

Power system investment incentives in a market environment

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Abstract

The electricity industry has been liberalized in many parts of the world. Power system investment decisions are therefore increasingly taken in a market environment. Still, market drivers are often supplemented with regulatory or government intervention to provide additional investment incentives. This paper discusses the various incentive schemes that have been deployed in a market environment to trigger power system investments, including transmission and demand side infrastructure and generation capacity investments. In addition, the relative success of these schemes in delivering the investments that are needed is discussed. This paper is based on the work conducted by the CIGRE Task Force C5-7.1, which is part of CIGRE Study Committee C5 - Electricity Markets and Regulation. The Task Force members are Tim Baker, Jea-Marie Coulondre, Yoshiro Hiraiwa, Juan LaGrange, Leonardo Meeus (convener), Joao Carlos Mello, Rana Mukerji, Andrew Ott, Konrad Purchala, Miroslav Sumpik, Manual Tinoco and Merryn York.

1. Introduction

While there is compelling evidence that the electricity industry liberalization has, in general, improved economic efficiency, and reduced operating and maintenance costs (Newbery and Pollit, 1997; Wolfram, 2004), there is yet no academic consensus on which market design provides the least distorting long-term investment incentives.

The original vision of the liberalization process was that generation is a potentially competitive industry whose prices should be set by a competitive wholesale market. Regulated prices were confined to the natural monopoly transmission and distribution businesses. Indeed, most investments in transmission in liberalized markets have been done by regulated monopolies, but also merchant investors have been allowed to enter the transmission business. Furthermore, generation capacity investments are mainly market driven, but governments and regulators have also intervened providing additional support schemes. Perhaps the biggest diversity in investment incentives is for demand side infrastructure such as smart metering. It is not always clear whether these investments are part of the transmission and distribution business or rather the supply business in a market environment.

2. Literature discussion

Generation capacity and demand side infrastructure

Since the beginning of the liberalization process, several authors argued that intervention is necessary to reduce the volatility of the generation capacity business cycle. More recently, several studies also suggest that without more demand side participation, the market can simply not provide adequate generation capacity. Cramton and Stoft (2006) quote several studies that indicate the current energy markets are underpaying investors whenever investment brings generation capacity close to the adequate level. The result is that investment stops well before reaching this level. In other words, the prospective revenues for a generation capacity investment are not only very risky and uncertain, they

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are also simply too low. This problem has been labeled the “missing money problem”. Joskow (2006) provides the most complete discussion of the causes of the “missing money” problem.

Without demand side infrastructure², demand cannot adequately participate in the wholesale and balancing markets. Instead, an administrator³ is needed to consciously set the level of reliability, as the market cannot. Demand side infrastructure such as active (real-time) meters played a marginal role in the original liberalization vision. It is not straightforward whether demand side infrastructure is a market driven investment that needs to be undertaken by utilities or whether it should be part of the transmission and distribution infrastructure. However, the degree of demand side participation in wholesale and balancing markets is key in the discussion on generation capacity adequacy.

Administrators have often intervened in the generation industry providing extra support schemes for generation capacity. Arriaga et. al (2002) reviewed different capacity mechanisms available to administrators to encourage investments in generation. In one version of capacity mechanisms, the administrator sets a price for capacity and lets the market determine the amount of capacity available, i.e. capacity payments⁴. In the other version, the administrator sets the amount of capacity that has to be available and lets the market determine the price, i.e. capacity requirements or obligations⁵.

Note also that separate support schemes are often provided for Renewable Energy Sources (RES), but these are driven by concerns other than generation capacity adequacy, such as environmental concerns and primary energy import dependency.

Transmission infrastructure

Most investments in transmission have been done by the regulated monopolies. It is important to understand whether there is considered to be enough, too much or too little investment in regulated transmission infrastructure. The balance of incentives for regulated monopolies to invest is important to achieving the “right” level of investment in transmission.

Merchant investors have been allowed to enter the transmission business. Vandezande et. al (2006) address the questions whether Merchant Transmission Investments (MTI) are a way of dealing with the situations where there may be underinvestment in transmission (Are we willing to accept third party investment?) and whether they are commercially feasible (Are third parties willing to invest?).

MTI are seen by many as a way of dealing with the situations of underinvestment in infrastructure, although the authors argue that in the long run it is also indispensable to improve the framework for regulated investments.

Whether MTI is commercially viable depends on the remuneration scheme, which in turn is a market design issue. The biggest risk for a MTI project is of course that a regulated line is built in parallel, making the MTI obsolete. Therefore, instruments that allow merchant investors to hedge their future congestion revenue is key. In the USA, Financial Transmission Rights allow merchant investors to hedge against volatility in nodal price differences. In Australia, a “right of conversion” has been established as an alternative way to mitigate some of the MTI commercial risk. In the first European MTI project called Estlink, it has been foreseen that the network monopolists can buy-out the merchant investor, which basically also means that the latter’s commercial risk is to a certain extent mitigated (Vandezande et. al, 2006).

² Perhaps interesting to use this term instead of for instance demand response infrastructure as demand response also has a more specific use in literature, i.e. type of demand side management initiative/project where consumers reduce their consumption in reaction to price signals from their utilities.

³ Government or regulator

⁴ Britain adopted capacity payments under the Pool, as did Spain and several Latin American countries.

⁵ The eastern pools in the US, including PJM, NYPP and New England, ensure generation adequacy by so called imposed installed capacity requirements on load serving entities (LSEs)

3. Results survey

Power system investment decisions are increasingly taken in a market environment. Still, market drivers are often supplemented with regulatory or government intervention to provide additional investment incentives. The relative success of these schemes in delivering the investments will be discussed based on the survey currently conducted by the CIGRE Task Force C5-7.1. The questions of the survey are in the appendix (section 5).

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5. Appendix

POWER SYSTEM INVESTMENT INCENTIVES

IDENTIFICATION					
Name of the market / system:					
Your name:					
INTRODUCTION					
1	How many years has the market been operational?		year		
2	What is the size of the market?				
2.1	the amount of installed capacity		installed capacity (MW)		
2.2	the level of peak demand		(MW)		
2.3	%energy actually supplied by the market		% (MWh) on annual basis		
Any other relevant information?					
GENERATION CAPACITY ADEQUACY					
				2006	2005
					...
3	What is the installed generation capacity margin (installed generation capacity - peak load (actual, temperature and diversity corrected) as a percentage of installed generation capacity)?		%		
4	Is there involvement of a central authority?				
4.1	Who is this central authority (regulator, government, etc)?		specify		
4.2	Does this authority determine the required generation capacity level?		yes/no		
4.3	How does he determine the required generation capacity level (based on capacity margin target, loss of load expectation, market price)?		specify		
5	Describe any support systems for generation capacity in the market.				
5.1	capacity payment		put a cross if true		
5.2	capacity obligation/requirement		put a cross if true		
5.3	other		specify		
6	Are there support schemes for specific types of generation capacity, such as RES?		answer YES/NO		
			specify		
7	Evolution of the generation mix			2006	2005
7.1	Nuclear		Nuclear/total		
7.2	RES		RES/total		
7.3	Gas		Gas/total		
7.4	Coal		Coal/Total		
7.5	other		other/total		
Any other relevant information?					

DEMAND SIDE INFRASTRUCTURE

			2006	2005	...
9	Contracted interruptible load (voluntary scheme)	MW			
10	Who has been investing in improved metering			<i>specify why</i>	
10.1	utility	<i>put a cross if true</i>			
10.2	transmission network owner	<i>put a cross if true</i>			
10.3	transmission network operator	<i>put a cross if true</i>			
10.4	distribution network owner	<i>put a cross if true</i>			
10.5	distribution network operator	<i>put a cross if true</i>			
10.6	third party (e.g. independent metering company)	<i>put a cross if true</i>			
	Any other relevant information?				

TRANSMISSION INFRASTRUCTURE

			2006	2005	...
11	What has been the total level of transmission investment (cash)?	cash			
12	What are the financial incentives for RTO-TSOs to invest in the network?	yes/no			
12.1	tariffs system (cost plus or price cap)	<i>specify</i>			
12.2	other specific financial incentives for investments	yes/no		<i>specify</i>	
13	Do the regulated monopoly transmission providers have mandated standards which	Answer YES/NO			
13.1	11a) Are these mandated standards related to reliability of supply to end users?	Answer YES/NO			
13.2	11b) Are these standard related to levels of congestion on the transmission system?	Answer YES/NO			
14	Is it possible/allowed to invest in MTI?	answer YES/NO			
<i>If YES proceed with the remaining questions of this topic:</i>					
15	What is the share of merchant investments in total level of transmission investment (cash)?				
16	Who is investing in MTI?				
16.1	Utilities	<i>put a cross if true</i>			
16.2	System operator subsidiaries	<i>put a cross if true</i>			
16.3	Third Party (other)	<i>specify</i>			
17	How do MTI earn revenue, what is the source of revenue?	<i>specify</i>			
	Any other relevant information?				

EXPECTED FUTURE DEVELOPMENTS

			2007	2008	...
18	What is the expected installed generation capacity margin (installed generation capacity - peak load (actual, temperature and diversity corrected) as a percentage of installed generation capacity)?	%			
19	Is the generation mix expected to change consi	yes/no			
19.1	Nuclear	Nuclear/total			
19.2	RES	RES/total			
19.3	Gas	Gas/total			
19.4	Coal	Coal/Total			
19.5	other	other/total			
20	What future actions can reasonably be expected to enhance demand side participation?	specify			
21	Does the government or regulating authority intends to increase regulation or not?	yes/no			
	new support schemes for RES	put a cross if true			
	new measures to enhance generation adequacy	put a cross if true			
	measures to facilitatate MTI	put a cross if true			

VIEWPOINT

22	What are the main weaknesses of the current incentive scheme?	answer freely
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