The Danish Model for Organising and Financing of District Heating

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PlanEnergi:
Consultant Engineers
33 years years with renewable energy

- biomass
- biogas
- solar thermal
- heat storages
- heat pumps
- district heating
- energy planning

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Agenda

- The development of district heating in Denmark
- The legal framework
- Examples of ownership and organisation
- Financing of district heating in Denmark
- Development trends

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1898	**Waste to heat**
1903	**Heat from power plants. Fuel: coal**
1960	**Change from individual coal and coke to individual oil or district heating. Fuel: Oil in district heating. From 1972 change to coal.**
1979	**Natural gas introduced. Law of heat supply and division in individual gas and district heating areas. Fuel: Coal and straw in district heating.**
1990	**Natural gas fired CHP-plants. Fuel: Natural gas (and still coal in power plants)**
2010	**Individual gas conversion to district heating. Fuel: Natural gas and renewable energy (and still coal in power plants, but power plants start to convert to biomass)**
2017..	**Conversion to renewable energy and excess heat in hybrid plants**

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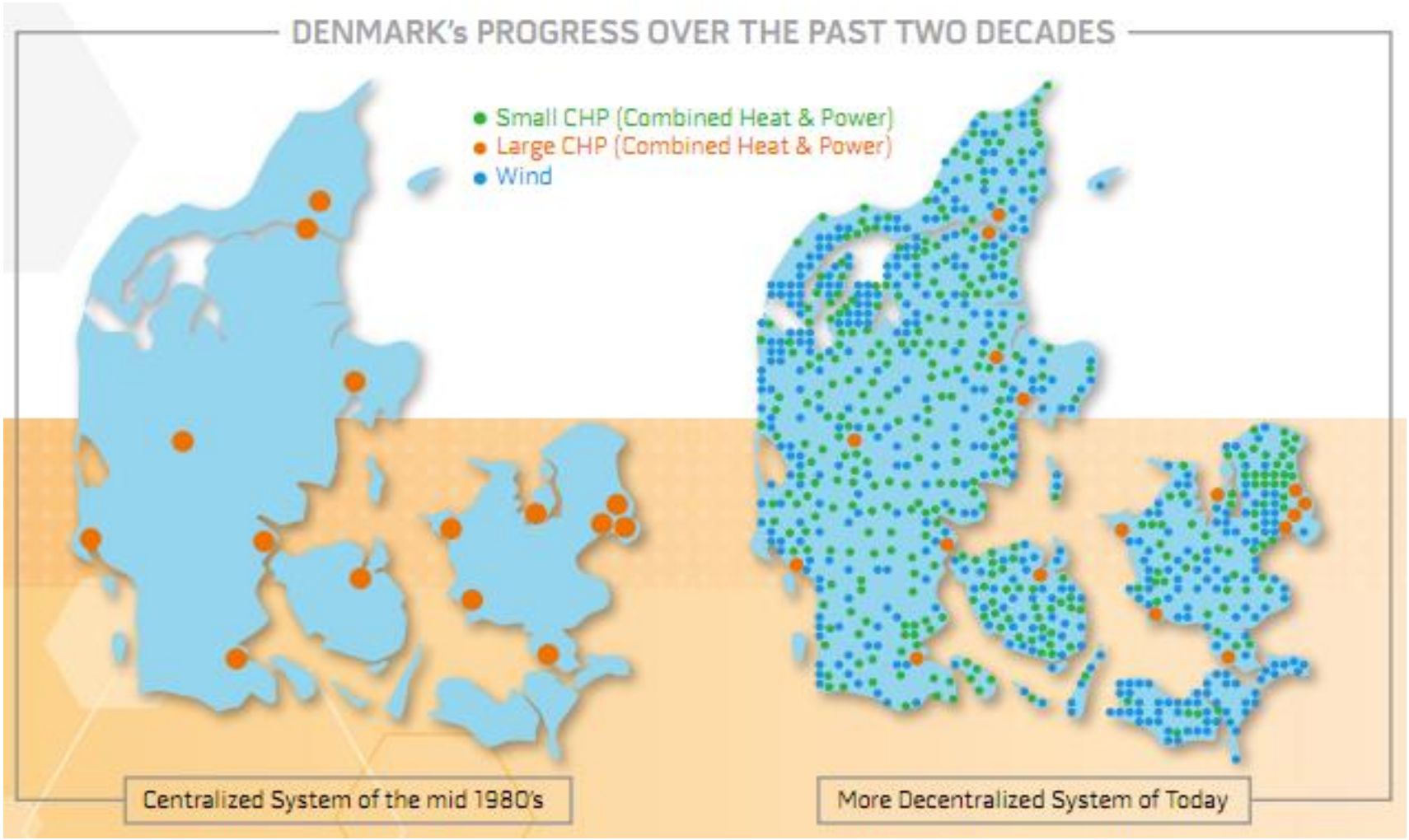

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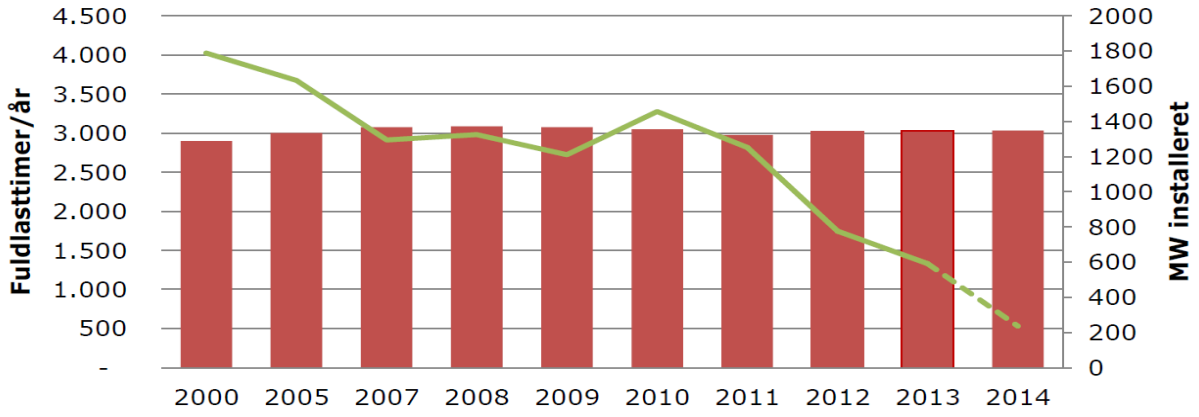
District heating status in Denmark today

- 65% of all Danish houses have district heating
- 54% of the heat demand is covered by district heating
- 50 municipal owned district heating companies deliver 70% of the heat
- 340 cooperatives deliver 30% of the heat
- 250 utilities have CHP with gas engines or gas turbines, but full load hours have been reduced from 4,000 in year 2000 to 500 in year 2014. No new gas engine capacity installed since 2007



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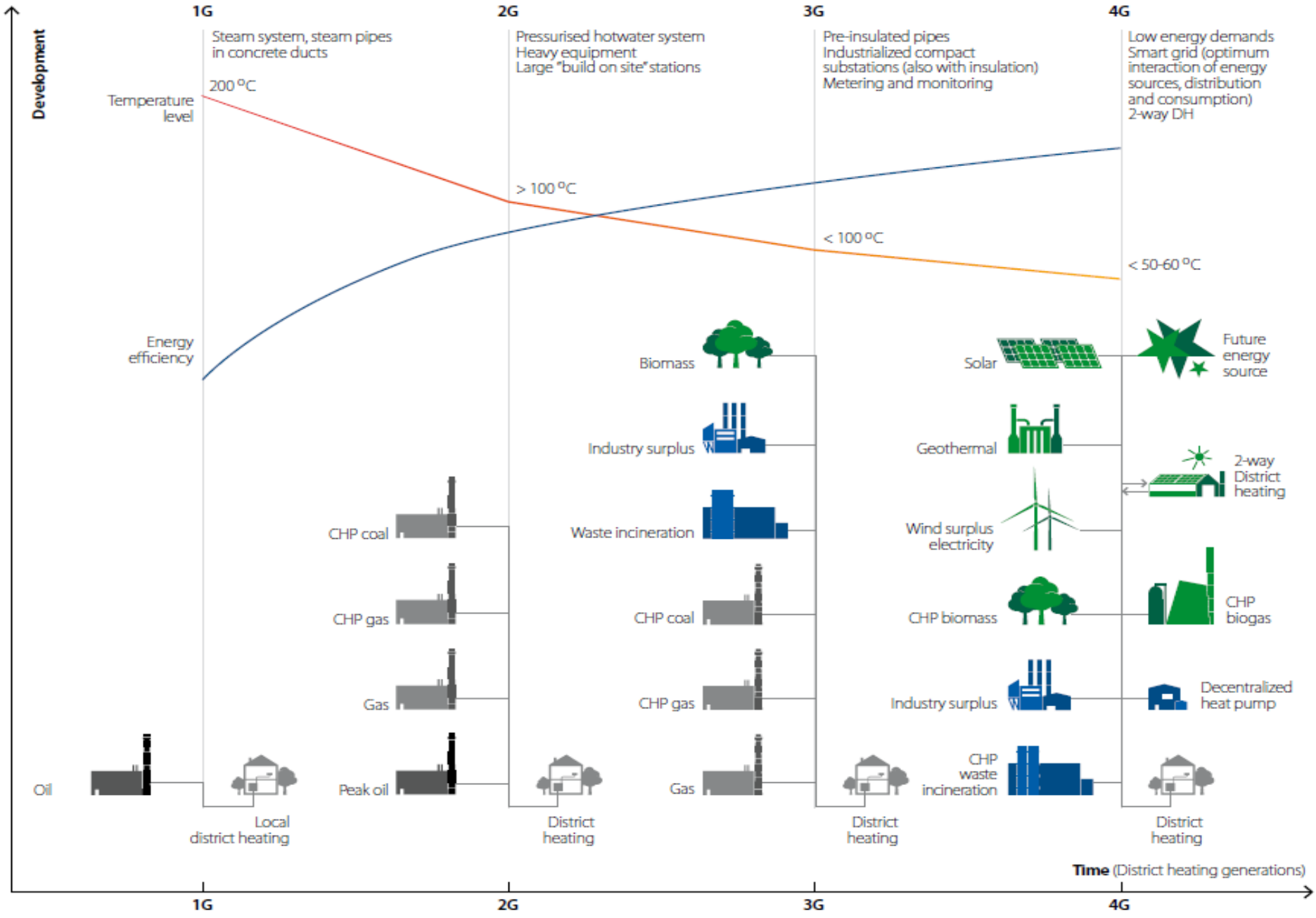
District heating from 1G to 4G



Law of Heat supply

1979: Every municipality should elaborate a heat plan where heat supply was defined as individual, natural gas, or district heating for consumers in the area to secure a market for natural gas heating in stead of individual oil. There was a public phase in the planning process.

After 1990: Only few municipalities made new heat plans. Instead new projects with change of heat supply or heat production have to be accepted by the municipality. The project proposal has to show that the actual project is the best socio economic option among possible alternatives. When a project proposal is approved by the municipality is allowed to expropriate land for the project.

Since 2007: The climate agenda has initiated new heat plans in municipalities. The heat plans are now part of a strategic energy planning process.

District heating sector in DK is non profit

Law of Planning

Regulates **area utilization** (where to situate new city parts, industrial areas, new infrastructure etc.)
Every municipality makes a **Municipal plan** and revise it every 4 years. A public phase of 8 weeks is part of the process.
To the municipal plan can be added **Thema plans** for instance for situation of wind power plants.
When an energy plant is built, a planning permission is needed. Normally a **Local plan** is elaborated. In the local plan the new energy plant is visualized and all consequences for landscape and environment are described. A public phase of 8 weeks is part of the process. When a local plan is accepted, the municipality is allowed to expropriate land for the project

Possibility for municipal guaranteed loans

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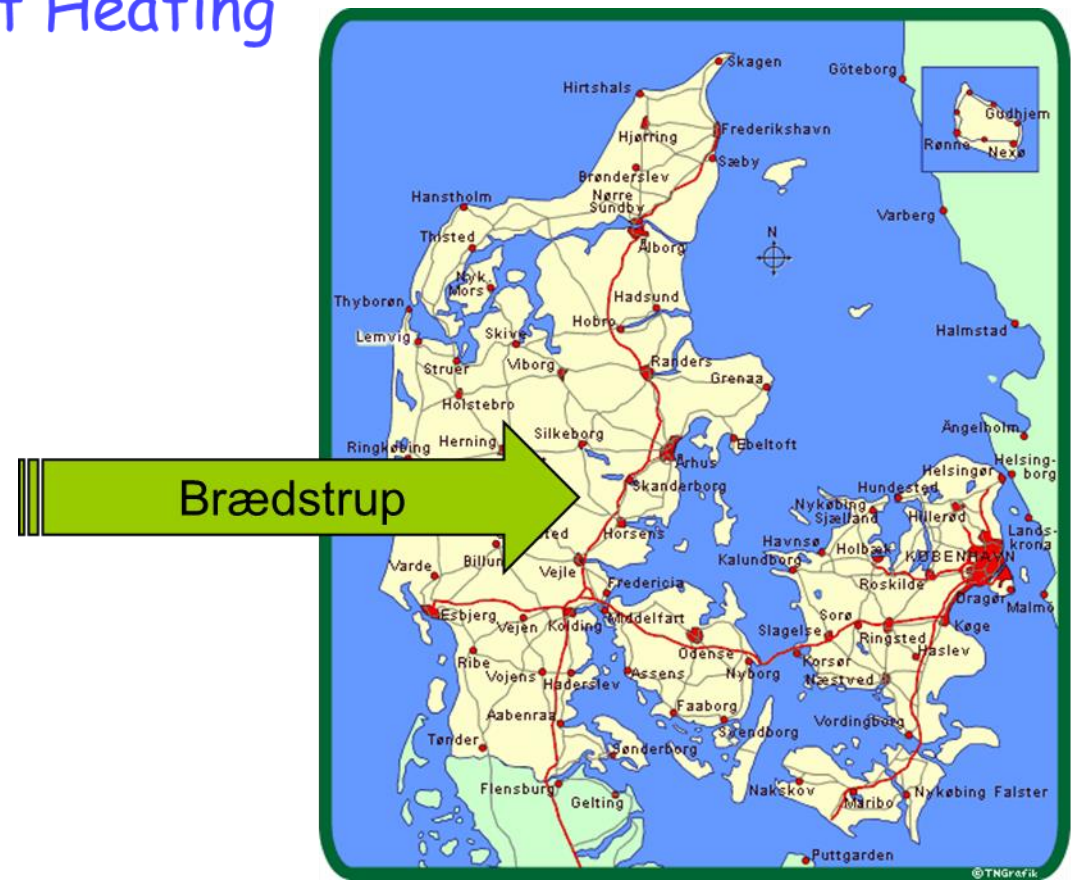
An example from Denmark: Braedstrup District Heating



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An example from Denmark: Braedstrup District Heating

- A cooperative owned by 1.550 consumers
- The consumer, the customer and the owner is one and the same person
- Annual production:
  Approx. 50.000 MWh heat – 22.000 MWh electricity
- Administration of approx. 5.000 water consumers

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All costumers

The General Assembly

All costumers have access

The Board

(4 members are elected by the General Assembly 1 from the mucipality)

Management and staff

An example from Denmark: Braedstrup District Heating

- The highest authority: The General Meeting (all consumers have access and the right to vote)
- A General Meeting at least once a year
- Information meetings through the introduction of new technologies
- Example:
  The approval of the first solar plant from 2007 (the first in the world with solar/CHP!!):
  122 votes for the proposal - 5 against
- The approval of the next solar plant from 2010 (Braedstrup SolarPark):
  199 votes for the proposal - 0 against

Braedstrup District Heating

199 votes for the proposal - 0 against!!!

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Braedstrup 2007

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Braedstrup ”in bricks”
Legoland

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Data – the 2007-project

Production: 3.600 MWh heat/year
(9 % of the production demand)

Invest: 1,6 mill. Euro
Grants: 0,4 mill. Euro
Nt. invest: 1,1 mill. Euro

Pay back time: 6,5 years

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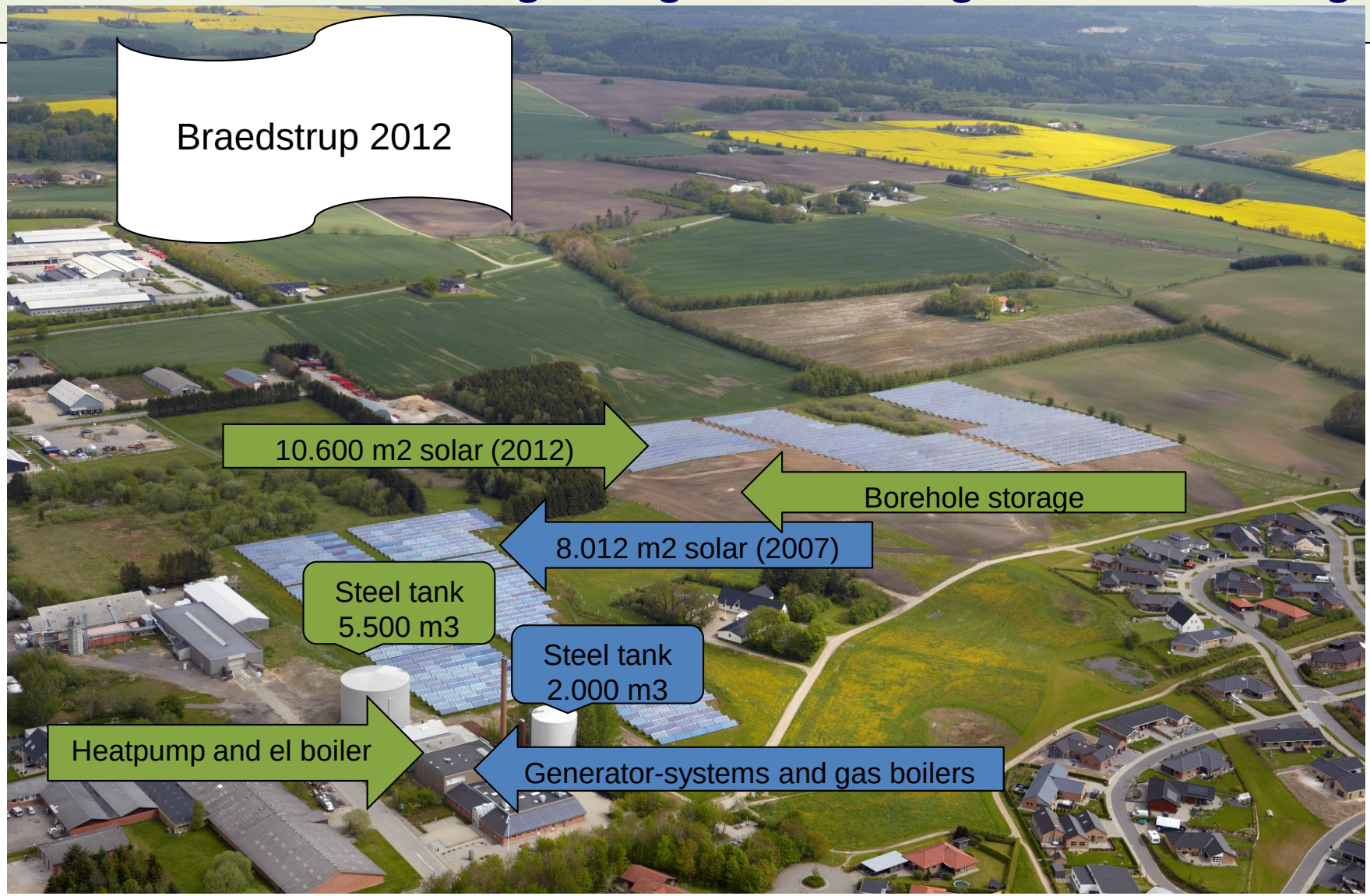

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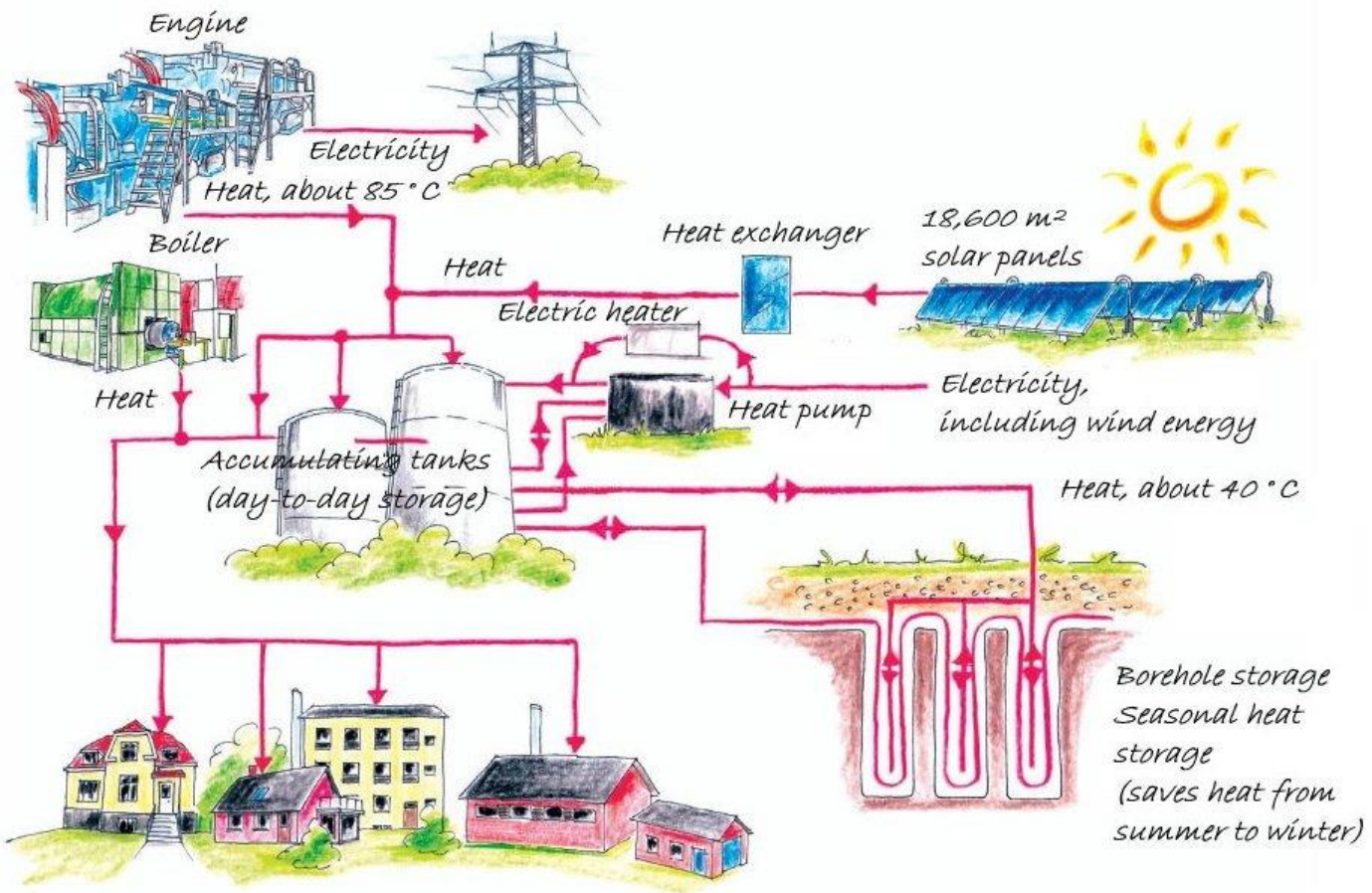
Braedstrup District Heating 2012



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Data – the 2012-project

Production: 4.800 MWh heat/year
(Total: 20 % of the production demand)

Invest: 3,6 mill. Euro
Grants: 0,9 mill. Euro
Nt. invest: 2,7 mill. Euro

Pay back time: 10 years

Business - models

Typical example (DK): Solar Area: 10.000 m2

Purchase of land (30.000 m2):	50.000 Euro
Solar modules. pipes, heat exchangers, pumps, heat transfer fluid, etc.:	1.850.000 Euro
Fencing, soil processing, etc.:	50.000 Euro
Transmission pipe (1.000 m):	300.000 Euro
Control-systems:	100.000 Euro
Counseling, case processing, etc.:	40.000 Euro
Total:	**2.390.000 Euro**

Calculated production: 5.000 MWh/year

Annual capital costs: 2.375.000 Euro x 5%/year: 119.000 Euro/year

Maintenance: 1,0 Euro/MWh: 5.000 Euro/year

Total production costs: $\frac{124.000 \text{ Euro/year}}{5.000 \text{ MWh/year}}$ = **24,8 Euro/MWh**

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Energy Service Company. Example Nordby-Mårup, Samsø

Owner: the energy supplier *NRGi (electricity company)*
Energy Service Companies (ESCO's) act as third-party financers by assuming the financing responsibility in energy projects
NRGi runs 11 small district heating plants. There is a fuel supply agreement for all district heating plants. It ensures the supply of biomass, and manages the risk of fuel interruption. Suppliers must pay for backup oil, if they cannot deliver straw / wood chips. 185 buildings connected

Private ownership. Example Onsbjerg, Samsø

Owner: A privately owned limited liability company *Kremmer Jensen Aps*
An example of third party financing
Management board: members of the family + two representatives for the 80 consumers + 1 representative from the municipality
The owner constructed the plant and runs it himself. He also takes care of the Ballen-Brundby plant.
The consumers pay a one-time connection fee, an annual subscription fee, and a price per consumed MWh

Consumer owned company. Example Ballen-Brundby, Samsø

Owner: The consumers in a co-operative (Coop) with limited liability
The members both own and manage the coop. The coop must be of the greatest possible use to the members, rather than give the highest profit.
In a coop every member has one vote, independently of the magnitude of his investment
The municipality issued a municipal guarantee for a loan.
Before construction members paid a fee of 80 DKK (11 EUR) to get connected.
After construction new members pay 45.000 DKK (6.000 EUR) for the connection labour and materials. 232 buildings connected.

Why local ownership? Reasons for Samsø

- it created collective wealth
- local community developed
- local acceptance improved
- it was an education

Financing Example EKF www.ekf.dk

About EKF

- Denmark´s official export credit company
- 94 years of experience
- Owned and guaranteed by the Danish state
- Works on commercial terms
- Operates under international rules and regulations, including standards for CSR-evaluations

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Financing - EKF

A note on rules & regulation

A management agreement between EKF and bank secures that each individual utilisation of the line of credit is acceptable to EKF & in compliance with OECD-rules.

For example:

- Each utilisation of the credit must be linked to a corresponding export contract.
- The buyer pays min. 15 per cent cash up front to get up to 85 per cent funded at the bank for each individual contract.
- The credit amount does not exceed the amount fundable according to OECD-rules (import value/local works limitation).
- During the utilisation period each utilisation accumulates under the credit line until SPOC (F.x. utilisation over 12 mths./SPOC in 12th month.).
- Maximum tenor of 8½ years - however longer tenor can be justified for renewable energy investments.

How to get started

- The buyer identifies a group of Danish technology & equipment providers, an investment budget and financing need over a certain time-frame.
- EKF conduct a CSR-compliance test of the buyer' activities, if connected with larger projects a project-specific CSR-test will apply.
- EKF check with each of identified Danish exporter whether the required Danish Economic Interest will be met.
- EKF, bank and buyer agree on terms of the credit line, how it's managed.

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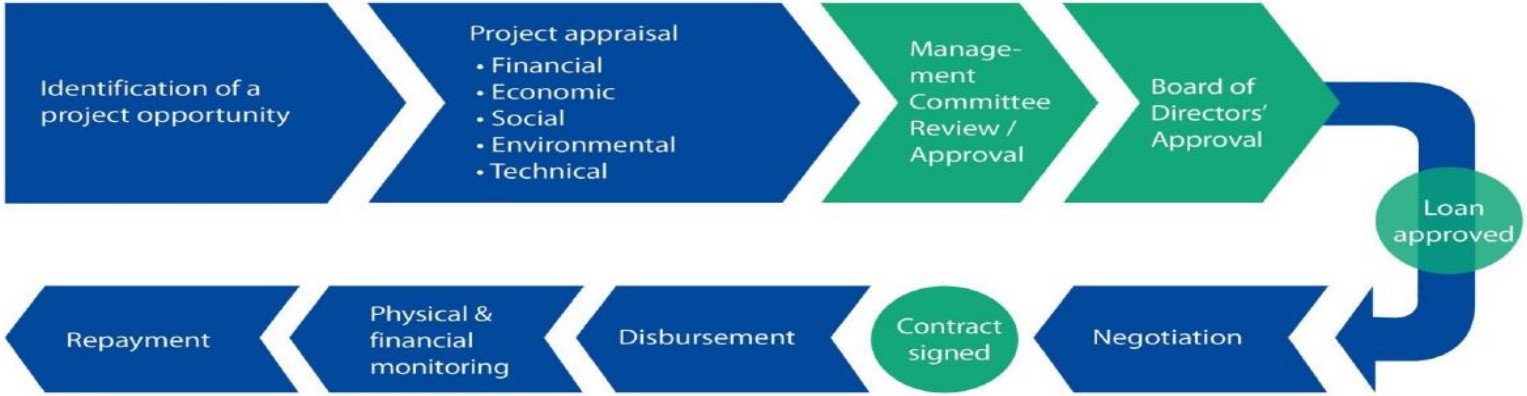
ELENA http://www.eib.org/products/advising/elena/

General operational considerations

- Projects financed by the Bank must be:
  - economically justified
  - technically viable
  - financially self-supporting and
  - environmentally and socially sound
- All projects financed by the Bank are appraised by a multi-disciplinary team; confidentiality is always respected.



European Local Energy Assistance - ELENA

ELENA
Technical Assistance

Support for
local or regional entities for :

- **Additional personnel**
- **Technical studies**
- **Preparation of calls for tender**
- **Financial structuring**

INVESTMENT PROGRAMME

EE and RE
in public and private buildings,
public lighting and traffic light network
photovoltaics,
heating/cooling systems ;

Efficient and sustainable urban transport
high-efficiency buses,
electrically powered cars,
logistical improvements;

Local energy facilities that support EE/RE
smart grids,
infrastructure for recharging electrically
powered cars,
information and communications technologies,

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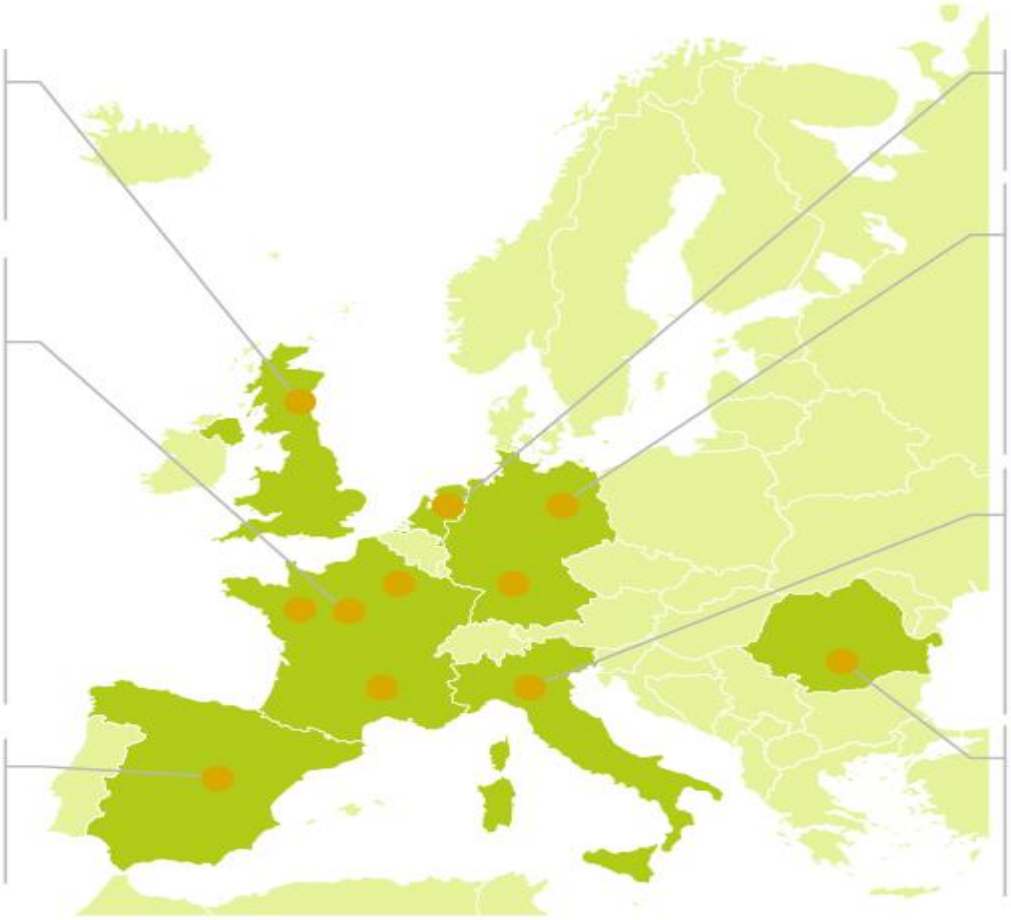
European Energy Efficiency Fund -http://www.eeef.eu/objective-of-the-fund.html

UK
- €4.2m senior debt to project entitiy **Cardenden Heat and Power**
  (EE: boiler replacement and RE: onshore wind)

FRANCE
- €5.1m junior funds to project vehicle to supply heat to **City of Orléans**
  (EE: CHP/biomass)
- €7.3m junior funds to project vehicle to supply heat to **City of Rennes**
  (EE: CHP/biomass)
- €30m senior funding to **Bolloré**
  (Clean Urban Transport: electric cars)
- €5m senior construction facility to project vehicle of **Région Rhône-Alpes**
  (EE: schools retrofit)

SPAIN
- €2.5m forfaiting loan to **Universidad Politécnica de Madrid** via Enertika *(EE: building retrofit)*



NETHERLANDS
- €8.5m senior debt to City of Venlo
  (EE: public lighting)

GERMANY
- €0.9m forfeiting loan to **Jewish Museum Berlin** via Johnson Controls' ESCO
  (EE: building retrofit)
- €0.6m forfeiting loan to **University of Applied Sciences Munich** via Johnson Controls' ECSO
  (EE: building retrofit + CHP)

ITALY
- €32m project and VAT bond facility to project entity upgrading **University Hospital S.Orsola Malpighi in Bologna**
  (EE: reduction on energy in entire fluid production and distribution system)

ROMANIA
- €25m subdebt to **Banca Transilvania**
  (Financial Intermediary investment: EE, RE, Clean Urban Transport)

Financing 1 mio. €

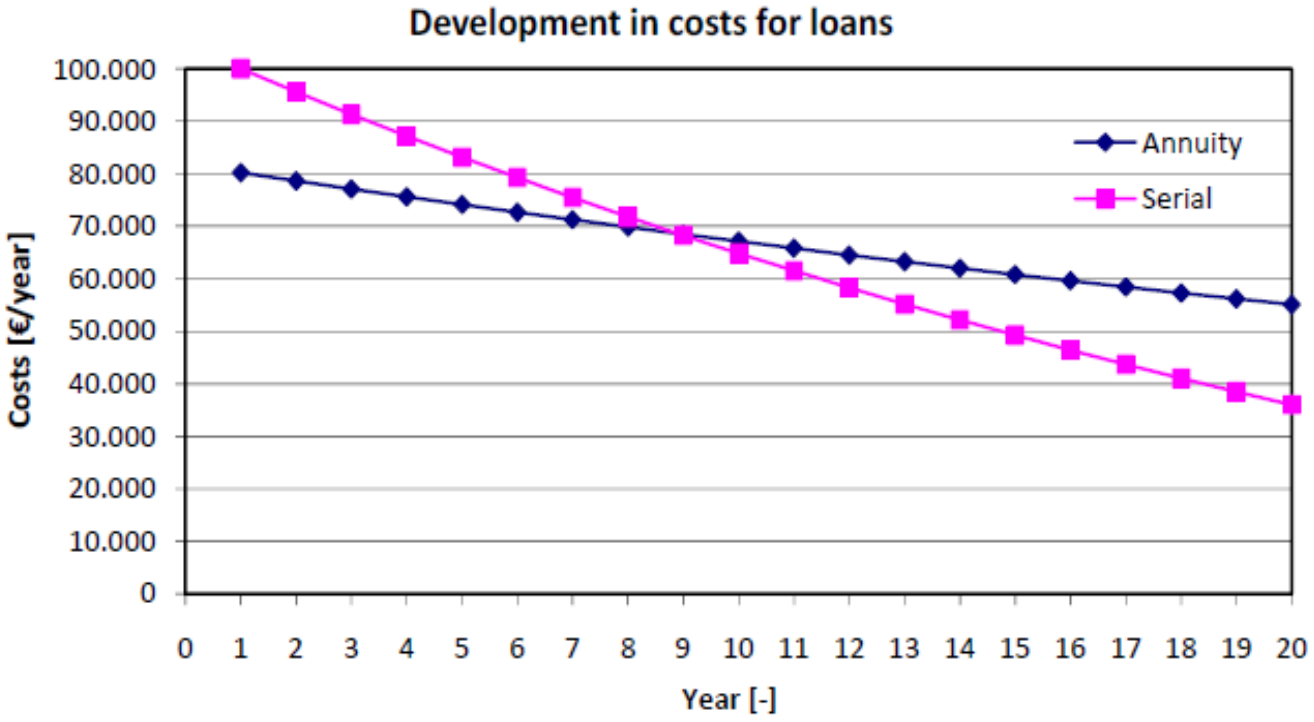


Fig. 2.4.1. Development in costs for annuity loans and serial loans, interest rate 5%, inflation 2%.

Financing costs for different interest rates

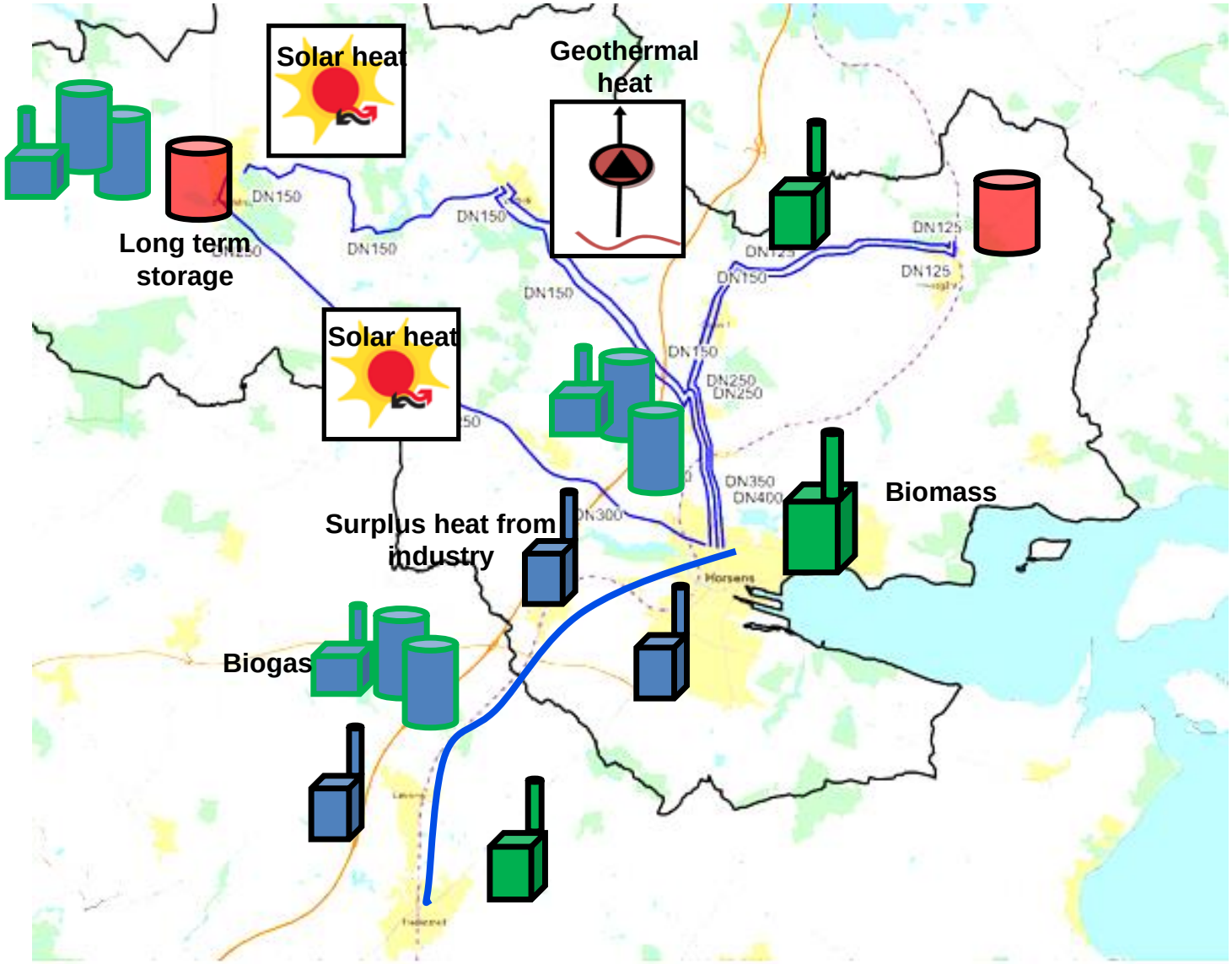
Loan 20 years, inflation 2%

Serial loan, 5%, 1.st year	10%
Serial loan, 3%, 1,st year	8%
Annuity loan, 5%, 1.st year	8%
Annuity loan, 4%, 1.st year	7.4%
Annuity loan, 5%, average	6.7%
Annuity loan, 4%, average	6.1%
Annuity loan, 3%, average	5.5%

Future development

- To increase efficiency: Small DH utilities will be administrated by the larger ones
- To reduce losses: Monitoring of consumption flow and return temperatures from buildings will be online (this is already realised for several utilities)
- Bench marking will be obligatory for the larger plants
- More transmission lines connecting utilities

The Flex Cities project



THE COPENHAGEN DISTRICT HEATING NETWORK

Vestforbrænding

Lynetten

Amagerværket

ARC

HCV

KARA/NOVEREN

SCA

Avedøreværket

Copenhagen Airport

Køge Kraftvarmeværk

Heat supply areas:

- CTR + HOFOR
- VEKS
- Vestforbrænding
- Other

- Waste-to-energy plant
- CHP station
- Peak load plant
- Transmission pipeline

10 km

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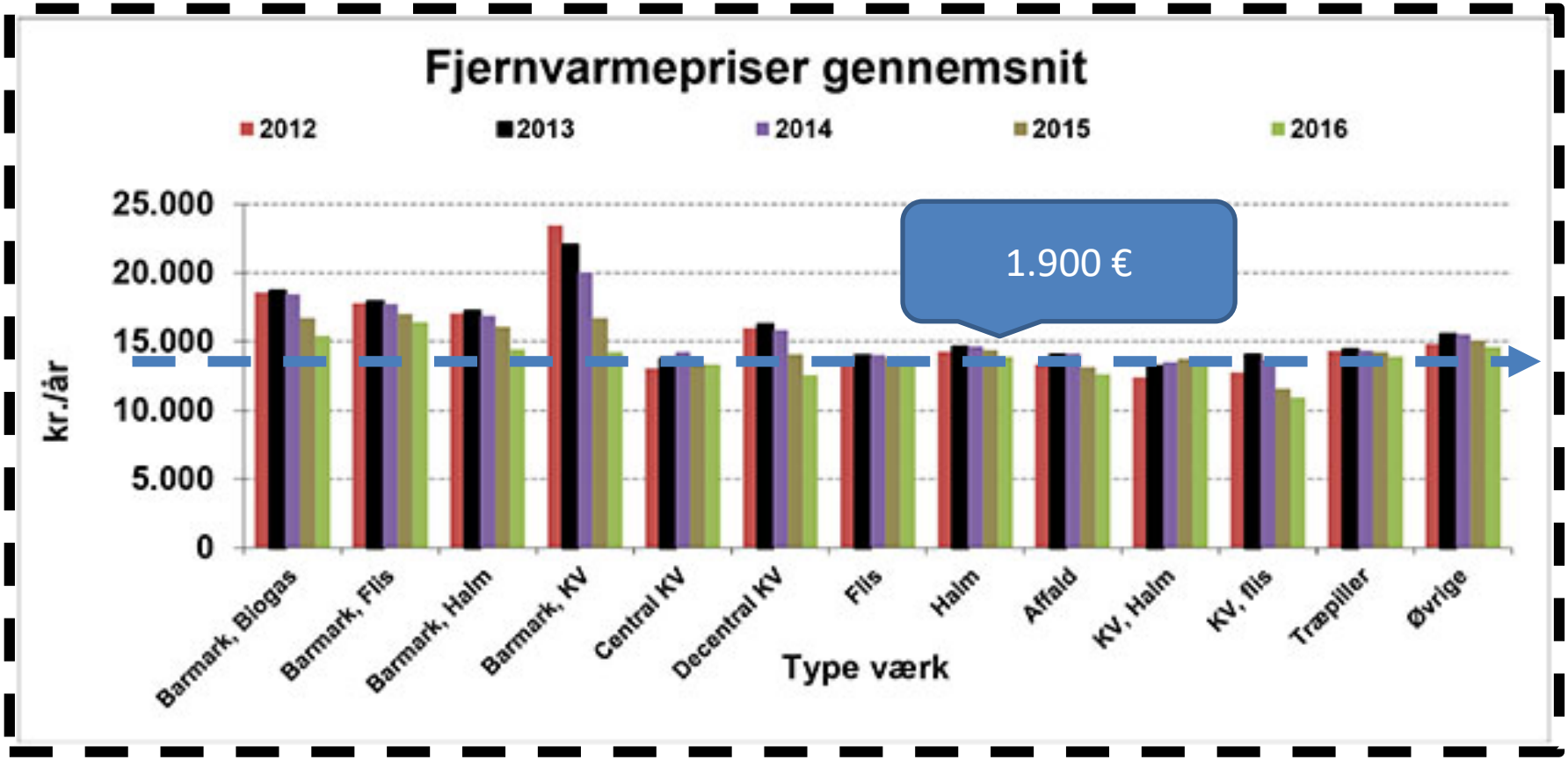

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Thank you for your attention

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