



DIGITAL TWINS OF WIND TURBINES

BENEFITS FOR OFFSHORE WIND PROJECTS

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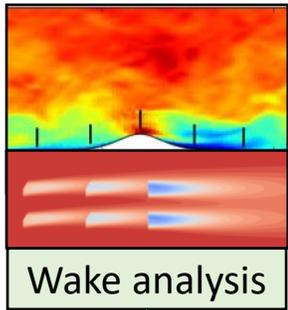
#4 GREEN FUTURE SOLUTIONS



IFPEN : AN INNOVATION DRIVEN PLAYER IN THE FIELD OF ENERGY, WITH A STRONG FOCUS ON OFFSHORE WIND

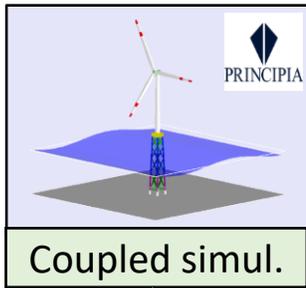
NEW ENERGIES

FarmShadow™



Wake analysis

DeepLines Wind™



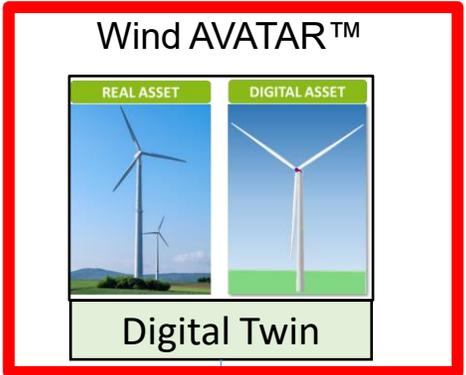
Coupled simul.



TLP Floater



Cable Eng.



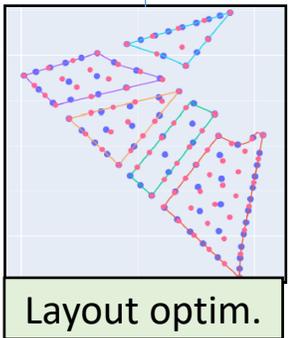
Wind AVATAR™



Digital Twin



Lidar analysis

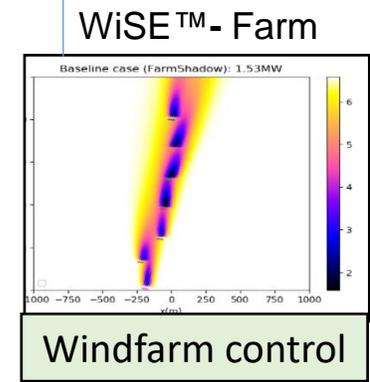


Layout optim.



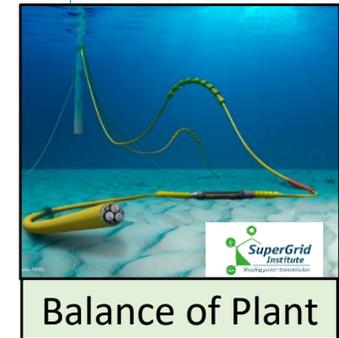
WISE™ - Control

Lidar Ass. Control

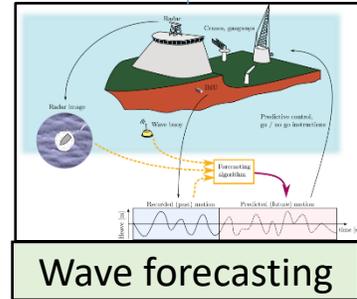


WiSE™- Farm

Windfarm control



Balance of Plant



Wave forecasting

Main figures

Over 10 years experience
30 FTE permanent experts and
5-10 PhD students and Post-Doc

Our network



WIND AVATAR® DIGITAL TWIN FOR OFFSHORE WIND WHY ?

Context

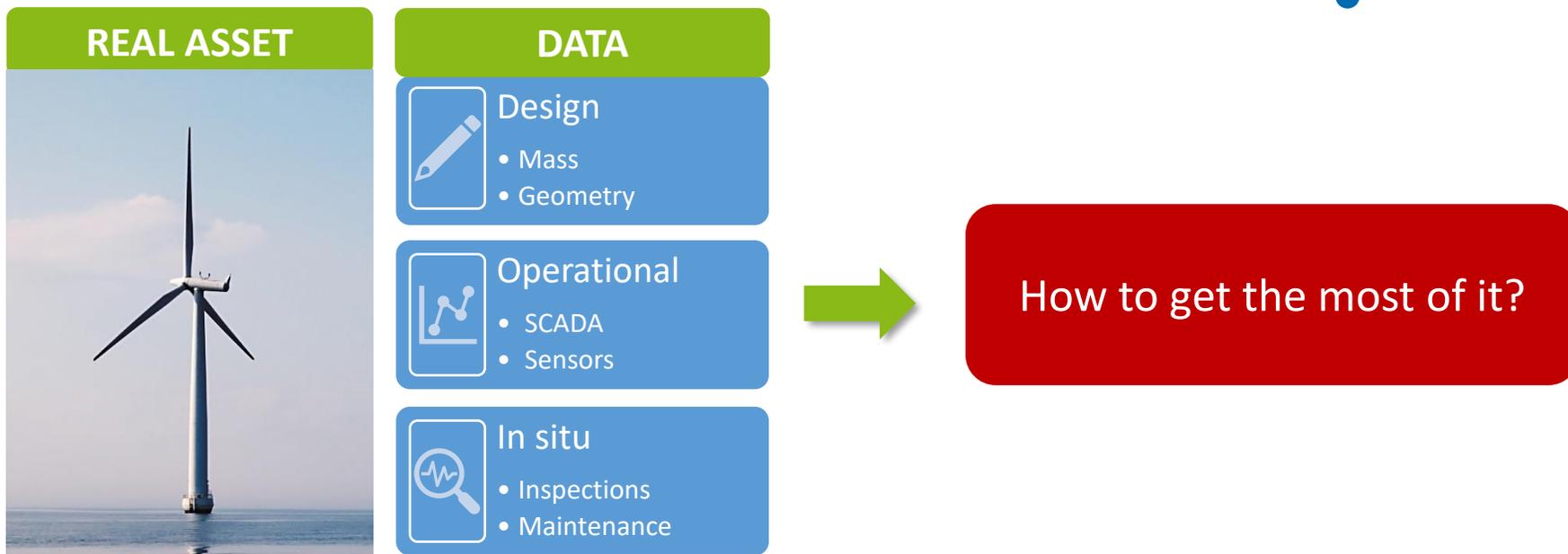
- Subsidy-free projects
- Strong impact of OPEX on LCOE
- Interest for Lifetime extension



Optimization of the production & maintenance costs

Problematic

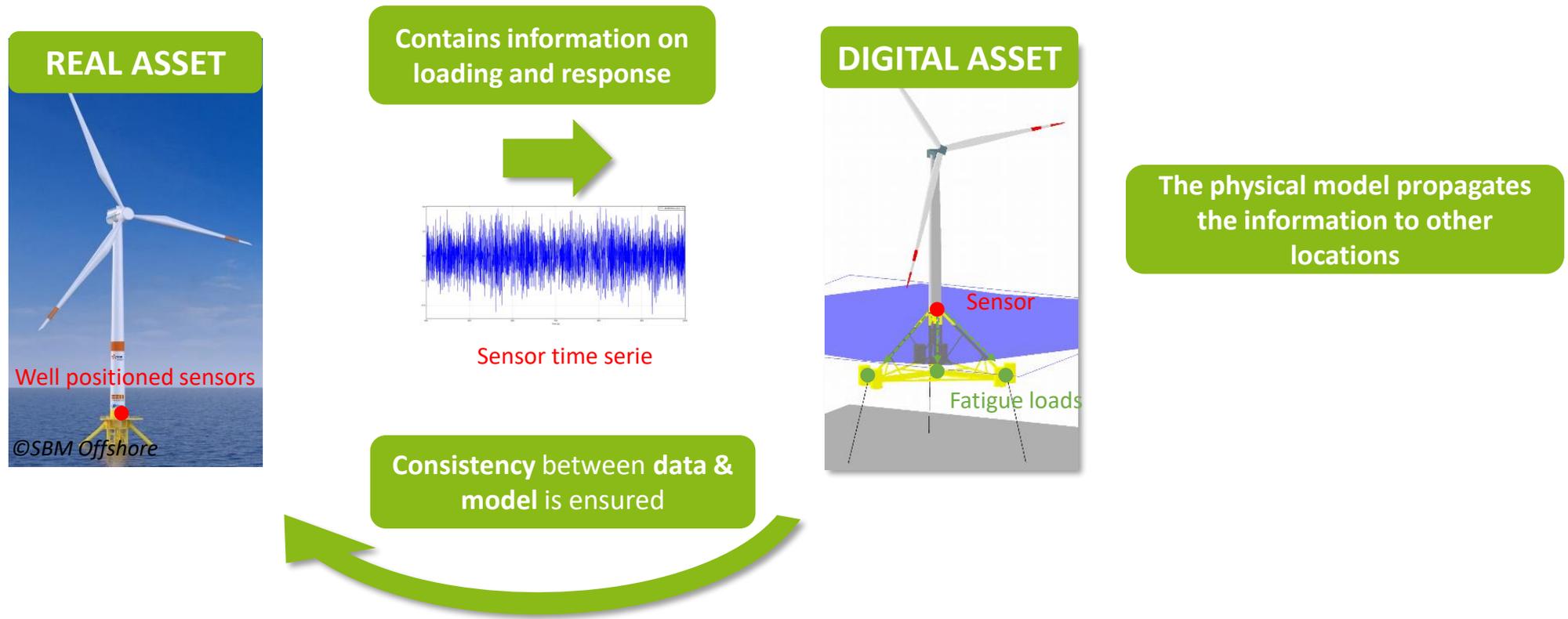
- **Asset optimization** : production, maintenance, lifetime
- **Limited data** : SCADA statistics, few sensors



WIND AVATAR® DIGITAL TWIN FOR OFFSHORE WIND WHAT IS IT ?

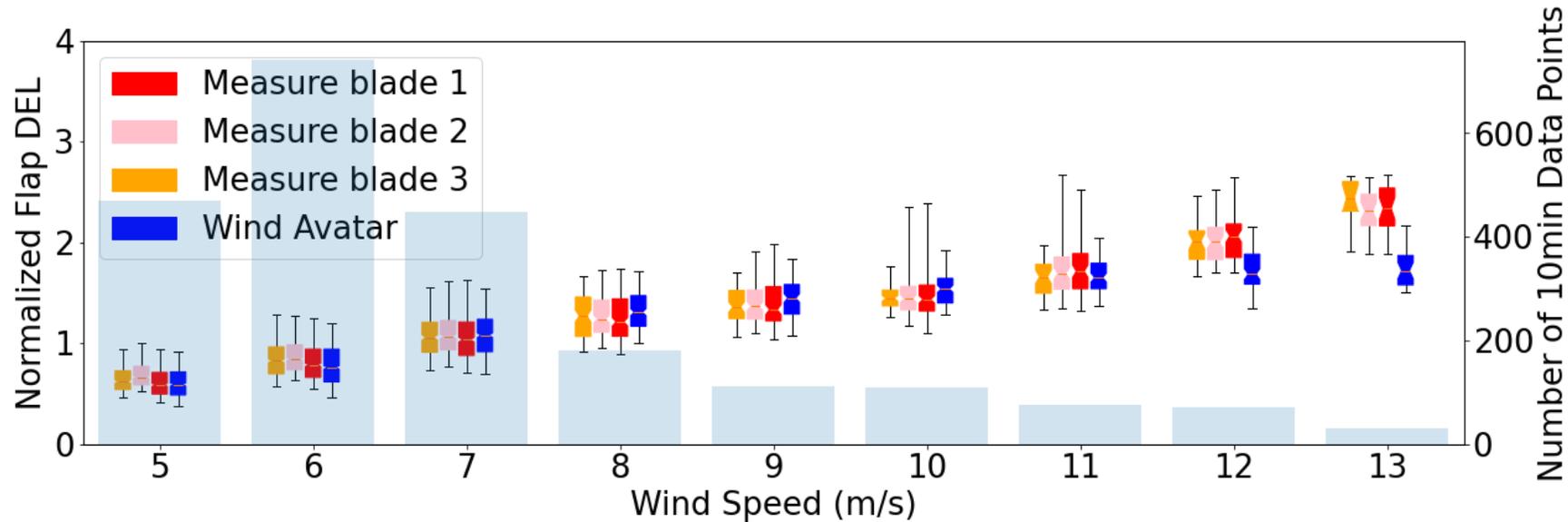
NEW ENERGIES

Enrich data with **physical models** to enable **virtual sensing & KPIs evaluation**



WIND AVATAR® DIGITAL TWIN FOR OFFSHORE WIND HOW ACCURATE IS IT ?

● Positive comparison of in-situ measurement and WIND AVATAR® load prediction



Example of validation on the SmartEole Project (onshore wind farm)



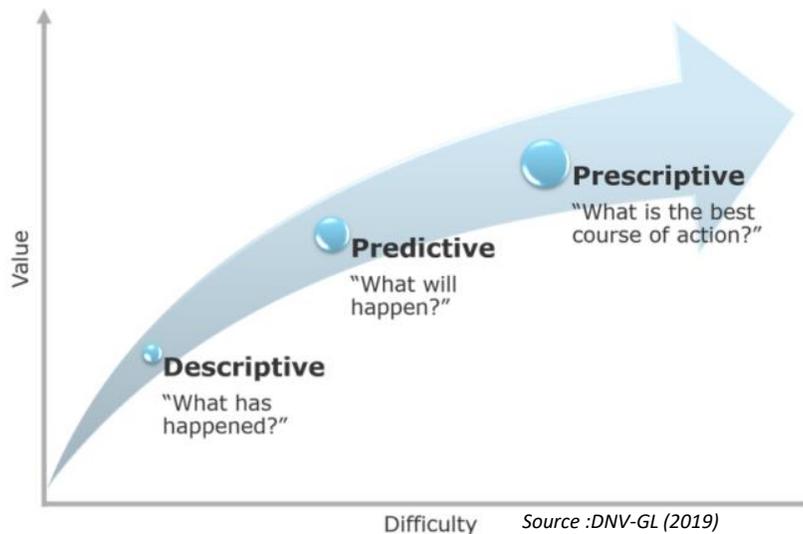
WIND AVATAR® DIGITAL TWIN FOR OFFSHORE WIND

WHAT ARE THE BENEFITS ?

NEW ENERGIES

FUNCTIONALITIES

- Under-performance detection
- Loads estimation
- Structural defaults detection
- "What-if" scenarios
- Optimal sensors location



BENEFITS

- Production optimization
- Lifetime extension
- Predictive maintenance
- Prescriptive maintenance
- Optimal monitoring

● LCOE reduction thanks to :

- Improved AEP
- Reduced CAPEX
- Reduced OPEX
- Extended lifetime



Onshore



Fixed offshore



Floating offshore

● Increased value thanks to :

- Production forecast
- Energy management for hybrid projects

Innovater les énergies

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 www.ifpenergiesnouvelles.fr

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