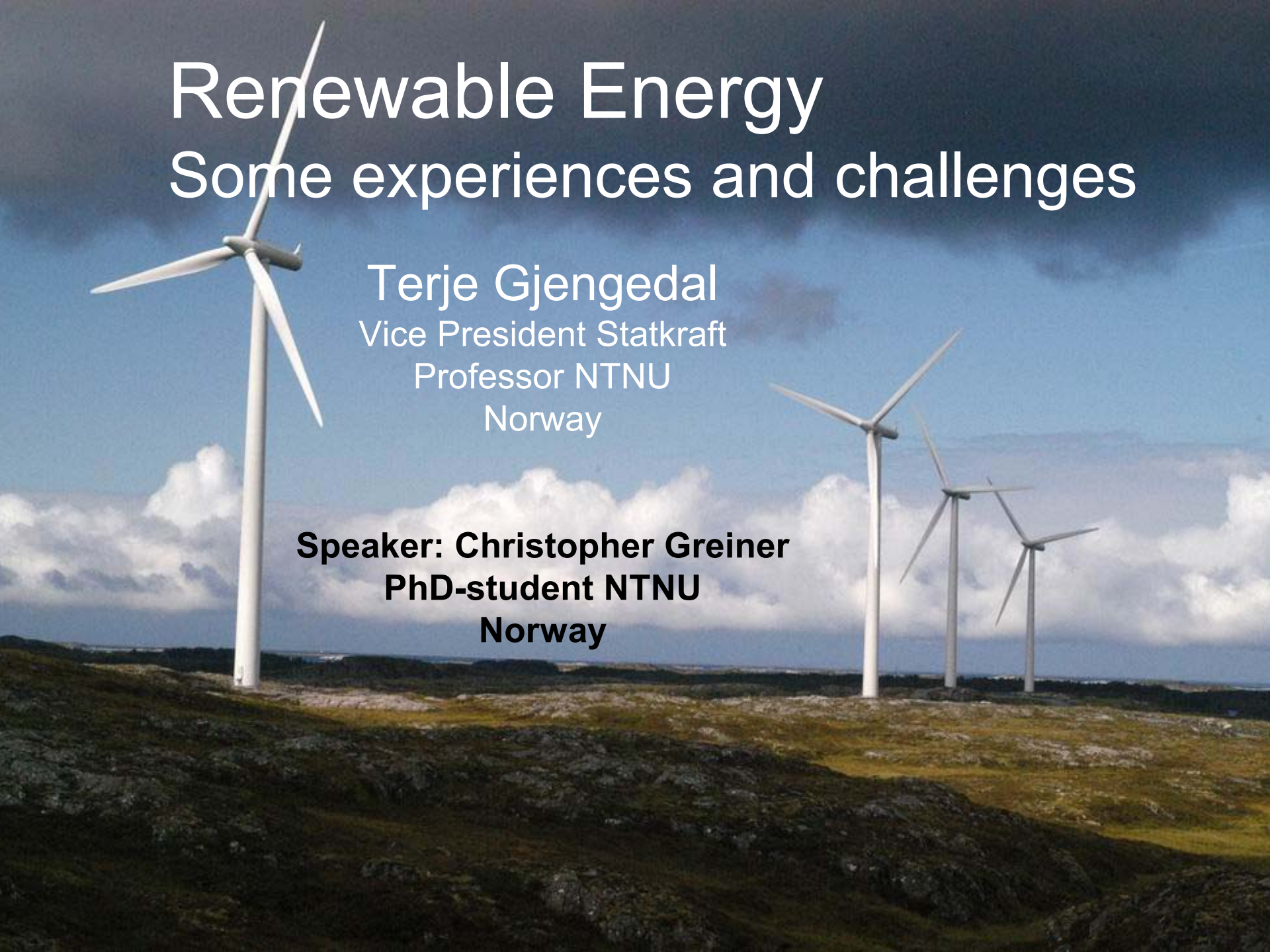

Renewable Energy
Some experiences and challenges

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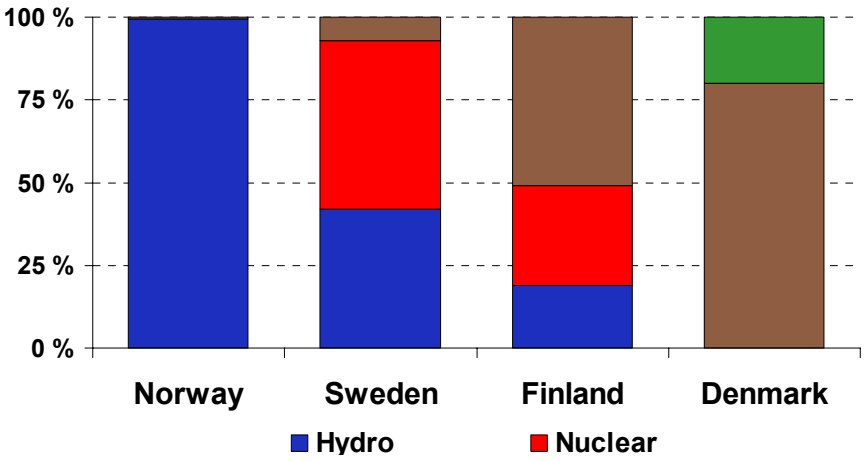
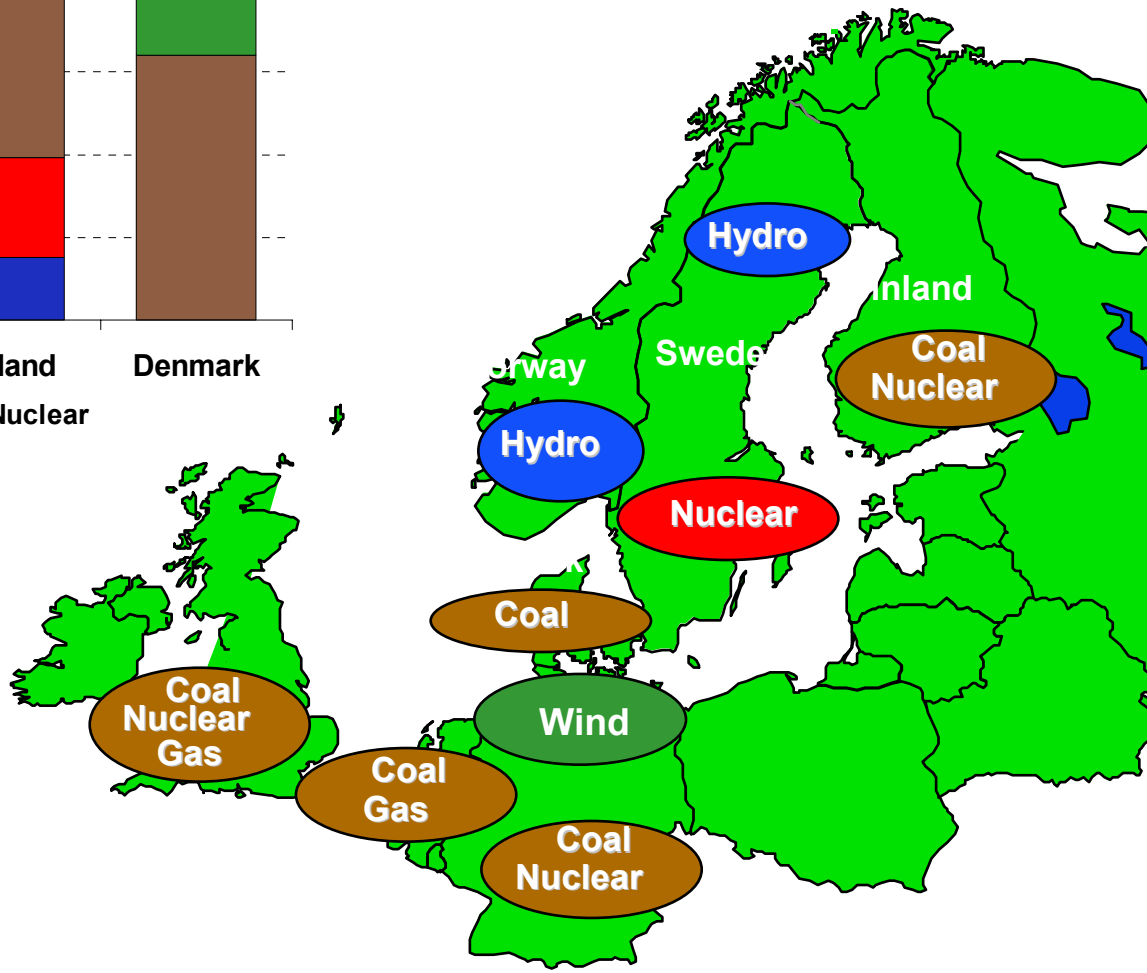
Vice President Statkraft
Professor NTNU
Norway

Speaker: Christopher Greiner
PhD-student NTNU
Norway

Nordic electricity generation

	Norway		Statkraft
• Installed capacity:	~28.200 MW	(hydro 99,8%)	~35%
	119 TWh		~35%





atkraft

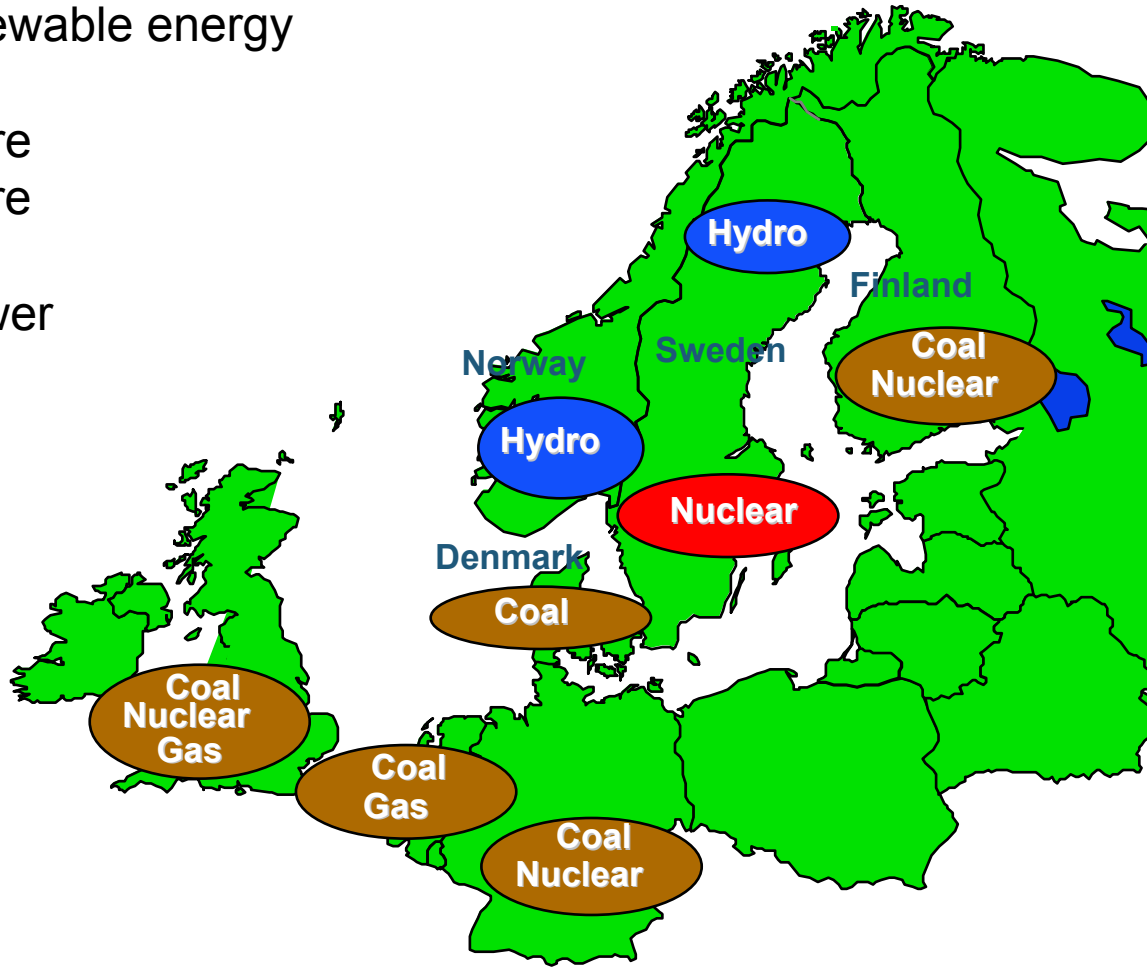
2006 p. 2

The Norwegian System

- Big oil and gas reserves offshore – one of the largest exporters in the world

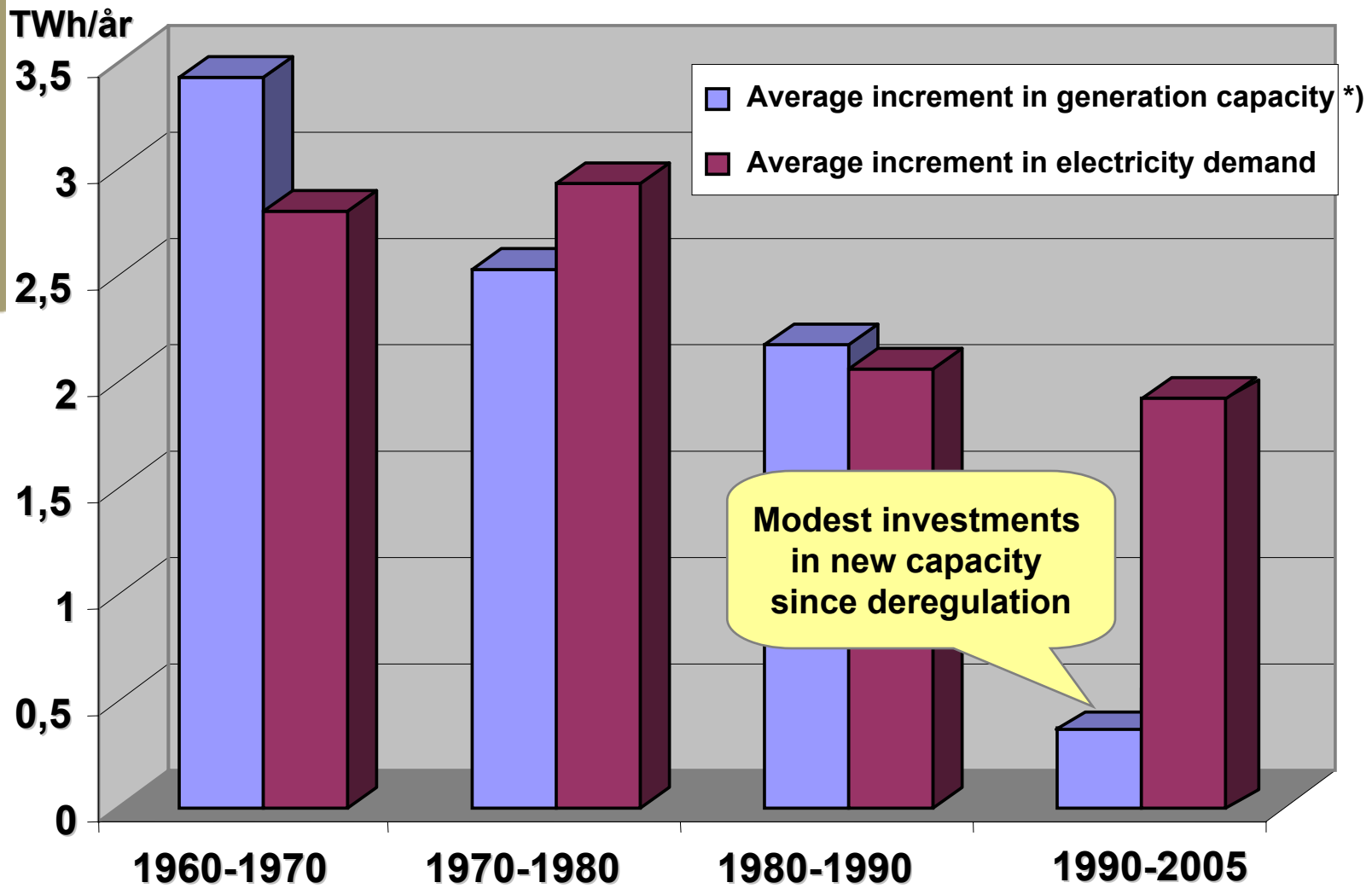
- Large potential for renewable energy
  - Hydro power
  - Wind power onshore
  - Wind power offshore
  - Bio energy
  - Wave and tidal power
  - Osmotic power
  - ++++

- The future of hydrogen processed from renewables



Average Annual Growth in Electricity Demand & Generation Capacity *).

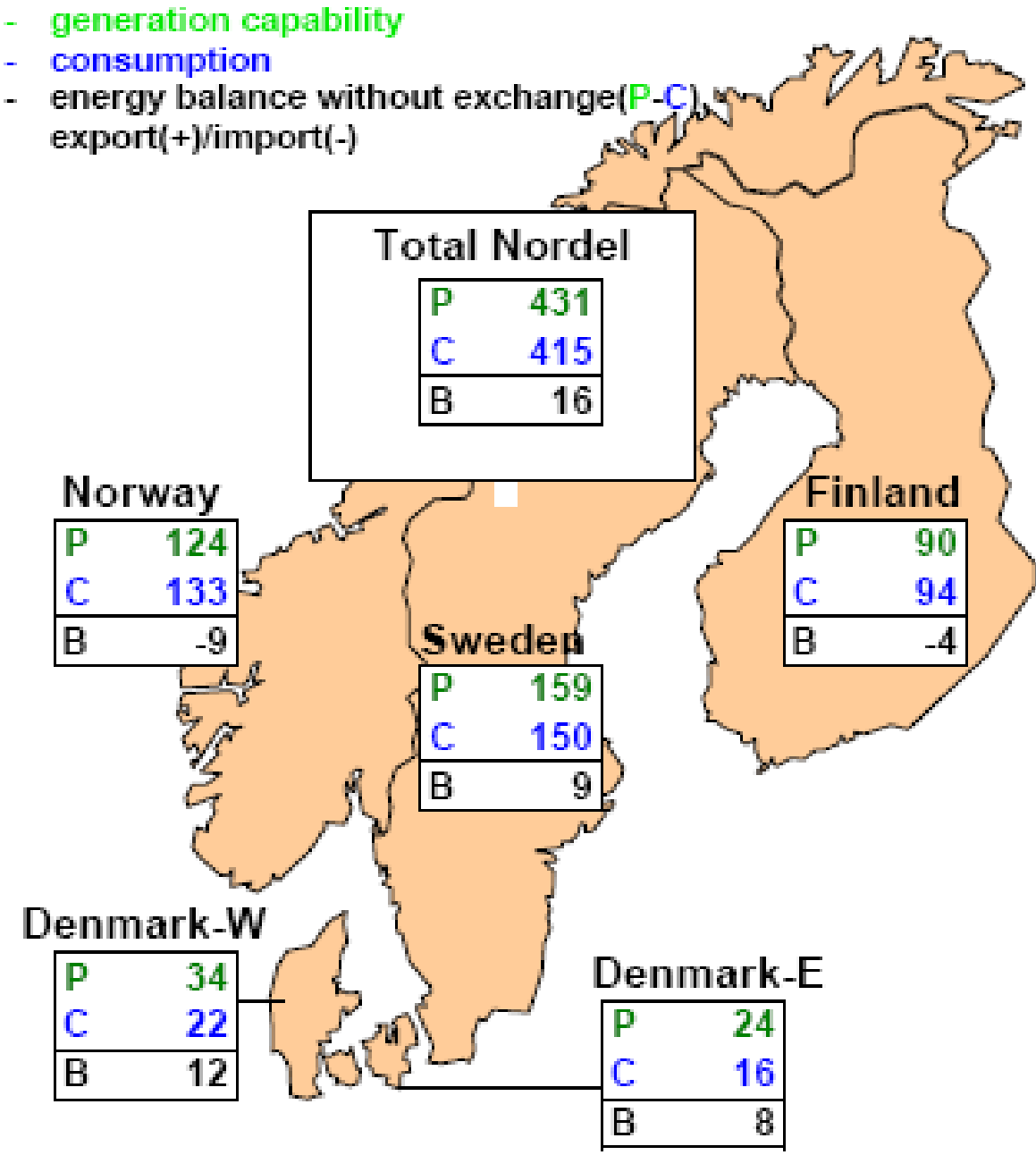
Norway 1960 - 2005



*) Increase in mean annual generation capacity

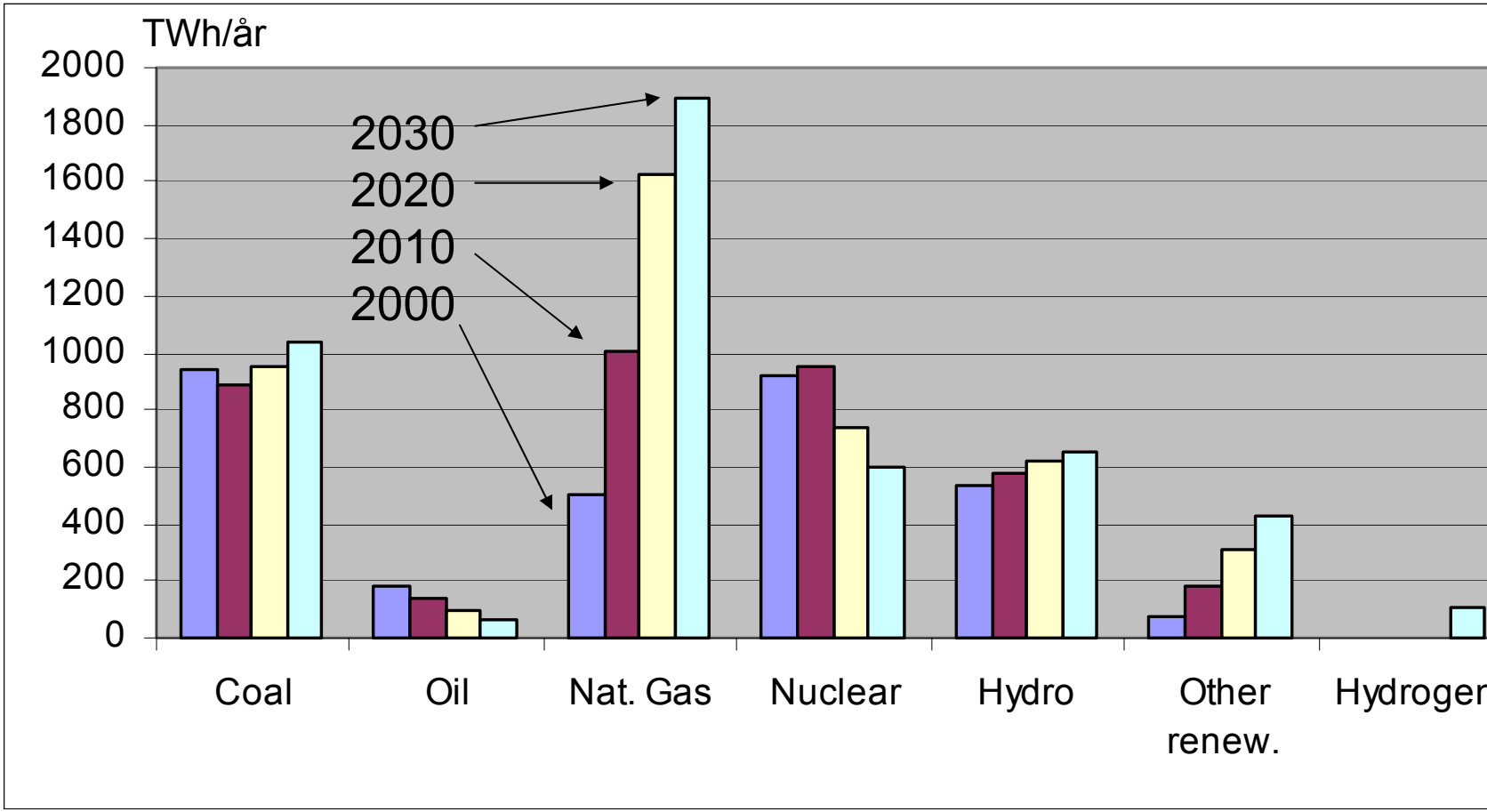
The Nordic System 2008

Energy balance
Normal inflow year



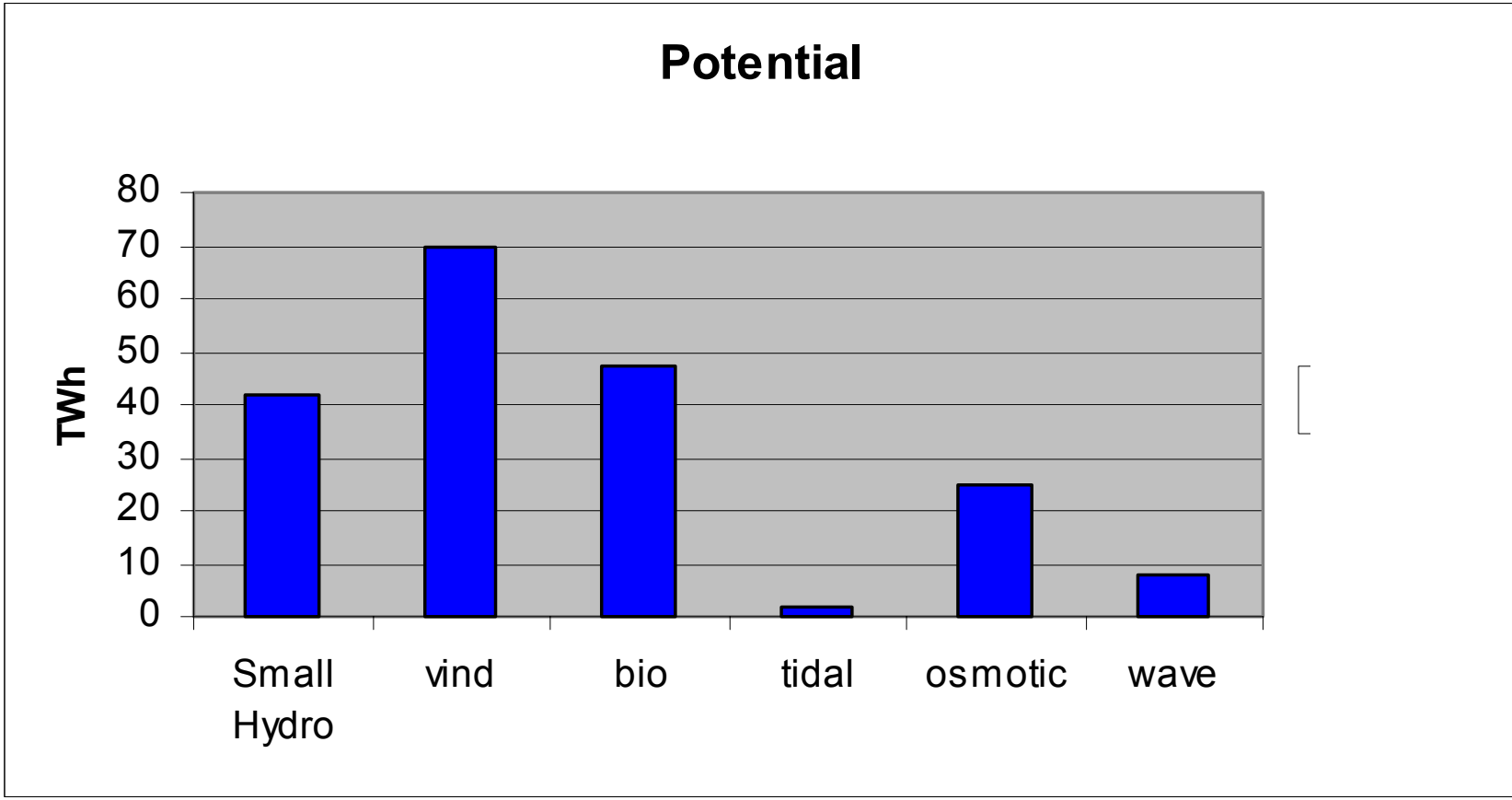
Power production in OECD-Europe

IEA Reference scenario 2000/2010/2020/2030



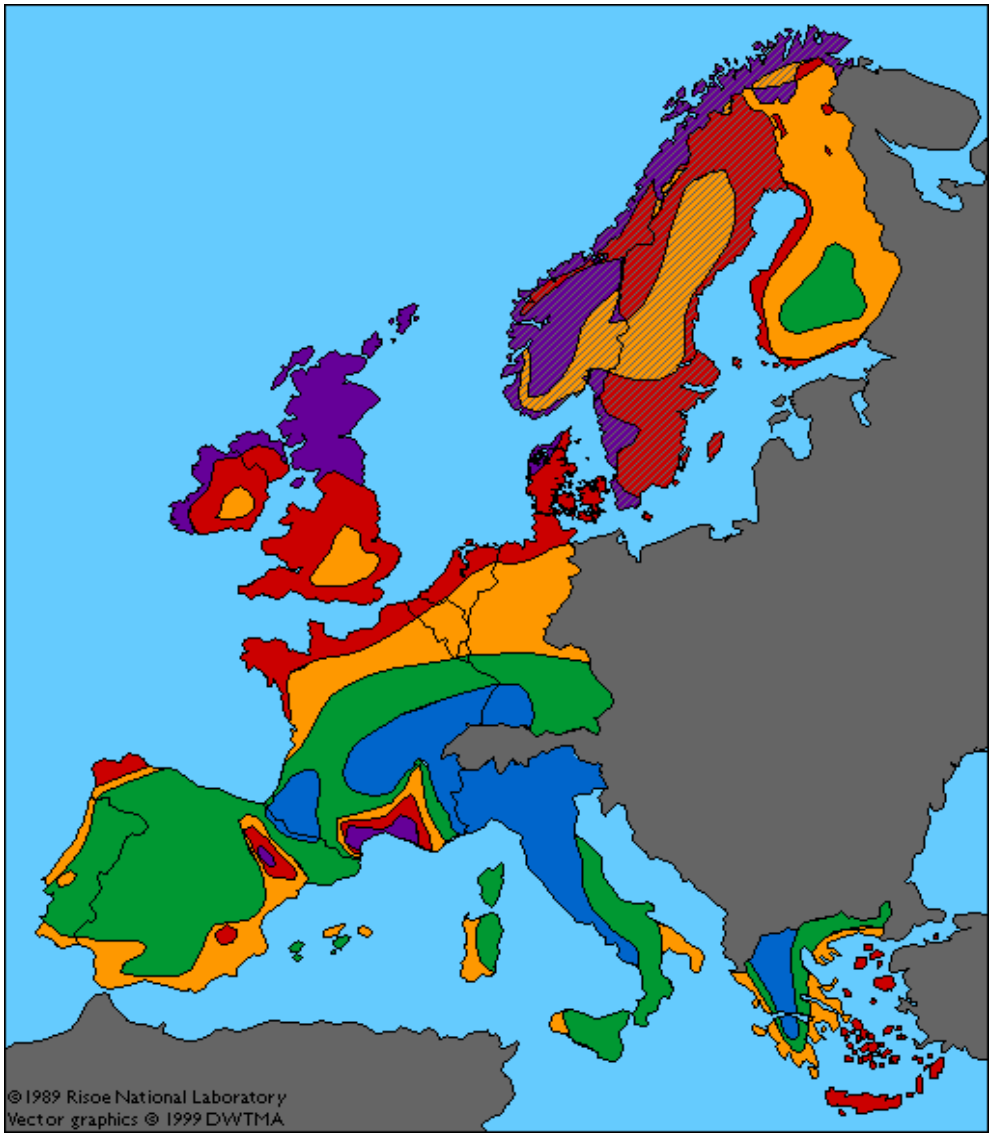
Source: International Energy Agency (IEA), ***World Energy Outlook 2002*****, SEfAS**

Some renewables in Norway –new capacity



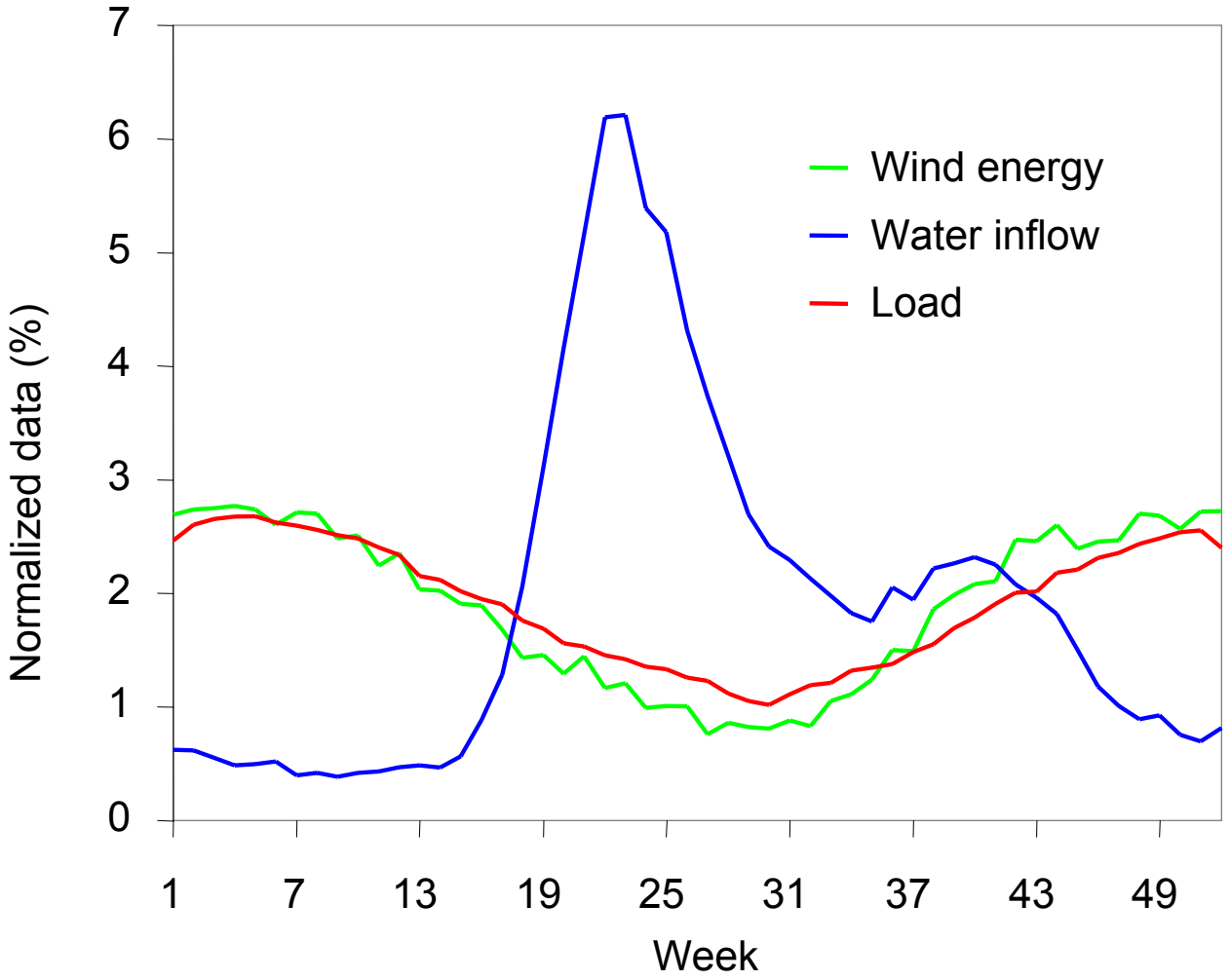
SUM: 200 TWh +/-

Good wind conditions in Norway



Blue and green	< 5.5 m/s
Yellow	5.5-6.5 m/s
Red	6.5-7.5 m/s
Purple	> 7.5 m/s

Wind Energy Variations - Norway



Wind Power Projects

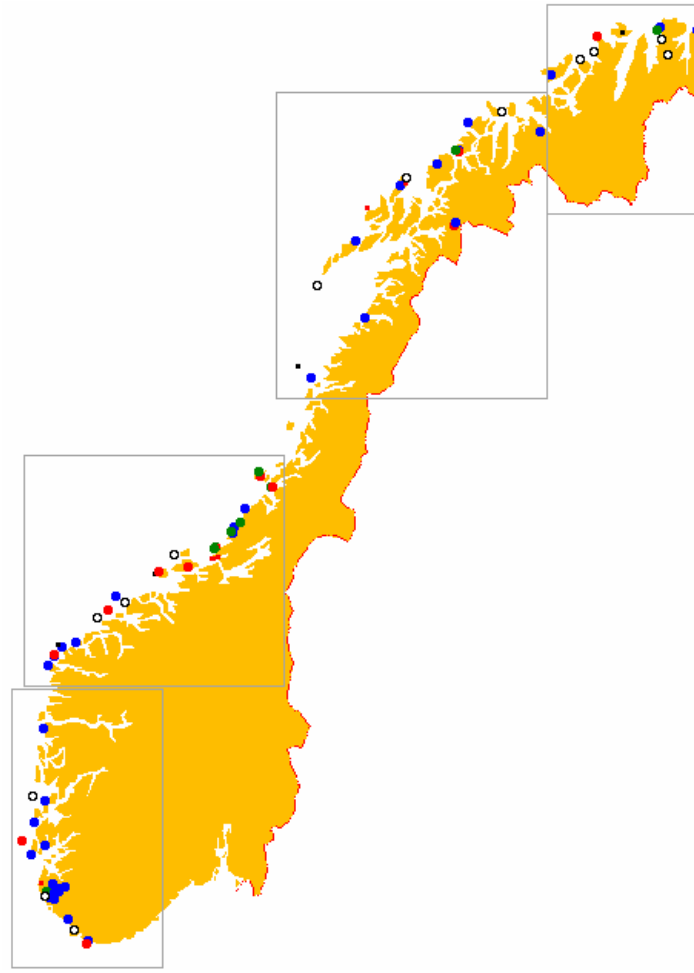
- In operation
- Planning in progress
- Concession applied
- Concession given

The official target is 3.0 TWh/year in 2010

Installed capacity 350 MW

Licenses for totally 850 MW given

Another 5.000 MW under licensing process

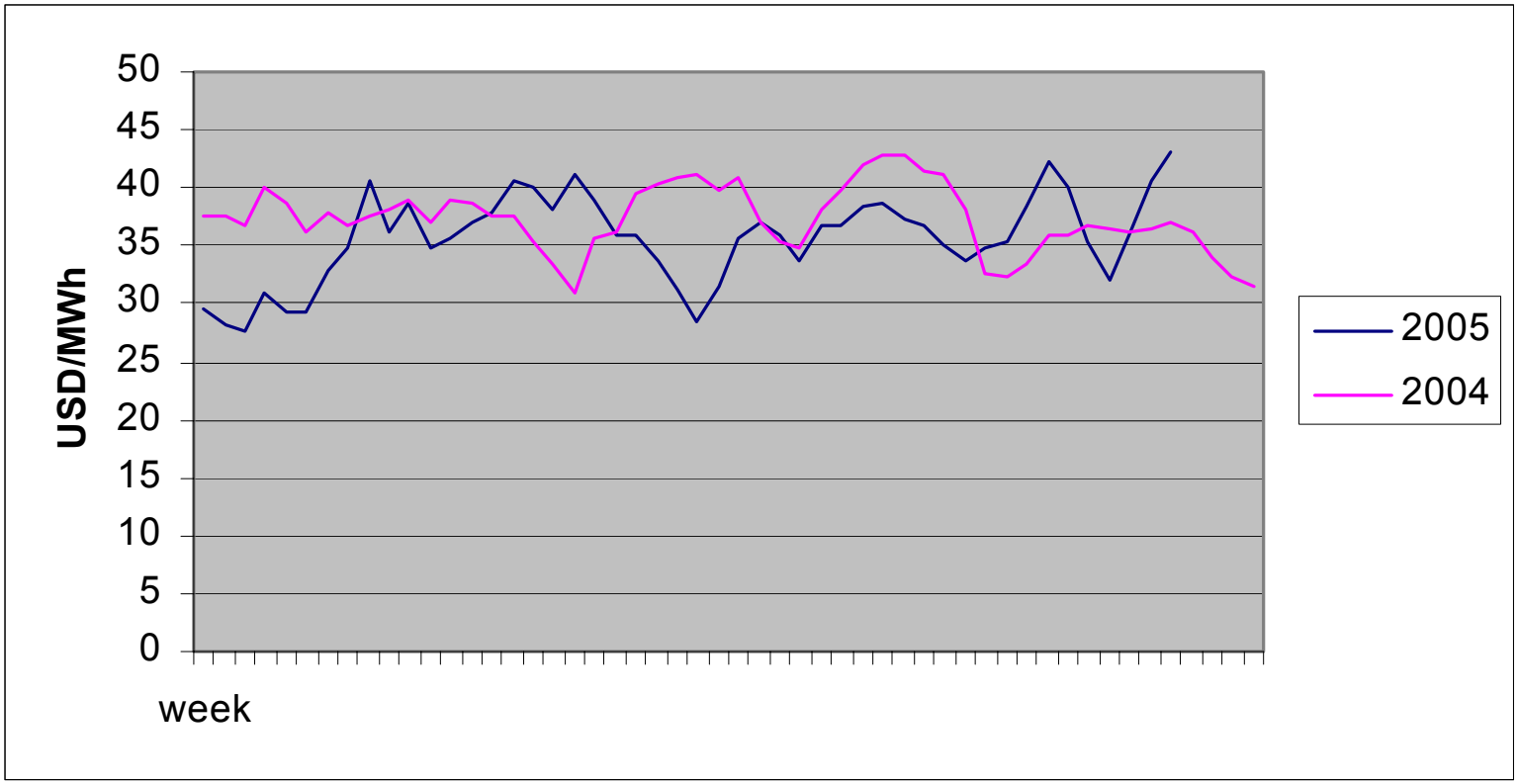


Kilde: NVE, august 2006

Main Challenges

- Get permission/ concession to build
- Get positive cash flow – ensure the project economy and return of investment
- Technology it self is usually not the limiting factor

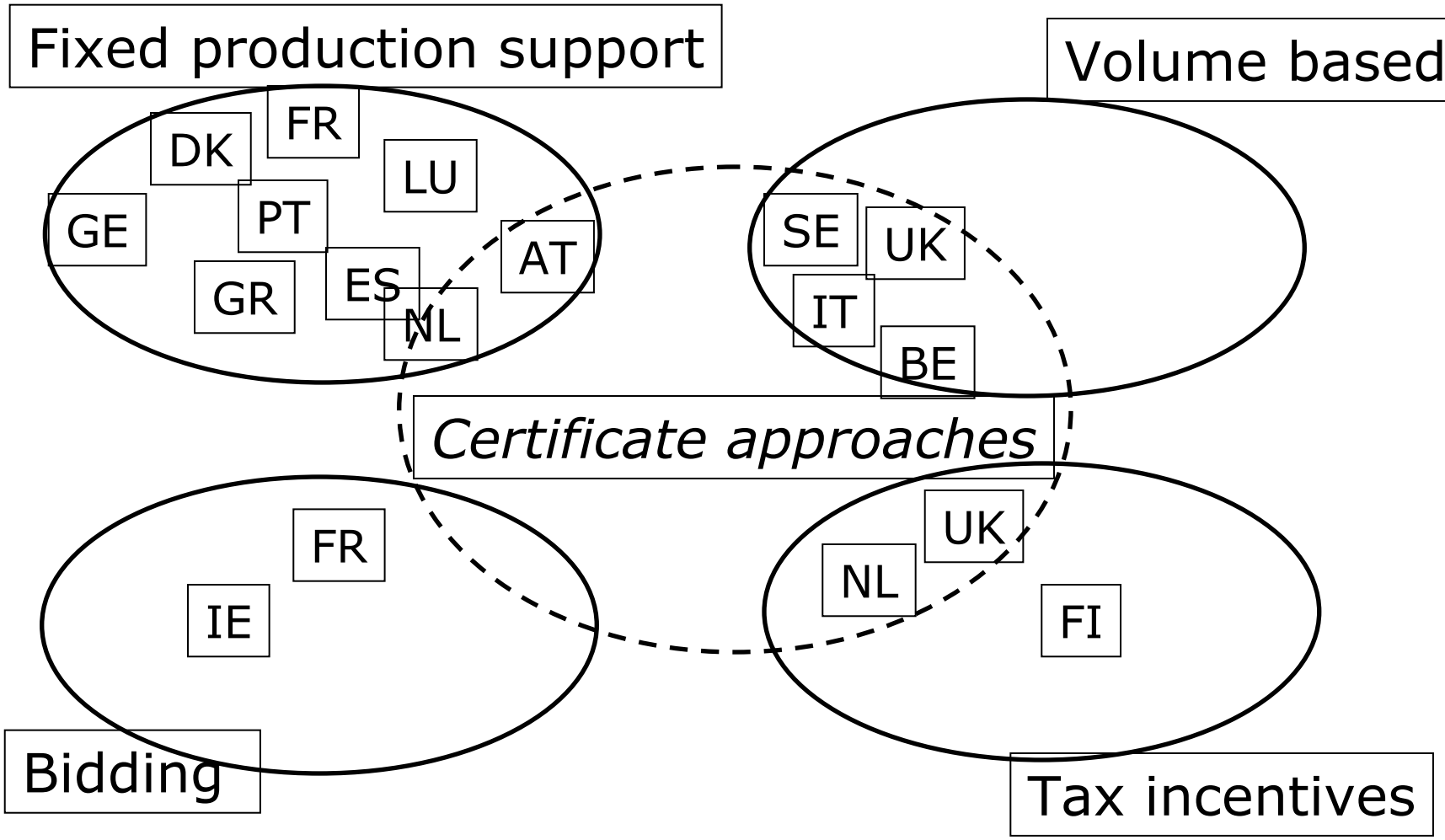
Spot Prices Nordic market



Need added value to implement more renewable energy

Support schemes are needed

Support schemes for renewable energy in EU-15 (15 EU countries)



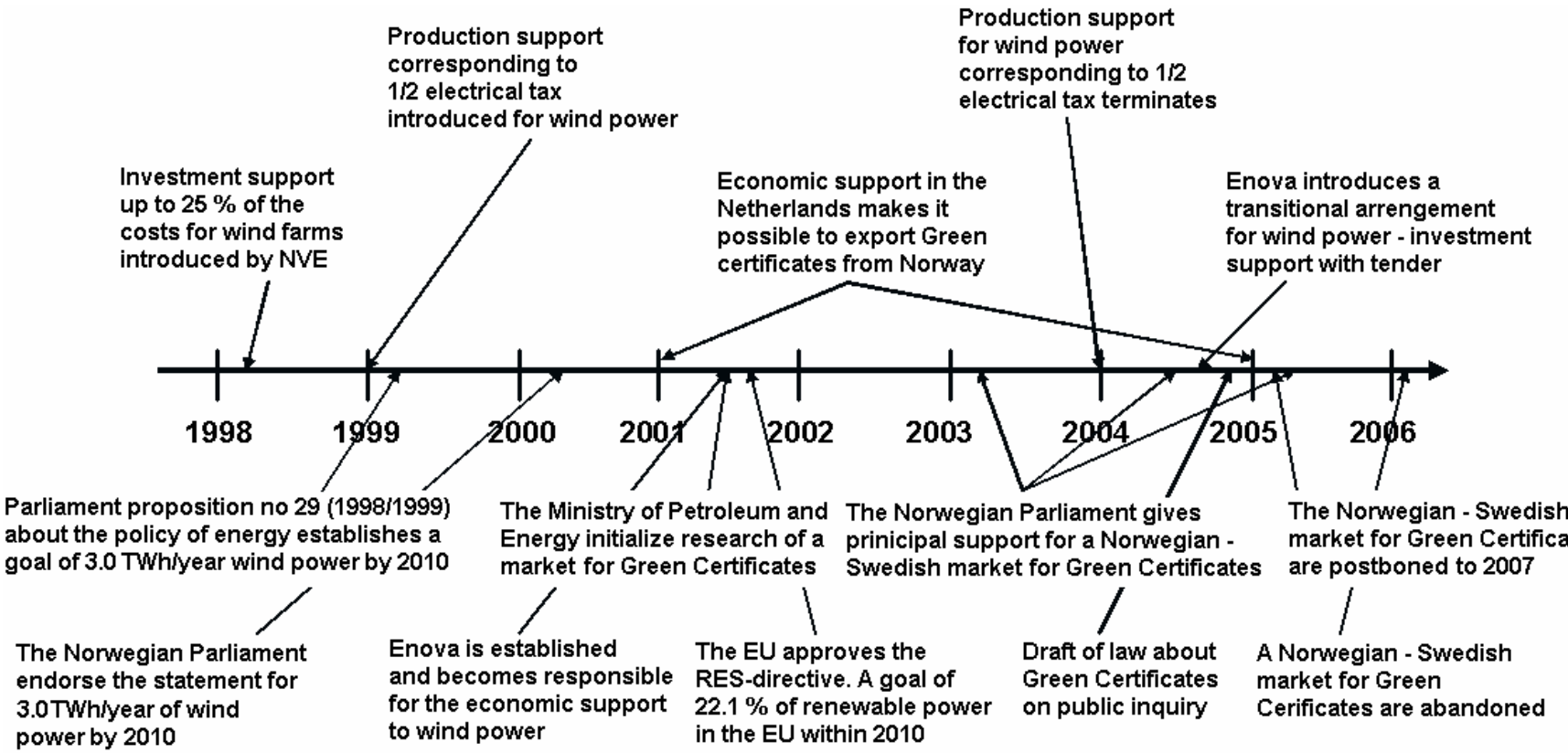
Source: EU DG TREN

Support to renewables in the EU

	PROs	CONs
REFIT (Feed-in tariffs)	Highly effective. Highly efficient due to the low risk for investors. Permits strategic support for technology innovation.	More difficult compatibility with the internal market. Needs regular adjustment.
Premium	Highly effective. Efficient due to the medium risk for investors. Good compatibility with the internal market.	Risk of over-compensation in the case of high electricity prices without appropriate adjustment.
TGCs (Green certificates)	Good compatibility with the internal market. Competition between generators. Supports the lowest-cost technologies.	Currently less efficient due to higher risks and administrative costs. Not very appropriate for developing medium- to long-term technologies.
Tendering	Fast development with political will.	Stop-and-go nature causing instabilities. If competition is too severe, development is blocked.
Investment subsidy	Good complement for some technologies.	Inefficient as a main instrument.
Fiscal measures	Good secondary instrument.	Good results only in countries with high taxation and for the most competitive technologies.

Kilde: EU DG T

Economic support for Wind Power
- The Norwegian Story



Changing economic support for renewable energy

- lack of predictability

Economic support for Wind Power
- Present Status

- **The proposed common market for green certificates between Sweden and Norway was abandoned winter 2006**
- **Minister of Energy stated, March 15th :**

  "I will within short time present an alternative [to green certificates] which secures the goal for new energy production based on renewable energy"

  "There is no reason to postpone the investments in wind power"

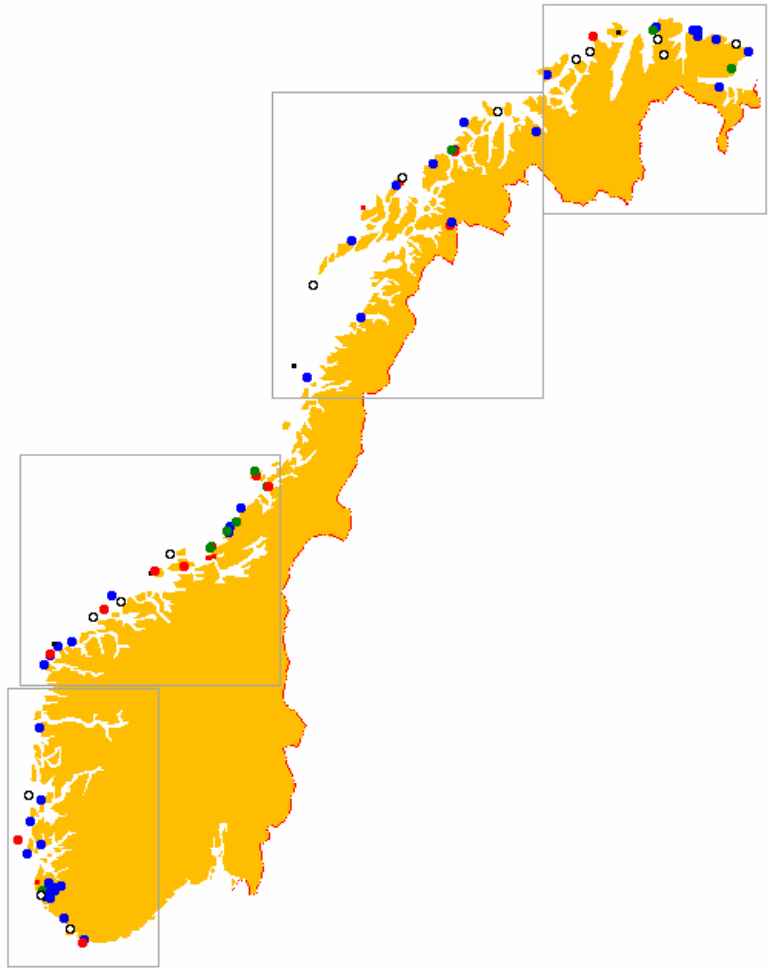
- **October 2006:**
  - **Wind Power: 1,2 cents/kWh (8 øre/kWh)**
  - **Bio Energy: 1,5 cents/kWh (10 øre/kWh)**
  - **Small hydro : 0,7 cents/kWh (4 øre/kWh)**
- **This will not ensure investments**

The Licensing process becomes more complicated: e.g. for Wind Farms

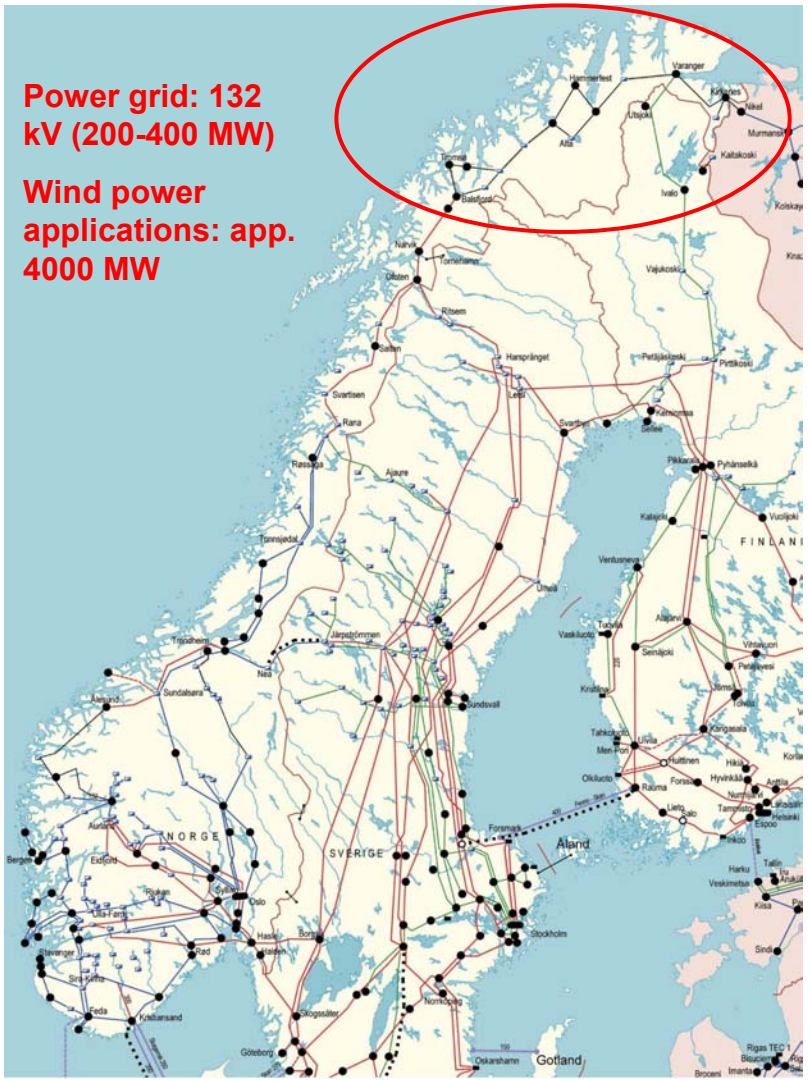
- **Notification**
  - **Public inquiry**
- **Application for license including impact assessment**
  - **Public inquiry, the public hearing process becomes more challenging**
  - **Opponents are increasing in number and 'power'**
- **Evaluation of the application by the authorities (Water and Energy Directorate – NVE) including thematic assessment of conflicts.**
- **Consession given by NVE**
- **If complaints**
  - the final decision by the Ministry of Oil and Energy
- **Total time frame: 2 – 5 years: tends to reach 4-5 years in average**

Technical Challenges

- Grid Connection and lack of transmission capacity

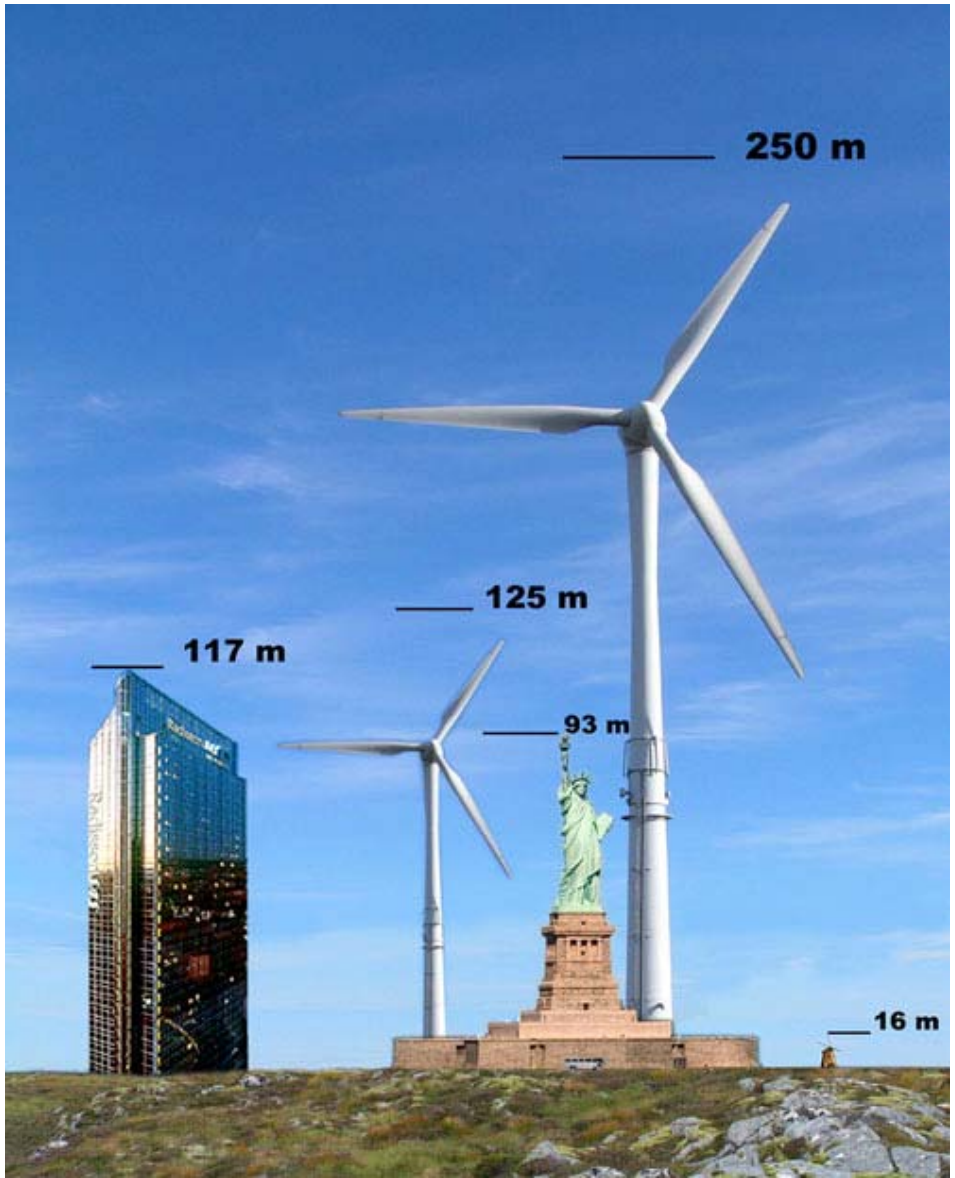


Reference: NVE, April 2006



Reference: Nordel, April 2006

Wind Turbines
- Beauties or Beasts?



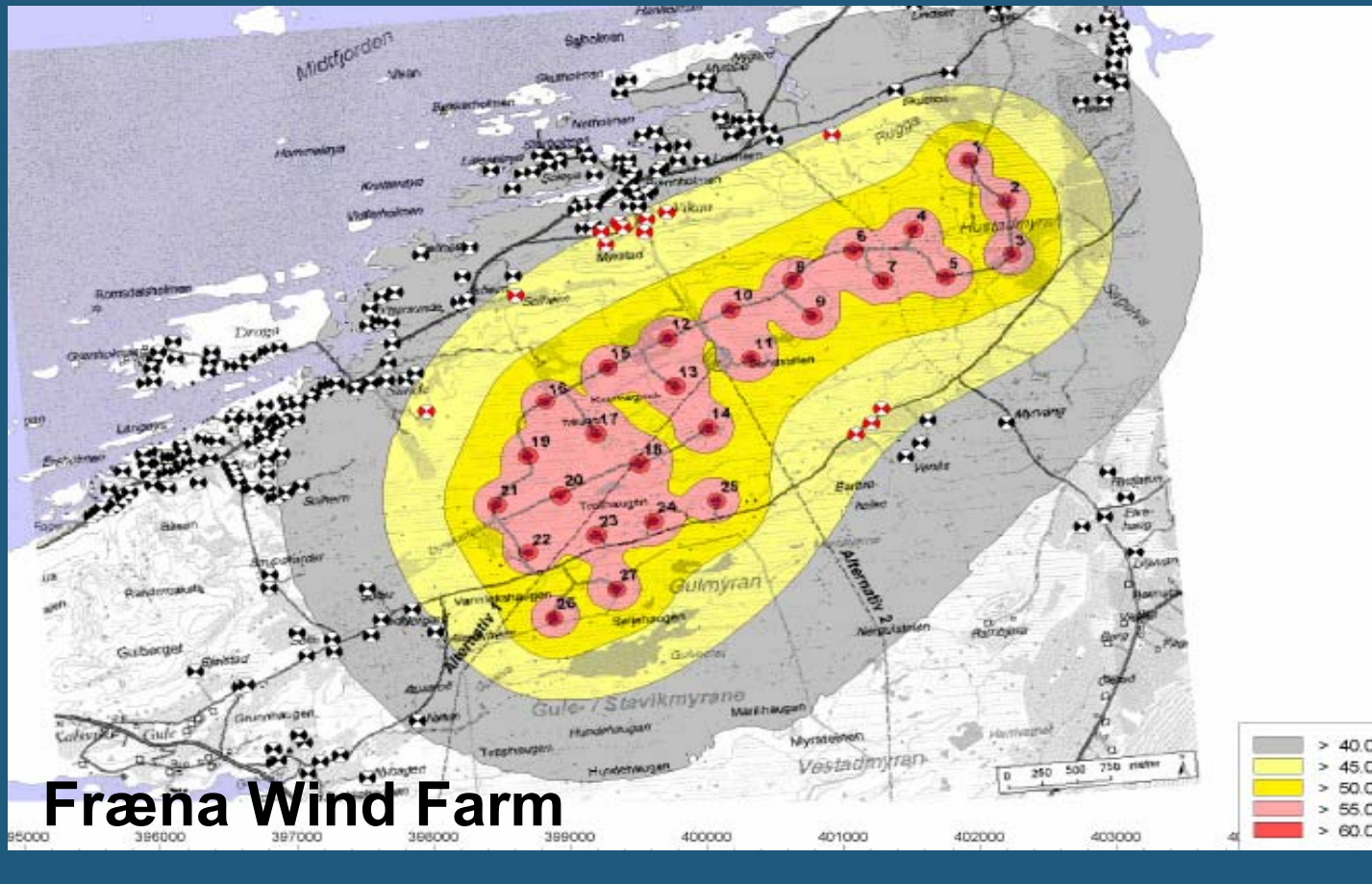
Classical challenges:

Challenges up North:

- Reindeer vs. Wind Power

”Hardware” challenges:

- Noise
- Shadow Effects
- Icing



Fræna Wind Farm

Common Challenges:

- Landscape
- Cultural Heritage
- Cultural Environment


Langevåg Wind Farm


Fræna Wind Farm

”New” challenges:

- Tourism

Atlanterhavsveien - The Atlantic road

Not In My Back Yard?

Summary:

- Norway has large potential for renewable energy
  - Wind power
  - Bio Energy
  - Wave and Tidal
  - Osmotic
- Also huge oil and gas reserves
- The future of hydrogen?
- Main challenges
  - Economy
  - Permission to build
- Opponents are increasing in number and power
  - Organizing against wind power