Impact of renewables on electricity markets – Do support schemes matter?

Jenny Winkler, Paris 13/10/2016

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Agenda

- Introduction
- Support systems for renewables and electricity markets
- Influence of renewables on electricity markets
- Methodology
- Results
- Conclusion and policy recommendations

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Introduction

- Renewable shares are rising globally
- Rising renewable shares influence electricity markets
- Different support schemes for renewables lead to different behaviour of renewables on electricity markets

→ Research question:

In how far does the chosen support scheme influence the impact of renewables on electricity markets?

→ The paper does however not provide a full assessment of support schemes for renewables

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Support schemes for renewables

Support scheme	Feed-in tariff	Sliding feed-in premium	Feed-in premium with cap and floor	Fixed feed-in premium	Quota-based support scheme	Capacity-based support scheme
Income	Constant payment per unit of electricity	Electricity price plus premium adapting to the market price	Electricity price plus premium, total income between cap and floor price	Electricity price plus fixed premium	Electricity price plus certificate price	Electricity price plus generation independent capacity premium
Advantages	Low risk for plant operators and low capital costs	Low risk for plant operators and low capital costs, reaction to short term market signals	Low risk for plant operators and low capital costs, reaction to short term market signals	Expected reaction to long term and short term price signals	Competitive determination of support	Undistorted market participation
Drawbacks	Risk of over or under compensation, no reaction to prices	Limited reaction to market signals, relatively high complexity	Limited reaction to market signals, relatively high complexity	High risk for plant operators unless fixed premium covers big share of income	High risk for plant operators due to double marketing	High risk for perverse incentives regarding plant design
Reaction to long term market signals	None	Very limited	Limited (depending on spread between cap and floor)	Yes	Yes	Yes
Reaction to short term market signals	No direct marketing	Support payments (or certificate prices) as opportunity costs for generation reduction				Undistorted market participation

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Can be auctioned!
(no difference regarding market participation)

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Compared in this study regarding the impact of renewables on electricity markets

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Influence of renewables on electricity markets – The merit-order effect

- Renewables have low variable costs or reduce demand (residual load)
- As a consequence, less conventional plant is needed to fulfill demand in hours with generation from renewables
- Thus, electricity prices are lower in these hours and average electricity prices decrease when renewable shares are rising

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Influence of renewables on electricity markets – The merit-order effect

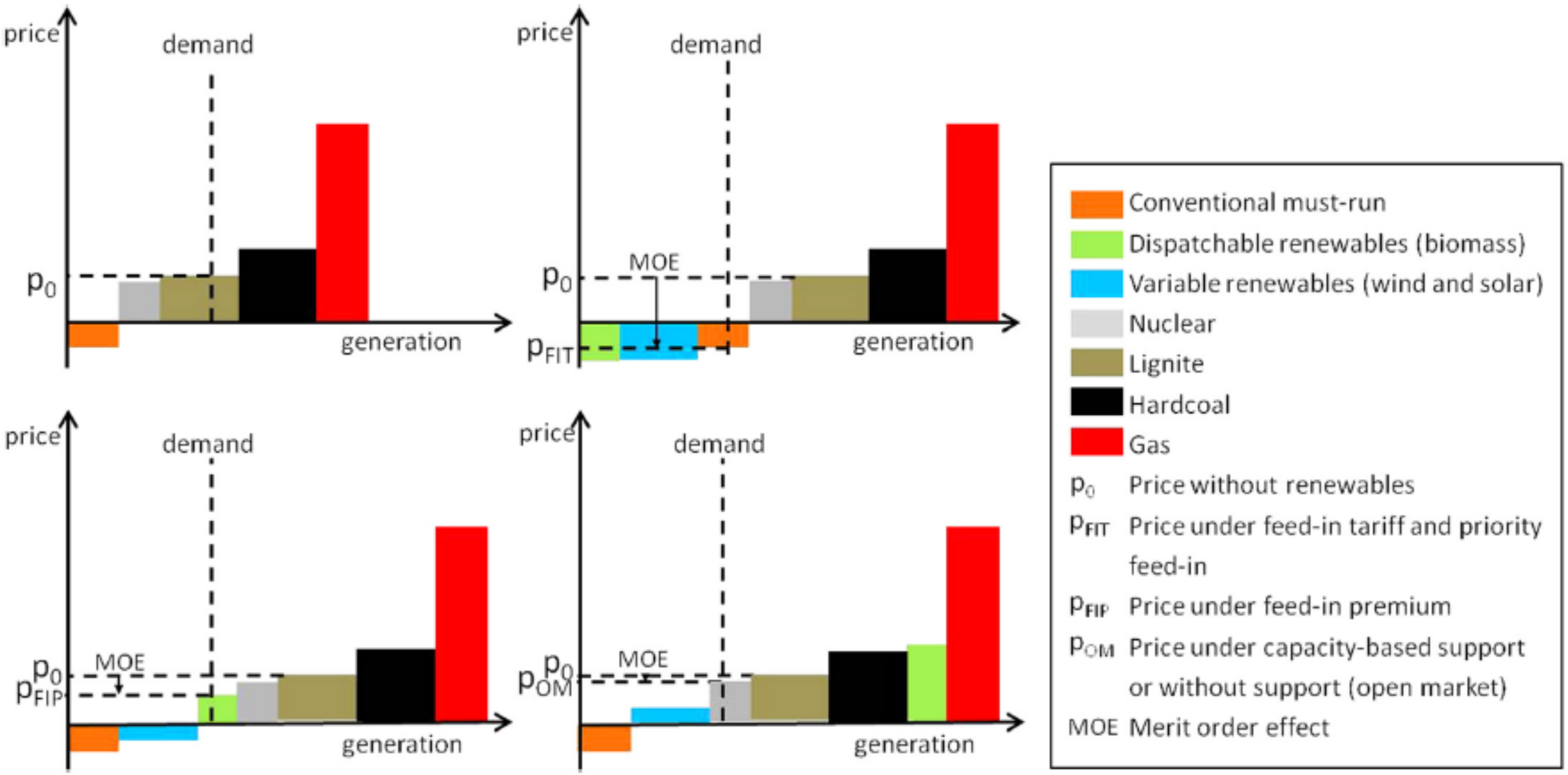

Fig. 1. Merit-order effect under different support schemes for a situation with low demand and high renewable generation.

Influence of renewables on electricity markets – Price volatility

- Residual load more volatile than demand
- Therefore, typically higher price volatility at higher renewable shares
  - Unless feed-in profile is well correlated to demand
- Also: number of hours with negative prices increases with higher renewable shares

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Methodology – Model set-up

- Plant mix and must-run capacities (as proxies for system flexibility) important parameters for effects of renewables on electricity markets
- Conventional capacity mix determined using optimization model

- Market prices and influence of renewables determined using simulation model
- Bidding behaviour of renewables:
  - Original bidding behaviour under FIT: $p_{GOT} = p_{MIN} + 1$
  - Optimized bidding behaviour under FIT: $p_{FIT} = -FIT$
  - Bidding behaviour under FIP: p_{FIP} = -(FIT- Forecasted monthly average market price*technology specific relative market value) + marginal generation costs
  - Bidding behaviour under CAP: p_{OM} = marginal generation costs

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Methodology – Scenarios

- Plant mix and must-run capacities (as proxies for system flexibility) important side parameters for effects of renewables on electricity markets

Scenario Group	Reference (RS)	Reference – sensitivity (RSa)	Alternative 1 (AS1)	Alternative 2 (AS2)
Renewables	Exogenous	Exogenous	Exogenous	Exogenous
Conventionals	Optimized	Optimized	Optimized, only gas-fired power plants allowed	Optimized
Existing capacities considered in the optimization	Renewables: Yes Conventionals: Yes	Renewables: Yes Conventionals: Yes	Renewables: Yes Conventionals: No	Renewables: No Conventionals: Yes
Must-run requirements	Reserve market plants 2020: 7760 MW 2030: 8947 MW	None	None	Reserve market plants: 20952 MW

- RS and Rsa modelled for 2020 and 2030, alternatives for 2030 only
- 24 model runs (4 bidding options for each scenario)

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Results – Average market prices

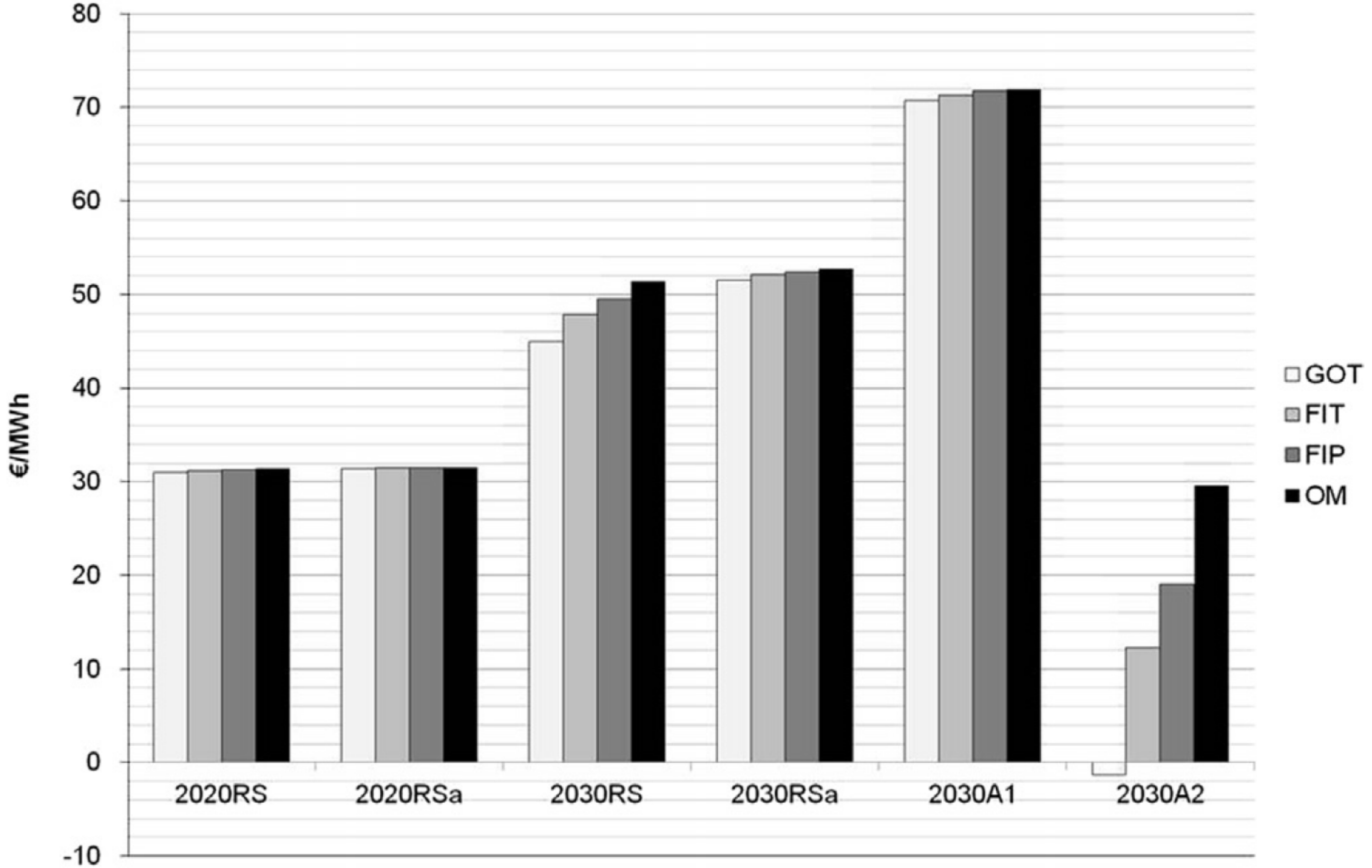

Fig. 3. Overview of development of average prices in different scenario groups depending on support scheme and trading behavior.

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Results – Average market prices

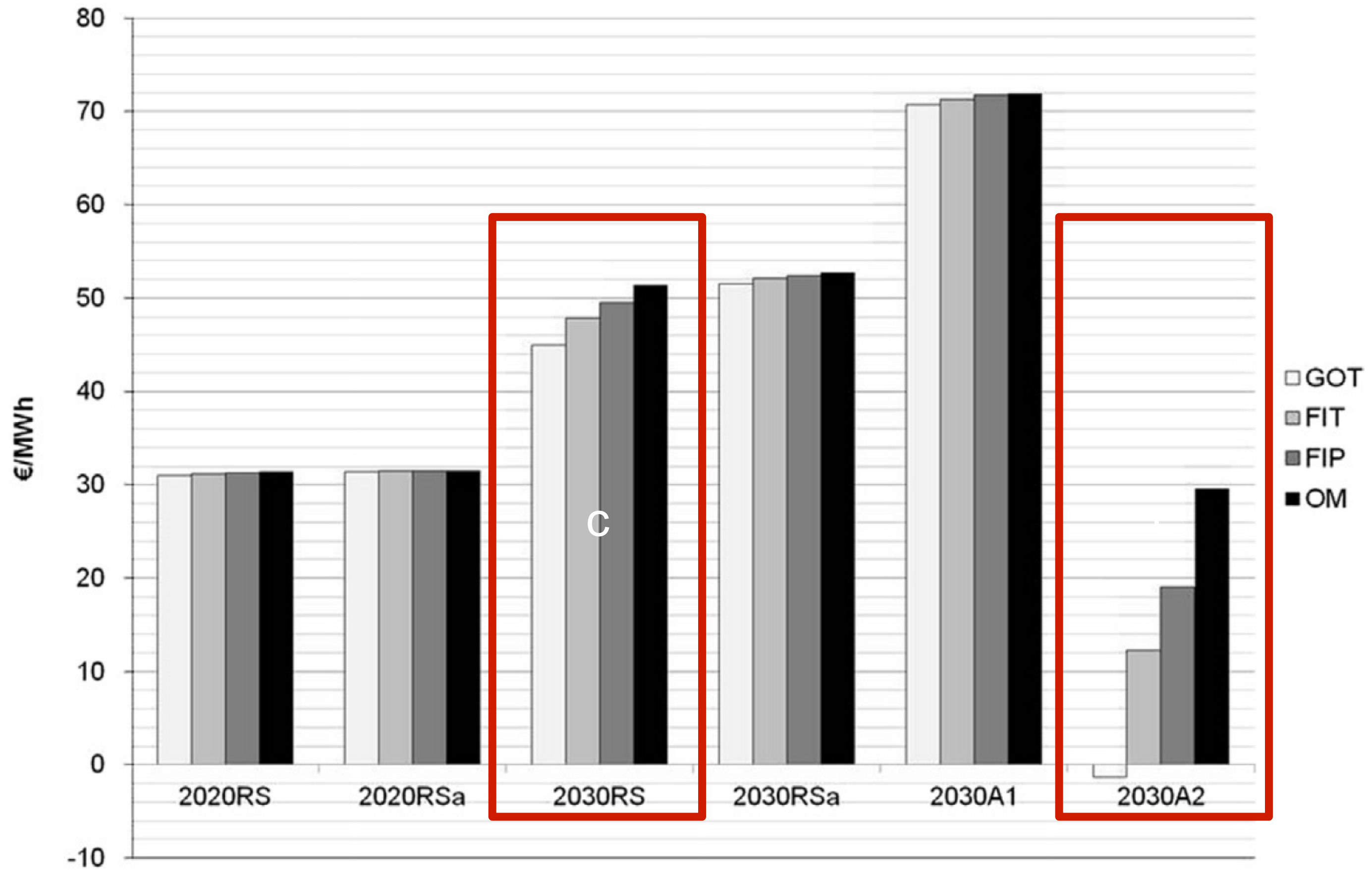

Fig. 3. Overview of development of average prices in different scenario groups depending on support scheme and trading behavior.

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Results – Price volatility

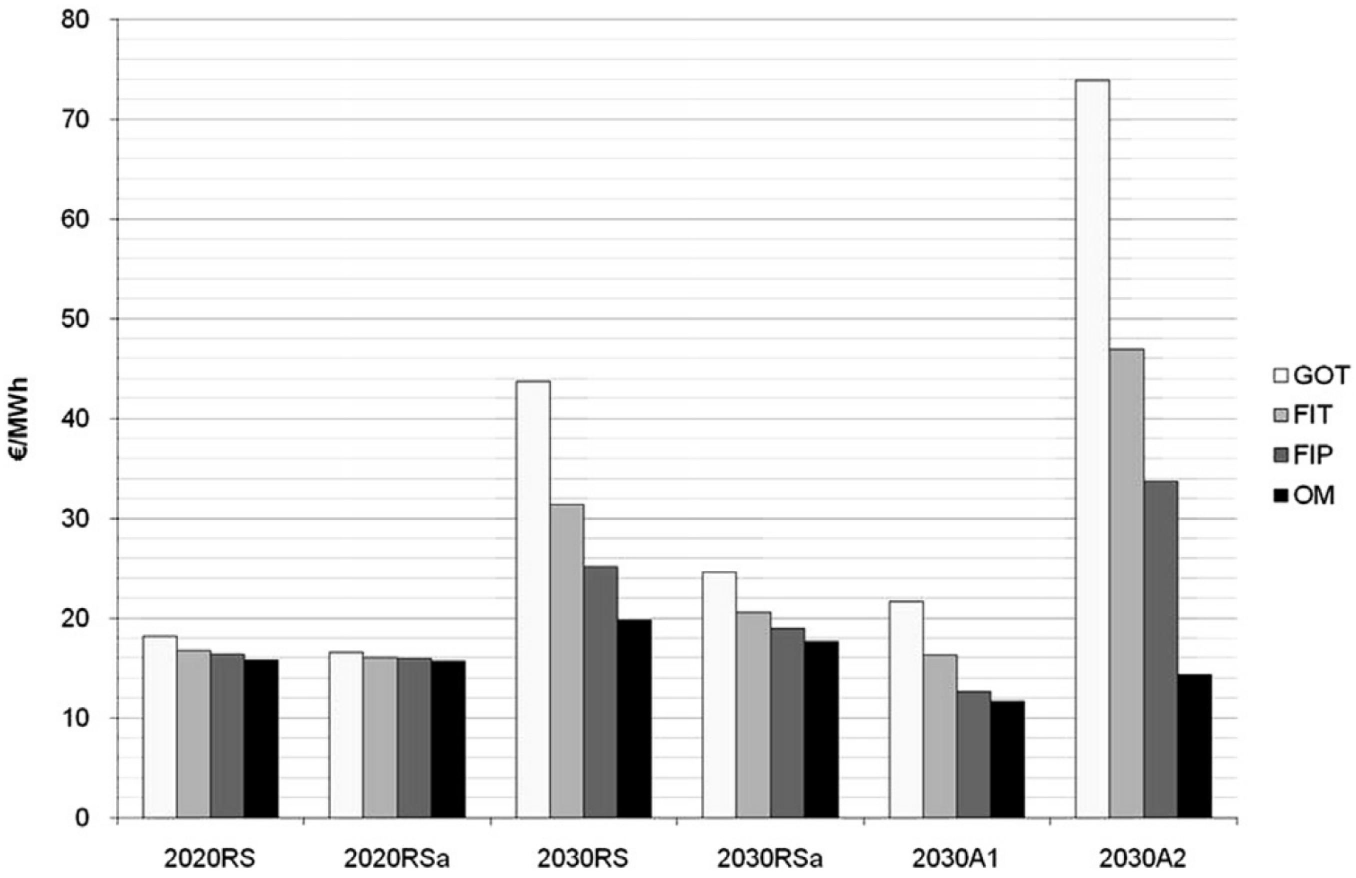

Fig. 5. Overview of development of standard deviation in different scenario groups depending on support scheme and trading behavior.

Results – Price volatility

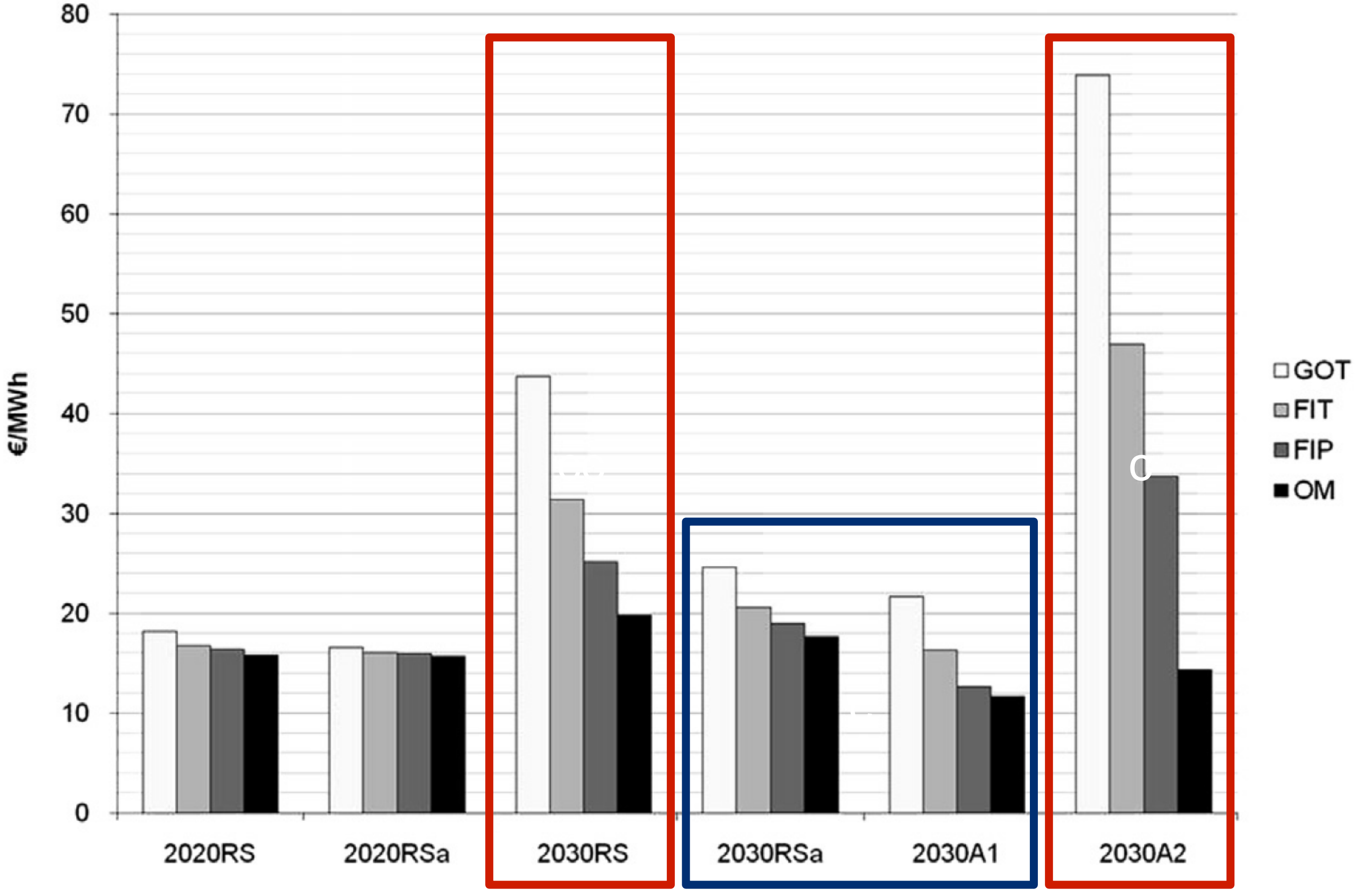

Fig. 5. Overview of development of standard deviation in different scenario groups depending on support scheme and trading behavior.

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Results – Price volatility

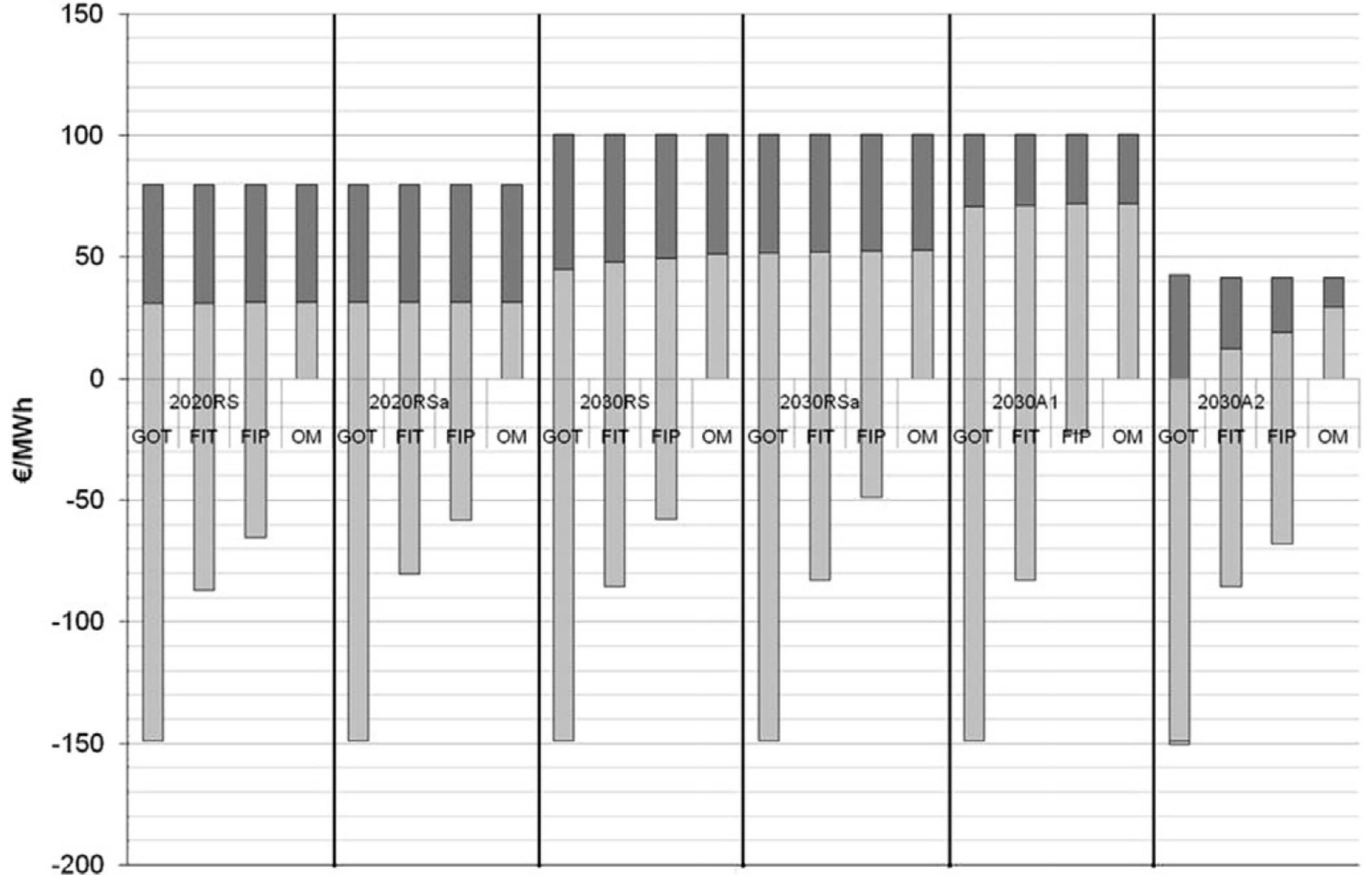

Fig. 7. Price ranges in different scenario groups depending on support scheme and trading behavior.

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Results – Market values of renewables

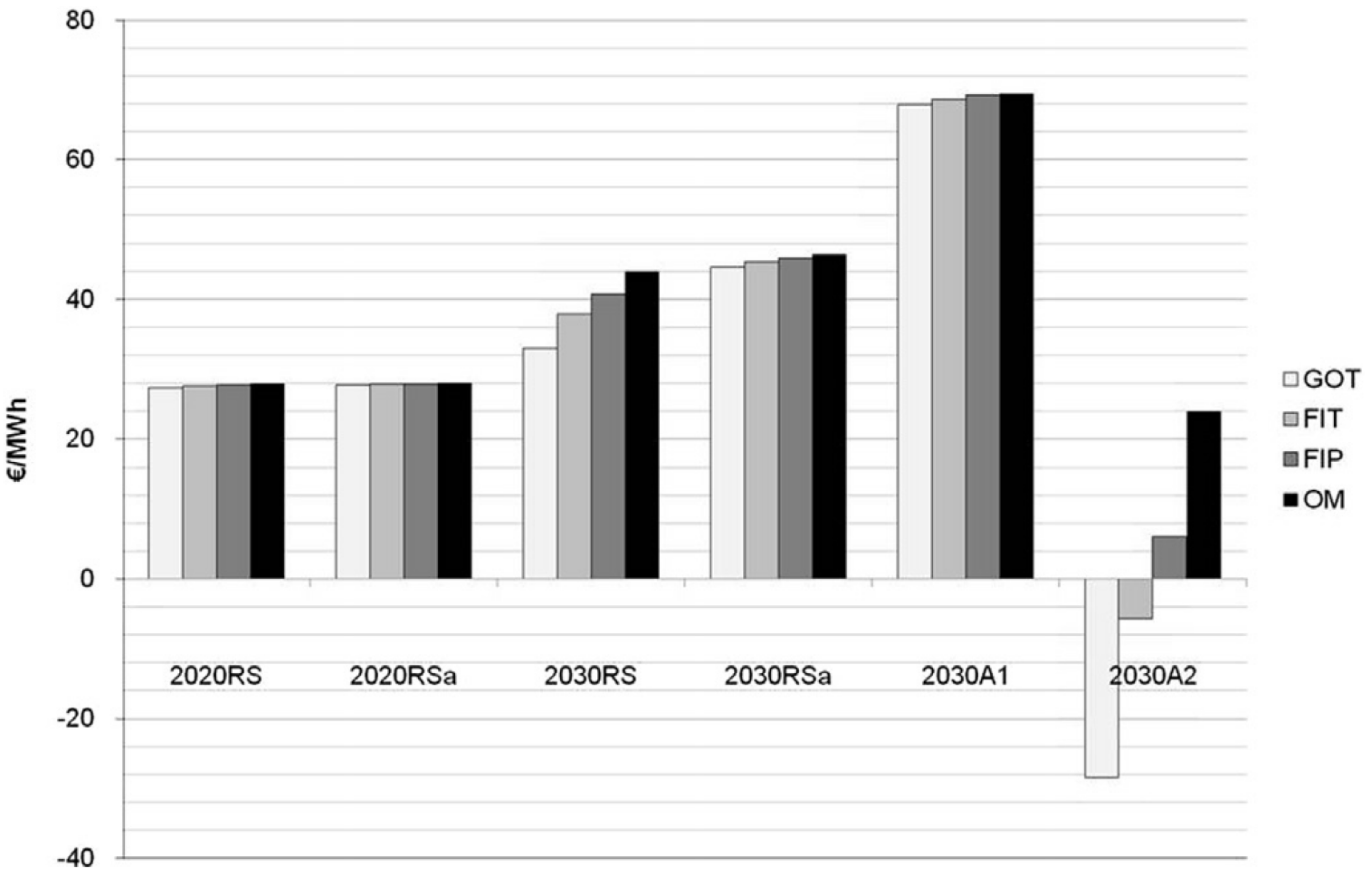

Fig. 9. Development of absolute market value of onshore wind under different scenarios and support schemes.

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Conclusion and policy recommendations

- Capacity-based support schemes reduce impact of renewables on electricity markets most effectively
- But: When chosing the support instrument for renewables, the degree of market distortion is only one criterion
- Capacity-based support schemes create perverse incentives for plant design and are therefore probably not appropriate
- Well-designed sliding premium schemes might be a good compromise between a certain degree of market participation and low risks for plant operators
- System flexibility is crucial for market integration of renewables
- In systems with low must-run requirements the need for market-oriented support for renewables is substantially reduced

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Thank you for your attention!

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