BASQUE CENTRE FOR CLIMATE CHANGE
Klima Aldaketa Ikergai

Which policy option can be more cost-effective in promoting the use of energy efficient appliances in Europe? A comparison of energy taxes, subsidies, tax credits and bans.

Ramon Arigoni Ortiz and Anil Markandya

December, 2009

BC3 PUBLIC POLICY BRIEFINGS

2009-02

The Basque Centre for Climate Change (BC3) is a Research Centre based in the Basque Country, which aims at contributing to long-term research on the causes and consequences of Climate Change in order to foster the creation of knowledge in this multidisciplinary science.

The BC3 promotes a highly-qualified team of researchers with the primary objective of achieving excellence in research, training and dissemination. The Scientific Plan of BC3 is led by the Scientific Director, Prof. Anil Markandya.

The core research avenues are:

- Adaptation to and the impacts of climate change
- Measures to mitigate the amount of climate change experienced
- International Dimensions of Climate Policy
- Developing and supporting research that informs climate policy in the Basque Country

The BC3 Public Policy Briefings are available on the internet at
http://www.bc3research.org/lits_publications.html

Enquiries (Regarding the BC3 Public Policy Briefings):

Ibon Galarraga

Email: ibon.galarraga@bc3research.org

www.bc3research.org

Which policy option can be more cost-effective in promoting the use of energy efficient appliances in Europe? A comparison of energy taxes, subsidies, tax credits and bans

Ramon Arigoni Ortiz and Anil Markandya[1]

Keywords: tax incentives, energy efficiency, durables, subsidies

Cite as: Ortiz, R.A and A. Markandya (2009), *Which policy option can be more cost-effective in promoting the use of energy efficient appliances in Europe? A comparison of energy taxes, subsidies, tax credits and bans.* BC3 Public Policy Briefings 2009-02. Basque Centre for Climate Change (BC3). Bilbao, Spain.

[1] Basque Centre for Climate Change (BC3), Gran Via, 35 – 2, 48009 Bilbao, Spain. Corresponding author E-mail: ramon.ortiz@bc3research.org

1. Motivation

Energy consumption accounts for a significant share of anthropogenic greenhouse gas (GHG) emissions and is associated with global climate change. Mitigating climate change has become a challenge for our society, requiring policymakers to design policy options that provide the right incentives for producers and consumers to improve energy efficiency and mitigate GHG emissions. The European Commission identifies increased energy efficiency as the most cost-effective and rapid way to reduce CO_2 emissions. It argues that achieving the ambitious task of 20 percent reduction in CO_2 emissions by 2020 requires, among other things, approximately 20 percent savings in energy consumption, most likely through energy efficiency measures. In this context, European policy makers have an important role to play in increasing energy efficiency, reducing CO_2 emissions, and mitigating climate change.

2. Method

This research aimed to assess, from both economic and environmental perspectives, the interaction and comparability of a number of fiscal incentives designed to foster the production and consumption of appliances in the EU. We investigated how cost-effective a group of policy options applied for specific goods would be in selected European countries, using market data for year 2007. Table 1 summarises the policy options, countries and goods evaluated. We have developed a simple economic-engineering-type model of consumers´ behaviour to support our analysis. We used this model to assess the effects of the policy options on sales of energy efficient appliances, estimating the energy savings and CO_2 reductions resulting from the observed changes in sales of different kinds of appliances. The benefits were then compared to inferred costs of the selected policy options.

Table 1: Case studies and policy options investigated

Case-study	Product	Member State	Baseline scenario	Policy option 1*	Policy option 2*
1	Refrigerator	France	Increase in electricity price (12%)	Subsidy for consumers (€50 class A+ only)	Energy tax: further increase in electricity price (10%)
2		Denmark			
3	Washing-machine	Italy	Increase in electricity price (12%)	Tax credit for manufacturers (€100 per appliance cl. A+; sold above historical levels - 3 years average)	B-class and lower removed from the market (market share of classes B and C shifted to class A)
4		Poland			
5	Boiler	Denmark	Increase in gas price (15%)	Tax credit for consumers (deducted from income tax; 25% of the appliance price for condensing boiler)	Energy tax: further increase in gas price (10%)
6		Italy			
7	CFLi	Poland	Increase in electricity price (12%)	Subsidy for consumers (€1 classes A and B)	Energy tax: further increase in electricity price (10%)
8		France			

Note: (*) Policies 1 and 2 are applied on top of baseline scenario (an increase in energy prices associated with the implementation of the European Emission Trading Scheme ETS).

3. Results

- **Refrigerators**

In France, the subsidy policy has a welfare cost of about €6.4 million while the energy tax has a gain of €3.2 million. The subsidy generates a bigger saving in CO_2 than the energy tax, almost six times greater. In terms of the welfare costs per ton of CO_2, the subsidy has a cost of €60/ton while the tax option has a welfare benefit of €185/ton. The administrative cost of the subsidy option is almost 22 times higher than the energy tax option. Finally, the producers' revenue gains are €180 million with the subsidies, while they only gain €30 million in higher value sales with an energy tax.

In Denmark, the subsidy policy has a small welfare benefit of about €15,900 while the tax option also has a benefit of €157,000. In terms of CO_2 savings the subsidy option reduces emissions by 38,000 tons against 16,000 tons for the energy tax option. In terms of the welfare costs per ton of CO_2, the subsidy option has a benefit of €0.4/ton against a gain of €10/ton with the energy tax. The administrative cost of subsidy option is almost 10 times higher than the energy tax option. Finally producers' revenue gains are much greater with the subsidy option (€17 million against €7 million for the tax option).

Both France and Denmark rank the two options similarly: energy tax is preferable to subsidies, i.e. energy tax presents higher welfare gains.

- **Washing machines**

In Italy, the tax credit has a net welfare cost of €19 million, against a net welfare cost of €5 million from the removal of inefficient appliances from the market, making the removal option more feasible. However, the removal option generates smaller savings in CO_2 than the tax credit (13,000 tons against 29,000 tons for the tax credit). In terms of the welfare costs per tCO_2, the removal option is therefore cheaper at €408/ton against €650/ton for the tax credit. Both these figures, however, would be considered unacceptably high for projects designed to reduce CO_2.

The results for Poland are similar to those for Italy: there is a bigger welfare cost from the tax credit option but a smaller reduction in CO_2 from the removal option. The cost per ton of CO_2 removed in tax credit option is now €284/tCO_2, while it is €190/ton for the removal option. The revenue gain to producers under the removal option is about €6million, while under tax credit option it is less, at €3 million. This last result is different from that in Italy. Since a lot more people have B and C class machines in Poland compared to Italy, the removal of these in Poland creates a bigger demand (relatively speaking) than in Italy. Hence the profits to producers are bigger under the removal option in Poland.

The ban of inefficient washing machines is preferable to tax credit for manufacturers but both policies present an unacceptable high welfare cost.

- **Boilers**

In Denmark the tax credit has a higher welfare benefit than the gas price increase (€2.5 million for tax credit and €557,000 for the gas price increase). The tax credit option therefore is also very cost-effective in per tCO_2 (a gain of €24/ton), while the gas price has a smaller welfare gain of €16/tCO_2. The tax credit reduces CO_2 by 100,000 tons against 34,000 tons for the gas price increase. The other big difference between the options concerns the revenue cost for the government – the tax option generates revenue of €4.5 million while the tax credit costs the government €4.6 million.

In the case of Italy a much bigger gain is made from switching out of non-condensing boilers. The reason for this is that while in Denmark most boilers are condensing boilers (80% of the market) in Italy most are not (only 12%). Hence both polices in Italy have a bigger impact, but especially the tax credit. This option generates a huge net welfare gain of €287 million because of the profits of producers. On the other hand the tax option has a net welfare benefit of €23 million. As a result the cost per tCO_2 removed is negative with the tax credit at €14.2/ton and €10/ton with the price increase. Both figures would be considered acceptable as a policy for reducing CO_2. We also note that the amount of CO_2 reduced under the tax credit is very large (1.3 million tons per year) while with the gas price increase it is 128,000 tons per year. Finally, while tax credit budgetary cost of €191 million the tax option generates a revenue gain of €69 million.

Tax credit to consumers is more cost-effective than energy tax (gas price increase) in both countries, although both policy options are cost-effective.

- **Light bulbs**

In Poland the net welfare benefit of the two options is similar: the subsidy option has a gain of €37 million while the tax option has a gain of €20 million. However, the administrative costs of the subsidy are much higher: €1.5 million against €160,000 for the tax. On the other hand the subsidy option reduces CO_2 by 2.2 million tons (lifetime basis) million tons per annum while the tax option reduces only 138,000 on the same basis. The cost per tCO_2 removed is negative for both the subsidy (€17/tCO_2) and the tax (€142/tCO_2) options. Finally note that while the subsidy option will cost the government €30million the tax option will generate €81million revenue.

The major differences between France and Poland are: (a) the welfare gain of the subsidy option at €4.6million is still lower than the tax option €24million. The subsidy option reduces CO_2 by 400,000 tons (lifetime basis) while the tax option reduces 32,000 tons. The gain/tCO_2 removed is higher than that for Poland. The figures are €11 for subsidy and €761 for the tax option. The main reason for this result is that in Poland a reduction in energy consumption generates a higher cost due to the use of coal for electricity generation. Finally note that while the subsidy option will cost the government €46 million, the tax option will generate €124 million revenue. Furthermore, the administrative costs for the subsidy are much higher: €2.3 million against €250,000 for the tax option.

Subsidies to light bulbs are more cost-effective than energy tax in Poland but the inverse holds for France.

4. Policy Recommendations

The analysis suggests that incentives to promote the use of energy efficient appliances can be cost effective, but whether or not they are depends on the particular country and the options under consideration. Comparing the subsidies against the energy tax options, we find that the subsidies are in most cases less cost effective than the energy tax, although subsidies in general produce larger CO_2 reductions but at higher welfare costs. Subsides are only preferred to taxes in the case for CFLi bulbs in Poland. Tax credits for boilers are more cost effective than energy taxes in both Italy and Poland. The tax option of course has the advantage of generating revenue that could be used for promoting energy efficiency while the subsidy option places a burden on the budget. In principle this burden has been accounted for by imposing a cost on the subsidy equal to the welfare cost of raising public funds but in situations of fiscal constraints additional pressures on the budget may need to be taken into account.

5. Research Gaps

Some issues need to be considered to strengthen this analysis. First, distributional factors could be taken into account. Empirical evidence suggests that a tax on energy is not regressive in the long run, however, there is concern that increasing energy prices hurt the very poor, who face fuel poverty. Likewise the option of removing from the market cheaper less efficient appliances would have a bigger impact on the budget of the poor than on that of the rich. These considerations need further investigation and possible policies to alleviate serious negative impacts have to accompany any tax measures. Second, the model does not fully allow for 'spill over' effects of the incentives. If a subsidy is provided for an appliance, there will be a tendency for more appliances to be sold, but also the savings in energy from the more efficient appliances could result in increased energy use elsewhere (the so-called 'rebound' effect). Third, our assumption of the welfare gains of producers (i.e. the producer surplus) is based on somewhat weak data and further studies would be of benefit to estimate this variable more accurately. Finally, we believe that the timing of a policy (the transitional period) may have an important influence on the effectiveness of that policy. Our approach assumed that consumers were fully aware of the new policy within the same year of its implementation, which may not be entirely true, depending on how this information is made available for consumers. More practically, we would expect adjustment to the full rational choice to take place over time, rather than in one year alone. Introducing a lagged adjustment component to the model, and making it dynamic would be a worthwhile extension to the model.

References

Markandya, A.; R. A. Ortiz; S.Mudgal and B.Tinet (2009), "Analysis of Tax Incentives for Energy Efficient Durables in the EU", *Energy Policy*, 37(12), p.5662-5674.

European Commission (2008), "A Study on the costs and benefits associated with the use of tax incentives to promote the manufacturing of more and better energy-efficient appliances and equipment and the consumer purchase of these products". Available online at http://ec.europa.eu/taxation_customs/resources/documents/taxation/gen_info/economic_analysis/economic_studies/study_costs_benefits_bio_en.pdf

BC3 POLICY BRIEFING SERIES

Basque Centre for Climate Change (BC3), Bilbao, Spain

The BC3 Policy Briefing Series is available on the internet at the following address:

http://www.bc3research.org/lits_publications.html

BC3 Policy Briefing Series available:

2009-01 Galarraga, I., M. González-Eguino and A. Markandya (2009), General comments on the COP 15: What happened in Copenhagen?

2009-02 Ortiz, R.A. and A. Markandya (2009). Which policy option can be more cost-effective in promoting the use of energy efficient appliances in Europe? A comparison of energy taxes, subsidies, tax credits and bans.