In the case of a household not paying tax or if the tax credit exceeds the taxes paid, the household will receive the remainder (because it is a credit tax and not a tax reduction).

The constant change in the applicable tax credit rates and the perimeter of eligible works is striking: between 0% and 50% of tax credit, depending on the equipment, the year of renovation, which had a huge impact on the readability of the policy. Many deemed it too much complicated and not adapted to common renovation works by citizens not expert in renovations and fiscal incentives. These changes in the rates explain the huge variability of the number of recipients and the associated tax expenditure in the previous table: between 0.6 and 2.8 billion euros depending on the year.

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\(^5\)Environment and energy agency

\(^6\)Scientific and technical center for building
2 Real case application: the tax credit for energy transition in France

Nature of the renovation works

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Energy efficiency</td>
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<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Low temperature boiler</td>
<td>2005 - 2008</td>
<td>15%</td>
<td>15%</td>
<td>15%</td>
<td>15%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Condensing boiler</td>
<td>2005 - 2017</td>
<td>25%</td>
<td>15%</td>
<td>15%</td>
<td>25%</td>
<td>15%</td>
<td>15%</td>
<td>15%</td>
<td>18%</td>
<td>15%</td>
<td>25%</td>
<td>20%</td>
<td>20%</td>
</tr>
<tr>
<td>Gas micro-cogeneration systems</td>
<td>2012 - 2017</td>
<td>17%</td>
<td>26%</td>
<td>15%</td>
<td>25%</td>
<td>30%</td>
<td>30%</td>
<td>30%</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Heating regulators</td>
<td>2005 - 2017</td>
<td>25%</td>
<td>25%</td>
<td>25%</td>
<td>25%</td>
<td>25%</td>
<td>22%</td>
<td>15%</td>
<td>0%</td>
<td>15%</td>
<td>25%</td>
<td>30%</td>
<td>30%</td>
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</table>

Thermal insulation

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<td>Energy efficiency</td>
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<tr>
<td>低 temperature boiler</td>
<td>2005 - 2008</td>
<td>15%</td>
<td>15%</td>
<td>15%</td>
<td>15%</td>
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</tr>
<tr>
<td>Condensing boiler</td>
<td>2005 - 2017</td>
<td>25%</td>
<td>25%</td>
<td>15%</td>
<td>25%</td>
<td>15%</td>
<td>15%</td>
<td>15%</td>
<td>18%</td>
<td>15%</td>
<td>25%</td>
<td>20%</td>
<td>20%</td>
</tr>
<tr>
<td>Gas micro-cogeneration systems</td>
<td>2012 - 2017</td>
<td>17%</td>
<td>26%</td>
<td>15%</td>
<td>25%</td>
<td>30%</td>
<td>30%</td>
<td>30%</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Heating regulators</td>
<td>2005 - 2017</td>
<td>25%</td>
<td>25%</td>
<td>25%</td>
<td>25%</td>
<td>25%</td>
<td>22%</td>
<td>15%</td>
<td>0%</td>
<td>15%</td>
<td>25%</td>
<td>30%</td>
<td>30%</td>
</tr>
</tbody>
</table>

Table 3: History of the evolution of the eligible renovation works and rates of the tax credit for energy transition. Source: national regulations and laws, website Legifrance and Official bulletins of public finances (BOFiP).

The radical change in September 2014 made it a lot easier to understand, with a flat rate of 30% of the cost of the equipment of materials, regardless of the works undertaken. However, by aligning the rates of eligibility, one had to trade energy performance for simplicity of the incentive.

While the evolution of the list of equipment may be a source of instability harmful to the readability of the device for households and associated industrial sectors, it is however common sense that the list of eligible equipment takes into account technological evolutions to prioritize tax expenditure on equipment that has a real environmental added value compared to the market.

2.2.2.3 A flat tax credit for all but benefiting to the richest

The second and most important drawback which is very castigated about the tax credit for energy transition, is its social inequity. Indeed, an analysis performed on the real data for 2017 of the Directorate General of public finances (DGFiP) shows that most of the recipients of the tax credit are well-off households (deciles 9 and 10, in red below), whereas low-income households represent a minority of the tax expenditure (deciles 1 to 4, in violet and blue below).
Real case application: the tax credit for energy transition in France

Number of recipients

<table>
<thead>
<tr>
<th>Quintile</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>2.65%</td>
</tr>
<tr>
<td>2nd</td>
<td>7.73%</td>
</tr>
<tr>
<td>3rd</td>
<td>15.84%</td>
</tr>
<tr>
<td>4th</td>
<td>28.99%</td>
</tr>
<tr>
<td>5th</td>
<td>44.79%</td>
</tr>
</tbody>
</table>

Tax credit expenditure

<table>
<thead>
<tr>
<th>Quintile</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>2.36%</td>
</tr>
<tr>
<td>2nd</td>
<td>6.57%</td>
</tr>
<tr>
<td>3rd</td>
<td>13.64%</td>
</tr>
<tr>
<td>4th</td>
<td>27.57%</td>
</tr>
<tr>
<td>5th</td>
<td>49.86%</td>
</tr>
</tbody>
</table>

Distribution of number of recipients (left) and of the amount of tax credit expenditure (right) among the quintiles of revenues in 2018, for renovation works realised in 2017.

Source: Data from income tax 2018, Directorate general of public finances.

These results are confirmed by a mission of the General Inspection of Finances and the General Council for the Environment and Sustainable Development realised in 2017 on the policy instruments for energy renovation [19], on the figure 10. This mission showed that the distribution of tax credit expenditure among the quintiles of revenues almost did not change since the beginning of the policy, with half of the credits being targeted at the richest 20% of households.

Figure 10: Distribution of the tax credit expenditure among the quintiles of revenues, between 2006 and 2015.

Source: Data from income tax, 2006 – 2015, Directorate general of public finances and General Council for the Environment and Sustainable Development. [19]
2.2.3 Objectives of the reform of the French tax credit for energy transition

2.2.3.1 Transforming the tax credit into a premium for modest households

As described in the previous section, below are the main limits of the current tax credit:

- Proportionate to the cost of the works, which certainly has an inflationary effect on the cost of renovation works performed by companies and craftspersons

- Uniform rate (30% for most of the works) that does not give a signal on the differentiated energy performance of the works (e.g. insulating walls rather than changing windows)

- Like other tax credits, it is paid with a year delay, at the settlement of income tax: it is a significant barrier for households with modest or average incomes that cannot pay an advance of several thousands euros for heavy renovation works

- Highly targeted recipients:
  - mainly well-off households: 50% of the tax expenditure for the last two deciles of richest income, whereas only 8% for the most modest households of the first four deciles of income
  - almost exclusively homeowners (94%, the 6% non owner-occupiers being tenants) of single-family homes (88%). The subject of lessors and collective housing is therefore very concerning given the energy savings possible in those dwellings.
2.2.3.2 Quantitative and economic analysis: assessing technical and budget scenarios

The objective of the study is therefore to participate in the design of the new policy, by analysing and preparing the implementation of the premium. In that regard, the following questions specific to the design of the new premium will tried to be answered:

- Concerning the financial and technical design and evaluation of the future device:
  - Which premium levels can one calculate by type of energy renovation work and how to analyse them in comparison to the initial input parameters, hypothesis and policy objectives set? (financial envelope, typology of eligible actions, links with existing incentives, etc.)
  - How can one take into account the effects of household adjustment at these levels, especially the elasticity of demand for the aid?
  - Which premium scale to establish based on these calculations, in coordination with the DGEC (Directorate General for Energy and Climate in the ministry), the National Housing Agency and by interacting with the departments of the relevant economic and financial ministries (DG Trésor in charge of economic analysis, Direction of
Budget), in order to create a consistent subsidy instrument suitable for all actors involved in the policy making?

- Which strategy can one adopt to coordinate the work, within the Directorate for Housing, Urban Development and Landscapes, between the sub-directorates (financing quality of construction), and with the other parties involved in the policy design process? How to assert the point of view of the housing department in the inter-ministerial negotiations, especially before the budget and energy departments points of view?

- How to make the transformation of the tax credit into a premium more coherent with the other systems of aids for the energy renovation of households?

The study will therefore focus on both a quantitative and technical analysis of the policy instrument, and in a succinct way on the implementation of the new instrument in budgetary, financial and legal matters and concerning the development of premium management processes.
2.3 Methodology: a bottom-up approach for building the new policy instrument for energy renovation of housing

In this central section we will describe and explain the process of designing the new policy of tax credit for energy transition from scratch. After presenting the groundwork on which the policy will be based, the elaboration of the tool used to calibrate the new measure will be presented along with the the quantitative analysis of budget scenarios and the evaluation *ex ante* of the policy.

2.3.1 Overview of the transformation of the tax credit

2.3.1.1 Main steps of the quantitative policy design

2.3.1.1.1 Conversion of tax credit into lump sum and quantitative design

The first step of the quantitative design will consist in elaborating the reference list of eligible renovation works and to determine the level of premium that will be granted to recipients for each category of works. The important change compared to the current tax credit is that the premium will be a lump sum based on the energy performance of the renovation works (energy efficiency and/or renewable energy integration), whereas the current tax credit is simply a percentage of the cost of the works as shown in the previous section.

2.3.1.1.2 Elaboration of technical and budgetary scenarios

Once the basis of the lump sum and the eligible works are established, different scenarios will be realised in order to calculate and optimise premium levels according to several parameters:

- Budget objectives
- General scheme of the distribution of the subsidies, in coordination with existing policies that need to be adjusted
- Category of recipients eligible to different subsidies (owners occupiers, lessors, condominiums...)
- Political objectives of renovation: target low-income households, quantitative objectives of works, etc.

The list above is not exhaustive at all but provides some milestones which will guide the policy design through these scenarios.

An important stage of the process will be taking into consideration the elasticity to price (therefore elasticity to subsidies) of the dynamics of renovation works.

2.3.1.1.3 Sensitivity and policy analysis

The final step of quantitative design will aim at testing the robustness of the scenarios and provide an in-depth view of the sensitivity of the scenarios to the hypothesis and the modelling used for their elaboration.

The overall results will be presented in the following section, along with graphic presentations and comparisons of the scenarios, which are essential for understanding the characteristics of the scenarios and for technical and political arbitration.
2.3.1.2 Groundwork: feedback on previous policies and political orientations

2.3.1.2.1 A popular instrument but unstable and lacking feedback

As described in the part 2.2.2, the tax credit for energy transition has known a huge number of changes through its existence since 2005. This long-lasting policy makes it quite well-known among the citizens undertaking renovation works, but the changes in the eligible works and subsidy rates hindered its readability and its recourse rate among non professionals.

Also, there is almost no data and feedback available on the tax credit use, because of many reasons: variety of recipients, housing context proper to each individual, companies and craftspersons doing the renovation works, renovation works that are undertaken and eligible, etc. Another difficulty is to access the little data existing, because of secrecy related to fiscal information and the difficulty to collect specific details in such a diffuse sector.

This is even more problematic when trying to assess ex ante the effects of a policy that could be expected, because the design and sizing of the measures depend a lot on the available data and hypothesis. In this regard, the effect of elasticity to price/subsidy is essential when designing a new subsidy scheme, because of the variability associated to such parameters.

2.3.1.2.2 Social context: towards simplicity and fairness in public support

The social and environmental context, coupled with the political engagements made by the President during his campaign, drive also considerably the design of the policy. When arbitration has to be made by the Ministers, a point is reached where technical considerations and modelling have to make way for decisions that are essentially political.

The transformation into a lump sum subsidy and the focus on modest households, with a change in the temporality of the distribution of the aid and with higher subsidies for them, are at the heart of the new policy. Also, a degressivity for well-off households is considered in order to contrast sharply with the current tax credit that has been criticised a lot for benefiting first and foremost the rich. This is even more important in the current context of social crisis in France with the Yellow vest movement since November 2018, and to which the Government attempted to provide answers in Spring 2019, with a specific response focused on ecological transition.

The will to simplify public policies, particularly tax policies, is also fundamental: their complexity, due to administrative and bureaucratic burdens, has always been strongly criticised in France.

2.3.2 A unique tool for quantitative design, a multitude of variables and scenarios

This part will be entirely dedicated to the construction of the model and the software enabling the quantitative design of the future policy, based on a lump sum subsidy for energy renovation works.

The idea is to use a bottom-up approach to determine the measures and category of recipients to consider, then the eligible works and the associated lump sum subsidies (by adapting those subsidies depending on the recipients), and finally set different objectives and indicators to lay the groundwork for the elaboration of scenarios.

2.3.2.1 Definition of the measures to transform and target recipients
2.3.2.1.1 Transformation of the tax credit and the National Housing Agency programs

The main measure to transform is obviously the tax credit for energy transition, which will be completely revamped for all categories of recipients (from a percentage of the cost to a lump sum by category of works) and additionally transformed into a premium for modest households eligible to the National Housing Agency programs.

In the section 2.2.1.3.1 were presented to two main programs on energy renovation provided by the ANAH:

- HM Serenity: a global set of renovation with a compulsory individual support by state professionals
- HM Agility: a supplementary set of subsidies for individual renovation works, like changing boiler or insulation of walls.

Each program has different eligible works, different levels of subsidies (35% of the cost in Agility, up to 60% in Serenity) and different objectives of energy savings to be eligible.

The reform project of the CITE proposed in 2018 is as follows:

- Keep the tax credit for non modest households
- Suppress the tax credit for modest households eligible to ANAH programs and suppress the HM Agility program, and in compensation:
  - For households not enrolled in a HM Serenity program: create a premium that will replace both the tax credit and the HM Agility aids (fusion)
  - For households enrolled in a HM Serenity program: add a bonus to the recipients in compensation for the suppression of the tax credit to which they were eligible before the reform.

2.3.2.1.2 Focus on modest households

The important change in the reform is to accentuate the focus on modest households, which are the ones with the highest financial impediments to engage costly renovation works and also the ones with higher probability to live in a housing with poor energetic performance.

The idea is therefore to improve the levels of subsidy via the premium or the bonus for the HM Serenity program, in order to reduce even more their remainder compared to non modest households. The comparison of the remainders before/after reform, after deduction of all subsidies (ANAH subsidies, white certificates, premium...) is therefore a decisive factor in the design of the packages.

For example, for the same renovation work consisting in installing a heat pump for 12 000€, a non modest households could benefit from a 3 000€ tax credit, whereas a modest household could receive a 8 000€ premium and a very modest household a 10 000€ premium. The remainder will therefore be 75% of the cost for non modest, 33% for modest and 17% for very modest households (which could still be too much to pay for very modest households, that often cannot even invest 2 000€ in such equipment).

From this general idea will be built the social aspect of the new reform of the tax credit for energy transition.

2.3.2.1.3 Keeping an incentive for richer households
2 Real case application: the tax credit for energy transition in France

Figure 11: General outline of the reform currently being planned: transformation of CITE (tax credit) into a premium for low-income households and improvement of ANAH programs.

Following the social angle of the reform, it was proposed to decrease the level of subsidy for well-off households, among the 9th and 10th deciles of revenues (above 33 000€ per household per year according to the French National Institute of Statistics and Economic Studies [21]). With the same example of heat pump at 12 000€ as before, instead of having a lump sum tax credit of 3 000€ like other non modest households (deciles 5 to 8), the wealthiest households could benefit only from a 1 500€ or 2 000€ tax credit in the future, with a remainder of 80% or 90% of the total cost.

However, it seems important to maintain a financial incentive for renovation for the wealthiest households, which represent an effective lever in terms of energy performance and the efficiency of public money invested (a position defended by the Ministry of ecology, but not shared by the economic and financial ministries).

2.3.2.1.4 Specific recipients: lessors and co-owners syndicates

While the main focus is on owners occupiers, because they represent most of the recipients of the tax credits or ANAH programs, one must not forget to consider other specific recipients in the private housing stock: these are the lessors/landlords and co-owners syndicates, mainly present in collective housing.

Although they might not be included directly in the launching of the reform, they have to be considered in the design of the new measures. More specifically, lessors and co-owners syndicates already helped by the HM Serenity program of the ANAH will also receive a bonus, in order not to be disadvantaged compared to the bonus provided to owners occupiers.

On the other side, keeping with the previous field of action of the tax credit, non residential buildings and public buildings stock will not be considered in this policy.
2.3.2.2 Hypothesis and available data

2.3.2.2.1 Technical data on energy renovation works

In order to build the basis of the quantitative analysis, the following technical information must be gathered:

- List of the future eligible renovation works, established based on the current tax credit and in coordination with Directorates of the Ministries and political orientations of the Ministers’ cabinets

- Relative proportion for a given work of each category of work among all renovations works: those data came mainly from the previous fiscal year of the tax credit, giving an insight of the recourse rate for the tax credit for each category of work.

- Expected performance of the renovation work, in energy efficiency and/or integration of renewable energy: those data came from a thorough study performed by the ADEME (Environment and energy agency) and the CSTB (Scientific and technical center for building), two public agencies specialised in the fields of energy and buildings and their technical analyses. [20]

Additional hypothesis based on previous reports and estimations had to be used for the quantitative study:

- Hypothesis concerning the average surface of insulating materials in each type of insulation work (ceiling, walls, windows, pipes...)

- Within each National Housing Agency program (HM Agility and Serenity): data on the distribution of categories of renovation works, average number of renovation gestures per recipient, distribution between modest and very modest households
2 Real case application: the tax credit for energy transition in France

− Other hypothesis on the current and expected volumetry of renovation works for lessors and condominiums currently helped by the ANAH.

2.3.2.2 Economic and behavioural hypothesis

Information related to the average cost of equipment/materials and the average cost of labour for each category of renovation works were needed to estimate the impact on budget (tax credit and premium) of each gesture. Those data were gathered thanks to a global database making an inventory of those costs in France\(^7\).

Besides, additional hypothesis had to be considered:

− Subsidy threshold rate: defined as the maximum percentage of the total cost that can be subsidised with the future premium. This rate was set for modest and very modest households, because there is a risk to oversubsidise their equipments by accumulating different subsidy programs (ANAH, white certificates, future premium...).

− Remuneration tariff of the white certificates: another reform currently underway in the Ministry is the change in the remuneration tariffs of those certificates, in €/MWh, which will have an influence on the remainder to pay by households (and therefore the elasticity in a future version of this model that we will see later).

In a first attempt to build scenarios, no elasticity was considered. However, in a second version more detailed of the model, elasticity parameters have been added, in order to take into account the level of subsidy compared to the cost of the works (indicated by the remainder). This process will be detailed in the paragraph on elasticity in section 2.3.3.

2.3.2.3 Changing policy parameters to create different scenarios

2.3.2.3.1 Lump sum baseline rates

This first part of the calculation is the most important because it lays the groundwork for all the quantitative results and scenarios that will follow. It consists in determining the lump sum, for each category of eligible renovation work, that will be granted to a non modest (and non wealthy, meaning in the deciles 5 to 8) recipient in the future tax credit.

This lump sum is determined using both the expected energy efficiency content of the new system (for example a new boiler enabling to save 70 MWh through its life, or wall insulation enabling to save 2 MWh/m\(^2\) through its life) and the renewable energy content of the new system (for example a new air/water heat pump enabling to use 90 MWh of renewable energy through its life, along with saving 260 MWh through its life).

\(^7\)Example of database: datab.fr
For the purpose of the calculations, and in coordination with the different ministries (in charge or energy, or housing, or budget), two coefficients A and B were introduced:
- Coefficient A is used to remunerate to energy efficiency content of the system (or equipment in the case of insulation), in €/MWh
- Coefficient B is used to remunerate the renewable energy content of the system, in €/MWh

The lump sum for each renovation gesture is therefore calculated as:

\[ \text{Lump sum} = A \times \text{MWh}_{\text{EnergyEfficiency}} + B \times \text{MWh}_{\text{RenewableEnergy}} \]  

The lump sum is therefore a fixed amount of subsidy, per system or per unit of surface for insulation, depending directly from the choice of those two coefficients. The final amount was rounded to the closest hundred euros for energy systems and €/m² for insulation.

Changing the coefficients A and B is thus the main tool to adjust the lump sums, equally for every renovation work, in a uniform manner for all renovation works so as not to arbitrarily favour certain actions, in order to adapt the subsidies and meet the different remainders and budget targets.

### 2.3.2.3.2 Multiplying factors to adapt the level of subsidies

The second part of the calculations consists in adapting the level of premium for modest households, in order to reduce their remainder to pay and to encourage them to renovate their housing. This is to meet the social objective of the reform of the tax credit, as we saw that most of the tax expenditure benefited to well-off households until now.

To do that, starting from the lump sum defined previously for non modest households of deciles 5 to 8, different multiplying factors are introduced, in order to increase the premium granted to modest households. Those factors can be changed between the scenarios (between x1 and x4 in our case), in order to model different distributions of the public help and the level of redistributivity of the policy. This means that if the subsidy for an equipment is 1 000€ for non modest households, it could be artificially increased up to 4 000€ to help more the modest recipients. In this way, the idea of differentiating the subsidy for works according to energy performance is kept, since the same coefficient is used throughout the lump sum scale for all works.

The same principle is also used to decrease the lump sum for the most well-off households (in deciles of revenues 9 and 10): in this case, degressivity factors are defined between x0.3 (high degressivity) and x1 (same level of support as deciles 5 to 8) depending on the scenarios.

### 2.3.2.3.3 Changing the perimeters of eligibility

Finally, as a last resort solution to meet budget or redistribution objectives, eligibility of certain category of equipment or category of recipients can be change at the margins. This is made at the discretion of the ministries and their cabinets.

To give an example, here are two scenarios that were tested throughout the study:

- In one scenario, gas boilers were excluded from the eligibility for non modest households, because of the tax credit expenditure that they represented in this scenario, and given their poor performances in combating greenhouse gas emissions.
− In another scenario, with very constraints budget objectives, higher deciles of revenues were completely excluded from the eligibility to the tax credit (degressivity factor equal to zero), in order to concentrate the public help on modest households.

2.3.2.4 Main indicators: objectives and calculation

Now that we have presented the main parameters and hypothesis used within the model, we will present the targets and indicators used to characterise the scenarios.

2.3.2.4.1 Aiming at a target budget

In every public policy, budget is the "sinews of war". The total expected budget of the new policy will have to meet certain requirements, mainly a total envelope fixed by the different Ministers in charge of the reform: mainly ministers in charge of energy and housing (advocating for an increase in budget), budget (claiming for a budget reduction) and especially Prime Minister for arbitration.

However, there could also be sub-global budget objectives, meaning targets of budget within different categories, for example a maximum amount of budget for one category of works (e.g. not subsidise too much the replacement of windows) or a minimum budget to distribute for modest recipients.

To give an idea, the tax credit for energy transition represented 2 billion euros of tax expenditure in 2018 (for works completed in 2017), and the estimate for the 2019 tax expenditure varies between 900 M€ [22] and 1.1 bn€ (DGEC reassessment). The tax returns were just made in May 2019, so there is no final statement for the works done in 2018. In comparison, the overall budget range envisaged for 2020 (premium + residual tax credit) is between 600 M and 1.2 bn€.

2.3.2.4.2 Number of recipients of each measure

Another essential objective is the number of recipients, and a fortiori the number of renovation gesture that are expected to be performed. This aims at targeting a certain number of people in each category of recipients (for example to establish ”social” targets) as well as realising a certain number of renovations, which is the core purpose of the original policy.

For example, the numbers that can be looked at in the scenarios can be the following:

− Number of expected recipients of the new premium
− Quantity of renovation gestures, and associated number of recipients of the residual tax credit for non modest households
− Average budget envelope per recipient within each measure (tax credit, premium, HM Serenity bonus...)
− Total aggregated number of global renovations (which will raise the question of the definition of a ”renovation” in every sense).

2.3.2.4.3 Comparing remaining balances by type of renovation work

Finally, an indicator that will at the heart of the integration of elasticity in the model, is the calculation of remaining balances, or remainder, which is the rest to pay by the recipient after benefiting from subsidies of the tax credit or the new premium, from the HM Serenity program from the ANAH or from whites certificates distributed by private energy service providers. This
remainder can be calculated for each renovation work, for each category of policy and each recipient.

Some specific objectives of average remaining costs per category of recipients may also be set (by ministerial cabinets in particular), in order to work towards a greater "tax and budgetary justice" in the distribution of public aid. For example, 70% of the cost of equipment could be a bearable cost for non modest households, while a 25% or 10% cost could be an acceptable target for modest and very modest households for the same equipment. The following section explains how the remaining load is used to integrate the elasticity of public aid into the design of flat rates.

Figure 13 summarises the main objectives associated with these indicators to characterise the different scenarios that will be developed for trade-offs.

![Figure 13: Main objectives and indicators used for the development of the different scenarios.](image)

**2.3.3 Elaboration of the technical and budgetary scenarios**

Now that all the elementary bricks of the model are in place (data, hypothesis, indicators...), different scenarios can be built in order to answer to specific political and/or technical demands of the ministries.

**2.3.3.1 An iterative process in cooperation with other administrations**

**2.3.3.1.1 A jerky progression punctuated by arbitrations at different levels**

The whole study has been articulated around different level of meetings, with different level of hierarchy, dealing with different levels of "technicity":

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2.3.3.1.2 Technical negotiation between services

At the level of the modelling, several parameters had to be discussed and negotiated between the administrations: each administration has its own objectives, which can be synthesised as follows:

- Ministry in charge of energy: achieve maximum energy savings and integration of renewable energy, in order to meet our national targets for the number of renovations and the fight against climate change
- Ministry in charge of housing: strengthen the social aspect of the future scheme, while supporting the National Housing Agency in the implementation of the premium and preserving its other original missions (fight against substandard housing and autonomy in housing in particular)
- Direction of budget: maintaining the envelopes allocated to the tax credit and the premium for modest households at a minimum, in a context of very limited public spending
- Prime Minister: find an equilibrium between the ministries, while considering the political and social expectations and difficulties at the time of the decision (fight against energy precarity, demand for social justice, etc.).

Such diverging positions lead to balances and trade-offs in the determination of some parameters of the model like: setting to $A = B$ the coefficients remunerating the content of energy efficiency and renewable energy of the renovation works, decreasing the amount of subsidy for richer people with the use of degressivity factor as shown previously, integrating a bonus to the pre-existing HM Serenity program of the ANAH in order to preserve its benefits and current recipients, etc.

2.3.3.2 Taking into consideration the elasticity to fiscal incentives

2.3.3.2.1 The issue of elasticity

The question of elasticity has been subject to a lot of debates during certain technical meetings, the DG Trésor (in charge of economic analysis in the Ministry of economy and finances) complaining that the scenarios proposed before by the "technical" ministries were not considering any elasticity to price, or elasticity to subsidy in our case.
Indeed, even if we gathered data on the distribution of the renovation gestures between each category of work, and even if we have data on the total absolute demand for tax credit per gesture thanks to previous fiscal data, how can we be sure that a change in the remuneration of energy efficiency or renewable energy (the coefficients A and B) will not affect the recourse rate of the eligible recipients to public subsidies?

For example, if a heat pump is subsidised at 3500€ instead of 3000€, how many more people will install heat pumps and ask for a tax credit or premium if they are modest households? Taking into account an elasticity will help sharpening the model and produce more precise scenarios.

### 2.3.3.2.2 A new model more precise in the method, but with still rough estimations

Starting from a reference scenario close to real data from recent years of the tax credit, we will implement an elasticity to the variation of the average remainder relatively to the average remainder in the reference scenario, for each category of recipient.

For example: if the average remainder in the reference scenario is 70% for non modest households, and if the elasticity is equal to $-3\%$ per % of remainder (noted $-3\%/\%$), then another scenario in which the average remainder will be 75% (so the subsidies are lower and therefore prices are higher) will see a diminution of the number of subsidies distributed of:

$$N_{\text{new}} = \text{Elasticity factor} \times N_{\text{ref}}$$

(2)

$$N_{\text{new}} = \left(1 + \text{Elasticity} \times \frac{R_{\text{new}} - R_{\text{ref}}}{R_{\text{ref}}} \right) \times N_{\text{ref}}$$

(3)

with $N_{\text{new}}$ and $N_{\text{ref}}$ the numbers of demanded subsidies in the new and reference scenarios and $R_{\text{new}}$ and $R_{\text{ref}}$ the average remainders in the new and the reference scenarios.

$$N_{\text{new}} = \left(1 - 3\%/\% \times \frac{75\% - 70\%}{70\%} \right) \times N_{\text{ref}}$$

(4)

$$N_{\text{new}} \approx 0.79 \times N_{\text{ref}}$$

(5)

so a decrease in the recourse rate to the subsidy, as expected with the increase of remainder and the prices of renovation works.

All we have to do is find the elasticity used to determine the relationship between remainder and recourse rate to the policy instrument.

As stated before, there is almost no data and quantitative analysis available concerning the tax credit for energy transition, because of the originality of such measure: what could be the elasticity to subsidy of modest and non modest households undertaking renovation works in their housing? The question is too specific to have been studied in details in the past.

However, there exist two working documents ([23] and [24]) produced by INSEE’s Directorate of Economic Studies and Synthesis, which analyse the effect of the variation in the tax incentive on the demand for subsidies for renovation works. These studies took advantage of the variation in the subsidy rate in the history of the energy transition tax credit (the large variability we saw in the table 2) to assess the degree of sensitivity of households to the tax incentives granted for energy efficiency investments.

For the sake of simplicity in our model, a broad estimate of elasticity is sufficient in a first approach. From 2006 to 2009, households who had purchased in the past 2 years a dwelling
constructed prior to 1977 could claim a 40% tax credit rate on their energy efficiency expenditures (higher efficient boilers, insulation materials, etc.) instead of a 25% tax credit rate for the others. For this +15% change in the subsidy rate, the studies showed an average increase of +1 to +28% of the renovation expenditures in 2006, +23% to +47% in 2007 and +27% to +41% in 2008. Those results suggest that the elasticity to subsidium might probably be within the 0 to +3.2%/ range, so the elasticity to the average remainder between 0 and –3.2%/.

In a first approach for our modelling to fit better to reality, we will therefore consider an elasticity to the average remainder of –3%/%, and we will use the [0 ; –3] range for our sensitivity analysis. Besides, as modest households might be more sensitive to the remainder than wealthy households, the elasticity for the latter will be taken closer to zero than for modest households.

2.3.3.2.3 The necessity of an iterative modelling

After implementing this elasticity in the number of renovation gestures, and consequently the link between the tax credits and premiums that will be demanded depending on the remainder (and therefore depending on the A and B coefficients), the last step of the process is to realise iteration in order to make the budget converge towards its objectives.

Indeed, a change in the coefficients A and B to adjust the budget will impact the number of tax credits and premiums and will have a retroactive effect on the budget. Let us take an example: imagine a situation where \( A = B = 8€/\text{MWh} \), giving a specific list of lump sums subsidies and associated remainder per category of works. The elasticity will give the number of tax credits demanded, for example 300 000, and the total budget would be for example 800M€.

However this is lower than the target budget: we then decide to increase A and B to 10€/MWh, which increases the number of tax credits demanded to 500 000 via the elasticity. But with those number, the budget is exceeds the target, so we have to decrease the coefficients A and B, and so on. The process is similar for the premiums, with the subtlety of the multiplying factors for modest households that also need to be adjusted individually: the higher the budget, the more we can afford to give a lot to each category of beneficiaries, whereas with a more constrained budget, choices of envelopes per category must be made.

This iterative process was made "manually" in the scenarios, as it seemed too time consuming to plug an optimisation algorithm given the number of parameters, constraints and the few number of scenarios that would be created. It would not have been possible simply with the tables as there would be self-determined values looping on themselves.

Finally, the "reference scenario" used as a reference for the implementation of elasticity (the scenario on which everything is based) was obtained thanks to a detailed analysis using an "Energy-Fiscality system Model" called MENFIS (Modèle Energie-Fiscalité in French): this model, developed by the Environment and energy agency (ADEME), is one of the most accurate to simulate energy systems within their social context, taking into consideration both technical parameters of energy systems, as well as behavioural and economic impact of individuals and policies through the years.
2.4 Scenarios and sensitivity analysis of the new policy instrument

In this section, we will present the different scenarios resulting from the design process implemented according to the above methodology on the side of the Ministry of ecology (noted MTES in French) and the Ministry of territorial cohesion (noted MCT). In addition, these scenarios are compared with those proposed by the Ministry of Economy and Finance (noted MEF) and the Ministry of action and public accounts (noted MACP), according to their own methodology. These are the exact scenarios that were presented to the ministers at a meeting on 29 May 2019 on the reform of CITE.

2.4.1 Different scenarios with various political and technical impacts

2.4.1.1 Typology of scenario supported by each administration

Although the design of scenarios is the result of joint work between administrations, it is necessary to keep in mind that each administration seeks to defend its interests, and that the game of negotiation between services makes it possible to reach a compromise that takes into account these sometimes divergent positions.

Two main types of scenarios were thus produced for this reform, the first in consultation between the MTES and MCT, the "technical" ministries, and the second by the MEF and MACP, the "economic" ministries. These different scenarios meet political, technical and budgetary objectives as well as design methodologies that are specific to each ministry.

2.4.1.1.1 Scenarios proposed by the MTES/MCT
The scenarios produced by the MTES/MCT have the following characteristics:

- Objective of the overall tax credit + premium envelope between 800 M€ and 1.6 bn€, so as not to decrease too much compared to previous years of the tax credit (2 bn€ of tax expenditure in 2018, 1.1 bn€ planned for 2019)
- Reduced number of eligible work categories: work with similar orders of magnitude of subsidies will benefit from the same rounded lump sum subsidies
- Number of categories of beneficiaries reduced: very modest, modest, non modest of deciles 5 to 8, non modest of deciles 9 and 10, landlords and condominiums assisted by the ANAH
- Multiplying factors to improve lump sums for modest households and degressivity to reduce those for wealthiest households
- Calculation of the remainders in relation to the percentage of the total cost of the work
- Implementation of the elasticity to the average remainder compared to the reference scenario at 1.2 bn€.

2.4.1.1.2 Scenarios proposed by the MEF/MACP

The scenarios produced by the MEF/MACP take a completely different form, and we will only present them in general terms, since they do not fully comply with the methodology described in the previous section. These scenarios were sent to us very shortly before the ministerial meeting, which did not allow the MTES/MCT to analyse the underlying assumptions precisely. Nevertheless, it can be said that these scenarios have the following characteristics:

- Objective of the overall tax credit + premium envelope between 400 and 800 M€ for budgetary savings
- Construction of different lump sum scales for each income decile, not by broad modest/non-modest categories
- Households in deciles 6 or 7 to 10 are automatically excluded from the scenarios, including a strong windfall effect according to these ministries; nevertheless, the renovations that these excluded deciles would carry out even without public support are included in the total renovations count
- Multiplying factors to improve flat rates for modest households and to reduce those for the better-off
- Calculation of the remainder in relation to the reference tax income and not relatively to the cost of the work
- Implementation of the elasticity to the average remainder compared to the reference scenario at 1.2 bn€
- In all scenarios, the residual tax credit for households not eligible for the ANAH is removed and fully converted into a premium.
Elements of critics of the scenarios proposed by the MEF/MACP:

- The proposed budget target represents a reduction from 2 to 4 times in the budget allocated to this major energy renovation program, while the political commitment to increase the number of renovations has been reaffirmed several times by the President of the Republic.
- The construction of lump sums scales per income decile certainly allows a great finesse in the distribution of public subsidies, with a very redistributive scale, but is fundamentally inoperative with regard to the complexity of its distribution by the public services and its illegibility for households.
- Deciles 6 to 8 can in no way be considered as wealthy, so public aid is needed to encourage these households to carry out renovation works.
- The total number of renovations displayed in the scenarios takes into account those carried out among the wealthiest households, even though they would no longer receive public subsidies, with the sole objective of artificially inflating the results of these scenarios.
- The complete suppression of the tax credit and its transformation into a premium clearly shows the MEF/MACP’s desire to abolish the tax credit and to have more control over the budget allocated to the premium replacing it, aiming at more control over the expenditure and significant budgetary savings.

2.4.1.2 Elements of comparison between the scenarios

In addition to being able to compare the methodology used for scenario construction by different administrations, we need to be able to compare the expected results of each scenario, which will be decisive for the arbitration on the selected scenario and the associated lump sum amounts.

The following results will therefore be used primarily for comparison and arbitration, and are strongly linked to the indicators described in part 2.3.2.4:

- Overall envelope of the scheme, with the breakdown of the envelope between premium, HM Serenity bonus and residual tax credit (in percentages and absolute values).
- Number of premiums, HM Serenity bonuses and tax credits allocated to each category of recipients.
- Possibly: average remainders, with and without windows replacement by category of beneficiaries, as well as the distribution of the general envelope, which also includes the ANAH grants from the whole HM Serenity program for modest households (and not only the bonus of this program implemented in the reform).

These elements can also be compared with the current situation, in particular the distribution of the pre- and post-reform envelope according to the categories of recipients, in order to fully appreciate the fundamental change in the logic of public subsidies for renovation, further rationalised in favour of low-income households.

2.4.2 Scenarios presented for the political arbitration

2.4.2.1 Expected effects of each scenario

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8Subsidising window replacement is indeed a fairly sensitive subject in the renovation sphere: it represented nearly 40% of the expenditure declared to CITE in recent years, with more than 600 M€ of associated tax credit, and the professional sector is very powerful, while scientific and technical studies by the public agencies ADEME and CSTB show that it is the least efficient action in terms of energy savings per euro invested, compared to insulation of walls or roof, for example.
For the presentation of the results of each scenario, tables and graphs will be used to better visualise the impact of these scenarios, and to see the influence of the input parameters on the output expectations of the instrument.

### 2.4.2.1.1 Scenarios proposed by the MTES/MCT

As a first approach, the table 4 presents the main results of the MTES/MCT scenarios.

<table>
<thead>
<tr>
<th></th>
<th>Scenario 1: Strong budgetary savings</th>
<th>Scenario 2: Constant budget</th>
<th>Scenario 3: Normal trend</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Global envelope</strong></td>
<td>€830 M</td>
<td>€1 200 M</td>
<td>€1 600 M</td>
</tr>
<tr>
<td><strong>Total number of recipients</strong></td>
<td>535 000</td>
<td>642 000</td>
<td>893 000</td>
</tr>
<tr>
<td>Recipients of the premium</td>
<td>76 000</td>
<td>105 000</td>
<td>107 000</td>
</tr>
<tr>
<td>% of the envelope</td>
<td>31%</td>
<td>35%</td>
<td>28%</td>
</tr>
<tr>
<td>Recipients of the HM Serenity bonus</td>
<td>64 000</td>
<td>76 000</td>
<td>76 000</td>
</tr>
<tr>
<td>% of the envelope</td>
<td>15%</td>
<td>14%</td>
<td>11%</td>
</tr>
<tr>
<td>Recipients of the residual tax credit (non modest)</td>
<td>395 000</td>
<td>461 000</td>
<td>710 000</td>
</tr>
<tr>
<td>% of the envelope</td>
<td>54%</td>
<td>51%</td>
<td>61%</td>
</tr>
</tbody>
</table>

Table 4: Presentation of the main results in terms of envelope and number of recipients per measure in the three scenarios submitted to arbitration by the MTES/MCT.

1 The budget for scenario 2 is stable compared to the tax credit budget for the 2018 works, which represents a net saving compared to the average annual cost of CITE, i.e. 1.6 bn€ (reference taken in scenario 3).

2 Excluding the 50 M€ budget of the current ANAH program HM Agility, which will merge with the CITE to form the future premium for modest households.

The following graphs now show the breakdown of the envelope between the different categories of recipients. For the sake of simplicity, this analysis covered only homeowners, modest or not, as well as scenarios 1 and 2, (because scenario 3 was requested later and could not be subject to this analysis). The graphs are given in percentages and absolute values (there are the two envelopes of 830 M€ and 1 200 M€ for scenarios 1 and 2 and the tax credit of 2018 at 1 953 M€).

Figure 15: Distribution of the CITE envelope alone among the different categories of recipients, in scenarios 1 and 2 and with the reference of the 2017 works. 

*TMO = very modest, MO = modest.*

A comparison with the reference situation of the 2017 work (CITE tax expenditure in 2018) is also provided for information purposes. It is clear that the reform has a redistributive effect, limiting the benefit of the scheme for the wealthiest households and increasing public assistance.
to low-income households, with the ultimate objective of significantly reducing the remainders costs for these households.

It is interesting to have a more global vision of direct subsidies, by also counting in this distribution the subsidies of the ANAH in its classic programs "Habiter Mieux", about 500 M€ in 2019, mainly on the HM Serenity program (cf. figure 16). This shows the distribution of the total budget of the two major direct public financing schemes (i.e. excluding eco-loans and VAT at reduced rates) for low-income households.

Figure 16: Distribution of the CITE envelope and "Habiter Mieux" program of the ANAH among the different categories of recipients, in scenarios 1 and 2 and with the reference of the 2017 works.

\[ TMO = \text{very modest}, \ MO = \text{modest.} \]

### 2.4.2.1.2 Scenarios proposed by the MEF/MACP

Unfortunately, we do not have the same graphical representations for the scenarios proposed by the MEF/MACP, and in a rather logical way since these scenarios were carried out according to a significantly different methodology and design tool. We will simply hand over the results presented to the ministers, without the detailed scenario analysis we were able to do on the scenarios presented by the MTES/MCT.

The proposal to submit five scenarios, which are not very different from each other, to the ministers on the MEF/MACP side for arbitration is an additional argument in favour of the inoperability and lack of pragmatism of the scenarios proposed by the MEF/MACP. However, we put them back in full in the table below.

<table>
<thead>
<tr>
<th>Eligible deciles</th>
<th>Scenario 1</th>
<th>Scenario 1 bis</th>
<th>Scenario 2</th>
<th>Scenario 2 bis</th>
<th>Scenario 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Deciles 1 to 6</td>
<td>Deciles 1 to 5</td>
<td>Deciles 1 to 6</td>
<td>Deciles 1 to 5</td>
<td>Deciles 1 to 10</td>
</tr>
<tr>
<td>Global envelope</td>
<td>400 M€</td>
<td>400 M€</td>
<td>600 M€</td>
<td>600 M€</td>
<td>800 M€</td>
</tr>
<tr>
<td>Total number of recipients</td>
<td>240 000</td>
<td>205 000</td>
<td>275 000</td>
<td>235 000</td>
<td>610 000</td>
</tr>
<tr>
<td>Recipients of the premium</td>
<td>55 000</td>
<td>70 000</td>
<td>75 000</td>
<td>85 000</td>
<td>80 000</td>
</tr>
<tr>
<td>% of the envelope</td>
<td>43%</td>
<td>55%</td>
<td>46%</td>
<td>54%</td>
<td>44%</td>
</tr>
<tr>
<td>Recipients of the HM Serenity bonus</td>
<td>70 000</td>
<td>70 000</td>
<td>70 000</td>
<td>70 000</td>
<td>70 000</td>
</tr>
<tr>
<td>% of the envelope</td>
<td>20%</td>
<td>20%</td>
<td>20%</td>
<td>20%</td>
<td>15%</td>
</tr>
<tr>
<td>Recipients of deciles 5 and above (non modest)</td>
<td>115 000</td>
<td>65 000</td>
<td>130 000</td>
<td>80 000</td>
<td>455 000</td>
</tr>
<tr>
<td>% of the envelope</td>
<td>37%</td>
<td>25%</td>
<td>37%</td>
<td>29%</td>
<td>41%</td>
</tr>
</tbody>
</table>

Table 5: Presentation of the main results in terms of budget and fiscal envelope and number of recipients per scheme in the five scenarios submitted to arbitration by the MEF/MACP. The scenario 3 of the MEF/MACP is the one that can be most comparable to the MTES/MCT scenario 1 in terms of envelope.
It is logical to observe that by having a more constrained budget envelope, fewer premiums, HM Serenity bonuses and tax credits are distributed.

Nevertheless, it is noted that the decrease is not as obvious as the associated budgetary restriction. Similarly, for an equivalent budget of 800 M€ the MEF/MACP scenarios result in significantly more recipients (> 600,000) than the MTES/MCT, due in particular to a larger number of recipients of the residual tax credit. There is undoubtedly a strong "scattering" effect given the target budget envelope and the number of renovations it would fund, which does not suggest a sufficient rate of support for these deciles to trigger renovation work (it should be noted that deciles 5 to 8 cannot be considered as wealthy at all).

2.4.2.2 Underlying technical characteristics of the scenarios

For information, to allow the reader to better understand what is behind these scenarios, we will also briefly present the technical underpinnings that lead to the results of the budget envelope and the number of recipients above.

2.4.2.2.1 Parameters independent of the scenarios

Energy saving certificate (white certificate) remuneration tariff: in our scenarios, in accordance with studies conducted by the DGEC, the white certificate remuneration tariff was set at 5.5 €/MWh, which was the current rate in 2019. A change in this value on the certificate valuation market would require a review of the sizing of the lump sums levels.

<table>
<thead>
<tr>
<th>Tariff white certificates</th>
<th>5.5 €/MWh</th>
</tr>
</thead>
</table>

Table 6: white certificates remuneration tariff applied in the MTES/MCT scenarios.

Capping rates: to avoid over-subsidising some renovation works, particularly because of the multiplying factors applied for modest and very modest households, we had to cap the aid for these households above a certain threshold.

The capping is obviously calculated by taking into account all the aids, i.e. premiums but also white certificates, and in the case of the HM Serenity subsidy, after deduction of the aid from the whole HM Serenity program and the average local governments subsidies. The latter are indeed almost systematic according to the National Housing Agency, and on average around 10% of the cost of the works.

<table>
<thead>
<tr>
<th>Capping rate</th>
<th>Premium</th>
<th>HM Serenity bonus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modest households</td>
<td>80%</td>
<td>70%</td>
</tr>
<tr>
<td>Very modest households</td>
<td>100%</td>
<td>90%</td>
</tr>
</tbody>
</table>

Table 7: Capping rates applied for modest and very modest households.

These capping rates were set at those usually used by the ANAH. The capping rate at 100% for very modest households does indeed mean that a remainder equal to zero for the homeowner is allowed for these households, like other market offers that are currently flourishing on the French market for changing boilers or insulation.

Elasticity: as presented in part 2.3.3.2, the elasticity has been set at –3%/% relatively to the percentage of average remainder for modest and non modest households in deciles 5 to 8. On
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<table>
<thead>
<tr>
<th>Modest households and deciles 5 to 8</th>
<th>Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deciles 9 and 10</td>
<td>$-3%/%_{\text{average remainder}}$</td>
</tr>
<tr>
<td></td>
<td>$\approx 0%/%_{\text{average remainder}}$</td>
</tr>
</tbody>
</table>

Table 8: Elasticity applied in the MTES/MCT scenarios.

The other hand, it has been set close to zero for deciles 9 and 10, which will tend to be less sensitive to a change in the rest to pay.

Other technical parameters are derived from the ADEME and CSTB studies, but do not need to be presented here for the simplicity of this report.

2.4.2.2.2 Multiplying and degressivity factors

For each scenario, different multiplying factors were used to adjust the distribution between categories of recipients to the size of the envelope: the more constrained the budget, the more likely it is that modest households will be favoured, so as not to increase their remainders too much and avoid a "scattering" effect of public money.

The following table 9 presents the factors used in scenarios 1 and 2 of the MTES/MCT. By definition, the factors for households in deciles 5 to 8 are equal to 1: they benefit from the basic lump sum scale calculated using the sizing tool.

<table>
<thead>
<tr>
<th>Premium HM Serenity bonus Residual tax credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMO MO TMO MO Deciles 5–8 Deciles 9–10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scenario 1 : 830 M€</th>
<th>Premium</th>
<th>HM Serenity bonus</th>
<th>Residual tax credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMO</td>
<td>3.5</td>
<td>1.2</td>
<td>1</td>
</tr>
<tr>
<td>MO</td>
<td>2.8</td>
<td>1</td>
<td>0.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scenario 2 : 1,2 bn€</th>
<th>Premium</th>
<th>HM Serenity bonus</th>
<th>Residual tax credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMO</td>
<td>4</td>
<td>1.5</td>
<td>1</td>
</tr>
<tr>
<td>MO</td>
<td>3</td>
<td>1.2</td>
<td>0.7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scenario 3 * : 1,6 bn€</th>
<th>Premium</th>
<th>HM Serenity bonus</th>
<th>Residual tax credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMO</td>
<td>4</td>
<td>1.5</td>
<td>1</td>
</tr>
<tr>
<td>MO</td>
<td>3</td>
<td>1.2</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 9: Multiplying factors applied for homeowners in the MTES/MCT scenarios.

$TMO = \text{very modest}, MO = \text{modest}.$

* With high performance gas boiler eligible to residual tax credit for non modest households.

In addition, in scenarios 1 and 2, gas boilers were excluded from the tax credit for non modest households (deciles 5 to 10), given the envelope that this equipment represented (100 to 150 M€) and their relatively low impact on reducing greenhouse gas emissions.

2.4.2.2.3 Lump sum scales

Finally, here are the (long-awaited) lump sums that are granted to non modest households in deciles 5 to 8 in single-family homes, from which the lump sums for the other categories of recipients are calculated using the multiplying factors above. These lump sums are only given for scenarios 1 and 2 in single-family homes, for the sake of simplicity.

For example, here is what this would give in scenario 1 to 830 M€ for each category of recipients for the installation of an air-to-water heat pump, whose average cost including labour is around 12 000€, rounded to the nearest hundred euros.

One can identify above the seven categories of renovation works that have been formed by grouping together actions with similar amounts of subsidies, which provides greater clarity for the public.
### Lump sums in single-family homes

<table>
<thead>
<tr>
<th>Description</th>
<th>Scenario 1: 830 M€</th>
<th>Scenario 2: 1,2 bn€</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very high energy efficiency gas boiler (except for non modest households)</td>
<td>700 €</td>
<td>800 €</td>
</tr>
<tr>
<td>Log stoves, fireplace, insert</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Efficient renewable heating system (wood boiler, air/water and</td>
<td>3 100 €</td>
<td>3 400 €</td>
</tr>
<tr>
<td>geothermal heat pump, combined solar heating)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pellet stove, individual solar water heater, double flow ventilation</td>
<td>1 000 €</td>
<td>1 000 €</td>
</tr>
<tr>
<td>Thermal part of a PV equipment, district heating and cooling,</td>
<td>500 €</td>
<td>500 €</td>
</tr>
<tr>
<td>removal of oil tank</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage water heater, energy performance diagnosis</td>
<td>200 €</td>
<td>200 €</td>
</tr>
<tr>
<td>Isolation of windows and opaque faces (walls, floor, attic),</td>
<td>16 €/m²</td>
<td>18 €/m²</td>
</tr>
<tr>
<td>excluding isolation of walls from the outside</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isolation of walls from the outside</td>
<td>36 €/m²</td>
<td>16 €/m²</td>
</tr>
</tbody>
</table>

Coefficients A and B, for information

A = B = 9.2 €/MWh
A = B = 10 €/MWh

Table 10: Lump sum scales calculated in scenarios 1 and 2 of the MTES/MCT.

<table>
<thead>
<tr>
<th>Scenario 1: 830 M€</th>
<th>Premium</th>
<th>HM Serenity bonus</th>
<th>Residual tax credit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TMO</td>
<td>MO</td>
<td>TMO</td>
</tr>
<tr>
<td>Example for a air/water heat pump</td>
<td>10 900 €</td>
<td>8 700 €</td>
<td>3 700 €</td>
</tr>
</tbody>
</table>

Table 11: Example of premium and tax credit levels for homeowners for an air-to-water heat pump in scenario 1 to 830 M€.

TMO = very modest, MO = modest.

### 2.4.2.2.4 Rest to pay/remainder

In addition, the sizing tool makes it possible to provide the average remaining costs associated with each scenario, for each aid scheme (premium, HM Serenity bonus, residual tax credit) and for each category of recipients and each renovation action, after adding up the premium or tax credit + HM Serenity program + white certificates. As a reminder, the level of public support reflects the energy performance and integration of renewable energy for each of the works, an objective that is at the heart of the reform.

An average is made to display an overall target of remainder for each category of recipients, regardless of the renovation action undertaken. It is important to note that this average remainder does not represent a systematic reality, and will depend on each renovation action and household situation.

One of the objectives of the reform is to introduce differentiated support according to the energy performance of the actions supported. The average remainder calculated for each category of households therefore covers a set of actions with a wide disparity in support rates. The main action that significantly increases the average remainder is the insulation of the windows (due to the very high cost of this work for an energy benefit comparable to that of the insulation of the opaque walls). This explains why it was deliberately chosen to display only average remainders that do not take into account windows replacement in the graph above.

It is also interesting to observe the evolution before/after reform of the remainder for some examples of renovation work. The works are chosen to represent several possible interventions: two more or less expensive renewable energy equipment (air-to-water heat pump and pellet stove), as well as two more or less expensive insulation interventions (insulation of windows and insulation of walls from the outside). The scenario 2 at 1.2 bn€ was chosen for this comparison.
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Figure 17: Average remainder, excluding windows replacement, for each category of recipients in scenarios 1 and 2 of the MTES/MCT. 
TMO = very modest, MO = modest.

Figure 18: Remainder before and after reform, for each category of recipients, for four examples of renovation work. 
TMO = very modest, MO = modest.

We can clearly see the effect of the reform of lump sum subsidy and support for low-income households:

- Renewable systems and efficient insulation equipments are better supported overall, or *a minima* with a similar level of support for non modest households

- The assistance provided for window replacement is almost unchanged or even reduced, reflecting the poor energy performance of this type of renovation work

- The works are generally more improved for modest households than for others, or even less helped for the wealthiest households, with very low targets of remainders for very modest households.
2.4.3 Testing the robustness of the scenarios: sensitivity analysis

It is essential when designing a policy (or when doing any prospective modelling) to perform sensitivity analysis to evaluate, if possible independently, the degree of influence and uncertainty of each parameters used and hypothesis taken in its elaboration. It is all the more so important since we are talking about a 1 billion euros policy with major impacts on energy consumption and greenhouse gas emissions.

2.4.3.1 Choice of the study parameters

Which parameters to use to analyse the robustness of the scenarios? Which hypothesis is deemed frangible enough to require more in-depth study of its impact on the overall policy? Oddly enough, the administration hosting this thesis was not particularly involved into performing those sensitivity analysis, as if a 100 million budgetary slippage were a risk to take carelessly. After all, on a 1 billion euros policy in a 300 billion euros State budget (without Social Security expenditures), and given the level of uncertainty on this reform of the tax credit, the position of the administration is understandable.

Nevertheless, the following parameters or hypothesis were looked at in more details:

- Sensitivity to the elasticity parameter, within the \([0 ; -3\%/\%]\) range as explained before, to reflect the impact of an apparently harmless parameter of the model
- Sensitivity to the white certificates remuneration tariff, which is a parameter reflecting on aspect of the market and economic uncertainty
- Sensitivity to the perimeter of eligible recipients, especially the opening of the tax credit to lessors and landlords for the renovation works they would carry out in the housing they rent.

These sensitivity analysis will be performed on the MTES/MCT scenario 1 at 830 M\(\)€, which is most likely to be close to the final arbitration given its median nature between the MTES/MCT and MEF/MACP scenarios.

**Important**: the coefficients A and B used as a basis for the lump sum calculations and the multiplying coefficients for the various categories of recipients were not adjusted during these sensitivity tests. Indeed, this analysis consists in seeing *a posteriori*, once the reform has been implemented and these parameters set, the effect of uncertainty regarding household behaviour (elasticity) and the white certificates market on the overall envelope of the premium and the residual tax credit. Only the numbers of recipients applying for support have been adjusted following the changes in the elasticity and remuneration tariff of white certificates.

2.4.3.2 Behavioural uncertainties: sensitivity to elasticity

The effect of the elasticity on the budget envelope and the number of premiums/tax credits demanded will be analysed by varying the elasticity of demand to the remainder to pay, so consequently the elasticity of demand to subsidy.

The following figure 19 presents a rough assessment of the budgetary variability that would result from an uncertain estimate of elasticity, and therefore of the recourse rate to the public aid. The elasticity parameter is noted E on the graph.

There is a significant increase in the recourse rate to the subsidies, and therefore an increase in the budget, as the elasticity decreases. This is because, compared to the 1.2 bn\(\)€ reference scenario, in the 830 M\(\)€ scenario analysed, the more the elasticity decreases towards 1 and the less
2.4.3.3 Economic uncertainty: impact of white certificates value on the budget

Another type of uncertainty that is interesting to analyse is the effect of the variability of white certificates value, which is essentially market-dependent. Indeed those certificates are bought and sold in a domestic market by energy service providers, on the same system as the European Emission Trading Scheme for greenhouse gas emissions.

A variation in the remuneration tariff of those certificates, between 4 to 10€/MWh for example (most extreme cases), will affect the level of additional subsidy that will be granted to individual for their renovation works, therefore their remainder to pay and consequently the number of renovation actions realised and the recourse rate to public subsidies for those gestures.

There is a very significant increase in the number of subsidies demanded, and therefore an increase in the budget, as the remuneration tariff of white certificates increases. This is because, compared to the 1.2 bureference scenario, in the 830 M€scenario analysed, the higher the certificates tariff increases, the more investments will be triggered, as households will be eligible for higher overall amounts of support by combining premium or tax credit + white certificates. At the most, we reach +54% of expenditure with a tariff of 10€/MWh per certificate compared to the initial scenario at 830 M€.

An incorrect (too low) calibration of the white certificates tariff in the sizing of subsidies could give households a greater incentive to carry out renovation actions, and thus lead to an
2 Real case application: the tax credit for energy transition in France

Figure 20: Sensitivity test of the overall envelope (bonus + HM Serenity bonus + residual tax credit) to a change in the white certificates (noted CEE in French) remuneration tariff.

unexpected increase in public expenditure through a higher recourse rate to the premium or the tax credit (in the case of a premium operating with an open funding such as the tax credit).

2.4.3.4 Regulatory uncertainty: eligibility of lessors to the tax credit

The question of eligibility of the lessors to the tax credit is also a very difficult matter playing on different fields:

− Political: it could be a strong signal to make them eligible to public subsidies on renovation works, as they are not eligible currently (they have been excluded from the tax credit in 2014)

− Budgetary: an opening could represent a very high budget to add to the envelope, with difficulty to estimate the recourse rate as there is no previous empirical data on such tax credit for lessors

− In terms of energy savings: the potential for energy savings is huge among rental housing, especially to eradicate energy "sieves" which represent more than 40% of the private rental stock.

In addition, the INSEE statistics shown in figure 21 below show that the more modest the households, the more they are on average renters of their housing, and the more likely they are to live in housing with poor energy performance. This therefore implies the need to encourage landlords to renovate rented housing (in particular energy sieves), in order to improve the comfort and reduce the energy costs of tenants who can hardly invest in housing that does not belong to them, especially since they are modest households.

Nevertheless, there is currently too little data available to accurately assess the effect on the budget envelope of opening the eligibility of the premium or tax credit to landlords:

− When the tax credit was open to landlords (before 2014), they represented on average 0.5 to 1.4% of the overall envelope of the scheme (data internal to the administration). A conservative estimate of 2% of the envelope was therefore the one used in the design tool

− However, a mission carried out jointly by ADEME and CSTB in 2018 using the MENFIS model (Energy-Fiscality Model) and responsible for evaluating different scenarios for transforming the tax credit into a premium, roughly estimated this opening at around
2. Real case application: the tax credit for energy transition in France

Figure 21: Distribution of owner and tenant households in the private and social park by income deciles.

Source: INSEE, enquête Logement 2013 [25]

10 to 15% of the envelope, if they were eligible under the same conditions as the owner-occupiers [20]

– Finally, the costing on which the DG Trésor and the Directorate of budget relied estimated this opening at 1.8 bn€/year (150 to 200% of the budget!). This estimate has many shortcomings: the number of renovated dwellings is overestimated (3.2 million by 2025, with an underlying future prohibition on the rental of energy sieves that would mechanically trigger almost all investment by landlords), the important amounts of works declared to the tax credit (17 500€ against 5 200€ observed in the current tax credit), etc.

It therefore seems necessary to remain vigilant in view of such variability in the estimates, as the reality is probably more likely to be in the vicinity of the technical estimates made by the ADEME/CSTB mission. In our scenario 1 to 830 M€, this would therefore give an unaccounted-for supplement of 60 to 110 M€ for the benefit of landlords.

2.4.3.5 Assessing the overall impact on the budget

Finally, a scenario combining all the most unfavourable possibilities was analysed in order to see the extent of a budgetary slippage in the event of an unexpected change in these two parameters alone: the elasticity and remuneration of white certificates.

It is interesting to note first of all that a decrease in the elasticity reduces the effect of the increase in the certificates tariffs: households are indeed less sensitive to changes in rest to pay for the works, and therefore incidentally to changes in the certificates tariffs, when the elasticity approaches zero.

As a result, there is a high variability in the expenditure relatively to the elasticity and the certificates tariff: a slippage of up to 15 to 40% of the target expenditure would be expected in the event of an incorrect assumption. It therefore seems necessary to express some reservations about the reliability of the budget estimation for any scenario (MTES/MCT such as MEF/MACP). In any case, the lack of empirical data on the triggering of investment and the propensity to apply for renovation aid, as well as uncertainty about white certificates market prices, do not guarantee either a number of renovations carried out or a target budget envelope.
2.5 Beyond technical aspects: guiding the transformation of a policy instrument

In parallel with the work of modelling and building the scenarios in collaboration with the other departments of the ministries, many other projects are under way with a view to carrying out this major reform of the main subsidy instrument for the energy renovation of private housing. These projects concern both the effective implementation of the future premium by the National Housing Agency (ANAH), the consultations to be carried out with the various technical or legal stakeholders as well as the legislative approach, aiming at adopting the new policy in the budget law for 2020.

2.5.1 The National Housing Agency *(Agence nationale de l’habitat, ANAH)*

2.5.1.1 The DHUP: budgetary and technical supervision of the ANAH

As the National Housing Agency (ANAH) had been appointed by the Prime Minister for the implementation of the future premium for low-income households to replace the tax credit, and the Directorate of Housing, Urban Planning and Landscapes (DHUP) of the Ministry of Territorial Cohesion (MCT) exercising the supervisory role of this agency, it was logical that the DHUP should pilot and co-build this reform hand in hand with the ANAH.

The budgetary supervision of the ANAH is thus exercised by the Housing and Development Budget Office (FE2), within the Housing and Development Financing and Economics Branch (FE), while the "technical" supervision is exercised by the Private Park Office (PH3), within the Housing Policy Branch (PH). A real coordination work between the various services of the Ministry, with the Directorate general for energy and climate (which co-pilots the reform with the DHUP) and the ANAH was therefore necessary for the good progress of the reform.

2.5.1.2 Monitoring of the development and implementation of the premium
Given that the ANAH already carries out energy renovation actions among modest households through the HM Serenity and Agility programs, it seemed logical that it should carry the future premium instrument for these households to replace the tax credit: this allows the agency to rely on its know-how in managing subsidies for these specific households while simplifying the number of actors the public have to face for their renovation works. This explains why the Prime Minister chose the ANAH for the development of the premium.

Thus, there are multi-monthly meetings between the ANAH project team (set up specifically for the implementation of the premium) and the relevant MTES/MCT departments, making it possible to monitor the progress of the project on the ANAH side while exchanging information on developments and arbitrations made on the ministerial side. These frequent meetings also make it possible to discuss technical or budgetary issues that may be problematic for the ANAH and that require clarification or support from the ministries.

The DHUP services also act as a relay and support for the ANAH’s position, in particular with regard to other administrative services (DGEC and economic and finance ministries) but also with regard to ministerial cabinets, in particular those of the MTES and the MCT.

Nevertheless, the agency is quite autonomous and thus continues to develop the project without even waiting for certain final decisions (such as the total amount of the future premium or the precise categories of recipients concerned): the ANAH indeed cannot afford to wait for these arbitrations (which arrive several months late), knowing that the time constraints associated with the service provision contracts for the future premium, the development of IT management systems or the modification of the legal corpus impose a very tight schedule if the deadline for a launch in 2020 must be respected.

### 2.5.1.3 Evaluation of the agency requirements: jobs and budget

One of the missions carried out jointly by ANAH and DHUP is to assess the needs for the implementation of the future premium: these needs are both material, with the implementation of a new IT system for the management of this subsidy, and human, with the provision of staff (ANAH officials or external service providers) for the management, file request examination, distribution and control of the new premium.

Several scenarios were proposed by the ANAH, varying according to the degree of externalisation of the premium management procedure, and quantified in terms of FTE (full-time equivalent) for internal human needs within the agency and in euros for the budget dedicated to the IT system and services:

- Internalised scenario with 66 FTE, including 39 FTE dedicated to file request examination, and 3.7 M€ of external services (including the IT budget)

- Externalised scenario with 27 FTE at ANAH headquarters and 6 M€ of external services, the increase being due in particular to the externalised processing of files.

These estimated needs must be compared both with the current needs of the Directorate generale of public finances (DGFiP) in charge of the current tax credit (the ANAH taking over part of the DGFiP work by transforming the tax credit into a premium) as well as with the proposals formulated by the Service and Payment Agency (ASP) specialised in the distribution of public subsidies, in particular those of the European Common Agricultural Policy. Indeed, the ASP was initially envisaged in 2018 for the distribution of a premium, and was then discarded at the end of 2018 in favour of ANAH when the focus was made on modest households.

The direct comparison between the ANAH and ASP estimates is very difficult, as the figures were made at different periods of the implementation of the reform and were based on radically

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different assumptions, both in terms of the number of premiums distributed (140 000 assumed by the ANAH in scenario 1 of the MTES/MCT at 830 M€, 1 000 000 for the ASP in a scenario of total distribution of tax credit as a premium to all households), control rates (5 to 7% for the ANAH, less than 3% for the ASP), digitisation rates, user assistance, processing time for subsidies, etc.

In fine, all things considered, the proposal for management by the ANAH seems more "expensive" than the one of the ASP (which we have not deliberately included here as a precaution in view of the uncertainties in the assumptions used). However, it should be noted that the ANAH's quality of service is much better, it has the knowledge of the public concerned, and its credit management has been praised several times by the Court of Auditors, in particular thanks to its specific two-step examination process allowing notification of subsidy to households before engaging the renovation works and payment on unpaid invoices: this unique process, which is certainly more costly, is part of the agency’s DNA and provides real security for modest households in their use of public subsidies while minimising the risk of fraud, which is very common in the world of public subsidies for energy renovation.

2.5.2 Public consultations to carry out

In any public policy, it is necessary to carry out different consultations in order to involve the audiences concerned by the different measures, in a co-construction work allowing a better acceptance of the transformations. In addition, consultation with certain specialised bodies is mandatory when the subject concerns very specific areas, such as energy or housing, in this case with the reform of tax credit for energy transition.

2.5.2.1 Technical conciliation with sector professionals

The radical change in the flagship measure of support for housing renovation, the tax credit, will necessarily have an impact on the actors in the buildings energy renovation sector, i.e. companies and craftsmen working in all parts of the country.

A two-stage technical consultation, conducted jointly by the DGEC and the DHUP, is therefore planned with representatives of the main actors in the sector, and may cover the following elements:

- List of eligible renovation actions for the new premium
- Lump sums levels
- Database referencing the detailed technical criteria for the eligibility of the equipments and materials.

This consultation will involve representatives of the French Building Federation and the Confederation of Crafts and Small Building Enterprises, which are the two heavyweight syndicates of the sector, but also representatives of each technical sub-sector such as manufacturers of structural materials, the renewable energy union, the French gas association, etc. The ADEME and the ANAH will also be invited to participate in technical discussions and provide public expertise on the subject.

In view of the trade-offs that are being made or will be made, there will certainly be big winners and big disappointments (for example, the window renovation sector), who will certainly represent their interests at the highest level of the public and political sphere by challenging the methodology used to review this renovation policy. The main challenge will be to convince public decision-makers that subjective adjustments to satisfy individual interests of certain
sectors should not hinder the more global reflection implemented to achieve this reform, where the core objective is to have a redesigned system to promote the most energy-efficient actions.

2.5.2.2 Simple information meeting for local governments and the public

In addition, it is also crucial to conduct effective communication to the general public in order to explain the important changes that are being introduced with this reform. The policy of aid for energy renovation in France has indeed been constantly criticised as being too complex with too many mechanisms, constantly changing and with different eligibility criteria from one measure to another. This is all the more so important since the reform has an impact on the most modest households, which require real support and security in their efforts.

At the minimum, an information meeting for representatives of local authorities, associations of local elected representatives (in particular with a view to the 2020 municipal elections where housing is a crucial subject), consumer associations and other support stakeholders is necessary in order to present the future developments of the new system: the rationale of lump sum for the subsidies, the introduction of the unified premium replacing the tax credit and the increase in subsidies under the HM Serenity program for modest households eligible for the ANAH aids.

2.5.2.3 Compulsory legal consultations

Finally, certain legal consultations are mandatory in order to amend the legislative and regulatory texts concerning the tax credit for energy transition and the ANAH:

- Consultation of the Superior council for building and energy efficiency (CSCEE, *Conseil supérieur de la construction et de l’efficacité énergétique*), giving an opinion on legal texts dealing in particular with the energy renovation of buildings

- The National Housing Council (CNH, *Conseil national de l’habitat*), with several missions including that of giving an opinion on all measures dealing with the rehabilitation of existing housing

- The Revision of the General Regulations of the ANAH, with a view to major technical and budgetary changes on the management of this new premium scheme.

2.5.3 Modification of the legal corpus

In conjunction with the consultation with the above-mentioned bodies, significant changes to the existing legal corpus must be made in order to incorporate the changes presented in this reform into the laws and regulations that will result from it.

Such a redesign of the tax credit and the ANAH subsidies requires amending at least the following texts, with a view to passing the reform into the budget law for 2020:

- General Tax Code (CGI, *Code général des impôts* [17] and [18]), defining the measures relating to the tax credit for the energy transition (eligible households, eligible equipment and works, expenditure limits, tax credit rates, etc.)

- Building and Housing Code (CCH, *Code de la construction et de l’habitation*), defining the measures relating to the National Housing Agency (organisation, missions, resources, power of sanction, etc.) as well as the subsidy schemes and housing assistance policy more generally
2 Real case application: the tax credit for energy transition in France

− General Regulations of the ANAH, which exhaustively set out the legislative and regulatory measures within the agency’s operations (subsidies, recipients, eligibility criteria, file request examination process, etc.).

Nevertheless, although some major arbitrations outlining the main aspects of the reform have been taken, there are still many questions that remain unresolved at the time of writing, the following list is far from exhaustive: sealing or not between the premium and the residual tax credit for modest households, ceilings and rules for adding up premiums, time limits for foreclosure, budgetary channels making it possible to top up the budget for the future premium, management of the instruction on the bonus for the HM Serenity program (currently being examined and distributed at local and not national level), the case of Overseas French territories where the ANAH does not intervene for homeowners, coordination of this national premium with the desire for decentralisation to local territories, etc.

Some of these "technical" questions may seem to be of no major political interest, but their resolution is fundamental to the successful launch of such a large-scale reform. A hasty launch in response to political or electoral objectives (before the 2020 municipal elections, for example) could lead to an industrial accident, as repeatedly reported by the ANAH, which already has to manage a major disruption in its missions.

2.5.4 Production of documents for communication and arbitration

Another mission but as important as the other consists in the production of explanatory notes or presentations to support reflection within the administration and at the level of the ministerial cabinets.

In order to arbitrate on the main orientations of the tax credit reform (envelope, recipients, articulation of mechanisms, etc.), successive files had to be prepared before the inter-ministerial meetings to present the approach, hypotheses, ins and outs of each of the scenarios. Associated with the table for calculating the lump-sum scales of the new premium and the residual tax credit for non modest households, there were also explanatory annexes validated within the services, intended in particular for ministerial cabinets.

It was also necessary to prepare presentations for the ministers, in order to enable them to take decisions on this highly technical and topical subject concerning energy renovation, a major issue in the ecological transition. However, it is difficult to remain clear and synthetic with a reform whose implementation is dragging on and when many crucial decisions have not been taken and are accumulating.

Of particular note is the important collaborative work between the different offices of DHUP and DGECE to reach a common position: this allows, at the cost of some compromises, to give a stronger voice to the "technical" ministries (represented by four ministers and secretaries of state) in the negotiation of arbitrations before the economic and financial ministries.

2.5.5 Transversal support for other subjects on the energy renovation

This mission within the DHUP Financial Aid Office was also an opportunity to participate and provide support on other topics related to energy renovation. As we saw in the second part, there is a constellation of policy instruments around energy renovation, which are grouped around a single objective which is that of 500 000 renovations per year.

For example, the following contributions that were realised can be mentioned:
− Monthly monitoring and updating of indicators for the following of policy instruments dedicated to the private housing park renovation: zero-rate eco-loan, eco-loan for social housing, white certificates, National Housing Agency programs, national public information campaign9 of the ADEME, etc.

− Notes to ministerial cabinets on topics related to energy efficiency

− Description sheets for the future public information platform of the ANAH

− Guide to the ADEME financial aid guidebook [26] and information leaflet on all housing aids [27] produced by the DHUP Financial Aid Office

− OECD survey on national housing renovation support schemes

− Third-party financing companies and Action Logement’s voluntary investment plan

− Participation in the meetings of the Technical Committee of the Buildings Energy Renovation Plan (PREB) and the Sustainable Building Plan meetings

− etc.

In summary, each time a subject dealing with energy renovation arises, there is a contribution to be made, language elements to be corrected or added, more or less rigorous figures or estimates to be provided (depending on the data available and the deadlines), even if it is only a review to confirm what other services may have proposed, in order to include all the offices in the contribution chain. There is thus a proliferation of subjects in central administration, which makes it difficult to carry out the substantive or analytical subjects that could benefit services in the longer term.

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9FAIRE campaign: Facilitate, Support and Inform for Energy Renovation, a campaign launched in September 2018 by the MTES/MCT and led by ADEME, with the aim of "bringing together all public and private actors in energy renovation and renewable energies and making their offer readable."
3 Discussion: the design of a policy instrument and its ex ante evaluation

3.1 Pitfalls of a biased, time- and data-constrained modelling

Although the quantitative analysis carried out using the methodology described above presents many pitfalls, it should be noted that it is very difficult to carry out such an evaluation ex ante of a new instrument meeting strong energy and political objectives.

The almost total lack of accessible individual data on the recipients of the current tax credit, on its incentive effects as a central mechanism for the energy renovation of private housing stock, as well as on some assumptions made in consultation between services but without real assurance that they systematically reflect reality, are among the main difficulties and sensitive points of this design. In addition, positions that are sometimes specific to each department can bias the analysis, as each department tries to express its point of view through certain scenarios, values or assumptions taken... Continuous vigilance is therefore necessary throughout the inquiry and the negotiations.

In particular, the lack of effective use of sensitivity analyses (or the absence of clear orders to carry out others) in the development of the policy is to be deplored, in view of the budgetary consequences that a poorly calibrated design could have. Similarly, the relevance of an elasticity model as presented in section 2.4 will also be questioned, especially when the rest to pay for the households approaches zero.

It would thus be necessary to be able to evaluate ex post, one or two years after the transformation of the tax credit into a lump sum and a premium for modest households, in order to be able to analyse both the effect on the renovation actions and the energy performances achieved thanks to the lump sum mechanism but also the incentive effect due to the transition from a tax credit to a single premium perceptible at the time of the renovation works.

Nevertheless, in any case, the new method of calculating subsidies for energy renovation as presented represents a major step forward compared to the current situation: we are moving from a simple percentage of a tax credit, chosen in a rather basic way, uniform for all renovation actions and all households, to a real tailor-made renovation scheme, adapted to the financial situation of each household and reflecting the energy performance of the work in terms of energy savings or renewable energy integration. This necessarily requires a more complex system to be able to meet real climatic, social and budgetary expectations that are sometimes difficult to reconcile.

3.2 Beyond the divergences between administrations to reach an optimal compromise

It is sometimes difficult to assert the position of the administration on certain subjects, such as the overall budget to be allocated, its distribution among the categories of recipients (and the definition of the categories of recipients themselves), on the supervision of the ANAH, etc. The divergence between "technical" ministries VS. economic and financial ministries is the most obvious on many subjects with a budgetary/tax impact.

These divergent positions are all the more difficult to reconcile when it comes to producing a joint communication or arbitration document between the services, as the experience had to be
made several times during the mission. Everyone agrees that it is necessary to act quickly and forcefully, but there is a structural impossibility of reaching agreement on such subjects, given the colossal size of the project and the limited resources (particularly financial).

We are therefore faced with an almost inextricable puzzle between energy performance, social dimension of the fight against energy precarity, and efficiency of public spending. However, the energy renovation of housing is really one of the few areas that reconciles the challenges of energy transition and household expectations in terms of quality of life and purchasing power. The renovation of private housing is thus a lever of attractiveness of territories and a factor in boosting private investment, for which there is no shortage of ideas for incentive or financing schemes, but which articulation remains extremely complex: this is perceptible from the point of view of the recipients, for whom public help for renovation could not be more opaque and indigestible.

Moreover, the importance of unspoken words and the transmission of information is crucial: when a particular department does not explicitly state its position to others, when it will seek to assert it through last-minute arbitrations by its hierarchy, when a particular office is not, voluntarily or not, included in a loop of e-mails and when the subject is kept in the background for more than a week, when a ministerial adviser presents more affinities with a department and leaves the other departments concerned aside, etc. These are all concrete situations that must be detected and analysed in order to make the right decisions, and to transmit or seek the right information accordingly.

3.3 "White elephant" or pioneering policy allying climate strategy, social justice and efficiency of the public expenditure?

3.3.1 The demography of public policies

It should be noted that in many public policies, there is a very fluctuating "demography" of the rules and mechanisms put in place. This can be understood as such: the launch of a new public policy, led by an ambitious government and full of experts of good will, leads to a very dynamic and unstable implementation period. Then, in view of the complexity for the user, who is almost always the final recipient, there is a desire to simplify all these mechanisms (most often at the whim of a political alternation) and stabilise them for a few years. Finally, inevitably, when budgetary, technical, environmental or social constraints appear, there is a return to complexity, in order to ensure the efficiency and performance of the system (and budgetary savings).

This process corresponds exactly to the history of tax credit for energy transition: between its launch in the form of the Sustainable Development Tax Credit in 2005 and 2014, eligibility criteria and tax credit rates have changed almost every year, due in particular to a desire to subsidise certain equipment, but also due to an explosion in tax expenditure in 2008–2009, followed by a first attempt at rationalisation over a few years to limit public spending (as shown in figure 9 and table 3). Then a political decision (led by the Minister of Ecology Ségolène Royal) to drastically simplify the system took place in 2014, with a uniform rate of 30% for all works, until 2018 with the reduction of subsidies for windows replacement.

We are therefore currently witnessing the third phase of the instrument’s life, where the blatant lack of effectiveness of public spending (high subsidy for replacing windows that are not the most energy-efficient works, very low envelope oriented towards modest households, etc.) is leading to a fundamental change in order to meet the new requirements that a tax credit in its
current 30% form did not meet: energy performance, social equity, fight against energy precarity and the efficiency of public spending.

3.3.2 A major challenge for households and businesses

We mentioned at the beginning of the report the difficulty for the millions of households suffering from energy precarity in France to be able to pay their energy bills; moreover, the most modest households are statistically those who are most at risk of living in a dwelling with poor energy performance (energy sieves).

Very recently, the 5.9% increase in the regulated electricity tariff at the beginning of June 2019 recommended by the Energy Regulation Commission (CRE, Commission de régulation de l’énergie) confirms the idea that the structural increase in energy costs, linked to technical and market reasons, against which no political goodwill can fight, is a major issue for all those households that already cannot heat themselves decently and provide for their current energy needs. The reduction of energy demand, via the energy renovation of housing, is therefore the most efficient lever with the greatest chance of success for all these households, provided that they are supported and helped in this difficult approach because it affects their most valuable property.

Let us not kid ourselves, the public policy of supporting the energy renovation of buildings is also a policy of support for the renovation industry, with tens or even hundreds of thousands of small businesses and craftsmen, which could not survive as it stands without public intervention to encourage renovation actions in households. Reduced VAT and tax credit are thus the main public financing instruments to support this sector, with two to three billion euros per year of tax expenditure in recent years, certainly at the cost of an inflationary effect on the cost of the works. Jobs linked to the construction sector, in particular the renovation/rehabilitation sector, cannot be relocated either, and contribute to the attractiveness and dynamism of the territories’ industrial and economic activity.

3.3.3 A complex policy more adapted to the different needs

As we have explained on many occasions, it is possible to be energy efficient while at the same time pursuing social policy and rationalising public spending. The whole question is how to properly size the system, so that the intrinsic complexity necessary to reconcile these different objectives does not turn into an abstruse ”white elephant” that would discourage households, especially the most modest, those who would benefit the most from these subsidies.

However, we must not go to the extreme, thinking that we can have enough renovations by constantly reducing the budget allocated, or thinking that if we impose regulatory measures (for example, banning the rental of energy sieves) then the renovations will be carried out regardless of the public assistance provided.

For nearly fifteen years, the tax credit for energy transition has been the flagship measure for financial support for the renovation of private housing stock, and it is essential to preserve this system in one form or another (with a premium for example) in order to maintain a dynamic of housing renovation, the only way to achieve our objectives of combating climate change and reducing energy consumption, which are now the challenges of our generation and those to come.

Around the tax credit there is a constellation of instruments, regulations, incentives, and each stakeholder seeks to take advantage of this complex situation. Do we have to rethink everything

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10 white elephant: something uselessly complicated.
to relaunch energy renovation from scratch? Should we keep the existing policy instruments, which have more or less proved their worth, try to align them with each other and simplify their articulation? Before answering these questions, the question of better monitoring the number of renovations must be resolved first: the indicators necessary for effective public policy monitoring are extremely important, and this is one of the current pitfalls of monitoring energy renovation. An observatory dedicated to energy renovation, currently being developed between the administrations, will undoubtedly help to clarify the accounting for renovations and the achievement of our objectives.

3.4 Evolution and proposal of improvement of the French policy instrument

3.4.1 Prospect of evolution of the mechanism

What are the possible evolutions of the new package [ premium + residual tax credit ] which is currently under development? Is the current reform only a first step towards a more global change, a redesign of support for the energy renovation of housing?

First of all, it should be recalled that the change made with this reform of the tax credit is quite radical, with many uncertainties about the propensity of households to carry out renovation work following the lump sum payment and the conversion into a premium for modest households. It would therefore be necessary to be able to evaluate *ex post* the new scheme, compare its results in terms of renovations triggered, public aid distributed, etc. and adapt the measure for future years (levels of lump sums, recipients and eligible works...).

One possible development, which recently became almost official following Prime Minister Édouard PHILIPPE’s general policy statement on June 12th 2019 in the National Assembly [28], is the complete disappearance of the tax credit and its transformation into a premium paid at the time of the work for all households.

« We will completely overhaul existing support for energy renovation. Because these aids are of appalling complexity. That they actually benefit the richest households. We will therefore transform the tax credit for energy transition into a more massive assistance for those who need it most. »

This announcement, which has been anticipated in the administrations for several months and strongly supported by the economic and financial ministries, raises various questions:

− Which households will be eligible for this future premium? All households like the current tax credit? All households except the wealthiest of the 9–10 deciles? Only modest households eligible for ANAH programs?

− Will condominium associations and landlords (not eligible for the tax credit) be future recipients of this premium, in particular to encourage more renovations in collective housing? What would be the cost of such an opening?

− What is the overall budget for this future premium, which totally replaces the tax credit? How can we make it sufficiently ambitious to achieve our climate and social objectives?

− What is the budgetary path from the tax credit (paid the year following the works) to the premium (paid at the time of the work)? How can this shift be smoothed in order to limit the budgetary impact of a potential double expenditure in the same year?

− Which distribution scheme and by which operator(s)?
This approach is part of the broader aim to simplify policies for energy renovation but also to limit the number of tax niches in order to maintain better control over public spending and limit windfall effects.

Moreover, with the current debates on a possible ban on the rental of energy sieves by 2025, there is a gradual shift from an initially informative mechanism (saving energy, being eco-responsible, etc.) to an incentive mechanism (through financial assistance) and then to a coercive mechanism through increasingly strict regulations (see the evolution of thermal regulations). This process seems to occur naturally when there is a desire for a profound change to achieve ambitious but necessary objectives, which in our case are the fight against climate change and energy precarity with the structural increase in energy costs.

3.4.2 Proposals of improvements of the instrument

Finally, and because the time and framework of the study did not allow certain pathways to be explored, some ideas or recommendations can be formulated with a view to a possible evolution of measures in favour of the energy renovation of housing:

− Exclude gas boilers from the scope of eligibility for renovation aid: the fight against climate change, by reducing greenhouse gas emissions from the residential sector, will necessarily involve the gradual eradication of fossil fuels as an energy source. As strongly recommended by the Shift Project\(^ {11}\) in its analysis note of November 2018 [29], we cannot continue to subsidise gas boilers, however efficient they may be, for long if we want to achieve our emission reduction targets and if we want to prevent thousands of households from becoming dependent on fossil fuels for the next 20 years.

− Calibrate the level of support on the global energy performance achieved: the main difficulty with the energy renovation of housing is that each situation is particular, and that only a global renovation program can achieve real energy performance. Encouraging more global renovations rather than renovations by gesture (as is currently the case with lump sum subsidies by type of action), by coupling subsidies to levels of energy savings or to jumps in the energy performance diagnosis label, would make it possible to turn to this overall vision.

− Include landlords in the schemes: condominiums are currently the weak link in the energy renovation policy (with very few condominiums deciding to carry out renovations), and this is very strongly linked to the subject of landlords, who mainly own housing in collective housing. To encourage the voting of works in assemblies of co-owners, it must be possible to arouse the interest of both owner-occupiers (eligible for economic incentives) and landlords, i.e. by including them in an incentive scheme.

− Generalise local mapping of energy renovation needs: in order to assess local needs (at the municipality level) and identify the few "quick win" energy renovation actions, it could be considered to launch more global campaigns (thermal studies on streets or districts, aerial views), making it possible to detect the main areas with energy sieves and to design actions targeting a group of dwellings rather than individual audits on a case by case basis.

− Create a single public operator to support renovation: with the expansion of the ANAH’s missions, until now focused on the fight against substandard housing and autonomy in housing, there is a profound questioning of the agency’s model, which will hardly be able

\(^{11}\) The Shift Project is a French think tank specialised in issues of fighting climate change, promoting energy transition and reducing our economy’s dependence on fossil fuels.
to carry out its original missions in addition to the broadening of energy renovation. A dedicated agency (e.g. National Agency for Energy Renovation) based on the model of the National Agency for Urban Renewal which already exists would make it possible to centralise these energy renovation missions and facilitate readability in the policy instruments for households. The mission of this agency would be to:

- Manage the distribution of public aid, like the premium
- Coordinate with banks the distribution of eco-loans at zero interest
- Monitor indicators related to the energy renovation of buildings
- Manage the accreditation of companies and fight against fraud
- Conduct specific programs for local authorities and condominiums by providing technical, social and financial engineering support to set up works programs.

In the long term, it would be possible to have a better organisation and coherence between the different instruments, led by a single public operator working in close collaboration with government services, local authorities, financing actors and energy companies, and coordinating the various channels of support for energy renovation, according to the following scheme on figure 23.

Figure 23: Simplified general outline of a future articulation between the different mechanisms of support and stakeholders for the energy renovation of housing: public (State through a single public operator, and local authorities), private energy companies (white certificates) and loans by financing actors.
4 Conclusion

4.1 A new integrated approach to address energy and climate issues in housing

It is now time to take a step back and conclude this master thesis. By the means of this concrete project at the heart of the administrative machinery, aiming at a real transformation of a policy instrument designed to trigger energy renovation in households, we can draw various conclusions on technical considerations but also on the functioning within the administration.

The first one is that policy instruments such as financial incentive or regulations are crucial and indispensable for a country if it wants to achieve its long-term goals on energy and climate issues. In that sense, there remains a lot of disparity in the means and measures implemented in the different countries in Europe. A transversal work of benchmark and harmonisation between the EU countries could in a first step help improving the actions implemented in favour of energy renovation of housing.

Besides, the *ex ante* evaluation of public policy is a complex process, where many assumptions (more or less reliable) must be made, where technical, social and budgetary impacts must be analysed and argued, and where often divergent positions between administrations must be reconciled. The multitude of possible technical and budgetary scenarios proposed by the various ministries in the real case application presented in this report is a perfect illustration of this issue, and it is understandable that the arbitration process could therefore be long and complex, and making some unsatisfied stakeholders in the end.

The trade-off between simplicity/readability and performance/efficiency of public expenditure is also a delicate issue, as we have seen the advantages of lump sums in renovation aids and their limits: if the added complexity to make the scheme more "tailor-made" is not compensated by increased communication and more personalised support for households with dedicated public services (because in the end, only the households can make the decision on their property), in a purely mechanical and economic rationale, then this can make any scheme, however effective, fail.

Finally, on such sensitive subjects with political commitments and both climatic and social challenges, the process of designing a new system is totally subject to political time. This would be viable if ministerial cabinets and the administration moved forward hand in hand, with close collaboration and anticipation of projects, rather than piecemeal progress and reversals of decisions taken several months earlier.

4.2 Recommendations for future work

As a last step, we can now provide some recommendations for future work to explore in order to deepen the analysis on such transformation of policy instrument, or to widen the analysis by proposing similar approaches on other policies or in other countries.

As stated before, a cross-cutting work between the EU countries seems interesting in order to compare the different policies implemented and necessary if one wants to improve the handling of the energy issue in housing at European level. However, this would need a common and transparent collaborative work between administrations (and we can all guess that ministries in charge of budget can be opaque in their work), as well as taking into consideration the specificities of the regulatory, financial and energy systems of the territories: whether tax credits or premiums are suitable instruments, whether district heating is used or if there is a high CO₂.

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content in the electricity, whether private individual housing or collective housing with landlords is dominant, etc.

A step further would be to consider and analyse how other sectors, apart from housing, could be integrated in such energy renovation oriented instruments: tertiary or public buildings, industrial processes, or even renovation of vehicles. As more standardisation could be expected from such sectors (in energy performance standards for large buildings, for common industrial processes or vehicles produced by a handful of car manufacturers), this cross-sector approach might be more easily developed at European level, and use different levers for action. The private individual housing sector is indeed a lot dependent on the self-decision of households and each building is a unique object with specific characteristics and needs for improvements.

Another parallel work on the definition of a "renovation" is needed, as we saw at the very beginning that this term was not unequivocal and subject to interpretations. Whether it could be based on the number of "actions" realised (like insulation of some parts of the households or changing energy systems), on the before/after difference in energy performance, or on the achieved final state of the households, or any combination of the preceding (or something else), this definition would need to be easily understandable and applicable for both common people and also for monitoring energy policies. This would help talking the same language between stakeholders, public institutions or private actors, and between countries at European level.

In the end, one could ask the following question: what is the real objective of all those efforts in energy renovation? Is it really renovating ancient buildings or houses and being able to show to the public a quantity of households that benefited from incentivising policies? Not really. It is, by improving the energy efficiency of buildings, to decrease the energy consumption and reduce greenhouse gases emissions that come along with it; this obviously echoes our overall objectives in fighting climate change. A thorough work would therefore be indispensable to establish and use real indicators to monitor the reaching of those paramount goals and pilot policies consequently.
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