French White Certificates

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ABSTRACT

White Certificates policy in France has been driven by three main factors: (1) need to increase energy efficiency in the hard to reach residential and commercial sectors; (2) limited success in increasing energy efficiency with traditional policy instruments; and (3) limited public funds to implement demand side management (DSM) activities. The purpose of this study is to provide an impact analysis of the first stage of the French white certificate program which ran from 2007 through 2009. Although there is a substantial literature on white certificates, this paper appears to one of the few studies using econometric and cost effectiveness methods to quantify the impacts of a white certificate program. .

Introduction

Tradable white certificates are a relatively new policy instrument for the improvement of energy efficiency, reduction in energy consumption, and reduction in green house gas emissions. The basic concept of white certificates is that energy savings targets are set for energy suppliers and distributors, who are typically referred to as obligated parties. The obligated parties fulfil their energy savings targets by implementing quantifiable energy savings measures for their clients within a given time frame. This fulfilment of the targets is recognized through the issuing of white certificates representing the quantity of energy savings represented by the implemented measures. Those obligated parties who more than meet their targets can sell the excess to obligated parties who have not met their targets (Oikonomou et al. (2009)).

Tradable white certificates have generated considerable interest in the European union as a means of encouraging cost-effective investment in energy conservation and reducing greenhouse gas emissions (Farinelli et al., 2005; Harrison et al., 2005; Langniss and Praetorius, 2006; Oikonomou et al., 2007; Vine and Hamrin, 2008). The three most ambitious white certificate schemes currently operate in France, Italy and Great Britain (Sorrell et al., 2009). White certificates policy in France has been driven by three main factors: first, the need to increase energy efficiency in the hard to reach residential and commercial sectors; second, the limited success in increasing energy efficiency with traditional policy instruments; and third, limited public funds to implement DSM activities.

The purpose of this study is to provide an impact analysis of the first stage of the French White Certificate program which ran from 2007 through 2009. Although there is a substantial literature on White Certificates, this paper appears to one of the very few studies using econometric and cost effectiveness methods to rigorously quantify the impacts of a white certificate program.

Program Design and Implementation

White certificates in France operate within the broader context of European greenhouse gas emission regulation and trading. Since some understanding of this broader context is important in considering the French white certificate scheme, this section briefly reviews the European Union Emissions Trading System before examining the design of the French white certificate system.

In October 2003, the EU issued Directive 2003/87/EU which introduced the European Union Emission Trading System (EU ETS) as a scheme for trading greenhouse gas emission allowances within the

European Union. The six fundamental principles underlying the EU ETS are as follows:

- Cap and Trade. An important distinction is that between (i) cap and trade systems and (ii) baseline and credit systems. In a cap and trade system, such as the EU ETS, an aggregate cap on emissions is initially set with the cap distributed among various parties either without charge or by auction. In a baseline and credit system, such as white or green certificates, emission credits or energy efficiency certificates are granted for specific project activities that reduce emissions or energy use below agreed baselines.
- Initial Focus. The initial focus of the EU ETS was on carbon dioxide emissions for large industrial emitters.
- Allocation. For the first period (2005-2007), allowances were allocated free of charge on the basis of historical emissions.
- Implementation. EU ETS was planned to cover about 45%-50% of the EU's total carbon dioxide emission by 2010. Energy or emissions savings are produced by concrete projects which produce savings which either reduce the demand for a specific fuel or change the demand profile so that less carbon-intensive sources or supply replace more carbon-intensive sources of supply at the margin.
- Compliance Framework. The two main approaches to emission accounting and compliance, the indirect or down stream approach and the direct or upstream approach. The concept underlying the downstream approach is that the final producers should understand the production carbon intensity and receive an allotted emission quota based on an appropriate baseline. The concept underlying the upstream approach is that emission accounting is based on the physical source emissions with the actual emitters providing emission allowances equal to their previous year's emissions.
- Linkages. Although the market per se for EU ETS is the EU, there are opportunities for linkage with project-based activities such as Joint Implementation and the Clean Development Mechanism under the Kyoto Protocol (see Bertoldi and Rezessy (2006), Neuhoff et al. (2007)).

Unlike the situation in many jurisdictions in North America, most European countries do not have extensive utility-driven DSM programs. Lacking the financial incentives of DSM activities, White certificates are an essential component of the EU system for greenhouse gas emission regulation> They are complementary to the cap and trade system of the EU ETS, because white certificates are aimed at reducing energy consumption and greenhouse gas emission of residential and commercial users while the EU ETS focuses on large industrial emitters. Bertoldi and Rezessy (2008) have developed a set of core design elements for white certificate schemes across countries. These core elements include, inter alia, the following:

- Policy Driver. The policy goals and the drivers of the policy goals have major implications for the appropriate type of trading scheme and its operational details. Energy savings obligations and trading schemes can address energy efficiency, security of supply, greenhouse gas emissions and local pollutants.

- Obligated Parties. Obligated parties are agents who have obligations under the white certificate scheme.
- Threshold and Apportionment Criteria. Thresholds refer to the criteria under which the requirements of the white certificate scheme become operational, while apportionment criteria refer to the manner in which the overall target is apportioned to individual agents.
- Trading. Trading refers to whether or not there is trading in obligations either with or without actual certificates.
- Cost Recovery. Mechanisms for cost recovery may be available for obligated parties to recover in whole or in part the costs required to meet obligations.
- Penalty. Penalties may be levied in some cases if an obligated party fails to adequately meet his or her

obligations under the scheme.

Table 1 summarizes the core elements of the French white certificate scheme, and to provide additional perspective, Table 1 also compares the white certificates schemes of the United Kingdom, Italy and France. There are some common features but also some differences between the three programs. In the United Kingdom, the white certificate program focussed on residential savings with the main measures being home insulation, lighting including CFLs, appliances and heating measures. In Italy, the white certificate program focussed on residential and commercial buildings, industry and public lighting and supply options with the main savings coming from heating and lighting measures. In France, the white certificate program focussed on residential buildings with more limited support for commercial buildings, industry, transportation and district energy, with the main savings coming from efficient boilers, heat pumps, insulation and energy efficient windows. It is worth noting that the French energy savings target is relatively small compared to those for the United Kingdom or Italy.

Table 1. Comparison of White Certificate Scheme Design Features

	United Kingdom (2005-08)	**Italy (2005-08)**	**France (2006-09)**
Target	Quota system based on TWh fuel-weighted energy benefits targeted at domestic customers with 185 tonnes CO_2 or about 128 TWh	Quota system based on tonnes of oil equivalent targeted at all customers with 2.4 tonnes of oil equivalent for a total of about 260 TWh	Quota system based on TWh targeted at all customers with total of 54 TWh on a lifetime discounted basis
Obligated parties	Electricity and gas suppliers	Electricity and gas suppliers	Electricity, gas, LPG, cold and heating fuel suppliers
Threshold and apportionment criteria	Threshold is 50,000 domestic customers with apportionment based on number of domestic customers	Threshold is 100,000 domestic customer with apportionment based on market shares for electricity and gas	Threshold is 0.4 TWh per year with apportionment based on market shares and energy sales turnover for residential and tertiary sectors
Trading	No certificates but obligations can be traded and savings can also be traded after own obligation met	Certificate trading	Certificate trading
Cost recovery	No fixed cost recovery but suppliers may include relevant costs in end-user prices	Determined ex ante by the regulator for obligated parties own energy vectors	Rise in prices/tariffs limited to 0.5% of the customer bill
Penalty	Regulator has authority to set penalty up to 10% of supplier's turnover	Regulator can set penalty which is greater than investment needed to compensate non-	0.02 Euro per kWh

		compliance	
Impact	Savings of 192 TWh for the period 2005 through 2008	Savings of 128 TWh for the period 2005-2008	Savings of 65 TWh for the period 2007 through 2009

Source. Modified from Bertoldi and Rezessy (2008) and Giraudet and Finon (2010).

In December 2010, the Government of France published two degrees and three administrative orders providing the new legal framework for white certificates in France [Banet (2011)]. Among other changes, the new framework increased the target for the second period to 345 TW over three years, placed priority on energy efficiency improvements in the transportation sector including automobiles, and redoubled the French commitment to increase energy efficiency by 20% by the year 2020.

Demand for White Certificates

To motivate the empirical analysis, we build a simple model of the energy and energy services markets following the development in Quirion (2005) and Giraudet and Quirion (2008). Energy consumers go though a two-stage budgeting process. In the first stage, they maximize utility subject to a budget constraint to generate a desired level of energy services ES. We don't explicitly model the first stage, but assume instead that following first stage budgeting, the consumer has an exogenous demand for energy services (ES). In the second stage, energy consumers buy energy (e) and energy-savings goods (g) which they combine to produce the exogenous (for this context) required level of energy services (ES). The good e and g are combined in a Cobb-Douglas technology to produce ES, so consumers choose the levels of e and g that minimize cost subject to the constraint that they attain ES. Let α be the energy budget share of α, where $0 \leq \alpha \leq 1$, $1 - \alpha$ be the energy budget share of e, P_g be the price of g, and P_e be the price of e, then formally we have:

(1) $\text{Min}_{e,g}\ P_e \cdot e + P_g \cdot g$ subject to $g^{\alpha} \cdot e^{1-\alpha} \geq ES$, $e \geq 0$ and $g \geq 0$.

The first-order conditions lead to the demands for good g and good e:

(2) $g = \{\alpha/(1-\alpha)\}^{1-\alpha} \cdot (P_e/P_g)^{1-\alpha} \cdot ES$,

(3) $e = \{\alpha/(1-\alpha)\}^{-\alpha} \cdot (P_g/P_e)^{\alpha} \cdot ES$.

Note that the demand for each good is: (1) decreasing in its own good price; (2) increasing in the other good price; and (3) increasing in the demand for energy services.

For empirical implementation, we take the log of both sides of (2) so that log(g) is a function of $\log(P_e/P_g)$ and of log (ES). Although Equation (3) plays no further role since this paper does not consider the demand for energy, in future work it might be useful to simultaneously model the demands for both energy-savings goods and energy. The dependent variable is the log of monthly sales of white certificates in thousands and the dependent variables are the log of the ratio of the pr ice of energy savings certificate to the retail price of electricity and a trend term, which is a proxy for the demand for energy services. Note that in a double log equation, the coefficients are elasticities. So, the coefficient on the log price ratio is the price elasticity of the demand for energy savings certificates.

Table 2 provides the results of the demand equation modelling. Model 1 is estimated using ordinary least squares, and it says that the demand for white certificates is a function of a constant term and the normalized price of white certificates, with an estimated price elasticity of -1.88. The coefficients are both statistically significant, and the explanatory power of the regression is reasonable, but there is weak evidence of autocorrelation. Model 2 is estimated using maximum likelihood using a first-order autocorrelation scheme to deal with the autocorrelation, and it says that the demand for white certificates is a function of a constant term and the normalized price of white certificates, with an estimated price elasticity of -1.50. The coefficients are both statistically significant, and the explanatory power of the regression is reasonable, but there is essentially no evidence of autocorrelation. Model 3 is estimated using ordinary least squares, and it says that the demand for white certificates is a function of a constant term, the normalized price of white certificates, and a trend term, with an estimated price elasticity of -2.68. The coefficients are all statistically significant, and the explanatory power of the regression is reasonable, but again there is weak evidence of autocorrelation. Model 4 is estimated using maximum likelihood to deal with the autocorrelation, and it says that the demand for white certificates is a function of a constant term, the normalized price of white certificates, and a trend term, with an estimated price elasticity of -2.46. The coefficients are all statistically significant, the explanatory power of the regression is reasonable, but there is essentially no evidence of autocorrelation. On the basis of the adjusted R-squared values, Model 4 is the preferred model.

Intuitively, we might expect that energy and energy savings are good substitutes for each other in producing energy services, so that we might anticipate estimated price elasticities fairly close to -1. For Model 1 and Model 2, the 95% confidence intervals around the price ratio coefficients do indeed include -1, but this is not true of Model 3 or Model 4.

Table 2. Demand for Energy Savings Certificates (log sales in thousands)

	Model 1 (OLS)	**Model 2 (ML)**	**Model 3 (OLS)**	**Model 4 (ML)**
Constant	10.6*** (2.29)	9.13*** (2.15)	14.8*** (2.95)	13.8*** (2.95)
Log price ratio	-1.88*** (0.58)	-1.50*** (0.55)	-2.68*** (0.66)	-2.46*** (0.67)
Trend	-	-	-1.82** (0.94)	-1.64** (0.82)
Adjusted R^2	0.46	0.49	0.58	0.66
Durbin-Watson	2.25 (-0.12)	1.96 (0.02)	2.45 (-0.22)	2.12 (-0.06)

Note. The numbers in parentheses are standard errors for regression coefficients and the estimated autocorrelation for the Durbin-Watson test. Two asterisks indicate that the coefficient is significant at the 5% level and three asterisks indicate that the coefficient is significant at the 1% level.

Some implications of these findings are as follows. First, although the French market for white certificates was relatively thin, demand is very responsive to price suggesting that the French market for white certificates is working quite well. Second, the estimated price elasticity is quite high, which suggest that white certificates and energy are very good substitutes. Third, the demand for white certificates in France shows a downward trend for the period examined, suggesting that French authorities may need to undertake additional measures to make the market for white certificates more robust.

Cost Effectiveness Analysis

Traditionally, the impacts of public policy are analyzed using cost-benefit analysis in which the costs of the policy and the benefits of the policy are quantified, monetized and then discounted to a common point in time using a common discount rate. Although cost-benefit analysis is useful in examining a given policy initiative in isolation, it has two major drawbacks when applied to the analysis of energy efficiency policies. First, the benefits of an energy efficiency policy are substantially driven by the future prices of energy and these are hard to predict. Second, different jurisdictions have energy prices that vary because of non-market factors such as taxes, subsidies and regulation of monopoly service providers, so that comparisons across jurisdictions are both difficult an opaque. See Braithwait and Caves (1994) for a comprehensive review of the California Standard Protocol Tests.

An alternative to cost-benefit analysis is the cost of conserved energy (CCE), where the cost of conserved energy is the present value of the flow of costs divided by the present value of the flow of energy (Stoft (1995)). The original method of constructing CCE assumed that the measure cost occurs entirely at time zero and that energy is saved at a constant rate. This approach annualizes costs and compares annualized costs with the constant flow of energy and avoids the mathematics of discounting. But since the discounting is trivial, it makes more sense to undertake the proper calculations. Table 3 shows the results of the CCE calculations for the program period 2007-2008 and the program period 2007-2009. CV and PV refer to current value and present value respectively. The stream of costs and energy savings pertains to the period 2007-2028, and come from 2009 DGEC data and use the official 4% discount rate.

For the first two years of the program, the present value of savings was 34.29 TWH while the present value of costs was 1,329 million Euros, so that the cost of conserved energy was 0.039 Euros per kWh. For the first three years of the program, the present value of savings was 44.46 TWH while the present value of costs was 3,762 million Euros, so that the cost of conserved energy was 0.085 Euros per kWh. Presumably, the increased cost of conserved energy for the full three-year period compared to the initial two-year period, reflects, at least in part, implementation of the most cost effective measures first.

Table 3. Cost Effectiveness Analysis (4% discount rate)

Period	CV savings (TWh)	PV savings (TWh)	CV costs (€million)	PV costs (€million)	CCE (€/kWh)
2007-2008	49.50	34.29	1,367	1,329	0.039
2007-2009	65.00	44.46	4,000	3,762	0.085

Summary and Conclusions

White Certificates policy in France has been driven by three main factors: (1) need to increase energy efficiency in the hard to reach residential and commercial sectors; (2) limited success in increasing energy efficiency with traditional policy instruments; and (3) limited public funds to implement DSM activities. The purpose of this study is to provide an impact analysis of the first stage of the French White Certificate program which ran from 2007 through 2009. Key conclusions of the study are as follows.

(1) Program Design and Implementation. The French White Certificates program design is relatively comprehensive and aggressive compared to certain other schemes. For example, in Italy the initial emphasis has been on lighting improvements (which are likely to provide only short term gains as efficient lighting technologies become ubiquitous through market transformation) whereas in France the initial emphasis has been on a wide range of technologies including building envelope improvements (which provide deeper and longer lasting energy savings and are unlikely to be undertaken in the absence of appropriate tax/subsidy schemes). The initial three-year obligation of 54 TWh has been more than met with estimated savings of 65 TWh.

(2) Market for White Certificates. To model the demand for white certificates, a two-stage consumer budgeting process is used where in the second stage, energy consumers buy energy and energy-savings goods which they combine to produce the required level of energy services. For empirical implementation, the d dependent variable is the log of monthly sales of white certificates in thousands and the dependent variables are the log of the ratio of the price of energy savings certificate to the retail price of electricity and a trend term, so that the estimated coefficients are elasticities.

(3) Costs and Benefits. The estimated cost of conserved energy is 0.085 Euros per kWh. For the first two years of the program, the present value of savings was 34.29 TWH while the present value of costs was 1,329 million Euros, so that the cost of conserved energy was 0.039 Euros per kWh. For the first three years of the program, the present value of savings was 44.46 TWH while the present value of costs was 3,762 million Euros, so that the cost of conserved energy was 0.085 Euros per kWh. Presumably, the increased cost of conserved energy for the full three-year period compared to the first two-year period, reflects, at least in part, implementation of the most cost effective measures first.

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