Standard Methods

Calculating Support Needs

Biomass Heating User Guide

RETD

IEA - RENEWABLE ENERGY TECHNOLOGY DEPLOYMENT

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Acknowledgments

The Standard Methods Tool and set of User Guides was prepared by Claus Hartmann, Tobias Kelm, Ole Langniß and Kristin Seyboth of the Centre for Solar Energy and Hydrogen Research Baden-Württemberg (ZSW) in 2007. Review comments were gratefully received from Raffaelle Piria (European Solar Thermal Industry Federation), Dimitra Teza (BESTEC) and Sonia Xavier (British Department of Business, Enterprise and Regulatory Reform).

For further information on the tool and user guide please contact the Operating Agent of the IEA RETD Implementing Agreement, operating.agent@iea-retd.org.

Introduction to Biomass Heat

Biomass heat has a long tradition, often in domestic stoves or furnaces fed with round-wood and is estimated to account for around 95% of the renewable heat produced today (IEA, 2007). Most countries and regions have access to one type of biomass supply or another and often in large quantities although obtaining accurate data on the biomass resource available is challenging, even on a local level because of the variation across years and seasons (IEA, 2007a). There is great potential for biomass to supply a greater share of our energy needs, in large part through an expansion of biomass combustion technologies. It is important to recognize that the share of renewable heating and cooling technologies within the energy supply could increase further with improved energy efficiency measures. This introductory chapter serves to brief the reader on the available technologies, current costs and markets and the current barriers which exist in striving for increased biomass heating deployment.

A wide range of systems are available to harness the energy from bioenergy including combustion, gasification, combined heat and power (CHP) and the production of biofuels. The Standard Methods tool and User Guide focuses exclusively on dedicated biomass combustion systems which cover a wide range of equipment, distinguished by variations in fuel and air delivery, design of combustion chamber and grate, type of heat exchanger, and handling of exhaust gas and ash (RETSCREEN, 2005). System sizes may range from small, residential sized systems (~50 kW) to larger industrial scale sized systems (>400 kW).

Modern biomass systems such as wood burning stoves and pellet boilers control the mix of air and fuel in order to maximize efficiency and minimize emissions. In addition, they include a heat distribution system to transport heat from the site of combustion to the heat load (RETSCREEN, 2005). It is important that well-designed stoves and/or boilers are selected such that the combustion process is better controlled, thereby reducing carbon monoxide pollution, hydrocarbons and particulate matter that may be associated with the burning of traditional biomass (IEA, 2007).

A wide range of biomass fuels or feedstock are available for use in modern systems including crop residues, forest and wood process residues, energy crops and short rotation forests, not to mention wastes such as municipal solid waste and animal wastes. Techniques for upgrading solid biomass fuels, which may be bulky with high moisture content, are advancing. Such techniques include natural drying, pelletising and briquetting (IEA, 2007a). The Standard Method Support Tool and User Guide are concentrated specifically on a solid pellet feedstock. Pellet heating systems were chosen over other biomass combustion technologies (e.g. round wood furnaces) because solid pellet feedstock systems are a comparatively modern and clean-burning technology, their markets are growing, and the similarity of the feedstock supply to conventional fuels facilitates handling and storage.

A reliable, low-cost, long-term supply of biomass fuel is essential to the successful operation of a biomass heating plant (RETSCREEN, 2005). The €/GJ of delivered energy can be very wide ranging depending on biomass type, transport distance and storage costs. Moreover, the quality of biomass feedstock is highly variable. Before a biomass heating system is installed, it is recommended that an assessment of the quality and quantity of biomass feedstock which is available, the reliability of suppliers and possible changes in future demand for the resource is undertaken.

Debate has been increasing over the sustainability of biomass feedstock production. For example, where native forests are harvested at a greater rate than natural regeneration, the

production of biomass is not sustainable. It is recommended that the biomass resource is assessed regarding its sustainable supply over the long term prior to selection.

Heat production from biomass combustion is a renewable technology which is often competitive with fossil fuels. It has been estimated that 2005 average investment costs for a biomass pellet heating system were on average €380/$kW_{th,}$ but may range between €120-800/kW_{th} (IEA, 2007). As mentioned above, fuel costs will vary considerably based upon the type of biomass, transport distance and storage costs. An important alternative to individual systems, biomass based district heating, may also be implemented in a highly cost effective means.

It is estimated that around 35 EJ/yr of traditional biomass resources are consumed annually with an additional 9.7 EJ/yr for "modern" bioenergy applications (IPCC, 2007). Countries with a high percentage of biomass heat in the energy mix tend to have good resource availability and a strong district heating infrastructure such as in Sweden, Austria and Denmark (IEA, 2007).

Most barriers to furthering biomass pellet heating development are non-technical, the most prominent being economic barriers (VTT, 2006). Barriers are created when the relatively high costs for biomass heat cannot compete with fossil fuels used to provide the same amount of energy (IEA, 2007a). Additional barriers include a lack of certainty about the availability of a long term quality fuel supply at an acceptable cost and concerns over environmental and sustainability issues and competition for land use. This tool is focused on policies aimed to overcome the first, financial barrier by means of direct subsidies.

The Standard Methods Tool

Background

In the face of market-failures which do not account for the positive aspects of energy generated by renewable sources such as security of energy supply and reduced carbon dioxide emissions, policies are often introduced in an attempt to make up for deficiencies in the market. Policy-makers worldwide are faced with the challenge of determining an adequate level of support in the design of instruments aimed to increase the deployment of renewable heat. The Standard Methods tool was created in order to assist in this process for subsidy-based incentive schemes.

In its design, when examined from the most basic of levels, policies aim to address the cost gap between conventional fuel heating technologies and biomass heating technologies including investment costs and running costs. These costs may vary widely depending on the local conditions to which the policy must be suited. A first step then is to determine the cost gap between technologies in these locally specific circumstances. This tool compiles national data among 9 countries by which the cost gap of heat generation costs between biomass pellet heating and conventional heating technologies is estimated[1]. It is important that the user recognizes and fully understands that the data compiled and presented in this tool is intended be interpreted as strictly indicative.

Purpose

The Standard Methods tool provides policy-makers with assistance in determining an adequate level of support in the design of subsidy-based instruments aimed to increase the deployment of renewable heat. The results of the tool provide the user with a basis upon which they can estimate the total and annual budget of policies tailored to support biomass pellet heating based on a number of country-specific considerations. However, as the tool has been overly simplified for demonstration purposes, it is important that local conditions and prices are carefully analyzed prior to policy implementation.

Subsidy schemes for renewable heat are one of many methods to increase the deployment of renewable energies. The cost effectiveness of these tools should be carefully weighted against the costs of similar, alternative policy measures. There is no over-arching solution to renewable heating policy design, but the Standard Methods tool offers a preliminary basis upon which subsidy-based policy budgets may be estimated.

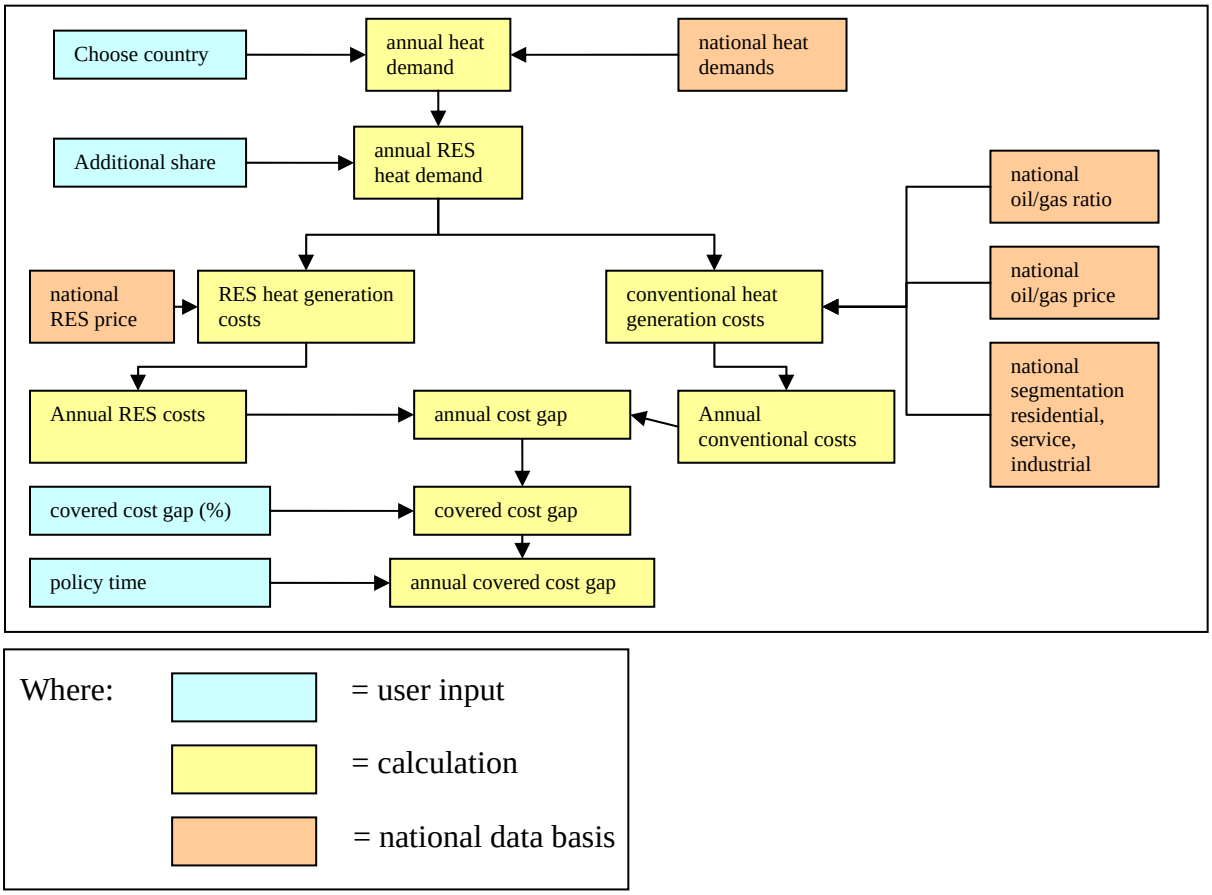
User Guide

The Standard Methods tool has been designed in a simplified, user-friendly schematic diagram in Microsoft Excel format. In using the tool, the user must recognize that it has been overly simplified for demonstration purposes. In designing policies, it is important that local conditions and prices are carefully analyzed prior to implementation. To provide an estimate of the support required, an individual may determine detailed specifics of the timeline and the targeted percentage of renewable heat to give a preliminary figure for the amount of budget which should be allocated with the Standard Methods tool. If it is a goal of the policy to cover only a portion of the cost-gap with conventional fuels, the actor may also specify this. Finally,

[1] Conventional heat generation costs have only included costs for oil and gas systems.

the importance of educational and informational campaigns to promote awareness of the tool itself has been recounted on many occasions. An option to include a certain percentage of the total policy budget for informational schemes has also been included. The methodology utilized in this support tool is represented in Figure 1.

Figure 1. Visual representation of the methodology used to calculate support need.



Via drop-down menus the policy-maker is able to select the information most relevant to their circumstances[2]. A bar-chart on the right simultaneously depicts the cost gap between biomass pellet heating and conventional heating. The cost of renewable heating installations is assumed to be the same for all countries investigated[3]. The total annual cost per heating system includes the following:

- investment annuity
- annual fuel costs
- auxiliary energy costs (1 % of heat generation)
- operational costs (2,5 % of investment)

Strictly wood pellet feedstock was considered for annual fuel costs[4]. All country feedstock prices are based upon this German example from 2006. It is strongly recommended prior to policy implementation to examine local feedstock prices as they compare to those cited in this

[2] Only drop-down boxes and boxes for data entry within the dialog table are available to individuals. Calculation sheets have been locked to prevent alterations.
[3] Data on the costs of biomass pellet installations originated from BAFA,2007 database and ZSW,2007.
[4] Wood pellet feedstock costs originate from the 2006 database of the Centrales Agrar Rohstoff Marketing und Entwicklungs Netzwerk at www.carmen-ev.de/dt/energie/pellets/pelletpreise.html.

tool. Other types of biomass feedstock such as straw and crop residues were not included in these calculations.

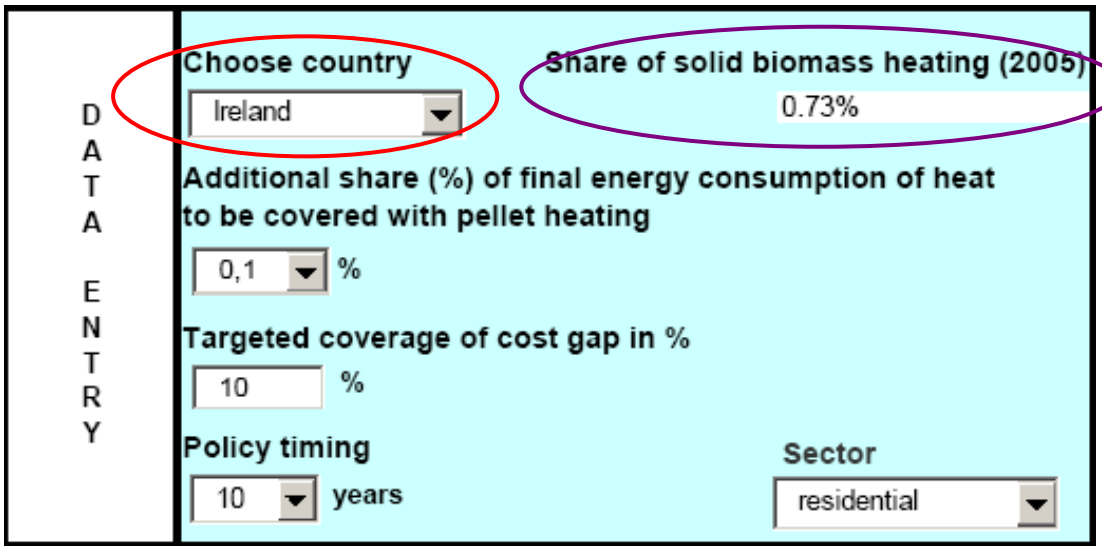
For the purposes of illustration, a typical example for Ireland was selected for use throughout this User Guide. Red ovals throughout the diagrams depict a point within the tool where the user is required to insert their desired policy specifics.

In order for the Standard Methods tool to function properly it is important to assure that the English decimal system has been selected before work with the tool is begun. In order to verify this, in Microsoft Excel on the Tools menu, click Options. Then, on the International tab under Number Handling, clear the Use System Separators check box. Type new separators in the Decimal Separator (.) and the Thousands Separator Box (,). Then, work with the Standard Methods tool may be begun.

The tool is broken into three user-friendly boxes. The first box, 'Data Entry' allows the user to insert unique policy design features and location specifications that produce results which are more specific to their individual circumstances. The second box, 'Results' simultaneously shows the results of the user's decisions and reflects the support need that is required to cover the cost gap (or percentage of the cost gap) with conventional fuels. The third box is a visual representation in graph format of the results of the selections.

Data Entry

First, the country of residence should be selected. The data that supports the selected country automatically includes the heat demand in that country and the national averages of conventional fuel costs[5]. In addition, for comparison of conventional fuel costs, statistics on the proportion of gas and oil heating systems typical in each country[6] have been integrated.

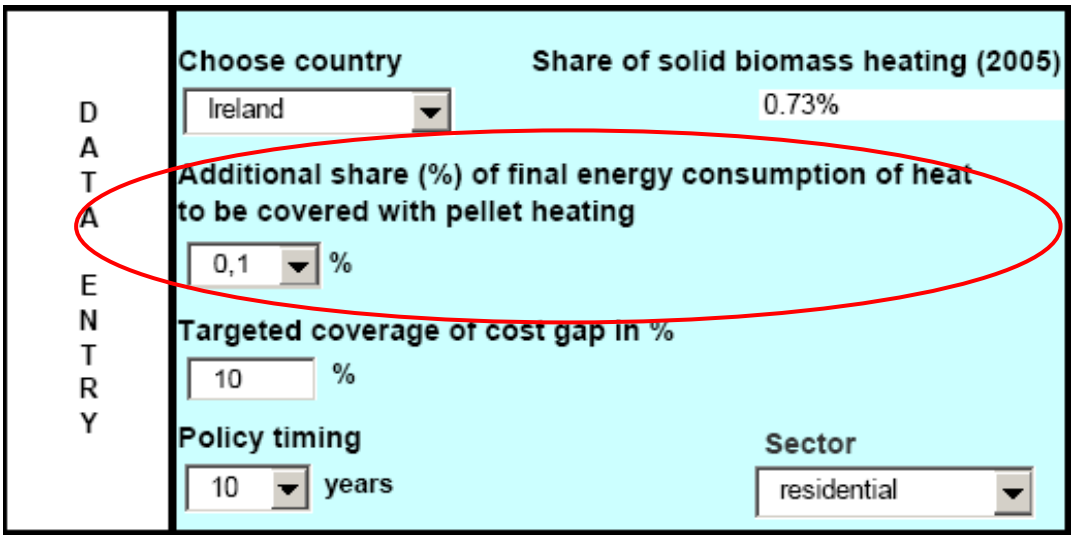


[5] Conventional fuel heating costs including oil, gas and electricity for each country originate from the EIA at www.eia.doe.gov.

6 Proportional gas and oil heating system data originated from Eurostat yearly energy statistics at http://epp.eurostat.ec.europa.eu for all countries except Norway and Canada. Norwegian data is based on household consumption sourced from Statistics Norway at http://www.ssb.no/husenergi_en/tab-2007-05-23-08-en.html while Canadian data originates from the Statistics Canada database at http://www.statcan.ca ..

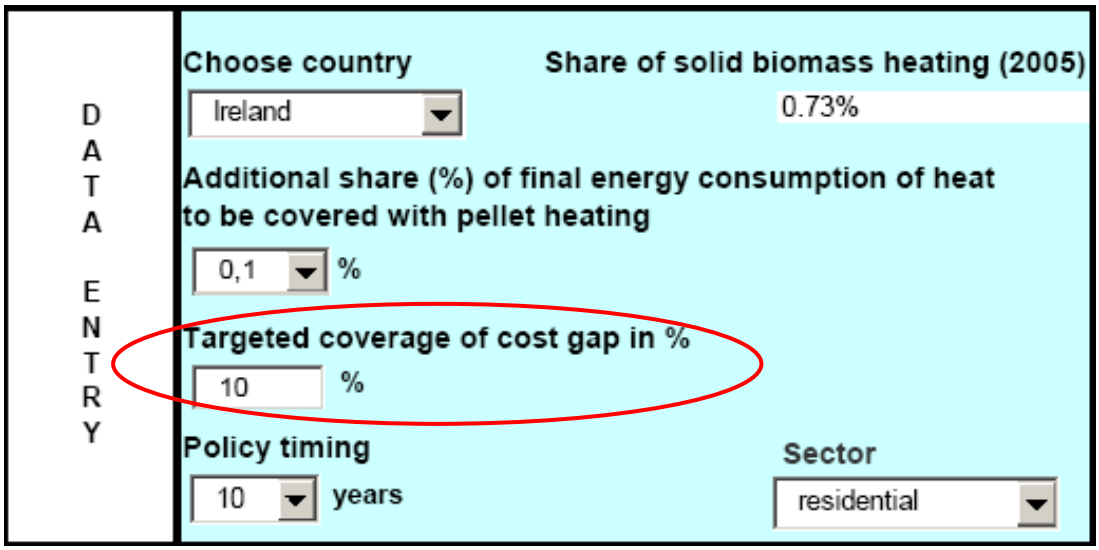
When the country is selected, the share of biomass pellet heat in that country in 2005[7] will automatically and simultaneously appear to the right of the box under the heading titled "Share of solid biomass heating (2005)", circled in the above graph in purple. This is provided to give the user a reference for the next step of the tool.

Next, the individual must determine what additional percentage of the total heat demand[8] they wish to be covered by biomass pellet heating. A dialog box allows a selection in increments (typically of 5%) up to 50% of the total heat demand. This maximum accounts for restrictions in the potential biomass fuel supply. Biomass feedstock potential may be very country specific. For the purposes of simplicity, in this tool a generic maximum of 50% has been included as an estimate. Because the circumstances surrounding feedstock supply and cost are variable, careful local resource assessment is recommended prior to policy recommendation.

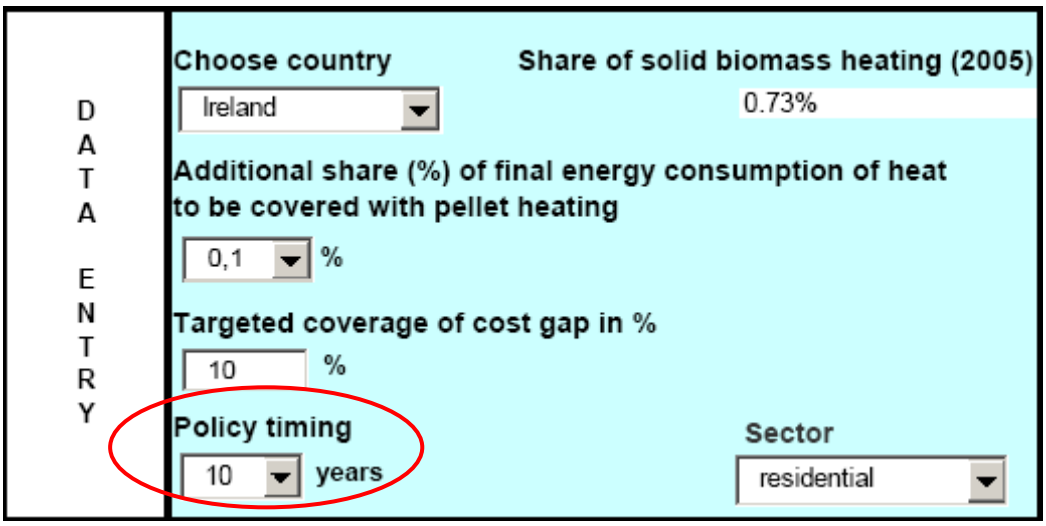


As mentioned above, this tool aims to address the cost gap between conventional fuel heating technologies and biomass heating technologies. The next box for data entry allows the user to determine to which extent they wish to cover this gap. If the aim of the policy is to address the full cost gap, the user should enter 100 in the data box (representing 100% of the cost gap). Lesser percentages may be entered in accordance with the wishes of the user.

[7] Data on the share of pellet heating in individual countries originates from EuroSTAT and Statistics Canada.
8 Heat demand data for European countries originates from Eurostat at http://epp.eurostat.ec.europa.eu. Canadian data is sourced from the Statistics Canada database at http://www40.statcan.ca/l01/cst01/prim71.htm. Calculations were performed as follows: Final energy consumption – electricity consumption – energy consumption of transport sector + correction value = estimate for final heat consumption.

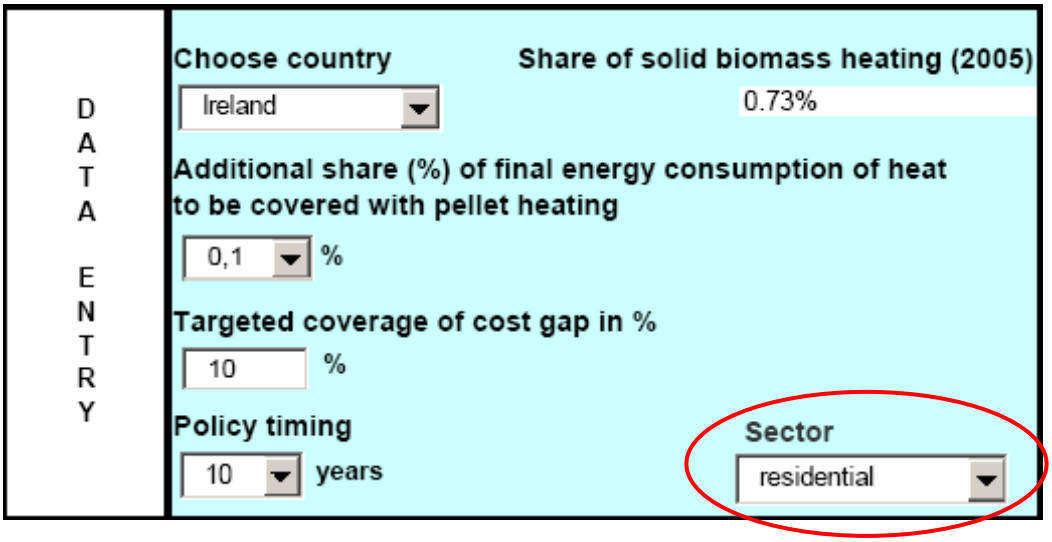


The Standard Methods Tool has been created to allow for variations in policy timelines. The user should then select from the 'Policy timing' dialog box an estimated timeframe for the life of the policy. Increments of 5 years are possible, to a maximum of 20 years.



Prices vary considerably depending on the sizes of pellet heating systems. The next entry allows the user to decide on the size of the system upon which they wish to focus support. The dropdown list provides the following choices: 1) residential 2) service/agriculture 3) industry and 4) total. Residential systems reflect the costs for the smallest, domestic systems. For this example, systems are assumed to be 15 kW. Service/agriculture systems reflect the costs for middle sized systems, or 100 kW systems. Industrial systems are the largest, here represented by 500 kW systems. The final choice, total, automatically selects an average mix of the system costs based upon the heat demand by sector in the country selected.

Industrial and service/agriculture systems are often associated with lower costs than residential pellet heating systems. In addition to the increased efficiency of larger sized systems, biomass residues are the predominant feedstock choice, lowering overall running costs. For example, biomass residues already collected onsite (such as bark at a paper mill) are cheaper than pelletised short rotation forests (IEA, 2007a). However, as biomass pellet heating increases, it is likely that the use of this feedstock will also increase in these larger sectors.



The methodology for calculating the 'total' option is based upon the assumption that annual heat demand by sector in each country[9] will be reflected in the proportions of industrial, commercial, and residential biomass systems installed. For example, a country with heat demands in the following proportions; residential 50%, industry 30%, commercial 20%, would reflect these demands in the installations of biomass systems. Half of the systems installed, therefore would be at the smallest residential scale, 30% large, industrial scale, and 20% medium, commercial scale.

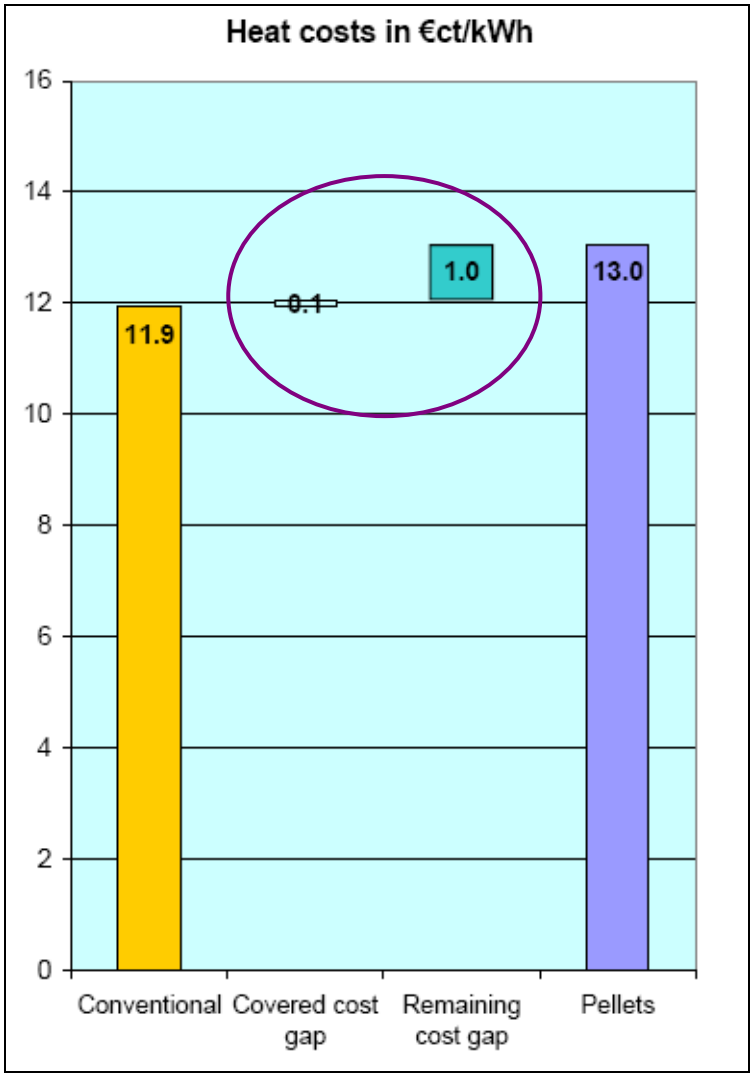
If the user selects the final 'total' choice, they must be aware that the assumptions made in the methodology may be reflected in the outcome of the results. Large pellet heating systems (>100 kW) are often profitable as compared to conventional heating systems of the same size whereas smaller pellet heating systems for single family homes ("residential") are generally not yet competitive. It results that in countries with a high share of heat demand in the industry sector, due to the assumptions made in this tool the economic advantage of large systems compensates the economic inefficiency of small systems. In other words, in countries with a high share of heat demand in the industry sector the tool may show that no support is needed from a macro-economic point of view, even though small systems may not yet be cost-competitive.

For this example, then the user has chosen to investigate the amount of support required for a 10-year policy in Ireland that aims to cover 10% of the cost gap with conventional fuels for a 0.1% over-all increase in pellet heating, specifically residential 15 kW systems.

Results

With each of the above selections, the costs of biomass and conventional heating in €ct/kWh are adjusted accordingly. These changes are reflected in a graph to the right of the dialog table which automatically adjusts to reflect whether the system costs selected are scaled according to residential, commercial or industrial systems. (See below).

[9] Data on the composition of heat demand in each country was sourced from the IEA member country database available at: http://www.iea.org/Textbase/country/index.asp.



The graph depicts the costs of conventional heat (far left, yellow bar), the costs of pellet heat (far right, light purple bar) and the cost gap between the two (shown here inside a purple oval). The total cost gap would be a combination of the two middle bars, in this example 1.1 €ct/kWh. The left, green bar is a representation of how much of the cost gap the user has chosen to cover with political incentives. The right, blue bar represents the cost gap which remains to be covered.

The second box of the tool, ‘Results’, is broken into two individual sub-boxes. The first of these sub-boxes tells the user how much support is required per system, in total, and per annum according to the selected timeline.

RESULTS

Support need over policy time:

Per kW	Total	Per annum
22 €/kW	18,000 €	2,000 €

Additional funding for policy marketing (% total)

10%	total Funding:	2,000 €
	Funding per annum:	0 €

Support need over policy time including funding:

Per kW	Total	Per annum
22 €/kW	20,000 €	2,000 €

The final sub-box of the Standard Methods tool pushes the user to consider additional funding which may be desired for marketing of the policy tool. It has been shown that those policies which are the most effective are those where parallel investments were made in guidance and educational programmes in order for the stakeholders (including building owners making personal investment decisions) to better understand the benefits that REHC has to offer. An appropriate percentage of 10% of the total policy spending is automatically selected. As the user enters policy conditions in the "data entry" section of the tool, the budget numbers are simultaneously amended to reflect the funding which would need to be allocated strictly to marketing activities to the right of the percentage box. These totals which match the selected percentage have been given in total and per annum (See below).

Additional funding for policy marketing (% total)

10%	total Funding:	2,000 €
	Funding per annum:	0 €

Support need over policy time including funding:

Per kW	Total	Per annum
22 €/kW	20,000 €	2,000 €

The final row of funding totals represents the total funding to cover the cost gap and for marketing activities.

Total support need = Cost gap support need + Marketing activities

Where marketing activities = (X%)*Cost gap support need

All budget numbers in the tool are rounded to the nearest thousand. For this reason, there is no guidance budget represented here.

With the information that this tool provides, the user is able to judge with a rough indication how much funding should be allocated in total and per annum to an incentive-based policy such as a subsidy scheme for pellet heating.

Tool cost comparisons

The investment costs in the Standard Methods tool are based on German Market information. These costs include all investment costs such as installation, feed system and storage.

The cost data in the IEA report "Renewable Energy for Heating and Cooling – Untapped Potential" are also based primarily on German market data: It refers to pellet heating systems with a capacity from 5 to 100 kW. The costs contain the heating system incl. control, but without installation, feed system and storage. For this reason the below listed costs in the report are lower than in the Excel tool.

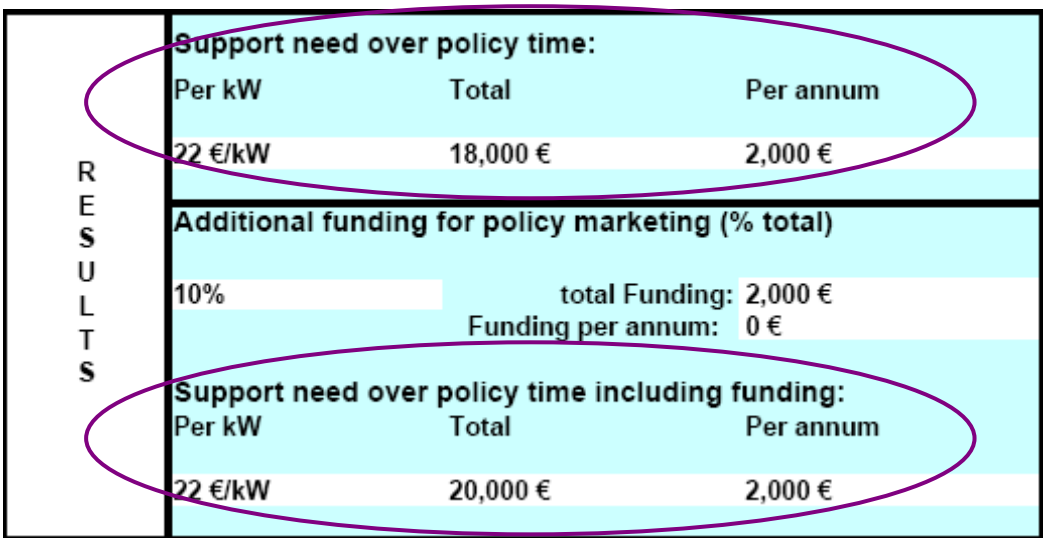
In the Canadian RETScreen tool, as in the RETD Excel tool, all inclusive investment costs are assumed. The RETScreen tool allows the user to evaluate renewable energy projects. This integrated product database contains comparatively low investment costs for specific pellet heating systems. The RETScreen tool provides no information on the size of the system for which costs have estimated. One possibility for the low estimates of this tool could be the focus on larger scaled, more cost-efficient systems.

Pellets	**Investment costs**
	€/kW_{th}
Excel Tool (excl. VAT)	
15 kW (residential)	975
100 kW (service)	315
500 kW (industry)	168
IEA REHC (excl. VAT)	
Minimum	120
Average	380
Maximum	800
RETScreen	
Biomass systems for heating	72-288

Understanding the results

The Standard Methods tool assists policy-makers as they face the challenge of determining an adequate level of support in the design of instruments aimed to increase the deployment of renewable heat. Focused specifically on subsidy-based incentive schemes, it clearly depicts the cost gap between conventional fuel heating technologies and biomass pellet heating technologies including investment costs and running costs. Based on this information and the user inputs for policy timeline and objectives, the tool produces an estimated budget for subsidy-based incentive schemes. It is important that the user recognizes and fully understands that the data compiled and presented in this tool is intended be interpreted as strictly indicative.

The results box provides the user with the following numbers of interest: Support need over policy time (per kW, total and per annum) and Support need over policy time including funding (per kW, total and per annum) (See below).



The first, 'Support need over policy time' tells the user that for the inputs entered (a 10-year policy in Ireland that aims to cover 10% of the cost gap with conventional fuels for a 0.1% over-all increase in pellet heating, specifically residential 15 kW systems) an estimated total budget of €18,000 would be required. This total, divided by its 10 year timeline therefore results in an annual budget of €1,800. Because the tool rounds to the nearest thousand, this has here been estimated as €2,000 per annum. Finally, an estimated 22 €/kW is needed. This result breaks down the total budget for the user to understand the cost gap requirements on a more tangible scale. These results show the user only the cost differences between the technologies and does not include administrative costs of the policy. When the policy itself is designed, these costs must be accounted for.

The second, 'Support need over policy time including funding' urges the user to incorporate educational or marketing based funding into the design of the policy tool to allow stakeholders (including building owners making personal investment decisions) to better understand the benefits that renewable energy heating and cooling has to offer. In this example, 10% of the total policy funding (€18,000) from the first set of results has been added for marketing purposes resulting in an estimated total policy budget of €20,000. This total, divided by its 10 year timeline therefore results in an annual budget of €2,000. The support needed per kW does not change.

While the results of the Standard Method tool are considered in the design of subsidy-based policies in support of biomass heating systems, the limitations of the tool and its prospects for further development must be taken into account. The cost data for renewable energy systems and biomass feedstock is assumed to be the same for all countries investigated. A more thorough approach would incorporate country-specific data on pellet biomass system costs and feedstock supply. Although a maximum of 50% has been included, biomass potential has not been accurately limited based on country-specific data. More specific potential data could be incorporated incorporating information on readily available biomass feedstock supply and installation manufacturing facilities. As the success of a policy depends in many cases on the how well the existing infrastructure has already been developed, a future tool could be designed to take supply chain infrastructure into consideration. Finally, the importance of a variety of renewable heating technologies must not be side-stepped as policies are designed for pellet heating. Other renewable heating technologies such as solar thermal and heat pumps should also be given thorough consideration and adequate support.

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