

# HYBRIT – System integration and flexibility

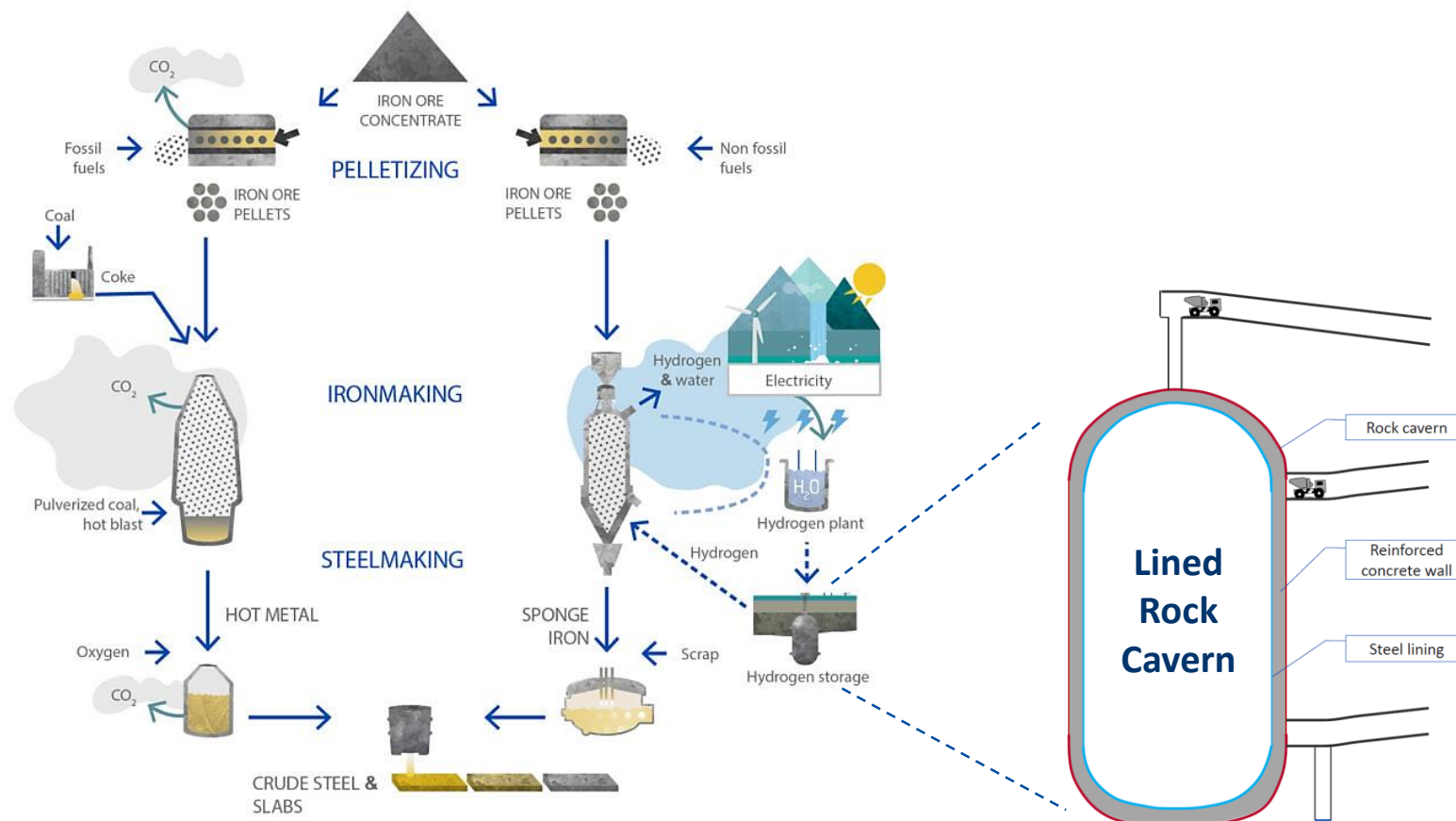
Tobias Rehnholm



# HYBRIT in short

## BLAST FURNACE PROCESS

## HYBRIT PROCESS



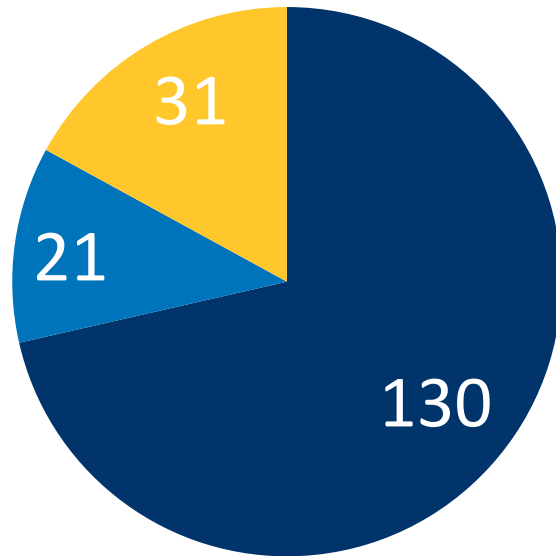
**SSAB**  
**LKAB**  
**VATTENFALL**



- **HYBRIT = HYdrogen BReakthrough Ironmaking Technology**

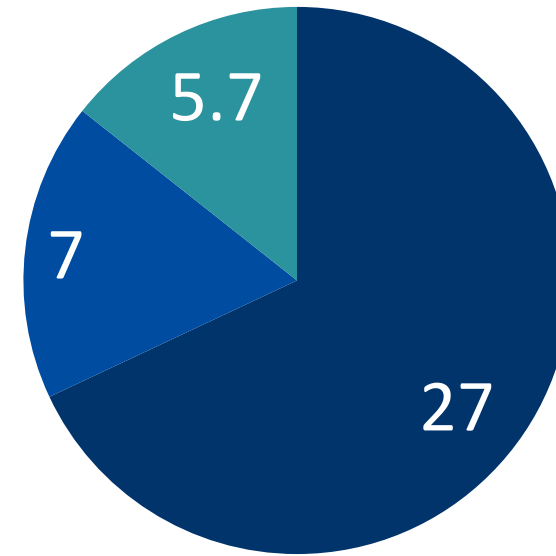
# Order of magnitude – transition of Swedish ore-based iron/steel

Electricity consumption [TWh]



■ Sweden final electricity consumption 2018  
■ SSAB supply conversion  
■ LKAB pellet conversion excl. SSAB supply

Power demand 52TWh case [GW]



■ Swedish electricity peak load 2018  
■ Constant load, no flex  
■ Flex with 100% electrolyser overcapacity

- *Reduce up to 35Mt of CO<sub>2</sub>*
- *+40% increase in Swedish electricity demand*
- *Minimum power demand can be reduced from 7GW to 1.3GW by storage flexibility*

# Scenario analysis with market feedback

## North European power market simulation

- 2035-2055
- 51 weather scenarios
- Energy demand is compensated with 100% wind

### Flexible 21TWh (40% in SE1)

- 180% electrolysis capacity [3.7GW]
- 7 days hydrogen storage [0.3TWh]

### Flexible 52TWh (95% in SE1)

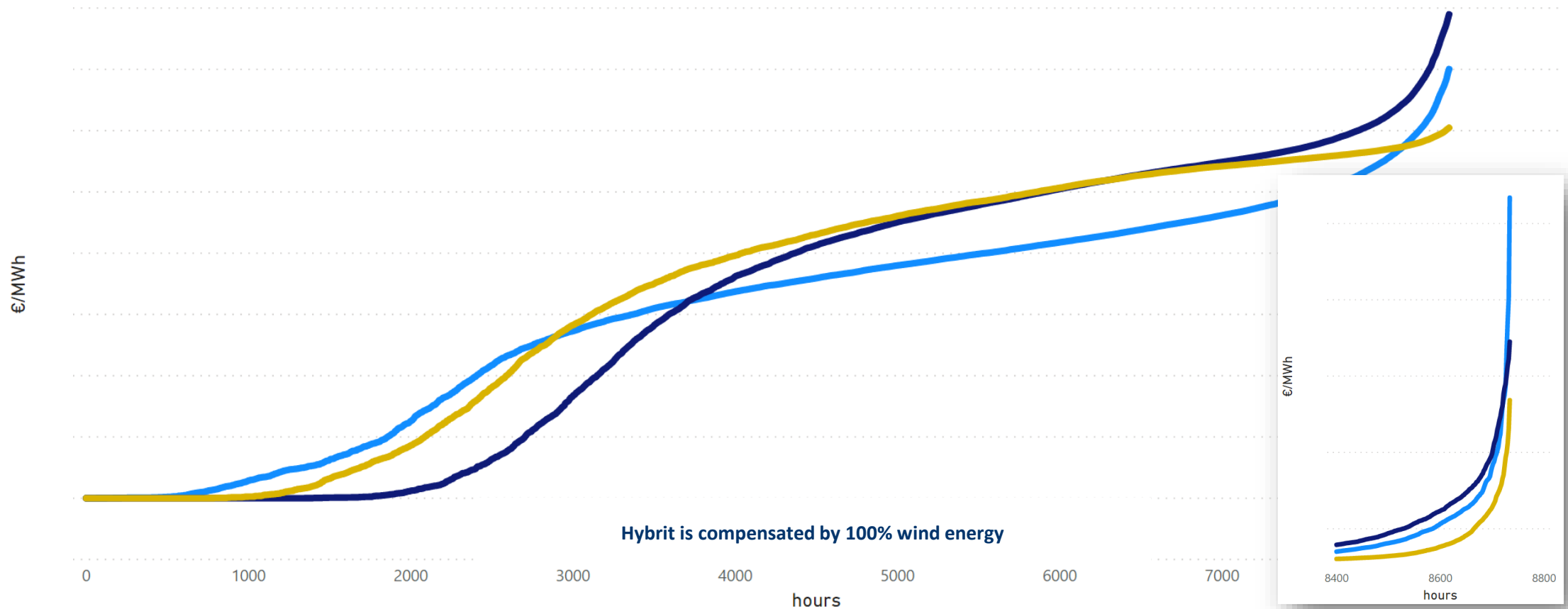
- 180% electrolysis capacity [10.2GW]
- 14 days of hydrogen storage [1.6TWh]



- *Flexible consumption can lower cost for Hybrit and increase the value of wind*

# SE1 price duration curves 2040: 52TWh

● Without Hybrit ● Hybrit 52TWh constant load ● Hybrit 52TWh hydrogen flex (180% electrolyser cap, 14 days storage)

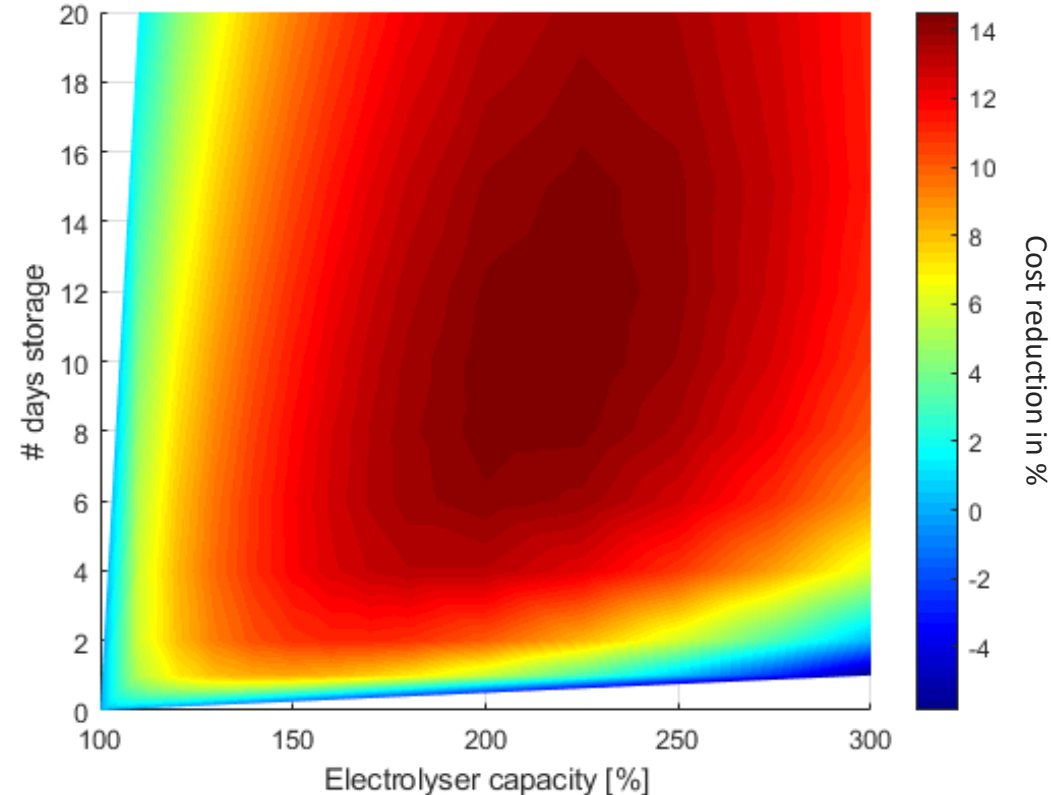


- *Hybrit flexibility raises low prices and lowers high prices*
- *More wind increases the number of low-price hours*

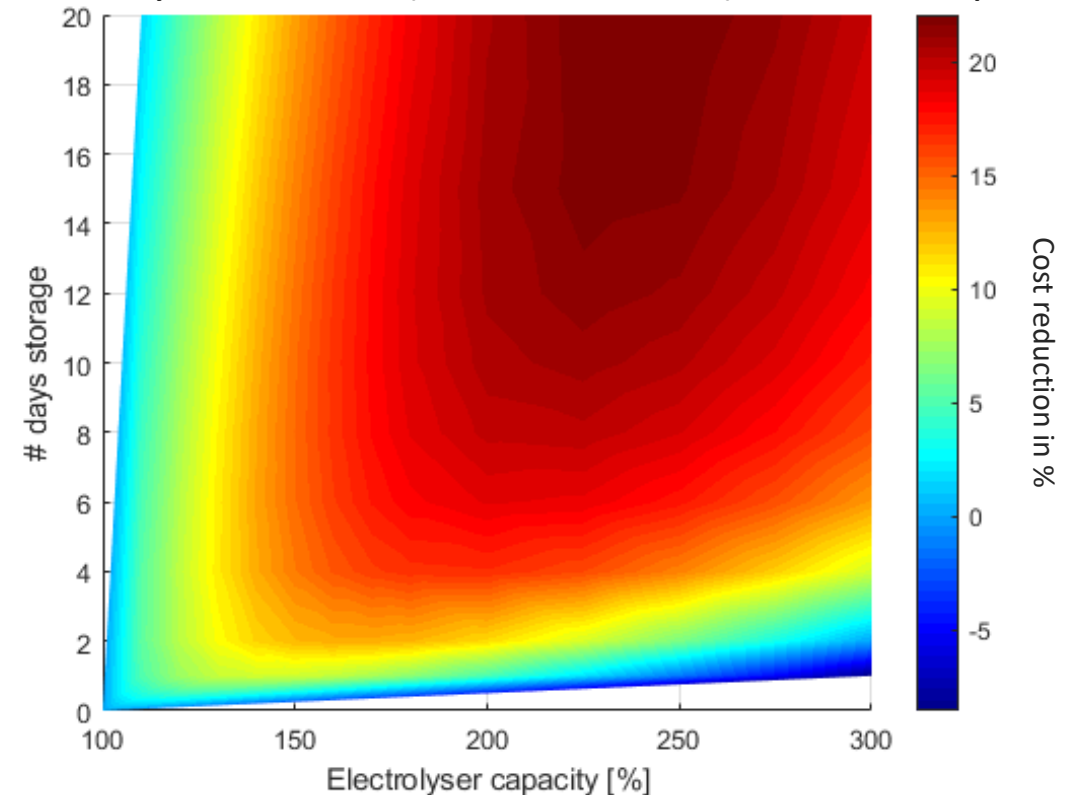
# Hybrit cost reduction with demand flexibility

Analysis exclude grid costs

Hybrit 21TWh (8.3TWh in SE1): ~15% cheaper



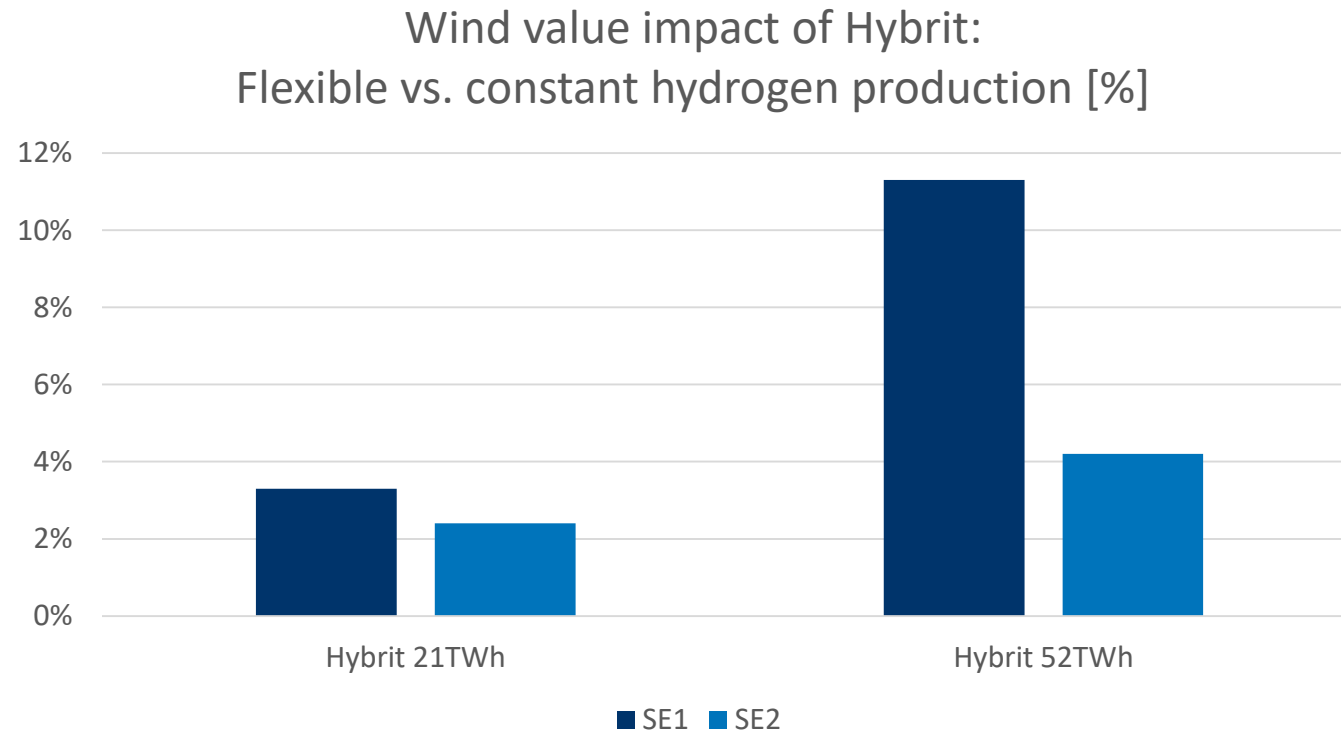
Hybrit 52TWh (49.3TWh in SE1): ~20% cheaper



- Flexibility reduces the cost of hydrogen production for Hybrit
- Increased wind penetration increases the value of flexibility



# Wind value impact of Hybrit flexibility



- *Demand flexibility increases the value factor of wind*
- *Challenging grid situation between SE1 and SE2 in the 52TWh case*

# Integrative approach

- Partnerships enable a more attractive approach to value chain transitions.
- Industry flex can increase build-out of variable renewables, which in turn benefits the industry.
- Solutions are built for fitting into the next generation electricity system.





The background of the slide is a photograph of a large industrial facility, likely a steel mill, with a tall, light-colored building and a chimney. The ground is covered in snow, and there are construction cranes and equipment visible in the foreground. The sky is clear and blue.

# HYBRIT

▶▶▶ FOSSIL-FREE STEEL

Tobias Rehnholm  
[tobias.rehnholm@vattenfall.com](mailto:tobias.rehnholm@vattenfall.com)