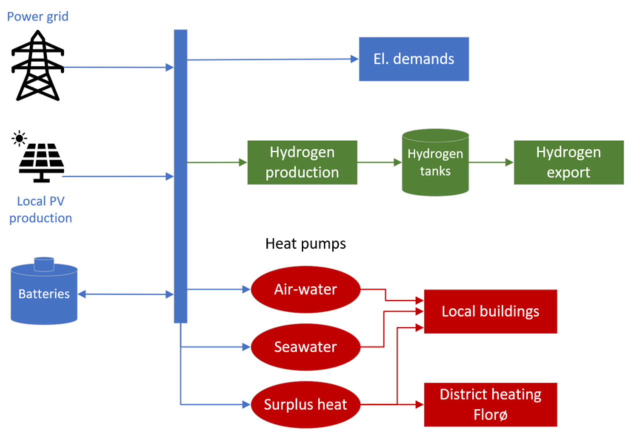
Fjord Base

Fjord Base is a large offshore supply base in Florø with the ambition to have 30 % of its turnover from green ventures by 2030. The port has a high focus on sector coupling; hydrogen production and supply of surplus heat to district heating and aquaculture.

Energy demand: The current electricity demands in the port area include buildings, outdoor lighting and onshore power supply (OPS) to ships, with a total use of 10 GWh per year and a maximum load of 3 MW. The waterborne heating demand for buildings is 1.2 GWh/year, currently met with air-water heat pumps.

In 2027, an additional electricity demand of up to 4 MW is expected due to electrification of existing and new operations, including OPS and cranes. From 2030, yet an increase of 10 MW is foreseen, due to industrial growth, resulting in an electricity use of over 70 GWh per year. In addition, small-scale hydrogen (H_2) production, with a 20-MWe electrolyser, is planned from 2027, and a large-scale ammonia (NH_3) production plant (200 MWe) from 2035. However these facilities will not be owned by the port.



Investment options for the port include batteries, a solar PV system of max 6.6 MWp, based on availble roof area of port buildings, a seawater heat pump, a heat pump driven by surplus heat from H_2 or NH_3 production, electric boilers, and infrastructure for exporting district heating to Florø.

A scenario where the port can invest in H_2 production and storage, but without NH_3 production, was also investigated.

Recommended investments. The analysis was made for three electricity price scenarios: baseline (normal), high spot price and high capacity tariffs. The recommended investments are given below, while the total costs and levelised cost of energy (LCOE) are presented on the following page.

Case 1: Given that investments in H_2 and NH_3 facilities are not made by the port, the recommended investments are:

- **PV panels:** 6.6 MWp (= max installation)
- **Battery system:** 1.4 MWh capacity at normal electricity prices, and up to 3.4 and 4.8 MWh with high spot price and high capacity tariff, respectively.
- **Seawater heat pump** (160 kW), complemented with an **electric boiler** of 200 kW: supplying heat to buildings in the port area. A heat pump driven by surplus heat from H_2 production is not economically feasible, due to a 2-km distance, and a small heating demand in the port area.
- **Large heat pump:** (16 MW): driven by **surplus heat** from large-scale NH_3 production, and a **district heating pipeline** to Florø (3.5 km), covering 90 % of the town's annual heating demand and 60 % of the peak demand.

Case 2: If the H_2 production facility, including a minimum H_2 storage capacity of 290 MWh is to be owned by the port, the following investments are recommended:

- **PV panels**: 6.6 MWp, same as in case 1 above.
- **Battery system**: up to 150 kWh, thus drastically reduced from case 1. The H_2 production and storage also enables flexible grid use.
- **Hydrogen storage**: minimum storage capacity, except in a low electricity price scenario where H_2 production becomes more profitable.

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Assessment of **INTERPORT** ***goals*** and ***key performance indicators***

Reduced Carbon Footprint *(target 50 % in 2030, 100 % in 2050)*

- ***Reduced local CO_2 emissions:*** close to 100%
- ***Share of renewable energy usage:*** 5.9 % for electricity

Reduced energy losses *(target 20 %)*

- ***Recovered energy:*** Potential for heat recovery: 5.5 MW from H_2 production and 70 MW from NH_3 production.
  High total energy efficiency: Changing the heat pump heat source from air to seawater/surplus heat reduces the electricity used by heat pumps

Lower peak demand *(target 30 %)*

- ***Peak load reduction:*** The highest PV and battery capacity will allow a peak load reduction of 1.2 MW (7.0 %).

High flexibility and reliable supply

- **Storage capacity**: Up to 4.8 MWh (batteries), and up to 350 MWh (hydrogen tanks, Case 2)
- ***Self-sufficiency ratio***: 5.9 % (electricity)

Cost-efficiency: ***annual costs and levelized cost of energy (LCOE),*** for supply of electricity and local heating demands:

Case 1	**Annual costs [MNOK/year]**						**LCOE**
Price scenario	**Investment**	**Energy**	**Grid tariffs**	**Service**	**Fuel**	**Total**	**[NOK/kWh]**
Baseline	9	30	10	2	-	**51**	**0.98**
High spot prices	10	38	10	2	-	**59**	**1.14**
High capacity tariff	10	30	15	2	-	**56**	**1.08**

Case 2	**Annual costs [MNOK/year]**						**LCOE**
Price scenario	**Investment**	**Energy**	**Grid tariffs**	**Service**	**Fuel**	**Total**	**[NOK/kWh]**
Baseline	24	2	18	4	-	**49**	**0.94**
High spot prices	24	29	15	4	-	**72**	**1.39**
High capacity tariff	24	6	23	4	-	**57**	**1.11**

Sector coupling

- ***Degree of sector coupling:***
  - Nearby fish farming requires 4 MW heat, which can be be provided from the small-scale H_2 production.
  - Potenital distric heaintg export to a nearby town (covering 90% of the demand) from large-scale NH_3 production.
  - The 20-MWe hydrogen production facility exports up to 59 GWh of hydrogen per year.
- ***Stakeholder involvement:*** The port developer has a strong collaboration with key stakeholders and is in active dialogue with grid and energy companies, as well as target users. There is also a good dialogue with municipalities, regional and relevant national authorities, considering the uncertain market situation for hydrogen and ammonia.

Space utilisation

- ***Increased share of nature areas in the port:*** Not considered.
- ***Infrastructure space requirements:*** Additional infrastructure for H_2 production and storage, heat pumps, district heating and batteries would increase the space demand, acquired through land reclamation.

Facilitate uptake and use of alternative fuels and energy carriers

- ***Supply capacity of alternative energy carriers:*** 16 MW district heat, 12 MW hydrogen
- ***Port acceptability:*** High socio-political and community acceptance. Strong local support. Alignment with national policies and expecting positive ripple effects. Changing framework conditions. Uncertain future demand of alternative fuels create market risks. Dependent on risk reduction measures (e.g. Contracts of Difference)
- ***Port-city relationship:*** Positioning as a regional energy hub. Spillover benefits for local industries and communities. Possibilities for industrial symbiosis.

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