



CL-Windcon

Closed Loop Wind Farm Control

4th Workshop on Systems Engineering for Wind Energy
13th – 15th September, 2017
Roskilde (Denmark)

Mikel Iribas
CENER



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727477



CL-Windcon

CLOSED LOOP WIND FARM CONTROL

- H2020 European funded project
- Coordinator: National Renewable Energy Centre of Spain (CENER)
- 14 partners from 6 European countries (Universities, technological centers, industry)
- Duration: November 2016 – October 2019 (36 months)
- Total cost: 4.931.422,50 EUR

Aerodynamic wind farm control: CL-Windcon will address **multi-fidelity dynamic modelling** and **open and closed-loop advanced control algorithms at a farm level** by treating the entire wind farm as a comprehensive real-time optimization problem.

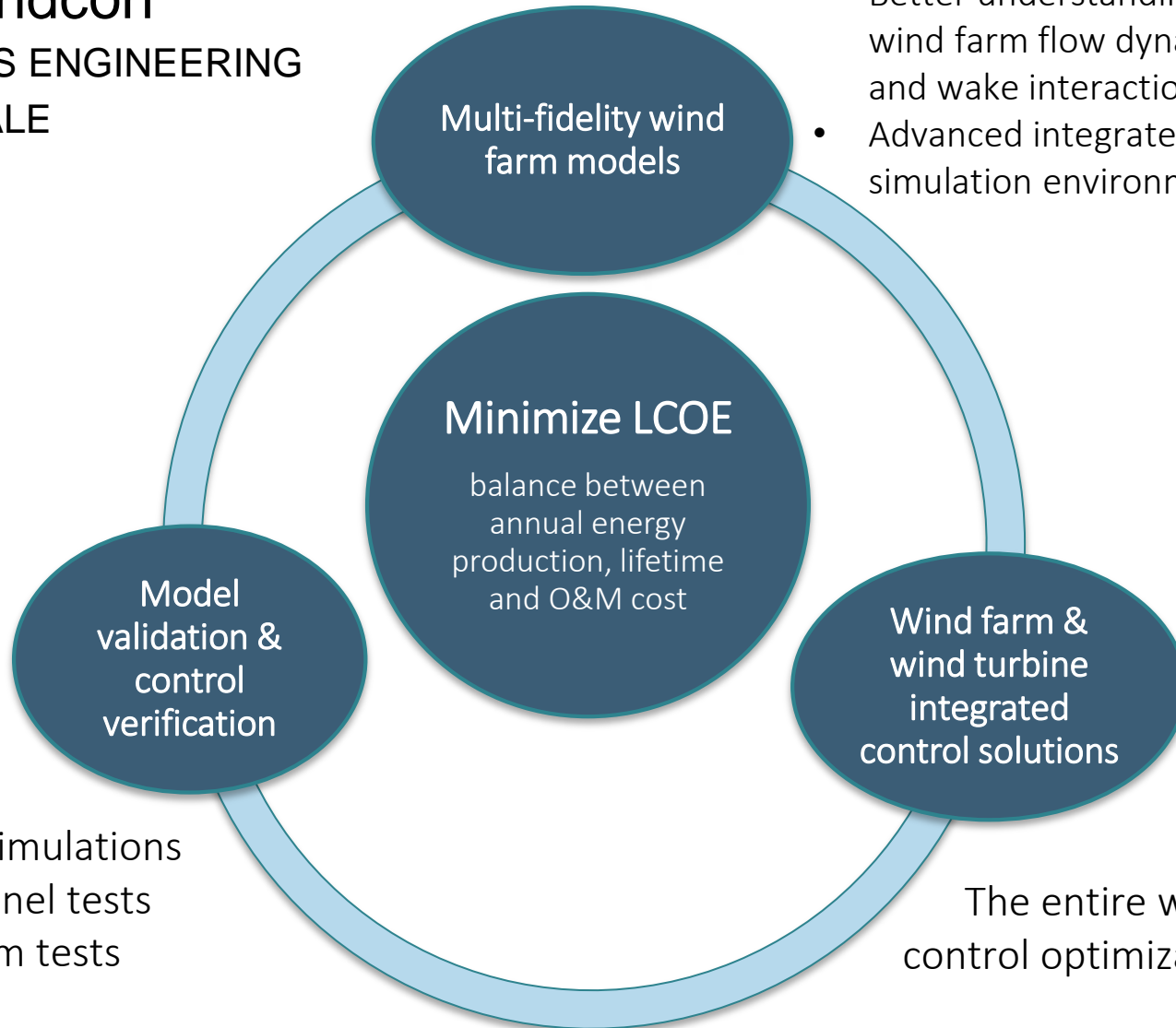




CL-Windcon

SYSTEMS ENGINEERING RATIONALE

- Better understanding of wind farm flow dynamics and wake interactions
- Advanced integrated simulation environments



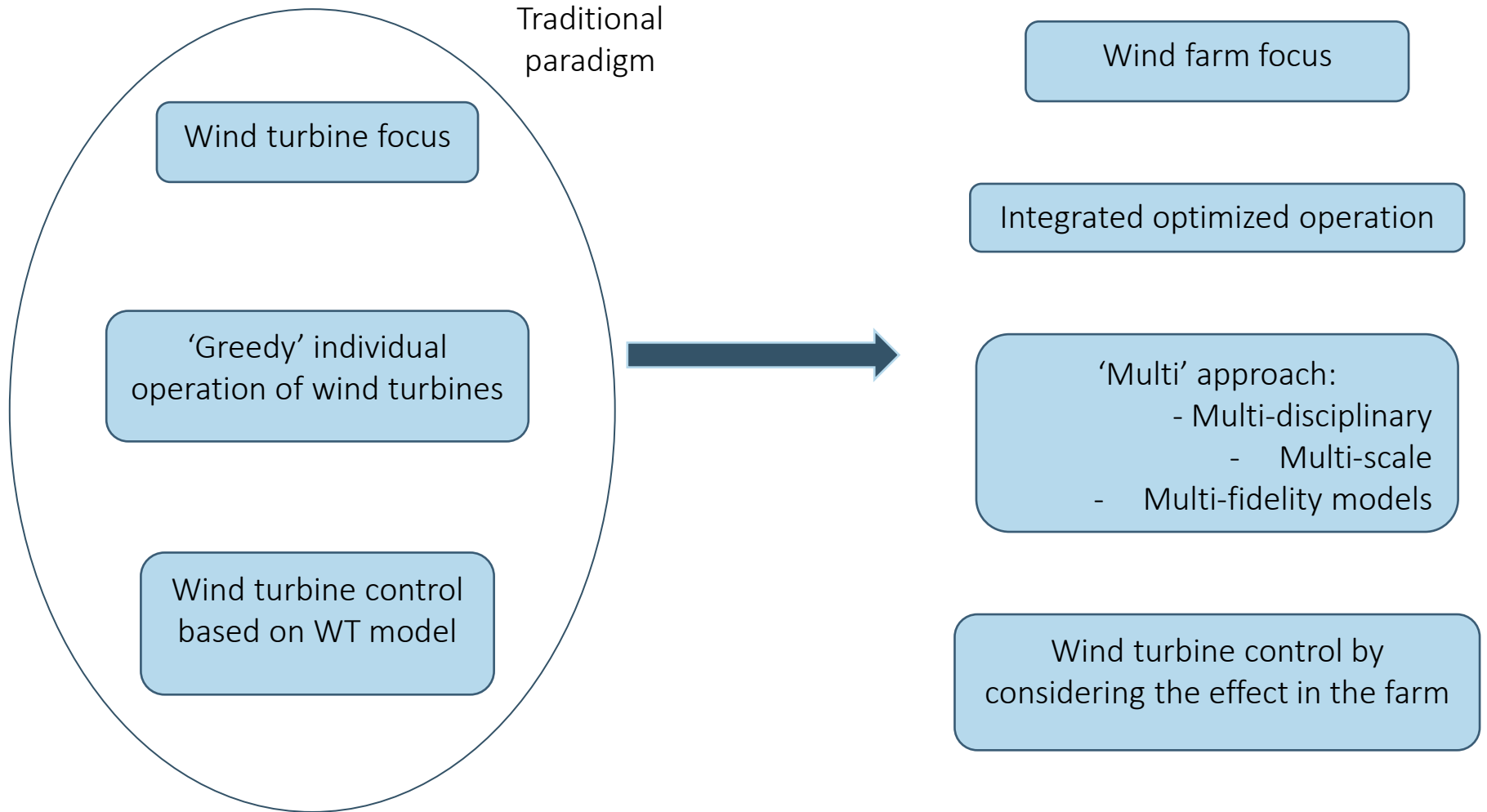
- SOWFA simulations
- Wind tunnel tests
- Wind farm tests

The entire wind plant as a control optimization problem



CL-Windcon

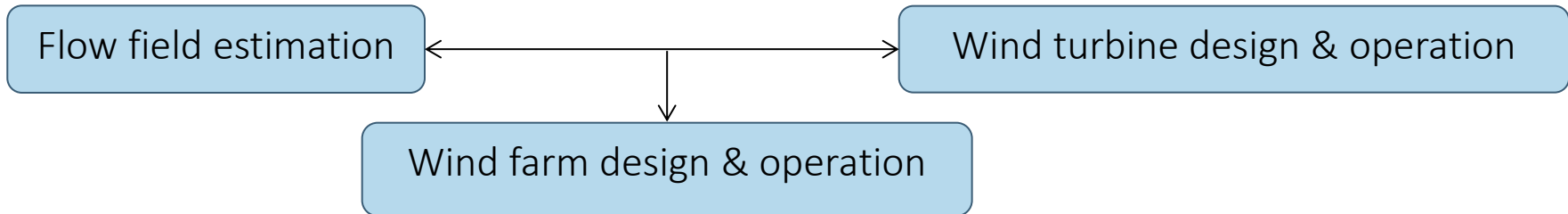
PARADIGM SHIFT





CL-Windcon

CHALLENGES




- Integration of different temporal and spatial scales and model fidelities
- Validation of CFD models against:
 - Wind tunnel tests
 - Wind field data
- Comparison among different multi-fidelity models: from CFD to control-oriented engineering models
- Multiple criteria optimization: production maximization & minimal loading by acting on aerodynamic interaction
- Unusual points of operation for wind turbines (e.g. yaw redirection)
- Control verification of different strategies: yaw redirection, derating

CL-Windcon

PLANNING



 CL-Windcon	2016		2017												2018												2019											
	November	December	January	February	March	April	May	June	July	August	September	October	November	December	January	February	March	April	May	June	July	August	September	October	November	December	January	February	March	April	May	June	July	August	September	October	November	December
WP1	Wind farm control-oriented model development																																					
WP2			Wind Farm Flow technologies and algorithms																																			
WP3	Demostration and Validation of Prototypes																																					
WP4													Feasibility																									
WP5	IPR, Exploitation, Dissemination and Communication of results																																					
WP6	Management																																					
WP7	Ethics requirements																																					



CL-Windcon

CURRENT STATUS

- Tasks already performed:
 - Definition of reference wind farms, simulation scenarios and use cases
 - Definition of the preliminary test matrix for wind tunnel experiments (wake characterization and tool validation). First tunnel tests performed.
 - Common pre- and post-processor for wind farm simulations
- On-going work:
 - Evolution of a set of multi-fidelity wind farm modeling tools, setting an adequate comparison framework
 - Creation of SOWFA reference simulation environment
 - Optimal wind turbine control strategies aimed at wind farm control
 - Wind farm control strategies (axial induction, wake redirection)
 - Detailed planning of full scale testing

THANK YOU!



miribas@cener.com

www.clwindcon.eu



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727477