Effects of RES support mechanisms on short-term markets

Post 2020 evolution of the Target Model: Quantitative assessments

Fernando Banez-Chicharro and Luis Olmos Camacho
Institute for Research in Technology (IIT) – Universidad Pontificia Comillas

19th May 2016

Co-funded by the Intelligent Energy Europe Programme of the European Union

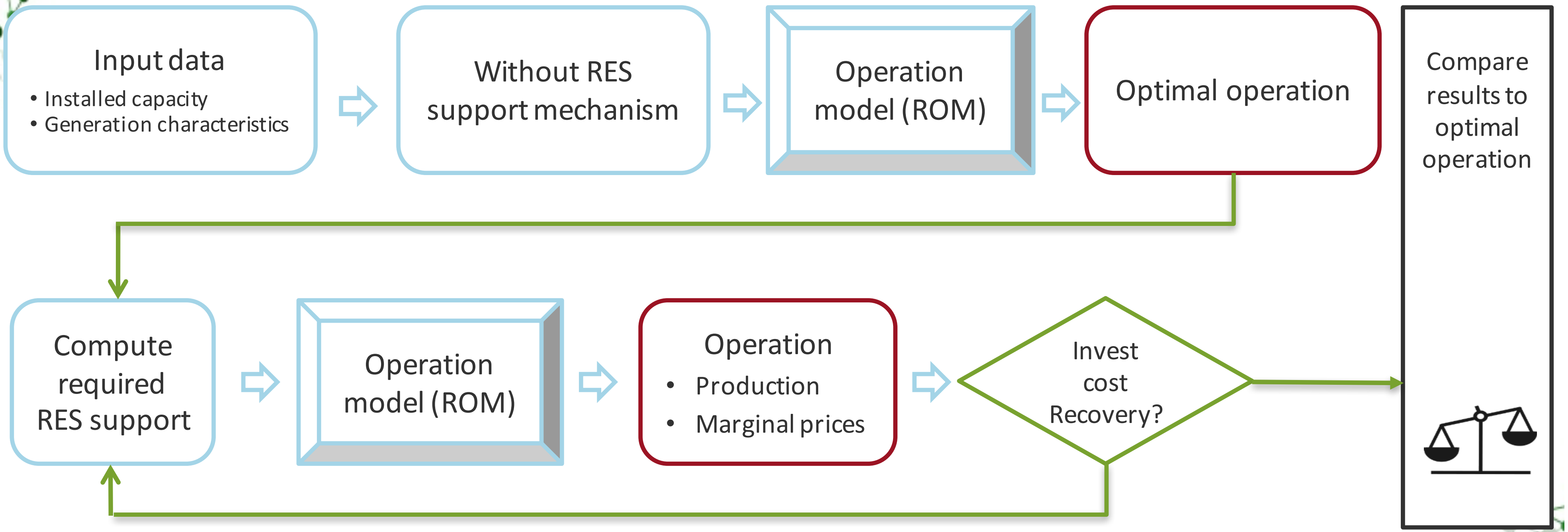
Overview

- Objective
- Methodology
  - ROM model
  - Scope
- RES support mechanism
- Results
- Conclusions

Objective

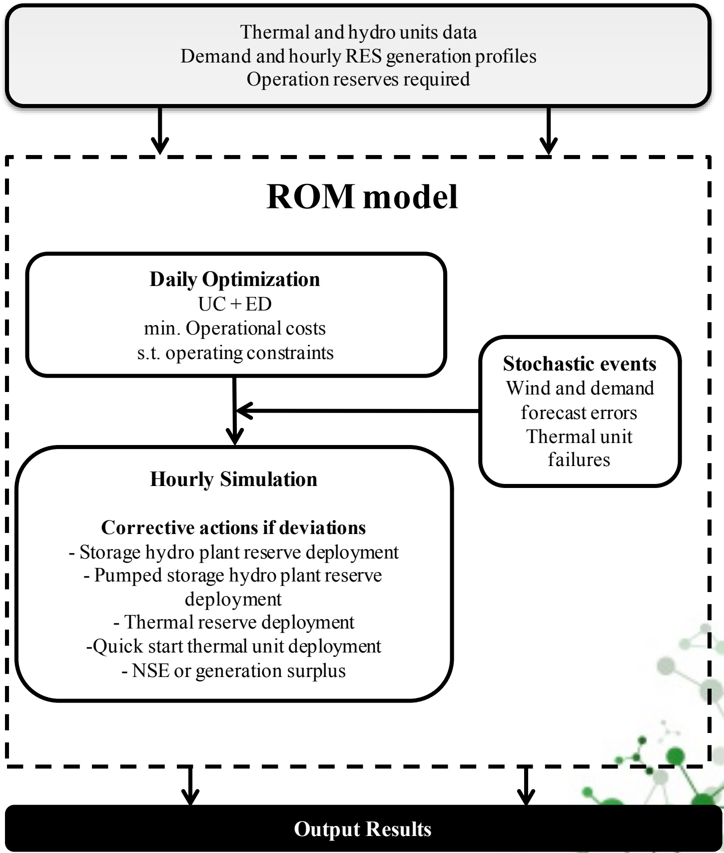
- Analyze performance in the short-term of different RES support schemes
  - Long-term clean capacity auctions
  - Feed-In-Premium fixed
  - Feed-In-Premium floating
  - Long-term clean energy auction

Methodology



Methodology: ROM model

- Operation model developed in IIT-Comillas
- Used in other EU projects
  - MERGE, SUSPLAN, TWENTIES…
- Unit commitment: represent day-ahead market
  - Technical constraints generation units: thermal and hydro
  - Operating reserves
  - Network



Methodology: scope

- Spain, France and Portugal in 2030
  - 1 year – 8,760 hours
  - Vision 3 TYNDP 2014
- Generation
  - Detailed generation units in Spain, France and Portugal
- Not real-time operation
- Network
  - No internal network
  - Interconnections between countries

Methodology: RES support schemes

- Long-term clean capacity auction
  - Provide subsidies out of the market
    - Based on capacity
  - Revenue obtained by subsidy is guaranteed
    - It does not depend on energy dispatched
  - Agents do not have incentives to dispatch more
    - Offers do not change

Methodology: RES support schemes

- Feed-In-Premium: fixed
  - Apply a premium over market price
    - Different for each country and technology
  - Revenue depends on the energy sold in short-term market
  - Incentive to produce more energy
    - Change in the offers

$$Revenue(g,h) = Production(g,h) \cdot [market\_price(h) + premium(g)]$$

$$Offer(g) = marginal\_cost(g) - premium(g)$$

MarketRES

Methodology: RES support schemes

- Feed-In-Premium: floating
  - Premium = reference value – reference market price
  - Conditions:
    - Reference market price computed for long period
    - Energy remunerated does not depend on energy dispatched (gross production)
  - Agents do not have incentives to dispatch more
    - Offers do not change

$$Revenue\_support(g) = Gross\_Production(g) \cdot [ref\_value(g) - ref\_market\_price(g)]$$

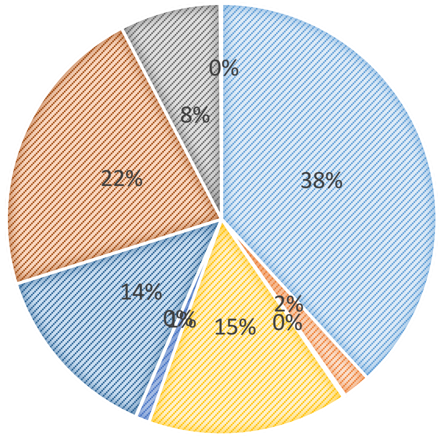
$$Revenue\_market(g,h) = Production(g,h) \cdot market\_price(g,h)$$

Methodology: RES support schemes

- Long-term clean energy auction
  - Pre-determined amount of energy sold in the long-term
    - Premium over the market to this energy
    - We assume 50% of potential energy
  - Whole amount of energy remunerated at market price
  - Obligation to generators to produce the energy sold in the long-term
    - Change their offers to guarantee the dispatch
    - Hours with most probability to be dispatched and obtain higher revenue in the market: expensive hours

Results: revenues without support scheme

- OtherRES technologies require support
  - OtherRES obtains very low incomes due to its low generation
- France generation requires support
  - Wind and solar also

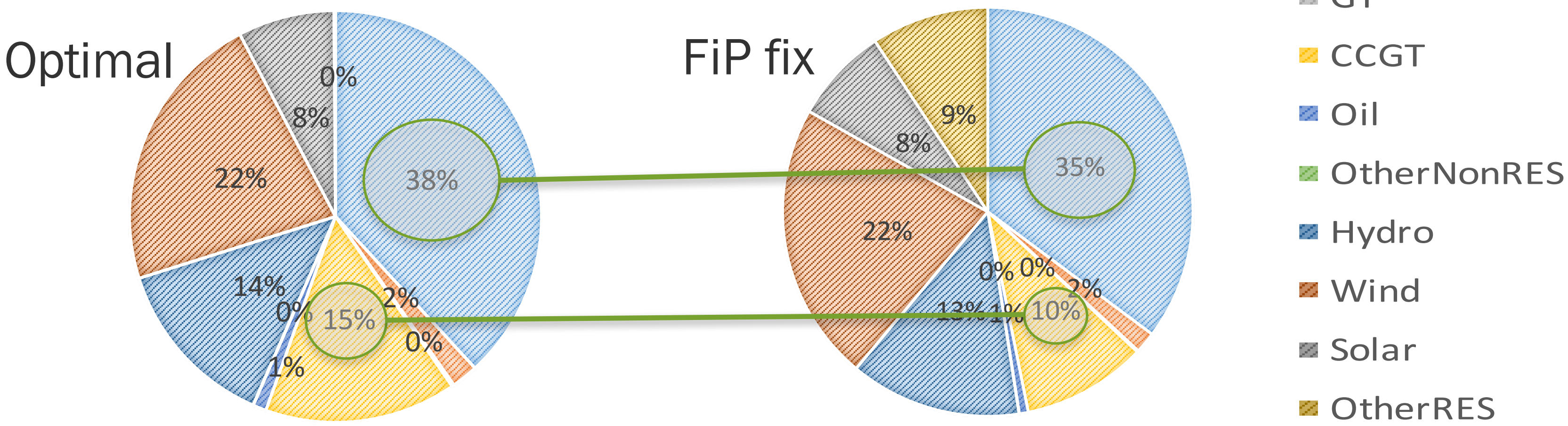


Units	Location	Market revenues [M€]	Net benefits in the dispatch [M€/yr]	Net benefits – Inv. Costs [M€/yr]
Wind	Spain	3,378	3,378	1,400
Solar		2,700	2,700	534
OtherRES		57	2	-3,271
Wind	France	2,003	2,003	-985
Solar		882	882	-1,433
OtherRES		215	91	-2,463
Wind	Portugal	176	176	75
OtherRES		3	0	-94

System	Average price [€/MWh]
Spain	104
France	60
Portugal	110

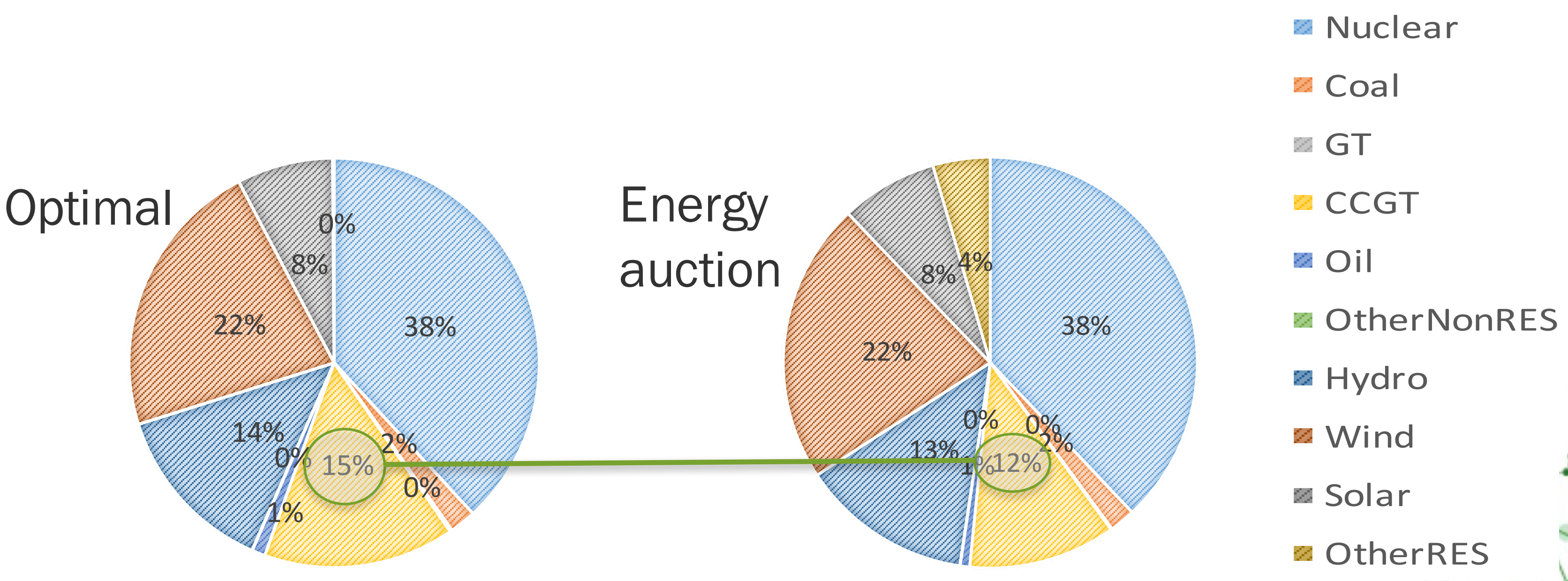
Results: system operation

- Capacity auction and FiP floating have same operation that optimal
- Application of fixed FiP
  - OtherRES produces more (0% to 9%)
  - Replaces nuclear and CCGTs



Results: system operation

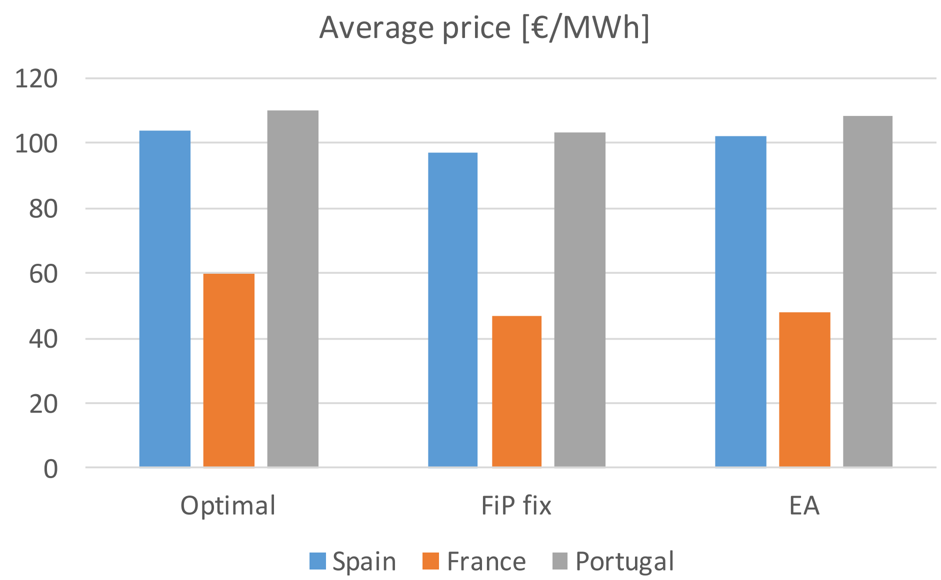
- Application of energy auction
  - OtherRES replaces CCGTs

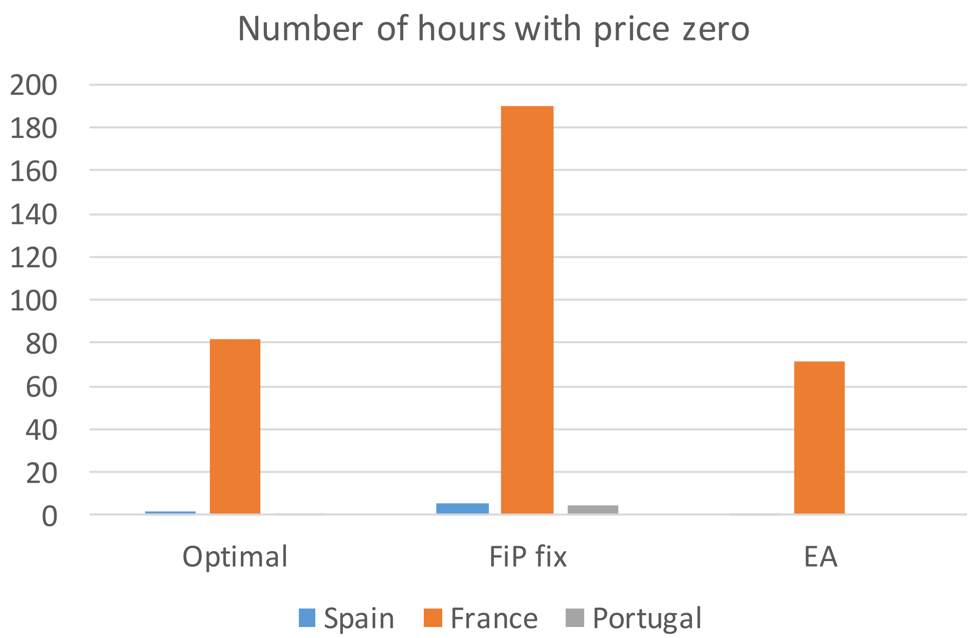


Market RES

Results: market prices

- Spain and Portugal are very correlated
- FiP (fixed) and energy auction reduce prices
  - Especially in France





Results: market prices

FiP fix

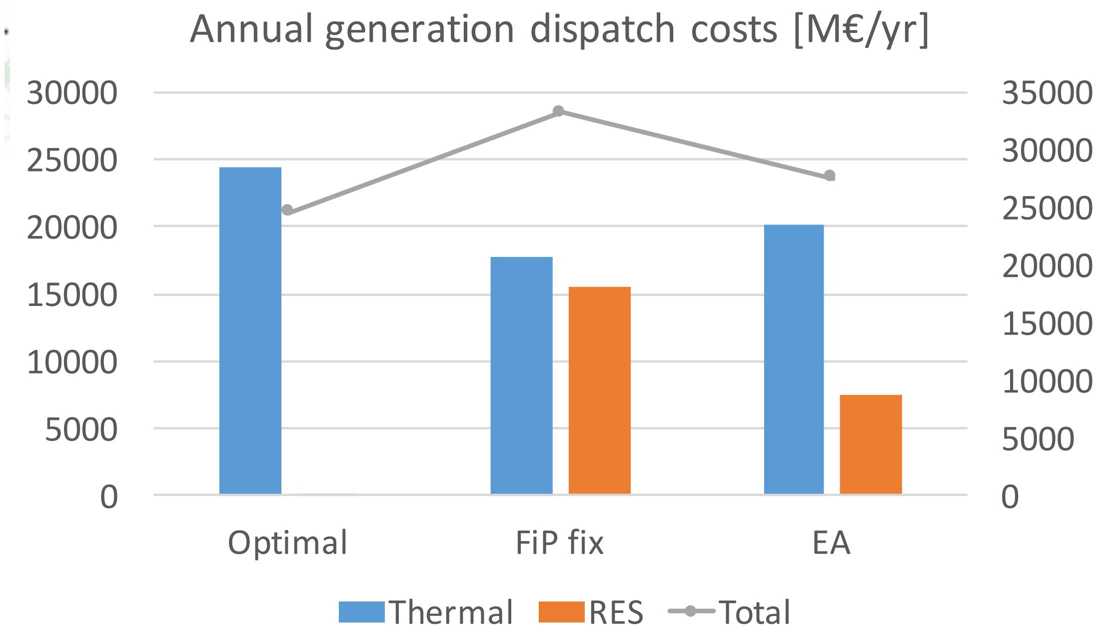
Units	Location	Unitary revenue [€/MWh]	Marginal price [€/MWh]	Coefficient
Wind	Spain	97.2	97.2	1.0
Solar	Spain	97.6	97.6	1.0
OtherRES	Spain	245.4	98.4	2.5
Wind	France	85.7	46.7	1.8
Solar	France	135.0	43.0	3.1
OtherRES	France	236.2	46.7	5.1
Wind	Portugal	103.2	103.2	1.0
OtherRES	Portugal	230.3	106.3	2.2

Energy auction

Units	Location	Unitary revenue [€/MWh]	Marginal price [€/MWh]	Coefficient
Wind	Spain	102.4	102.4	1.0
Solar	Spain	102.9	102.9	1.0
OtherRES	Spain	304.4	107.4	2.8
Wind	France	86.5	48.2	1.8
Solar	France	144.2	45.1	3.2
OtherRES	France	326.7	93.7	3.5
Wind	Portugal	108.3	108.3	1.0
OtherRES	Portugal	304.6	122.6	2.5

- Interference with efficient short-term signals
  - RES generation supported is producing electricity with higher costs than other cheaper options

Results: costs



- FiP (fixed)
  - Total dispatch costs 35% higher than optimal dispatch
  - High production with OtherRES technologies
- Energy auction
  - Lower cost increase than FiP (fixed)

MarketRES

Conclusions

- Long-term clean capacity auction
  - ➢ Revenues do not depend on energy sold in the market (capacity)
    - ➢ No incentives to generators to sell more energy in short-term
  - ➢ No interference with short-term operation ⟶ optimal

- Feed-In-Premium: fixed
  - ➢ Revenues depend on energy sold in the market
    - ➢ Incentives to generators to sell more energy in the short-term
  - ➢ Changes optimal short-term operation
  - ➢ Marginal prices are reduced
  - ➢ Increases generation dispatch costs by 35%

Conclusions

- Feed-In-Premium: floating
  - ➢ Revenues do not depend on energy sold in the market
    - ➢ No incentives to generators to sell more energy in short-term
  - ➢ No interference with short-term operation ⟶ optimal

- Long-term clean energy auction
  - ➢ Revenues depend partly of the energy sold in the market
    - ➢ Incentives to generators to sell more energy in the short-term
  - ➢ Changes optimal short-term operation (less than FiP fixed)
  - ➢ Marginal prices are reduced (less than FiP fixed)
  - ➢ Increases generation dispatch costs (less than FiP fixed)

Coordinated by SINTEF

Wind EUROPE

Energy Economics Group

TU WIEN
TECHNISCHE UNIVERSITÄT WIEN
Vienna | Austria

UNIVERSIDAD PONTIFICIA ICAI ICADE COMILLAS MADRID

TECHNOFI

Rte
Réseau de transport d'électricité

3E

IBERDROLA

SolarPower Europe

FRIENDS OF THE SUPERGRID

Info: Market4RES@sintef.no
Results and news: www.market4RES.eu

Co-funded by the Intelligent Energy Europe
Programme of the European Union

Thank you very much for your attention

MarketRES