

Grid connection rules for wind power in five countries with high ambitions concerning amount of wind power in the power system?



Swedish "Network connection inquiry"

Lennart Söder, KTH, Stockholm-Sweden

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Lennart Söder, Thomas Ackermann, Eva Centeno-Lopez

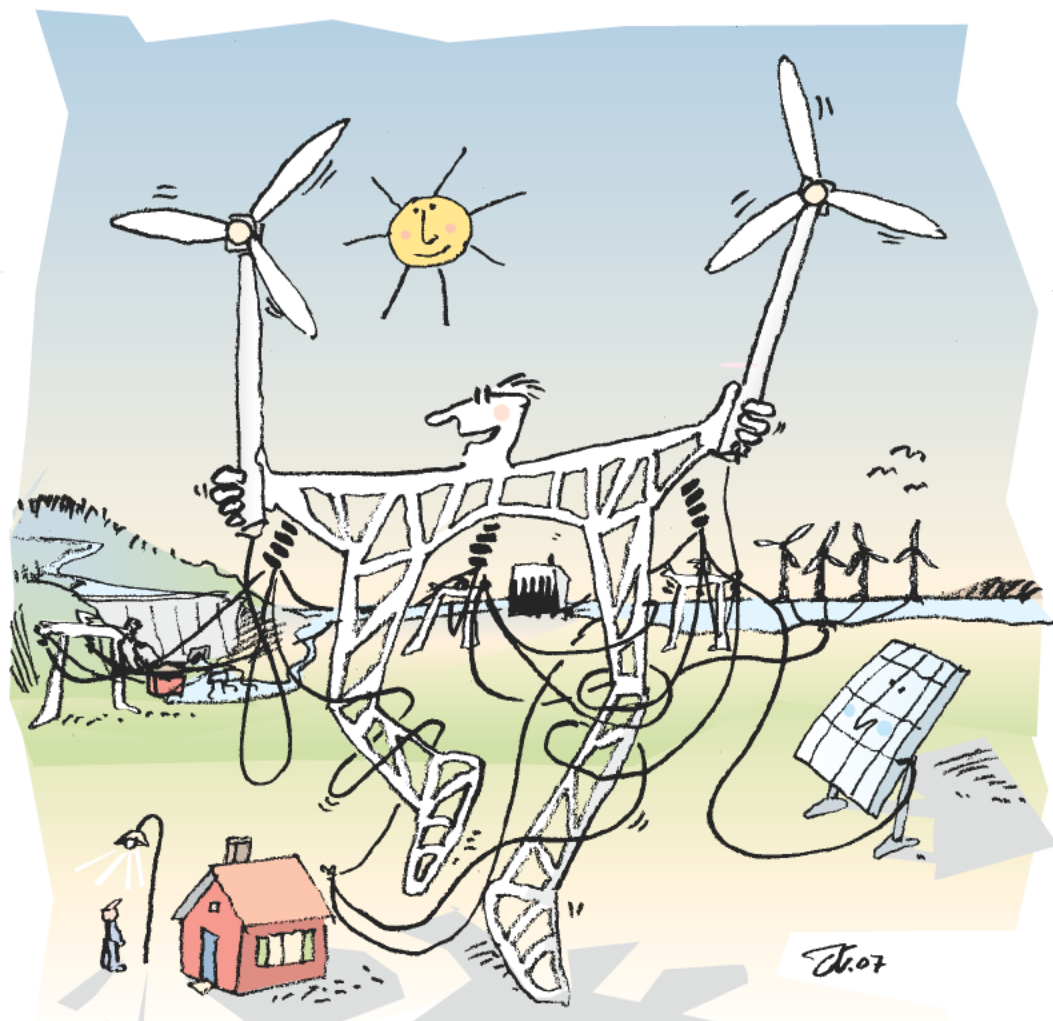
Network connection inquiry



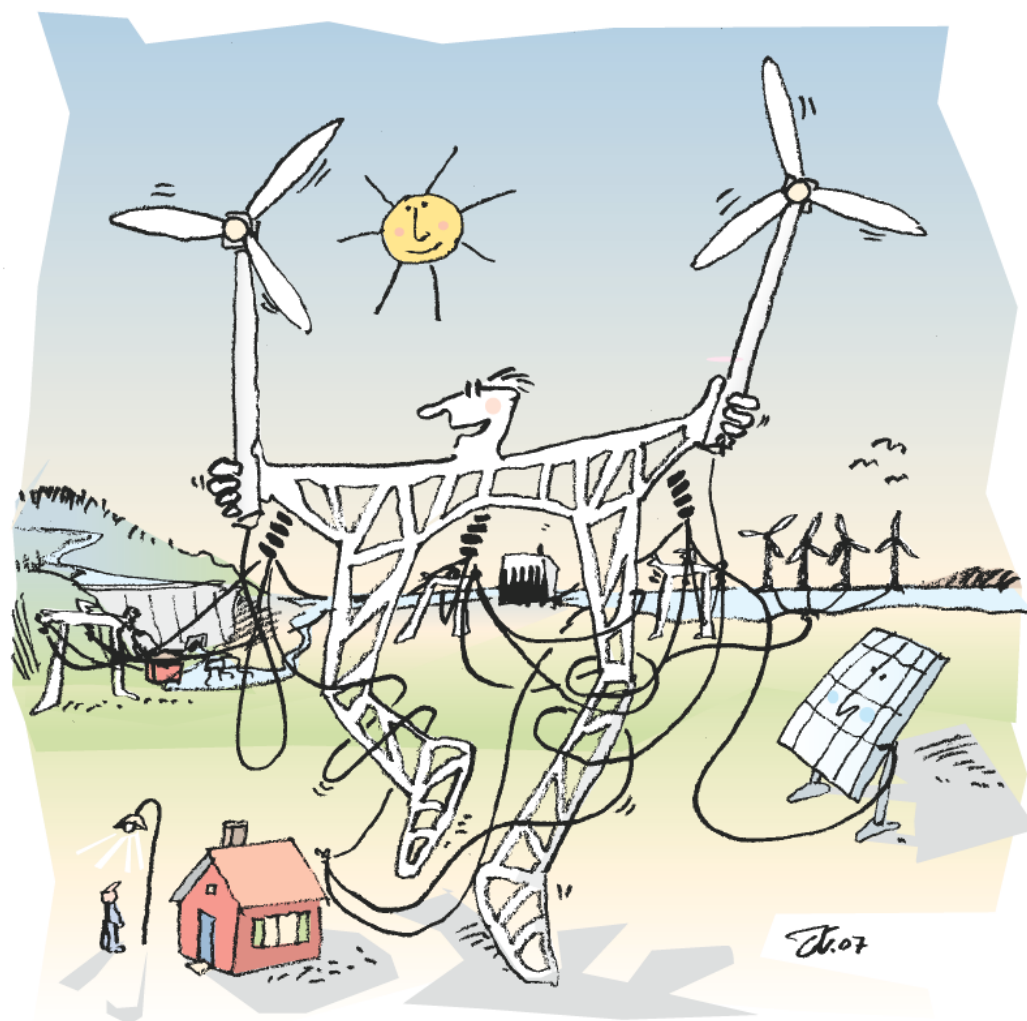
- **Decision:** 1:st February, 2007
- **Presented:** 20 February, 2008
- **Main aim:** Investigate whether the current rules for renewable electricity production create barriers for a large scale introduction and expansion of the renewable production. If the conclusion is that there are barriers, then the investigator **should suggest changes** of the corresponding rules.
- **Included:** International comparison of relevant grid rules and **current** Swedish laws

Grid Issues for Electricity Production
Based on Renewable Energy Sources in Spain,
Portugal, Germany, and United Kingdom

Bättre kontakt via nätet
– om anslutning av förnybar elproduktion



Appendix: 218 pages



Main report: 255 pages

Structure

Grid connection issues:



- General support overview
 1. Contact grid owner
 2. Write a contract
 3. Build line from wind farm to the grid
 4. Strengthen the grid up streams
 5. Measure the produced power
 6. Pay grid fee.

Payment comparison - 1

	Sweden	Spain	Portugal	Germany	UK
Regulation Scheme	Electricity Certificates	Feed-in tariffs & market option (market price + premium)	Feed-in tariffs	Feed-in tariffs	Renewables Obligation Certificates (ROC)
Total Payment Level for wind power 2006 [€/MWh]	=69.12 ¹⁵⁰ Certificate=21 Energy=48.12	Feed-in tariff: 77.73 Market option: 91.01 (Premium 31 plus energy 48 plus market incentive 7 plus other complements)	92.8	(on-shore) 83.6 for first 5 years, then 52.8	= ~124-130 ¹⁵¹ ROCs 59-65 (buy out: 47.9) plus ~65 for energy
Total Installed Generation Capacity end 2006 [MW]	33,819	82,336	13,607	111,000	83,045

Payment comparison - 2

	Sweden	Spain	Portugal	Germany	UK
Total Installed Wind Capacity end 2006 [MW]	572	11,615	1,716	20,622	1,958
Wind Capacity added in 2006 [MW]	80	1,587	692	2,195	616
Total Payment Level for Solar Photovoltaics 2006 [€/MWh]	=69.12 ¹⁵²	Feed-in tariff: P<100kW:440 P>100kW:230	Feed-in tariff: P<5kW:447 P>5kW:316	Feed-in tariff: P<30kW:518-568 30kW<P<100kW: 493-543 P>100kW:487-53	= ~124-130
Installed PV Capacity[MW] end 2006	4.8	118	2.3	2,863	9.9
PV added in 2006 [MW]	0.6	60	0	953	1

Capacity Limits in the Regulations for Renewable Energy

	Sweden	Spain	Portugal	Germany	UK
Capacity limits for payment of network tariffs	Yes, 1.5 MW ¹⁵⁵	No	No	No	Not for transmission grid, but for distribution grids ~10-50 MW
Capacity limits for support scheme	No	Feed-in tariff can vary depending on project capacity, projects with capacity >50MW get much lower payment	Feed-in tariff can vary depending on project capacity	Feed-in tariff can vary depending on project capacity	No
Capacity limits for connection to the grid	No	At least 100 MW to connect to 220 kV and 250 MW to connect to 400 kV.	Installations with installed capacity >50 MW connect to the transmission grid, others to the distribution grid	No	Might come for offshore wind farms (new rules regarding the grid connection of offshore wind farms under discussion)

1-2: Network connection procedure

	Sweden	Spain	Portugal	Germany	UK
Procedure Description	Detailed procedure for connection to the transmission grid but not well described for connection to the regional/local grid	Detailed procedure	Detailed procedure	The procedure is not clearly outlined in law, but legally renewable generation has the right to be connected.	Detailed procedure for transmission and distribution connection defined by National Grid, approved by Regulator
Deadlines	Defined deadlines for connection to transmission grid but not for connection to other grids.	Defined deadlines	Defined deadlines	Delays can cause complaints to regulator	Max. 3 months time to deal with application
Fees	None for transmission grid. For other grids it depends on the grid owner.	Yes, both for connection to the transmission and the distribution grid. 500 €/kW for solar photovoltaic ¹⁵³ and 20 €/kW for other renewables.	Yes, both for connection to the transmission and the distribution grid. 400 €/MW for study on available capacity and 500 €/kW for allocation of connection point.	No	Yes (depend upon size, type and location)

3-4: Network investment cost - 1

Who pays the costs for...	Sweden	Spain	Portugal	Germany	UK
Connection installations from wind farm on-shore to network connection point	Wind Farm Owner	Wind Farm Owner	Wind Farm Owner	Wind Farm Owner	Wind Farm Owner
Connection installations from wind farm off-shore to network connection point	Wind Farm Owner	Wind Farm Owner	Wind Farm Owner	Transmission Company	Independent Transmission Company (if the connection voltage is 130kV or higher)
Upgrades in the distribution network and regional network	Upgrades that benefit only the wind farm owner are paid by the wind farm owner. When upgrades benefit others then costs are shared.	Mainly paid by new power plant	Mainly paid by new power plant	Network companies	Generator and grid owner share costs

4: Network investment cost - 2

Who pays the costs for...	Sweden	Spain	Portugal	Germany	UK
Upgrades in the transmission network	Upgrades that benefit only the wind farm owner are paid by the wind farm owner. When upgrades benefit others (mainly in the 400 kV grid) then SvK pays a part or all costs.	Upgrades are paid by transmission company (socialized)	Upgrades are paid by transmission company (socialized)	Network companies (Costs are socialized between all customers in Germany)	Upgrades are paid by transmission company
Fees or deposits to be paid in relation to upgrade works	No	Yes, but only for upgrades in the transmission grid. 20% of the upgrading costs.	Yes, both for transmission and distribution grid when upgrading costs are accelerated, agreed between grid owner and wind farm owner.	No fees	Deposit equal to 2 year Use of System charge for transmission network upgrades

3-4: Network concessions

	Sweden	Spain	Portugal	Germany	UK
Can wind power producers build/own the power cables connecting the turbines within a wind farm?	No	Yes	Yes	Yes	Yes
Can wind power producers build the power lines connecting a wind farm to the distribution/transmission grid?	No	Yes	Yes	Yes	Yes

5: Metering requirements

	Sweden	Spain	Portugal	Germany	UK
Metering	Requirement of hourly measurement for all production.	No requirement of hourly measurement and possibility to choose between net-metering and im/export metering for small projects ¹⁵⁷ .	No requirement of hourly measurement for small projects connected to the low voltage grid (<1 kV).	15 min im/export, active/reactive metering for units larger 500 kW; for units smaller 500 kW only yearly energy metering required; net-metering for smaller units possible with agreement.	30 min im/export active/reactive metering; if export less than 16 amps/phase im/export metering required. Net-metering currently not possible, but discussed.

6: Network tariffs

	Sweden	Spain	Portugal	Germany	UK
Network Tariff for Power Producer	Yes, but also remuneration from grid owner*	No	No	No	Yes (Use of System charges) if connected to transmission system, but also remuneration from grid owner*

* Network tariffs in Sweden are defined in order to give locational signals which means that producers which reduce network losses receive economic compensation. This can result in negative network tariffs. This system is also used in the UK.

Priority Production and Curtailment Policy

	Sweden	Spain	Portugal	Germany	UK
When is curtailment possible?	Only via counter buying by SvK when wind farm owner has agreed to principal curtailment in advance	When there are nodes with capacity restrictions and security of the system.	When there are nodes with capacity or security restrictions	Only possible if wind farm owner has agreed to principal curtailment in advance	Only if wind farm has submitted a bid for the regulating market for down regulation
Payment for curtailed energy	Based on market price	For curtailment on real time operation: 15% of the electricity market price. For planned curtailment: no payment.	No payment	No payment	Based on the bid price for down-regulation submitted by the wind farm

Inquiry proposals

- Mention that certificate system is the absolutely most important factor for large scale expansion of renewable energy.
- Create a fund where producers can apply for financing of caused mainly upstream grid strengthening.
- No concession needed for internal wind farm grid
- Simplified rules for connection line only used by one producer
- Introduction of a “code of conduct” for grid connection
- Replace the 1,5 MW limit with a reduced grid tariff.
- Compulsory location dependent grid tariffs also on regional grids.
- Take away requirement of hourly measurements for small producers (<45 kW).
- Consider losses in the same way for grid tariffs on transmission and regional grids.