Developing and maturing large scale solar thermal heating plants

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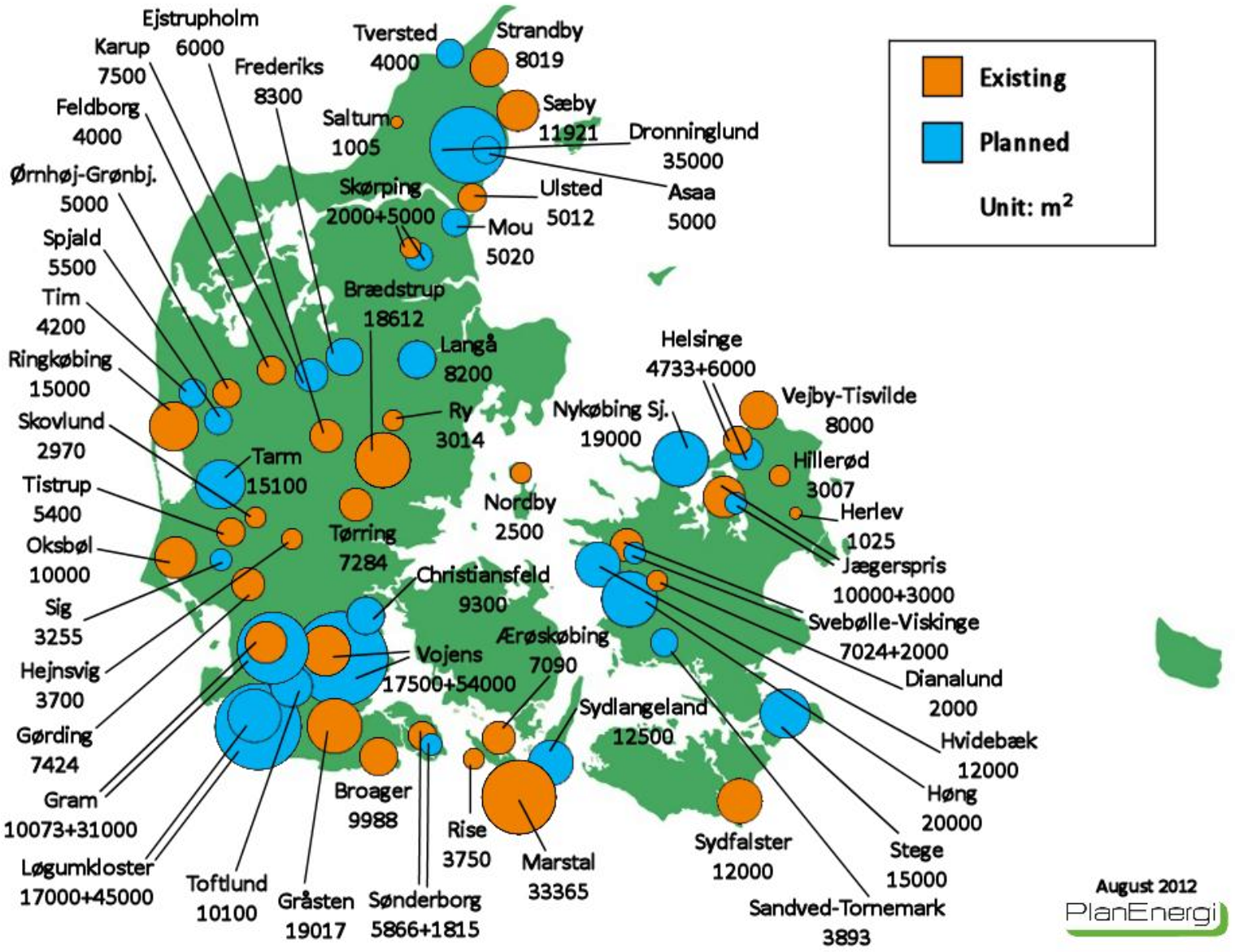
MATURING OF A TECHNOLOGY. HOW ?

- Reduce cost.
  - Simplify installation.
  - Competition / tender.
  - Cancel subsidies.
  - As Simple As possible
- Increase performance.
  - R&D of Panels.
  - Innovative integration.
  - Reduce temperatures.
  - As Complicated As needed.

PRICE / PERFORMANCE

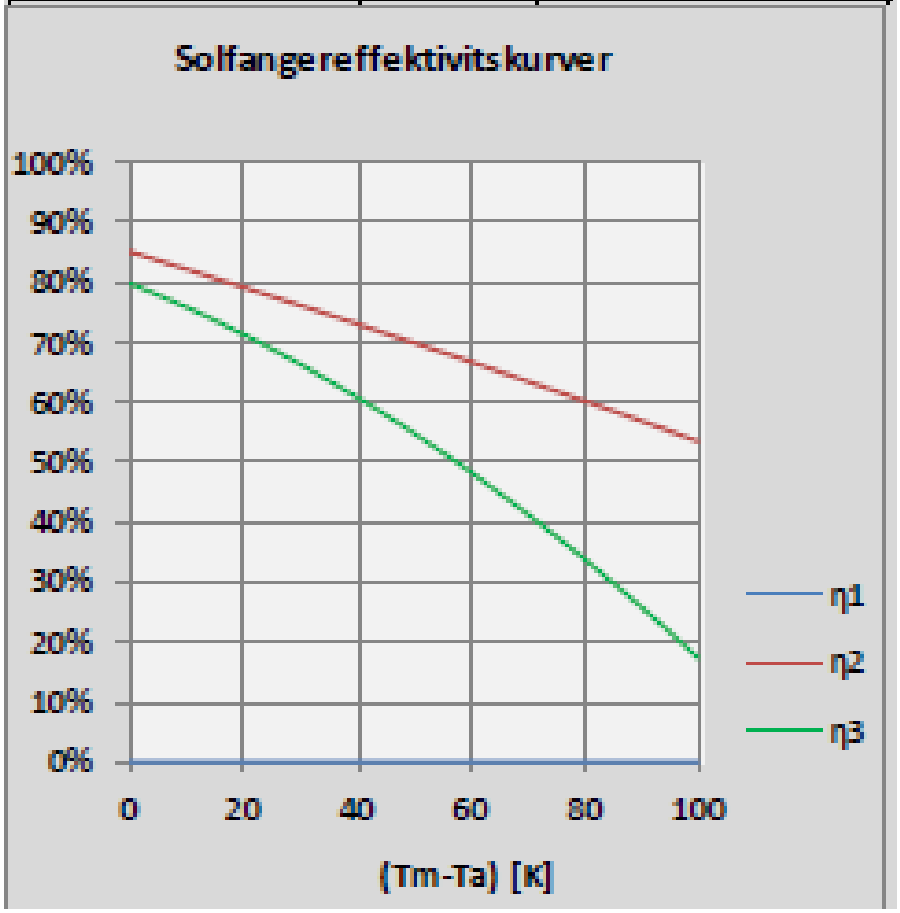
- The larger area of panels, the lower price / m².
  - Small systems up to 800 € / m². (4 – 5 m² system)
  - Large systems up to 200 € / m². (> 5.000 m²) (Danish projects)
  - International large systems up to 400 € / m2.
- Performance.
  - "normal" temperatures: ~500 kWh / m2 / year.
  - "low" temperatures: ~550 – 600 kWh / m2 / year.

Solar district heating in Denmark



PERFORMANCE

G	800	W/m²



- n2: 2012 panels.
- n3: 2002 panels.

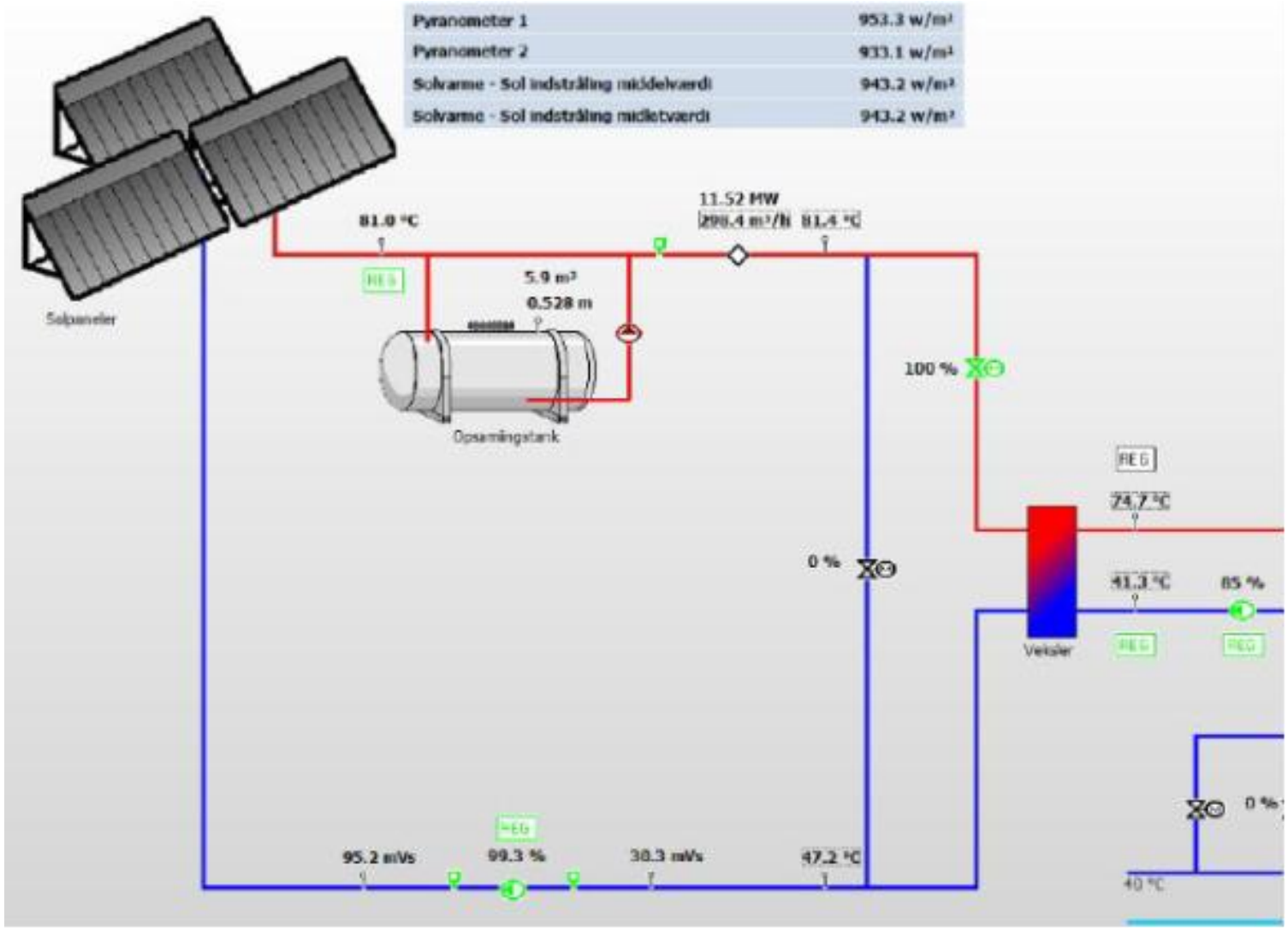
DH OPERATING TEMPERATURES.

- District heating, average temperatures at Danish plants:
  - Forward flow: 68 – 75 degrees.
  - Return flow: 30 – 45 degrees.

SOLAR OPERATION.

- Summer. Flow 80, return 45 degrees C.
- Winter. Flow 40, return 20 (When heat pump added)
  - Winter 40 – 60 (without heat pump)
- Spring / autumn: Flow 60 – 70, return 20 / 40 (with / without heat pump)

SOLAR LOOP.


Pyranometer 1 953.3 w/m²
Pyranometer 2 933.1 w/m²
Solvarme - Sol indstråling middelværdi 943.2 w/m²
Solvarme - Sol indstråling middelværdi 943.2 w/m²
Solpaneler
81.0 °C
11.52 MW
298.4 m³/h 81.4 °C
5.9 m³
0.528 m
Opsamlingstank
100 %
REG
74.7 °C
41.3 °C
85 %
Veksler
0 %
95.2 mVs
99.3 %
38.3 mVs
47.2 °C
40 °C

ASAP / ACAN

- Large fields – one HX unit. (1 HX, 2 pumps, 1 control unit etc.)
  - Large number of panels in serial connection (20 – 25 panels).
  - Ground mounted panels.
  - Coming plants ~50.000 m² in one unit.
    - Upper limit on size: In principle NO.
- Control strategy:
  - Variable flow control. (Fixed flow temperature, very low use of electricity (3 kWh elec. / MWh of heat produced)).
  - Deliver heat at lowest possible temperature levels.
  - Innovative integration into existing DH plant.

VARIABLE FLOW STRATEGY

HOW DID WE GET HERE ?

- Large district heating sector.
  - Heavy taxed fuels, gives increase in efficiency at DH plants.
  - Owner ship. (Owned by the consumers).
    - No investors to demand profit.
    - Fast decision process.
- R&D projects to develop the concepts.
- No R&D to be involved in commercial projects.
- Involve consultants with experiences in DH-projects.
  - Solar heating is not rocket science.

HOW DID WE GET HERE ?

- No grants for solar heating.
  - Giving a faster realisation.
  - No risk of missing grants.

AT PRESENT.

- Manufacturers do develop panels.
  - Strong competition is a driver.
  - R&D is involved in few cases.
- Consultants is integrating solar / boilers / storages / CHP units / heat pumps.
- Contractors are active in smaller systems. (where no consultants are involved)

IN SHORT

- Large scale.
- No grants.
- Heavy taxed fossil fuels.
- No R&D.
- Tendering / competition.


Gram solar heating plant

THANK YOU