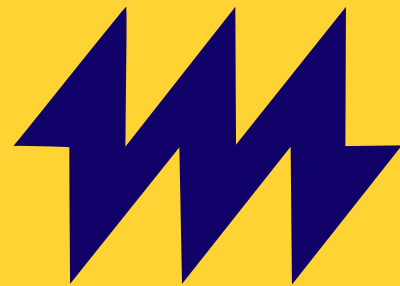


Sector coupling and flexibility

Tuukka Hartikka, Business lead renewable hydrogen & Power-to-X



HELEN

Helen in brief

Number of employees
in the Helen Group

1015

Net sales of the
Helen Group in 2021

1,318 EUR
mill.

Total of

1409 km

of district heating
network

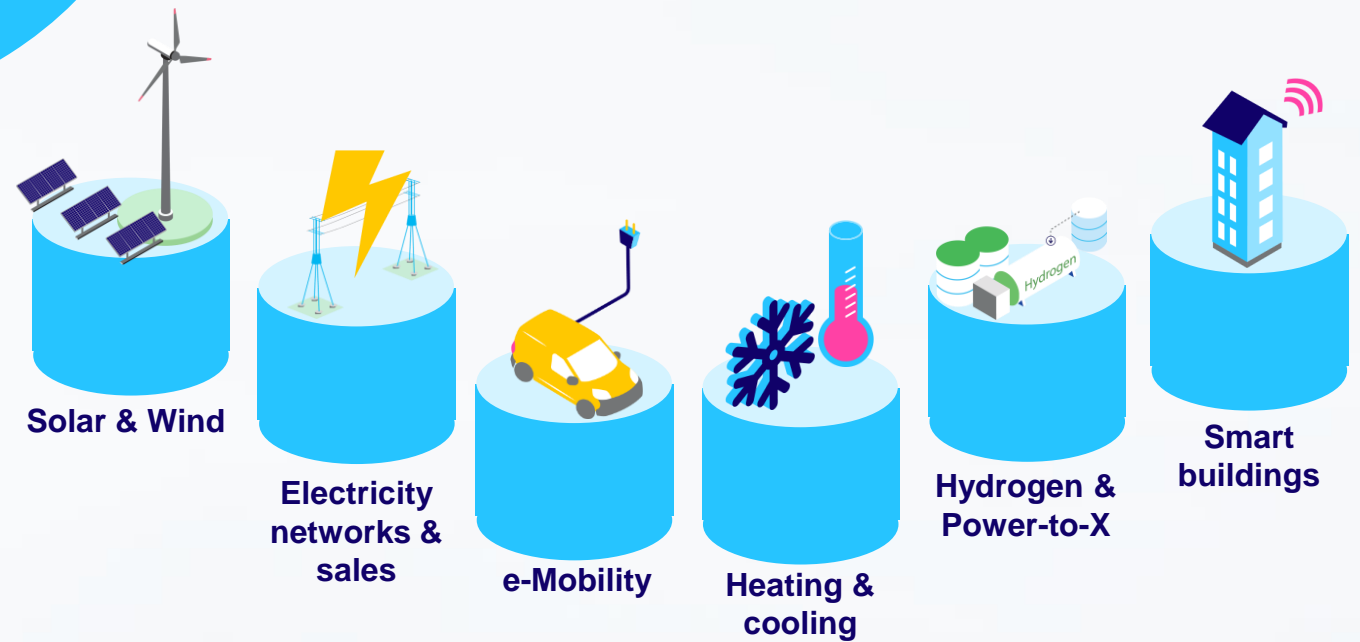
Total of

6,200 km

of electricity
network

In Helsinki, our security of electricity supply
is among the best in the world:

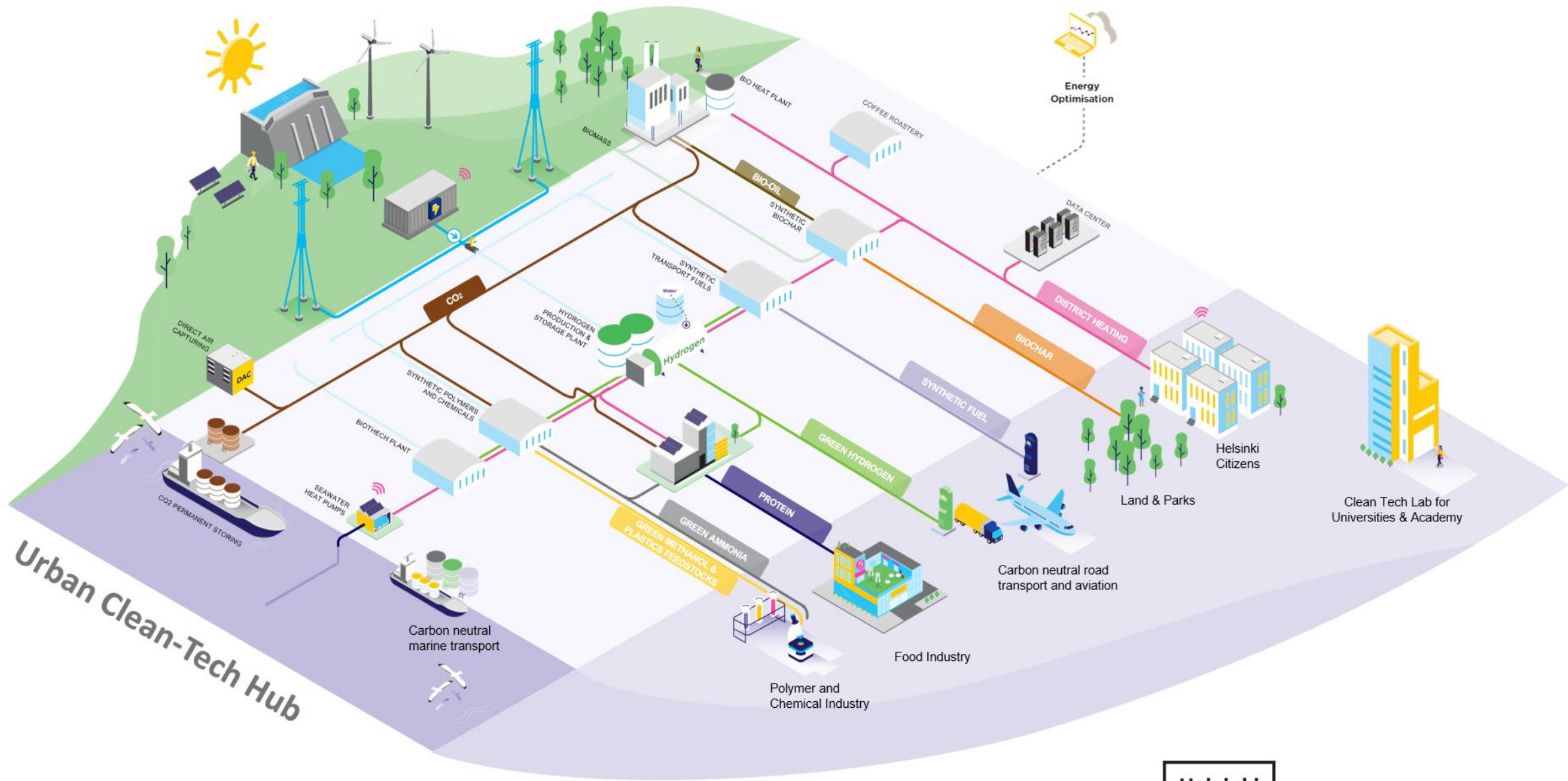
99.999%



Helen is carbon neutral by **2030**

Over a hundred years of urban energy

The electricity company of the City of Helsinki was established in 1909 in order to create a safer and more environmentally friendly way to produce energy in a smoky city.







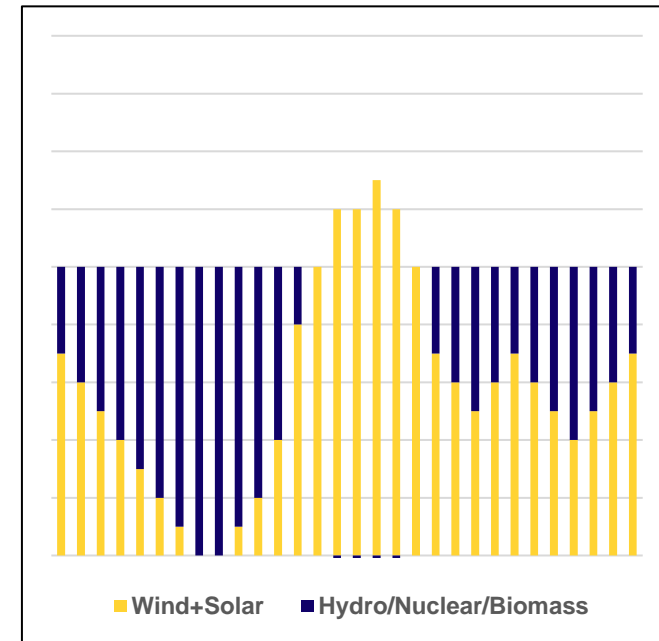
"Maailman toimivin kaupunki"
 New investments & workplaces
 Internationalization Opportunities
 Efficient use of the land



Baseload operation with optimized wind asset





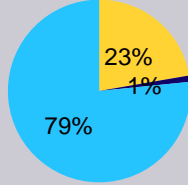
Continuous hydrogen demand

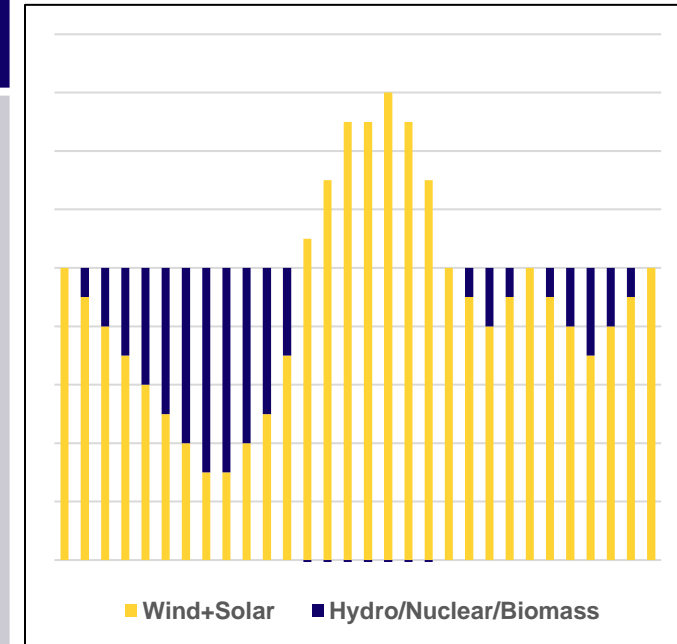
	Energy source		H2 production		H2 storage		H2 end users	Levelized cost of hydrogen
<ul style="list-style-type: none"> 100 MW Baseload PPA 280 MW Wind power needed to fulfill the annual energy demand Capacity factor 35% 	<ul style="list-style-type: none"> 100 MWe alkaline electrolyser 30 MWh of heat produced per hour 65% is "Green hydrogen" 		<ul style="list-style-type: none"> 1 hour (67 MWh) hydrogen buffer storage for interruptions 		<ul style="list-style-type: none"> Continuous hydrogen demand of 2 ton/hour E.g. eFuels production, HVO process, oil refining 			<ul style="list-style-type: none"> 3.0 €/kg Baseload electricity price 41 €/MWh <div data-bbox="1574 921 1803 1210"> <p> ■ CAPEX ■ OPEX ■ Electricity </p> </div>



Baseload operation with oversized wind asset





Continuous hydrogen demand

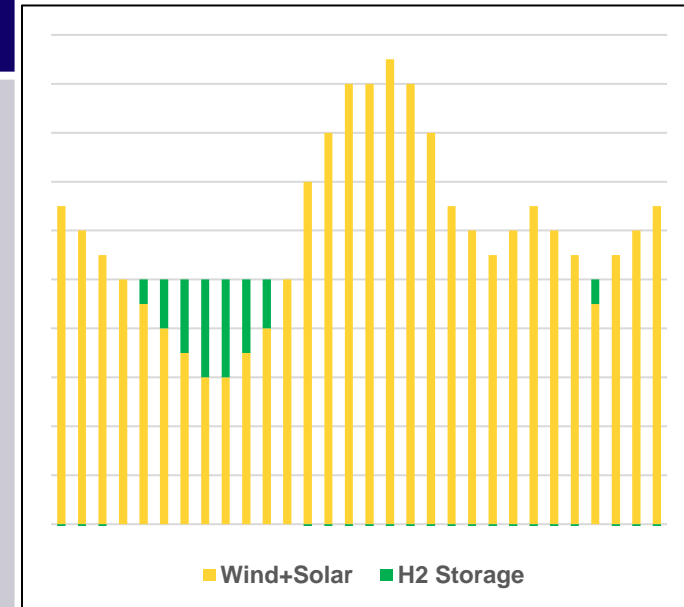
	Energy source		H2 production		H2 storage		H2 end users	Levelized cost of hydrogen
<ul style="list-style-type: none"> 100 MW Baseload PPA 400 MW Wind power to increase the green H2 amount Capacity factor 35% 	<ul style="list-style-type: none"> 100 MWe alkaline electrolyser 30 MWh of heat produced per hour 80% is "Green hydrogen" 		<ul style="list-style-type: none"> 100 MWe alkaline electrolyser 30 MWh of heat produced per hour 80% is "Green hydrogen" 		<ul style="list-style-type: none"> 1 hour (67 MWh) hydrogen buffer storage for interruptions 		<ul style="list-style-type: none"> Continuous hydrogen demand of 2 ton/hour E.g. eFuels production, HVO process, oil refining 	<ul style="list-style-type: none"> 3.5 €/kg Baseload electricity price 45 €/MWh due to cannibalization effect  <p> ■ CAPEX ■ OPEX ■ Electricity </p>



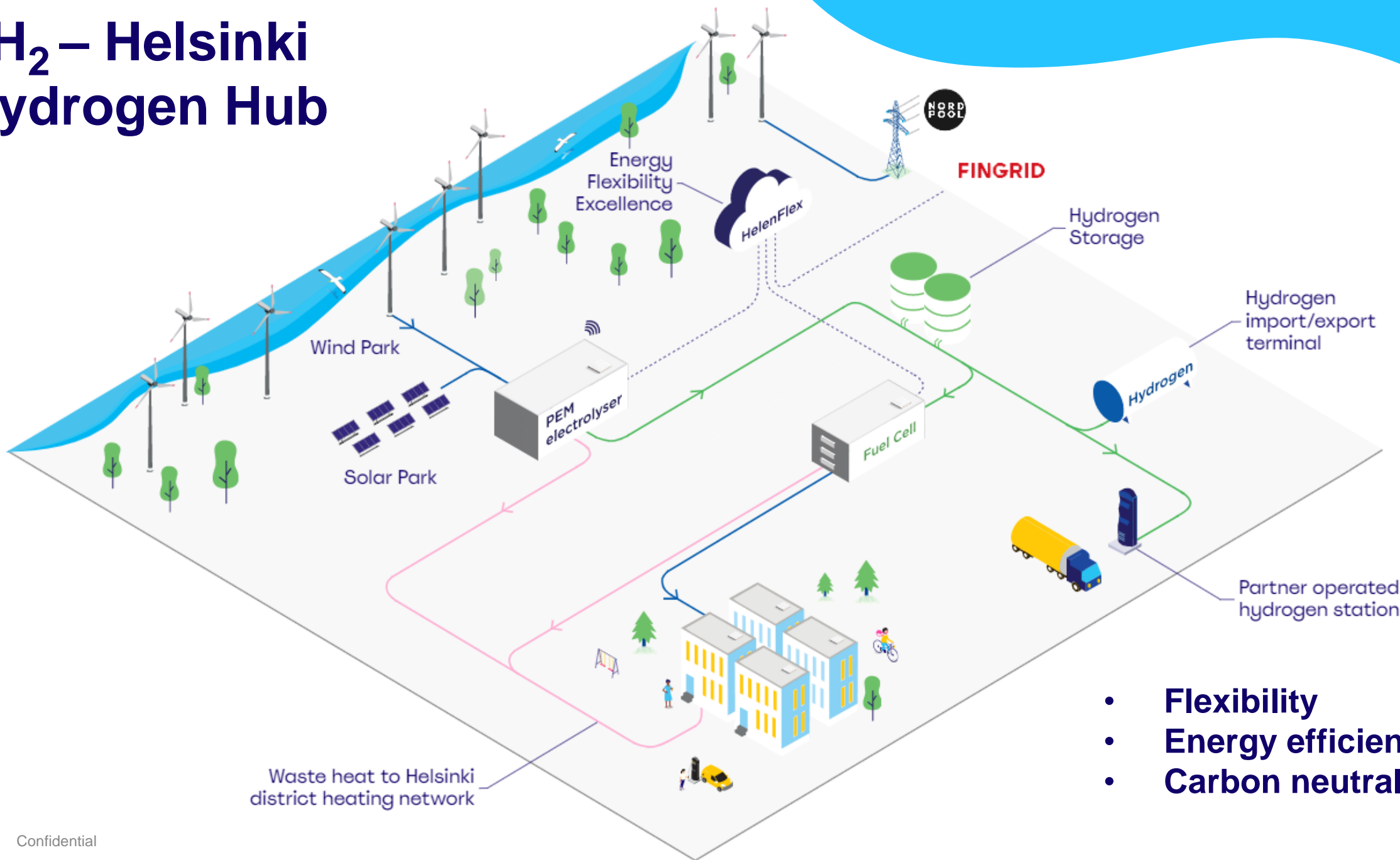
Flexible operation with oversized wind asset + storage

Continuous hydrogen demand

 Energy source	 H ₂ production	 H ₂ storage	 H ₂ end users	 Levelized cost of hydrogen
<ul style="list-style-type: none"> 550 MW Wind power to supply the energy demand every hour Capacity factor 35% 	<ul style="list-style-type: none"> 190 MWe alkaline electrolyser Load factor 52% Variable heat production 100% is "Green hydrogen" 	<ul style="list-style-type: none"> 11 days (25 GWh) hydrogen storage to provide continuous flow 	<ul style="list-style-type: none"> Continuous hydrogen demand of 2 ton/hour E.g. eFuels production, HVO process, oil refining 	<ul style="list-style-type: none"> 6.7 €/kg PPA wind price 35 €/MWh <div data-bbox="1574 925 1763 1110"> </div> <div data-bbox="1541 1172 1763 1239"> <ul style="list-style-type: none"> ■ CAPEX ■ Electricity ■ OPEX </div>



3H₂ – Helsinki Hydrogen Hub



- Flexibility
- Energy efficiency
- Carbon neutrality

**Thank you for your attention!
Questions?**



HELEN