ecoheatcool

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ECOHEATCOOL

Work package 6

Project Recommendations

This report is published by Euroheat & Power whose aim is to inform about district heating and cooling as efficient and environmentally benign energy solutions that make use of resources that otherwise would be wasted, delivering reliable and comfortable heating and cooling in return.

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Up-to-date information about Euroheat & Power can be found on the internet at www.euroheat.org

More information on Ecoheatcool project is available at www.ecoheatcool.org

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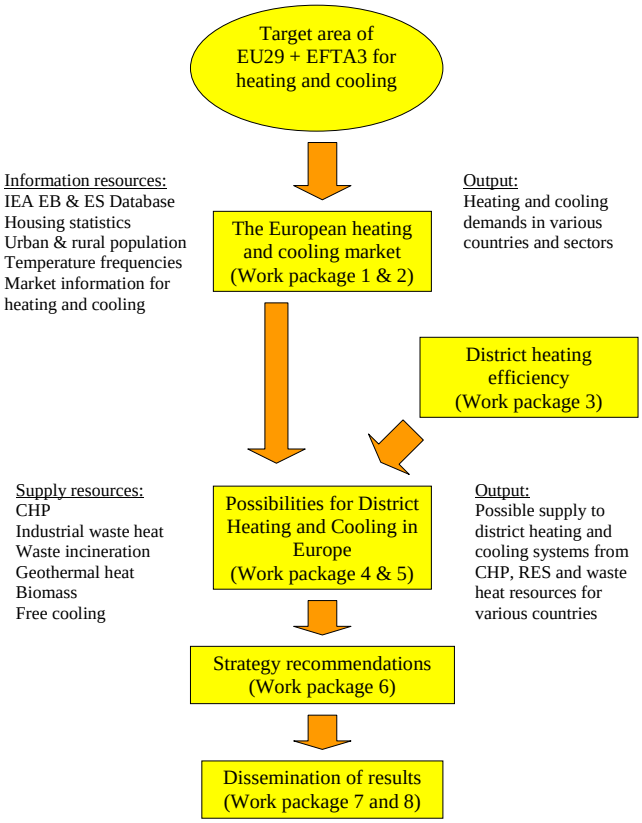

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Italian District Heating Association, Italy

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Work Package 6 - Recommendations

Twenty per cent less energy consumption, twenty per cent less CO_2 and twenty per cent renewables by 2020. These targets are the ambitions Heads of State and Government set for the European Union in spring of 2007. In other words: Europe must reduce losses in its energy balance and must reduce the use of fossil fuels.

The Ecoheatcool project shows promising pathways and proposes concrete measures for achieving these goals.

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1. Ten top priorities - Executive summary

1. End-use demands: Heating and cooling markets need more attention and be systematically addressed by European and national legislation

- The heating and cooling markets offer tremendous opportunities to reduce the use of scarce and precious fossil fuels in Europe.
- While being affected by all policies on electricity, gas or specific fuels, the heating and cooling markets have their own specificities that need to be taken into account.

2. Urban areas: Heating and cooling policies should prioritise action in urban areas.

- Three quarters of the European population live in urban areas and around half in multi-family buildings, measures targeting urban areas can be expected to have the biggest impact
- District heating and cooling grids allow to systematically build up coverage for residential and service sector demands.

3. Local conditions: Sitting production facilities and infrastructure planning / support must be based on cost/benefit analysis of the various supply options.

- Heating and cooling markets are local, demand-driven markets. Tailor-made solutions are required to connect demands to locally available surplus heat and renewable resources**.**
- It is essential that public authorities get actively engaged in cost/benefit analysis and subsequent planning with a view to ensuring that those options are chosen which will be the most beneficial for the community as a whole.

4. Statistics and monitoring: EU and national governments need to ensure better monitoring of local heating and cooling markets to enable proper analysis and policymaking

- Policy making must be based on solid facts and figures. Current statistics do not provide a complete picture of heating and cooling markets.
- The EU should ensure continuous and complete monitoring.

5. Resource efficiency: Impact of all legislative measures and energy investments must be evaluated from a primary resource perspective

- The distinction between demand and supply sides does not reflect the reality of the complex energy system anymore. Focus on a single energy source or technology can result in sub-optimal and inefficient use of resources
- The concept of resource efficiency combines energy efficiency with the use of renewables from the perspective of reduced fossil fuel use. It reconciles the three objectives of EU energy policy: security of supply, climate protection and competitiveness
- Primary resource factors (PRF) which take into account the whole chain from energy conversion to delivery to the final end customer should be systematically used to assess and compare the resource efficiency of all heating and cooling options.

6. DHC Policies: Barriers exist in form of inadequate legal frameworks. DHC must be systematically integrated in and promoted by adequate policies as one of the most effective tools to reduce Europe's fossil fuel consumption.

- The Ecoheatcool project shows the enormous possibilities of district heating and cooling: higher energy efficiency, higher security of supply, lower carbon dioxide emissions
- District heating and cooling systems are highly profitable from a national economy perspective. However, they are longterm commitments while liberalised energy markets prioritise short term commitments with shorter payback periods.
- The EU, governments and authorities should help to overcome these barriers by giving DHC a more prominent role in policymaking and by providing an adequate framework for planning, promotion and authorisation.

7. DHC Expansion: Policies need to consider DHC as important tool to optimise energy use and should prioritise expansion and establishment of new DHC systems in markets, which are not yet mature.

- There is enormous scope for extending the contribution of DHC to reduce fossil fuels and heat losses in Europe's energy balance. Market penetration of District Heating is higher in smaller countries than in five largest EU countries. Market penetration of District Cooling is higher in Nordic than in Southern European countries. The EU must encourage the transfer of experiences on with DHC, also in its international cooperation agreements.

8. DHC Improvement: In the new Member States (EU-12) policies should prioritise market stabilisation, financing system rehabilitation and give incentives for system improvement.

- The high market shares of district heating in the new Member States provide an excellent starting point for bringing higher efficiency and more renewables to the heating and cooling markets.
- However, given the need for investment in system improvements, market stabilisation and customer satisfaction are paramount.

9. Allocation: Benefits and costs related to the use of RES/CHP should be properly allocated between parties to enable fair return on the infrastructure investment

- DHC systems provide the necessary infrastructure for the larger scale uptake of RES/CHP
- While the benefits (including avoided cost for alternative investment and environmental savings) resulting from the integration of surplus and renewable energy sources are huge for the local community and society as a whole, they do not necessarily generate profit for the DHC system operator. Attention must thus be given to the proper allocation of the costs and benefits between all beneficiaries.

10. Research and Dissemination: Research programmes should target actions to cut costs for DHC equipment; EU should provide a long-term framework for benchmarking and transfer of best knowledge / legislative practice

- To ensure that research efforts benefit a larger number of stakeholders and to foster continued system adaptation with a view to enabling more and better integration of surplus and renewable energies, a dedicated European platform / programme providing improved financial and material basis for joint research activities on district heating and cooling is indispensable.

2 Recommendations for policy-makers

The energy balance of the 32 countries clearly shows that heat demands dominate the end-use of energy. At the same time, large amounts of heat are being lost in energy transformation processes (cf. Annex Figure 1). Here lies an enormous opportunity: These losses can be "recycled" to cover genuine heating and cooling comfort demands - provided the necessary infrastructures (heating and cooling grids) are put in place. This implies the establishment of mechanisms allowing to overcome the inertia of the current energy system, in which policies to foster the use of renewable energies and to enhance efficiency strongly focused on electricity, based on traditional ways of thinking in terms of "supply side" and "demand side".

Only since recently, attention is shifting to the heating and cooling markets. But what do politicians need to know when addressing these markets? Partners in the Ecoheatcool project have screened the wealth of findings of the project with a view to formulate policy recommendations. A tentative set of 10 recommendations has been discussed at the 3rd workshop:

1. Energy end-use demands: Heating and cooling markets need more attention and be systematically addressed by European and national legislation

Heat represents almost 70% of all end-use demands. Most of these demands are covered by fossil fuels (natural gas, oil) and electricity. Almost 50% of Europe's natural gas consumption relates to the production of heat.

For cooling demands which are more difficult to be identified as they are embedded in electricity use, it can be estimated that they presently account for 8% of the annual electricity generation in the EU-15 and will continue to grow rapidly. Already today cooling demands add more and more heavy constraints on the electricity grids during summer.

However, growing electricity demands are a serious concern given high transformation losses and the current need for new investments in both production and network capacity. Natural gas is one of most precious fossil fuels which in proportion of up to 60 % have to be imported from third countries.

Thus, there are at least three good reasons to have a closer and systemic look on both existing and possible future legislation affecting the heating and cooling market: the need to limit the growth of electricity consumption, the need to reduce Europe's high dependence on imported fossil fuels, and the need to preserve our climate for future generations

The Ecoheatcool project underlines the European dimension of the question. The Southern European countries have much lower heat demands than the Northern Europeans? The new Member States consume or waste more heat per m2 than the old Member States? Only myths. As a matter of fact, space heat demands vary by far less between the North and South of Europe, the EU-10 and the EU-15 than one would have expected

So far, the European Union has concentrated on the liberalisation of the electricity and gas markets with little consideration of its effects in the heating and cooling market. However, any policy that is adopted for electricity and gas has major impact on the heating and cooling markets. Being local markets and demand driven, these have their own specificities that need to be taken into account.

- Heating and cooling should benefit from increased attention and be integral part of European and national energy policy. Similar treatment with electricity and gas can lead to missed opportunities offered by local solutions
- Coherent and integrated approach for European legislative initiatives is required to ensure a balanced policy framework which duly recognises local solutions as an important factor for achieving European policy goals.
- Given the dynamics of market development, steering measures need to taken early in order to ensure that sustainable cooling technologies including district heating and cooling are used to cover cooling demands.
- Policies on heating and cooling must be based on both top down (taking into account the national energy priorities and mix) considerations and bottom –up measures (making use of local specificities, available sources, replication of successful experiences).

2. Urban areas: Heating and cooling policies should prioritise action in urban areas.

To be cost-effective and maximise impact policies should focus on measures targeting areas with high heating and cooling loads. Three quarters of the European population live in urban areas, and almost half of dwellings are located in multi-family buildings. Most of the service sector demands are located in urban areas as well. Cooling demands are highest in the service sector. Hence, most of the heating and cooling demands are located in urban areas. To maximise their impact, heating and cooling policies should thus primarily look for sustainable solutions to satisfy urban needs.

Today, most of the biomass use is concentrated in rural areas. To further expand the use of biomass with a view to achieving the European Union's renewable target (5x20), a shift of focus is required. At the same time, most of Europe's waste is being produced in urban areas and the efficiency of waste incineration plants could be substantially increased by the recovery of heat.

Thus, to significantly reduce fossil fuel consumption for heating and cooling purposes, more efforts are needed to integrate renewable energies and efficiency technologies in urban areas. District heating and cooling grids are an instrument of choice to systematically build up coverage of these urban demands.

- Heating and cooling policies should take into account the specificities of urban structures and focus on the establishment of district heating and cooling grids as infrastructures to allow for the largest possible outreach of innovative conversion technology together with available renewable and surplus heat resources.

3. Local conditions: Policies need to carefully address issues related to sitting production facilities and infrastructure planning

Heating and cooling markets are local markets and demand-driven. Therefore, and different than electricity and gas, heat cannot simply be produced and "pushed" to a very wide geographical market. Hence the local community needs to be involved very closely in all developments.

Tailor-made solutions are required to connect demands to locally available surplus heat and renewable resources. Which resources are or could be made available locally by integrating key community functions such as water supply, energy supply, waste management, even transport fuel supply? How can resources, which are considered waste by neighbouring industries, be recycled? By bringing waste incineration closer to cities rather than establishing them on the green field, it becomes possible to cover heat demands by recovering the heat from the incineration plant and thereby significantly improving its environmental records while replacing fossil fuels in individual boilers.

- Policies should encourage the direct involvement of communities both in the necessary mapping of heating and cooling loads, evaluation of available supply options and take the results into consideration when planning and authorising new installations

The Ecoheatcool project shows that investment in district heating and cooling infrastructures is highly profitable for local communities and national economies, especially when energy prices are high. However, the investor does not necessarily benefit from these advantages. Furthermore, deregulation and liberalisation of the energy markets prioritise short term commitments with shorter paybacks while energy efficiency technologies such as district heating and cooling are capital intensive long term commitments.

In addition, the development of a district heating or network supplying cooling implies not only major investments but also compliance with authorization and licensing procedures to which individual technologies are not submitted. Long and uncertain negotiations with authorities can become a barrier for district projects.

To correct these market failures

- Communities should consider support of / participation in the infrastructure investment.
- Policies should ensure increased market value of non-fossil resources , i.e. by taxation of fossil fuels, taxation of heat that is not recycled but wasted, and/or bonus/incentive systems for heat recycling
- Policies should help to create the awareness of the European citizens for the contribution of district heating and cooling systems to a sustainable energy future
- Procedures for developing infrastructures should be clear, transparent and quick enough to facilitate the development of district projects

4. Statistics: EU and national governments need to ensure better monitoring of local heating and cooling markets in cooperation with professional associations to enable proper analysis and policymaking

Policy making needs to be based on solid facts and figures. However, current statistics do not provide the complete picture of heating and cooling markets. District heating data are often not properly transferred from the national to the international level. In European statistics, about one fourth of district heating deliveries are not recorded in the relevant databases. However, incomplete district heating and cooling statistics lead to distortions in energy modelling. Mistakes are carried forward and thereby multiplied. While national and international professional associations often dispose of a more accurate and complete picture of the sector, policymakers only accept official data from statistical offices as a basis for discussion and decision.

No relevant European survey currently exists neither on cooling nor on hot water consumption though the latter represents between ¼ and 1/3 of the residential sector heat demands. While electricity and gas prices are well documented at European level, there is no aggregate European information on heat prices available which would allow to compare district heating and cooling performance with alternatives on a fair basis.

- Responsible statistic offices at national and international level should take up the identified issues and establish close cooperation with the national and European professional associations with a view to improving data
- Proper monitoring of the heating and cooling markets including developments in the district heating and cooling sector should be made mandatory.

5. Resource efficiency: Impact of all legislative measures and energy investments must be evaluated from a primary resource perspective

The traditional distinction between demand and supply sides does not reflect the reality of the complex energy system anymore. Focus on a single sector, energy source or technology can result in sub-optimal and inefficient use of resources. Often, the promotion of specific renewable or energy efficiency technologies is presented as a goal in itself. Intelligent energy solutions take up what cannot be used in one sector to make it available in another. They will develop, if reduction of end-use, use of more efficient technologies at all levels and increased use of renewables are optimally combined and assessed in terms of their resource efficiency, i.e. their ability to reduce the consumption of fossil primary energy. This is even more true as an application which contributes to saving primary fossil fuels in one local situation does not necessarily have the same effect in other circumstances.

Therefore, the overriding principle must be to evaluate every measure in the context of its application and in respect of its capacity to contribute to the overall objective of reducing fossil fuel consumption. To give a fair picture, an assessment encompassing the whole supply chain - from conversion to delivery - is needed that enables local decision-makers and customers to evaluate available alternatives. When comparing different possibilities for heating a building, one will realize that the energy consumption for heating the building is the same, no matter how the energy is fed into it. But only looking at the system as a whole, including the transformation, conversion and transport of the energy to the building, we get a picture of how much fossil fuels have been used to supply this energy.

The systematic use of primary resource factors (PRF) would make it possible to have a comprehensive assessment of the contribution of different heating and cooling options to reduce losses and fossil fuel supply in the energy balance. Furthermore, when it comes to quantifying effects of different policy measures, double counting (i.e. on the demand and on the supply side) would be largely avoided and transparency enhanced. Instead of competing with each other, energy efficiency and renewable policies would finally go hand in hand.

- European and national policies should shift their focus from separate policies on either energy efficiency or renewable energies to resource efficiency. Reducing fossil fuel consumption and heat losses in the energy balance implies reduced import dependency and increased security of supply
- Primary resource factors are an ideal tool to make sure that efficiency measures and renewable energies both on the demand and supply side will go hand in hand and be fairly evaluated in comparison to other options!

6. DHC Policies: Barriers exist in form of inadequate legal frameworks. DHC must be systematically integrated in and promoted by adequate policies as one of the most effective tools to reduce Europe's fossil fuel consumption.

The Ecoheatcool project impressively shows the possibilities of district heating and cooling: from higher energy efficiency and higher security of supply to lower carbon dioxide emissions. To fully reap these benefits, district heating and cooling must be given a more prominent role in policymaking.

Varying fossil fuel prices, existing infrastructure (particularly gas networks), low public awareness or social habits combined with inconsistency in EU / national policies and short term profits as main decision making criteria restrain the growth of existing and the establishment of new district heating and cooling schemes**.**

- Policy-makers need to avoid market distortions to the detriment of district heating and cooling systems which could arise from regulation in other sectors (i.e. avoid cross-subsidies from larger to smaller natural gas consumers)
- The willingness to foster the expansion of district heating and cooling must be explicitly stated in governmental and EU policies to provide long-term perspectives to potential investors
- Tariff regulation, also and in particular for social reasons, in the district heating and cooling as well as in competing sectors can constitute a major barrier to the expansion of district heating and cooling and hence must be very carefully handled

7. DHC Improvement: Policies should prioritise market stabilisation, financing system rehabilitation and give incentives for system improvement, social dimension must be considered and distortions disadvantaging DHC and its customers avoided.

While every country has its specificities when it comes to the position of district heating and cooling in the heating and cooling markets, the comparison between the new EU Member States with the EU-15 in the Ecoheatcool study allows to draw a few general conclusions. Heat costs represent a larger fraction of the GDP in EU-10 than in EU-15 , with cost of heat representing 40% higher financial burden for Central and Eastern European countries. Tariff regulation in the new Member States, for social reasons or as an element of industrial policy, tends to distort heating and cooling market (see also under 6). Heat distribution losses are higher in EU-10 than in EU-15, while share of recycled heat (heat from CHP, surplus heat from industrial processes) and the share of renewable energies is lower (60% -70%) in comparison to the EU-15 (80%-100%). District cooling is in its very beginnings.

These differences need to be taken into account when defining priorities. District heating is more widely spread in the new EU Member States. The existing infrastructure provides an excellent starting point for bringing better resource efficiency to the heating and cooling markets, but currently does not yet fully correspond to the "fundamental idea" of district heating which is to recycle heat that otherwise would be wasted. Given the need for investment in system improvements, market stabilisation and customer satisfaction are paramount.

- In the new EU Member States (EU-10) and the accession countries, policies should in the first instance focus on improving the performance of existing scheme to provide maximum customer satisfaction and hence avoid massive disconnections which risk to destabilize the market
- Attention should be given to improving the efficiency and environmental records of existing schemes by increasing the use of surplus heat from power generation (CHP) and conversion from fossil fuels to renewables
- Such policies need to acknowledge regional specificities and differences regarding the availability and possibility of using renewable energy sources
- National financial policy combined with the European Union support under the form of structural funds and adequate state aid policy should foster the upgrading of existing district heating schemes and the integration of cooling functions

8. DHC expansion: Policies need to consider DHC as important tool to optimise energy use and should prioritise expansion and establishment of new DHC systems in markets, which are not yet mature.

The resource efficiency of the overall European energy system is low (45%). Half of the primary energy is lost in the energy transformation sector and only one forth is used as heat. Why do policymakers accept such high losses? District heating and cooling systems can recycle heat surpluses from the existing energy system and be early options for the

extensive use of renewables in the heating and cooling markets. In Europe, especially large countries (Germany, UK, France), have a low market penetration of district heating (representing only 2.5% in the final end use of the net electricity and heat) while in smaller countries this fraction is approximately 11%. In addition, supply sources are more diversified in the small than in the large countries. Another paradox, the market penetration for District Cooling is higher in Nordic than in Southern European countries - expertise which could and should be transferred.

- Policies should consider DHC as important tool to optimise energy use and should prioritise expansion and establishment of new DHC systems in markets, which are not yet mature
- The EU should encourage transfer of best practice and knowledge from successful district heating and cooling examples by creating European/national district heating and cooling platforms involving European, national and local stakeholder Creating links between different municipalities at national level to ensure correlated planning and to fully exploit the use of recycled heat and renewable energy sources.

9. Allocation: The benefits and costs related to the use of RES/CHP should be properly allocated between parties to enable fair return on the infrastructure investment

District heating and cooling as infrastructures enable the larger-scale uptake of RES and surplus heat sources. Combined Heat and Power represent another major source for district heating and cooling schemes**.** But both district heating and cooling networks are long term investments and although the benefits for local community and society as a whole (including avoided cost for alternative investment and environmental savings) are significant, they do not necessarily generate profit for business. Therefore the benefits associated with the use of CHP/RES, should be properly allocated between the electricity and heat side, respectively generation and distribution side, especially when the heating and cooling network is not owned by the producers.

The European and national RES/CHP support schemes are mainly designed for increasing RES/CHP electricity generation. Therefore a lot of effort is put in many countries for increasing the electricity output without increasing heat generation and ensuring the heat loads.

Specifically for CHP plants, an indicator such as CHP district heat/capita shows low values for many countries since they are lacking district heating systems as heat sinks for CHP plants. In some others countries in spite of high share of DH per capita the CHP share remains low. The high potential for more CHP in the latter often remains unexploited due to the existence of unfavourable structures or conditions on the electricity markets.

In addition, most support schemes are designed for small scale RES/CHP units, though large units usually offer better efficiencies and possibilities for flexible response to market developments.

- CHP/RES mechanisms should focus on primary energy (fossil fuel) savings and should not discriminate between the sizes
- Benefit and cost allocation distortion between the heat and electricity should be avoided
- Units allowing for flexible response to varying needs in both the electricity and heat markets should be encouraged - not be penalised

10. Research and Dissemination: Research programmes should target actions to cut costs for DHC equipment; EU should provide a long-term framework for benchmarking and transfer of best knowledge / legislative practice

The competitiveness and the capacity to innovate of the district heating and cooling sector must be maintained through sustained research activities. Given the local specificity of the sector, only limited funds for research are currently made available. The replicability of the case-specific results in European countries is very high, though. Currently, more than 5000 DH systems exist in Europe. However, local experiences from customer relations, sparse district heating, efficient heat distribution, CHP, waste incineration, industrial surplus heat, biomass, geothermal heat, free cooling possibilities, innovative equipment design etc. are not visible beyond national borders.

Activities targeting the reduction of the costs of district heating schemes through initiatives such as standardization of customer installations (substations), development of new pipes and components structures, of technologies which reduce cost for construction works should be prioritised at European and national level. The extensive integration of combustible biomass, surplus heat from industrial processes, geothermal and solar heat and free cooling resources into district heating and cooling systems should represent another priority. The development of district cooling technology and increased efficiency of district heating schemes by using the existing infrastructure and integrating of district cooling equipments in existing buildings is another challenge for the sector and big opportunity for Europe.

Given the comprehensive approach of district heating and cooling to resource efficiency, research must focus on system aspects rather than on single related production technologies.

- The EU, national governments and the district heating and cooling industry should join in an effort to create a dedicated European platform and to provide improved financial and material basis for joint research activities on district heating combined
- To enable exchange of knowledge beyond local projects and national borders, research efforts should be combined with a European training programme

Conclusion

Why policymakers should embark on the recommendations above:

Doubling the sales of district heat will entail the following benefits:

- **Higher energy efficiency**, since primary energy supply for local heat demands are mainly replaced with recovery of heat losses from the energy system. The current benefit is 21,3 Mtoe/year reducing the overall primary energy supply from 1943,1 to 1921,8 Mtoe/year. If the current district heating systems are improved and heat sales are doubled, this benefit will increase to 71,1 Mtoe/year. The possible reduction of 50,7 Mtoe/year is equivalent to the whole annual primary energy consumption of Sweden.
- **Higher security of supply**, since imports of fossil fuels are reduced and use of domestic renewable resources are increased when district heating systems are improved and district heat sales are doubled. This combined effect will reduce the current import dependency with 105,5 Mtoe/year or 5,5 % of all primary energy supply. This is more than the whole primary energy consumption for Poland.
- **Lower carbon dioxide emissions**, since fossil primary energy supply is reduced from improved and doubling district heat sales. The present avoided emissions (113 million tons annually) can be further increased to 516 mln tons, if district heating systems are improved and district heat sales doubled. The reduction will be 404 mln tons annually, corresponding to 9,3 % of all carbon dioxide emissions from fuel combustion in the target area or more than all annual carbon dioxide emissions from fuel combustion in France.
- Furthermore district cooling could **avoid 50 to 60 TWh of the yearly electricity consumption** and 40 to 50 millions of CO2 emissions annually if 25 % of the cooling demand would be delivered from district cooling systems by 2020 (cooling demand is assumed to reach 660 TWh corresponding to a saturation rate of 49%).

3. Specific recommendations for DHC – European initiatives one by one

Energy Performance of Building Directive

At European level, the Buildings Directive (2002/91) specifies that the positive influence of district heating and cooling shall be included in the calculation of the energy performance of a building. This can only be done by using an integrated approach including the whole district heating or cooling production and distribution system. The related CEN pre-standards are based on this very principle, which are also guiding already existing buildings regulations in Germany and Sweden. Other countries tend to focus solely on saving final energy in buildings - and thus miss the enormous potential to save fossil fuels by optimising the whole chain of energy production and delivery.

Energy Service Directive

In the same line of thinking, the Directive on Energy Services (2006/32) specifically mentions district heating and cooling systems as energy efficiency improvement measures. No other energy distribution system gains this status. This is clearly in recognition of the contribution of district heating and cooling to the efficiency of the energy system outside the buildings.
As for the Energy Performance in Buildings Directive, fair calculation of the savings along the whole value chain is a prerequisite to make sure the Directive delivers and to avoid double counting of savings. To secure effective implementation, Member States should also be requested to report back to the Commission on which are the measures they foresee to ensure the upgrading, expansion and establishment of new district heating and cooling schemes.

Emissions Trading

The Emissions Trading Directive (2003/87) so far has failed to give Member States clear guidance on how to take into account the specificities of energy efficient technologies such as cogeneration and district heating. As long as and where the allocation of allowances is based on grandfathering only, the efficiency advantages of CHP/DHC are not economically rewarded. In several countries, producers tend to even reduce heat and power production in their own - highly efficient - CCGT plants and buy from the market

The upcoming revision should focus on moving from grandfathering to benchmarking and a harmonised approach towards CHP/DHC.

Emission trading should also be complemented with measures dealing with energy efficiency , reward CO2 reductions. Through trading or other measures the value of CO2 should be incorporated in the prices of smaller heating systems (households)

CHP Directive

In how far the Cogeneration Directive (2004/8) will deliver the expected results remains to be seen. So far it seems that Member States have little trust in the mechanisms of the Directive. As the guidelines for implementation have not yet been finalised by the respective CHP Committee established by the Commission, the respective national activities and legislative procedures have been put on ice.

Trading CHP Guarantees of Origin can become an interesting tool for companies provided the accompanying framework provides for sufficient trust in the market and for financial value which from the outset is unlikely to be high enough to effectively substitute other support mechanisms such as tax relief and CHP premium payments.

To facilitate CHP expansion, Member States need to take measures to make the market transparent across the electricity, gas, heating, cooling, industry and building sector. In this effort the recommendations outlined in the previous chapter can provide useful guidance.

Action Plan on Energy Efficiency

The Action Plan for Energy Efficiency (COM(2006)545final) represents a strong signal that the European Union intends to keep efficiency high on the agenda . According to the Council recommendation for actions under the pillar "Improving energy transformation" of November 2006, the most energy efficient technology available should be used for the construction of new capacity. These encompass the increased use of high-efficiency CHP, district heating and cooling and waste heat recovery, and whilst taking into account considerations relating to cost-effectiveness, security of supply and the environment.

In the light of these conclusions the actions with regard to CHP/DHC that our outlined in the Plan should be substantially reinforced.

Revision of the guidelines for environmental state aids

When revising the guidelines for environmental state aids the Commission should consider how to ensure sufficient room for manoeuvre with regard to investment and operation aid for district heating and cooling systems. Based on the findings of the Ecoheatcool-project it is recommended to use primary resource factors for the evaluation of the performance of district heating and cooling schemes. A "block exemption" should be provided for schemes which are based to a great extent on CHP and/or renewable fuels and hence are able to prove significant reductions of fossil fuel use.

Framework Directive on renewables

Any new initiative addressing RES-electricity, RES-heating and cooling and biofuels should encourage intelligent solutions aiming at improved resource efficiency across sectors (combined effect of CHP and RES, transfer of energy products which would be lost in one sector to another etc.). Furthermore, it should provide strong incentives for developing district heating and cooling grids as efficient shortcut between renewable and surplus heat sources and the heating and cooling demands. As for other legislative initiatives, the Directive should ensure that collective solutions such as CHP/DHC are incentivised and not penalized as it is often the case today. The Directive should develop an integrative system approach to make sure that energy efficiency and renewables will not compete with each other but become competitive in comparison to conventional fossil fuel technology.

4. Support measures for RES and CHP in heating in various countries

The table presents an overview of various types of support measures use for the promotion the renewables and CHP in various countries.

MEASURE	DESCRIPTION	COUNTRY EXAMPLE
Investment Grant	Funding granted for a certain percentage of the investment costs of an installation.	**Austria** A program for the promotion of biomass district heating in rural areas provides investment support of up to 40% of total installation costs. For CHP employs a scheme for supporting the construction of new CHP plants in which a maximum of 10% of the investment costs is covered. € 60 million is envisaged for plants built before 2014 **UK** Households can receive a subsidy of max £ 400 for a solar thermal installation and £1200 for a heat pump. Both are subject to a maximum limit of 30% of total costs.
Conversion Grant	Conversion to a more desirable type of energy production is promoted.	**Italy** Financial support is granted for the conversion of electrical water heaters into those fuelled by renewable sources.
Tax incentive	Taxation of the primary energy sources and/or the end product (e.g. electricity, heat) with exemptions for energy efficient production processes and renewables.	**UK** The Climate Change Levy charges Electricity £ 0.43 pence/kWh Gas £ 0.15 pence/kWh LPG £ 0.96 pence/kWh Coal £ 0.15 pence/kWh or £ 1.17 pence/kg Exempted from taxation are, amongst others, electricity from renewables and primary energy used in CHP. **Germany** CHP installations are exempted from energy taxation on natural gas when their efficiency exceeds the threshold of 70%. Heat as an end-product is not taxed either.

Tax incentive	Tax rebates on energy efficient equipment.	**France** Scheme for the promotion of high efficiency and renewable energy using equipment. A tax cut of 50% may be provided when equipment has an efficiency rate of at least 65%.
Tax incentive	Tax on emissions	**Sweden** Taxation exists on CO2, Sulphur and NOx. Emissions produced by biofuels are exempted.
Low Interest Loan	Low-interest loans provided for investments.	**Germany** Low-interest loans with the interest rate set for 10 years are provided for new large-scale biomass facilities.
Debt Release	Debts are (partially) released when engaged in an energy efficiency or renewables project.	**Germany** A partial debt release of € 60 per rated kW can be provided for large biomass installations with a maximum of € 275.000 per facility.
Purchasing Obligation	Consumers or grid operators are obliged to have a certain percentage of their energy supply provided through renewable or efficient sources.	**Austria** Grid operators are obliged to accept electricity from renewables sources and allocate it through to the customers. End consumers pay for this through an additional charge.
Voluntary Agreement	Support is provided when a subject enters into a voluntary energy savings agreement.	**The Netherlands** Dutch authorities provide (partial) energy tax cancellation when a company enters into a voluntary energy savings agreement with the government.

Certificates	Tradable certificates are introduced to boost the best available technologies in efficiency.	**Belgium** Certificates are acquired for avoided CO2 emitted by fossil fuels. In such manner, the most energy efficient technologies and renewables are promoted.
Installation Obligation	Obligation to employ a certain kind of energy production method.	**Spain** The Madrid region obliges new and refurbished buildings to install solar panels, which are to provide a 60 to 75% of the building's heating demand.
Obligatory Connection	Buildings may be obliged to connect or prohibited to disconnect from a network.	**Denmark** Municipalities may, in principle, oblige a building to connect to a district heating network or to prevent it from disconnecting.
Prohibition of technologies	A certain type of technology is prohibited to be used in energy production.	**Denmark** A ban on electrical heating is employed. Exceptions: apply when electric heating has already been installed before the ban came into force and when the building's installation cannot, or only with difficulty, be connected to the district heating network
Liberalization	Taking away market distorting regulations may result in benefit for CHP and district heating when those are fully efficient.	**Finland** For strong and effective CHP, the liberalized market allows for the achieving the complete system's natural efficiency

5. Case studies: national approaches to district heating and cooling – country examples

This section provides examples for national approaches for the promotion and the development of CHP and RES in heating and cooling markets. Some of the measures can be sources for inspiration.

Denmark

The country was chosen as example as it benefits from a strong legislative framework regarding district heating sector and has a high share of CHP and use of renewable sources in the district heating sector

Denmark

Denmark knows a stable and strongly planned energy market. Due to its structure and the variety of regulatory mechanisms employed, district heating and CHP benefit from the framework created. 16 centralized and around 415 decentralized CHP plants provide the heat to the system. Throughout the last ten years 400.000 new customers have been connected to the network.

Municipalities, subject to certain exceptions, have the right to oblige new and old buildings to connect to the district heating network or, if already connected, to remain so. 241 of Denmark's 275 local authorities make use of this competence. Furthermore it is not allowed to use electricity for heating purposes. Exceptions apply when the electric heating has already been installed before this regulation came into force and when the building's installation cannot or encounter difficulties when connected to the network.

Fuels for electricity and heat production are taxed, biofuels are exempted. Decentralized CHPs (smaller, regional former heating plants that have been converted to CHP) from 2005 onwards can produce heat without electricity in a more flexible manner. When the market price for electricity is low plants are allowed to produce heat only through their peak and reserve boilers. Tax-free fuels may be used in the instances that the capacities of the reserve boilers are increased due to high heat demand and when the installation was running on biofuels from the outset.

A subsidy exists for electricity from CHP for the purpose of promoting cogeneration. This subsidy applies to electricity from waste, natural gas and biogas. The subsidies represent about €1 cent/KWh. Large-scale, centralized CHP using biomass or biogas receives a surcharge paid by customers which represent in € 8 cent/KWh. When biogas and natural gas are used together, the charge is € 3 cent/KWh.

The country was chosen due to the fact that it has a strong legislative framework for promoting the CHP use while the district heating sector has not yet reached the market maturity. The case study shows also various types of support measures for renewables in the heat market

Germany

German legislation on CHP establishes an obligation for grid operators to purchase electricity produced by means of CHP. In addition, operators need to pay a premium on top of the market price. This premium is calculated on basis of the age and the technological processes employed by the plant. The burden of payment of the premium is spread equally over all grid operators. For the period 2002-2010 the bonuses are expected to amount to € 4.5 billion in total.

The German Federal 'Market Incentive Program' (MAP) for renewable energy sources provides a support scheme which focuses primarily on renewables in heating market (biomass and solar thermal). Enacted in 1999 and running till the end of 2006, it provides support by means of grants, loans and (partial) releases of debts. In 2005 the scheme's budget was €180 million. Small scale biomass heating projects usually receive investment grants, while large-scale facilities benefit from debt release and/or long-term, low-interest loans with interest rates set for 10 years.

From 2002 to 2004 a total support of € 162.8 million was granted which triggered a total investments of €1.279 billion. Three quarter of this was related to solar thermal applications and 16% to biomass.

In the same period, a capacity of 277 MW was installed through support for small scale projects which amounted to € 19.5 million and led to an investment volume of € 196 million. Biomass applications increased considerably when a minimum support of € 1,500 was granted, independent of the capacity installed. 282 large scale biomass boilers with 128 MW have been installed. € 37.4 million was paid from the scheme € 52.4 million invested in total. Another € 5.1 million was granted in the form of debt release. Remarkably, mainly heat-only systems were supported and only 6 CHP installations.

With regard to biomass, two other pieces of legislation on land use planning are available and which, although not really support schemes, do indirectly influence the availability and, therefore, the competitiveness of biomass. These acts are concerned with steering urban development and land planning for the sake of public interest. Such public interest may include the provision of fuel for biomass CHP plants.[1] Also, a minor VAT tax reduction is provided for agricultural products as compared to fossil fuels (7 and 16 % respectively). This rule though has been applied in a quite unstable fashion due to lack of public funds.

ensuring the high use of renewable energy sources and of waste heat.

Sweden

Sweden applies a tax scheme from which benefit the renewable energy sources in general, but which also has an impact on renewables in heating market . In 2000, it was decided that € 3.226 million of tax revenues should be switched over a ten year period. In this scheme, the tax increase on emissions and energy use is linked to a decrease in employment taxation. A tax on CO2, Sulphur and NOx exists, while biofuels are exempted. Biomass represent a resource which is available in Sweden and which represent a good alternative to imported fossil fuels. Heat pumps are also favored by this tax

Up to 2003, the aggregate income from these taxes was a little less than € 6.7 billion, about 10% of the total national tax revenue.

General tax	€ 4.1 billion
CO2 levy	€ 5 billion
Sulphur levy	€15 million

The 2004 CO2 tax rate was 0.098/kg of CO2 emitted. Also, a separate NOx levy exists.

Although hard to determine, the exact impact of the tax on energy use due to many factors involved, it presumably has had a quite positive effect on the uptake of renewables. Over the period 1990 – 2002 renewables share has increased by 54% while the use of gas oil has decreased by 23%.

In addition to its tax incentives legislation, Sweden, has embarked upon an extensive information and expertise campaign to increase the uptake of more efficient and environmental friendly energy production and consumption methods. Municipal energy advisers trained by the Swedish Energy Agency proved very valuable in providing consultations to households and enterprises that were interested in switching to more efficient energy production methods but knew little about their technical implications. Beside consultations the experts can also provide financing. All 290 Swedish municipalities now have such advisers. The campaign has a budget of € 59 million for a period of five years

6. Recommended literature

- The European Heating and Cooling markets. Ecoheatcool study. All work packages at **www.ecoheatcool.org**
- District Heating and Cooling. Country-by-Country survey 2007. Euroheat & Power 2007 (available from 20 June 2007)
- District Heating - Best practices in municipalities, Energy Charter, 2006
- Coming in from the cold. Improving District Heating Policy in Transition Economies, OECD/IEA 2004
- Prices in European District Heating Systems. Prof. Sven Werner, Chalmers University, 2004
- Towards Local Energy Systems: Revitalizing District Heating and Co-Generation in Central and Eastern Europe, World Energy Council 2002
- Cogeneration and District Heating: Best Practice for Municipalities, Energy Charter, 2006

Annex

District Heating and Cooling as part of the European Energy landscape – position and possibilities

European energy balance

Europe wastes more heat than it consumes:

- 29% of all primary energy supply is lost in energy transformation processes (23,8 EJ or 568,3 Mtoe), most of this heat being lost in thermal power generation due to low conversion efficiencies
- high temperature industrial processes, heat generation in local boilers, and energy to overcome friction generate a further waste of roughly 20 EJ

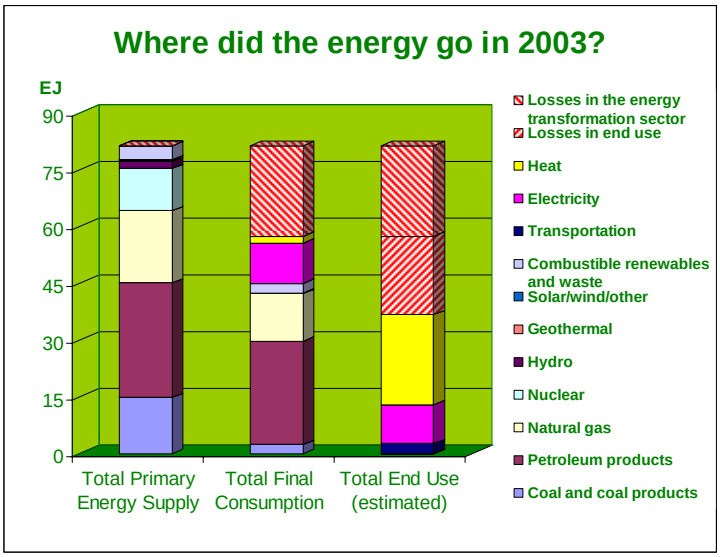

Figure 1

The huge total heat losses correspond to more than half of the total energy supply. The heat sector in general and district heating in particular could contribute to meet the objective of reducing these losses in a future energy system to satisfy local heat demands on the European market

Heat demands

Heat dominates the European final energy demand. In 2003 for Europe 32, the estimated heat used was 21.7 EJ (….) while the electricity used was 10.4EJ out of a total estimated end use of 36 EJ.

Residential and industrial heat demands accounts for more than 80% of the total heat demands: aprox 9.3 EJ for residential and respectively 8.7 EJ for industrial needs while the service sector represent 2.8 EJ.

- Industrial heat demands
  - do not normally correlate with the outdoor temperature.
  - are process temperature level dependent. The high temperature demands represent 43% of the total demand while medium temperature levels (100-400°C) correspond to 30% and demands below 100°C represent 27% of the industrial heat demands. The low temperature demands are suitable for district heating supply
- Residential and service sector demands
  - The heat demands for space heating do not vary very much from northern to southern Europe. The heat demand in Stockholm should only be 20% higher than the heat demand in Brussels. Florence should have a 20% lower demand than Budapest
  - Heat demands per capita are higher in EU-15 than in NMS-10. The use of residential floor space increases with the national GDP, but is not directly proportional to GDP (rather to the square root)
  - The overall market shares for the whole target area was 33% natural gas, 31% electricity, 20% fuel oil, 7,5% heat, 5,7 % combustible renewables, 1,8% coal and coal products, 0,4% geothermal (district) heat, and 0,2% solar heat.

Cooling demands

Cooling demands in Europe 32 grow fast. While the demand in the year 2000 was only 150 TWh, corresponding to a saturation rate of 14%, current developments indicate that the cooling demand for Europe 32 in the residential and service sector will amount to 660 TWh by 2018, corresponding to a saturation rate of 49% (60% for the service sector and respectively 40% for the residential sector). Assuming a saturation rate of 100%, the cooling demand for the region would be 1400 TWh (5EJ) - this would correspond to about one forth of the present total heat consumption.

Some facts about the cooling demands:

- A comparison between the electricity demands in April (heating neutral) and July reveals an increasing electrical power demand during summer, indicating that production of cooling is responsible for an inceasing part of the electricity demand. A trend of increasing ratio can be observed in all EU-15 countries, indicating steady and fast growth of cooling demands.

- A large proportion of the total cooling demand is due to non climatic conditions which implies a wide variation of full load hours within the same geographical region.
- The market share of district cooling is today about 1-2% or between 2 and 3 TWh of the total cooling market.

District Heating possibilities

Two thirds of EU-25 district heat deliveries appear in the EU-15 and one third in the NMS-10. But since much more people live in EU15, the relative use of district heat in NMS10 is much higher. Within EU-32 heat deliveries decreased in average with 2% / year over the last 11 years, but only with 1% in the EU-25 area. The expansion was 3% /year in the EU15 countries and 2% in the EFTA countries while the decrease was 5% in the NMS10

The five suitable strategic local heat and fuel resources for district heating include:

- Useful upgraded residual heat from thermal power stations (combined heat and power (CHP) and also called cogeneration)
- Useful heat obtained from waste incineration
- Useful surplus heat from industrial processes or fuel refineries
- Natural geothermal heat sources
- Fuels difficult to handle and manage in small boilers as most combustible renewables as wood waste, peat, straw, or olive residues.

The combined effect of the use of renewable energies (RES) and recovered heat (CHP, surplus heat, large heat pumps) highlights how well the national district heating sector fulfills the fundamental idea of the district heating (the use of energy which otherwise would be wasted or of fuels difficult to handle). The average recovery factor is of approximately 80% with differences among the countries.

<u>Potential of fossil free resources for DH</u>

The technical potential from these five strategic sources (9,48 Gtoe/year) is approximately 200 times higher than their present use in district heating and 30 times higher than the total heat demands.

- *CHP :* The potential of residual heat resulting from the thermal power generation is 19.2 EJ (455 Mtoe)/year (out of which only 1.6 EJ (43 Mtoe)/year was used for DH and 1.3 EJ (38 Mtoe)/year in the industry). The cumulated present use represents 15% of the potential
- *Waste to energy plants:* Out of the 2 EJ (47 Mtoe)/year non recycled waste, ¾ are placed in landfills that produces methanol, the gas with the highest

greenhouse effect and only 0.5EJ (12 Mtoe)/year are incinerated. The present use represents 7% of the potential.

- *Surplus heat from industries:* The potential is 1.1 EJ (26 Mtoe)/year and the present use is 0.03EJ (1 Mtoe)/year and mainly in Sweden, resulting in a current use of 3% from the total potential.
- *Biomass:* The potential for biomass in Europe is approximately 13-18 EJ (308-427 Mtoe)/year. Most of the potential is related to agriculture. The present use in DH is 0.17 EJ (4 Mtoe) - 1% of the potential
- *Geothermal:* The total technical potential is approximately 15 times higher than total heat demands in Europe (370 EJ / 8768 Mtoe). Presently, only 0.03 EJ (1 Mtoe)/year are used (0.008% of the potential). Geothermal heat represents a long term option for the district heating sector in Europe.

Future possibilities regarding district heating improvement (at current heat sales) imply:

- Increase of the CHP share from 68% to 80% while improving power-to-heat ratios
- Increase heat generation from waste incineration from 3,9 to 8,3 Mtoe/year at the current heat sales by improving conversion efficiency for waste incineration plants and by increasing the incinerated volume
- Extend the use of industrial surplus heat from 0,59 to 4,74 Mtoe/year, corresponding to 18% of the current practical recovery potential
- Increase the use of geothermal heat from 0,62 to 1,18 Mtoe at current heat sales
- Increase the volume of 3,9 Mtoe/year from combustible renewables to 11,85 Mtoe/year at current heat sales
- An ambition can be to increase the annual heat generation from 2,37 to 47,4 ktoe of solar heat to customers having the willingness to pay relatively higher prices.

<u>DH potential, costs and benefits</u>

As 74% of the population live in urban areas and most of the service sector buildings are also located to urban areas and as out of 240 million dwellings, 48% are located in multi-family buildings a large fraction of residential and service sector heat demands can be reach with urban district heating systems. The low temperature industrial heat demands represent also a market for district heating sector

The remaining market shares for fossil fuels in the urban industrial, residential and service sector are the main targets markets for the expansion of district heating. Hence, the expansion of district heat in each country should be proportional to the remaining market for fossil fuels which in 2003 had a total magnitude of 15,8 EJ (374,4 Mtoe). Using estimated expansion factors the complete European district heat potential is estimated at 6,8 EJ (161,1 Mtoe) heat/year. The doubling of the current annual heat sales from 46,2

Mtoe to 92,4 Mtoe will require that 29% of the potential market for district heat will be converted to district heat. This corresponds to an annual growth rate of 4,7% during 15 years.

The investment cost for doubling heat sales can be estimated at 75 EUR/GJ or almost 150 billion EUR in the EU-32 (about 40% for distribution and 60% for various heat generation facilities. Note: These values are approximations based on Swedish experiences

Benefits from improved and more district heating:

- Higher energy efficiency: Will reduce primary energy supply by 2,6% (2003) or 2,1 EJ (50,7 Mtoe)/year (= primary energy supply of Sweden)
- Higher security of supply: Will reduce the import dependency with 4,5 EJ (105,4 Mtoe)/year (= primary energy supply of Poland)
- Lower carbon dioxide emissions: Will annually be reduced with 404 million tons, corresponding to 9,3 % of the current emissions (= current emissions of France from fuel combustion)

District Cooling possibilities

For the EU-32 a district cooling market share of 25% of the total cooling capacity corresponds to

- A cooling energy demand of about 165 TWh_c, a peak cooling capacity demand of about 140 GWc and investments in new district cooling infrastructure of 55 to 80 billion EUR
- With a typical district cooling system, the efficiency is 5-10 times higher, thus about 50 to 60 TWh electricity could be saved
- These savings correspond to CO2 savings of 40 to 60 million tons annually for the EU-32 (corresponding to around 15% of the European share of CO2 savings under the Kyoto protocol)

If the marginal investment impact is 20% of the total avoided electricity capacity (50 GW) the avoided investment will be about 30 billion EUR or 40-50% of the investment for new district cooling structure.