Modeling the impact of solar thermal support policies

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Abstract

The 2020 RES-targets of the EU until 2020 require substantial growth of RES-technologies and sectors. Solar thermal energy can provide an increasing share of this amount, in particular looking on the period beyond 2020. However, this will need corresponding ambitious policy instruments and support. This paper provides scenarios for solar thermal energy in selected European countries (AT, GR, LT, NL, PL, UK) up to 2030. A techno-economic bottom-up model is applied for simulating the impact of different policy instruments (and design options of these instruments). In particular, the focus is on the following policy instruments: economic incentives and RES-Heat obligations. The results are based on a comparison of these different scenarios and provide insight into barriers, challenges and opportunities for solar thermal energy in the selected regions. The paper ends with discussions regarding the role of the solar thermal targets in NREAPs and provides conclusions for the design of solar thermal support instruments. The paper is based on the work done within the IEE project RES-H Policy (www.res-h-policy.eu).

1 Introduction

The 2020 RES-targets of the EU until 2020 require substantial growth of RES-technologies and sectors. Solar thermal energy can provide an increasing share of this amount, in particular looking on the period beyond 2020. However, this will need corresponding ambitious policy instruments and support. This paper provides scenarios for solar thermal energy in selected European countries (AT, GR, LT, NL, PL, UK) up to 2030.

The core objective of this paper is to identify possible pathways for future solar thermal market development in selected regions in Europe und to derive conclusions with respect to the design of support policies. Thus, the paper deals with the following research questions:

- What are possible scenarios and targets for solar thermal energy in selected EU countries up to 2030?
- Which support policies are required for achieving these targets? What are the costs for these policies?
- What are elements and characteristics of efficient and effective solar thermal support policies?
- How do the support policies for solar thermal interact with the support of other RES-H technologies?

2 Methodology

The basic methodological approach of this paper is based on the following steps:

- Investigation of possible solar thermal targets. This is done by different approaches: a detailed investigation of literature, previous results of modeling activities and scenario development (in particular the simulations with Green-X model, see e.g. [1]) and a bottom-up approach. For details with respect to methodology and investigated literature see also [2]-[7].

- A bottom-up model for the building sector (Invert/EE-Lab) is applied for assessing the impact of policy instruments. The model, basic assumptions and input data are described below.
- A comparative analysis of these scenario outcomes is carried out for the different countries.
- The ranges of these solar thermal scenarios and targets are compared to the values from the national renewable action plans to be submitted by the EU member states until mid 2010.
- As a last step an inter-regional comparison is carried out and related conclusions are derived.

2.1 Modelling the space heating and hot water sector: Invert/EE-Lab

One of the core approaches of this paper is the application of the model Invert /EE-Lab. Invert/EE-Lab is a dynamic bottom-up simulation tool that evaluates the effects of different promotion schemes (in particular different settings of economic and regulatory incentives) on the energy carrier mix, CO2 reductions and costs for society promoting certain strategies in the building related energy demand sector (space heating and hot water). A disaggregated description of the building sector and the related heating and hot water systems is the basis for this calculation. The core of the tool is a myopical, multinominal logit approach, which optimizes objectives of "agents" under imperfect information conditions and by that represents the decisions maker concerning building related decisions. Invert/EE-Lab models the stock of buildings in a highly disaggregated manner. Therefore the simulation tool reflects some characteristics of an agent based simulation. For more details regarding selected previous applications of Invert/EE-Lab and methodological descriptions see e.g. [8], [9] and www.invert.at.

2.2 Basic assumptions and input data

Energy prices: We are using Eurostat price relations for 2007-2009 and take into account two different energy price scenarios according to Capros (2009).

Cost data for solar thermal (and other heating and hot water) systems: The cost data for solar thermal systems have been taken from literature, data collection from producers and regional solar thermal associations. We have assumed technological learning, in particular in countries with currently high costs.

Investigated policies: In this paper we are focusing on the analysis of economic incentives (in the form of investment subsidies (AT, NL, LT, PL), income tax incentives (GR) and bonus systems like the renewable heat incentives (UK)) and obligations for RES-H systems. For the case of obligations, investors are obliged to install RES-H systems (or in particular solar thermal systems) in case of certain conditions coming into place. This may be the construction of a new building or a major renovation or just the replacement of a heating system. In contrary to these use obligations, the UK system of supplier obligations requires energy suppliers (utilities) to take action for investing in RES-H capacities.

Policy settings for Invert/EE-Lab simulations: We carried out simulation runs for each of the selected countries for economic incentives and for obligations (and each of them for a high-energy-price and a low-energy-price scenario). However, the detailed settings for the policy instruments vary between the regions. When comparing the results between the regions this might be biasing. On the other hand, the policy conditions and current discussions are quite different among the countries. Thus, the policy settings that we selected are reflecting to some extent recently ongoing political discussions or even decisions and should identify the impact of a somewhat ambitious policy. Partly the intention for these policy settings was also to provide insight into specific open questions for the related region. In any case we do not consider these policy settings as forecasts but as basic input for which we will investigate the impact on the solar thermal market. We have to take this into account in the conclusions and we are aware that there might be other relevant policy settings that would be interesting to cover.

Table 1. Summary of policy settings for the country simulations with Invert

	Policy settings	
	Economic incentives	Obligations
AT	Investment subsidies (35-45%, slightly higher than recent support schemes)	Overall RES-H obligation for new buildings and buildings with major renovation (2011 7%, 2015 15%, 2020 20%, 2030 30%, a penalty of 50€/m² if no RES-H is applied)
GR	Income tax incentives (25%, in a similar range as recent support schemes)	Overall RES-H obligation for new buildings and buildings with major renovation (2011 60% RES hot water, 2014 50% of total space heating and hot water energy demand)
LT	Investment subsidies (ambitious level of 45 to 50% in order to see the high amount of support required for pushing the market to somewhat ambitious growth rates)	Overall RES-H obligation for new buildings and buildings with major renovation, target of 30% RES-H up to 2020, 50% between 2020 and 2030, a penalty of €50/m², if no RES-H is applied
NL	Investment subsidies (45%, slightly higher level than recent support)	Overall RES-H obligation for new buildings and buildings with major renovation (50% RES-H from 2015; penalty for not fulfilling the obligation: 62 €/m²)
PL	Investment subsidies (higher level than recent support): 30% of investment costs	Overall RES-H obligation for new buildings and buildings with major renovation; obligation level of 20 % from 2010 to 2030; penalty for not fulfilling the obligation: 60 €/m² dwelling area
UK	Renewable heat incentive (as suggested by Radov et al 2010): 17 p/kWh solar thermal (=19.55 c/kWh)	Combined renewable heat incentive and supplier obligation (implemented as an obligation on the whole building stock); obligation level of 12% RES-H in 2020, 20% in 2030; penalty for not fulfilling the obligation: 50€/m² dwelling area

2.3 System boundaries

Our system boundaries are mainly specified by the following aspects:

- Regional boundary: We are investigating the solar thermal developments within the national borders of the following countries: Austria, Greece, Lithuania, Netherlands, Poland, UK.
- Technological and system boundary: We are investigating those solar thermal systems that we consider to be crucial for the development in the next two decades of the specific region. The basic technologies are flat plate collectors. In Greece also thermosyphonic collectors are considered.
- Investigated sectors: We are investigating the uptake of solar thermal systems in buildings (space heating and hot water). We are considering residential and non-residential buildings.
- Policies: We are focusing on economic incentives and regulatory instruments. We do not explicitely analyse the impact of so-called “soft” measures like training, awareness raising, campaigns etc.

3 Country results

This section presents preliminary results for the selected countries. Final results will be available in autumn 2010 (www.res-h-policy.eu). According to the methodology described above for each region we are comparing scenarios for the development of solar thermal energy from the literature, the Green-X-model, a bottom-up-investigation of realizable targets, the NREAP and the policy model runs carried out with the Invert model. We are showing each policy scenario in two energy price scenarios, a high- and a low- price scenario (see 2.2). We did not change the policy settings in these two price scenarios. Of course, the high-price scenario leads to a stronger growth of solar thermal installations than the low-price scenario. For the investment subsidies, this means that in the high price scenario a higher public budget amount is required than in the low price scenario.

3.1 Austria

Austria is among those countries with the highest share of solar thermal collectors per capita. This is going back to strong private initiatives in the 1980's. Due to the promotion of training activities, awareness raising campaigns and investment subsidies from regional governments this finally led to the development of a strong solar thermal market in Austria. The Austrian NREAP foresees a target for solar thermal energy of about 11.3 PJ in 2020, which reflects 6.4% of all renewables in the heating and cooling sector and 2.9% of the overall renewable energy target.

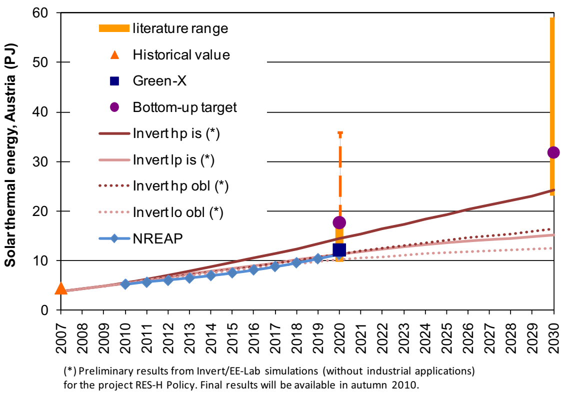

Figure 1: Comparison of solar thermal energy scenarios for Austria according to the NREAP, literature and different model runs of Invert (hp – high price, lp – low price, is – investment subsidies, obl – obligations) [2]

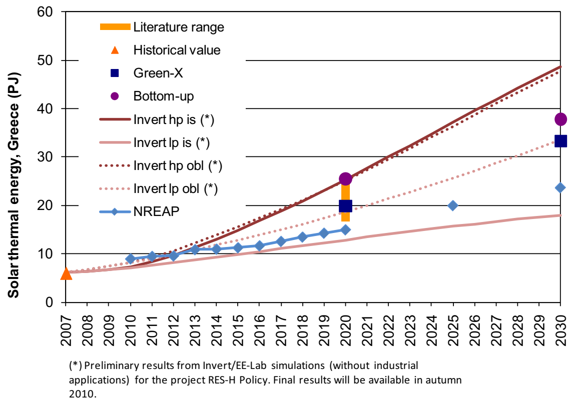

Figure 2: Comparison of solar thermal energy scenarios for Greece according to the NREAP, literature and different model runs of Invert (hp – high price, lp – low price, is – investment subsidies, obl – obligations) [3]

The public budget requirement for the development of solar thermal in the investment-subsidy-scenarios is about 100-160 M€ and 80-200 M€ in 2020 and 2030, respectively (depending on energy price scenarios).

3.2 Greece

Greece has a well developed solar thermal market and for many years held one of the highest solar thermal capacities within Europe. The solar thermal market in its early stages was promoted by a large advertising campaign, together with low interest loans and tax credits that were available at that time. Nowadays for the promotion of solar thermal collectors, the only support measure available is a tax instrument for the residential sector, according to which a percentage of the amount of the money spent for the purchase of solar collectors is deducted from the taxable income. In June 2010 a new RES Law was voted in Greece (Law 3851/2010), which sets use obligations for covering part of the needs for the production of hot sanitary water in a building. The Greek NREAP (preliminary version of June 2010) foresees a target for solar thermal energy of about 15.0 PJ in 2020, which reflects a 28% share of solar in the overall RES-H/C sector and a 7.4% share of solar in the overall renewable energy target. For Greece the target, set by Directive 2009/28/EC, is 18% of RES in the gross final energy consumption, while the Greek government set with Law 3851/2010 a more ambitious target of 20% RES.

Compared to the scenarios from literature and Invert model runs we can see that the NREAP values are in the lower range of the other scenarios. In the first case because of the high energy prices, more RES systems are installed and the budget is about 258 M€ in 2020 and 298 M€ in 2030, while in the low price scenario the values are 74.8 M€ and 75.1 M€ respectively. However, the scenarios show that introducing an obligation for RES-H and especially for solar thermal energy could both reduce public budget requirement and increase the growth of solar thermal energy.

3.3 Lithuania

Solar thermal energy is barely used in Lithuania these days. In 2007 there were 3.450 m² of solar thermal collectors in operation, 700 m² were newly installed. Lithuania therefore is the country of the European Union (EU-27) with the second lowest capacity of solar thermal collectors installed. [10] There are two main reasons for this poor solar thermal market in the country, the geographical position and the existing energy system. In partiular there is traditionally a high share of district heating systems in the country. In 2007 about 48% of the heat needed in the building sector (space heating and hot water) was provided by district heating, about 75% of the residential buildings are connected to a district heating grid. Besides district heating, stoves fired with biomass fuels play an important role in the Lithuanian heat market. About 70% of the heat, not covered by district heating, is provided by firing wood and wood waste. Due to these facts there is no political will and no policy instrument to support solar thermal systems in Lithuania.

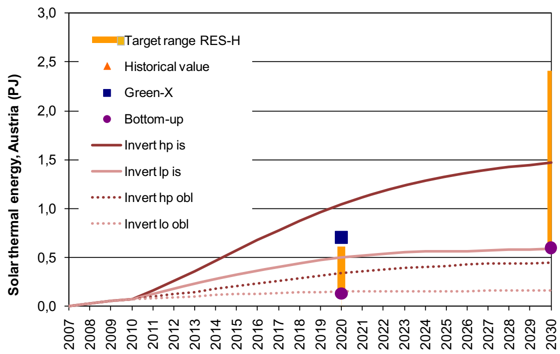

Figure 3: Comparison of solar thermal energy scenarios for Lithuania according to the NREAP, literature and different model runs of Invert (hp – high price, lp – low price, is – investment subsidies, obl – obligations) [4]

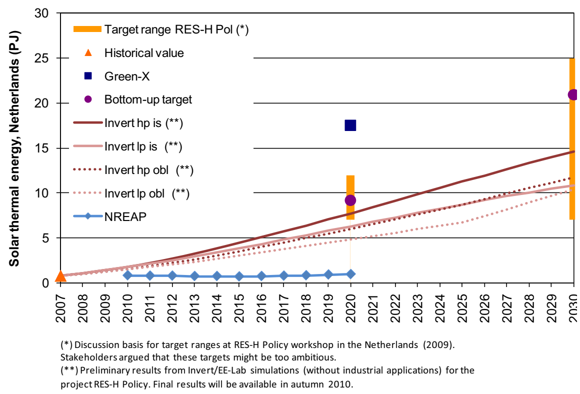

Figure 4: Comparison of solar thermal energy scenarios for the Netherlands according to the NREAP, literature and different model runs of Invert (hp – high price, lp – low price, is – investment subsidies, obl – obligations) [5]

For the simulations of the Lithuanian heat market two policy instruments have been calculated: investment subsidies and obligations. The results show, that solar thermal systems won't play an important role in the market, even if high investment subsidies of 40-45% are paid (see Figure 3). For the RES-H obligations it turns out that they do not lead to a strong increase of solar thermal systems because the obligations are mainly fulfilled by biomass boilers. There is no NREAP document available at this moment (7 July 2010).

3.4 Netherlands

The Dutch market focuses on small solar thermal systems, standardization and economic optimization. As of 1998, various policy measures have been implemented: grants, promotional campaigns and covenants. For solar thermal, grants in the Netherlands are based on heat production, not on collector surface area, which is done to stimulate efficient systems. Grants have always had a temporary nature and were sometimes terminated abruptly in the past, as in the case of the Energy premium scheme. Installers have little experience with solar boilers and hence will not recommend them right away. In the Dutch Action Plan (published July 2nd, 2010) solar thermal energy plans a minor role in renewable heating: it increases from 16 ktoe (0.7 PJ) in 2005 to 23 ktoe (1.0 PJ) in 2020. The NREAP does not assume increased policy attention for solar thermal: the projection is based on current and anticipated policy. For solar thermal the consequance can be read from the policy listing in the previous section: the grant scheme available from the 'Clean and Efficient' programme will end by the year 2011. Starting from the year 2015, tightening the energy performance standard will result in an uptake of solar thermal installations in newly built houses.

Figure 4 shows the comparison of literature and different scenarios. Again it turns out that a RES-H obligation by itself does not necessarily lead to a stronger breakthrough of solar thermal systems. The impact on the one hand is restricted by the limited number of new buildings and renovated buildings. On the other hand it turns out that the obligation often is cheaper to fulfill with biomass or heat pumps. This in particular is the case with increasing RES-H obligation share (i.e. above 30%).

3.5 Poland

The deployment of solar thermal systems and RES heating on general have been lacking for an adequate significance in Polish energy policy in the past. However, the solar thermal market has shown a successful development with one of the highest growth rates in recent years. In 2009, the annual installed collector area rose by 11 % to almost 145 000 m² which increased the cumulative capacity to roughly 510 000 m² [10].

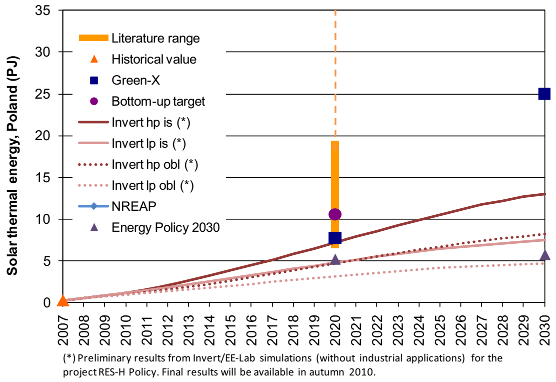

Figure 5: Comparison of solar thermal energy scenarios for Poland according to the NREAP, literature and different model runs of Invert [6]

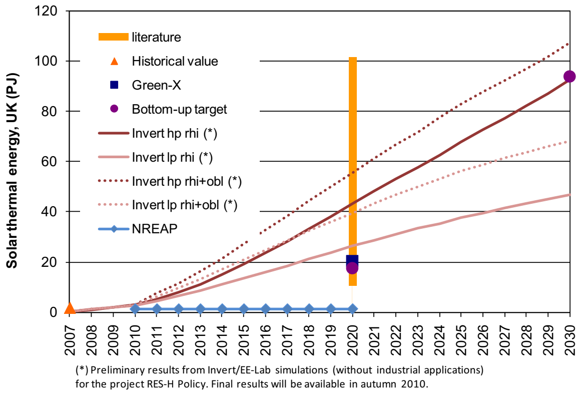

Figure 6: Comparison of solar thermal energy scenarios for the UK according to the NREAP, literature and different model runs of Invert [7]

Up to now, the Polish legislation provides only few supports for energy saving technologies including solarthermal systems. Nevertheless, there are several funds based on the Environmental Protection Act in place. Currently, a new solar thermal subsidy scheme within the National Fund for Environmental Protection has been announced which will be provide up to 74 Million € in the period from 2010 to 2012 [10]. Beside the financial support, promotional activities were implemented in order to remove non financial barriers. Up to now, no official NREAP is available for Poland (7 July 2010).

Two different policy instruments – investment subsidies and an obligation to use RES – have been simulated with the Invert model. Thereby, the cumulative budget requirement for the development in the investment-subsidy-scenarios amounts between 977 Mio. € and 1456 Mio. € up to 2020, increasing to 1777 Mio €, respectively 3000 Mio € up to 2030. The scenarios also show that the introduction of an obligation to deploy renewable energies in new and majorly renovated buildings without any subsidies will not reach the same deployment of solar thermal systems in 2020 and 2030. As for other countries, we can see that the RES-H obligation does not lead to stronger uptake of solar thermal system than investment subsidies, because the obligation in most cases is fulfilled by biomass heating systems.

3.6 UK

The UK sources only a very limited amount of energy from solar thermal systems. It is estimated that 90,000 solar water heaters are installed with a total output of 55,7 ktoe (0.65TWh) [11], [12]. The UK has used financial incentive for solar to increase the attractiveness of heat opportunities to increase its market penetration. Aid is available for the support of solar thermal technology through the Clear Skies Initiative (2003-2006) and the Low Carbon Buildings Programme (2006- present). These two programmes provided grants to support the cost of installing solar thermal units: the first made available grants of €750-€7,500 for installation of domestic systems but has a limit of €600 for solar water heating in the latter grant. In 2008, the UK government legally introduced the Renewable Heat Incentive (RHI) in the Energy Act. According to this policy mechanism, tariff is set to impact the economics of RES-H technologies, including 6% rate of return for deployment of solar thermal. For small installations of solar thermal systems that are up to 20 KW, the tariff is 18pence for per kWh heat produced. For systems that are between 20-100kW, 17pence/kWh heat is provided. The modeling results show that this instrument could provide a considerable incentive and thus stimulate a strong market growth.

4 Synthesis and conclusions

The different current situations and possible future development paths are depicted in the Figure 8. It shows that in Austria and Greece a high share of current heating and hot water energy demand is covered by solar energy. The other regions have much lower solar market shares (NL a little bit higher than the other ones). However, the policy instruments that might come into place in the future (as well as the energy price level) will play a crucial role for possible development paths. Figure 8 shows that none of the policy targets for solar thermal energy according to the NREAPs can be classified as “ambitious”. This provides evidence that policy makers (at least those responsible for the NREAP) in the investigated regions do not consider solar thermal energy as relevant or cost efficient solution for meeting the RES targets in 2020. Interesting enough that despite of the low solar thermal targets in the NREAP there are countries which might implement (or continue) ambitious solar thermal support policies.

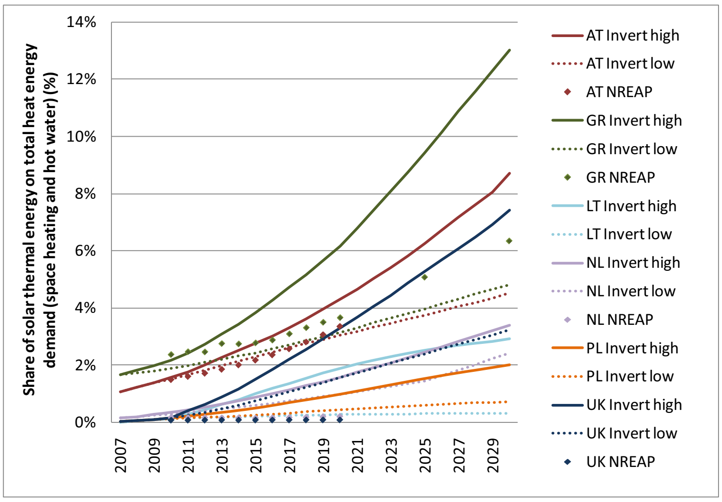

Figure 7: Share of solar thermal energy in different policy scenarios and different countries

With respect to the choice and design of policy instruments our analyses led us to the following conclusions:

Grants have been proven to be an effective policy instrument. In particular in periods with high pressure on public budgets the question is to which extent this support mechanism is providing high continuity and investment security for the solar thermal industry and installers.

Obligations can be an effective policy instrument to push RES-H. With respect to the impact on solar thermal systems the following aspects are relevant.

- A general RES-H obligation does not necessarily lead to a high solar thermal growth because the obligation can also be met by biomass boilers and heat pumps. This in particular is the case if people are obliged to meet a high share of RES in their heating energy demand.
- If the obligation is only targeting new buildings, the impact on the overall heat market is relatively low due to the general low rate of new building construction. If the obligation also covers buildings undergoing “major renovation” the impact is higher.

- The supplier obligation foreseen in the UK might be an effective instrument for an obligation covering the whole building stock. For the Invert/EE-Lab simulations it has been assumed that this is the case. The results show the high effectiveness. However, the question remains how the detailed policy design will be set and to which extent this has been reflected in the current modeling assumptions.

Economic incentives are important but not sufficient. Information, training and awareness raising play a crucial role. Especially, this might also lead to exploiting the potential for cost degressions of technologies and installations which is an important driver for solar thermal market growth.

5 Acknowledgment

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