New technical strategies for the connection of wind power plants into the distribution networks

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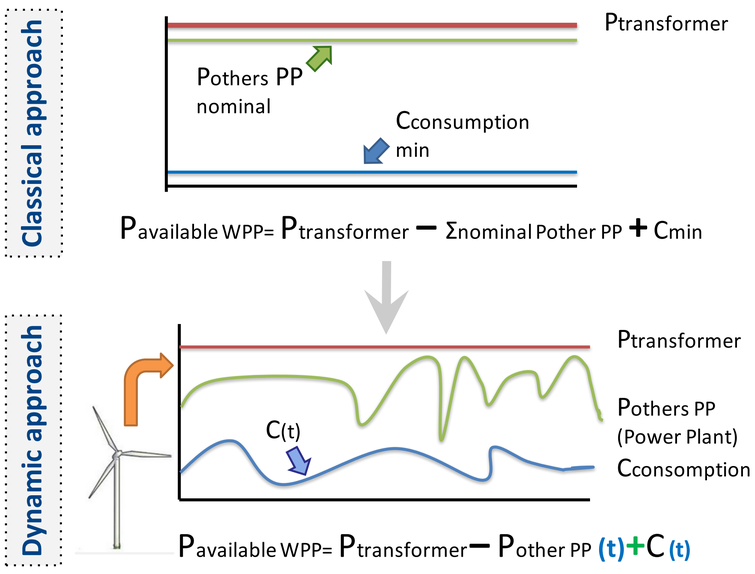
Abstract

High shared costs imposed by the mutualisation schemes implemented in France since 2012 could jeopardize the viability of some wind power plant projects. In parallel, locations of new projects are far from power substations also increasing costs for wind developers.
In this context,we propose **new strategies for the connection of wind power plants (WPP) into the distribution network** to increase the feasibility of new projects.

Objectives

- Optimize sizing of the electrical networks while integrating wind power into the grid
- Use a dynamic method and estimate the shortfall for the operator because of the wind power curtailment [2].



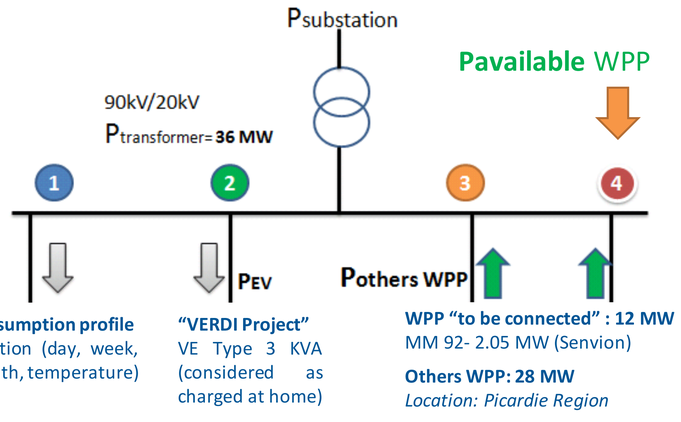
Graph n°1 : Expected evolution of the method of power allocation for new WPP connections

- Compare costs between different technical connection configurations by using cable sizes never used before by the french DSOs

Methods

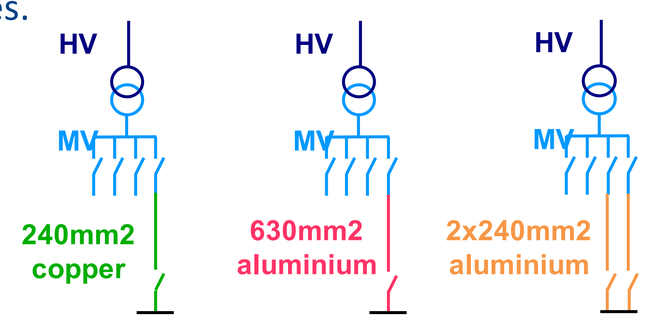
Case study n°1 : Economical optimisation of a 10,2MW Wind Power Plant connection

Case study n°2 : Connection of a 12MW Wind Power Plant to a 36MW substation (by comparing static case and dynamic case)



Graph n°2 : Details of case study n°2

Case study n°3 : Non-standard WPP connections to the distribution grid.
DSOs standards for a WPP (≤ 17 MW) connection are 240mm2 copper or aluminium. However, 630mm2 and 2x240mm2 aluminium are good candidates to lower total connection costs (investments and losses) while reducing losses.



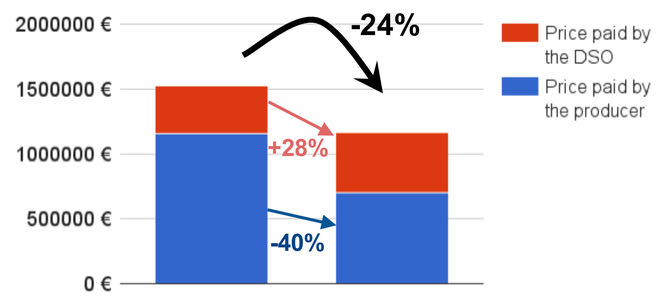
Graph n°3 : WPP connections to the distribution grid

Cable type	R20°C [Ω/km]	Imax (summer) [A]	Smax [MVA]
240mm2 - copper	0,075	504	17,46
630mm2 - aluminium	0,0469	665	23,04
2x240mm2 - aluminium	0,0625	790	27,37

Table n°1 : Technical data for each cable of the study

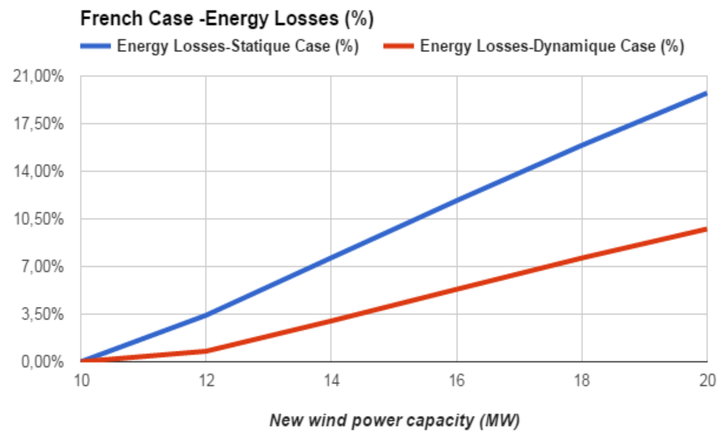
Results

1-Avoiding over-sized equipments on the WPP connection can generate substantial savings on the connection costs (24% in this example). However, well-sized equipments tend to increase losses and only the producer benefits from economical gains.



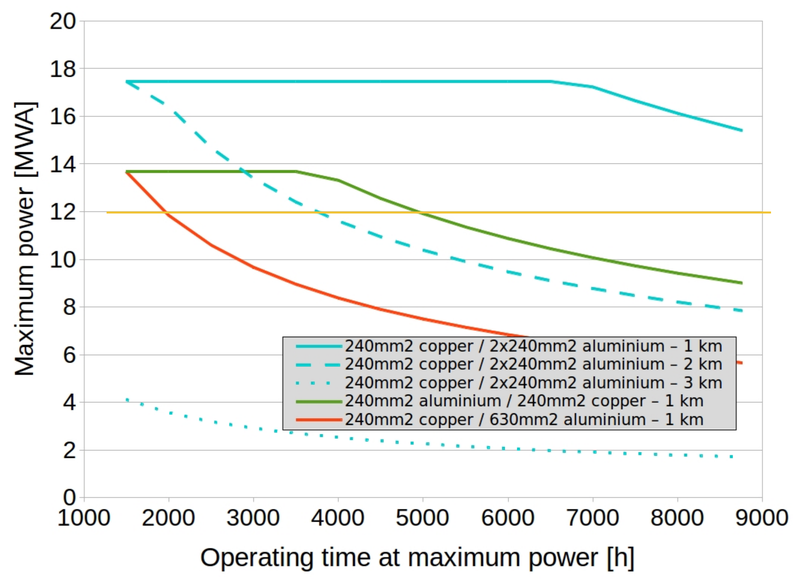
Graph n°4 : Economical gain by optimising the connection sizing

2-Turning available power capacity calculation into a dynamic allocation reduces significantly the energy losses and therefore the shortfall.



Graph n°5 : Energy losses for classical and dynamic approaches

3-Connection costs integrate cable supply and laying. The economical optimum is estimated by french DSOs by balancing losses costs and investments.



Graph n°6 : Power limits representing the economical balance between two connection configurations

Well-known for reducing losses the 240mm2 copper solution is never competing with 240mm2 aluminium in case of standard 12MW WPP connection.
The wind project owner could rather choose either 2x240mm2 or 630mm2 aluminum cables for distances over 2 km, avoiding a bigger amount of losses (-17% for the 2x240mm2 solution and up to -37% for the 630mm2 solution) than the 240mm2 copper solution while lowering the investment too.

Conclusions

Currently, the development of wind power requires high investment for electrical networks expansion while technical constraints are increasing. The proposals on new connections strategies allow finding a technical and economic optimum for both wind project owners and network operators. Furthermore, the implementation of new electrical configurations when connecting WPP requires willingness from operators to change technical standards. Moreover, the use of the available power capacity in an optimal way requires PLCs and measuring devices for exchange information between producers, consumers and networks operators. The implementation of new devices needs to be addressed in a smart grids context.

References

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