Study on further issues relating to the inter-TSO compensation mechanism – assessment of cost level data

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Executive Summary

Formalised and disaggregated data on network costs will be required for the implementation of an enduring ITC scheme post 2007. Frontier Economics and Consentec[1] were asked to provide assistance in relation to the collection and sample verification of cost data from 35 countries[2] in relation to the ITC mechanism.

We collected a range of TSO cost data from regulatory authorities and identified a subset of information to analyse in detail in order to verify certain aspects of consistency of interpretation. We noted that conceptually, particularly in relation to regulated costs, consistency of absolute cost levels might not be expected because of differences in the environment and regulatory regime associated with individual TSOs.

We carried out a review of a number of aspects of the data received, and through discussions with regulatory authorities, identified a number of issues with consistency of interpretation which we subsequently addressed and corrected. As a result of these corrections, while differences remain, the distribution of unit cost data across the TSO systems considered was reduced.

Finally, based on the experience of having undertaken this verification exercise, we made a number of generic observations in relation to the process. We noted that improved transparency of revenue determinations by regulators would make corroboration of data easier, and that until the process of submitting ITC cost data is "bedded down", the number of data and definition issues uncovered during the review of 9 countries as part of this study suggests that an ongoing process of review of all relevant data would be beneficial. Finally, we noted that while the verification process had reduced the distribution of unit cost data across the TSOs considered, material diversity between cost levels could be expected to remain even in the absence of interpretational inconsistencies.

1 This work was performed under a subcontract with MVV Consulting.

2 EC25 plus Norway, Switzerland and 8 Energy Community states (Albania, Bosnia Herzegovina, Bulgaria, Croatia, Macedonia, Montenegro, Romania and Serbia).

1 Introduction

Regulation 1228/2003 on cross border exchanges in electricity allows for binding guidelines on inter TSO compensation (ITC) to be adopted by a regulatory process consistent with Commission Decision 1999/468/EC. The Regulation sets out that Member States should receive compensation for any cross border flow that imply additional costs to the TSO concerned.

The compensation arrangements have two elements – an allocation approach and a costing methodology. In a previous study which considered both aspects of the scheme[3], a number of principles in relation to the costing methodology were set out. This document considers costing levels in more detail, based on the principles established in our earlier report.

Principles in relation to costing methodology

Regulation 1228/2003 requires that costs incurred as a result of hosting cross-border flows shall be established on the basis of:

- forward looking long-run average incremental costs; and
- the cost of existing infrastructure;[4]

The previous study inquired into the appropriate balance between these two cost components. Since the main objective of the ITC mechanism is cost recovery (as opposed to providing price signals to participants to encourage economically efficient decisions) it was argued that a higher weight should be placed on the cost of existing infrastructure (for example, [75%] regulated costs and [25%] LRAIC).

In addition, the previous study considered a number of points relating to the definition of the costs to be considered.

- The cost of existing infrastructure can be approximated by using an appropriate regulated revenue measure for each TSO. In considering such appropriate measure the previous document suggested that only purely network related revenue should be considered (i.e. excluding revenue associated with activities such as System Operation).
- In relation to the long-run average incremental costs different approaches were discussed regarding the treatment of joint and common costs. The report suggested a "thin" definition of incremental costs, excluding all joint and common costs and limiting the scope of project specific costs to be considered. This was suggested in order to minimise subjectivity, and help to ensure consistent interpretation across countries.
- In order to derive unit costs be defined for different asset classes, it was noted that information on cost relativities between asset types would be required in order to allocate the total regulated cost of existing infrastructure

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3 "Study on the further issues relating to the inter-TSO compensation mechanism", European Commission - Directorate-General Energy and Transport, 2005.

4 Transmission losses are dealt with in another part of the ITC mechanism.

(determined by regulators) between asset classes and to derive long-run average incremental costs for a range of asset classes while only looking in detail at a single project.

Scope of this report

Formalised and disaggregated data on network costs will be required for the implementation of an enduring ITC scheme post 2007. In preparation for the implementation of such a scheme, the European Commission asked Frontier Economics and Consentec[5] to provide assistance in relation to the collection and sample verification of cost data from 35 countries[6] in relation to the ITC mechanism.

The scope of our work was to:

- request relevant data from each of the regulatory authorities via a standard questionnaire;
- carry out a detailed review of the data submitted for 4 "core" countries and a high level review of 4-5 countries whose submitted data indicated that they were "outliers";
- attempt to resolve any issues raised by this review with the regulatory authorities involved; and
- report to the Commission on any revised data, the issues raised and resolved, and any specific or general issues raised by our review that remain outstanding.

Our scope was focused on the "cost level" inputs to any future ITC mechanism – that is, we were not asked to consider any aspects of the "cost allocation" methodology to be used.

In this document, we set out

- in section 2, the process followed in order to complete the work;
- In section 3, a detailed description of the review of the data submitted for the 4 "core" countries and the 4-5 "outlier" countries.

In order to maintain confidentiality with respect to the data submitted by regulators, in this published version of our report, the results of the analysis are presented[7] *relative to* the sample median in each asset class category, rather than in absolute terms. While this ensures the confidentiality of the data is maintained, it does reduce the extent to which comparisons between some of the data items can be made. Also, figures reported for Austria and Germany in this published version are presented as weighted averages of the figures obtained for each TSO

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5 This work was performed under a subcontract with MVV Consulting.

6 EC25 plus Norway, Switzerland and 8 Energy Community states (Albania, Bosnia Herzegovina, Bulgaria, Croatia, Macedonia, Montenegro, Romania and Serbia).

7 Tables in Figure 3-Figure 4, Figure 7-Figure 10 and Figure 15-Figure 17 in Section 3, and Figure 26 and Figure 27 in Annexe 3

in both countries.[8] Weights are a function of the relative dimension of each TSO's network in its own country.

In addition, we provide at Annex 1 and Annex 2 a copy of the questionnaire and explanatory note to the questionnaire distributed to the regulators to request the relevant data. Annex 3 illustrates the results of the preliminary analysis of the data received which was used to choose the "outlier" countries.

8 This has been requested by national regulators from Austria and Germany.

2 Process followed

Our overall approach to the collection and verification of data can be divided into four key steps:

- development of the data questionnaire;
- the Brussels workshop;
- identification of core and outlier countries; and
- data review and discussions with regulators.

2.1 DEVELOPMENT OF THE DATA QUESTIONNAIRE

Based on the requirements of the Regulation and on the draft ITC guidelines, we developed a questionnaire for completion by regulators in order to capture the data likely to be required in relation to individual country cost levels for the ITC mechanism.[9]

The questionnaire requests information necessary to calculate the unit regulated revenue of existing network assets and the forward looking long-run average incremental cost (LRAIC) of new network assets.

Participating entities

The questionnaire requested data at the level of a "participating entity". In each country a participating entity might correspond to:

- a single TSO (or a single network where one TSO operates two different but not synchronously interconnected networks); or
- a group of TSOs

Regulators were given the option to submit data on a more disaggregated basis.

Asset classes

For the purposes of collecting cost information in relation to the transmission network, six asset classes have been defined in the questionnaire:

- **Class A**: Transmission AC lines and cables with voltage > 300kV;
- **Class B**: Transmission AC lines and cables with voltage ≥ 220kV and ≤ 300kV;
- **Class C**: Transmission AC lines and cables with voltage < 220kV;
- **Class D**: Transmission DC lines and cables of any voltage;

[9] Since no decision has yet been made on the cost allocation methodology to be used in any future ITC mechanism, we had to make an assumption about the nature of cost information which a future mechanism would require. For the purposes of this report, we have made the assumption that the methodology will require cost information for each TSO's entire system (i.e. not just on an *ex ante* definition of a horizontal network).

- **Class E**: Transformers transforming between voltages of assets in class B and class A, or between voltages of assets in class A, or between voltages of assets in class B; and
- **Class F**: Transformers transforming between voltages of assets in class C and class B or class A.

While class C and F assets are not part of the ITC mechanism, in that they form part of transmission systems in relation to which regulated revenue is received, data on them is required to derive unit regulated revenues for asset classes A, B and E.

Weighting factors

Regulated revenue data clearly covers several asset classes,[10] while LRAIC estimates are likely to be specific to one asset class (as they will typically be based on cost information from recent projects).

Therefore, for both cost components, information on the relative unit costs of each of the defined asset classes is required:

- for regulated costs, to weight together appropriately the data on asset volumes to derive a unit regulated revenue; and
- for LRAIC, to convert unit cost estimates relating to one asset class to each of the others.

The questionnaire therefore requested regulators to provide information on unit costs for all the asset classes. With such information we computed "weighting factors" which express the unit cost of asset classes B-F relative to the unit cost of asset class A. We requested that unit cost information should be based on "factory gate" prices. "Factory gate" prices should have the advantage of being less subjective and more consistent across countries than other measures – and the actual level of the weighting factors is not important, as they are only used to provide information on unit cost relativities.[11]

Regulated costs

The approach taken to derive unit regulated costs data is shown in Figure 1.

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10 The exact range of classes covered depends on the national or TSO specific delimitation between transmission and distribution network.

11 The cost of switchgear bays was not contained in the unit cost of network assets. The unit cost of transformers, in asset classes E and F, was defined to include the cost of associated components such as shunt reactors, busbars, voltage control equipment, secondary systems, batteries, etc., provided their use was typical on the network of the respective TSOs.

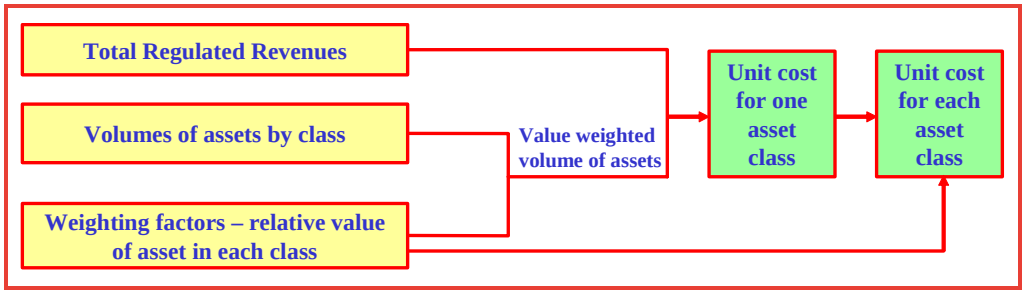

Figure 1: Approach to deriving unit regulated costs

Source: Frontier Economics / Consentec

Based on this approach, regulators were asked to provide:

- allowed total regulated TSO revenue corresponding to year 2005. Where revenue is not regulated, or figures for 2005 are not available, an estimate of this TSO revenue was required, with a description of the estimation methodology used. In order to ensure that the scope of revenues included was appropriate – i.e. that the revenue considered related to network assets only, and that revenues related to physical system operation, ancillary services procurement, etc. were excluded – the questionnaire requires information on (i) any congestion management income accruing to the TSO in relation to international interconnections, and (ii) revenue related to non-network activities and included in the total TSO regulated revenue. Both of these are deducted from total regulated revenue.
- the dimension of the transmission network at the end of year 2005. The dimensions required are total circuit length (in km) of transmission line and cable assets, and the rated power (in Mega Volt Amperes - MVA) of transformers. The questionnaire has been designed in order to ensure that the definition of network length for different asset categories (or equivalent length, in the case of transformer assets) was consistent.

LRAIC

The approach taken to derive unit regulated costs data is shown in Figure 2.

Process followed

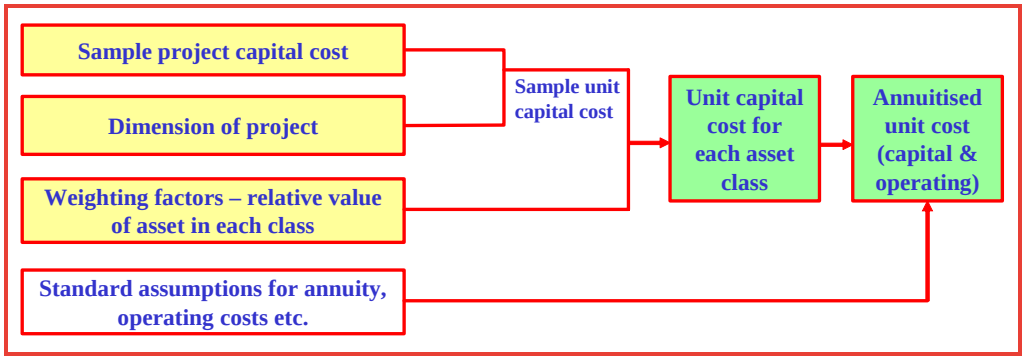

Figure 2: Approach to deriving unit LRAICs

Source: Frontier Economics / Consentec

Regulators were asked to provide estimates of the long-run average incremental investment cost of new network assets. They were asked to provide LRAIC estimates which are:

- representative of the assets typically used on the transmission system in question (for example, in terms of design, construction approach, terrain, specialised equipment such as wind reinforcement, etc.)[12]; and
- forward looking – i.e. to provide information regarding the level of costs that will be incurred in relation to such assets in the future (taking into account volatility in input prices).

In order to improve consistency of responses, the questionnaire requested unit cost information for line or cable projects in one of asset classes A or B. Equally, the questionnaire requested that only direct costs should be taken into account – that is, that costs borne jointly with other projects or other TSO activities, and overheads of the TSO were excluded.

In order to allow cross country comparisons and an understanding of the drivers of potential cost differences, the questionnaire requires disaggregated cost data for various components of the line or cable project (the questionnaire asked for cost data broken down by asset component, land component, installation costs and commissioning costs).

Standard assumptions were made in relation to a range of parameters required to convert unit project capital costs into annual costs. Specifically, we assumed:

- a lifetime of network assets equal to 40 years;
- that the standard nominal rate of return is equal to 10%; and
- an annual operating cost as % of the Gross Asset Value of the asset equal to 2%.

12 If no one project is considered representative, regulators were given freedom to provide cost estimates from a range of projects. Similarly, regulators were permitted to refer to an international project which they believed was likely to have similar cost characteristics as a representative domestic project.

Process followed

We note that since the purpose of our study was a *comparative* analysis of costs across countries, the specific assumptions made are unimportant (though they will clearly influence the relative levels of LRAIC and regulated costs).

Discussion and testing

The questionnaire and an accompanying guidance note were discussed with the European Commission and ERGEG Task Force. In addition, an initial version of the submitted questionnaire was piloted by three volunteer countries (Austria, Finland and Great Britain) before being released generally. This piloting provided valuable experience in relation to the final version.

2.2 WORKSHOP IN BRUSSELS

We presented a draft of the questionnaire and notes, and the experience from the pilot countries, at a workshop in Brussels on 27 October 2006. Several representatives from ERGEG , the European Commission, Norway, Switzerland and the Energy Community countries attended the conference and comments were provided by participants.

After the workshop in Brussels, regulators provided a small number of further comments to the questionnaire and to the explanatory note. The final version was distributed to the regulators for completion on 3 November 2006.

In **Annex 1** and **Annex 2** a copy of the final questionnaire and the explanatory note is provided.

2.3 IDENTIFICATION OF CORE AND OUTLIER COUNTRIES

Once the completed questionnaire was received from the majority of the regulators,[13] we agreed with the European Commission and ERGEG Task Force on a list of criteria in order to select the set of core countries for detailed review, and a set of outlier countries for high level review.

2.3.1 Core countries

The criteria for the choice of core countries were as follows:

- to be of medium/large size;
- to be located towards the centre of the European wide electricity transmission network; and
- to accommodate a significant amount of cross-border flows of electricity.

13 By mid January, 27 regulators had already submitted all or part of the information required in the questionnaire.

Based on these criteria the following countries were reviewed as core countries:

- Czech Republic;
- France;
- Germany; and
- Switzerland.

2.3.2 Outlier countries

Whereas the choice of core countries was based on the fundamental characteristics and importance of systems to the ITC mechanism itself, the choice of outlier countries was driven by the data submitted.

For each country where sufficient data was available we calculated, for each asset class:

- weighting factors (expressed as a percentage of the unit cost of class A assets);
- regulated unit costs; and
- unit LRAIC estimates.

In **Annex 3** we present a series of charts showing the results of this initial analysis. Based on this analysis, we created a list of candidate outlier countries with reference to the frequency with which countries appear as outliers in relation to weighting factors, regulated cost and LRAIC data – the countries considered as outliers were:

- Latvia;
- the Netherlands;
- Serbia;
- Great Britain; and
- Slovenia.

2.4 DATA REVIEW & DISCUSSIONS WITH REGULATORS

Having defined a set of core and outlier countries, we undertook several pieces of analysis to attempt to identify any issues with the data submitted itself, and any potential inconsistencies with the rest of the sample.

For the core countries, this involved:

- assessing the level of regulated revenues – this principally involved cross-checking data provided against any public information on regulated revenues available for the country in question. We also performed a high level "sense check" of the relative magnitudes of any components of allowed regulated revenue identified as "non-network related" and therefore excluded.

- reviewing the data submitted in relation to network length for different asset categories (or equivalent length, in the case of transformer assets) against publicly available information;
- assessing the "weighting factor" data in relation to cost relativities against the rest of the sample;
- "sense checking" the breakdown of project costs used for LRAIC estimates between the different identified components, and identifying whether different results would be obtained if alternative definitions of the scope of costs to be included were adopted;
- reviewing the details of the projects used to derive LRAIC estimates to take a high level view as to whether they could be argued to be representative of investments on the system as a whole; and
- assessing the LRAIC data for each country in relation to the rest of the sample.

For the outlier countries, we undertook a comparative analysis of unit regulated and LRAIC costs and weighting factors across countries to identify potential data issues or inconsistencies.

We then discussed any resulting issues with the relevant regulatory authorities in order to assess whether amendments to the data would improve accuracy or consistency.

Process followed

3 Review and validation of data

In this section, we set out the results of our analysis of the data submitted by regulators. We deal in turn with data relating to LRAIC, regulated costs and weighting factors. . In order to provide an overview of the importance of the individual asset classes in each country, in Annex 3 (Figures 28 and 29) we provide details of the country by country breakdown by class (using the final data).

We finally present updated data following a number of corrections, and report on generic issues arising from the validation process.

3.1 LRAIC

3.1.1 Analysis of data submitted

Figure 3 below presents unit LRAIC estimates based on the data submitted by regulators for the core and outlier countries – the sample median has been calculated for the sample of all countries that completed the questionnaire.[14]

	Czech Republic	France	Germany	Switzerland	Great Britain	Latvia	Netherlands	Serbia	Slovenia
Asset Class A	103.13	92.54	100.00	136.86	182.69	279.31	251.41	36.30	58.74
Asset Class B	88.38	100.00	107.13	183.34	153.16		321.41	29.66	86.38
Asset Class C	116.88	110.72	106.12		160.88	274.79	462.17	30.18	120.19
Asset Class D		425.83							
Asset Class E	195.60	43.69	114.68	189.20	33.43		47.17	40.30	215.65
Asset Class F	107.12	95.61	132.70		85.98	137.37		46.42	125.73

Figure 3: LRAIC unit costs using own weights, (sample median for each asset class = 100)

Source: Frontier Economics and Consentec

Given the methodology used to calculate these estimates, the differences between them represent a combination of differences in LRAIC estimates and differences in weighting factors. Therefore, in Figure 4 we present LRAIC estimates for each core and outlier country based on the median weighting factors for the sample as a whole. The use of sample median weighting factors removes the

14 The countries that had completed the questionnaire by mid January 2007 were Austria, Belgium, Bosnia Herzegovina, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Great Britain, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Macedonia, Netherlands, Norway, Poland, Portugal, Serbia, Slovakia, Slovenia, Spain and Turkey.

impact of using different weights across countries – the remaining differences relate to LRAIC estimates alone.[15]

	Czech Republic	France	Germany	Switzerland	Great Britain	Latvia	Netherlands	Serbia	Slovenia
Asset Class A	103.13	92.54	100.00	136.86	182.69	279.31	251.41	36.30	58.74
Asset Class B	103.13	92.54	100.00	136.86	182.69		251.41	36.30	58.74
Asset Class C	119.63	107.34	115.99		211.91	323.99	291.62	42.11	68.13
Asset Class D		115.61							
Asset Class E	103.13	92.54	100.00	136.86	182.69		251.41	36.30	58.74
Asset Class F	111.45	100.00	108.06		197.42	301.83		39.23	63.47

Figure 4: LRAIC unit costs using sample median weights, (sample median for each asset class = 100)

Source: Frontier Economics and Consentec

3.1.2 Issues considered

For the core countries and then for each of the outliers, we set out below the key issues considered during the review and validation process, a description of discussions held with individual regulators, and a statement of whether (and how) any issues identified were resolved.

Core countries

The LRAIC estimates for network assets for the core countries, estimated using the information provided, are (with the exception of Switzerland) all broadly in line with the median of the sample of countries that had completed the questionnaire.

We therefore undertook limited "sense checking" of the breakdown of project costs between the different identified cost components, to identify whether different results would be obtained if alternative definitions of the scope of costs to be included were adopted.

Figure 5 sets out the relative contribution to total costs of the asset, land, installation and commissioning components. Switzerland provided detailed unit cost information for asset classes A, B and E based on replacement costs, but did not break this unit cost information down by cost component. Therefore, disaggregated data for Switzerland are not available[16].

15 The estimates of unit cost for asset class A in both figures are equal because this asset class is used as the numeraire when calculating the weighting factors.

16 The Swiss authorities conducted a detailed assessment of the replacement cost of various different line and transformer assets on their system. However, this analysis did not break the replacement costs down into individual cost components. The Swiss indicated that while substation land costs

	Czech Republic	France	Germany	Switzerland
Asset component in LRAIC	45%	45%	45%	Not available
Land related component in LRAIC	9%	9%	4%	Not available
Installation cost in LRAIC	26%	45%	50%	Not available
Commissioning cost in LRAIC	19%	0%	1%	Not available

Figure 5: Share of total cost for each component in LRAIC. Core countries

Source: Frontier Economics and Consentec

Although there would appear to be some differences in interpretation as to whether certain costs are categorised as installation or commissioning, this analysis indicates that consistency between LRAIC estimates would be broadly maintained even for different scopes of cost.

The information on the projects provided by the regulators for the LRAIC estimates show that most of the projects are related to transmission lines in the 380 kV grid (asset class A). Although the line lengths of the different projects vary over a wide range, there is nothing in the project descriptions provided which indicates that they would not be reasonably representative of the respective systems and therefore an adequate basis for determination of suitable LRAIC unit costs.

As we note above, the Swiss LRAIC estimates are higher than those of the other core countries. The Swiss regulatory authorities indicated that assessment of breakdown of replacement costs into individual cost components would be a large exercise. Therefore, while the higher LRAIC for Switzerland *could* be explained with reference to non-asset (e.g. terrain and geographic) issues, it is difficult to say with confidence whether this, or data interpretation and consistency issues are driving the results obtained.

Outlier countries

The LRAIC estimates for the outlier countries were more variable than was the case for the core countries. In order to understand the source of this variability further, we again compared the breakdown of LRAIC estimates for all the non-core countries into their asset, land, installation and commissioning components.

were included in their estimates, costs for installation and commissioning (and other land costs) were not.

	Great Britain	Latvia	Netherlands	Serbia	Slovenia
Asset component in LRAIC	50%	48%	85%	47%	69%
Land related component in LRAIC	excluded from estimate	19%	excluded from estimate	2%	17%
Installation cost in LRAIC	50%	22%	15%	50%	12%
Commissioning cost in LRAIC	excluded from estimate	11%	excluded from estimate	2%	2%

Figure 6: Share of total cost for each component in LRAIC. Outlier countries

Source: Frontier Economics and Consentec

These results indicate that the contribution of each of the components of cost varies more significantly across the outlier countries than was the case with the core. In order to correct for this, we calculated LRAIC estimates based on the asset component alone – as this should be less influenced by local factors.

	Czech Republic	France	Germany	Switzerland	Great Britain	Latvia	Netherlands	Serbia	Slovenia
Asset Class A	103.48	92.83	100.00	Not available	201.55	296.74	470.36	37.35	89.48
Asset Class B	87.91	99.45	106.21	Not available	167.52		596.15	30.26	130.47
Asset Class C	110.50	104.66	100.00		167.26	275.10	814.80	29.26	172.55
Asset Class D		271.17							
Asset Class E	222.37	49.65	129.94	Not available	41.78		100.00	46.99	372.25
Asset Class F	100.00	89.23	123.47		88.26	135.79		44.44	178.23

Figure 7: LRAIC unit costs (asset component only), using own adjusted weights, (sample median for each asset class = 100)

Source: Frontier Economics and Consentec

	Czech Republic	France	Germany	Switzerland	Great Britain	Latvia	Netherlands	Serbia	Slovenia
Asset Class A	103.48	92.83	100.00	Not available	201.55	296.74	470.36	37.35	89.48
Asset Class B	103.48	92.83	100.00	Not available	201.55		470.36	37.35	89.48
Asset Class C	115.64	103.74	111.75		225.25	331.62	525.64	41.74	100.00
Asset Class D		106.84							
Asset Class E	103.48	92.83	100.00	Not available	201.55		470.36	37.35	89.48
Asset Class F	111.48	100.00	107.73		217.13	319.67		40.24	96.40

Figure 8: LRAIC unit costs (asset component only), using sample median weights, (sample median for each asset class = 100)

Source: Frontier Economics and Consentec

There is clearly still variation within these figures. We therefore reviewed the detail of each country's estimates.

Netherlands

The LRAIC information submitted by the Dutch regulator produces a high unit cost estimate, especially for a project based on a replacement line (i.e. where there was no incremental land purchase). Equally, the asset component of total costs is very high relative to the sample.

While not indicated explicitly in the questionnaire, the Dutch regulator confirmed that the project corresponded to a double circuit line. However the information submitted initially in the questionnaire provided the length of the line where we have asked for the circuit length. We have agreed with the Dutch regulator that the length of the LRAIC project should be doubled.[17]

The regulator also indicated that the asset component of the LRAIC project includes the cost of the transformers associated with the line (the questionnaire and notes requested that the cost of such transformers should be excluded from the reported costs). However, they stated that they were unable to provide such disaggregated cost information.

To judge the magnitude of this impact, and using the information provided on unit cost of transformers in the Netherlands for the purpose of calculating weighting factors, we estimated a value for the cost of the transformers involved in the project line, and adjusted the data submitted using this estimate.[18]

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17 The initial value of the length of transmission circuit (in km) involved in the project for the Netherlands was 33km. This value has been now corrected to 66km.

18 In order to estimate the cost of transformers included in the asset component cost of the Dutch LRAIC project, we have used the information provided in the weighting factors section of the questionnaire. The unit cost of transformers provided in the Dutch questionnaire was €[✂] per MVA. The Dutch regulator indicated that the asset component cost of the LRAIC line project

Following the adjustment, the class A LRAIC unit cost for the Netherlands became the sample median.

While our adjustment is clearly only approximate, it indicates that if either the actual data or an improved estimate could be obtained, it would increase the consistency of the sample.

Slovenia

The LRAIC information submitted by the Slovenian regulator produces a low unit cost estimate. We discussed this with the Slovenian regulator, who indicated that they believed that commissioning and installation costs were low due to the specifics of this project. In addition, the Slovenian regulator argued that labour costs are low when compared with those in other EU countries.

This explanation is consistent with the asset only LRAIC estimates, where Slovenia is more in line with the sample median.

Serbia

The LRAIC information submitted by the Serbian regulator produces a low unit cost estimate. We discussed this with the Serbian regulator who indicated that all relevant cost components of the specific project had been included. They further indicated that the data provided was in accordance with their general standards and experience across the asset classes.

As with Slovenia, the LRAIC estimate for Serbia appears closer to the sample median when only asset costs are considered – however, a differential remains.

Great Britain

The LRAIC information submitted by the GB regulator produces a high unit cost estimate, even on an "asset only" basis.

While the GB regulator did not submit details of actual projects (they regard this information as too commercially sensitive) they indicated that their data was based on reasonably representative projects (e.g. >30km long for line assets) and included only relevant costs.

Latvia

The LRAIC information submitted by the Latvian regulator produces a high unit cost estimate (even when only the asset component of cost is considered). This may be due to the short length of the line involved (i.e. a high level of fixed costs spread over a relatively short length).

We have suggested the Latvian regulator to either (i) try to estimate the proportion of the project costs which would vary with the length of the line, or (ii) to provide cost information for another project. The Latvian regulator indicated that at the moment there was no other project available to provide LRAIC information.

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included 4 transformers of size 500 MVA. We have therefore deducted €[✂] million from the asset component cost of the Dutch LRAIC project.

3.2 REGULATED REVENUE

3.2.1 Analysis of data submitted

Figure 9 below shows unit regulated costs estimates based on the data submitted by regulators for the core and outlier countries – the sample median has been calculated for the sample of all countries that completed the questionnaire.

	Czech Republic	France	Germany	Switzerland	Great Britain	Latvia	Netherlands	Serbia	Slovenia
Asset Class A	121.55	151.40	107.86	210.97	316.55	60.23	323.17	70.20	160.27
Asset Class B	95.92	150.66	106.56	260.27	244.38		380.46	52.82	217.06
Asset Class C	128.44	168.90	115.18		259.93	55.25	553.95	54.42	305.81
Asset Class D		455.24							
Asset Class E	231.56	71.79	124.38	292.95	58.17		60.91	78.29	591.05
Asset Class F	102.41	126.88	115.61		120.85	24.03		72.82	278.31

Figure 9: Regulated unit costs using own weights, (sample median for each asset class = 100)

Source: Frontier Economics and Consentec

In Figure 10 we present the estimated unit regulated costs using the sample median weighting factors instead of those corresponding to each country. As with the LRAIC data, the use of sample median weighting factors removes the impact of using different weights across countries – the remaining differences relate to regulated revenues alone.

	Czech Republic	France	Germany	Switzerland	Great Britain	Latvia	Netherlands	Serbia	Slovenia
Asset Class A	111.06	147.41	104.70	242.20	224.63	53.31	190.82	56.34	238.63
Asset Class B	106.53	141.40	100.43	232.31	215.47		183.04	54.04	228.90
Asset Class C	109.18	144.92	109.03		220.83	52.40	187.59	55.39	234.59
Asset Class D		156.25							
Asset Class E	106.53	141.40	100.43	232.31	215.47		183.04	54.04	228.90
Asset Class F	114.30	151.71	107.75		231.17	54.86		57.98	245.58

Figure 10: Regulated unit costs using sample median weights, (sample median for each asset class = 100)

Source: Frontier Economics and Consentec

3.2.2 Likelihood of consistency of regulated revenues

At the outset, it is important to consider whether it should be expected that regulated unit revenues across the sample would be consistent. In fact, there are a number of valid reasons for *differences* in unit regulated revenue. For example:

- **environment**: some systems will operate in environments which result in higher unit cost levels, and hence will require a higher unit allowed revenue. For example, terrain and consumption density are likely to be important cost drivers, as are technical and planning standards. Similarly, labour costs, land costs and tax rates are all likely to have an impact on allowed revenue;
- **efficiency**: the overall efficiency of the network operators – which may result from economies of scale, economies of scope, or simply from differences in working practices – will also have an impact on allowed revenues. While regulators may recognise that some network operators are more efficient than others, and that those that are less efficient should improve their productivity, it is unlikely that those perceived as inefficient will have an allowed revenue set which assumes they achieve benchmark efficiency levels overnight;
- **regulatory factors**: there are a range of regulatory factors which will influence the level of allowed revenue of an operator. For example, the asset valuation approach (and in particular, whether any write-off of asset value has taken place, or the way in which the average age of existing assets has been taken into account) will be an important determinant of the level of allowed revenue, as will be the allowed rate of return on assets.

The potential effect of the asset age structure on the unit cost estimates derived from regulated revenue figures can be illustrated on the basis of public data concerning the German 380 kV grid. Figure 11 shows the development of the

total 380 kV circuit length over the past 40 years for each of the four German TSOs. In 1965, two TSOs (or they predecessor companies) already had lines amounting to 20 % of their present total length, whereas the other two had just started to erect their 380 kV grids. Although it is not possible to tell from the data whether the two former TSOs have already replaced some of their old lines, it is reasonable to assume that they today still operate a share of lines that are older than 40 years. This is not the case for the two latter TSOs.

As a result of the different age structures, the unit regulated revenues would clearly differ between TSOs.

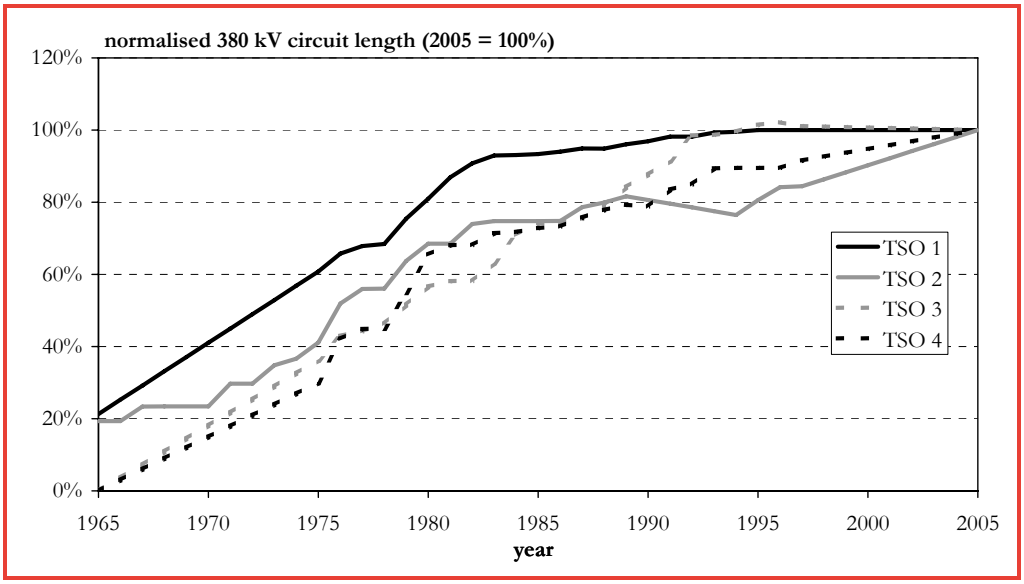

Figure 11: Development of 380 kV circuit length of German TSOs

Source: Frontier Economics and Consentec based on VDEW and DVG statistics and TSOs' websites

Hence, in considering the unit regulated revenue data, it should not be assumed that significant variations from the sample average or median are purely the result of data issues or inconsistency of interpretation. Equally, because of the range of factors creating potential differences in unit costs, care should be taken in the interpretation of differences between countries, or in using any of the countries as an efficiency benchmark.

3.2.3 Issues considered

For the core countries and then for each of the outliers, we set out below the key issues considered during the review and validation process, a description of discussions held with individual regulators, and a statement of whether (and how) any issues identified were resolved.

Core countries

The unit allowed revenue figures for the core countries lie within a relatively wide range (maximum of +142%) of the sample median.[19]

[19] Excluding Switzerland would result in a range with a maximum of +52%.

Notwithstanding the comments above in relation to the likelihood of consistency of regulated cost data, we attempted to validate both revenue and physical data:

- **revenues**: we attempted to validate the information on regulated revenues provided by the regulators of the core countries using published documentation. The regulators in Germany, France and the Czech Republic have confirmed the regulated revenue figures provided, but informed us that there is no public source available by which they can be validated. The agency in charge of the Switzerland's submission corrected the revenue figures initially submitted, which corresponded only to the so called "Horizontal Network". They provided revised revenue figures and asset volumes for the entire Swiss transmission network. Again, they have indicated that there is no published source by which the data can be confirmed;
- **physical data**: we have compared the data submitted in relation to total line lengths and installed MVA for the networks of the core countries to data available in public sources. In no case have we been able to identify any inconsistency in the data; and
- **breakdown of revenues** – we performed a high level check on the related magnitudes of the components of allowed revenue identified. Figure 12 shows the ratio of revenue for non-network related activities to total allowed TSO revenue. The number for France appears low if compared with the other core countries – however, the French regulator confirmed that both figures are correct. The Swiss authorities provided no data in relation to the revenue relating to non-network related activities or congestion management. They indicated that the revenue figures provided related to network activities only.

Czech Republic	France	Germany	Switzerland
64%	28%	53%	Not available

Figure 12: Revenue from non-network activities / Allowed revenue

Source: Frontier Economics and Consentec

Therefore, while the data demonstrates significant variability across the core countries, we have not been able to identify specific data issues lying behind this variation. However, the lack of published material in relation to regulated revenue makes detailed analysis of this issue difficult.

Netherlands

The unit regulated costs for the Netherlands appear to be reasonably high relative to the remainder of the sample. However, the Dutch regulator has confirmed

the data provided, and has provided us with a reference to documentation on the final method decision for TSO TenneT B.V., which supports the values used.[20]

Slovenia

The unit regulated costs for Slovenia appear to be high relative to the remainder of the sample.

The Slovenian regulator has confirmed the regulated revenue figures, which come from the company's official balance sheets and from an official report, reviewed by auditors and also analysed by the regulator. However, in discussions with the Slovenian regulator it became clear that declared regulated TSO revenue included also compensations for ancillary services, balancing services and the cost of network losses. Those compensations amount to 44% of the total regulated TSO revenue. In order to ensure consistency with the data from other countries, we have excluded these revenues.

Serbia

The unit regulated costs for Serbia appear to be low relative to the remainder of the sample. The Serbian regulator has indicated that the figures are based on preliminary data – they are currently reviewing the allowed revenue. However, they indicated that any revision would result in figures *lower* that those presented in the questionnaire.

The Serbian regulator suggested that allowed revenue variations resulting from relatively low salary levels may affect the whole of the South East European region.

In order to investigate this proposition, Figure 13 below illustrates the differences in regulated costs across different South East European countries, and the relation between the median of regulated costs for all South East European countries and for the whole sample. The median of regulated unit costs when considering the whole sample of countries is 39% higher than the median when including only the South East European countries.[21] The figure confirms the fact that there is a South East European effect regarding regulated cost figures.

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20 TenneT B.V. (landelijk), Tariefblad, 23/12/2004, document 101748-35, page 11, http://www.dte.nl/images/NE-TAR%20Tennet_tcm7-8963.pdf.

21 The figure already incorporates the revised regulated revenue numbers for Slovenia.

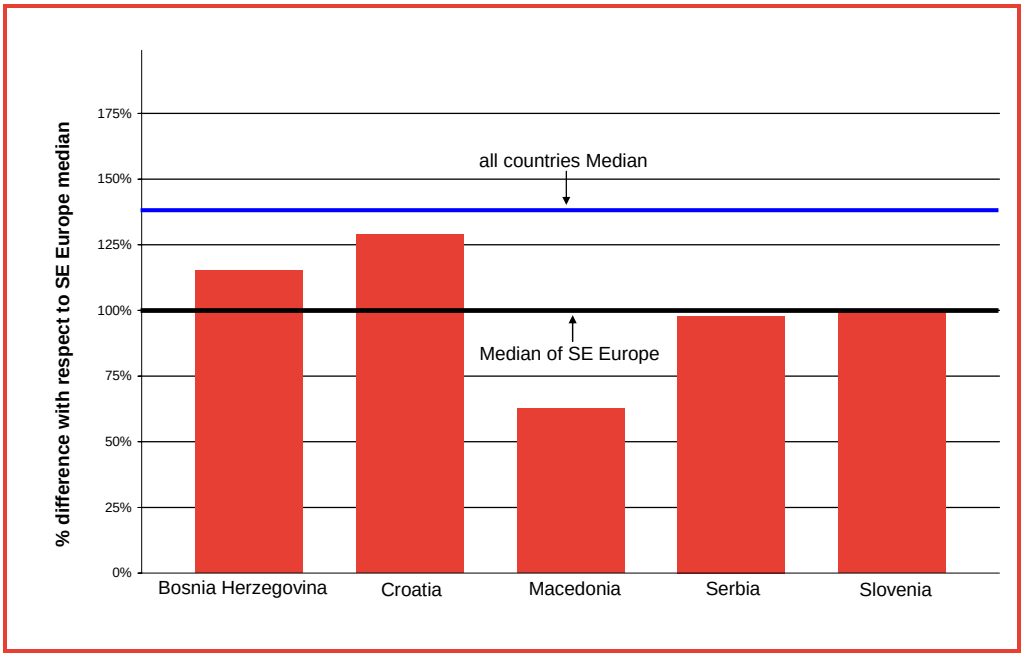

Figure 13: Unit costs from regulated revenue using own weights. Asset Class A.

Source: Frontier Economics and Consentec.

Latvia

The unit regulated costs for Latvia appear to be low relative to the remainder of the sample. The Latvian regulator has indicated that the Latvian TSO became a legally separated company from the 1st of September, and provided us with revenue figures for their TSO before and after this date.

The monthly revenue corresponding to the first 8 months of 2005 is much lower than that corresponding to the last 4 months of that year. While recognising that seasonality may play an important role in the profile of revenues, and that therefore extrapolating from Q4 revenues may significantly over-estimate the annual figures, we have nevertheless estimated regulated revenue on this basis. The resulting unit regulated costs are only slightly higher – on the basis of annual revenues, the Latvian regulated unit cost for asset class A was 45% below the sample median. On the basis of annualised Q4 revenues, the asset class A regulated unit cost is 32% below the sample median – still a substantial gap.

3.3 WEIGHTING FACTORS

In this section, we consider the "factory gate" cost estimates for the different network asset classes.

3.3.1 Analysis of data submitted

Figure 14 below shows, for the core and outlier countries, the estimated weighting factors for each asset class calculated using "factory gate" prices

provided by the regulators.[22] We also show the median weighting factors for the sample of all countries that completed the questionnaire.

	Czech Republic	France	Germany	Switzerland	Great Britain	Latvia	Netherlands	Serbia	Slovenia	Sample Median (*)
Asset Class A	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Asset Class B	0.52	0.66	0.66	0.82	0.51		0.78	0.50	0.90	0.64
Asset Class C	0.44	0.47	0.41		0.34	0.38	0.72	0.33	0.80	0.43
Asset Class D		8.32								3.24
Asset Class E	0.05	0.01	0.03	0.04	0.01		0.01	0.03	0.10	0.03
Asset Class F	0.03	0.03	0.04		0.01	0.02		0.04	0.07	0.04

(*) Sample refers to all the countries that have submitted the questionnaire.

Figure 14: Weighting factors, in km of asset class A / km/MVA of asset class *X*

Source: Frontier Economics and Consentec

3.3.2 Issues considered

For the core countries and then for each of the outliers, we set out below the key issues considered during the review and validation process, a description of discussions held with individual regulators, and a statement of whether (and how) any issues identified were resolved.

Core countries

With the exception of Switzerland, the weighting factors for asset classes A, B, C, E and F for the core countries are generally in line with the median of the sample of countries that completed the questionnaire.

The Swiss estimate of the weighting factor for asset class B is high relative to the sample median.

The Swiss authorities did not provide separate factory gate cost estimates. However, they provided estimates for replacement costs of a number of different asset classes. We have imputed weighting factors from these estimates. It is possible that this approach has led to a slight lack of consistency between the Swiss and other country data.

Information on unit costs corresponding to asset class D has only been provided by 5 countries.[23] The information provided by those regulators show a big spread on unit costs (the range lies within +157% and -69% of the sample median). We

22 The estimates of unit cost for asset class A in both figures are equal because this asset class is used as the numeraire when calculating the weighting factors.

23 Countries that submitted information on asset class D are Finland, France, Greece, Italy and Norway. Sweden submitted information after mid January 2007.

therefore believe that the information relating to asset class D is not sufficient to make valid comparisons across countries.

Netherlands

The Netherlands suggested relatively high weights for asset classes B and C, and low weights for transformers - asset class E. We asked the Dutch regulator to review the figures of unit costs provided and to confirm whether it would be possible to break the data down to differentiate between factory gate price components and other components.

The Dutch regulator confirmed that some costs relating to installation had originally been included in line asset classes (class A, B and C), and agreed that these could be removed.[24] In addition, the Dutch regulator clarified that, in the initial submission of the questionnaire, unit costs were calculated from double circuit lines, without this having been taken into account in the unit cost calculation. We have therefore agreed with the regulator adjustments to the data to take this into account.

Great Britain

The weighting factors submitted by Great Britain suggested relatively low weights for transformer assets in classes E and F. We asked the UK regulator to review the figures.

The UK regulator provided additional and more detailed information on the unit costs used in the estimation of weighting factors. This additional information allowed us to exclude installation costs in line asset classes (class A, B and C), originally included in the information provided in the questionnaire.[25]

Slovenia

The weighting factors submitted by Slovenia suggested relatively low weights for assets in class A. We asked the Slovenian regulator to review the data in the light of this finding.

The Slovenian regulator explained that the values of unit costs provided were estimated by the regulator on the basis of a valid government approved document, which sets out the network development and investment plan. However, they noted that since no transmission line involving assets in class A has been constructed in Slovenia for the last 6 years, the estimated values for asset class A may appear low. The regulator stated that they did not have access to any more up to date data.

France

The weighting factors submitted by France suggested relatively low weights for transformer assets in class E. We asked the French regulator whether there are

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24 According to the information provided by the Dutch regulator, installation costs may account for between 32% and 45% of the unit costs of line assets.

25 According to the information provided by the UK regulator, installation costs account for 50% of the unit costs of line assets.

any reasons to believe that unit costs for asset class E would be higher than those provided.

The French regulator has confirmed the information on unit costs of transformer assets in class E provided in the initial submission of the questionnaire.

Czech Republic

The data for the Czech Republic is in line with sample median. Discussions with the Czech regulator did not reveal any material issues.

3.4 AMENDMENTS TO DATA

Based on the above analysis and discussions with regulators, we have made a number of changes to the data submitted initially.

In relation to LRAIC estimates:

- we agreed with the Dutch regulator that the original estimates should be adjusted to take into account the fact that reported costs in the initial submission corresponded to double circuit lines, without this having been taken appropriately into account; and
- the direct capital cost of the asset component corresponding to the LRAIC project submitted by the Netherlands has been lowered by 30%. This amount corresponds to the *estimated* cost of transformers included in the asset component of the LRAIC project, which should be excluded.[26] This has had the effect of lowering the unit cost estimates in LRAIC for the Netherlands in all the asset classes.

In relation to regulated revenues:

- the total regulated TSO revenue provided by the Slovenian regulator originally included compensations for ancillary services, balancing services and the cost of losses. We have been provided percentage estimates of the order of magnitude of these concepts, which in aggregate amount to 44% of the TSO revenue, in order to discount them from the total revenue figure. This has had the effect of lowering the unit regulated cost estimates for Slovenia in all the asset classes; and
- Switzerland provided initial figures for regulated revenue and asset volumes which corresponded to the Swiss "Horizontal Network". The agency in charge of the Switzerland's submission of the questionnaire corrected the initial figures, which corresponded to the so called "Horizontal Network". Revised revenue and asset volume figures now account for the entire Swiss transmission network.

In relation to weighting factors:

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26 We would have preferred this information to be confirmed by the Dutch regulator with some objective data. However, the Dutch regulator has declared that the breakdown for the asset component in LRAIC is not available.

- unit costs of line network assets (in asset classes A, B and C) for the Netherlands have been lowered in order to (i) account for the fact that reported costs in the initial submission of the questionnaire corresponded to double circuit lines and (ii) exclude the installation costs. This has had the effect of lowering the weighting factors of line network assets, while raising the weighting factors of transformer assets (in class E); and
- unit costs of line network assets (in asset classes A, B and C) for Great Britain have been lowered in order to exclude the installation costs. This has had the effect of lowering the weighting factors of line network assets, while raising the weighting factors of transformer assets (in class E and F).

Amended LRAIC cost estimates

Analysis of LRAIC submissions suggested that greater consistency may be achieved by considering only asset costs. Below, we therefore present amended data both for all costs and for asset only costs.

Figure 15 corresponds to the unit costs when only considering the asset components, while Figure 16 shows the LRAIC unit costs including all components. Note that only the estimated values for Great Britain and the Netherlands have changed.

	Czech Republic	France	Germany	Switzerland	Great Britain	Latvia	Netherlands	Serbia	Slovenia
Asset Class A	103.48	92.83	100.00	Not available	201.55	296.74	166.01	37.35	89.48
Asset Class B	87.91	99.45	106.21	Not available	167.52		181.76	30.26	130.47
Asset Class C	110.50	104.66	100.00		167.26	275.10	232.50	29.26	172.55
Asset Class D		271.17							
Asset Class E	196.26	43.82	114.68	Not available	73.76		92.78	41.47	328.53
Asset Class F	82.59	73.70	101.98		145.80	112.16		36.71	147.21

Figure 15: LRAIC unit costs (asset component only), using own adjusted weights, (sample median for each asset class = 100)

Source: Frontier Economics and Consentec

	Czech Republic	France	Germany	Switzerland	Great Britain	Latvia	Netherlands	Serbia	Slovenia
Asset Class A	109.30	98.07	105.98	145.04	193.61	296.01	100.00	38.47	62.25
Asset Class B	88.38	100.00	107.13	183.34	153.16		104.21	29.66	86.38
Asset Class C	116.88	110.72	106.12		160.88	274.79	140.24	30.18	120.19
Asset Class D		425.83							
Asset Class E	181.15	40.46	106.21	175.22	61.91		48.84	37.33	199.71
Asset Class F	85.19	76.04	105.54		136.77	109.25		36.92	100.00

Figure 16: LRAIC unit costs, using own adjusted weights, (sample median for each asset class = 100)

Source: Frontier Economics and Consentec

Amended regulated cost estimates

Figure 17 shows the regulated revenue unit costs following the adjustments made to the data and Figure 18 show the unit costs following these adjustments. Note that only the estimated values for Switzerland, Great Britain, Slovenia and the Netherlands have changed.

	Czech Republic	France	Germany	Switzerland	Great Britain	Latvia	Netherlands	Serbia	Slovenia
Asset Class A	125.23	155.98	111.12	216.49	288.29	62.05	346.48	72.32	73.91
Asset Class B	98.72	155.07	109.68	266.82	222.35		352.04	54.37	100.00
Asset Class C	128.44	168.90	115.18		229.78	55.25	466.07	54.42	136.88
Asset Class D		455.24							
Asset Class E	192.86	59.79	103.59	243.02	85.66		157.24	65.20	220.34
Asset Class F	102.41	126.88	115.61		213.66	24.03		72.82	124.57

Figure 17: Regulated unit costs using own weights, (sample median for each asset class = 100)

Source: Frontier Economics and Consentec

While it is not possible to observe from the tables above (because the data is expressed in terms of relativities to sample medians rather than absolute unit costs), in the majority of cases the absolute level of unit regulated costs is lower than the LRAIC estimates. However, this need not be the case – indeed, for the

Dutch network, the opposite is true. A number of factors could influence the relativity of the two cost measures – for example:

- the LRAIC definition adopted was deliberately "thin" in that it excluded certain cost categories (including joint and common costs) in order to increase comparability. Clearly these cost categories will be included in regulated costs (as they require remuneration); and
- changes in the nature of network development projects over time – if the trend is towards relatively cheaper (more expensive) development projects on a unit cost basis, the LRAIC estimates would tend to be lower (higher) than regulated unit costs.

Amended weighting factors

Figure 18 shows the weighting factors after correcting for the last adjustments reported by the regulators. Note that only the estimated values for Great Britain and the Netherlands have changed.

	Czech Republic	France	Germany	Switzerland	Great Britain	Latvia	Netherlands	Serbia	Slovenia	Sample Median (*)
Asset Class A	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Asset Class B	0.52	0.66	0.66	0.82	0.51		0.68	0.50	0.90	0.64
Asset Class C	0.44	0.47	0.41		0.34	0.38	0.58	0.33	0.80	0.41
Asset Class D		8.32								3.24
Asset Class E	0.05	0.01	0.03	0.04	0.01		0.02	0.03	0.10	0.03
Asset Class F	0.03	0.03	0.04		0.03	0.02		0.04	0.07	0.04

(*) Sample refers to all the countries that have submitted the questionnaire.

Figure 18: Weighting factors, in km of asset class A / km/MVA of asset class *X*

Source: Frontier Economics and Consentec

3.5 GENERAL ISSUES FOR ITC COST ASSESSMENT ARISING FROM ANALYSIS

The analysis undertaken has resulted in a number of specific data issues with the core and outlier countries being addressed, as described above.

While it has not highlighted issues which would imply a general adjustment to all data submitted, it has also raised a number of more generic issues of relevance to the determination of costs under the ITC scheme.

- **Lack of published data in relation to regulatory determinations**: it has proved difficult to corroborate data submitted by regulators in relation to regulated revenue, as the details of the relevant determinations have not been published. This means that the Commission has to rely on the data provided by regulators being accurate, and also means that the basis of the regulated revenue cannot be easily understood and verified to ensure cross-country

consistency. This is likely to be of particular importance in relation to consistency of the deductions to total allowed revenue which are required in order to ensure that the scope of activities for which costs are submitted is appropriate;

- **Lack of disaggregated data**: a number of countries have indicated that it is too difficult to provide the breakdown of LRAIC costs into individual cost components (asset, land, installation and commissioning). For the core countries (with the exception of Switzerland, for which no data was provided) the proportions relating to each component were reasonably consistent. However, this was not the case for the outlier countries, where use of an "asset only" LRAIC estimate would result in greater consistency. While LRAIC estimates are likely to contribute only to a small proportion of the total ITC costs, if the Commission wished to use a cost definition which was likely to increase consistency, then obtaining this breakdown for all countries would be important; and
- **Benefit of data review**: finally, until the process of submitting ITC cost data is "bedded down", the number of data and definition issues uncovered during the review of 9 countries as part of this study suggests that an ongoing process of review of all relevant data (either by the Commission or by regulators as a peer review) would be beneficial.

The analysis also indicates that, even following a number of amendments to the data to ensure better consistency of interpretation, there is still a reasonable amount of variability between countries. Looking at the sample as a whole, it would appear that the variability in LRAIC estimates is greater than the variability in unit regulated revenue.

Annexe 1: Questionnaire

Cost of existing network assets

Total Regulated TSO Revenue (in €m)	1.1	
If Total Participating Entity Revenue (in 1.1) includes congestion management income, specify the amount of this congestion management income (in €m)	1.2	
Deductions from total revenue for non-network related activities (in €m)	1.3	
Relate here which components of the total revenue, for non-network activities or congestion management, come from a regulatory process and which components have been estimated	1.4	
If estimated, provide basis of estimation	1.5	

Volumes

Asset class	Description		
A	Transmission AC lines and cables with voltage > 300kV (in km)	1.6	
B	Transmission AC lines and cables with voltage ? 220kV and ? 300kV (in km)	1.7	
C	Transmission AC lines and cables with voltage < 220kV (in km)	1.8	
D	Transmission DC lines and cables of any voltage (in km)	1.9	
E	Transformers transforming between voltages of assets in class B and class A, or between voltages of assets in class A, or between voltages of assets in class B (in MVA)	1.10	
F	Transformers transforming between voltages of assets in class C and class B or class A (in MVA)	1.11	

Figure 19: Regulated Cost

Source: Frontier Economics and Consentec

Forward looking long run average incremental cost of new network assets

Is the LRAIC estimate based on representative project(s) of your system? (Y/N)	2.1						
If not, what is the basis of the LRAIC estimate?	2.2						
LRAIC cost components	Direct capital cost of each component of the project (in €m)		Project name used to assess the component cost in LRAIC		Indicate any approach taken in the estimation of the cost data		
Asset component in LRAIC	2.3		2.7		2.11		
Land related component in LRAIC	2.4		2.8		2.12		
Installation cost in LRAIC	2.5		2.9		2.13		
Commissioning cost in LRAIC	2.6		2.10		2.14		
For each project used to estimate the LRAIC cost components	Type of transmission line or cable involved in the project (choose among the asset classes A and B)		Length of transmission circuit (in km) involved in the project		Project commissioning date	Direct cost of the whole project (in €m)	
Project used to assess the cost of the asset component in LRAIC	2.15		2.19		2.23	2.27	
Project used to assess the cost of the land related component in LRAIC	2.16		2.2		2.24	2.28	
Project used to assess the installation cost in LRAIC	2.17		2.21		2.25	2.29	
Project used to assess the commissioning cost in LRAIC	2.18		2.22		2.26	2.30	

Figure 20: LRAIC Cost

Source: Frontier Economics and Consentec

Unit cost data to calculate weights

Asset class	Unit cost of assets and average length/rated power in each asset class	
A	Unit cost of transmission AC lines and cables with voltage > 300kV (in € per km)	3.1
B	Unit cost of transmission AC lines and cables with voltage ? 220kV and ? 300kV (in € per km)	3.2
C	Unit cost of transmission AC lines and cables with voltage < 220kV (in € per km)	3.2
D	Unit cost of transmission DC lines and cables of any voltage (in € per km)	3.4
E	Unit cost of transformers transforming between voltages of assets in class B and class A, or between voltages of assets in class A, or between voltages of assets in class B (in € per MVA)	3.5
F	Unit cost of transformers transforming between voltages of assets in class C and class B or class A (in € per MVA)	3.6
	Provide source of information used to estimate unit cost of assets and describe what (if any) alternatives to factory gate prices have been used	3.7

Figure 21: Weighting factors

Source: Frontier Economics and Consentec

Annexe 1: Questionnaire

Annexe 2: Notes to the questionnaire

The purpose of this note is to guide regulators through the questionnaire requesting information on the cost of network transmission assets for the purposes of the ITC mechanism.

INTRODUCTION

Regulation 1228/2003 on cross border exchanges in electricity allows for binding guidelines on inter TSO compensation (ITC) to be adopted by a regulatory process consistent with Commission Decision 1999/468/EC. The Regulation sets out that Member States should receive compensation for any cross border flow that imply additional costs to the TSO concerned.

According to the Regulation 1228/2003 Article 3(6) the relevant costs for the ITC scheme are required to be established on the basis of the forward looking long-run average incremental costs, taking into account losses, investment in new infrastructure, and an appropriate proportion of the cost of existing infrastructure, as far as existing infrastructure is used to transmit cross-border flows. When establishing the costs incurred, standard-costing methodologies shall be used. Benefits that a network incurs as a result of hosting cross-border flows shall be taken into account.

Formalised and disaggregated data on network costs will be required for the ITC scheme post 2007. The European Commission have asked Frontier Economics and Consentec to provide assistance in relation to the collection and sample verification of cost data from 35 countries in relation to the mechanism. We have therefore developed a questionnaire for completion by regulators in order to inform the appropriate level of costs for the ITC mechanism.

Following Article 3(6) of the Regulation 1228/2003 and the 2005 Consentec and Frontier Economics report on the ITC mechanism, this unit cost will be calculated as a weighted average of the unit cost of existing network assets and the unit cost of the forward looking long-run average incremental cost of new network assets.

The purpose of this note is to provide guidance to regulators filling in the questionnaire. We note at the outset that no data provided through the questionnaire will be used other than for the purpose of advising the European Commission in relation to the ITC scheme – the data will only be shared between relevant regulatory authorities and the Commission unless explicit approval otherwise is given by all relevant TSOs.

PARTICIPATING ENTITIES

Transmission system operators (TSOs) in all EU and EEA Member States, which are connected to the network of another TSO, participate in the inter TSO compensation mechanism either as a single entity or collectively. Participation collectively in the inter TSO compensation mechanism has to be approved by the regulator(s) involved and notified to the Commission according to the Regulation 1228/2003 Article 2(b). Networks that are operated by one TSO, but not

synchronously interconnected shall form separate entities as regards the calculation of the inter TSO compensations.

In case a group of TSO's participates collectively in the inter TSO compensation scheme, the relevant regulator(s) can choose to provide the information on revenue and volumes at an aggregate participating entity level, or to provide this information for each TSO individually.

DEFINITION OF ASSET CLASSES

For the purposes of collecting cost information in relation to the transmission system, we have defined and will collect information on assets falling into one of six classes:

- **Class A**: Transmission AC lines and cables with voltage > 300kV;
- **Class B**: Transmission AC lines and cables with voltage ≥ 220kV and ≤ 300kV;
- **Class C**: Transmission AC lines and cables with voltage < 220kV;[27]
- **Class D**: Transmission DC lines and cables of any voltage;
- **Class E**: Transformers transforming between voltages of assets in class B and class A, or between voltages of assets in class A, or between voltages of assets in class B; and
- **Class F**: Transformers transforming between voltages of assets in class C and class B or class A.[28]

INFORMATION TO CALCULATE REGULATED COST

Allowed Revenue

Regulators are required to provide information regarding the total regulated TSO revenue[29] corresponding to year 2005. Where revenue is not regulated, or figures for 2005 are not available, an estimate of this TSO revenue is required, with a description of the methodology used to estimate that revenue.[30]

From total regulated TSO revenue, any congestion management income accruing to the TSO in relation to international interconnections is deducted. Information regarding the amount of any such congestion management income is required.

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27 Line and cable assets below 220kV may have only minor effects on the ITC mechanism. However, the cost of transmission assets below 220kV will be included in the TSO's revenue. We therefore require information in relation to asset class C here in order be able to appropriately calculate regulated unit revenue for transmission assets at higher voltage (for this calculation, consistency between revenue and the total size of the network is required for this purpose)

28 Transformers transforming between voltages of assets in class C have been excluded from the ITC mechanism as their relevance for the cost of CBTs is low. They will be included as such in class C.

29 Regulated revenue is used as a measure of the costs which national regulators approve to be reasonable, given the asset base of the relevant TSO.

30 Regulators are free to choose the data that they consider most appropriate in order to construct the estimate of regulated revenue for 2005 but they have to be transparent in their choice.

Annexe 2: Notes to the questionnaire

Revenue related to non-network related activities, and included in the total TSO regulated revenue, is also deducted and should therefore be provided. The non-network related activities, whose costs should be deducted in order to exclude them from the ITC cost base, includes (but is not limited to):[31]

- net costs of balancing the system, namely costs of energy market activities relating to
  - balancing total supply and demand
  - addressing congestion management
- cost of procuring ancillary services;
- cost of procuring losses (where applicable);
- despatch centre / control room costs.

In case these cost figures are not readily available, from a regulatory determination or other verified source, regulators are invited to provide estimated cost figures for such non-network activities, and the methodology used to estimate these costs.

- In cell 1.1 regulators should provide the total allowed revenue received by the participating entities in the transmission system under the jurisdiction of the regulator.
- If congestion management income in relation to international interconnections accrues to the TSO, in cell 1.2 the regulator should provide the total amount of this congestion management income for 2005.
- Cell 1.3 asks for the proportion of the allowed revenue corresponding to non-network related activities.
- Cell 1.4 asks information about which of the above data items are derived from a regulatory process and which components have been estimated.[32]
- Cell 1.5 asks for further information on how the revenues have been derived, in case estimated values are reported in cells 1.1 to 1.3.

Volumes

Regulators are required to provide an estimate of a measure of the dimension of the transmission network at end year 2005. The dimensions required are total circuit length[33] (in km) of transmission line and cable assets, and the rated power (in Mega Volt Amperes - MVA) of transformers.

- Cell 1.6 asks for the total length of circuits (in km) in asset class A;

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31 Regulators may include other deductions if they consider that other relevant costs related to non-network activities should be excluded from the ITC cost base.

32 I.e. based on information/documentation which is not part of a formal regulatory process.

33 In the following cells, 1.5 to 1.12, length information of the transmission network is required at circuit level. This means that the reported length of a double circuit line should be twice the length of the line itself.

Annexe 2: Notes to the questionnaire

- Cell 1.7 asks for the total length of circuits (in km) in asset class B;
- Cell 1.8 asks for the total length of circuits (in km) in asset class C;
- Cell 1.9 asks for the total length of circuits (in km) in asset class D;
- Cell 1.10 asks for the total rated power of transformers (in MVA) in asset class E; and
- Cell 1.11 asks for the total rated power of transformers (in MVA) in asset class F.

LONG-RUN AVERAGE INCREMENTAL COST (LRAIC) ESTIMATES

Regulators are required to provide estimates of the long-run average incremental investment cost of providing additional lengths of a new transmission line or cable in one of the asset classes in either class A or class B.

In contrast to the regulated cost data, LRAIC estimates are intended to:

- be representative of the assets typically used on the transmission system in question (for example, in terms of design, construction approach, terrain, specialised equipment such as wind reinforcement, etc.); and
- be forward looking – i.e. to provide information regarding the level of costs that will be incurred in relation to such assets in the future (taking into account volatility in input prices).

The estimate should therefore be based on recent experience of the cost of constructing a new transmission capacity line or cable. Regulators should base estimates on investment projects which are reasonably representative of the current network assets in place and of projects which might reasonably be undertaken in the future. If no one project is considered representative, but specific components from a range of projects are (in combination) believed to be representative, regulators may provide cost estimates based on these specific components along with an explanation of the approach taken.

If no such representative projects have been undertaken recently, regulators shall exercise their discretion to refer to an international project which is likely to have similar cost characteristics as the representative domestic project.

- Cell 2.1 asks whether the project chosen by the regulator is representative of the system;
- If not, Cell 2.2 asks for the basis of derivation of the LRAIC estimate.
- In cells 2.3 to 2.6 regulators are required to provide disaggregated cost data for various components of the line or cable project, coming from a unique or from different projects. Regulators are required to report the estimated direct capital cost of the following components of the line or cable project:[34]

[34] By capital cost it is understood the capital outlay associated of the line or cable component of the project.

Annexe 2: Notes to the questionnaire

- asset cost;
- land related cost (permits, environmental costs, etc.);
- installation cost; and
- commissioning cost.

- Cell 2.3 should incorporate, along with asset costs, also the cost of other capital equipment associated with the asset cost[35]. However, only direct costs should be taken into account – costs borne jointly with other projects or other TSO activities, and overheads of the TSO should be excluded (e.g. project management overhead across a number of investment projects, corporate centre costs etc.);
- In cells 2.7 to 2.10 regulators should provide the names of the project(s) used to estimate the various cost components of the LRAIC;
- In cells 2.11 to 2.14 regulators are required to indicate any estimates used in each cost component of the LRAIC;
- In cells 2.15 to 2.18 regulators should indicate the asset class of the project(s) (i.e. whether the costs to be provided correspond to either class A or class B circuit assets) chosen for each component;
- In cells 2.19 to 2.22 regulators should provide information regarding the circuit length (in km) of the line or cable[36] involved in the project(s) chosen;
- In cells 2.23 to 2.26 regulators should indicate the project(s) commissioning dates; and
- In order to gain further understanding and get a sense check of the project(s) chosen, in cells 2.27 to 2.30 regulators are required to report the total direct cost of the project(s).[37] This could include other costs besides those of the line or cable component – for example, the capital cost of additional or upgraded transformers and other network components included in the project.

WEIGHTING FACTORS

LRAIC estimates are only required for a single asset class. Regulated revenue data will cover all asset classes – however, it is not possible using data on revenue alone to establish unit costs for individual line and cable assets. Therefore to arrive at LRAIC estimates for all asset classes, and to disaggregate regulated revenue data, information is required on the relativity of costs across the asset classes.

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35 Since the LRAIC should reflect an average line or cable project from the respective TSO's point of view, the direct network costs should include the cost of other associated equipment related but not directly included in the line or cable costs, provided that those elements are representative of the construction of the transmission network of the respective TSO.

36 As before, length information should be provided at circuit level.

37 For the avoidance of doubt, this number will not be included in the calculation of the LRAIC, being only required to get a sense check of the project(s) chosen by the regulator.

Annexe 2: Notes to the questionnaire

Since this information is not used to derive cost levels but rather relativities *given* a predetermined level (either a single asset class LRAIC or a multi-asset class regulated revenue), it can be considered reasonable to use "factory gate" prices[38] as weighting factors. Compared to installed and tested cost estimates, factor gate prices should have the advantage of being less subjective and more common across countries. Nevertheless, if it is easier in the context of their national regime, regulators may use alternative approaches to estimate relative prices across the asset classes as long as it produces relativities consistent with factory gate prices. Where an alternative approach has been adopted, a detailed description of the methodology should be provided.

- Cells 3.1, 3.2, 3.3 and 3.4 ask for the unit factory gate cost (in € per circuit km) of lines and cables in asset classes A, B, C and D respectively. Regarding the unit cost in asset class D (in cell 3.4), unit costs should include the cost of converter stations.
- Cells 3.5 and 3.6 ask for the unit factory gate cost (in € per MVA) of transformers in asset classes E and F respectively.[39]
- In cell 3.7 regulators are asked to provide information regarding the source of information used to estimate the unit factory gate costs of assets, including a description of any alternative to factory gate prices used in the estimation process.

WORKED EXAMPLES

The questionnaire contains two worked examples setting out how the information detailed above will be combined with standard assumptions (e.g. a standard asset life, standard rate of return) to generate estimates of unit regulated costs and LRAICs.

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38 By "factory gate" prices, we mean the cost of equipment, such as transformers, towers, lines/cables/wires and other associated assets, as delivered by the manufacturers (i.e. prior to any installation or site related costs). These prices should be quoted exclusive of VAT.

39 The unit cost of transformers should include the cost of associated components such as shunt reactors, busbars, voltage control equipment, secondary systems, batteries, etc., provided their use is typical on the network of the respective TSOs.

Annexe 2: Notes to the questionnaire

Annexe 3: Analysis of submitted data

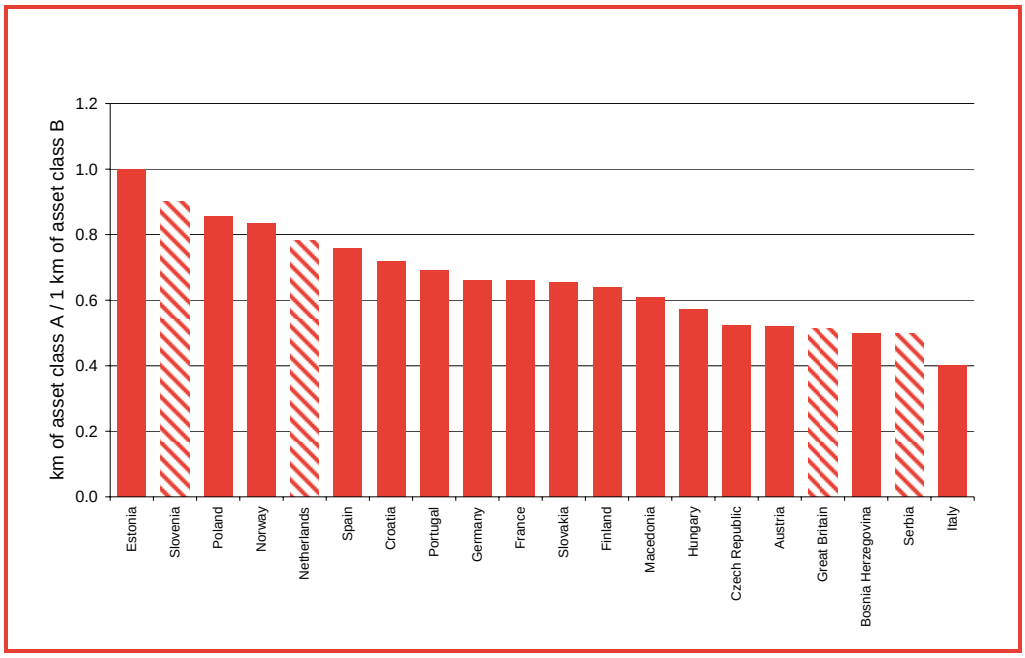

Figure 22: Weighting factors. Asset Class B.

Source: Frontier Economics and Consentec.

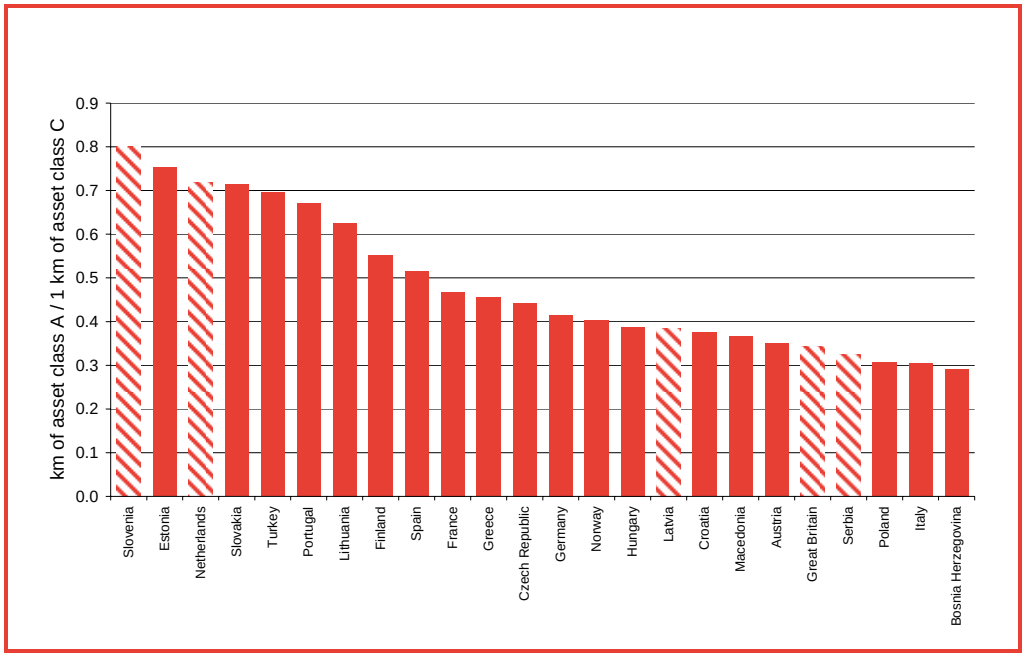

Figure 23: Weighting factors. Asset Class C.

Source: Frontier Economics and Consentec.

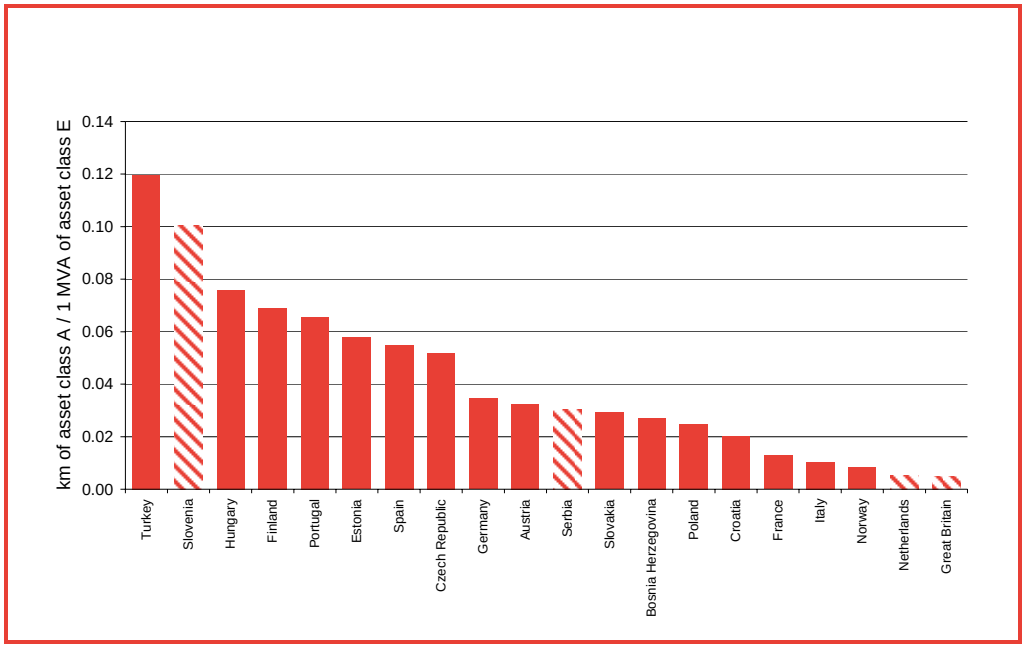

Figure 24: Weighting factors. Asset Class E.[40]

Source: Frontier Economics and Consentec.

[40] In this case the fraction with respect to the cost of asset class A has been calculated as €/MVA of asset class E over €/km of asset class A.

Annexe 3: Analysis of submitted data

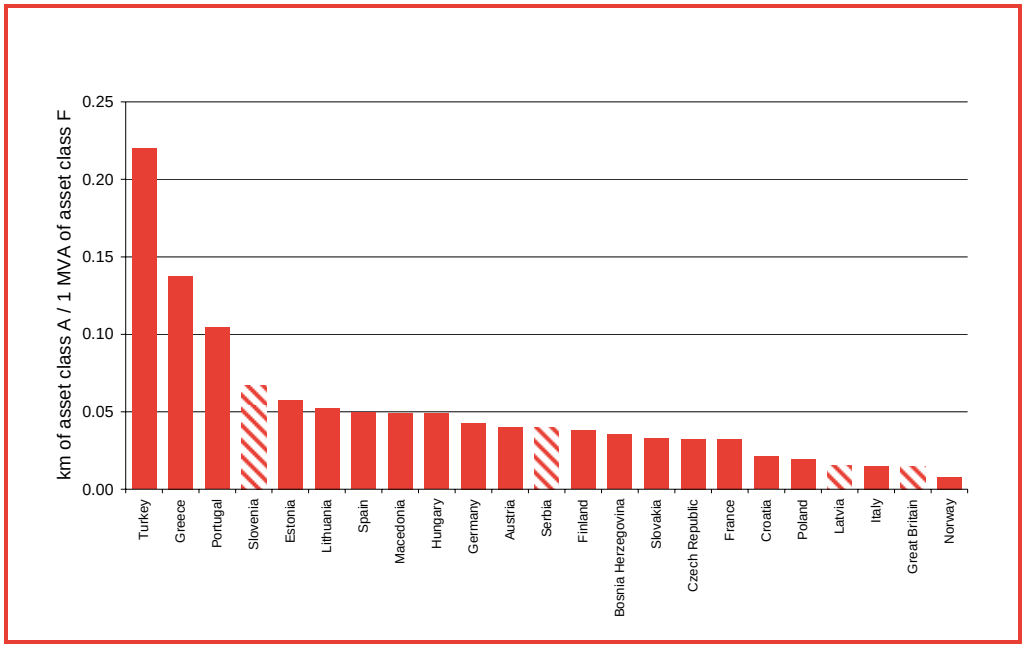

Figure 25: Weighting factors. Asset Class F.[41]

Source: Frontier Economics and Consentec.

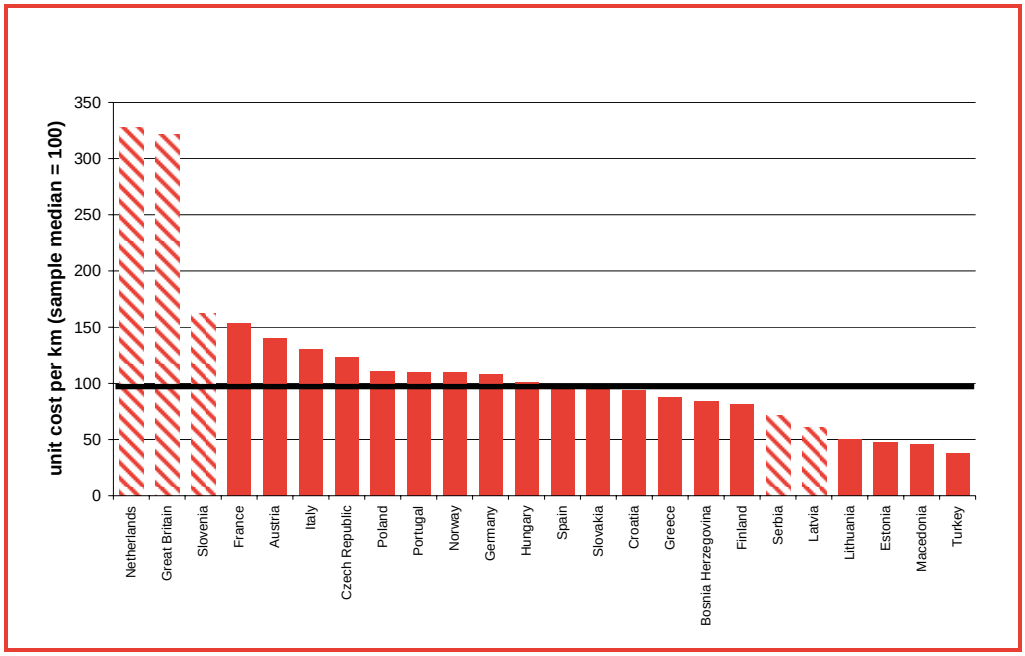

Figure 26: Unit costs from regulated revenue. Asset Class A.

Source: Frontier Economics and Consentec.

41 Idem to footnote 40.

Annexe 3: Analysis of submitted data

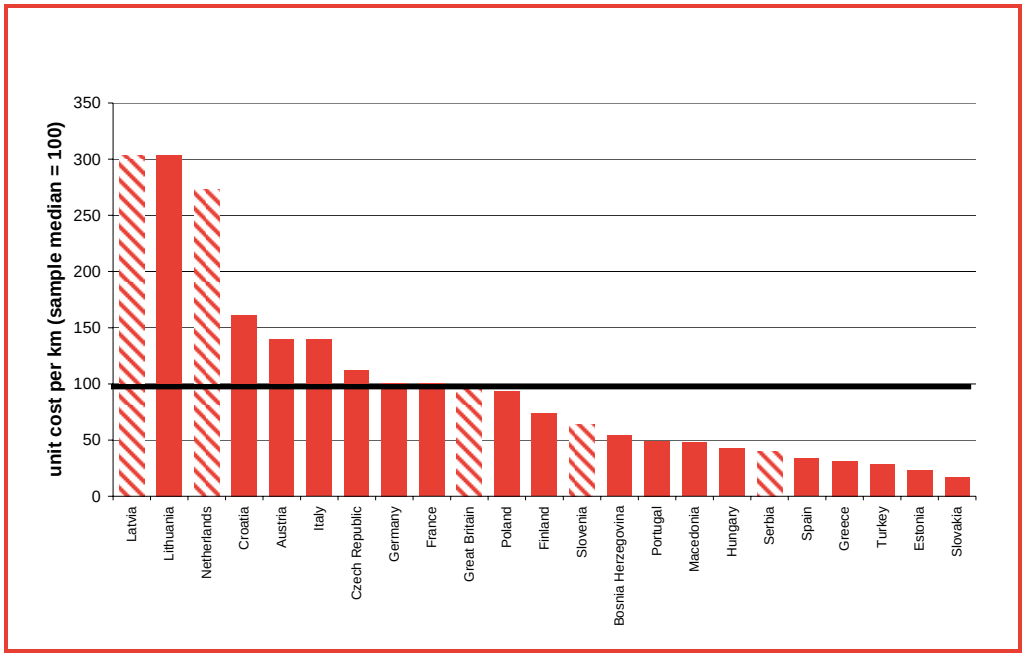

Figure 27: Unit costs from LRAIC. Asset Class A.

Source: Frontier Economics and Consentec.

Annexe 3: Analysis of submitted data

Country	Asset Class					
	A	B	C	D	E	F
Austria	24%	46%	31%	0%	48%	52%
Belgium	11%	4%	86%	0%	14%	86%
Bosnia Herzegovina	16%	25%	60%	0%	40%	60%
Croatia	16%	17%	67%	0%	31%	69%
Czech Republic	63%	35%	2%	0%	14%	86%
Denmark East	17%	0%	77%	7%	0%	100%
Denmark West	23%	1%	63%	13%	0%	100%
Estonia	21%	3%	76%	0%	0%	100%
Finland	28%	17%	54%	1%	10%	90%
France	21%	26%	52%	0%	52%	48%
Germany	37%	27%	36%	0%	32%	68%
Great Britain	52%	27%	21%	0%	38%	62%
Greece	26%	0%	73%	1%	0%	100%
Hungary	61%	35%	5%	0%	26%	74%
Ireland	6%	28%	65%	0%	22%	78%
Italy	23%	26%	49%	2%	23%	77%
Latvia	24%	0%	76%	0%	0%	100%
Lithuania	25%	0%	75%	0%	0%	100%
Macedonia	21%	3%	76%	0%	0%	100%
Montenegro	21%	32%	47%	0%	38%	62%
Netherlands	58%	23%	19%	0%	9%	91%
Norway	20%	54%	25%	2%	45%	55%
Poland	39%	60%	0%	0%	25%	75%
Portugal	23%	43%	34%	0%	20%	80%
Serbia	16%	22%	62%	0%	16%	84%
Slovakia	64%	35%	2%	0%	16%	84%
Slovenia	20%	13%	67%	0%	44%	56%
Spain	51%	49%	0%	0%	100%	0%
Sweden	70%	28%	0%	2%	100%	0%
Switzerland	26%	74%	0%	0%	100%	0%
Turkey	31%	0%	69%	0%	34%	66%

Figure 28: Percentage volume of each asset class (line and transformer assets measured separately).

Source: Frontier Economics and Consentec.

Country	Asset Class					
	A	B	C	D	E	F
Austria	36%	36%	15%	0%	6%	8%
Belgium	N/A	N/A	N/A	N/A	N/A	N/A
Bosnia Herzegovina	32%	25%	35%	0%	2%	5%
Croatia	29%	22%	45%	0%	1%	2%
Czech Republic	66%	20%	1%	0%	3%	11%
Denmark East	26%	0%	58%	5%	0%	10%
Denmark West	37%	1%	50%	11%	0%	0%
Estonia	24%	3%	65%	0%	0%	7%
Finland	36%	14%	38%	4%	1%	6%
France	31%	25%	36%	1%	2%	5%
Germany	52%	25%	5%	0%	5%	14%
Great Britain	54%	15%	8%	0%	4%	19%
Greece	36%	0%	47%	1%	0%	16%
Hungary	60%	20%	2%	0%	6%	12%
Ireland	24%	45%	29%	0%	1%	2%
Italy	42%	19%	28%	4%	1%	5%
Latvia	44%	0%	54%	0%	0%	2%
Lithuania	33%	0%	63%	0%	0%	4%
Macedonia	37%	3%	48%	0%	0%	11%
Montenegro	34%	32%	30%	0%	0%	5%
Netherlands	66%	18%	13%	0%	3%	0%
Norway	24%	55%	12%	7%	1%	1%
Poland	41%	53%	0%	0%	2%	4%
Portugal	23%	31%	23%	0%	3%	20%
Serbia	34%	23%	42%	0%	0%	0%
Slovakia	65%	23%	1%	0%	2%	9%
Slovenia	21%	12%	57%	0%	5%	4%
Spain	53%	39%	0%	0%	9%	0%
Sweden	80%	19%	0%	0%	1%	0%
Switzerland	28%	65%	0%	0%	7%	0%
Turkey	29%	0%	44%	0%	6%	21%

Figure 29: Percentage volume of each asset class in the total.

Source: Frontier Economics and Consentec.

Figure 29 illustrates the percentages of proportionate contribution to network volume of each asset class, previously converting units of each asset class into units of asset class A using the weighting factors. The figure for Belgium is not provided given the insufficient data available for this country in order to compute its weighting factors.

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