MOWAT ENERGY, A RESEARCH HUB AT THE MOWAT CENTRE, AT THE REQUEST OF THE ONTARIO MINISTRY OF ENERGY

FUTURE INNOVATION IN ENERGY PLANNING:
A SPECIAL SESSION TO ADVISE ON ONTARIO'S LONG-TERM ENERGY FUTURE

WORKSHOP SEPTEMBER 26, 2013
COMMUNITY ENERGY PLANNING:
BEST PRACTICES FOR INTEGRATING LAND USE, TRANSPORTATION AND ENERGY PLANNING

DANISH DISTRICT ENERGY PLANNING EXPERIENCE

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GRØN ENERGI – ASSOCIATION

- Grøn Energi, www.gronenergi.org
  - Association with members from the Danish district heating sector (utilities, consultants and suppliers)
  - Activities comprise; analyses, innovation projects and support of export activities

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EXAMPLES OF ACTIVITIES

- 4DH, research project, system integration etc. (wind turbines and heat pumps), www.4dh.dk
- Heat pumps – new development (from decentral and competition to centralized solutions and combination with district heating
- FjernvarmeVækst ("Regional Support Programme") – developing businesses (suppliers etc.) related to district heating. Focus is employment and green energy

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WHY DISTRICT ENERGY?

- Multiple advantages (comfort, environment)
- But – the price has to be competitive. This is why you may need regulation – **to internalize some of the external costs** (e.g. environmental costs) to society, in order to regulate the behavior of the consumers (ensure that that the price of district heating is lower than the alternative)
  - Surely, there should not be district heating for all houses. You need a heat density of a certain level, to have an efficient system. Some places should have other solutions than district heating
- District heating is a good idea when the heat loss from distribution is lower than the advantage of utilizing surplus heat, renewable energy (more efficient than individual systems, e.g. solar heating). Other advantages are flexibility for the energy system.
- Waste incineration – solving societal tasks efficiently by utilizing the resources
- District heating as energy infrastructure – enabling utilization of waste heat resources, renewables, balancing the electricity system

- Multiple advantages
- Competitive price for consumers – society economy
- Facilitates solving of e.g. waste problem
- An enabling energy infrastructure

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PUBLIC PARTICIPATION AND ACCEPTANCE

- Crucial for the success of collective systems
- Key parameter is correlation between social and individual economy. Benefits of the society (e.g. utlisation of waste heat resources, reduce climate effects) should be reflected in the regulation (taxes etc.)
- "What's in it for me"
- Think global – act local. Important to facilitate local initiatives – and coordinate the complexity
- Liberalisation and freedom of choice for consumers
  - How would e.g. water supply, waste water or solid waste handling be handled without collective systems?
  - Priorities of society (climate etc.) legitimates limitation of individual solutions. Fulfillment of e.g. environmental standards is – often – most cost efficient in collective systems
  - Three out of four Danes are supplied with collective heat supply systems (district heating or natural gas)
    - 1 % paid more than the costs would have been with individual heat supply system

Public acceptance ensured by local initiative

Advantages for all actors – "what's in it for me" (can, will, want)

What is the value of freedom of choice?

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OPPORTUNITYISNOWHERE

- Perceive district heating as energy infrastructure – enabling and facilitating utilisation of energy resources
- Requires appropriate framework conditions – providing incentives to the actors

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DANISH HEAT PLANNING – BEFORE THE PLANNING

Today, municipalities are the main authority on heat planning and can own a heat supply utility, and thus be involved in operation. But originally, heating of homes was solely an individual task

- In the beginning of the 1900s the surplus heat from the power plants was utilised in e.g. hospitals and other large buildings
- In the 1920s and 1930s, centralised collective heating emerged in larger new-build areas of houses
- In the 1950s a largescale establishment of district heating plants was initiated – 5 new plants per year.
- The peak was in the 1960s, with 45 new plants in 1964
- The development of district heating was on private initiative – consumers organised themselves and established a district heating plant
- Only in a few cases, municipalities was behind the establishment of a district heating plant
- The primary role of the municipalities was to provide guarantees for loans

District heating started without national political objectives

Private initiatives, consumers organised themselves (consumer owned utilities)

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DANISH HEAT PLANNING – THE 1970S

- The two oil crises in the 1970s initiated an energy policy in Denmark
- 1979 – the first Heat Supply Act
  - Rules and framework for heat planning, a new public planning
  - Steps
    - Municipalities to map the existing heat demand, the applied heating methods and energy usage
      - Municipalities to estimate the future heat demand and heating possibilities
      - The data form the municipalities was applied by the counties in regional heat supply overviews
    - The municipalities to elaborate drafts for the future heat supply, the counties elaborated regional drafts
    - The counties elaborated regional heat plans
  - The contents of the plans
    - Identify in which areas the different heat supply technologies had priority
    - The location of future heat producion plans and pipelines

- Oil crises in the 1970s initiated energy policy
- Heat Supply Act in 1979 – detailed planning
- Security of energy supply, reduce oil imports
- No more ”free choice” for consumers

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DANISH HEAT PLANNING – THE 1980S

- The planning in the 1980s enabled
  - More environmental friendly supply
  - Utilisation of the investments in domestic natural gas infrastructure
  - Co-production of heat and power (CHP), utlise the surplus heat production (large power plants)
  - Small CHP-plants, 450 MWel, agreement i 1986 between the state and the power plants
    - Priority was to investigate different technologies, including biomass and waste
- Mandatory connection to collective supply (district heating or natural gas)
  - 1982, still in force, but not widely applied
  - The municipalities could secure the investments made by the utilities as regards heat density
- Ban against electrical heating
  - 1988, new buildings, 1994 existing buildings with waterbased heating system
- Taxes on fossil fuels for heat production
  - Biomass and biogas was exempt from taxes
  - High level of taxes also in times of low fuel prices to keep incentive for energy conservation

- Environment
- CHP
- New technologies
- Mandatory connection
- Ban against electrical heating
- Taxes

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DANISH HEAT PLANNING – THE 1990S

In the 1980s: All developed areas was included in the municipal heat plans for collective heat supply

- Change of Heat Supply Act in 1990
  - New planning scheme – project based
  - Conversion from oil and coal based heat-only production to natural gas based combined heat and power production (CHP)
  - Increased use of natural gas
  - Increased use of biomass etc.
- Main objectives
  - Reduce national CO2-emissions
  - Secure the investments in the natural gas infrastructure
- Implemented in regulations
  - Issued by the state to municipalities
  - Phases
    - 1 phase (1990-1994): Large coal-fired district heating plants with access to natural gas, to be converted. Introduction of waste incineration
    - 2 phase (1994-1996): Remaining coal-fired district heating plants with access to natural gas to be converted. Biomass (straw, wood chips)
    - 3 phase (1996-1998): Small natural gas fired district heating plants converted to CHP. Remaining small plants converted to biomass

- After successful implementation in the 1980s
- Objective was to simplify and decentralise the decision process for establishment of new DH plants
- Project based planning scheme
- Reduce CO2-emissions and secure investments in natural gas infrastructure
- Detailed regulation facilitated implementation

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DANISH HEAT PLANNING – SUMMARY

- 1980's: Security of supply
  - After the oil crisis, substituting oil with natural gas (own production)
  - Zoning of geographical areas – individual natural gas and district heating (in total four types of zones)
  - Process driven by the energy utilities
  - The municipalities had a active role in the planning process
- Since approx. 2007: Climate agenda
  - New round of heat planing, new employees in the municipalities
  - Project-scheme
  - The municipalities has a role again (after some years without heat planning, after the success in the 1980s and 1990s).
  - Municipal guarantee
  - Resources from the municipalities: hours (no investments)
  - Now more focus on the differentiated role of the munipalities; authority (taxes) and operation (fees for heat supply)
- The development is driven by political targets (security of energy supply, climate, etc.)
  - Value of the political targets should be reflected in the regulatory framework (e.g. taxes)

The planning hierarchy in the 1980s:
- The state
- The counties
- The municipalities

In 1990: The municipalities became solely responsible for the heat planning, given some overall regulations by the Minister

Regulatory framework is somewhat outdated

Today: The municipalities
- May wish for a more active national planning, enabling the municipalities to obtain the overall political targets

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DANISH HEAT PLANNING – REFLECTIONS AND THE FUTURE

- The current trend is strategic energy planning – a broader scope in terms of both topics and geographical areas
- The subject of public participation – or acceptance – is crucial for the success of collective systems
  - Unless participation is made mandatory (which was the case in Denmark).
  - A crucial argument for introducing collective systems (including heat systems) is that it is an advantage to both the individual and the society.
  - You need organizations to organize the investments etc., i.e. linking the individual and the society (in this case district heating companies).
- Planning of district heating should be made in coordination with other energy planning, in particular electricity
  - The large – and increasing – amount of wind power in the Danish energy system can only be utilized effectively if electricity is used in heat pumps, which also utilize waste heat from industry etc.
  - District heating does not only concern heat supply and supply of hot tap water – district heating is a crucial part of the energy infrastructure, enabling utilization of fluctuating renewable energy sources.

- Broad scope and long time horizon is crucial for district energy
- Public acceptance – and adoption, i.e. local initiative is crucial
- ”Organic growth”, supported by national and regional planning

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DISTRICT HEATING AND CHP - THE IMPLICATIONS OF ELECTRICITY PRODUCTION

- Subsidy for electricity production (1992)
- Electricity production – not always
  - In 2003; change in the subsidy for electricity production for CHP-plants
  - Avoid economic losses for society, only producing electricity when there is a demand (not exporting below production costs)
  - Flexible, storages

- Denmark has 16 central CHP – plants which originally was only power plants
- Denmark has 415 decentral plants, of which 285 are CHP and 130 are heat-only plants. All decentral plants was originally heat-only plants
- Main purpose of the decentral plants is heat production

- Observe the system advantages and disadvantages
- Flexibility is key
- Central and decentral plants

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THE ROLE OF THE MUNICIPALITIES

- Role as heat authority
  - Planning authority – responsible for planning the heat supply in the municipality together with utilities and other relevant actors
  - Approving authority – approving specific projects in the municipality, ensure implementation
  - The municipality can take initiative on specific projects
  - Reponsible for coordination with other municipal planning
- Role as owner and operator of district heating utilities
  - Approx. 55 district heating utilities (of more than 400) are municipal, but delivering more than 60 % of the district heating.
  - Close cooperation – often representatives from the municipality in the board of the utility

Role as authority

Role as owner and operator

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THE ROLE OF THE MUNICIPALITIES

- From 1990 to 2006, only 35 % of the municipalities has elaborated heat plans
  - The old heat plans applies, new heat plans is not binding (new regime – projects)
- 10 % of the municipalities has not implemented the obligatory ban on electrical heating
- Project regime – has to be pragmatic (no project process for small changes of a plant)
- Only i a few cases, the Danish Energy Agency has exploited the option to take over the approvement of a project from the municipality
  - The Danish Energy Agency has not exploited this option with regard to mandatory connections or zoning
- In 2006, only 8 % of the municipalities cooperates with other municipalities on administration of heat supply
  - This is changing now with strategic energy planning

Challenge of capacity and competences in the municipalities

The municipalities has a large responsibility

Strategic energy planning address this gap

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COMMUNITY ENERGY PLANNING – REFLECTIONS ON THE PROGRAMME

- *Community energy planning*
  - Strategic Energy Planning, in Denmark not including transport. Main focus is on district heating and electricity.
  - In Denmark: The municipality is the key authority for heat plans.
  - Heat Supply Act – role of municipality. Role of the state (Danish Energy Agency).
  - Taxes plays an important role – can be counterproductive related to the energy and climate policies. Hence, the state plays an important role.
  - Regional level – no formal responsibility. Facilitates coordinaton between municipalities (own initiative, not regulated role). Motivation – generate employment.

- Roles of different actors changing over time

- Outdated regulation is counterproductive for obtaining new political objectives

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ENERGY INFRASTRUCTURE - INVESTMENTS

- *"Energy infrastructure requires investment in expensive assets in order to both maximize their benefits and minimize disruption to other systems"*
  - District heating infrastructure is an investment with a long time horizon
  - The benefits include enabling utilisation of resources that otherwise would be wasted – not visible value
  - By utilising surplus heat from industry and various renewable sources, the consumption of primary energy resources is reduced (economy of scope)
  - Enables efficient use of renewables, in particular low temperature district heating, e.g. solar heating, geothermal (economy of scale)
  - Other benefits include comfort, security of supply, flexibility regarding fuels/energy input, absorbing fluctuating renewable energy (heat and power) production.
  - Low risk of "disruption of other systems" due to the high flexibility

- District heating is crucial energy infrastructure facilitating efficient utilisation of energy resources

- A number of advantages to balance the heat loss (in distribution, not transmission) and the investments

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INTEGRATION OF ENERGY PLANS

- *"Community energy plans integrate effectively with other infrastructure plans"*
  - Based on society economic principles.
  - Method for calculating society economics, input parameters, scenarios.
  - Strategic energy planning – mapping of energy resources, compared to the energy demand (heating, but also electricity).
  - Utilisation of surplus heat from industry may reduce operation costs, thus improving the economy of these industries, thus facilitating employment.

- Society economic approach facilitates best use of investments
- Value of input parameters is key (interest rate)

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INTEGRATION OF PHYSICAL INFRASTRUCTURE PLANNING

- *"Integration of physical infrastructure planning and processes"*
  - Energy efficiency and efficient utilisation of resources (primary energy factor) should govern the process. District heating will be the obvious choice of energy infrastructure in many cases (but not all!).
  - Being a collective system – collecting resources which would otherwise be wasted – district heating requires organisation to facilitate the establishment.
  - Hence, organization becomes crucial – how could this be facilitated? Local acceptance is crucial, as is knowledge of local resources and conditions.
  - The framework conditions, legal framework and taxes etc. is also crucial. Predictability is a key parameter for long term investments such as district heating
  - Non-profit serves to protect the consumers against exploitation of monopolies – makes consumer-owned or municipal owned companies relevant to consider.

The process of planning requires framework conditions, which facilitates the organisation and investments

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RECOMMENDATIONS

- *"What policies, programs and pilots might be required?"*
  - Who are the key actors?
    - The central government (Federal) (cross border pipelines and nuclear safety regulation)
    - The provincial government (Ontario) (responsible for energy and planning)
    - The power purchaser and system operator (OPA and IESO)
    - The communities
    - The consumers?
  - What are the incentives?
    - Federal, provincial, power purchaser and system operator
      - Import/export of energy resources
      - Security of energy supply
      - Climate mitigation
    - Communities, consumers
      - Affordability of energy consumption
      - Creation of jobs
      - Local environment
  - What are the costs?
    - What are the savings and advantages?

- Acknowledge district energy as key energy infrastructure
- Create framework for establishment of local organisations investing in and operating district energy
- It is a common challenge – create the framework and focus on local initiative

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REFLECTIONS ON ”MAKING CHOICES – REVIEWING ONTARIOS LONG-TERM ENERGY PLAN”

- Page 3, Conservation
  - Reduce energy consumption, use energy resources efficiently, ”PEF – primary energy factor” (~ district heating)
- Page 4, Introduction
  - Electricity is not a fuel, but an energy carrier – and so is district heating
  - Natural gas, significant investments. Parallel to the Danish case in the 1980s
- Page 5, Over $ 10 billion invested in transmission and distribution system
  - Could be reduced if more local production (CHP and DH)?
- Page 6, supply mix
  - Wind power could be even more than 10 %, but could require DH with heat pumps to meet the balancing needs

- Primary energy factor
- Fuel / energy carrier
- Types of infrastructure costs, DH could substitute electricity?
- Supply mix – enable wind power

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REFLECTIONS ON ”MAKING CHOICES – REVIEWING ONTARIOS LONG-TERM ENERGY PLAN”

- Page 7, peak demand
  - CHP and DH can play important roles; flexible production (e.g. gas engines) and flexible consumption (e.g. heat pumps or electrical boilers)
- Page 8, how to balance ratepayer costs, system reliability and GHG emissions
  - Calculation of society economy, put a price on GHG and system reliability (what is the value for society?), regulation should make sure that this is reflected on the consumers prices (thus ensuring acceptance).
- Page 9, system reliability and integration
  - DH (incl. heat pumps, renewable sources etc.) and CHP with thermal energy storage is perfect for balancing hourly, diurnal and even seasonal
- Page 11, demand management
  - Reduction in heat supply would be easier to implement due to the inerty of heating

- Flexible production and consumption of electricity
- Society economy
- DH as balancing technology in all time perspectives
- The dynamic of heating is an advantage

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REFLECTIONS ON ”MAKING CHOICES – REVIEWING ONTARIOS LONG-TERM ENERGY PLAN”

- Page 12, nuclear
  - Nuclear, being baseload, constitute a barrier to emerging energy technologies, including renewables
- Page 14, natural gas
  - What about biogas?
  - You need natural gas for flexibility – CHP can increase energy efficiency
- Page 17, ”increasing local control over future renewable energy projects… require energy planners and developers to work directly with municipalities to identify appropriate locations and site requirements”
  - Good news for district heating?
- Page 18, energy storage
  - Both electricity and heat
- Page 19, regional energy needs
  - Possibilities for DH in e.g. York Region?
  - Local employment could be improved with DH

- Central or decentral energy production?
- Biogas?
- Positive trends, good options for developing district heating

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REFLECTIONS ON ”MAKING CHOICES – REVIEWING ONTARIOS LONG-TERM ENERGY PLAN”

- Page 20, Transmission planning
  - DH can reduce the need for transmission lines, local production including utilisation of wind power in heat pumps
- Page 23, Smart Grid
  - Combined smart meters for heat and electricity (not water, but is possible), case from Aarhus
- Page 26, natural gas
  - Imagine if you utilised a higher share of the natural gas, by applying CHP and district heating
  - Interest of the natural gas companies? Selling directly to consumers? Could sell to CHP-plants
  - Natural gas may develop a new market in transportation – giving room for district heating?

Types of infrastructure – DH and electricity

Smart grid includes district heating!

Role of natural gas

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REFLECTIONS ON THE OTHER WORKSHOPS

- Workshop 1: Community energy planning
- Workshop 2: Conservation first
  - Behaviour. Reduction of consumption can be facilitated by information, but mostly by economic incentives or automatic regulation (without compromising the needs of the consumers).
  - Insulation included? Balance between investment in reduction of demand and efficient energy usage through e.g. district heating (45 % – 90 %) – primary energy consumption should be the reference parameter
- Workshop 3: Emerging technologies
  - Storage technologies, including heat storages?
  - Supply side – diversified energy production, the role of CHP?
- Workshop 4: Smart grids
  - Is district heating included as part of the smart grid? Heat pumps and electrical boilers (balancing the electricity system and utilising surplus wind power)
  - Standards? (E.g. CHPCOM-project)

Energy planning relates to supply, demand, technology and system integration

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