

# Looking forward - The Swedish energy system into the 2040s

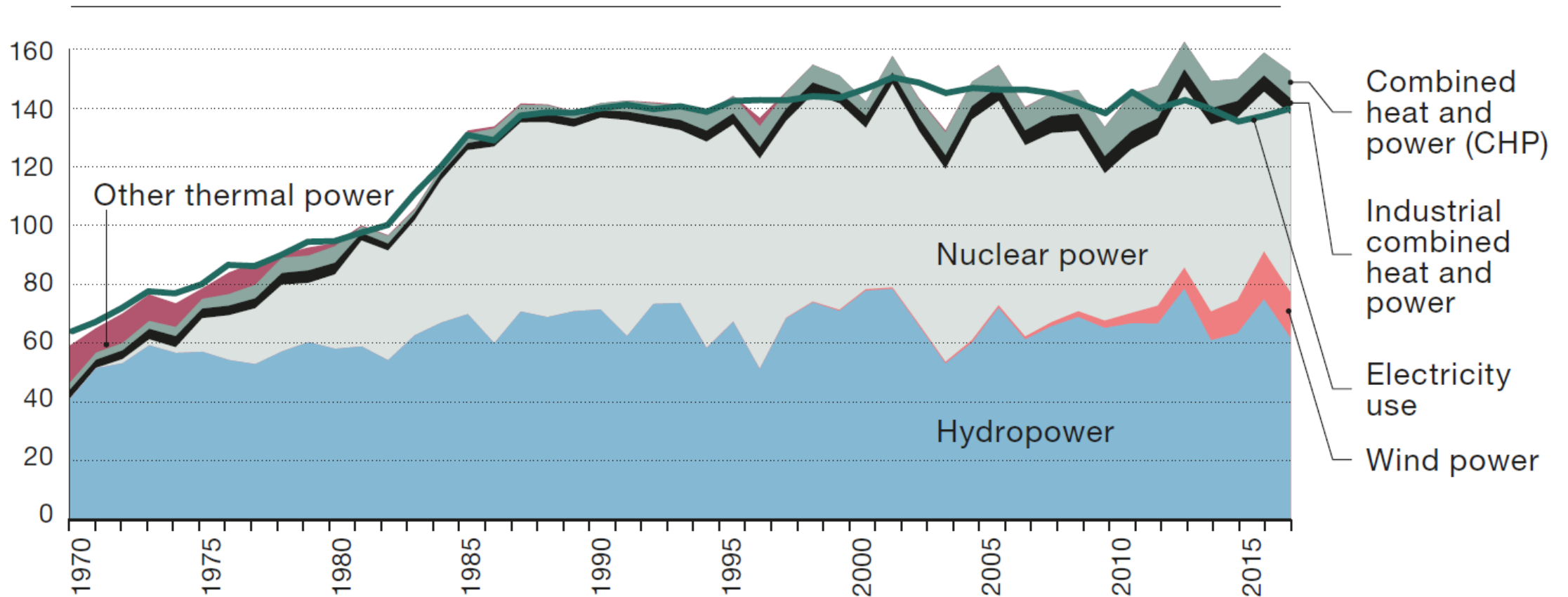
Umeå 2019-03-27

David Newell,

Swedish Energy Agency



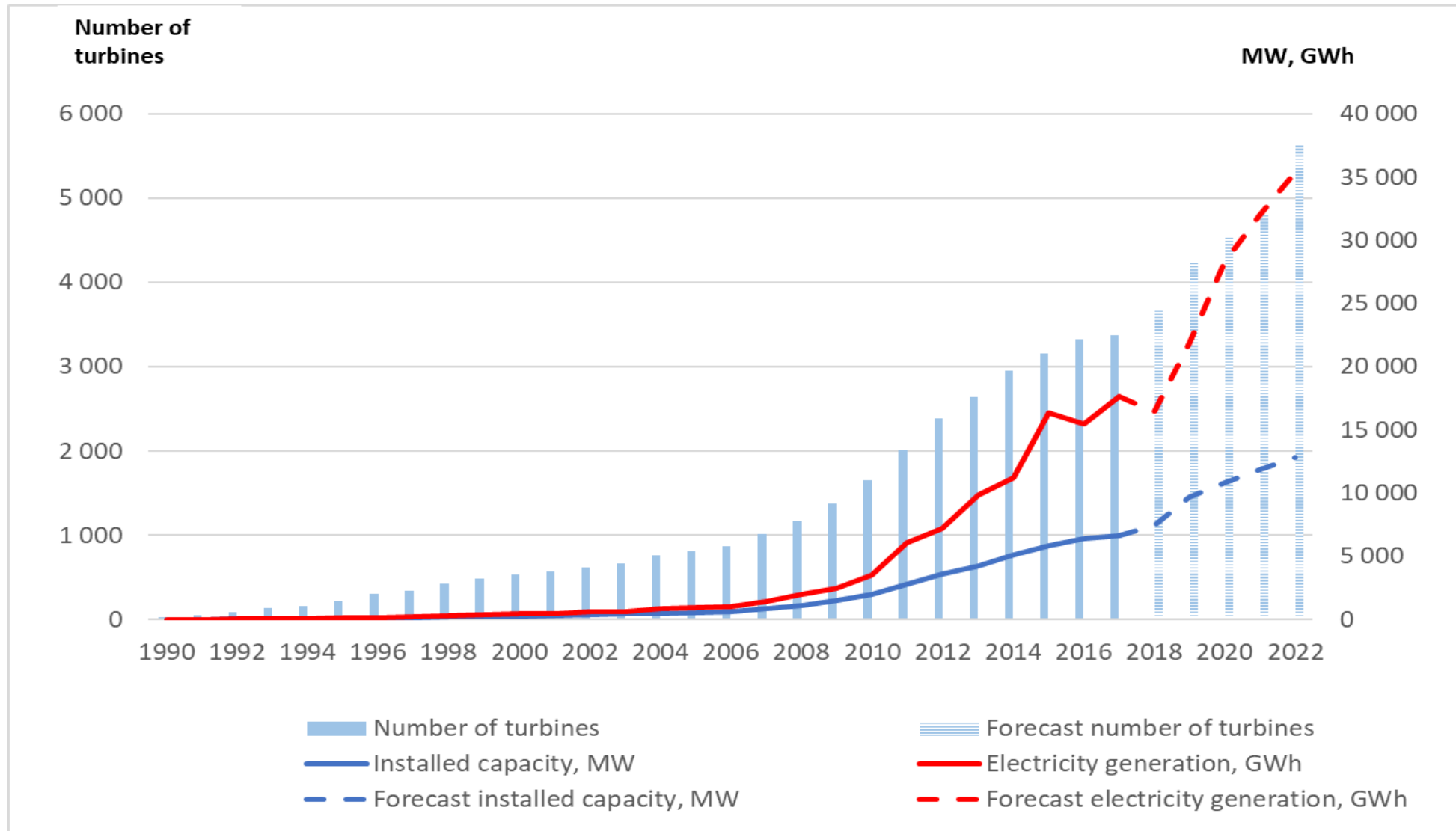
# Electricity use and generation by type of power today



Sources: Swedish Energy Agency and SCB (Statistics Sweden).

Remark: Electricity generation for own use is not included.

# Wind power installation in Sweden

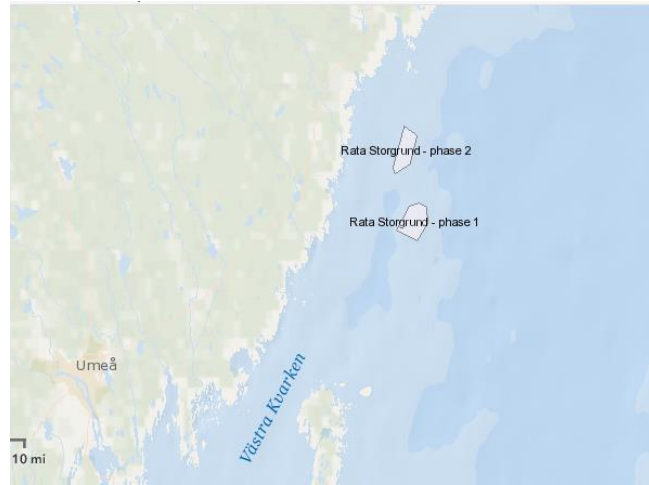


# Offshore wind power in Sweden today



Name	Installed capacity, MW	Estimated generation, TWh
<b>In operation</b>		
5 wind farms	200	0,6
<b>Authorised</b>		
Stora Middelgrund	800	3,2
Krigers Flak	640	2,6
Storgrundet	350	1,4
Utgrunden II	90	0,4
Taggen	415	1,7
Stenkalles grund, Vänern	90	0,4
Kattegatt offshore	282	0,7
<b>Application process</b>		
Södra Midsjöbanken	1100-1600	6-7
Finngrundet	1100	6

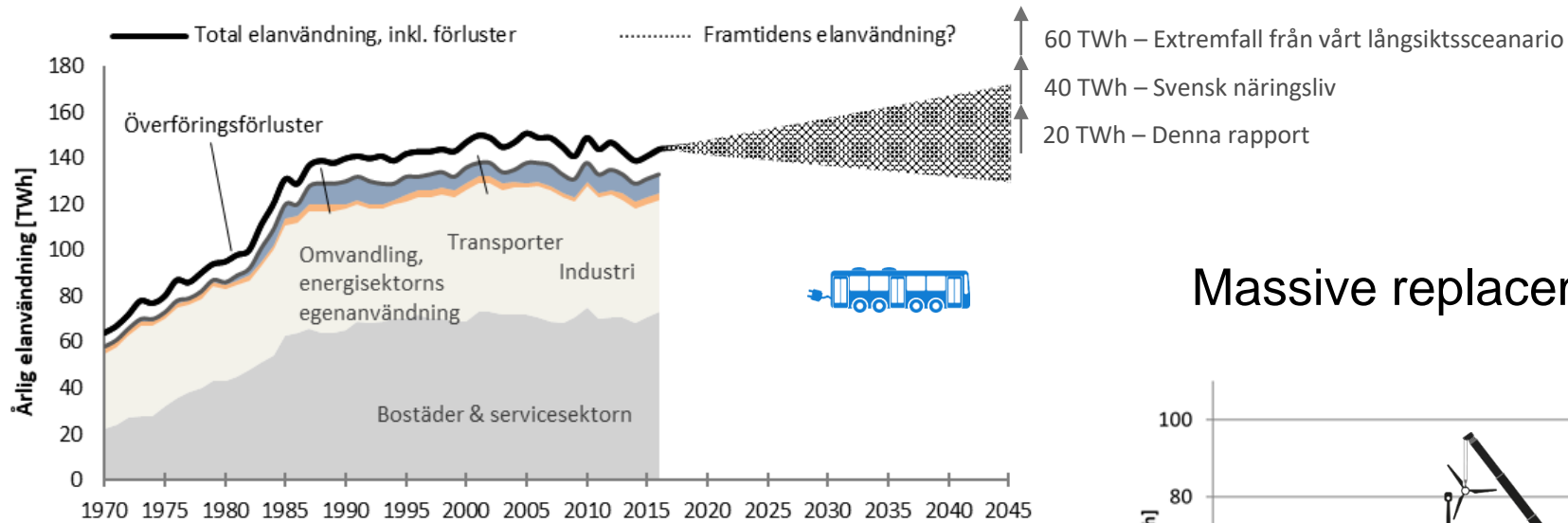
# Projects in the Baltic Sea area



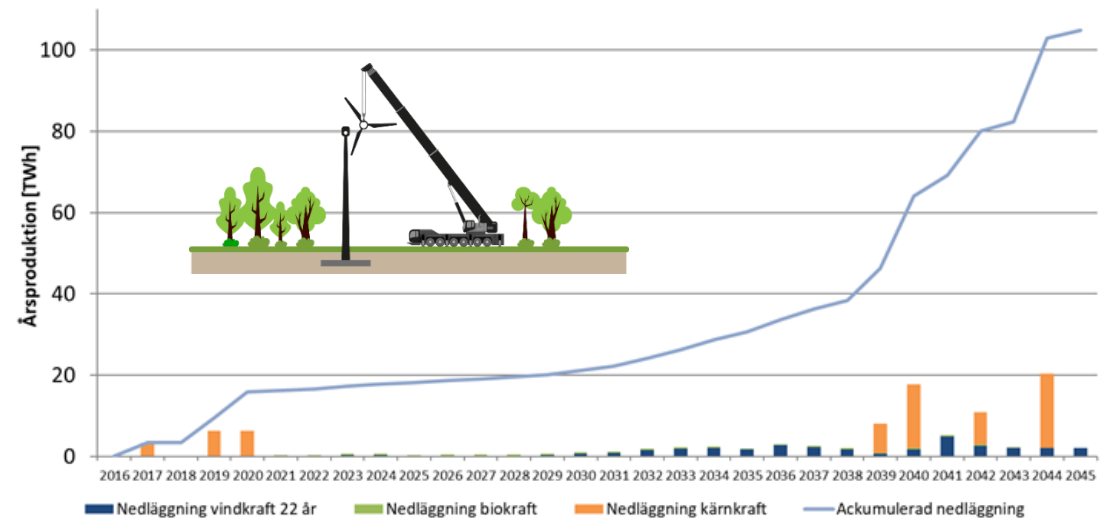
Namn på projekt	Projektör	Kommentar
Klocktärnan	Wpd Scandinavia	Ligger på is pga konflikte med FM, RI vindbruk
Rata Storgrund I & II	Rewind Offshore AB	Projekt ligger på is
Finngrundet	Wpd Scandinavia	Avslag på Natura 2000-ansökan
Gretas klackar	Sveavind AB	
Utposten	Sveavind AB	
Utposten II	Sveavind AB	
Campsgrund	Sveavind AB	
Sylen	Sveavind AB	
Utknallen	Sveavind AB	
Svenska Björn Offshore	Solid Vind AB	Ligger på is
Almagrundet	Sveavind AB	Ligger på is
Långgrund I och II	Sveavind AB	Ligger på is
Södra Landsort	Sveavind AB	Ligger på is
Södra Midsjöbanken	E.ON	Lämnat in tillståndsansökan, omgivet av ett Natura 2000 område, största RI vindbruk området
Sydkustens Vind	EPD	RI vindbruk, ej med i havsplaner pga konflikte med FM

# Future power sector needs

Electricity use will probably increase due to electrification trends

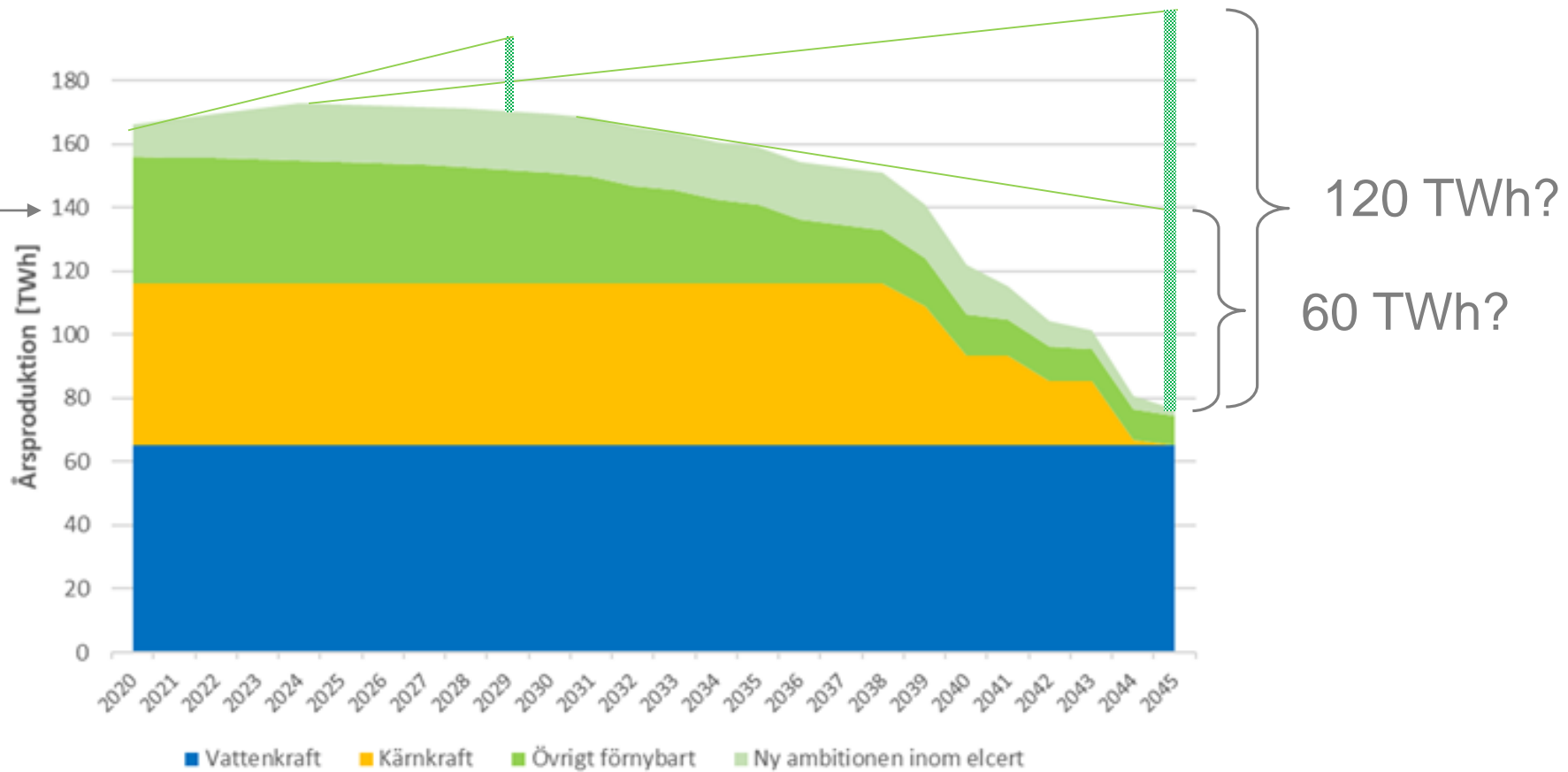


## Massive replacement of electricity generation

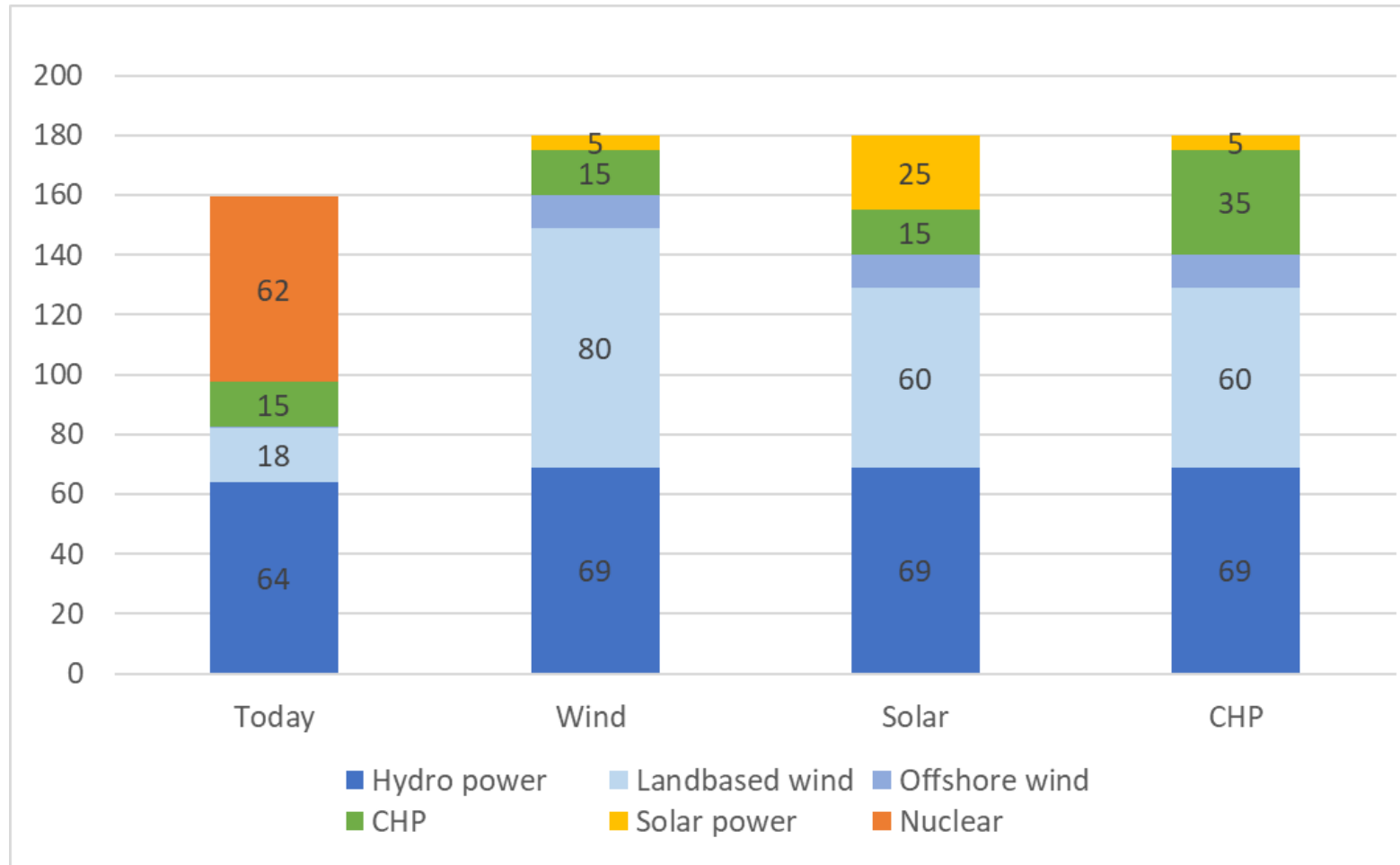


# New electricity generation needs by 2040's

Electricity use today



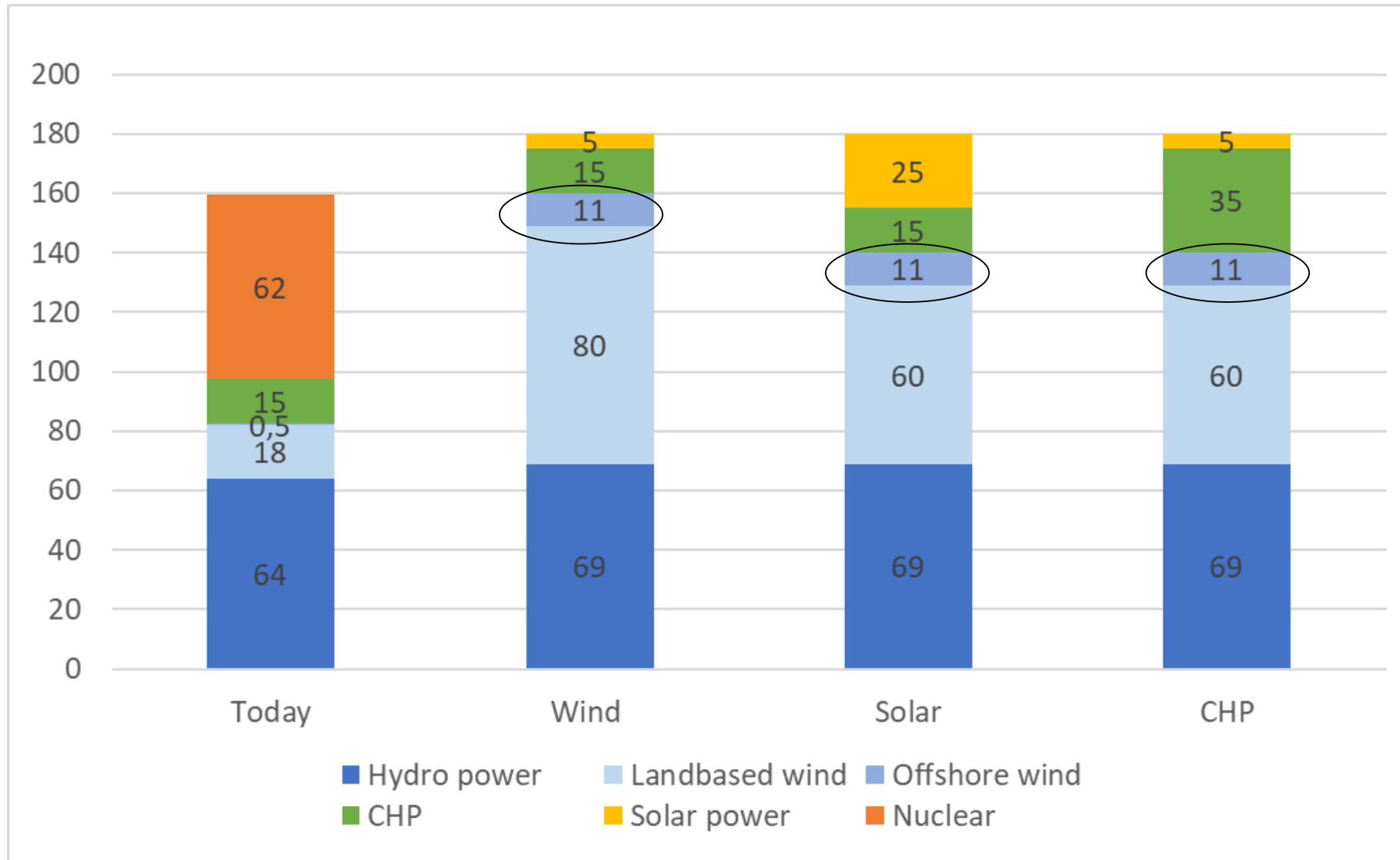
# Four 2040 scenarios



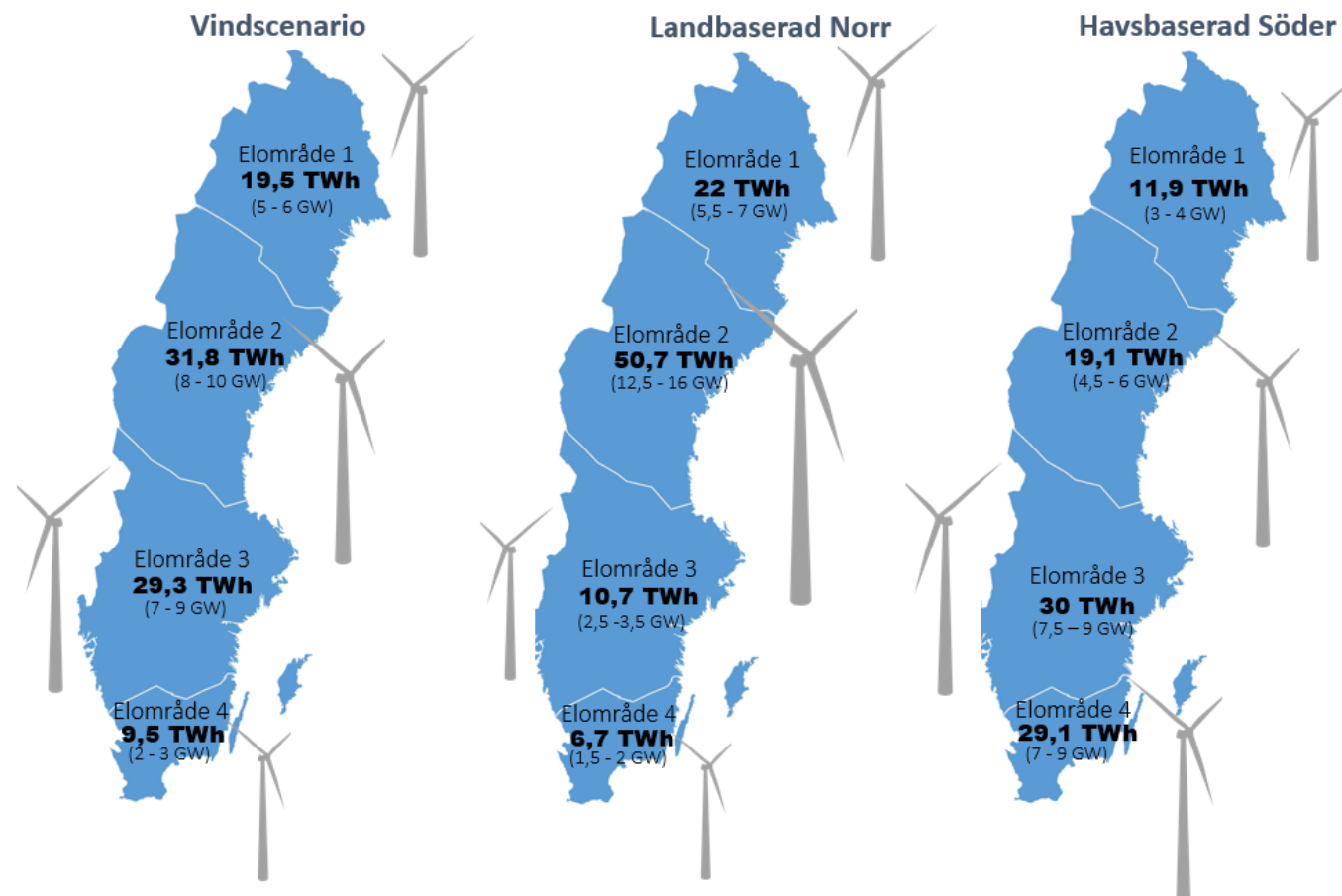
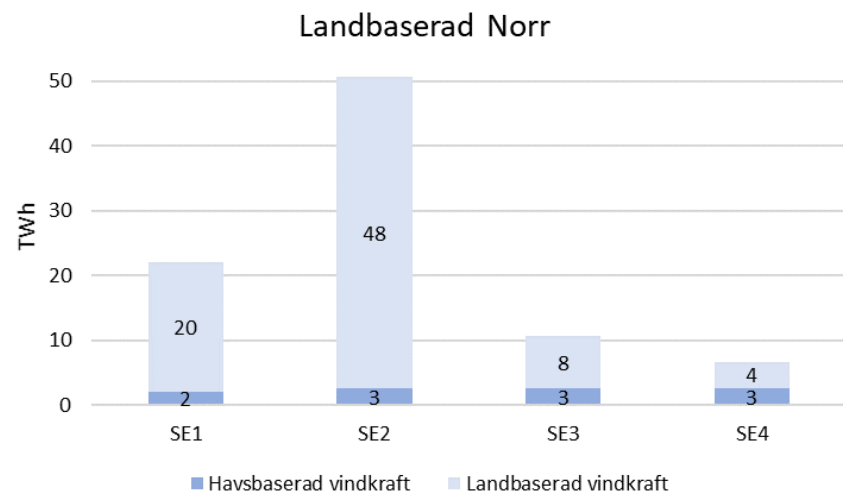
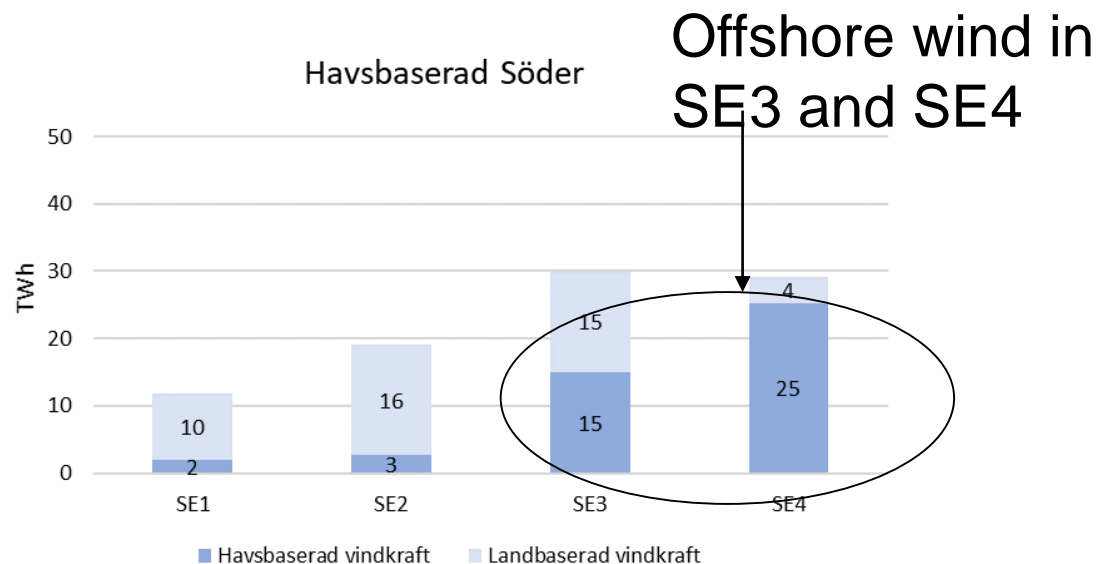
- **Wind:** most cost-effective alternative
- **Solar:** electricity generation discordant with today's electricity use
- **CHP:** best alternative for security of supply, but most costly alternative and requires new techniques



# 11 TWh offshore wind in all scenarios



# Primarily land based wind in the "Wind" scenario



# Conclusions

## Several trends indicate a comprehensive energy system transition by the 2040's

- 100 TWh electricity generation must be replaced
- Most new electricity generation will likely be variable
- The power system expands into new sectors due to increased electrification and electricity use
- Electricity use patterns will likely change



# Conclusions

## The "wind" scenario has advantages compared to other scenarios...

- An extensive expansion of wind power is now underway; this scenario can be realized with market-based conditions due to technological developments and a large potential for wind power in Sweden
- A large amount of installed wind power is a prerequisite for achieving 100% renewable electricity generation by the 2040's, the majority of which will be land-based wind power



# Conclusions

## A 100% renewable energy system is possible...

- Significant potential of competitive renewable electricity generation and flexibility
- Significantly stronger incentives for flexibility and "system-friendly" activities/generation

## ...but action is required

- Society needs to strive toward defined same targets
- Electricity prices need to promote "system-friendly" actions
- Security of supply must be monitored
- The power grid must be upgraded
- Potential of cost-effective renewable electricity generation must be realized



# Will we reach 100% renewable electricity generation by the 2040s?

Probably.

The challenge is how to reach a 100% renewable, **cost-effective** electricity generation coupled with high **security of supply** and low **environmental and social impacts**





Thank you for your attention!

Email: [david.newell@energimyndigheten.se](mailto:david.newell@energimyndigheten.se)

Tel: +46 (0)16 544 23 08

[www.swedishenergyagency.se](http://www.swedishenergyagency.se)

# The Nordic power grid





# Changes in the transfer capacity 2020-2040

Commissioning	Cut	Changes (MW)	Total MW	Information/ namn
2022	SE2 $\leftarrow$ $\rightarrow$ SE3	+500	7800	Reinforcement cut 2
2023	SE2 $\leftarrow$ $\rightarrow$ SE3	+300	8100	Reinforcement cut 2
	SE3 $\leftarrow$ $\rightarrow$ SE4 SE4 $\leftarrow$ $\rightarrow$ SE3	+600 +400	7200 3600	Ekhyddan-Nybro-Hemsjö
2026	SE2 $\leftarrow$ $\rightarrow$ DE	+700	1315	Hansa Power Bridge
2026	SE1 $\leftarrow$ $\rightarrow$ FI FI $\leftarrow$ $\rightarrow$ SE1	+800 +900	3200 total SE-FI	3:rd AC
2029	SE2/SE3 $\leftarrow$ $\rightarrow$ FI	+400	3600 tot SE-FI	Decommission of Fenno-Skan 1, new HVDC (800 MW SE2-FI)
2031-2039	SE2 $\leftarrow$ $\rightarrow$ SE3	+2400	10500	Reinforcement cut 2

# TSO's long term market analysis



- The decommissioning of nuclear power and some other thermal power will mean that available system inertia will decrease, which degrades the frequency stability of the Nordic system.
- Large deficit of domestic electricity generation in Sweden during winter's high load hours by the 2040's, but import is expected to cover the deficit
- Volatility in the system will increase and makes it harder to keep the system in balance. Hydro power's regulation contribution and value for the electricity system will increase
- Need for greater transfer capacity 2030-2040 for a more efficient utilisation of the power capacity.