How do companies use statistics in assessment of investment projects
Inogate 23.04.2013
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Presentation and background

- **Ramboll**
  - Independent Multidisciplinary Consultant
  - Owned by the Ramboll Foundation
  - 10,000 Employees
  - 200 offices in 25 countries
  - World leading within several energy services

- **Anders Dyrelund**
  - Civ. Eng. in buildings, Grad. diploma economy
  - 1975-81 Ramboll (BHR)
  - 1981-86 Danish Energy Agency
  - 1986- Ramboll
  - 1980 The First Heat Plan in Denmark for Aarhus, project manager
  - 1981- Copenhagen Regional DH system, task manager/consultant
  - 1990- Consultancy services to more than 20 countries mainly utilities and authorities in major cities, including Beijing, Moscow, Tallin, Riga, Vilnius, Warsaw, Bucharest, Bishkek, Eravan, London, Tokyo
  - Develop investments in DH systems, 100 million Euro per year
Content

• Experience of Ramboll in energy investment projects
• Overall energy policy and framework for assessment
• How to do it in a simple way
• Case 1: Heat plan Denmark
• Case 2: Invest in DH networks in Copenhagen
• Case 3: Invest in new peak capacity
• Case 4: How could the DH system in Copenhagen be financed?
• Case 5: Invest in waste to energy
• Case 6: Invest in CHP
• Case 7: Should the municipality guarantee for loan?
Experience of Ramboll in statistics and investment projects

- Ramboll provide consultancy services for a wide range of energy companies regarding identification and assessment of profitable investments in energy projects
  - District heating
  - Waste to energy
  - Other renewable energy
  - Power plants
  - Wind power
  - Buildings

- Ramboll has experience working in most of the former centrally planned economies
  - and is fully aware about the difficulties getting reliable data based on measurements and statistics
The overall energy policy objectives in EU

- **Reduce the fossil fuel consumption**
  - For security of supply and
  - For climate reasons

- **In a cost effective** way for the society

- **In the most sustainable** way
  - Minimizing life-cycle costs incl. environmental costs
  - Minimizing long-term costs for the local community
The energy policy sets the framework for assessment of investment projects

- The overall aim of the EU energy directives for building, RES and EE is to promote cost effective projects to increase security of supply and reduce climate emissions.

- The Danish Energy Policy is
  - to be independent of fossil fuels before 2035 within heating and electricity
  - in a cost effective way for the society taking into account environmental costs

- The national governments sets the legal framework and provide incentives through taxes and subsidies.

- The aim of any energy company is
  - to meet objectives of profit
  - same as lowest heat prices for Danish DH companies
  - by investing in profitable projects

- How to do it?
How to identify and assess investment projects?

- It is like cross country running
- You know where to end (objective of more profit)
- You need to know where you are (reliable base-line data)
- You must have good shoes and be in good shape (models etc)
- You should use experience from the previous route to assess the best route (statistics)
How to use statistics in the assessment of investment projects

- Find reliable data and statistics
- Identify and assess the best projects
- Implement Investment project
- Monitor and prepare statistics
Case 1: Fuel consumption for heat supply in Denmark - Heat Plan Denmark

• Strategic study of the heating sector in Denmark

• How much has the CO$_2$ emission in the heating sector been reduced since 1980? 30%? 60%?

• Can the heating sector be independent of fossil fuels within 2035? Yes or no

• Which projects have contributed most to reduce the emission since 1980? DH, CHP, waste to energy, gas, end-use savings?

• Which projects can contribute most to the future reduction? DH, CHP, waste to energy, biomass heat pumps, solar heating and wind? And how??
Case 1: Statistics from DEA and the Danish District Heating association do not give the full answer

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Climate adjusted

Index 1990=100

Heated floor space

Final energy consumption

Final energy consumption per m²

Ramboll

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Case 1: step 1 find the market share of heating and cost effective heat savings

Heat supply of the building stock
Modest development

Historical  →  Projection

Source: Heat Plan Denmark, Ramboll
Case 1:

**Step 2:** divide DH on types of heat production

Estimated based on various sources as due to lack of statistics

**Step 3:** calculate fuel consumption for each type of production

**Step 4:** calculate CO2 emissions
Case 1: Heat Plan Denmark Result

- Proved how the CO₂ emission in the heating sector has been reduced by 60% since 1980
- Proved that DH, CHP and waste-to-energy projects have contributed most
- Indicated that the heating sector can be almost independent of fossil fuels before 2035
- Showed that DH, CHP and waste to energy plus heat pumps, solar plus more cost effective heat saving can do it
- Inspired Danish DH to prepare the statistic in more details
Case 2: Investment projects to expand the DH system in Greater Copenhagen

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Case 2: one of many projects: 300 million DKK to shift 150 GWh/a from gas to DH
Case 2: Feasibility study for increasing market share of DH based on following data:

- Digital maps including all geographic information, including landowners register
- Building register, type of building, m² heated area, type of heating, normative data for consumption to existing and new buildings (kWh/m²)
- Energy consumption data reported by all energy suppliers to the building register to calculate actual consumption in kWh/m² (new)
- Consumer data base of the gas company (confidential, but access to average consumption)
- Normative data for heat consumption in new buildings seems to be too optimistic – statistical data are needed and therefore DH companies will develop statistics
- Statistics for costs of pipes (DKK/m) and for substations and boilers (DKK/kW) a good basis for investments
Case 3: Feasibility study on need for base load capacity to meet annual demand (MWh)

- Old approach
  - Estimated production demand divided by e.g. 5,000 hours
  - Standard heat duration curve

- New approach
  - Statics based on measurements on annual production hour by hour
  - Heat duration curve for demand (hours sorted)
  - Heat duration curve for available base load production
  - Basis for simulation of actual heat production for extended new market
Case 3: Feasibility study on investment in new peak boilers to meet maximal demand (MW)

- **Old approach:**
  - normative consumption and estimates

- **General approach:**
  - demand (MW) = measured production to network (MWh) divided by standard max load hours (h)

- **Accurate approach:**
  - Statistics combining heat load and weather data from previous year
  - Estimate max load in design situation

Max hour (blue) corresponds to 3.000 hours max load
Max daily average (red) corresponds to 3.300 hours
Case 4: The DH in Greater Copenhagen

Technical data

- Production 10,000 GWh/a
- Maximal load appr. 3,000 MW
- Heat sale 8,500 MWh/a
- 60 mio. m² heated floor area
- Heat losses 15%
- More than 40 peak boilers
- **98%** connection to the DH networks in the DH zones
- **97%** of production is CHP
- **25%** of fuels are waste
- All waste heat is utilized
- Optimization by a heat market unit (CTR, VEKS and HOFOR)
- Developing in accordance with the Heat Supply Act
Case 4: The DH in Greater Copenhagen
Developing the system 1980-2010-

- Heat supply planning in 20 municipalities formed the basis for more DH and new natural grids – cost effective zoning based on assessment of investment projects.

- The regional heat supply planning formed the basis for the most cost effective regional DH grid.

- The Minister approved in 1984 two new 235 MW/330 MW CHP plants at Amager and Avedøre – Avedøre was a completely new site allocated close to the heat market in the western suburbs.

- The system is still growing – according to the Heat Supply Act
  - Cost effective shift from (large) gas boilers to district heating based on project proposals assessment of investment projects.
  - Extension of the heat transmission and more interconnections.
  - New production facilities for waste incineration, biomass CHP, peak boilers, Geothermal heat, large heat pumps, thermal storages.
Case 4: The DH in Greater Copenhagen
Funds and procurement

- 100% financed by the most competitive loans
- 100% loan guarantee by the municipalities
- No subsidies (except a few around 1980 and 1990)
- National energy policy: tax to compensate for drop in oil price

- Precondition for 100% efficient financing
  - Stable national energy policy
  - Transparent accounting and statistical data
  - Open and transparent tender for all contracts
  - Heat consumers pay only necessary costs (regulator)
  - Heat consumers (building owners) can pay for the heat
    - Cost allocation and division of costs on apartment buildings
    - Apartment owner can pay for their share
    - Poor families can get subsidies
    - Social housing
Case 5: The DH in Greater Copenhagen
Do we need more Waste-to-energy capacity?

- Vestforbrænding,
  - 2x35 t/h
  - 23% electrical
  - 95% total efficiency with flue gas condensation

- ARC (Amagerforbrænding),
  - Old units replaced by new
  - 2x35 t/h units
  - Architectural design for public acceptance – skiing loop
  - 22% electrical
  - 104% total efficiency with flue gas condensation and heat pump

- KARA/NOVEREN
  - 1x25 t/h
Case 5: Statistics show that there is a need for more capacity to reduce landfills in Europe

- Huge potential in many countries for more efficient use of waste
  - Reuse
  - Recycling of resources
  - Recycling of energy
  - Use of waste heat from incinerators through large integrated DH systems
- Markets for waste (to be treated in efficient plants)
- Markets for useful deposits (e.g. in mines to avoid landfills)
Case 5: Therefore a potential for more efficient use of waste for DH and CHP

- Large market for hot water DH at low temperature can increase the energy utilization of the waste significantly
- A heat pump can increase the condensation of heat from the wet flue gas

![Graph showing annual use of energy from one ton of waste, in MJ/ton, LHV 10.8 GJ/ton]
Case 6: Is there a market potential for CHP in Greater Copenhagen in the next 30 years

- More wind energy

- **Statistics** show fluctuating wind and prices

- More power line interconnection in Northern Europe to establish a larger power market

- **Statistics** show that there is still many condensing plants on the margin in this system

- Therefore still CHP potential, but with accumulators
Case 6: Therefore there is a CHP potential in new power generation, and therefore:

- Large scale low temperature CHP plants can reduce the fuel consumption significantly compared to boilers and heat pumps
- Heat accumulators can increase the flexibility and help the power system
- The precondition for CHP benefit is that power plants are in operation in condensing mode in the system
Case 7: Assessment of an existing DH system basis for investment and municipal guarantee

• 20 km network, 200,000 m², 1,100 consumers buildings connected, heat sale 22,000 MWh according to heat meters,

• The heat price is among the lowest 20% (Regulators statistics)

• Statistics show
  • Reliable heat supply, no complaints
  • Stable heat loss around 23% according to heat meters
  • Water losses stable around 2 m³/day
  • Less than one leak a year, plus regular thermographic inspection

• This indicates
  • that the infrastructure is in a good shape
  • that the allocated budget for maintenance is at a suitable level
  • that the municipal guarantee will be “on safe ground”
Thank you for your attention!

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