

# SAVOSOLAR



Solar thermal technology taken to the next level

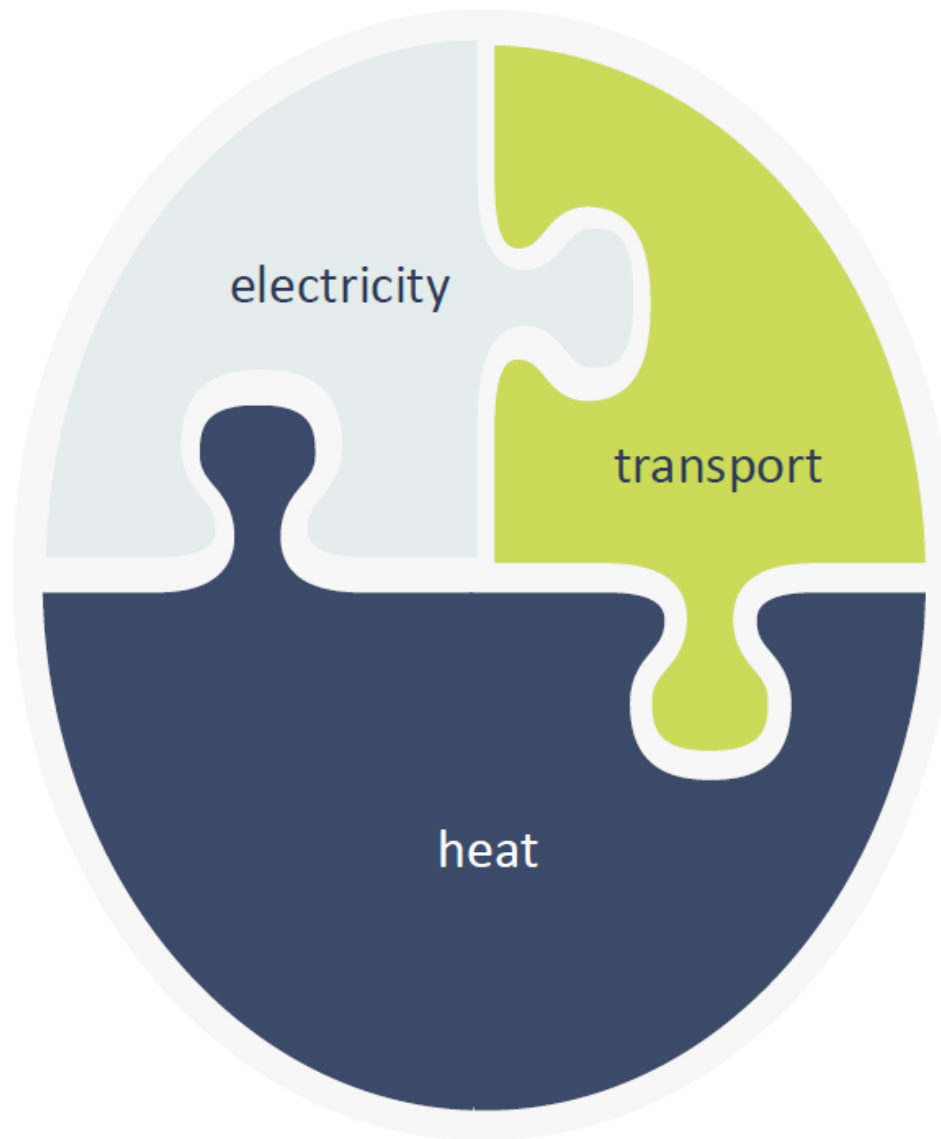
**Tampereen Oopperajuhlat**  
- **MAAMME ENERGIA**

27.10.2016



# Jelling – solar thermal district heating





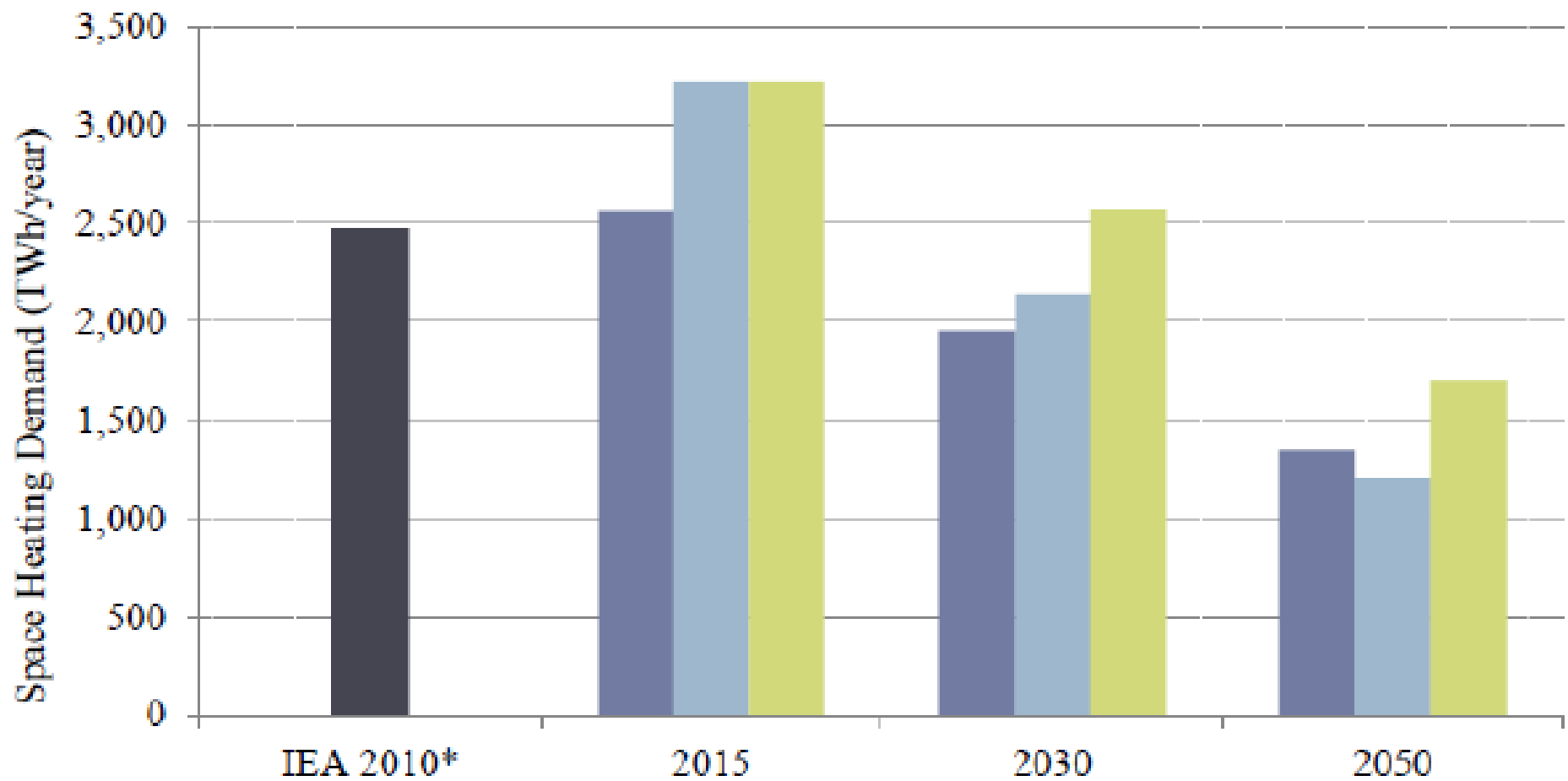
Source: Euroheat & Power

# EU Heating and Cooling Policy

- 'Electrification' of everything, everywhere
- Just stop needing heat...
- Phase out district heating?



■ Deep Renovation (Ecofys)   ■ EU-EE Scenario   ■ HRE-EE Scenario



Source: Heat Road Map Europe (2013)



## The EU's Heating and Cooling Strategy



Heating and cooling will remain the biggest demand in 2050



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# Energy Storage

**Pump Hydro Storage**  
175 €/kWh

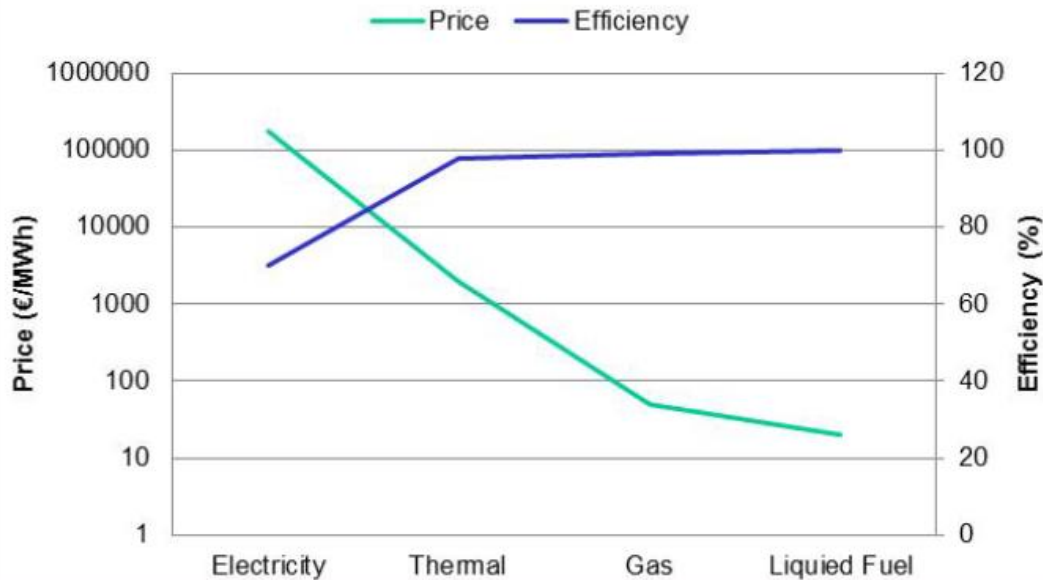
(Source: Electricity Energy Storage Technology Options: A White Paper Primer on Applications, Costs, and Benefits. Electric Power Research Institute, 2010)



**Thermal Storage**  
1-4 €/kWh  
(Source: Danish Technology Catalogue, 2012)



## Energy storage: Price and Efficiency



**Oil Tank**  
0.02 €/kWh  
(Source: Dahl KH, Oil tanking Copenhagen A/S, 2013: Oil Storage Tank. 2013)



**Natural Gas Underground Storage**  
0.05 €/kWh

(Source: Current State Of and Issues Concerning Underground Natural Gas Storage. Federal Energy Regulatory Commission, 2004)





# Thermal Storage

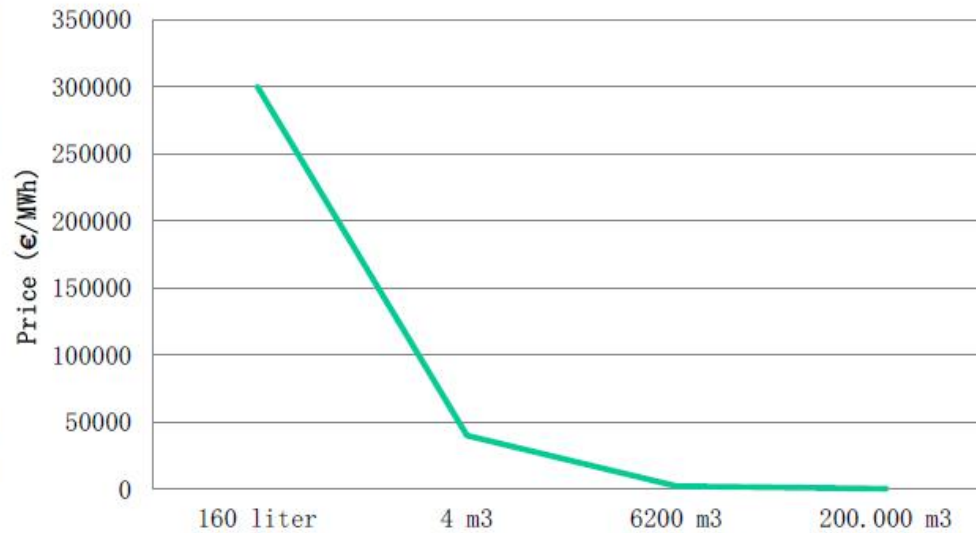
0.16 m<sup>3</sup> Thermal Storage  
300.000 €/MWh  
(Private house: 160 liter  
for 15000 DKK)  
300 €/kWh



6200 m<sup>3</sup> Thermal Storage  
2500 €/MWh  
(Skagen: 6200 m<sup>3</sup>  
for 5.4 mio. DKK)  
2.5 €/kWh



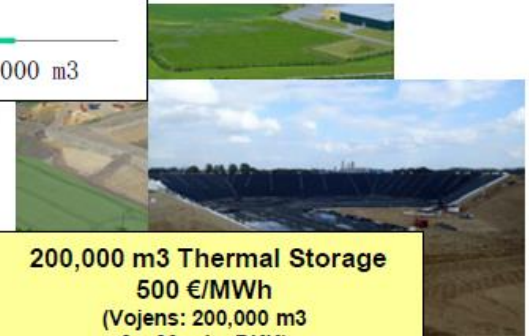
Thermal storage: Price and Size



4 m<sup>3</sup> Thermal Storage  
40,000 €/MWh  
(Private outdoor: 4000 m<sup>3</sup>  
for 50,000 DKK)  
40 €/kWh



200,000 m<sup>3</sup> Thermal Storage  
500 €/MWh  
(Vojens: 200,000 m<sup>3</sup>  
for 30 mio. DKK)  
0.5 €/kWh



# Electricity Storage

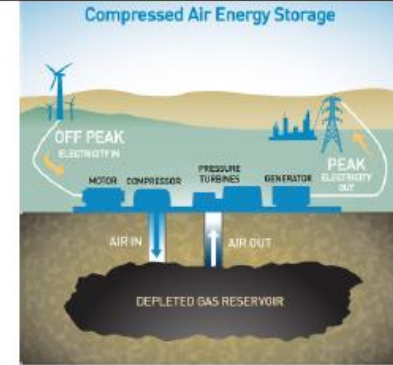
**Pump Hydro Storage**  
100 €/kWh

(Source: Goldisthal Pumped Storage Station, Germany, [www.store-project.eu](http://www.store-project.eu))

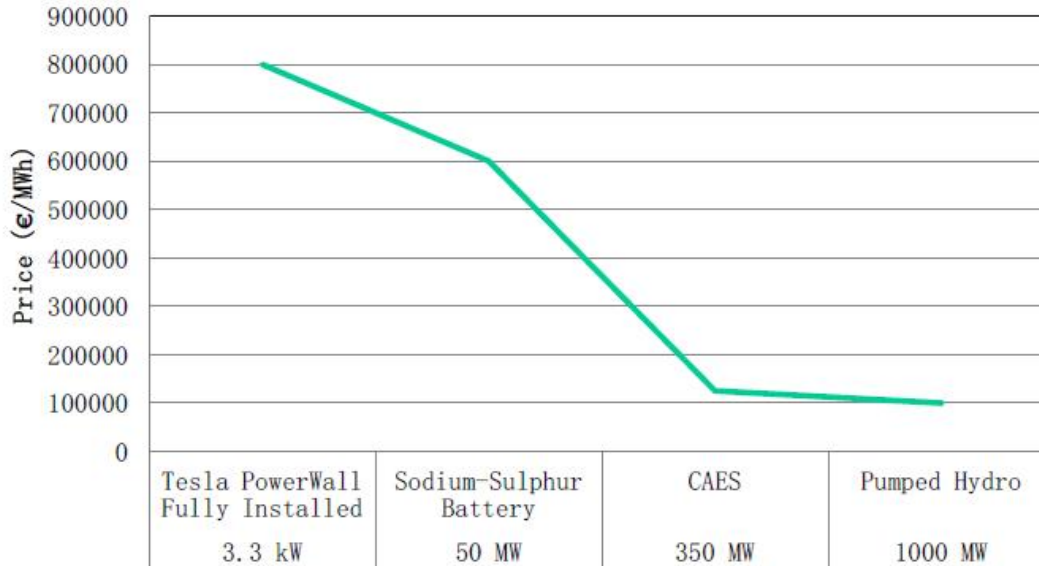


**Compressed Air Energy Storage**  
125 €/kWh

(Source: <http://www.sciencedirect.com/science/article/pii/S0196890409000429>)



**Electricity Storage: Price and Size**



**Tesla PowerWall**  
800 €/kWh

(Source: <http://solarlove.org/solarcity-tesla-battery-create-turnkey-systems-depth/>)

**Sodium-Sulphur Battery**  
600 €/kWh

(Source: Table 4: <http://large.stanford.edu/courses/2012/ph240/doshay1/docs/EPRI.pdf>)



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## The EU's Heating and Cooling Strategy



Heating and cooling will remain the biggest demand in 2050



Current reliance on 'obsolete fossil-fuel boilers' is unsustainable

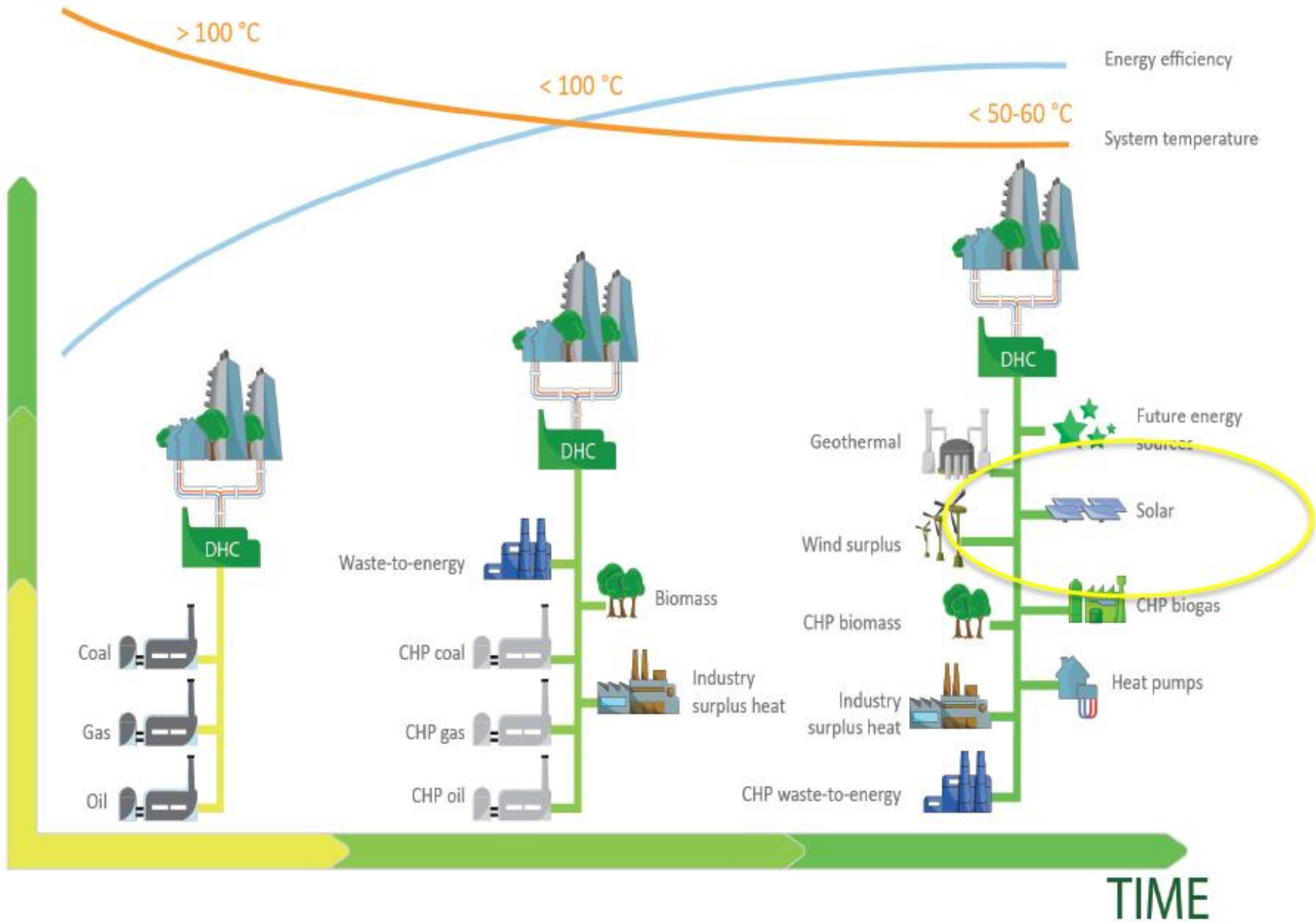


A shift to reliance on RES and surplus heat is possible and necessary

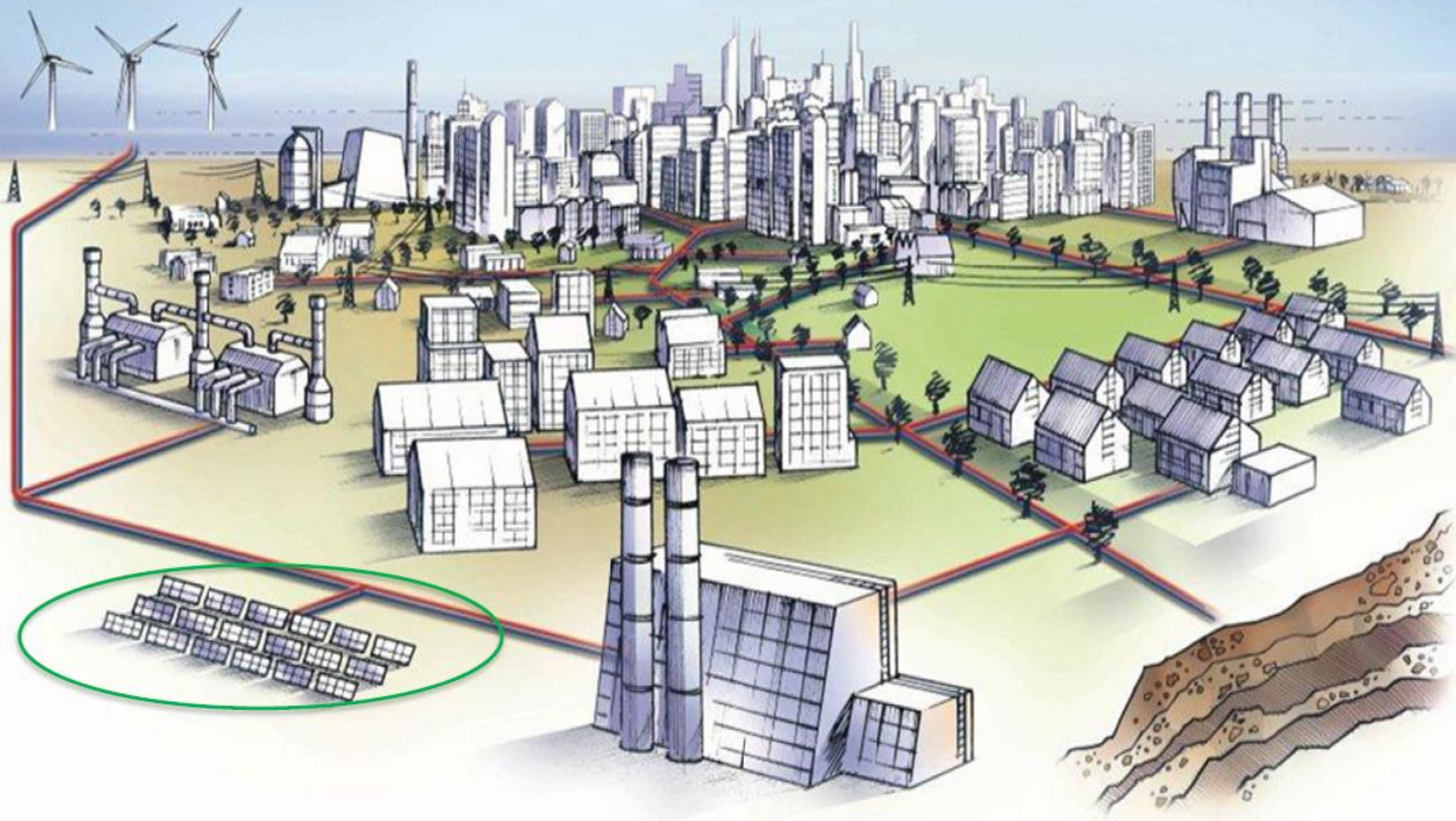


District heating will have a vital role to play in supply green heat and enabling integration of energy system!

DEVELOPMENT



Source: Euroheat & Power





*The sun rises in the North!*

**SAVOSOLAR - solar thermal technology taken to the next level**

**Thank you!**

SAVOSOLAR 