Wind Power Statistics and H_2-Evolution

How a Controlled Bypass Load Enhances Availability of Electric Wind Energy

mailto: hubert.bellm@gmail.com

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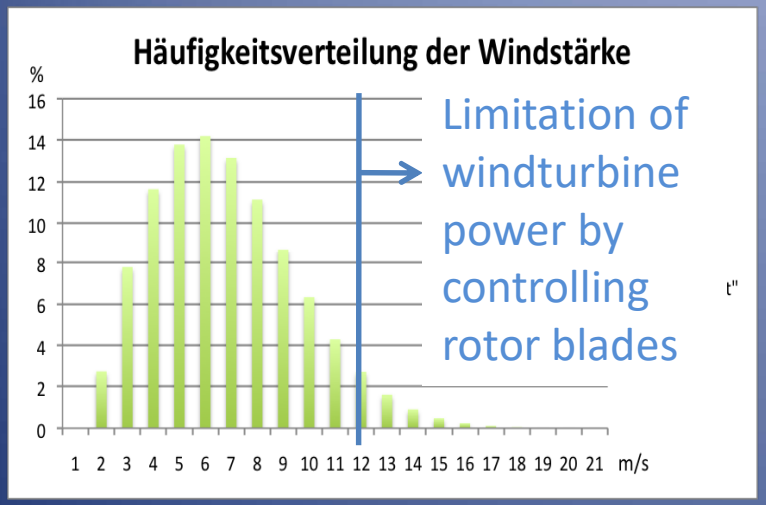
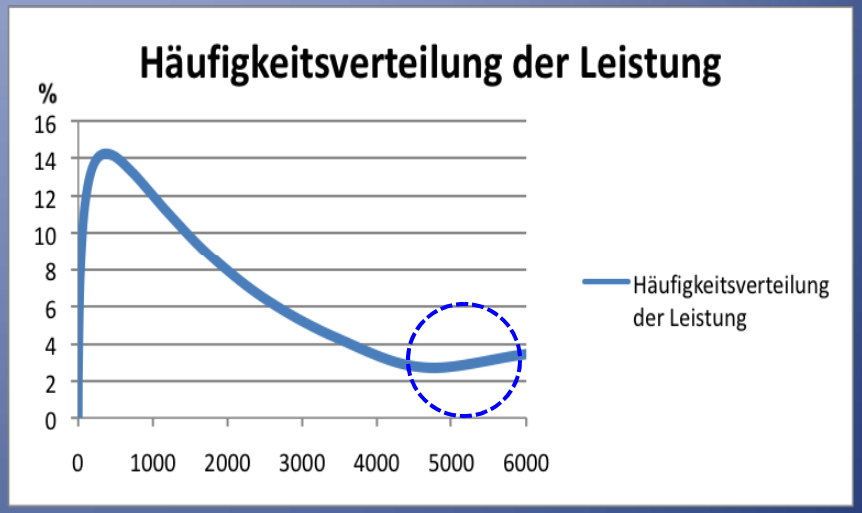
* Technical Power-Limit enhances Frequency of Occurence *

* This is realized today already! *



Example for the frequency of wind speed

(source: https://wind-data.ch/tools/weibull.php)



Calculated frequency of power based on data shown at left hand

Numbers must be treated as an example, because wind speed frequency strongly depends on the site of the windturbine !

Power scaled in relative units.

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Rare known Fact with Windturbines if Strong Wind is Blowing:

- Because power output of a windturbine increases with (windspeed)^3 offshore wind farms some times suffer a shut down 1) during stormy weather !
- This is due to a non controllable lesser power demand by the grid especially around 3 am.

1) Power controllability of a windturbine by its rotor blades usually is restricted to an interval between 12m/s and 25m/s windspeed. In this intervall it delivers constant maximum output power.

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Preventing Windturbine from Shutdown by Clipping Grid Fed Power by a Free Controllable Bypass-Load

- Possible workarounds to avoid the regrettable necessity of a shutdown are
  - Build long transmission lines from wind farms to power stations and dynamically reduce their output power during strong wind – if technical possible and economic reasonable,
  - Use a big controllable load nearby the wind farms to bypass grid fed power. Usually H_2-Evolution is choosen for this purpose 2),
    – H_2 is less valuable 3) than ready to use electric power, but easier transportable in big scale and STORABLE,
  - May be both possibilities …

2) https://new.siemens.com/global/de/produkte/energie/erneuerbare-energien/hydrogen-solutions.html

3) But compare this to the „value“ of a shutdown …

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Influence of Bypass Load on the Statistics of Availability

- Bypass controlling a wind farm enhances overall produced electric energy, because the necessity of shutdowns will be reduced.
- Bypass controlling also reduces the peak power requirements of dedicated transmission lines.
- Economic success of bypass controlling results from two sources:
  1. The value of additional grid fed electrical energy while avoid a shutdown by controlling grid fed peak power and
  2. the value of the produced Hydrogen.

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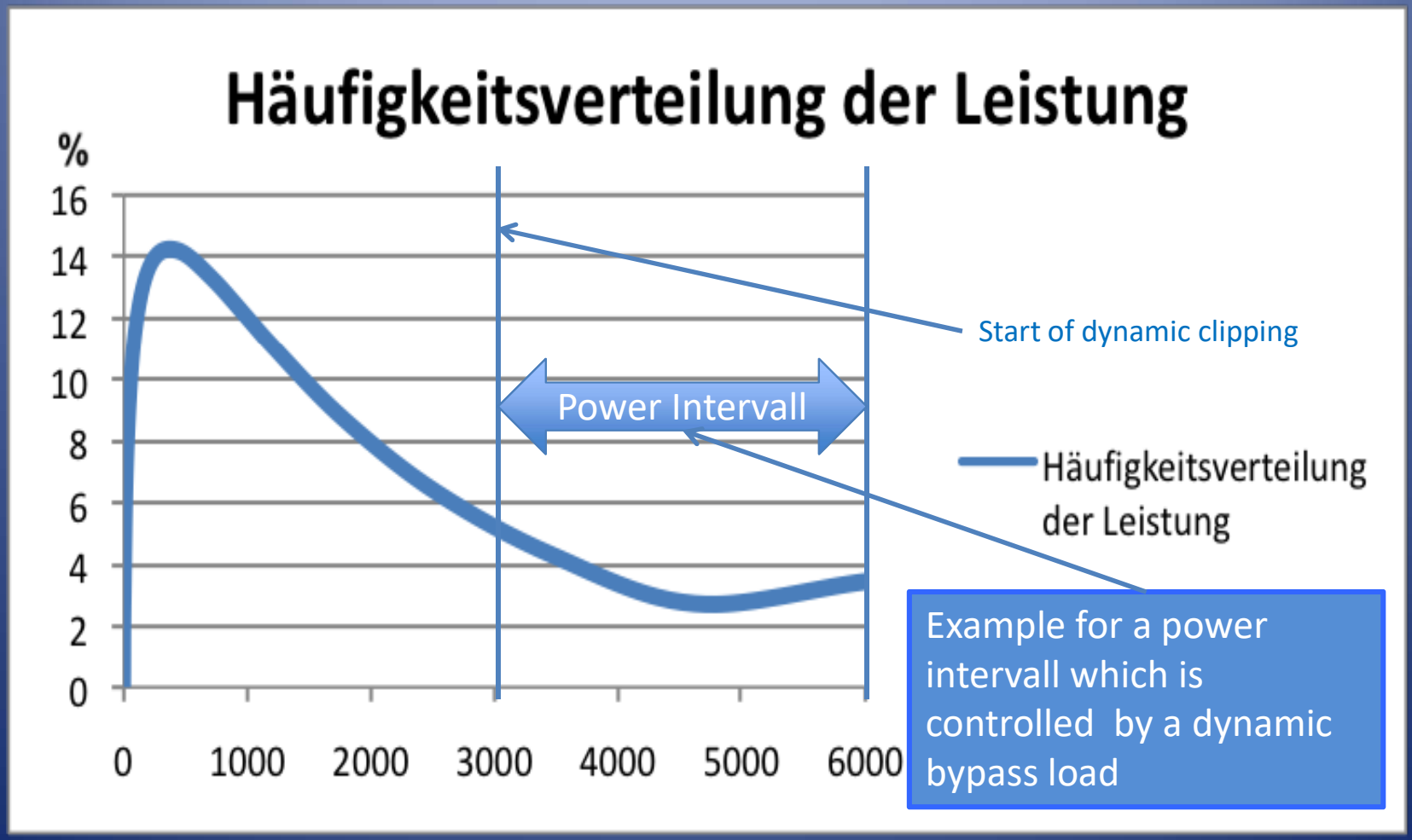
Suitable Power Intervall for Clipping Grid Fed Power by H_2-Evolution



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Simplified estimation of the amount of electric energy gained, while clipping the grid fed wind power by H_2-Evolution

1. Calculate the sum of produced electric energy if too much power due to weak demand and stormy weather causes a shutdown at 3000RU: 5675 Energy Units.
2. Calculate the sum of produced electric energy for the left and for the right intervall (were power will be clipped by H_2-Evolution at 3000RU): 8408 Energy Units.
   => We got a benefit of 2733 Energy Units (+48%) !
3. Calculate the sum of consumed power for the H_2-Evolution plant: 1460 Energy Units. This energy will be transformed to hydrogen and gives an additional benefit.

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Appendix: Tables of Data used for the Graphs

Assuming operating hours from frequency of occurence (100% => 8700h/y)

Windge-schwindig-keit v [m/s]	Dynamik der Leistung [RE]	Häufigkeit der Leistung [%]	Anteilig produzierte elektrische Energie [RE]	Produzierte elektrische Energie n. Begrenzung auf 3000 [RE]	Im Bypass verbrauchte elektrische Energie [RE]
0	0	0	0,0	0,0	0,0
1	3	2,75	0,8	0,8	0,0
2	28	7,80	18,9	18,9	0,0
3	94	11,64	94,9	94,9	0,0
4	222	13,79	266,6	266,6	0,0
5	434	14,20	536,2	536,2	0,0
6	750	13,15	858,0	858,0	0,0
7	1191	11,14	1154,3	1154,3	0,0
8	1778	8,72	1348,7	1348,7	0,0
9	2531	6,34	1396,2	1396,2	0,0
10	3472	4,30	1299,0	1122,3	176,7
11	4622	2,73	1097,7	712,5	385,1
12	6000	1,62	845,6	422,8	422,8
13	6000	0,91	475,0	237,5	237,5
14	6000	0,48	250,6	125,3	125,3
15	6000	0,24	125,3	62,6	62,6
16	6000	0,11	57,4	28,7	28,7
17	6000	0,05	26,1	13,1	13,1
18	6000	0,02	10,4	5,2	5,2
19	6000	0,01	5,2	2,6	2,6
20	6000	0,00	0,5	0,3	0,3
Summe		100,00	9867	8408	1460

Numbers should be treated as an example, because wind speed frequency strongly depends on the site of the windturbine !
Power and energy scaled in relative units.