NORTHSOL
SOLAR POWER PLANTS IN THE NORTH

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THE BEST PERFORMING PV SYSTEM IN SWEDEN

- Two dual-axis tracking systems in Piteå, Sweden
- Installed size: 20 kWp
- Yearly yield: 1500 kWh/kW_p
- Research features – solar tracking, different module technologies, weather monitoring, power optimizing system.

SPIN-OFF: ACUSTICUM SOLAR PARK – PITEÅ (OWNED BY PITEENERGI)

SPIN-OFF: KLIMALAB OTTA

norut
NORTHERN RESEARCH INSTITUTE

SPIN-OFF: LNS BOLIGBLOKK I LONGYEARBYEN, SVALBARD

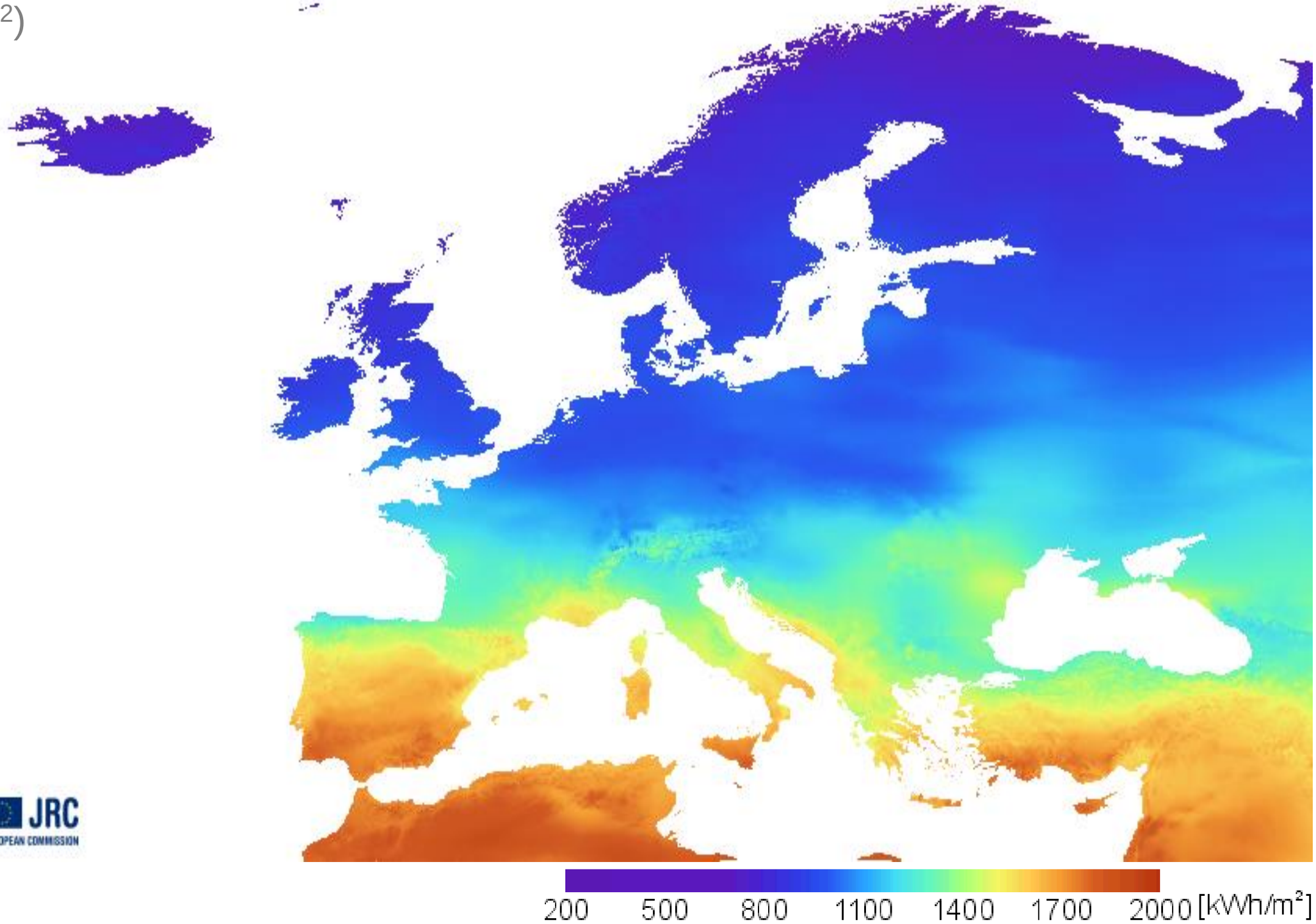
SPIN-OFF: NTNU ZEB LIVING LAB, TRONDHEIM (NORGE)

ABOUT THE PROJECT

- Background: PV in Northern regions
- Project group
- The PV systems
- Results
  - *Performance*
  - *Economy*
  - *Power quality*
- What's next?

YEARLY IRRADIATION ON A HORIZONTAL SURFACE

(kWh/m^2)



JRC
EUROPEAN COMMISSION

YEARLY IRRADIATION ON AN OPTIMALLY INCLINED SURFACE

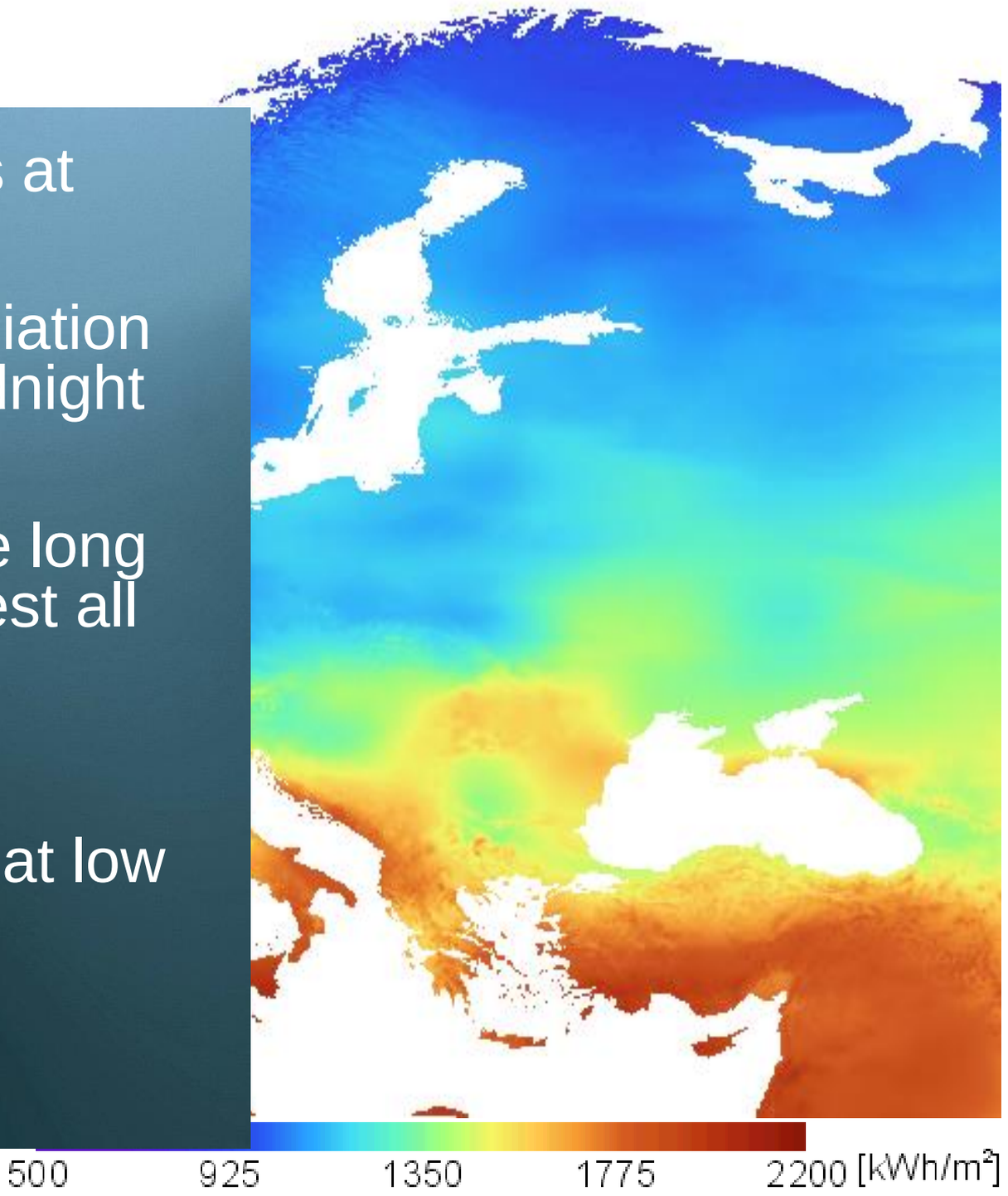
(kWh/m^2)

Challenges for PV installations at high latitudes:

- Large variations in solar irradiation over the year (polar night/midnight sun)
- Variable solar path during the long summer days – hard to harvest all sunlight

Advantages

- Solar cells are more efficient at low temp
- Snow reflects sunlight



YEARLY IRRADIATION ON A 2 AXIS TRACKING SURFACE

(kWh/m^2)

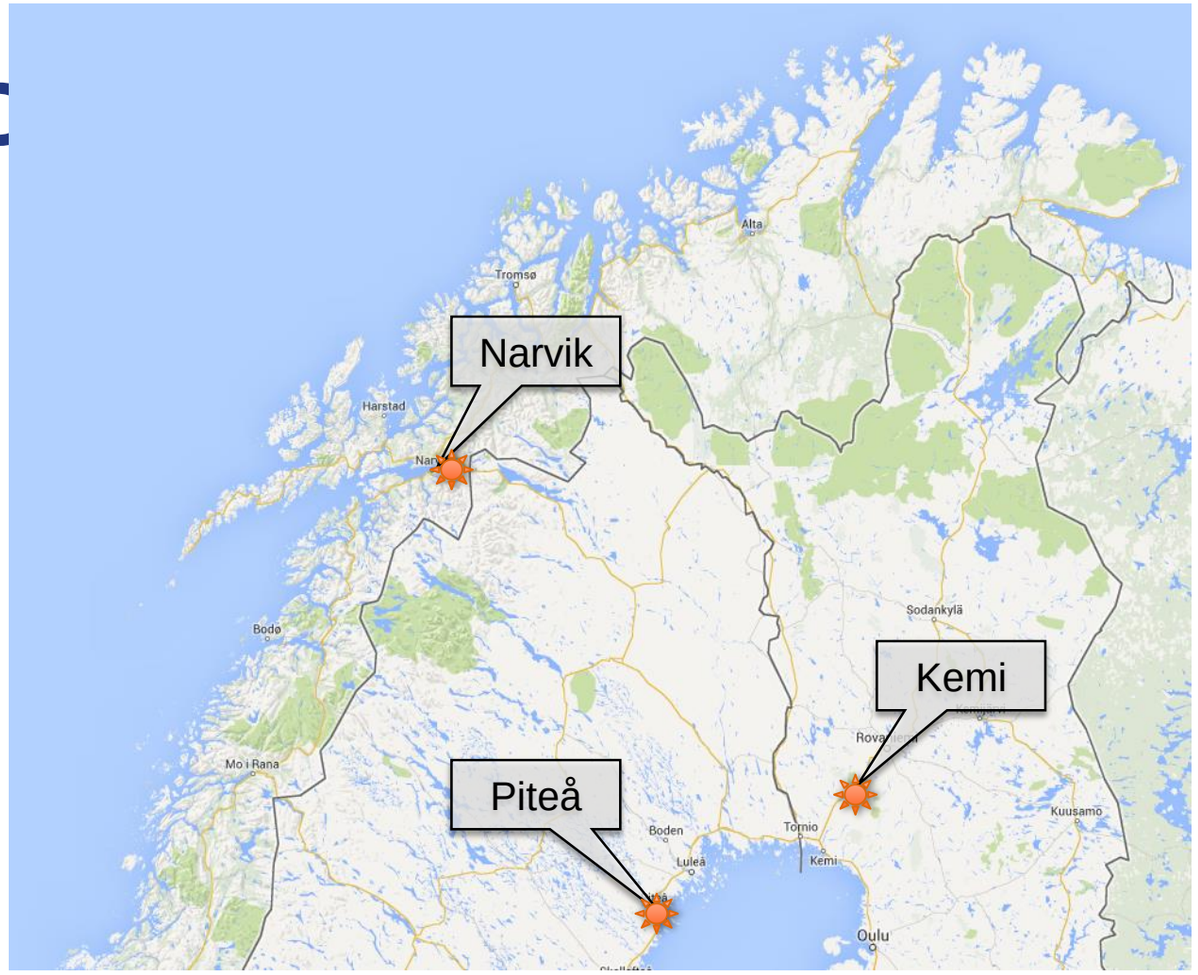
Germany is one of the world's largest markets for PV.

The area around the gulf of Bothnia has great potential for PV!

JRC EUROPEAN COMMISSION

400 1050 1700 2350 3000 [kWh/m^2]

PROJECT GROUP



Project owner/industry partner:

- PiteEnergi AB
- Contact person: Daniel Fåhraeus

R&D-partners:

- Norut Narvik, Norway (project leader)
- Kemi-Tornionlaakso Municipal Education and Training Consortium Lappia, Finland
- Luleå Technical University, Sweden

PROJECT GOALS

- Demonstrate, under real conditions, that photovoltaic power plants can be technically and economically feasible in high latitudes.
- Find the PV technology that is best suited for harsh Nordic climates.
- Identify the drawbacks as well as advantages of high latitude and cold climate on the performance of the PV systems, and suggest remedies.
- Identify methods for estimating the hosting capacity of the grid and market for solar power.

THE OUTDOOR PV LAB IN NARVIK

- Installed in May 2009
- Dual-axis solar tracking
- Grid-connected (SolarEdge)
- Module area 12.4 m^2
- Rated power 1.7 kW_p
- Individual module monitoring
- Weather station + pyranometers

THE PV SYSTEM IN KEMI

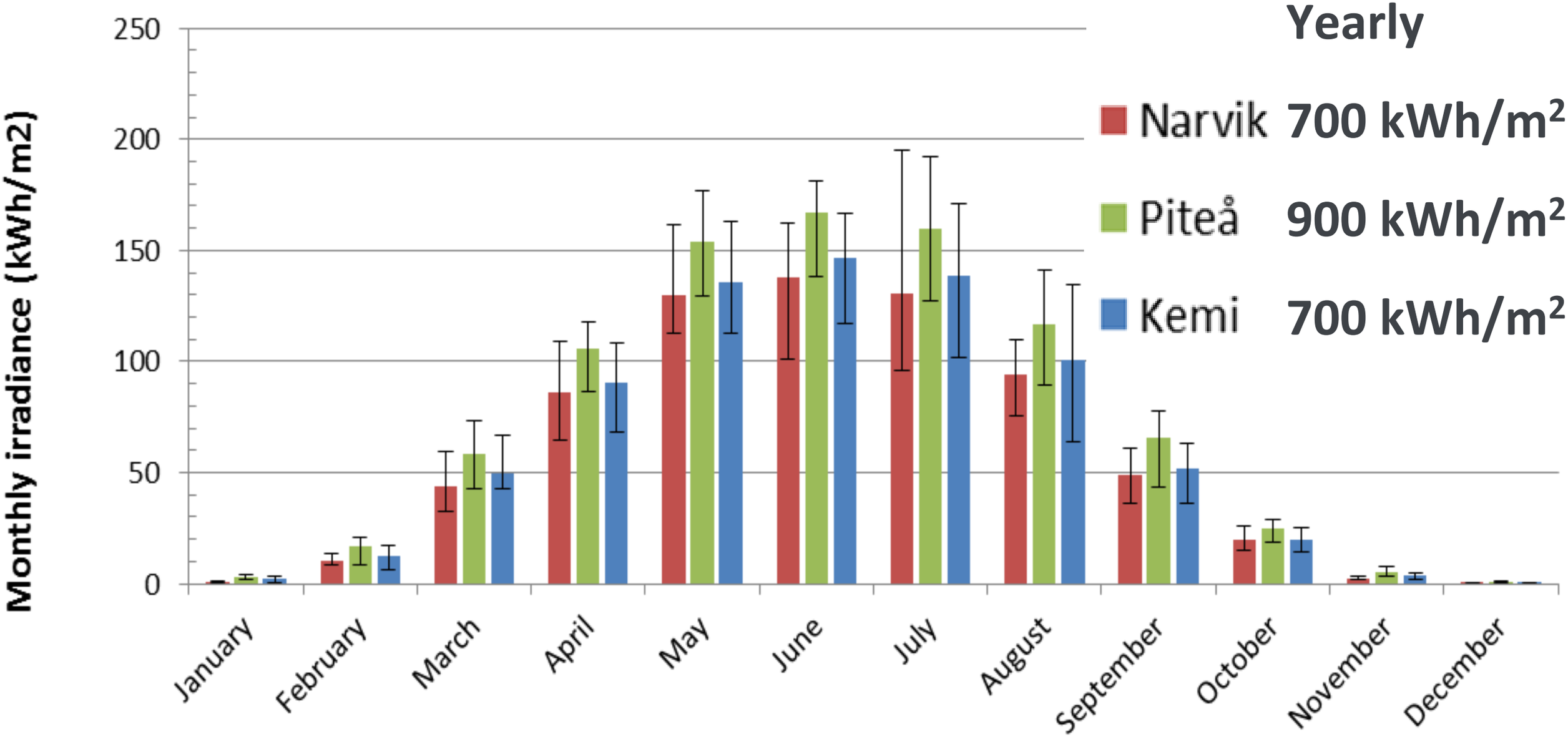
- Installed in dec 2012
- Dual-axis solar tracking
- Grid-connected (SMA)
- Module area 13.07 m^2
- Rated power 2.04 kW_p
- System level monitoring

THE PV POWER PLANT IN PITEÅ

- Installed in dec 2012
- In operation from March 2012
- Dual-axis solar tracking (astronomical and optical tracking)
- Grid-connected (SolarEdge)
- Module area 75 m^2 + 70 m^2
- Rated power 20 kW_p
- Individual module monitoring
- Weather station + pyranomete

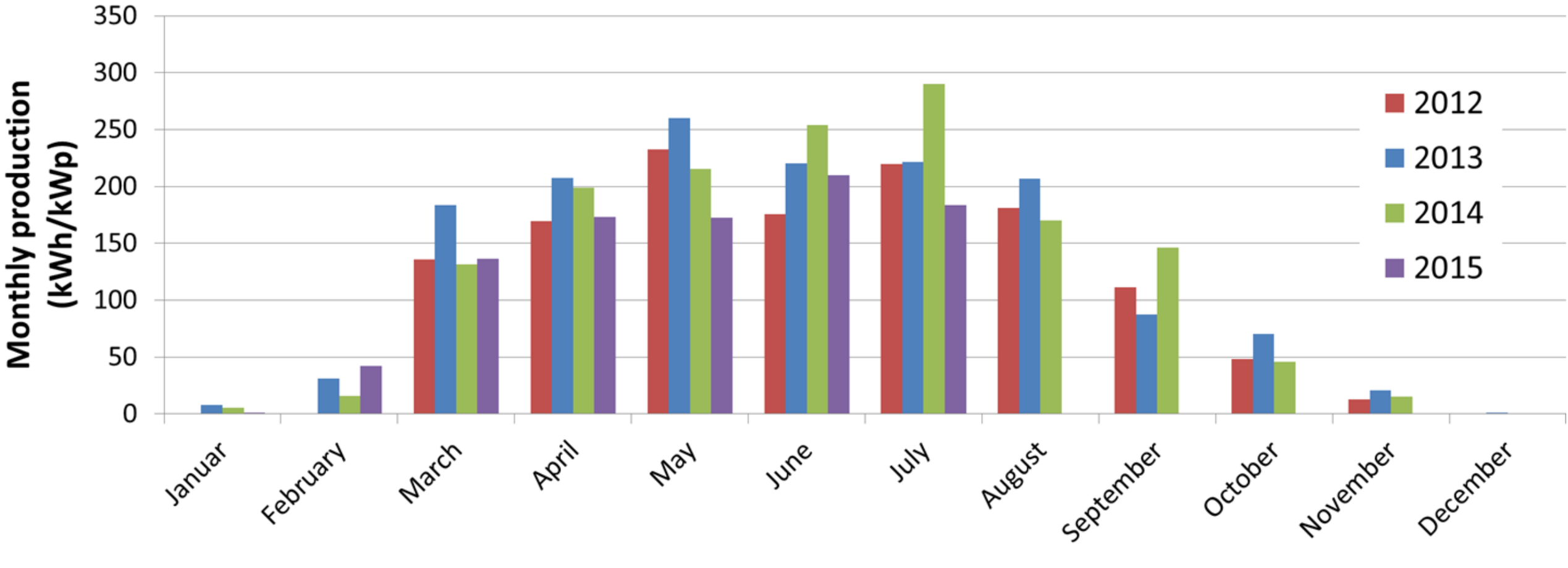
SOLAR RESOURCE

- Monthly horizontal irradiance (1999-2014) from STRÅNG

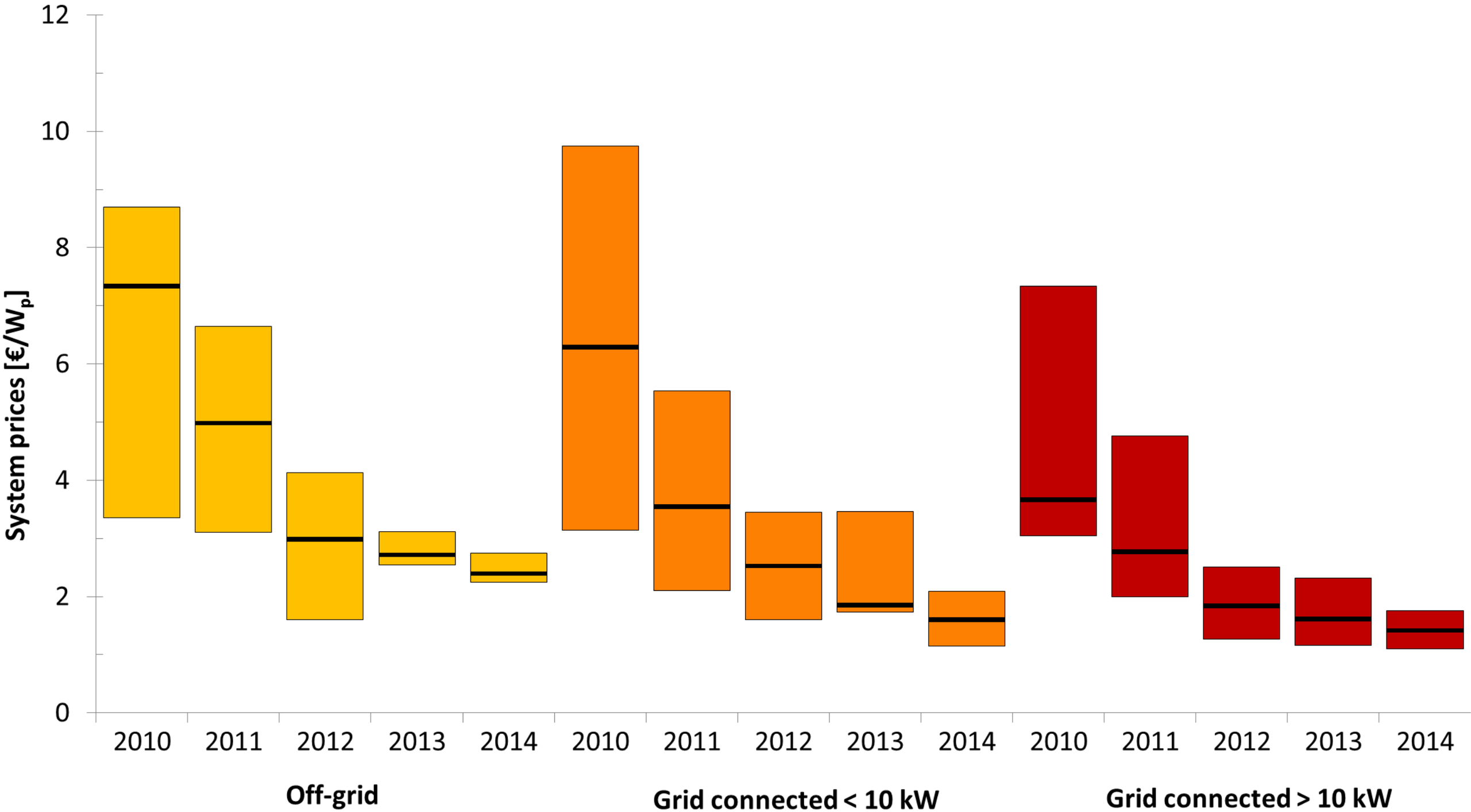


SYSTEM PERFORMANCE PITEÅ

- Yearly system performance
  - *2013: 1520 kWh/kWp*
  - *2014: 1490 kWh/kWp*
- There is still room for improvement!
  - *5% - 10% higher output possible*



PV SYSTEM PRICES - SWEDEN



OUTLOOK

- Results from this project has already led to
  - *Better system design*
  - *New projects*
  - *International interest*
  - *Show potential for solar energy in Northern Scandinavia!*

- New technology for northern conditions
  - *No moving parts*
  - *Almost as high yield as solar tracking*

- Pilot plants in Sweden (PiteEnergi) and Norway are realised now

- Looking for cooperation for large scale project in northern regions!

THANK YOU!

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Nordic Energy Research

Sustainable Energy Systems 2050
NORDIC ENERGY RESEARCH PROGRAMME

Energimyndigheten

PITE ENERGI
NÄRA DIG – VARJE DAG