I-SEM Validated Model – Clarifications following Information Session

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Introduction

Baringa has recently supported the RAs in the development of their I-SEM Validated PLEXOS model. Following the publication of this model and the accompanying Validation report[1], the RAs and Baringa held a public Information Session to discuss the model and encourage transparency of the approach and outcomes of the I-SEM model. Given that there is significant uncertainty in modelling a market that is not yet live, the RAs and Baringa recognise the importance of transparency in relation to the approach taken and the rationale behind design decisions in the I-SEM model. The RAs have therefore published an intermediate Information Note and survey[2], in addition to the final Validation report and Information Session held on 5th of December[3].

Following comments and questions received during the Information Session, Baringa has performed further analysis of the results of the model. We wish to give additional detail of some of the methodologies in the I-SEM model to that provided in the documentation previously published.

In this note we give more detail on two areas of the model:

- Wind load factor profiles
- Uplift

> NOTE: Following the implementation of the "Integrated Single Electricity Market" (I-SEM) market arrangements in May 2018, the all-island electricity market will still be referred to as the "Single Electricity Market" (SEM), but, for the purposes of this document, we refer to the existing arrangements as the "SEM" and the new arrangements as the "I-SEM".

Wind load factor profiles

The RAs I-SEM Validated model uses hourly load factor profiles that are based on data from historical years (5 separate profiles, one each from 2011-2015). In the I-SEM model wind is separated into 2 regions – NI and RoI, with a set of 5 load factor profiles for each region.

[1] https://www.semcommittee.com/publication/i-sem-plexos-model-validation-2018-2019-information-paper-0
[2] https://www.semcommittee.com/publication/baringa-survey-validation-ras-2018-19-sem-plexos-model
[3] https://www.semcommittee.com/publication/2018-19-plexos-model-validation-information-session

Basis of historical profiles

There was some uncertainty in the Information Session as to whether the historical profiles were based on availability or metered output. We have confirmed with the TSOs (who supplied the raw data) that the historical profiles used in the I-SEM model are based on historical availability.

Basis of capacities

A question was raised in the Information Session around whether de minimis wind was included in the wind capacity values used in the RAs I-SEM Validated model. The capacity values used in the I-SEM model come from the TSOs Generation Capacity Statement 2017-2026, and include all transmission and distribution connected wind, including de minimis wind. All wind (transmission or distribution connected, de minimis or otherwise) is treated the same in the model.

Representing wind withholding volume from Day-Ahead Market

There was discussion in the Information Session about whether including wind as being fully available in the Day-Ahead Market (the I-SEM model seeks to represent the DA market only) was over-estimating the volume of energy that would actually be present. Under I-SEM arrangements, all generators (including wind) are exposed to the balancing costs of changes in their actual availability at gate closure compared with their forecast availability from the Day-Ahead stage. It is likely that some wind generation will hold back some of their forecast generation from the DA market to avoid being exposed to high imbalance costs if their actual availability is lower than forecast.

It is difficult to predict what proportion of wind generation volumes may be withheld from the DA market in this way, before I-SEM arrangements go live. A recent decision paper[4] on how the REFIT support scheme (applicable to RoI wind) should operate under I-SEM arrangements suggests an 80:20 blend of DA and Balancing prices based on testing using 20% volume steps. At this stage these are just proposals for REFIT, and may change, and in any case it is not clear that REFIT support will change the incentives for how RoI wind generators apportion their volumes.

Though we expect wind to withhold some volume for the DAM, and we cannot easily predict the size of this volume, it is not necessary to remove these volumes from the I-SEM model. The incentive to reduce imbalance costs by withholding a portion of volume from the DA market is not unique to wind generation, and is seen for all generation and demand. As described in the intermediate I-SEM model Information Note and the Validation report, the high level assumption we have taken is that all forecast generation and demand will clear in Day-Ahead market. While this is unlikely to be true for the real DAM, we assume that the real DAM will be liquid enough that prices from the DAM will be very close to a scenario where all generation and demand clears in the DAM.

Granularity of wind regions

The RAs I-SEM model has two wind regions – NI and RoI. Given that the model represents the DA wholesale power market, it is not necessary to have a regional breakdown of generation and demand, as the market is scheduled on an unconstrained basis. It is a single node model, with all supply and demand located at the same point. We have used 2 regions, as this was the spatial

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[4] https://www.dccae.gov.ie/en-ie/energy/consultations/Documents/32/consultations/2017_11_30%20Proposed%20Decision_REFIT%20Transition%20to%20I-SEM_.pdf

granularity of data available to us to allow for 5 sets of historical load profiles to be used, as described in the Validation report.

However, by using only 2 wind regions (compared with 13 in the previous SEM validated model) we have reduced the spatial granularity of load factors, which means that capacity increases are assumed to occur linearly across the 12 regions that are now included in the single "RoI" region. In the previous SEM model a large increase in capacity of a high load factor region would push up the average load factor overall. In the I-SEM model the load factor for RoI remains constant regardless of where in RoI new capacity is situated. This is a reduction in precision of the model, however we have tested the effect of moving from 13 regions to 2 regions and for 2018-19 found the effect to be insignificant.

Summary

We confirm that the basis of the wind profiles used in RAs model is available energy, inclusive of de minimis wind, and that we believe this is the correct basis for modelling the DA wholesale power market. We do not believe it is necessary to account for some wind volume being withheld from the DA market to reduce imbalance exposure.

In moving from 13 regions to 2 regions we note that there is a loss in spatial granularity which has the potential of reducing the precision of the wind generation forecasts for future years. However, we have tested the impact for 2018-19 and found it to be minor, and believe it is an acceptable simplification, to allow for a multi-year (2011-2015) wind profile dataset to be used.

Uplift

In the RAs I-SEM Validated model, start and no-load cost recovery is ensured by application of the "Korean" uplift algorithm. As described in the validation report, the move from SEM uplift to Korean uplift has the biggest effect on baseload prices of all the changes made in the I-SEM model, a reduction of 2.1 €/MWh (under the commodity assumptions used in the validation report).

In the Information Session we attributed the lower baseload prices seen when using Korean uplift to the fact that SEM uplift was not optimised to reduce uplift, but rather a combination of low uplift and low uplift volatility. However, following discussions with attendees we have investigated this further.

Uplift minimisation

The SEM Uplift algorithm seeks to minimise a combination of uplift and uplift volatility. Whether uplift minimisation or volatility minimisation is prioritised can be set through the α and β terms in the SEM Uplift formula. By setting $\alpha=1$ and $\beta=0$ it is possible to use the SEM Uplift algorithm to minimise uplift only, ignoring volatility.

We have performed a test using the default SEM Uplift settings ($\alpha=0.1$ and $\beta=0.9$) and compared to results using $\alpha=1$ and $\beta=0$, to assess the impact of uplift minimisation alone. When SEM Uplift is forced to be uplift minimising, prices do decrease, but the effect is fairly minor (decrease of 0.1€/MWh).

Our hypothesis was that the reduction in baseload prices seen as a result of moving away from SEM Uplift was due to the fact that the SEM uplift algorithm is trading off volatility against uplift minimisation, but upon further investigation this has been shown to be a minor effect.

Treatment of Hot/Warm/Cold Start Costs

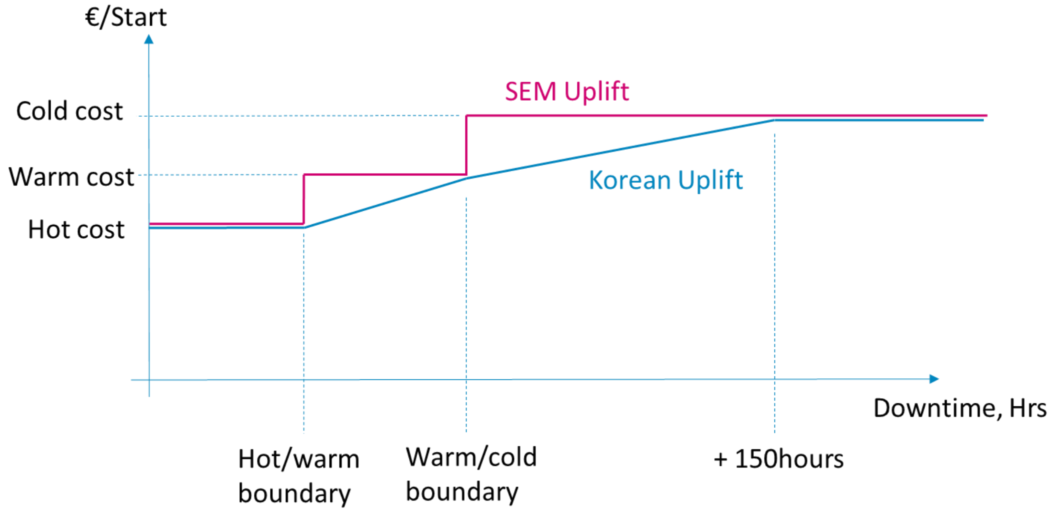
In moving from SEM Uplift to Korean Uplift a number of SEM Uplift specific assumptions are removed from the model. We have investigated separating these out to find the main driver of the reduction in prices found under Korean vs SEM Uplift.

Under the SEM Uplift algorithm, start costs are assumed to be constant across the whole of each start "state" (i.e. hot, warm or cold). This results in a low granularity stepwise function of start cost vs downtime, as shown in Figure 1. This is as modelled in the previous SEM Validated model, and matches the current SEM Uplift algorithm used by the market software. To be clear, by "start costs" we are referring to the combination of financial costs (€/start, £/start) and fuel costs (GJ/start).

In reality we expect start costs to vary as a continuous function – increasing as downtime is increased until a fully "cold" state is reached. When using the Korean Uplift algorithm we assume that costs vary linearly (i.e. high granularity), from hot to warm, and from warm to cold, as shown in Figure 1.

The Korean algorithm is mimicking one simple strategy generators might follow, increasing their bids to recover their start and no-load costs during each period of operation. We assume that this approach is cost reflective, and therefore the start costs that generators seek to recover will vary as a continuous function of downtime, as shown in Figure 1.

Figure 1 Start cost vs down time – SEM vs Korean assumption



We have tested using a low granularity stepwise assumption vs linear assumption for start cost recovery and found this to be the main driver of the 2.1 €/MWh reduction seen when moving from SEM to Korean Uplift.

Start Data

As stated in the Validation report, no generator data has been changed in the RAs' I-SEM Validated model, and remains the same dataset that was validated for the previous SEM Validated model in June 2017. Start costs and start state boundaries remain as per the SEM Validated model. The hot/warm and warm/cold boundary times were validated against recent market submissions as part of the previous validation. The time taken to get from warm to fully cold is assumed to be 150 hours for all plant, an assumption that has been in the RAs' validated models dating back to 2012. While there is some uncertainty around what this number should be (as it is not a parameter submitted by generators in Technical Offer Data), we have tested the sensitivity of prices to the value of this parameter and found it to be fairly insensitive for quite large changes (if reduced to 72 hours, for example, baseload prices increase by 0.45€/MWh).

Summary

As stated in the Validation report and information paper, start cost data assumptions have not been changed in the RAs' I-SEM Validated model. The method of recovery of these costs has changed, through moving from SEM to Korean Uplift algorithms. Our previous hypothesis was that the decrease in baseload prices seen in the RAs' I-SEM model was primarily due to the lack of uplift minimisation in the SEM Uplift algorithm. However, following feedback received during the Information Session, we have carried out further investigation which has shown this to be a minor effect, and the main driver of cost reduction has been found to be moving away from the SEM Uplift specific stepwise start cost assumption to a more realistic linear start cost assumption.

Version History

Version	Date	Description	Prepared by	Approved by
1.0	8th Dec 2017	Draft for RAs' review	Luke Humphry	Andrew Nind
2.0	13th Dec 2017	Final version	Áine Lane Luke Humphry	Andrew Nind

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