TradeRES

New Markets Design & Models for 100% Renewable Power Systems

vRES Support & Investment Derisking

Christoph Schimeczek[1] & Silke Johanndeiter[2]

[1] German Aerospace Center, [2] EnBW

Acknowledgements

Evelyn Sperber[1], Johannes Kochems[1], Kristina Nienhaus[1], Amelie Schmidt[2], Clemens Cremer[2]

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 864276

vRES Support & Investment Derisking
Motivation

Problem

- Cost optimisation results not necessarily feasible for all involved actors
- Cause: Cannibalisation & limited foresight
- Effect: Possibly missing money for some market actors

Research questions

1. (When) Do missing money constellations occur?
2. Can vRES remuneration schemes solve the missing money problem?
3. How should vRES remuneration schemes be designed?

vRES Support & Investment Derisking
Main findings

Missing-money situations occur in some **scenarios** for certain **technologies**

- High interdependency with **hydrogen** price & level of **flexibility** (e.g. electrolysers)
- Highest investment risks for **small-scale PV** and **wind offshore** power plants

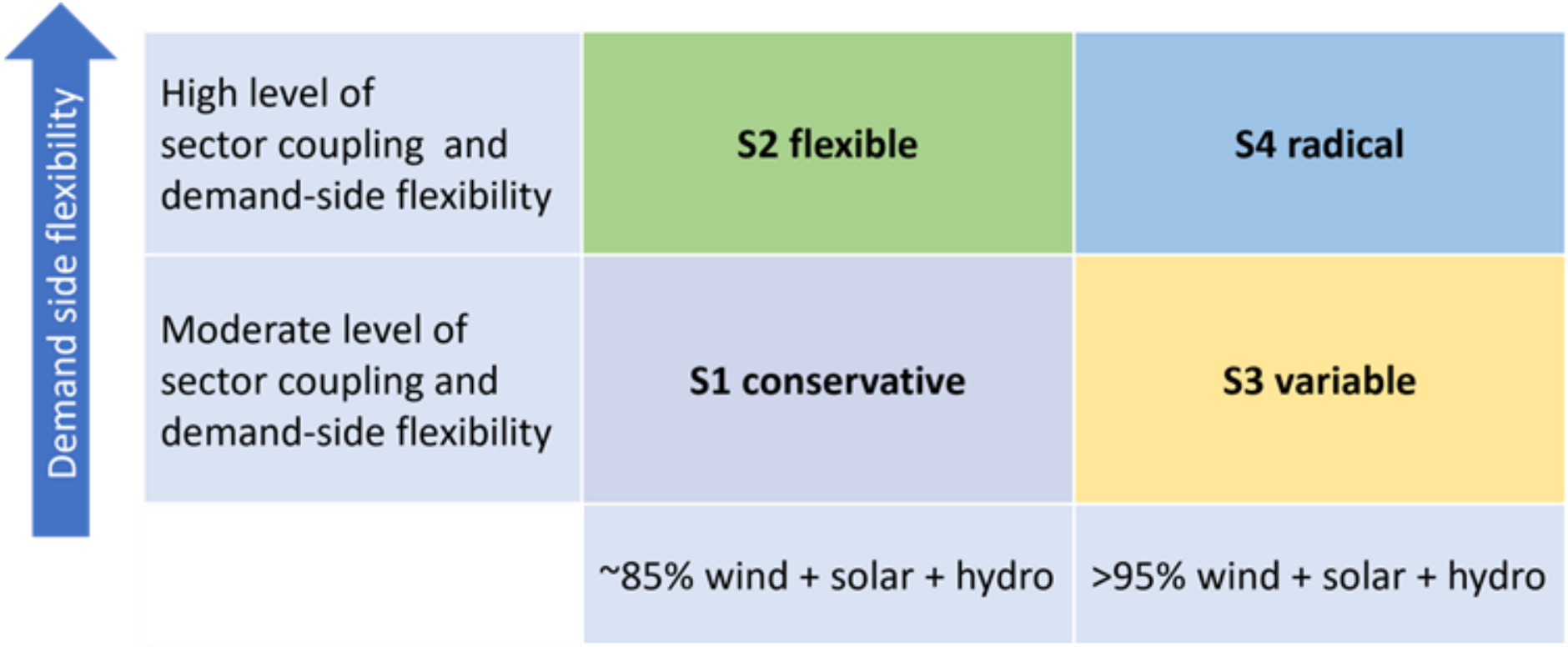
Support instruments can **derisk** vRES investments

- If chosen well, support instruments can **ensure** that vRES actors **recover** their **costs**
- But: they can also cause **distortions** on electricity markets

Support instrument design can also **impact**

- **Curtailment**: can induce lower / higher market-based curtailment of vRES
- **Market Prices & Total Cost**: can increase / decrease prices as well as overall cost

TradeRES Scenarios of ~100% RES Markets



vRES Support & Investment Derisking

Scope

Approach

- Europe: Investment & dispatch **cost optimization**
- Germany: **Agent-based** dispatch simulation
- Both: Vary **support instruments**
- Assess market performance

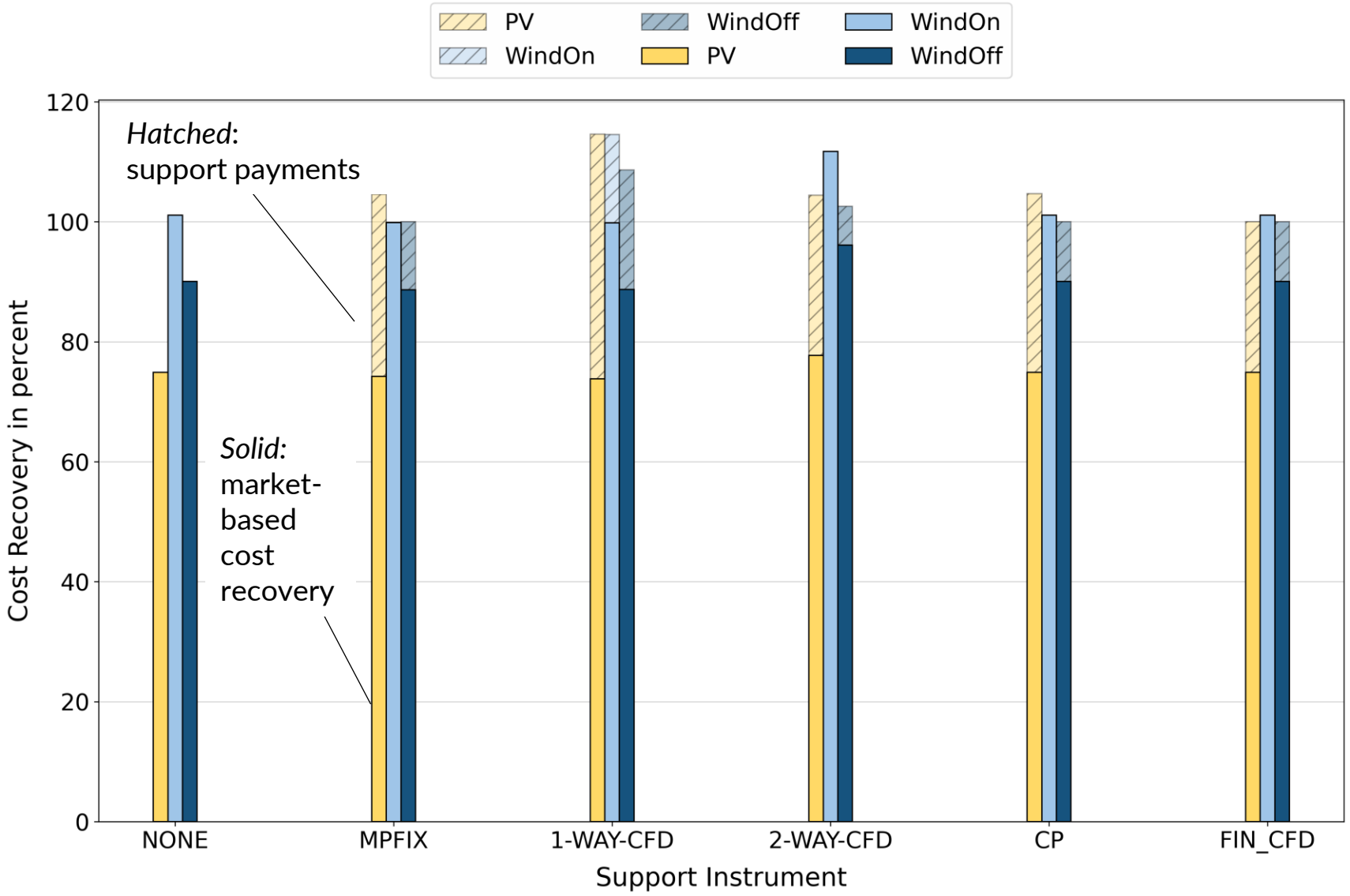
Support instruments

- "**NONE**": energy-only market
- "**BASIC CFD**": Contracts for Differences (CfD) with hourly spot price as reference price
- "**MPFIX**": fixed market premium (ex ante)
- "**1-WAY CFD**": variable market premium (ex post)
- "**2-WAY CFD**": two-way CfD as extension to the 1-WAY-CFD (ex post)
- "**CP**": fixed capacity premium
- "**FIN CFD**": Financial CfD, as suggested by Schlecht et al. (2023); country average as reference

Support instruments influence bidding behaviour

vRES Support & Investment Derisking

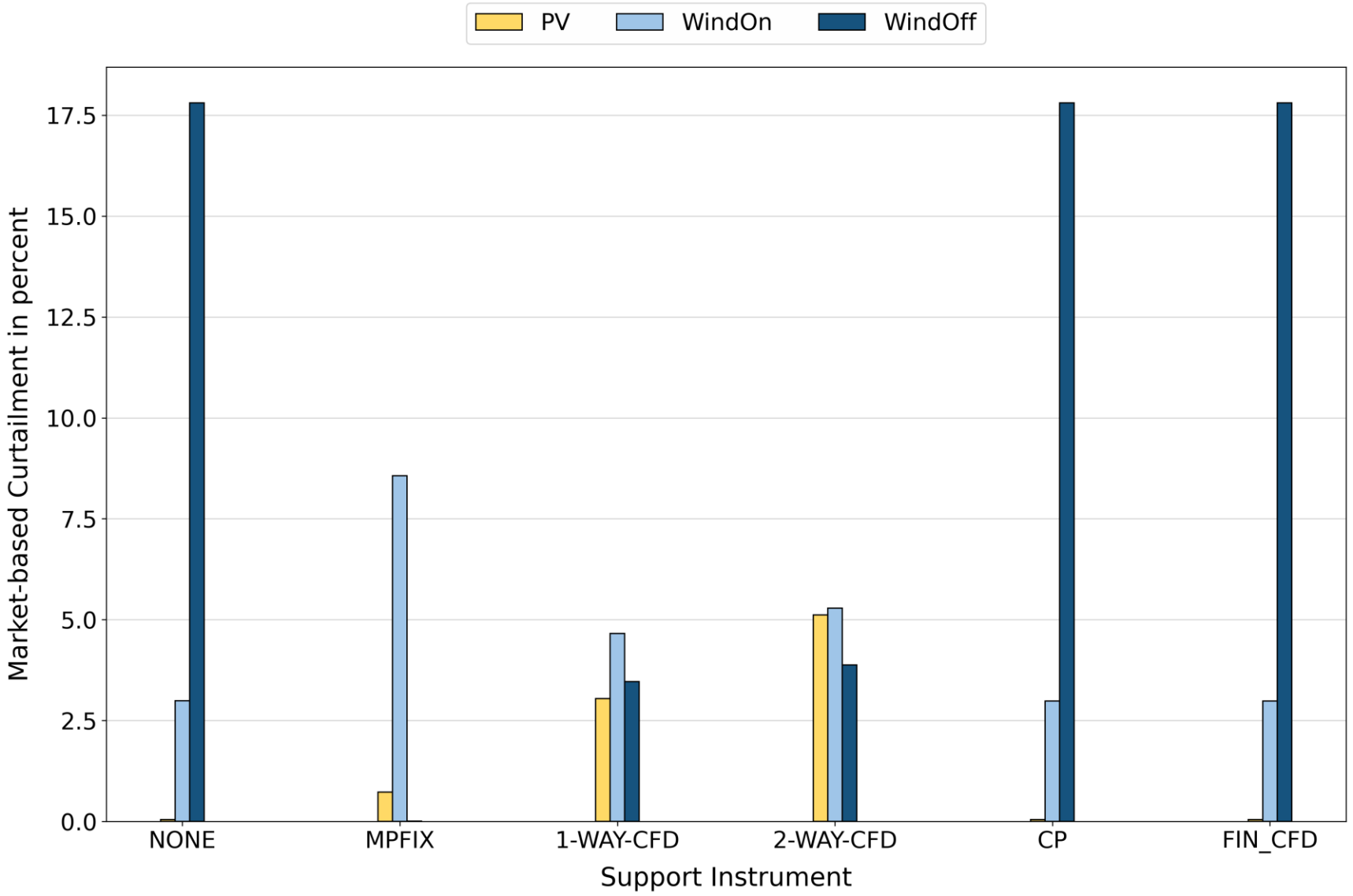
Cost Recovery – Scenario S1 – Germany



- No market-based refinancing for **small-scale PV** in any case
- **Wind** can (almost) recover costs on the market
- **1-WAY-CFD** and **2-WAY-CFD**: additional support payments during months with insufficient market incomes
- **2-WAY-CFD**: higher prices due to negative premia in clawback periods and corresponding bidding / curtailment

vRES Support & Investment Derisking

Market-based Curtailment – Scenario S1 – Germany



Offshore wind

Highest variable costs among considered vRES technologies

→ Heavy **curtailment** for NONE, CP and FIN_CFD (no dispatch distortions)

MPFIX & CFD

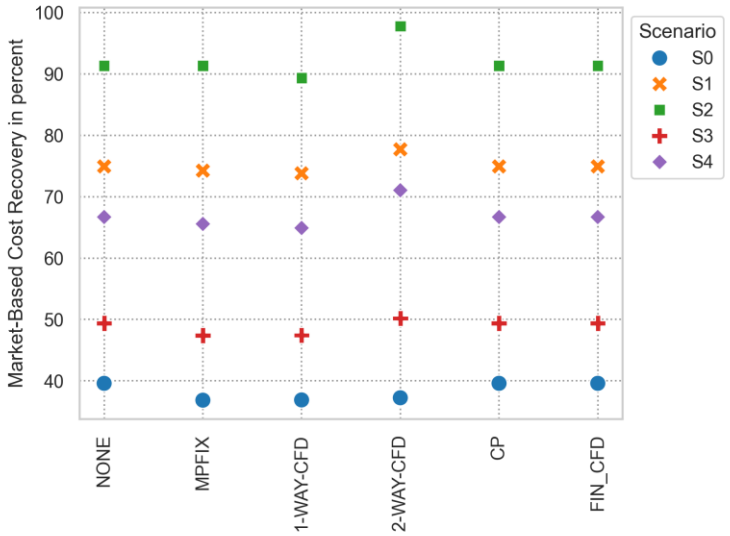
Bids & merit order impacted by expected premium payments

→ **Displacement** of PV & onshore wind by offshore wind

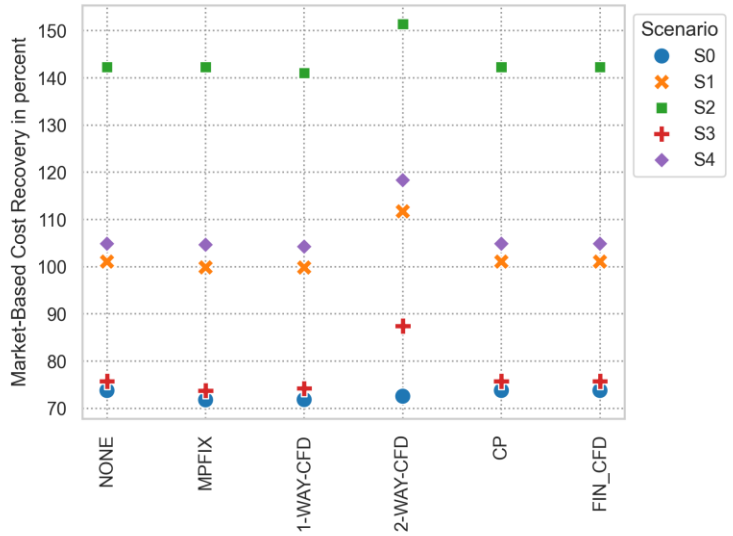
vRES Support & Investment Derisking

Scenario Dependency of Cost Recovery – Germany

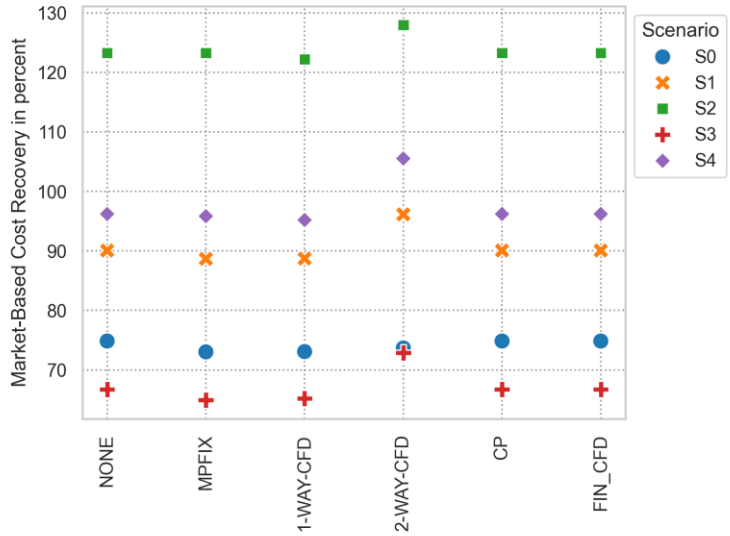
PV



Wind Onshore



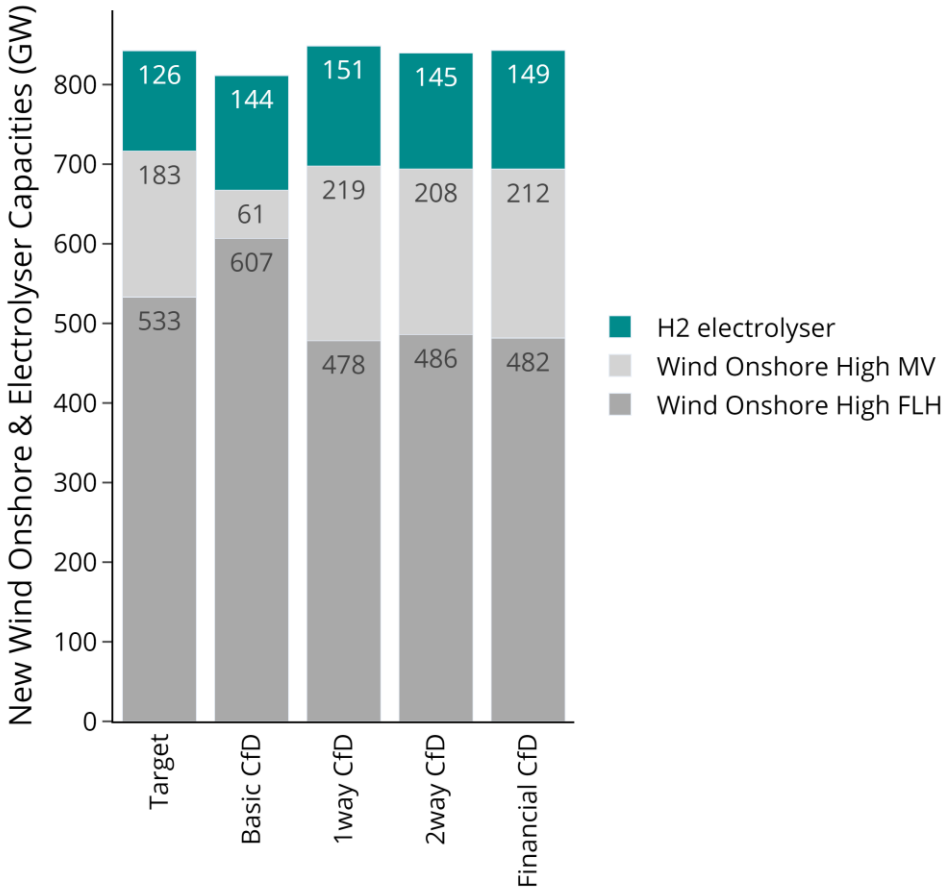
Wind Offshore

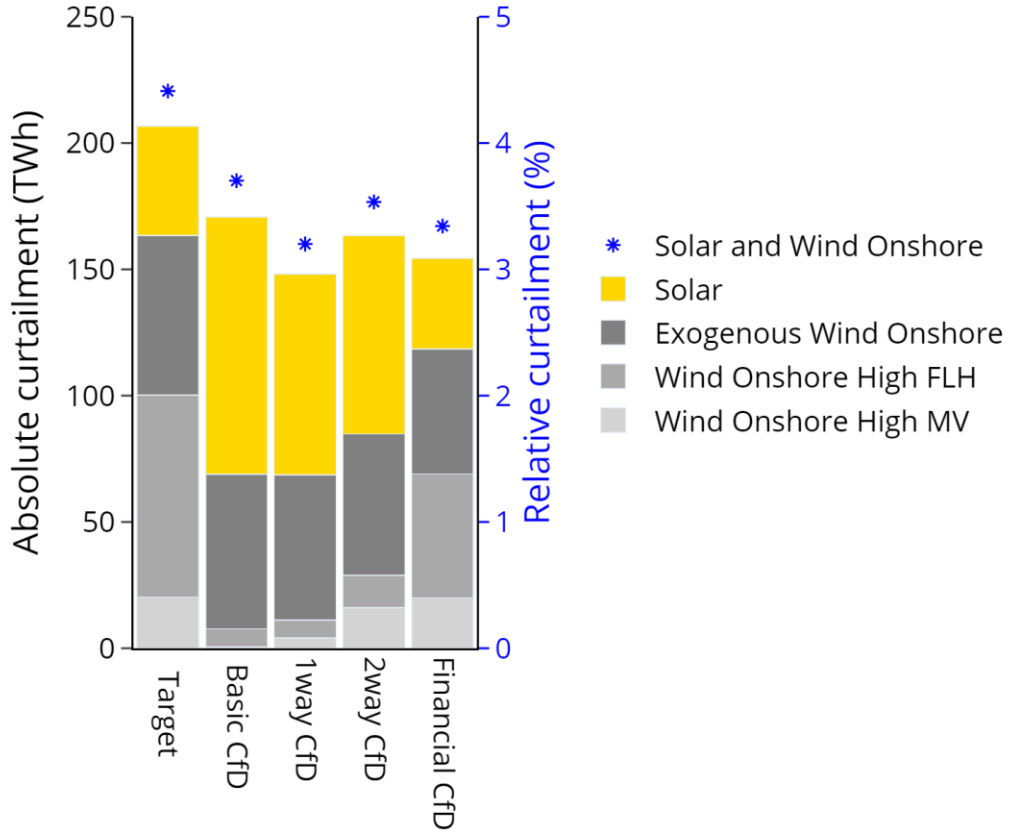


- Highest cost recovery rates for flexible scenario S2 due to higher hydrogen price
- Lower hydrogen price in S4 → less vRES cost recovery
- S3: lowest prices and market values for PV and wind across scenarios S1 to S4 (more vRES, less electrolysis)
- **2-WAY-CFD significantly changes market behavior**
- **Differences between scenarios** have a greater impact than those between support instruments!

vRES Support & Investment Derisking

Investment effects on the European scale



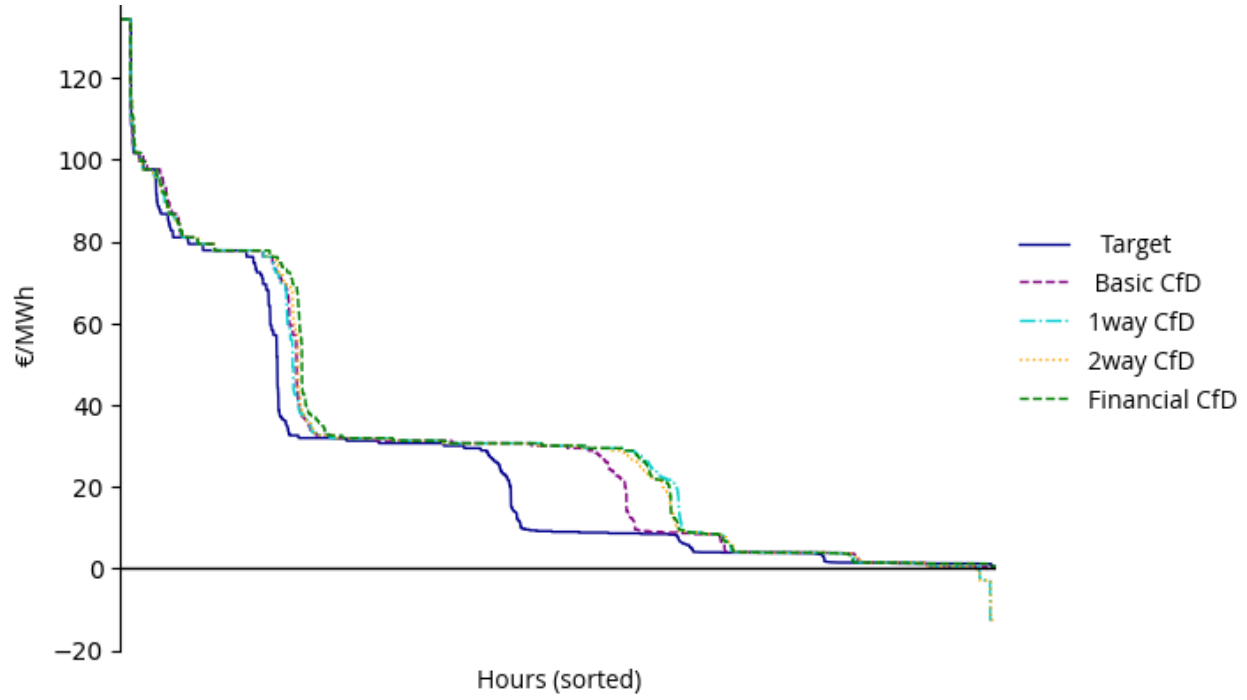


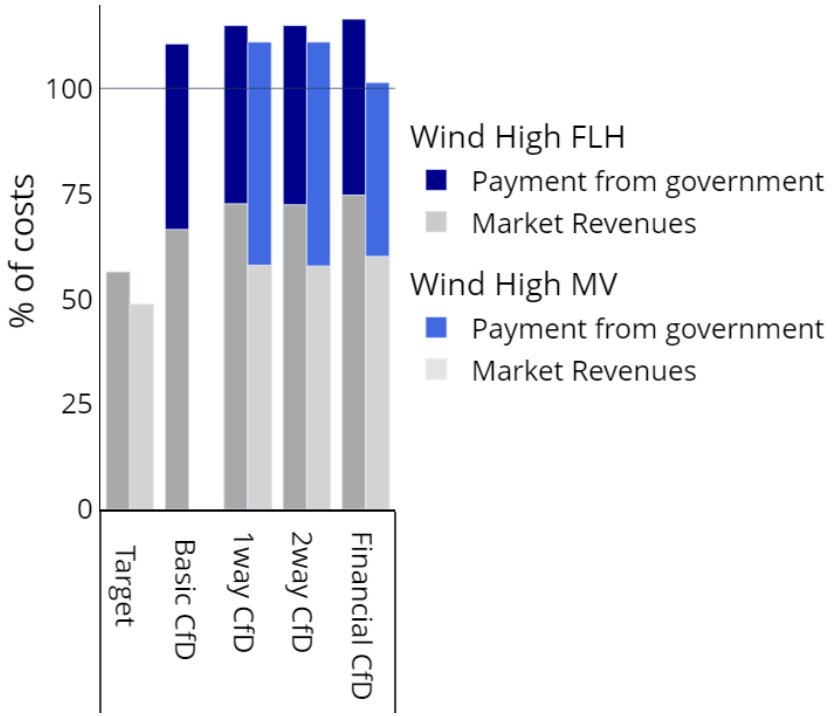
- Investment Changes & Dispatch distortions
- Curtailment affected by new composition of wind power plant types & dispatch distortions

vRES Support & Investment Derisking

Shift in prices and consequences for cost recovery

Price duration curve & ex-post recovery at the example of Denmark





Changes in prices cause shifts in market-based cost recovery & CfD payments

TradeRES

New Markets Design & Models for 100% Renewable Power Systems

Join at slido.com #2539 471

Questions or Comments?

Ask & vote on Slido!

More information at: https://traderes.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 864276