

# The role of district heating in a highly electrified hydropower based energy system

- The case of Norway

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sEnergies



Innovation Fund Denmark



# Background

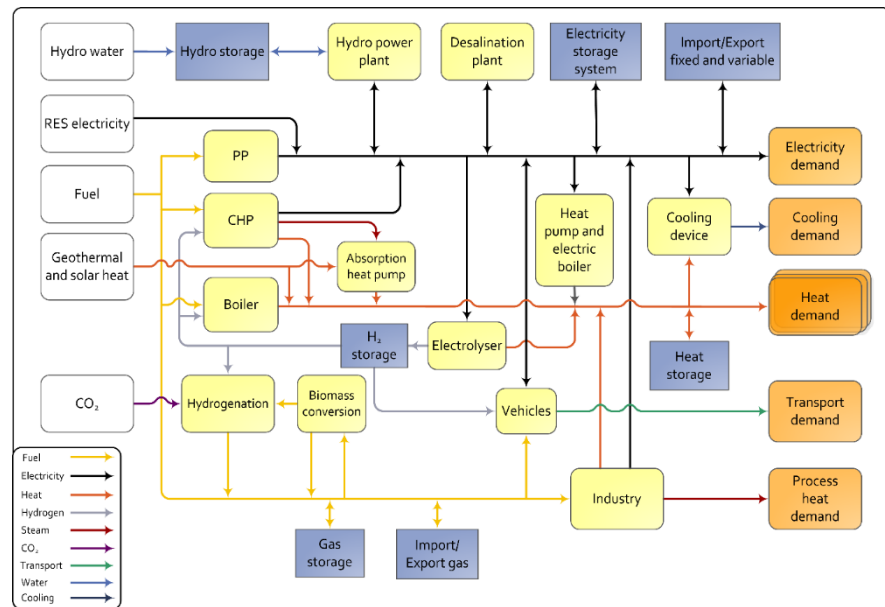
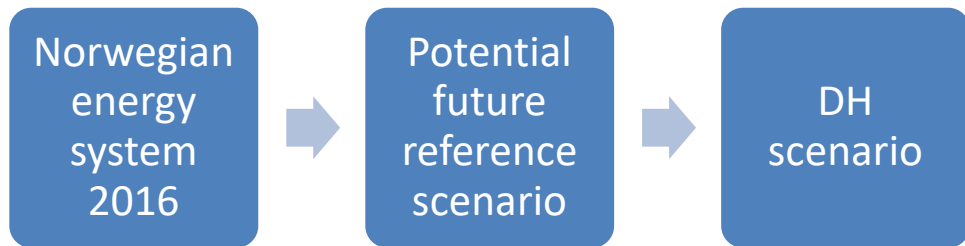
- DH is widely discussed and analysed in a European context as a way to increase energy system efficiency and provide flexibility in the transition towards 100% RES
- DH penetration in the Norwegian energy system is low compared to neighbouring countries
- Hydropower dominates the electricity production in Norway, unlike many other European countries where traditional thermal power plants have had a more significant role
- In the future, hydropower is still expected to be a dominant production technology in the Norwegian energy system

# Research question

What is the potential contribution of district heating in the Norwegian energy system?

# Methodology

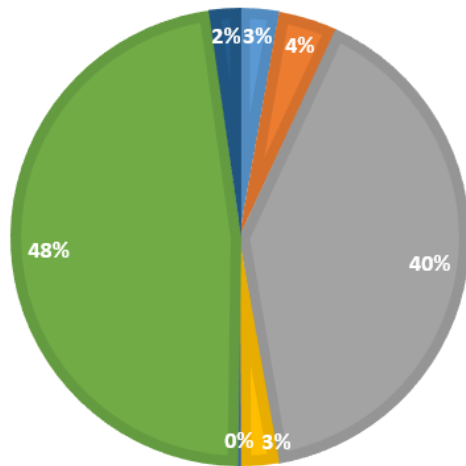
National energy system analysis using EnergyPLAN to simulate the hourly operation of the system



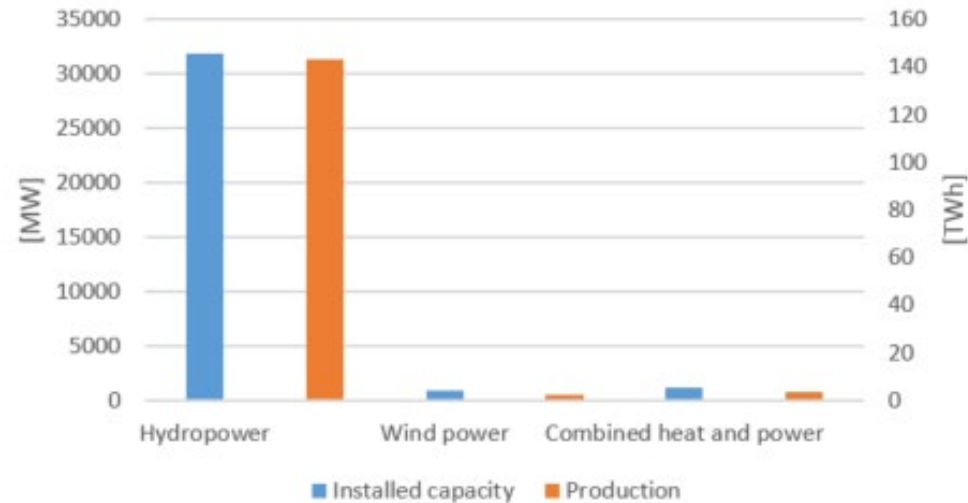
# Energy consumption and electricity generation in Norway

## NET INLAND CONSUMPTION OF ENERGY 2016

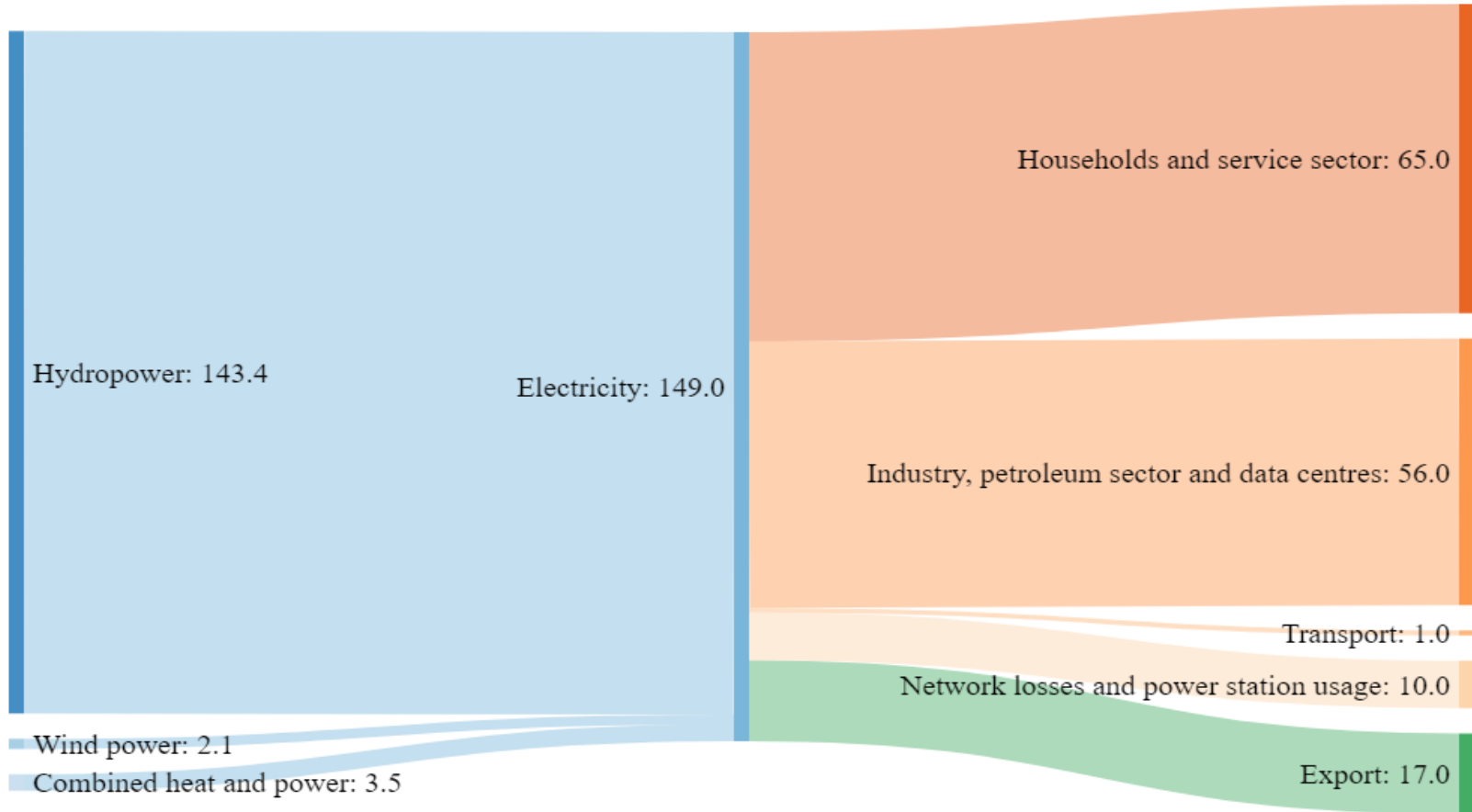
■ Coal ■ Natural gas ■ Oil ■ Biofuels ■ Waste ■ Electricity ■ District heating



## Electricity generation 2016



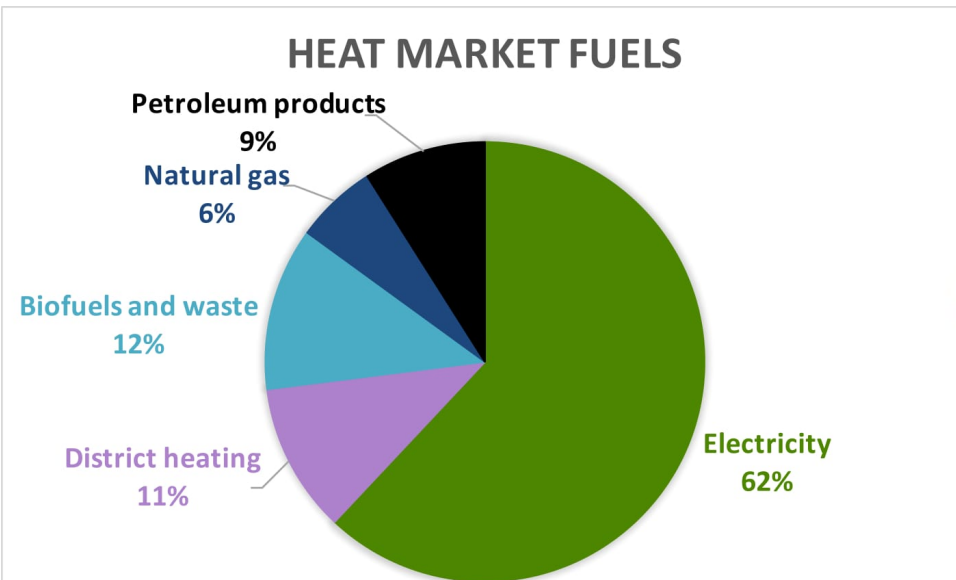
# Electricity end use



# Heating and district heating

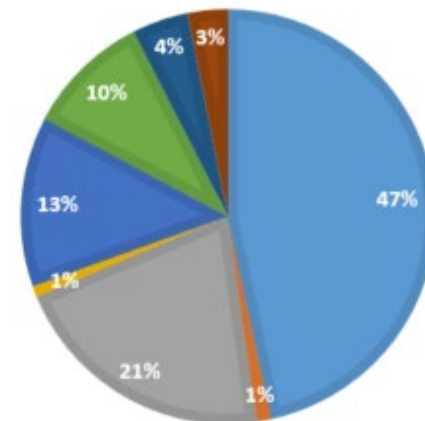
District heating delivered to consumers in 2016: **5.2 TWh**

County	DH demand (GWh)
Oslo	1747
Trøndelag	703
Akershus	520
Hedmark	332
Hordaland	286
Østfold	165
Buskerud	157
Møre og Romsdal	153
Troms	151
Oppland	147
Vest-Agder	136
Vestfold	136
Rogaland	135
Telemark	98
Nordland	94
Aust-Agder	21
Finnmark	8
Sogn og Fjordane	0



**DISTRICT HEATING PRODUCTION 2016**

- Waste incineration
- Oil boilers
- Biomass boilers
- Bio oil boilers
- Electric boilers
- Heat pumps
- Gas boilers
- Excess heat



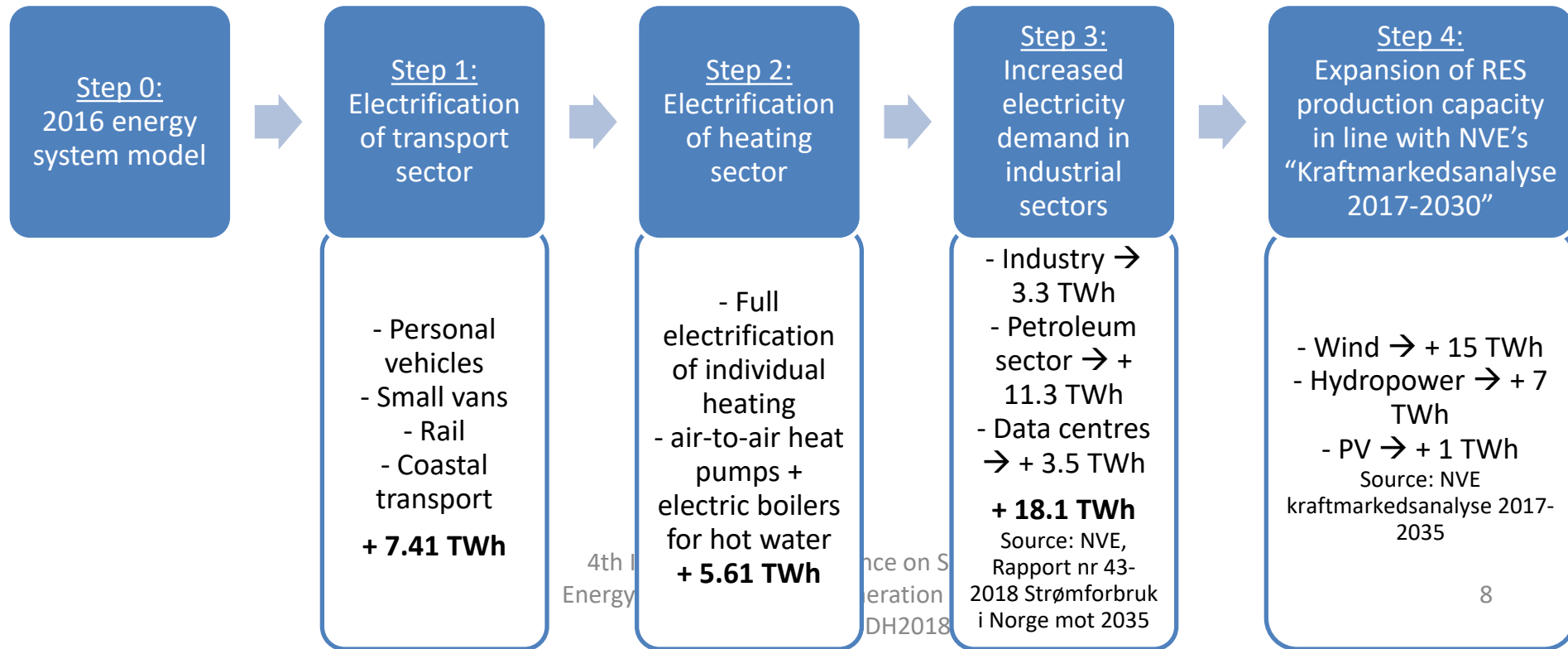
Source: Enova. Markedsutviklingen 2015 - Hovedtrender i Enovas satsningsområder, Enova, September 2015.

4th International Energy Systems and Heating 20

# Construction of reference scenario

Purpose: Creating a transparent approach to analyse a *potential highly electrified future scenario for the Norwegian energy system*

Not a prediction of a future scenario, but the construction of a reference point that can be used to analyse effects of implementing different measures in the energy system



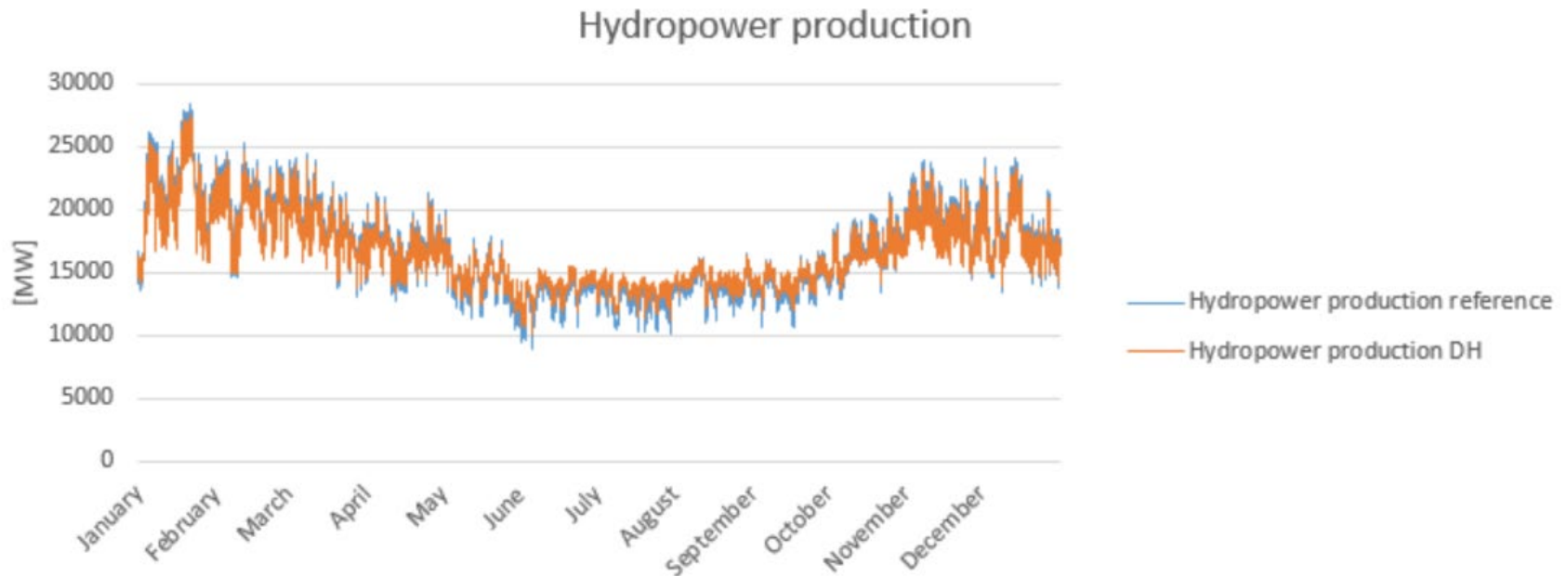


# DH scenario

- Existing DH remains as it is
- Conversion from direct electric heating to district heating
  - 5.6 TWh
- 30% heat savings in buildings converted to DH
- Large scale heat pumps for base load
  - COP 3.5
- Electric boilers for peak load

# Results

	Electricity demand [TWh/year]	Net export [TWh/year]
Reference scenario	164.29	4.92
District heating scenario	160	9.21



# Conclusions

- An expansion of DH can increase the total system efficiency in a highly electrified hydropowerbased energy system due to heat savings and more efficient heat production technology
  - Can increase export potentials
  - Can reduce the need for added electricity production capacity

# Thank you for your attention! Questions?

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