**[*price guarantee and subsidy in wind farm auctions* ]**

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## Overview

Wind energy is expected to come online below market prices without additional subsidy, which implies that governments can generate revenues by issuing wind farm permits. Governments want to promote wind energy and maximize their revenues from issuing the wind farm permits by implementing a simple, transparent, and efficient policy. Auction is a good tool to do so. However, due to uncertainies in electricity price and wind turbine cost in the future, the winner of the permit auction is often not the most productive bidder because the most productive bidder may be more risk averse than other bidders, and the winner is often not putting the optimal effort to produce wind energy because of risk aversion, which leads to an efficiency loss in utilizing the wind farm permit. Since acution is not widely used in allocating wind farm permits and the data on wind farm auctioon is barely available even if it exists, we use a series of auction experiments to investigate wether a price guarantee policy that governments gurantee the wind farmers a fixed electricity price could help in selecting the most productive bidder and motivating the winner to produce more. In addition, we study whether subsidy is still needed even though wind farms could be built without subsidy assistance. We find that price gurantee improves the efficiency in selecting the most productive bidder hence increase wind energy production and government’s revenue in the auction. In contrast, even though the price subsidy policy increases wnd energy production, it reduces government’s revenue and does not help improve the efficiency in selecting the most productive bidder. Hence the price subsidy policy is useful only when the producing wind energy is much more important than genertating revenue for governments in the scenario wind farms could be built without subsidy.

## Methods

We use controlled lab experiments to evaluate whether the price guarantee policy and the price subsidy policy are effective to promote wind energy and increase government’s revenue. The design is a 2 x 2 full-factorial design, since it includes all four of possible combinations of whether the price guarantee is implemented and whether the price subsidy is implemented.

In the baseline (No Subsidy No Guarantee), bidders face an electricity price that is randomly picked from a distribution. Before knowing the realized electricity price, bidders have to decide how much effort to put for production and how much to bid for the wind farm permit. The highest bidder wins the permit and pays what she bids.

In the treatment (No Subsidy Yes Guarantee), compared to the baseline, the only change is that bidders now face a fixed electricity price equal to the average price of the baseline.

In the treatment (Yes Subsidy No Guarantee), compared to the baseline, the electricity price still follows the same distribution but on top of whichever realized price the winner receives a subsidy equal to 20% of the average price of the baseline.

In the treatment (Yes Subsidy Yes Guarantee), compared to the baseline, bidders face a fixed electricity price equal to the average price of the baseline and one top of the fixed price the winner receives a subsidy equal to 20% of the average price of the baseline.

By comparing the treatment (No Subsidy Yes Guarantee) with the baseline, we know the effect of the price guarantee on wind energy production and government’s revenue in the auction. By comparing the treatment (Yes Subsidy No Guarantee) with the baseline, we know the effect of the price subsidy on wind energy production and government’s revenue. By compareing the treatment (Yes Subsidy Yes Guarantee) with the baseline, we know the effect of both policies on wind energy production and government’s revenue.

In addition, we can also evaluate the effect of the price guarantee and the price subsidy on the efficiency in selecting the most productive bidder, the effect on government’s average revenue and the revenue’s volatility in auctions.

## Results

We find that the price guarantee policy increases wind energy output by 7%, increases government’s revenue by 29%, decrease the revenue’s volatility by 36%, and increase the efficiency of selecting the most producetive bidder from 50% to 70%. In contrast, the price subsidy policy increases wind energy output by 21% but reduces government’s revenue by 13%, and does not change the efficiency in selecting the most productive bidder.

## Conclusions

The price guarantee policy is effective to promote wind energy production and increase government’s revenue by issuing wind farm permits via auction. The price subsidy policy increases wind energy production but at the cost of government’s revenue reduction. Only if producing more wind energy is much more important than increasing government’s revenue, governments may consider the price subsidy policy in the scenario wind farms could be built without subsidy.

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