Key Issues for
K4RES-H
Renewable Heat in Europe

Setting Verifiable Targets for RES-H

(Deliverable 5)

WIP Renewable Energies

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Abstract

Targets represent an important step in policy making. The rapid market development and technological advancement of the renewable energy sector in recent years ensured progress on the White Paper targets in the area of electricity and biofuels, where Directives have set concrete targets. Analogous targets for the heating and cooling sector will guide national and local policy makers in their decisions and send important signals to investors and the public.

One objective of the K4RES-H project is to develop recommendations for a methodology to set RES-H targets.

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CHAPTER ONE
INTRODUCTION

1 Objectives

Targets represent an important step in policy making. The rapid market development and technological advancement of the renewable energy sector in recent years ensured progress on the White Paper targets in the area of electricity and biofuels, where Directives have set concrete targets. Analogous targets for the heating and cooling sector will guide national and local policy makers in their decisions and send important signals to investors and the public.

Nevertheless, setting verifiable absolute targets for RES heating and cooling implies the solution of some statistical and methodological issues. One objective of the K4RES-H project is to tackle these issues and identify the improvements of the EU statistics. Recommendations how to improve EU statistics are given in Deliverable 4 of the K4RES-H project.

Another objective of the K4RES-H project is to develop recommendations for a methodology to set RES-H targets. The outcome of the K4RES-H project enables policy makers to discuss RES-H targets with stronger statistical knowledge and methodological proposals on how to set verifiable RES-H targets.

This report is elaborated by WIP, based on the reports provided by ESTIF, EGEC and AEBIOM (Deliverables 3).

2 Structure of the Report

This report gives recommendations and a methodology how to set verifiable targets for RES-H. Definitions of K4Res-H were given in Deliverable 4, chapter 2.

Chapter II gives an overview about the importance of targets, intermediate targets and monitoring. Chapter III – V give recommendations and methodologies how to set verifiable targets for solar thermal, biomass and geothermal. Chapter VI gives a summary of the targets and some recommendations.

CHAPTER TWO
IMPORTANCE OF TARGETS, INTERMEDIATE TARGETS AND MONITORING

A Importance of targets and problems of setting targets

Verifiable absolute targets represent an important step in policy making. The rapid market development and technological advancement of the renewable energy sector in recent years ensured progress on the White Paper targets in the area of electricity and biofuels, where Directives have set concrete targets. Analogous targets for the heating and cooling sector will guide national and local policy makers in their decisions and send important signals to investors and the public.

Targets are powerful instruments to motivate people and organisations, to initiate actions and steering instruments and to get things done. The more detailed and concrete targets are the more powerful they will be. A very general target without numbers such as ‘increase the share of renewables in the heating sector’ is more or less worthless. While a specific target such as for example "In each member state X thousands of ton oil equivalent final heat from biomass should be produced by 2010 and 2020" is much more clear.

European and national targets within a directive are a successful method to promote renewables. Therefore also in the heating directive clear targets should be defined for EU25 and each member state.

Setting verifiable absolute targets for RES heating and cooling implies the solution of some statistical and methodological issues. Recommendations how to improve EU statistics are given in Deliverable 4 of the K4RES-H project.

B Pragmatic target setting for 2020

Even though the long term potential for RES heating and cooling is much higher than today’s usage in the EU, it cannot be fully realised in a few years. Changes do not come over night and any policy measure introduced now will take time to take full effect. Therefore 2020 is already very close. The typical opportunity for including RES heating and cooling into buildings or industrial processes comes with the new installation or renewal of the heating and cooling systems. This is one of the limiting factors for fast penetration.

Until 2020 there will be a lot of technological advancement but a large part of the new installations will be with products of today or similar to today’s. Even a breakthrough in the field of e.g. advanced heat storages by 2015 would not have a huge impact on achieving a target for 2020. This would be radically different if the time horizon was 2030 or even further.

Targets and measures to achieve them are inevitably interdependent. With stronger measures, higher growth and ultimately higher targets can be achieved. And setting of ambitious targets should help focus on strong measures to achieve them.

Ideally the target should be determined in a detailed bottom-up study taking into account the demand in different sectors, development of skilled professionals etc. But a detailed study should not distract from the immediate need to set meaningful and verifiable targets now. This can be achieved in a more pragmatic way by means of estimations, comparisons, and analogies – without going too much into detail.

Pragmatic approaches for each sector are shown in the chapters below. They are based on extrapolations using the existing installations and achievable growth rates. This means essentially, that for the setting of 2020 targets, one can start with what has been achieved today and extrapolate from this level taking into account the framework conditions that are to be realised to promote RES heating and cooling.

In any case the target should be set based on a simplified statistical conversion from installed capacity to energy production.

C Importance of intermediate targets and monitoring

If targets are to have an effect as guideline for policy making and as a benchmark for the success so far, then it is clear that intermediate targets are essential. Waiting until 2020 only to find out that a target was missed, is not sensible. Instead the progress must be verified in frequent intervals and policy measures adapted where necessary.

D Long-term targets (beyond 2020)

The longer-term target should be to cover as much as possible (i.e. close to 100%) of the heating and cooling demand with RES.

On the longer term, today's level of RES heating and cooling has almost no influence on the overall result: Even a country which has only little usage so far has enough time to close the gap to today's front-runners and to eventually overtake them. Therefore, an extrapolation from today's penetrations would not be appropriate to set a longer-term target.

A longer-term target would have to take into account longer term scenarios for the heating and cooling demand as well as the expected – or possible – technical development.

In the solar thermal sector, the European Solar Thermal Technology Platform (ESTTP), which was officially launched in May 2006, is already working on these issues and aims at developing a comprehensive roadmap for solar thermal in Europe, encompassing technological and non-technological barriers to growth and measures to overcome them. Any government aiming at setting longer-term targets for solar thermal should support the ESTTP work in this field and take the results of the ESTTP as input to their own studies, where suitable.

A similar Technology Platform is proposed by the geothermal sector. A European Geothermal Energy Technology Platforms could provide a framework for stakeholders to define research and development priorities, timeframes and action plans in the longer term. It could also play a key role in ensuring an adequate focus of research funding and address technological challenges that can potentially contribute to a number of key policy objectives.

CHAPTER THREE
SOLAR THERMAL – SETTING VERIFIABLE TARGETS FOR EU 25

1 Methodology to set targets for 2020

Two approaches to set targets are outlined below, beginning with the more pragmatic one as that is the one that would be useful for Member States to use when drawing up national action plans to fulfil the new binding target of 20% RES in Europe by 2020.

In any case the target should be set based on a simplified statistical conversion from installed solar thermal capacity (or collector area) to solar thermal energy production.

Based on the works of the International Energy Agency's Solar Heating and Cooling Programme (IEA-SHC), ESTIF uses a European average collector energy yield of 500 kWh/(m^2 * a). This factor takes into account the energy produced by 1m² of collector area in typical local solar thermal systems and weighs the different country-factors according to their relative market size. Each country may in the future calculate its own specific factor based on the typical systems and specific energy productions in their country.

1.1 Approach 1: Pragmatic setting of targets

Changes do not come over night and policy measures will take time to take full effect. The typical opportunity for including solar thermal into buildings or industrial processes comes with the new installation or renewal of the heating systems. This is one of the limiting factors for the fast penetration of solar thermal technology. Even a breakthrough in the field of e.g. advanced heat storages by 2015 would not have a huge impact on achieving a target for 2020. This would be radically different if the time horizon was 2030 or even further.

For the setting of 2020 targets, one can start with what has been achieved today and extrapolate from this level taking into account the framework conditions that are to be realised to promote solar thermal.

As the analysis of the solar thermal capacity per capita in different countries shows that the very different penetration of solar thermal in different countries, does not depend much on climatic conditions (two of the leading solar thermal markets in Europe, Austria and Germany, are not in the sunny Mediterranean region, whereas Italy, France and Spain have much lower solar thermal penetrations), it is reasonable to benchmark most European countries against the market leaders and not against neighbouring countries.

Two benchmarks are of highest relevance in this context:

- **Solar thermal capacity in operation per capita**

  This parameter is both, closely linked to energy production (because it looks at the installed capacity) and it takes into account the different size of the national markets. It shows very well the relative penetration of solar thermal in different countries.

- **Actual past growth rates of the solar thermal market**

  This parameter can be used as "reality check". What growth rate would be needed to achieve a certain target in 2020, and has such a growth rate been realised in at least one country over a longer time span, i.e. could it be used as a yard-stick for the period 2007-2020.

A Solar thermal capacity in operation per capita

The EU leaders in this category are Cyprus (479 kWth/1.000 capita at the end of 2005), Austria (199 kWth/1.000 capita) and Greece (193 kWth/1.000 capita). For comparison: The EU-average is 24 kWth/1.000 capita.

As a central European country, Austria is a very interesting example and can serve as a benchmark for the rest of the EU. This country has taken 20-30 years to reach this level of solar thermal usage. When solar thermal started to grow in Austria, there were hardly any commercial solar thermal systems and most systems were self-built. Over the years a strong industry has developed and technology has become highly efficient and reliable.

With today's products and know-how it should take other countries much less time to achieve similar rates. The "Austria Benchmark" should serve as a minimum target for 2020 for any EU country.

Depending on many country-specific factors, higher numbers seem well achievable in many Member States.

The European Solar Thermal Industry Federation is promoting a 2020 target of 1m² of collector area per European. These are 700 kW_{th}/1.000 capita and would translate into 320 GW_{th} installed capacity in 2020.

This target applies for the average of the EU. Some countries, like Cyprus, Austria, Greece, Germany should achieve even higher levels while others will not be able to reach $1m^2$ per capita by 2020. As a very minimum each of them should target the "Austria Benchmark" of 199 kW_{th}/1.000 capita.

	Capacity in Operation 2005 GW_{th}	Capacity in Operation 2020 GW_{th}	ST Energy 2020 mtoe/a	Average market growth rate 2006-2020 % p.a.	Capacity in operation per capita 2020 kW_{th} / 1000 capita
"Austria scenario" (minium target)	10,9	91,2	5,6	16%	199
"$1m^2$ per capita scenario" (ambitious target)		320,4	19,7	31%	700

B Actual past growth rates as "reality check"

If the market grew with a constant growth rate until 2020, how fast would it have to grow to achieve a certain target in terms of capacity in operation per capita. In many countries, the solar thermal market is still in its infancy and therefore very high growth rates can be expected in the coming years. But the question is, what growth rate can be realistically achieved on a longer-term, e.g. from now until 2020.

For the EU to achieve the ESTIF target of 1m² per capita by 2020, the EU market would have to grow at around 31% every year from 2007 to 2020.

In order to check how realistic such a growth rate is, it could be compared to the biggest national solar thermal market over a time span of the same length (1993-2006): During this period, the German solar thermal market grew at least by 20% in 11 out of these 14 years, and in 6 of these the growth rate exceeded 30%. For a country that has relied so far on "soft" support measures such as awareness raising campaigns and financial incentives, this is a remarkable achievement. One can only speculate what could have been achieved with even stronger measures, such as solar thermal (or renewable heat) obligations for new buildings and for those buildings undergoing major renovations.

A 31% growth rate seems to be a well achievable rate, if a government intends to continuously support solar thermal.

C Adjusting targets to country specific conditions

ESTIF's overall target for the EU in 2020 needs to be broken down by Member State. As pointed out earlier, not every single country will reach 1m² of collector area by 2020.

Instead the European target should be adjusted to the local conditions. Important success factors for the near term future are:

- Current level of solar thermal usage (implying also a certain level of solar thermal awareness and of market infrastructure)
- Current level of usage of other RES-H technologies
- Current energy technologies used for heating and cooling
- Cost competitiveness with existing heating technologies
- Other (policy) priorities in the heating/cooling sector (e.g. efficiency measures in buildings, district heating networks)

1.2 Approach 2: Detailed bottom-up study to set 2020 target

Another approach to set a target for the short- to medium term (up to 2020) is to conduct a detailed study on the realisable potential in this time span.

In this case it should be assessed how much low-temperature heat is currently being used, in which market segments and for what applications. Based on the rate of new-built heating systems as well as the typical renewal rates for existing heating equipment in the different segments and applications, the immediately available potential for the introduction of solar thermal should be assessed. This potential needs to be adapted to take into account that not every low-temperature heat demand could be covered by solar thermal (e.g. because of lack of suitable roof or facade area in high-density urban environments).

Outline of a detailed target-study:

- Total potential: Low- to medium temperature heat demand
- Short-term technical potential: Low- to medium temperature heat demand that could be covered by solar thermal technology available today or in a few years.
- Realisable technical potential 2020: Share of heat demand, which is covered by heating systems, which are to be newly built or renewed between now and 2020
- Solar thermal target 2020: Based on this realisable technical potential 2020, governments need to determine how much of this they want to realise. This would be their 2020 solar thermal target.

The policies they enact should then be targeted at reaching that share.

2 Monitoring of progress towards reaching a target

After having shown how targets for solar thermal could and should be set at national or local level it is important to point out how these targets can be made verifiable. A target without frequent and verifiable monitoring of the development of solar thermal installations would be meaningless. How could policy makers assess the success of their support policies without a feedback on the number of existing installations.

Two options are feasible:

1) Collecting data on the number of new solar thermal installations and their capacities: While this would allow only to monitor the newly installed systems, a methodology for how to subtract old systems, which are deemed to have gone out of operation. The latter is necessary in order to not just accumulate the annual numbers for newly installed capacities and to receive a realistic figure for the solar thermal capacity "in operation".

2) Directly collecting data of solar thermal capacity in operation: If done correctly, this would give the better results. But it creates additional costs for the collection of these data.

2.1 Collection of data on newly installed capacities and assumption on life time of solar thermal systems

This approach has been used so far by EU Member States, national solar associations and other bodies publishing solar thermal statistics. A thorough analysis of such statistics has been conducted within the K4RES-H project (see Deliverables 2 and 4) and recommendations on how to improve the quality of solar thermal statistics have been given therein:

(1) Improvement of data collection

Whilst no national register of solar thermal systems exists ("what is where installed and in operation?"), data collection should be based on:

- Surveys of solar thermal manufacturers/importers, which are done in co-operation with the relevant national trade association and which keep the individual data confidential

- Data obtained from financial support schemes at national level, if they are generally believed to cover most of the solar thermal market (i.e. only few installations are done, which do not receive these financial incentives)
- Ideally, the two methods are used together in order to cross-check the data and to fill potential information gaps

(2) Non-inclusion of old systems, which can be assumed not to be in operation anymore

Statistics which do not foresee that old systems are decommissioned at some point in time will show less and less realistic figures.

ESTIF strongly recommends using a uniform assumption on the usage time of solar thermal systems: Due to various reasons, solar thermal systems are decommissioned after 20 years (15 years for systems that were installed before 1990). This means that systems installed before 1990 are not included in today's data of solar thermal systems in operation.

2.2 Direct collection of data on solar thermal capacity in operation

In various EU Member States frequent checks of heating systems is required by law. In Germany for example, chimney cleaners measure emissions of ovens and boilers on an annual basis. And as most solar thermal systems have a back-up heater typically burning either gas or biomass it would be simple to add a requirement on having a look also at the solar thermal part of the heating system. Such a requirement would allow building up and maintaining a register of currently existing solar thermal capacities and it could help ensure that the systems are functioning properly.

3 Conclusion

Verifiable targets for solar thermal can be set with reasonable effort and accuracy. For shorter periods (e.g. up to 2020) the target should be set based on the existing penetration of solar thermal, measured in kW_{th} per capita. Benchmarks for the target setting in one country or region should be the penetration level achieved already in other countries and regions. For each EU Member State the minimum target for 2020 should be to achieve a solar thermal penetration reached already today by Austria. As a whole, the EU should be able to reach at least $1m^2$ of solar thermal collectors in operation per capita.

In order to make the targets verifiable a system of monitoring the development of solar thermal capacities in operation must be put in place. This could be achieved either by collecting data on newly installed capacities and subtracting old systems, deemed to have gone out of operation. Or to directly assess the capacity in operation, e.g. by building up and maintaining a national register of existing solar thermal systems, verified each year by competent inspectors of heating systems (such as the chimney cleaners in Germany and other countries.

CHAPTER FOUR
BIOMASS – SETTING VERIFIABLE TARGETS FOR EU 25

1 Methodology to set targets for 2020

1.1 Existing targets for 2010 - Biomass Action Plan (BAP)

The BAP can be considered as an excellent contribution for bioenergy development in Europe. About 30 concrete measures to overcome barriers have been identified and it is important to implement them.

The targets mentioned in this BAP have the advantage to exist (Table 1), which is important. In addition these targets should remain valid for 2010.

However these targets contain some problems:

- Mixture of primary energy and final energy: It does not make sense to add biomass for electricity and liquid biofuels as it will lead to incomprehensive targets. For example, in the future wood might be used for second generation biofuels as well as for heat and electricity. So one can not add wood to the transportation fuels made of it.
- Bioheat into electricity target: cogeneration is included in the term biomass for electricity. It means that a part of the bioheat is included in the target for electricity.

Table 1: Biomass Action Plan targets for EU25 [1]

	2003 results	2010 targets	Bioenergy increase 2003-2010
Bioelectricity (TWh)	48	174	126
Biomass for electricity (Mtoe)	20,6	56*	35,4**
Biomass for heat (Mtoe)	48,2	74,8*	26,6**
Liquid biofuels (Mtoe)	0,5	18,6	18,1
TOTAL (Mtoe)	69,3	149,4	80,1

* biomass for electricity and heat : 56 + 74,8 = 130,8 Mtoe
* biomass for electricity and heat : 35,4 + 26,6 = 62 Mtoe

Therefore it is proposed to:

- Keep BAP targets but couple biomass for heat and biomass for electricity together. It means 130,8 Mtoe by 2010.
- Improve the situation of target setting through the national biomass action plan.

It is proposed to express the targets as follow:

[1] COM(2005)628, Biomass Action Plan

Input	**Output**
Biomass for heat	bioheat
Biomass for cogeneration	bioheat and bioelectricity
Biomass for electricity	Bioelectricity
Biomass for transportation biofuels	Transportation biofuels

Only the bioheat that is really used should ideally be considered. Alternatively the useful heat could be taken into account (the heat that can potentially be used). Indeed, if heat is wasted in cogeneration units for example it should not be considered, as it does not replace any fossil alternative and does not contribute to greenhouse gas reduction.

1.2 Methods to distribute to the Member States (MS)

Several methods can be used to distribute the overall EU goal down to the MS level. The following features might be taken into account :

- **Southern Europe**: MS in Southern Europe have a lower demand for heat and could have lower objectives.
- **Existing use of bioenergy**: On one hand MS that have already developed bioenergy to a large extend have an existing infrastructure and industry and they can easier go ahead. However they might already have exploited a significant part of the biomass resource and/or covered a large share of the market (% of households heated by wood, % of district heating using biomass, etc.) and therefore the increase of bioenergy calculated as a percentage might be low. On the other hand MS with a small share of bioenergy could increase much more in terms of percentage.
- **Efficiency**: A goal in terms of primary energy is not sufficient and the final energy has to be considered, or in other words the efficiency of the conversion. For example the efficiency of biomass combustion to produce heat in modern installation reaches 90%, as compared to 25% -30% efficiency of biomass co-firing in power plants for electricity only. Therefore the new directive on heat should draw the attention on this efficiency and maybe state a minimum overall efficiency for biomass conversion, for example 75%.
- **Potential of the resource**: Targets should also take the potential of biomass into account, taking care of the other kinds of use of the wood (paper and pulp, sawn goods, board manufacture). If it appears that the potential does not fit the target measures should be taken to increase the resource (better techniques for collection of forest residues, agricultural crops for solid biofuels,etc.). Imports might also be considered from another MS or from outside the Union but for this latter option provisions should be stated to maintain sustainability.

Whatever the method used it will be necessary to consult the MS because it is extremely important to get their commitment for bioenergy development. This can be done through Biomass Action Plans. So the European Commission should propose some indicative targets, to be evaluated by each MS.

As the same biomass can be used for heat, electricity or liquid biofuels, the impact of biomass for each of these uses should be evaluated. Criteria like CO_2 mitigation, efficiency, energy independence, employment will help MS to allocate biomass where it is the most efficient. The situation might be different in each MS as well as the implementation possibilities (district heating network are sometimes absent, etc.).

The targets should be expressed in energy terms (toe and TWh) so that it is comparable among MS and with Eurostat data. In the national action plans the goals might be detailed in terms of scenarios of number of units and investments as it gives another approach for decision makers.

1.3 Three different approaches to set targets for 2020

As explained above for the period from now to 2010 the targets of the BAP should be used. But it is also necessary to develop targets for a longer time horizon to give clear signals for the economy and the consumers. These indicative targets could be revised every three to five years based on the experience gained. The targets for biomass should also be related to the demand for final energy and to basic principles of biomass deployment such as high conversion efficiency and a competitive cost structure.

We should keep in mind that roughly 50% of the final energy consumption goes to the heat market. Therefore balanced targets for heat, electricity and transportation biofuels should be envisaged. In addition due to thermodynamic laws (efficiency for cogeneration) the objective for electricity should be much lower than for heat.

Therefore the targets defined below are based on the following AEBIOM targets.

Table 2: Targets for 2010 and 2020

	2003 results	2010 targets BAP	2020 targets AEBIOM
Bioelectricity (TWh)	48	174	180
Biomass for electricity (Mtoe)	20,6	56	60*
Biomass for heat (Mtoe)	48,2	74,8	120
Liquid biofuels (Mtoe)	0,5	18,6	40
TOTAL (Mtoe)	69,3	149,4	220

*of which 36 for cogeneration and 24 for electricity only

Targets for 2020 are based on AEBIOM best estimates, being ambitious but still reasonable and realistic to reach. It should be noted that bioelectricity should not grow so much between 2010 and 2020 according to AEBIOM as the main emphasis (much) higher energy conversion efficiencies. These targets are below the biomass potential that has been estimated by the European Environmental Agency.

Three approaches are described below for target settings to each member states.

A Approach 1: Targets based on existing biomass for heat – different increase per country

The total biomass for heat in 2001 is given by the Commission[2], as well as the target of 74800 ktoe for EU25 countries in 2010 given in the Biomass Action Plan. As the countries are in different development stages regarding the use of biomass for heat, it would not be realistic to increase biomass for heat uniformly. For example one can't consider an equal increase in Finland where biomass represents about 1/3 of the total heat market and The Netherlands where biomass represents roughly 1% of the heat market. As a **tentative** approach of national targets for biomass for heat AEBIOM multiplied the national percentage of biomass for heat using the following formula:

Percentage in 2010 = percentage in 2001 x 1,25 + 2,87

This formula gives a linear increase of the biomass for heat: the smallest the percentage in 2001, the highest proportional increase. Using such calculation Belgium has to increase biomass for heat by a factor 2,6 (from 2 to 5,2%) while Sweden has to increase by a factor 1,34 (from 34 to 45.7%). When multiplied by the market for heat in 2010 we can calculate the needed biomass for heat in 2010.

The same calculation method is used by AEBIOM for 2020 to reach a target of 120 000 ktoe :

Percentage in 2020 = percentage in 2001 x 1,50 + 8,80

[2] European Commission, 2004, " The share of renewable energy in the EU. Country Profiles. Overview of Renewable Energy Sources in the Enlarged European Union", COMMISSION STAFF WORKING DOCUMENT SEC(2004) 547,{COM(2004)366 final}, 26.5.2004, 111 p - 2001 data

Table 3: Biomass for heat
National targets (ktoe* and %) for 2010 and 2020 calculated by AEBIOM

	Total fuels for heat market[3]	ktoe	as %	as %	ktoe	as %	ktoe
Year	2010	2001	2001	2010	2010	2020	2020
Austria	13.111	2.373	18	25,5	3.343	36,0	4.714
Belgium	20.346	384	2	5,2	1.064	11,6	2.367
Cyprus	679	3	0	3,3	23	9,4	63
Czech Republic	15.037	432	3	6,5	972	13,1	1.972
Denmark	7.218	891	12	18,3	1.321	27,3	1.972
Estonia	1.778	398	22	30,9	549	42,4	754
Finland	14.696	4.818	33	43,9	6.445	58,0	8.521
France	72.224	9.567	13	19,4	14.033	28,7	20.710
Germany	123.542	5.480	4	8,4	10.399	15,5	19.097
Greece	8.034	962	12	17,8	1.433	26,8	2.150
Hungary	10.830	302	3	6,4	689	13,0	1.407
Ireland	4.961	145	3	6,5	324	13,2	654
Italy	62.075	5.613	9	14,2	8.799	22,4	13.885
Latvia	2.459	592	24	33,0	811	44,9	1.104
Lithuania	2.315	574	25	33,9	784	46,0	1.065
Luxembourg	1.212	25	2	5,4	66	11,8	144
Malta	35	-	0	2,9	1	8,8	3
Netherlands	28.638	324	1	4,3	1.228	10,5	3.007
Poland	37.149	2.539	7	11,4	4.241	19,1	7.079
Portugal	9.031	1.885	21	29,0	2.616	40,1	3.623
Slovakia	6.392	103	2	4,9	312	11,2	717
Slovenia	2.332	383	16	23,4	546	33,4	780
Spain	36.194	3.383	9	14,6	5.268	22,8	8.261
Sweden	14.564	4.995	34	45,7	6.662	60,3	8.775
United Kingdom	69.574	700	1	4,1	2.873	10,3	7.176
EU 25	**564.423**	**46.870**	**8**	**13,3**	**74.800**	**21,3**	**120.000**

ktoe = thousands of ton oil equivalent

B Approach 2: Targets based on biomass for heat, cogeneration and electricity – uniform increase in all countries

Eurostat gives figures for biomass as part of the Gross Inland Consumption (GIC). In these figures liquid biofuels can be considered as negligible and therefore biomass covers biomass for heat and biomass for electricity (and also some waste for some countries).

The target for 2010 has been defined in the BAP (see Table 1). National objectives have been defined simply by multiplying the 2004 biomass contribution of each country by the same factor 1,82.

For 2020 the AEBIOM target is 180000 ktoe for EU25 (biomass for heat, cogeneration and electricity, without transportation biofuels). It can be reached by multiplying the 2004 figures by a factor 2,50.

[3] Based on Eurostat pocketbook, own calculation (final energy consumption minus transport, minus electricity), and corrected by an annual increase of consumption of 0.05% (IEA assumption).

This is obviously a simplistic way to calculate the national contributions that does not take into account the potential of the biomass resource and its current use (a country that would already exploit a significant part of the biomass potential cannot increase it by 250 %).

Table 4: Biomass as Primary Energy (ktoe, biomass for heat, cogeneration and electricity, without transportation biofuels)
National targets for 2010 and 2020 calculated by AEBIOM

	1999 Eurostat	2000 Eurostat	2001 Eurostat	2002 Eurostat	2003 Eurostat	2004 Eurostat	2010 AEBIOM	2020 AEBIOM
BE	597	596	673	627	864	913	1.661	2.286
CZ	589	444	510	637	1.036	1.324	2.409	3.315
DK	1.633	1.668	1.789	1.872	2.073	2.154	3.919	5.393
DE	6.384	6.830	7.300	7.929	8.643	9.367	17.041	23.451
EE	509	500	550	542	608	685	1.246	1.715
EL	913	946	970	996	945	953	1.734	2.386
ES	3.894	4.049	4.149	4.328	5.018	4.853	8.829	12.150
FR	11.232	11.579	11.802	11.134	11.739	12.007	21.844	30.060
IE	167	164	180	176	170	214	389	536
IT	1.624	1.572	1.653	1.637	2.012	3.145	5.722	7.874
CY	9	9	9	10	6	5	9	13
LV	1.456	1.284	1.411	1.584	1.776	1.866	3.395	4.672
LT	621	627	630	666	677	706	1.284	1.768
LU	36	44	46	44	51	59	107	148
HU	384	415	387	784	818	860	1.565	2.153
MT								-
NL	1.476	1.529	1.519	1.642	1.940	2.175	3.957	5.445
AT	2.910	2.819	3.140	3.204	3.411	3.452	6.280	8.642
PL	3.572	3.625	3.874	3.933	3.996	4.126	7.506	10.330
PT	1.933	2.053	2.583	2.838	2.842	2.877	5.234	7.203
SI	233	458	450	465	460	470	855	1.177
SK	73	100	328	260	331	385	700	964
FI	6.158	6.536	6.433	6.915	7.112	7.556	13.746	18.917
SE	7.929	8.330	7.967	8.174	8.773	8.883	16.160	22.239
UK	1.897	2.069	2.148	2.327	2.759	2.863	5.208	7.168
EU 25	**56.229**	**58.246**	**60.501**	**62.724**	**68.060**	**71.898**	**130.800**	**180.000**

A similar calculation could be done using the Gross Inland Consumption (GIC). In this case member states would have to reach a certain percentage of the GIC through biomass for energy.

C Approach 3: Targets for Biomass for heat

The best method to establish targets for bioenergy would be based on national enquiries. The sectors of heat – small scale and medium to large scale, cogeneration, electricity and second generation liquid biofuels should all be addressed in the same study.

Targets should be expressed as primary and final energy as described in 1.1. Objectives should also be compared with the potential of biomass at national, European and world levels.

The tables in Annex 1 are giving a first attempt for such targets. Starting from a reference in 2004, goals are defined for 2010 and 2020. Some AEBIOM members have defined these targets and conversion efficiencies. For the others AEBIOM used a factor that multiplies the 2004 figures to reach 74.800 ktoe in 2010 (BAP target) and 156.000 ktoe for 2020 (AEBIOM target for biomass for heat and cogeneration).

Based on estimated conversion efficiencies that should be increased for 2010 and 2020 based on technology improvements, one can calculate the bioheat and bioelectricity.

Defining such targets is obviously more complicated than the above mentioned approaches. However studies at national level with detailed objectives would be excellent instruments to highlight the need to address the different sectors separately and to increase the efficiency especially for the small scale individual systems.

Table 5: Biomass for heat and CHP (ktoe)
National targets for 2010 and 2020 calculated by AEBIOM

ktoe	Small scale individual heating systems for hou			Medium and Large scale boiler			CHP		
	2004	Objective 2010	Objective 2020	2004	Objective 2010	Objective 2020	2004	Objective 2010	Objective 2020
Austria	1.420	1.420	5.439	655	1.587	2.509	835	2.152	2.299
Belgium	188	621	720	191	631	732	-	-	-
Cyprus	-	-	-	-	-	-	-	-	-
Czech Republic	466	1.540	1.785	13	43	50	125	186	344
Denmark	485	1.603	1.858	478	1.580	1.831	844	1.254	2.323
Estonia	337	1.114	1.291	88	291	337	26	39	72
Finland	1.120	1.720	1.820	450	1.050	1.460	5.190	5.500	6.400
France	7.325	8.100	28.057	1.422	1.600	5.447	1.276	1.800	3.513
Germany	4.130	4.920	5.820	740	890	1.068	2.140	2.840	4.260
Greece	702	2.320	2.689	-	-	-	8	12	22
Hungary	496	1.639	1.900	3	10	11	22	33	61
Ireland	43	142	165	-	-	-	-	-	-
Italy	3.235	7.700	15.000	1.536	2.020	4.000	297	720	1.500
Latvia	696	2.300	2.666	278	919	1.065	3	4	8
Lithuania	432	420	400	95	120	200	9	106	200
Luxembourg	15	50	57	-	-	-	-	-	-
Malta	-	-	-	-	-	-	-	-	-
Netherlands	223	737	854	-	-	-	177	263	487
Poland	2.469	8.160	9.457	25	83	96	-	-	-
Portugal	1.158	3.827	4.436	-	-	-	922	1.370	2.538
Slovakia	31	102	119	7	23	27	186	276	512
Slovenia	324	1.071	1.241	9	30	34	84	125	231
Spain	2.019	6.673	7.733	-	-	-	780	1.159	2.147
Sweden	1.101	1.617	2.064	5.279	5.185	4.471	2.666	4.299	8.598
United Kingdom	226	747	866	59	195	226	176	262	485
0	-	-	-	-	-	-	-	-	-
EU25	28.641	58.544	96.437	11.328	16.256	23.563	15.766	22.400	36.000

2 Monitoring of progress towards reaching a target

It is essential for the Commission to set the framework for data collection through an agreed protocol with Eurostat. Proposals have been given in Deliverable 4 to improve the statistics.

Targets can be proposed by the Commission but the commitment of the member states is essential.

A monitoring procedure should be implemented to ensure that deviation from the target will appear as soon as possible so that corrective measures could be taken.

3 Conclusion

As it can be seen in this chapter biomass is not an easy issue as far as statistics and targets are concerned. Therefore several possibilities to define the current state of the market and target settings have been explained.

It is considered that the structure of the statistics and the targets as mention by Eurostat and in the Biomass Action Plan could be improved by dividing bioenergy into more items. Biomass for cogeneration would be particularly suited.

CHAPTER FIVE
GEOTHERMAL – SETTING VERIFIABLE TARGETS FOR EU 25

1 Methodology to set targets for 2020

Geothermal energy is a promising component of the renewable energy mix in the European Union. Geothermal energy is delivering heat and power 24 hours a day throughout the year, a resource nearly infinite and available all over Europe.

EGEC first makes some recommendations on how to define targets for geothermal heating and cooling and then presents figures on the market for 2020.

An issue for setting targets for geothermal heating and cooling is that first of all a unified definition of geothermal energy, at national and European level should be adopted soon and should be used in all regulations, communications and statistics. The EGEC proposal is to define geothermal energy as the energy stored in the form of heat beneath the surface of the solid earth. This definition includes direct uses and geothermal - ground source heat pumps (see Deliverable 4, chapter 2).

The first goal will be to present good statistics, to have a good view of the present situation for geothermal heating and cooling. After this the discussion of the perspectives have to be agreed by the geothermal community.

1.1 The overall methodology

A The present conditions

And, it is clear that the actual market conditions for energy have to be taken into account in all these perspectives for geothermal energy. The setting of targets implies boundary conditions to be taken into consideration:

- the current status of the geothermal market in the EU (in RES-H energy production per capita)
- the potential of geothermal energy based on a market study and an inventory of the resources in each EU country; and the market structures (e.g. penetration of district heating)
- achievable growth rates

The methodology has to concern:

- the different applications: DHW, space heating, cooling, process heat, etc.
- the kinds of usage: small residential, large residential, hotels, office buildings, swimming pools, agricultural applications, process heat in different kinds of industries (laundries, food industry, heat intensive industrial sectors ...), desalination, etc.

B Different approaches

To set targets for geothermal heating and cooling, different methodologies could be adopted.

A pragmatic approach will permit more easily to set targets, based on simplified conversion. The basis will be the actual installed geothermal systems.

Targets could be defined for specific technology (geothermal heat pumps, district heating, cooling etc.) and for different intermediate periods (2010, 2015).

But, it is recommended not to make projection only based on growth-rate, because for example the GSHP market is yet juvenile in a lot of countries and all conditions are not yet present to make such prospective.

Another approach to set targets, with a more detailed study, could take into account different structural elements:

- develop training of architects, heating engineers, construction companies, installers
- rates of new construction in Europe
- distribution chains of geothermal products
- penetration of district heating
- assumptions on technological development able to make innovative applications largely available and/or price reductions
- management of social and economic impact
- technological / market developments

1.2 The present situation and the targets for 2010

Concerning heating and cooling from geothermal resources: deep and shallow geothermal, the possibilities of accounting are double:

- the number of dwellings (objective 2010, 2015, 2020)
- the total production in MWth
- for deep geothermal systems, the number of dwellings in condensed regions (those suitable for district heating) and the geological potential (deep aquifers) are limiting factors

For geothermal heating and cooling two sectors have to be separated:

- **Shallow geothermal applications**: The market grows for 20 years, specially for ground source heat pumps, and represents yet half of geothermal heating and cooling. But the growth rates are high (20%) in the mature market, and a lot of countries are still in a juvenile stage. The expectations are great.

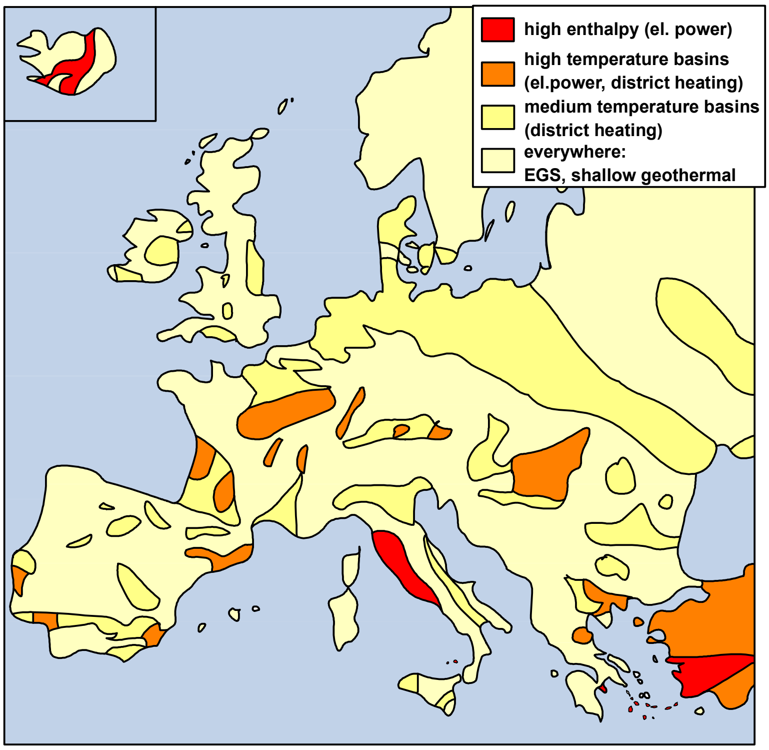
  If the sector is able to maintain an average annual growth rate of 15% of its capacity until 2010 (compared to ca. 14 % from 1995-2005), it could reach **10.700 MW$_{th}$** capacity in 2010 (from 4630 MWth in 2004).

- **Deep geothermal applications**: the technology is ancient, notably with district heating. The sector has rather good statistics on the actual situation. A potential exists in Eastern Europe.

  The difficulty for experts to determine the exact capacity of low and medium temperature geothermal applications makes the task of forecasting very hard with respect to the production of heat.

  However, with a basic year in 2004 showing an installed capacity of 4.241 MW$_{th}$ (see deliverable D2 - geothermal), a low increase of 50 MW$_{th}$ per year until 2010 would bring medium and low temperature capacity up to 4.540 MW$_{th}$, which seems a lower limit. An increase by 100 MWth per year is still a reasonable assumption on a EU-wide scale, which would result in **4.840 MW$_{th}$**.

  For the forecast and the setting of targets for deep geothermal systems, the geological potential has to be considered in addition to the demand. The demand can be determined by the number of dwellings in condensed regions (those suitable for district heating), and the geological potential by the existence of suitable deep aquifers with sufficient temperature and permeability (see figure below). Methods known as Enhanced Geothermal Systems (EGS), developed currently for geothermal power production (cf. the project in Soultz-sous-Forêts), may allow in the future to increase the geothermal potential to low-permeability areas, too.



Map showing suitable areas for deep geothermal systems in Europe

The combined number of 15.550 MWth, set from actual growth percentages for deep and shallow energy, is very close to the EGEC target of 16.000 MWth in 2010. It is much higher than the White Paper target of 10.000 MWth for 2010 (if 2004 is considered as a reference year with ca. 8.800 MWth).

The new Commission Guideline, the "Sustainable Energy Europe" programme, has determined new objectives to be reached between 2005 and 2008, i.e. 250.000 new heat pumps, 15 new electric power plants and 10 new low temperature power plants.

Taking current geothermal heat pump market growth into consideration (25% between 2003 and 2004), the new Commission objective appears to be completely feasible and attainable. Success of these objectives in terms of high and low temperature applications will mainly depend on the results of geothermal drillings that are currently underway and which will trigger investment decisions.

1.3 Pragmatic Setting of Targets for 2020

The trend 2001-2010 will probably show a growth rate for geothermal heating and cooling between 15% to 20%.

For the period 2010-2020, EGEC sets a rather moderate growth rate of 10% in the EU. Indeed the sector is still in a really juvenile stage in a lot of countries, especially in Southern and Eastern Europe, and mature in Northern Europe. The replication of good practices from a country to another one are often uncertain, and depending on local barriers.

The capacity installed for the EU-27 could reach ca. 40.000 MWth in 2020, representing 8 Mtoe.

These rates are extrapolated from the actual growth rate in the (Swiss), German, French and Swedish market were we can have verifiable data collected with a solid methodology.

Table 6: EGEC Targets for 2010 and 2020

Geothermal heating & cooling	2005	Target 2010	Target 2020
Installed capacity	8750 MW_{th} (EU 27)	16000 MW_{th}	39000 MW_{th}
Heat production	2,1 Mtoe	4 Mtoe	8 Mtoe

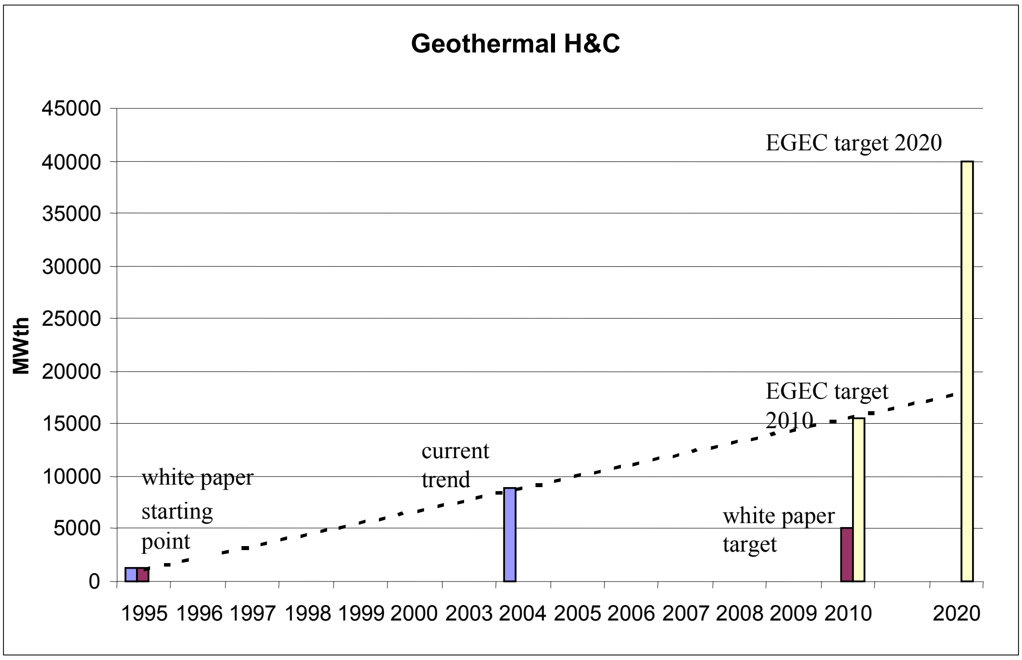


Table 7: Annual growth rates up to now and expected until 2020

Geothermal heating & cooling	Real growth 1995-2000	Real growth 2000-2004	Average growth 1995-2005	Average growth 2001-2010	Average growth 2010-2020
White Paper / Eurostat	3.3%	18.0%		11,7 %	
after projection EGEC			14.2 %	19,7 %	8,0 %

It is interesting to see that the targets set in 1999 by EGEC in the Ferrara Declaration were reachable and are verified today, specially for the mid-term target of 2010.

Table 8: Ferrara-Declaration of EGEC 1999 (for comparison)

	1998	**2010**	**2020**
Heat: Deep and shallow resources	920.000 dwellings 5.200 MW_{th}	3.000.000 dwellings 15.000 MW_{th}	12.000.000 dwellings 48.000 MW_{th}

2 Monitoring of progress towards reaching a target

2.1 Monitoring of Shallow Geothermal Energy

For the geothermal heat pump sector the monitoring is based on an Industry based / supply chain method. Each EU country has to realise a yearly survey on sales figures. It will permit to know the number of new installations.

An alternative exists: The licensing process for drilling as measurement of new installations is actually the methodology done in Switzerland with good success, and also in some other regions (e.g. in some German states, like in Hessen).

For old installations, data from all entities implied should be compared: national/local authority in charge of licensing, drillers, heat pumps companies, energy agencies.

Calculation of the energy delivery of geothermal systems (EGEC suggestion)

In a second step, in all ground source heat pump systems, there is a basic difference between the heat output to the heating system, and the geothermal heat input into the system (Qg). The auxiliary energy (mainly Qph) is always higher than 5 %, and is typically in the order of 20-30 % of the final energy output. Thus it cannot be neglected.

For the purposes of geothermal energy statistics, however, only the heat from the ground should be considered, and the heat output corrected by the annual average COP. The formula then should be completed as follows:

$$P = Qmean * ha * ((COP-1)/COP)$$

with:

- P: the annual heat delivery [kWh/a]
- Qmean: the heating capacity (heat output) of the heat pump [kW]
- ha: annual operation hours (full-load hours depending on the climate) [h/a]
- COP: the seasonal mean COP

A specific problem for GSHP is given for the number of sales, in the fact that the different types of heat sources for the heat pump are often not distinguished, so a guess on the fraction of GSHP in the total heat pump sales has to be made (e.g. in Germany, the figures for 2005 show that more than 70% of HP sales are GSHP)

As further steps, the countries need to agree on the methodology of sampling and calculation.

Reliable statistics of the sales numbers should be established in all countries, distinguishing at least the heat sources (groundwater, ground incl. direct expansion) and some capacity classes (e.g. <5 kW, 5-10 kW, 10-15 kW, 15-25 kW, 25-50 kW, 50-100 kW, 100-250 kW, and exact values for those above). For the full-load hours and COP, more monitoring campaigns are required to get sufficient data for extrapolation, and for calibration of methods to calculate the values from climatic data, etc.

The heat pump output and efficiency (COP or SPF) should be given according to standards EN 255, EN 14511, EN 15450, or other applicable standards of the member states.

2.2 Deep geothermal Energy

For deep geothermal applications, the methodology cannot be based on the industry supply chain.

For the district heating and industrial applications data from public communication, public authorities, in particular municipality and region, geothermal associations and energy agencies have to be collected and compared. For agricultural and industrial applications, drillers could be the good source to collect statistics.

Because most of the deep geothermal systems are subject to licensing and supervision by authorities (typically on a regional level), these authorities are key information sources for statistics on deep geothermal applications.

For the quantification of heat delivery from geothermal district heating plants, EGEC agrees with the proposals of the ThERRA-project (slightly adjusted):

> Proposal 1 - monitoring: Data from monitoring (system temperatures and flow rates as well as efficiency). This is the most preferable method and should be the standard in any district heating application.
>
> Proposal 2 – plant side estimation: Calculation of the renewable heat output from the nominal, installed capacity (ground), the number of full load hours and the system efficiency. This method can replace proposal 1 for smaller plants (without monitoring), in agriculture etc. In general this is the default method for smaller geothermal heat pump plants (shallow geothermal energy).
>
> Proposal 3 – load side estimation: Calculation of the renewable heat from geothermal plants from the demand side. Based on the definition of the number of equivalent households connected to the geothermal plant and considering an average heat demand of these households, the total heat delivered to the households can be calculated. This method only works for district heating networks, and it is the least desirable. In such installations typically a monitoring system should be installed. The accuracy of the estimation is low, in particular in a district heating net with diverse demand structure.

3 Conclusion

This chapter presents different methodologies on how to set verifiable targets for 2020 in the geothermal heating and cooling sector. It is not an easy task considering the difficulties to have good statistics on the actual situation. But it is important to secure the market and plan the investments.

The targets set 10 years ago in the Ferrara Declaration are reached. So the methodology adopted was good and the figures realistic.

But for longer term target the forecasts are more difficult. The market conditions will play a big role. A future creation of a Technology Platform will be more than useful. Indeed, a European Geothermal Energy Technology Platforms could:

- Provide a framework for stakeholders to define research and development priorities, timeframes and action plans in the medium to long term.
- Play a key role in ensuring an adequate focus of research funding
- Address technological challenges that can potentially contribute to a number of key policy objectives.

CHAPTER SIX
TARGETS FOR RES-H IN EUROPE AND RECOMMENDATIONS

1 Targets for RES-H in Europe

The following table shows an overview of the different targets developed by ESTIF, AEBIOM and EGEC for 2020.

Table 9: Targets for RES-H in Europe in 2020

ESTIF targets	
EU 25 totally installed capacity	320 GW_{th}
Average target EU 25 (installed capacity)	700 kW_{th}/1.000 capita
Minimum target per country ("Austria Benchmark")	199 kW_{th}/1.000 capita
EU 25 heat production	19.700 ktoe
AEBIOM targets	
EU 25 biomass for heat	120.000 ktoe
EU 25 biomass for heat, cogeneration	156.000 ktoe
EU 25 biomass for heat, cogeneration and electricity	180.000 ktoe
EGEC targets	
EU 25 totally installed capacity	40 GW_{th}
EU 25 heat production	8.000 ktoe

2 Recommendations

The setting of binding and indicative targets is an important step in policy making. K4RES-H gives the following recommendations for target setting and monitoring.

- Targets have to be clear and concrete
  General target without numbers such as 'increase the share of renewables in the heating sector' are not very useful. While a specific target such as for example "In each member state X thousands of ton oil equivalent final heat from biomass should be produced by 2010 and 2020" is much more clear.

- Pragmatic target setting for 2020 instead of detailed studies
  Changes do not come over night and policy measures will take time to take full effect. For the setting of 2020 targets, one can start with what has been achieved today and extrapolate from this level taking into account the framework conditions that are to be realised to promote RES-H.
- Different approach for target setting for periods far beyond 2020
  A longer-term target would have to take into account longer term scenarios for the

heating and cooling demand as well as the expected – or possible – technical development. Today's level of RES heating and cooling has almost no influence on the longer term result. Therefore, an extrapolation from today's penetrations would not be appropriate to set a longer term target

- Setting targets for each member state
  Targets should be set for each country. The target setting should take into account country specific factors like the current use of RES in the country, differences in heat demand (Southern Europe vs. Northern Europe) and the limited potential of the resources (biomass, geothermal).

- Intermediate targets and monitoring are essential
  Waiting until 2020 only to find out that a target was missed, is not sensible. Instead the progress must be verified in frequent intervals and policy measures adapted where necessary

Nevertheless, setting verifiable absolute targets for RES heating and cooling implies also the solution of various statistical issues. These issues was tackled in Deliverable 4 of the K4RES-H project

ANNEX - CALCULATION OF TARGETS FOR BIOMASS (APPROACH 3)

Preliminary definitions

all figures below in **ktoe** (1000 ton oil equivalent = 41868 GJ = 11630 MWh)
Small scale individual heating systems are systems for households (but if you would like another definitions, like systems below 100 kW, please indicate)
Medium and Large scale boiler : for industries and district heating, for all types of fuel (wood, straw, biodagradable part of waste)
CHP: cogeneration, including for all types of fuel (biogas, wood, straw, biodagradable part of waste)
Efficiency : ratio between energy content of biofuel and energy content of final energy after conversion under real life conditions (not laboratory numbers)

Bioheat in 2004

ktoe	Small scale individual heating systems for households			Medium and Large scale boiler			CHP					Total		
	biomass for heat	Efficiency	bioheat	biomass for heat	Efficiency	bioheat	biomass for CHP	Efficiency for heat	Efficiency for electricity	bioheat	Bio-electricity	biomass for heat and CHP	overall efficiency	bioheat
Austria	1420	69%	980	655	80%	524	835	55%	25%	459	209	2.910	67%	1.963
Belgium	188	50%	94	191	80%	153						379		247
Cyprus	0		0			0						0		0
Czech Republic	466	50%	233	13	80%	10	125	40%	25%	50	31	604	49%	293
Denmark	485	50%	243	478	80%	382	844	40%	25%	338	211	2.030	47%	963
Estonia	337	50%	169	88	80%	70	26	40%	25%	10	7	573	0%	
Finland	1.120	70%	784	450	85%	383	5190	60%	30%	3.114	1.557	6.760	63%	4.281
France	7325	40%	2.930	1422	80%	1.138	1276	40%	25%	510	319	10.023	46%	4.578
Germany	4.130	63%	2.602	740	78%	577	2140	22%	27%	471	578	7.010	52%	3.650
Greece	702	50%	351		80%	0	8	40%	25%	3	2	710	50%	354
Hungary	496	50%	248	3	80%	2	22	40%	25%	9	6	521	50%	259
Ireland	43	50%	22		80%	0		40%	25%			43		22
Italy	3.235	40%	1.294	1.536	85%	1.306	297	78%	20%	232	59	5.068	56%	2.832
Latvia	696	50%	348	278	80%	222	3	40%	25%	1	1	977	59%	572
Lithuania	432	70%	302	95	85%	81	9	50%	30%	5	3	536	72%	388
Luxembourg	15	50%	8		80%	0		40%	25%			15		8
Malta		50%	0		80%	0		40%	25%			0		0
Netherlands	223	50%	112		80%	0	177	40%	25%	71	44	400	46%	182
Poland	2469	50%	1.235	25	80%	20		40%	25%			2.494		1.255
Portugal	1158	50%	579		80%	0	922	40%	25%	369	231	2.080	46%	948
Slovakia	31	50%	16	7	80%	6	186	40%	25%	74	47	224	43%	96
Slovenia	324	50%	162	9	80%	7	84	40%	25%	34	21	417	49%	203
Spain	2019	50%	1.010		80%	0	780	40%	25%	312	195	2.799	47%	1.322
Sweden	1.101	65%	716	6.552	85%	5.569	360	50%	30%	180	108	8.013	81%	6.465
United Kingdom	226	50%	113	59	80%	47	176	40%	25%	70	44	461	50%	231
EU25	**28.641**	**51%**	**14.547**	**12.601**	**83%**	**10.498**	**13.460**	**47%**	**27%**	**6.313**	**3.671**	**55.047**	**57%**	**31.108**
Biomass for heat only	**41.242**													

Bioheat targets 2010

ktoe	Small scale individual heating systems for households			Medium and Large scale boiler			CHP					Total		
	biomass for heat	Efficiency	bioheat	biomass for heat	Efficiency	bioheat	biomass for CHP	Efficiency for heat	Efficiency for electricity	bioheat	bioelectricity	biomass for heat and CHP	overall efficiency	bioheat
Austria	1.420	80%	1.136	1.587	80%	1.270	2.152	57%	23%	1.218	503	5.159	70%	3.624
Belgium	621	60%	373	631	85%	537		45%	27,5%			1.253		909
Cyprus	0	60%	0	0	85%	0		45%	27,5%			0		0
Czech Republic	1.540	60%	924	43	85%	37	186	45%	27,5%	84	51	1.769	59%	1.044
Denmark	1.603	60%	962	1.580	85%	1.343	1.254	45%	27,5%	564	345	4.437	65%	2.869
Estonia	1.114	60%	668	291	85%	247	39	45%	27,5%	17	11	1.443	65%	933
Finland	1.720	60%	1.032	1.050	85%	893	5.500	45%	27,5%	2.475	1.513	8.270	53%	4.400
France	8.100	60%	4.860	1.600	85%	1.360	1.800	45%	27,5%	810	495	11.500	61%	7.030
Germany	4.920	65%	3.198	890	80%	712	2.840	25%	28%	710	795	8.650	53%	4.620
Greece	2.320	60%	1.392	0	85%	0	12	45%	27,5%	5	3	2.332	60%	1.397
Hungary	1.639	60%	984	10	85%	8	33	45%	27,5%	15	9	1.682	60%	1.007
Ireland	142	60%	85	0	85%	0		45%	27,5%			142		85
Italy	7.700	50%	3.850	2.020	85%	1.717	720	80%	22%	576	158	10.440	59%	6.143
Latvia	2.300	60%	1.380	919	85%	781	4	45%	27,5%	2	1	3.224	67%	2.163
Lithuania	420	75%	315	120	85%	102	106	50%	30%	53	32	646	73%	470
Luxembourg	50	60%	30	0	85%	0		45%	27,5%			50		30
Malta	0	60%	0	0	85%	0		45%	27,5%			0		0
Netherlands	737	60%	442	0	85%	0	263	45%	27,5%	118	72	1.000	56%	561
Poland	8.160	60%	4.896	83	85%	70		45%	27,5%			8.243		4.966
Portugal	3.827	60%	2.296	0	85%	0	1.370	45%	27,5%	617	377	5.197	56%	2.913
Slovakia	102	60%	61	23	85%	20	276	45%	27,5%	124	76	402	51%	206
Slovenia	1.071	60%	642	30	85%	25	125	45%	27,5%	56	34	1.225	59%	724
Spain	6.673	60%	4.004	0	85%	0	1.159	45%	27,5%	522	319	7.832	58%	4.525
Sweden	1.617	75%	1.213	5.185	85%	4.407	4.299	60%	30%	2.579	1.290	11.101	74%	8.199
United Kingdom	747	60%	448	195	85%	166	262	45%	27,5%	118	72	1.203	61%	732
EU25	58.544	60%	35.192	16.256	84%	13.694	22.400	48%	27%	10.664	6.156	97.200	61%	59.549
Biomass for heat only	74.800													

Bioheat targets 2020

ktoe	Small scale individual heating systems for households			Medium and Large scale boiler			CHP					Total		
	biomass for heat	Efficiency	bioheat	biomass for heat	Efficiency	bioheat	biomass for CHP	Efficiency for heat	Efficiency for electricity	bioheat	bioelectricity	biomass for heat and CHP	overall efficiency	bioheat
Austria	6.089	85%	5.176	2.809	90%	2.528	2.757	50%	30%	1.379	827	11.655	78%	9.082
Belgium	806	70%	564	819	90%	737		50%	30%			1.625		1.301
Cyprus	0	70%	0	0	90%	0		50%	30%			0		0
Czech Republic	1.998	70%	1.399	56	90%	50	413	50%	30%	206	124	2.467	67%	1.655
Denmark	2.080	70%	1.456	2.050	90%	1.845	2.787	50%	30%	1.393	836	6.916	68%	4.694
Estonia	1.445	70%	1.012	377	90%	340	86	50%	30%	43	26	1.908	73%	1.394
Finland	1.820	75%	1.365	1460	90%	1.314	6400	50%	30%	3.200	1.920	9.680	61%	5.879
France	31.410	70%	21.987	6.098	90%	5.488	4.213	50%	30%	2.107	1.264	41.720	71%	29.581
Germany	5.820	70%	4.074	1.068	83%	886	4.260	30%	29%	1.278	1.235	11.148	56%	6.238
Greece	3.010	70%	2.107	0	90%	0	26	50%	30%	13	8	3.037	70%	2.120
Hungary	2.127	70%	1.489	13	90%	12	73	50%	30%	36	22	2.212	69%	1.537
Ireland	184	70%	129	0	90%	0		50%	30%			184		129
Italy	15.000	60%	9.000	4.000	90%	3.600	1.500	90%	30%	1.350	450	20.500	68%	13.950
Latvia	2.984	70%	2.089	1.192	90%	1.073	10	50%	30%	5	3	4.186	76%	3.167
Lithuania	400	80%	320	200	85%	170	200	50%	30%	100	60	800	74%	590
Luxembourg	64	70%	45	0	90%	0		50%	30%			64		45
Malta	0	70%	0	0	90%	0		50%	30%			0		0
Netherlands	956	70%	669	0	90%	0	584	50%	30%	292	175	1.541	62%	962
Poland	10.587	70%	7.411	107	90%	96		50%	30%			10.694		7.507
Portugal	4.965	70%	3.476	0	90%	0	3.044	50%	30%	1.522	913	8.010	62%	4.998
Slovakia	133	70%	93	30	90%	27	614	50%	30%	307	184	777	55%	427
Slovenia	1.389	70%	973	39	90%	35	277	50%	30%	139	83	1.705	67%	1.146
Spain	8.657	70%	6.060	0	90%	0	2.576	50%	30%	1.288	773	11.233	65%	7.348
Sweden	2.064	80%	1.651	4.471	90%	4.024	8.598	60%	30%	5.159	2.579	15.133	72%	10.834
United Kingdom	969	70%	678	253	90%	228	581	50%	30%	291	174	1.803	66%	1.197
EU25	104.959	70%	73.222	25.041	90%	22.452	39.000	52%	30%	20.108	11.657	169.000	69%	115.782
Biomass for heat only	130.000													