Energy Systems
a balance act

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Outline

• District heating resources
• Swedish district heating
• Changing heat demand
• District-heating development
• Benefits of district heating
Optensys offers energy consultancy services, primarily:

- Analyses of electricity and district-heating supply
- Surveys of energy demand and resources
- Municipal energy issues
- Sustainable energy scenarios

Optensys analyses interplay between energy supply and energy conservation.
Energy supply and use in Europe

Losses by energy conversion, mainly electricity generation

Heat demand
District heating sources

- Biomass fuels
- Energy from waste
- Combined Heat and Power (CHP)
- Industrial Surplus Heat
- Surplus heat from automotive biofuel production
- Surplus heat from auto-motive biofuel production
- Heat pumps
- Solar, geothermal
- Fossil fuels for peak load

Heat market
District Heating in Sweden

- 9 million inhabitants
- 50 TWh district heating
- 50% of total heat market
- 650 urban areas have district heating
- District heating in every municipality with more than 10,000 inhabitants
District heating supply

Common plant types and energy flows for a local Swedish utility

Combined heat and power production

Gas → CHP

Waste → CHP

Wood → Heat-only boilers

Oil → Industrial waste heat

Electricity grid

Heat pump

DH network

Heat demand

Electricity market

DH system in Göteborg (Gothenburg)

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Condensing power plants and Combined Heat and Power plants
District heating production

A Swedish example

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Marginal cost for district heating production

Example

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Cash flow for new DH system

Investment
Operation
Revenue
Accumulated net cash flow

Year

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

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12th International Symposium on District Heating and Cooling, Tallinn, Estonia, 7 Sept 2010
The district heating value chain

District heating company

- Fuel
- Preparation
- Storage
- Production
- Distribution
- Sales
- Heat exchanger
- Indoor climate
Low-energy houses

• Thick insulation
• Windows of high standard
• Ventilation with heat recovery
• Solar heating

• Higher investment cost
• Lower operation cost
• Lower energy use
Climate change

GWh

Space heating

Hot tap water etc

År

2000 2020 2040 2060 2080 2100

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Köpmanholmen

1 kWh/m² of land and year
4
5-7
8-9
10-13
23-28

1-19 District number
S Single-family houses
M Multi-family houses
I Industry
V Service
1950 etc Average erection year
12 ha etc Size in hectares

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Ulf Ranhagen

Indehällning grundad på workshop 06/10/03, byggnadernas nybyggnadsår, användning
Enable DH use in areas with low heat demand

- Use district heating for new purposes
  - Dish washers
  - Washing machines
  - Tumble dryers
  - Industry
  - Cooling
- Solar electricity rather than solar heat
- Fair competition with individual gas and electricity use: regulations, prices, etc
Switching from electric heating to district heating from a CHP plant

Other electricity production reduces electricity demand

CHP plant increases electricity production

District heating network

Switching
Cooling with heat

- Reduces electricity consumption
- Increases heat demand during summer and
- electricity generation in CHP plants

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Possible future production of district heating, electricity, steam, cooling and biofuel
Estimated local renewable fuel resources

- **Forest branches etc.**
  - Now: 100 GWh/year
  - Utilise present coppice and devastated forest areas etc

- **Straw**
  - Now: 1200 GWh/year

- **Waste**
  - Now: Waste quantities increase to Czech level

*GWh = gigawatthour = 1 million kilowatthours (kWh)*

Niš city region in Serbia

Rest of Nišavski district

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Possible development of district-heating production in Niš, Serbia

- **El** = electricity
- **Bio** = biomass fuel
- **GWh** = gigawatthour = 1 million kilowatthours (kWh)
- **CHP** = Combined heat and power (plant or production)

**Graphic Description:**

- **2010**
  - Reference: 100 GWh/year
  - Small bio: 50 GWh/year
  - Large bio: 50 GWh/year

- **2015**
  - Reference: 200 GWh/year
  - Small bio: 100 GWh/year
  - Large bio: 100 GWh/year

- **2020**
  - Reference: 400 GWh/year
  - Small bio: 200 GWh/year
  - Large bio: 200 GWh/year
  - Waste CHP: 100 GWh/year
  - 2 CHP: 200 GWh/year

- **2025**
  - Reference: 500 GWh/year
  - Small bio: 300 GWh/year
  - Large bio: 300 GWh/year
  - Waste CHP: 200 GWh/year
  - 2 CHP: 400 GWh/year

**Legend:**

- Green: Heat from biomass CHP
- Orange: Heat from gas boilers
- Dark Red: Heat from waste
- Light Green: Heat from biomass boiler
- Brown: El from waste
- Light Grey: El from biomass

**Note:**

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Benefits of renewable CHP

• Low fuel demand in CHP plants due to high efficiency
• Wood fuel use initiates local biomass industry and promotes local business
• Using waste fuel reduces landfilling of waste
• Utilisation of local renewable energy resources means higher security of energy supply and reduces CO₂ emissions
Influencing energy demand

- Energy conservation reduces energy demand
- Load management reduces capacity demand
- Energy carrier switching e.g. from electricity to fuel or district heating
Production of district heating, electricity, steam and cooling

- Cold winter days
- Oil-fired boilers
- Wood-fired Heat-only boiler
- Wood-fired Combined Heat and Power plant
- Steam supply to industry
- Absorption cooling
- Waste incineration / surplus heat from industries for hot tap water and industries
District heating systems are valuable assets, which enable efficient resource utilisation.

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