Nuclear Capacity Auction

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Sweden stands at a crossroad

Ageing nuclear parc stands for 43 % of electricity production

The parliament decided that old nuclear plants can be replaced by new ones

Questions

Should Sweden invest in new nuclear plants ?

If so, who should build them ?

The Swedish electricity market is deregulated and investements are meant to be market based.
A market with entry barriers

Investments in large scale hydro power is forbidden by law

Limited transmission capacity restricts import

Nuclear power owners can block entry

• Every new reactor must replace an old one
• New reactors must be built on current sites owned by incumbents
• New reactor can start produce only after old reactor has been decommissioned.
Problems with entry barriers

Entry barriers imply that incumbents are responsible for nuclear investments

But capacity utilization is low in Sweden

The difference in capacity utilization represents one reactor
Reduce entry barriers

We propose a nuclear capacity auction to open up for new competitors.

Potential investors should bid for the license to build new plants. The most efficient investor should have the largest willingness to pay and should therefore win the license.
New nuclear plant

$k_n - k_0$ : yearly capacity in the new plant

Supply shifts from $S_0$ to $S_n$

Price drops from $p_0$ to $p_n$

g : yearly profit gain

l : yearly profit loss following the price drop

b : profit loss on peak load production

l + b + s : increase in CS

F : cost of building the new plant
New nuclear plant, cont’d

Effects (disregarding F)

- **G**: ENPV (profit gain) from nuclear capacity expansion
- **L**: ENPV (profit loss) on inframarginal output following the price fall
- **B**: ENPV (profit loss) on peak load production
- **L + B + S**: Increase in CS

Welfare change: **G + S - F**
Investment incentives: Incumbent

Incumbent invests if \( G - L > F_i \)

Under investment if \( G - L < F_i < G + S \)

The incumbent exercises market power:

- Internalizes profit loss L
- Disregards surplus S
Numerical example

Vattenfall replaces 2 old plants by a modern one of 1600 Mwe

- $k_n - k_0 = 12.6 \text{ TWh}$
- 60 years of expected life span

No uncertainty and stationary yearly profit and losses

G depends on price / cost margin and assumed real interest rate

- $p_n = 37$ and $c = 7$ (in EUR / MWh) $\Rightarrow$ $g = 378 \text{ mEUR}$
- $r = 8.5 \%$

$\Rightarrow$ $G = 4.4 \text{ bEUR}$
Numerical example

Vattenfall replaces 2 old plants by a modern one of 1600 Mwe

- $k_n = 12.6 \text{TWh}$ (and $k_0 = 8 \text{TWh}$)
- 60 years of expected life span

No uncertainty and stationary yearly profit and losses

G depends on price / cost margin and assumed real interest rate

- $p_n = 37$ and $c = 7$ (in EUR / MWh)  \(\Rightarrow\)  $g = 378 \text{ mEUR}$
- $r = 8.5\%$  \(\Rightarrow\)  $G = 4.4 \text{ bEUR}$

L depends on

- Profits from Vattenfall’s generation in its hydro and (old) nuclear plants
  - Hydro accounts for 33 TWh for 60 years and old nuclear for 35.5 TWh for 10 years
- Price drops by 3.25% (i.e. $p_0 = 38.25$)

\(\Rightarrow\)  $L = 0.8 \text{ bEUR}$
A nuclear capacity auction

Vickrey auction to sell the license to build and operate the new plant

J entrants where $F_E = \min \{ F_j \}$

Entrant’s valuation: $G - F_E$

Because the incumbent’s relevant alternative is that an entrant invests, the incumbent’s valuation is

$G - F_I$

Underinvestment occurs iff

$G < \min \{ F_I, F_E \} < G + S$

The auction produces 3 improvements:

1. Because of the entry threat, the incumbent no longer internalizes $L$

2. Absent underinvestment, the most efficient producer wins the license (if $F_E < F_I < G - L$)

3. The auction generates revenues to the seller
Recommendation 1: Encourage as many bidders as possible - entrants, incumbents and energy intensive industries

Benefits of attracting many potential investors:

• Increased competition for the license
• Increase the likelihood of finding the most efficient owners
• Increase the likelihood that investments are profitable

Do not only encourage entrants

• Incumbent may be the most efficient investor (if $F_E > F_I$)
• Large industrial internalize part of consumer surplus, $S$, and thus reduces the underinvestment problem

Swedish Competition Authority
Recommendation 2: Joint ownership by large producers should be discouraged

Increases market power and thereby exacerbate the underinvestment problem
Short run market power

So far no short run market power

=> incumbents exercise market power in investment decisions only

But Swedish plants have low capacity utilization rates which may partly reflect short run market power

Could incumbents invest in a costly new plant and exercise short run market power – under utilize the plant – ex post?

• Threat of entry could force incumbents to over invest
• At times of low demand, incumbents may have incentives to reduce output so as to increase the price

The option to exercise short run market power increases incumbents willingness to pay in the auction

=> incumbent may win the auction even if $F_E < F_I$
Virtual power plants

Winner in the auction must sell capacity as VPP contracts

VPP contract: holder has the option to buy electricity at MC

Owner of the plant earns profits from selling the option rather than from selling electricity

VPP auction delegates short run production to financial actors lacking market power
Recommendation 3: Force owners to sell a significant share of their capacity as VPPs

The VPP auctions have no effect if incumbents lack short run market power

BUT

If incumbents have short run market power, then the VPP auctions

• Reduce distortions due to short run market power

AND

• Reduces incumbents’ incentives to bid for market power in the nuclear capacity auction
Summary and conclusion

Nuclear capacity auction reduces entry barriers

Nuclear capacity auction increases the likelihood of finding the most efficient investors

Nuclear capacity auctions and VPP auctions are complements rather than substitutes

More work is of course needed to work out the details of the nuclear capacity auction
Thank You