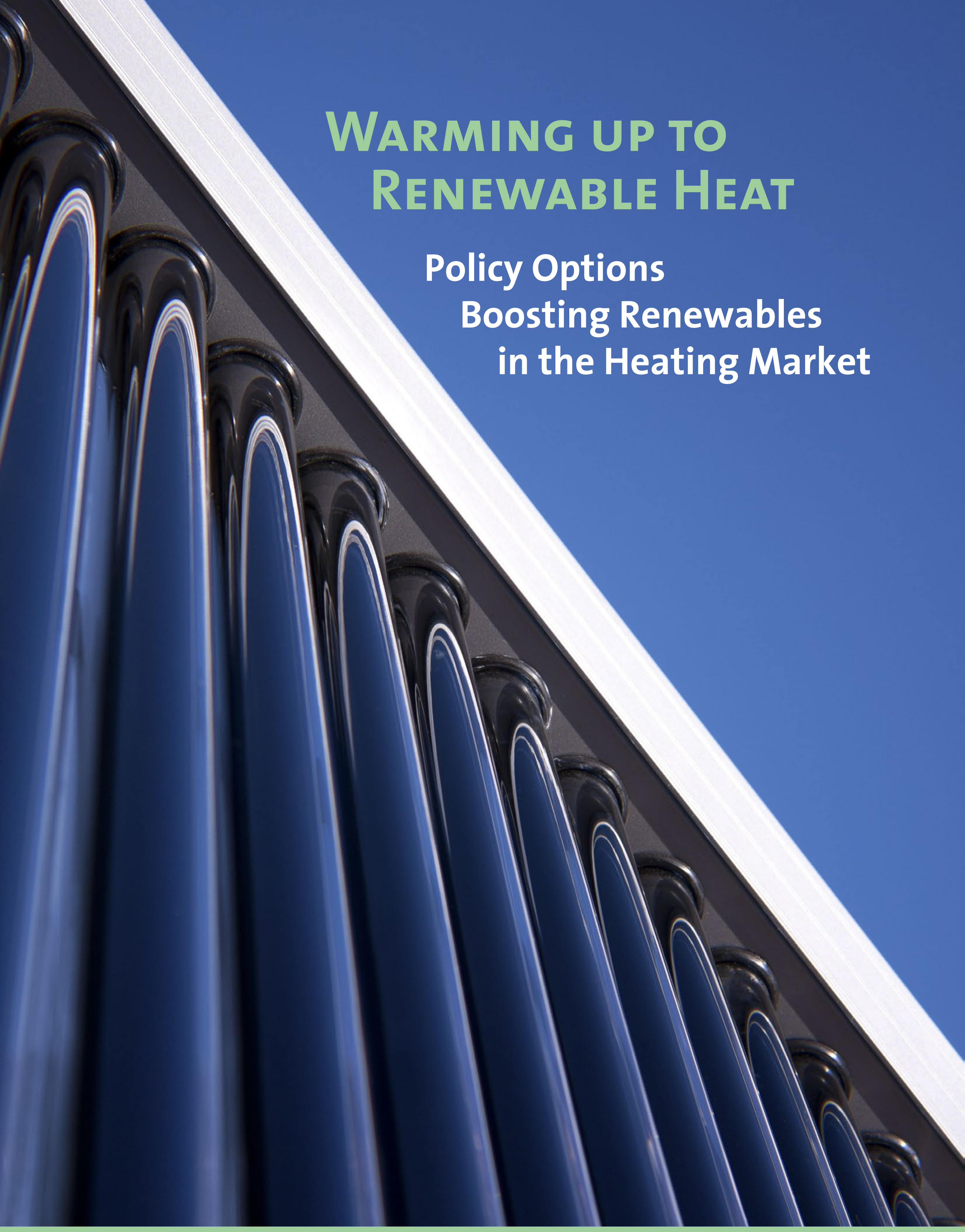

Warming up to Renewable Heat

Policy Options Boosting Renewables in the Heating Market

RES-H POLICY

Supported by INTELLIGENT ENERGY EUROPE

Final Report of the IEE project

"Policy development for improving RES-H/C penetration in European Member States (RES-H Policy)"

July 2011

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The project "Policy development for improving RES-H/C penetration in European Member States (RES-H Policy)" is supported by the European Commission through the IEE programme (contract no. IEE/07/692/SI2.499579).

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1 INTRODUCTION

1.1 Objectives of the project

The project "Policy development for improving RES-H/C penetration in European Member States (RES-H Policy)" aimed at assisting the governments of Member States in preparing for the implementation of the EU Renewables Directive 2009/28/EC[1] as far as aspects related to renewable heating and cooling (RES-H/C) are concerned. Selected Member States were supported in the determination of their national sector-specific targets for RES-H/C for the years 2020 and 2030. Moreover for each of the target countries the project aimed at analysing a variety of different policy sets to support RES-H/C. Based on a policy analysis that included a broad range of different qualitative as well as quantitative elements the project developed policy recommendations for how to best design a support framework for increased RES-H/C penetration in the respective national heating and cooling markets. Both elements – target setting and policy analysis – are geared to supporting Member State governments in the elaboration of their National Renewable Energy Action Plans (NREAPs) as required by Article 4 of the Renewables Directive.

On the EU level the project aims to gain insights into the effects of different degrees of coordinating or gradually harmonising national RES-H/C policy approaches. In particular different degrees of harmonisation of national RES-H use obligations were quantitatively assessed against potential benefits and options for cost allocation.

1.2 Regional scope

The target countries/regions of the project comprised Austria, Greece, Lithuania, the Netherlands, Poland and the UK – countries which have a diversity of framework conditions for RES-H/C. With the Member States selected, some key characteristics of potential RES-H/C market frameworks are covered. This approach allowed for the development of generic policy recommendations applicable to most Member States. Additional dissemination activities have been carried out in Cyprus, Hungary and Latvia.

1 Directive 2009/28/EC of the European Parliament and the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC. OJEU L 140/16 of 5 June 2009.

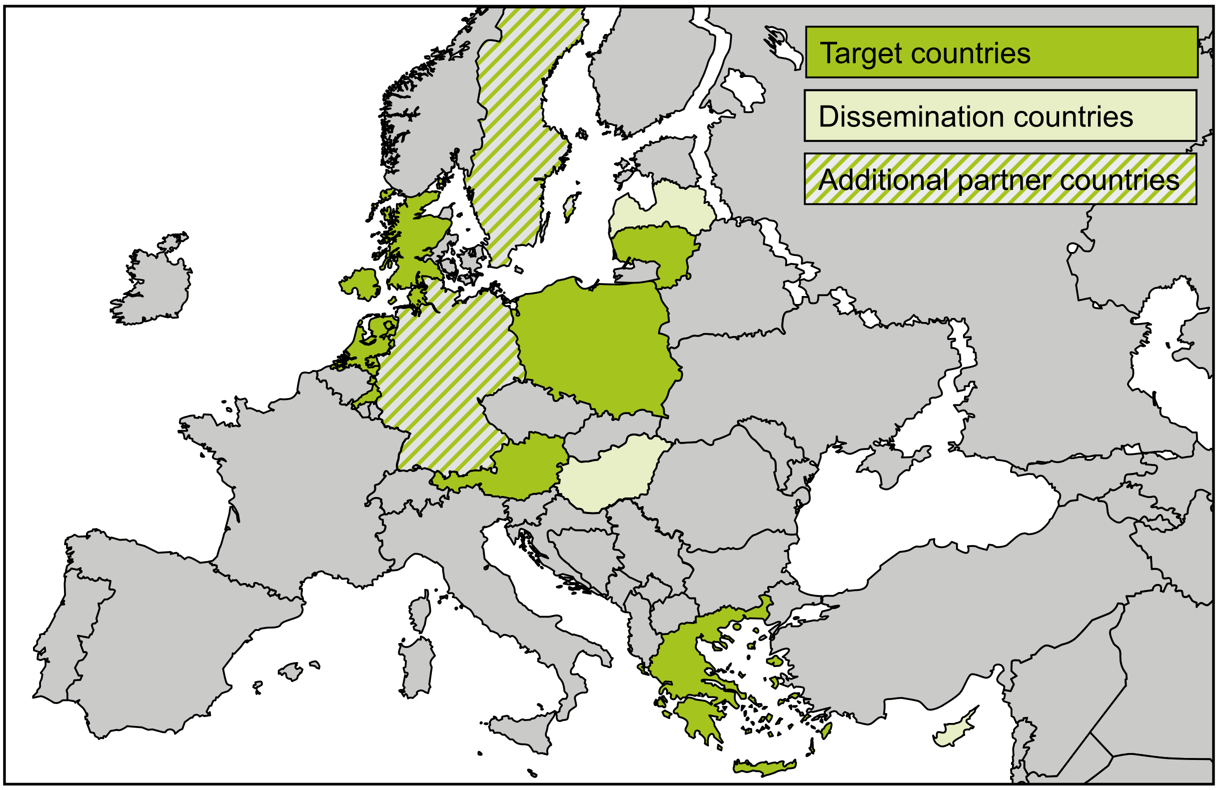

Figure 1: Regional scope of the RES-H Policy project

1.3 The structure of the project

As a starting point overviews of the current national frameworks for the heating and cooling markets including the policy and regulatory framework and the current market penetration of RES-H/C technologies were compiled for the target countries of the project. In addition a detailed overview and assessment of principle policy options to stimulate increased RES-H/C market penetration in the Member States was produced[2] as well as a working paper laying out the experience with the implementation of district heating systems in Sweden (see section 2).

Based on different methodical approaches for each of the target countries possible ranges of RES-H targets for 2020 and 2030 were examined and compared to the sector-specific indicative targets reported by Member States in their NREAPs. The proposed target ranges were subject to national stakeholder consultation processes (consultations, workshops) and revised accordingly.

2 This report constitutes one of the major sources for the chapter on policies on the deployment of RES-H/C in the IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation (http://srren.ipcc-wg3.de/).

For each of the target countries the corresponding project partner described a range of different policy sets for supporting the market penetration of RES-H/C. These policy sets were assessed against comprehensive qualitative evaluation criteria (see section 3.2). The results were again subject to a stakeholder consultation.

In a second step two policy sets per target country were subject to a comprehensive model-based quantitative assessment covering elements such as growth in RES-H/C capacities (broken down to different technologies and sectors), public budget requirements (for fiscal support instruments), avoided fuel costs, public administration costs, reduction of GHG emissions and gross employment effects (see section 3.3). Again the results were discussed with representatives of the target group.

Project partners developed policy recommendations for how to best design a support framework for RES-H/C in the target countries/regions. The recommendations concern concise policy packages including flanking measures that the project partners deem necessary and appropriate to overcome, for example, non-financial (e.g. administrative) barriers. In addition, generic policy recommendations applicable to all Member States were developed (see section 5).

For the EU level different degrees of harmonisation of national RES-H use obligations were quantitatively assessed against potential benefits and options for cost allocation (see section 4). Moreover the role which Guarantees of Origin for RES-H/C could play in the context of support instruments and on the voluntary heating/cooling market was analysed. The results of the respective analyses were presented at two workshops in Brussels.

The results of the project were disseminated by different means, including a European Dissemination Conference, national dissemination conferences in the target countries and several workshops in non-target countries.

All reports and dissemination material from the project can be downloaded at www.res-h-policy.eu.

2 ASSESSMENT OF GENERAL POLICY OPTIONS TO SUPPORT RES-H/C

The RES-H Policy project qualitatively assessed the possible options for supporting RES-H/C in the Member States with a view to feeding into subsequent working steps concerning the modelling and recommendation of Member State-specific policies. Additionally, the project considered the development of district heating in Sweden, and the attendant development of policy and regulation relating to the expansion of DH systems and the limits and problems experienced with this.

Addressing the need for more sustainable sources of heat, and increasingly of cooling, will have to become a major component of renewable energy policy in the Member States if the EU is to achieve its targets for 2020 and if innovation and deployment are to continue beyond that date. Perhaps the overarching lesson of the RES-E policy experience is the need to develop a holistic policy environment whereby all elements of policy are addressed in order to be effective. The different levels of technological maturity represented by the RES-H/C technologies will mean that they require different policy instruments if they are to progress from the demonstration phases to commerciality. These policies will need to provide both appropriately targeted financial support to create opportunity for demonstration and increasing demand for technologies, whilst applying other instruments to assist in overcoming barriers to penetration of technologies. Action to expand stakeholder awareness and engagement must be leavened with practical assistance to expand the reserve of trained personnel capable and willing to deliver systems to consumers. The lesson to be learnt from Austria is that making the process as easy and painless as possible will more easily attract consumers to engage with the technology.

Individual policy instruments may prove more suitable in some Member States than others and it is important to emphasise that no single set of policy instruments may be able to deliver the holistic solution described above across all Member States. However all Member States must have a clear view of what they are trying to achieve with their respective renewable energy policy strategies, take into account the advantages and disadvantages of different instruments and draw conclusions as to the most appropriate ones based on comparative assessment alone. Evidence from the experience gathered with RES-E – such as the failure of quota mechanisms to deliver the cheapest possible renewable energy as a result of the competitive process – must inform decisions concerning instruments to support RES-H/C.

The RES-E policy experience represents a rich source of information in terms of the practical application of policy instruments to support renewable energy and one which must be drawn upon if Member States are not to re-learn lessons already learned at considerable expense. At the same time, care must be taken to account for the differences between RES-E and RES-H/C when applying instruments to the latter. The different characteristics of the delivery and trading of electricity and heat will have significant implications for the application of some policy instruments, for their relative merits and demerits and, potentially, for the costs of their application. The heterogeneous nature of the RES-H technologies may well compound some of these issues, requiring technology-specific combinations of policy instruments and other solutions.

The subsidisation of RES-H/C throws up challenges not present in supporting RES-E. The avoidance of perverse incentives is likely to be a key hurdle in providing support for RES-H/C deployment whilst protecting the public purse. This is a particular risk as regards RES-H since it is typically generated close to the point of use and there is frequently little use for excess heat – with little or no option to export to the grid where district heating does not exist. The dearth of experience in providing financial support to RES-H/C on a large-scale means that this has not been addressed much up to now, though the UK has considered two possible methodologies to address this within the scope of the tariff-based Renewable Heat Incentive which is being introduced in 2011-12. The first was a proposal of estimated limits of a RES-H subsidy based on the total heat demand for an energy-efficient building by type. This has now given way to a tiered subsidy whereby a high initial rate is substantially reduced above a certain output. The latter is being applied to biomass generation of heat in commercial premises with the aim of the lower rate being too low to justify excessive fuel use.

The project also qualitatively compared tariffs and quota instruments for subsidising RES-H. It concluded that there is no reason to think that the evidence suggesting tariffs can stimulate RES-E generation more economically would not also hold for RES-H/C and that, additionally, the smaller scale of RES-H/C would tend to mean greater transactional and administrative costs under the quota mechanism.

It is clear that regulatory as well as financial instruments offer significant potential for expansion of RES-H/C. The use obligation in particular (applied to both RES-H/C and RES-E) has been adopted nationally in Germany and Spain and is made compulsory from 2014 by the Directive 2009/28/EC for any Member State which has not implemented an acceptable alternative. However, there remain unresolved problems with its application, most notably that it may place significant burdens on individual stakeholders and may be politically difficult to justify in some territories. There are other opportunities to address particular issues and remove barriers to wider deployment of RES-H/C through appropriate application of regulation relating to buildings, planning, district heating network provision and other areas. This is an area where more research is required.

Policies for increasing renewable cooling can also draw on the experiences gathered with RES-E, while also taking into account the needs of the technology and the specific context of the Member State. There is also a clear need to ensure that policies for supporting RES-H/C cohere with policies to support increased energy efficiency, reductions in fuel poverty, increased use of waste energy and that they complement policies for supporting RES-E and biofuels, particularly in areas where there is potential competition for the resource, as is the case with biomass.

It has already been noted that it is unlikely that one single instrument will be able to overcome all the barriers to the wider adoption of RES-H/C.

Table 1 shows some of the key points arising from the qualitative assessment of potential RES-H/C instruments carried out as part of the RES-H Policy project, including summaries of the key advantages and disadvantages of the policy instruments discussed.

RES-H/C support mechanisms		Previous experience in Europe		Capability to differentiate		Cost efficiency[1]		Political feasibility[2]	Predictable effectiveness[3]	Certainty for RES industry	Main advantages/disadvantages
		RES-H/C	RES-E	RES technologies	Small/large scale	Government	End user				
Financial mechanism	Investment subsidy	✓	✓	✓	✓	☹	☺	☺	😐	😐	+High stakeholder acceptance -Budget dependency=> future uncertainty
Financial mechanism	Public procurement	✓		✓	✓	☹	☺	☺	☺	😐	+Ability to create initial market for nascent RES technology -Limited applicability
Financial mechanism	Quota mechanism*		✓			☺	☹	☹	☺	😐	+Effective; little political involvement -Supports only the currently most competitive RES technology; the certificate price mechanism may lead to overcompensation and high end-user costs; high administrative and transaction costs for small scale application
Financial mechanism	Tariff mechanism*		✓	✓	✓	☺	😐	😐	😐	☺	+Capability to support not yet commercial RES technologies and nurture initial market; provide certainty for RES industry -High administrative and transaction costs for small scale application
Financial mechanism	Tendering*		✓			☺	☺	😐	☺	☹	-Tranche-based nature fails to create stable demand conditions; associated with previous failure; not suitable for small scale
Financial mechanism	Levies (eg. CO_2 tax)	✓			✓	☺	☹	☹	☹	☹	+Target the externalities (e.g. emissions)=> promotes both RES and efficient use of fossil fuels -Low predictable effectiveness; unpopular with end users
Financial mechanism	Tax incentives (e.g. no VAT)	✓		✓	✓	😐	☺	☺	😐	😐	+Cost efficient; uncomplicated -Low predictable effectiveness; reduce government incomes
Financial mechanism	Soft loans	✓	✓	✓	✓	☹	☺	☺	😐	😐	Similar characteristics as investment subsidies but less attractive for end-users in the residential sector. -May be difficult to support in some financial/institutional frameworks
Non-financial mechanisms	Use obligation (buildings)	✓		✓	✓	☺	☹	😐	☺	☺	+Promotes stable growth; stimulates learning in the building sector on the integration of RES-H/C technologies in buildings. -Limited market; promotes individual systems over district heating (unless DH is also eligible)
Non-financial mechanisms	Skills, education & training	✓	✓	✓	✓	😐	☺	☺	☹	😐	+Promotes (correct) deployment assuming there is a demand for RES-H/C; necessary for industrial growth and may assist in contributing to competitive advantage
Non-financial mechanisms	Information & awareness	✓		✓		😐	☺	☺	☹	☹	+Potentially cheap; improve the functioning of other support mechanisms -Low predictable effectiveness
Non-financial mechanisms	Standardisation	✓	✓	✓	✓	😐	☺	☺	☹	☺	+Displaces less efficient equipment=>public confidence -Potentially costly for small manufacturers

*evaluated based on performance as RES-E support mechanisms.

[1]Cost efficiency of the policy instrument refers to the ratio between the *additional costs* of instruments and the increased use of RES-H/C achieved through the implementation of the policy instruments. Long-term effects are not taken into account.

The *government perspective* focuses on government budget costs including administrative and monitoring cost and transfers (e.g. subsidies).

The *end user perspective* focuses on the additional costs experienced by the end user, including additional investments, increased operational costs, as well as transfers (received subsidy, paid tax etc).

[2]The political feasibility may vary greatly between countries depending on the institutional setting and policy tradition.

[3]Predictable effectiveness refers to the ability of the policy instruments to in a predictable way achieve RES-H/C targets.

Table 1: Qualitative assessment of different RES-H/C support instrument options

Swedish experiences with district heating

District heating (DH) has considerable potential in terms of the more effective use of RES-H/C systems across Europe as well as the potential to make fossil fuel heating and cooling more efficient. Sweden has a long history of employing DH systems and dealing with the issues that arise from its management and this was reviewed with the goal of informing potential future consideration of DH systems. The key findings are detailed below:

1. DH systems are characterised by high capital costs that are only justified when there is a certain minimum heat demand and heat density. Heating indexes – which are proportional to heat density – are highest in Northern, Central and Eastern Europe, though they are also likely to be sufficiently high in dense urban areas found elsewhere in Europe.

2. The opportunity to produce electricity efficiently in CHP plants was the main argument for building the first DH systems in Sweden and may be the most compelling argument in Member States where condensing power plants burning either coal or gas are the dominant electricity provider. The motivation to drive DH growth to deliver RES-H/C specifically may depend on the available local resource or potential for the easy import of biomass for CHP generation.

3. Swedish energy and environmental taxes have promoted district heating over other heat options and greatly influenced the use of fuels and energy sources in DH production. The reproducibility of these drivers will be dependent on, and limited by, the political perspective of individual Member States on carbon taxes.

4. Existing energy infrastructures can be a barrier to the introduction of DH systems. Electricity has been the major competing system in Sweden, initially for direct use, more recently with the application of heat pumps. It may be more likely that the main competitor in other Member States is gas, though the future growth of heat pumps may also prove to be a challenge elsewhere, too. Lock-in to competing technologies is likely to be a particular problem when buildings do not have central heating, with the water-based heat distribution essential to DH. The absence of any historical DH in a Member State may make the creation of such a regulatory framework for achieving it a major barrier to be overcome if DH is to be adopted on a large scale. Since the core of electricity and gas delivery networks predates the European single market for energy, and the emphasis on competitive markets that is central to energy delivery in many Member States, it is difficult to know whether this expansion might be politically possible in a number of Member States.

5. The emergence of district heating in a particular setting requires the existence of an actor that is willing to make long-term investments and that this organisation has organisational resources to run the system. The growth of DH networks may require an investor mandated by regulation as occurs with electricity and gas networks and this may be politically difficult in policy and regulatory frameworks where there is little experience with DH and no mandated champion of its expansion.

6. There has traditionally been a high acceptance for community-wide technical solutions in Sweden. District heating has also enjoyed a generally good reputation due to reliable supply and competitive prices. These aspects are important since the connection to DH system implies a loss of control of the heating system for the building owner and the lock-in to one DH supplier (disconnection is possible but requires an investment in new heating equipment). The acceptance for collective solutions and the perception of district heating may be very different in other countries, depending on their cultural and political heritage.

Further details can be found in the corresponding RES-H Policy working paper (Ericsson 2009).

3 SPECIFIC POLICY ASSESSMENT IN THE TARGET COUNTRIES

For each of the project's target countries a broad range of qualitative and quantitative steps have been taken in the analysis. The aim was to identify the quantitative role which RES-H/C should play in the respective countries to achieve the overall national 2020 RES target. At the same time the aim of the analysis was to assess which support policy set would be suitable for delivering the desired output in terms of increased market penetration of the different RES-H/C technologies. The different methodologies applied within each of the working steps are outlined in the following section.

3.1 Methodology

3.1.1 RES-H/C targets

Possible ranges of RES-H targets for 2020 and 2030 were analysed and compared to the sector-specific indicative targets reported by Member States in their NREAPs. The target ranges were derived by means of different research approaches comprising the following elements:

- Existing national scenarios for RES-H/C: For each target country a comprehensive literature review were carried out with respect to existing scenarios and assessment of RES-H/C potentials. The results from this literature review were presented in a comparative way.
- Scenario-based top-down approach: Recent scenario simulations from the Green-X model (Resch at al. 2009) were used as a reference for consistent top-down scenarios for each of the target countries.
- Bottom-up approach: The bottom-up approach for the buildings sector was based on a disaggregated data compilation of the building stock and parameters such as thermal renovation rates, the existing national technology split, maximum technology-specific diffusion rates, resource availability for biomass. For industry the bottom-up approach consisted of an assessment of the heat demand per temperature level for various industry subsectors and the opportunities for replacing conventional energy carriers with renewable heating technologies in those subsectors. The assumed parameters like diffusion rates etc. have been the subject of discussions with stakeholders.

The results from these three elements were documented and presented to stakeholders. A questionnaire was developed as a guideline for this consultation process. The results from the consultation were discussed in stakeholder workshops and revised accordingly. Finally, target ranges for RES-H/C were derived together with national stakeholders.[3]

For industry proposed target ranges have been compiled similarly to the buildings sector. Stakeholder and expert views have been integrated into targets, assisted by the model-based inventory of temperature-level dependent opportunities for renewable to displace conventional energy carriers.

3.1.2 RES-H/C support policies

Based on the broad range of general support instrument options (see section 2) for each of the target countries a range of different policy sets to support the market penetration of RES-H/C has been analysed. In a first step each of the selected instrument options has been qualitatively assessed against a variety of different qualitative criteria (see section 3.2). This analysis was then subject to a stakeholder consultation (consultation and workshop). Subsequently the selection of support options was narrowed down to two policy sets per target country. In a second step those two policy sets were subject to a profound quantitative assessment (see section 3.3). Here, for each target country a detailed assessment of the effectiveness and economical efficiency of the two policy sets has been performed. The assessment covered the following factors:

- Growth in RES-H/C capacities broken down to the different technologies
- For fiscal support instruments public budget requirements
- Avoided fuel costs
- Public administration costs
- Reduction of GHG emissions
- Gross employment effects

The quantitative assessment was mainly based on two models:

- INVERT[4] is a dynamic bottom-up model for simulating space heating and hot water demand in buildings (domestic and non-domestic) and for evaluating the effects of different support schemes and energy price settings on the energy carrier mix, CO_2 reduction and policy costs.

- RESolve-H/C[5] is a simulation model for renewable heating and cooling. For modelling the industry sector the heat demand is broken down into several temperature levels, in which renewable energies compete with fossil energy carriers. Policy measures can influence the costs and benefits for both items, resulting in a change of renewable energy penetration.

The architecture of both models is described in more detail in the annex of this report.

3 The results of this working step can be found in the corresponding RES-H Policy Target Reports (D6).

4 INVERT was originally developed by Vienna University of Technology/EEG in the frame of the Altener project INVERT (Investing in RES&RUE technologies: models for saving public money). During several projects – this does also apply to the RES-H Policy project – and studies the model has been extended and applied to different regions within Europe.

5 The RESolve-H/C model was designed by the Energy research Centre of the Netherlands (ECN).

For each of the target countries and policy sets the public administration costs[6] were estimated, however only for the buildings sector. The estimation was based on some basic assumptions such as the total number of support cases that has to be dealt with by the executing authority per year (number of funding applications; number of supported installations), the management processes to run the support scheme and the assumed "efficiency" of the programme execution (e.g. number of processed applications per day and staff).

Figure 2 summarises the different assessment steps of the policy analysis in the target countries.

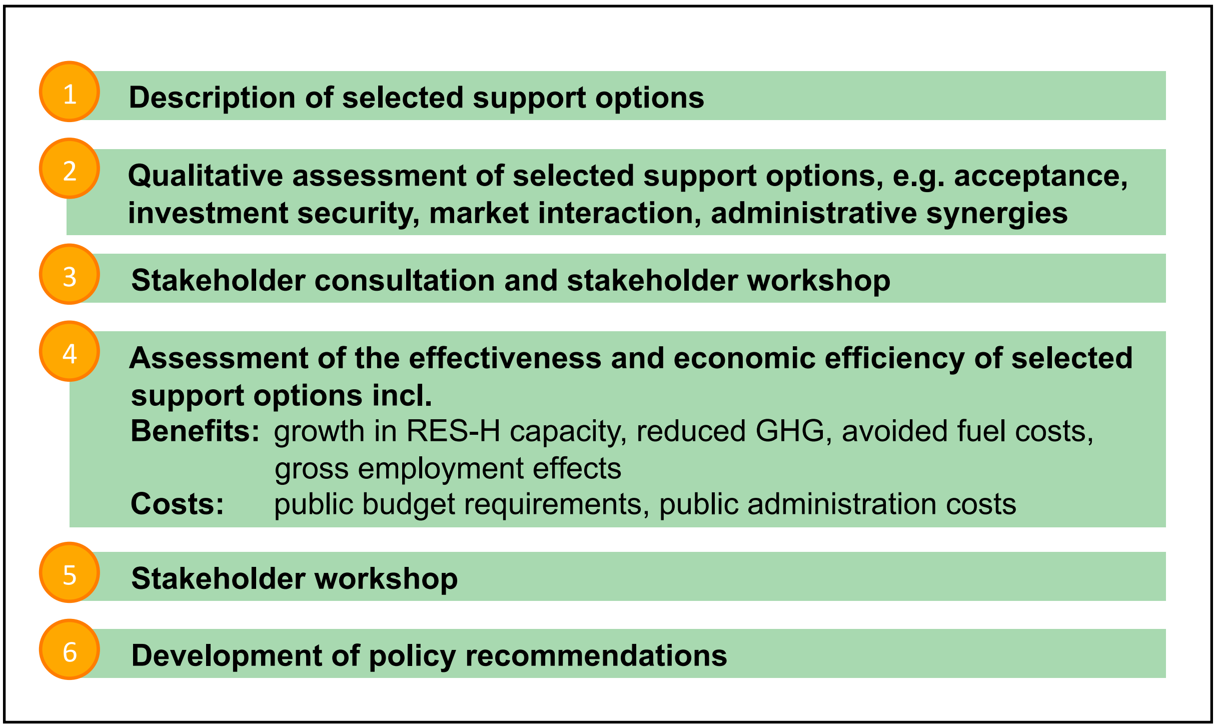

Figure 2: Assessment steps of the policy analysis

6 Public administration costs cover costs that arise to public authorities or experts who act on behalf of a public authority from the execution of a political measure (e.g. for administering a use obligation or a subsidy scheme). The costs for such an enforcement scheme typically rise with the complexity of an instrument and the degree to which different levels of administration are involved. Public administration costs are an important element in the discussion about policy instruments as

- often an estimation of the expected public administration costs needs to be reported to the policy sector before adopting a regulatory norm for implementing a new instrument,
- generally they have to be covered by public budgets.

3.2 Qualitative policy assessment

Policy support instruments can be assessed against quantitative and qualitative criteria. Future RES-H/C penetration rates, policy costs, economic benefits in terms of avoided fuel costs or employment can be quantified through economic modelling, while factors like the political acceptance, the agreement with important principles (e.g. the polluter pays principle) or the effect on long-term structural changes can only – in the latter case at least partly – be assessed using qualitative criteria. Qualitative assessment is based on system knowledge, experience and judgment.

In the context of the RES-H Policy project the application of the qualitative assessment criteria has mainly been used to short-list possible support mechanisms for RES-H/C. Only for those options that are designed as to ensure good target accuracy, comply with the most important principles and at the same time seem enforceable, the detailed quantitative analysis has been conducted within the following working step.

In the following some of the key criteria are highlighted.[7] Numerous of these criteria are picked up again in the policy recommendation section (see section 5):

- **Target achievement:** The term target accuracy reflects how well the initial aims aspired by the implementation of a policy instrument are achieved. Some instruments can only motivate market actors to invest in RES-H/C technologies, like investment grants or soft loans, for example. The extent to which they react to these incentives depends on the market actors. Therefore the final results are difficult to forecast and it might be necessary to re-adjust them (e.g. of the grant level for a specific technology) after some time. Other instruments are more coercive and thus more predictable in their effects, like installation obligations or quota systems.

- **Stable and reliable investment conditions:** Investment into new heating (and cooling) systems is often a decision for 20-30 years. Predictable and reliable conditions regarding future costs and incomes related to the heating (and cooling) systems are thus desired by investors. Policy instruments differ widely in the ability to ensure stable investment conditions. Budgetary incentives for example are dependent on the respective amounts allocated every year to the respective support programmes. Yearly modified rates of incentives, available funds and general support conditions make investors feel insecure. Market oriented instruments on the other hand are usually completely independent from the financial situation of the state, but are in turn reliant on a well functioning market.

- **Technology diversification:** Different RES-H/C technologies have different investment and operating costs. They also vary in terms of technological maturity and accompanied degree of economies of scale. Therefore supporting

7 The full range of criteria can be found in the corresponding RES-H Policy working paper (Bürger/Varga 2009).

different technologies to a different extent is justified as it ensures that a wide range of technologies can enter the market. Different policy approaches and the specific design of an instrument are two major drivers for technology diversification. Support instruments must be assessed against their principal capability of supporting a broad technology spectrum.

- **Avoiding over-incentivisation:** Windfall profits are unexpected or unjustified incomes, which can be seen as over-subsidisation in the case of financial grants or other forms of government support. Incentivising RES-H/C systems can have this effect if the policy instrument provides more financial support than required for the economic operation of a RES-H/C appliance; or if the instrument provides additional income to those who would have invested anyway without these policy instruments. This willingness to pay can vary significantly among the target group and differs even more among different countries. Thus a certain rate of investment support, for example, might be too low to boost the market in one country, while in another with an environmentally more conscious society the same rate might lead to high windfall gains.[8] Especially in the case of financial support, different shortlisted policy instrument options should be assessed against the risk of over-subsidisation.

- **Administrative synergies:** Administrative costs can become very high if the implementation and maintenance of a support scheme requires additional resources for data collection, administration, control mechanisms, etc. Where synergies with existing instruments could be achieved should be examined. For example, claiming the premium payments for a bonus type of system on companies operating in the fossil fuel supply chain (e.g. producers and importers of oil, natural gas, coal and/or electricity) might be justified by synergies with energy taxation systems under which all relevant data (e.g. about the annual fuel supply of a company) might already be registered due to taxation purposes. Proving compliance with an installation obligation for new buildings might be linked to similar compliance processes in the context of building codes.

- **Acceptance:** A support instrument with the lowest costs can still fail introduction if it conflicts with some interests of stakeholder groups. The most important parties whose support might be essential for the implementation of a RES-H/C policy instrument comprise the policy sector, RES-H/C investors (including small scale investors such as private building owners, large scale investors, e.g. operators of renewably fed district heating or cooling systems), tenants, RES trade associations, conventional fuel suppliers and media. The acceptance of different instrument options within the relevant stakeholder group should be thoroughly investigated.

8 The willingness to pay and thus the optimum rate of support can also change in time as after a while those that would have invested "anyway" (due to a high degree of willingness to pay) are then equipped with the RES-H/C systems and the remaining ones that have only a low willingness to pay thus require more financial motivation in order to invest. Costs associated with RES-H/C relative to other technologies may also change over time. All these effects make it rather difficult to determine the optimum rate of support for RES-H/C systems.

- **Policy sector** support (e.g. by parliamentarians, relevant parliamentarian committees) is influenced by several aspects such as views and preferences of different parties / governments, available budgetary funds, visible short-term effects, sensible short-term costs or the activity of different lobbying groups. Very important is also the experiences made with other support instruments or the political culture of government support, which influence the acceptance of certain kinds of policy instruments. For instance, command and control instruments are more popular than market based instruments in several countries.

- Many **private non-commercial building owners** base their investment decisions only partly on economic criteria. Numerous non-financial barriers (including preferences, attitudes, fears, administrative, technical or legal barriers, information deficits or asymmetries) often hinder investments in RES-H/C installations. Each instrument must be assessed against its potential to sufficiently incentivise or motivate non-commercial building owners to invest in RES-H/C. It must also be assessed whether in the tenant sector the financial burden due to the installation of a RES-H/C device and the financial benefit due to the reduced costs for using conventional fuels are fairly shared between landlord and tenant.

- **Private and municipal housing companies, social housing organisations** often own and manage a large number of buildings. Whereas housing companies often have sufficient technical skills to handle even innovative RES-H/C technologies especially private companies generally base their economic calculation on shorter pay back times than, for example, private building owners in the domestic sector. In addition the level of willingness to pay might generally be lower than with small scale investors.

- **RES trade associations** are believed to support any kinds of policy instruments in favour of RES-H/C production; still there are measures they might prefer to others. As government grants, for example, are dependent on state budgets and thus their amount can change significantly from year to year, the induced stop-and-go development of the supported technologies might make investment grants less popular. Use obligations or financial support programmes that are independent of public budgets (e.g. bonus schemes in which the boni have to be covered by companies operating in the fossil fuel supply chain) might be favoured since they might provide more stable support conditions.

- The view of **suppliers of conventional fuel** is very important, as they constitute a very strong lobby group in the energy sector. Fuel suppliers are affected by a growing rate of RES-H/C systems in terms of a decreasing demand for their "traditional products" (especially coal, gas, oil), but in certain support schemes fuel companies can also serve as financiers. The bonus payments granted to producers of RES-H/C in a bonus system might be financed by producers and importers of gas and oil, as these companies are said to cause the environmental damage associated with traditional heat production (Bürger et al. 2008). Conventional fuel suppliers are therefore most likely to oppose policy instruments that favour RES-H/C systems. At the same time fuel companies increasingly change their supply portfolio (e.g. towards biomass-based fuels) or redefine themselves as "energy companies" following technological changes by, for example, investing in geothermal projects.

- **Impact on competition:** The implementation of a new policy instrument alters the terms in the given market as it aims to stimulate certain changes. Depending on the kind of policy instrument certain groups of stakeholders are favoured while others have to bear the burdens. Support instruments should be assessed against their potential to distort the competition among different players on the heating and cooling market (e.g. companies differing in size and in terms of utilised fuels. However, it must be considered that already now competition is affected by some distortion, e.g. by state determined gas prices. Also it has to be stressed that certain distortions of competition are justified by commonly accepted principles (like the polluter pays principle) as externalities like environmental damages are typically not internalised in energy prices.

- **Provision for the "polluter pays principle":** According to the polluter pays principle the party responsible for producing pollution is also responsible for paying for the damage done to the natural environment (OECD 1972). Different policy instruments apply the polluter pays principle to a varying extent. While, for example, installation obligations allocate the costs to all building owners, in a bonus type of system the bonus payments might be allocated to companies supplying fossil fuels. In both cases it can be argued that a "polluter" is bearing the costs: building owners as they burn fossil fuels and thus harm the climate, fuel companies as they put fossil fuels into circulation. In the case of budgetary investment grants or tax reductions the provision for the polluter pays principle depends on the sources for the earmarked financial sources. Often it is taken from the general budget and therefore the polluter pays principle is violated.

- **Distribution of costs and social fairness:** The question of burden sharing raises the need for a fair distribution of costs from a social point of view. Heating costs make up a bigger share of total expenses of people with less income, so costs associated with the policy instrument supporting RES-H/C systems might have a more significant effect on them. It should be assured that the policy instrument – if it consists of some kind of obligation or if the costs associated to the support scheme are allocated to, for example, households – takes into account the constricted possibilities of poor people. Moreover, in schemes where costs are allocated to different demand sectors costs often end with those consumers that show the lowest demand elasticity. Instruments should be assessed as to whether any form of financial burden is fairly distributed among different consumer groups.

- **Risk of counter-productive secondary effects:** Specific instrument architectures might lead to counter-productive secondary effects. If not properly designed the implementation of an installation obligation can, for example, have the effect that in order to avoid the obligation, modernisations of heating system will be postponed as long as possible. Thus instead of motivating the use of environmentally sound RES-H/C applications, outdated technologies are maintained. Other counter-productive effects can arise if policy instruments favour solely renewable energy technologies and do not consider the importance of concurrent energy efficiency improvements in, for instance, the buildings sector. Policy instruments should be evaluated with regard to their capability to minimise the risk of potential counter-productive secondary effects.

Table 2 provides an overview of all qualitative criteria applied.

Cost efficiency and transaction costs	Target achievement
	Establish stable and reliable investment conditions
	Capability to support specific RES-H/C technologies
	Long-term perspective contributing to dynamic efficiency
	Avoiding over-incentivising (contributing to static efficiency)
	Transaction cost (contributing to static efficiency), especially public administration costs
	The ability to exploit administrative and organisational synergies at the interface to other related instruments (e.g. energy taxes)
	Incentive for efficient system operation (contributing to static efficiency)
Acceptance	Policy sector (public authorities, policy makers)
	Building owners (small scale investors) and tenants
	RES-H/C system operators (large scale investors)
	RES trade associations
	Fuel suppliers and associations (conventional fuel)
	Media
	Experience from other countries
	Communication
Market interaction	Level of market conformity
	Impact on competition
	Impact on market stability
Other	Provision for the "polluter pays principle"
	The consideration of local characteristics
	Distribution of costs and social justness
	Counter-productive secondary effects
	The ability to avoid lock-in effects

Table 2: Qualitative criteria of the policy analysis

3.3 Quantitative policy assessment

For a quantitative policy assessment in the RES-H policy project the following parameters have been calculated, based on the models for the buildings as well as industry sector:

- **Total RES-H supply** (and for the different technologies): in terms of final energy
- **Share of RES-H** on total supply in the respective sector
- **Avoided fuel costs** due to fossil fuel savings: compared to a purely fossil reference scenario with the mix of fossil technologies in the year 2007
- **Public budget expenditures / revenues** due to applied policies: in the case of subsidies, tax incentives or the Renewable Heat Incentive in the UK, public money is spent to economically support renewable technologies (budget expenditure); the use obligation for renewable energies is modelled with a penalty that has to be paid once in the case of non-compliance with the obligation (budget revenue)
- **Public administration costs** of the applied policies
- **Reduction of GHG-emissions** due to fossil fuel savings: compared to a purely fossil reference scenario with the mix of fossil technologies in the year 2007
- **Employment effects**

Table 3 provides an overview of the main characteristics of the policy sets that were subject to the quantitative policy assessment for the buildings sector. The determination of the policy sets was the outcome of an interactive, participatory discussion process with national stakeholders within each target country.

For each target country the outcome of investment subsidies (in general 25% of the investment costs) has been modelled for the industry sector. For the Netherlands and the UK a tariff-based mechanism was also modelled. Here input was taken from the UK Renewable Heat Incentive (RHI). The model runs were based on the RHI tariff levels published by the UK Department of Energy and Climate Change in March 2011.[9]

The following country sections give a concise overview of the simulation results of the quantitative policy assessment, i.e. the developments of RES-H shares, the average annual growth rates of RES-H, avoided fuel costs, public budget requirements, public administration costs as well as reduction of GHG-emissions.[10] For each target country the current exploitation (base year 2007)

9 See www.decc.gov.uk/rhi

10 The results of the quantitative policy assessment can be found in the corresponding RES-H Policy Policy Reports (D13).

of RES-H, the target ranges derived within this project, and the scenario simulation runs for the building and industry sector for the two different policy sets and for two energy price scenarios are shown.[11]

As employment effects were calculated on the basis of these results, however applying a different methodology, the findings are presented in a separate chapter (see section 3.4).

	Policy set 1	Policy set 2
AT	Technology-specific investment subsidies in the range of 10-35% of investment costs	Use obligation for RES-H or DH for new buildings and for existing buildings that are subject to major renovation: 2011 - 2030: 7% - 30% of final energy demand for heating (space heating + hot water) Non-compliance: Penalty 20 EUR/m² floor space
Upper AT	Technology-specific investment subsidies in the range of 20-40% of investment costs	Use obligation for RES-H or DH for new buildings and for existing buildings that are subject to major renovation 2011: 50% 2015-2030: 100% of final energy demand for heating (space heating + hot water) Non-compliance: Penalty 65 EUR/m² floor space
GR	Technology-specific tax incentives equivalent to 10-30% of investment costs	Use obligation for new buildings and for existing buildings that are subject to major renovation: 2011-2013: 60% of domestic hot water demand 2014-2030: 50% of final energy demand for heating (space heating + hot water) Non-compliance: Penalty 50 EUR/m² floor space
LT	Technology-specific investment subsidies in the range of 20-45% of investment costs	Technology-specific investment subsidies for the non-DH sector equivalent to 15% of investment costs, for biomass district heating installations of 21% of the investment costs
NL	Technology-specific investment subsidies in the range of 10-40% of investment costs	Use obligation for new buildings (Energy Performance Regulation) Required shares of renewable in the case of obligation increasing from 10% in 2011 to 30% in 2020 and 2030 Investment subsidies in the range of 10-30% of the investment for existing buildings
PL	Technology-specific investment subsidies in the range of 20-45% of investment costs	Use obligation for new buildings and for existing buildings that are subject to major renovation: 20% of final energy demand for heating (space heating + hot water) Non-compliance: Penalty 60 EUR/m² floor space
UK	Renewable Heat Incentive (RHI) with technology-specific support level of 2.0-17.5 pence per kWh RES-H	RHI combined with a modified supplier obligation (CERT)

Table 3: Policy sets analysed for the buildings sector

11 Two price scenarios have been used, based on PRIMES data; for some countries they have been adjusted in order to tally with country-specific projections. The scenarios are indicated as 'high energy price scenario' and 'low energy price scenario'.

3.3.1 Austria

The modelling results of the Austrian heat market for the buildings sector show that both the subsidy scheme (policy set 1) and the use obligation (policy set 2) are predicted to lead to remarkable growth of RES-H capacities in the country. RES-H market shares of 44-68% seem to be reachable with the respective policies up to 2030 (see Table 4).

Assessment of selected policies for the building sector - Austria		Subsidies						Use obligation					
		low price			high price			low price			high price		
		2010	2020	2030	2010	2020	2030	2010	2020	2030	2010	2020	2030
Total RES-H	[PJ]	106,8	137	151,9	106,8	166,3	201,1	103,3	122,9	132,6	104,2	159	191,8
Share RES-H	[%]	29	40	51	29	48	68	29	36	44	29	46	65
Delta Share RES-H*	[%]	3	14	25	3	22	42	3	10	18	3	20	39
Avoided Fuel Costs*	[M€]	369	1148	1599	812	5777	9240	324	931	1256	772	5422	8661
Reduction of GHG emissions*	[Mt]	0,9	3,1	4,1	0,9	5,7	9,8	0,6	2,1	2,7	0,7	5,1	8,6
Public Budget**	[M€]	241,1	294,1	272,6	265,5	458,0	453,1	0	-13,4	-15,2	0	-0,9	-1,0
Average Annual growth of RES-H	[GWh]	626			1311			406			1217		
*base year of the calculation is 2007													
**positive when money is spent (subsidies, tax incentives, RHI), negative when money is received (obligation)													

Table 4: Results of the quantitative policy assessment for buildings - Austria

As illustrated by Figure 3 the current market for RES-H in the buildings sector in Austria shows that biomass systems predominate. According to the simulations this will continue in the future, and mainly consist of modern wood chips and pellet boilers with high conversion efficiencies. Solar thermal systems, which have a long tradition in the country, will also continue to gain importance.

In the case of heat pumps the simulation results show higher growth rates in all scenarios than it was expected in the target setting. This is due to different assumptions concerning the COP of the installations: while for the targets a minimum COP of 4 was requested, in the simulations a lower COP was allowed but lowering the economic feasibility of the technology option. The results therefore show that heat pumps with lower COP than 4 are also economically viable compared to other technologies, leading to the installed systems having a decreased efficiency. However, allowing lower COP increases the number of potential applications, in particular in existing buildings, at least in the short and medium term.

In Austria the simulation shows that the use obligation is less effective in terms of growth of RES-H capacities than the subsidy scheme. This is mainly due to the limited part of the building stock that is addressed by the obligation, only the new buildings and the buildings undergoing major renovations. Therefore, a combination of the both policies seems to be an attractive opportunity: while the obligation addresses new buildings and buildings undergoing major renovations, subsidies could also be given when the heating system is simply being changed.

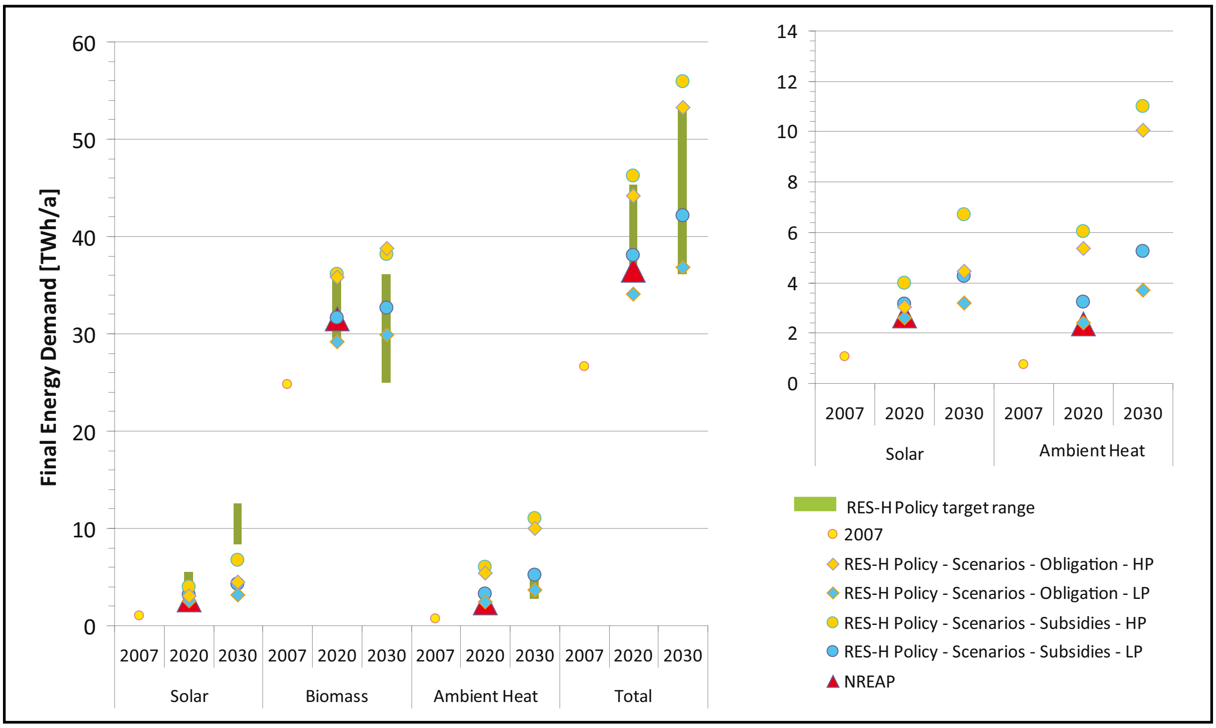

Figure 3: Historical data (2007), NREAP targets, INVERT scenario results and target ranges according to literature, bottom-up analysis and stakeholder dialogue for the buildings sector in Austria (LP – low energy price scenario; HP – high energy price scenario)

The public administration costs for the subsidy scheme in the buildings sector would vary between 0.4 and 0.9 million EUR per year. Under the use obligation the public administration costs would be in a similar range. Thus it is evident that these costs play a minor or even negligible role, especially when they are compared to the overall public budget requirements under a subsidy scheme. Nevertheless efforts should be taken to increase the efficiency of the programme administration to an upmost possible extent thus decreasing the corresponding administrative costs. One crucial aspect is to make use of synergies between administering different support programmes. In Austria this is partly the case regarding the synergies between the support of residential building construction (Wohnbauförderung) and investment subsidies for RES-H systems. A crucial discussion point in this respect is the division of support programmes between the nine regions (Bundesländer).

The Austrian industry sector currently already has a considerable use of biomass for energy purposes (see Table 5). Although the annual amount varies from year to year, a significant increase is still possible in the future, and from the simulations it follows that fuel price is a decisive parameter for this. For example, the 'no policy' scenario shows a very high penetration of biomass technology in the high price variant, which is only slightly further increased by an investment grant (25%

of the investment is assumed subsidised). In the 'low price' variant the impact of the investment grant is much more significant. The expenses for the public budget in all cases are higher than the benefits from the avoided fuels, but still in the same order of magnitude.

Both non-biomass technologies – solar thermal and deep geothermal energy – have the potential to increase but to a significantly less degree than biomass technologies. Remarkably the investment grant (25%) is not sufficient for effectively making solar thermal energy penetrate significantly (high price including investment grant yields 0.1 PJ of solar thermal by 2030). Deep geothermal is closer to the market, and the price of the conventional fuels is decisive for its penetration: in the high price variant it penetrates well, but because the potential is limited the share of deep geothermal remains modest compared to biomass. The investment grant (25%) only contributes a little to increased consumption of geothermal in the high price variant, but in the low price variant it is able to make the difference.

As the effect of the reference fuel prices is a very important factor, connecting any support measure for renewables to the fuel price development is suggested. Specifically for solar thermal, and to a lesser degree for deep geothermal, the subsidy might also be justified when future energy prices are high, and possibly the support levels should even be increased to gain more impact.

Assessment of selected policies for the industry sector - Austria		No policy						Investment grant					
		low price			high price			low price			high price		
		2010	2020	2030	2010	2020	2030	2010	2020	2030	2010	2020	2030
Solar thermal	[PJ]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1
Geothermal	[PJ]	0,0	0,1	0,2	0,0	2,6	4,5	0,1	0,2	0,4	0,1	2,8	4,6
Biomass	[PJ]	34,3	34,8	37,5	37,7	66,5	75,4	36,4	38,6	43,3	36,5	72,8	79,0
of which from waste	[PJ]	6,7	4,3	4,5	7,4	13,2	17,4	7,9	6,0	7,0	7,9	17,8	20,2
of which from wood	[PJ]	27,6	30,5	33,1	30,3	53,3	58,0	28,6	32,6	36,3	28,6	55,0	58,8
Total renewable	[PJ]	34,3	34,9	37,7	37,8	69,2	80,0	36,5	38,8	43,7	36,5	75,5	83,7
Share RES-H	[%]	15%	14%	15%	16%	28%	32%	16%	16%	18%	16%	31%	34%
Delta Share RES-H*	[%]	0%	0%	1%	1%	14%	18%	1%	1%	3%	1%	16%	19%
Avoided Fuel Costs	[M€]	0	0	0	0	0	0	327	345	402	398	1614	2032
Reduction of GHG-emissions	[Mt]	2,1	2,2	2,4	2,4	4,2	4,9	2,3	2,4	2,7	2,3	4,6	5,1
Public Budget	[M€]	0	0	0	0	0	0	177	305	458	177	2019	2368
Average annual growth of RES-H**	[GWh]		0			0			0			0	
** Compared to 'low price' variant in the year 2010*													
*** Average calculated for the period 2010 - 2030 relative to 'low price' variant in the year 2010*													

Table 5: Results of the quantitative policy assessment for industry - Austria

3.3.2 Upper Austria

For Upper Austria, a region of Austria with a long tradition in RES-H, the modelling results for the buildings sector show still large growing potentials for RES-H until 2030 reaching a share of 80% RES-H in the high price variants with both a subsidy (policy set 1) and an obligation scenario (policy set 2), see Table 6.

The subsidy scheme and the use obligation show more or less the same effects for the region, while of course through the penalty payments the obligation leads to an income for the public budget whereas the subsidy scheme is fed by it.

Assessment of selected policies for the building sector - Upper Austria		Subsidies						Use obligation					
		low price			high price			low price			high price		
		2010	2020	2030	2010	2020	2030	2010	2020	2030	2010	2020	2030
Total RES-H	[PJ]	23,3	29,5	31,5	23,4	33,0	36,7	23,2	28,7	32,0	23,3	32,8	37,2
Share RES-H	[%]	40	57	69	41	63	80	40	55	69	40	62	80
Delta Share RES-H*	[%]	4	21	33	5	27	44	4	19	33	4	26	44
Avoided Fuel Costs*	[M€]	79	162	191	172	875	1191	78	142	173	170	844	1128
Reduction of GHG emissions*	[Mt]	0,2	0,6	0,8	0,2	0,9	1,4	0,2	0,5	0,7	0,2	0,9	1,3
Public Budget**	[M€]	113,3	132,4	123,3	118,3	159,4	157,1	0	-11,3	-12,6	0	-6,5	-5,8
Average Annual growth of RES-H	[GWh]	115			185			122			194		
*base year of the calculation is 2007													
**positive when money is spent (subsidies, tax incentives, RHI), negative when money is received (obligation)													

Table 6: Results of the quantitative policy assessment for buildings – Upper Austria

In 2007 Upper Austria had a share of 36% of RES-H in the buildings sector. The dominant RES-H technologies are biomass systems. However, as illustrated by Figure 4, solar thermal also plays a significant role, and has shown strong market growth in recent decades. In terms of installed m2 solar thermal collectors per capita, Upper Austria is among the leading regions in Europe. Upper Austria shows a strong political will to increase this success story and has officially adopted a target of 100% RES-H up to 2030 (including district heating counting as "eco-heat"). Due to the fact that Upper Austria is a region within Austria, there are no NREAP values available.

The high price variants in both policy scenarios come close to this political target: Up to 2030 the share of renewable energy in the heating sector increases to 80%, when district heating is included it increases to 92%. This shows that even higher efforts are required as assumed in these scenarios, particularly in terms of the building renovation activities as well.

The scenarios show that a strong market growth of solar thermal energy, but also of heat pumps would be required to achieve this target. Biomass would have to expand, starting from a high level. The current use of biomass is strongly dominated by wood log systems, with a much stronger recent market dynamic in the case of wood pellets, wood chips heating systems and biomass district heating. Especially in the case of wood pellets, the scenarios show a strong market growth up to 2030, whereas wood log systems slowly decline (in particular in the low price variant).

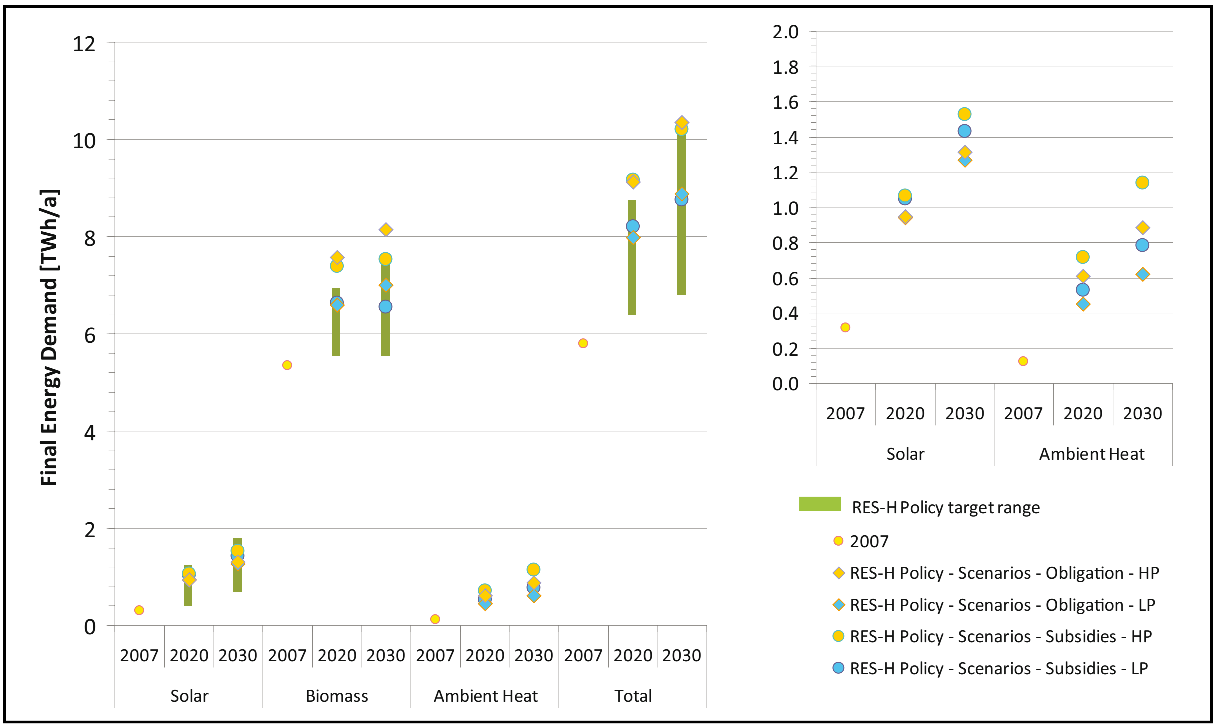

Figure 4: Historical data (2007), NREAP targets, INVERT scenario results and target ranges according to literature, bottom-up analysis and stakeholder dialogue for the buildings sector in Upper Austria (LP – low energy price scenario; HP – high energy price scenario)

The analysis of the public administration costs in the buildings sector clearly showed that the costs related to the administration of support programmes play a minor or even negligible role compared to the overall public budget required for the overall programme. In the case of the investment subsidies the public administration costs are estimated to increase until 2020 from 0.4 million EUR to 0.7 (low price scenario) respectively 0.9 million EUR (high price scenario). For the use obligation the public administration costs would be in a similar range.

No regional industry modelling has been performed for Upper Austria.

3.3.3 Greece

The modelling results of the Greek space heating and hot water demand in the buildings sector show that the support effects for RES-H in the case of the use obligation (policy set 2) are less affected by the energy carrier price developments than is the case with the tax incentives (policy set 2), see Table 7.

An interesting result of the simulation is the relatively high amount of revenues under the obligation policy compared to the other investigated countries. The reason for this is the existing support policy for gas heating systems, which leads to installations of gas technologies in many new buildings. New buildings must be installed with gas pipes and the VAT for gas is only 11% while for all the other energy carriers it is 23%. For that reason according to the modelling results, under use obligations, natural gas will be installed in a considerable share of new buildings but building owners have to pay the related penalties.

Assessment of selected policies for the building sector - Greece		Tax incentives						Use obligation					
		low price			high price			low price			high price		
		2010	2020	2030	2010	2020	2030	2010	2020	2030	2010	2020	2030
Total RES-H	[PJ]	37,6	35,7	31,4	37,8	55,6	81,2	38,7	43,7	55,7	39,4	55,6	82,4
Share RES-H	[%]	16	16	15	17	20	27	16	25	38	17	25	40
Delta Share RES-H*	[%]	0	0	-1	1	4	11	0	9	22	1	9	24
Avoided Fuel Costs*	[M€]	24	165	79	223	2212	4129	53	364	729	255	2479	5127
Reduction of GHG emissions*	[Mt]	0,0	0,0	-0,2	0,0	1,7	4,4	0,1	0,7	2,0	0,1	1,8	5,1
Public Budget**	[M€]	31,9	80,8	82,8	47,1	371,1	441,1	0,0	-145,3	-242,4	0,0	-44,7	-55,9
Average Annual growth of RES-H	[GWh]	-86			604			236			597		
*base A64year of the calculation is 2007													
**positive when money is spent (subsidies, tax incentives, RHI), negative when money is recieved (obligation)													

Table 7: Results of the quantitative policy assessment for buildings - Greece

The simulation results suggest that the NREAP targets cannot be reached with the simulated policies (see Figure 5); however a combination of both policies would lead to higher RES-H market shares.

Besides dominating biomass systems solar thermal systems have an important contribution in the Greek RES-H market and will most probably gain higher relevance for the future development. Tax incentives as well as a use obligation lead to remarkable growth rates in the simulations overshooting the indicative NREAP target for solar thermal in all scenarios.

While therefore the indicative NREAP target for solar thermal systems doesn't seem very ambitious, the opposite is the case for ambient energy. Although an effective stimulation of the market for heat pumps can be developed by the proposed policies in the simulations, the NREAP target is only reached in one scenario and not in 2020 but in 2030.

Biomass is currently the most important RES-H source, mainly wood log fired in outdated single stoves. According to the simulation results the policies currently under discussion do not provide enough incentive for new modern biomass boilers.

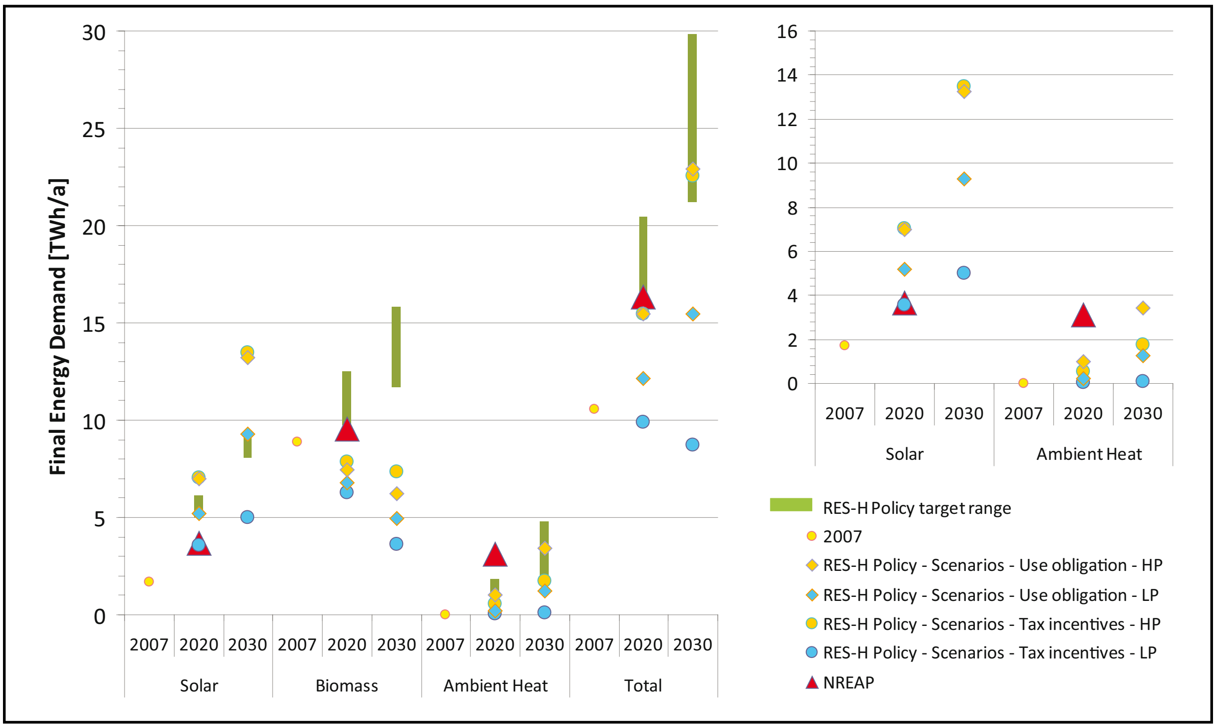

Figure 5: Historical data (2007), NREAP targets, INVERT scenario results and target ranges according to literature, bottom-up analysis and stakeholder dialogue for the buildings sector in Greece (LP – low energy price scenario; HP – high energy price scenario)

For administering the analysed tax break scheme in the buildings sector the state will incur public administration costs in the range of 0.4 and 0.9 million EUR per year. This is less than 1% of the budget required to run the scheme (support equivalent of the tax incentive). Under a use obligation the public administration costs are estimated to be higher, increasing from approx. 1.4 million EUR in 2010 to approx. 4 million EUR in 2030. The reason for the considerable higher cost assumptions is the anticipated considerable higher administrative effort associated with the system (e.g. higher control depth including on-site random inspections to verify compliance).

In the industry sector the assumed potentials for solar thermal energy and deep geothermal energy are small. Solar thermal potential is assumed to be 3.0 PJ in 2020 and 4.6 PJ in 2030, while deep geothermal was assumed to be even smaller (0.4 PJ in 2030). For solar thermal it can be seen in Table 8 that in the 'no policy' scenario as well as in the investment grant scenario (25% subsidised) the potential is almost fulfilled in the high price variant while the low price variant has a minor to small penetration only. The small potential for deep geothermal is not being exploited at all, even in the subsidised case (25% subsidy).

For biomass the potential was defined as 32 PJ, which is indeed fully met as a result of high conventional fuel prices or as a result of the investment subsidy (25% of the investment is assumed to be covered). Almost all contribution for the biomass technologies is expected to come from wood.

As the effect of the reference fuel prices is a very important factor it is suggested that any support measure for renewables is connected to the fuel price development. The support level for deep geothermal in Greece may have to be increased to levels above 25% of the investment costs for application in industry.

Assessment of selected policies for the industry sector - Greece		No policy						Investment grant					
		low price			high price			low price			High price		
		2010	2020	2030	2010	2020	2030	2010	2020	2030	2010	2020	2030
Solar thermal	[PJ]	0,0	0,0	0,3	0,0	1,4	4,1	0,0	0,1	1,0	0,1	2,5	4,5
Geothermal	[PJ]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Biomass	[PJ]	10,8	17,9	25,6	15,7	23,7	31,7	13,6	21,7	30,1	16,1	23,7	31,8
of which from waste	[PJ]	0,1	0,1	0,1	0,2	0,2	0,3	0,1	0,1	0,2	0,3	0,2	0,3
of which from wood	[PJ]	10,7	17,8	25,5	15,5	23,5	31,4	13,5	21,5	29,9	15,8	23,5	31,5
Total renewable	[PJ]	10,8	17,9	25,9	15,8	25,1	35,8	13,6	21,8	31,1	16,2	26,2	36,3
Share RES-H	[%]	8%	12%	18%	12%	17%	24%	10%	15%	21%	12%	18%	25%
Delta Share RES-H*	[%]	0%	4%	10%	4%	9%	16%	2%	7%	13%	4%	10%	17%
Avoided Fuel Costs	[M€]	191	323	479	191	323	479	240	391	573	338	917	1431
Reduction of GHG-emissions	[Mt]	0,7	1,2	1,8	0,7	1,2	1,8	0,9	1,5	2,1	1,1	1,7	2,4
Public Budget	[M€]	0	0	0	0	0	0	207	359	546	300	541	730
Average annual growth of RES-H**	[GWh]	0			0			0			0		
** Compared to 'low price' variant in the year 2010*													
*** Average calculated for the period 2010 - 2030 relative to 'low price' variant in the year 2010*													

Table 8: Results of the quantitative policy assessment for industry - Greece

3.3.4 Lithuania

The results of the simulations of the Lithuanian heating market for buildings show the very important influence of energy carrier price developments on RES-H deployment rates, while the application of subsidies (policy set 1 and 2) results in comparably low effects (see Table 9).

Assessment of selected policies for the building sector - Lithuania		Subsidies high						Subsidies low					
		low price			high price			low price			high price		
		2010	2020	2030	2010	2020	2030	2010	2020	2030	2010	2020	2030
Total RES-H	[PJ]	28,8	27,7	23,4	28,8	38,0	45,0	28,8	25,2	19,0	28,8	37,0	43,7
Share RES-H	[%]	48	40	30	48	63	80	48	44	36	48	65	84
Delta Share RES-H*	[%]	4	-4	-14	4	19	36	4	0	-8	4	21	40
Avoided Fuel Costs*	[M€]	34	14	102	79	250	429	34	10	95	80	260	453
Reduction of GHG emissions*	[Mt]	0,1	-0,3	-0,7	0,1	0,4	0,6	0,1	-0,2	-0,6	0,1	0,4	0,7
Public Budget**	[M€]	0	0	0	0	0	0	0	15,5	10,7	0	49,2	50,6
Average Annual growth of RES-H	[GWh]	-179			178			-135			206		
*base year of the calculation is 2007													
**positive when money is spent (subsidies, tax incentives, RHI), negative when money is received (obligation)													

Table 9: Results of the quantitative policy assessment for buildings - Lithuania

As illustrated by Figure 6 the current heat market for buildings in Lithuania is strongly dominated by two heating systems: District heating (gas-fired as well as biomass-fired) and decentralised biomass heating systems. Therefore the current RES-H share of 44% is high compared to other countries.

The availability of cheap new wood log boilers in combination with unfavourable climatic conditions will probably lead to solar and ambient energy having a slow market entry.

For biomass, further development will mainly depend on two questions:

(1) To what extent will new, innovative (and low-emission) biomass boilers replace existing systems?

(2) Will biomass play an increasing role in the supply of district heating?

Therewith, the competition of biomass heating plants and biomass CHP with gas-fired CHP will be a crucial aspect, and explains the high dependency of RES-H shares on the energy price developments.

NREAP targets and the RES-H policy targets for solar thermal systems and heat pumps can be considered quite ambitious, while for biomass the NREAP targets are somewhat lower than the derived target range in the project and closer to the low price scenarios as to the high price ones.

Figure 6: Historical data (2007), NREAP targets, INVERT scenario results and target ranges according to literature, bottom-up analysis and stakeholder dialogue for the buildings sector in Lithuania (LP – low energy price scenario; HP – high energy price scenario)

For managing the analysed low subsidy scheme (policy set 2) in the buildings sector public administration costs in the range of 0.5-0.8 million EUR are estimated. This is very low compared to the budget requirement to run the scheme (subsidy volume and support equivalent of the tax incentive).

Table 10 presents the model outcomes for the 'no policy' scenario and the '25% investment subsidy' scenario for RES-H technologies for the industry sector in Lithuania. The investment subsidy has a significant impact in the low price scenario, but in the high price scenario the 'no policy' penetration is already very close to the maximum potential, which leaves only a little room for additional renewable heat.

The most important contribution can be expected from biomass: more specifically heat-only biomass boilers and CHP plants, fueled by wood and waste streams make comparable contributions. For deep geothermal direct heat use there is no potential perceived for industry. One region in Lithuania has geological properties that would suit the use of deep geothermal energy, but this region lacks any industrial activity whatsoever and transferring industrial activity towards this region for exploiting the deep geothermal heat is not considered realistic. Due to climate conditions the potential for solar thermal energy is not regarded as relevant for industry.

As the effect of the reference fuel prices is a very important factor it is suggested that any support measure for biomass is connected to the fuel price development in order to reduce the free riding effect.

Assessment of selected policies for the industry sector - Lithuania		No policy						Investment grant					
		low price			high price			low price			High price		
		2010	2020	2030	2010	2020	2030	2010	2020	2030	2010	2020	2030
Solar thermal	[PJ]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Geothermal	[PJ]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Biomass	[PJ]	0,4	0,7	0,9	2,0	3,4	4,2	0,6	1,1	1,4	2,2	3,6	4,4
of which from waste	[PJ]	0,2	0,4	0,5	0,9	1,7	2,1	0,4	0,8	1,0	1,0	2,0	2,4
of which from wood	[PJ]	0,2	0,3	0,4	1,1	1,6	2,0	0,2	0,3	0,4	1,2	1,6	2,1
Total renewable	[PJ]	0,4	0,7	0,9	2,0	3,4	4,2	0,6	1,1	1,4	2,2	3,6	4,4
Share RES-H	[%]	2%	2%	2%	7%	9%	9%	2%	3%	3%	8%	10%	10%
Delta Share RES-H*	[%]	0%	0%	0%	6%	8%	8%	1%	1%	1%	7%	9%	8%
Avoided Fuel Costs	[M€]	6	10	13	23	60	85	8	13	16	25	63	89
Reduction of GHG-emissions	[Mt]	0,0	0,1	0,1	0,1	0,2	0,3	0,0	0,1	0,1	0,1	0,2	0,3
Public Budget	[M€]	0	0	0	0	0	0	4	6	8	12	27	34
Average annual growth of RES-H**	[GWh]		6			52			14			56	

** Compared to 'low price' variant in the year 2010*

*** Average calculated for the period 2010 - 2030 relative to 'low price' variant in the year 2010*

Table 10: Results of the quantitative policy assessment for industry – Lithuania

3.3.5 The Netherlands

For the Dutch buildings sector two policy measures have been evaluated by means of modelling activities. As a first observation it should be noted that conventional fuel price assumptions have a very important influence on the competitiveness of the RES-H technologies and thus strongly impact the modelling results. In the high price scenario a very high penetration of RES-H occurs in the case of 'no policy', which even overshoots the amount defined as a realisable target. Therefore no further policy was simulated for the high price case (see Table 11).

Under low price development conditions a subsidy scheme and a combination of a subsidy and a use obligation were simulated. Both policy sets result in comparable realisation in terms of renewable energy penetration in the longer term. The avoided fuel costs are considerable in the case of both policy measures, but are slightly higher in the case of the renewable obligation, which is also valid for the avoided CO_2 emissions. Similarly, the policy costs are comparable, but as a result of the penalty accompanying the obligation a significant 'benefit' is attributed to the government. This means that the government expenses in the case of the renewable obligation are lower than for the subsidy regime, which may result in the obligation being preferable to the subsidy for the buildings sector.

Assessment of selected policies for the building sector - Netherlands		Low price						High Price		
		Subsidies (Subs)			Subs + Obligation			no policy		
		2010	2020	2030	2010	2020	2030	2010	2020	2030
Total RES-H	[PJ]	20,9	33,2	51,9	23,1	39,4	64,9	21,2	53,6	105,0
Share RES-H	[%]	4	7	11	4	8	14	4	11	23
Delta Share RES-H*	[%]	0	3	7	0	4	10	0	7	19
Avoided Fuel Costs*	[M€]	87	551	1246	160	801	1768	175	3280	8602
Reduction of GHG emissions*	[Mt]	0,0	0,8	2,0	0,2	1,2	2,8	0,1	2,2	5,9
Public Budget**	[M€]	19,9	327,5	391,0	48,5	177,9	142,4	0	0	0
Average Annual growth of RES-H	[GWh]	431			580			1164		
*base year of the calculation is 2007 **positive when money is spent (subsidies, tax incentives, RHI), negative when money is received (obligation)										

Table 11: Results of the quantitative policy assessment for buildings - Netherlands

The Netherlands begins with a low amount of RES-H (about 4% in 2007). Currently, the main share of RES-H is covered by biomass with a small amount of ambient heat. All scenarios show a considerable growth of ambient heat, partly used by heat pumps and partly by combined natural gas-boilers and heat pumps (see Figure 7).

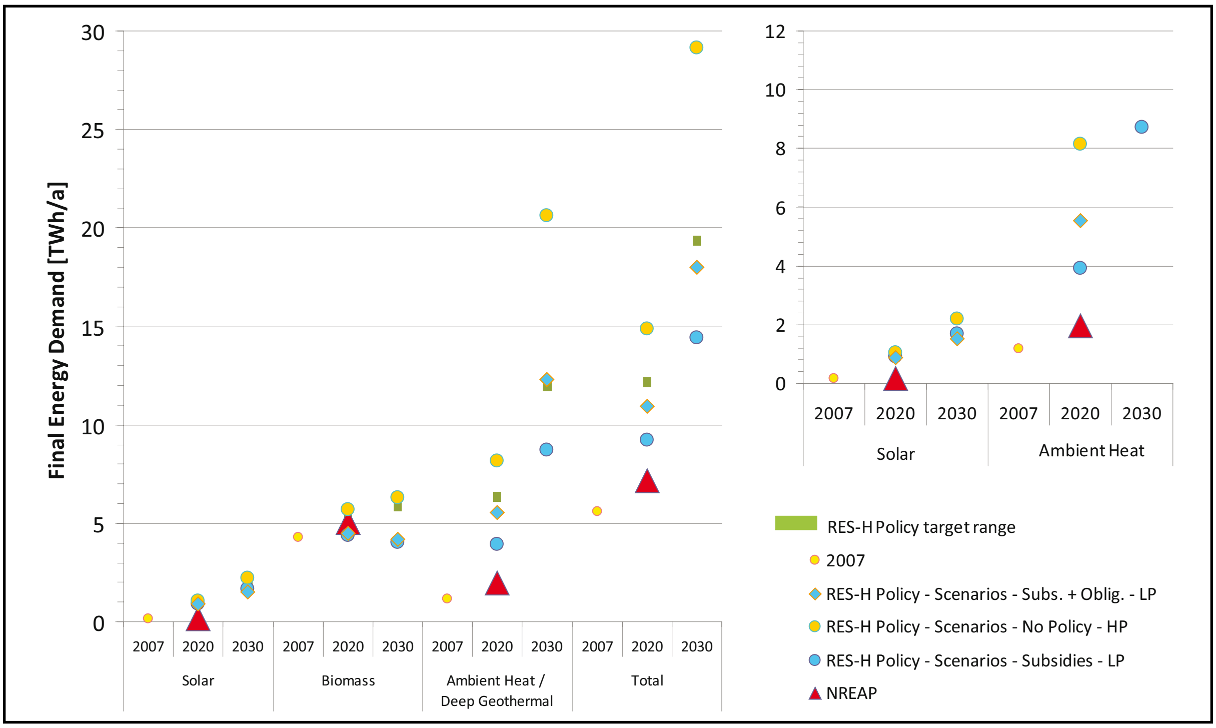

Figure 7: Historical data (2007), NREAP targets, INVERT scenario results and target ranges according to literature, bottom-up analysis and stakeholder dialogue for the buildings sector in the Netherlands (LP – low energy price scenario; HP – high energy price scenario)

For the Netherlands it appeared to be difficult and sensitive to make quantitative statements on public administration costs. Indicatively, qualitative cost levels have been estimated for the assessed support policies. A distinction was made between fixed costs (costs made for the support scheme as such and not related to the number of applications) and variable costs (costs that increase when the number of applicants rise).

	Public administration costs per installation
Investment subsidies	Average
Energy performance standard in the built environment	Zero
Obligations for new constructions and large-scale renovations	Low

In industry the effect of subsidies (investment grants of 25% for all technologies) is considerable in the low price scenario (for 2030 from 6.5 PJ to 10.5 PJ for the low price variant, and from 13.9 PJ to 15.2 PJ in the high price variant, see Table 12). In the latter variant the high fuel prices already result in high penetrations, and an investment subsidy can only in a limited way increase the penetration. It can be concluded that the added value of the investment subsidy is higher in the low price scenario. In the high price variant the subsidy makes non-biomass technologies penetrate, notably deep geothermal.

Moreover a bonus support system has been modeled for the Dutch industry sector, where the bonus system was assumed to be comparable to its design in the UK. Compared to the investment grant system, the bonus system results in considerable additional penetration, notably of solar thermal and deep geothermal, which were not developed in any other low price simulation variant at comparable policy costs.

It may be concluded that first of all conventional fuel price development is to be considered in support measure design, and secondly that technology-specific policy might be worthwhile: bonus or (high) investment subsidies for deep geothermal and solar thermal, and no policy or other types of policy measures for biomass technologies.

Assessment of selected policies for the industry sector - Netherlands		No policy						Grant			Bonus		
		low price			high price			low price			low price		
		2010	2020	2030	2010	2020	2030	2010	2020	2030	2010	2020	2030
Solar thermal	[PJ]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,8
Geothermal	[PJ]	0,0	0,0	0,0	0,1	0,4	0,9	0,0	0,0	0,1	0,2	0,4	1,0
Biomass	[PJ]	2,3	4,7	6,5	6,2	9,3	13,0	3,8	7,1	10,4	7,0	9,7	13,4
of which from waste	[PJ]	0,9	2,2	1,6	1,7	3,3	2,1	1,4	3,0	2,0	1,8	3,4	2,2
of which from wood	[PJ]	1,5	2,4	4,9	4,5	6,0	10,9	2,4	4,1	8,4	5,2	6,3	11,2
Total renewable	[PJ]	2,4	4,7	6,5	6,3	9,7	13,9	3,8	7,1	10,5	7,2	10,3	15,2
Share RES-H	[%]	0,4%	0,7%	1,0%	1,1%	1,5%	2,2%	0,7%	1,1%	1,6%	1,2%	1,6%	2,3%
Delta Share RES-H*	[%]	0,0%	0,3%	0,6%	0,7%	1,1%	1,7%	0,3%	0,7%	1,2%	0,8%	1,2%	1,9%
Avoided Fuel Costs	[M€]	24	47	68	78	222	362	39	72	109	69	99	150
Reduction of GHG-emissions	[Mt]	0,1	0,3	0,4	0,4	0,6	0,8	0,2	0,4	0,6	0,4	0,6	0,9
Public Budget	[M€]	0	0	0	0	0	0	72	145	252	101	156	255
Average annual growth of RES-H**	[GWh]	58			161			113			178		
** Compared to 'low price' variant in the year 2010*													
*** Average calculated for the period 2010 - 2030 relative to 'low price' variant in the year 2010*													

Table 12: Results of the quantitative policy assessment for industry - Netherlands

3.3.6 Poland

Looking at the results of the scenarios for the heating and hot water energy demand in the Polish buildings sector, use obligations (policy set 2) for RES-H show a stronger effect on the RES-H development than subsidising RES-H technologies financially (policy set 1). Thus, the impact of new buildings and those undergoing major renovation is enough to provide an ambitious increase in RES-H installations (see Table 13).

In all evaluated scenarios remarkable growth of RES-H capacities and effects on GHG-emissions reduction and avoided fuel costs can be achieved. Comparing the simulated effects with the targets in the NREAP, which are quite ambitious, a combination of both policies seems to be promising.

Assessment of selected policies for the building sector - Poland		Subsidies						Use obligation					
		low price			high price			low price			high price		
		2010	2020	2030	2010	2020	2030	2010	2020	2030	2010	2020	2030
Total RES-H	[PJ]	118,0	152,8	175,1	120,1	195,7	261,9	115,9	163,3	202,5	117,2	202,4	288,4
Share RES-H	[%]	14	21	28	14	27	40	14	23	33	14	28	46
Delta Share RES-H*	[%]	1	8	15	1	14	27	1	10	20	1	15	33
Avoided Fuel Costs*	[M€]	16	219	593	169	1360	1418	8	169	666	156	1770	3150
Reduction of GHG emissions*	[Mt]	0,5	2,7	3,8	0,7	6,7	13,4	0,4	3,3	5,0	0,5	6,5	12,6
Public Budget**	[M€]	239,1	261,4	230,7	290,2	501,0	482,2	0,0	-18,6	-20,7	0,0	-8,0	-9,7
Average Annual growth of RES-H	[GWh]	793			1970			1203			2378		
*base year of the calculation is 2007 **positive when money is spent (subsidies, tax incentives, RHI), negative when money is received (obligation)													

Table 13: Results of the quantitative policy assessment for buildings - Poland

As illustrated by Figure 8 the current market for RES-H in buildings in Poland shows a strong dominance of biomass systems, while the use of solar thermal systems and heat pumps is currently nearly negligible. Nevertheless the simulation results promise significant growth potential of solar and ambient energy up to 2020 and 2030.

Currently wood log is the main biomass energy carrier but is expected to decrease in the coming decades, mostly due to comfort and efficiency reasons. The simulations show a promising potential for modern biomass boilers using pellets and wood chips and in particular a large potential for biomass in district heating grids displacing fossil fuels, district heating accounts for about 25% of the current heating market (for buildings).

The RES-H targets stated in the NREAP for biomass, solar thermal and ambient energy are not reached in the simulations of the proposed policies, even though all technologies can probably expect large capacity increases. The main reasons are the high ambitiousness of the stated targets, especially in the case of solar thermal systems on the one hand, the high barriers for developing a new market and too low incentives in the simulated scenarios. In particular, a combination of subsidies and use obligations could lead to more effective and efficient policies.

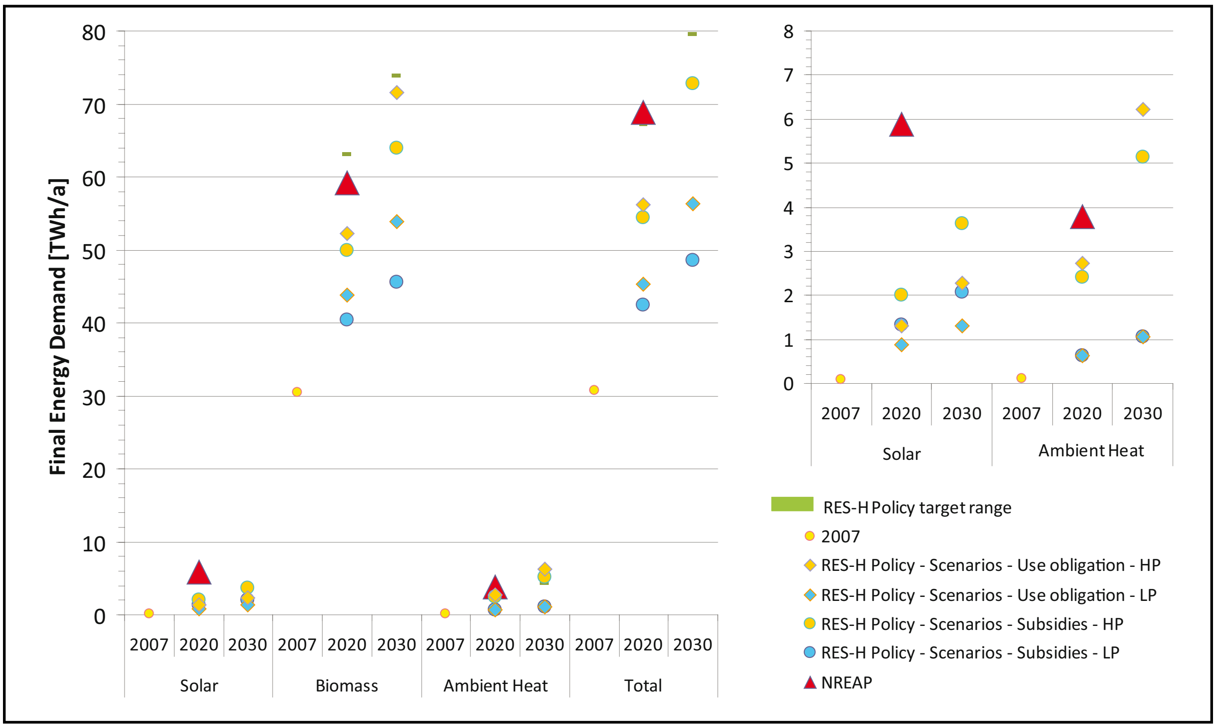

Figure 8: Historical data (2007), NREAP targets, INVERT scenario results and target ranges according to literature, bottom-up analysis and stakeholder dialogue for the buildings sector in Poland (LP – low energy price scenario; HP – high energy price scenario)

For administering the analysed subsidy scheme in the buildings sector the state will incur public administration costs in the range of 0.5 and 3.5 million EUR per year, which will peak in the years 2010-2015. The large variation is driven by the anticipated development of the number of applications to the scheme. In the case of the use obligation the public administration costs are estimated to vary between 1.2 and 2.5 million EUR.

As illustrated by Table 14 for the Polish industry sector the simulation results show zero penetration of solar thermal and deep geothermal energy, although potentials have been defined as non-zero (0.6 PJ for solar thermal and 7.0 PJ for deep geothermal in the year 2030). Given the absence of the impact of fuel price assumptions for both technologies, a subsidy scheme, notably for overcoming the investment hurdle, would seem appropriate. What is noteworthy in the case of Poland is the very high potential of biomass (mostly waste streams) by the year 2030 in the high price variant. In the industry sector simulations have concentrated on the effect of biomass prices in renewables penetrations: a doubling of the assumed biomass prices resulted in a decrease of the amount of biomass.

Assessment of selected policies for the industry sector - Poland		No policy						Double biomass prices					
		low price			high price			low price			High price		
		2010	2020	2030	2010	2020	2030	2010	2020	2030	2010	2020	2030
Solar thermal	[PJ]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Geothermal	[PJ]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Biomass	[PJ]	19,9	36,2	41,8	37,1	87,5	105,7	16,4	29,5	32,8	29,4	67,9	87,4
of which from waste	[PJ]	14,7	32,2	38,8	29,7	80,9	100,8	12,2	26,3	30,4	22,9	62,6	83,3
of which from wood	[PJ]	5,2	4,1	3,0	7,4	6,6	4,9	4,2	3,3	2,4	6,5	5,3	4,1
Total renewable	[PJ]	19,9	36,2	41,8	37,1	87,5	105,7	16,4	29,5	32,8	29,4	67,9	87,4
Share RES-H	[%]	4%	6%	6%	7%	14%	16%	3%	5%	5%	5%	11%	13%
Delta Share RES-H*	[%]	0%	2%	3%	3%	11%	12%	-1%	1%	1%	2%	8%	10%
Avoided Fuel Costs	[M€]	204	421	481	419	1485	1829	204	421	481	362	1392	1750
Reduction of GHG-emissions	[Mt]	1,3	2,5	2,9	2,5	6,6	8,2	1,3	2,5	2,9	1,9	4,9	6,5
Public Budget	[M€]	0	0	0	0	0	0	0	0	0	0	0	0
Average annual growth of RES-H**	[GWh]	304			1192			179			937		
** Compared to 'low price' variant in the year 2010*													
*** Average calculated for the period 2010 - 2030 relative to 'low price' variant in the year 2010*													

Table 14: Results of the quantitative policy assessment for industry - Poland

3.3.5 United Kingdom

The case of the UK shows that ambitious policy instruments could lead to significant market stimulation and corresponding growth of RES-H. As illustrated by Figure 9 in the starting year (2007), the share of RES-H in the buildings sector is below 1%, mainly as a result of a relatively small number of biomass heating systems. However, corresponding to the overall RES targets, the government has developed the support instrument of Renewable Heat Incentive (RHI) along similar lines as the feed-in-tariffs for RES-E. The simulation runs show that the highly attractive support levels could lead to significant market growth, higher than in all other countries investigated within the scope of this project. This would result in a RES-H share of 10% - 27% until 2030, particularly in the case of combining the RHI with the supplier obligation (policy set 2), see Table 15.

As the RHI is paid for the whole lifetime of the technologies, support levels increase remarkably over time: in the high price scenarios costs rise to EUR 8.2 billion in 2030. But apart from the low price combination scenario the avoided fuel costs are higher than the public spending in all other scenarios. This is also the case with all scenarios in the other countries under analysis in this project.

Such high growth rates require substantial and fast development of skilled staff and know-how. High quality equipment has to be made available at an acceptable cost. Therefore, corresponding activities like training, awareness raising, ensuring quality of equipment etc. are crucial for the success of such a programme, especially in the case of very fast progress.

According to these scenario simulations high growth rates of all technologies (solar thermal, biomass, heat pumps) could be expected. The scenarios do not provide evidence for the high penetration of heat pumps foreseen in the NREAP.

Assessment of selected policies for the building sector - United Kingdom		Renewable Heat Incentive (RHI)						RHI + Supplier obligation					
		low price			high price			low price			high price		
		2010	2020	2030	2010	2020	2030	2010	2020	2030	2010	2020	2030
Total RES-H	[PJ]	15,3	101,6	152,0	15,5	177,9	312,3	29,7	236,4	352,8	30,4	217,1	398,9
Share RES-H	[%]	1	6	10	1	10	21	2	14	24	2	13	27
Delta Share RES-H*	[%]	0	5	9	0	9	20	1	13	23	1	12	26
Avoided Fuel Costs*	[M€]	1103	3396	3527	1409	12316	19802	1364	4176	5331	1750	15506	25294
Reduction of GHG emissions*	[Mt]	0,0	6,4	10,6	0,0	11,7	22,3	1,1	15,1	27,2	1,1	15,4	30,5
Public Budget**	[M€]	0,0	2644,3	3427,0	0,0	4131,1	6346,2	0,0	4802,7	5822,5	0,0	4946,0	8179,7
Average Annual growth of RES-H	[GWh]	1899			4123			4488			5118		
*base year of the calculation is 2007													
**positive when money is spent (subsidies, tax incentives, RHI), negative when money is received (obligation)													

Table 15: Results of the quantitative policy assessment for buildings – United Kingdom

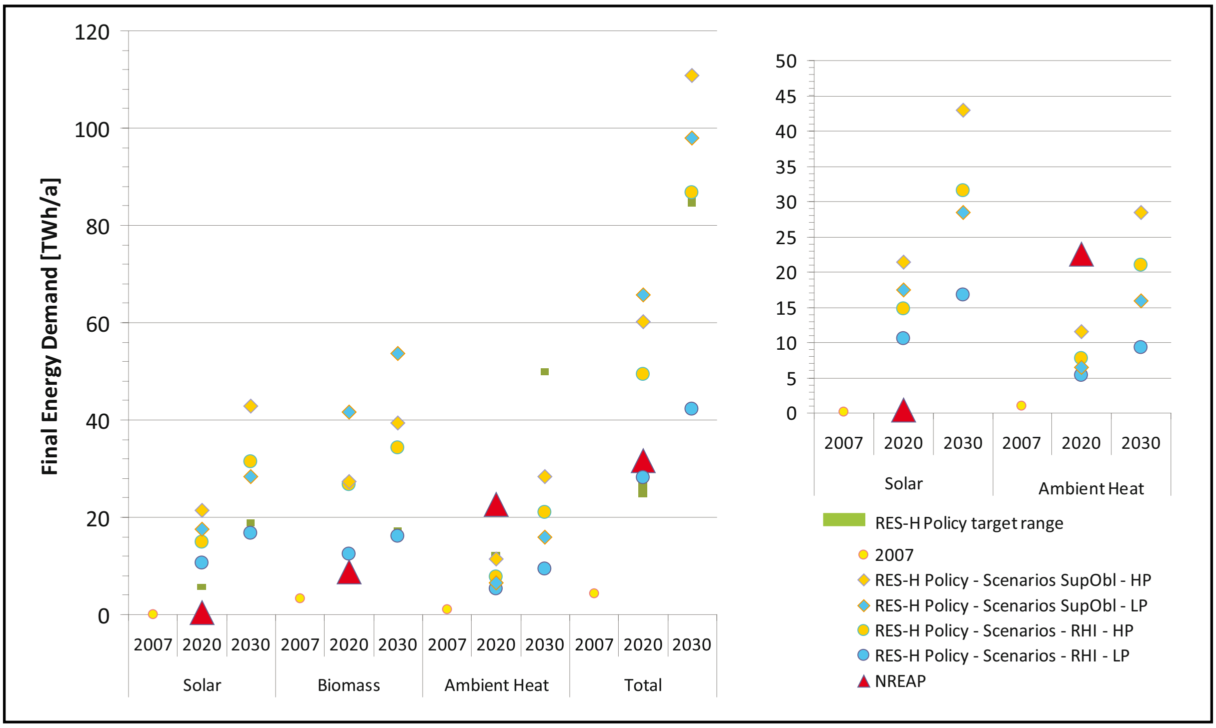

Figure 9: Historical data (2007), NREAP targets, INVERT scenario results and target ranges according to literature, bottom-up analysis and stakeholder dialogue for the buildings sector in the UK (LP – low energy price scenario; HP – high energy price scenario)

Public administration costs for administering the RHI in the buildings sector are estimated to be in the range of 3 and 5 million GBP (Great British Pounds) in 2011 gradually increasing to 5-10 million GBP/a until 2030. The models suggest that over time public administration costs decline significantly as a fraction of total RHI costs. Starting from 2011 public administration costs dip from around 0.75-0.80% of total RHI costs to a point where they account for only 0.15% of total RHI costs by 2030. This represents a huge comparative cost reduction and this level of transaction cost provides another justification of the RHI as a key mechanism for the support of RES-H in the UK. As would be expected, the public administration costs for the combination of RHI with the supplier obligation would be higher as a result of the compulsory element of that instrument combination. The latter would require additional checks of installations and performance, in line with auditing of the supplier obligation CERT (Carbon Emissions Reduction Target) as it is currently applied. In the whole period up to 2030 the estimated public administration costs would be in the range of 17-20 million GBP.

Regarding the industry sector modelling results for the UK suggest that the key determinant of deployment is likely to be the price of energy on world and national markets: the model suggests that a high energy price will tend to drive enough demand for RES-H that additional policy (either RHI or a grant system) make only a very limited difference to the volume of RES-H that is incentivised (see Table 16). This is notable as it means that the public funds going into the RHI may not represent value for money where energy prices are high. The model suggests the RHI will have more influence on industry uptake of RES-H in the lower price energy scenario, with about a third more RES-H being generated in the industry sector by 2020 where the RHI is introduced, and about 50% more energy coming from RES-H by 2030 with the RHI than without. This does suggest that it will be worthwhile for the government to regularly review the level of RHI subsidy made available to industry, with a view to curtailing any excess payments, particularly should energy prices rise towards the prices assumed in the high price scenario. Although the RHI is the preferred policy for the UK, the impact of an investment grant scheme has been modelled as well (25% investment subsidy). This resulted in comparable penetrations, but at higher public budget costs.

Assessment of selected policies for the industry sector - United Kingdom		No policy						Investment grant						Bonus					
		low price			high price			low price			High price			low price			High price		
		2010	2020	2030	2010	2020	2030	2010	2020	2030	2010	2020	2030	2010	2020	2030	2010	2020	2030
Solar thermal	[PJ]	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,0	0,3
Geothermal	[PJ]	0,3	0,8	1,7	2,1	4,5	9,1	0,6	1,6	3,2	2,2	4,5	9,1	2,1	4,3	8,8	2,3	4,7	9,4
Biomass	[PJ]	7,6	18,7	23,7	13,0	34,5	40,2	10,7	27,8	35,0	15,1	35,8	40,8	11,1	22,9	27,3	14,5	36,3	41,8
of which from waste	[PJ]	4,1	15,2	20,9	7,8	29,7	36,5	6,3	23,5	31,6	9,7	31,0	37,1	5,2	17,6	23,2	8,2	30,7	37,5
of which from wood	[PJ]	3,5	3,4	2,9	5,3	4,8	3,7	4,4	4,3	3,4	5,4	4,8	3,8	5,9	5,3	4,1	6,4	5,6	4,3
Total renewable	[PJ]	7,9	19,5	25,4	15,1	39,0	49,3	11,3	29,3	38,3	17,3	40,4	50,0	13,2	27,2	36,1	16,8	41,0	51,5
Share RES-H	[%]	1%	2%	2%	1%	3%	4%	1%	2%	3%	2%	3%	4%	1%	2%	3%	1%	3%	4%
Delta Share RES-H*	[%]	0%	1%	1%	1%	3%	3%	0%	2%	2%	1%	3%	3%	0%	2%	2%	1%	3%	4%
Avoided Fuel Costs	[M€]	0	246	330	0	1060	1513	0	366	487	0	1079	1521	0	320	441	0	1068	1531
Reduction of GHG-emissions	[Mt]	0,5	1,2	1,5	0,9	2,4	3,0	0,7	1,8	2,3	1,0	2,5	3,1	0,8	1,7	2,2	1,1	2,5	3,2
Public Budget	[M€]	0	0	0	0	0	0	312	1197	1768	667	1907	2346	95	180	232	101	187	248
Average annual growth of RES-H**	[GWh]	242			574			421			584			391			605		
** Compared to 'low price' variant in the year 2010*																			
*** Average calculated for the period 2010 - 2030 relative to 'low price' variant in the year 2010*																			

Table 16: Results of the quantitative policy assessment for industry – United Kingdom

Lessons from modelling renewable heat in process industry

In the RES-H Policy project modelling activities were performed to evaluate the penetration of renewable heat options and the possible impact of policy measures in process industry. Technologies considered in these activities are: biomass (both heat only and combined heat and power) for all temperature levels and deep geothermal and solar thermal, the latter technologies for temperature levels up to 200°C. The modelling activities have taken place for the six target countries in the project: Austria, Greece, Lithuania, the Netherlands, Poland and the United Kingdom. The most important lessons from the modelling are listed below:

- For all countries: fuel price is a decisive modelling input. At low conventional energy prices (almost) no (additional) penetration of renewable heat options occurs in process industry. As the effect of the reference fuel prices is a very important factor it is suggested that any support measure for renewables is connected to the fuel price development.

- Financial support measures improve the cost-benefit ratio and the financial attractiveness of renewable heat projects. Investment subsidies help industry overcoming their barrier towards investments, and from this perspective they are a defendable policy measure. Specifically for biomass technologies an investment subsidy will not be able to cover all heat production costs, since the fuel costs represent an important share in the heat costs. A drawback of the investment subsidy is that no guarantee is provided for continued renewable heat production: in the case the owner of the installation after having received the investment subsidy decides not to use biomass fuels, usually no penalty is given. An exploitation subsidy (bonus or feed-in tariff like the United Kingdom Renewable Heat Incentive, RHI) do provide such guarantees (provided that the payments are based on metering). Likewise, lower interest rates for financing investments in renewable heat result in more advantageous values of a project's internal rate of return, which thus supports industrial players in a positive investment decision. An advantage of supporting large industrial installations is that the administration costs for governments are lower compared to supporting small-scale installations (this effect has not been modelled explicitly). For deep geothermal and solar thermal, investment subsidies can be very suitable, especially due to the relatively low running costs of these technologies (no fuel costs). Sensitivity runs have shown that sometimes very high support levels are needed for making these options penetrate (more than 50%, depending on the fuel price scenario).

- Cheapest options penetrate first: biomass heat-only (especially if based on waste streams, which are assumed to be available at very low or even negative prices when costs for removal are avoided) good competitive strength occurs, but generally these fuel streams are very limited in potential.

- Most expensive options (solar thermal, geothermal) generally do not penetrate at low conventional energy prices.

- In some countries the potential for solar thermal energy in industry has been found to be very limited. Deep geothermal is slightly better positioned, but due to a mismatch in the availability of geothermal hot-spots and industrial activity the realisable potential still might be zero. Biomass potential in all countries is regarded as the most important option for process industry.

- Sensitivity analyses show that besides the impact of the level of conventional fuel prices, there is high uncertainty in the modelling output for the biomass price scenarios.

3.4 Employment effects

Employment and economic activity are important parameters for national governments. This is why assessing the expansion of RES-H/C in terms of the effect on employment forms an essential part of a quantitative analysis. For each of the target countries the gross employment effect (expressed in full-time equivalents (fte)) was estimated for the two RES-H/C diffusion developments linked to the two different policy sets. These calculations have been carried out for the buildings sector only.

3.4.1 Methodology

The estimation was based on data about investments and expenditures associated to the policy induced RES-H deployment. These data result from the model runs with INVERT (see above) and was multiplied with technology-specific employment coefficients that were taken from the EmployRES project.[12]

The gross employment effects of RES-H/C result from the economic impact of the renewable heating industry and the industries indirectly depending on it. The latter are mainly suppliers of inputs needed in the production process or of capital goods as well as of inputs for the supply chain of biomass. In this gross perspective, negative employment effects – e.g. in industries linked to conventional energy generation or in the overall economy due to the budget effect induced by higher costs of RES – are not included.

In the EmployRES project, calculations of gross employment effects are based on the annual turnovers deriving from enhanced RES market penetration. The study combines different models – including two macroeconomic models (Astra, Nemesis), a RES sector model (GREEN-X) and an input-output (IO) model (MULTIREG) – in order to determine the economic and technological impacts of RES expansion (Figure 10). The IO model MULTIREG is used to calculate the current value added of RES activities and the employment effects. The technology classification and the cost structures of RES technologies are based on the GREEN-X database. The Green-X model delivers scenarios for the future development of RES activities and their corresponding expenditures and investments. This output data then serves as the input for the macroeconomic models, which determine the economic effects. This modelling step is performed by two real-world macro models – NEMESIS and ASTRA.

12 "EmployRES: The impact of renewable energy policy on economic growth and employment in the European Union" carried out by Fraunhofer ISI, Ecofys, Energy Economics Group, Rütter + Partner Socioeconomic Research + Consulting, Lithuanian Energy Institute and Société Européenne d'Économie. on behalf of Directorate-General for Energy and Transport of the European Commission

With the input-output model, a demand-side approach is used, which subdivides expenditures for renewable energy use into the cost components investments, operation maintenance and fuel expenditures and allocates them to economic activities. The resulting production vectors for each RES technology, differentiated by country and by economic sector, form the basis for calculating the direct gross value added and thus the direct employment effects. The indirect economic effects are determined by incorporating the RES production vectors as additional final demand in the input-output model.

Therefore, technology-specific as well as country-specific employment coefficients are derived from the EmployRES results for each cost component – investments, operations maintenance and fuel expenditures. The coefficients express the ratio of employment in full-time equivalents (fte) to value added (million euro) for each RES-H reference technology. The total gross employment effects are calculated by multiplying the coefficients by the corresponding drivers taken from the INVERT model for the respective policy scenarios. Therewith, the employment effects induced by the RES expansion in the different policy scenarios of the target countries can be estimated.

For a detailed description of the scenarios and the methodology used in the EmployRES project, please refer to Ragwitz et al. (2009).

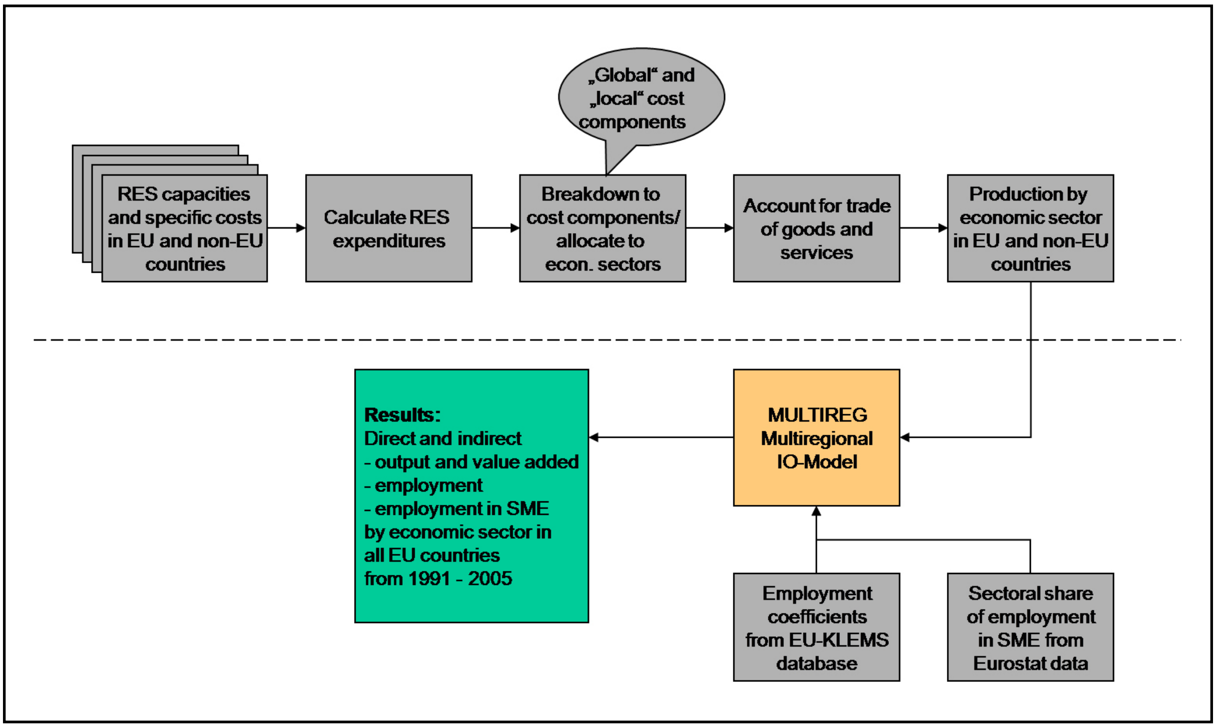

Figure 10: Overview of the modelling steps taken in the EmployRES project

3.4.2 Results

The following figures show resulting annual employment effects for each target country. In accordance with the INVERT scenarios, two different policy sets in combination with two different energy price scenarios have been calculated.[13]

Since the specific employment coefficients account for future change in productivity, overall employment effects show a general tendency to decrease in the future; even if there is a further expansion of RES-H, an effect, which is particularly relevant for the new Member States. The results also show a significant difference between the high and the low price scenario. On the one hand, this is due to the respective RES-H expansion according to the INVERT results – higher fuel prices increase the economic efficiency of RES technologies. On the other hand, the applied methodology results in higher specific employment effects induced by biomass fired technologies in the case of higher biomass prices. Since employment effects are linked to cost components, higher energy prices (including higher biomass prices) lead to more fuel costs and thus to higher employment effects in the calculation. However, higher prices due to higher demand cannot be fully transformed into more activity but also to higher margins for biomass producers/sellers. Hence, employment effects of biomass are likely to be overestimated in the high price scenario and underestimated in the low price scenario.

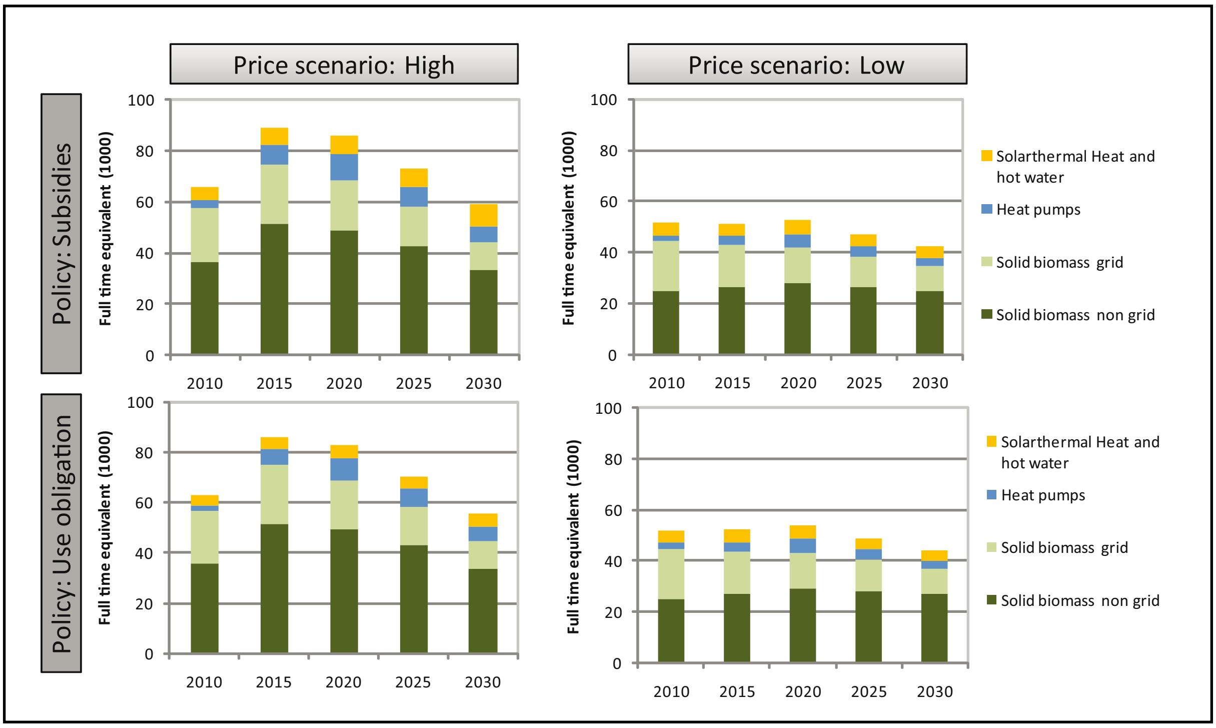

Figure 11: Annual gross employment effects for Austria

13 The results of this working step can be found in the corresponding RES-H Policy Reports (D13).

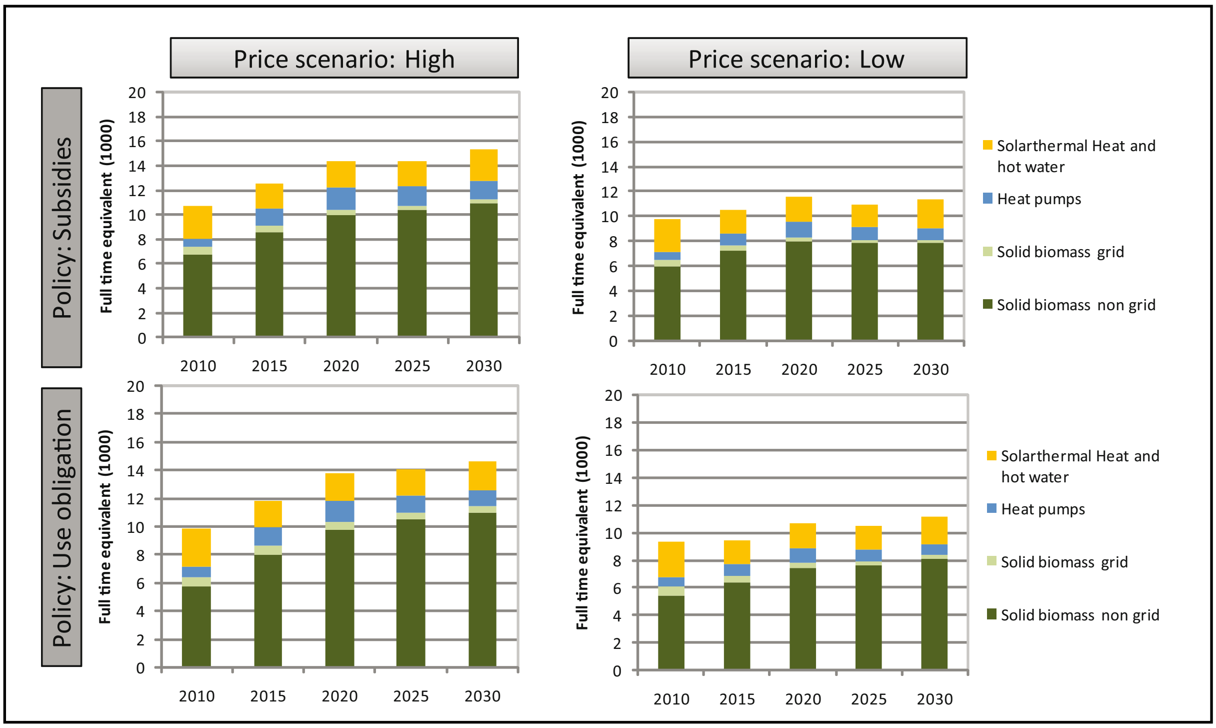

Figure 12: Annual gross employment effects for Upper Austria

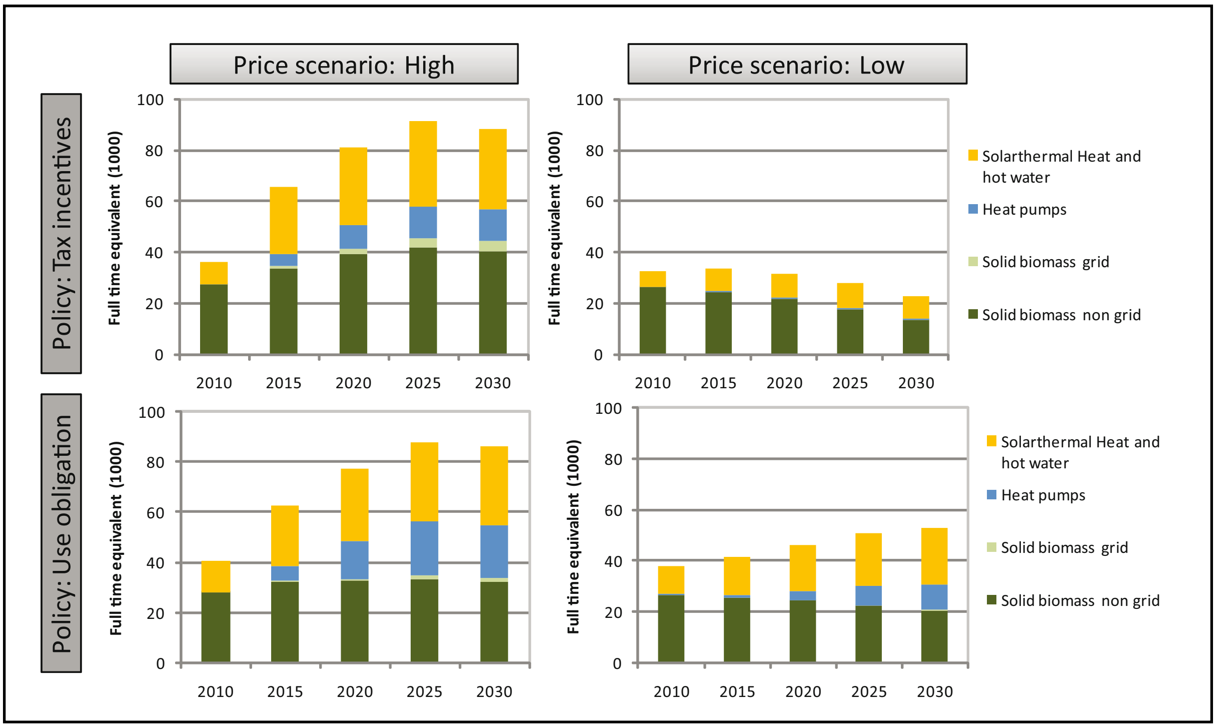

Figure 13: Annual gross employment effects for Greece

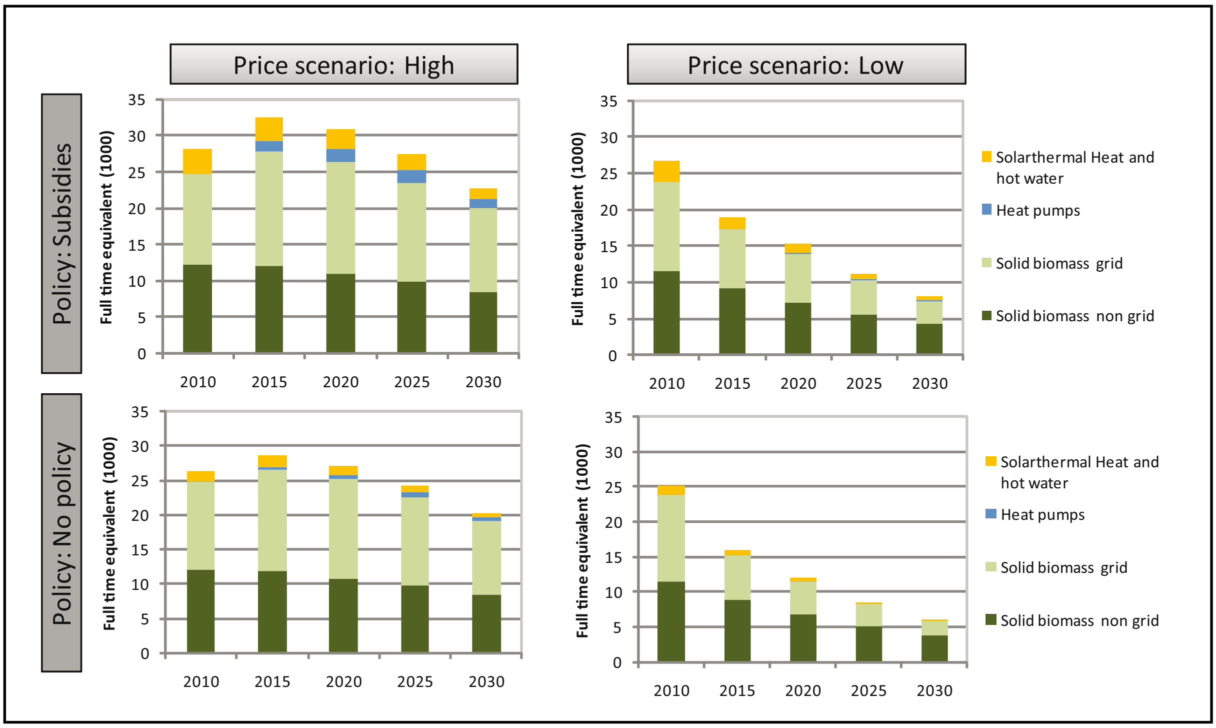

Figure 14: Annual gross employment effects for Lithuania

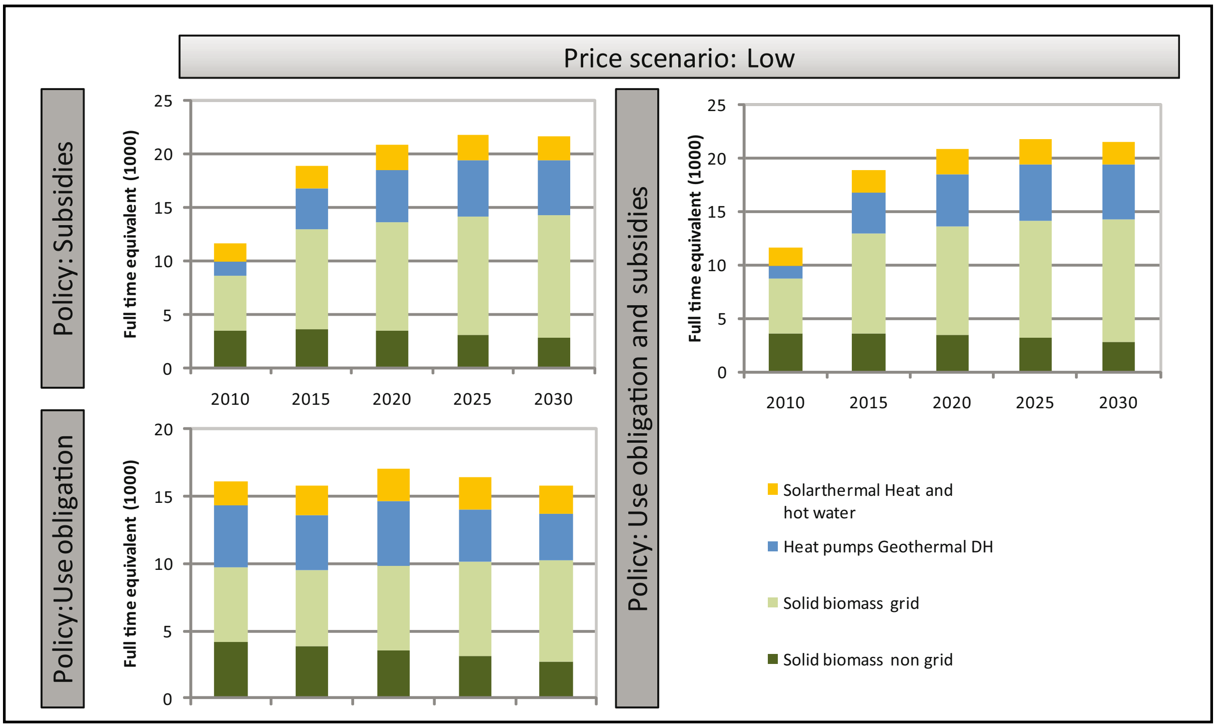

Figure 15: Annual gross employment effects for the Netherlands

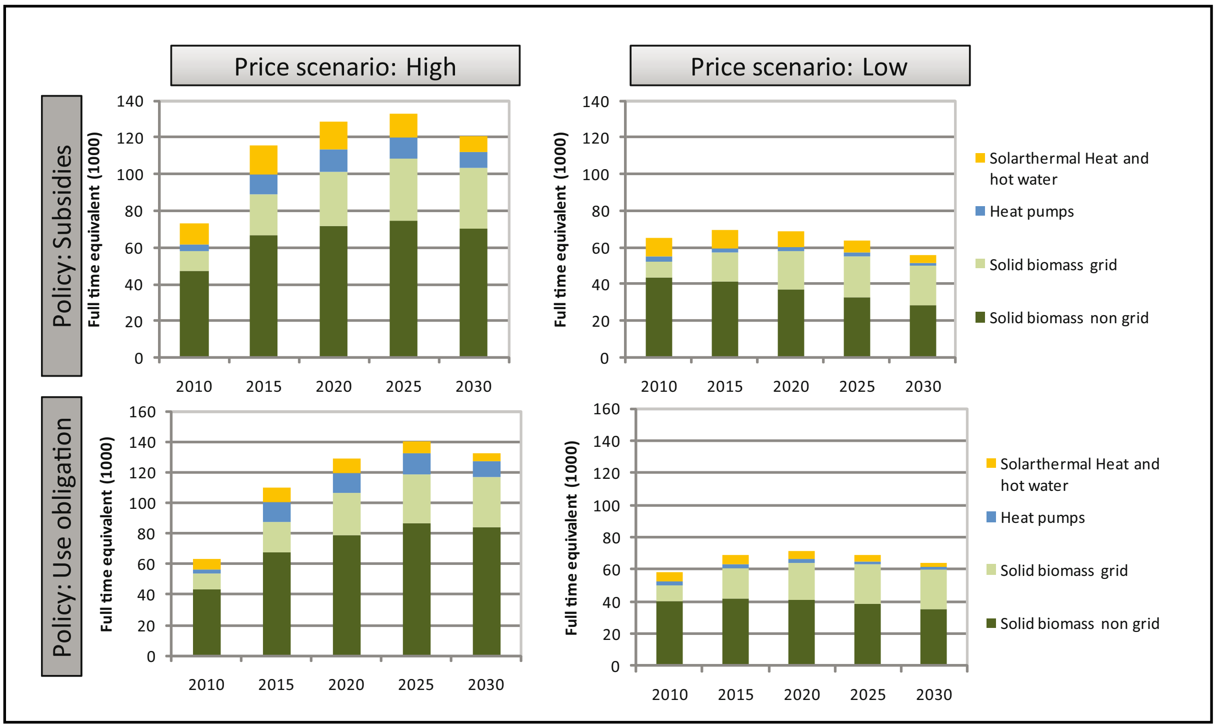

Figure 16: Annual gross employment effects for Poland

Figure 17: Annual gross employment effects for the United Kingdom

POLICY HARMONISATION

In order to meet the targets stated in the Directive 2009/28/EC, the challenge either for national Members States or a harmonised European renewable energy policy is to increase the share of RES-H/C significantly until 2020. In this context, it should be assessed whether a more coordinated or fully harmonised policy framework would be able to address the main barriers to an expansion of RES-H/C more effectively and economically efficient than an uncoordinated policy on the Member State level.

Directive 2009/28/EC is the first strong legislative measure for the promotion of RES-H/C in Europe. As well as including RES-H/C in the determination of the overall target and in the NREAPs requirements, in Art. 13(4) the Directive also defines an explicit obligation for the use of RES-H in new and refurbished buildings:

"By 31 December 2014, Member States shall, in their building regulations and codes or by other means with equivalent effect, where appropriate, require the use of minimum levels of energy from renewable sources in new buildings and in existing buildings that are subject to major renovation."

Although this could be interpreted as a significant move in the direction of a harmonisation of support schemes, it also leaves a lot of room for there to be differences in how Member States design the support instruments.

4.1 Defining RES-H/C policy harmonisation and implications of Directive 2009/28/EC

The term 'policy harmonisation' is generally linked to the process of economic integration of regions, federal states or countries. In the case of the European Union (EU), harmonisation or the implementation of common competition or trade policies is a prerequisite for creating internal goods, service and factor markets (Pelkmans 2006). Up to now, harmonising policies to support the deployment of renewable energies has mostly been discussed with respect to RES-E policy. Ensuring the most cost-effective resource allocation has been the major argument in favour of policy harmonisation. This implies the introduction of a harmonised support mechanism with common levels of support and thus an internal market for electricity from RES (del Río 2005; Toke 2007; Voogt and Uyterlinde 2006). In the new Directive 2009/28/EC, policy harmonisation is addressed in the context of renewable heating and cooling.

However, the background for the harmonisation of RES-H/C policy is quite different. The characteristics of the heating sector have to be considered not only from a technology- and agent-specific point of view, but also from the perspective of economic integration. The electricity sector in general can be classified as a network industry with the potential physical exchange of energy between Member States. In contrast, the cross-border trade of heat is only feasible in terms of primary energy sources such as biomass or fossil fuels.

The harmonisation discussion should not be linked initially to the introduction of a specific support mechanism with common support levels. RES-H/C policy harmonisation already begins with an agreement on common targets for future RES deployment (1) (Figure 18). If it is assumed that RES-H/C installations are still not economically viable without support, Member States will have to promote RES-H/C in some way as the first consequence of the common target setting. Subsequently, the next step in the harmonisation process is the postulation of binding framework conditions for all types of RES-H/C support in terms of technical standards or minimum design criteria for certain policy instruments, whereas the actual specific type of support is chosen by the Member States autonomously (2). The Renewable Directive addresses this level of harmonisation for instance by defining common technical standards for solar thermal systems (Solar Keymark) and heat pumps and by introducing minimum conversion efficiencies of biomass boilers. According to Bergmann et al. 2008, such a framework is defined as “central co-ordination”. In contrast a “convergent policy” at EU level defines one common support instrument, which may be designed nationally in all Member States. In this study, the latter is described as convergence of instrument type (3). Referring to the Renewable Directive, this is addressed by the postulated use obligation (see above).

If the precise design of a common support instrument is also specified on the EU level, the degree of harmonisation is denoted here as convergence of instrument design (4). For instance, in the case of a use obligation as the common policy instrument, full harmonisation would imply the regulation of technology-specific minimum levels of RES-H/C deployment as well. Figure 18 summarises the different levels of policy harmonisation and the implications of the Renewable Directive’s implications in this context.

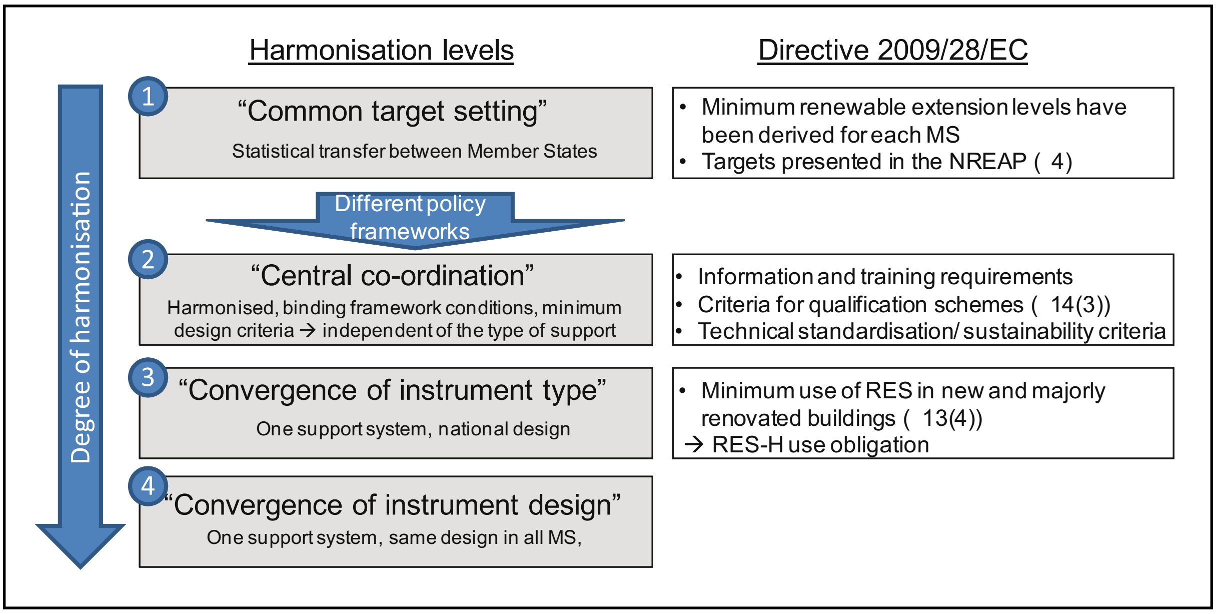

Figure 18: Levels of policy harmonisation and implications of Directive 2009/28/EC
Source: Steinbach et al. 2011

4.2 Assessment of RES-H/C policy harmonisation

The development of renewable heating in the selected Member States differs significantly with regard to the level of market maturity, availability of RES-H/C potential, applied technologies, energy supply structure as well as the current state of energy efficiency in buildings. Figure 19 summarises an analysis of the current competitiveness of RES-H technology in the selected Member States using three indicators:

(1) Consumer prices for heating oil, natural gas and electricity used for heating;

(2) The relation of the specific investments for RES-H-based technologies to fossil fuel-based technologies;

(3) The current RES-H deployment as an indicator for market maturity.

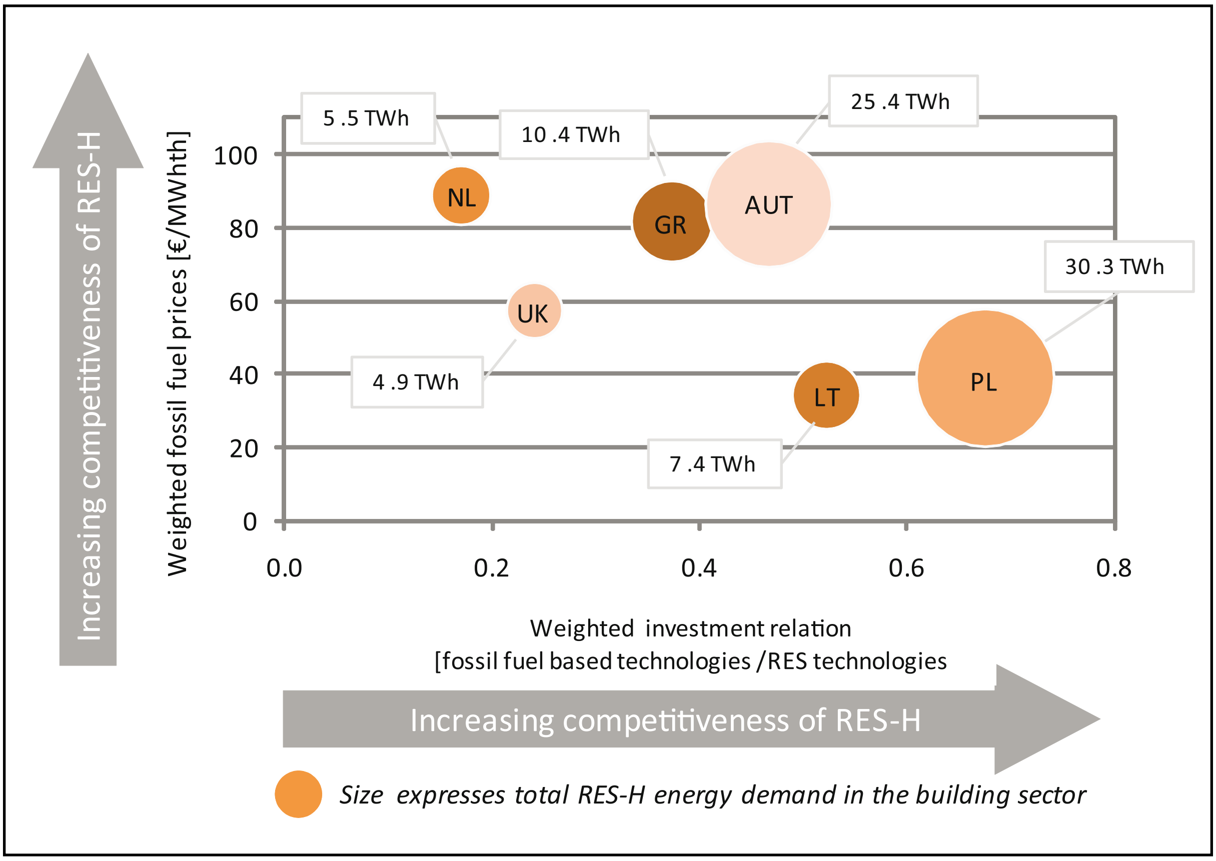

Figure 19: Comparison of the economics of RES-H/C among selected Member States

Considering the different economic conditions for RES-H/C among the selected Member States, a key question is whether different national circumstances require differentiated national support schemes or whether a more coordinated or harmonised policy framework is able to address the main barriers to an expansion of RES-H/C more effectively and economically than an uncoordinated policy at Member State level. In general, the potential economic benefits of harmonisation can be evaluated according to the following main criteria:

1. Cost optimal resource allocation – minimisation of generation costs by investing where it is most profitable
2. Enforced target compliance – assuming that without a harmonised policy framework, Member States would only continue the current policy mix
3. Minimisation of transaction costs
4. Minimisation of total policy costs
5. Avoidance of market distortions in order to support the idea of a common European internal market

In this study, different levels of policy harmonisation have been evaluated using a quantitative modelling approach. The bottom-up energy system model INVERT/EE-Lab is applied to assess the possible costs and benefits of different harmonisation levels. The national use obligation is chosen as the policy instrument against which the effects of policy harmonisation are examined. The analysis focuses on two issues relating to the criteria defined above:

(1) What effect does a convergent policy have in terms of enforced target compliance?

(2) Would a more harmonised policy framework achieve a cost optimal resource allocation of RES-H/C?

Therefore, two harmonisation scenarios – convergence of instrument type and convergence of instrument design (see section 4.1) – and a no policy reference scenario are defined. In the first harmonisation scenario the use obligation is set within national design (minimum share, level of penalty for opting out) which is based on national targets for RES-H/C diffusion. The second harmonisation scenario is determined using an approach to minimise total generation costs constrained to enforce the overall RES-H diffusion of all selected Member States of the first scenario. These scenarios are compared considering, for instance, the allocation of RES-H/C generation volumes and the distribution of total generation costs. Firstly, the results suggest that a use obligation has a significant effect in terms of enforced target compliance (Figure 20 – left) independently on a national or harmonised implementation. Secondly, a harmonised use obligation changes RES-H/C diffusion among Member States and shifts the technological RES-H/C portfolio within and between Member States suggesting a slightly more cost optimal resource allocation (Figure 20 – right). However, the reduction in total generation costs accounts for only 0.2 % of total generation costs up to 2030. The substantial part of this cost reduction results from the fact that the assumed design of the harmonised obligation has a stronger focus on low cost technologies than the assumed national use obligation. The latter assumption is based on the extrapolation of current trends in the national support of the RES-H technology portfolio. Therefore the main effect of cost reductions results from an optimisation of policy design, which could also be performed at national level, rather than from a least cost resource allocation between Member States.

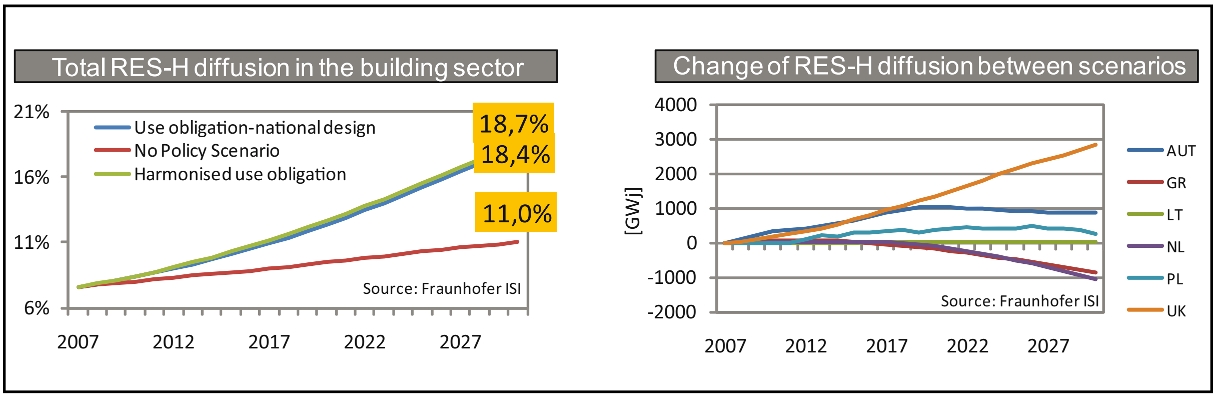

Figure 20: Comparison of harmonisation and no policy scenarios

4.3 Conclusions for RES-H/C policy harmonisation

Directive 2009/28/EC already entails a high degree of policy harmonisation. The far-reaching aspect is the introduction of a use obligation as a common policy instrument. However, there is currently relatively little empirical information on the impact of novel (budget neutral) RES-H/C policy instruments to select the best practice candidate for harmonisation. As outlined in section 2 there are other budget neutral instruments beside the use obligation, which may be more appropriate for RES-H/C support in certain countries. Thus, the legal interpretation of the acceptability of alternative instruments to fulfil the requirements of the Directive ("[...] or by other means with equivalent effect)" is an important issue. Therefore it is advisable to carefully evaluate the effectiveness and efficiency of different budget neutral instruments in the EU Member States before engaging in stronger harmonisation measures as compared to the current RES Directive.

The analysis suggests that RES-H/C policy harmonisation has effects in terms of enforced target compliance and cost optimal resource allocation. In this way, design features of harmonised or national instruments are substantially more important than harmonisation as such. Any type of harmonisation should take into account the long-term objectives of the energy/heating sector as well as climate mitigation targets.

POLICY RECOMMENDATIONS FROM THE PROJECT

5.1 General policy recommendations

Adjusting priorities: In the National Renewable Energy Action Plans all Member States made statements on the projected contributions of renewables to the electricity sector, heating and cooling and the transport sector. Up to 2020 the largest contribution in absolute terms is expected to come from renewable electricity on average in the EU, but an important role is also foreseen for renewable heating and cooling (RES-H/C). As illustrated by Figure 21 some Member States (especially Belgium, Hungary, Ireland, Italy, Luxembourg, the Netherlands and the UK) have very high ambitions for RES-H/C. However the need for a support framework aiming to enhance exploitation of RES-H/C potentials does not get adequate attention in all Member States. The governments of Member States and all other policy makers need to adjust their policy priorities by putting more effort into establishing adequate framework conditions for a sound development of RES-H/C markets.

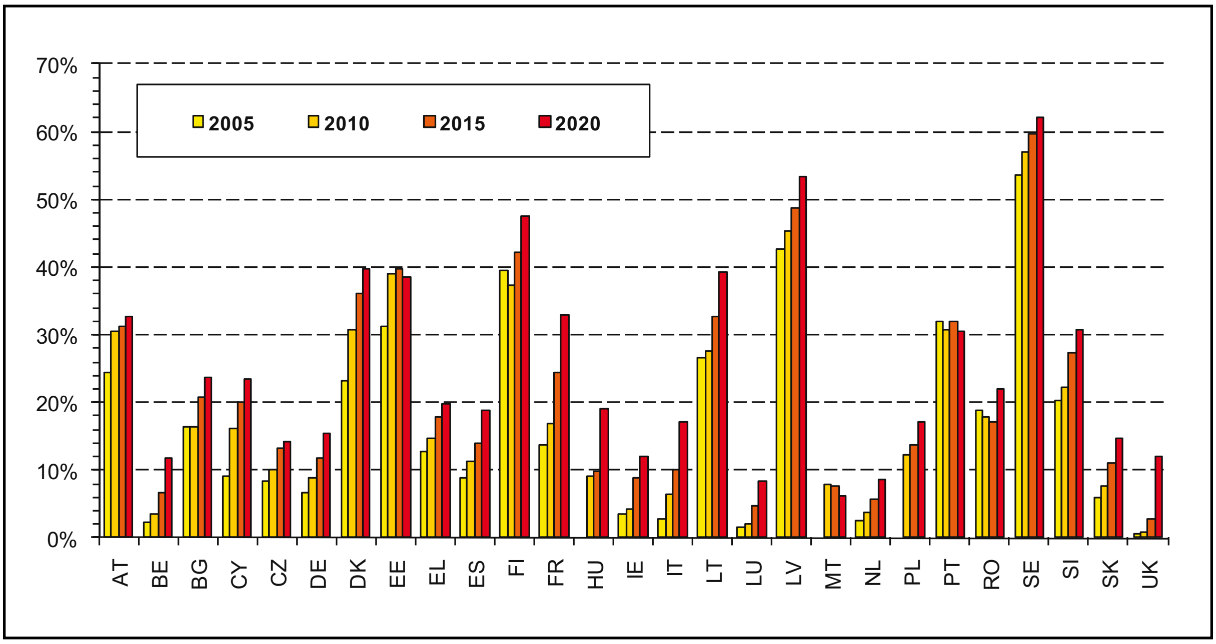

Figure 21: Indicative RES-H/C targets of the EU-27

Coherent and coordinated policy packages: A sound development of RES-H/C markets requires a coherent and coordinated policy framework which considers the needs of multiple heterogeneous technologies used at different scales and to produce different qualities of heat. Policies and regulations need to cover measures to overcome existing economic barriers but also adequately addressing the broad range of non-financial barriers that hinder the exploitation of existing RES-H/C potentials. For instance, such barriers comprise legal or administrative hurdles, psycho-social aspects such as attitudes, preferences, fears, technical hurdles as well as information deficits and information asymmetries. In order to create a coherent policy framework special focus needs to be laid on policy elements that specifically address these hurdles. Policy elements that proved to be effective encompass information measures (e.g. minimum information requirements for architects, planners, installers etc.), measures for awareness raising and motivation, training and education (e.g. for architects, installers). It is important to tailor these measures to the specific context and needs of the different target groups. Furthermore Member States should implement measures to overcome existing administrative barriers. This could be achieved, for example, by streamlining administrative procedures.

Integrated policy packages: Support policies for RES-H/C should be aligned especially with those policies addressing efficiency measures in buildings (e.g. building codes, refurbishment standards), policies to support CHP and the use of industrial waste heat. Integrated policy packages are required to trigger integrated renovation measures in existing buildings but also to steer the buildings sector towards nearly zero-energy buildings as required by Directive 2010/31/EU[14].

Minimum policy requirements: In order to strengthen the ambition level of RES-H/C policy development within the EU the level of policy harmonisation already included in Directive 2009/28/EC needs to be clearly implemented in national legislation and might require further enhancement in the future. This particularly concerns the requirements of RES-H/C 'use obligations' (or other policy instruments with equivalent effect) in the existing building stock (see section 4), which should be implemented based on common and sufficiently ambitious requirements for RES-H/C shares. Weak implementation of this important policy element of the RES Directive at national level will endanger the achievement of the overall RES target in Europe.

Recommendations specifically addressing use obligations

Extension to the existing building stock: Existing use obligations for renewable heat (as applied on the national level in Germany, Spain and Portugal) are typically restricted to new buildings. As shown above, for the coming two decades this building segment will only be a small niche compared to the existing building stock, both in terms of floor space and total thermal energy demand. For that reason consideration should be given to extending use obligations to existing building stock. They should become effective when, for instance,

14 Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings. OJEU L 153/13 of 18 June 2010.

the building is subject to a major renovation or even when the heating system is replaced.[15] In the latter case, care must be taken to ensure that regulation does not motivate building owners to postpone modernisation of their heating system as long as possible in order to avoid the obligation. This can be addressed by setting a final date by which all affected buildings must be modernised.

Technology-specific obligation: The design of a use obligation can have a major impact on the technology mix that obliged parties will choose owing to the varying investment costs and different generation characteristics of different RES-H/C technologies. Low mandatory minimum shares are beneficial for solar thermal, high minimum shares might lead to higher contributions of biomass technologies and heat pumps. In order to derive a balanced technology mix different technology-specific minimum levels could be introduced. This would mean that in the case of solar thermal a lower minimum share would apply than in the case of, for instance, heating installations using solid biomass or heat pumps.

Dynamic obligation: Existing use obligations are rather static by setting a (partly technology-specific) mandatory minimum level for the use of RES-H/C. Long-term climate scenarios show that the renewable heat coverage in the buildings sector has to increase significantly compared to what is required by existing use obligations today. For that reason use obligations should be tightened over time by gradually escalating the required minimum share. There should be transparency regarding the time schedule of this dynamic development of use obligations in order to inform stakeholders and investors about the long-term policy perspective.

Introduction of compensation elements: Rigid use obligations do not incentivise property owners who have very good conditions for the use of RES-H/C to make the best possible use of existing potentials. This implies that renewable potentials can only be tapped on a sub-optimal basis in many cases. A compensation element could be introduced in one of two ways: either by introducing a compensation charge or an exchange mechanism between obliged parties (Bürger et al. 2008). In the first option, those obligated parties who are not willing or are not in a position to fulfil the installation obligation have to pay a legally fixed compensation charge (which could also be used to support RES-H/C appliances). In the second option an exchange mechanism could be introduced: property owners who exceed the minimum share in their obligation to use renewables would receive some form of credits. In turn they could sell these credits on to other owners who are also subject to the obligation and for whom the purchase of credits is cheaper than the physical fulfilment of the obligation.

15 In this context Article 13 (4) of the Renewables Directive 2009/28/EC needs to be considered (see above).

Innovative support instruments: Most Member States apply different financial instruments (e.g. investment grants, tax related support, soft loans) to support the diffusion of RES-H/C technologies on the respective markets. In general these instruments are financed through public budgets and available budgets are often rather limited. Only a few Member States apply non-fiscal measures such as use obligations (e.g. Germany, Portugal, Spain) or the eligibility of RES-H/C investments under the umbrella of White Certificate Schemes (e.g. France, Italy). Apart from these policy approaches Member State governments should be encouraged also to consider the implementation of new innovative approaches, e.g. price- or quantity based instruments (as has been the case in, for example, the UK with the introduction of the Renewable Heat Incentive).

Reliable investment conditions: Support instruments differ widely in their ability to ensure stable investment conditions. Financial support programmes supported from public budgets depend on the respective amounts earmarked every year for the respective purpose. Thus available funds and respectively funding conditions are dependent on the financial situation and potential budgetary constraints of the Member States. Yearly modified incentive rates, available funds and general support conditions make investors feel insecure. Moreover, it usually takes a lot of time for the information about programmes to reach the relevant target groups. Thus frequent changes of a programme can lead to confusion and discourage potential investors in terms both of companies investing in installation capacity and in terms of individual generators. In order to avoid this, financial support instruments should provide continuity. Governments need to commit to earmarking funds ahead of time and making this fact clear to the market. The instruments should be designed as to ensure predictable and reliable investment conditions, both for small-scale investors (e.g. households) as well as large-scale investors. Amongst other things, this refers to the time period until which financial incentives are granted according to the conditions of the support programmes.

Importance of the existing building stock: In recent years in many Member States the annual rate of constructing new residential buildings was in the range of 1%. If we assume that this rate will not substantially increase in the next 10 to 20 years, the buildings sector in 2020 and 2030 will still be dominated by buildings that already exist today. Additionally, due to building codes new buildings have a much lower specific heat demand than existing buildings. For that reason support policies for RES-H should be designed as to specifically address the existing potentials for RES-H/C in the current building stock. Furthermore due to the long investment cycle in the building stock and also for heating devices there is a strong inertia to the accelerated use of renewable energy in existing buildings. Buildings which are renovated during the next 10 years, for example, may not be renovated again until 2030 – 2040. Therefore the necessary level of ambition in terms of GHG mitigation and reduced fossil fuel consumption for a 20 year period must be anticipated when taking any measures directed at current building stock.

Non-residential buildings: A considerable share of building-related final energy use comes from non-residential buildings (the service sector, industry, agriculture). Non-residential buildings often have different characteristics compared to residential buildings regarding thermal demand (e.g. higher cooling demand due to internal thermal loads) and demand profiles. At the same time non-residential buildings also offer considerable potential for the use of renewable heating or cooling devices. Therefore the support framework for RES-H/C should also provide elements that specifically address these potentials.

Long-term perspective: Support policies are often blind to long-term requirements as they fail to provide sufficiently effective price signals that would be required to trigger technology diversification or changes in the infrastructure that might be required from the long-term perspective (e.g. the long-term climate targets). For RES-H/C new technology options must be developed and promising technologies that have not achieved market maturity yet should be further supported in order to allow for a breakthrough at a later stage. This is necessary in order to have a sufficiently large technology portfolio in the long term. A support framework should be designed in view of this long-term horizon and should also be capable of triggering the required adjustments in the heating market infrastructure. RES-H/C support schemes should be considered as part of an active innovation policy.

Quality standards: In order to steer the RES-H/C market towards high quality technology and system standards as well as high system efficiencies (e.g. in the case of heat pumps), Member States should be encouraged to apply technology-specific minimum requirements for the different RES-H/C technology options that might even go beyond those required by Directive 2009/28/EC. This is especially important for small installations for which the level of support usually is determined on the basis of standard parameters (e.g. the collector area in the case of solar thermal). In order to avoid poorly performing installations or those that are even out of service to receive support, ambitious quality standards including the device and the way it is installed are key.

Efficient system performance: RES-H/C applications operate more effectively the better they fit with the overall system design (especially the heating system). For example, a ground source heat pump cannot deliver the desired performance if the respective building is without an adequate heat distribution system and insulation. Thus support policies for RES-H/C should create incentives for a good overall system performance.

Exemplary role for public buildings: Public buildings have an exemplary role with respect to the efficiency standard of the building envelope but also the way in which the thermal energy demand is met. Taking into account the previous point, ideal policy should see effective planning for both in public buildings to maximise benefits. As foreseen by Directive 2009/28/EC, Member States should adopt policies which ensure that renewable heating technologies are installed at all new public buildings and all those that are subject to a major renovation (as defined by the Directive). Member States should extend this requirement to cases where only the heating system is modernised. The exemplary role is especially relevant for buildings that are accessible to the public, e.g. schools, public administration, libraries.

Clusters and networks: Clusters are a recognised instrument in economic policy to foster innovation and to ensure the competitiveness of specific industries. Also in RES-H, they can play a key role to ensure the provision of innovative products and services. Cluster with their well-established information channels support the quicker market uptake of new programmes, legal requirements and also new products.

Renewables in district heating (DH) systems: The use of renewable energy resources in existing DH systems can be supported through various financial instruments (e.g. investment grants, tax related support, soft loans) or quota-based instruments. Today the use of renewable resources is indirectly supported in DH production (beyond that of fossil fuels) through the EU ETS. A major challenge for renewable district heating is the expansion of DH systems themselves. The expansion could be promoted through soft loans and investment subsidies, but it is also important to address non-financial, mainly institutional, barriers, e.g. to promote and enable local heat planning and to provide a regulatory framework which offers greater certainty to investors. Promoting the expansion of DH systems is motivated by the fact that these systems can provide an enabling infrastructure for increased RES-H deployment. Centralised heat production facilitates the use of low grade renewable heat sources that are not suitable for use in individual heating systems. These include biodegradable waste, agricultural and wood process residues, and waste heat (sometimes, but not necessarily from renewable resources) from CHP generation, industrial processes and biofuel production.

Administrative synergies: Managing a support instrument requires additional resources, for example, for administering funding applications or verifying whether obliged parties fulfil their obligations. In order to minimise these public administration costs it should be investigated whether synergies could be achieved by aligning to existing administrative procedures that have been established in the context of managing other policies (e.g. taxation, funding programmes in other policy fields, verifying building codes).

Avoiding undesirable effects of policy measures

- Substitution versus final consumption: In the statistical method using gross final energy (as adopted in the EU directive) the unit of heat is evaluated in the same way as a unit of electricity, while electricity has a greater effect on the amount of primary energy, the consumption of which is avoided.[16] The distribution between the yield of heat and of electricity is therefore neutral as far as target achievement regarding Directive 2009/28/EC is concerned, but this is not the case where the quantity of primary

16 Assuming an overall efficiency of approx. 40% from the available electricity park, renewable electricity replaces 2.25 times as much fossil energy as renewable heat (with an efficiency of 90% for the reference boiler).

energy is concerned. The statistical method for the determination of the share taken by renewable energy is set more or less firmly up to 2020 by Directive 2009/28/EC. What method will be adopted internationally after 2020 and the extent to which the European Member States will have the freedom to apply their own methodology are unknown. With that in mind it would not appear wise to tie the incentive scheme entirely to the gross final method.

- The relationship between renewable heat supply and energy savings: When meeting a demand for heat it is possible in most cases to introduce modifications in the heat-demanding process, reducing the quantity of heat required. The failure of a policy measure to take account of this will mean the unnecessary deployment of renewable heat and – in the case of financial support programmes – the unnecessary payment of subsidy. In order to achieve the renewable energy target it will be beneficial to use a large amount of renewable heat, but where energy consumption is reduced the so-called "denominator effect" will come into play: every saving in energy brings the achievement of a certain share for renewable energy closer, without the additional deployment of renewable options. Practical examples of the "communicating vessels" concept: a water-saving shower head used with a solar boiler, the insulation of a reactor vessel or an additional heat exchanger in the combustion gases in an industrial context.

- The boundaries of the system affect efficiency: The choice where to place the boundaries of the system – that is, the place in the system where the heat yield is measured – is important in the case of an operating subsidy. A typical example would be the heat released by an installation used to ferment biogenous streams. It is important that useful heat production should be used in determining the amount of subsidy, and not total heat, since the latter would equate to an incentive to insulate the reactor less, because the amount of subsidy would remain unchanged while there are savings on the cost of insulation.

- The strategic behaviour of players: In the case of new investment, the energy producer (electricity and heat) is free to choose the design parameters for the new installation. In the case of projects where an internal demand for heating must be met, the primary objective will be to effectively meet this demand. Where a subsidy is available for heat it is possible that investors who originally intended to install a CHP plant will opt instead for a heat-only installation when the financial parameters favour that option, such as investment amount and return on investment. Therefore, it is possible that the optimal operational parameters for the installation will be selected not on the basis of its energy performance but rather on the maximal yield from subsidies. The heat subsidy thereby unintentionally takes on a steering role.

- Biomass allocation: green gas versus heat and electricity: Crude biogas can be used to make bio-SNG but it can also be used to generate heat and electricity, possibly in combination. The latter can be done without a refining stage, avoiding losses on conversion. The conversion of crude biogas is most efficient when it is directly converted into heat. Efficiency is lower when the conversion is via bio-SNG. If the bio-SNG could be used directly in transport then the efficiency would be higher, although it is unclear how that could be expressed in statistical and technical terms. The method of recording the injection of bio-SNG into the natural gas network has not yet been determined by Eurostat, so that will remain an uncertain factor.

Monitoring and evaluation: With the implementation of a support policy for RES-H/C Member States should implement appropriate measures to monitor and evaluate the impact of adopted policy. Monitoring and evaluation are key elements for enabling the policy sector to react to undesirable effects; to adapt and further develop the design of an instrument and thus to maintain or even strengthen the effect towards the desired policy aim. Special attention might be needed to disclose the information to the public and to other governments in order to make sure that best practice information exchange and cross-fertilisation will be achieved.

Transparency and data provision: In order to ensure a high level of transparency Member States should implement adequate reporting requirements, e.g. periodic policy evaluation reports that are disseminated to national parliaments and other interested stakeholders, including the public. Additionally, statistical data about RES-H/C should be collected and made available in a suitable level of disaggregation. As an example for providing detailed, comparable data and at the right level of detail, the NREAP template is an example to be followed.

Renewable cooling: Today's absolute cooling demand is rather small compared to the overall European demand for heating. However, there is an upward trend in cooling demand and it can be expected that cooling demand will continue to increase for climate and comfort reasons. At the moment the market diffusion of renewable cooling devices is still rather low. Member States should strengthen their efforts in supporting R&D activities in this specific field as well as support the market introduction and penetration of renewable cooling technologies while simultaneously addressing efficiency standards of buildings in terms of cooling energy consumption.

Apart from the more general policy recommendation the national policy design needs to take into account the specific context in which a policy will be implemented. Partners of the RES-H Policy project developed a range of country-specific recommendations derived from the national policy processes in the target countries of the project.

Austria

- About 50% of stakeholders consulted in the RES-H Policy project stated that use obligations should be part of the policy mix. The monitoring of use obligations is not considered as a major barrier. A successful implementation of a use obligation is only possible in mature markets, i.e. when high quality equipment is available at acceptable costs. In Austria, this is the case.

- In order to ensure acceptance and to deliver a broad technology mix, the use obligation should be combined with additional technology-specific economic incentives.

- A carbon tax on fossil fuels could be a reasonable instrument for financing the support of RES-H in form of investment subsidies. Finally, this leads to the conclusion that effective support schemes should be based on a combination of investment subsidies and use obligation (in particular for new buildings and existing buildings that are subject to major renovation).

- For the further development of RES-H support schemes it is considered important to build on widely accepted and broadly applied current support schemes. In Austria, the support of residential building construction (Wohnbauförderung) is such a scheme. This would allow a stronger integration of renovation in the support schemes of RES-H systems.

- The current RES-H support schemes are strongly based on regional policies. There has been controversy in discussion about harmonising these schemes on a federal level. Arguments for a stronger harmonisation are a reduction of transaction costs of market players (e.g. installers, consumers), a guaranteed minimum level of support for all technologies in all regions and a higher level of transparency. Arguments for the current, regional support schemes are the good experience in the past, at least in some regions, the flexibility to allow regions to opt for more ambitious policies and the competition among regions in terms of the success of policies and RES-H market growth. It was not possible to derive a clear recommendation in this field.

The Netherlands

- The focus of Dutch policy is now based on the EU target of 14% for renewables in gross end consumption. This means that the renewable heat options weigh as heavily in the balance as the electricity-related options. However, the electricity options have a proportionately greater effect in driving out fossil energy carriers. Renewable electricity will therefore continue to be important. It is also important to anticipate what will be necessary for the transition to renewable energy provision in the long term, for the period after 2020. Technologies that are not (yet) seen as qualifying for incentivisation may become so from a post-2020 perspective.

- The RES-H Policy project showed that there have been good experiences in Germany with obligations in the buildings sector to provide renewable heat in new buildings and with renovations in certain federal states. This type of obligation might work in combination with a technology-specific share, tightening of the requirements over the course of time, clear communications, and possibly certification to allow the parties to trade. However, such an obligation conflicts with the spirit of the Dutch Energy Performance Norms (EPN) in which requirements are laid down for the energy performance of new buildings (EPC requirements) but the market is left free in terms of selecting the measures to be taken and system design. It is anticipated that, were the EPC to be further tightened as proposed, renewable energy implementation would be necessary to meet the EPC requirement.

UK

- The Renewable Heat Incentive (RHI) has the potential to be effective in achieving at least a significant fraction of the UK's RES-H targets for 2020 and in driving deployment beyond that date. The advanced state of the RHI in the adoption process makes it the obvious choice to support RES-H in the UK and our results suggest it has the potential to drive RES-H adoption on a much larger scale than is currently deployed. However, in neither the high or low energy scenario do we foresee the RHI allowing the UK to meet the goal of 12% of all heat coming from RES-H by 2020, the figure that UK government has suggested will need to be the RES-H contribution if the UK is to meet its 2020 RE goal under the 2009 Renewables Directive.

- Stakeholder feedback suggested that there was little support for the expanded use of grants to support growth in RES-H and that the 'use obligation' seen as central to efforts to drive RES-H in some EU Member States would be less politically acceptable in the UK, with the attendant potential for intrusion into private homes. The modelling carried out within the project suggests that an extended form of the UK's current supplier obligation, the 'Carbon Emissions Reduction Target' could fruitfully work with the RHI to allow RES-H targets to be met in full at probably the least possible cost to the consumer or taxpayer. This suggested mechanism would effectively apply a competitive incentive to utilities to increase capacity and would have the potential to allow the UK to meet its 12% heat target for RES-H.

- It is notable that while the high energy price scenarios see greater uptake of RES-H in domestic and commercial premises, the UK models suggest that in this scenario the subsidy provided by the RHI will have little impact on industry uptake. Effectively, it is assumed industry will find its own route to adoption of RES-H technologies on the basis of their economic viability alone.

- The UK's Microgeneration Certification Scheme (MCS) aims to ensure that all microgeneration (RES-E and RES-H) must be installed by a suitably qualified company and the technology is of an appropriate standard. Such a scheme is essential to protecting the individual consumer and to protecting the public purse as regards subsidy. However, the MCS as currently applied received some criticism as regards the difficulty and cost of achieving accreditation and there seems to be an argument for a review with regard to easing accreditation while maintaining standards for both technology and installation.

- The use of district heating (DH) systems has the potential to make a significant contribution to more sustainable delivery of heat energy in domestic, commercial and industrial premises. However, there is currently no clear route through which DH networks can expand in the UK. A review of how DH might be financed in the UK and of the regulatory framework which might best suit its growth should be a priority for the UK Government. Effective policy in this area should seek not to exclude use of waste heat from any discussion of extending provision of RES-H.

5.2 Specific recommendations addressing the use of RES-H/C in industry

Targeted policies: Industry is a very important energy consuming sector in Europe, which thus deserves considerable policy attention. However, apart from the EU Emission Trading Scheme (EU ETS) not many policies are in place. There are several opportunities for renewable options: Industry has a high local energy density and a high (and constant) heat demand which matches very well with deep geothermal energy. Industry requires large installations for energy supply. For local emission prevention it is easier to control one large industrial installation instead of numerous small-scale (household) devices. Large areas of roof surface provide large space for solar thermal. Since industry usually has a high energy demand, the resulting impact of support measures is potentially large, and support measure transaction costs per GJ are relatively low. It is thus recommended to shape, alongside the EU ETS, measures for a long-term sustainable and renewable energy supply for industry specifically.

Bringing parties together: When choosing a settlement for an industrial installation and the industry energy provision, the possible use of renewables (or alternatively residual waste heat from other industrial parties) has not yet received much attention from the industrial players: more important are logistics and licensing, for example. Governments could play a facilitating role in bringing parties together (e.g. local market for residual heat, considering geothermal hot spots, reserved zones for concentrated solar thermal in an industrial area).

Scaling up demonstration plants: For all renewable heat options (biomass, biogas (either CHP, heat only, bio-based substitute natural gas), aquifer thermal energy storage, deep geothermal energy, solar thermal (low and high temperature)) demonstration or commercial projects are in operation. Member States are recommended to scale up demonstration plants by targeted research and development to overcome technical, financial and organisational barriers.

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ANNEX

Modelling the energy demand for space heating and hot water in buildings – The INVERT/EE-Lab model

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, CO_2 reductions and costs for RES-H support policies. Furthermore, Invert/EE-Lab is designed to simulate different scenarios (price scenarios, insulation scenarios, different consumer behaviours, etc.) and their respective impact on future trends of renewable as well as conventional energy sources on a national and regional level.

The basic structure and concept is described in Figure 22.

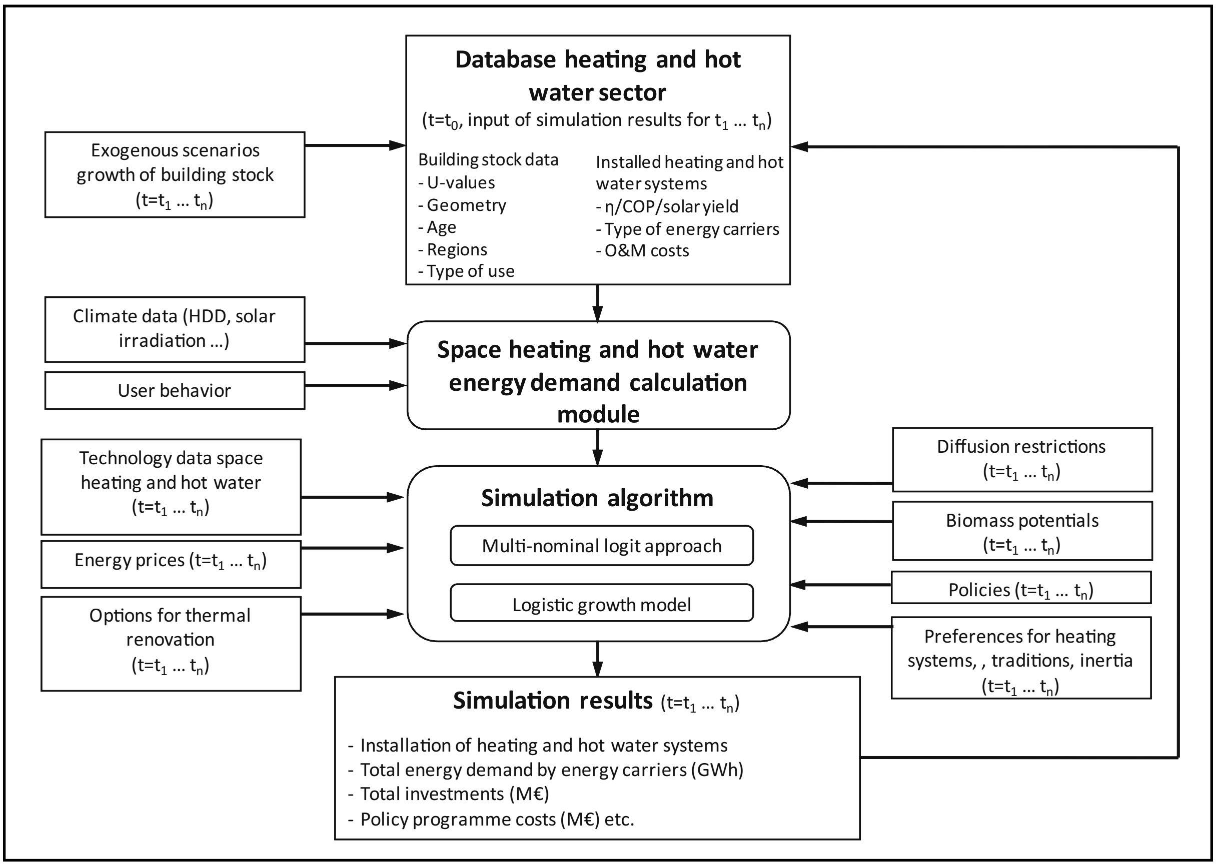

Figure 22: Structural overview of Simulation-Tool Invert/EE-Lab

The Invert simulation tool was originally developed by the Vienna University of Technology/ EEG within the scope of the Altener project Invert (Investing in RES&RUE technologies: models for saving public money). During several projects and studies the model has been extended and applied to different regions within Europe, see for example Biermayr et al. (2007), Haas et al. (2009), Kranzl et al. (2006), Kranzl et al. (2007), Nast et al. (2006), Schriefl (2007), Stadler et al. (2007). The last modification of the model in 2010 included a re-programming process and accommodation of the tool, in particular taking into account the inhomogeneous structure of decision makers in the buildings sector and corresponding distributions (Müller 2010). The current state of the model relies on this new calculation core (called EE-Lab) leading to the current version of the model Invert/EE-Lab506 used in this project.

The core of the tool is a myopical, multinomial logit approach, which optimises objectives of "agents" under imperfect information conditions and represents the decisions maker concerning building-related decisions. Invert/EE-Lab models the building stock in a highly disaggregated manner. Therefore the simulation tool reflects some characteristics of an agent-based simulation.

Modelling the opportunities for renewable energy in the industry sector – the RESolve-H/C model

The RESolve-H/C model consists of numerous consecutive steps, which can all be attributed to two main loops:

a) determining the potential of RES-H in industry, resulting in a time series of energy data for the selected renewable heat technologies, and

b) determining the penetrations of RES-H in industry under various policy assumptions, resulting in a time series of energy data for the selected renewable heat technologies and expected policy expenses.

The profitability of investment in a renewable heat technology is determined once the costs and avoided fuel costs are known. For each possible investment, and Internal Rate of Return (IRR) is calculated. The IRR is the interest rate that makes the net present value of the investment equal to zero. The cash flows are based on perfect foresight. Future energy prices are assumed to be known. The model considers the cash flows from the perspective of the investor. Important components of the cash flows are investment costs, benefits from reduction of the energy demand and consequently the avoided fuel costs due to savings in terms of the costs of non-renewable energy sources. Cash flows related to the loans consist of repayments and interest, with repayment assumed to take place in equal shares. Cogeneration has an effect on the cash flow through additional income from electricity sales. Technologies considered for the industry sector are: biomass (wood/waste and heat only/CHP), solar thermal energy and deep geothermal energy.

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