TenneT Submission on E3grid2012 and STENA2012

COMMENTS FROM FRONTIER/SUMICSID/CONSENTEC

ACM received a submission from TenneT with regard to the benchmarking analysis underlying ACM's draft Method Decision. TenneT raised 6 topics in their submission. In this note we discuss these topics and refer to the respective section in the e3grid2012 final report[1].

TenneT made the following statements, which we discuss in detail:

1. The efficiency measurements do not exhibit characteristics of a "normal distribution".

2. The individual efficiency measurements are sensitive to subjective assumptions and modelling choices.

3. The efficiency measurements and model parameters are not stable.

4. The size of the comparison group limits to a large extent the number of relevant factors that can be explained in the benchmark. It makes a statistical analysis and applying weight restrictions difficult.

5. The comparison is based on incomparable, unreliable and incomplete data.

6. The standardisation of very heterogeneous assets to a uniform cost norm is misleading.

1. The efficiency measurements do not exhibit characteristics of a "normal distribution"

We do not share the viewpoints of TenneT.

The efficiency analysis that TenneT refers to has been undertaken using the technique of Data Envelopment Analysis (DEA) – a standard technique in regulatory benchmarking. While a "smooth" distribution of efficiency scores is a possibility in DEA it is by no means a given.

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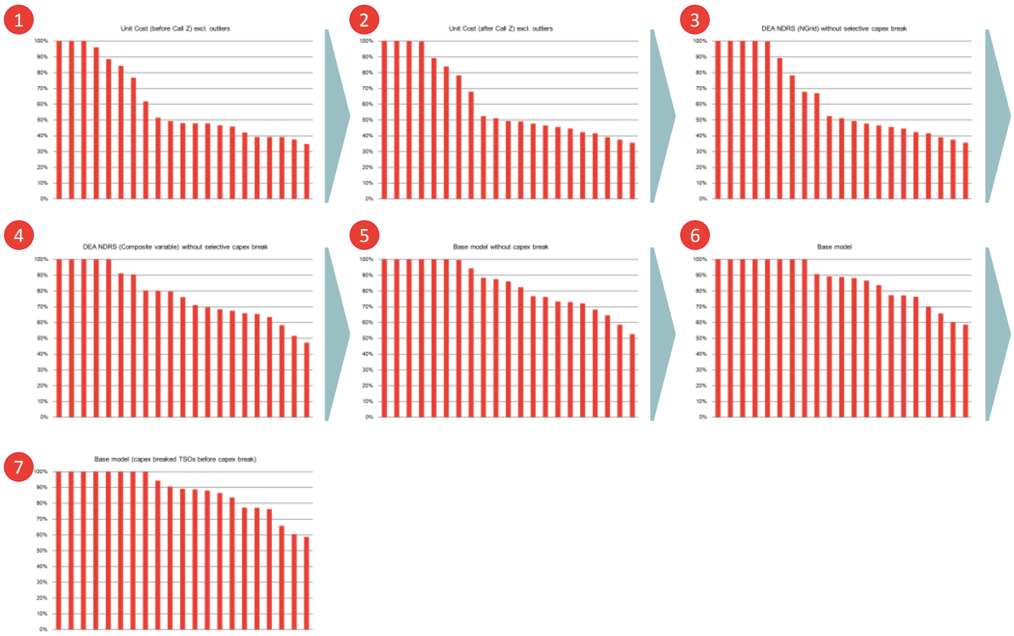
[1] Frontier/Sumicsid/Consentec, *E3GRID2012 – European TSO Benchmarking Study*, Report for European Regulators, 2013.

Section 7.3.1 (p.87ff) in e3grid2012 illustrates the results for the base model. The final efficiency scores for the base model are influenced by various factors. In order to make the impact of these factors visible we showed the development of the efficiency scores step by step starting from a simplified model. The development included 7 steps (We note that the following results are after outlier detection):

- **Step 1** – Efficiency scores from unit cost model.
- **Step 2** – Impact from Call Z cost adjustments on unit cost model scores.
- **Step 3** – Impact from returns to scale assumptions.
- **Step 4** – Impact from adding environmental parameters as composite variable.
- **Step 5** – Impact from relaxing weights on composite variable. This also constitutes the base model.
- **Step 6** – Impact from selected Capex break as additional instrument for outlier analysis.
- **Step 7** – Efficiency scores using efficiency scores for TSOs, where selected capex break applies, from Step 6.

Figure 1 shows the development of the distribution of efficiency scores for the different steps.

Figure 1. Development of distribution of efficiency scores



Source: Frontier/Sumicsid/Consentec

The unit cost model shows a distribution which can be characterised as half-normal, i.e. a step tail which fades out at the lower end. The distribution is rather smooth. The following steps result in an increase of the efficiency scores on the lower end. In step 5 the efficiency scores show a distribution which TenneT may call a "normal distribution". The distribution of the efficiency scores is smooth with no grouping of TSOs in some efficiency ranges.

Step 6 includes the selected capex break which was introduced as a further DEA outlier analysis to ensure that the efficiency frontier spanned by the peer companies sets feasible cost targets that are not unduly influenced by the absence of historical investment data. This additional adjustment works in favour of companies not (yet) 100% efficient and pushed further TSOs to the efficiency frontier and increased the average efficiency by 2%. However, based on the logic from TenneT we should have forgone this step – that favours certain TSOs – because the resulting distribution of efficiency scores is not a "normal distribution" any more. This shows that the "smooth" distribution of efficiency scores in DEA must not be seen as a given, but other considerations are more valuable.

Step 7 illustrates the distribution of efficiency scores for the e3grid2012 base model using the efficiency scores for the 2 Capex breaked TSOs before Capex break was applied. The distribution looks "normal" again as the drop between the 100% companies and the next inefficient company narrows down.

TenneT states that the use of the alternative technique of Stochastic Frontier Analysis would have allowed for statistical analysis. We are not sure what relevance this statement should have to the observation that the efficiency scores in the study do not follow what TenneT considers as a "normal distribution".

TenneT points to a "15% step" between the most efficient and the next not fully efficient companies. It then makes reference to a Frontier statement according to which the Frontier should be achievable. TenneT then states that it considers a 15% gap as not achievable. We stress that in the comment on the frontier being achievable in e3grid2012 (e3grid2012, p.94)[2], we referred to the logical consistency of the comparison – which is adhered to be the frontier model – and not the empirical observation of specific efficiency performances of individual firms. Whether the regulator requires the empirical performance to be improved so that the firm becomes fully efficient over a short time period is a question of implementing the efficiency requirement within the revenue glide path on which ACM decides separately. It is not a question of the design of the benchmarking analysis.

2. The individual efficiency measurements are sensitive to subjective assumptions and modelling choices

We do not share the viewpoints of TenneT.

With regard to the differences between e3grid2012 and STENA2012 we refer to the separate note "Comparing the STENA and e3GRID results for TenneT" provided to ACM on 19 September 2013.

However, we confirm that apart from using distinct parameter values for TenneT in the STENA 2012 study, the same model specification and methodology was applied in e3grid2012 and STENA2012.

With regard to the impact of sensitivities on the efficiency scores we refer to the discussion in the e3grid2012 report (p.93ff). The respective section also includes a discussion on the reasons for variations in the efficiency scores.

In relation to the influence of weight restriction mentioned by TenneT we refer to the relevant passage (e3grid2012, 2013: 93), which also explains why the application of weight restriction is reasonable:

"*DEA without weight restrictions" (p. 93)* – As sensitivity to the base model we relax the weight restriction and calculate a model without weight restrictions (DEA

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2 The report says: "As outlined above we introduced a further DEA outlier analysis – the so called "selected Capex break" – to ensure that the efficiency frontier spanned by the peer companies sets feasible cost targets that are not unduly influenced by the absence of historical investment data." (p. 94).

(NDRS) unrestricted) average efficiency increases by 5 % points from 86.1% to 91.1%, where 13 TSOs increase their efficiency. The number of 100% efficient companies increase from 8 to 11. … In the following we analysed the weights DEA puts on the three output parameters for these 13 TSOs, when DEA can choose freely (unrestricted) the respective weights. The weights give information which output parameters drive the efficiency scores in the unrestricted DEA. Figure 16 illustrates that in the unrestricted DEA for 5 TSOs improving their efficiency the technical asset base covered by the NormalisedGrid has no impact on the efficiency scores, which is not intuitive and contradicts the result from the cost-driver analysis. For 3 TSOs the efficiency scores are only driven by the value of the weighted angular towers and for 1 TSOs only by the densely-populate area, ignoring the other two output parameters. For 1 TSOs only the value of weighted angular towers and densely-populated area matters. For 4 TSOs the weight DEA puts on NormalisedGrid is below 10%, which again contradicts the results from the cost-driver analysis."

This clearly explains the relationship between changes in certain input assumptions (sensitivities) and efficiency scores. We have also highlighted in that report which assumptions we regard as most plausible (namely those of the base model). The sensitivities have merely been analysed to make transparent the effect that changes in assumption (to less plausible assumptions) would have. This does not in any way render the base case arbitrary.

3. The efficiency measurements and model parameters are not stable

We do not share the viewpoints of TenneT.

Tennet has a number of contentions which we address in turn:

Tennet is concerned with changes in efficiency scores between the 2009 and 2012 benchmarking study

With regard to the comparison between the e3grid study in 2009 and e3grid2012 we note that there are various reasons explaining the difference, e.g.:

- Change in the data sample (the TSO samples are not identical in both studies);
- Change in underlying cost data (the costs of some TSOs have risen, while for others they have fallen);
- Adjustment of model specification (as TenneT already states, the parameters have been refined for the 2012 study. Moreover weight restrictions on DEA have been introduced in the 2012 study); and
- Additional method for outlier detection.

With regard to the output parameters used in 2012 we refer to e3grid2012 (Section 6), where the steps of the model specification and cost driver analysis are described in detail (see also e3grid2012, Annex 4).

TenneT points out that different output parameters were used in the benchmarking models in 2009 and calls the choice arbitrary.

We disagree with this notion.

Rather the model specifications in each study reflect the appropriate model for the sample selection, data availability and the point in time of the analysis. For example, an extensive process has been used in the E3Grid2012 process to refine data definitions. Moreover the 2012 study uses more recent data. It is therefore no surprise that a refined model specification results from the 2012 study. The model specification follows a clear process that is based on scientific principles and that is well documented.

As part of the 2012 analysis we have also tested the model specification used in 2009 with the 2012 data. We note that renewable energy was one of many other parameter candidate tested in the cost-driver analysis (see e3grid2012, Annex 1 for the full list of parameter candidates). Annex 4 also includes the results for the model specification from the e3grid 2009 study mentioned by TenneT, which was inferior compared to the final model in e3grid2012.

In addition, we tested the potential impact from renewables on the efficiency scores in a second-stage analysis. The purpose of a second stage analysis is to ensure that we have appropriately specified the best model using the available data. None of the other tested variables was found to be significant. (see e3grid2012,p . 103-104, and Annex 5).

As the 2012 model includes more refined core data, the renewable parameter has not been found to be statistically significant in the 2012 study.

Tennet points out that in 2009 there had been an interactive process between Consultants, NRA and TSO.

Without stating this explicitly Tennet thereby tries to create the impression that the 2012 process has not been interactive. We strongly contend this notion.

With regard to the claimed differences of results and Inconsistency in reports we note that during the e3grid2012 project there was an extensive interaction between the consortium, NRAs and the TSOs with regard to data specification and validation. The process during the E3Grid2012 study is also documented in the Annex 3 of the respective report.

This process also resulted in the detection of data errors (e.g. resulting from TSOs misreporting data or reporting data differently from the instructions) which were then corrected for the final report.

In addition, we note that the interaction also involved discussion on the preliminary findings on the model specification. We note that the final model specification with regard to the output parameters for the final model was stable during the model specification process. Data corrections during the process only affected the value of the preliminary regression coefficients.

TenneT contends that the parameter "peak load" should have been included in the benchmarking model.

We have already extensively discussed the decision against the use of peak load in the main benchmarking model. We refer to the e3grid2012 report (p. 79-80, and Annex 4, p.130-131):

"In the following we describe a subset of additional output and model variants we analysed:

- **Peak load** – In the R1 report we discussed peak load instead of the value of weighted angular towers as a potential cost driver. However, we already mentioned in R1 that the coefficient for peak load had the "wrong" (negative) sign in the regression analysis, indicating that costs will decrease when peak load increases. Further analysis showed that the negative sign persists also with the data set after R1, e.g. after cost adjustments from Call Z claims. A criticism by Weyman-Jones (2013: 12) was that the negative sign of peak load may indicate that other cost drivers, in particular the NormalisedGrid, are not good indicators to measure the transmission service. ... In addition we point out that:
  - Peak load is typically a variable driving the size of the technical asset base. Hence, the cost impact from peak load should already be largely reflected in NormalisedGrid;
  - TSOs pointed out in the consultation on Call Y that the relationship between potential output indicators and costs must be plausible from an engineering or business process perspective and that statistical evidence alone may not prove the actual relation itself. Hence, the negative sign of peak load tends to be in contradiction to the costs and output parameters in "real life", as one would expect an increase in costs by increasing peak load; and
  - Given the size of the sample and the restriction on the number of potential outputs in the final model specification to 2 or 3, a balance has to be made between certain outputs. In other words, peak load and value of weighted angular towers are mutually exclusive output parameters. In direct comparison the value of weighted angular towers has superior properties from a statistical point of view, e.g. correct sign, but also from an engineering perspective, as it explains additional costs for constructing and maintaining the technical asset base.

> Hence, we decided to drop peak load as output in our final model specification and retained the value of weighted angular towers instead."

In addition, we note that only the efficiency scores for the final model and not preliminary models and/or model variants were included in the report.

4. Limited size of the comparison group

Tennet argues that the size of the comparison group is limited in important areas with a number of relevant factors that can be explained in the benchmark. TenneT considers that this makes executing statistical analysis and adapting weight restrictions hard/difficult.

Firstly, Tennet claims that the chosen model systematically omits relevant cost drivers

We do not share the viewpoints of TenneT.

With regard to the claimed limitation of relevant factors we note:

- The cost-driver analysis in e3grid2012 (Section 6.4) describes the statistical analysis of parameter candidates. The results confirmed that the statistical analysis in relation to the model specification is technically possible.
- Moreover the first stage cost driver analysis considered many permutations of possible cost drivers and arrived at a clearly preferred model. When considering this model as the base model then no further parameters were found to be statistically significant.
- The model used in e3grid2012 is an asset-driven model assessing the efficiency of operating, maintaining and constructing the current technical asset base. Hence, one main cost-driver is the amount of technical assets. In addition the model takes into account environmental factors which may have an impact on maintaining and constructing the assets. These environmental factors can be categorised into
  - Environmental factors as outputs – densely-populated area and share of value of angular towers;
  - Environmental factors from Call Z – Contrary to what TenneT claims, further environmental parameters have been reflected in the final benchmarking model. This was achieved by making corrections to the cost base to reflect company specific circumstances that only affect one or few companies. In particular three factors have been relevant in this context: Higher costs due to:
    - Lines in mountainous regions;
    - lines in coastal areas; and
    - cables in cable tunnels.

These factors have been reflected through a cost adjustment where the companies had substantiated a respective claim.

- Second stage analysis was used to check that even after the specification of a significant base model and the call Z cost adjustments empirical evidence could be found that efficiency scores were in some way correlated with certain cost drivers (practically the same cost drivers already tested in the initial cost driver analysis). This analysis once again confirmed that no parameters have been omitted. The second stage analysis is described in Annex 5 of the e3grid2012 report.

Tennet further contends that weight restrictions used in DEA were not derived in a reliable manner.

We disagree with this notion.

With regard to the determination of "weight restrictions" we refer to the respective part in e3grid2012:

- p. 43-47 describes the principles on weight restriction. There options to determine the weights are discussed;
- p. 91-94 describes the way how the weight restrictions were determined in the final model. There we also discuss range of the intervals for the upper and lower bound for the confidence intervals of the cost elasticities for the log-linear cost function from Section 6. The upper and lower bounds of the 99% confidence interval indicates a range for the coefficients of +/-29% points for NormalisedGrid, +/- 18% points for densely populated area and +/- 37% points for the value of weighted angular towers. Hence, this confirms that a range of +/-50% is reasonable.

With regard to the regression coefficients in e3grid2012 and STENA2012 we refer to the separate note.

These documents show that the weight restrictions were derived in a systematic manner and based on empirical data and that prudent ranges for the weight restrictions were used in the benchmarking analysis.

5. The comparison is based on incomparable, unreliable and incomplete data

Tennet alleges inconsistencies in the data.

We do not share the viewpoints of TenneT.

With regard to the allocation of operational costs we refer to the detailed cost reporting guide which was consulted with the companies. We note that in the data validation process TSOs were approached in relation to the allocation of costs. We note that for example TenneT was approached in relation to the headcount and costs involved in the planning activity.

With regard to the Call X asset data we note that TenneT asked in its submission to the Call X for the inclusion of angular towers in the asset data, which was then included in the final Call X data template.

With regard to investment flows we refer to the e3grid2012 report in relation to the calculation of benchmarked capex (p. 57-58).

"For the 21 TSOs included in the e3grid2012 project:

- 9 TSOs reported investment for the full range 1965-2011; and
- 12 TSOs reported investment for less than the full range 1965-2011 and at a certain year in their investment stream an opening balance based on revaluated assets, market values and opening book values appears."

For the 12 TSOs the opening balances were used when calculating the benchmarked capex.

However, to the extent that such companies later become peers to others in the efficiency benchmark the investment data was put to additional scrutiny in order to ensure that efficiency results are not unfairly biased by the estimation of historic investment streams for peer companies. This was undertaken by a new outlier detection approach introduced in e3grid2012, the so-called selected capex break (see e3grid2012, Section 7.2.2, p. 87). Hence, the selected capex break approach was introduced to obtain conservative efficiency scores, but must not be interpreted as an indication for incomplete data, as asserted by TenneT.

Tennet also notes an inconsistency in the reporting of the application of the capex break approach:

- TenneT points out that the e3grid2012 interim report stated that capex break had been applied in the first round of analysis, while it had not been. The Consultants already acknowledged shortly after the publication of the report that this was a typo in the report where the word "not" had been omitted. This was mentioned in a workshop with the industry and also documented in the respective minutes.
- TenneT points out an inconsistency in the e3grid2012 report where the text states that selective capex break had been applied to 3 companies while a table in the report states it had been applied to two firms. We can clarify that selected capex break has been applied to 2 firms.

With regard to the limited salary adjustment we share the statement from TenneT that TSOs did not deliver the requested data.

6. The standardisation of very heterogeneous activities to a uniform cost norm is misleading

Tennet assert that our approach to standardising costs is misleading.

Tennet claims the cost standards are not sufficiently transparent.

We do not share the viewpoints of TenneT.

With regard to the alleged neglecting of exogenous conditions we note that these are reflected in other output parameters, which are part of the DEA model besides the "Normalised Grid" parameter. We refer to the e3grid2012 report (p. 70-71):

"The inclusion of the technical asset base results in a distinction between two output categories:

- **Outputs driving size of the technical asset base** – These outputs, e.g. peak load, connections of load and generation, are in principle already reflected through the technical asset base. Hence, even if these outputs are not explicitly included in the model specification, their main cost effects on the technical asset base will be reflected, if only indirectly.

- **Outputs driving the costs of constructing and maintaining the technical asset base** – Reflect the potential impacts from environmental factors on the costs of the given technical asset base, e.g. higher construction costs due to topographic reasons."

With respect to the claimed limitation / incompleteness of the standard cost model we note that, by contrast, the adopted approach allows taking into consideration the asset base in high granularity when compared to alternative approaches, such as separate consideration of (a then highly limited number of) asset types. We refer to the e3grid2012 report (p. 71-72):

"The information on physical assets of the TSOs constitutes essential information for e3grid2012, as it is used as a main output parameter in the benchmarking analysis. The physical assets are collected in different units (km, MVA). In order to obtain "one" output parameter including all physical assets it is necessary to transform the different units into one single number. Cost weights are used for this task. In fact, this allows for a very detailed reporting and consideration of assets with a high level of differentiation – e.g. by asset type (lines, transformers, etc.), by voltage level, by capacity (e.g. maximum current or power) – while at the same time respecting the need to limit the total number of output parameters in the benchmarking analysis.[3]

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3 For details on the reporting structure we refer to e3grid2012, Data Call for EHV/HV Assets (Call X), version 1.15, 2013-02-20.

Haney/Pollitt (2012: 13-14) have argued that the use of the cost weights for the aggregation of the physical assets is in contradiction with the principle of DEA, which chooses input and output weights in such a way as to give the firm the highest efficiency score possible. We agree that in principle this can be a logical consideration, although in the instance this may on balance be against the interest of the benchmarked companies:

- The variable "NormalisedGrid" includes all technical assets from the TSO in a high granularity, e.g. differentiated between voltage levels, asset categories, etc.[4] Aggregation of these assets to one parameter allows keeping all detailed information while making the parameter usable for DEA.

- The high granularity of the technical asset data does not allow DEA to find the weights for the different assets based on a sample consisting of 21 TSOs. This would imply a DEA model with 21 input data and more than thousand output data. It is straightforward that this will lead non-sensible results.

- Letting DEA choose the weights for the assets given the sample of 21 TSOs would mean to sharply reduce the granularity of the asset data, e.g. only including total line length and number of transformers. We note that this will results in a substantial reduction of the information contained in these parameters compared to the variable "NormalisedGrid"."

The costs of foundations have been taken into account on the cost (not output) side as part of the Call Z process.

The costs of towers vs. conductors are firstly considered through the fact that Call X asset reporting distinguishes between single, double, etc. circuit lines, and secondly by the inclusion of the value of weighted angular towers as a separate output parameter.

Furthermore we note that the granularity of the standard cost model has been increased since the previous e3grid study, both with respect to lines (e.g. more current classes) and substations (e.g. new differentiation by short circuit currents).

Tennet further mentions that the relativities of cost standards in different countries may change over time and that this could affect the benchmarking scores.

We consider that this aspect is being addressed through a number of features in the model, including:

4 Haney/Pollitt (2012: 13) referring to the e3grid project 2008 note: "The normalised grid size measure was calculated starting from 1200 different grid characteristics using assumed weights." In FN 4 they continue: "These characteristics cover eight asset classes: lines, cables, circuit ends, transformers, compensating devices, series compensations, control centers and other assets (such as HVDC)."

- The calculation of annuities to represent capex in the cost base. This helps contain the effect of asset age/year of investment on the benchmarked cost;
- Inflation adjustment of assets;
- Salary adjustments for national conditions; as well as
- Option to apply for further adjustments through the call Z process.