Type B effects

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Initial thoughts: What does a wind turbine (not) do?

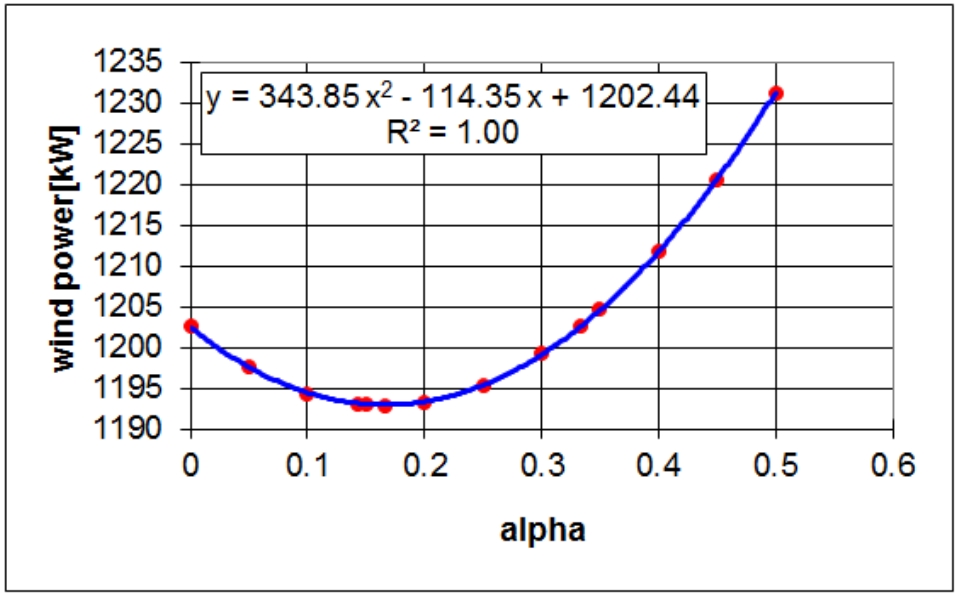
- Conversion of kinetic power (into mechanical power) into electric power.
  NOT: ~~Conversion of wind speed into electric power~~
- Efficiency is output/input, i.e. electric power divided by kinetic power.
- An investigation of "Type B" effects requires a close look at the "Type A" effects in advance. (In other words: To investigate the efficiency, we must first know what the actual kinetic power is.)

Why does shear reduce efficiency? (And what to keep in mind?)

- Shear causes a non-ideal angle of flow (towards blade) during the rotation (e.g. at lower and/or upper tip height).
- The overall shear coefficient alpha (of the rotor area) might not tell the full story.
- IEC 61400-12-1 Ed. 1 (2005) does not consider the effect of shear on average kinetic power of a 10-minute period.

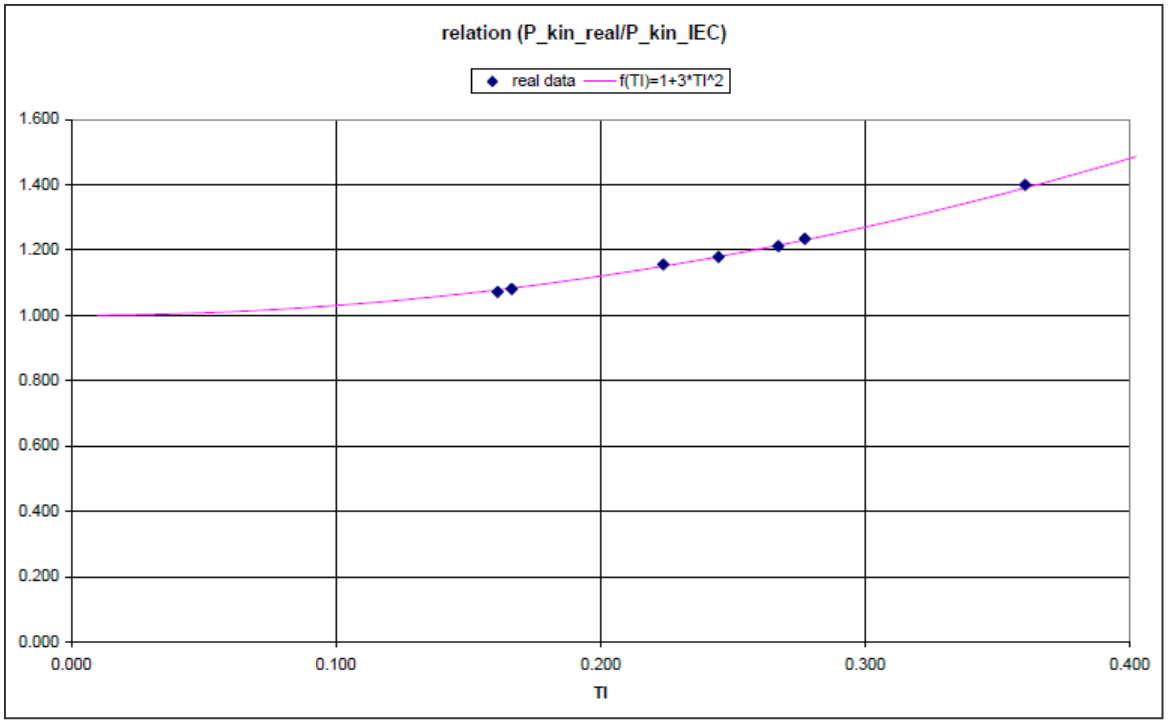
Assumption:

Parameter	Value	Unit
Hub height	50	m
Rotor diameter	50	m
Air density	1.225	kg/m^3
Wind speed (hub)	10	m/s



Why does TI reduce efficiency? (And what to keep in mind?)

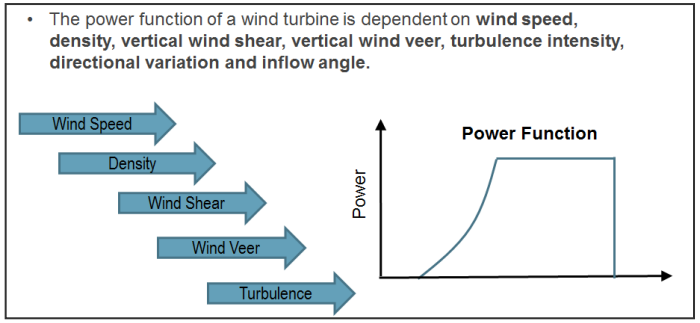
- TI causes a non-ideal angle of flow (towards blade) after every change of the wind speed.
- The TI percentage might not tell the full story.
- IEC 61400-12-1 Ed. 1 (2005) does not consider the effect of TI on average kinetic power of a 10-minute period.



What about veer?

- Veer causes a non-ideal angle of flow (towards blade) during the rotation.
- The significance of this issue depends on whether we consider (at each height) the horizontal wind speed or only the component which is vertical to the rotor.
- In veer-related discussions, the issue of yaw (mis-)alignment might be kept in mind.

Reconsideration of our existing approach

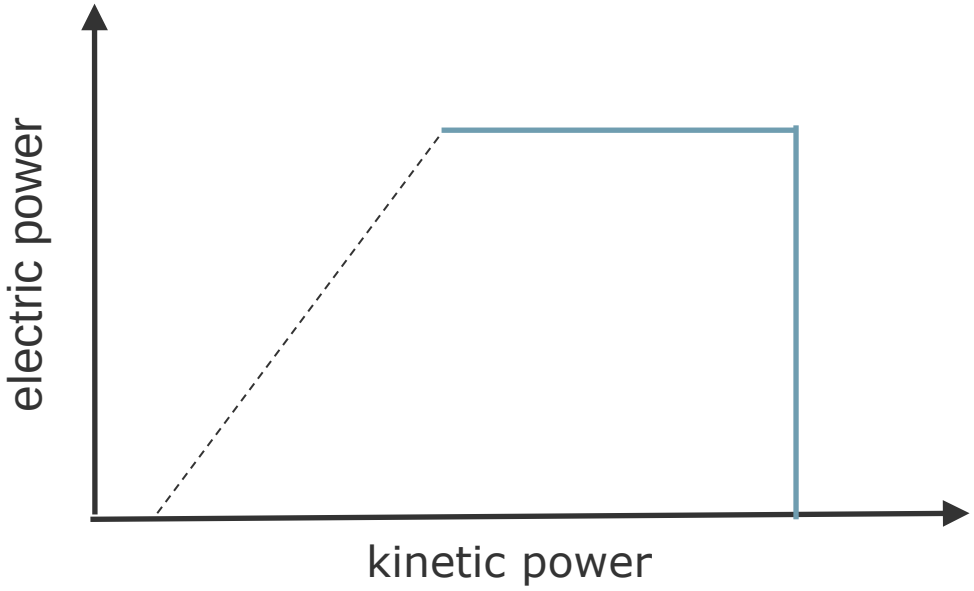


→ Why not say:

- The electric power function (vs. kinetic power) of a wind turbine under certain conditions depends on (and shows directly) the efficiency of the power conversion under these conditions.
- The kinetic power related to a certain area (i.e. rotor area) and to a certain averaging time (typically 10 minutes) is determined from the flow, with respect to speed, direction, and density (and under consideration of changes in terms of space and time). This can be done by means of "proxies" such as a shear value and a TI percentage, but it could (at least theoretically) also be done by a direct analysis (using a high resolution in terms of space and time).

Proposal for a new approach

- Let's try to create a new kind of power curve: electric power vs. kinetic power (instead of using various corrections on wind speed, in order to get a wind speed which represents the kinetic power correctly, and to plot electric power vs. this wind speed).



Thank you!

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