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TOWARDS A COMPREHENSIVE ANALYSIS OF ENERGY EFFICIENCY POLICIES FOR BUILDINGS: LESSONS LEARNT FROM THE ITALIAN TAX RELIEF SCHEME

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ABSTRACT

Energy efficiency is deemed to play a crucial role in improving sustainability. Within the current debate on the design of more effective policies to promote energy efficiency in industry and society, the aim of this paper is to carry out an exhaustive evaluation of the Italian tax relief scheme by a specifically developed comprehensive multi-stakeholder cost-benefit evaluation framework. The framework considers the entire set of stakeholders involved in a broad set of cost-benefit items. The application of the evaluation framework in the Italian context shows that tax relief scheme had a positive impact for energy users and players in the energy efficiency value chain, while the State and energy utilities suffered from a negative cost-benefit balance. In particular, results seem to call for a business model transformation for the energy efficiency value chain, where utilities may counterbalance a reduction in their original business (marketed energy) through a greater role in offering energy efficiency value-added services to final users. The findings, beside providing policy-makers with useful insights on the (re)design of energy efficiency incentive mechanisms, also contribute to future academic research on the topic.

Keywords: energy efficiency; tax relief; multi-stakeholder perspective; cost-benefits; cost-effectiveness; energy policy.

NOMENCLATURE

Abbreviations	
EEMs	Energy Efficiency Measures
EEVC	Energy Efficiency Value Chain
NEBs	Non-Energy Benefits
WCS	White Certificates Scheme

1. INTRODUCTION AND RESEARCH BACKGROUND

Within the growing worldwide debate on designing more effective policies to promote energy efficiency and mitigate climate change [1], a tax relief scheme (or tax deductions) represents a valuable energy efficiency policy instrument, currently in place in many countries, through which Countries strive to achieve their targets of increased energy efficiency. In Italy, one of the major European economies and ranked first in the world for the 2018 International Energy Efficiency Scorecard (which measures the efficiency policies and performance of 25 of the world's top energy-consuming countries) [2], the scheme has been proposed since 2007 (by the Budget Law for 2007) for existing buildings. Since its introduction in Italy in 2007, more than 3 million EEMs were implemented thanks to the scheme at the end of 2017 [3]. The scheme has been recently revised increasing the tax deduction (initially set to 55%) to first 65% and, currently up to 70% or 75% for interventions on the building envelope contributing to improve the energy performance. For the reasons above, understanding the cost effectiveness of such scheme that is an energy efficiency champion in a major world's economy could offer valuable insights for also policy-making purposes.

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To assess the cost-effectiveness of energy efficiency policy instruments, existing studies propose different and even complementary approaches. On the one hand, in terms of metrics adopted. For example, the comparison of the total costs associated with the scheme and the energy saving achieved, i.e. the so-called negawatt-hour cost [4–6], or the economic efficiency of the scheme, assessed through the schemes' cost-benefit ratio. On the other hand, research has adopted so far different perspectives [7]. The first (technical perspective) focuses on estimating the costs associated with the adoption of Energy Efficiency Measures (EEMs) and the related benefits linked to reduced energy consumption [8-10], assuming the perspective of parties involved in carrying the cost of such measures. The second (program administrator perspective) enables policy-makers to make decisions focusing on the impact of an energy efficiency program from their own standpoint, e.g., evaluating the program cost per unit of energy saved [11–13]. But, as research notes, a multi-stakeholder perspective [14-15] can be particularly effective, since it can lead to a more comprehensive and holistic evaluation of an energy efficiency program, by including all the stakeholders involved, implying the introduction of further appropriate metrics.

To the best of our knowledge, only a few studies adopt this last viewpoint. One of the most recent contributions on the topic [16], focused on the Italian White Certificates Scheme (WCS), aims at evaluating the economic efficiency of such scheme following a multi-stakeholder perspective. The same can be said for studies [4; 17] assuming different complementary approaches at the same time, that could provide very useful insights. The advantage of the proposed method is to improve the comprehension of the scheme by taking the perspective of a single stakeholder, therefore on the one hand by better understanding its current profitability; on the other hand, by glimpsing future opportunities and business models to face new challenges in the energy efficiency market.

By taking inspiration from previous research, the present study aims at providing an exhaustive evaluation of the Italian tax relief scheme, complementing well-developed methodologies within the literature with emerging ones. To this aim, we propose and discuss a comprehensive multi-stakeholder cost-benefit evaluation framework that considers the entire set of stakeholders involved and a broad set of cost-benefit items. We have applied the framework taking as dataset the last year of operation of tax relief in Italy for which robust information is available (i.e., 2016).

We believe that our analysis may offer a valuable contribution to the academic discussion over policy mechanisms for increased energy efficiency. Further, findings can be a valuable source of insights for Countries currently evaluating the introduction of an energy efficiency incentive scheme, as well as for those seeking to strengthen the effectiveness and efficiency of existing ones.

The remainder of the paper is organized as follows: Section 2 introduces the main characteristics of the Italian tax relief scheme and illustrates the multi-stakeholder evaluation framework and the other approaches to evaluate the scheme. Section 3 presents the results of the application of the evaluation framework. Finally, Section 4 provides concluding remarks, in addition to limitations and avenues for future research.

2. THE MULTI-STAKEHOLDER EVALUATION FRAMEWORK

The Italian tax relief scheme has been a powerful tool to promote energy efficiency in buildings in Italy in the last decade [3]. It allows residential energy users to deduct from their income taxes a percentage of the expenses incurred to implement certain EEMs, such as insulations (e.g., vertical walls, roof, slabs, windows and shutters replacement) and solar panels for product domestic hot water, condensing boiler and high-efficiency heat pump.

The evaluation framework considers the effects produced by the Italian tax relief scheme, assuming the following complementary perspectives: Energy users, Utilities, i.e. companies operating in energy sale, Players in the Energy Efficiency Value Chain (EEVC), which provide energy users with energy efficiency technologies and services, and the State, including institutional players and society at large. To develop the multi-stakeholder evaluation framework, we take inspiration from previous work by Franzò et al. [18] to identify the items, i.e. the costs and benefits, associated with the tax relief scheme. The evaluation framework includes the following items, each one may represent a cost for one (or even more than one) stakeholder and a benefit for another stakeholder, as reported in Table 1.

To estimate the value associated to each item, we set an ad-hoc metric for their estimation. Multiple information sources were used to collect data (e.g., official documents issued by institutional stakeholders,

i.e. GSE and ENEA). Furthermore, regarding some variables considered in our framework, we formulated conservative assumptions.

To estimate the direct costs of EEMs (item #1), we measured the total costs of EEMs in 2016 in Italy, by identifying the EEMs whose installation was driven by the presence of the WCS.

To estimate tax relief (item #2), we started from the estimation of the direct costs of EEMs (item #1), then multiplied by the tax relief rate (65%). Furthermore, to take into account that the whole incentive (tax deduction) is split in ten annual equal payments, we have divided the resulting amount by 10. Further, the yearly cash flows have been discounted by using a rate equal to 1.5% (that represents a conservative value for a residential investor).

Similarly, we estimated energy bill reduction (item #3) by multiplying the amount of annual energy savings generated by implementing EEMs and the average annual energy price for each year of the EEM useful life, discounting them using the same discount rate. We calculated energy savings as the energy savings generated by implementing EEMs, i.e. the difference between the ex-ante and the ex-post energy consumption [19]. Regarding energy price, we considered the annual average electricity and natural gas prices for residential users in each analysed year (source: EUROSTAT).

ITEMS	Description	State	Players in the EEVC	Energy users	Utility
1. Direct costs of EEMs	It includes investment costs of EEMs implemented.		+	-	
2. Tax relief	It includes the amount of incentives incurred by the State due to the EEMs implemented, as a reduction of taxes gathered.	**-**		**+**	
3. Energy bill reduction	The reduction of energy operating expenditure for energy users that adopt EEMs.			**+**	**-**
4. Tax levies reduction related to energy bill reduction	The reduction of the amount of taxes (VAT, corporate tax, and energy tax) paid by utilities as a consequence of energy bill reduction due to implementing EEMs.	-			+
5. Tax levies increase related to EEMs	The increase in the amount of taxes (VAT, corporate tax, and income tax) paid by EEVC players and energy users as a result of implementing EEMs.	+	-	-	

Table 1 The proposed evaluation framework. "+" indicates that the impact is positive for a specific stakeholder (i.e. a benefit); "-" indicates that the impact is negative for a specific stakeholder (i.e. a cost).

In doing so, we assume that the reduction of energy consumption for energy users after the implementation of EEMs leads to a reduction of the same amount in energy bills [3], despite utilities might increase the unitary energy price to counterbalance the loss of turnover (due to energy efficiency), and energy bills include both fixed and variable costs.

Tax levies reduction related to energy bill reduction (item #4) encompass multiple sub-items, namely VAT reduction of energy bills, corporate tax and energy tax reductions. First, we estimated VAT reduction considering the reduction of energy bills driven by the implementation of EEMs multiplied by the average VAT rate in each year (10%) (source: Italian Revenue Agency). Second, we calculated corporate tax (IRES – in Italy) reduction considering the reduction in energy bills driven by the implementation of EEMs, which corresponds to a loss in utilities' turnover. Then, we measured the average Earnings Before Taxes (EBT)-turnover ratio for electricity and gas/other fuels (source: AIDA – Bureau Van Dijk) to assess the reduction of EBT due to the reduction of energy bills. Finally, we calculated corporate tax reduction by multiplying the reduction of EBT by the average corporate tax rate in each year (source: Italian Economic Development Ministry). Third, we measured energy tax (excises) reduction as the reduction of energy bills driven by the implementation of EEMs multiplied by the average tax rate in each year (source: Italian Customs and Monopolies Agency). All three are discounted following the same approach described above.

We calculated tax increases related to the implementation of EEMs (item #5) by considering VAT increase from the cost of EEMs, corporate tax increase (for the same reason) as well as personal tax, to encompass considerations regarding increased turnover for players in the EEVC. First, we measured the VAT increase starting from the costs of EEMs multiplied by the average VAT rate in each year (source: Italian Revenue Agency). Second, we assessed the corporate tax (IRES – in Italy) increase starting from the costs of EEMs, which corresponds to an increase in turnover for EEVC players. Then, we calculated the average EBT-turnover ratio for EEVC players (source: AIDA – Bureau Van Dijk) to assess the increase in EBT due to the costs of EEMs. We measured, in the end, the corporate tax increase by multiplying the reduction of EBT by the average corporate tax rate in each year (source: Italian Economic Development Ministry). Third, we calculated the income tax (IRPEF) increase starting from the costs of EEMs corresponding to an increasing turnover for EEVC players. In terms of the increase in employment, we multiplied the costs of EEMs by the number of jobs created per million euro invested in EEMs (employees-turnover ratio), as Rosenow and Bayer [4] suggested. In particular, we assessed the average employee-turnover ratio of EEVC players (source: AIDA – Bureau Van Dijk) to measure the increase in employment due to the increased turnover. Finally, we calculated the income tax increase through multiplying the number of new employees by the average annual wage in the EEVC and the average income tax rate in each year (source: Italian Economic Development Ministry).

3. RESULTS AND DISCUSSION

Table 2 shows the results of the application of the developed multi-stakeholder evaluation framework introduced in Section 2 to the Italian tax relief scheme in 2016.

ITEMS	State	Players in the EEVC	Energy users	Utility
1. Direct costs of EEMs		+ 3,309	- 3,309	
2. Tax relief	- 1,983		+ 1,983	
3. Energy bill reduction			+ 2,468	- 2,468
4. Tax levies reduction related to energy bill reduction	- 519			+ 519
5. Tax levies increase related to EEMs	+ 400.5	- 400	- 0.5	
TOTAL	**- 2,101.5**	**2,909**	**1,141.5**	**-1,949**

Table 2 Multi-stakeholder evaluation of the Italian tax relief scheme (2016).

Firstly, the application of the multi-stakeholder framework shows that the tax relief scheme in Italy has generated a null net benefit in 2016, i.e. assuming a country-level perspective, with significant different impact on the stakeholders involved.

The State experienced a negative cost-benefit balance, equal to -2.1 billion €, due to the tax reduction related to tax relief and energy bill reduction, which is only partially offset by the tax increase related to EEMs. Similar negative cost-benefit balance can be observed for utilities, equal to -1.9 billion €, due to energy bill reduction, only partially offset by the tax decrease related to the reduction of the amount of energy sold.

Nevertheless, in this scenario, the State triggered the development of the economic system, enabling the achievement of positive effects for players in the EEVC and energy users. In particular, the EEVC players show the highest positive cost-benefit balance, equal to 2.9 billion €, mainly due to the selling of EEMs, while the energy users show a positive ratio, equal to € 1.1 billion, due to a significant reduction in their energy bills (€ 2,4 billion) and tax relief (€ 2 billion), which offset the costs they incurred for EEMs.

Regarding the EEMs costs (item #1), we can assume that such costs are sustained by residential energy users, due to the purchase of EEMs. In fact, despite EEVC players may (totally or partially) sustain such costs, their role in financing EEMs in the Italian residential energy efficiency market is rather limited [20]. However, in the light of a recent provision (Lex 27 December 2017 n. 205 by the Italian government and related implementing decree by the Italian Tax Agency on April 2019), an increasing role by players in the EEVC and utilities

indirectly investing in EEMs can be foreseen. Nevertheless, in the absence of market data, it is worth mentioning the recently developed offering by several Italian major players. In addition, also thanks to the combination of incentives in place, such as tax relief and white certificates, utilities are increasingly considering energy efficiency as an emerging business opportunity [18, 21]. In fact, by working as a player in the EEVC offering higher value-added services to final users (e.g., energy audits, metering, etc.) may increase the cost-benefit ratio for utilities in the next years. In this regard, our findings are consistent with some previous contributions in the literature, according to which, to remain competitive, utilities must go beyond their traditional business models and start delivering a broader bundle of services to their customers, including energy efficiency ones [22–26].

Finally, concerning energy users, it is worth mentioning that our evaluation framework is being limited to the energy savings and monetary expenses for EEMs, therefore not accounting for the so-called Non-Energy Benefits (NEBs) associated with the implementation of such EEMs [27]. In this regard, literature has started developing frameworks to encompass them for industrial decision-makers (e.g., [27, 28]), but a thorough modelling of them for residential users is lacking, and even examples are scattered (e.g., [29]). However, the presence of NEBs may significantly influence the investment decisions of energy users [28, 30] and could further increase the positive cost-benefit ratio for energy users as well.

4. CONCLUSIONS

The tax relief scheme is a valuable policy instrument to promote and foster the diffusion of EEMs among residential final users. To better appreciate the costs and benefits of the scheme, a multi-stakeholder framework has been developed, being further applied to the Italian context, so to conduct an analysis for major stakeholders involved.

Our application reveals that the scheme results, on the one hand, particularly beneficial for both players in the EEVC as well as final users, the first being stimulated by a larger diffusion of EEMs, the latter by experiencing energy and monetary savings (as well as NEBs, not accounted in our evaluation though). On the other side, utilities and State are experiencing a negative cost-benefit, due to energy bill reduction, and tax relief respectively. Our preliminary findings suggest that utilities may look forward to offering additional higher value-added energy efficiency services to increase their margins and mitigate current losses due to energy bill reduction. The results are particularly interesting for other countries that are either currently implementing similar schemes (e.g., UK, Australia, The Netherlands, Canada) or planning to do so.

In conclusion, we want to acknowledge a few limitations of our study. First, we identify, but do not evaluate, several social or private benefits, due to their intangible nature and/or complex assessment. At the utility level, we have not accounted for avoided or deferred investments in generation, transmission, and distribution assets and reduced reserve requirements [31] and the reduction of energy marketed by utilities to energy users imported from other countries [18]. At the societal level, we have not included improvements in health, comfort, and asset value of buildings and facilities, increasing the rate of employment in the energy efficiency market and the alleviation of fuel poverty [4] and the reduction of CO_2 emissions achieved thanks to the reduction of energy consumption by energy users adopting EEMs [18]. Further, we have not encompassed in our evaluation the presence of NEBs, that should increase the cost-benefit balance for final users.

Finally, our study offers several opportunities for further research: first, it would be important to conduct a sensitivity analysis on some of the major parameters so to discuss the robustness of the considerations offered. Second, it would be important to broaden the evaluation to consider the other years in which the tax relief scheme was in place, to understand the impact of a different technological mix on the evaluation. Third, it would be quite interesting to apply the new evaluation framework in other countries in which tax relief schemes have been adopted, so to analyse commonalities and differences for a different context. Fourth, the framework could be deepened by focusing the analysis not only on the mechanism as a whole, but also in terms of each energy efficiency technology category that is eligible to obtain tax relief, in order to inform the debate on the optimal configuration of energy efficiency policy instrument maximizing the cost-benefit trade-off.

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