Tuning offshore wind performance:
ClusterDesign design and operational tool

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ClusterDesign

Abstract

In the ClusterDesign project (EC GA-230719) six partners in four countries work together in order to improve the capabilities to design and operate large offshore wind clusters. Their philosophy is as follows:

- To accurately predict the energy production and the fatigue-life consumption, the designer must take into account the interaction between wake losses and electrical losses.

- To take the maximum out of a wind farm, the operator needs to find a balance between energy production and fatigue-life consumption in a wind farm.

- The designer and the operator must take grid requirements into account.

This has led to the development of a design and operational toolbox, currently being validated at an offshore wind farm site.
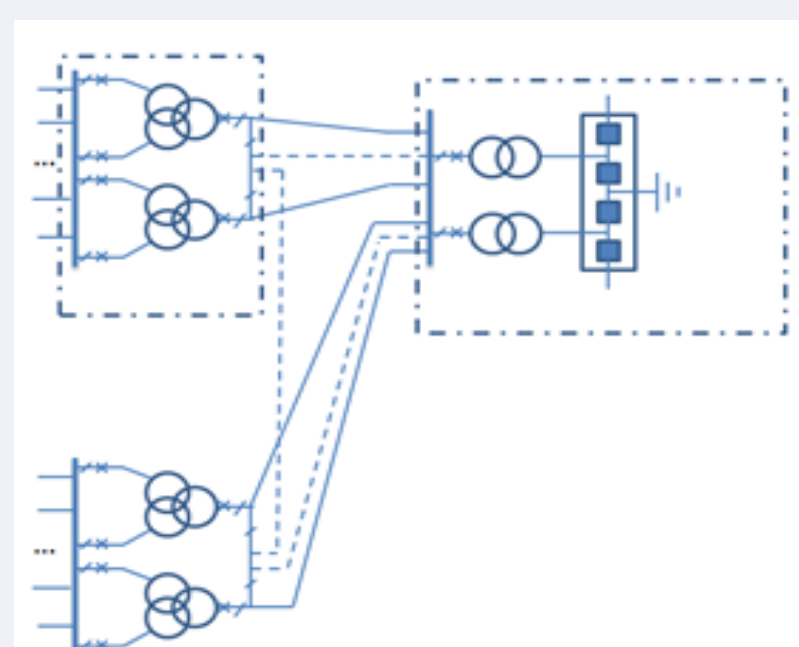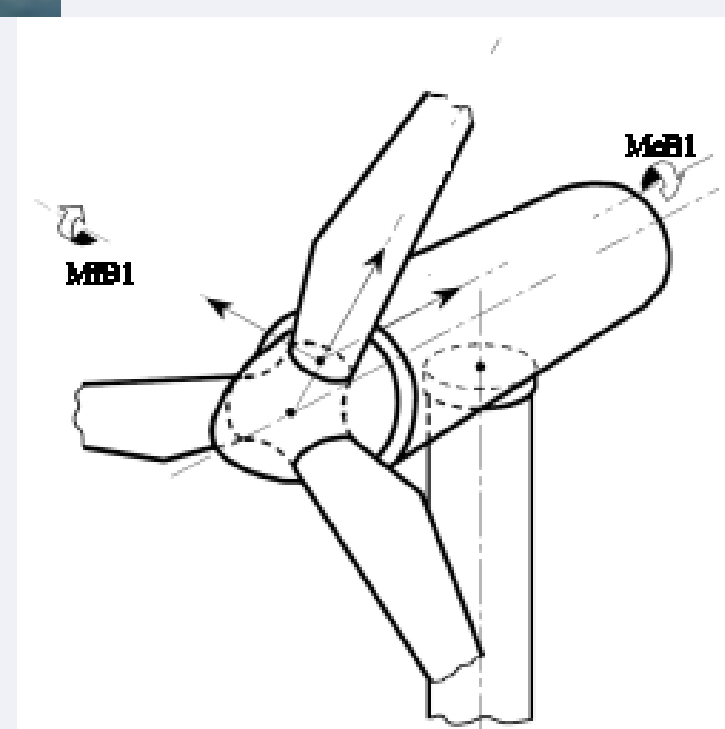
Toolbox Elements

The toolbox methodology breaks the task of wind farm clusters in 5 modelling steps:
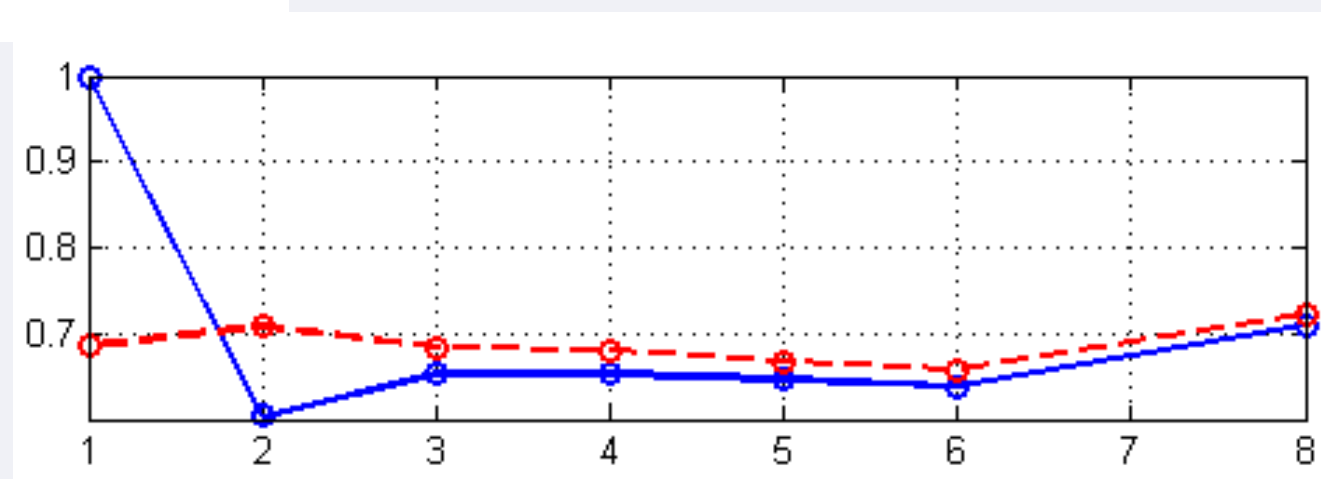
Regional resource estimation
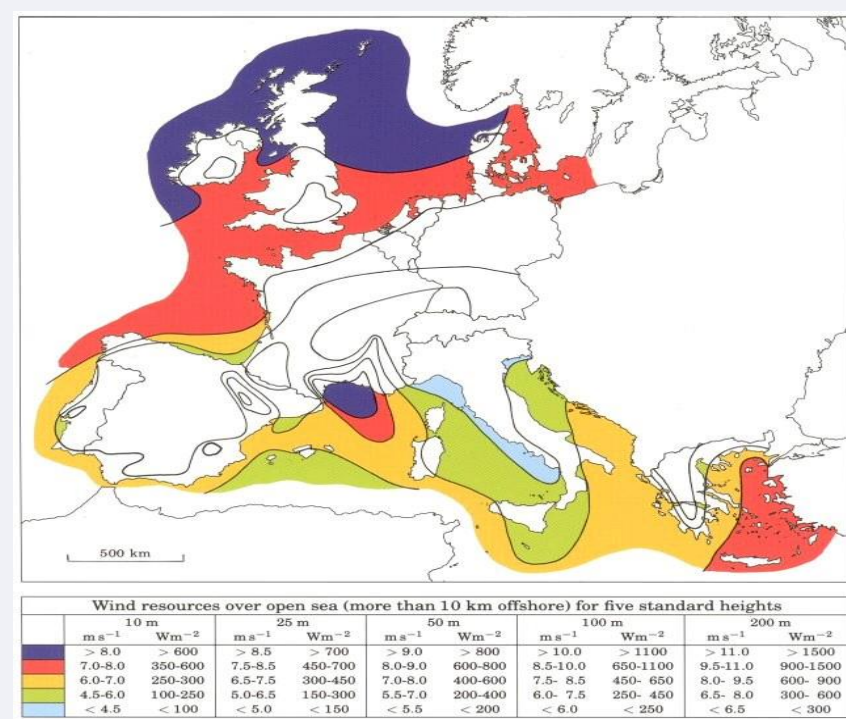
Inter- and intra-farm wake effects modelling

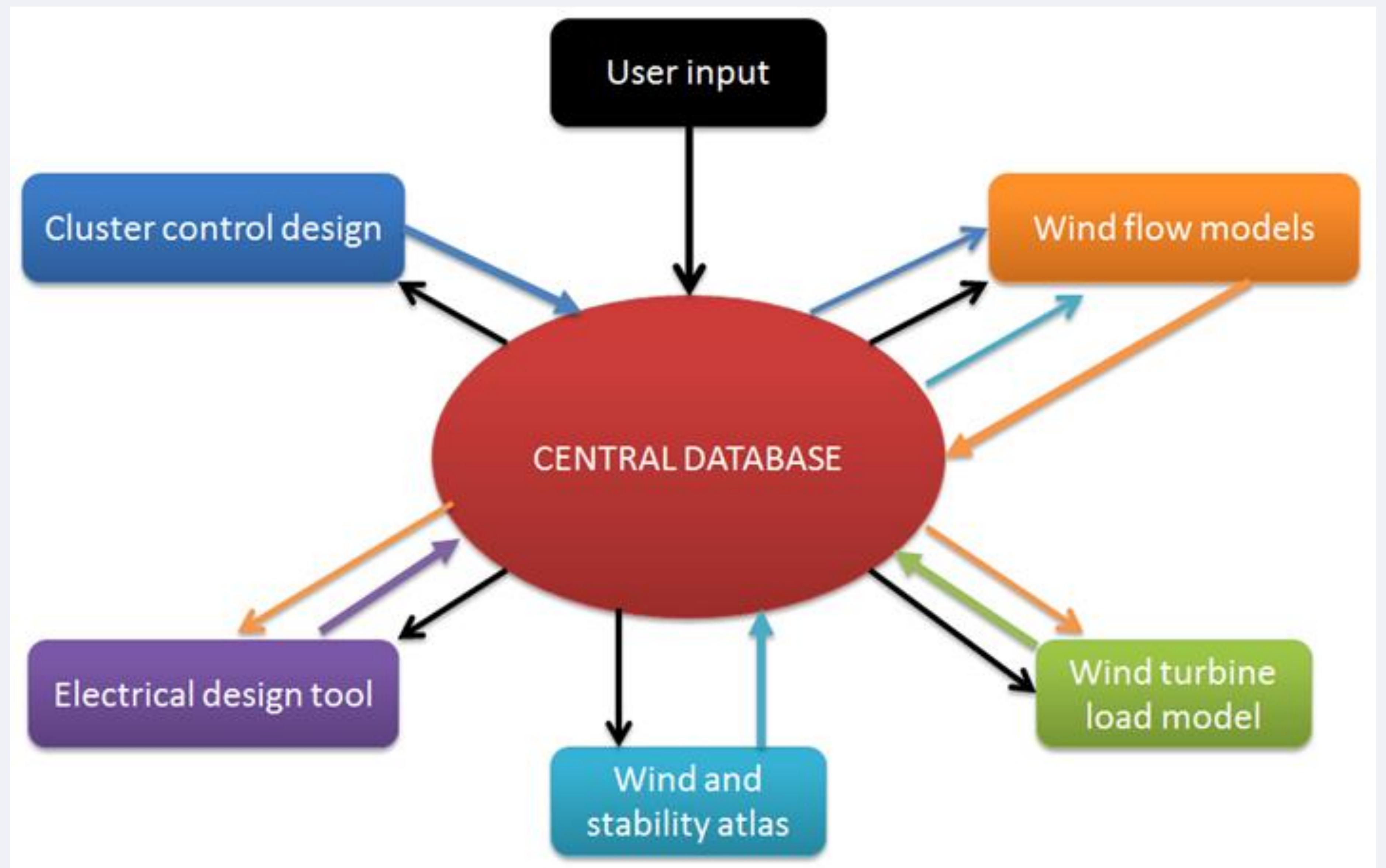Turbine production & mechanical loading modelling

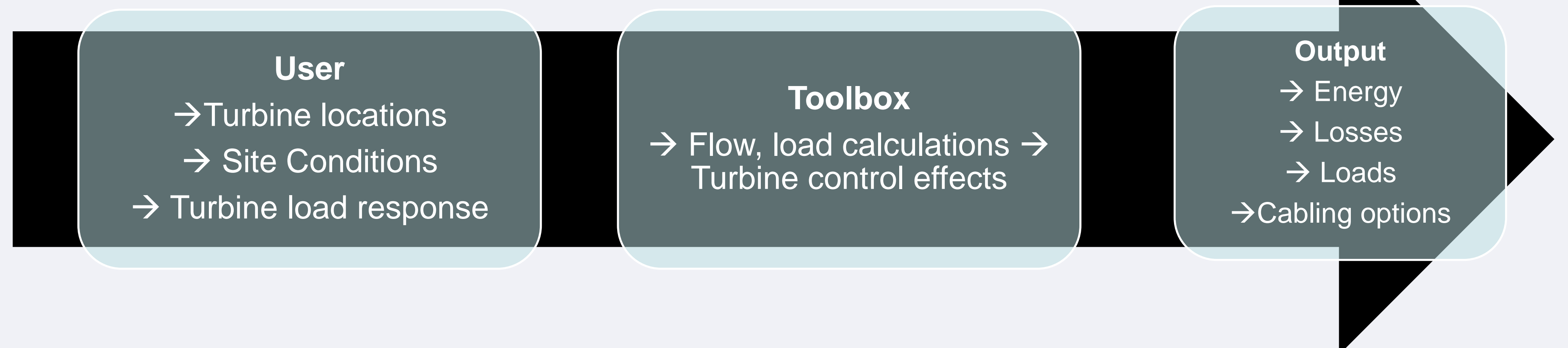Electrical topology and grid connection

Active Wake Control

These models are all integrated in an online platform allowing comparison of different layouts and operating strategies e.g. Active Wake control.
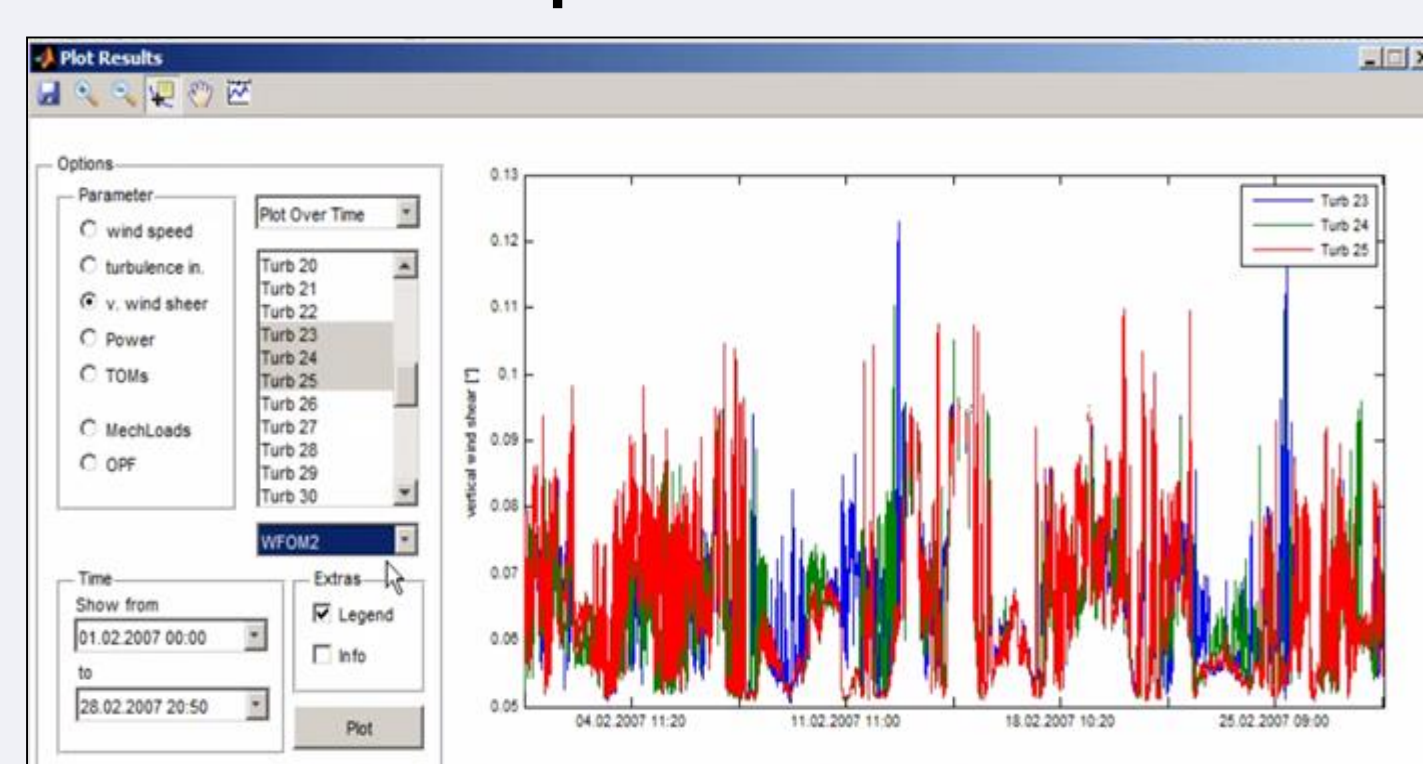
Data flows

- Each potential turbine configuration is evaluated for both load and production response to the environmental conditions

- All configurations can be compared with and without turbine control strategies

- A range of cabling options for each configuration are presented taking into account failure rates and lost production due to maintenance/repair

- Cabling element cost estimates are provided but can be changed by the users

- Modular open source coding allows incorporation of any flow/cost/load model

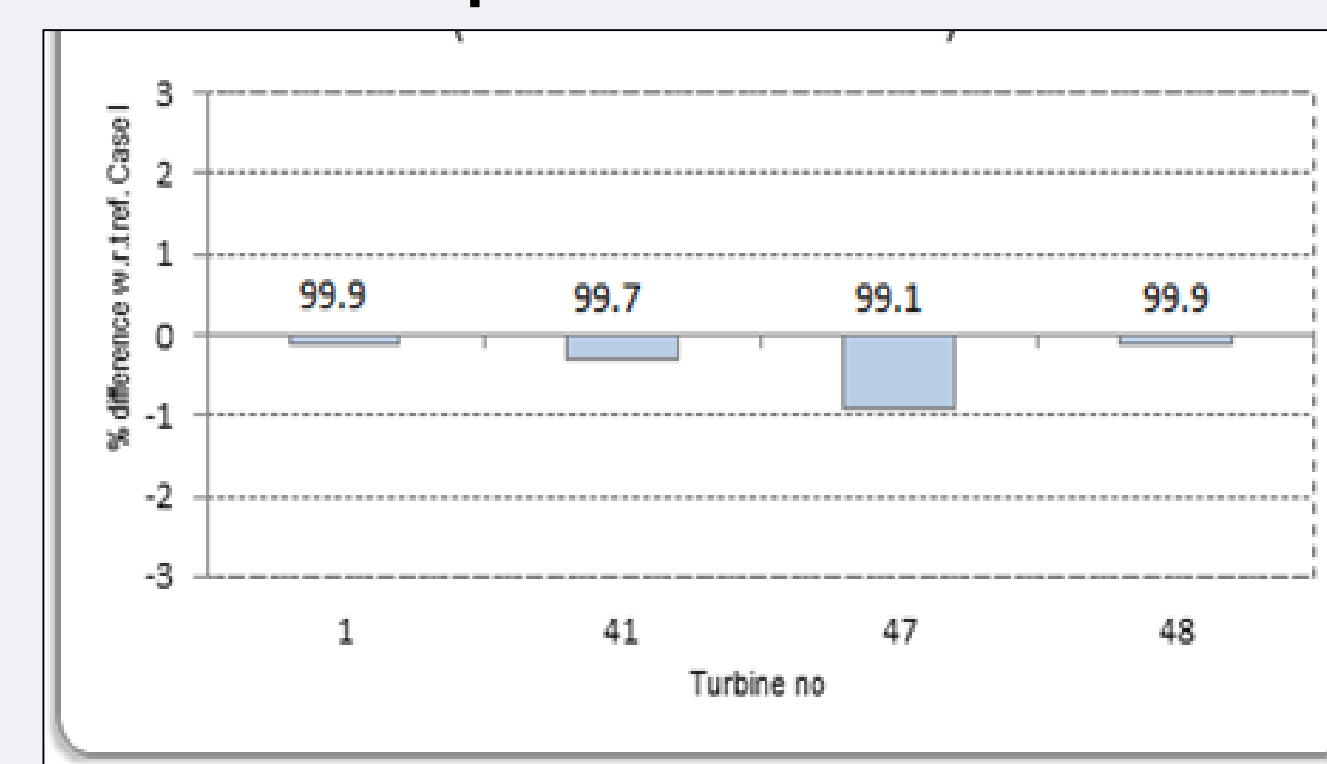- Modelled or measured resource data accepted

User
→Turbine locations
→ Site Conditions
→ Turbine load response

Toolbox
→ Flow, load calculations →
Turbine control effects

Output
→ Energy
→ Losses
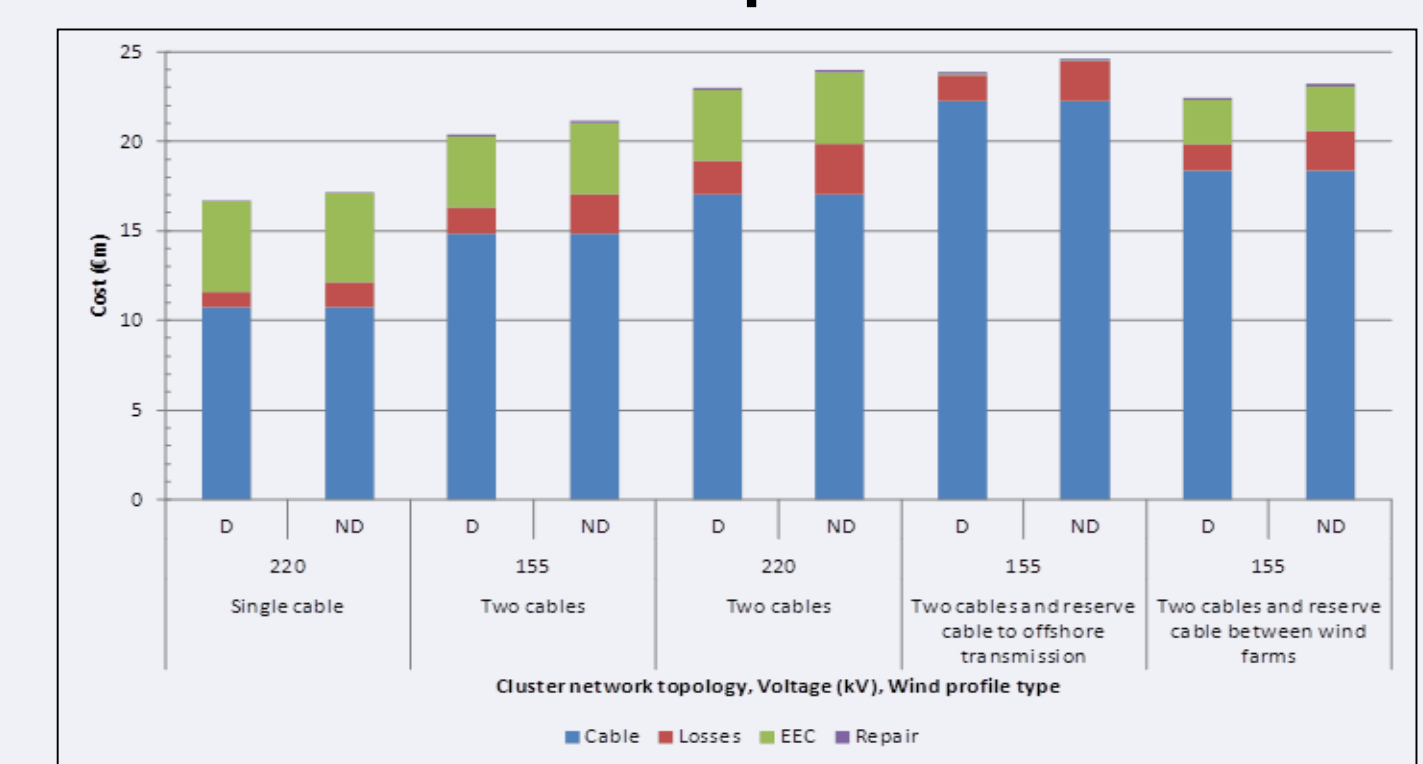→ Loads
→Cabling options

Outputs

Online interpolation tool

Comparative loads and production

Cabling Cost options

Conclusions

The ClusterDesign toolbox can be used by any operator/developer to gain valuable insights into the real costs and returns associated with a range of offshore cluster design options. The process of combining the many models together is greatly simplified allowing comparison of a wide range of configurations using engineering flow models and high precision assessments of selected configurations using research grade flow models.

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