PRIMER

SUSTAINABLE SOCIETY

ENABLING GREEN ENERGY TRANSITION

RAMBØLL

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HOW IT IS DONE

85% of the world's energy consumption comes from fossil-fuelled power plants. However, this balance is challenged by an ever increasing need for more and greener energy. This is a task that calls for an improvement of the energy infrastructure, the energy efficiency and a change in the choices of fuel. Here is how to meet the challenge:

- Create an energy vision and strategy and involve key-stakeholders as early as possible.
- Establish an integrated energy system that includes power grid, district heating/cooling grid, and biogas grid. This will provide a flexible system with thermal storages which can use surplus heating/cooling and power from various sources depending on weather, local resources, season and the time of day. Almost no energy is wasted in an integrated energy system and it can be based on 100% renewable sources.
- Move energy facilities to the cities in order to use of up to 100% of the energy from the surplus heat.
- Convert power plants from coal to biomass while increasing the energy production from renewable sources.

Improving energy efficiency with district energy

It takes an energy strategy that focuses on integrated solutions for urban design, energy, buildings and transport to create highly efficient district energy grids. Once these grids are established, they will facilitate the production and distribution of thermal energy throughout a city in the most cost-effective and sustainable way. It becomes possible to produce heat/cooling and electricity adjustably for the local district network and its storages instead of discharging the surplus heat.

Local governments should plan the urban development and its energy and building infrastructure in a cost-effective way to the benefit of the citizens and all other stakeholders in the city. And whenever urban development projects are planned, the establishing of a basic network for district heating/cooling should be considered.

It is crucial to prepare the networks for future expansion so that they can be scaled to meet a variety of demands rather than being limited to the area that is being developed. In order to identify cost effective and climate friendly solutions it is necessary to map and address all major economic, social and environmental consequences that the energy solutions will have for urban citizens.

District cooling – an unexploited opportunity

Today, district cooling is growing in the Nordic countries but is only exploited to a limited degree in other locations such as the Middle East where the potential is huge and the economy could be improved for society and plant owners: the energy efficiency will be improved, carbon emission would be saved, and the need for new power capacity reduced.

70% of the electricity production in the Middle Eastern region is used for air conditioning even though district cooling is 50% more efficient than individual chillers.

Moving plants to the city

As a consequence of reducing the reliance on fossil fuels in power and heat generation, waste-to-energy makes an important contribution by transforming municipal and industrial waste into energy to the citizens. By making sure to establish the energy facilities within the cities, it becomes possible to utilize up to 100% of the energy from waste.

Furthermore, energy facilities should be designed in a way that fits into a city by offering recreative spaces or other benefits for the citizens and in this way becoming an integral part of the urban environment. Consider how the facility can play a part in making the city liveable.

How to solve the waste-to-energy challenge

Using heat pumps to boost flue gas condensation and recover heat can be costly and result in electricity loss. But by minimising the energy that drives the heat pump while also maximising energy output from the process, less electricity will be lost. At the same time it is possible to cool the flue gas which produces 5-6 KWh of heat for every KWh of power put into a district heating system.

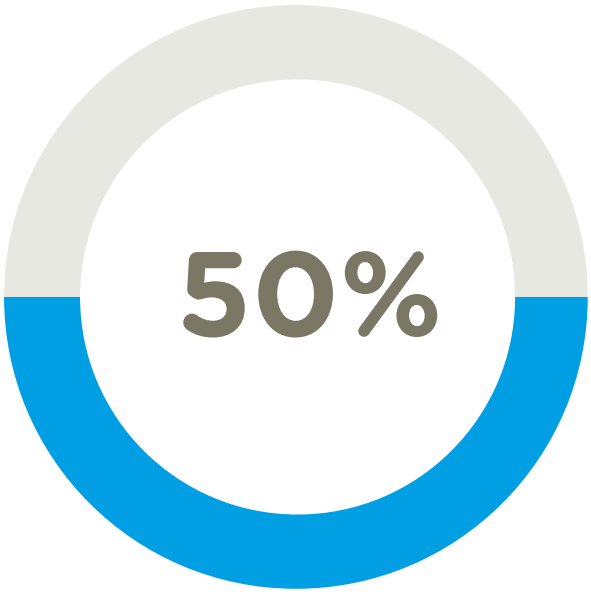
These optimisation techniques boost energy production by around 20%. It also removes even more pollution from the flue gas, which is not only positive for plant owners but also for society as a whole. The system can be seen as resource efficient and carbon neutral, because no additional fuel is used to recover the heat from the flue gas condensation.

Bioconversion and lifetime extension is a time and cost saver

Biomass is a limited resource, but with sustainable production methods it makes great sense to convert existing large coal-fired power plants into biomass-fired plants and hereby cut carbon footprints significantly, e.g. during a transition towards renewable energy.

Often, a bioconversion goes hand in hand with a lifetime extension, giving 15-25 years of additional operation. A lifetime extension saves time and costs; In Europe, establishing a new thermal power plant typically costs about $780 million. In comparison, modernising and refurbishing an existing plant typically costs just under $170 million. Moreover, an existing plant takes about 1-2 years to refurbish whereas a new plant takes four to five years to construct.

IMPROVING ENERGY EFFICIENCY WITH DISTRICT COOLING



District cooling is approx. 50% more efficient than individual chillers

THE IDEA BROUGHT TO LIFE

High-efficient energy from waste with a recreational touch in Copenhagen

Centrally located in the capital of Denmark, the multi-functional waste-to-energy facility, Copenhill, is raising the bar for resource optimisation with an energy efficiency of 107% and a high potential for recycling and recovery.

With a supply of low-carbon electricity to 550,000 people and district heating to 140,000 households every year, the facility has reduced emissions to far below limit values.

The incineration process provides the opportunity for material recycling through recovery of resources that would not otherwise be recycled. As an example, 15-20% of the incoming waste can be reused for road construction.

The recreational potential is supported by its central urban location and the plan is to establish an integrated ski slope and climbing walls from the roof meaning that not only will Copenhageners get cheaper and more sustainable electricity, district heating and recycled materials; they will also get a new recreational space.

Ramboll is among other things providing project planning and definition, conceptual design, tendering, procurement, project and contract management, supervision and commissioning.

Creating district cooling in Saudi Arabia

Among the world's biggest district cooling initiatives is a 500 MW project in Makkah, Saudi Arabia, which among other things is expected to improve the conditions around the pilgrim activity during Hajj.

During the last eight years, 3,600 dilapidated buildings have been demolished in Makkah in order to clear up space for a new central pedestrian pathway measuring 3.65 km in length running from the city outskirts to the Grand Holy Mosque. The average width is 320 meters, and the project includes the construction of two roads, a metro line, a grand mosque and over 200 plots that will house more than 100,000 people.

The project will need 150 MW power to produce the 500 MW of cooling and this has a significant impact on the power network. Ramboll's first deliveries will be the design, location and quantity of the chiller plants together with the piping design and advice on the buildings' connectivity to the pipeline network.

In Phase 2, Ramboll will assist the client in the procurement of the chiller plants.

The total construction area covers 6.3 million m^2, and the project timeframe is approx. ten years.

MOVING ENERGY FACILITIES TO THE CITIES MAKES IT POSSIBLE TO USE 100% OF THE ENERGY FROM THE SURPLUS HEAT

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