

## **Development of design software for wind energy applications.**

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The developments in wind energy are going fast. The installed power is increasing rapidly with growth rates between 30% and 50%. At the same time, the size of wind turbines are growing. The growth is realized although when the size is doubled, the generated power is increased by four while the mass grows with a factor of eight. The only reason that the growth has been made possible while cost of energy is still decreasing is the continuous implementation of innovations in modern wind turbines. This talk will highlight the current developments, and show improvements in code development. The codes range from engineering approach for the required design calculations to more accurate codes for scientific purposes. The group rotor&farm aerodynamics of ECN Wind Energy is developing advanced tools for accurate simulations of wind turbine rotors and the flow through and around large wind farms, or wind farm clusters. Some ECN innovations to optimize large offshore wind farms are explained: wind turbines are no longer controlled to extract maximum energy from the flow, but the wind farm is optimized to extract maximum power as a whole.