

Auctions for Renewable Energy

Model-based analysis

Penalties and pre-qualifications in the UK CfD auction scheme

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AURES: Who we are

- A coordination and support action under the EU Horizon2020 programme
- Project runs from January 2015 to December 2017
- Eight partners from seven EU countries
- Cooperation with policy makers, market participants and other stakeholders.



AURES project at a glance

AURES combines

- **Target-oriented analysis**
 - empirical analysis
 - interviews with stakeholders
 - lessons from other industries
 - auction experiments
 - simulations in energy models
- **Capacity building activities**
 - workshops
 - webinars
 - case cooperations
 - bi- and multilateral meetings
 - interactive website

...find more information on:
auresproject.eu

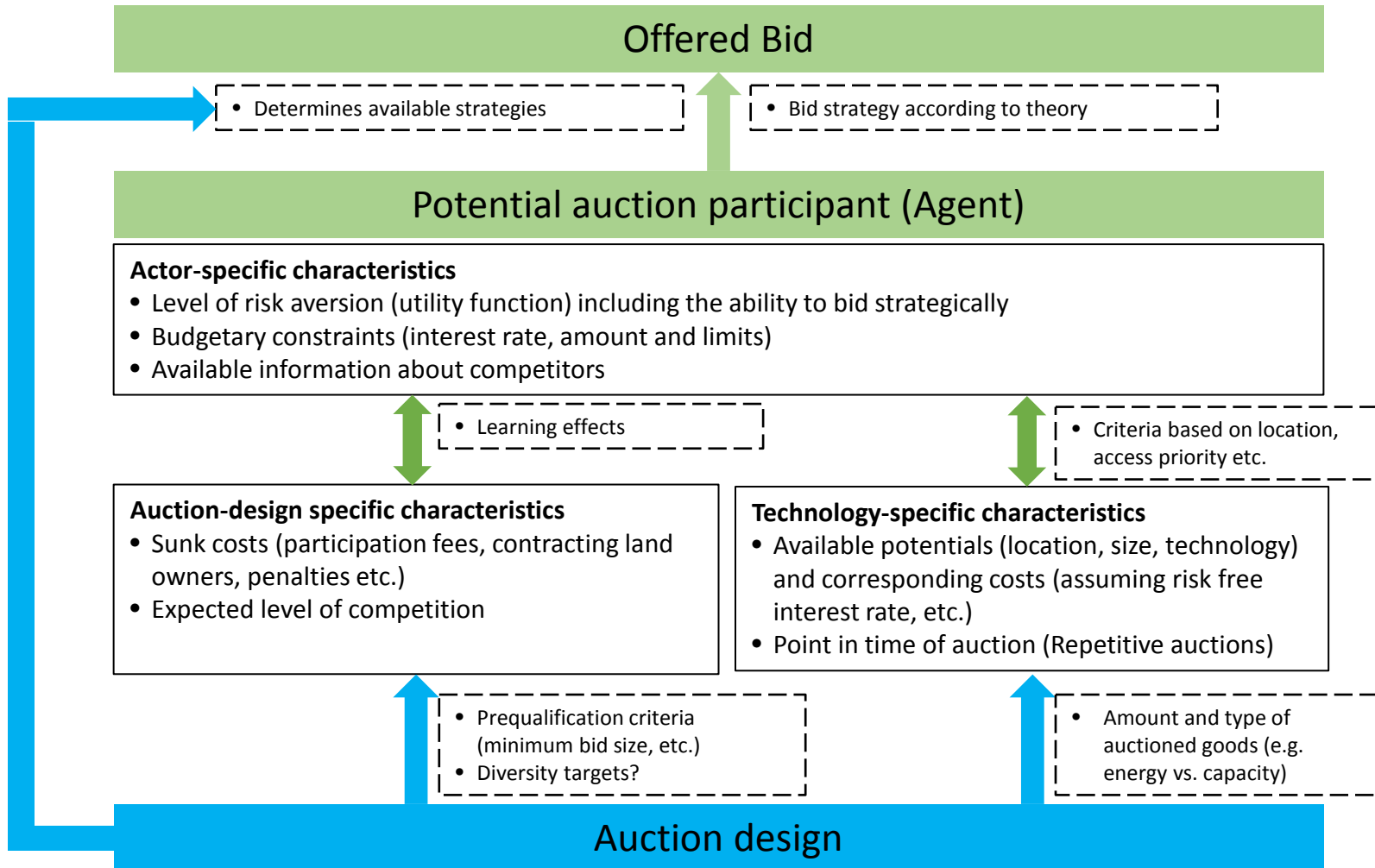
Motivation

- Ongoing auction schemes in many European member states & more are planning to get started soon
- EU legislation (Directive 2009/28/EC on the promotion of the use of energy from renewable sources and “Guidelines on state aid for environmental protection and energy 2014-2020”)
- Currently we can observe lower prices in each auction round and for all kinds of technologies (onshore & offshore wind in Germany, PV in Denmark etc.)
- Long-term experience exists in energy auctions (e.g. in Brazil, in the UK)
- In AURES, we have the unique possibility of consulting auctioning entities for designing and improving their auction schemes

Research Question

- The question investigated is part of a larger study assessing different auction designs and their influence on outcomes
- **For the UK, we investigate the influence of penalties and pre-qualification criteria on the CfD (renewables) auction outcome**

Modelling Framework



Modelling Framework

- **Uniform pricing:** bid truthfully, incentive compatible

$$b_i = c_t$$

- **Pay-as-bid:** bid at least their costs, bid shading; maximize expected profit over all rounds (discount factor δ for future rounds)

for $t=0,1,2,\dots,T$

$$E(\pi(\mathbf{b})) = \sum_{i=t}^T \delta^{i-t} \cdot (b_i - c_t \cdot Pr(\text{"successful bid in round } i\text{"})) \prod_{x=1}^{i-t} Pr(\text{"unsuccessful bid in round } i - x\text{"}))$$



Modelling Case: Penalties and pre-qualifications in the UK CfD auction scheme

Background: The UK auction scheme

- The original policy objective of the CfD auctions was to increase competition within technology groups to bring down support costs and limit producer surplus
- The CfD auctions are multi-unit, sealed-bid, uniform price auctions and they have technology-specific ceiling prices
- The auctions take place for several bidding years at one point in time and each bidding year is capped by a certain budget
- The auctions are technology diverse, but divided into two pots: mature and less mature technologies (we look at the mature technology pot)

Source:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/307993/uk_national_energy_efficiency_action_plan.pdf

Model set-up

- Two technologies participate: onshore wind and solar PV; four types of bidders (weak and strong for each technology); 21.5 % for solar PV and 78.5 % for wind onshore to represent the sector in the year 2014
- Auctioned capacity is translated from the budget by using the official “budget impact” equations by DECC
- Pricing rule is uniform pricing with the highest awarded bid determining the final strike price for all bidders
- Competition in total is assumed to be rather low (as has proven to be the case in the actual auctions)
- Bidders’ costs are derived from several sources on current and future cost developments, as bidding years are up to 2020

Model set-up

- We compare **two cases**: **Uniform pricing with** and **without a functioning penalty** scheme in place
- In the case with a penalty, bidder bids exactly her costs: $b_i = c_t$
- Risk behaviour changes depending on whether or not bidders expect to be penalized for a bid that does not cover their costs:

The bidder receives a cost signal x with an uncertainty factor :

$$y = x + \hat{\partial} \text{ where } \hat{\partial} \in [-\varepsilon, \varepsilon]$$

The bidding function resulting is:

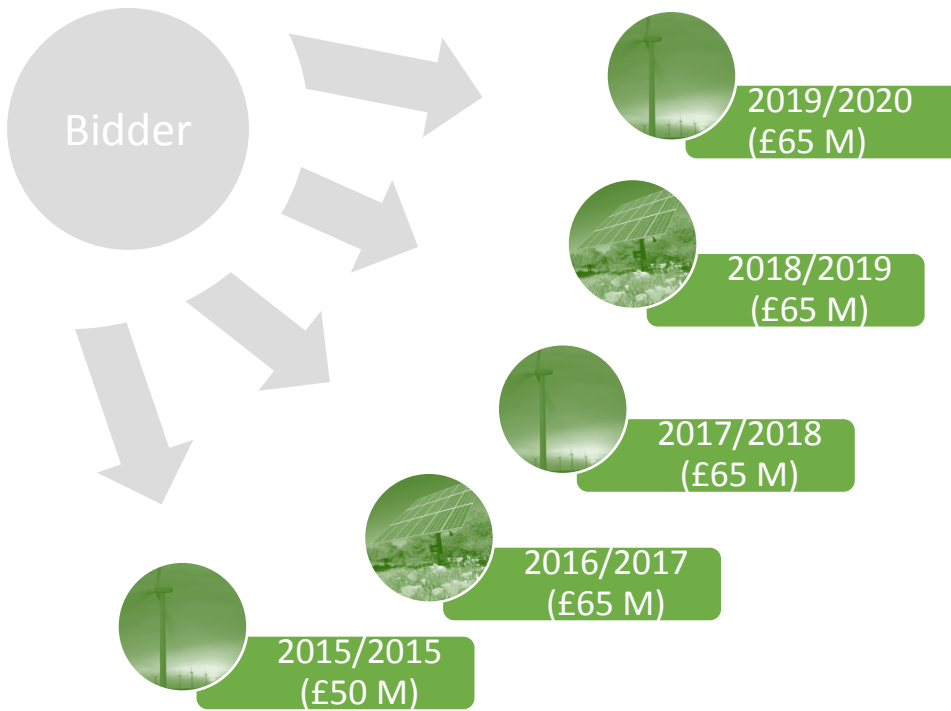
$$b^2(x) = x - \hat{\partial}$$

- As the bidder is able to default, she can submit a bid in the lower bound of the range of her signal, even though it might result in a loss

Agent distribution

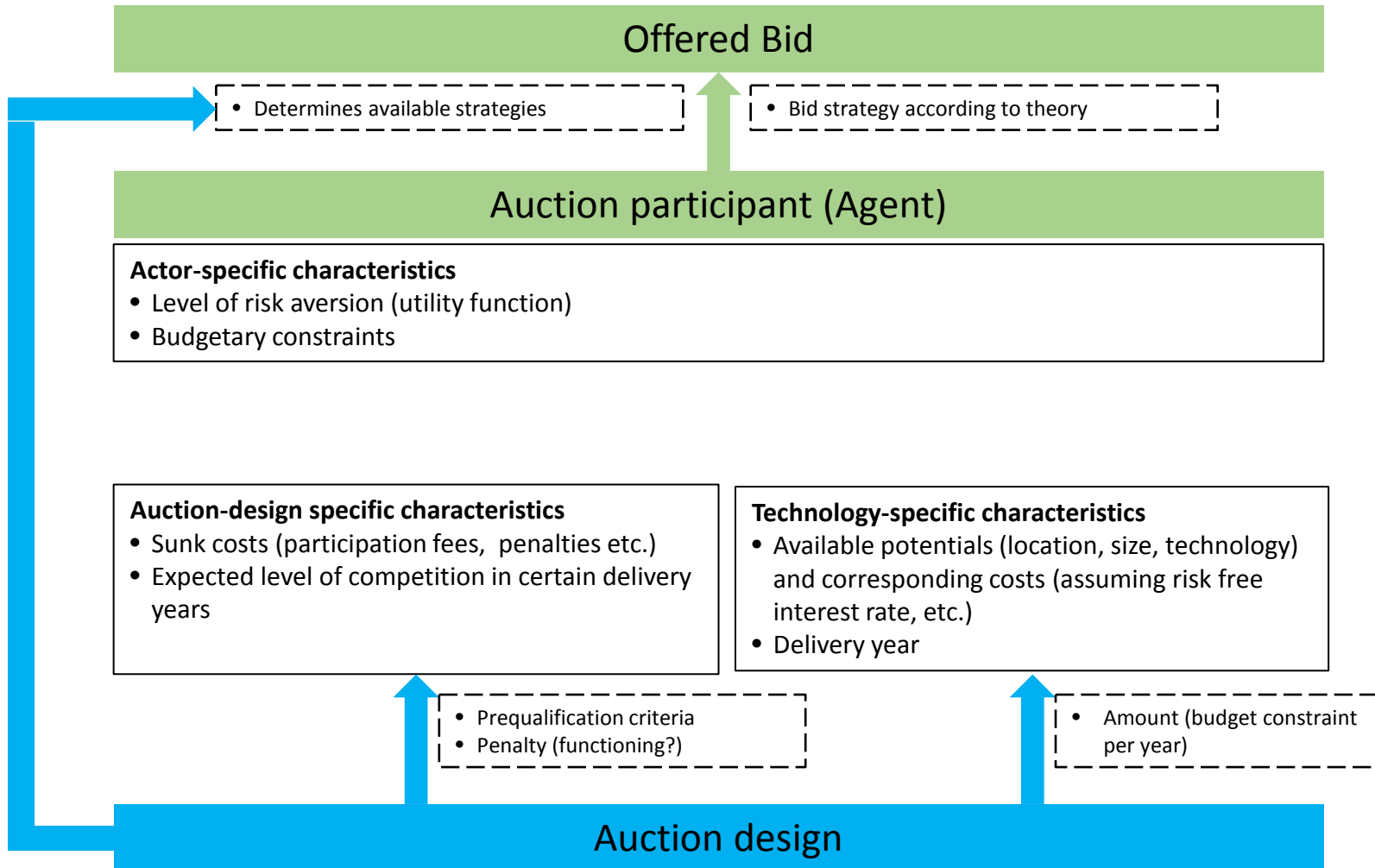
Agents	PV (strong bidder)	PV (weak bidder)	Wind (strong bidder)	Wind (weak bidder)
Average number of bidders (first delivery year)	10	10	15	15
New random draw of bidders (per delivery year)	0-2	0-2	0-2	0-2
Range of capacity bid [MW]	5-15	5-15	5-50	5-50
Cost distribution [p/kWh]	4.7-6.2	6.2-7.6	7.1 - 8	8 - 9.4
Cost digression	piecewise: 7.5% first year, then 2.5% annually		1.95% per year	

Bidding process



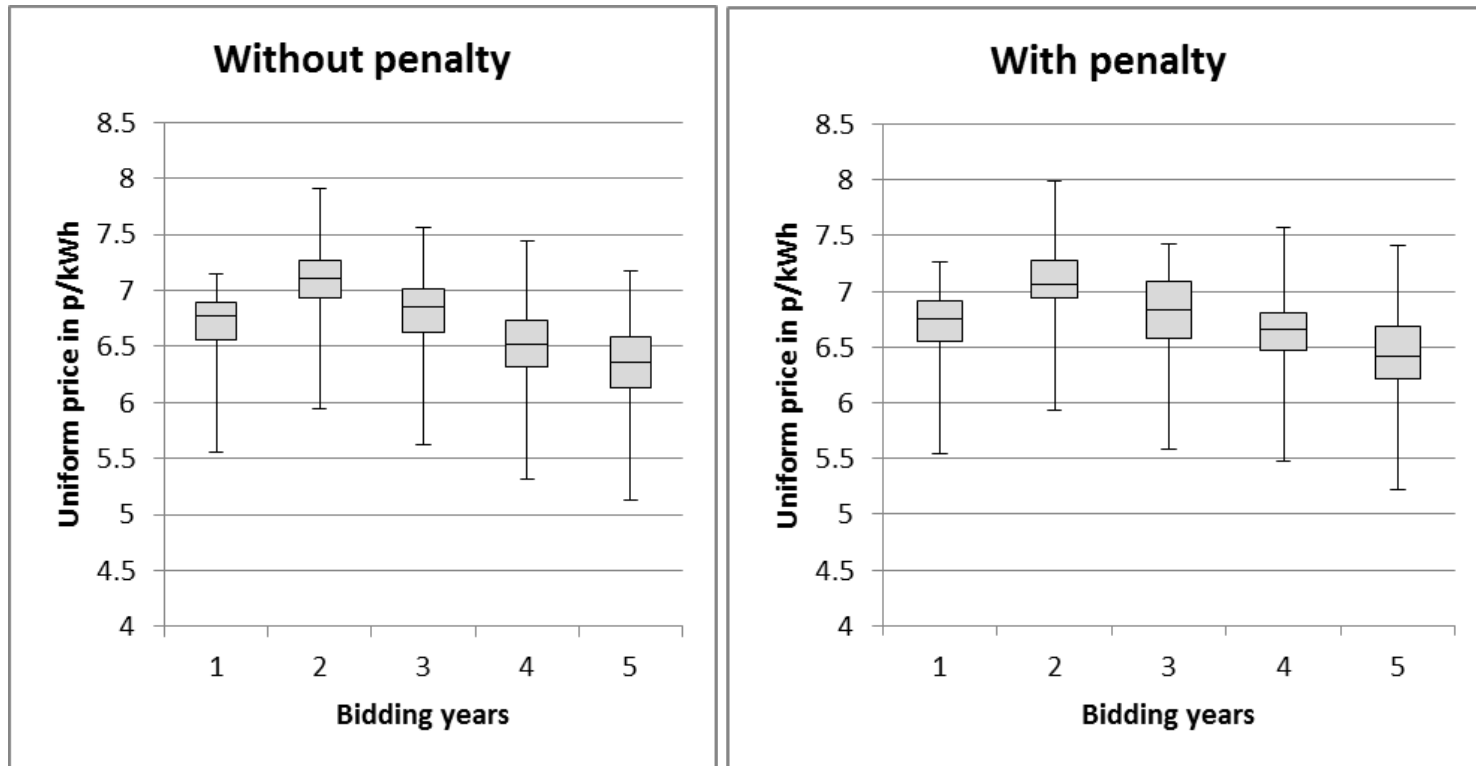
- One shot auction
- Bidder can bid into one of five bidding years
- Each bidding year is capped by a budget

Bidding process



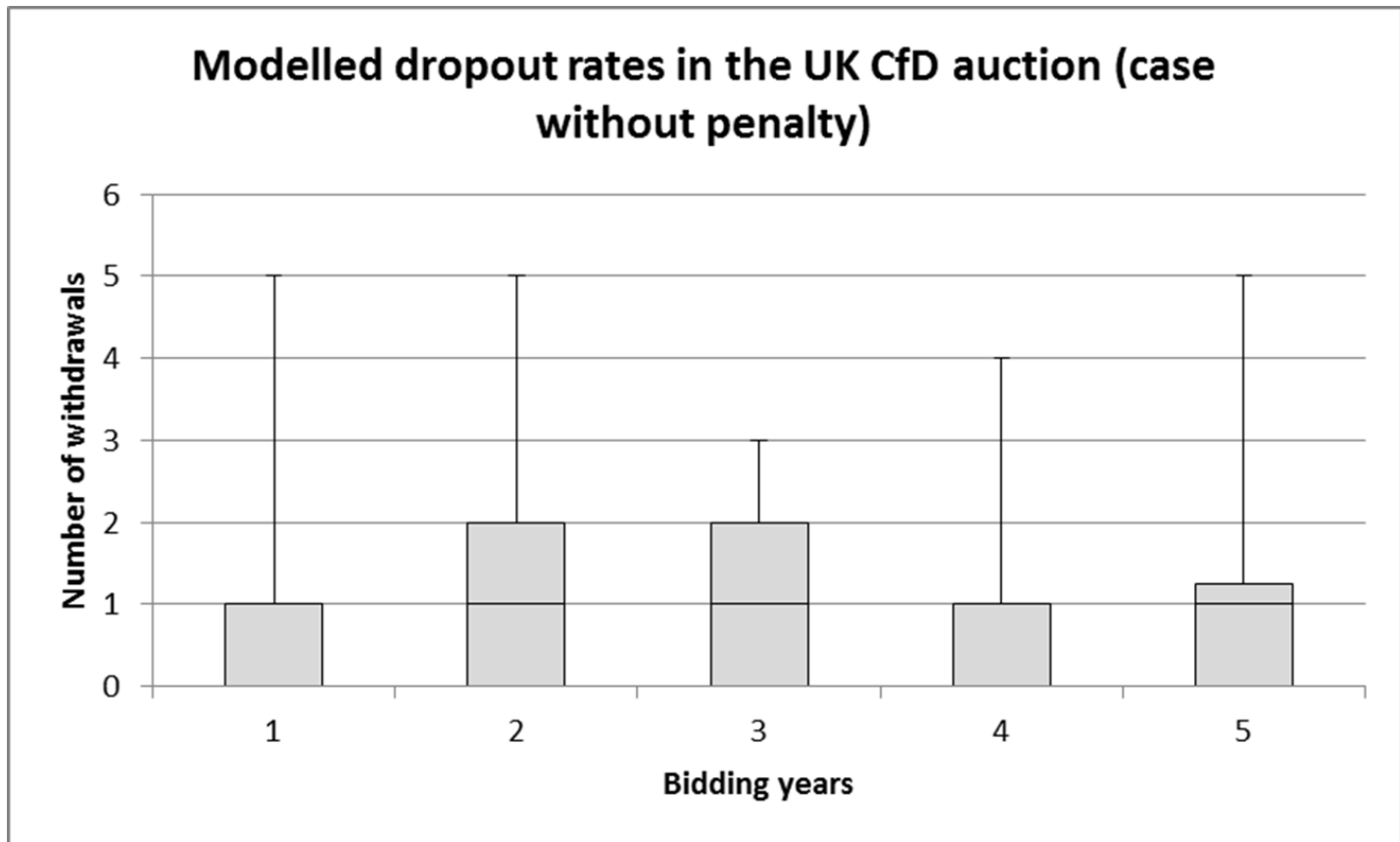
Model results

UK Contract for Difference (CfD) auction prices (modelled results)



*Comparison of the two modelled cases; one can see that the prices do not differ substantially between the case with and without penalty

Model results



*Default is shown as number of withdrawals; this is on average 23 MW per round, depending on whether large or small bidders drop out, up to 100 MW of drop out is possible

Findings and policy implications

- Auctions without penalties and/or pre-qualification criteria have a higher likelihood of strategic bidder behaviour which leads to a certain amount of default (insecurity)
- This does not come at the benefit of lower prices but does increase slightly the average profit of bidders
- In terms of policy implications, if the auctioning authority wants to achieve certain capacity goals, it should consider functioning penalties and/or pre-qualification criteria

Thank you!

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