# Public regulation and the change from fossil fuel- to Renewable Energy based District Heating Systems

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# 1. The type of change

# Cogeneration and district heating at a turning point

1. The present district heating system are efficient fossil fuel systems. But this is not enough in 2030-2050.
2. In 2050 fossil fuels have to be replaced by renewable energy systems.

3. The questions are:

3.a. Is district heating system a feasible infrastructure in future renewable energy systems?

3.b. If yes, which technical system should be used? (I will link to this)

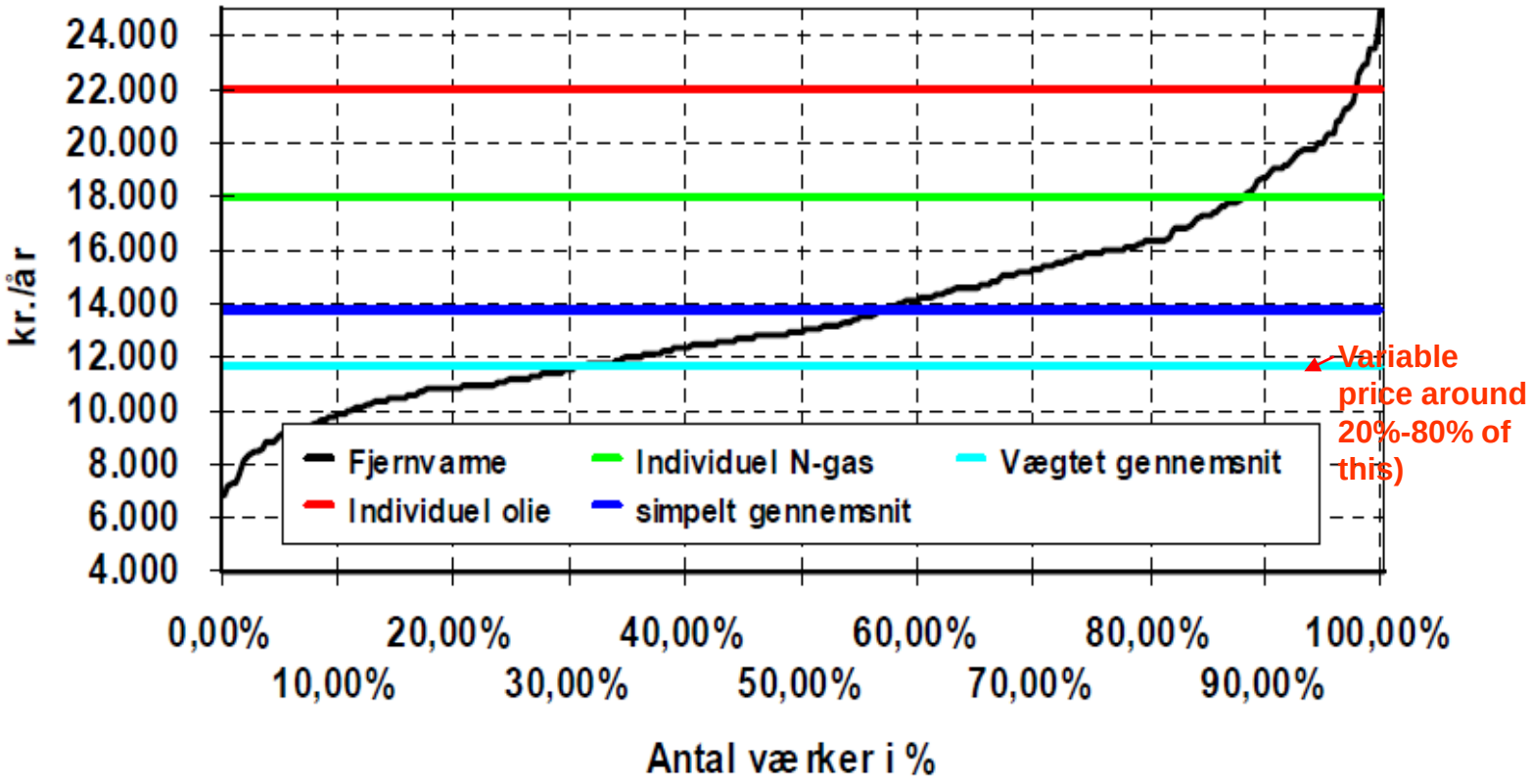
3.c. Which public regulation should be implemented? (and deal with this)

# Characteristics of the technical scenarios

1. Reduction of heat demand 25-50%.
2. Expansion of district heating area from 47% to 60%-70% of heat market.
3. Change to renewable energy supply systems based on wind-, solar-,biomass-, geothermal sources
4. Establish heat systems that are able to integrate fluctuating renewable energy sources. (Low temperature,heat storage,heat pumps, etc.)

# 2. The present tariff situation

# Heat prices incl. VAT 2006/2007



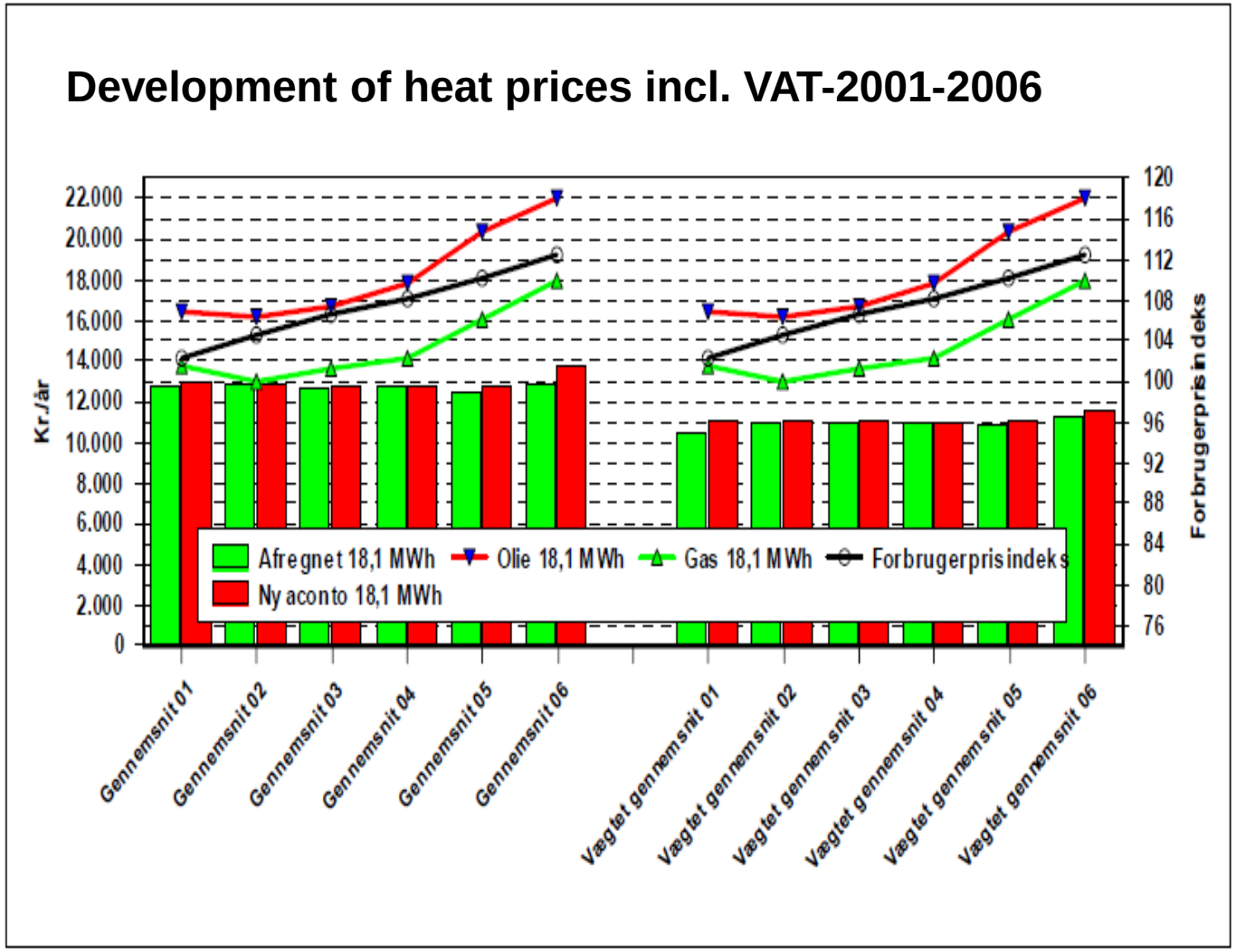

Variable price around 20%-80% of this)

Husstørrelse: 130 m² - 18,1 MWh/år
Olie/gaspriser: Gennemsnit 2006 til september
Virkningsgrader: Olie: 72%, N-gas: 85% - ingen afskrivninger, »gamle anlæg«

**Source: Notat fra Energitilsynet, "Fjernvarmepriser i Danmark- resultatet af prisundersøgelsen I 2006, 16 okt.**

Figuren viser, at den gennemsnitlige pris for opvarmning af et hus på 130 m² og med et forbrug på 18,1 MWh/år i alle de fem år har ligget under såvel individuel oliefyring som individuel naturgas.

Samtidig viser figuren, at forbrugerprisindekset er steget med ca. 10 % i perioden.




Source: Energitilsynet 16 okt. 2006

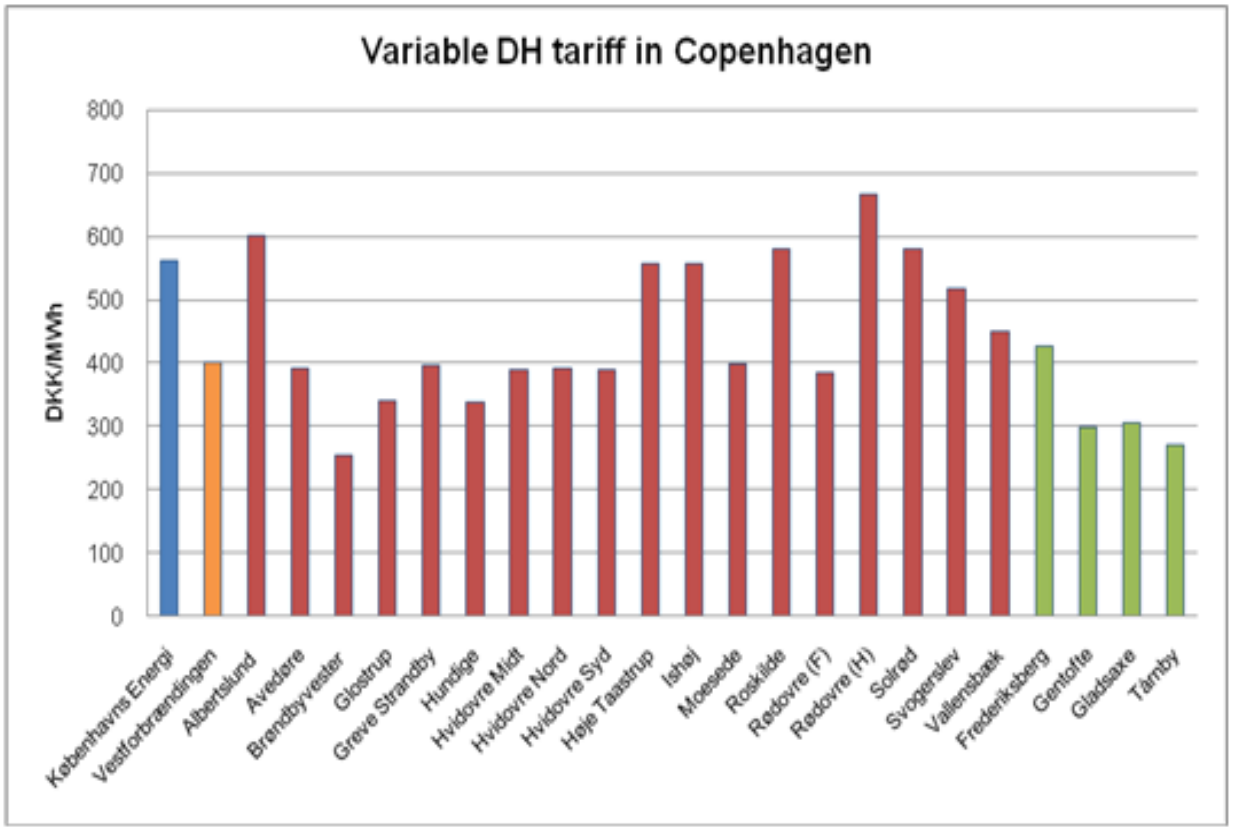



Figure 11.1: The figure shows the variable tariff in the different heat companies of the Copenhagen DH system. The blue chart is KE, the yellow the west incineration plants

Source: Anders Larsen, “Towards a sustainable district heating system in Copenhagen”, Master thesis 2008

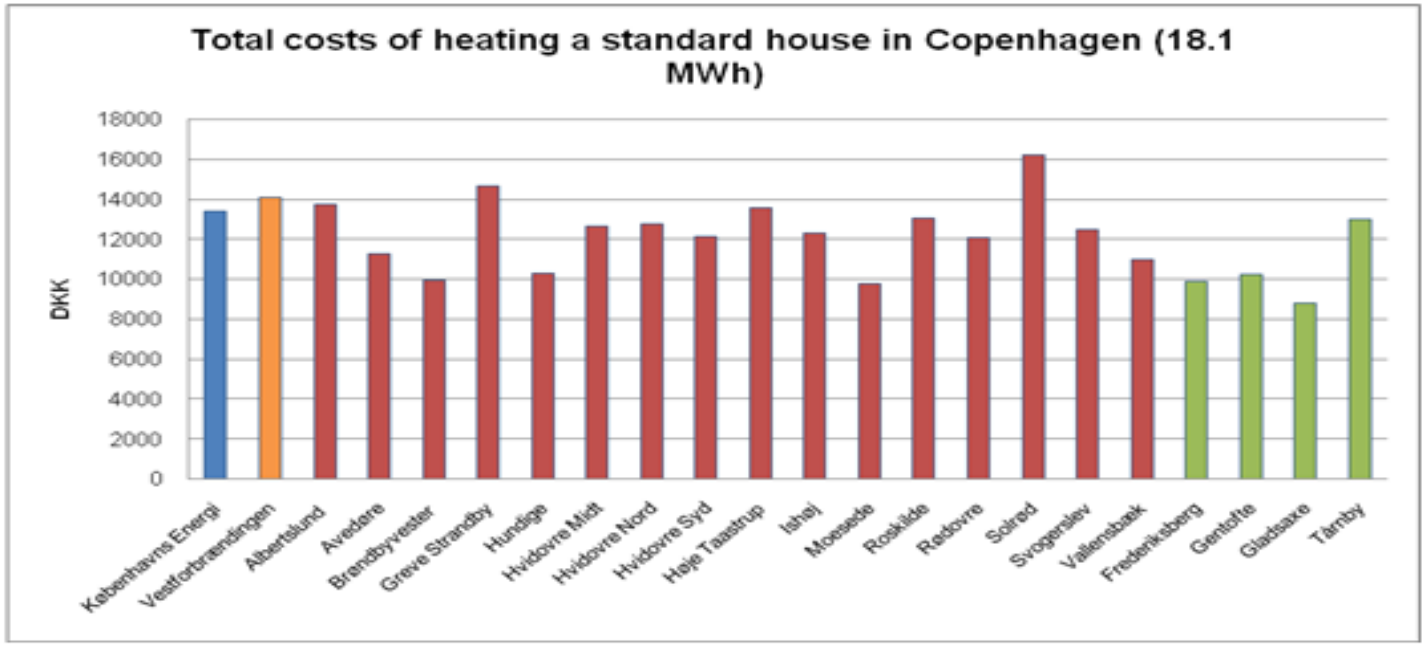
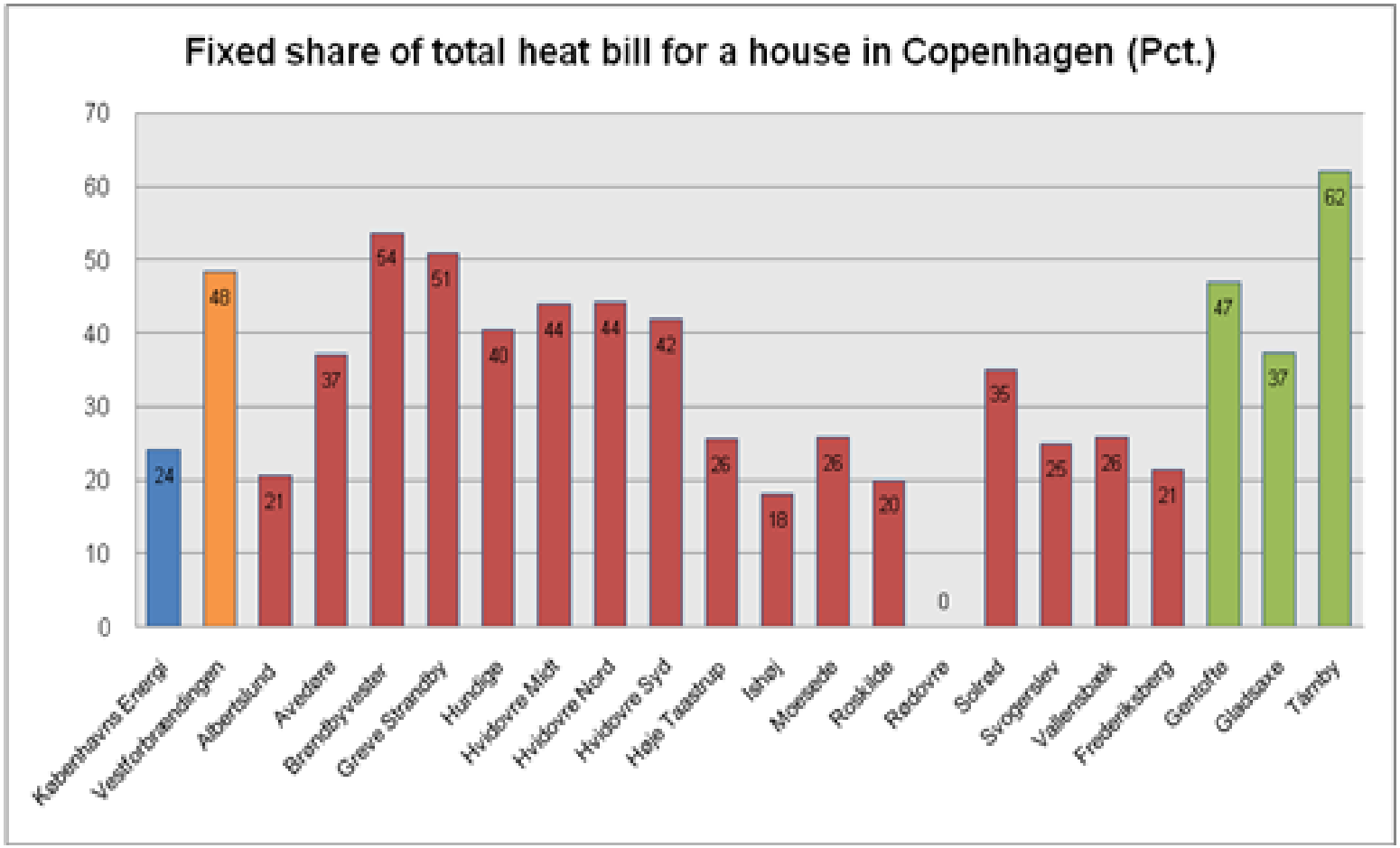



Figure 11.3: The figure shows the total costs of heating a standard house in Copenhagen, which is defined as having a yearly heat consumption of 18.1 MWh. The blue chart is KE, the yellow the west incineration plants system, the red is VEKS and the green is CTR. For a geographical map of these areas see figure xx. All prices are for 2009, when these were not available, 2008 prices were used. (CTR 2009) (VEKS 2009) (KE 2009) (VF 2009) (Municipalities 2009)

Source: Anders Larsen: “Towards a sustainable district heating system in Copenhagen” Master thesis 2008.




Source: Anders Larsen: “Towards a sustainable district heating system in Copenhagen”

# Tariff problems/characteristics

1. Factor 4 differences in heat prices. Amongst others due to differences in energy taxes. This gives regional and social problems!
2. High fixed prices reduces the motivation for energy conservation.
3. Factor 4 differences in fixed share of the tariff. The fixed share varies from 18%- 62% of the heat price in the Copenhagen area. (best practice 18%)
4. Heat prices in the large cogeneration cities are low. Between 6.000 and 14.000 Dkr/year.
5. Heat prices have been decreasing in the cogeneration areas.

# The Copenhagen case/some examples (18.1 MWh/year house)

| | Annual heat payment Dkr. | Annual variable payment Dkr | Annual saving in case of 25% house improvements Dkr. | **Break even investment (6% discount rate/15 year lifetime- 25% house improvement.** |
|---|---|---|---|---|
| Tårnby | 13.000 | **4.949** (38%) | 1.235 | **11.994** |
| Gentofte | 10.000 | **5.300** (53%) | 1.325 | **12.868** |
| Albertslund | 13.800 | **10.902** (79%) | 2.725 | **26.465** |
| København Energi | 13.500 | **10.260** (76%) | 2.565 | **24.911** |
| Brøndby Vester | 10.000 | **4.600** (46%) | 1.150 | **11.169** |
| Frederiksberg | 10.000 | **7.900** (79%) | 1.975 | **19.181** |

1. It does not pay to make 25%-50% heat conservation
2. It does not pay to introduce renewable energy technologies.
3. No motivation for “absorbing “ fluctuating energy sources.

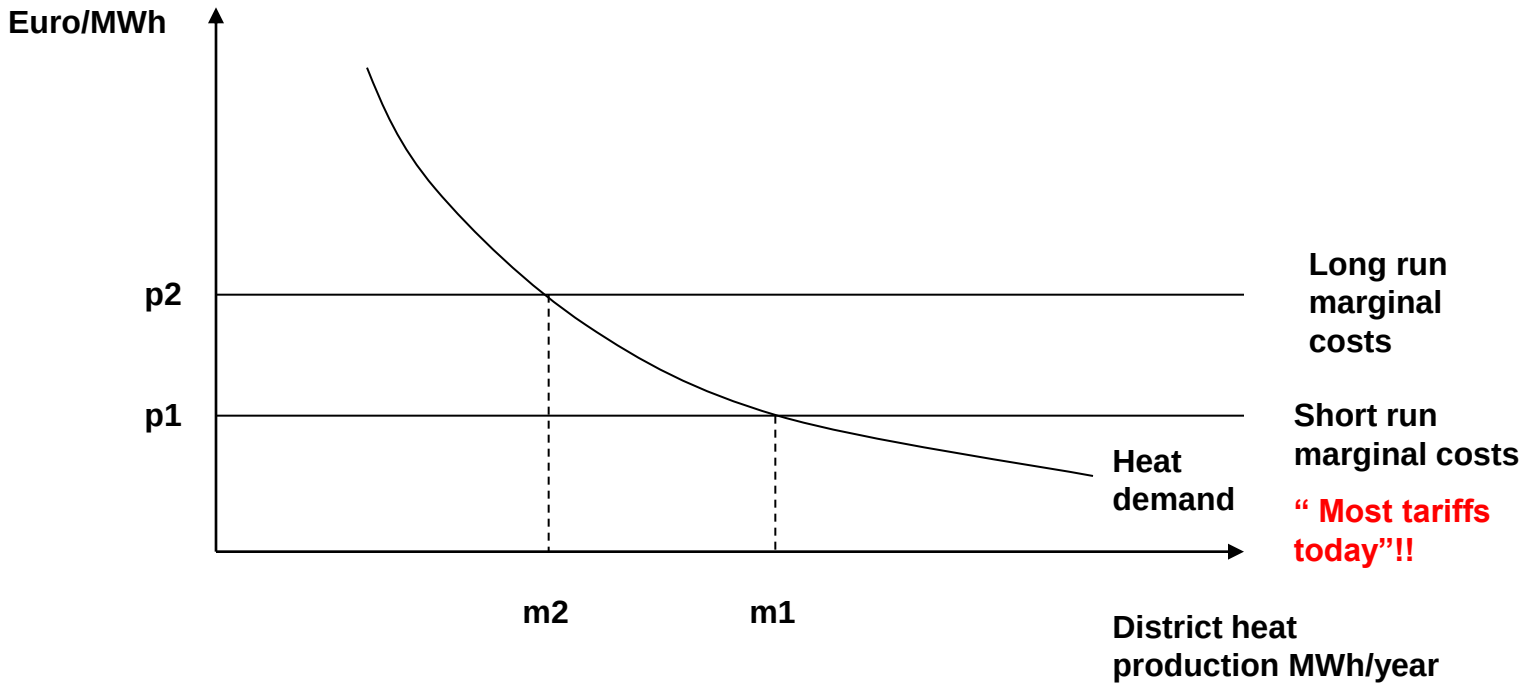
A new set of public regulation measures is needed.

# Conclusion regarding tariff problems

1. It does not pay to make 25%-50% heat conservation in most district heating areas
2. ‘It does not pay to introduce renewable energy technologies.
3. No motivation for “absorbing “ fluctuating energy sources.
4. Social problems linked to high energy prices in some areas.
5. New public regulation measures are needed.

# 3. Tariffs for change

# Long run or short run cost tariffs?



# The tariff dilemma!

1. SRMC (Short Run Marginal Cost) tariffs are economically "correct" on a short term base.

   But they don´t lead to the goals!

1. LRMC (Long Run Marginal Cost) tariffs are "economically "correct" on a long time base,

   And they lead to the goals we have!

   But it might costs money for a while, and they will meet a strong opposition in the district heating companies.

# The “coming” will never come, if prices are the present SRMC tariff.

| | 1.Present coal based district heating system | 2. “Coming” wind-heat pump-heat storage system |
|---|---|---|
| a. (SRMC) Variable cost | 400 (Present SRMC tariff) | 170 |
| b. Annual fixed costs | 632 | 688 |
| c. Total costs (LRMC) | 1.032 (Future costs if SRMC tariffs) | 858 (Future costs if LRMC tariffs) |

# Conclusion on “the right tariff question”.

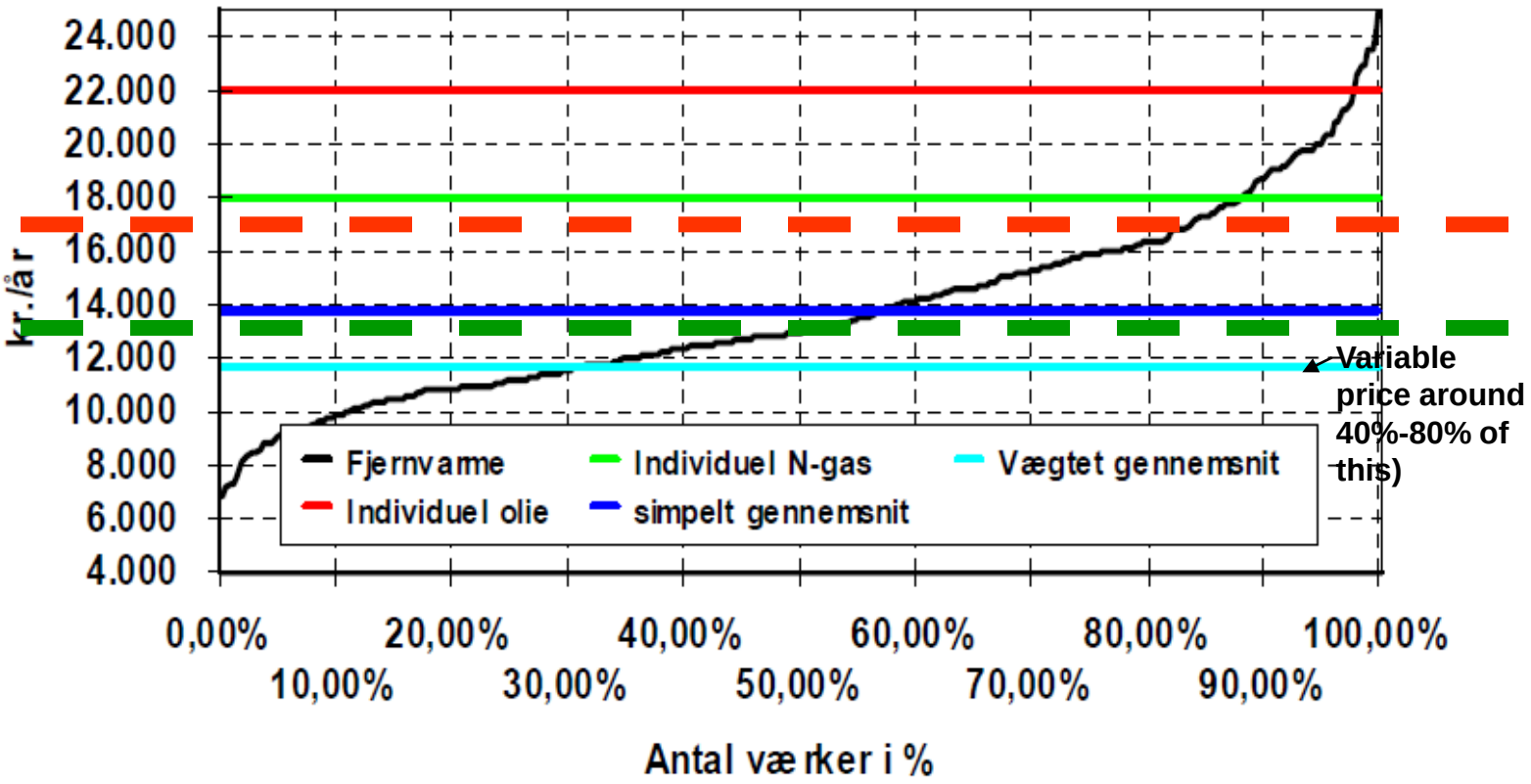
1. The future supply system should be defined.

   (Here we define it as a system of wind power + heat pumps+ heat storage. It also could be combined with Geothermal energy)
2. This system is calculated to have a cost of 8-10 Eurocent per kWh at the consumer level.
3. Furthermore there is a variable cost linked to the district heating network. This will be estimated later, but is here set to 2 Eurocent per kWh.
4. Consequently the variable tariff should be between 10 and 12 Eurocent per kWh before VAT.
5. For a 18.1 KWh/year house the annual variable heat price would then be around 17.000-19.000 Dkr/year.
6. If houses are improved, and the heat consumption reduced by 30%, the annual heat bill will be around 12.000-14.000 Dkr.

# Heat prices incl. VAT 2006/2007

Future cost 18.1 MWh/year

Future cost 12.7 MWh/year

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# 4. Conclusion/suggestions

# Supply system

1. LRMC tariffs based upon estimates of future RE systems.
2. Open access for renewable energy sold to the district heating system for RE combined with heat pumps and heat storage.
3. “Feed in” price of around 8 Eurocent for 80 degree C water for such systems.
4. Right to sell heat back to the system from households for the variable heat price they pay.

# Demand system

1. LRMC tariff system
2. 30% subsidy for energy conservation investments proposed/accepted by energy consultants.

   Paid by the surplus accumulated in the district heating companies.
3. Establishment of consultancy service for heat and electricity.
4. Long term low interest loans. May be with “District heating company” guaranty.

Further suggestions PEM summary.

# Policy for single houses outside district heating area.

1. System: Heat pump/heat storage/wind power systems.
2. Policy:

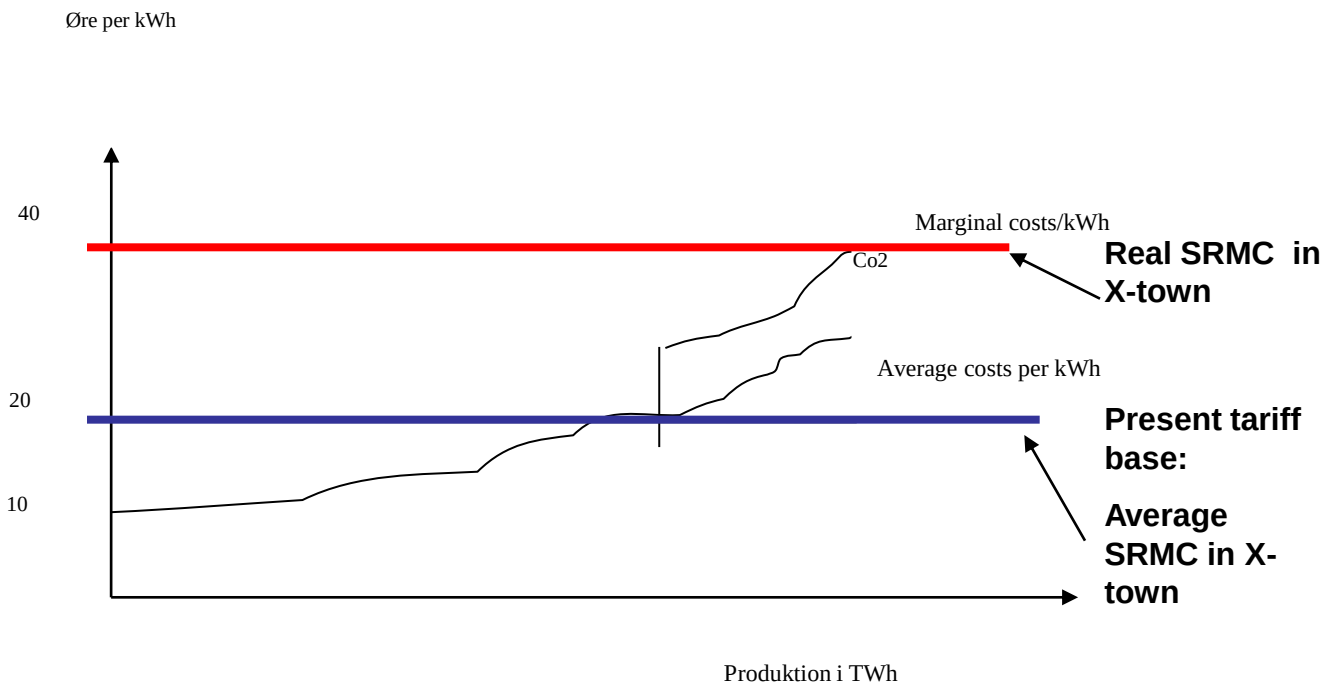
   - 0 energy tax for up to 8.000 kWh/year if system 1 is established according to certain specifications. (only electricity used with a minimum efficiency of the heat pump)

   - 30% in subsidy to such systems.
3. Right to ownership share of new wind turbines.

   This system will replace oil and natural gas, and lower the energy bill at the single houses by around 30% seen in relation to oil furnaces.

# 5. Further analysis

# A possible cost structure in X-town



# Causes of higher “real marginal costs” in X-town

**Conservation :**

- Saves the last production unit which have higher marginal costs than the first production units.
- Makes it possible to lower water temperature.
- Removes an expensive “peak production”. (may be 1 and 3 is the same?)
- Makes “room” in the pipes for expansion of the district heating system.
- Gives lower water temperature and a better efficiency at heat pumps.

These effects are usually not included in marginal cost calculations. If they are, the “costs” of LRMC tariffs might be considerably lower than usually expected. This should also be examined further in the rest of the CEESA project.