

JULY 2014
BASREC

District Heating and Combined Heat and Power

The Sustainable Way for Urban Communities

POLICY PAPER

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List of Abbreviations

BASREC	Baltic Sea Region Energy Co-operation
CC	Climate Change
CHP	Combined heat and power
DC	District cooling
DE	District energy, DH and DC together
DH	District heating
DHC	Both district heating and cooling
EE	Energy efficiency
EHP	Euroheat & Power - association
ETS	Emission Trading System of the EU
FIT	Feed-in tariff
GHG	Green house gases
GSEO	Group of Senior Energy Officials
IEA	International Energy Agency
PEF	Primary energy factor
RES	Renewable energy sources
TPES	Total primary energy source

1 Introduction

Achieving the EU 2020 and 2050 energy and climate goals requires strong and focussed energy development strategies. EE and integration of RES into the markets for electricity and heating are important steps in the entire development process.

The Northern European energy systems have a solid foundation for meeting the challenges of the future, and the Baltic Sea Region has a unique opportunity to become a frontrunner in the development process. The region is endowed with vast natural resources in terms of biomass, wind and hydro power, and there is a long tradition for electricity cooperation between the Nordic countries ensuring optimal utilisation of the resource potentials possible in short, medium and long term.

To ensure efficient utilisation throughout the development process the interaction between the electricity and heat market is of utmost importance. It is recognised, that CHP and DH have a key role to play in helping Europe reach its EE target of 20% in 2020.

In the Communiqué adopted at the BASREC Meeting of Energy Ministers in Berlin 14–15 May 2012 the Parties confirmed that their co-operation in the upcoming co-operation period 2012-2015 will concentrate on certain energy topics in order to meet global energy policy challenges. Two of these topics are:

- 1) Increased use of renewable resources available in the region, including integration of fluctuating wind power into the electricity system, and
- 2) Rehabilitation and development of DHC and CHP.

On 25 October 2012, the EU adopted the Directive 2012/27/EU on EE. The Directive establishes a common framework of measures for the promotion of EE within the Union in order to ensure the achievement of the Union's 2020 20 % headline target on EE and to pave the way for further EE improvements beyond that date. According to this, Member States by 31 December 2015 shall carry out

and notify to the Commission a comprehensive assessment of the potential for the application of high-efficiency cogeneration and efficient DHC.

Under consideration of both the EU requirements and the specific goals and objectives in the Baltic Region, identification of new actions and cooperation issues within these fields have high priority in BASREC. With an objective to establish a decision basis for this, BASREC decided to initiate a project with the objectives:

- › To make a survey of the state of the art on DH, DC, CHP generation and use of Renewable/Local Energy Sources in BASREC countries; and,
- › Based on the survey to propose project(s) by which to fulfill the assignments set out in the Communiqué in an efficient way and benefiting the majority of the BASREC countries.

The project:

"District Heating and Cooling, Combined Heat and Power and Renewable Energy Sources - Best Practices Survey"

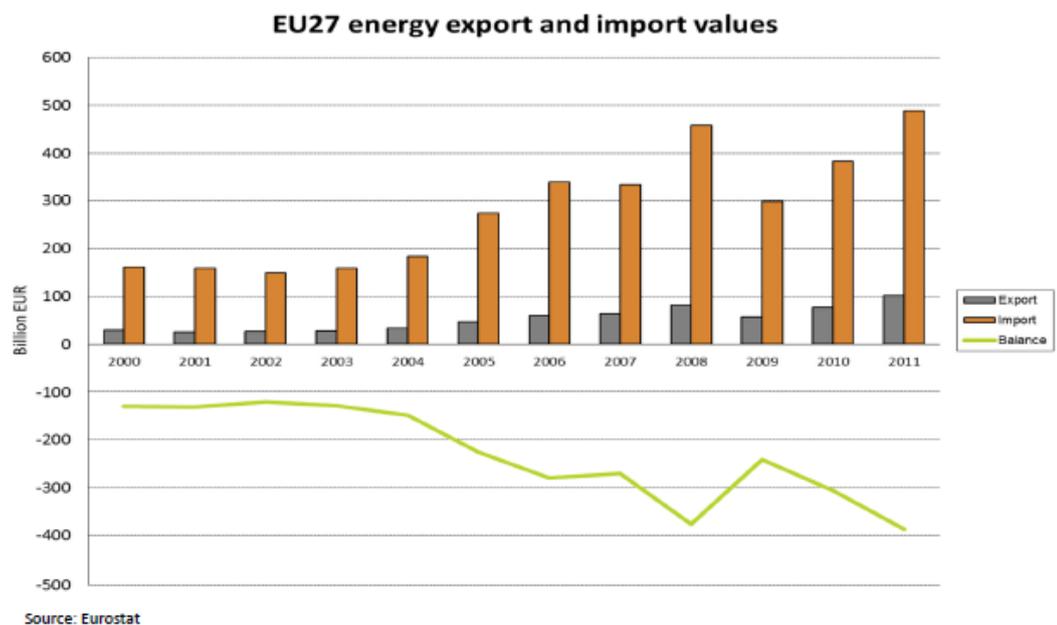
was carried out by Nuorkivi Consulting and COWI A/S during August 2013 – April 2014.

The results were discussed among relevant stakeholders at a Seminar in Helsinki on May 23, 2014. The present recommendation paper prepared as input for policy makers, is based on the survey as well as on the discussions and recommendations from the seminar.

The report at hand aims at identifying new ways of strengthened pioneering in research of DH, CHP and RES with links to other research underway and planned elsewhere.

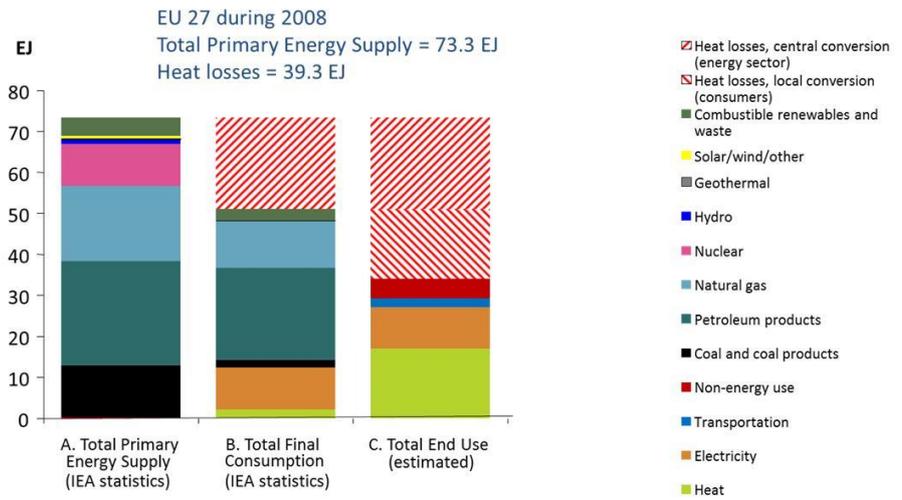
2 Energy in Europe: Dependency – Losses – Sustainability

Europe's energy dependency is increasing. In 2011, energy imports to the EU amounted to €400 billion.



Noteworthy however is that the value of dependency is about equal to the value of the energy losses anchored in the energy system of EU. Energy losses worth €400 billion have materialized mainly in the power sector from fuel based power-only production where 50% to 70% of the fuel energy is lost to the atmosphere¹ as unused heat.

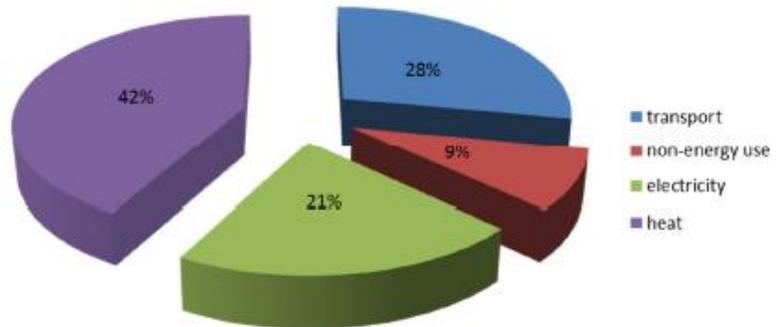
¹ Euroheat & Power, Brussels, Belgium



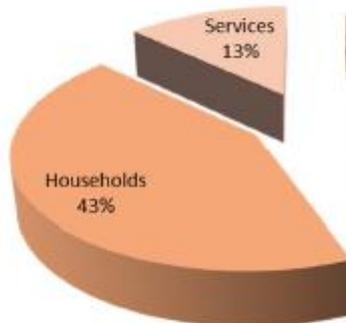
But what about the energy demand structure?

In EU 27, heat is the major player in final energy demand, even twice the size of the electricity. Totally, heat accounts for 42%, being ahead of the others transportation (28%), electricity (21%) and non-energy uses (9%) (IEA. 2011)

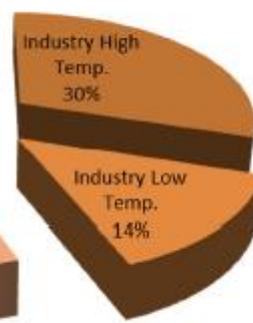
Final energy demand by energy service, 2011 (EU 27)



Residential and Services sectors

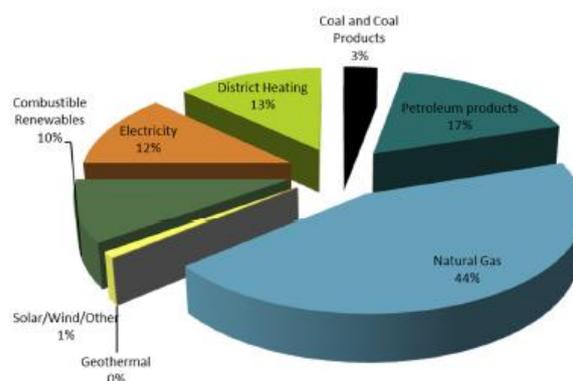


Industrial processes



Low temperature heat represents approx. 70% of the demand (DHC – Platform data 2006), and the origin of the heat supply is closely connected with EU's energy dependency on imported fuels (Heat Roadmap Europe II (2013)).

Origin of heat supply to residential and service sector buildings, 2010 (EU 27)



The EE Directive ((2012/27/EU) establishes a common framework of measures for the promotion of EE within the Union in order to ensure the achievement of the Union's 2020 20 % headline target on EE and to pave the way for further EE improvements beyond that date. It lays down rules designed to remove barriers in the energy market and overcome market failures that impede efficiency in the supply and use of energy, and provides for the establishment of indicative national EE targets for 2020.

CHP and DE can help develop sustainable solutions and reduce energy losses and energy imports through heat recovery and recycling whilst satisfying local demand for heating and cooling.

Increasing the market share of DHC and CHP to 50% by year 2050², basically doubling the current volumes, would

- › Decrease primary energy supply and especially fossil fuels and CO₂ emissions
- › Decrease annual costs of energy in Europe by approximately €14 billion in 2050
- › Create additional 220 000 jobs over the period of 2013-2050³

By 31 December 2015, Member States shall carry out and notify to the Commission a comprehensive assessment of the potential for the application of high-efficiency cogeneration and efficient DHC. If they have already carried out an equivalent assessment, they shall notify it to the Commission. The comprehensive assessment shall take full account of the analysis of the national potentials for high-efficiency cogeneration carried out under Directive 2004/8/EC.

² Heat Roadmap Europe 2050, Euroheat&Power

³ Euroheat & Power

Member States shall adopt policies which encourage the due taking into account at local and regional levels, the potential of using efficient heating and cooling systems, in particular those using high-efficiency cogeneration. Account shall be taken of the potential for developing local and regional heat markets. For the purpose of the assessment, Member States shall carry out a cost-benefit analysis covering their territory based on climate conditions, economic feasibility and technical suitability. The cost-benefit analysis shall be capable of facilitating the identification of the most resource- and cost-efficient solutions to meeting heating and cooling needs.

To ensure efficient utilisation throughout the development process, the interaction between the electricity and heat market are of utmost importance. It is recognised that CHP and DH has a key role to play in helping Europe reach its EE target of 20% in 2020. DH is an important infrastructure for phasing out the direct use of fossil fuels for heating purposes in the short term. A common recognition of this importance at regional level would support national strategies and create a sound basis for the necessary investments in the heat supply structure to ensure the overall efficiency of the integrated energy structure up to 2020 and between 2020 and 2050. After 2050 new technologies might be ready to take over.

3 BASREC – Models to Europe

The Northern European energy systems have a solid foundation for meeting the challenges of the future, and the Baltic Sea Region has a unique opportunity to become a frontrunner in the global development process. The region is endowed with vast natural resources in terms of biomass, wind and hydro power, and there is a long tradition for electricity cooperation between the Nordic countries ensuring optimal utilisation of the resource potentials possible in short medium and long term.

The DH sector is large in Europe. There are already some 5 000 DH systems in operation in the EU and 20 000 in the European part of Russia. Around 62 and about 100 million citizens are served by DH in EU and Russia, respectively.

DH sales of BASREC reach 92% of the DH sales in Europe, equal to about 4500 of 4900 TJ in total, if we assume some 50% of the DH sales in Russia come from the European part. Without Russia, the DH sales of BASREC countries amount to 70% the European DH sales, equal to 1034 TJ of 1475 TJ in total. Therefore, decisions and agreements concluded amongst inside BASREC could have a key role in promoting energy efficient DH and CHP combined with RES in Europe.

Strengthening CC and reduction of costs of fossil fuels are some of the new challenges that DH, CHP and RES are facing now. To meet the new challenges, the BASREC countries shall continue pioneering work in the global context.

The BASREC countries comprise a large variety of sizes, affiliations and energy systems ranging from small Iceland with 100% renewable to huge Russia with some 1%. Therefore, BASREC countries offer various models to other parts of the world in terms of successful implementation of DHC and CHP as such and particularly linked with RES.

The substance of DHC, CHP and RES is wide. Demands for development vary due to diversity of substance, stage of progress, differences in municipality size, geography and national interests. The differences inside BASREC are both technically, economically and institutionally a treasure of experiences for paving the road to the future.

The BASREC Best Practices Survey has established a comparable and consistent overview of the present structure of DH, CHP, DC and use of RES for the 11 BASREC countries.

The capital cities in the countries are all active players in establishing and implementing sustainable energy development schemes. Therefore it has been chosen to “tell the energy story” of the capital cities for each country along with other selected best practices in the individual countries. Although some of the best practices may not be directly replicable due to different circumstances prevailing in the countries the cases serve as inspiration and give ideas to be exchanged among the countries and to other parts of Europe, on how system performance could be improved.

A short summary of ongoing both national and international research and development programs on DHC and CHP with RES is included to set the framework for decisions related to new needs and activities.

4 Best Practices to be Shared

The lessons learned from the areas with more successful implementation of DHC and CHP tell primarily that energy planning is the most essential parameter. In general, a wide focus on energy planning as basis for ensuring development and implementation of policy goals at both national and local level is very important for the development.

Energy planning with focus on *gross energy savings*, meaning the reduction in total primary energy source (TPES), needs to be emphasized to optimize system performance and cost on a national and international level. In this respect CHP can play a major role. Some BASREC countries have a widely developed DH sector, but much fossil fuel in the electricity mix, meaning that there is a large amount of waste heat that can be utilized in DH at a low cost, reducing operation at inefficient heat- and power plants. This is one example of energy planning leading to reduced costs and TPES savings.

It is essential to estimate the *spill over/repercussions* of an energy scheme, prior to implementation. The effects of implementing one scheme in country A, will impact the energy system of the neighbouring country B. This again will lead to a response which might have a negative impact on country A. The energy planning over borders and cooperation when developing national energy plans is important to avoid *backfiring*.

As some countries in the region have stated that independence from foreign energy supply is top priority, there is a risk that environmental considerations are not adequately cared for. Biomass (and waste) heating/CHP could be promoted as an ideal alternative and a measure to achieve the desired energy independence.

When implementing measures aimed at improving national energy systems, the procedure to have the measures implemented at municipal level can be troublesome. The lessons learned from well-developed energy systems are valuable and should be shared with decision makers of less developed systems.

In the market where it is desired to increase the share of DH/CHP/RES, the conditions for such establishments have to be in order. A competitive market with relatively low entry barriers is not always granted.

All eleven BASREC countries have good examples on how the technologies have been implemented at city level. While having such a strong background, high requirements are set to the volume and substance of the related research activities in the BASREC countries.

Three best practices suggested for European wide adoption have been identified:

Integral Urban and Energy Planning

Integral urban and energy planning is an important issue while planning urban structures to favour EE and RES development, and with DHC and CHP in particular. Such new planning approach requires training and co-working of energy and urban planners.

Planning and Integral Operation

Planning and pooled operation of several energy production plants in integrated urban CHP/DH systems based on RES (biomass/geothermal/solar) is important to optimise the use of different types of renewable sources in different heat and electricity markets. Flexibility and links between the electricity systems and the heat market are required to ensure that valuable energy is not wasted.

District Cooling

DC shall be developed as a complementary product to CHP and DH in locations where sea or lake water can be used as a natural cooling source. Thus, the PEF of cooling can be substantially reduced.

5 Institutional Development Needed

Euroheat&Power has carried out a survey of the sectors own view of the future. According to this:

- 49% of the Sector see their own business growing over the next 5 years
- 46% of the Sector see their level of investment related to DHC growing over the next 5 years
- 64% of the Sector have or are involved in investment plans in RES to be realised in the next 5 years.

BUT

- 72% of the Sector think that the regulatory framework does not provide sufficient incentives to the development of DHC
- 49% of the Sector believe that R&D in DHC requires more attention/funding in order to keep pace with competing technologies.

The role of BASREC can be to support the institutional development of DHC, CHP and related RES. In this respect, the following development issues have been identified:

Benefits of CHP

The materialized energy savings of CHP since 2000 will be estimated. In Finland, for instance, such benefits in one year (2011) have been about 700 kg of hard coal equivalent consumption and 1600 kg of CO₂ emissions per capita lower than without CHP. In other countries this has not been analyzed yet. The BASREC level benefits of CHP will be used for marketing CHP and DHC in the BASREC countries.

Uniform CHP Statistics

Statistics of CHP still lack consistency. The CHP share in electricity production most often is reported only based on installed capacity and not based on annual electricity production in CHP mode. For some time already, the issue has been

intensively discussed at EU level, and in the Energy Efficiency directive a set of definition and standards has been agreed upon. It is recommended to establish a BASREC overview of CHP both in the heat and in the electricity market which is harmonized with the definitions used in the Energy Efficiency directive. This approach will also set focus on the strong role of the BASREC countries in the overall European DH/CHP/DHC and RES development. Further it will be important for the internal cooperation and development among the BASREC countries.

CHP and RES in the Electricity Market

The Electricity markets in Northern Europe are integrated to a wide extent. RES policy in one country and electricity trade thus highly influences the market conditions for electricity in general, and for CHP produced electricity in particular, in all the interconnected countries. These aspects could be further analyzed and discussed among the BASREC countries in the context of evaluating the future development of CHP/DHC/RES.

CHP with Individual RES Applications

Both CHP and RES are good to be promoted but how to integrate them is not that simple. Individual RES installed in the DH area with CHP supply reduces heat demand of DH, and the potential of CHP, and may lead to increased primary energy consumption. Analysis and consecutive guidelines to deal with the conflict are needed. For the instructions, it is important to have a realistic view of carbon neutral heating and power in the future.

Hiding Heating with Electricity

There is substantial electric heating in households and commercial buildings that is hiding behind the energy statistics. Such hiding heating is used in dish washing, laundry washing, floor heating of sanitary rooms, heat pumps, entrance of doors, etc. Converting such electric heating to DH and other RES would reduce primary energy consumption.

District Cooling

Review of various methodologies for DC being available in BASREC countries and various regions such as locations near the sea side, lake and river side, geothermal area, etc. as well as the potential for DC development in the next 10 years will be elaborated. Benefits of DC to traditional cooling modes will be assessed.

DH is often in a dominant market position. Therefore, transparent and fair pricing is needed. Competition to other heating forms may require new pricing methods to be adopted.

6 The Way Forward

The BASREC Best Practices Survey on District Heating and Cooling, Combined Heat and Power and Renewable Energy Sources study has revealed a strong background for BASREC to exchange experiences and in this way enforce the position of Baltic Sea Region as a frontrunner in developing and implementing sustainable energy- and resource strategies as the European best practice.

During the BASREC seminar in May 21, 2014, in Helsinki the close links between challenges and opportunities at EU level, regional level, national level and local level and between the different parts of the present and future integrated energy systems were clearly brought forward and discussed among the stakeholders represented.

The way forward is to enforce the understanding between different parties and to promote the cooperation at different levels to ensure a continuous development process in the frontrunner field.

Local CHP/DHC schemes should be linked to the national and cross border development of the electricity systems, as well as to local urban planning procedures.