Roadmap

A. The Norwegian Electricity Sector
   – The Basics

B. The Norwegian Electricity Grid
   – Organization and Regulation

C. Grid Connection
   – An Obstacle for Wind Power and Hydro Power Projects
A. The Norwegian Electricity Sector
- The Basics
• In Norway, the use of energy is mostly based on electricity.

• The main reason is that Norway has a large energy production based on hydropower:
  – The world's largest per capita hydropower production.
  – The sixth largest hydropower producer in the world.

• Hydropower generation covers approximately 99% of Norway's total electricity production.
• In 2007:
  – Total Electricity Production: 137 TWh.
  – 135 TWh from hydropower.
  – 0.9 TWh from wind.
  – 1.5 TWh from gas-fired power plants and other thermal power stations.
• Most of the hydro power is produced in western and northern Norway and must therefore be transmitted from the West to the East and from the North to the South.
• The electricity consumption in Norway is steadily increasing.
• This creates a need to increase the electricity production capacity.
• “The time is over for new big hydro power projects.”

  – A large proportion of Norway’s hydropower potential is already developed or protected:

  – Many energy sources pollute (emission of greenhouse gases). Pressure to increase the use of renewable energy sources.
With this in mind, how should Norway increase the electricity production capacity?

Small scale hydro power and wind power seem to be good alternatives.

The politicians agree. The government wants to:

- “[M]ake fuller use of the potential that is inherent in (...) the construction of small, mini and micro power plants.”
- “[I]ncrease the development of environment-friendly wind power.”
Small Hydro Power Stations
Small Hydro Power Stations

• Hydro power stations with an installed capacity up to 10 MW are designated as small. These are sub-divided into:
  – Micro: Installed capacity below 0.1 MW
  – Mini: Installed capacity from 0.1-1 MW
  – Small: Installed capacity from 1-10 MW

• Interconnected to the distribution grid (the lower levels of the transmission grid).
Wind power

• Norway has fairly good wind resources.
• The government has ambitious goals:
  – “Norway is an energy nation. The Government’s vision is that Norway shall be an environmentally-friendly energy nation that leads the world in the development of environmentally-friendly energy.”
  – This sounds good! But is it this only talk?
• Also, the electricity market is favorable for development of renewable energy:
  – High electricity prices.
  – An expanding market: The European energy market.
• So far it all seems so easy... But what happens when:

+ The Transmission Grid
The BIG problem

• Transmission Interconnection!
• Interconnection of the wind and hydro power facilities often requires:
  ─ Construction of new lines.
    • The sources (the wind and the water falls) are often far away from existing electricity lines.
  ─ Enforcement of the existing grid.
    • The existing grid does not have enough capacity to receive electricity from new production facilities.
• Grid construction is expensive! Who should pay the bill?
• Despite these well known issues, the transmission interconnection of power plants is somewhat “forgotten”.
• The Norwegian regulator has rather focused on transport of electricity and the electricity market.

Interconnection is a pre-requisite for later stages:
→ No interconnection – no electricity to be transported – no electricity to sell on the market.
• This presentation focuses on the “interconnection regime”
  = The regulation of third party transmission interconnection.

• More specifically:
  – “Interconnection” → In Norway
  – “Third Party” → Producers → Wind power and small scale hydropower plants
  – However, the same issues will occur in other parts of the world and for other energy sources
B. The Norwegian Transmission Grid
- Organization and Regulation
• The Norwegian transmission grid is organized in 3 levels:
  1. The Central Level
  2. The Regional Level
  3. The Distribution Level

• The regulation differs with the grid level.
The Central Grid

- The “motorway system” for power supply.
  - High transmission capacity: 300-420 kV.
- Covers the entire country.
- Embraces transmission lines to other countries.
There are interconnections between Norway and the neighbor countries

Cross border transmission capacity in the Nordic countries:
The Regional Grid

• High transmission capacity, but not as high as the Central grid.
• Covers only a particular region.
• Links the Central and Distribution grids.
• Most energy-intensive industries and generation facilities are connected to the Regional and Central grids.
The Distribution Grid

• Low transmission capacity.
• Generally used to distribute power to end users (you and me).
• In addition, small generation facilities are connected to the local distribution grid.
Regulation

• The 1990 Energy Act introduced a market reform on the energy sector.
  1. Electricity generation and sale is subject to competition.
  2. Grid management and operation have been defined as a natural monopoly, and this sector has not been opened to competition.
  – The sectors are often referred to as (1) the electricity market and (2) the grid monopoly. This presentation focuses on sector (2).
• The 1990 Energy Act and regulations issued in pursuance thereof provides the legal basis for regulating grid management and operation.

• Remember: Norway is a civil law country – regulation, regulation, regulation and regulation.
• To prevent grid companies from exploiting their positions, the authorities have put in place very detailed regulation of their operations as monopolies.

• The objective of the monopoly regulation is to safeguard user rights and ensure a well-functioning electricity market and efficient management and development of the grid.
• The grid monopoly regulation can be divided in two:

1. The grid companies’ income = income regulation
   • The Norwegian regulator sets an annual upper limit on each grid company’s income (income caps).

2. How the grid costs are being collected from the customers – the setting of the tariffs = tariff regulation
   • This presentation focuses on the tariff regulation.
The Tariff Regulation

• The grid company’s income is derived primarily from *transmission tariffs*. Grid companies are required to use “point tariffs”:
  – Kind of rent for the use of the transmission grid.
  – Like an entrance ticket to the entire Norwegian electricity grid. Grid customers pay the same tariff regardless of whom they buy electricity from or sell to.
  – All customers pay a share of the costs on higher levels.

• The grid company can, within the narrow frames of the tariff regulation, decide how to set its tariffs.
• **Investment contribution**
  – The grid company can in some situations require its customers to pay for specific one-time costs.

• **In what situations?**
  – To cover the costs of connecting new customers to the network.
  – Reinforcement of the network for existing customers.

• **Objective**
  – To make the customer responsible for the costs related to its network connection. This promotes efficiency.
To sum up: Where are we in the electricity sector?

- Grid monopoly & electricity market
- Tariff regulation & income regulation
- Investment contribution & point tariffs
C. Transmission Interconnection
- An Obstacle for Wind Power and Hydro Power Projects
• Again, the big problem is:
The underlying problem:

• Interconnection is costly. Who should pay?
• 4 alternatives:
  1. The grid company?
  2. The wind/hydro power project?
  3. Other grid customers?
  4. The government?
• Even in situations where all actors want a project to materialize, the project can be hindered by the current regulation of the grid monopoly.
Obstacle 1: No obligation to connect producers

- If there is no free capacity in the transmission grid, the grid company has no obligation to connect new generation facilities.
- No obligation to build new grid or reinforce the existing grid.
- The grid owner can of course make constructions on voluntary basis. Often skeptical to do so.
Obstacle 2: Investment contribution

- Very complicated and detailed rules.
- Grid construction is very costly. The wind/hydro power project often has limited financial resources.
- The investment contribution can thus block the project.
Obstacle 3: The tariff regulation

• Studies show that Norwegian electricity customers are willing to cover the costs coming from the development of wind/hydro power facilities.

• But... The current tariff regulation does not allow the grid company to transfer the construction costs to the customers.
What can be done?

- Unfortunate situation: Good wind/hydro power projects are being blocked.
- Solution: Look to Denmark!
- Denmark has grid connection regulation that is customized for wind power producers.
Denmark

• Areas designated for wind power generation.
• Within these areas, the grid company has an obligation to connect wind power facilities.
• The interconnection costs are divided in a simple way:
  – The producer pays for grid costs from the generation facility to the border of the designated wind area.
  – The grid company pays for the rest.
  – The grid company’s costs are passed on to the Danish grid customers through an additional tariff.
DESIGNATED WIND

Producers pays

Grid company pays

Costs passed on to grid customers
AND...