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Abstract

Les certificats négociables sont un bon outil de promotion des activités économiques quand celles-ci permettent d'améliorer le surplus social. Les certificats blancs, parce qu'ils encouragent les activités destinées à réduire la consommation d'énergie et parce que ces activités sont des 'biens de confiance', c'est-à-dire des biens dont la qualité réelle ne peut pas être vérifiée, sont contreproductifs. Ils suscitent des comportements opportunistes de la part des professionnels de la rénovation des bâtiments et de l'installation des systèmes de chauffage. Pour rendre le système vertueux, il faudrait que les certificats garantissent les résultats effectivement mesurés et non des évaluations techniques faites ex ante. Compte tenu du coût des contrôles, la sincérité des déclarations devrait être assurée par de lourdes sanctions en cas d'infractions, ce qui n'est pas réalisable quand les entreprises sont trop petites. Il faudrait donc encourager une concentration dans le secteur de la rénovation des bâtiments en respectant un arbitrage entre avantage collectif d'avoir de grosses entreprises responsables des performances énergétiques et risques d'abus de position dominante ou de collusion sur le marché par ces mêmes entreprises.

Tradable certificates are a good tool to promote economic activities when they increase the social surplus. White certificates are counterproductive, because although they encourage activities aimed at reducing energy consumption, these activities are 'credence goods', i.e. goods whose real quality cannot be verified. They therefore lead to opportunistic behavior by professionals of building renovation and heating system installation. In order to make the system virtuous, certificates should guarantee the results actually measured, instead of ex ante technical evaluations. Given the cost of controls, the accuracy of the declarations should be ensured by heavy penalties for infringements, which is not feasible when companies are too small. Concentration in the building renovation sector should therefore be encouraged, respecting a trade-off between the collective benefit of having large companies responsible for energy performance and the risk of abuse of a dominant position or collusion by these same companies.

I. INTRODUCTION

1. Energy utilities are legally bound to promote energy efficiency in 24 US States, 14 European countries, four Australian States and Territories, Brazil, Canada, China, Korea, South Africa and Uruguay (International Energy Agency, 2017, 2020). The majority rely on a scheme of 'white certificates' (also known as 'energy saving certificates').

2. These mechanisms are designed to correct a perceived 'energy efficiency gap'. In the early 2000s, a few studies (e.g., McKinsey 2009) argued that energy efficiency investments (e.g., attic insulation) were cost effective, which means that the value of the energy savings appropriately discounted exceeds the investment cost necessary to reduce energy consumption. In practice, few households make these investments. Possible explanations for this lack of investment include

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a lack of information (households are not aware of the value of the savings), myopia (households are aware of the value of the savings, but do not value them fully), missing supply (households would like to invest but cannot find a contractor qualified to do the job) or capital constraints (banks do not want to lend money on projects with fuzzy returns).

3. Moreover, in countries where many households rent rather than own their dwellings, particular attention must be paid to misaligned incentives between tenants who may not stay long enough to enjoy the full value of the energy savings, and owners of rented properties who are unsure they can pass the value of energy saved through to their tenants. To remedy this perceived 'energy efficiency gap', governments intervene, by imposing technical standards, by directly subsidizing energy efficiency investments, or by encouraging the investments with indirect transfers such as white certificates.

4. Certificates are guarantees that some obliged companies – generally the main sellers and distributors of energy – have spent resources to retrofit industrial facilities, commercial sites, or residential dwellings to lower the amount of electricity, gas and oil consumed. The costs of energy saving operations are usually passed through to energy final users, and when energy savings are guaranteed by white certificates, these are intangible assets that can be traded over the counter or on a spot market.

5. Official documents usually present the white certificates scheme as 'market-based', as it specifies only the outcome to be delivered. It does not prescribe the type of works to be carried out or the type of equipment to be installed. The choice is up to decentralized decision makers who will find the least-cost investment to match the policy makers' objectives.

6. In reality, the observed results are far from the expected ones. The white certificates system is very inefficient because it disregards information problems, in particular the information gap between the professionals and the energy final users.

7. First, it is very difficult to assess at the outset the exact value of energy savings since they are supposed to last for more than a decade. Between the ex-ante planned savings and those observed ex-post the difference is often large.

8. Second, there are strong information asymmetries among the different agents involved, in particular when it comes to households. The energy consumers who are supposed to benefit from the investment partially financed by obliged agents lack the expertise and knowledge to accurately evaluate the type and quality of the works to be carried out and the professionalism of subcontractors. Specifically, information asymmetry creates three problems. First, as households do not have the information necessary to select the most cost-effective solution for their particular circumstances, they rely on the contractors' suggestions. The latter is likely to propose the solution that maximizes his profits (e.g., attic insulation), not the most cost-effective for the customers (e.g., boiler replacement). Thus, renovation works completed are unlikely to be the most effective. Second, households do not have the information necessary to monitor the effort exerted by the contactors. Third, as the quality of works is not immediately observable (e.g., it takes a harsh winter for a household to observe

that its attic is poorly insulated), the effects of renovation works are unlikely to make a difference right away. As a result, the difference between the promised savings reflected by certificates and those delivered is significant.

9. As it is, the white certificates scheme is a flawed 'market-based' mechanism, but attacks on it on the basis of competition policy have been unsuccessful (II). Actually, the system's main flaw is informational. It cannot work without either close control by a public authority – which means that it is more a central-planning tool than a market-based scheme –, or scarce controls but high penalties in case of performance default – which can succeed only if the firms obliged to increase energy efficiency are large enough to pay the duties without going bankrupt (III).

II. THE WHITE CERTIFICATES MECHANISM

10. Even though they can differ in the details, all systems of white certificates rely on the same principles: certificates must be produced by obliged agents, who usually purchase them from certificate producers that perform certain specific tasks (Bertoldi and Rezessy, 2008). The result is a complex entanglement of the energy production markets, the energy efficiency markets and the certificates market (A). Partially because of this complexity, energy saving programs, in particular those sustained by a white certificates scheme, are inefficient in terms of cost-benefit analysis (B). As governments oblige large energy sellers to incur expenditures in the equipment market that can be passed through to final consumers of energy, the system can raise challenges in terms of state aid and competition distortions (C).

A. How does it work?

11. To reduce greenhouse gas emissions, governments endeavor to decrease the consumption of fossil energy sources. But energy is not a final consumption good. It is an intermediary good that needs to be combined with some form of equipment to produce services, e.g., electricity plus a fridge to produce cold, or natural gas plus a heater (and a well-insulated house) to produce warmth. Hence, decreasing the energy burnt without deteriorating the services consumed can be done by enhancing the performance of the accompanying equipment: improving the insulation of dwellings, upgrading electrical household appliances, using high-performance industrial machinery, etc.

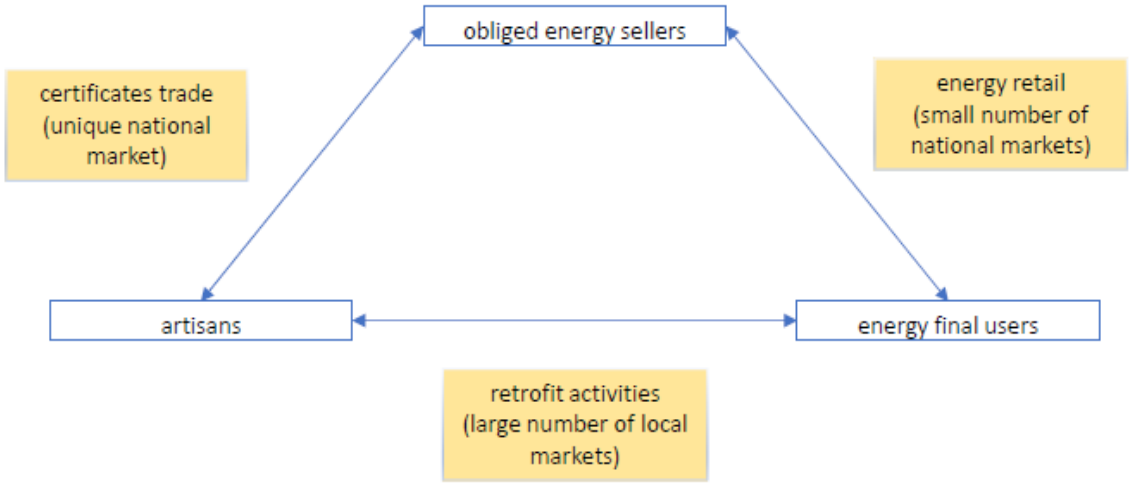
12. In a decentralized framework, this should be left to the users' discretion, with the public authority intervening only to oblige polluters to internalize the environmental damages they cause. As for greenhouse gas emissions, the tool favored by economists is a carbon tax that would substantially increase the cost of burning fossil fuels. They argue that, faced with these high fuel costs, energy consumers would be incentivized to invest in low-consumption equipment, contingently helped by social transfers in the case of low-income households. But the reality is that public authorities are reluctant to create new taxes or to increase the existing ones, be they environmental or not. They favor any form of subsidy, as long as the way it is financed remains hidden. That is exactly what white certificates are designed for.

13. The certificates game begins with the government obliging energy suppliers (or, in some countries energy distributors) to prove that they have produced a given amount of energy savings (generally proportional to their turnover) at consumption locations they freely choose. At the end of a fixed period (2 or 3 years), the obliged agents will have to deliver a certain number of certificates stating that the works have been completed. But the obliged parties are not always qualified to perform the works on their own.

14. Here enters the pivotal agent of this game, the insulation specialist or the installation technician. Let's name this person 'the artisan'. He or she is the intermediary between the obliged companies and the energy final users who contract for energy savings works or who buy appliances. The artisan has two sources of revenue: the bill payed by the consumer for the works, and the sale to the obliged agent of certificates generated by these works. The relationship between the works and the number of certificates generated is defined roughly at the outset. This is very frequent for residential heating where efficient boilers, heat pumps, insulation and windows are eligible for a predetermined present value of saved kWh.[1] In the case of specific operations, an ad hoc measurement of the expected kWh saved is necessary to determine how many certificates will be delivered.[2]

15. An alternative way to obtain the required certificates is to buy them from obliged agents who have more than their obligations, or eligible agents without any obligation (e.g. housing associations and property management companies). In general, trade is over the counter[3], but some cases of spot markets do exist.[4]

16. At the end of the regulation period, the obliged party must pay a penalty for each missing certificate. In some places, the penalty



[1] As an illustration, there are hundreds of data sheets giving the equivalence between standardized operations and number of certificates awarded, at http://calculateur-cee.ademe.fr/user/fiches/BAT.

[2] See https://www.ademe.fr/sites/default/files/assets/documents/certificats_economies_energies_operations_specifiques_installations_fixes-dispositif_cee_2015_2017ademe_guidetechnique.pdf for the French guide.

[3] e.g. https://www.emmy.fr/public/donnees-mensuelles in France

[4] e.g. https://www.mercatoelettrico.org/en/ in Italy

cancels the obligation to meet the target (e.g. France), in others it does not (e.g. Italy).

17. Overall, the white certificates mechanism has many similarities with other environmental regulations such as the Emissions Trading Scheme (ETS) aimed at reducing greenhouse gas emissions. The main difference is that it is national, contrary to the ETS that is implemented at the European Union scale. They both rely on market mechanisms, but they cannot work efficiently without tight controls at all stages of the game. This is much more difficult to implement for white certificates since their sources are widely scattered around the country.

18. Assuming that all the agents involved acted as expected, we should observe significant decreases in energy consumption for two cumulative reasons: first, after the investment, consumers can obtain the same level of final service with less energy and, second, energy is more costly because energy suppliers increase their selling prices to compensate for the cost of the certificates scheme. However, even if the scheme was not impaired by the information problems that we will discuss in Section III, as shown in the Figure, it links up three markets (energy, insulation, and certificates) with quite different structures. The result is a delicate system, the performance of which should be gauged comprehensively, not just by measuring the virtuous impact on fossil fuel consumption.

B. Deceptive outcomes

19. Energy efficiency programs, whatever the method used to implement them, seem to have decreased energy consumption, even though we lack data to distinguish their role from the general downturn of economic activity (Giraudet and Finon, 2014). But at what cost?

20. To decide upon whether to undertake energy savings works, the consumer should balance today's investment cost and the discounted value of the future energy savings. Only works with a positive net present value should be undertaken. Direct subsidies and indirect help through certificates or low interest rates should be used only to compensate for a market failure such as missing high carbon prices (that would increase the present value of energy savings) or borrowing restrictions.

21. Capital budgeting analysis based on expected energy savings shows that investments have been profitable (Rezessy and Bertoldi, 2010). However, with actual savings well below the expected ones, the true average performance of the national systems is negative. For example, Blaise and Glachant (2019) analyze energy efficiency works in the French residential sector. They calculate that with an investment of €1,000, the value of energy savings expected using administrative data, which amounts to €65 per year, is much larger than the one they measure in their sample, which is only €8.39 per year.

22. Similarly, using a sample of low-income households in Michigan, Fowlie et al. (2018) find that the upfront investment costs are about twice the present value of the actual energy savings, mainly because projected savings are roughly 2.5 times the actual savings. The resulting average rate of return is negative, approximately -9.5% annually.

23. Could such bad performance be due to imperfect competition or unfair conditions of competition in the emission and trade of

certificates? We consider this possibility in the following.

C. Competition issues

24. The white certificates mechanism generates several potential competition issues. First, insofar as funds are channeled from a quasi-tax to private construction companies, it could be considered state aid (1). Second, since handling the obligation has fixed costs and the energy savings targets differ from one energy to the other, it potentially distorts competition between small and large energy suppliers (2). Finally, while non-regulated energy retailers can freely pass through the additional costs to consumers, that is not the case for the utilities that sell at regulated tariffs (3).

1. ARE WHITE CERTIFICATES STATE AID?

25. Energy efficiency is one of the pillars of the EU environmental policy, along with the abatement of greenhouse gas emissions and the promotion of renewable sources of energy. Member States must achieve the objectives of new savings every year, i) from 1 January 2014 to 31 December 2020, of 1.5 % of annual energy sales to final customers; and ii) from 1 January 2021 to 31 December 2030, of 0.8 % of annual final energy consumption.[5]

26. According to the 'Guidelines on State aid for environmental protection and energy 2014-2020' (2014/C 200/01), energy-savings measures are part of 'environmental protection'. To reach the target, governments can freely choose the aid instrument, provided that it is coherent with the market failure that it aims at addressing, and that it does not infringe upon the regulation on state aid. White certificates are not mentioned in these texts. Could they be state aid that is not in accordance with EU rules?

27. In February 2014, an association of French retail energy operators asked the Conseil d'Etat (the supreme administrative jurisdiction in France) to cancel a 2013 decree that extended by one year the second three-year period of energy saving obligations.

28. In order to soften the system constraints, the association of retailers had chosen a line of attack in terms of State aid by referring to a decision of the European Commission concerning the emission trading scheme for nitrogen oxides in the Netherlands (State Aid n° N35/2003).[6] The Commission had decided that the NOx emission trading scheme constituted State aid within the meaning of Article 87(1) of the EC Treaty (now 107 of TFEU). The Commission also concluded that such aid is compatible with the Common Market.

29. By relating the French white certificates to the Dutch trading scheme, the plaintiffs wanted to focus on one possible infringement of the regulation by the French authorities. When creating the energy savings certificates in 2005, the French government did not notify the Commission. Yet, except for block exemption, de minimis aid, and aid in a category already authorized by the Commission, EU State aid control requires prior notification to the Commission, and Member States must wait for the Commission's decision before they can put the measure into effect (Art. 108 TFEU).

[5] Directive (2012/27/EU) amended in 2018 (2018/2002)

[6] For a follow-up on this case, see Slot 2013.

30. The Conseil d'Etat dismissed the plaintiffs' application on the basis that in State Aid n° N35/2003 referred to above, the Commission distinguishes two kinds of trade systems: a) systems where a tradable emission or pollution document is considered an intangible asset representing a market value which the authorities could have sold or auctioned, leading to foregone revenues (or a loss of State resources), hence State aid, and b) systems where a tradable emission or pollution document is considered as authorized proof of a certain production that cannot be sold or auctioned to the recipient, hence there are no foregone revenues, therefore no State resources, and no State aid.

31. In the French system, the certificates are just authorized proof that cannot be sold by the government. In other words, they are not granted from State sources, neither directly nor indirectly, which means that the scheme is not State aid.[7] This can be viewed as a quality of the certificates system if the national authorities want to skip the obligation to wait for the green light from the European Commission. In any event, the poor economic performance of energy efficiency campaigns sustained by white certificates seems to be unrelated to a distortion of competition imputable to public transfers.

2. MARKET DISTORTIONS

32. The graph shows that the three markets for certificates, energy sales, and energy savings have quite different structures. Let us examine how the certificates scheme could impair competition mechanisms on each of them.

33. **On the certificates market.** One recurrent complaint by opponents of the certificates scheme is that it gives a competitive advantage to the incumbents at the expense of new entrants, because energy efficiency obligations are computed with respect to the quantity sold without considering market shares. They argue that it gives the incumbents a specific trading capacity as they can obtain or buy large volumes of certificates. It is true that when the certificates are exchanged over the counter, large holders could try to abuse their dominant position in bilateral bargaining with artisans or eligible parties by buying at low prices, and with obliged parties by selling them at high prices when their net demand for certificates is high. However, we are not aware of any case of abuse in the certificates markets. The most likely reason is that there are numerous sources of white certificates, so that all obliged firms can easily find the quantities they need at a cost well below the default penalty. This could change in the future with higher volumes to collect and more costly works to extract the certificates.

34. **On the energy markets.** The very creation of obligations generates distortions in the exercise of competition, and when the obligations rely on tradable certificates, the distortions are even more difficult to identify and measure. For example, the obliged firms incur a fixed cost of implementation. As this organization cost is independent of the quantity of certificates to handle, the larger the

[7] On the economic analysis of State aid, see Besley and Seabright (1999), Spector (2009), and Dewatripont and Seabright (2010).

obliged firm, the smaller the impact on its unit total cost of production. How much of the certificates' cost each energy seller can pass through to end users depends on its current profits and the price elasticity of energy demand. To avoid the double cost of: i) paying for energy savings and ii) having lower sales, energy sellers can try to promote energy savings at locations using an energy different from their own. For example, a seller of natural gas can promote the replacement of electric heaters by gas-fired heaters. This is not forbidden by law and can easily be countered with a symmetric offensive by the competitor selling electricity.

35. Another potential distortion relates to the exemption thresholds of obliged parties. Recall that only 'large' firms have the obligation to collect certificates. As the energy industry is heterogeneous, the exemption conditions will most likely differ from one sector to the other, for example between electricity and motor fuels. If the thresholds that separate obliged and non-obliged parties differ for two energies that are near substitutes, there is an obvious distortion of competition. By contrast, if each type of energy has its own relevant market, a differential treatment is innocuous.[8]

36. **On the energy efficiency markets.** Large established firms can organize networks of artisans that will use the incumbents' reputation to convince final users that they need energy savings works. Then, even if the obliged parties do not directly enter the market of energy efficiency, they have a leverage that can distort competition there. A more direct intervention could be the selling of efficient appliances jointly with energy contracts – a bundling strategy that can be very efficient in terms of energy savings but distortive in terms of competition.

37. The relationship between the artisan and the energy consumer is more problematic. Whereas there is a large number of artisans at national scale, they are not very numerous in a given region. After the energy consumer has requested works quotations from several providers, it cannot easily compare the offers to choose the best one. On these markets, transactions look more like imbalanced bilateral arrangements than fairly competitive agreements. We address the problem in Section III.

38. **Relevant market.** How should certificates be considered in merger cases? When two firms with energy savings obligations want to merge, should the competition authorities consider the market for certificates separately from the market(s) of the product they sell, or rather like a mere mandatory regulatory scheme. If it is a separate market, the merger impact must be measured by variations in the concentration indices on complementary markets (energy + certificates).

39. The relevant **geographical market** is clearly national when the certificates targets and the way to collect them are defined by national authorities. Extending energy savings obligations up to a supra-national scale would be quite complex. It would necessitate the certification of measures undertaken by obliged firms outside their country and/or the control of the veracity and quality of the

[8] See https://www.doctrine.fr/d/CE/2018/CEW:FR:CECHR:2018:410360.20181203 for a case examined in France by the Conseil d'Etat.

certificates bought in other countries (European Commission, 2009: 38-41)

40. By contrast, according to the European Commission, the definition of the relevant **product market** remains an open question for white certificates.[9] From a purely economic point of view, we could consider that there is a relevant market for certificates, whatever their color. The core issue is to mitigate global warming, and together energy efficiency, GHG emissions abatement and the promotion of renewables all work toward this objective. White, green, and brown (EU-ETS) certificates could thus be viewed as substitutes in a large market for environmental obligations. This is a view to consider as the fight against global warming becomes a priority in public policies (Sorrell et al. 2009).

3. ENERGY PRICES VS. TARIFFS

41. In some countries, the opening of energy retail to competition is not complete. The incumbents still have the obligation to propose contracts with tariffs that are fixed by a public authority, for example the energy regulation agency.

42. When both the energy sellers subject to some form of price regulations (e.g. electricity and gas prices in the residential sector) and those without price regulation (e.g. heating oil suppliers or transport fuel suppliers) are under certificates obligations, the latter may have a competitive advantage in terms of passing through all costs from energy savings compliance in end-use prices, while regulated entities are not free to do so (European Commission, 2009, p.9).

43. In regulation contracts, the share of costs the regulated firms cannot avoid is covered by the tariff under a cost-plus rule. Since the utilities cannot avoid the white savings obligation, they should see their tariffs cover this additional cost. However, looking closer at the problem, the certificates cost is equal to the required quantities multiplied by their unit cost or price. It is true that the obliged firms cannot modify the quantity of white certificates they must submit. They still have some leeway on the certificates cost or the price they pay to certificates sellers. If the regulated firm has the guarantee of full cost recovery through the energy tariffs, it has little incentive to adopt least-cost energy savings, but it faces the risk of losing clients attracted by the competitors' contracts. Then, when collecting certificates, the regulated firms will not behave very differently from their free-market competitors.

44. Overall, the above sketchy analysis suggests that all the energy sellers involved in the white certificates game are reasonably fairly treated. Neither the energy markets nor the certificates markets seem to be impaired by the white certificates scheme as regards competition policy. This is not true when we consider the markets for works, where the energy consumers and the artisans interact.

III. THE VULNERABILITY OF ENERGY CONSUMERS

45. White certificates increase demand for renovation works. In all sectors, when demand increases, existing firms expand their workforce, or new firms enter the market. In

[9] https://ec.europa.eu/competition/mergers/cases/decisions/m7137_20140625_20310_3804903_FR.pdf, pages 29-30. This view was taken up by the French competition authority in Decision n°19-DCC-195, October 22nd, 2019.

most economic settings, increasing competition, in particular increasing entry by new firms, increases consumers' surplus. This may be different in the energy efficiency sector: somewhat paradoxically, by increasing entry in the home renovation industry, the white certificates scheme may reduce welfare. This is due to the informational gap between the agents who need energy efficiency works and the artisans who execute them (A). A scheme based on performance contracts would be welfare-enhancing by curbing both problems of adverse selection and moral hazard (B).

A. Information issues

46. End users of energy face two informational challenges when negotiating with artisans. First, they are not able to distinguish between those who are well prepared and equipped, and those who are not. This is a problem of adverse selection in the lingo of contract theory (Christensen et al., 2020). Second, there is a problem of moral hazard: all agents, skilled or not, incur costs when exerting high levels of effort (Giraudet et al. 2018a). If the effort cannot be observed and verified by the ordering customer, the agent's effort will be suboptimal.

47. The adverse selection problem (is the artisan intrinsically good or bad?) can be partially solved by means of an accreditation system. The good artisans have a common interest in delivering a label of skillfulness, but they still have to inform and convince the energy consumers that it is not a fake label (Dranove and Jin, 2010). Firms with a good reputation – which supposes they are not new entrants –, can use their brand as a label. Otherwise, the label must be delivered by a public authority.

48. The moral hazard question (does the artisan work as hard as he should?) is trickier. If the results of the effort could be verified with certainty in the short run, the artisan could be made responsible for any bad result. Even in this simple case, by how much he should be fined is not a straightforward question (see B below). As energy savings are expected to last for more than a decade, not all the expected results can be measured precisely. Giraudet et al. (2018a) provide empirical evidence of moral hazard in the U.S. home retrofit market. They find that actual energy savings are subject to day-of-the-week effects: energy savings are significantly lower when works are done on a Friday rather than another weekday, probably because of lower workers' productivity. They show that the Friday effect explains 65% of the discrepancy between predicted and actual energy savings.

49. Lastly, note that the final performance of the energy savings works also depends on external events that are out of the artisan's control (e.g. storms, snow) and on the behavior of the consumer (Wirl, 2015). Encouraged by new equipment, consumers will have an incentive to increase their consumption of energy services, for example to buy additional appliances, with the result of burning more energy. This 'rebound effect' is not the responsibility of the artisan.

50. Energy efficiency works belong to the category of 'credence goods' (Giraudet, 2020), which means that their true quality will never be fully revealed to the buyer. Other categories are medical treatment, taxi travel, and car repairs. For this type of good, inappropriate treatment and overcharging are quite

common. The economic literature reports on lab and field experiments analyzing the scope of the problem and offering some feasible solutions (Kerschbamer and Sutter, 2017).

51. The discrepancy between expected and actual energy savings is not entirely due to white certificates since the informational gap on insulation works is the main cause. However, by encouraging undertakings with almost uncontrollable quality, the certificates system worsens the welfare damage.

B. Second best for energy efficiency and white certificates

52. From the preceding discussion, it clearly appears that no energy efficiency program will reach a first-best level, irrespective of how it is sustained: technological standards, direct subsidies, reduced interest rates or certificates (1). One second best solution is to foster a concentration in the renovation works industry and to make the resulting large firms responsible for the measured ex post outcomes of the undertakings they have sustained through the certificates emitted (2).

1. ENERGY EFFICIENCY AS A CREDENCE GOOD

53. Due to the severity of information asymmetry problems, new firms (or existing firms expanding) need not deliver appropriate (effective) and high-quality (efficient) renovation solutions. In fact, since the subsidy reduces incentives for customers to evaluate and monitor the works, it is likely that low-cost low-quality firms enter more massively, or that existing firms expand in the low-cost low-quality segment. This means that white certificates are likely to reduce the average Net Present Value (NPV) of the renovation projects completed.

54. Empirical studies find that the NPV of renovation projects is negative on average (Fowlie et al. 2015, 2018). Therefore, white certificates that increase the volume of renovation work increase the aggregate negative NPV from renovation projects. Since that aggregate negative NPV is financed by an excise tax on energy users, their net surplus is decreased. Of course, this decrease in net surplus is partially compensated by the increased profit from the construction firms. But the policy, by increasing low-cost low-quality competition, leaves customers worse off.

55. The first-best solution to the perceived 'energy efficiency gap' would be to set an adequate price for CO_2, so that the pollution externality is correctly accounted for in households' energy bills. It would then be to educate households on the value of different energy efficiency investments. This would increase households' propensity to undertake energy efficiency investment.

56. The second-best way to promote efficient energy savings is to consider the activity as a credence good and to design a solution that balances the unavoidable information asymmetries and the will to increase the investment in energy efficiency. Since credence goods are such that buyers are unable to know whether the quality they observe is in line with the inputs they have paid for, the control of quality must be transferred to a third-party with a sanctioning power, and the sellers must be made liable for the results (Dulleck et al. 2011).

2. PERFORMANCE CONTRACTS

57. On practical grounds, to alleviate the information asymmetry problem in the field of energy efficiency, policy makers should encourage the use of performance contracts. The contractor is remunerated through the measurable energy savings realized, not by an upfront payment based on savings estimates. This aligns the incentives of the contractor, the household, and society at large.

58. Performance contracts would solve the selection-adverse problem since it would be in the interests of the firms to provide training to their employees. They would transfer the moral hazard problem to the internal relationship between the contracting firm and its employees or subcontractors. Finally, they would be welfare improving as regards exogeneous information asymmetries (climate events, appliance outages) since it would entail a transfer of risks from highly risk-averse customers (in particular households) to weakly risk-averse large operators.

59. Performance contracts present two challenges. First, since they create significant risk for the contractor, only large firms have the financial capacity to offer them. This then leads to a consolidated energy efficiency industry: possibly a large number of local subcontractors who undertake renovations under the control of 5 to 10 large, national, energy efficiency firms. This degree of concentration would warrant strong antitrust attention to prevent abuse of dominance and collusion.

60. Second, energy performance contracts are by nature complex contracts. For example, savings on energy consumption is good for society, and it is easy to measure with smart electricity and gas meters. But what about the financial gains for the consumer? How are savings computed when the underlying energy price increases or decreases? In the first case, the investment has been undersized; in the second case, the gains are smaller than expected.

61. Who is responsible for these "miscalculations"? Large energy customers have highly specialized staff in their purchasing departments, dedicated to negotiating and managing such contracts. Without help, small customers will find it difficult to do so. One possible solution would be for an agency to draft standard contracts, or standard contract clauses, to limit the risk of households signing inappropriate contracts. Also, the same agency could support households in contract management. This means that the public backing of the white certificates scheme must go beyond the mere writing of technical data sheets, with the creation of a clear responsibilities framework.

62. To guarantee the efficiency of the consolidated energy efficiency industry, public controls need to be frequent and/or highly penalizing when inadequate performance is observed. Today, controls are scarce and are only carried out in the case of complaints (DGCCRF, 2019: 40). Since controls are costly, rather than increasing their number, the level of the penalties should be increased. In France, the 2019 Law on Energy and Climate has modified the level of pecuniary penalties in case of observed mismatch between the works and the emitted certificates. It has been increased from 2% to 4% of turnover excluding tax, and from 4% to 6% in the event of a new breach of the same obligation.

63. Note that the "concentration remedy" mainly concerns renovation works. The appliances industry is already quite

concentrated, and manufacturers have been implementing systems of quality certification with guaranties, voluntarily or under mandatory rules, for a long time already (Nauleau et al. 2015).

64. In this consolidation process, energy retailers could play a more active role through a vertical integration with firms in the renovation industry (Giraudet et Finon, 2011). Note that this is not necessary a de facto financial integration. It can be soft, by means of long-term provision contracts.

65. In this paper, we have disregarded the important problem of fuel poverty. All programs that increase the cost of energy have distributional consequences. Since low-income households dedicate a larger share of their income to energy than do wealthier people, all certificates systems are regressive. Therefore, energy efficiency programs, whatever their financial backing, must be accompanied by subsidies to low-income customers (Giraudet et al., 2018b).

66. Finally, given the informational biases identified above, the need for reliably controlling the works and identifying deviations, and the necessary support to low-income energy consumers, the question remains of why governments delegate energy efficiency programs to energy sellers rather than implementing them directly (Giraudet et al, 2019).

IV. CONCLUSION

67. All the countries that have created white certificates to support their energy efficiency programs seem to be satisfied with the outcomes. They even try to enlarge the scope of the programs. However, the 'good' results they are proud of are computed on the basis of energy savings determined administratively ex ante. Evidence shows that the real savings, when observed ex post, are well below the expected levels (ADEME 2020, Glachant et al. 2020).

68. The reason for this bad performance is due more to the very nature of energy savings than to white certificates. Works dedicated to domestic or industrial energy savings belong to the category of 'credence goods', which means that they cannot be fully verified, neither ex ante nor ex post. As guarantees of the energy savings works, white certificates transmit erroneous information. Additionally, as they encourage the production of these credence goods, they are detrimental for welfare.

69. Certificates guaranteeing the achievement of performance contracts, that is, based on ex post results, would be welfare enhancing. A public entity would need to check the results against the certificates. Given the high cost of ex post controls, the scheme would necessitate severe fines in case of infringement, with a risk of bankruptcy if a firm that is proved guilty is small.

70. To be efficient, the system of performance contracts certified by white certificates requires the consolidation of the renovation and insulation industry. This implies firms large enough to have qualified employees, capable of controlling the effective operation of the work, and financially sound enough to be liable in case of noncompliance.

71. An alternative form of this consolidation process is greater involvement of the obliged energy retailers in the energy process, either by the bundling of appliances and energy sales, or by a vertical integration of activities, at least under a soft form. This would imply the signing of long-term contracts with

artisans, that would be more tightly controlled than at present.

72. The drawback of this reform is a weakening of competition in terms of the number of operators. It means that the competition authority should be more careful in controlling contract design and pricing practices.

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