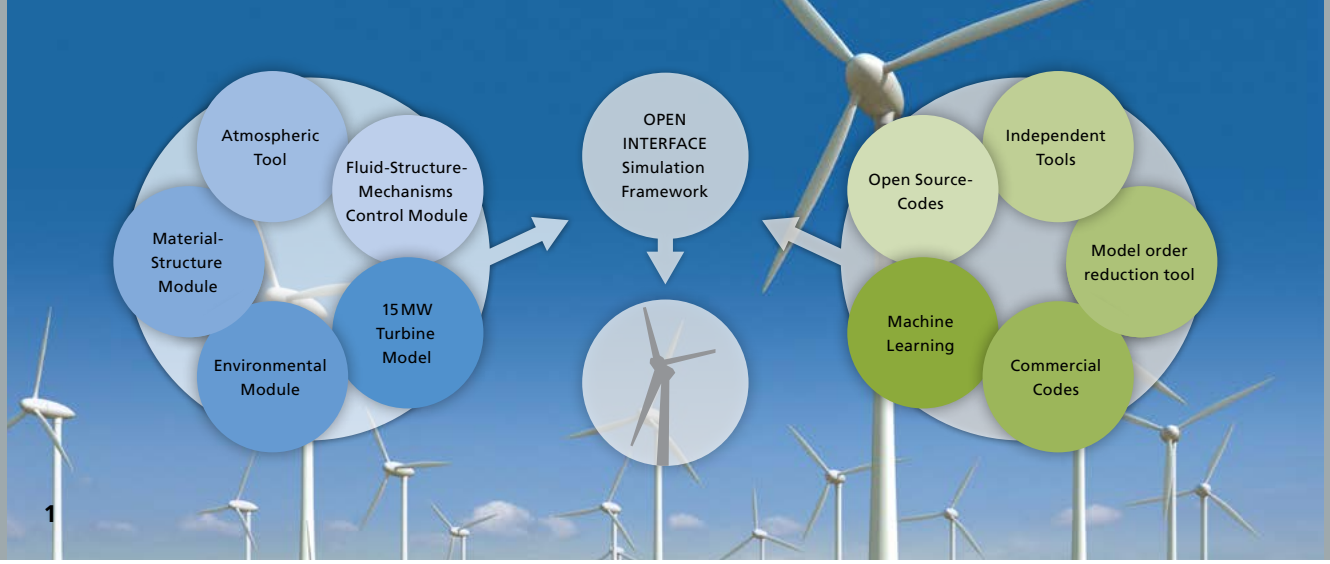

1 *Overall simulation of a wind farm*

UPWARDS – SIMULATION OF THE PHYSICS OF WIND TURBINES AND ROTOR DYNAMICS

The EU project »UPWARDS - Understanding of the Physics of Wind Turbine and Rotor Dynamics through an Integrated Simulation Framework« was launched in April 2018 with the aim of enabling the development of bigger and better designed wind turbines and thus increasing wind energy capacities throughout Europe and the rest of the world.

This goal will be pursued through the development of the next generation of multiphysical simulations specializing in wind flow, turbine mechanics and their interactions. These simulation tools enable a more cost-effective and faster development of prototypes for wind turbines.

UPWARDS is of strategic importance for the future of sustainable development in Europe and is implemented by a consortium of eleven partners (companies, research institutions and universities) from eight countries and two continents.

Road to more efficient wind turbines

The most important challenges for the development of larger and more efficient wind turbines are:

- Turbulence originating from atmospheric conditions, terrain or wind turbine wake that causes significant fatigue on the rotors
- As rotors become larger the tip speeds increase, resulting in more noise that potentially prohibit use in many onshore locations
- Longer and more slender blades will experience more bending that results in complex, dynamic stresses that need to be accounted for in structural design and material qualification.

Added value through mathematical and computer science methods

Fraunhofer ITWM is developing an integrated simulation platform for the individual software modules; these simulate wind turbines and wind farms with high precision, including wind flow, fully coupled fluid structure interaction, system fatigue and sound propagation.

Methods of model order reduction and high performance computing generate precise simulation results of the relevant system behavior in a short computing time. Machine learning methods are used to identify correlations between important phenomena such as inflow and turbine wind, rotor noise and failure of the composite materials in order to optimize the performance of the associated wind turbines.