CONCERT

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Control and Uncertainties in Real-Time Power Curves of Offshore Wind Power Plants

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## WP3 : Multi-Objective Wind Farm Control

Develop Wind Power Plant controller that will combine several objectives: increase power production through down-regulation of the most upstream wind turbines, to extend wind turbines lifetime through better load management and to provide cost efficient upward regulation taking uncertainties into account by optimizing the individual wind turbine set points

- A real-time load estimation procedure[1]
- Development of WPP controller[2]
- Integration and implementation of the dynamic WPP controller[2]

WP1 : Preparation, Market investigation, Literature Review

Study the state of art to form a basis for **WP2**

- Literature survey on Uncertainty Quantification & propagation & reduction
- Selection of candidate models & implement on historical data

WP0 : Management & Dissemination

Drive the project forward, report to the funding agency and to resolve upcoming issues

- Reporting & Management
- Employment of Personnel
- Dissemination
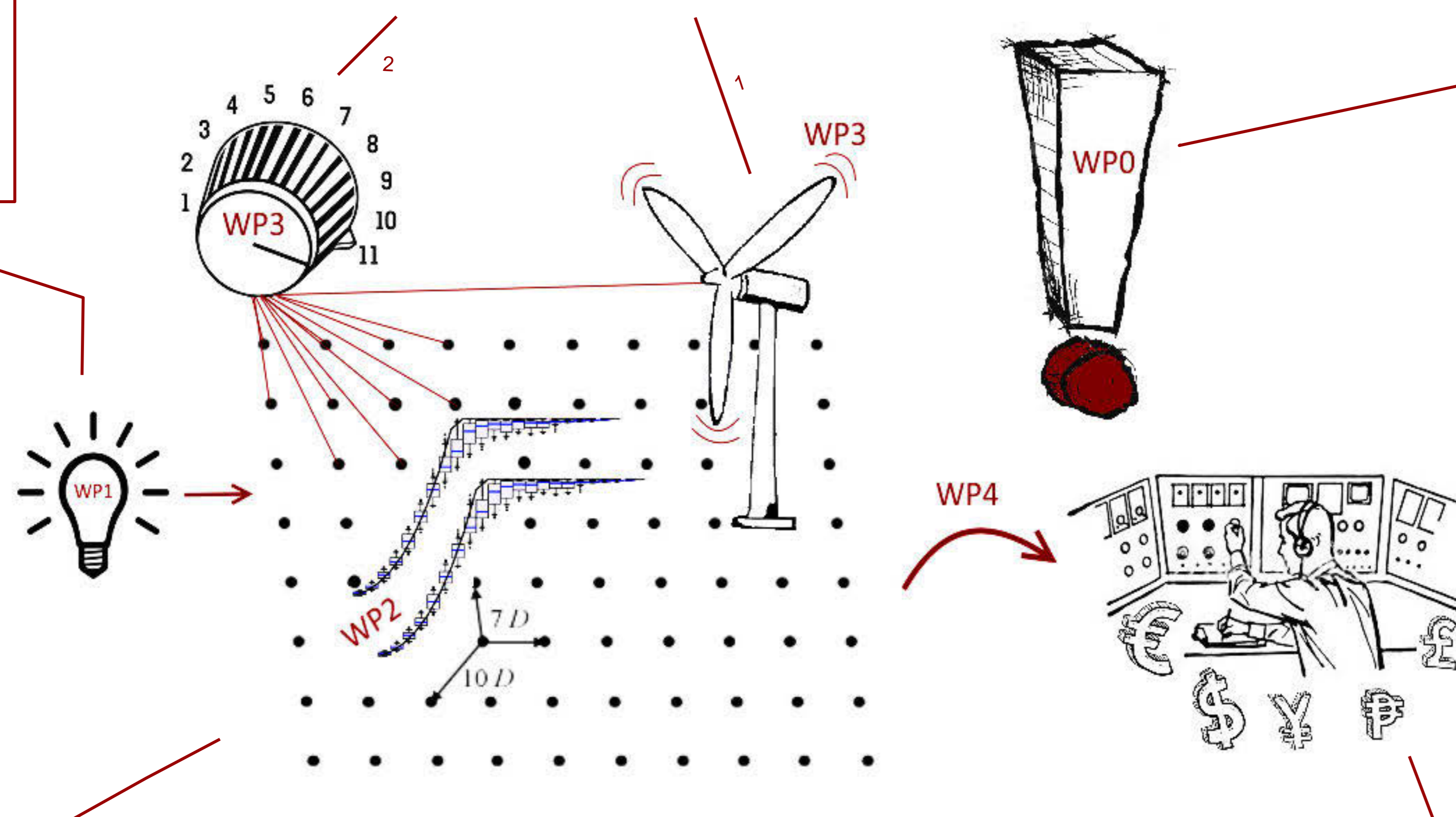
WP4 : Experimental Verification & Trading Market Aspects

Assess the economic outcome of the reduced uncertainty in WP2 and investigate the market structure after WP3 is implemented

- Full-scale downregulation experiments to test outcomes of **WP3** & validation
- Demonstration of the economic outcome of **WP2**
- Analysis of the market structure with the smart active wind farm control execution

WP2 : Estimation and Mitigation of Uncertainty in (Available) Active Power

Develop the uncertainty module using the literature survey performed in WP1 for both online and forecast power

- Uncertainty Quantification for the real-time available power
- Convolution of the uncertainty in the real-time power & forecast available power
- Enhancement of the available power algorithm (both forecast and real-time) using machine learning uncertainty reduction techniques

Follow-up Project of PossPOW (ForskEL 10763)

Verified and accepted way to estimate the Possible / Available Power of Down-Regulated offshore wind farms

- Estimation of wind speed using power, pitch & rotational speed using SCADA @ upstream turbines
- Advect the wind speed along the wind farm via real-time wake modelling
- Full-scale experiments in Horns Rev-I & final validation
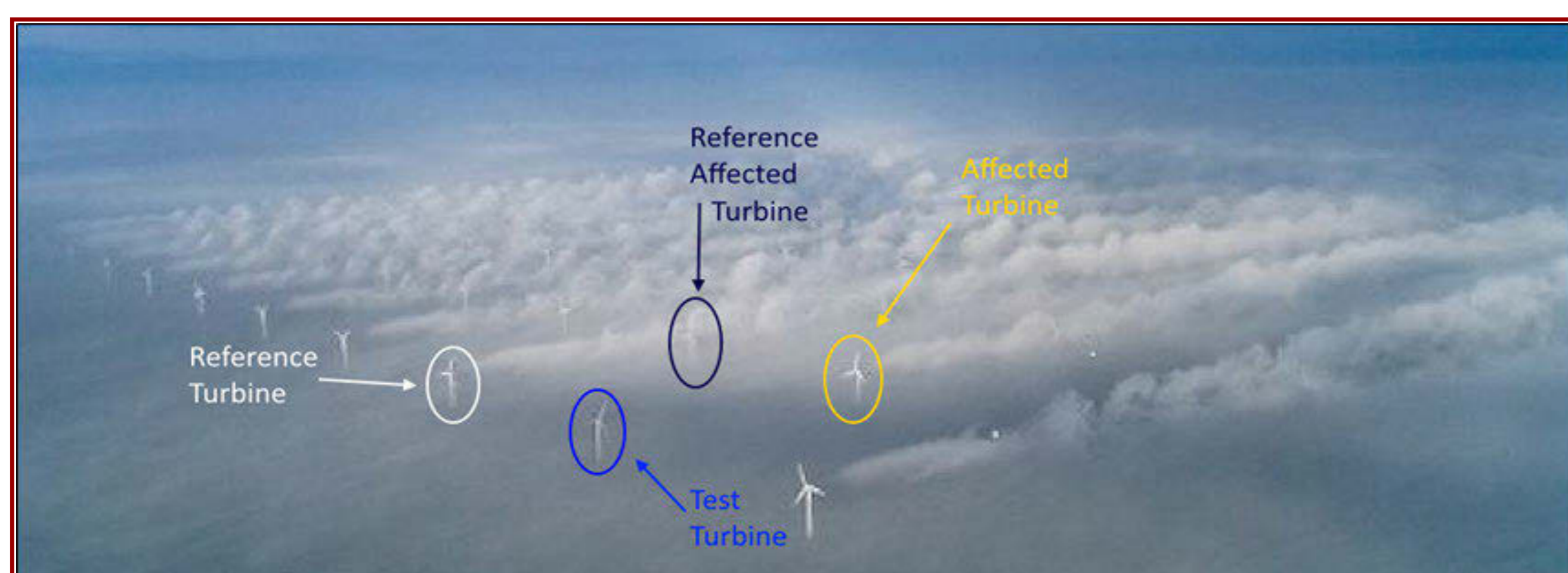
in normal operation:
$$Available\ Power_{Test\ Turbine} = Active\ Power_{Reference\ Turbine}$$
due to upstream curtailment:
$$Active\ Power_{Affected\ Turbine} > Active\ Power_{Ref.\ Affected\ Turbine}$$
what should be in normal operation:
$$Available\ Power_{Affected\ Turbine} = Active\ Power_{Ref.\ Affected\ Turbine}$$