Danish Energy Agency

Governance Models and Leadership for District Energy

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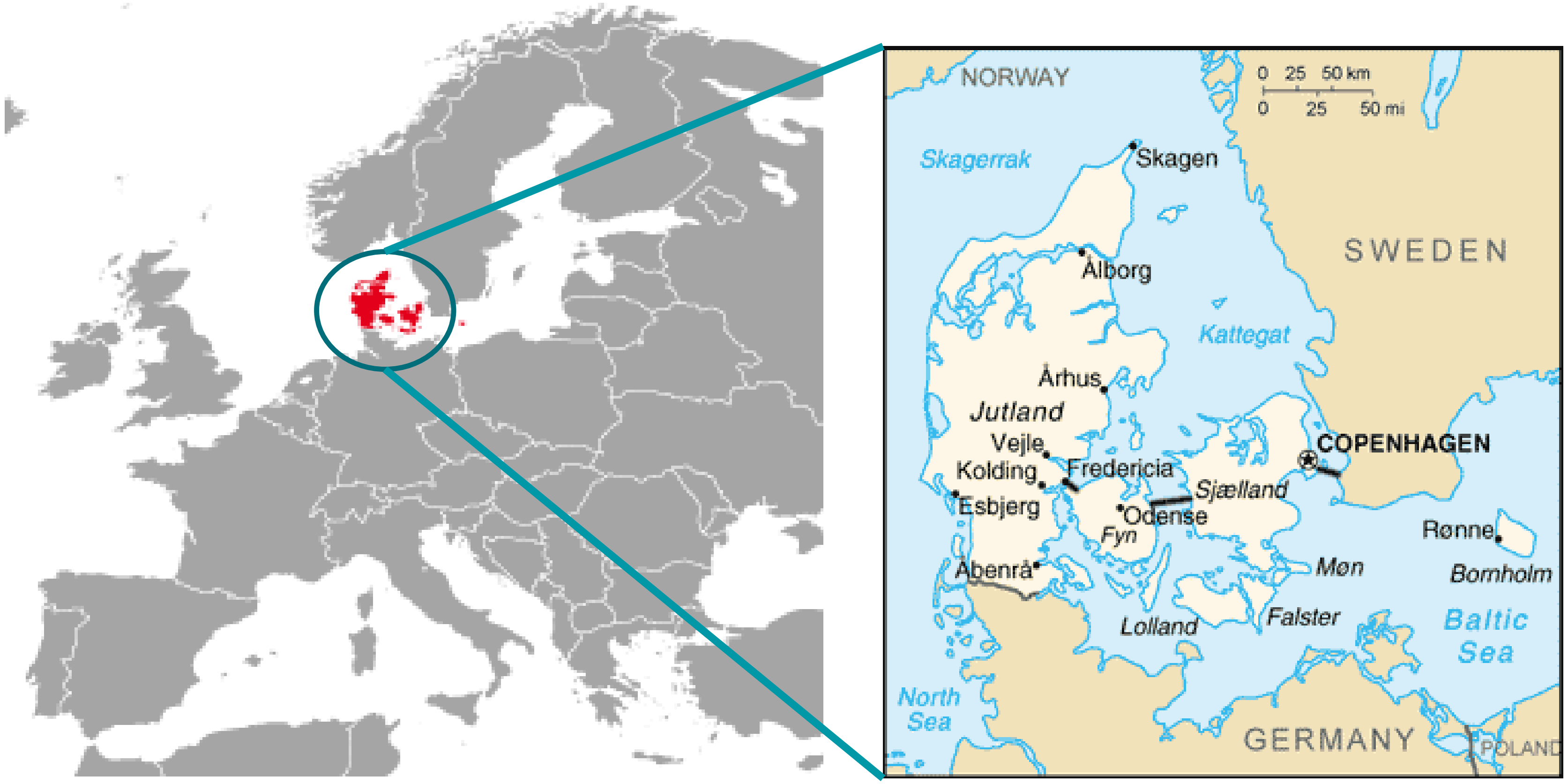
So, where is Denmark?



Denmark

Population: 5.7 million

Area: 16,577 square miles

Coastline: 4536 miles

Land use: 2/3 of land area used for agriculture

Water Source: 100% ground water

Government: Constitutional monarchy.

GDP per capita (2017): 56.307 USD (~5 % lower than US)

Energy Consumption per Capita:

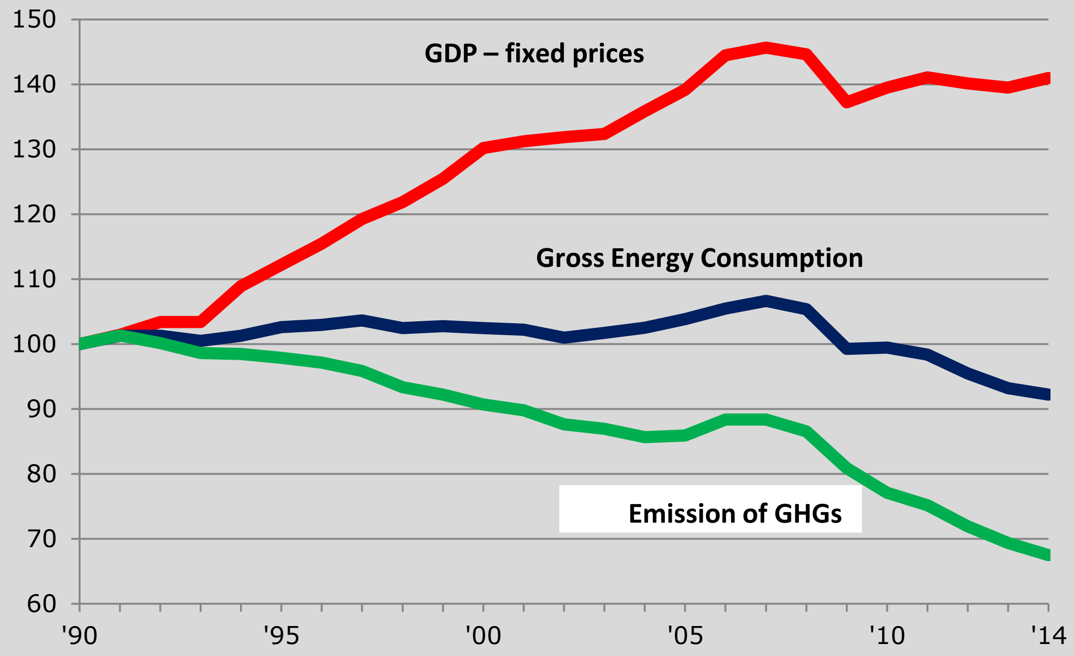
105 million BTU (CA:199 million BTU)

One of the world's **happiest** nations according to UN, OECD

64 pct. of households has DH ~ 20,500 miles of DH pipe

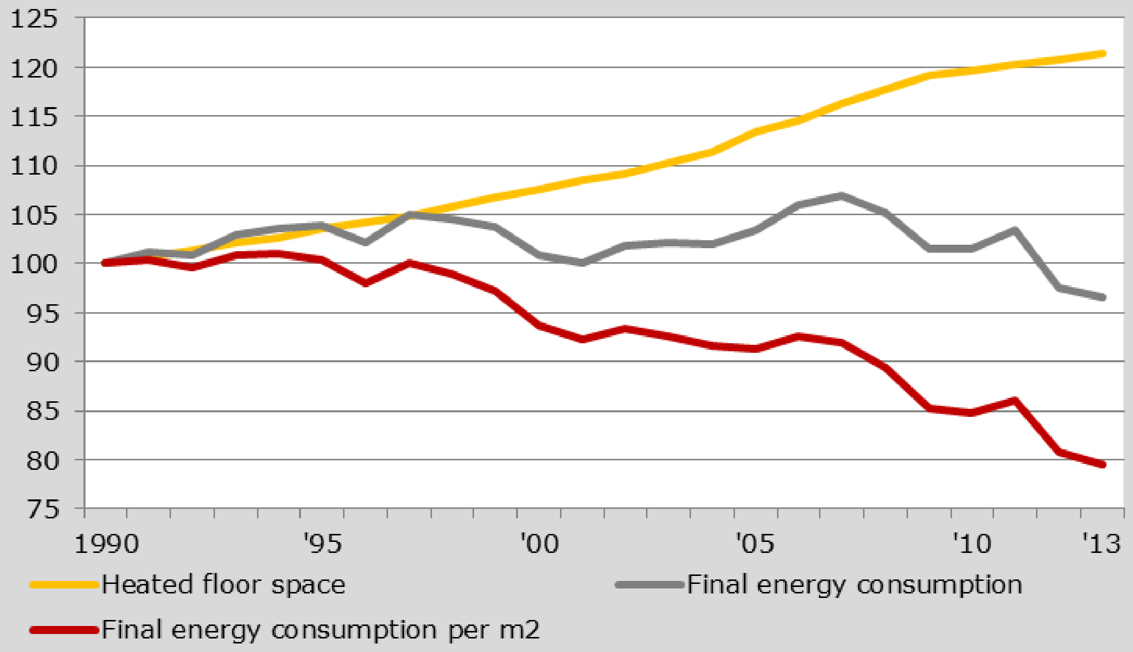
Danish energy highlights

- The world's highest share of new renewables (non-hydro) in electricity generation – 64 % in 2017.
- 43 % share of wind power in electricity generation (2017).
- Very high degree of energy security (99,996% for electricity).
- Electricity prices among the lowest in the EU.
- … while maintaining economic growth and reducing GHG emissions.



Danish energy highlights

- Energy consumption per GDP-unit is lower than in any other EU-country.
- World leader in advanced energy technologies - district heating and CHP, wind, biomass, energy saving technologies.
- Energy efficiency **-** heating demand per m^2 reduced by 45 pct. since 1975.
- **District energy is a cornerstone in the Danish energy system – enabled by local heat planning!**



Pittsburgh as our partner

1. Ambitious emissions reductions goals for the City of Pittsburgh (20% by 2023; 50% by 2030; 80% by 2050).
2. International outlook and orientation - and position.
3. Energy leadership and a template for other cities – American "City of the Future".
4. Energy infrastructure ambition with "District Energy: Grid of Microgrids".
5. Strong local partners.
6. Pittsburgh Energy Baseline established.

Points in this presentation

Local government leadership important in:

- Supporting data and tools development for heat and energy mapping
- Identifying candidate spots for DE
- Facilitating implementation through creative governance models and network expansion to meet GHG targets.

Attenttion to pitfalls and decision gates

- District energy (DE) offer tremendous economic and emission reduction benefits and is often a critical prerequisite to cost-effectively integrate lowcarbon technologies to meet GHG goals.
- Local heat energy planning is a prerequisite for enabling DE and empowers city leaders to identify the best suitable solutions for local conditions.
- A strong local governance structure is a prerequsite for the implementation, investments, operation and expansion of cost-effective DE systems

3 Key Principles to consider

- Heat planning. Standardized and mandatory feasibility study of all DH project alternatives = Quality assurance of economic viability of CHP and/or renewables
- Investor protection: Possibility for City Council to establish requirements that individual (commercial) buildings that are not low-energy connect to DE systems. A fixed tariff on the consumer bill guarantee repayment of all loans and credits.
- Consumer protection: Public hearing of all DE projects. All consumers can complaint about irregularities or misuse of tariffs/prices. Consumers part of the Board for heating companies. Unbundling.

	Cost-coverage and not-for-profit	Fully commercial DE market	Public ownership, but private O&M	ESCO market for commercial owners of DH
Characteristics	Typically municipality/consumer-owned – provide cheap heat to owners.	Market driven by supply and demand – only commercial actors	Local City government entity owns DE system w/o operating it.	ESCO's provide capital and technology to establish DE systems.
Pro's	• Low consumer prices, if optimally designed and managed. • Can (in some places) give access to low-interest loan financing. • Transparency for consumers and empowers the community served by the DE system. • Municipial/City Council control of DE as a means to achieve GHG target – integration with spatial planning.	• Market forces are at full play to increase competition and lower heat production costs.	• Enables development of DH sector without prior experience. • Private sector expertise engaged to improve efficiency and service quality. • Length and extent of privately run O&M can be adjusted to specific needs through lease or contract.	• Consumers are ensured a fixed (competitive) heat price for a fixed period. • Risks relocated to a private company.
Con's	• Requires proper management and trained supervision to ensure efficiency and lower prices for consumers by investing in new tech and ensure that maintenance is done when required not when funds are available. • Large investments – long payback	• Natural monopoly (or at least very limited competition) where market forces can be misused against consumer interests by overpricing. • Lack of municipal/City Council control	• Rate of return is typically low so incentive to enhance long term efficiency is limited. • Public-private contract must be very specific and requires significant expertise on choice of performance criteria, prerequisites for fuels, efficiency standard, data sharing etc.	• ROI expectations typically higher which results in "cherry-picking" and suboptimal solutions. • Requires the presence of several competing ESCO's to ensure competitive prices • Requires carefully prepared contractual obligations on delivery conditions, maintenance and handing over after contract expiry.

Ownership model matters

Denmark

- Only necessary costs allowed to be included in consumer heat price.
- Transparent pricing available in national statistics.
- Regressions analysis showed significant difference in heat prices according to ownership.

Example of a energy company that bought several CHP plants from municipalities and consumer coops. After 4 years prices had increased almost 50 pct. and several municipalities decided to buy back the plants and prices dropped.

Europe

- Re-municipalisation of DE systems
- Municipal ownership provides democratic control.

Economic Regression Analysis of DH Prices (2013)		Difference/ year
Location	Medium size town	0
	Big city	19 €
	Small town	530 €
DH volume	10 000 MWh	0
	50 000 MWh	- 420 €
	1 000 000 MWh	- 830 €
Ownership	Consumer cooperative	0
	Municipality	155 €
	Private company	760 €

Heat demand for a typical Danish household including hot water: 18,1 MWh/65 GJ/61,8 mmBTU per year

Consumer Protection

- Unbundle heat/cooling production (plants) from other activities, i.e. transmission and distribution – to ensure market competition and 3rd party access for competitive pricing.
- For CHP: Separate accounts for power and thermal loads – provides transparency
- Give consumers the right to chose the majority of a district net company's board members - to ensure local ownership and transparency.
- Publish heat prices – so consumers can check their prices.

Governance structure considerations

City/Municipality- and consumer-owned DE companies allows for maintaining control over major decision making as well as:

- Access to information essential for energy & heat planning purposes.
- Decisions on where and how new DE systems will be deployed and which technology to be used.
- Integration of heat planning with land use planning to ensure that future developments is aligned with GHG targets and ambitions.
- Transparency by publishing prices and engage community ownership by having consumer representation on the board/company leadership.

DE company could act like a quasi-agency within City Government

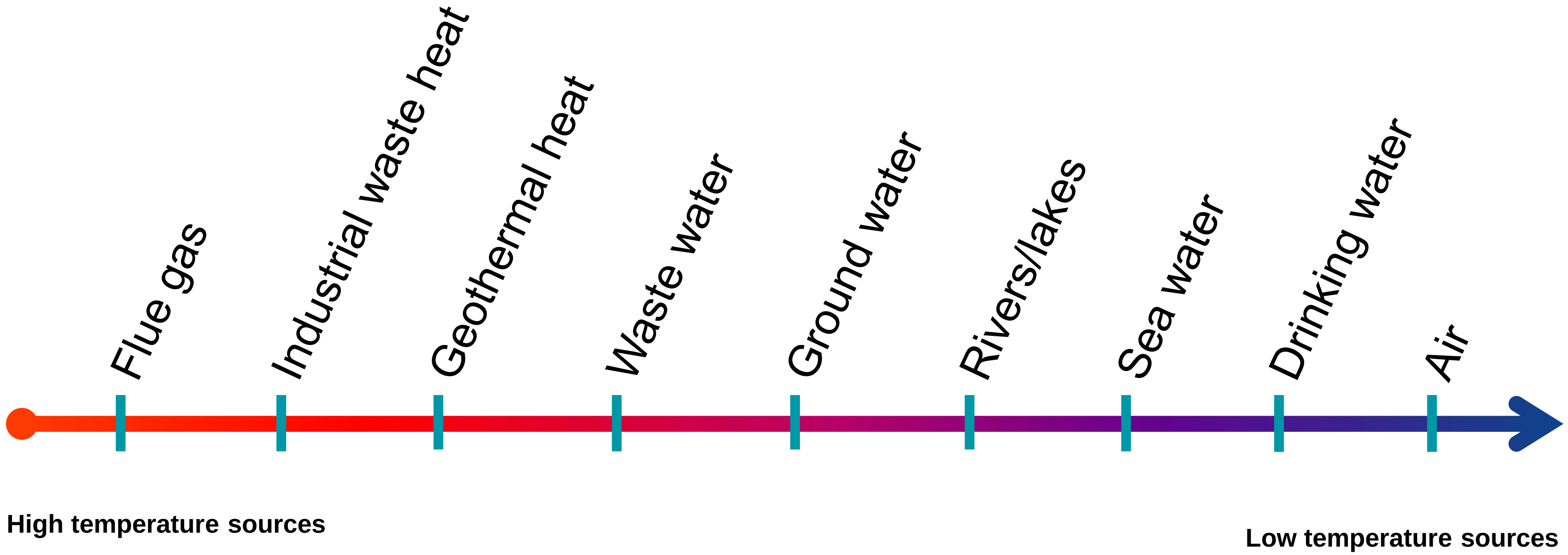
Ideas for implementation

- Use standardized feasibility study methodology for comparing projects.
- Ensure competition via Third Party Access.
- Require fixed and variable tariffs to ensure a viable company economy and transparent pricing.
- Require public access to some data and restricted access for (some) authorities.
- Connect all city-, county and state-owned buildings.
- Use locally vested powers (zoning, property tax policies, energy franchise agreements etc.)
- PACT?!

Case on standardized feasibility study

Smaller size local DH system, 250 homes and a school – 6,400 MWh/year
Objective: Fuel switch from NG to local RE in order to lower heat price

- Step 1: Screening for heat sources

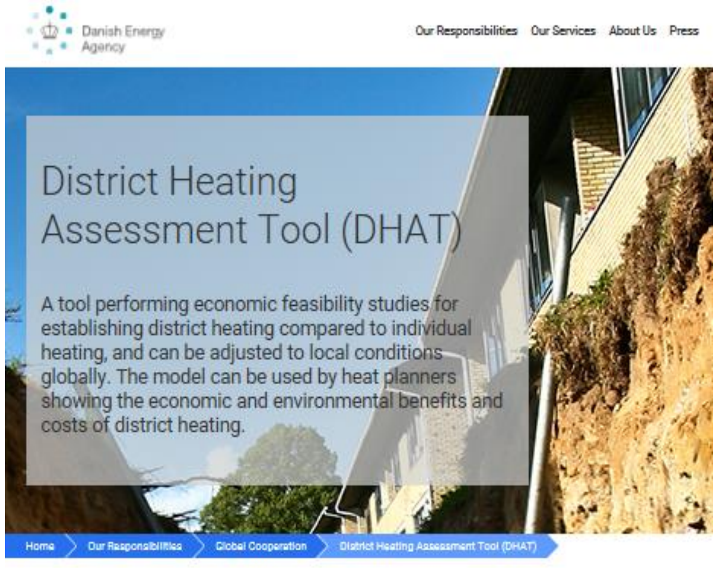


Case on standardized feasibility study

- Step 1: Screening for heat sources
- Step 2: Define alternatives (biomass, electric heat pump or solar thermal)
- Step 3: Software simulations → estimated heat prices

District Heating Assessment Tool

- A simplified version of the Danish method to compare heat technologies and prices for the feasibility study.
- Is a LCOE-tool for screening of DH in other countries but requires local adaption before specific feasibility study can be done.
- Download excel-tool + manual free of charge



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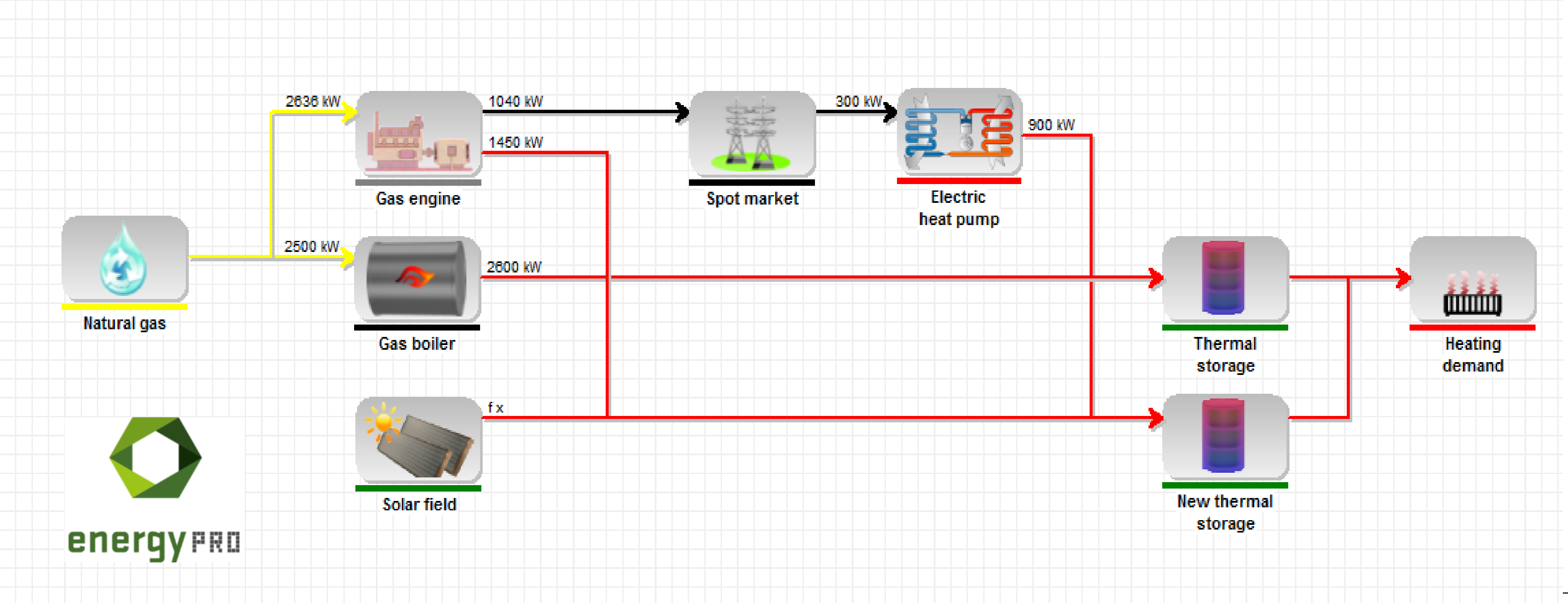

Heat Storage: Investment Costs

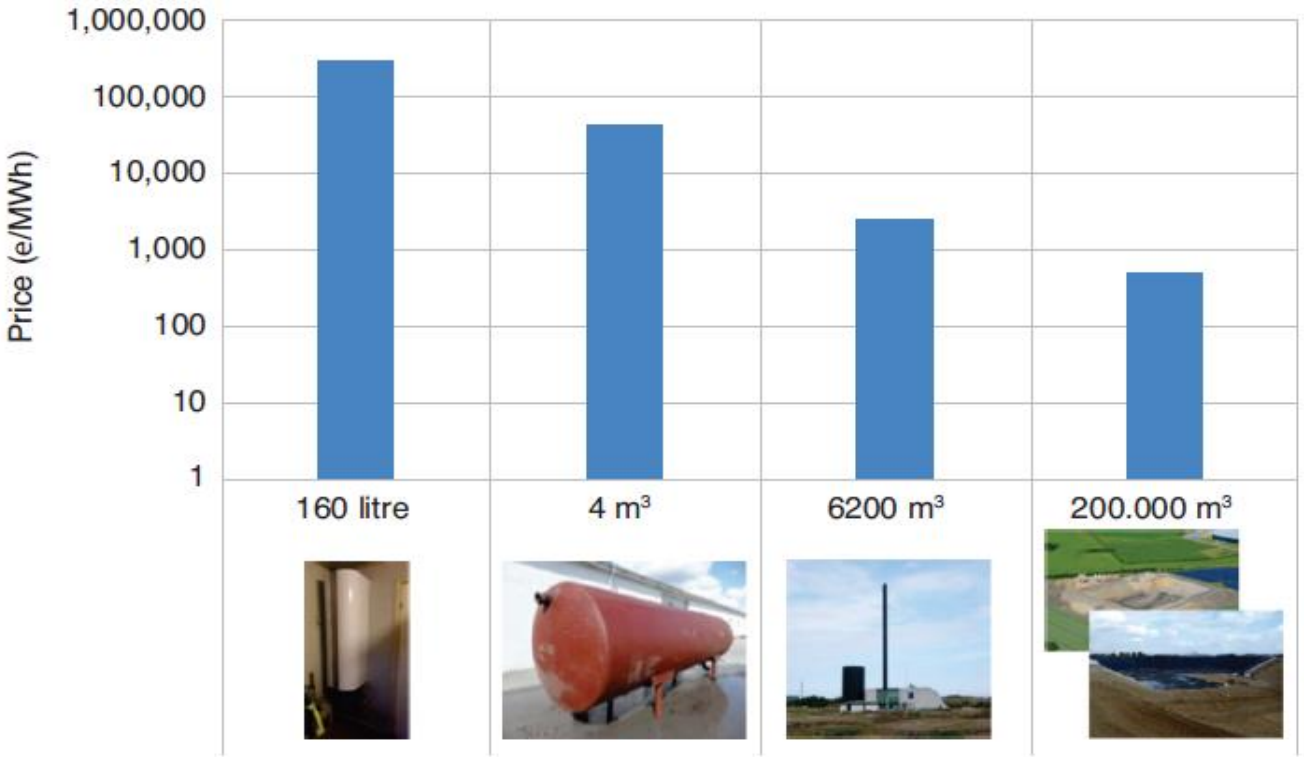

Figure 3: Investment cost comparison of different sizes of thermal energy storage technologies. The sizes correspond to storages for a dwelling, a larger building, a CHP plant and a solar DH system

Thank you for our attention.

Any questions?

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