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Review of annual fixed O&M cost

Peer review of "Cost of Capacity for calibration of Belgian CRM"

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Offices in countries:

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- ÅF and Pöyry merged to become an international engineering, design and advisory company in February 2019 which is listed on the stock market in Stockholm
- The new common brand AFRY was launched in November 2019
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- Almost 17,000 employees worldwide
- Projects in more than 100 countries
- Serves 25% of Fortune 500
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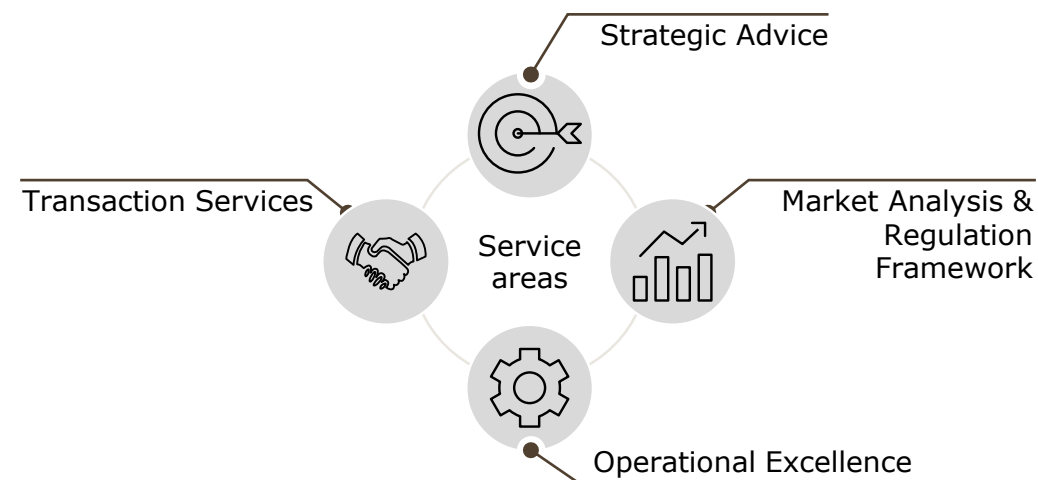
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STUDY OBJECTIVES

The objective of this study is to validate the annual O&M cost for OCGTs/CCGTs, and estimate a 'typical' annual O&M cost for pumped storage

Background

- A Capacity Remuneration Mechanism (CRM) is set to be introduced in Belgium from 2025, and capacity auctions will take place in October 2021
- Elia (and CREG) has been working on the design parameters. One key consideration is the gross (and net) cost of new entry and the fixed cost estimates for existing units. These costs are used for the purposes of defining the relevant price caps for new and existing capacity providers.

Starting point

- A study undertaken by Fichtner provides for cost estimates for new entrant technologies and for existing/operating technologies in Belgium.
- The Fichtner study was completed in April 2020. Subsequently Elia organised a public consultation regarding a set of inputs to be used in the calibration process with the cost estimates in the Fichtner report being a focal point.

Study objective

- We have now been asked to review the Fichtner annual O&M cost estimates for existing OCGTs and CCGTs, and to provide for an estimate for the annual fixed O&M cost for pumped storage
- In the case, where we think that the 'original' cost estimates are unreasonable, we provide for an alternative estimate alongside the corresponding justification

APPROACH

We have used a “Review-Compare-Recalculate” approach for providing a further opinion on the annual fixed O&M cost estimates

Review

- First, we review the Fichtner study, and extract the relevant cost estimates
- Then we attempt to understand the methodology used and the underlying assumptions for arriving at these cost estimates

Compare

- We use a selected set of existing literature from other studies looking at cost estimates for the purposes of CRM parameters (I-SEM,PJM)
- We compare the different elements used to make up the annual fixed O&M cost
- We identify any potential differences and attempt to understand the drivers behind the differences and comment on whether we think the ‘original’ estimates are reasonable or not

Recalculate

- Finally, where we see any difference between the ‘original’ cost estimates and the wider literature and what we think is appropriate, we recalculate the respective cost elements

Our cost review is limited to annual O&M costs for OCGTs, CCGTs and pumped storage

DEFINITION OF FIXED O&M COSTS

The fixed O&M cost is assumed to include the following components:

- fixed operating costs including personnel costs, administrative costs, electricity and gas transmission charges (where applicable);
- the O&M insurance for general liability, machine breakdown and interruption of operation of a power plant;
- fixed maintenance costs including intra-year maintenance and a provision for major overhauls that do not necessarily take place on an annual basis.

TECHNOLOGIES

We have focused on the following technologies:

- Open Cycle Gas Turbines;
- Combined Cycle Gas Turbines; and
- Pumped Storage.

The Fichtner specific O&M cost estimates for existing peaking units is broadly reasonable, but on the upper end of the spectrum for turbojet units

Unit	Capacity (MW)	Type	Commercial operation date	Specific fixed O&M cost (€/kW/a)		
				Fichtner	AFRY	AFRY (excl. grid charge)
Angleur 3 - TG31	25	Frame type	1978	25.40	40.68	40.19
Angleur 3 - TG32	25	Frame type	1978	25.40	40.68	40.19
Angleur 4 - TG41	63	Aero	2012	18.49	19.08	18.59
Angleur 4 - TG42	63	Aero	2012	18.49	19.08	18.59
Ham - HAM31	56	Aero	2006	19.38	19.08	18.59
Ham - HAM32	56	Aero	2006	19.38	19.08	18.59
Cierreux	18	Turbojet	1960's	33.83	29.49	29.00
Beerse	32	Turbojet	1960's	28.94	23.07	22.58
Zelzate	18	Turbojet	1960's	33.83	29.49	29.00
Aalter	18	Turbojet	1960's	33.83	29.49	29.00
Zedelgem	18	Turbojet	1960's	33.83	29.49	29.00
Noordschote	18	Turbojet	1960's	33.83	29.49	29.00
Zeebrugge	18	Turbojet	1960's	33.83	29.49	29.00

Our review of the Fichtner analysis has highlighted the following:

- the EPC cost suggested by Fichtner appears to be on the low side, and we would recommend that this is set at 180% (instead of 130%) of the total equipment cost;
- on the other hand, the annual operating cost put forward by Fichtner appears to be rather conservative, and we would expect this to be significantly lower;
- the resulting specific O&M cost appears to be reasonable for aero-derivatives, but on the upper end of the spectrum for turbojet units.

Our estimates are based on an assumed 800h of operation and 150 starts per annum. More restricted operation would most likely mean lower maintenance costs and the fixed O&M would be lower than that presented in the table.

We are in agreement with the Fichtner CCGT estimates; however, assuming a more limited operating profile would result in lower maintenance costs

Unit	Capacity (MW)	Type	Commercial operation date	Specific fixed O&M cost				
				(€/kW/a)				
				Fichtner	AFRY (8000h)	AFRY (4000h)	AFRY (8000h, no elec)	AFRY (4000h, no elec)
T-Power	425	1x1	2011	41.41	41.39	32.08	36.46	29.62
Seraing	485	2x1	1994	40.21	42.10	32.06	37.16	29.59
Amercoeur	451	1x1	2010	40.58	40.26	31.34	35.32	28.88
Marcinelle	405	1x1	2011	41.73	42.36	32.71	37.42	30.24
Saint-Ghislain	350	1x1	2000	43.14	45.52	34.74	40.59	32.28
Drogenbos	460	2x1	1993	40.65	43.22	32.77	38.28	30.30
Knippergroen	315	1x1	2010	44.13	48.06	36.36	43.12	33.89
Ringvaart	357	1x1	1998	43.14	45.07	34.46	40.13	31.99
Herdersbrug	480	2x1	1998	40.21	42.31	32.19	37.38	29.73
Zandvliet	384	1x1	2005	42.19	43.47	33.43	38.53	30.96
Inesco	138	1x1	2007	53.99	56.46	43.88	51.52	41.42

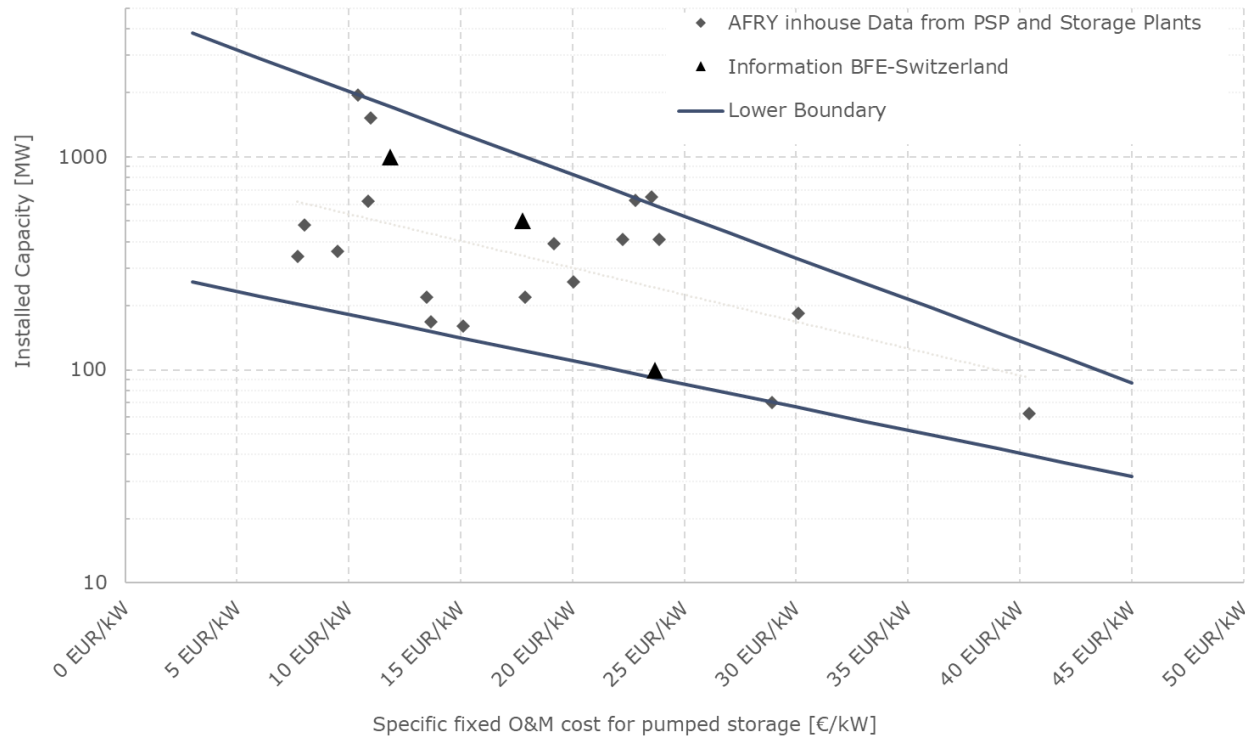
Our assessment of the Fichtner existing CCGT cost estimates suggests that these are reasonable assuming 'baseload' operation

We do however, recognise that existing CCGTs in Belgium are operating in a more mid-merit fashion. This could then reduce the need for major maintenance, and the corresponding costs could be lower. This would also mean lower grid transmission costs. Assuming 4000h of operation, we expect the annual O&M to be 9-12€/kW lower.

Part of the grid costs are incurred on a variable cost basis – therefore such costs can be considered as variable and recoverable from the energy markets. Excluding those would further reduce the specific O&M cost.

PUMPED STORAGE

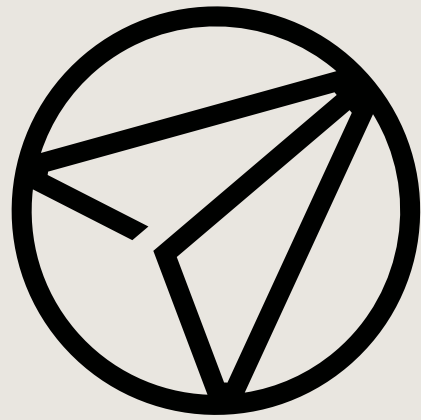
There is a strong degree of variation in pumped storage annual O&M costs, and believe that 19 €/kW is a reasonable estimate for Belgian plants



Our review of different public data sources (from power utilities as well as authorities) combined with our inhouse knowledge suggests annual fixed O&M cost for PSP in the range of 10 to 30 €/kW.

There may, however, be a significant difference between small and large PSP plants, and recommend the use of an average cost of 19 €/kW for the purposes of defining a typical fixed O&M value for a pumped storage plant in Belgium.

The lower end of the range is more representative of pumped storage integrated in a pool of hydropower plants allowing the utility to optimise resources – most notably manpower. On the other end of the spectrum, smaller PSP plants tend to have a higher O&M cost – a similar sized team is needed to operate the plant when compared to larger plants



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