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Does Income Distribution Affect Energy Investments?

By Nadia Ameli* and Daniel M. Kammen**[1]

New methods are needed to accelerate clean energy policy adoption. Financing barriers represent a notable obstacle for energy improvements, especially in those countries where most of the population belongs to the low-middle income range, thus facing financial constraints. A policy such as PACE – Property Assessed Clean Energy – provides up-front funds to residential property owners, allowing them to install electric and thermal solar systems and to make energy-efficiency improvements to their buildings. This article discusses the potential application of PACE to the Italian case study.

Keywords: *financing barriers, energy efficiency, solar PV, energy investments*

JEL Classifications: *Q42, Q55*

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PACE, Property Assessed Clean Energy

The diffusion of energy efficiency and renewable energy technologies at residential level would change significantly the energy equation, given that housing structures account for more than 35 percent of total energy use and almost 23 percent of electricity consumption in Italy (Department of Economic Development 2010).

There is a substantial "efficiency gap" between a consumer's actual investment in energy efficiency and the investments that appear to be made in the consumer's own interest (Golove and Eto, 1996). Various reasons such as financial barriers, insufficient information/knowledge and analytical capacity (Sanstand and Howarth, 1994), transaction costs, uncertainty of savings, split incentives, and the need for investments in upfront costs, explain the existence of the energy efficiency gap.A key issue emerging within the debate in previous years, is how policy and programs may influence consumer perception and enable investments in energy efficiency.

In this article we present a candidate policy to tackle these issues. A Property Assessed Clean Energy (PACE) program represents a novel financing tool that spreads clean energy payments over the usage period, thus shifting the up-front financing burden to one closely to payment for services. This program allows residential property owners to install energy efficiency measures, solar thermal, and solar PV, while paying for the cost over a 20-year period through a special tax, which is collected as a line item on the property tax bill. If the property is sold before the end of the repayment period, the new owner takes over the remaining special tax payments as part of the property's annual tax bill (Fuller, Kammen 2008).In the United States, 27 states enacted legislation and programs that have been implemented through city, county, and state-level initiatives *[Note 1]*.

The Italian case

If financing barriers represent a notable obstacle for energy improvements, this is particularly true for low-income households (Gutermuth 1998, Brown 2001). To ensure a high impact of any policy, a key step is to identify the potential population that would benefit from it. For our Italian case study we quantify the households belonging to the low-middle income range which would be the target of our policy (table 1).

In 2010 the Gini coefficient for Italian taxpayers is 0.4, while for owner taxpayers it is 0.42, hence the average household in Italy belongs to the income range 10,000-26,000 €/year. Considering that the average income per capita is 18,900 euro (taxpayer) and 22,700 euro (owner taxpayer), a typical energy investment with a value of 16,000 € would represent 85% and 70% of their annual income, respectively. These numbers highlight the fact that the overall condition of Italian households makes investments in

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energy projects unlikely.

We now consider the potential benefit of applying PACE policy to the Italian context. To assess the impact of PACE financing on residential customers, we compare the net present value of annual cash flows over 25 years for energy retrofits. For an average household in Italy, the net present value was calculated for solar photovoltaic installation only and then for combined energy efficiency improvements and solar photovoltaic installation. Different scenarios are modeled and we take into account the year of installation, relevant to compute the solar PV incentive. Most of the projected scenarios have a positive net present value, especially when energy improvements are made in 2012 and 2013 (table 2).

The Italian homeowners in the thought experiment could opt for different solutions to finance energy improvements. To select the most cost-effective options we compared the net present value and the profitability index (which quantifies the amount of value created per unit of investment) *[Note 2]* for a typical energy package. This energy package has an assumed value of 16,000 euros depending on how it is financed and it includes the solar PV and energy efficiency options. *[Note 3]* Alternatives are compared with the application of three different options:

- a 5-year unsecured personal loan at 8.97% *[Note 4]*
- a 10-year financing banks solution for solar PV and energy efficiency *[Note 5]* at 7.01% *[Note 6]*
- a 20-year tax assessment PACE program.

To provide a complete analysis on the financing solutions available on the market, we consider the loan for use contract offered by the private companies. *[Note 7]* In civil law, a loan for use agreement is defined as a free concession of anything, either movable or not movable, under certain timeframe with the obligation to return the good received (Civil Code art. 1803-1812). It is important to note that this type of contract is available only for solar PV. Companies are responsible for all the project's aspects in terms of cost, installation and maintenance as well as beneficiaries' incentives. The homeowner will benefit from the electricity produced by the solar system. This formula is very attractive for companies that take advantage of generous feed-in tariff scheme over a period of 20 years. The loan for use contract ensures positive cash flows to homeowner, given by the energy saved on monthly utility bills and the net present value derived is about 4,175 €. Comparing this result to NPV based on PACE tax assessment (Table 3), we registered a difference of about 4,024 €. The gap computed is mainly due to the "Conto Energia" incentive. Feed-in tariff scheme contributes for about 50-55% to positive annual cash flows and consequently to the NPV value. In the case of private companies providing financial solutions to support solar PV, firms will profit by this incentive. Energy efficiency is not supported by a similar economic support scheme, and consequently is less appealing business for companies. Greater uncertainty in savings added to limited profit margins are key issues in discouraging firms from designing suitable financial products for energy efficiency.
Even though the financing formula provided by the private sector addresses upfront cost, it does not maximize net present value for customers.

Conclusion

Overcoming the upfront cost of energy investments is a crucial step for addressing barriers to energy improvements, especially for low-income households. Analyzing income inequality is important to understand how it affects the accessibility to energy-saving measures. In this article we present the Italian case study. Considering that the national average income per capita is 18,900 euro (taxpayer) and 22,700 euro (owner taxpayer), a typical energy investment with a value of 16,000 € would represent 85% and 70% of their annual income, respectively. These numbers highlight the fact that the overall condition of Italian households makes investments in

energy projects unlikely.

The implementation of a PACE in Italy could represent a cost-effective way to finance energy improvements. Well-designed, it could in principle ensure higher NPV than the other market options.

A PACE program can be a powerful policy for regional governments in order to increase the accessibility to energy saving measures. The economic benefits of energy cost savings are distributed over time, but an up-front cost is required to begin these improvements. This model corrects this disconnection and allows the costs of the clean energy installation to be distributed over time just as the benefits are. Local governments play a key role in creating the right framework conditions to improve energy performance in stock buildings. Meeting national energy needs and achieving climate targets will be possible only with an understanding of the benefits of clean energy and the methods that can be applied to finance it.

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Notes

[Note 1] Database of States Incentives for renewable and Efficiency, updated October 2011

[Note 2] Profitability index quantifies the amount of value created per unit of investment.
(Present value of future cash flows/ initial investment)

[Note 3] Fuller, Portis et Kammen, "Municipal Financing for Energy efficiency and Solar power"

[Note 4] Average interest rate applied by 20 banks

[Note 5] After the introduction of feed in tariff scheme, many banks offered specific packages for solar PV

[Note 6] Average interest rate applied by 10 banks which provided specific energy package

[Note 7] Private companies: Enel Green Power, Sorgenia, Enfinity

Links

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Table 1: Income Distribution in Italy

Income range (€, euro)	Taxpayers			Owner taxpayers		
	Taxpayers number	Average income	Relative frequency	Owner taxpayers number	Average income	Relative frequency
< 10'000	14,112,749	4,656	0.340	6,210,707	4,946	0.256
10'000 - 26'000	18,914,233	17,458	0.456	11,299,196	17,820	0.465
26'000 - 55'000	6,970,245	34,349	0.168	5,460,127	34,631	0.225
55'000 - 75'000	734,919	63,689	0.018	623,904	63,737	0.026
> 75'000	790,908	129,973	0.019	696,533	130,249	0.029
Total	41,523,054		1.000	24,290,467		1.000

***Source*: Department of Treasury and ISTAT 2010**

Table 2: Net present value comparison, basic scenario

	Year of installation				
	I semester 2012	I semester 2013	I semester 2014	I semester 2015	I semester 2016
Solar PV	8,199 €	5,493 €	2,299 €	(862) €	(4,270) €
Solar PV and EE	8,474 €	5,768 €	2,574 €	(587) €	(3,995) €

*Parentheses indicate negative value

Table 3: Comparison of financing options

	Year of installation				
	I semester 2012	I semester 2013	I semester 2014	I semester 2015	I semester 2016
Solar PV	8,199 €	5,493 €	2,299 €	(862) €	(4,270) €
Solar PV and EE	8,474 €	5,768 €	2,574 €	(587) €	(3,995) €