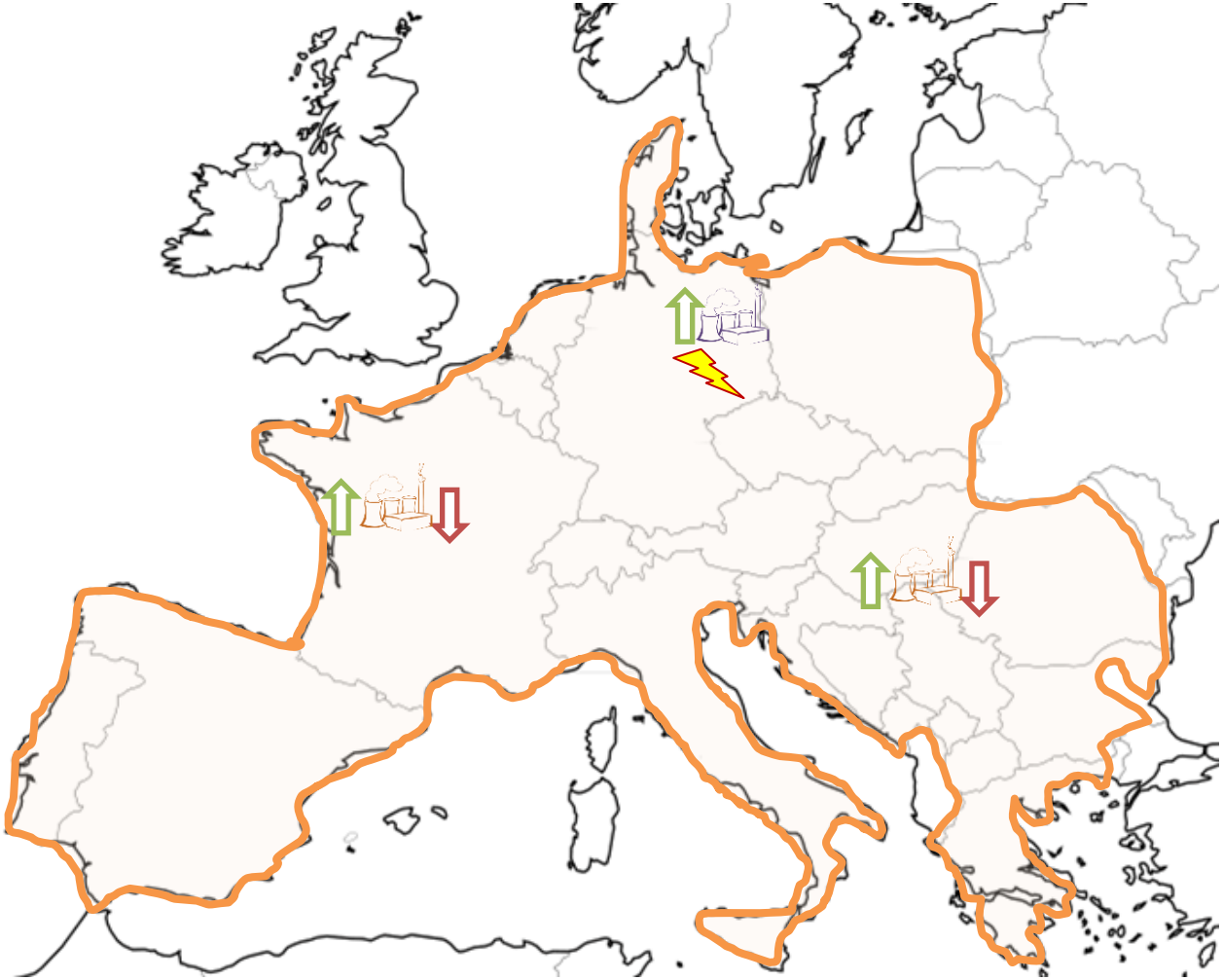
Providing reliable and cost effective Ancillary Services by variable renewable power plants

Marc JEDLICZKA, Paris, 27/09/2018

Context



ENTSOE (ex-UCTE)

Fault

1st reserve

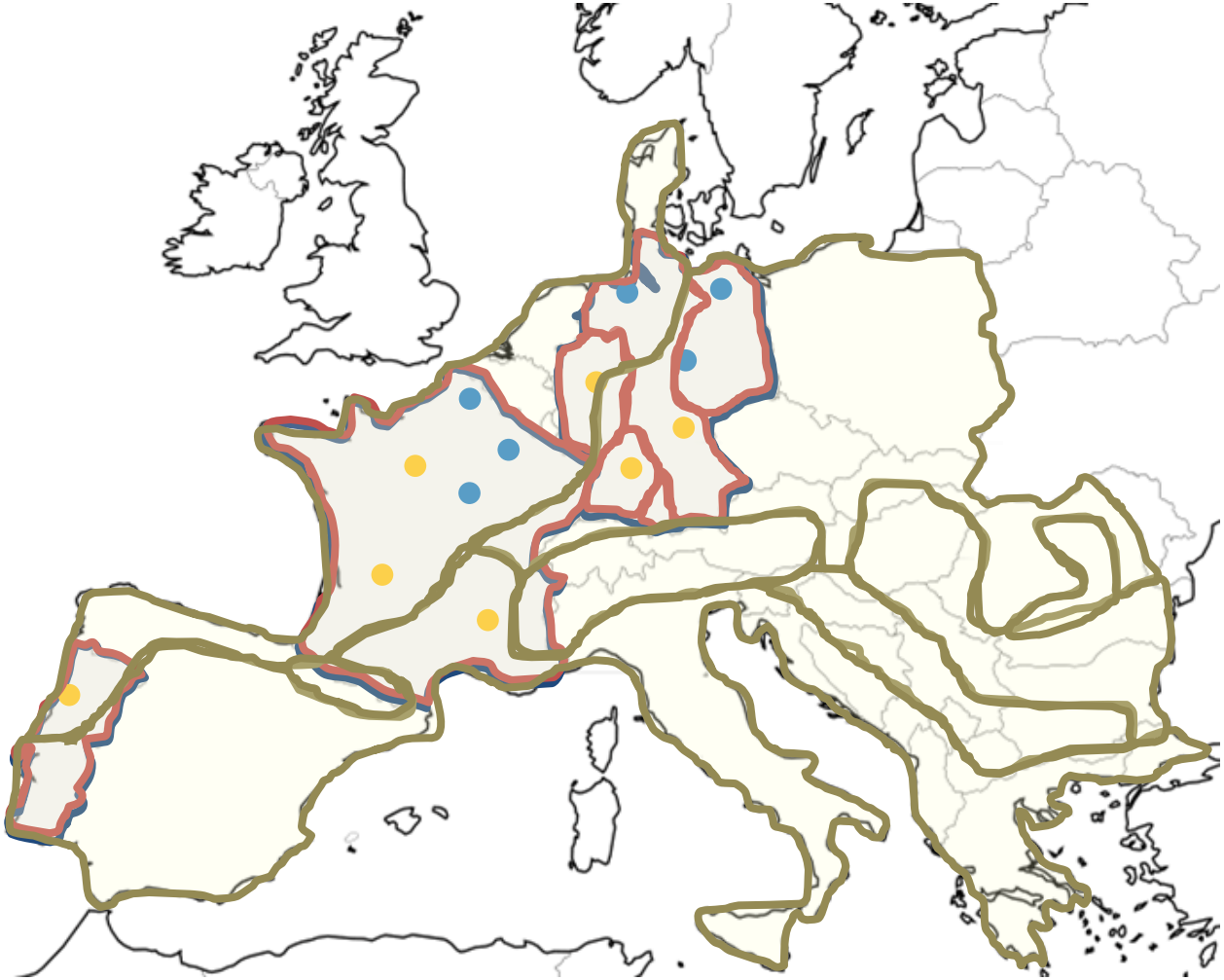
2nd & 3rd reserves

Today, renewables do not take part to AS mechanisms & markets :

⇒ Cap on renewable penetration

⇒ Missed/lost revenue

REstable scope



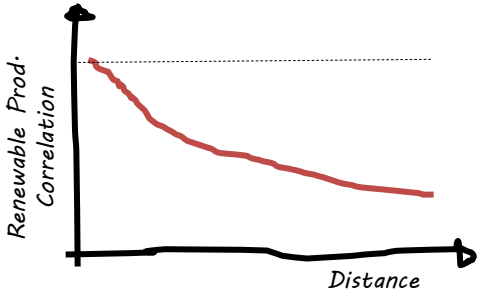
Partner countries

Solar farms

Wind farms

TSOs

Climatic regions



Partners and funding

ARMINES

MINES ParisTech

Artelys optimization solutions

ENGIE Green

HESPUL

Fraunhofer IWES

ENERCON ENERGY FOR THE WORLD

INVESTISSEMENTS D'AVENIR

ADEME Agence de l'Environnement et de la Maîtrise de l'Energie

Federal Ministry for Economic Affairs and Energy

INESCTEC TECHNOLOGY & SCIENCE | ASSOCIATE LABORATORY

FCT Fundação para a Ciência e a Tecnologia

Objective and means

Objective

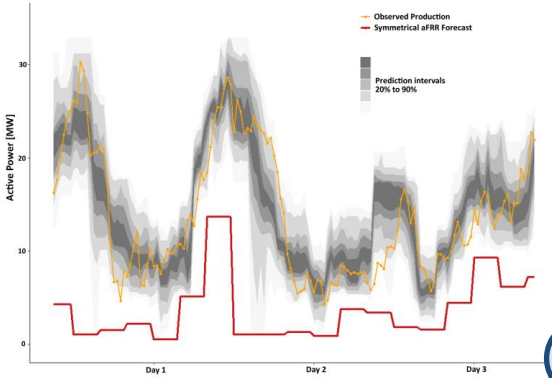
To allow variable renewables to provide ancillary services to the electrical system and to possibly earn complementary income from this

Means

- Forecasts improvement => to anticipate volumes & prices
- Virtual power plant (VPP) => to aggregate distant and heterogeneous RES power plants
- Bidding strategies => to pre-qualify offers on the market
- Demonstration tests => to run the VPP at real scale

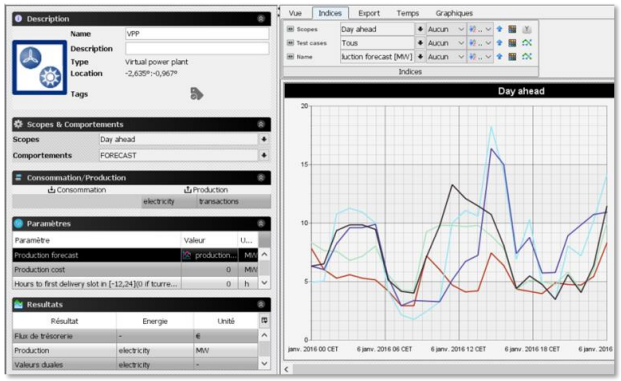
REstable business chain

Forecasts: volume and prices
Challenges : reliability, scalability, adaptability

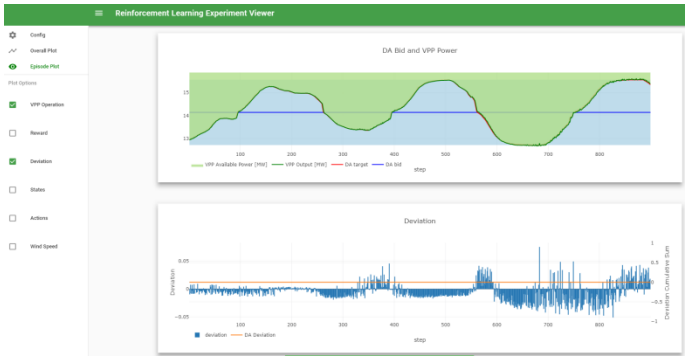


Virtual Power Plant – Control system
Challenges : AS markets, heterogeneous technologies

Energy and services markets bidding
Challenges : uncertainty, arbitration



Advanced dispatch and validation
Challenges : artificial intelligence,
Markov decision process

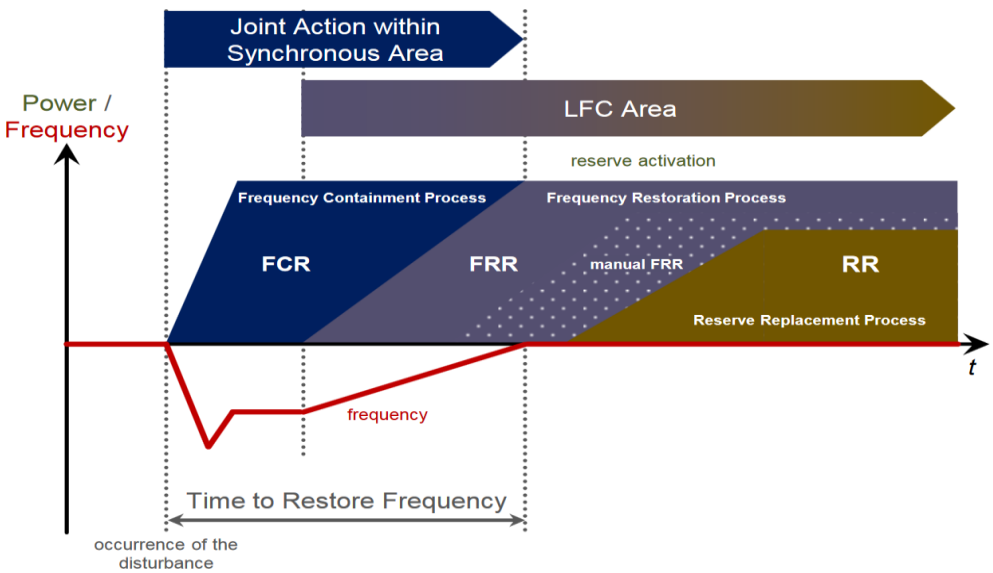


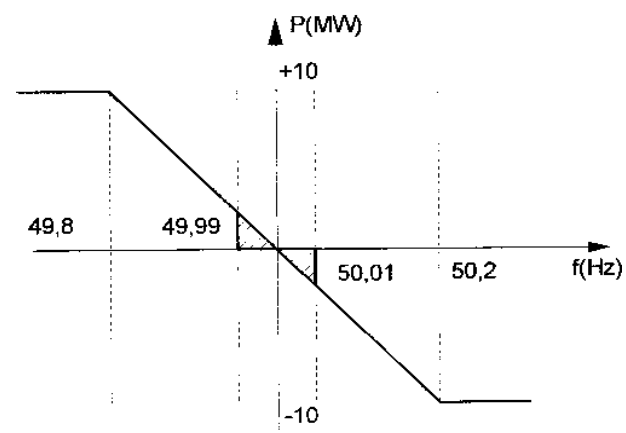
DEMONSTRATION

Demonstration – Use cases

5 Use cases (9 KPIs per test)

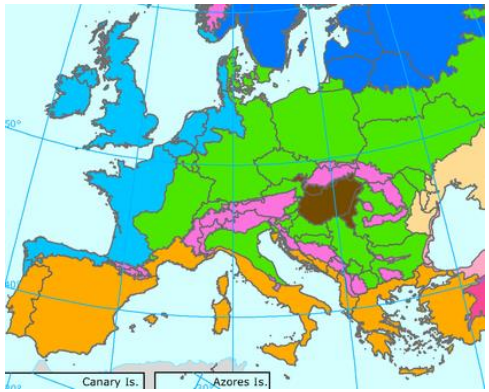
⇒	**UC 1**	FCR :	Frequency Containment Reserve *(Primary reserve)*
⇒	**UC 2a**	aFRR :	Automatic Frequency Restoration Reserve *(a. Secondary reserve)*
⇒	**UC 2m**	mFRR :	Manual frequency restoration reserve *(m. Secondary reserve)*
⇒	**UC 3**	RR :	Replacement reserve *(Balancing Reserve)*
⇒	**UC 4**	VC :	Voltage Control *(Local congestion management)*





Demonstration – Scope

			Climate			Total agreed (MW)
Partner	**Technology**	**Country**	**Atlantic**	**Continental**	**Mediterranean**	
ENERCON	W	DE	50	150	-	200
	W	FR	-	-	30	30
	W	PT	-	-	20	20
HESPUL	PV	FR	-	0,7	11	11,7
	W	FR	10	-	-	10
CNR	PV	FR	-	14	-	14
ENGIE-GREEN	W	FR	94,3	151,7	-	246
TOTAL			**154,3**	**316,4**	**61**	**531,7**



Demonstration – Tests

	AP Test	UC1 FCR	UC3 RR	UC4 VS	TOT
n of tests UP		5	0	3	4
n of tests DOWN		5	1	3	8
n minutes per test		15	30	15	75
MWh	40	35	5	0	80,0

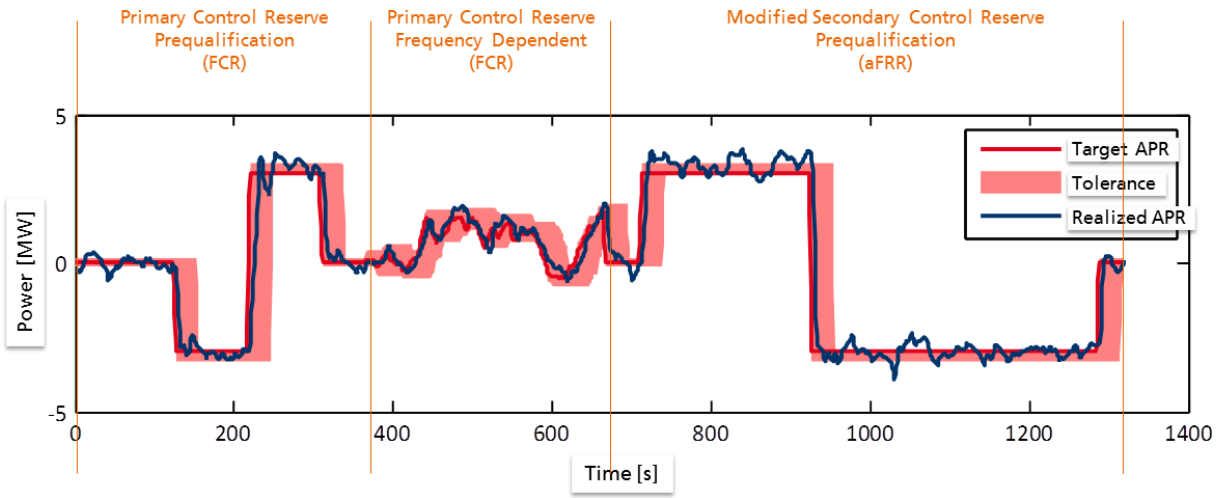
- VPP ability to provide services to be evaluated by repeating a relevant number of times pre-qualification tests usually requested for conventional power plants
- Energy losses during tests capped at 80 MWh (total)

Demonstration – Metrics

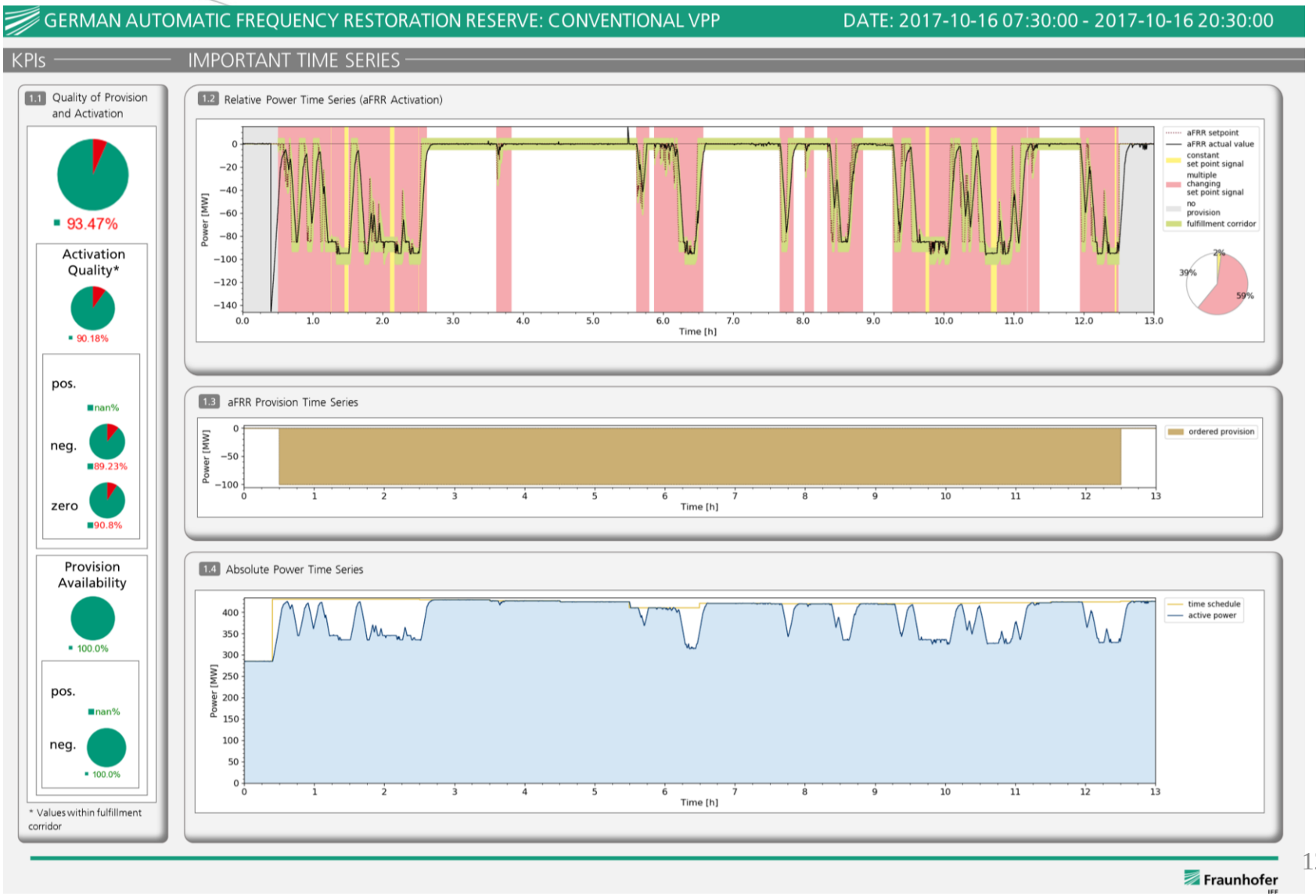
9 KPIs per use case

- Number of under-fulfilments
- Number of over-fulfilments
- Maximum under-fulfilment respecting to the offer
- Maximum over-fulfilment respecting to the offer
- Maximum under-fulfilment
- Maximum over-fulfilment
- Energy of under-fulfilment
- Energy of over-fulfilment
- Amount of the service provided

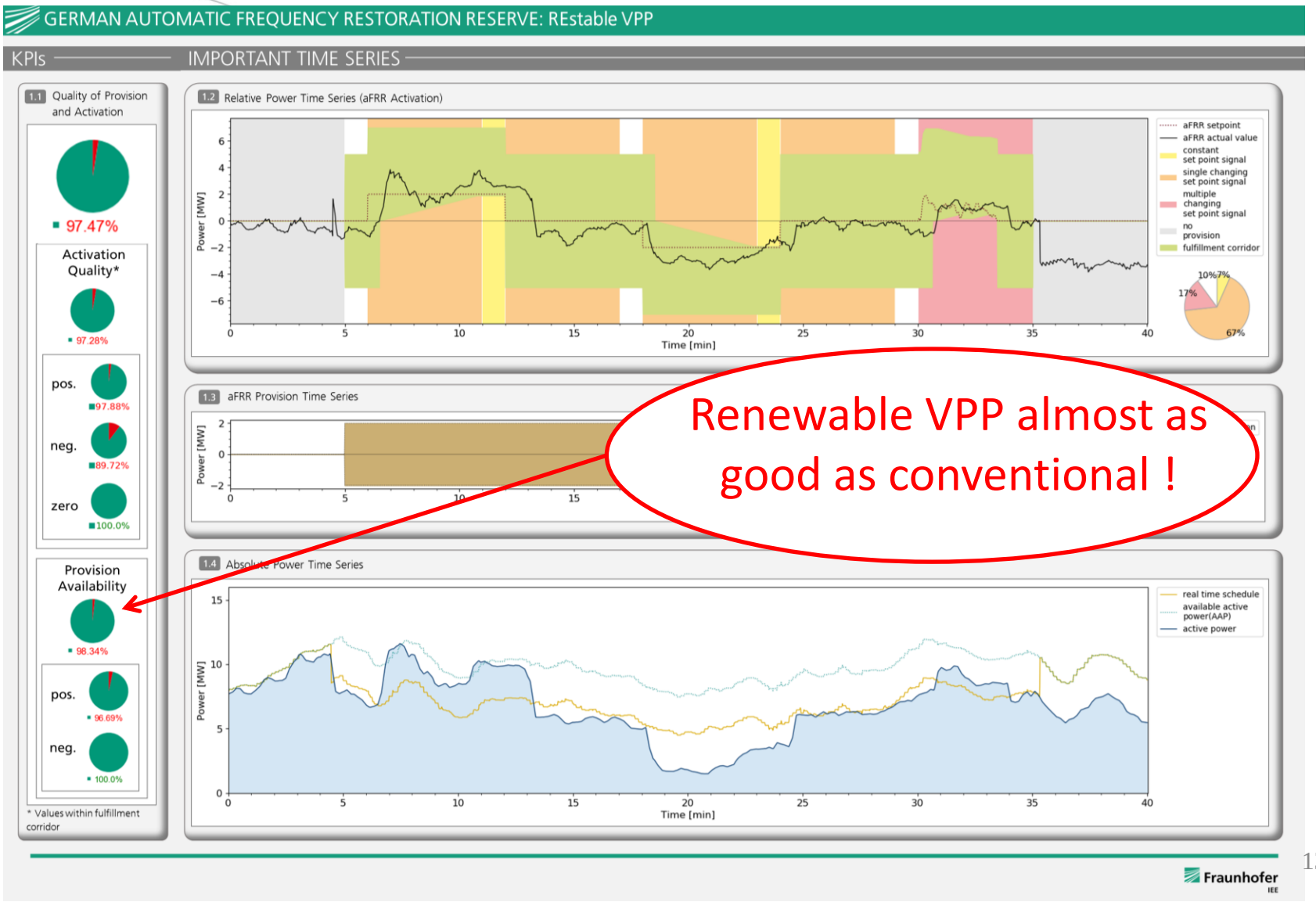
Target = 0!



Demonstration : conventional VPP (reference)



Demonstration : first results



Dissemination

Website

https://www.restable-project.eu (news, factsheet, deliverables)

Publications

1) Simon Camal, Andrea Michiorri, Georges Kariniotakis, Andreas Liebelt. « Short-term Forecast of Automatic Frequency Restoration Reserve from a Renewable Energy Based Virtual Power Plant ». *The 7th IEEE International Conference on Innovative Smart Grid Technologies - ISGT Europe 2017*, Sep 2017, Torino, Italy. 2017.
2) José R. Andrade, Jorge Filipe, Marisa Reis and Ricardo J. Bessa "Probabilistic Price Forecasting for Day-Ahead and Intraday Markets: Beyond the Statistical Model", Sustainability 2017, 9(11), 1990; doi:10.3390/su9111990
3) Ricardo J. Bessa , Corinna Möhrlen, Vanessa Fundel Malte Siefert, Jethro Browell, Sebastian Haglund El Gaidi, Bri-Mathias Hodge, Umit Cali, and George Kariniotakis, « Towards Improved Understanding of the Applicability of Uncertainty Forecasts in the Electric Power Industry", Energies 2017, 10(9), 1402; doi:10.3390/en10091402

Factsheet

14. June 2016: REstable wins the German-French-Innovation-Prize for Renewable Energies of the dena

28. September 2017: REstable wins the Special Award "European Energy Project" 2017 of the Handelsblatt Energy Academy

Name: Restable - Improvement of Renewables-based System Services Through Better Interaction of European Control Zones. April 2016 - February 2019. Budget: 3.5 M€

Objectives and methods: To provide ancillary services through : improved forecasts, Virtual power plant, bidding strategies, HV & LV renewables

Expected outcomes: Reduction of a barrier to high penetration of renewables;
higher and diversified revenue for renewable producers

Funded by: ADEME « Investissements d'Avenir » (FR), BMWi (DE), Foundation for Science and Technology (PT), Within the ERAnNet Smart Grid Plus program

Partners: ARMINES Mines-ParisTech, ARTELYS, ENERCON, ENGIE GREEN, FRAUNHOFER IWES, HESPUL, HYDRONEXT, INESC TEC, SOLAR WORLD

Also with the collaboration of: EDISUN, VALOREM, CNR

Website: restable-project.eu

Supported by:

THANK YOU FOR YOUR ATTENTION !

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