Innovation Vouchers for the Transition of Energy and Innovation Systems

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Abstract

Over the last ten years, innovation vouchers have become a frequently used instrument of the innovation policy mix of EU countries. Vouchers help stimulate collaborative research and innovation activities among small and medium sized enterprises and research organizations. This article analyzes the design and outcomes of the innovation voucher instrument in the EU-funded ener2i project. Vouchers were here successfully applied with the dual purpose of coupling innovation stimulation and support for renewable energy and energy efficiency in four target countries: Armenia, Belarus, Georgia, and Moldova. The voucher projects underwent review by internal experts and the whole scheme was reviewed by a panel of specialists who were not involved in ener2i. This first pilot group of vouchers in the target countries proved successful in stimulating renewable energy usage and energy efficiency through measures such as market studies, prototyping, and certification. Furthermore, the goal of establishing contacts between research and business could be achieved. To attain these results, it was instrumental that the design of the voucher scheme foresaw a low administrative effort necessary for accommodating the relevant businesses and that the specific features of the target countries were taken into account.

Keywords: innovation vouchers; innovation policy; energy transition; energy efficiency; sustainable development; ener2i project

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Energy supply and usage, as well as the encouragement of innovation activities are some of the most important challenges for the EU and for countries involved in the EU's Eastern Partnership.[1] Increased resource efficiency and innovation in renewable and sustainable energy offer the best potential to help solve the urgent societal challenge of climate change. The EU has consequently included the societal challenges of secure, clean and efficient energy and of climate action, environment, resource efficiency and raw materials in its Horizon 2020 program for Research and Innovation (R&I).

A growing body of literature discusses the specific policy mix for innovation in the energy field and for sustainable transition. Studies analyze how the policy mix affects technological innovation for energy transition [*Reichardt, Rogge,* 2015], how a mix of policy instruments encourages a reduction in energy use (improved energy efficiency [*Kern et al.,* 2017]), or how a suitable mix of creative and destabilizing instruments furthers the sustainability transition [*Kivimaa, Kern*, 2016]. At a higher level of innovation policy, Schot and Steinmueller [*Schot, Steinmueller,* 2018] suggest that it needs to be newly framed with a focus on transformative change, so that the current environmental and social challenges, such as the energy transition can be addressed. The socio-technical system transformation (or transition) is about changing skills, infrastructures, industry structures, products, regulations, user preferences, and cultural predilections.

One element to deal with these issues is setting incentives for companies to improve the energy efficiency of their production processes and for producing their own renewable energy, such as innovation vouchers that are the focus of this paper. Innovation vouchers are a funding scheme for small-scale joint innovative projects among SMEs and research institutions. By linking the companies up with research performers, this allows for tackling the critical issue of stimulating research and business links in the framework of national innovation policies. Despite its innovativeness and growing diffusion, innovation vouchers have received only limited attention in the literature [*Sala et al.,* 2016].

Innovation vouchers fit in a broader portfolio of innovation support instruments, which constitute the innovation policy mix of a country or region. Innovation support instruments can be divided into three large categories, including regulatory instruments, economic and financial instruments, and soft instruments [*Borras, Edquist,* 2013]. Regulatory instruments use legal tools such as laws and directives, economic and financial instruments concern pecuniary incentives or disincentives such as grants and taxes, and soft instruments include recommendations and voluntary agreements. Innovation vouchers fall under category two, economic and financial instruments. They need to be differentiated from vouchers for consumers, which allow individual consumers to purchase energy efficient products and services [*Urpelainen*, 2018].

Our focus in this paper is on one specific instrument in the policy mix, on innovation vouchers, which contribute to energy transition and transformative change. However, we highlight here the dual benefits of the instrument: besides its stimulation effect for renewables and improved energy efficiency, we put forward that its impacts and advantages include connecting research and business players in countries where these links are weak.

We discuss in this article the results and lessons that can be learned from the EU-funded ener2i project, which used vouchers as an innovation policy stimulation instrument in the energy field in the period 2014-2016.[2] We first outline the role of innovation vouchers as an instrument in innovation policy and in the energy field. This overview is followed by a description of the innovation voucher competitions for energy, implemented by the ener2i project. We compare the case study with examples and lessons from other countries and draw our final conclusions.

Methodologically we can rely on the direct experience of the authors having coordinated and implemented ener2i innovation voucher competitions in the four countries. Furthermore, internal evaluation and analytical reports on the competitions are available as well as an assessment by an external review panel for ener2i.

Innovation Vouchers as a Financing Tool

Innovation vouchers have become a popular and standard instrument of innovation policy in EU member states and other world regions over the last several years. A survey among European funding organizations conducted by the European Commission in 2009 showed that the number of innovation voucher schemes before 2006 was rather low: there were only about three schemes in total. They, however, multiplied quickly and reached already 23 voucher schemes in Europe in 2009, including 13 EU member states and two non-EU member states[3] [European Commission, 2009]. More EU countries have followed suit since then.[4]

The schemes all differ in details, but the main aim of the instrument is to stimulate cooperation between Small and Medium Enterprises (SMEs) and research organizations. As a result the competitiveness of SMEs

[1] The EU Eastern Partnership is a cooperation framework involving the EU and its member states with Armenia, Azerbaijan, Belarus, Georgia, Moldova, and Ukraine. The Partnership was launched in 2009 and is currently focused on strengthening institutions and good governance, economic development and market opportunities, better interconnectivity, and mobility and stronger society through people-to-people contacts. See https://eeas.europa.eu/diplomatic-network/eastern-partnership/419/eastern-partnership_en, last accessed 25.10.2018.

[2] See www.ener2i.eu, last accessed 25.10.2018.

[3] Austria, Belgium, Cyprus, Denmark, France, the Former Yugoslav Republic of Macedonia, Germany, Greece, Ireland, Netherlands, Poland, Portugal, Slovenia, Switzerland, and the United Kingdom. Innovation vouchers are of course in use also in other global regions, for example in Australia.

[4] For example, the Czech Republic [*Matulova et al.,* 2015] and Lithuania [*Atanavicius et al.,* 2016].

is strengthened by supporting the development of innovations at the firm level. In EU Eastern Partnership countries, innovation vouchers help establish and re-establish the links between research and business organizations. These linkages are a main concern for the region, as they were in many cases broken due to the economic transformation process the countries went through.

In the classical approach, the voucher budget amounts to 5,000–20,000 euro. Usually, the budget is allocated to an SME to purchase research services from research performing organizations [OECD, 2010a]. Vouchers are characterized by low entry barriers, in the sense that it is relatively easy for organizations to apply for and report on their projects. Overall the administrative procedures are kept to a minimum.

The encouragement of research-business collaboration, as a subset of innovation policy, also includes a portfolio of instruments into which vouchers fit.[5] This portfolio ranges from instruments with low budget and low entry barriers (such as vouchers) to support of larger scale collaborative projects, the creation of competence centers, Science and Technology Parks, incubators, and more complex Public-Private Partnerships (PPPs). A well-developed portfolio requires a costly investment from public sources [*Nauwelaers,* 2018]. Such investment is difficult to finance for lower income countries, such as the target countries of innovation voucher competitions in ener2i, which were Armenia, Belarus, Georgia, and Moldova.

Typical activities to be implemented with the voucher scheme include prototyping, market and feasibility studies, material and design studies, and other research and consultancy services. Vouchers offer several advantages for innovation systems in the EU Eastern Partnership countries:

- They require relatively low public investment in the program. While the grant seems low, it must be considered that prices in the region are generally much lower than, for example, in Western European countries, and consequently the impact of the grant is more significant.
- They help to build contacts and foster a collaborative culture among research and business actors.
- They address the lack of demand from business for research services (a weakness often mentioned by researchers in the region).
- They allow a project pipeline to be developed for more significant support programs or investment. A quantitatively higher amount of innovation vouchers can serve as a testing ground for more significant cooperation among research and business actors.

With the help of collaborative schemes for research-business cooperation, the innovation systems should go beyond technology adoption from abroad and stimulation should be provided for local technology development and innovation activities [*Gulda et al.,* 2018].

Application of Innovation Vouchers in the Energy Field

Innovation vouchers are usually used in thematically open competitions, where applications dealing with all different areas are possible. We can observe, however, that there are also thematically focused competitions, which request applications in specific fields such as energy [*European Commission,* 2011]. The instrument in question was promoted in Europe under the title "Green Innovation Vouchers" for usage in sectors or areas with a positive environmental impact [*European Commission,* 2011].

In the ener2i project, innovation vouchers were used to support SMEs in becoming more energy efficient and produce renewable energy. This allowed them to innovate their production, reduce costs, and become more competitive. The background of the ener2i project was that both energy and innovation are core policy fields of the EU. With the Clean Energy Package of 2016 [*European Commission,* 2016], the EU strives to accelerate the energy transition to renewables and energy efficiency in its efforts to limit climate change. Energy transition is also an important business opportunity for energy producers, energy service providers, and for new entrants on the energy market.

Another interesting example of innovation vouchers for energy projects is currently (2017-2018) under implementation in Ukraine.[6] Climate innovation vouchers amounting to 20,000 euro each were allocated to companies for reducing energy use, greenhouse gas emissions, and the energy intensity of production. The total budget of the scheme amounts to 1 million euro, which is financed by the European Bank for Reconstruction and Development (EBRD).

Innovation vouchers need to be discussed in the context of innovative financing. Recent approaches to generating financing for renewable energy and energy efficiency, which have gained momentum, are energy cooperatives and crowdfunding. They mobilize investments from citizens and are in this sense socially innovative instruments [*Spiesberger et al.,* 2018]. A sizeable number of energy cooperatives has joined forces in the European Federation of Renewable Energy Cooperatives (REScoop)[7] and received EU support. A specific project was also supported under the EU's Horizon 2020 program to facilitate crowdfunding for renewable energy[8]. Innovation vouchers in the case of ener2i allocated public financing for power generation from renewables and increased energy efficiency, but they also encouraged additional investments from beneficiary SMEs. We can therefore file it also under socially innovative approaches to energy financing.

[5] For an overview of instruments see for example [*Nauwelaers,* 2018].

[6] http://innovoucher.com.ua/?lang=en, last accessed 25.10.2018.

[7] https://www.rescoop.eu/, last accessed 25.10.2018.

[8] http://www.crowdfundres.eu/, last accessed 25.10.2018.

Table 1. **Local Innovation Voucher Managers under the Ener2i Project**

Country	Organization
Moldova	Agency for Innovation and Technology Transfer, AITT
Belarus	Belarusian Innovation Fund, BIF
Armenia	Energy Efficiency Centre Georgia, EECG
Georgia	Technology Transfer Association, TTA

Source: authors.

The Implementation of the Innovation Voucher Instrument in the Ener2i Project

The innovation voucher scheme was implemented in Armenia, Belarus, Georgia, and Moldova for the first time in 2014-2016 in the framework of the EU's FP7-funded ener2i project. The instrument was applied only in the energy field.

Ener2i was coordinated by the Centre for Social Innovation (ZSI) from Austria. The voucher competition was conceptualized and implemented under the guidance of ZSI and the project partners included energy engineers from Germany. Four local voucher competition managers, one for each of the target countries, were in charge of local management (Table 1). The tasks of the local country managers were the operational implementation of the voucher scheme, including the organization, promotion and execution of the competition in the respective target country. This included supporting the candidates during proposal preparation, issuing contracts for beneficiaries, monitoring the project's progress during implementation, and collecting the project reports afterwards. The competitions were financed by the EU via ener2i.[9]

The partners launched a call, evaluated, and financed projects with a budget of 4,000 euro per voucher. Each competition was held on a small scale with a total of six vouchers allocated each in Armenia and Georgia, seven in Belarus, and 11 in Moldova (Table 2). This was due to the pilot character of the action.

The voucher was allocated to an SME that had to collaborate with a research partner. Thus, the research work was driven by the needs of the company and performed in a collaborative way. This approach has to be seen in a different light from the linear approach to innovation, which can usually be observed in the target countries of ener2i, whereby research results are generated by universities and public research organizations and are then applied and transferred to business or society. The voucher budget could be spent on R&D-related manpower required for project implementation (e.g., technology or market studies, prototyping, energy or innovation audits, etc.), material and equipment, and travel arrangements facilitating knowledge transfer at the national and international levels.

SMEs according to the European Commission's definition [*European Commission,* 2003] were eligible to participate in the ener2i voucher scheme, including start-up businesses and new companies established by researchers (spin-offs) with energy related innovation targets. The project could deal with innovations in renewable energy technologies (RES) or improving the energy efficiency (EE) of production processes. The established cooperation projects were meant to be pilot programs, which should become good practice examples and therefore initiate further cooperation.

Suitable projects were research and development (R&D) services, such as technology and market surveys, feasibility studies or energy and innovation audits, and implementation-oriented R&D activities, such as the development of prototypes, engineering services, or environmental compatibility.

In comparison to other innovation voucher schemes, the ener2i competition had some particularities. Usually, participating enterprises first receive funding and afterwards they search for a cooperating research institution to provide the necessary knowledge. In the case of ener2i, the applying SMEs have to initially prove in their proposals that they have identified a research organization, with whom they intend to implement the project. This must be done before any funding decision is made.

In many innovation voucher schemes the project teams receive the whole amount of funding after finishing their project and on the condition that they present a final report on the results of the project and thus justify the voucher budget. In ener2i, the supported project teams received 60% of the amount of the voucher at the beginning of the project and the remaining 40% after handing in the implementation report. Apart from that, the project duration of six months was shorter than that offered by other voucher schemes, where durations can be up up to 12 months. Furthermore, it was obligatory in several schemes that the companies spend a defined percentage of their own money on the projects. In ener2i, companies have to opportunity to voluntarily make their own contribution, but it is not obligatory.

Proposals for the ener2i innovation voucher competition had to be submitted online and in English. All submitted proposals had to pass two assessment-steps, the pre-assessment (eligibility check) and the final

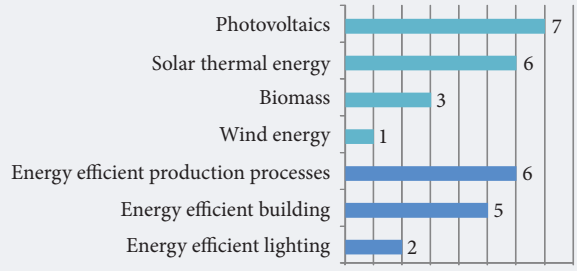
Table 2. **Overview of Proposals and Funded Projects over all 5 IVCs**

	Belarus 1	Belarus 2	Moldova	Georgia	Armenia	Sum
Proposals	8	15	34	18	14	**88**
Eligibility check passed	7	13	29	18	10	**77**
Projects funded	**4**	**3**	**11**	**6**	**6**	**30**

Source: authors.

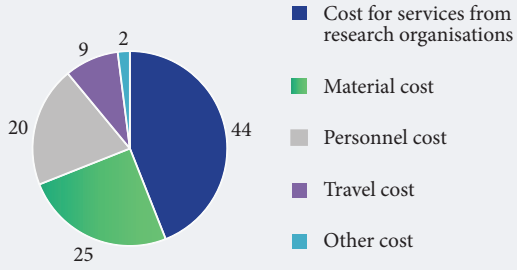
[9] The call documentation, including Terms of Reference and Application Form are available at the project website: https://ener2i.eu/innovation_vouchers/about_iv_competition, last accessed 25.10.2018.

Figure 1. **Thematic Distribution of all Projects Funded over Innovation Vouchers**



Source: authors.

Figure 2. **Categories of Spending of Ener2i Innovation Vouchers** (%)



Source: authors.

evaluation by an international panel composed of experts from the ener2i consortium and local energy and innovation specialists. The number of submitted proposals was nearly three times higher than the vouchers available: this shows that the IVC was an attractive funding instrument for all countries under consideration. It is also evidence of the perceived potential for innovation in all four countries

Thematic Fields of Ener2i Vouchers

The voucher projects were implemented over the years 2015-2016 and covered different energy-related topics, including solar energy, construction materials, and biomass for power and heat generation[10]. Of the funded projects, 13 dealt with energy efficiency and 17 with different renewable energy technologies. For some, this categorization is ambiguous and the figures give only a rough idea of the projects' focus. One example is a project on the use of alternative energy sources in fish farming. We categorized it as a photovoltaic project, but it could also be defined as a project dealing with improving the energy efficiency of a production process.

A more detailed analysis shows that 13 of the realized projects focused on solar energy (Figure 1), either photovoltaic (7) or solar thermal (6). Given that there are more than 200 days of sunlight in Moldova, Armenia, and Georgia, it is reasonable that so many projects focused on using this resource with such high potential.

Three projects dealt with biomass-to-energy, predominantly pellet or briquette production. Only one project was devoted to wind energy, more concretely, the short-time forecasting of wind speeds.

The projects on energy efficiency can be divided into three groups. Six of the 13 projects aimed at improving the energy efficiency of production processes, five dealt with the energy efficiency of buildings or the development of energy efficient construction materials. One project focused on energy efficient street lighting and another dealt with the development of new photoluminescent materials, which could make electrical lighting redundant in some applications like emergency signs.

For all projects, roughly half (44%) of the IV budget was spent on services from research institutions, this is the category toward which most of the budget was allocated (Figure 2). *Personnel costs* accounted for a fifth (20%) of the spending. In some cases it was not clear whether the spending referred to the project team or external personnel (e.g., research partners). A quarter (25%) of the budget was used for materials, while much less was spent on business trips. *Travel costs* accounted for just 9 %.

The flexibility in the use of the voucher budget was noted by the project managers. This is reflected by in diversity of the spending. In other innovation voucher schemes with a similar budget, spending is often limited to consulting services [OECD, 2010b]. This flexibility made it possible to fund very diverse project proposals and it also enabled implementation-oriented projects, which is proven by a number of the prototypes that were constructed.

Impact of Innovation Voucher Schemes

Not many assessments of voucher schemes are available. An example is a support program for generic innovation vouchers (not energy-specific) that has been implemented in Lithuania for several years already. An evaluation of the 2012-2014 calls was conducted in 2016 and revealed good results yielded by the scheme [*Atanavicius et al.,* 2016]. During this period, three calls were implemented and a total of 815 projects were funded with 3.5 million euro; 776 of the projects were completed successfully. The vouchers had a positive impact upon the engagement of SMEs in R&D activities. About 20 % of the SMEs surveyed in the evaluation, which had no R&D experience before the voucher project, had launched new R&D activities shortly after the end of the voucher project. Of the surveyed SMEs, 66.5 % either continued to cooperate with the research organization or intended to do so after the project. No significant impact on SME's business productivity and competitiveness indicators was quantitatively measured, which is not surprising given the limited scope of vouchers. However, in the survey

[10] Information on funded projects is also accessible at the project website: https://ener2i.eu/innovation_vouchers/funded_projects, last accessed 25 October 2018.

among voucher recipients, two-thirds of respondents noted that the instrument had a positive effect on the development of new products and services as well as competences. It was found that successful examples of SMEs also include some that managed to follow up and receive funding from more significant funding programs [*Bullinger et al.,* 2017]. As a consequence, experts recommended introducing a complementary, more substantial follow-on scheme, in Lithuania's innovation policy mix [*Bullinger et al.,* 2017].

An internal evaluation of the energy specific innovation voucher action was conducted by ener2i through an analysis of the final evaluation of the voucher projects and through reporting sessions. In Moldova, all voucher project participants were convened for a reporting meeting and question and answer sessions took place in front of a committee composed of national and international experts. Evidence from this internal evaluation demonstrated that contacts among SMEs and research performers were successfully created, prototypes were developed, and technology assessments conducted. In several cases, international cooperation increased, either through the attendance of fairs or cooperation with research organizations. For example, a Moldovan and Belarusian SME each worked with a German research organization on the certification and development of solar devices while a Georgian SME worked with a Czech university on street lighting with photovoltaics.

Cases with a particularly significant impact included a Moldovan farm, which became independent from the centralized power and heating systems. It used its own bio-resources that were processed into pellets for power and heat generation. The Moldovan technical university served as the research partner and helped optimize the collection and production processes for this form of bioenergy. As a result, the cost of energy consumption was cut and know-how spread to farm enterprises in the same village. Again in Moldova, a young entrepreneur granted support to work with Moldova State University on developing an energy independent greenhouse for organic food production. Based on the prototype developed, the company was able to build additional industrial greenhouses, with a total area of 1,000 square meters, employing seven or eight different technologies. Overall, this project had a large impact upon the growth of the company, according to the owner. In Belarus, a company received a voucher to work with a German research partner, Next Energy, on verifying research results about solar modules with wear-resistant coating, which increases the efficiency and the durability of solar cells and modules.[11]

Conclusions

From the experience of the ener2i voucher competition, we can draw several conclusions. First, minimal bureaucratic effort should be required from the SMEs during the application procedure and implementation of innovation voucher projects. The ease of the application will ensure that many SMEs attempt to participate and thereby encourage innovation in their respective countries.

Second, keeping in mind that the instrument of innovation vouchers was new in the four countries where it was applied in the framework of the ener2i project, implementation was successful and the results were more than satisfactory. This was proven by the ener2i internal evaluation and the success of the scheme was also acknowledged by the External Review Panel for the project [*Weiss,* 2015]. The panel found out that vouchers attracted attention for the SMEs and that winning a voucher was directly related to national and international recognition. Some of the successful SMEs used the voucher as marketing instrument for their companies. The ener2i innovation vouchers were also included as a good practice case in a review report by the Moldovan Research and Innovation System [*Gulda et al.,* 2016], which was implemented by an expert panel under the Horizon 2020 Policy Support Facility (PSF) in the period of November 2015-July 2016.

Third, the design of the voucher scheme needs to be adapted to national requirements. For example, if beneficial for the project results, companies should also be allowed to receive part of the funds. In classical voucher schemes, the budget is allocated to the SME, which has to use it for paying for the services of an R&D service provider. In ener2i, both the SME and research partner could receive shares of the budget. This proved well adapted to the local circumstances, because it encouraged SME participation and commitment to the project. From the feedback submitted during the evaluation, we could gather that the scheme allocated public grant money to local SMEs for innovation activities for the first time. In the use of the voucher budget, relative flexibility was granted to the project partners. The budget could be spent on various items and a project team from Moldova gave positive feedback: "One more advantage of the innovation voucher was the possibility of using the obtained money for all necessary items." Budget categories included travel costs and therefore cooperation with international partners was possible. These features of the scheme enabled international partnerships to be created through ener2i vouchers, which was highly appreciated by the voucher grantees. Furthermore, the payment schedule has to take account of the local situation. While in most schemes the payment of the voucher amount is done at the end of the project against submitted invoices, the ener2i project stipulates an upfront payment of 60% of the voucher amount with the remaining 40% paid after the completion of the project. This was necessary to kick-start the projects given the difficult task of obtaining loads at affordable interest rates in the target countries.

Fourth, the assessments of voucher schemes face specific challenges. The impact of a low budget instrument is normally limited and the measurement of impact in quantitative terms is difficult and in several cases

[11] Information on all supported ener2i innovation voucher projects is available at the project website: https://ener2i.eu/innovation_vouchers/funded_projects, last accessed 25 October 2018.

impossible. Its main focus is on solving small scale problems and more importantly, on building linkages between SMEs and research organizations. The impact of the ener2i innovation voucher managing organizations (innovation funds) in Moldova and Belarus was obvious. They gained knowledge about how to implement this innovation stimulation instrument and it enlarged their possible portfolio of instruments. This instrument involves, however, the risk of failure and this risk needs to be accepted by the programming and funding authorities.

Finally, we can state that innovation vouchers are an innovation policy instrument well suited for the needs of EU Eastern Partnership countries. These countries have an important SME sector and limited public budgets. With the help of a limited investment, innovation vouchers serve the purpose here of establishing or re-establishing links between research and business. However, vouchers alone are not enough and a more comprehensive portfolio of support instruments and a conducive environment for research-business collaboration are also required. Vouchers can obviously help solve smaller specific problems for SMEs, but in a support chain for innovation more substantial funding will also be required. In general, the voucher instrument is becoming more frequently used in the energy and sustainable technology fields and has proved its utility.

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