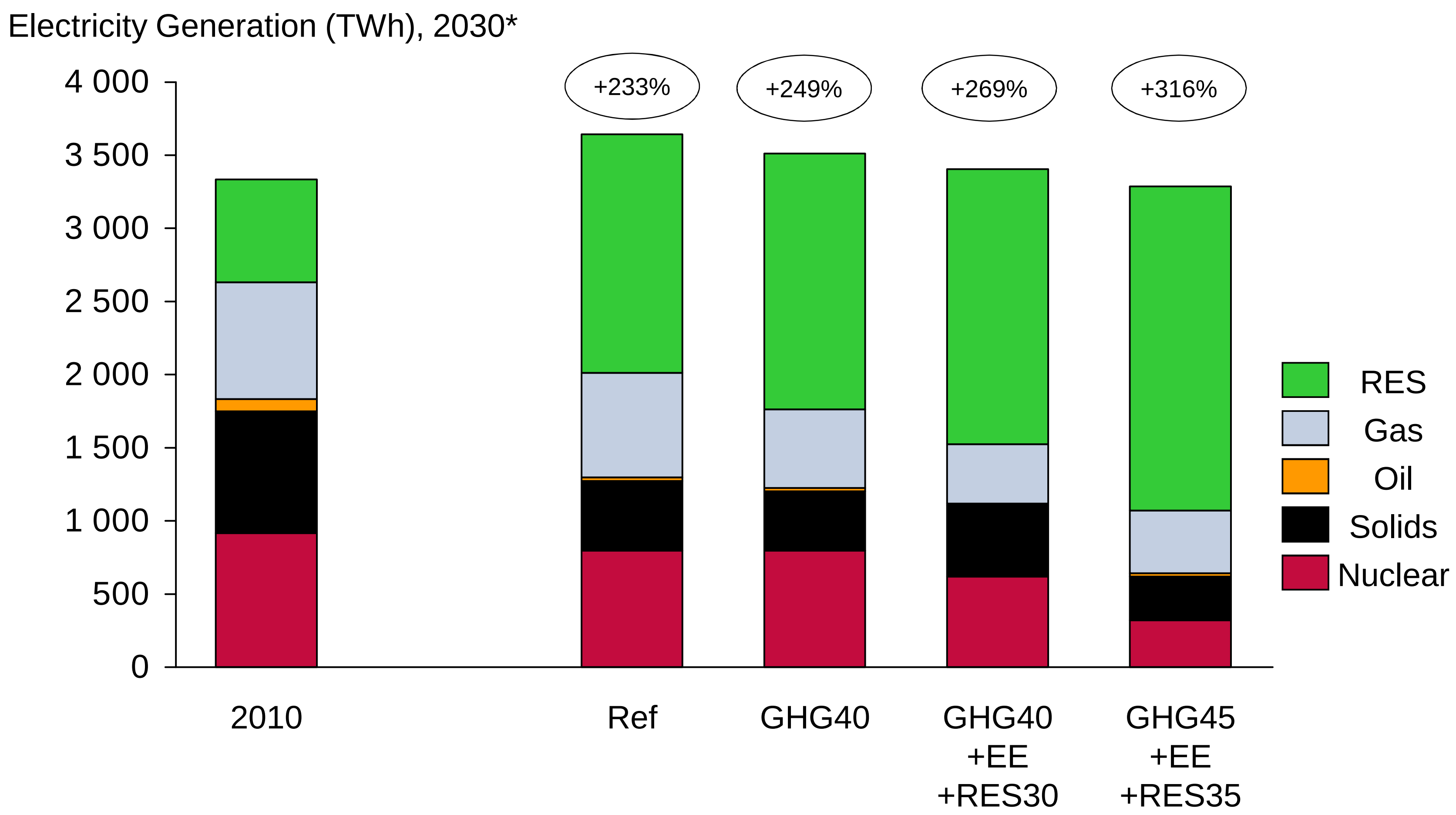
Four things to consider for generation adequacy in a “high renewable” electricity system

IEA Electricity Security Workshop

Tomas Björnsson, Vice President Strategy & Market Intelligence
Paris, 2015-09-28

Decarbonization agenda will drive a significant growth in renewables – regardless of chosen policy route…

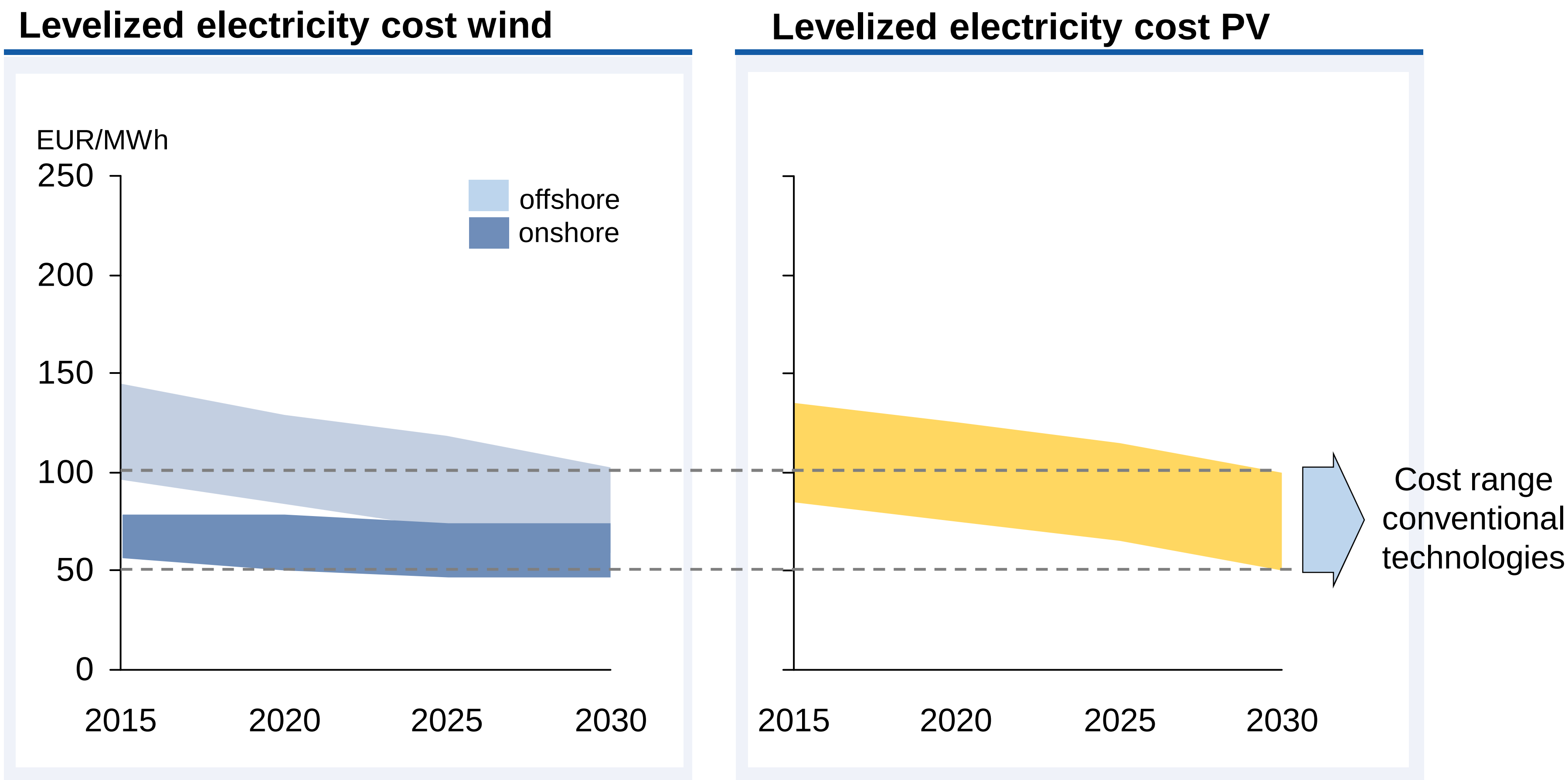
Impact assessment from "A policy framework for climate and energy in the period from 2020 up to 2030"



Note: Not exact numbers. Calculation made from numbers in the IA page 71: Total Gross Electricity Generation is presented in TWh. Generation technology in one digit shares of total.

Source: Impact Assessment accompanying the Communication "A policy framework for climate and energy in the period from 2020 up to 2030"

…as will general technology development (regardless of policy)

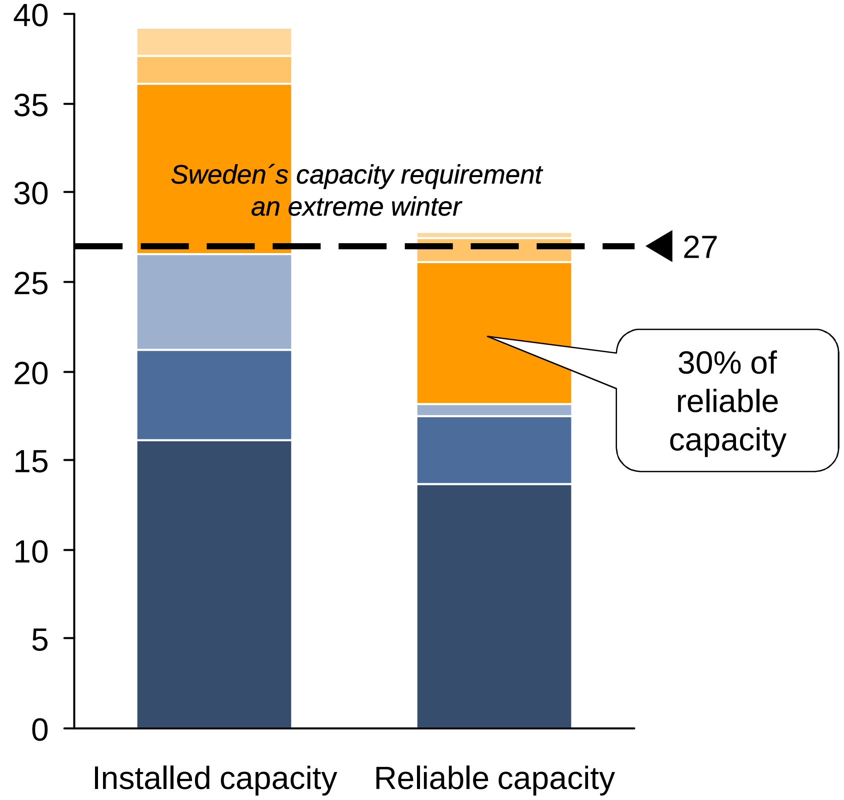


- Technology developments. Supply chain & installation efficiency drive down levelized cost of electricity of renewables
- Conventional thermal technology facing increasing levelized cost levels through rising CO2 prices (or cost) and decreasing operating hours

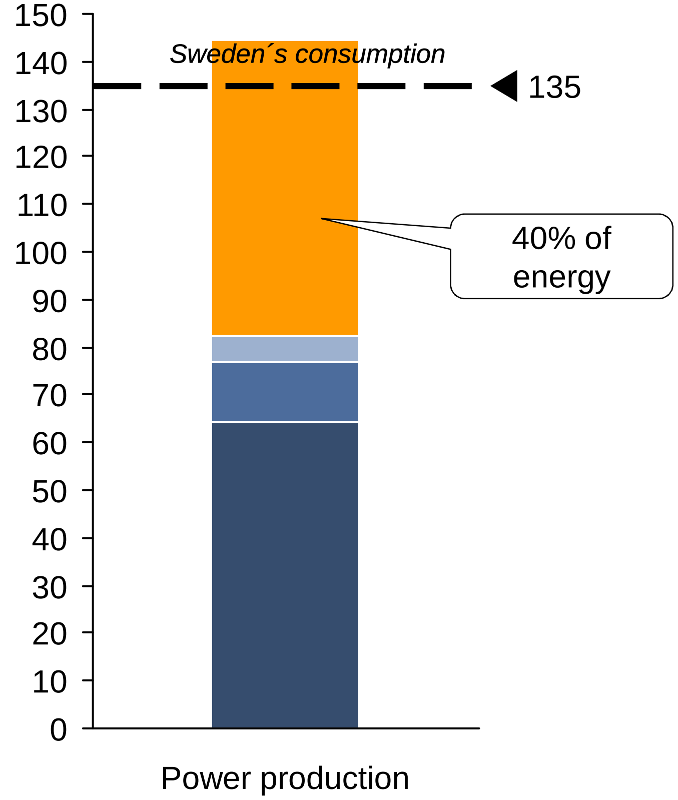
VATTENFALL
Confidentiality – Medium (C2)

For Sweden, generation adequacy challenges will be enhanced as the nuclear fleet starts to be decommissioned

Installed and reliable **"Capacity"** 2014, GW



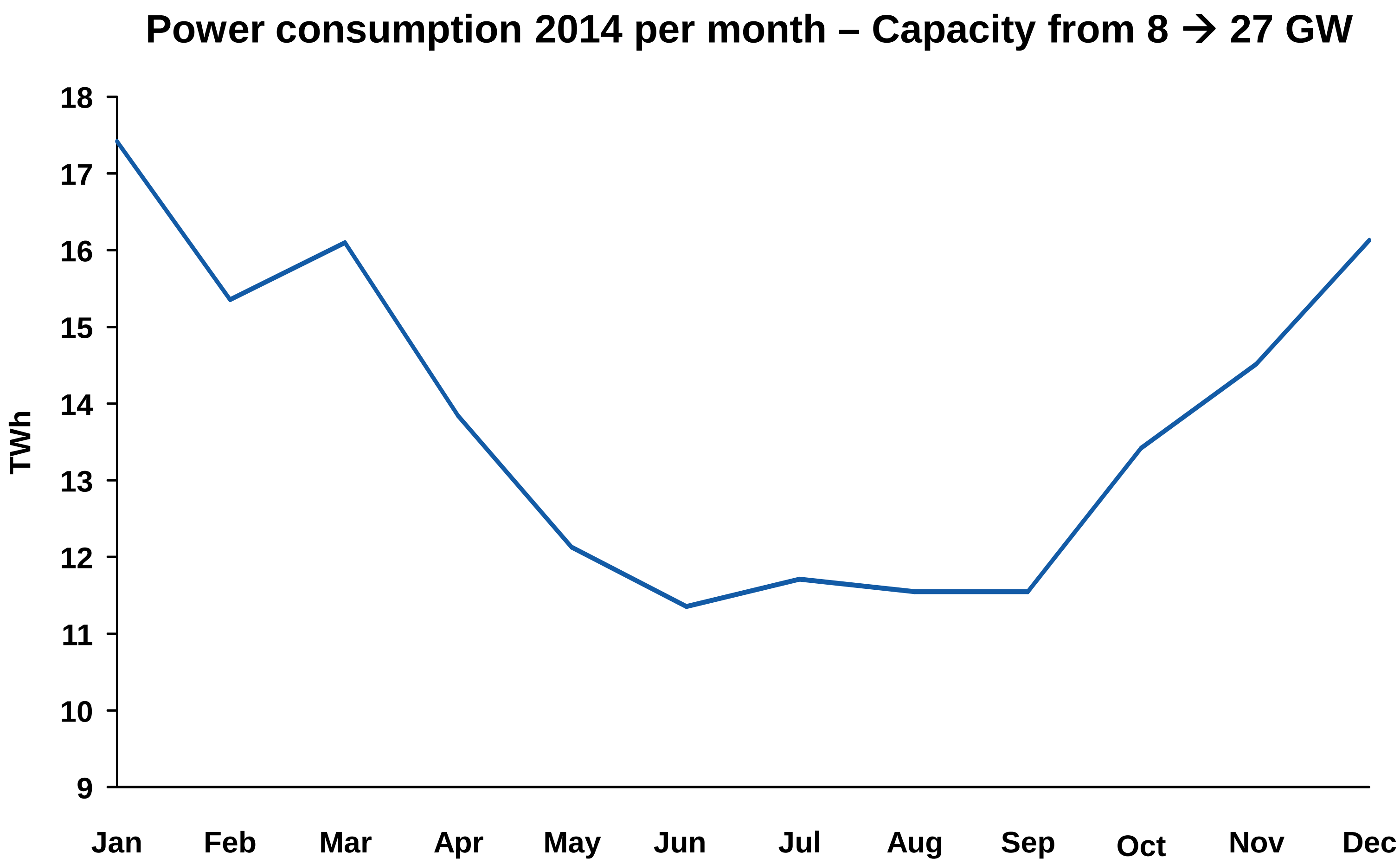
Power production **"Energy"** 2014, TWh



Gas turbines Condense Nuclear Solar Wind Back pressure Hydro

VATTENFALL

Sweden has a challenging demand profile over the year



Sum of power consumption per month

4 important areas to address the need for flexibility

Transmission infrastructure & integrated market

Stronger coupling of heating and power systems

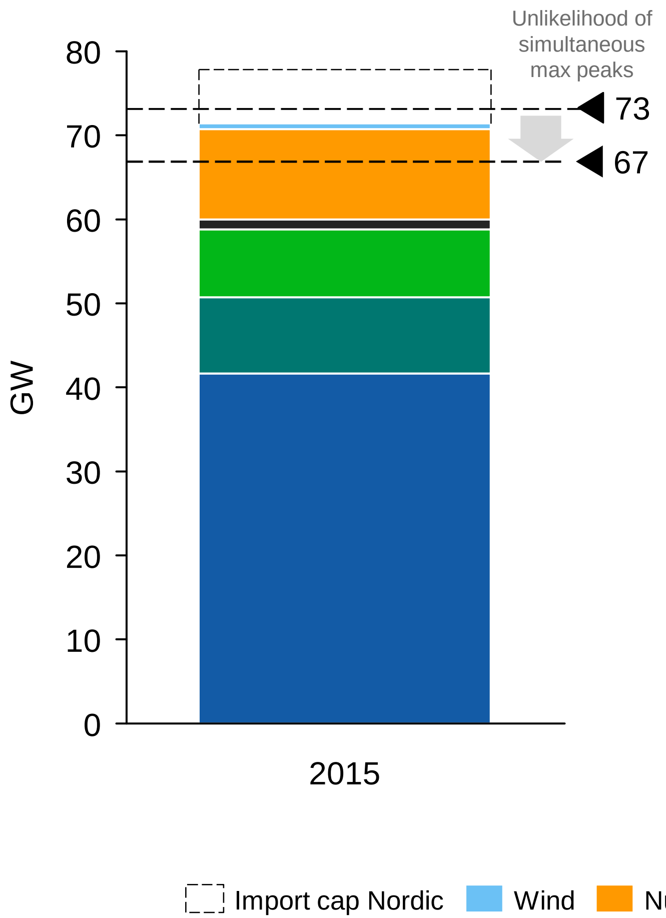
Demand-side management

Flexibility of hydro power

Transmission capacity and an integrated market reduces the capacity deficit

1

Nordic "reliable capacity" + full import



- Unlikelihood of simultaneous Nordic peaks reduces current peak from 73 to 67 GW
- Possibility to rely on interconnectors and imports reduces urgency of securing domestic capacity

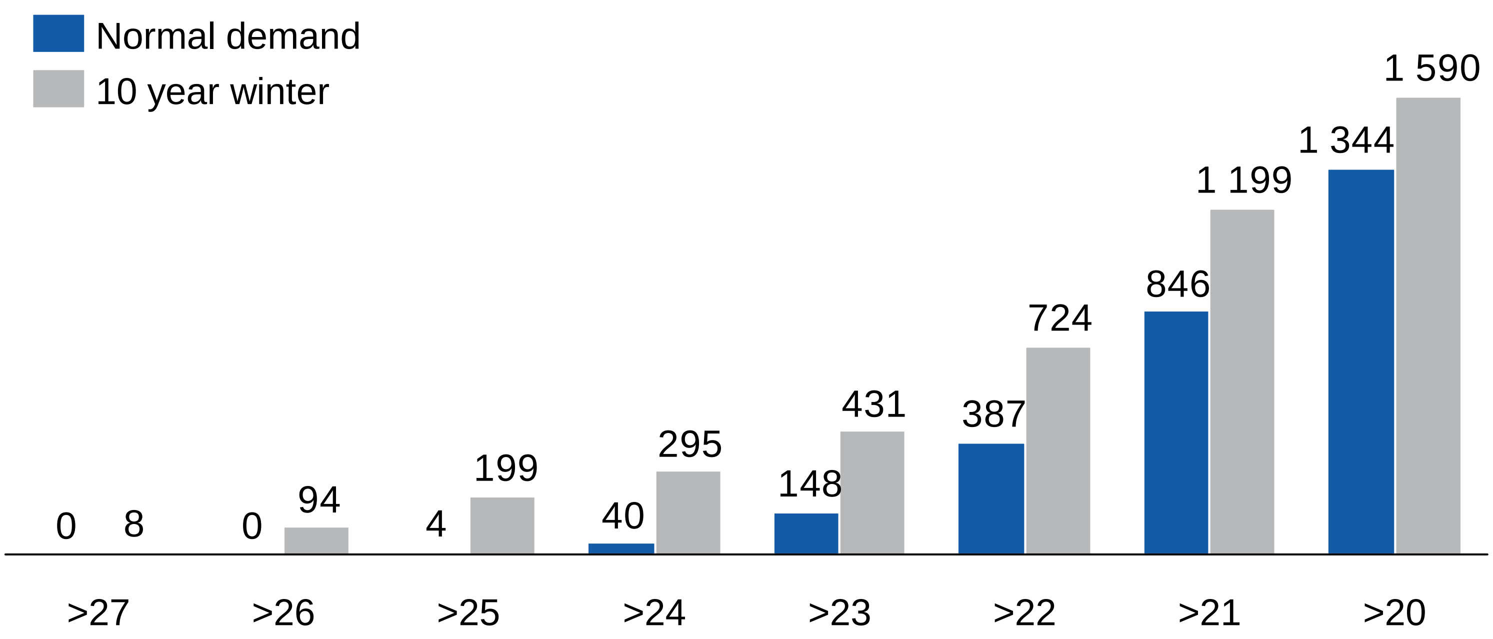
*Availability according to SvKs assumptions winter 14/15: Hydro 85%, Nuclear 84%, Wind 6%, Condense 90%, Backpressure 76%.

VATTENFALL

Demand-side participation will be essential to "resolve" peak situations - extreme peaks occur only a handful of hours per year

2

Number of hours with high demand > X GW



Much to gain from permanently reducing peak demand - and from allowing for active demand-side participation

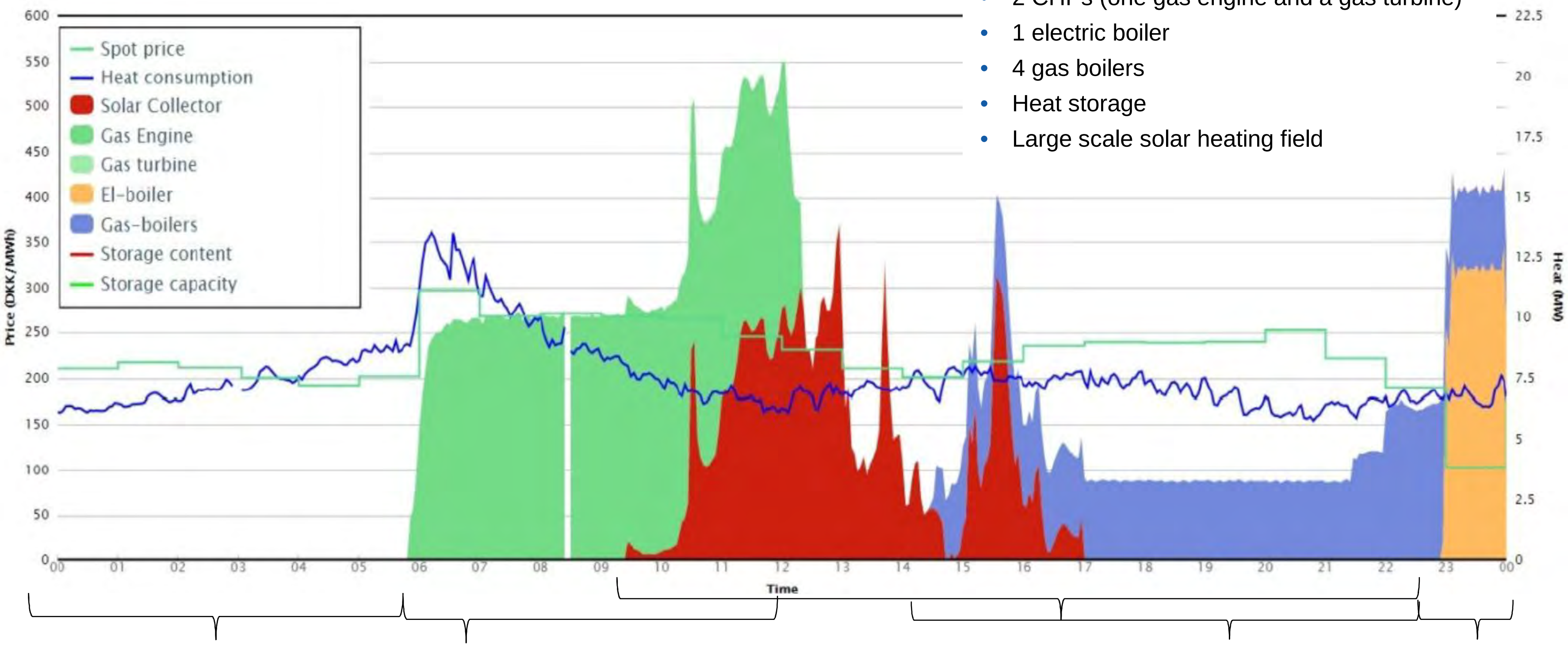
VATTENFALL

Stronger coupling of heating & power systems valuable from a system perspective

3

Flexible CHP example - Ringkjøbing district heating plant (Denmark, 6 October 2014)

- 2 CHPs (one gas engine and a gas turbine)
- 1 electric boiler
- 4 gas boilers
- Heat storage
- Large scale solar heating field



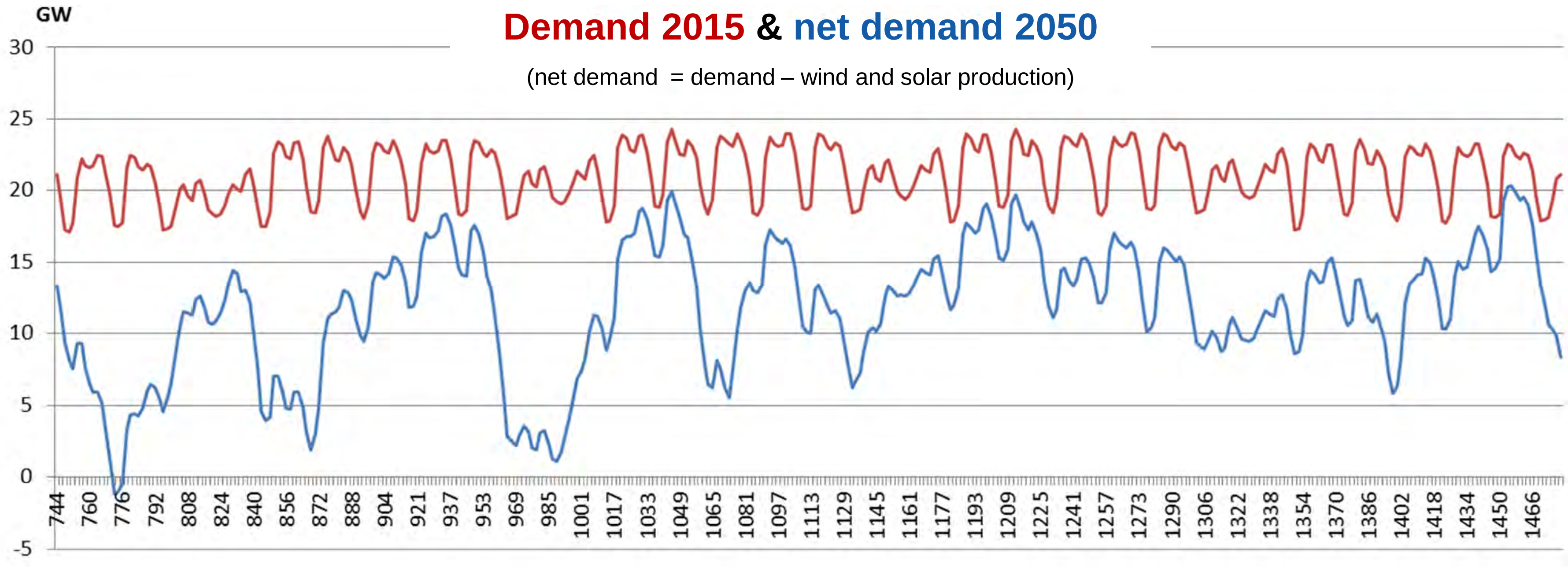
1. Prices not high enough for CHP to start
2. Heat demand is met by **thermal storage**
3. Prices >30EUR/MWh → economically viable to run gas engine in **CHP to meet heat demand** and obtain revenues from electricity
4. **Solar fields** heat water
5. **Thermal storage** meets demand until 23:00
6. **Gas boilers** heat water
7. Prices are <20EUR/MWh → **electric boilers** heat water

VATTENFALL

Source: PointCarbon

4 Hydro power flexibility will be essential to utilize (or at least preserve)

Consumption minus wind and solar production, assuming significant RES growth (Feb 2015 vs 2050)



Net demand variability and ramp rates increase for all operational timeframes (yearly, seasonal, weekly, daily, hourly) – for system to manage, flexibility of hydro power, heat infrastructure, DSM and imports will play important roles

VATTENFALL

4 important areas to address the need for flexibility

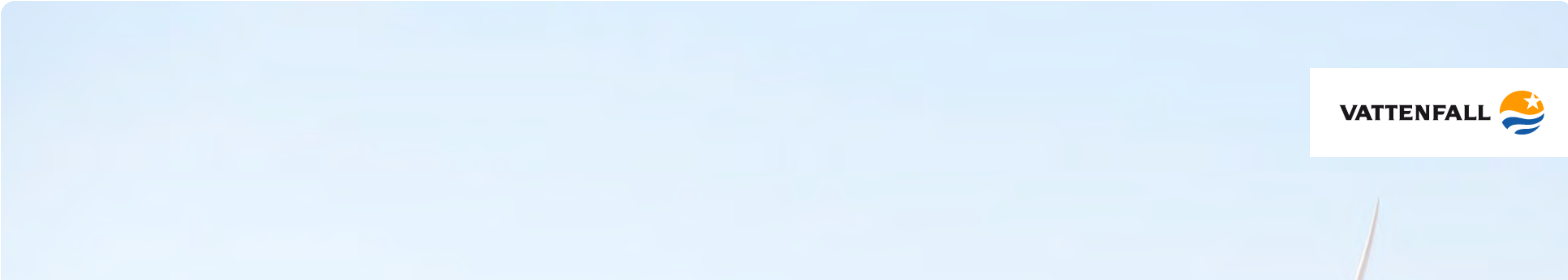
Transmission infrastructure & integrated market

Stronger coupling of heating and power systems

Demand-side management

Flexibility of hydro power

VATTENFALL



Thank You