Usporedba centralnih toplinskih sustava: Danska i Hrvatska

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Zagreb

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Introduction

• 20-20-20
• Reduction of primary energy consumption is not currently on track
• One of the greatest energy consumers in EU are buildings
• District heating is one of the ways of supplying space heating and domestic hot water to households, and heat energy to businesses and industry
• 63% of Danish dwellings and 11% Croatian households
• What are possible improvements of district heating systems in Denmark and Croatia?
  • What are the future trends in district heating?
  • What renewable energy sources could be integrated in DH?
  • How the renewable energy sources could be integrated?

• Comparative analysis
The long-term Objective of Danish Energy Policy

Expressed by former Prime Minister Anders Fogh Rasmussen in his opening speech to the Parliament in 2006 and in several political agreements since then:

To convert to 100% Renewable Energy

Prime minister 16 November 2008: "We will free Denmark totally from fossil fuels like oil, coal and gas"

Prime minister 16 November 2008: "... position Denmark in the heart of green growth"
New Government, Denmark September 2011

“The government will convert Denmark to a green economy by promoting renewable energy, better public transport and green growth companies.”

- 100% RES by 2050
- 100% RES for electricity and heating by 2035
- No coal on power plants and no oil for heating households by 2030
- 50% wind in electricity supply by 2020
- 40% CO2 reduction by 2020 compared to 1990
New government, Croatia, December 2011
NREAP – before and after EU

<table>
<thead>
<tr>
<th></th>
<th>2009 non-EU</th>
<th>2013 EU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind [MW]</td>
<td>1200</td>
<td>400</td>
</tr>
<tr>
<td>Solar [MW]</td>
<td>45</td>
<td>52</td>
</tr>
<tr>
<td>Biomass [MW]</td>
<td>140</td>
<td>85</td>
</tr>
<tr>
<td>Waste/biogas [MW]</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Geothermal [MW]</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Small hydro [MW]</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Large hydro-upgrade [MW]</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>TOTAL RES capacity [MW]</td>
<td>1845</td>
<td>987</td>
</tr>
<tr>
<td>Total RES all sectors [PJ]</td>
<td>88,42</td>
<td>61,50</td>
</tr>
</tbody>
</table>
Strategy for Smart Specialisation

- Health
- Sustainable energy and environment
- Engineering
- Bio-technology (bio-economy)
- Creative and cultural industries
- ICT
- Tourism
- Green growth

The Danish Council for Strategic Research

FSB
Denmark - 40 years with a stable energy consumption!

Croatia - 32 years with a stable energy consumption?
District Heating Systems
Decentralized generation
CROATIA – developed/registered RES projects
Methodology - Comparative analysis

• Data is organized and structured so to allow clear and concise comparison
• Analysis and comparison for each part of the DH system has been made, from which conclusions are drawn about possible improvements
District Heating Systems
Diversification and flexibility in available energy sources for heat generation, Denmark

- Boilers, biomass
- Boilers, fossil fuels
- Heat Pump / Electric heat boilers
- Solar heat
- Biomass CHP and geothermic
- Surplus heat from industry
- Decentral Gas CHP (back pressure)
- Central Gas CHP (back pressure)
- Waste Incineration Heat / CHP
- Power Plant Heat Extraction
HEP – grupa i HEP - toplinarstvo

• HEP Toplinarstvo najveći je distributer toplinske energije u Hrvatskoj
• U 2012., HEP Toplinarstvo opskrbljivalo je 117145 kućanstava i 6051 poslovnih korisnika u Zagrebu, Zaprešiću, Samoboru, Velikoj Gorici, Sisku i Osijeku
Kompanije - Aalborg Forsyning

• Aalborg Forsyning-Koncernen je grupa komunalnih kompanija u vlasništvu okruga Aalborg koje pružaju brojne usluge kućanstvima i poslovnim korisnicima
Average air temperatures Aalborg - Zagreb

<table>
<thead>
<tr>
<th>Month</th>
<th>Aalborg 2011(°C)</th>
<th>Aalborg 2012(°C)</th>
<th>Zagreb 2011(°C)</th>
<th>Zagreb 2012(°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Feb</td>
<td>-1</td>
<td>-1</td>
<td>-3</td>
<td>-3</td>
</tr>
<tr>
<td>Mar</td>
<td>3</td>
<td>7</td>
<td>7</td>
<td>9</td>
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<tr>
<td>Apr</td>
<td>10</td>
<td>6</td>
<td>13</td>
<td>12</td>
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<tr>
<td>May</td>
<td>11</td>
<td>12</td>
<td>16</td>
<td>16</td>
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<tr>
<td>Jun</td>
<td>15</td>
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<td>17</td>
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<tr>
<td>Jul</td>
<td>17</td>
<td>16</td>
<td>17</td>
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<tr>
<td>Aug</td>
<td>14</td>
<td>13</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td>Sep</td>
<td>10</td>
<td>8</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Oct</td>
<td>7</td>
<td>8</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>Nov</td>
<td>4</td>
<td>-1</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Dec</td>
<td>4</td>
<td>11</td>
<td>4</td>
<td>3</td>
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<table>
<thead>
<tr>
<th>Month</th>
<th>T_{terminal}(°C)</th>
<th>Aalborg 2011(°C)</th>
<th>Aalborg 2012(°C)</th>
<th>Zagreb 2011(°C)</th>
<th>Zagreb 2012(°C)</th>
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</thead>
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<tr>
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<td>6.3</td>
<td>6.3</td>
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<td>Mar</td>
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<td>11.1</td>
<td>15.8</td>
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<td>Apr</td>
<td>10.7</td>
<td>19.2</td>
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<tr>
<td>May</td>
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<td>Jun</td>
<td>15.7</td>
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<td>20.2</td>
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<tr>
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<td>15.5</td>
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<td>Aug</td>
<td>12.3</td>
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<td>5.8</td>
<td>1.4</td>
<td></td>
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<td>Sep</td>
<td>8.9</td>
<td>4.3</td>
<td>4.3</td>
<td>10.78</td>
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<td>Oct</td>
<td>4.3</td>
<td>1.3</td>
<td>1.3</td>
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<tr>
<td>Nov</td>
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<td>7.48</td>
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<td>Dec</td>
<td>7.48</td>
<td>8.17</td>
<td>8.17</td>
<td>8.17</td>
<td></td>
</tr>
</tbody>
</table>

The chart shows the generated heat energy (T) and heating degree days over time for Aalborg and Zagreb.
Heat Supply
Total heat power

![Heat Supply Diagram](image-url)

- **Zagreb DH**
  - Heat only boilers
  - CHP

- **Aalborg DH**
  - Surplus heat from industry
  - Waste-to-energy
  - Heat only boilers
  - CHP
Heat Supply
Generated heat energy and electricity

- Zagreb DH
- Aalborg DH

Generated heat energy and electricity

- Generated electricity
- Generated heat energy
- Steam DH
- Hot water DH
Heat Supply
Commission year of heat only boilers and CHP plants
Heat Demand
Specific heat power and specific electricity capacity per connected area

Specific power (W/m²)

250
200
150
100
50
0

Zagreb DH Aalborg DH

Specific electricity capacity
Specific heat power

Specific energy generation (MJ/m²)

2500
2000
1500
1000
500
0

Zagreb DH Aalborg DH

Specific electricity generation
Specific heat energy generation
Distribution

Total length and specific connected area per km of DH network

- Zagreb DH
- Aalborg DH

Total length of the DH network (km)

Specific connected area (m²/km)
Distribution
Specific heat loss

![Bar chart showing specific heat losses for Zagreb DH and Aalborg DH. Zagreb DH has significantly higher losses than Aalborg DH.](chart.png)
Economics

Energy prices

![Bar chart comparing energy prices for Zagreb DH and Aalborg DH.](chart_image)

- **Zagreb DH**
  - Total cost (EUR/a): 1200 (Power), 1000 (Energy), 200 (Subscription)

- **Aalborg DH**
  - Total cost (EUR/a): 1600 (Power), 1400 (Energy), 400 (Subscription)
Economics
Heat sales, other income and total expenses

[Bar chart showing heat sales, other income, and total expenses for HEP District Heating and Aalborg District Heating]
Conclusion

• Aalborg DH is more advanced
  • More recommendations can be made for Zagreb DH

• Heat Supply
  • New CHP unit in Zagreb DH
  • Integration of renewable energy sources

• Heat demand
  • Expansion of the system coverage area

• Distribution
  • Reduction of heat losses

• Economics
  • Reduction of generation costs
  • Revision of energy prices

• Technological advancement in generation, distribution and storage of heat energy
“BEAST”-Beyond Energy Action Strategies

• koordinator projekta East Sweden Energy Agency iz Linköping.
• BEAST projekt treba pomoći pri provedbi SEAPa - Sustainable Energy Action Plans
• konzorcij 9 partnera iz 9 europskih zemalja
• Ukupni budžet 1.082.458 EUR (75% EU)
• Glavni ciljevi projekta:
  • 1) uspostava strukture i izgradnja kapaciteta za provedbu SEAPa na lokalnoj razini
  • 2) identificirati i pripremiti 23 projekta u suradnji s lokalnim zajednicama
  • 3) pomoć pri implementaciji ostalih akcija iz SEAP-a

• FSB tim će podržati lokalne zajednice u Hrvatskoj
HVALA NA PAŽNJI!

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The work has been carried out in the scope of 4th Generation District Heating Technologies and Systems project in cooperation among coordinator from University of Aalborg, University of Zagreb, HEP and Aalborg Utilities