Auktionen für EE in kleinen Märkten

Möglichkeiten und Grenzen

Die Fallstudie, die zitiert wird, stammt aus dem Horizon2020 project AURES, grant number 646172.

TU WIEN TECHNISCHE UNIVERSITÄT WIEN

Agenda

The way to go & stops in between.

1. Background – Auction Design
2. Hypothesis
3. Method
4. Results
5. Outlook

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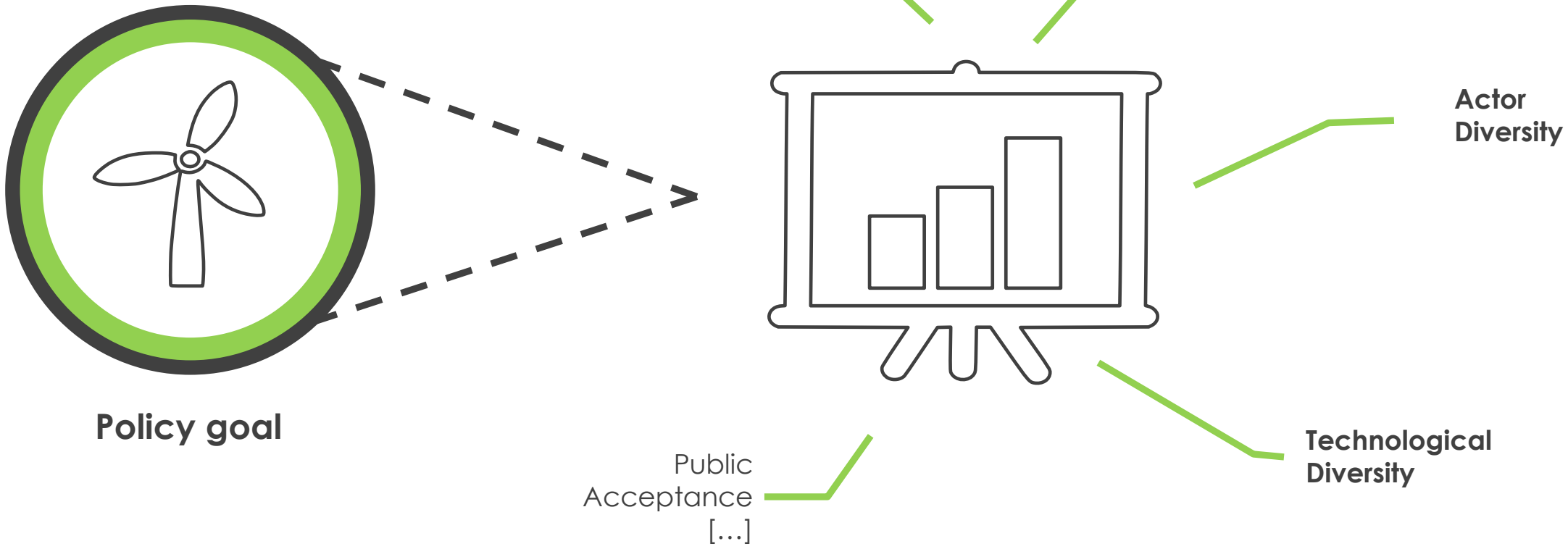
Auction Design 1/3

What to consider?



Auction Design 2/3

How do the goals line up?

Policy Goal Metrics

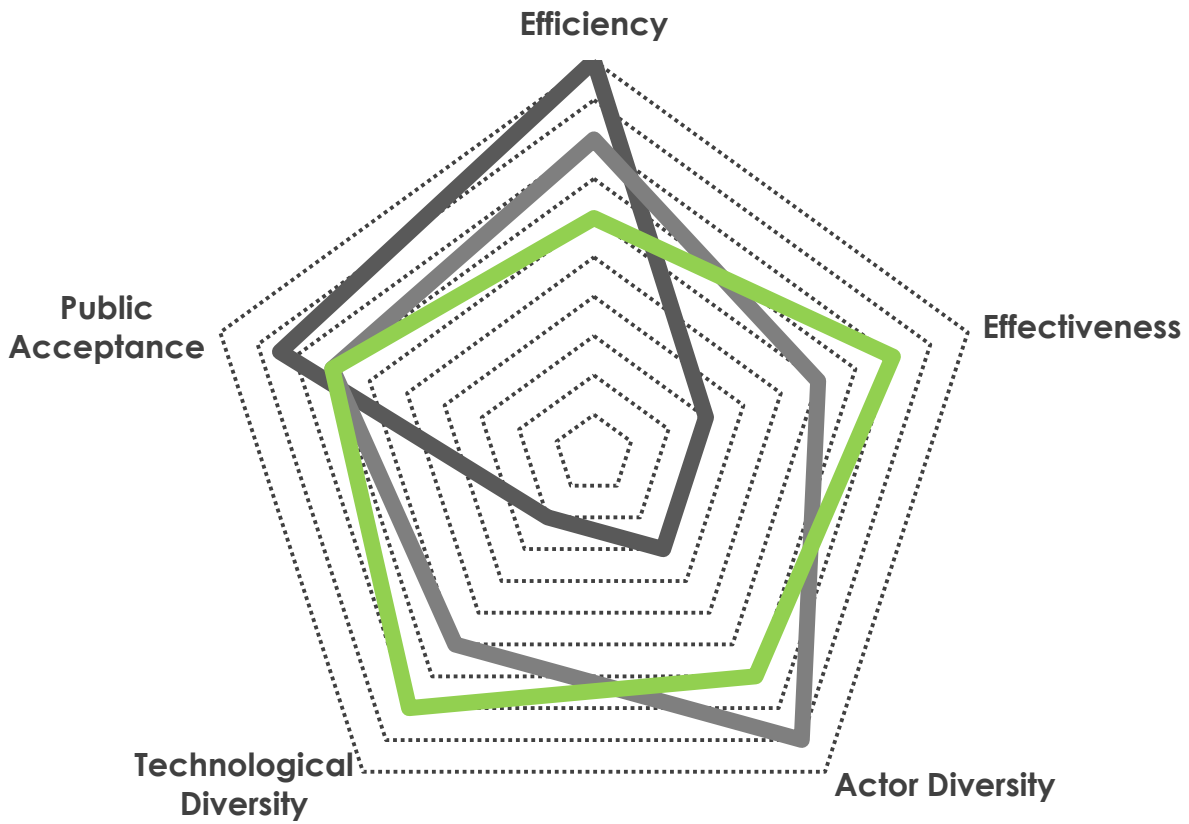


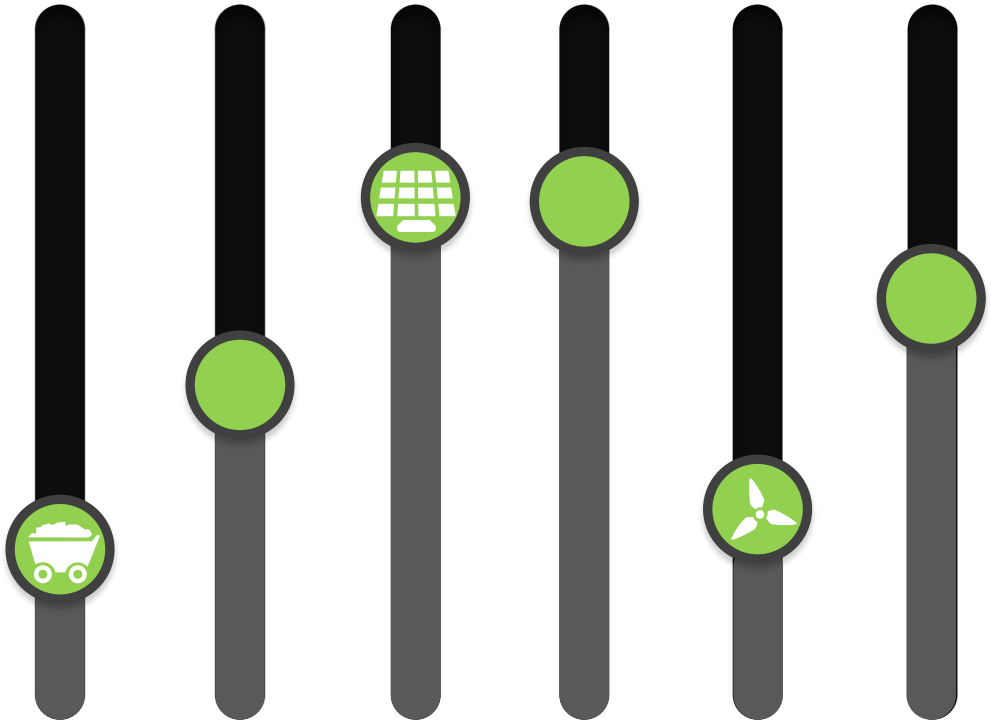
Figure: Performance of three possible auction policy designs (source: own elaboration)

- When designing auctions "the devil lies in the details".
- Different policy goals, aside of (cost) efficiency and effectiveness can be envisaged.
- These policy goals sometimes diverge and can not all be combined equally as illustrated in the metrics (left hand side).
- Designing an auction carefully is therefore crucial to achieve the planned result.

Auction Design 3/3

How to achieve the goals?

Auction design set screws



- Penalties/pre-qualifications
- Volume/schedule
- Level of technological diversity
- Budget flexibility
- Measures to influence actor diversity

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Hypothesis

Small markets have additional concerns to be taken into account when auctioning RES

Questions concerning small markets

- Small markets with a limited number of potential auction participants are quite frequent in the European Union
- Implementing renewables auctions there can be challenging – due to potential lack of competition, relatively small auctioned capacities and other factors.
- The main research question is how setting the auction schedule and the auctioned volume per round impacts the outcomes of the auction.
- Furthermore, a flexibility mechanism is tested, that allows budget shifts between rounds and can potentially increase deployment rates.

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Method 1/2

Combining Auction Theory and ABM for the model-based analysis.

Modeling of new auction design schemes

- Insights from policy makers on auction design process and/or detailled auction outcomes.
- Using a novel approach to analyse a new support scheme.
- Auction theoretic concepts implemented in an agent-based model (ABM).
- Use of all available data to model the respective market and their participants close to reality.
- Statistical analysis of auction outcomes and technological data to complement the analysis.

Method 2/2

How does learning take place over auction rounds?

Bidder‘s calculus before and during the auction

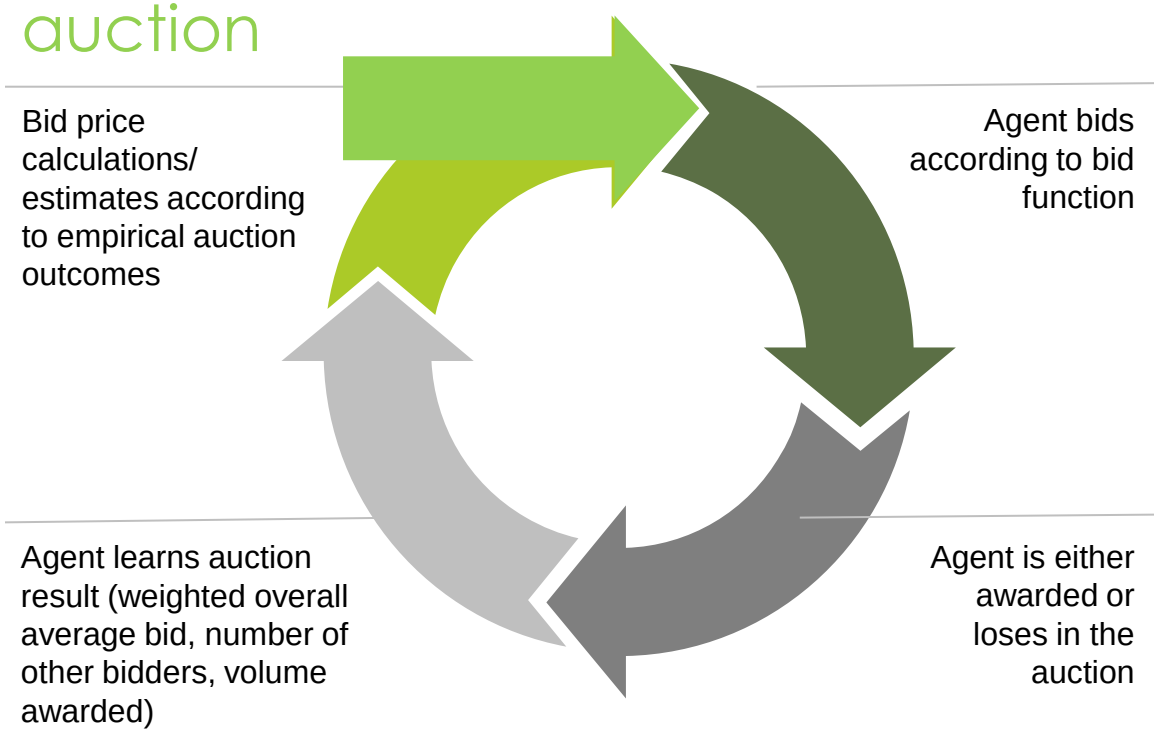

Figure: Simplified depiction of the agent's learning process in the model (source: Anatolitis and Welisch, 2017)

- Mean value (μ) is the central configuration parameter.
- Agents' learning algorithm consists of adapting μ to new information generated in the auction rounds.
- First round: the assumptions on μ of $F()$ are based on each agent's own signal (her cost).
- In each round, new information is incorporated: agents adjust cumulative distribution function by updating μ with the last round's overall mean bid.

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Results

How does setting the schedule and volume influence auction outcomes?

Background

- Different criteria for the design of multiunit renewable energy (RES) auctions in small markets are assessed.
- The multi-technology RES auctions in Denmark beginning 2018 serve as an exemplary case for the assessment.
- Two auction rounds of 200 MW planned for 2018-2019, after that (up to 2025, frequency and volume to be auctioned are still up to discussion).
- Pay-as-bid, multiple technology "open-door" common tender scheme (onshore wind, solar PV and offshore wind).
- Setting the auction schedule and the auctioned volume per round impacts the auction outcomes.
- A flexibility mechanism that allows up to 50% of the auction volume to be shifted between auction rounds is also tested.

Results

How does setting the schedule and volume influence auction outcomes?

Approach

- Number of and capacity bid by solar PV bidders estimated from recent joint solar PV auction between Denmark and Germany; for onshore wind bidders this information stems from the most recent analysis on the Danish market (ENS, 2017).
- Bidders‘ costs were calculated by estimating the LCOE with ENS data on technology costs and developments.
- Bidders were subdivided into multi and single project bidders; multi-project bidders submit three bids each for simplification reasons.
- Pay-as-bid pricing was modeled as explained earlier.

Results

How does setting the schedule and volume influence auction outcomes?

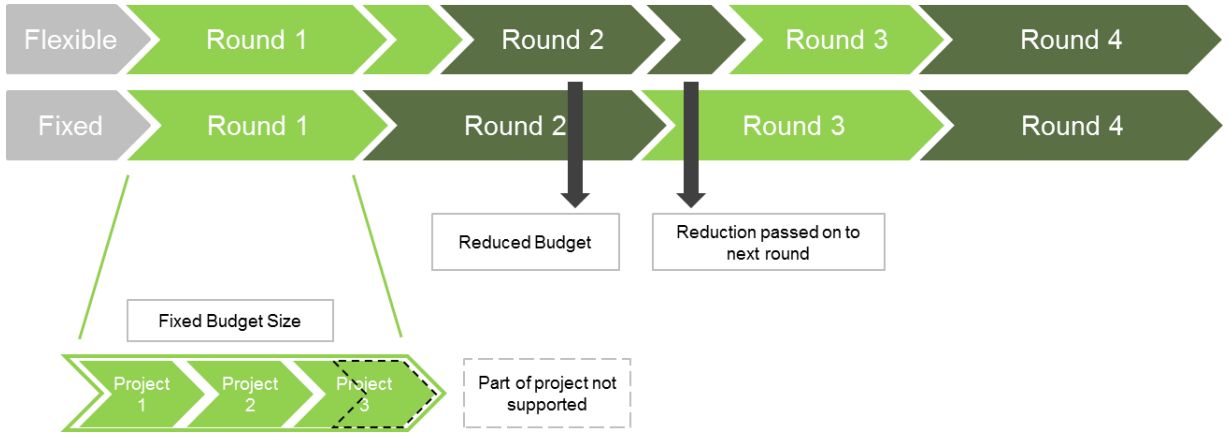

Figure: Comparison of flexible and fixed budget options (source: own elaboration)

Results

- First application of the model, was to look into the impacts of varying volume and schedule.
- Specifically, a flexibility mechanism (left hand side) was implemented and assessed.
- Too small volumes exclude large-scale/multi-project bidders and decrease capacity expansion; bid prices don't increase strongly with higher volumes/fewer rounds.
- A flexibility mechanism can help to ameliorate this.

Results

How does setting the schedule and volume influence auction outcomes?

Figure: Comparison of prices and non-realization in annual and bi-annual DK auction schemes (from 2018 to 2025) (source: own elaboration)

Results

- The bi-annual scheme performs better in terms of bid prices, whereas the annual scheme is able to ensure a much higher realization rate.
- Average non-realization in the form of rejected marginal projects is almost double the amount in the bi-annual case.
- Agent distribution is not shown, as due to the large price differences and relatively low auction volumes, only onshore wind bidders were awarded.

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Outlook

How does setting the schedule and volume influence auction outcomes?

Applicability for small markets

- An auction design for small markets should account carefully for the volume auctioned in each round
- It should ideally be flexible in allowing for the marginal bidder to exceed the auctioned volume.
- Furthermore, low auction volumes could lead to a concentration of the cheapest technology and large-scale bidders.

Thank you!

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Back-Up: Pricing Mechanisms

Nomenclature

Auction		
$range(T)$	rounds per iteration	
t	auction round	
n^t	number of bidders in round t	
n_s^t	number of successful bidders in round t	
d^t	total demand in round t	MW
s^t	total supply in round t	MW
p_{lim}^t	price limit in round t	ct/kWh

Back-Up: Pricing Mechanisms

Nomenclature

c_i^0	bidder i's initial costs in the first round	ct/kWh
q_i	quantity offered by bidder i	MW
δ	discount factor	$\in (0,1)$
$comp$	initial assumption on competition	
$succ$	initial assumption on successful bidders	
λ^t	degression factor in round t	
β	bidding function	
x	bidder's signal	
δ	uncertainty factor	