” A small country with big ideas”

Monica Araya 2016

100% Green Electrical Energy for the Faroes by 2030

Lessons for Small Islands

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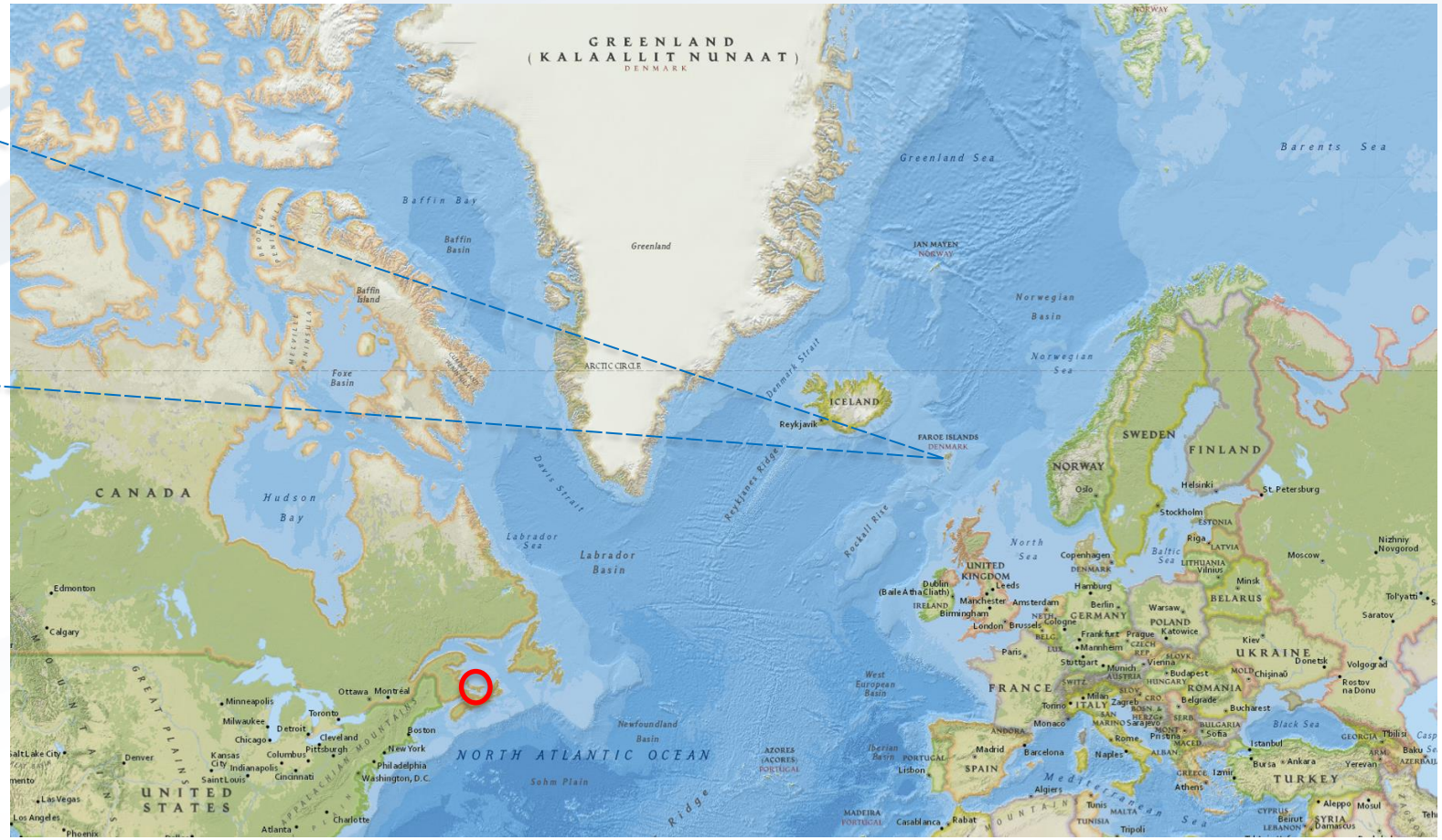
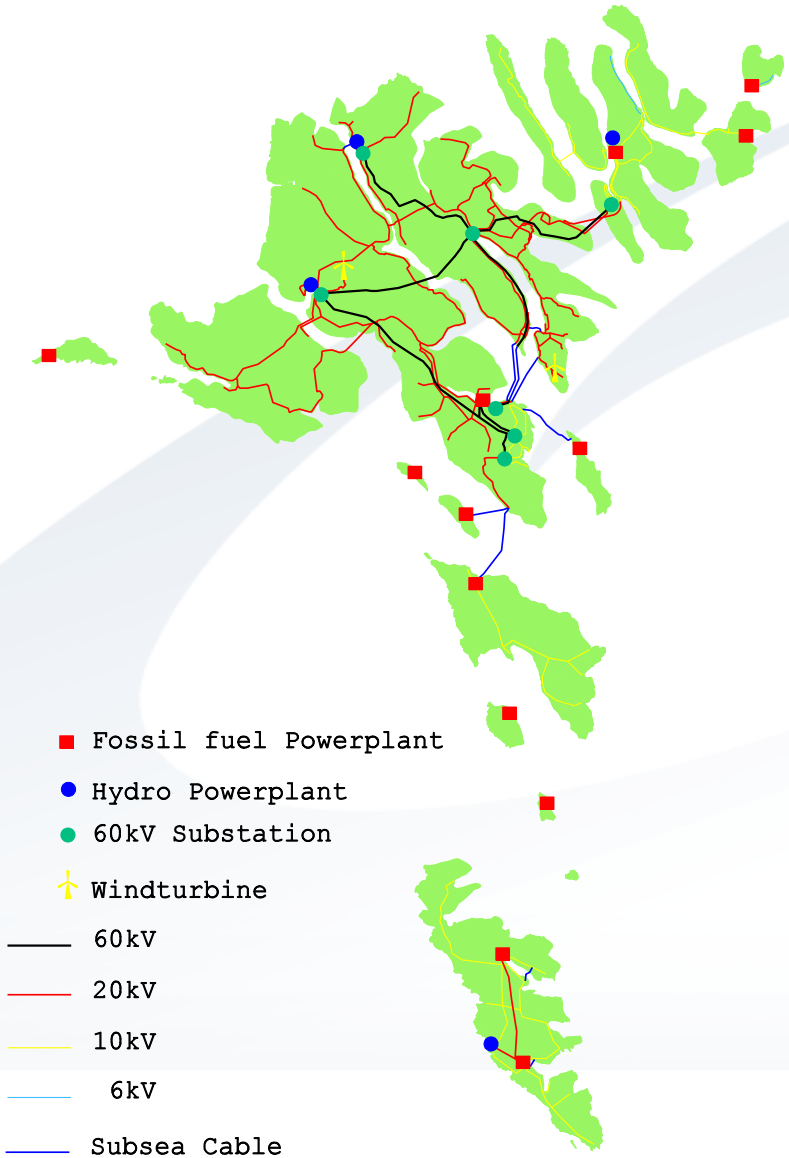
Faroe Islands



Faroe Islands

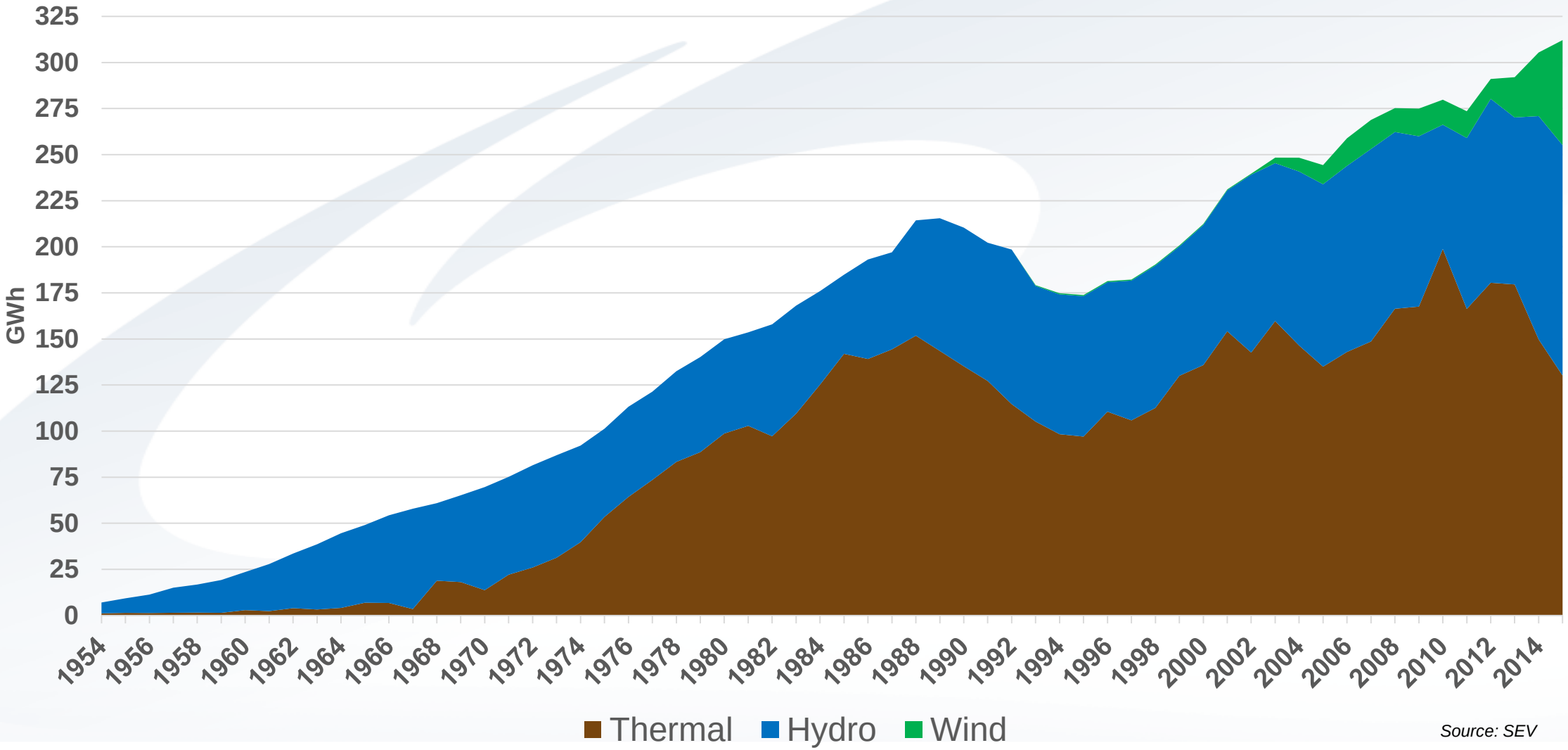
- **General data:**
  - 18 islands (17 are populated)
  - 50.000 inhabitants
  - Area of 1.399 km^2
  - Main export: Fish and fish products

Electrical Company SEV



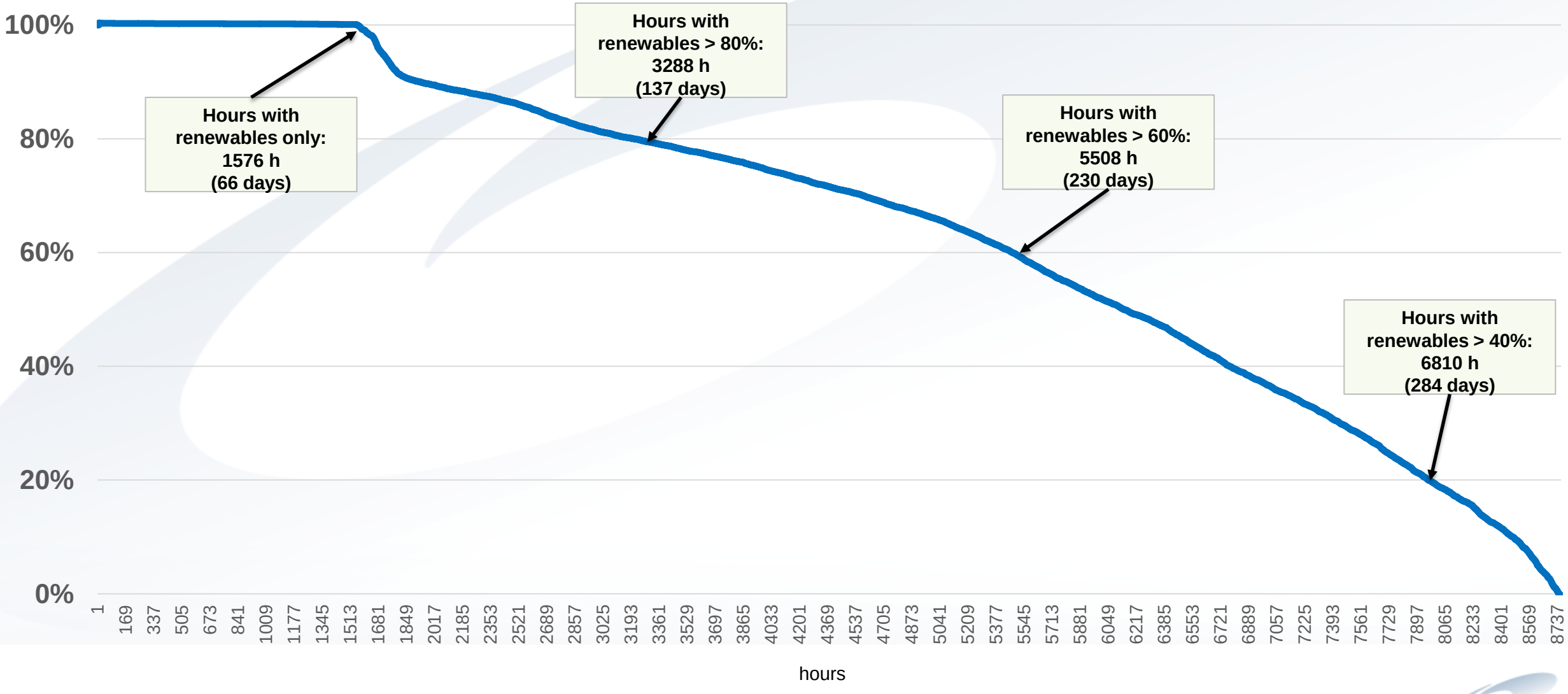
- **Company Structure:**
  - Non-profit, founded 1st October 1946
  - 100 % owned by all Faroese municipalities
  - Monopoly on grid operation *(transmission & MV/LV distribution)*
  - "*De facto*" monopoly on production (98%)
  - Joint and several price structure
  - Vertically Integrated Company
  - *"Micro isolated system" in EU terms (< 500 GWh)*
    - *Directive 2009/72*
      - *Derogation from relevant provisions in different chapters about unbundling, third party access etc.*

Energy Mix 1954 - 2015



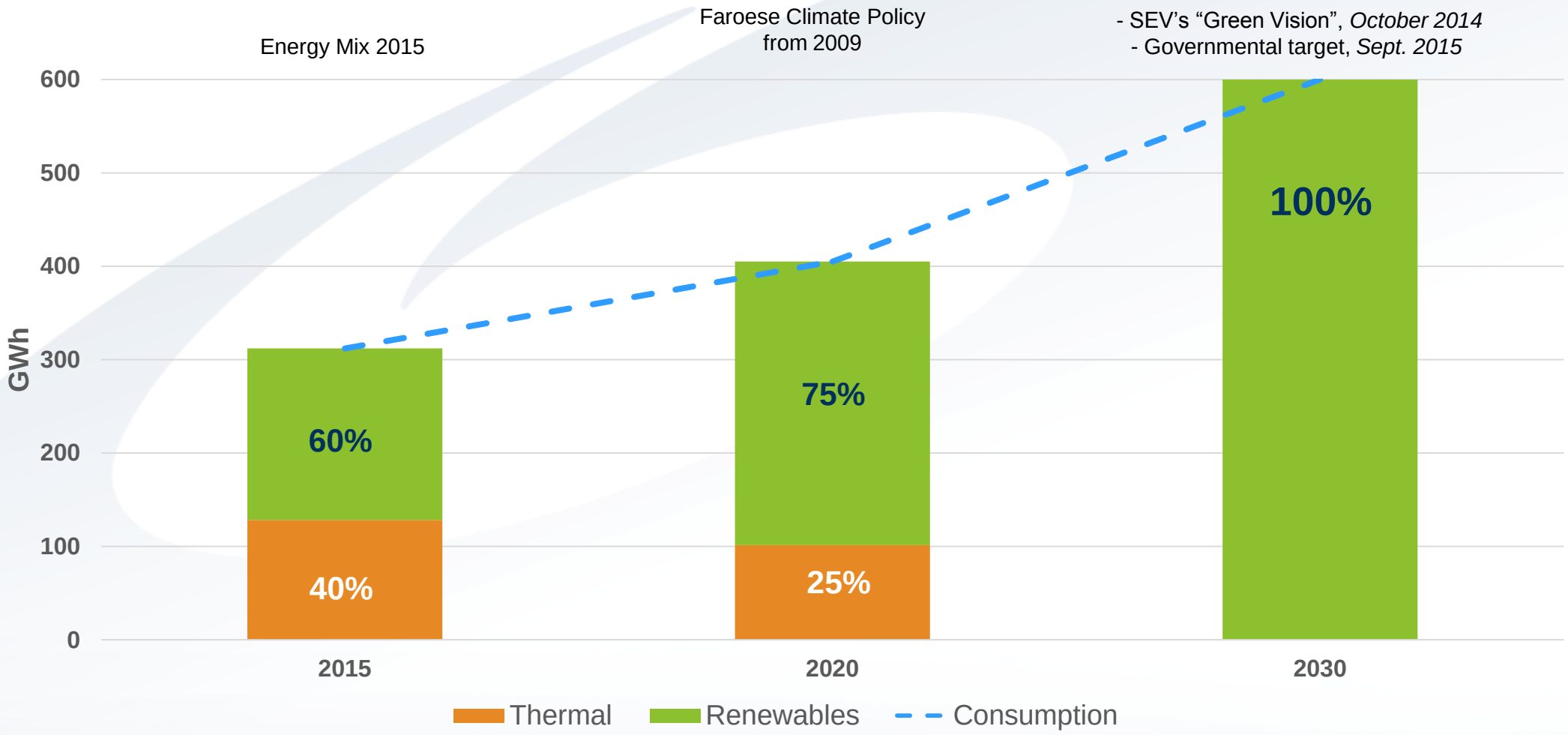
Source: SEV

Renewable energy duration curve 2015



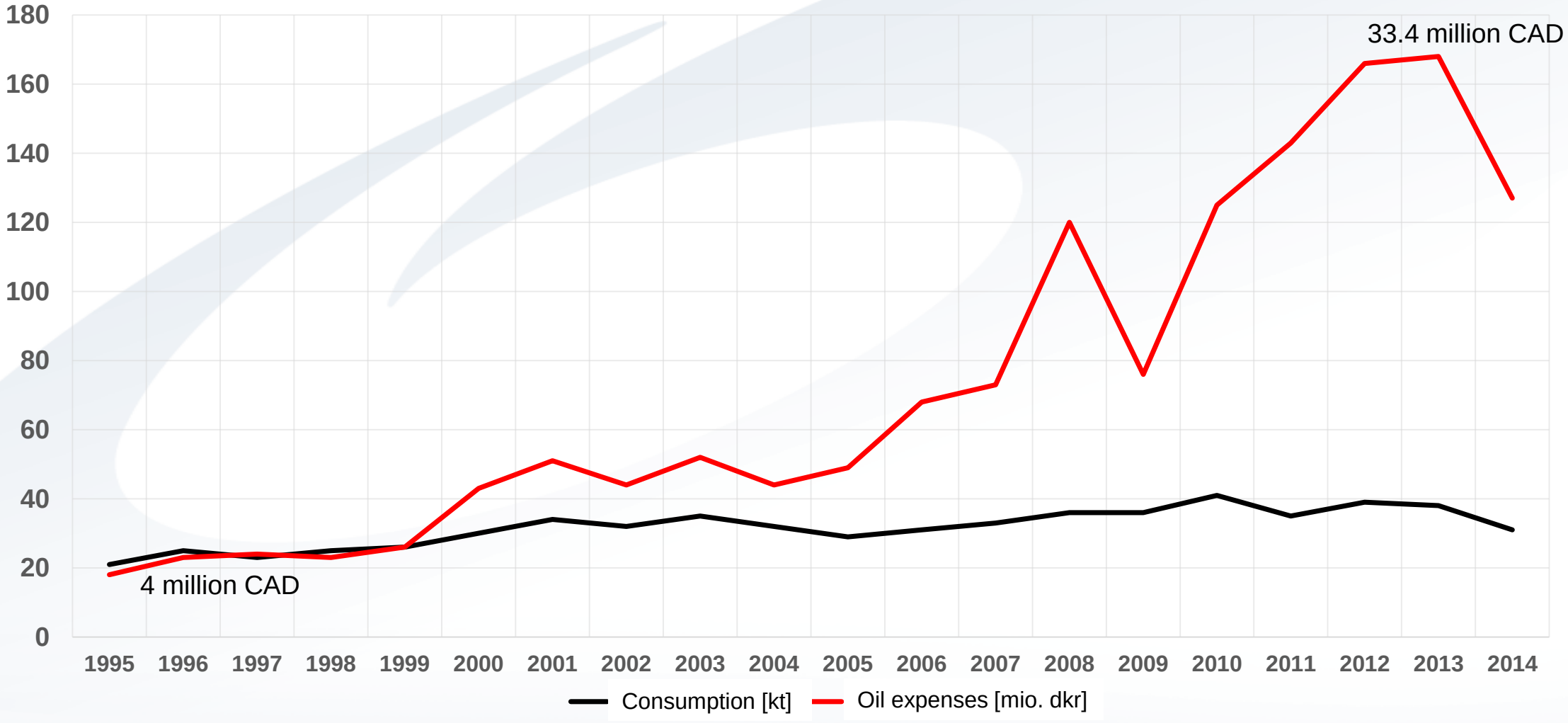
Main drivers for renewable energy in the Faroe Islands

Carbon free electricity by 2030



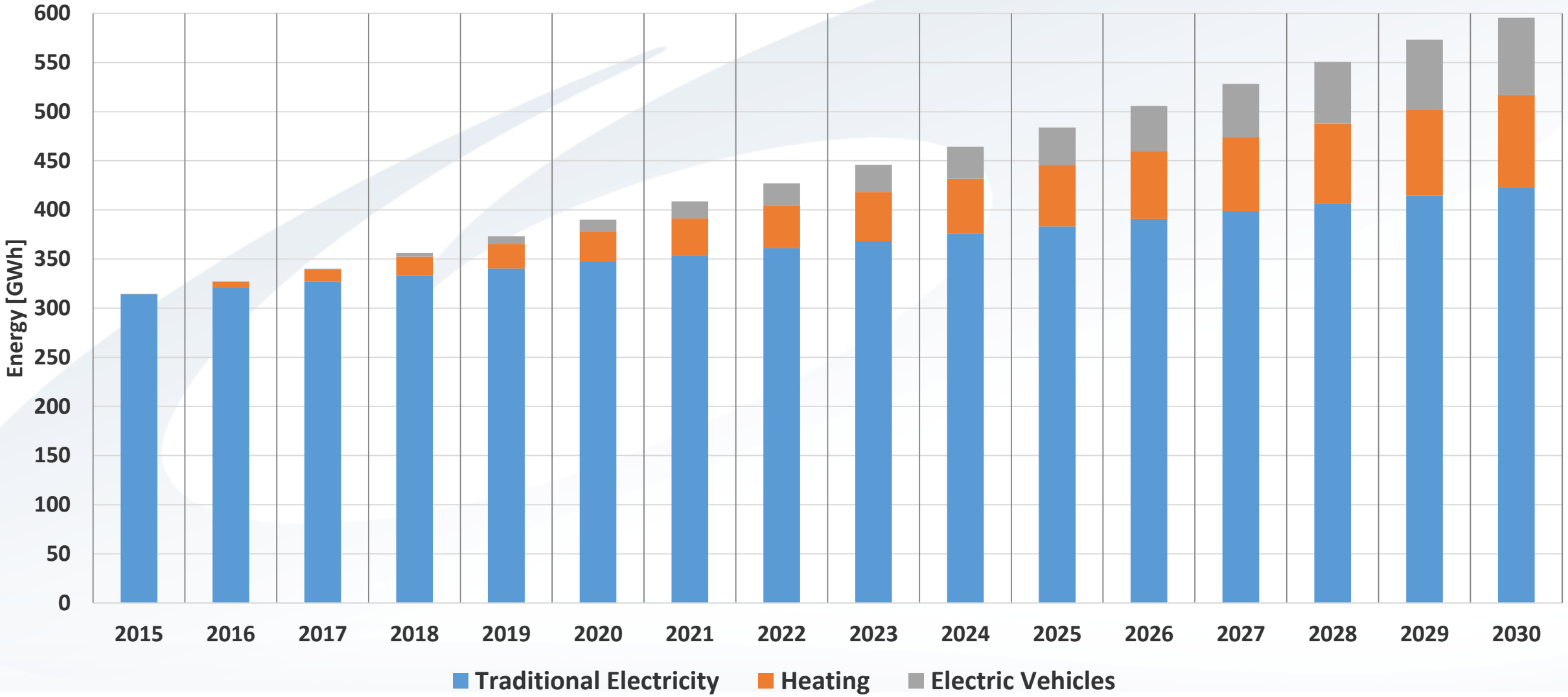
Assumptions:
- *2% increase in consumption annually*
- *Linear electrification of Heating 2016 – 2030*
- *Linear electrification of transport on land*

Unpredictable oil expenses



Projected Energy Demand

Projected Energy Demand 2015-2030



Renewable resources in the Faroe Islands

A systematic approach to identify local resources in order to set up a technology roadmap

Assessment of local renewable resources

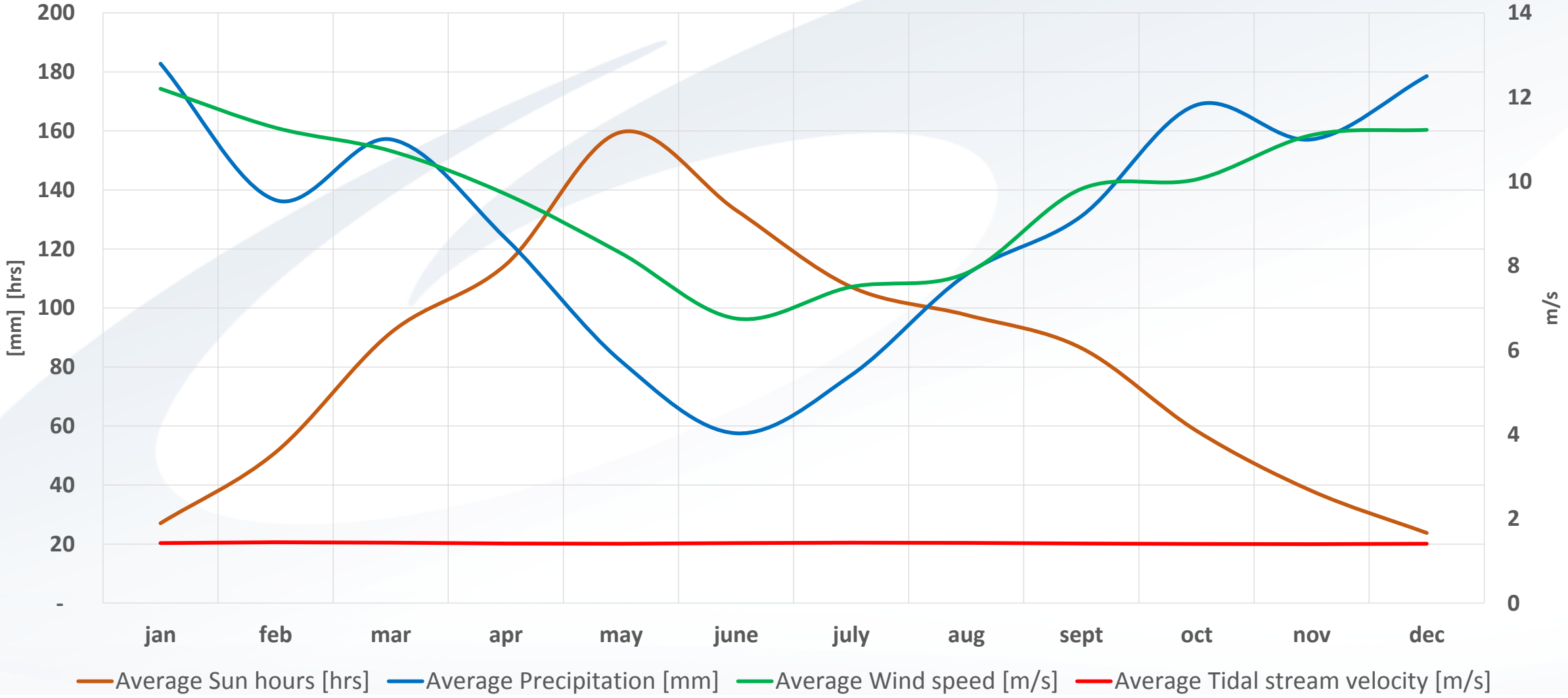
Average wind speed: > 10m/s

Precipitation: ~1284 mm/year (PEI: 890mm/y) soruce: www.gov.pe.ca

Peak tidal velocities: ~ 3.5 m/s

Average sun hours: ~ 1100 hrs/year (PEI: 1841) soruce: www.currentresults.com

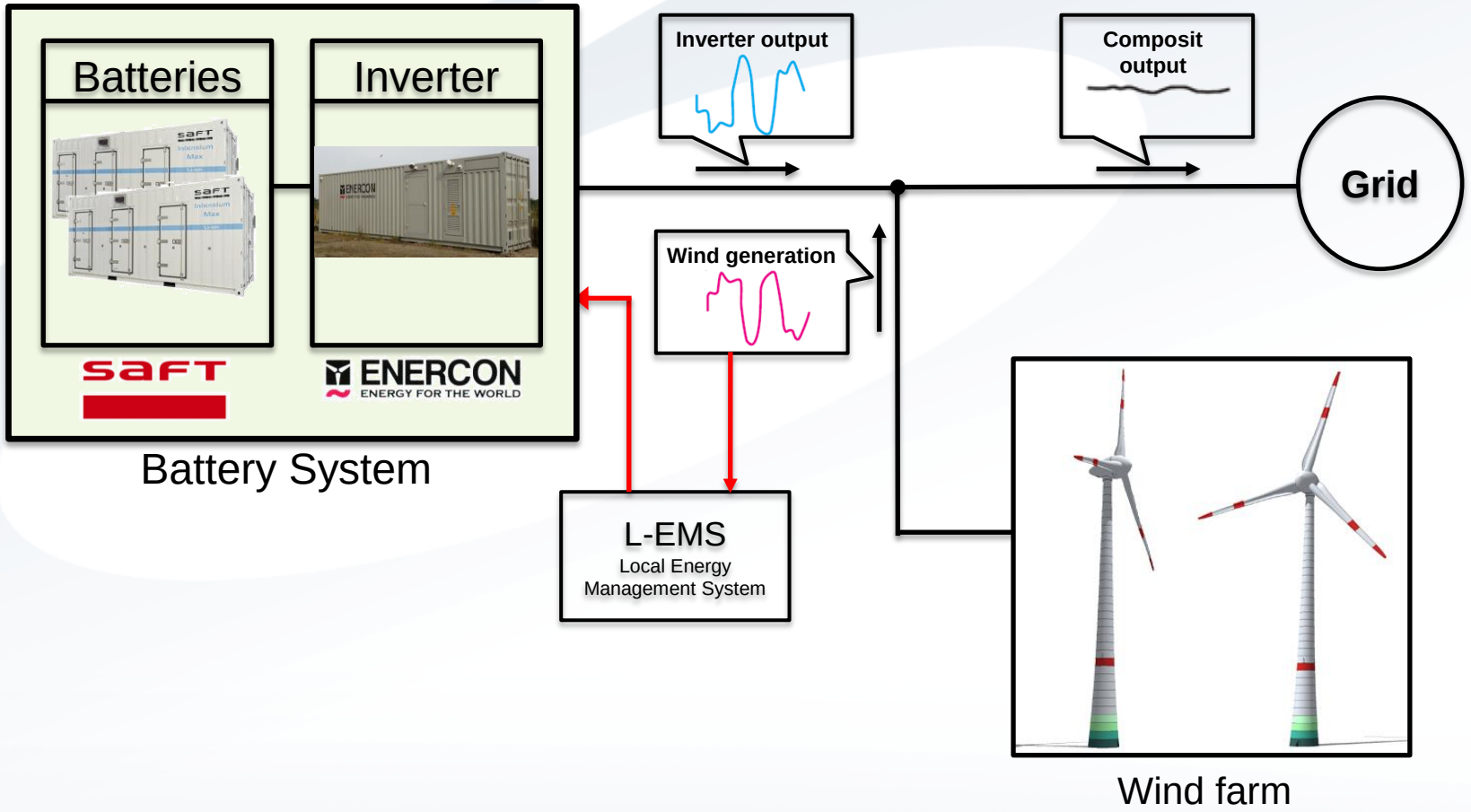
Correlation between the resources



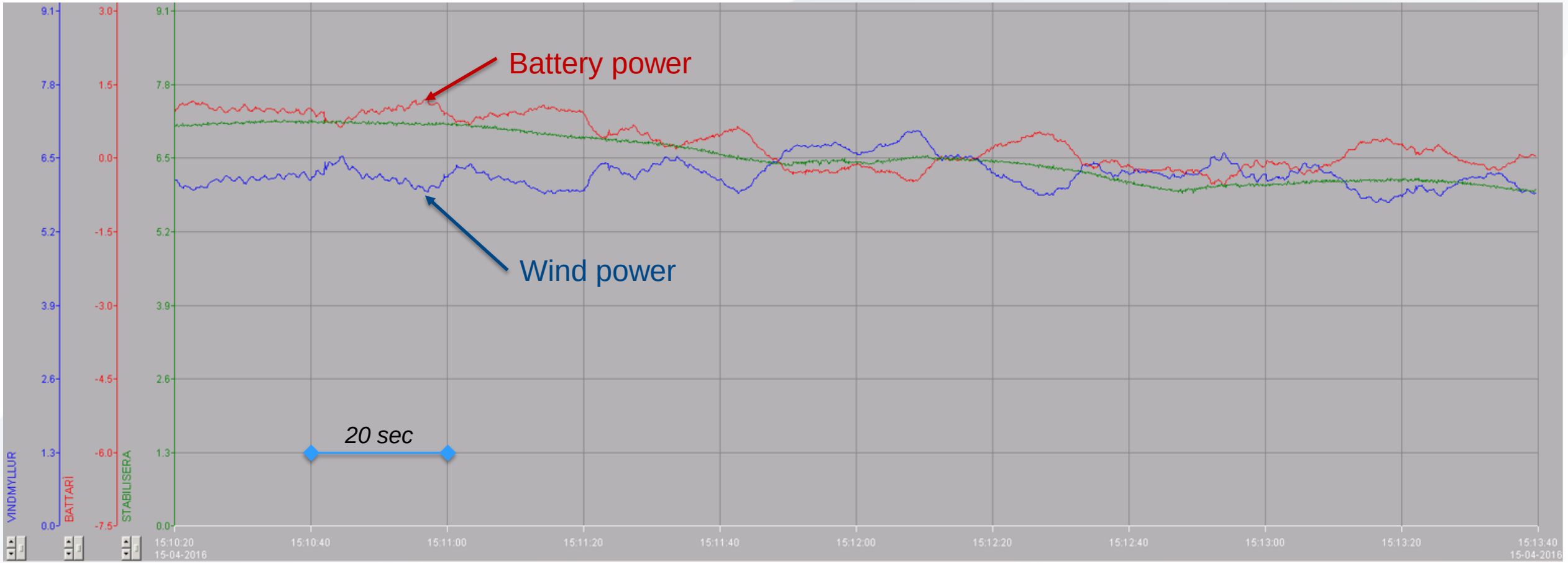
Testbed for Smart Grid Technologies

Battery system in Húsahagi

Schematic overview of battery system



Battery system in operation

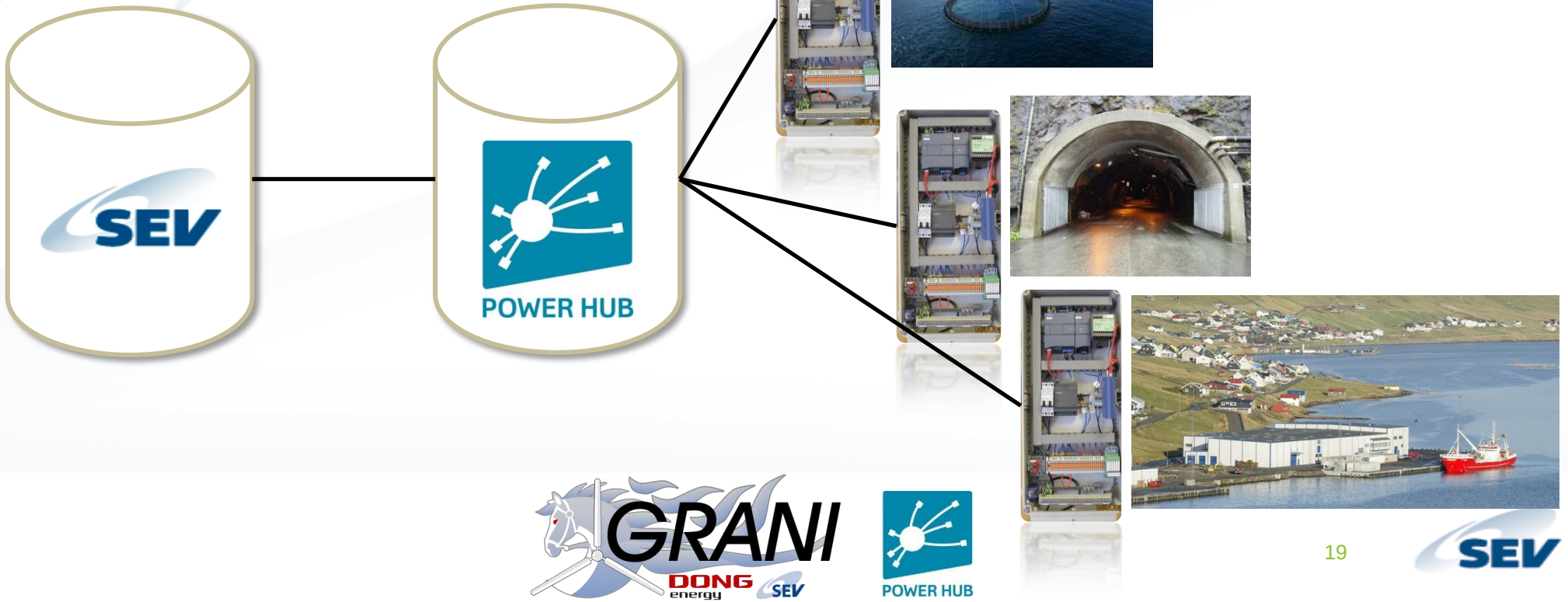


Schematic overview of PowerHub

Power Management System

IT system

A box at different Industries



Testbed for Smart Grid Technologies

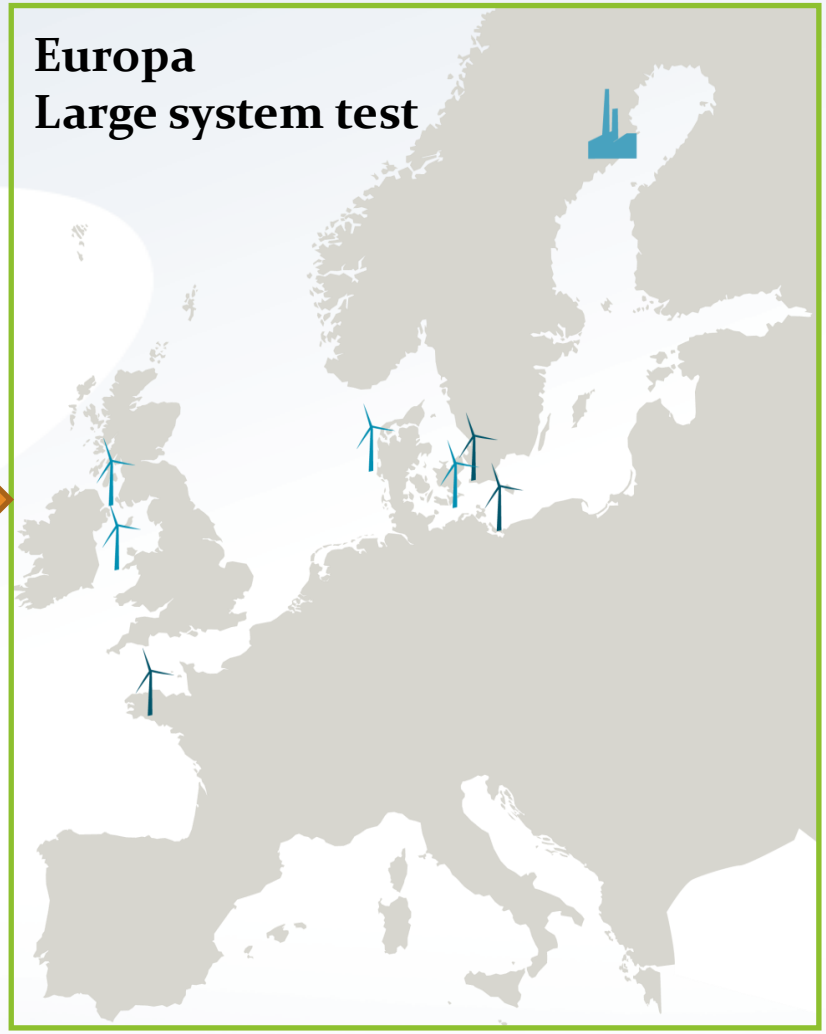
Faroe Islands
Testbed

~ 40 MW

Denmark
Small system test

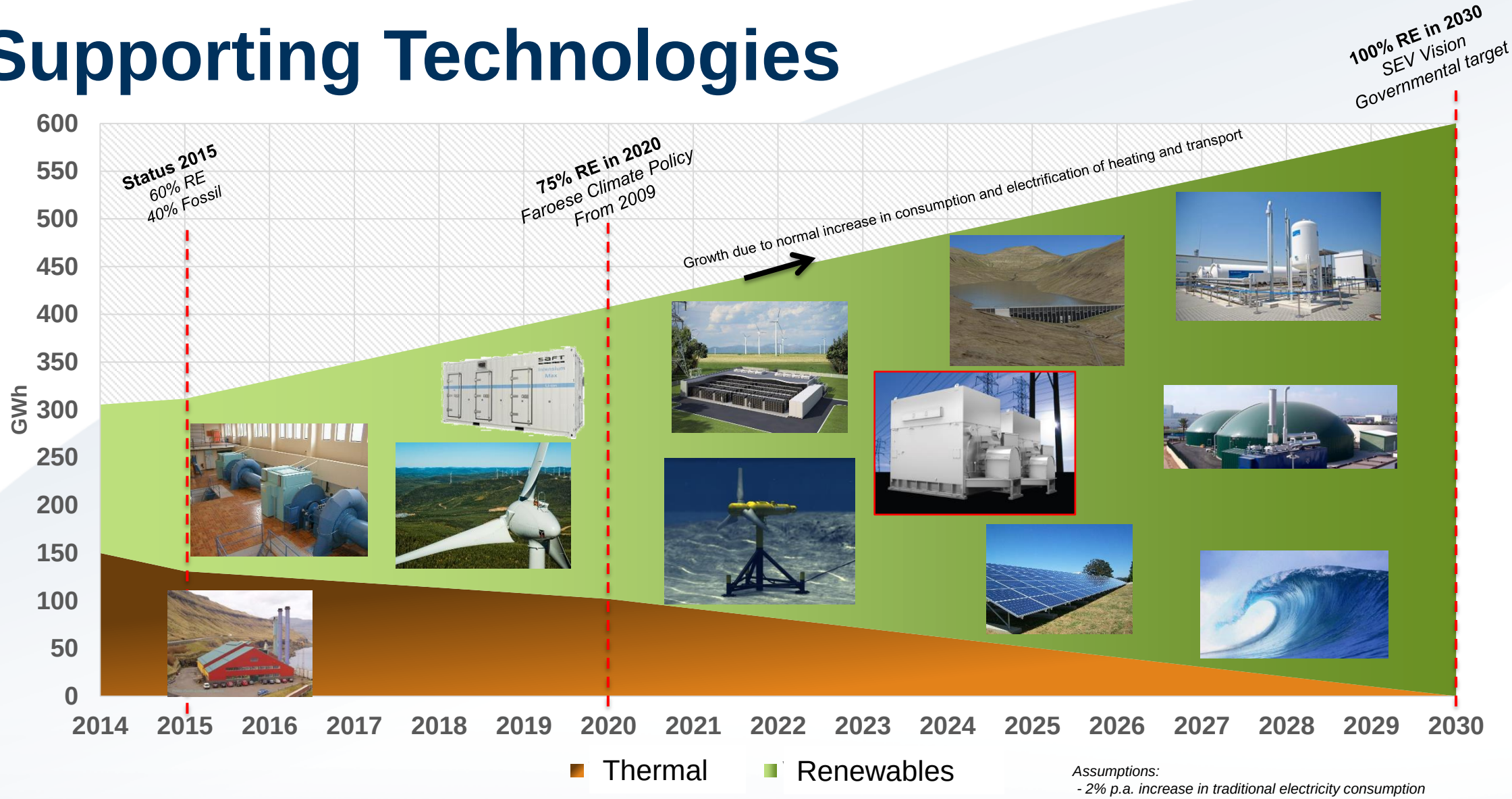
~ 4000 MW

Europa
Large system test



Technologies supporting the 100% RE Vision

Supporting Technologies



Assumptions:
- *2% p.a. increase in traditional electricity consumption*
- *Electrification of the transport sector*
- *Electrification of the heating sector (houses and buildings)*

Nordic Council Nature and Environment Prize

Chair of Board Mr. Jákup Suni Lauritsen and CEO Mr. Hákun Djurhuus

Motivation:

"The prize goes to the Faroese electricity company SEV for its ambitious targets and innovation. SEV's work is not only important for the phasing in of renewable energy in the Faroe Islands, but also for the European grid as a whole.

Its ambitious targets and the creative nature of its efforts to reduce dependency on fossil fuels make SEV a worthy recipient of the Nordic Council Nature and Environment Prize 2015."

” We simply must balance our demand for energy with our rapidly shrinking resources.
By acting now we can control our future instead of letting the future control us”

Jimmy Carter 1977

Thank you!

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Wind energy

The Neshagi Wind farm

Project specification:

- *3 pcs ENERCON E44/900kW (2,7MW)*
- *Capacity factor: 45%*
- *Annual production: 10,6 GWh*
- *Building phase: 2011-2012*

Economical figures:

- *Total cost: 5.2 million CAD*
- *Oil savings: 2.300 ton/year*
    - *more than 1.2 million CAD/year*
- *Generating cost: 0,081 CAD/kWh*

Carbon footprint:

- *Annual CO_2 reduction: 7.000 ton/year*

The Húsahagi Wind farm

Project specification:

- *13 pcs ENERCON E44/900kW (11.7MW)*
- *Capacity factor: 42%*
- *Annual production: 41 GWh*
- *Building phase: 2013-2014*

Economical figures:

- *Total cost: 20.3 million CAD*
- *Oil savings: 8.000 ton/year*
    - *approximately 4,6 million CAD/year*
- *Generating cost: 0,063 CAD/kWh*

Carbon footprint:

- *Annual CO_2 reduction: 28.000 ton/year*

Other renewable resources

Hydropower

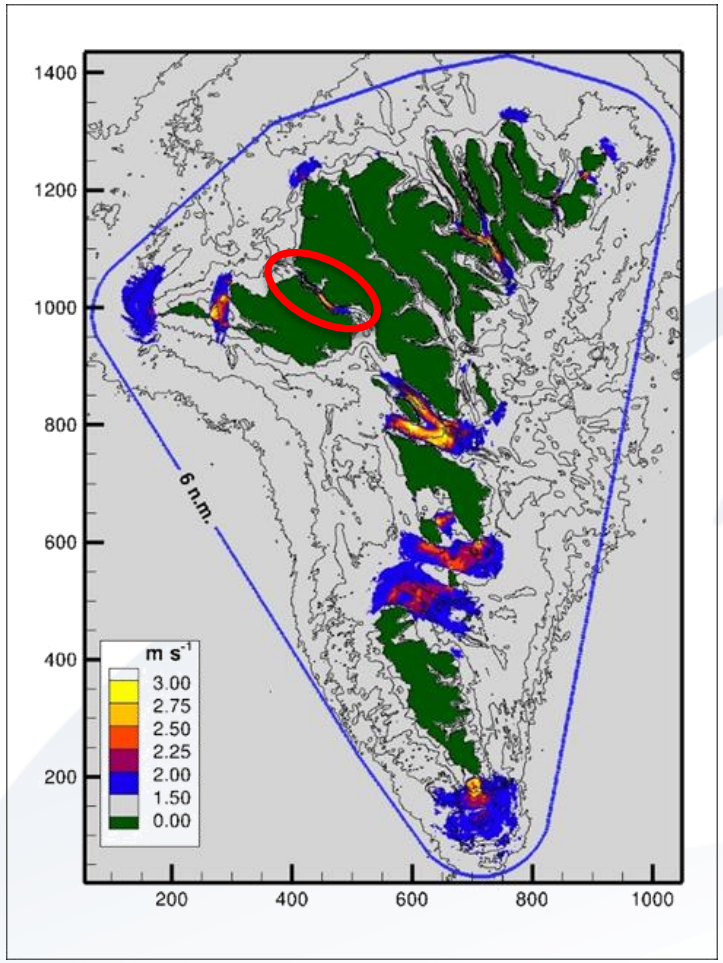
6 Hydropower plants

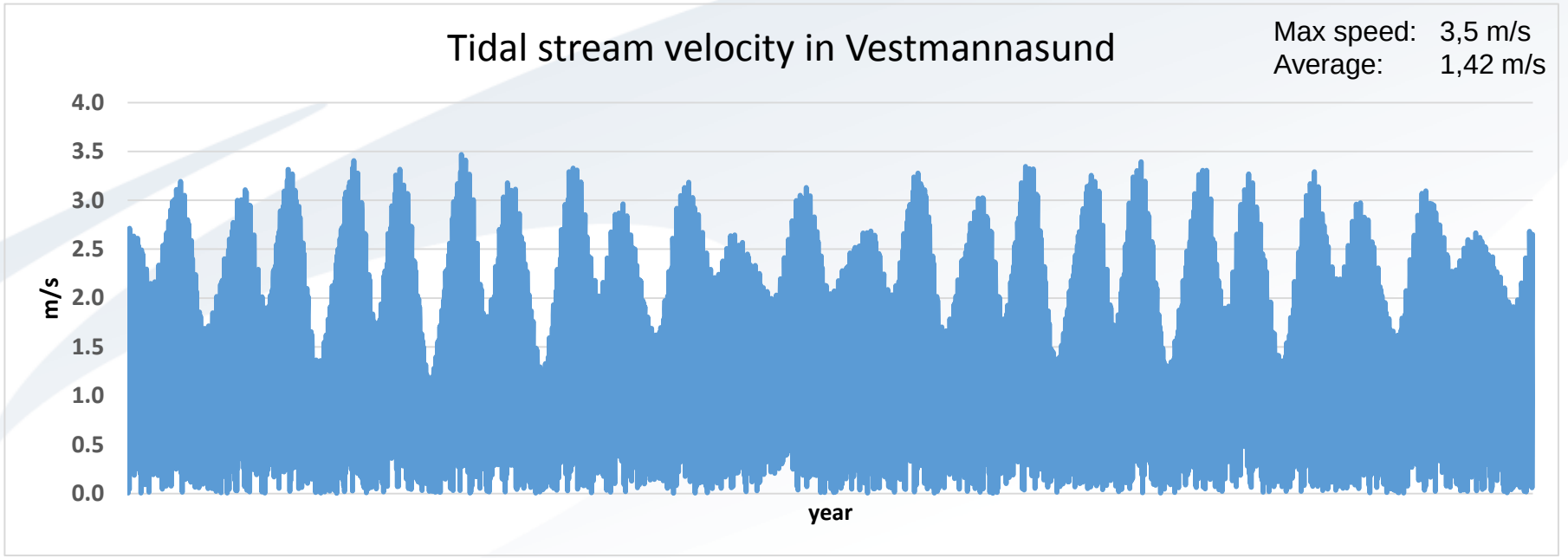
Total installed capacity: 37MW

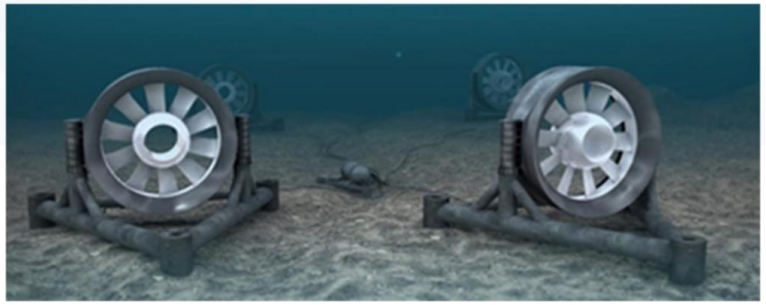
Annual energy production: 115 GWh

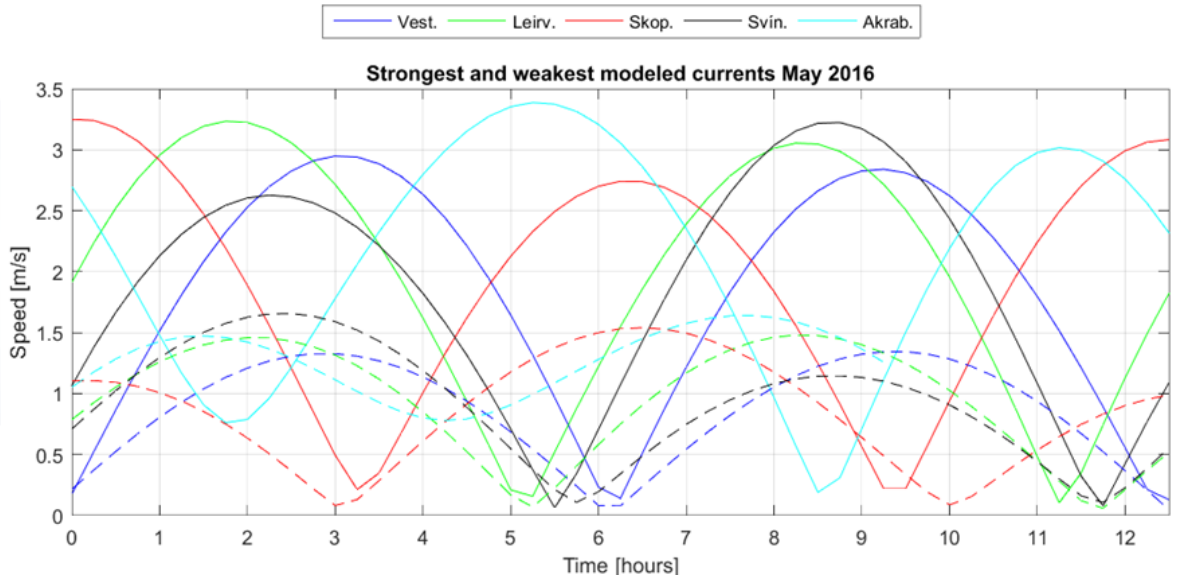
First installation in 1921

Tidal energy

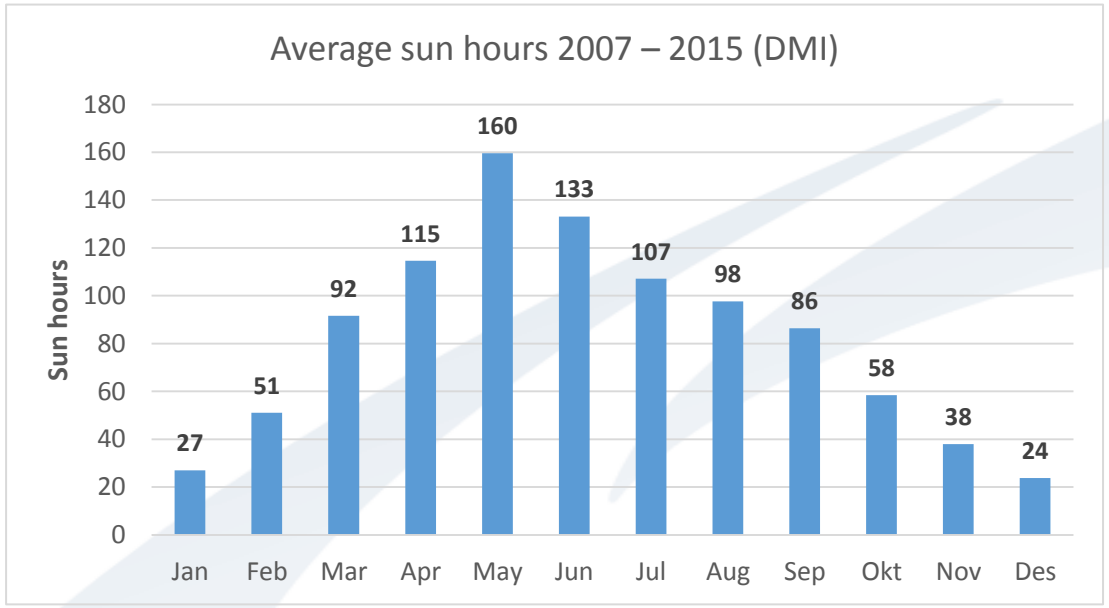


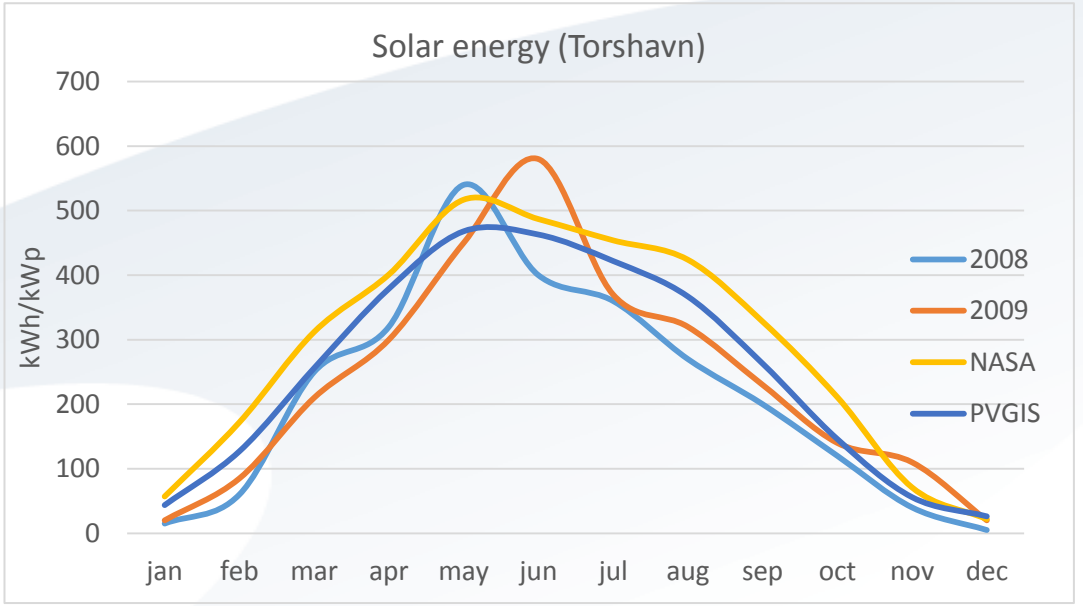




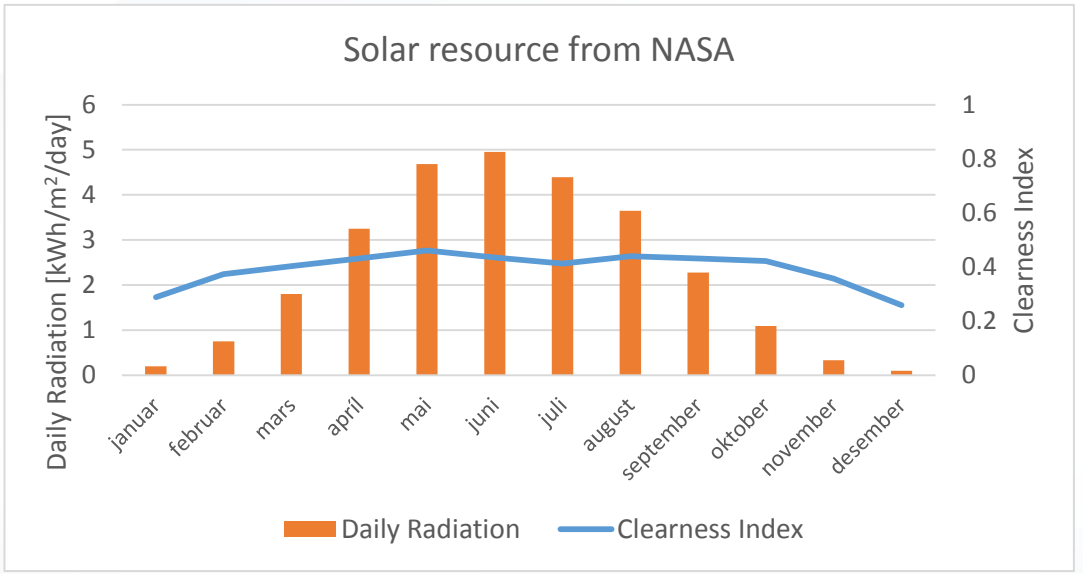


Photovoltaic

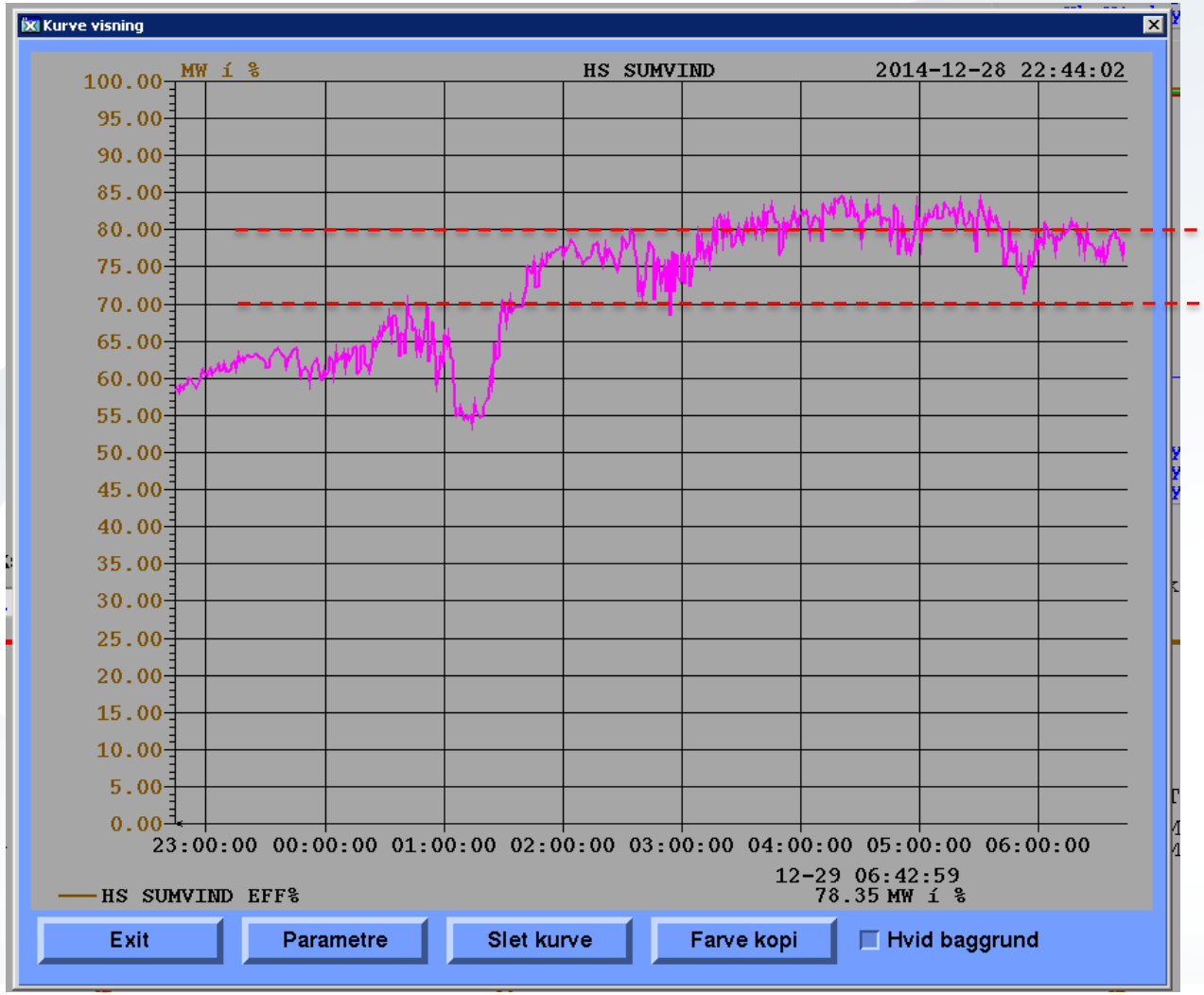




2008 – 2009 figures from local PV installation



Instantaneous wind penetration

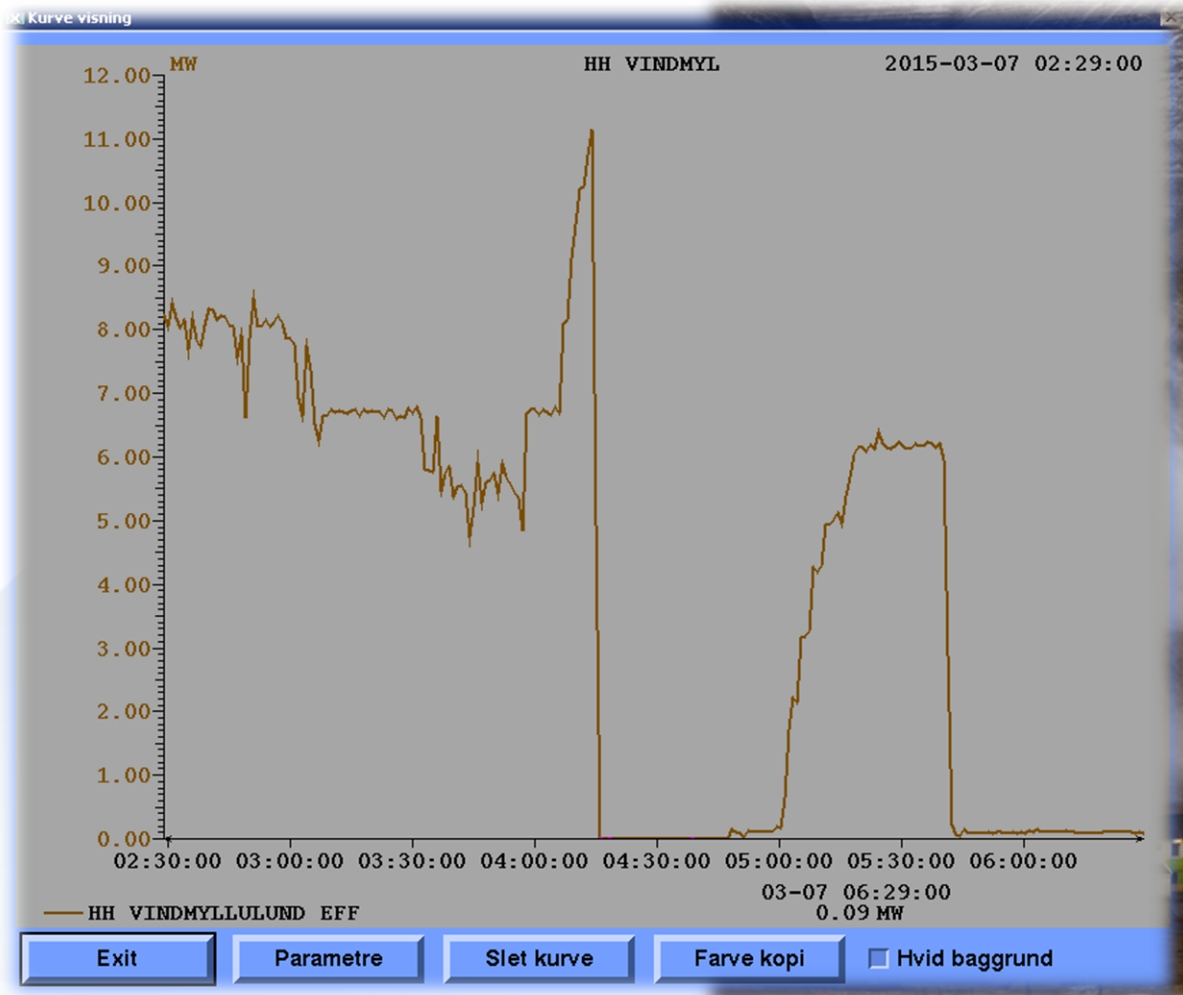


80% Instantaneous wind penetration

70% Instantaneous wind penetration

From SEVs SCADA system (BECOS32)

Challenging weather conditions



Customers

HiddenFjord - Fútaklettur

Salmon Farm delivering superior quality salmon.
Power Hub controls the heat pump that keep the newly born salmons at the right temperature before they are send out

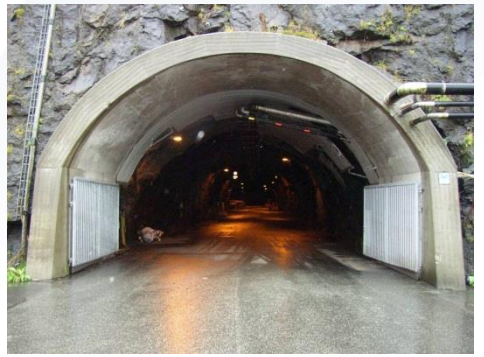
(35 kW heat pump)

Bergfrost

Bergfrost is a cold storage where all kind of frozen marine products is kept. The cold storage is build in a mountain cave.

Care for the environment was the primary reason for blasting tunnels from the mountain for the cold store. It was felt that the blot on the landscape would be too visible if the quarry in Fuglafjørður was extended northwards. Far-sighted council members came up with the idea of going further into the mountain for stones.

(150 kW cooling compressor)

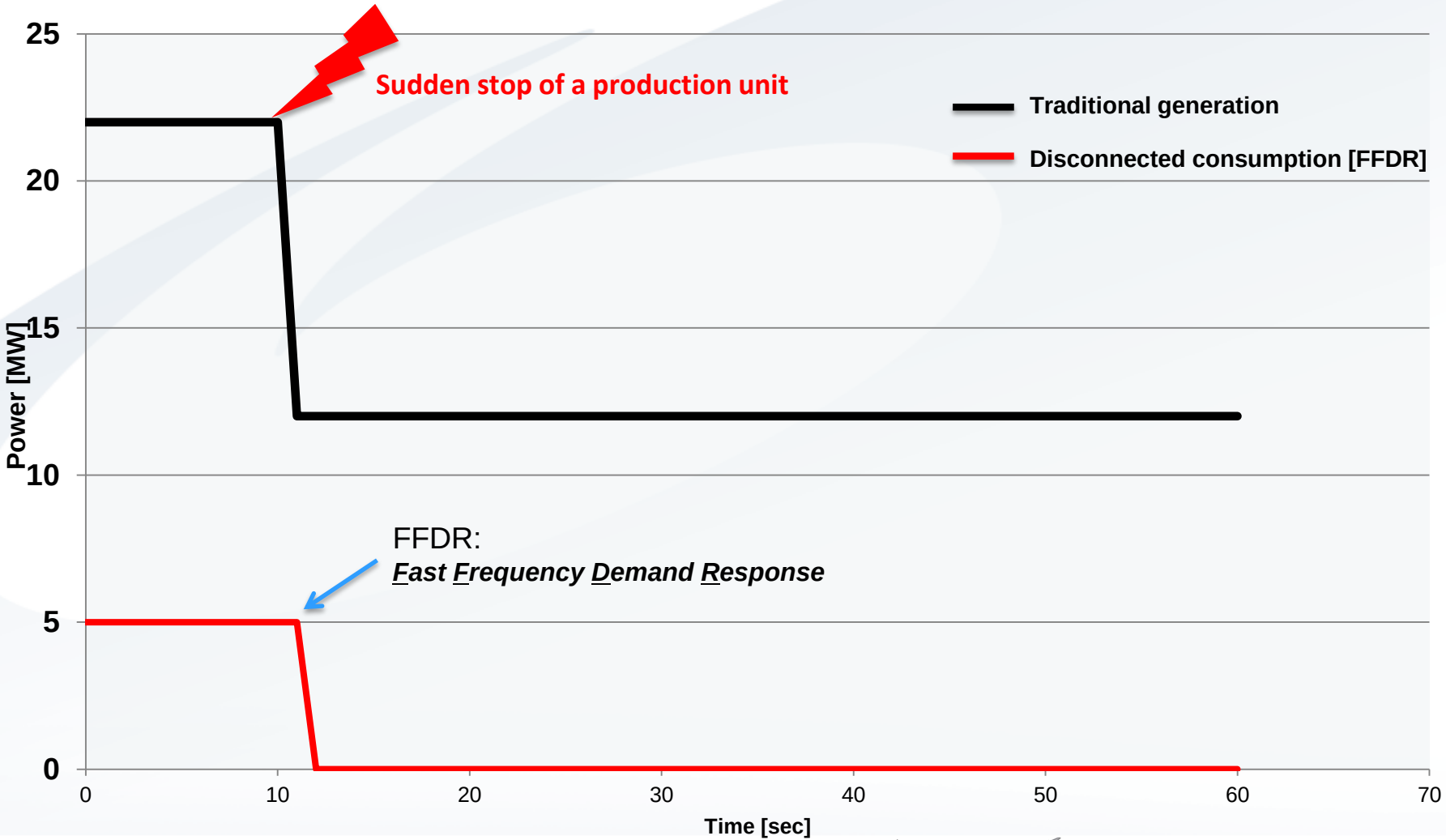


Kollafjord Pelagic

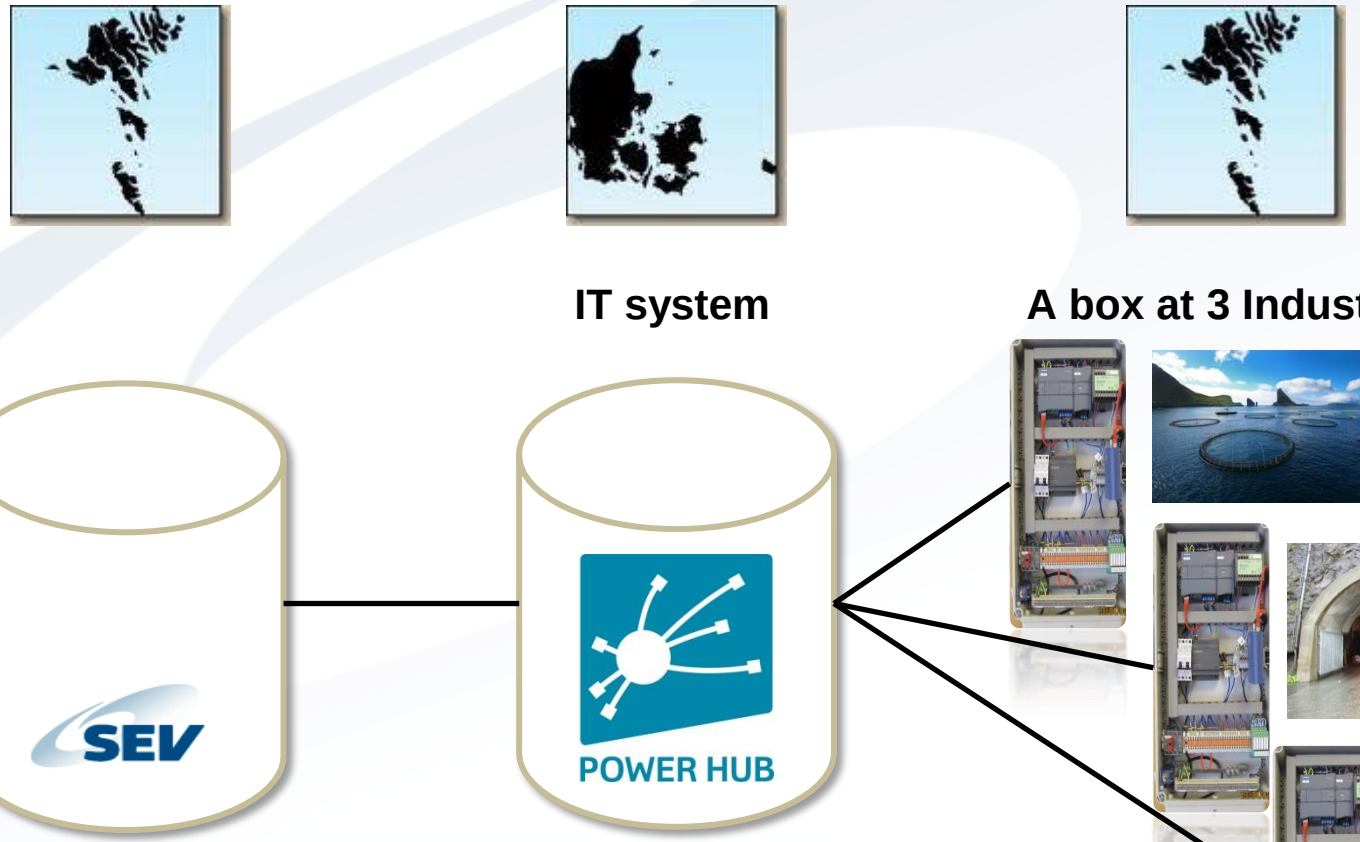
Receives freshly caught fish and freeze it. The facility in Kollafjørð is one of the world's largest and most advanced processing facilities for human-consumption pelagic fish.

(4.200 kW cooling compressors)

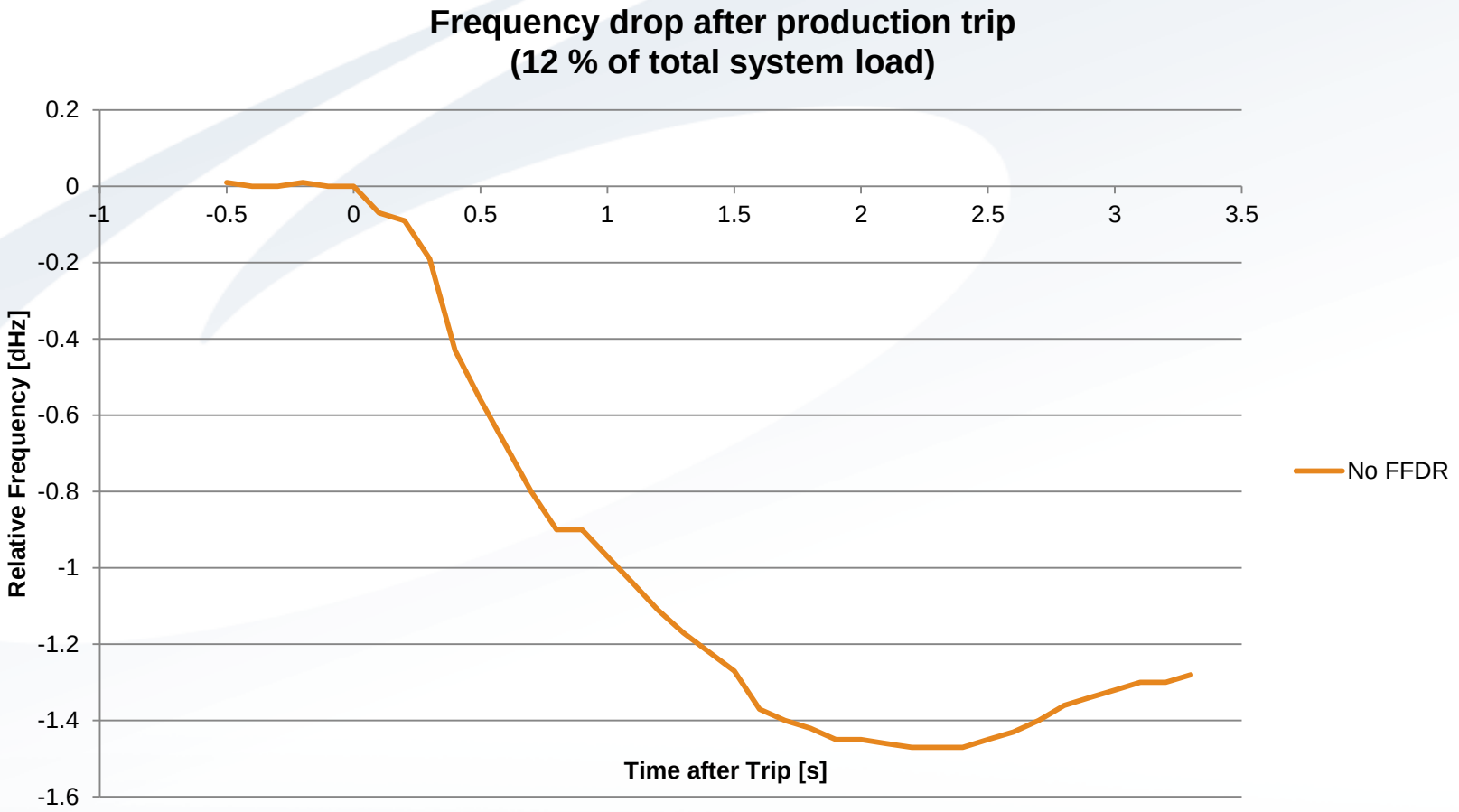
Disconnecting flexible loads



PowerHub system topology



PowerHub FFDR test



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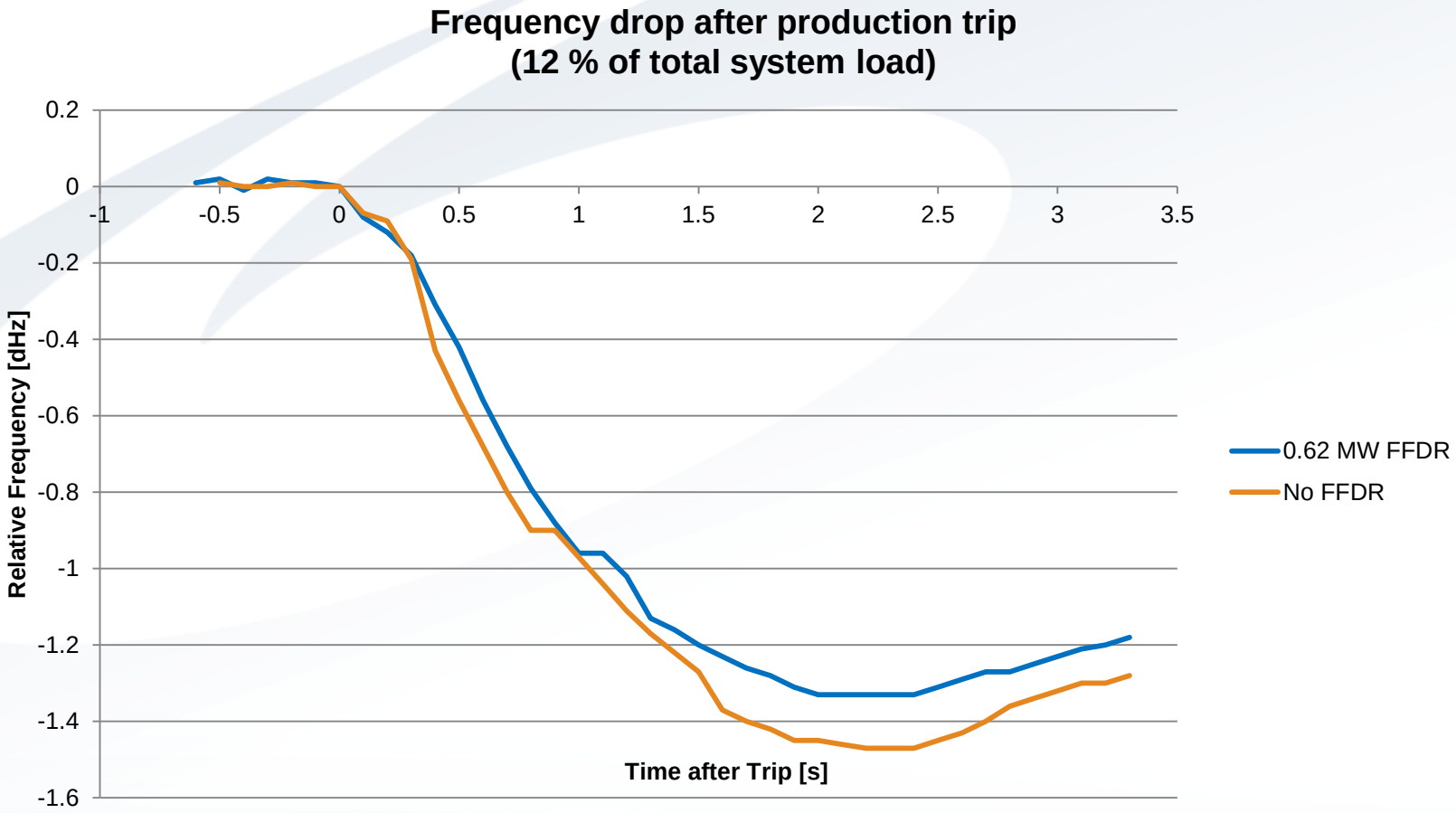

PowerHub FFDR test