Policy interactions between European directives and the French white certificate scheme or how to give the right signal to the residential refurbishment market

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Abstract

Recent European energy policies like the Energy Efficiency Directive (EED) and the EcoDesign Directive (EDD) set new targets to increase energy efficiency.

Article 7 of EED implies that EU Member States set up energy savings amounting to 1.5 % of the annual energy sales to final customers from 2014 to 2020. To comply with this requirement the level of French White Certificate (WC) obligation should double in the next period.

Moreover, the EDD directive sets the minimum energy efficiency level only for a limited number of equipment such as boilers, heat pumps and water heater. In this regard, the WC scheme deemed savings must be revised in order to comply with the European calculation rules of EED's Annex 5.

Certain adjustments must be made to the French WC which has been enforced since 2006 and is entering its third period (2015-2017) to be in tune with these directives. Thus, the WC scheme undergoes a revision of unitary savings differentiating between devices already covered by EDD (e.g. boilers) and appliances which are not (e.g. windows). The outcome is a blend of different references (stock, market) and savings (total, marginal) depending on the considered unitary action. Consequences could be a lack of clarity especially for non-specialists of energy policy.

This paper addresses the question of a possible conflict of interests between the European system, allocating savings by directive, and the overall customer savings. Scenarios embedded impacts of the new European rules on the WC market are quantified in order to answer the question: will the third period of WC give a positive signal to the refurbishment market?

The overall revising process of the third period of WC and its consequences will be presented concerning the building sector. More precisely, calculations to quantify impacts on unitary action savings, on WC costs and on the retrofitting market structure are detailed.

Finally, suggestions are proposed that enable both the enhancement of energy efficiency at the European level as well as the sustaining of the dynamics of the French WC market by providing clear and explicit information.

Introduction

Recent European energy directives like the Energy Efficiency Directive (EED) (European Commission, 2012), and EcoDesign Directive (EDD) (European Commission, 2009) aim at increasing energy efficiency and getting energy savings. The requirements in these directives target respectively on the one hand the energy savings to achieve and the other hand the minimum of performance for energy related products. The wide coverage of these directives leads to interactions with some national energy efficiency policies. In this way, the White Certificate (WC) scheme will fall in January 2015 within the European legal framework set by the EED, which forces the Member States to conduct a proactive policy for energy savings. In its notification, France indicated that almost 90 % of the 1.5 % annual savings will be achieved thanks to WC (Gazeau et al., 2014). Furthermore, the EED requires that only WC associated with actions going beyond the regulations under EDD will count towards meeting the objectives. This last point sets a constraint against the WC scheme and its necessary review to meet these requirements.

In the literature, the existence of several instruments to deal with similar energy and/or environmental challenges and the inherent complexity has already been pointed out as well as potential interactions (positive or negative) (Boonekamp, 2006; Bye and Bruvoll, 2008; Spyridaki & Flamos, 2014). Especially concerning the energy efficiency for end-users, objectives are targeted by various policies from regulation to financial instruments or market-based certificate mechanisms (Oikonomou et al., 2010, Bertoldi et al., 2013).

However, the discrepancy between different evaluations of energy savings accounted by WC or the EED[1] framework was already presented (Broc et al., 2010). The question of the reference (or the baseline) which is the salient point is always arguable as it is a way to represent the reality from different perspectives: a macro level for the European Commission vs. a micro level for customers or obliged energy companies (Thomas et al. 2007).

Thus, Thomas et al. (2007) defined the different steps of evaluating energy savings using a bottom-up methodology, especially the unitary gross savings which are at the moment equivalent to the deemed savings of the WC scheme. According to the authors, "gross energy savings refer to the point of view of final users which means energy savings observed by the final user". From the European directives perspective, what counts are the net savings that can be different from the gross savings due to correction factors (especially the double-counting in our case study but also the rebound effect, multiplier or free-rider effects …).

Finally, two available evaluation reports on the French WC scheme (Gazeau et al., 2014, Cour des Comptes, 2013), providing advices for the scheme evolution, were used to analyze it at the light of the European policies. This helps us to make proposals for the next period to comply both with European and national necessities.

Firstly, this paper describes the different European directives (EED, EDD) in relation to the French WC scheme. Secondly, the French WC scheme is presented as well as the French tax credit policy targeting the same efficiency measures. In the third part, the reviewing process of the French WC for the third period is detailed. Finally, the discussion section presents the consequences of this reviewing process on the dwelling sector. More precisely, this is an attempt at quantifying the impacts on WC pricing and on the retrofitting market structure. This last section concludes with proposals for an evolution of the French WC scheme.

European directives

ENERGY EFFICIENCY DIRECTIVE (EED)

According to Article 7 of the EED, the target, achieved by implementing an energy saving obligation scheme on energy suppliers and/or energy distributors, should be at least equivalent to 1.5 % of the energy sold between 2010-2012 (averaged over the volume) to provide new savings each year from 2014 to 2020. Moreover, Annex V of the EED and an accompanying document provide general principles for calculating the impact of energy efficiency obligation scheme (European Commission, 2013-d) that provides "golden rules" for evaluation:

- "For energy efficiency obligations, deemed and scaled savings have to date been the most commonly used methodologies."
- "… That in some cases, only savings that go beyond the minimum requirements originating from EU legislation can count. This is relevant for individual actions that are a result of energy efficiency obligation scheme …", "… For products – the requirements established by implementing measures under the Ecodesign Directive …"
- By contrast, where the required energy performance is determined by national policy choices which are not a result of mandatory and applicable EU requirements, then for the individual actions that are a result of these policy measures all of the resulting energy savings can be attributed to these individual actions.
- "Member States shall ensure that when the impact of policy measures or individual actions overlaps, no double counting of energy savings is made."

ECODESIGN DIRECTIVE (EDD)

The EDD already covers a list of numerous appliances (ECEEE, 2015), especially space and combination heaters (European Commission (2013-a), sanitary water heaters and hot water storage tanks (European Commission, 2013-b) and air conditioners (European Commission, 2013-c) that are dedicated to the building sector. At the moment, the EDD sets minimum energy efficiency levels only for a limited number of equipment and is not yet covering energy related products for building insulation.

The efficiency measures studied in this paper are covered by four product lots of the EDD process (Table 1) with one of them only at the studying phase.

National policies

FRENCH WHITE CERTIFICATE SCHEME

The new obligation

Pursuant to Article 3 of the EED, France has set an indicative target of final energy consumption of 131.4 Mtoe in 2020.[2] Moreover, Article 7 of the EED requires that Member States put in place mechanisms to achieve annual energy savings that are quantified for the French case as follows (MEDDE, 2013):

- 2010–2012 average annual consumption: 97.06 Mtoe (excluding transport).
- Flexibilities up to 25 %: excluding sales under Emissions Trading System sites and early action taken since 2009[3].

1. At the time of the Energy Savings Directives (ESD) whose EED is the recast.

2. Including transportation.

3. "The EU emissions trading system (EU ETS) is a cornerstone of the European Union's policy to combat climate change and its key tool for reducing industrial greenhouse gas emissions cost-effectively" (European Commission, 2014).

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Table 1. Products covered by the French WC in buildings and their status in the EcoDesign process (ECEEE, 2014).

Product lot	Status	Products covered	Year of application
Space and combination heaters: 813/2013 and 811/2013 (Lot 1)	Ecodesign and labeling regulations in force in September 2013	Boilers, air/water-heat pump	2015
Water heaters: 814/2013 and 812/2013 (Lot 2)	Ecodesign and labeling regulations in force in September 2013	Sanitary hot water-heat pump	2015
Room air conditioning appliances: 206/2012 and 626/2011 (Lot 10)	Ecodesign regulation in force in March 2012. Labeling regulation in force in July 2011	Air/air-heat pump	2013
Window products, ENER Lot 1/03	Study ongoing	Double glazing	unknown

Table 2. Overview of the French White Certificate scheme from 2006 to 2017 (source: DGEC, 2015).

Period	Time frame	Obligations per period	WCs delivered
1st period	01/06/2006–30/06/2009	54 TWh_{cumac}	65.2 TWh_{cumac}
Transitory Period	01/07/2009–31/12/2010	No obligation	99.1 TWh_{cumac}
2nd period	01/01/2011–31/12/2013	345 TWhcumac including 255 TWh_{cumac} for historically obliged parties of the 1st period and 90 TWh_{cumac} for fuel wholesalers	317.4 TWh_{cumac}
2nd period extension	01/01/2014–31/12/2014	115 TWh_{cumac}	153.2 TWh_{cumac}
3rd period	01/01/2015–31/12/2017	700 TWh_{cumac}	–
4th period	01/01/2018–31/12/2020	unknown	–

- Annual Target: 1,092 Mtoe or 12.7 TWh. New savings each year, so in the period 2014–2020 the cumulative binding target is 355 TWh.

To comply with the EED target of Article 7, the French government has decided to rely mainly on its WC scheme (approximately 90 % of the target) (Menager, 2013).

The French White Certificate scheme introduced in July 2006, requires energy suppliers to help customers in reducing their energy consumption. This scheme is now in its 3rd period of obligation (Table 2). More precisely, it has been decided that the target for the next period (2015–2017) will be 700 TWh_{cumac}[4]. Moreover, about 76 % of annual cumulated savings (i.e. 176 on 230 TWh_{cumac}/p.a.) have been assessed to comply with EED[5] requirements and are able to fulfill the directive target[6]. (Menager, 2013; DGEC, 2013; MEDDE, 2013; Buffard, 2014.)

4. TWh_{cumac} means TWh cumulated over the lifetime of the measure implemented and discounted (4 %). The "kWh_{cumac}" is the accounting unit of the French WC scheme. This unit is corresponding to the energy saved annually, accumulated over a period of conventional life determined for each measure entitling certificate and discounted.

5. Non compliant WC are concerning specific programmes and soft measures (craftsmen training, energy audits) (140 TWh_{cumac}), bonuses for 30 TWh_{cumac} (fuel poor, overseas territories …) and that are not directly related to energy savings (Buffard, 2014).

6. Corresponding to an expected energy savings of 12.2 TWh/p.a.

The new deemed savings

In the French WC scheme, the majority (95 % [MEDDE, 2014]) of WCs are delivered based on a portfolio of 300 Standardized Actions (SA) (e.g. efficient boiler, insulation …) covering each sector of activity (residential, tertiary, industry, farming and transportation) (ATEE, 2013). An SA is rewarded by *ex-ante* deemed savings (expressed in kWh_{cumac}) according to segmentation parameters (e.g. single family housing [SFH] or multi-family housing [MFH]; geographic location …) as described on an SA worksheet.

Since the beginning of the scheme, SA are mainly delivered in the building sector (74 % for the residential compared to 14 % for the tertiary sector) (Table 3) (DGEC, 2015). The current paper solely presents the consequences on residential sector examples.

As an obligation mechanism now under the umbrella of EED, the French WC policy must be revised in order to comply with the "golden rules" aforementioned. Thus, the WC scheme undergoes a revision of the energy savings differentiated between equipment that is already covered by EDD (e.g. boilers) and that which is not yet covered (e.g. windows) or not in the EDD process (e.g. roof insulation). The predicable outcome is a blend of different references (stock, market) and savings (gross, net) depending on the considered SA. This is presented in the section below concerning the revision of deemed savings.

Table 3. Top-ten WC standardized actions (source: DGEC, 2015; Illenberger, 2014).

sector	Standardized actions	% of WC delivered since 2006 (end of January 2015)	% of WC delivered in 2014 (end of September 2014)
residential	Condensing boiler	14.44 %	10 %
residential	Roof insulation	9.75 %	12 %
residential	Wall insulation	7.57 %	10 %
residential	Collective condensing boiler (w/ or w/o energy service)	9.69 % (5.91 % + 3,78 %)	7 % (4 % + 3 %)
residential	Wood stove	5.47 %	5 %
residential	Low temperature boiler	4.17 %	1 %
tertiary	Roof insulation	4.98 %	9 %
residential	Double glazing	4.05 %	3 %
industry	Electronic speed variation system in an asynchronous motor	3.91 %	5 %

THE TAX CREDIT: A COMPLEMENTARY POLICY

Implemented in 2005, the tax credit[7] (Nauleau, 2014) is a subsidy mechanism for energy efficiency dedicated to housing refurbishment and has undergone numerous modifications since its inception. This policy is regarded as a demand incentive tool, but with a strong impact on public finances, as opposed to the WC scheme regarded as a market tool with small impact on public finances[8] (MEDDTL, 2011, MEDDE, 2014). Between 2005 and 2008, 4.2 million households made use of this scheme, corresponding to 15 % of the principal residence stock. In 2009, the main actions subsidized, in the amount of €2,626 M in the state budget, were double glazing, heat pumps, energy-efficient boilers, insulation, wood stoves … Unfortunately, to our knowledge, no recent evaluation is available (MEDDTL, 2011).

For the year 2015, the tax rebate corresponds to a rate of 30 % of the up-front cost paid by households (Prémartin, 2014). According to the eligible efficiency level, the tax credit is a significant incentive to investment but presents a weak signal to households about energy savings at the opposite of WC. Indeed, the tax credit rewards the up-front cost while the WC scheme the energy savings. Such different rewards for the same measure according to different schemes and their consequences are detailed in Bertoldi et al. (2013).

The tax credit presents a strong overlap with the WC scheme which targets the same energy efficiency actions in housing. Moreover, the efficiency level required in the WC will be aligned for the 3rd period with those of the tax credit as requested in the evaluation report of WC in order to present a consistent energy policy (Cour des Comptes, 2013). The existence of two different policies linked to up-front cost (tax credit) or energy savings (WC) targeting the same objective by two separate ways (household or installer) may found justification in the literature in the occurrence of a market failure. The interaction between WC and tax credit appears to present a positive effect to target GHG mitigation (Oikonomou et al., 2010).

In the specific case of energy efficiency measures both covered by the WC scheme and tax credit, the financial incentive provided by the tax credit was higher than the potential incentive provided by certain obliged utilities. Historically, the obliged energy suppliers organize mainly marketing and quality insurance in the WC framework as well as soft loans through subsidiaries (Bertoldi et al., 2010; Baudry et al., 2011). However, during the second WC period, the new obliged parties (i.e. fuel wholesalers) provided a direct financial incentive to households due to the lack of their own endorsed network of installers. Today, it is possible for a household to compare the different WC incentives proposed by various stakeholders[9].

Reviewing the White Certificate's deemed savings

Previously detailed, the deemed savings of SA have to be revised for different reasons (Menager, 2013):

- The reference data changed since 2006, year of implementation of the scheme. Updating methodological worksheets for the reference data (e.g. consumption) or the calculation methods (stock vs. market).
- Compliance with the EED "golden rules" and other regulations (e.g. building regulation).
- Alignment with other policies, generally increase of efficiency level (especially tax credit).
- Harmonization between SA worksheets.

Historically, the WC deemed savings were mainly gross savings (Thomas, 2007) (Figure 1) corresponding to the total energy savings expected by the household and impacting its own consumption. A few counting exceptions already existed in the WC scheme and concern renewable energy (heat pump, solar, biomass) where the savings were rewarded by the amount of re-

7. In French, "Crédit d'Impôt de la Transition Énergétique (CITE)". Previously, "crédit d'impôt développement durable (CIDD)" before September 2014.

8. For the government the cost of the WC scheme is relatively limited because it has only the charge of steering scheme's strategy, the development of the necessary legislation and the control of WC delivering (MEDDE, 2014).

9. Incentives corresponding to a WC price from €2.5 to €3/MWh_{cumac} according to seven stakeholders is currently proposed (see: http://www.nr-pro.fr/).

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newable energy taken from the environment (i.e. not counting the saved final energy itself). The revising process ought to lead to better consistency between the SA that count only the final energy saved. Unfortunately, this is not necessarily the case as is discussed below.

The consequences of this revision process have raised new questions. One must keep in mind that at the moment of writing this paper, the reviewing process is still a work in progress (i.e. certain SA were officially published in December 2014 [MEDDE, 2014] but a few SA aren't yet reviewed) the definitive figures will be slightly different. However, the changes presented in this paper will remain accurate.

The main consequence of the "golden rules" of EED is that the SA gross savings of the second period, concerning equipment covered by EDD, are now divided into two parts: one linked to the requirement of the EDD or other regulations ("directive savings") and one only related to WC ("WC savings").

Nevertheless, in case of building insulation or in case of enhancement of an existing system (e.g. a programmable thermostat on an existing space heating system) the WC deemed savings remain rewarded by gross savings (i.e. stock reference). The impact[10] on WC rewards was for equipment the decrease of energy savings from -50 % to -20 % and for insulation measures an increase from +20 % to +35 % (Table 4). The origin of these changes is coming from:

- The reference data regarding observed energy consumption[11] of the building stock.
- The calculation methodology switching from a stock reference to a market reference.
- The minimal performance of equipment covered by EDD.

Discussion

POLICY INTERACTIONS: COMPLEMENTARY OR FRICTION

We have learned that at a national level more consistency is important between different policies (i.e. WC scheme and tax credit). An alignment of efficiency requirements is essential for a better clarity for households and that was done by the WC reviewing process. At the interface between national and European policies, a need for consistency is also necessary but is more difficult to achieve due to the existence of different perspectives.

The accounting methodology developed during the reviewing process of WC appears to be obvious from a regulation perspective to avoid double counting and to allocate energy savings to the dedicated policy (splitting gross energy savings into net savings for different policies). This is in line with the EED calculation requirements but raises the question about the divergence between the different perspectives (households and stakeholders vs. national and European policy-makers).

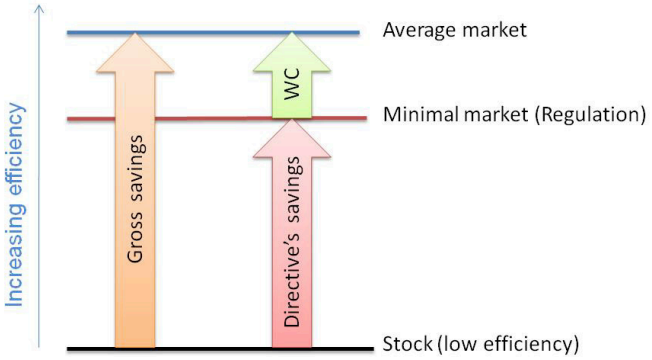

Figure 1. Deemed calculations depending on threshold. Gross savings are observed savings (stock reference) (WC in 2006–2014), regulation savings are savings issued from regulation (e.g. EDD), WC savings are marginal or net savings (market reference) rewarded by WC for the next period (2015–2017).

In fact, the energy savings calculation methodology implemented for the next period of WC is not in phase with the recommendations of the evaluation report by the French public bodies (Gazeau et al. 2014). This report recommends that the WC scheme evolves toward more realistic energy savings in order to have a proper signal to households.[12] Even if the previous savings of the SA were arguable and improvable, the methodology was in line with the French recommendations (household perspective prevailing) but not perfectly in line with the European directive. Now, the new allocation of savings for the third period of WC is in line with the EED but will diverge with the observed energy savings. From one period to another, we swing between the household and policy maker perspectives. Moreover, heterogeneities of calculation methodology targeting the same object (space heating consumption) is then introduced in the scheme between SA dedicated to space heating equipment and building insulation due to the partial coverage of SA by EDD.

POTENTIAL IMPACTS ON THE RETROFITTING MARKET

The potential impact on the retrofitting market of residential buildings is coming both from the increase of the obligation level and from the review of deemed savings.

Globally the reviewing process, at a constant perimeter (i.e. same structure and same volume of TWh_{cumac} of the year 2013), leads to a decrease of about -13 %[13] of the potential quantity of kWh_{cumac}. This is equivalent to an increase of the obligation level by the same absolute percentage, that is to say: adding an amount of at least[14] 20 TWh_{cumac}/p.a. This value is correspond-

10. We must keep in mind that the percentage of variation is a rough estimate as it depends on segmentation (dwelling type, location …) of the SA implemented.

11. The energy consumption of the residential from 2005 to 2012 evolves with a slight decrease of -1 %/p.a. The annual reference Heating Degree-Days (HDD) were also reduced from 2,450 to 2,250 HDD to take into account the climate change over the last 30 years (CEREN, 2014).

12. We could notice that the DGEC (General Directorate on Energy and Climate) communicates on gross energy savings: "… from 1st July 2006 to 31st august 2014 … the operations realized will lead during their lifetime … to energy savings corresponding to almost ⅓ of the French annual consumption" (i.e. 1,800 TWh) (DGEC, 2014-b).

13. Equivalent to 12 TWh_{cumac} on 96 TWh_{cumac}. The overall amount of WC is not totally covered by the studied SA as not all the SA was reviewed. For the year 2013, around 137 TWh_{cumac} were delivered (author's calculation, source: ATEE, 2014, Gazeau et al., 2014, DGEC 2014).

14. Considering an annual WC delivering of 187 TWh_{cumac}/p.a. (see footnote below).

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Table 4. Example of the impact of the revision process on SA energy savings dedicated to buildings between 2014 (second period) and 2015 (third period) (source: ATEE, 2014, Gazeau et al., 2014, DGEC 2015). SFH: Single Family Housing, MFH: Multi Family Housing.

Standardized action	Savings alteration	Reason of alteration	GWh_{cumac}/year in 2013
Roof insulation	+25 %	Reference data, level of efficiency	11,195
Wall insulation	+25 %		11,468
Floor insulation	+20 %		2,258
Insulation of flat roof	+25 %		1,000
Double glazing	+35 %		2,790
Air-(or water) to-water heat pump	-30 % SFH -20 % MFH	EDD, calculation method	961
High efficiency boiler	- 40 %	EDD	17,384
Wood stove	- 50 %	Calculation method	4,802
Air-to-air heat pump	-25 % SFH -35 % MFH	EDD, calculation method	628
Collective high efficiency boiler	- 52 %	EDD	5,457
Programmable thermostat	-20 % electric space heating -45 % combustible space heating	Reference data	199
Heat pump for sanitary hot water	+30 %	EDD, calculation method	26
Collective air-(or water) to-water absorption heat pump	-35 % space heating -20 % space heating and hot water	EDD, calculation method	126

ing to 10 % of the WC to be delivered annually in the third period. This relatively limited decrease of the average amount of kWh per SA is due to the balance between the decreased of deemed savings for thermal installations and the increase for insulation. This seems, at the first glance not revolutionizing the scheme but it's complex because the internal structure of the WC scheme could be transformed:

- The share of SA within the WC scheme could be modified at the detriment of the residential building sector's share compared to the others (industry, tertiary, transportation …). This subject is however out of the scope of this paper and will not be described here[15].
- Within the residential building market, the repartition of SA could evolve by the increase of the building insulation to the detriment of thermal equipment even those using renewable energy (e.g. biomass, heat pump …). One must notes that these appliances also help to reach the targeted share of renewable energy in the French energy mix.

Moreover, the increase of the national obligation level from 115 TWh_{cumac}/p.a. to 233 TWh_{cumac}/p.a. (Table 2) corresponds to a double increase[16]. As expected by (Gazeau et al. 2014) and by (Brunetière et al. 2015), the consequence is the saturation (i.e. rewarding of almost the whole current market) of certain market segments especially the boiler's market with a limited remaining potential of WC (i.e. almost the reward of the whole current annual market of retrofitted boilers). The number of boilers that could be rewarded by WC is of 400,000 unit/p.a. corresponding to about 80 % of installed boilers each year for existing housing[17] (Gazeau et al. 2014). On average, since year 2011 around 300,000 boilers/p.a. were rewarded by WC compared to the potential of 400,000 units/p.a. eligible to WC that corresponds to a reward of 75 % of the potential (DGEC, 2015).

Concerning roof insulation measures, a place for a large increase of the number of retrofit is generally assumed because only less than 4 %/p.a. of total potential was rewarded by WC in the second period according to Lefebvre (2012). This remaining potential of insulation measures eligible to WC appears to be appealing, but according to a recent market survey (ADEME, 2013-b), the number of residential insulated roofs reaches around 125,000 dwellings/p.a.

Otherwise, considering an average[18] of 1,500 kWh_{cumac}/m^2 and an average insulated area of 80 m^2/dw, the number of participants in the WC scheme is assessed to 90,000 insulated roofs[19]. This last figure is lower but of the same order than another estimation (Gazeau et al., 2014) considering 10,000,000 m^2 of insulated roof area for the year 2013 in the WC scheme. Following the same hypothesis of 80 m^2/dw, this is corresponding to about 125,000 units/p.a. These figures seem to throw a shadow on the large unexploited potential (i.e. from a stock perspective) of some insulation measure to be rewarded by WC (i.e. annual market limitation). This is confirmed by the last WC scheme evaluation considering an annual potential eligible market to the WC of a steady 18,000,000 m^2 (Gazeau

15. This trend is already observed as the residential share decreases from 83 % in 2012 to 75 % in 2014 (DGEC, 2015).

16. Even if we have to take into account the WC not rewarded by direct energy savings, they were already existing in the second period. Thus, the WC assessment is not 233 but 187 TWh_{cumac}/p.a. (Gazeau et al., 2014).

17. Around 500,000 in 2013 for the refurbishment of dwellings (source: Uniclima 2014, Gazeau 2014, authors calculation).

18. According to the SA worksheet, WC reward is of 1,200 kWh_{cumac}/m^2 for electric space heated and of 1,900 for combustible heated dwellings. A weighted average by the number of dwellings gives an average of 1,500 kWh_{cumac}/m^2. In 2013, the WC concerning the roof insulation was 11.2 TWh_{cumac}.

19. This is in accordance with DGEC reporting, on average since 2011, 100,000 insulated roofs per year (DGEC, 2014-b).

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et al., 2014) leading to a little more than 50 % of the insulated roofs already included in the WC scheme.

To conclude in the light of these two emblematic examples, we can make the assumption on future pressure coming on the retrofit residential market to produce enough WC to comply with the level of obligation. *Ceteris paribus,* a potential increase[20] of the number of retrofitted dwellings would be necessary to reach the target.

POTENTIAL IMPACT ON THE PRICING OF WHITE CERTIFICATE

The consequence of the WC reviewing process for the households is, assuming a constant current WC pricing[21], the modification of the WC financial incentive:

- A financial incentive decrease for equipment (e.g. boiler, heat pump …) from -50 % to -20 %.
- A financial incentive increase for insulating action (e.g. roof, wall or double glazing) from +20 % to 35 %.

From a customer perspective, it is difficult to understand the decrease of financial incentive between two WC periods coming along with the increase of efficiency.

According to a partial survey of participant households[22] in the WC scheme, the financial incentive was considered by about half of participants as important to conduct a more efficient retrofit or to plan more actions (ADEME, 2013-a). In the WC scheme the financial incentive of some obliged stakeholders is proportional to the amount of kWh_{cumac}.

Thus, considering to uphold the financial incentive for households covering the same share of up-front costs that are supposed to remain steady in the next period, the increase of WC's market pricing, due to the structural evolution of rewarded savings ($\Delta kWh_{cumac}^{2013\rightarrow2015}$), could be calculated *ceteris paribus* according to two extreme scenarios to frame the possible evolutions. Considering an historical WC price ($WC\ price^{2013}$) of €3/MWh_{cumac} and the amount of WC produced annually (GWh_{cumac}^{2013}), the future WC pricing ($WC\ price^{2015}$)is calculated as following considering that the savings variation is compensated by the WC price (e.g. a WC price increase with rewarded savings decrease) (Table 5):

$$WC\ price^{2015} = \frac{GWh_{cumac}^{2013} * WC\ price^{2013}}{\left(1 + \frac{\Delta kWh_{cumac}^{2013\rightarrow2015}}{kWh_{cumac}^{2013}}\right) * GWh_{cumac}^{2013}} \quad (1)$$

- Low price scenario: +10 % on the average WC price compared to the current price of €3/MWh_{cumac}. This resulting low increase of the price is due to the compensation between SA concerning insulation measures with an increase of deemed savings of +26 % (weighted average) lowering the WC price and the decrease of savings for space heating (-41 % weighted average) increasing the WC price. This means that this compensation leads to a quasi-steady WC price (Table 5).
- High price scenario: +28 % of the average WC price that to say €3.8/MWh_{cumac}. In this case, we considered only the decrease of deemed savings that impacts the WC price meaning that we consider a low threshold of €3/MWh_{cumac} for each SA. This means that the financial incentive will increase for insulation measures and stay stable for the others. This scenario is corresponding to a constant WC price for insulation measures leading to an increase of the financial incentive for household due to the increase of rewarded savings. The increase of WC price for the space heating measures is due to the decrease of rewarded savings that had to be compensated to maintain a constant financial incentive for household (Table 5).

Of course, these assessments are limited and don't take into account the potential arbitrage[23] between sectors and of the effect of the obligation increase but give us the order of the potential structural effect of the reviewing process of deemed savings. However, we must also keep in mind the existence of in bank WC[24] in the national registry exceeding their obligation level for some stakeholders but we are unable to estimate the impact of these to reduce the constraint.

At the opposite of the scenario supporting a steady incentive, the incentive could decrease for the devices covered by EDD (e.g. a condensing boiler). It is quite clear that these devices on the market are obliged to be efficient and the household have no choice to buy them and the financial incentive is then questionable.

Incidentally, this could help to achieve one recommendation of the evaluation report (Gazeau et al., 2014) that advices to avoid windfall profit (Gazeau et al. 2014) by promoting SA with a minimum of incentive. Some of the SA are more or less obliged to be realized by the household due to equipment covered by the EDD (minimum of efficiency ensured) falling into disrepair[25]. Such renewal markets will then have less financial incentive compared to those entirely dedicated to energy efficiency like insulation of opaque wall at the exception of double glazing that is in-between.

But this is quite contradictory with the same evaluation report (Gazeau et al., 2014) that recommends better informing the households about the relevance of financial and efficiency performances. Especially, stress was put on a WC rewarding on the basis of observed savings (*ex-post* evaluation) instead of deemed savings (*ex-ante*) to deliver WC with more accuracy and to give a right signal to households.

However, the feasibility but also the complexity and uncertainty of *ex-post* evaluation of energy efficiency measures in the residential linked to the diversity of households and dwellings were presented by (Raynaud, 2014). As relevant examples of this complexity, we quote partial studies showing preliminary results sometimes contradictory:

- 95 % of participant household of the WC scheme believe they have reduced their energy costs (Buffard, 2014);

20. The number of energy efficiency actions in the residential sector is considered as 2.5 million for the year 2011 (ADEME, 2013-b).

21. Around €3/MWh_{cumac} in 2014 (source: EMMY, 2014). This value is currently used by certain obliged parties to calculate the financial incentive paid to household.

22. Less than 5,000 participants and not surveying all the obliged energy suppliers.

23. The share of residential WC is tendentiously decreasing: 63 % since January 2014 vs. 76 % since January 2006 (Illenberger, 2014).

24. It is assessed that the reserve of WC at the beginning of the 3rd period will be 230 TWh_{cumac} (Illenberger, 2014).

25. According to a survey, 40 % of households quote "*the fall into disrepair*" as a reason for the retrofit as well as "*energy savings*" for a share of 60 % and "*enhancement of comfort*" for 25 % (ADEME, 2013-a).

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Table 5. WC market price according to WC delivered in 2013 and evolution of deemed savings for residential following a hypothesis of a constant incentive per SA (source EMMY, 2014, Gazeau, 2014).

Standardized action	WC for the year 2013 (GWh_{cumac})	Constant financial incentive at current market price* (€)	WC expected for the year 2015 (GWh_{cumac})	Calculated low pricing (€/MWh_{cumac})	Calculated high pricing (€/MWh_{cumac})
Roof insulation	11,195	33,584,009	13,993	2,4	3,0
Wall insulation	11,468	34,402,574	14,334	2,4	3,0
Floor insulation	2,258	6,774,197	2,823	2,4	3,0
Double glazing	2,790	8,369,672	3,766	2,2	3,0
Insulation of flat roof	1,000	3,000,760	1,250	2,4	3,0
Air-(or water) to-water heat pump	961	2,883,162	673	4,3	4,3
High efficiency boiler	17,384	52,153,085	10,431	5,0	5,0
Collective high efficiency boiler	5,457	16,369,728	2,619	6,3	6,3
Wood stove	4,802	14,404,980	2,401	6,0	6,0
Air-to-air heat pump	628	1,883,811	440	4,3	4,3
Total	**57,942**	**173,825,978**	**52,730**	**3,3**	**3,8**

** Current market price of €3/MWh_{cumac} for year 2013.*

- even if energy savings present a wide variation from -40 % to +50 % of initial consumption depending on dwelling (Gazeau et al., 2014).

PROPOSAL FOR THE 4TH PERIOD (2018–2020)

In the French debate concerning the future energy transition law (Actu Environnement, 2014), the existence of the 4th period (2018–2020) of WC is confirmed, and so it is necessary to think about possible evolutions. For this fourth period some adjustments could be done to comply both with the national and the European levels following two possibilities:

- To develop a sort of double accounting system without any modification of the SA worksheets,
- To review the WC scheme in depth by excluding some SA and to revise the obligation level in line with these exclusions.

The first proposal appears to be simple by rewarding SA actions according to the gross energy savings at the national level to give the right market signal to customers but also, to take into account the European directives, only rewarding at the European level the marginal savings to comply with European requirements. However, this proposal brings more complexity to the administration side of the scheme.

The second proposal is to deeply review the WC policy by excluding products covered by EDD that are already efficient and belonging to a replacement market with an exception for those using renewable energy. To keep the renewable-based devices (biomass, solar, heat pump …) within the WC scheme sounds necessary for better ensuring profitability to households by receiving financial incentives as there is no special reward for renewable energy for households (Suerkemper et al., 2011). All the current devices could remain within the tax credit scheme to reduce the up-front cost regardless to energy savings as it is nowadays.

This last proposal could move the WC from the "low hanging fruits" (e.g. devices like boiler or double glazing) to the "highest fruits" (e.g. wall insulation or devices using renewable energy).

Of course, the level of obligation has to be lowered in consequence of these changes (i.e. decrease of the SA portfolio) and the French energy policy hasn't to rely solely on the WC scheme to fulfill the 1.5 % EED's energy savings target as it is today. This would roughly mean switching from 90 % to around 70 % of WC's contribution to reach the EED target.

Conclusion

This paper is a good opportunity to get a direct insight of the reviewing process of a national energy policy in the framework of European directives and the problems that have to be solved. We present the links between national and European policies and emphasize how it is difficult to deal with all the stakeholders' perspectives even if the target of an energy consumption decrease is well shared between them. The sole purpose of this paper is to expose the problematic about a case study on policy interaction to open the discussion.

In the framework of European directives, the WC scheme which undergoes a reviewing process has moved from a customer or energy company perspective (i.e. gross savings) to a government perspective (net savings). Even if the energy savings had to be accounted by net savings to comply with European directives and allocating savings by energy policies, the outcome is a blend of different references (stock, market) and savings (total, marginal) depending on the considered unitary action. The market signal to customers and to stakeholders is then confusing because the link between observed energy savings for household and the WC rewarding is broken in some cases. This new perspective leads potentially to diminish WC financial incentives to households or to increase the WC pricing.

However, due to the necessary hypotheses done in this paper to overcome the uncertainties in order to study the WC scheme, the need for deeper evaluation is highlighted.

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