European Network of
Transmission System Operators
for Electricity

entsoe

Cost Benefit Analysis for Electricity Balancing – ISP harmonisation methodology

A report for ENTSO-E

Prepared by Frontier Economics and Consentec

20 October 2015

1. Contents

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

2. Introduction

Context and scope of report

The Network Code on Electricity Balancing (NC EB)[1] covers three major aspects of balancing namely:

- Procurement of balancing services;
- Reservation and use of cross zonal capacity for balancing; and
- TSO settlements.

The NC EB requires a cost benefit analysis (CBA) be undertaken in support of various decisions:

- **European Integration Model** (Article 16(3), 18(3), 20(3), 22(3)): CBA to support TSOs' proposal to modify the European integration model (Replacement Reserves (RR), Frequency Restoration Reserves with manual activation (FRR-m), Frequency Restoration Reserves with automatic activation (FRR-a)), and the imbalance netting process); and
- **Application of a TSO-BSP model** (Article 41(2)): CBA to identify the efficiency of the application of a TSO-BSP model for at least the control area or scheduling area for the relevant TSOs.

In addition, the Agency for the Cooperation of Energy Regulators (ACER) proposes that its recommendation on the Imbalance Settlement Period is assessed by a cost benefit analysis to be undertaken by ENTSO-E before the NC EB enters the Comitology process.[2]

ENTSO-E has asked Frontier and Consentec to develop a general methodology for TSOs in relation to the completion of the CBAs envisaged in the NC EB, and a specific methodology for the completion of the CBA for ISP harmonisation:

- **General methodology for performing CBAs** – this task covers the development of a general framework for performing a CBA in the context of the NC EB.
- **Specific methodology for the CBA for ISP harmonisation** – this task covers the development of a specific methodology for performing the CBA for ISP harmonisation. This methodology should be consistent with the design of the general methodology for performing CBAs.

In this report we deal with the second task, with regard to the **methodology for the CBA for ISP harmonisation**. We deal with the first task (the general methodology for performing CBAs) in a separate report.

ISP harmonisation relates to the duration of ISPs (and to the time as to when each ISP starts). Therefore, this report focuses on those aspects of the power market directly affected by ISP duration.

The CBA for ISP harmonisation falls outside the NC EB itself. Therefore, this CBA need not necessarily follow the general methodology for performing CBAs under the NC EB. However, we take the view that it

[1] ENTSO-E Network Code on Electricity Balancing, Version 3.0, 06 August 2014 with proposed amendments set out in the Recommendation of the Agency for the Cooperation of Energy Regulators No 03/2015 of 20 July 2015 on the Network Code on Electricity Balancing.

[2] Recommendation of the Agency for the Cooperation of Energy Regulators No 03/2015 of 20 July 2015 on the Network Code on Electricity Balancing, Annex II, Footnote 2.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

would be good practice for the CBA for ISP harmonisation to follow the general methodology. Therefore, this report only elaborates on the specifics of the CBA for ISP harmonisation that are not defined by the general methodology.

Organisation of this report

This report is organised as follows:

- **Section 3** describes the role of the ISPs so as to provide a common understanding for the framework for thinking about the remainder of the report.
- **Section 4** describes the planning cases to use for the CBA.
- **Section 5** identifies possible costs and benefits arising from ISP harmonisation.
- **Section 6** defines the evaluation approach for the CBA including the criteria for evaluation, the overall evaluation approach and the approach to assessing each cost and benefit identified in Section 5.
- **Section 7** describes the content of the CBA.
- **Section 8** sets out how the final results from the CBA will be reported and interpreted.
- **Section 9** describes the process for undertaking the CBA, including a timeline.

3. Role of ISPs

In this section we describe the role of the Imbalance Settlement Period so as to provide a common understanding for the framework for thinking about the remainder of the report.

The ISP is defined by the NC EB as "the time units for which Balancing Responsible Parties' Imbalance is calculated."

A market entity (or representative) is financially responsible for its energy imbalances over each ISP, where the imbalance is calculated for each ISP and is the difference between:

- The physical volume of energy injected or taken off the system allocated to a market entity (or representative); and
- The volume of energy from commercial transactions or scheduled energy injection or withdrawal of the market entity (or representative), adjusted for balancing transactions with the TSO.[3]

The TSO financially settles imbalances with the responsible market entity (or representative) at the imbalance price for the relevant ISP.[4] The ISP therefore defines the granularity for imbalance prices.

The pricing of the settlement of imbalances differs by country. Typically pricing reflects costs so as not to provide an uneconomic incentive to be out of energy balance over the ISP and in some countries pricing is

[3] The definition of an energy imbalance differs by country. For example, some countries refer to commercial transactions and others refer to scheduled energy.

[4] In practice another central entity may be used to carry out financial settlement of imbalances. However, we use the term TSO for clarity.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

designed to incentivise parties to reach a balanced energy position over the ISP, e.g. where dual imbalance prices are applied. There is no incentive provided by the settlement of imbalances to achieve any particular power profile within an ISP. Therefore the ISP defines the period over which parties seek to manage their energy balance.

The ISP also determines the minimum duration of commodity product which is traded between participants since there is no incentive to trade a shorter duration product. The choice of ISP duration therefore affects the organisation of the traded market, e.g. the day ahead and intra-day markets, in terms of the definition of the finest granularity of traded products.

The ISP may have other roles in some countries, although these are not necessary roles of the ISP. For example, in some countries the finest granularity of information provided to the TSO about physical production and consumption plans is defined as the ISP duration whereas in other countries the granularity of information is independent of ISP duration. The ISP duration in some countries may also affect the definition of reserve products and the timing and approach used by the TSO to procure those products.

4. Choice of planning cases

Use of planning cases

The NC EB requires all TSOs to develop a proposal to harmonise the main features of imbalance settlement,[5] subject to approval by all NRAs.[6] However, the Imbalance Settlement Period duration falls outside this proposal and will be drafted into the final version of the NC EB. ACER has reviewed the draft NC EB and has proposed that the Imbalance Settlement Period duration be harmonised at 15 minutes. ACER also proposes that its recommendation on the Imbalance Settlement Period is assessed by a cost benefit analysis to be undertaken by ENTSO-E before the NC EB enters the Comitology process. The Framework Guidelines for Electricity Balancing (FG EB)[7] contemplate ENTSO-E undertaking the CBA.

If the ISP duration is not harmonised some of the other harmonisation objectives of the NC EB would be difficult or perhaps impossible to achieve, e.g. harmonisation of the Balancing Energy Gate Closure Time and the timing of when the TSOs begin to accept bids and offers from the Common Merit Order in the Co-ordinated Balancing Area, and harmonisation of imbalance settlement pricing. If the other harmonisation objectives had net benefits one would assume that they would be implemented and therefore these net benefits should be taken into account in the ISP harmonisation CBA. However, if the other harmonisation objectives had negative net benefits, one would assume that they would not be implemented and the related negative net benefits should not be taken into account in the ISP harmonisation CBA.

We discuss further below the precise geographic scope of the CBA. Here it is sufficient to understand that the CBA is performed for 'Europe', i.e. for many countries. The potential for the choice of ISP in one country to have cross border affects means that it would not make sense for an independent CBA to be done for each country. Instead a collective CBA on ISP harmonisation should be done.

5 Recommendation of the Agency for the Cooperation of Energy Regulators No 03/2015 of 20 July 2015 on the Network Code on Electricity Balancing, Annex II, Article 24.

6 Ibid. Article 6(6).

7 FG-2012-E-009, 18 September 2012, Page 25.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

The costs and benefits of ISP harmonisation will vary from one country to another because, for example, the current ISP duration differs by country, and some countries already have the same ISP duration as their neighbours while others have a different ISP duration to their neighbours. This means it is quite possible that the results of the CBA (in terms of optimal ISP duration) differ by country. Therefore, the optimal outcome may be to have different ISP durations in different countries. Although ACER's proposal is to harmonise ISP duration at 15 minutes, the CBA is intended to assess this proposal to understand whether it is the best choice of ISP duration or whether alternative proposals would be better. For this reason we suggest considering multiple factual scenarios, not just a single scenario of moving to 15 minute ISPs throughout Europe.

The three key points (the CBA must be done for multiple countries, the CBA should be done collectively for the countries and the optimal CBA may differ from one country to another) suggest that, in theory, all reasonable combinations of ISP duration should be tested for all countries in order to identify the optimal set of ISPs for all countries (possibly as constrained by the requirements of the FG EB that no ISP is greater than 30 minutes unless supported by a cost benefit analysis of the relevant TSO). However, it is impractical to test all combinations of ISP duration as part of the CBA.

Therefore, it is necessary to define a limited number of "planning cases", consisting of a combination of ISPs in different countries, to test using the CBA. The planning cases form the factual for the CBA, with the counterfactual being the business as usual combination of ISPs. Since there are multiple planning cases, there will be multiple factuals tested and ranked by the CBA in order to choose the preferred case. By business as usual we mean the ISPs that would prevail in the absence of ISP harmonisation.

As each country or, to be more correct, balancing zone[8] can define only one ISP, the planning cases are mutually exclusive. This means that the CBA needs to provide a ranking of the planning cases (and a comparison to the counterfactual). This is an important difference to other CBAs that ENTSO-E is required to undertake which are required to compare a single factual to the counterfactual, e.g. when assessing Projects of Common Interest (PCI).

As noted above, the CBA for ISP harmonisation sits outside the NC EB and is currently intended to inform the drafting of the NC EB, i.e. prior to the NC EB entering the comitology process. The design of the factual and counterfactual may need to change if the proposed requirements for ISP harmonisation in the NC EB changed.

Defining planning cases

Choice of ISP duration

A planning case consists of the set of the new ISP duration for each country within the scope of the CBA. As described above, the CBA will be used to compare a limited number of planning cases to one another and to the counterfactual.

The planning cases should be designed such that the best planning case resulting from the CBA is also the optimal combination of ISP durations. To decide upon the design of the planning cases we start with the status quo, consider the counterfactual and then choose the planning cases (factual) to test different hypotheses about possible drivers of costs and benefits.

8 In the remainder of the report we refer to the ISP for a country. However, we recognise that a balancing zone need not be defined by a country's borders, for example, the Single Electricity Market (SEM) covers Ireland and part of the UK, i.e. Northern Ireland.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

The planning cases should also be defined consistently with any requirements. The CBA is intended to be used to help decide on the ISP duration that is written in the NC EB and therefore the NC EB does not constrain the choice of ISP duration. ACER has proposed that the ISP duration be harmonised at 15 minutes. This does not constrain the choice of ISP duration for the factual cases since we need to define alternative cases to test whether ACER's proposal is the optimal choice of ISP duration. The FG EB requires that ISP duration shall not exceed 30 minutes. Therefore, all of the planning cases we describe below have an ISP duration of 30 minutes or less. In addition, we assume that ISP duration for any country should be no longer than the country's current ISP duration.[9]

Status quo ISP durations

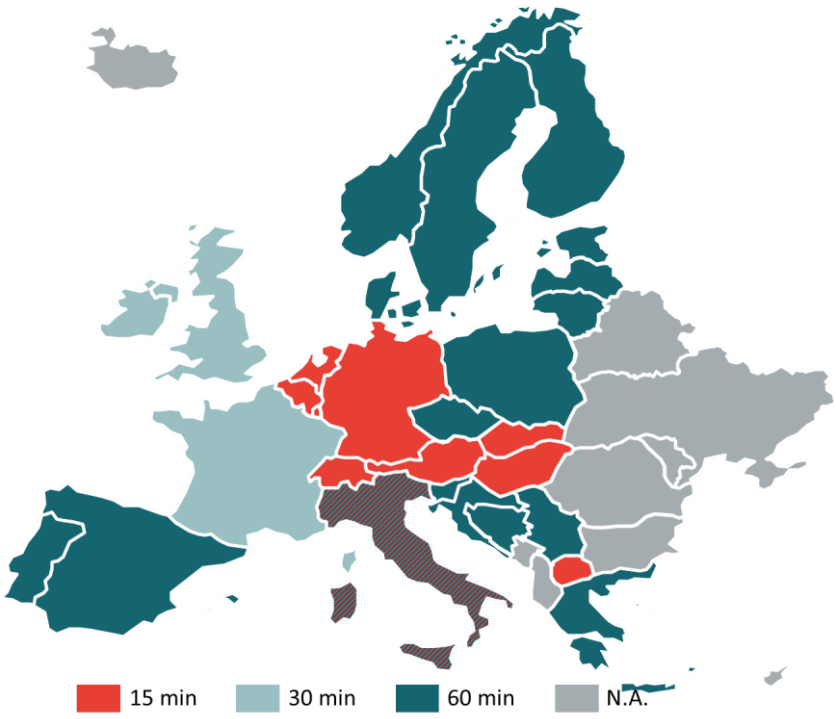
The set of ISP durations as of 2014 for all countries is depicted in **Figure 1**.[10]

[9] Since several countries currently have an ISP of 15 minutes, this precludes a factual case whereby all countries are harmonised to an ISP duration of 30 minutes or more.

[10] The NC EB would not apply to the transmission networks of Bosnia, Serbia, Kosovo and FYROM, which are included in the map. However, these countries are likely to be affected by the choice of ISP duration for their neighbours. While we suggest the scope of the CBA be limited to the EU 28 plus Liechtenstein, Norway and Switzerland, there could be an argument for extending it further to include non-EU countries in the Balkan region or elsewhere. See further below for a discussion of the geographic scope.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

Figure 1. ISP duration – 2014



Source: ENTSO-E WGAS, Survey on Ancillary services procurement, Balancing market design 2014, Jan 2015. Also TSO websites.
Note: Italy has a 60 minute ISP with the exception of Balancing Service Providers (BSPs) that are required by regulation to have a 15min ISP.

Choice of counterfactual

The choice of the counterfactual is important since the costs and benefits of ISP harmonisation are identified as the change in costs and benefits between the counterfactual and the factual. This means that any costs and benefits that have already been derived in implementing and applying the counterfactual are ignored for the purposes of this CBA. These are *sunk* costs and benefits.

The FG EB requires that ISP duration shall not exceed 30 minutes. This requirement could be interpreted as applying irrespective of the CBA, in which case it would apply to both the counterfactual and factual. However, one would expect the CBA to test the costs and benefits of any significant change imposed by the NC EB (or FG EB). Therefore, we suggest including the costs and benefits of imposing the requirement for ISPs to be no longer than 30 minutes in the CBA, i.e. assume that this requirement does *not* form part of the counterfactual.

In deciding upon the counterfactual for the CBA, it needs to be considered whether the current status of ISP duration will continue to exist absent the proposed harmonization or whether, irrespective of harmonization under the NC EB, ISPs would change at some point in time. For example, in line with the roll-out of smart meters some countries may already have plans to change their ISP duration. Given the difficulty in predicting future changes, we suggest that the current status of ISP duration be used as the counterfactual for the CBA and that future changes to ISP duration be taken into account only where the decision to change ISP duration in a country has been taken at the time the CBA is carried out.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

Choice of factual (planning cases)

To apply the CBA the factual or planning cases need to be unambiguously defined. In selecting a limited number of planning cases, the objective should be to choose cases that are likely to include the optimal planning case. Without doing a full CBA this is impossible to know with certainty. However, we can select planning cases that are likely to be optimal if certain hypotheses about the drivers of costs and benefits were true. Therefore, in what follows we consider different possible drivers of costs and benefits and select a planning case accordingly. It is not possible to consider only those costs and benefits of *harmonisation* itself and to ignore the costs and benefits related to a change to ISP *duration* itself. Any change to ISP duration as a result of the NC EB affects both harmonisation and duration. Therefore, the costs and benefits due to harmonisation and duration are attributable to a change caused by the NC EB and both should be taken into account in the CBA.

We expect that a key cost driver under the CBA is a *change* to the ISP duration in a country. It is possible that a key driver of the benefits under the CBA is the *duration* of the ISP. However, it is also possible that a driver of benefits under the CBA is the *harmonisation* of ISP duration between countries. These theories about possible drivers of costs and benefits suggest at least three planning case designs that could potentially be the optimal planning case:

- Minimise costs by minimising change with the possibility of missing out on some benefits related to minimising ISP duration or maximising harmonisation;
- Maximise net benefits by significant ISP harmonisation with minimal change, with the possibility of missing out on some benefits related to minimising ISP duration; and
- Maximise benefits through full harmonisation by shortening ISP duration, with the possibility of incurring high costs.

In selecting planning cases, we also aim to choose the ISP duration such that any country's ISP duration is an integer multiple of the duration of any country with a shorter ISP duration. This would facilitate coordination of cross border trade. Given that the current shortest duration ISP is 15 minutes, and the FG EB requires that no ISP be longer than 30 minutes, we explore planning cases with 15 and 30 minute duration ISPs. To understand whether there are additional benefits of an even shorter ISP duration, we also explore a planning case that could maximise benefits through full harmonisation by shortening ISP duration to below 15 minutes.

It is possible for a country to use a different ISP for types different market participants, as is the case today for Italy. However, in defining the planning cases we assume that the same ISP is applied in a country to all BRPs.

Therefore, in total we define four planning cases. We discuss each possible planning case in more detail below. We note that the names of the planning cases are labels that are intended to help stakeholders understand how the planning cases have been derived. These labels do not imply any pre-determined conclusion as to the outcome of the CBA.

Minimise costs by minimising change

As noted above, it is possible that a key cost driver will be the change to the ISP in a country. If the ISP is changed, software and metering devices would most likely need to be modified in many countries, some of which could be done remotely and some of which may require a site visit. This planning case is selected to try to minimize those costs by changing ISP duration for as few countries as possible, and thereby test whether net benefits in the CBA are maximised by trying to minimise costs.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

To be clear, the CBA will be performed using the same approach for all planning cases, i.e. the CBA will assess benefits and costs of moving from the counterfactual to the planning case. In additional, as noted above, the CBA is applied to all countries.

The FG EB defines a maximum ISP of 30 minutes, which means that ISP changes in countries which currently use 60 minutes ISP are unavoidable. This planning case therefore assumes that all countries currently with an ISP of 30 minutes or shorter retain their ISP duration. Countries currently with an ISP of more than 30 minutes could either reduce their ISP duration to 15 minutes or reduce their ISP duration to 30 minutes.

Before the CBA is applied the planning case must be unambiguously defined because we suggest that a plethora of additional planning is not defined in order to test different possible combinations in order to keep the effort required to undertake the CBA manageable. This means TSOs collectively or ENTSO-E need to decide as the first stage of the CBA itself whether a country currently with an ISP duration of greater than 30 minutes moves to a 15 or 30 minute ISP for this planning case. Issues to be considered in taking the decision are as follows:

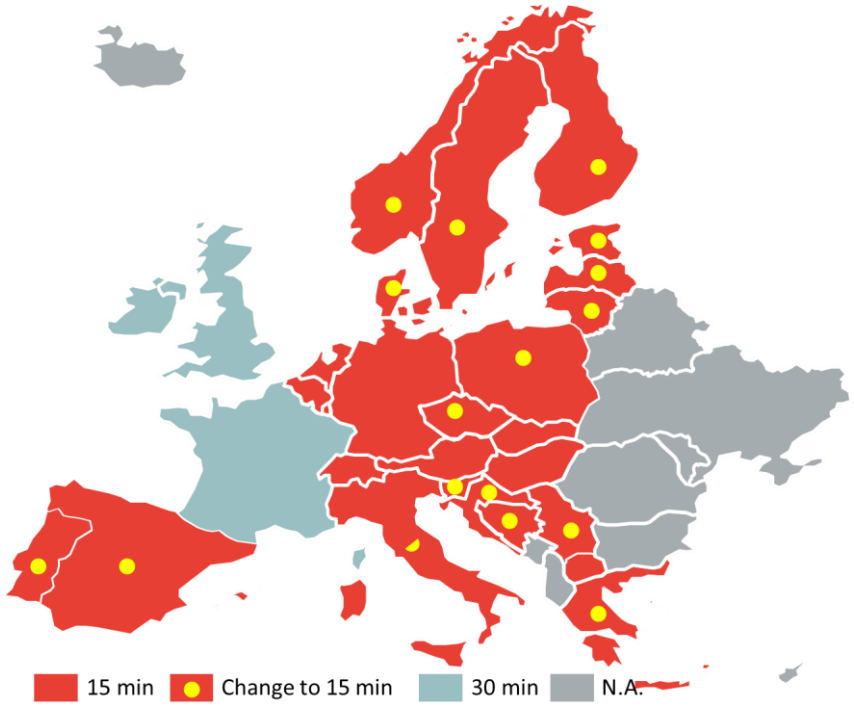
- Whether a single rule is applied to all countries or the rule can vary by country;
- Whether a 15 minute or 30 minute ISP duration likely to be the optimal solution in terms of benefits and costs;
- Whether a country's neighbour(s) has a 15 minute or 30 minute ISP duration (in order to maximise harmonisation);
- Whether a country's neighbour(s) that currently has a 60 minute ISP duration is assumed to move to a 15 minute or 30 minute ISP duration; and
- The planning case should distinct from the other planning cases so as to provide more information about the optimal set of ISP durations from the CBA.

In considering the second of the issues listed above note that this planning case is intended to test whether the main cost driver is the *change* to ISP duration, as opposed to the ISP duration *per se*. If it is assumed that the benefits from a shorter ISP exceed the benefits from a longer ISP and that these benefits are likely to exceed the costs of the incremental change to a 15 minute ISP, this suggests moving all countries currently with a 60 minute ISP to 15 minutes for this planning case. If this assumption were correct, this planning case would dominate (i.e. have greater net benefits) than a planning case whereby all countries with an ISP of more than 30 minutes reduced the ISP duration to 30 minutes.

Figure 2 shows a map of the ISP durations resulting from the planning case assuming that all countries with a 60 minute ISP move to a 15 minute ISP (noting that the TSOs and ENTSO-E may design the planning case such that some or all countries with a 60 minute ISP move to a 30 minute ISP). The figure also highlights the countries where a change to the counterfactual is required.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

Figure 2. ISP duration – planning case minimise costs



Note: Italy has a 60 minute ISP with the exception of BSPs that are required by regulation to have a 15min ISP. Therefore, Italy would need to change the ISP for non-BSPs to 15 minutes under this case.

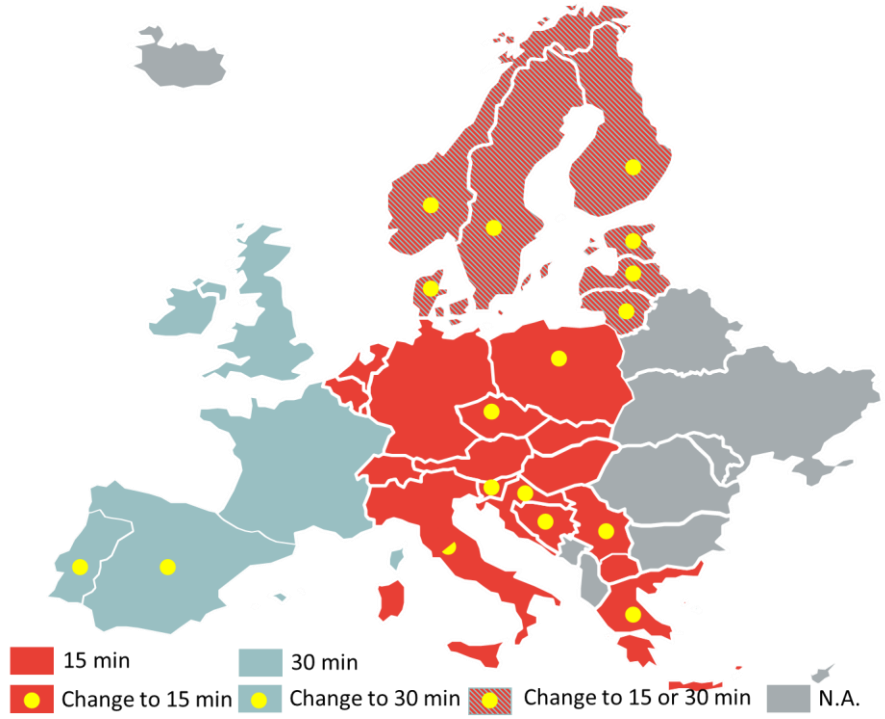
Maximize benefits by harmonising ISP duration

It is possible that the key driver of benefits is the *harmonisation* of ISP duration. This planning case is defined to maximize the harmonisation between neighbouring countries while minimising costs by minimising the change required. Again, all countries that currently have a 60 minutes ISP would need to change ISP duration. In this case, they change to have the same ISP duration as the ISP duration of their largest neighbour, i.e. they do not necessarily all change to a 15 minute ISP or a 30 minute as with the previous planning case.

Figure 3 shows a map of a set of possible resultant ISP durations and highlights the countries where a change to the ISP duration is required.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

Figure 3. ISP duration – planning case maximize benefits by harmonising ISP



Note: Italy has a 60 minute ISP with the exception of BSPs that are required by regulation to have a 15min ISP. Therefore, Italy would need to change the ISP for non-BSPs to 15 minutes under this case.

In this planning case Spain and Portugal would align their ISPs with France, resulting in one harmonised south-western region with 30 minute ISPs. As an alternative, France could select a 15 minute ISP duration to align with its neighbours to the East, to which it has relatively strong connections, and not to align to its neighbours to the West and North to which it has relatively weak connections.

All countries in central Europe move to an ISP of 15 minutes, as is already the case in Germany and other countries in the region. The Nordic and Baltic countries shorten their ISP, but can choose between a 15 minute or 30 minute ISP. For these countries there is no clear neighbouring country with which to harmonise and they have a relatively weak connection to the rest of Europe.

This planning case also needs to be unambiguously defined by the relevant TSOs or ENTSO-E as the first step of the CBA. The issues to consider are similar to those listed for the previous planning case with the exception that the intention of this planning case is to test the optimality of limiting costs incurred in ISP harmonisation.

Maximise benefits through full harmonisation by shortening ISP duration

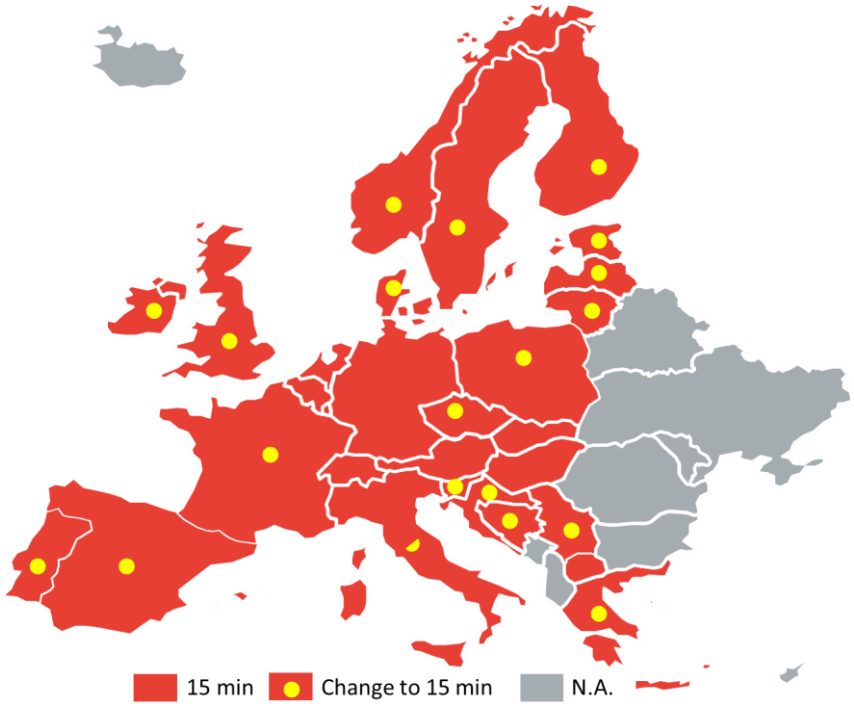
It is possible that the benefits of changing ISP duration arise both from *reducing* duration and from *harmonising* duration. This planning case attempts to maximise benefits by all countries moving to the shortest existing ISP duration, which is 15 minutes in every country. The CBA will test with this planning case whether the benefits of the short duration ISP outweigh the costs of changing ISP.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

By not reducing duration below the current shortest duration ISP, the number of countries that need to change ISP duration is reduced, possibly increasing net benefits by reducing costs relative to moving to an even shorter ISP duration.

Figure 4 shows a map of the resultant ISP duration and highlights the countries where a change to ISP duration is required.

Figure 4. ISP duration – planning case maximize benefits by shortening ISP



Note: Italy has a 60 minute ISP with the exception of BSPs that are required by regulation to have a 15min ISP. Therefore, Italy would need to change the ISP for non-BSPs to 15 minutes under this case.

Maximise benefits through full harmonisation by shortening ISP duration to below current minimum

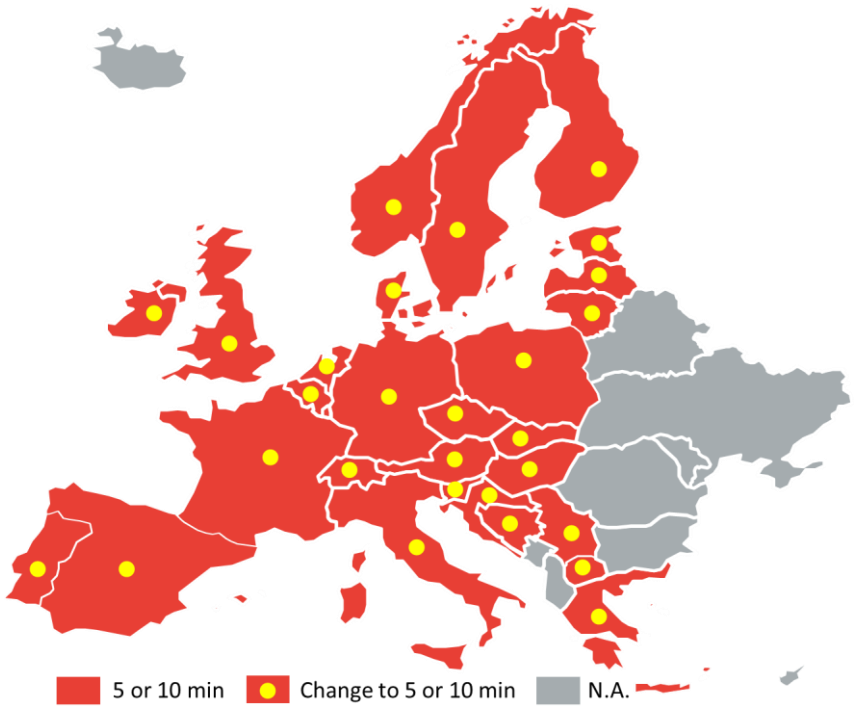
As with the previous planning case, this case attempts to maximise net benefits by *reducing* ISP duration and maximising *harmonisation* for all countries. However, instead of moving all countries to the shortest current ISP duration, all countries are moved to a 5 minute ISP duration, as shown by **Figure 5**. The CBA will test with this planning case whether the benefits of an even shorter duration ISP outweigh the costs of reducing ISP duration.

A possible advantage with a 5 minute duration ISP over, say, a 10 minute duration ISP is that current systems are based around periods that are an integer multiple of 5 minutes, e.g. traded contract durations.

However, it is possible that a 5 minute duration ISP is not optimal if some countries found it difficult to change their equipment to this duration. Therefore, if moving all countries to a 5 minute ISP had positive net benefits (or small negative net benefits), it may also be worth exploring whether it is even more beneficial to move all countries to a 10 minute duration ISP.

Therefore, this planning case would be all countries move to a 5 minute ISP and if this has positive net benefits then re-apply the CBA to all countries moving to a 10 minute ISP.

Figure 5. ISP duration – planning case maximize benefits by shortening ISP



Summary of planning cases

In summary, the CBA would compare four planning cases and the counterfactual:

- Counterfactual (status quo);
- Planning case 1 (minimise costs by minimising change);
- Planning case 2 (maximize benefits by harmonising ISP duration);
- Planning case 3 (maximise benefits through full harmonisation by shortening ISP duration); and
- Planning case 4 (maximise benefits through full harmonisation by shortening ISP duration to below current minimum).

As noted above, planning cases 1 and 2 would need to be unambiguously specified by the TSOs or ENTSO-E as the first step of the CBA itself.

Implementation date

The date at which changes to ISP duration are implemented also needs to be defined for each planning case since this could affect the net benefits of the case, in particular if the implementation date varied by planning case. In addition, all countries may implement the change under a planning case simultaneously or the timing for the change may differ by country. Where the timing for the change differed by country,

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

additional costs could arise or benefits could be reduced if the transitional period reduced harmonisation and created confusion.

In practical terms it would add significant complexity to the CBA to consider the effect of different timings for the introduction of the change to the ISP duration. Therefore, we suggest that for the purposes of the CBA all countries are assumed to implement the planning case at the same time, and that a single implementation date be assumed for all planning cases.

The choice of implementation date assumed for the CBA should take account of the period of time required to undertake the CBA, take a decision as to ISP duration and implement a change to ISP duration. ACER's proposed changes to the draft NC EB, require that implementation of the change be made by 1 July 2019.

5. Possible costs and benefits

In this section we identify possible costs and benefits of ISP harmonisation that need to be considered as part of the CBA and, if possible, monetised.

The extent of costs and benefits due to a change to ISP duration will be affected by the specific implementation approach taken for a country. We suggest that for each planning case two different implementation approaches be used to estimate the cost and benefits of change:

– **Minimum change.** Here only those systems and processes that must be changed as a result of a change to ISP duration are modified or replaced. Other systems and processes would be left unchanged as a result of a change to ISP duration. For example, some classes of market participant would need to change their systems to provide data consistent with the shorter ISP but other classes of participant would not. Central processes would need to be defined to translate data defined over longer timescales into data that match the ISP. While minimising the costs of change to stakeholders, this approach may add complexity to central systems and processes that must deal with data in different timeframes.

– **Maximum change.** Here all systems and processes that used the current ISP duration would be changed to use the new ISP duration. While increasing costs of change to stakeholders, this approach would reduce complexity for central systems and processes.

We begin this section by providing context in the form of a brief overview of the CBA process.

Context – overview of CBA process

As discussed in the report on the general CBA methodology, a CBA compares costs and benefits for a defined geographic region for two cases:

– A *factual*, which is the world with the design option being assessed (in this case a change to the ISP duration); and

– A *counterfactual*, which is the business as usual world without the design option being assessed.

As discussed above, costs and benefits that have already been derived in implementing and applying the *counterfactual* are ignored for the purposes of the CBA since these are *sunk* costs and benefits.

The relevant costs and benefits to consider as part of the CBA are those that are directly or indirectly affected by the change imposed. As noted above, if the ISP duration is not harmonised some of the other

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

harmonisation objectives of the NC EB would be difficult or perhaps impossible to achieve. These related costs and benefits should be factored in to the ISP harmonisation CBA if clearly attributable to the decision on ISP harmonisation.

One might argue that if the other harmonisation objectives had net benefits they would be implemented and therefore these net benefits should be taken into account in the ISP harmonisation CBA. However, if the other harmonisation objectives had negative net benefits, they would not be implemented and the related negative net benefits should not be taken into account in the ISP harmonisation CBA. Only if there is a clear link between the decision making for the other harmonisation objectives and ISP harmonisation should these related costs and benefits be considered as part of the ISP harmonisation CBA. However, this would imply jointly undertaking multiple CBAs required under the NC EB, which may be impractical.

As noted above, it is not possible to consider only those costs and benefits of *harmonisation* itself and to ignore the costs and benefits related to a change to ISP *duration* itself. Therefore, the costs and benefits due both to harmonisation and duration should be taken into account in the CBA on ISP harmonisation.

As also discussed in the report on the general CBA methodology, the overall European social welfare is the relevant objective of the NC EB. Nevertheless, the CBAs under the NC EB shall report on regional and country effects for information purposes but should not take account of these effects in the overall CBA assessment.

In the report on the general CBA methodology we also discuss three different approaches to the overall evaluation to use for the CBA:

- **Standard CBA** – In a standard CBA only those costs and benefits that can be monetized are included.

- **Augmented CBA** – The augmented CBA considers those costs and benefits that can be monetized and augments this result with an assessment of costs and benefits that cannot be monetized. The latter are considered by the decision maker without a formal process. However, an understanding of the broad scale of the non-monetised elements is needed.

- **Multi Criteria Analysis** – The MCA considers those costs and benefits that can be monetized and those that cannot be monetised. The MCA recognises that there may be multiple objectives, devises a set of assessment criteria to reflect those objectives, and establishes a set of weights and a scoring system that allows formal account to be taken of the full set of costs and benefits (monetised and non-monetised). Although a more formal process than the augmented CBA, the MCA requires potentially subjective decisions about weights and scores.

The general CBA methodology concluded that as a general principle as many of the costs and benefits should be monetised as is possible. Having done this the most appropriate CBA approach then depends on an assessment of the relative importance of monetised and non-monetised benefits and costs. The process to be applied to determine whether to apply a pure CBA, augmented CBA or MCA for the CBA for ISP harmonisation is as follows:

- Firstly, identify possible costs and benefits;
- Secondly, identify and group objectives into similar categories;
- Thirdly, map possible costs and benefits onto those categories of objectives; and
- Fourthly, consider the ability to monetise those objectives that are measurable.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

Having decided upon the overall approach to the CBA, the way in which each objective will be modelled (to estimate a monetary value) or otherwise assessed and scored must be decided. Scenarios and data sources must be chosen and a process for collecting data defined. Weights and a scoring approach must be chosen in the case of a MCA. Then the analysis must be undertaken, reviewed and a decision taken. Stakeholder consultation would be made at different points in the process.

Possible costs of ISP harmonisation

Here we scope out possible costs of ISP harmonisation that will need to be estimated for moving from the counterfactual to each of the planning cases. We develop a list of possible costs in order then to develop a methodology to estimate them. Some of the costs may turn out to be negligible or non-existent when information is gathered from stakeholders and the analysis under the CBA is undertaken. Additional costs may also be identified as part of the CBA.

Costs due to a change in ISP duration can be categorised as cash costs (i.e. one-off costs of a change to the ISP duration and ongoing additional costs of IT, data management etc.) and non-cash costs (both one-off and ongoing).

One off cash costs of changing ISP duration

The one-off cash costs of a change to ISP duration (i.e. a reduction in duration) may include the following:

– **Scheduling and settlement systems.** TSOs, PXs, BSPs and BRPs and other stakeholders would need to adapt their scheduling and settlement systems to the new ISP duration. We assume these systems include systems for notifying contract positions to the central settlement agencies, which is why we have included PXs some of whom notify contract positions on behalf of BRPs. We expect that this cost largely relates to developing new IT systems or modifying existing systems.

  The incremental cost of implementing a change to ISP duration would likely depend on the lifetime of IT systems, including software, and the transitional period allowed to implement a change to the ISP duration.

  This cost is likely to relate mainly to the need for a change *per se* rather than to the duration of the ISP period. Therefore the cost for Europe as a whole is likely to be lower for those planning cases for which fewer countries are required to change ISP duration. It is possible that the systems costs for increasing ISP duration are different from the systems costs of reducing ISP duration – this asymmetry means that the cost of harmonisation *per se* may differ from the costs of ISP duration *per se*.

  This cost is likely to be very significant for both central systems and non-central systems of stakeholders. Even stakeholders that operate across multiple countries and that have systems in place that can cope with a range of ISP duration would need to modify their systems. To the extent that harmonisation led to simpler systems (e.g. in the case of a stakeholder operating in multiple countries) there may be an ongoing cost saving.

  There could be two effects on costs of the maximum and minimum implementation cases. Firstly, the different implementation cases may affect the number of stakeholders required to change systems as a result of the change to ISP duration. Secondly, the settlement systems will be more complex for the minimum implementation case since profiles will be required to allocate volumes to the new ISP where profiles may not have been used for these stakeholders previously.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

– **Trading platforms.** A reduction in ISP duration will mean that trading platforms, at least those used for trading in intra-day timescales and perhaps also those used in day-ahead timescales, will need to be adapted to allow trade of shorter duration products.

  The complexity of market clearing processes and the time required to run them by PXs may change with a different ISP duration. In turn this could require changes to the organisation as to when PXs are cleared and market coupling solutions published and it could potentially affect the efficiency of market clearing solutions if the optimisation process took too long.

– **Metering systems and allocation systems.** The change in ISP duration will require a software update or a physical exchange of some existing meters. Those meters for which consumption profiles are used to allocate metered consumption to individual ISPs for settlement purposes, e.g. as is used by many households and small businesses, would not need to be replaced or updated in either the minimum or maximum change case. However, the settlement system would need modification with respect to those meters since the load profiles would need to allocate consumption to the new ISP. In the minimum implementation case, only those meters that must be changed as a result of a change to ISP duration would be updated or replaced. The settlement system would need modification with respect to those meters that provide information that matches the current ISP duration but that do not need to change to the new ISP since load profiles would need to be introduced, e.g. to allocate consumption over each one hour period to each of four 15 minute periods (in the case that the ISP duration fell from one hour to 15 minutes). In the maximum implementation case, all systems and processes that used the current ISP duration would be changed to use the new ISP duration. The cost of modifying metering systems, where applicable, would relate to the following:

  – When switching to another metering period, if devices that can be updated are reset and the metering history forgotten, historic data would need to be read out and saved before the change.

  – The metering period could in most cases be switched by remote control, avoiding the cost of a site visit. However, in some (not all) countries there are legal barriers to doing so. For example, in Germany (although note that Germany has a 15 minute ISP) such a change must be done under supervision of the authorities such as the office of weights and measures. This requires the meters to be physically removed from the site, taken to the authorities where the metering period is changed and the meter then reinstalled at the site.

  – Those meters that cannot be updated will need to be physically replaced.

  – Adapting systems for collecting and storing metering data.

  – Consumption profiles may have to be updated.

  The relevant cost of changes to metering systems depends on current practices around regular meter calibration, replacement and the updating of consumption profiles. For example, where meters must be recalibrated every few years and recalibration is all that is required to adapt the meter to a change in the ISP duration, a change to the ISP duration would have no additional costs if an implementation period equal to or longer than the recalibration period were allowed.

  We expect that an approach to reducing costs could be to allow most customers (under both the maximum and minimum change case) to choose whether to have their meters upgraded when the ISP changes. The choice could be between updating the meter to the new ISP duration or for the meter to read consumption data over two ISPs (e.g. to read over 30 minutes instead of over the 15 minute ISP) and for a standard load pattern to be applied to the two ISP information to determine deemed metered data over each of the individual new ISPs.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

There may be additional costs for the transitional arrangements, especially for settlement systems. However, the longer ISPs are always a multiple of the shorter ISPs, which should allow the use of meters with shorter and longer timescales until the moment all meters are compatible with the shorter ISP duration.

The relevant costs might also be affected by the (planned) roll-out of smart meters. Similar to regular replacements and recalibration, when smart meters are to be rolled out regardless of the change to ISP, the CBA would not attribute these roll-out costs to ISP harmonisation.

The planning cases should therefore consider what would be:

- An acceptable time horizon for implementation; and
- The most economic scenario for roll-out (which may differ by country) given the time horizon and any expected smart meter roll-out.

Metering costs could relate both to the need for a change *per se* and to the duration of the ISP period, if the latter affected whether a meter needed to be physical changed or adapted as opposed to remotely adjusted. The cost is likely to be lower for those planning cases for which fewer countries change ISP duration and may be higher for those planning cases with shorter ISP durations.

- **Billing systems.** Retail suppliers that bill customers according to wholesale price outcomes at the level of the ISP (e.g. for large customers) may need to modify their billing systems (the costs of retail supplier settlement and allocation systems are addressed in the previous point).
- **Documentation changes.** Centralised codes and agreements affected by a change to ISP duration will need to be updated, including for example European-wide agreements, e.g. TSO-TSO agreements and operational handbooks. Country specific documentation changes may be required for balancing codes, network codes, ancillary services codes and agreements, documented procedures underlying codes (e.g. for profiling), transportation charging agreements etc. Bilateral agreements will also need to be updated, e.g. standard contracts for the sale and purchase of power and contracts for the sale and purchase of options over flexible power plants.
- **Costs for forecasting and shifting energy balancing responsibility.** A reduction in ISP duration may give BRPs additional incentives and better tools for managing their scheduling such that at gate closure their imbalances are smaller than with a longer ISP. If this is the case, the *effect* would be that additional balancing effort is made by BRPs leaving the TSO with a smaller imbalance to manage. Balancing by the TSO and by BRPs have different costs:
  - A more centralized forecast by the TSO has advantages in that the forecast is undertaken by a single party and the forecast is for the net position of the system. In some countries TSOs have their own demand and intermittent generation forecasting tools and are able to take balancing related actions pre-gate closure.[11] However, this cost may not necessarily change with a change to ISP duration.
  - A decentralised forecast is undertaken by many different parties (incurring greater costs than if undertaken by a single party), each of whom is forecasting a sub-set of the overall system. The

[11] As an example, in some countries a TSO may forecast that the system will have an energy imbalance and trade before gate closure to bring the system towards an expected balance. As a second example, in some countries a TSO will forecast a particularly large change in consumption and arrange for generation to be running in a particular state so as to be able to provide the necessary flexibility to manage the change.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

individual market entities will have better insights than the TSO about their own load and generation patterns, in particular for the lower or medium voltage grid. It is possible that a shift of balancing effort from the TSO to market entities increases the cost and effort expended by market entities in forecasting systems as the time period for energy balance responsibility might change (i.e. increase for market entities).

- There may also be different costs in achieving efficient forecasting/scheduling/balancing outcomes through (i) competition between market participants or (ii) by centralised decision making by regulated TSOs or tightly controlled rules based systems.

– **Costs of trading and data handling.** A reduction in ISP duration may result in increased trading by stakeholders as they use the intra-day market to manage their imbalance position. In addition stakeholders will need to handle more data associated with a shorter ISP duration. Stakeholders will therefore need to develop new trading and data processing systems.

  Where stakeholders operate across multiple countries they may already have systems in place to handle data on the timescales of shorter duration ISPs, potentially reducing the cost of a shorter ISP duration. This point applies to many of the cash-costs listed in this section.

It is possible that the one-off cash costs are affected by the choice of ISP duration. This could relate to the number (and size) of countries affected by the change, the new ISP duration (it's possible that it is more expensive to move to a shorter ISP duration than a longer one) and also whether the new ISP duration is currently used (and therefore some systems may have already been developed for use with the new ISP duration).

Ongoing cash costs of shorter ISP duration

In addition to one off cash costs there may be ongoing cash costs related to a shorter ISP duration. These are likely to include the following:

– **Scheduling and settlement systems.** TSOs, DSOs, PXs, BSPs and BRPs and other stakeholders would need to handle more data on an ongoing basis and this is likely to come at an increased cost of processing and storing.

– **Trading platforms.** Trading platforms will need to handle more data for a greater range of traded products and potentially also handle more trades on an ongoing basis.

– **Metering systems and allocation systems.** Metering systems would be required to handle more data on an ongoing basis and this may come at an increased cost of data collection and storage.

– **Billing systems.** The bulk of ongoing costs related to billing are likely to be incurred in settlement, metering and allocation systems rather than then billing systems themselves. However, the possibility of additional ongoing billing systems costs should not be ruled out.

– **Forecasting.** Aside from developing better forecasting tools, there is likely to be an ongoing cost of greater effort placed on forecasting.

– **Trading and data handling.** There will be an ongoing cost to stakeholders of increased trading activity and data handling.

Many stakeholders participate in multiple markets. Therefore, some systems may already be capable of handling data on 15 minute or 30 minute timescales reducing the cost of shortening ISP duration elsewhere.

Non-cash costs

The one-off non-cash costs of a change to ISP duration are likely to include the following:

– **Uncertainty during transition.** A change to the ISP duration may add uncertainty among industry participants during the transitional phase to the new ISPs. If so, this would be particularly critical

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

during a period of significant investment needs for the sector. In addition, there could be uncertainty during the period prior to a definitive decision having been made as to the future ISP duration for each country. The issue with uncertainty is that it could increase the return required for investment in generation and other parts of the sector.

The size of this cost would be difficult to estimate and an indication could be obtained from a survey of market entities.

- **Change to liquidity.** Liquidity in traded markets could be affected by a change to ISP duration in a number of ways that could increase or decrease liquidity, for example:
  - The shorter ISP duration may give BRPs a greater incentive to use day ahead and intra-day markets to help manage their imbalance positions, increasing liquidity.
  - BRPs with inflexible plants may find it difficult to participate in markets with a finer granularity if there are no options to trade block bids, discouraging trade in those markets and reducing liquidity.
  - Sharper imbalance price signals provided by a shorter ISP duration may encourage small BRPs to aggregate their load and consumption with other BRPs or to vertically integrate. This could have the effect of reducing participation in certain markets, reducing liquidity.

  Liquidity is not a benefit in itself. Rather liquidity affects the efficiency of markets and would ideally be measured in the form of social welfare. A change to liquidity could be expected to affect the bid ask spread in a market and to affect competition in upstream or downstream markets. If the bid ask spread represents the cost of a market maker then a change to the bid ask spread is a real cost change, i.e. not simply a transfer.

  Improved liquidity in wholesale markets improves access for retail suppliers and for generators to the market, improving competition and efficiency of those markets. The value of a change to competition in upstream or downstream markets would be difficult to estimate although it would be worthwhile exploring with stakeholders as part of the information request. Absent a quantitative measure of this effect, a qualitative measure such as traffic lights could be used.

In addition, there may be an effect on certain market entities / BRPs that could be beneficial or detrimental, as described below:

- **Wider access to balancing markets.** With a shorter ISP duration, if the timing of gate closure is unchanged relative to the start of each ISP, the maximum time between gate closure and real time dispatch falls (e.g. the time in the case of a 1 hour gate closure and 60 minute ISP varies from 60 to 120 minutes whereas the time in the case of a 1 hour gate closure and 15 minute ISP varies from 60 to 75 minutes). A shorter period between gate closure and delivery may allow less controllable generation and loads to participate in the balancing market where they could not with a longer periods. Whether the ISP duration affects the ability to participate in the balancing market depends on the specific rules of the market.
- **Possible higher costs for certain market entities.** Sharper imbalance price signals provided by a shorter ISP duration could mean that BRPs with disproportionately high imbalances (e.g. small BRPs or BRPs with less controllable generation or loads) are perceived as facing disproportionately higher imbalance cost than BRPs with more predictable and controllable generation and loads. However, this would be a potential issue only if imbalance prices were excessive compared to the TSO's costs of balancing the system.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

As noted, it will be difficult to estimate some of these types of non-cash costs and the information request to stakeholders will be a useful way to understand whether each effect is likely to have a material effect on the CBA.

Possible benefits of ISP harmonisation

Here we scope out possible benefits of ISP harmonisation that will need to be estimated for each of the planning cases. We do not categorise benefits into cash and non-cash items as we did with costs since in the case of benefits there are few, if any, direct cash benefits. Instead, we consider benefits from a shorter ISP duration and from ISP harmonisation *per se*.

Some of the benefits will accrue as a result of the reduction in ISP duration. Other benefits would accrue due to related changes, e.g. the introduction of shorter duration products in the intra-day and day-ahead wholesale markets. We consider both types of benefit on the assumption that the related changes will take place. However, the changes envisaged by stakeholders (in this case PXs) would need to be confirmed through the information request.

Benefits from shorter ISP

The main benefits of shorter ISPs are likely to include the following:

- **Reduced imbalance.** Shorter ISPs are likely to incentivise market entities to reduce their imbalance positions or the overall system position (depending on the imbalance settlement pricing scheme). The question is how strong the incremental incentive is and which parties are able to react to those incentives. If shorter ISPs bring a reduction to imbalance positions, it would result in:
  - Lower demand for reserve capacity. If the power imbalances on the system are reduced the TSO may be able to reduce the procured amount of reserves or share reserves with other TSOs according to the minimum requirement defined in LFCR NC.
  - Better optimisation of regulating power. The TSO may be able to better optimise its dispatch of regulating and reserve plants if it receives better information about generation plans (i.e. plans with finer granularity).[12]

  A way to think of this benefit is an effective shift of balancing from TSOs to BRPs (due to market participants making a greater effort to manage their own imbalances prior to gate closure). A benefit therefore may be better price signals provided to the market at the intra-day stage about the marginal value of electricity since the cost of balancing would be reflected in intra-day market prices. This would allow generators and loads to take better informed decisions as to their operating patterns than if they primarily received signals as to the marginal cost of electricity through imbalance prices.

  The reduction of reserves required by TSOs to be held as a result of reduced imbalances managed by TSOs, if confirmed by stakeholders, would likely be a major benefit of reduced ISP duration. There will be a redistributive effect among market parties, e.g. BSPs may receive less revenue directly from the TSO (reducing costs to consumers), flexible generators may receive greater revenues in the intra-day market (increasing costs to consumers), and in the long run it is possible that less capacity is required on the system reducing overall costs.

[12] The approach taken by TSO to balancing the system varies from country to country. In some countries the TSO is able to take balancing actions pre-gate closure, e.g. warming plant. The provision of earlier and better information pre-gate closure about the system balance may therefore allow the TSO to take more efficient balancing actions in some countries.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

A shorter ISP could also reduce imbalances faced by the TSO in a different way. As noted, if gate closure was maintained as a certain period of time prior to the start of each settlement period, the average time between gate closure and actual delivery would fall with a reduction in ISP duration. Therefore, on average BRPs would have longer to manage their own imbalances before the TSO took over.

- **Reduced deterministic imbalance.** There may be an interaction between the ISP duration and the level of deterministic imbalance on the system. Imbalances are calculated as the amount of energy over the ISP and these energy blocks mean that the ramping of units on the system may not perfectly follow load, even though all of the units are in balance over the ISP. For example, with hourly ISP and therefore hourly management of balances by participants, it is often possible to observe large changes in overall system balance at the boundary between hours, as participants adjust their position to achieve balance over the preceding hour and optimise their position for the coming hour.[13] A shorter ISP duration may reduce the deterministic imbalance because the scale of changes by participants at the ISP boundary may be expected to reduce. Similarly, shorter duration ISPs may result in smaller changes to cross border trades from one market time unit to another.[14] These effects would potentially have two benefits:
  - TSO takes fewer balancing actions. This may be partially offset by BRPs making a greater effort to manage their imbalances prior to gate closure and any net reduction would be reflected as a benefit in terms of plant investment and operating costs.
  - Improved system frequency quality. Particularly in systems with high intermittent renewable generation (especially solar) penetration, these changes at hour boundaries can be of such magnitude as to result in frequency deviations. Reducing ISP duration could therefore be viewed as an improvement in frequency quality.
  - However, it is difficult to estimate directly the benefit of a change to frequency quality. Therefore, we suggest that for the purposes of the CBA, frequency quality is maintained at the counterfactual level. Frequency deviations could be addressed with greater volumes of faster ramping plant on the system. By holding frequency quality constant there could be a potential cost saving from a reduction in the quantity of fast ramping plant held in reserve (i.e. the benefit described in the previous bullet point).
- **Sharper price signals in balancing markets and changed investment signals.** The costs of managing the system imbalance are signalled (or recovered) through the imbalance price among those parties that are out of balance in aggregate over the ISP. Since parties have no obligation to balance within the ISP, the minute by minute balance position of parties could vary significantly from the aggregate position over the ISP. However, these minute by minute variations do cause real costs to be incurred by the TSO in managing the system balance (e.g. by aFRR activation). At least some of these costs are reflected in imbalance prices imposed on those entities with an imbalance *in aggregate* over the ISP, which can be materially different from the minute by minute deviations that caused the costs.

[13] This is a type of 'deterministic imbalance' i.e. an imbalance within a settlement period due to a predicted mismatch between supply and demand, including cross border exchanges.

[14] See Eurelectric and ENTSO-E, Deterministic frequency deviations – root causes and proposals for potential solutions, December 2011. Page 44.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

Reducing the ISP duration means that more balancing costs are imposed on those entities with unforeseen and partially or wholly offsetting deviations within the original longer ISP (which contributed to the additional balancing costs), because the scope for entities to offset their own deviations within the shorter ISP is reduced.[15] Additionally the risk of a BRP managing its own imbalance over the shorter ISP through counter deviations within the ISP is reduced. To avoid imbalance prices with the shorter ISP duration, a market entity could:

- Improve its forecast and use the information to manage its imbalance position by physical actions and through trade. Trade is the mechanism by which the market identifies the most efficient generation to meet demand.
- Respond to the sharper incentives by putting more effort into managing its imbalance position in relation to the reduced ISP by physical actions and trade.

A possible result, if market entities can react to the incentives, is that balancing actions will shift from TSO actions post gate closure to market entity actions pre-gate closure (as with the benefit of reduced imbalances, above). Market trade will provide information about the shape and level of demand to be met with longer lead times than in the case of post gate closure TSO actions, which could only call upon generation or demand that is immediately available to change output.[16] The market can respond to these signals through trade in the intra-day market so as to match supply and demand.

The cost of BRPs managing imbalances pre-gate closure could be expected to feed through into market prices. This would in turn affect investment signals for flexible plant. Investment signals are provided through TSO action and the prices the TSO pays for managing the system balancing. Therefore, the *change* to investment is relevant to the CBA.

– **Wider access to balancing, day-ahead and intra-day markets.** As noted above, a shorter ISP duration may allow less controllable generation and loads to participate in the balancing market where they could not have done so with a longer ISP duration. Similarly, a shorter ISP duration may allow less controllable generation and loads to participate in the day-ahead and intra-day markets if the shorter ISP allows them to be more certain as to their production over the trading period.

  However, we note that in the case of loads a change to ISP duration would not change fundamental issues related to the participation of loads in the wholesale market, e.g. profile settlement and the related lack of exposure to price with the time resolution of the wholesale market.

Benefits from harmonising ISPs

The benefits from harmonising ISPs should be treated separately from the benefits from shortening ISPs. As a thought-experiment the benefits originating from harmonization should also occur when the ISP duration is increased to achieve harmonisation. Hypothetically moving countries from a 15 minutes ISP to a 30 minutes ISP in line with their neighbours would ensure the identified benefits are purely benefits from harmonization. The benefits of harmonisation are likely to include the following:

– **Allow efficient generation to be dispatched.** Harmonizing ISPs will result in the same duration of programmed transfers on interconnectors as the ISPs in all countries. Currently, programmed transfers

15 This implies that even if the magnitude of prices is unchanged a shorter ISP duration would provide stronger incentives for BRPs to balance.

16 In some countries TSOs are able to take pre-gate closure actions to ready plant to provide reserves, which would potentially reduce this benefit of reduced ISP duration.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

are typically set equal to the longer ISP. This prevents market entities from being credited or debited with energy over the duration of the shorter ISP, as only the energy delivered in aggregate during the longer ISP can be verified. This prevents market entities with a shorter ISP from contracting potentially cheaper generation from abroad to manage their imbalances within the shorter ISP timescales.

This barrier depends on the granularity of interconnector products.

The result would be improved BRP to BRP trading opportunities across borders as opposed to TSO-TSO trading, potentially allowing plant to be scheduled further in advance of real time. There may be additional benefits from improved liquidity in markets for short duration products as a result of improved ability to trade those products across borders.

– **Improved secondary market outcomes.** The shortest duration wholesale market traded product in each country is equal to the duration of the ISP since there is no incentive to trade products with a duration less than the ISP. Harmonisation may bring benefits from liquidity of short duration wholesale market products since the number of participants in the market for short-term products should increase with harmonisation. However, it is possible that liquidity moves from one product to another, e.g. trading in 15 minute products increases while trading in 60 minute products decreases. (In addition, sharper price signals from shorter duration ISPs are likely to result in an overall increase in trade in short term products as market entities use the traded market to manage their imbalance positions. The increased trade brings liquidity benefits and increased costs of trading).

  If liquidity does increase, it would make it easier for all market participants to determine the efficient price, increasing trust in the market and encouraging efficient investments in flexible generation and demand side response. Market power may also decrease with more participants in the market for short term products, leading to more competitive prices for those products. All of these benefits are not due to liquidity per se but rather due to the increased efficiency in dispatch and investment that ultimately stems from greater liquidity.

– **Uniformity of information.** Apart from dispatch and market effects there could be more simple benefits due to creating information on a uniform basis. This would mean trading systems all over Europe only need to deal with one harmonized product definition, simplifying stakeholder systems that currently need to deal with multiple ISP durations.

– **Other harmonisation objectives.** The NC EB contains a number of different harmonisation objectives, e.g. harmonisation of the Balancing Energy Gate Closure Time and the timing of when the TSOs begin to accept bids and offers from the Common Merit Order in the Co-ordinated Balancing Area, and harmonisation of imbalance settlement pricing. These objectives are largely reliant on ISP harmonisation. Therefore, as noted above, to the extent the decision regarding implementation of these other objectives can be clearly linked to ISP harmonisation then it would make sense to include these benefits in the ISP harmonisation CBA.

6. Evaluation approach

In this section we define the evaluation approach for the CBA, i.e. pure cost benefit analysis, augmented CBA or a multi-criteria analysis. We start by setting out the information required to decide upon the evaluation approach, i.e. the criteria for evaluation and the approach to assessing each cost and benefit identified in the previous section.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

Criteria for assessment

As discussed in the general CBA methodology, the decision as to the appropriate CBA approach depends on various factors:

- the scale of unquantifiable benefits (if these are small, relying on a monetised CBA and qualitative assessment of other benefits may be more appropriate);
- the extent to which an appropriate and commonly accepted set of weights can be devised and agreed upon (this is a subjective exercise and securing consensus on it has the potential to create delay); and
- the extent to which one can devise a scoring matrix that can objectively and transparently differentiate alternative planning cases in terms of likely benefits or costs (conversion of a monetary amount to a score is subjective and can be difficult to justify to regulatory authorities).

As a first step to identifying the scale of unquantifiable benefits we classify the range of objectives set out in the NC EB into three categories, below. Grouping objectives also allows the complexity of the analysis to be reduced. We then consider the ability to monetise those objectives that are measurable.

- **Pass/fail condition** – defined by specific characteristics required of a design option or an absolute standard that a design option must fulfil. The pass/fail condition defines a minimum standard and a design option that "better" fulfilled the pass/fail condition may or may not receive a higher score in the CBA than another option that only just met the pass/fail condition, depending on whether better fulfilment was valued. It is important that the pass/fail condition is not set so strictly so as to pre-determine the outcome of the CBA by unnecessarily narrowing the range of possible options.
- **Benefits (scoring)** – used to score or rank different options, e.g. a monetary value, a score out of 10 or a ranking of two or more options.
- **Costs (scoring)** – used to score or rank different options, as per benefits.

The objectives for the ISP CBA are taken from the NC EB Article 11:

- fostering effective competition, non-discrimination and transparency in Balancing Markets;
- enhancing efficiency of Balancing as well as the efficiency of European, regional and national Balancing Markets;
- integrating Balancing Markets and promoting the possibilities for Exchanges of Balancing Services;
- ensuring Operational Security;
- contributing to the efficient long-term operation and development of the electricity transmission system and electricity sector in the Union;
- facilitating the efficient and consistent functioning of day-ahead, intraday and Balancing Market;
- ensuring that the procurement of Balancing Services is fair, objective, transparent and market-based, avoids undue barriers to entry for new entrants, fosters the liquidity of Balancing Markets while preventing undue distortions within the internal market in electricity;
- facilitating the participation of Demand Side Response including aggregation facilities and energy storage while ensuring they compete with other Balancing Services at a level playing field and where necessary act independently of energy suppliers when serving a single Demand Facility; and
- facilitating the participation of Renewable Energy Sources and support the achievement of the European Union target for the penetration of renewable generation.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

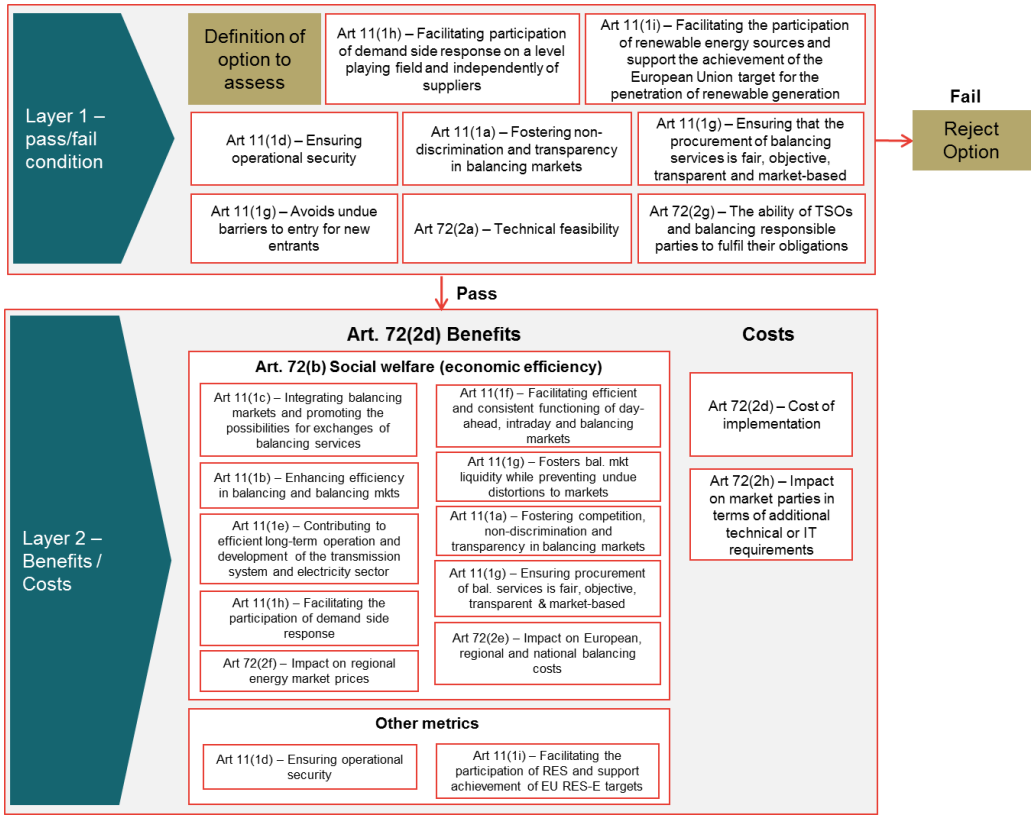
The CBA should also take into account Article 72(2), namely:

- technical feasibility;
- economic efficiency;
- the impact on competition and integration of balancing markets;
- the costs and benefits of implementation;
- the impact on European, regional and national Balancing costs;
- the potential impact on regional energy market prices;
- the ability of TSOs and Balancing Responsible Parties to fulfil their obligations; and
- the impact on market parties in terms of additional technical or IT requirements assessed in cooperation with the affected stakeholders.

These are broadly the same objectives as those set out in the report on the general CBA methodology, which referred to Version 3.0 of the NC EB dated 06 August 2014, prior to ACER's proposed amendments. Here we summarise the grouping of objectives into the three categories and do not repeat much of the discussion provided in the general CBA methodology. The classification is shown in **Figure 6**.

We have combined some of the objectives and other issues to take into account in the CBA. For example, the issue of 'the impact on competition and integration of balancing markets' is fully captured by the objectives of 'fostering effective competition … in balancing markets' and 'integrating Balancing Markets …'

Figure 6. Grouping of objectives for the ISP CBA



Source: Frontier

The pass fail criteria set out minimum standards that any option (planning case) must comply with regarding:

- Security of supply (ensuring operational security and the ability of TSOs and BRPs to fulfil their obligations);
- Market design (facilitating demand side participation, facilitating renewable participation, avoiding barriers to entry, non-discrimination and transparency in balancing markets, and ensuring fair, objective and transparent and market based procurement of balancing services); and
- Ability to implement (technical feasibility).

"Ensuring Operational Security" is classified as a pass/fail condition and enters the analysis *before* assessing benefits and costs of the respective options. It then enters again as a possible benefit, only to the extent that value is placed on the additional security above the minimum threshold. This means that the comparison of benefits and costs in Layer 2 relates mainly to social welfare and costs but includes metrics related to security, where required. To avoid the need to place a value on different levels of security of supply, the security standard should be maintained at the same level in the factual and counterfactual and the monetary cost of doing so, if any, enters the CBA under the objective of "Enhancing pan-European Social Welfare".

Within the measurable benefits, several objectives set out in Art. 11 are related to "Enhancing pan-European Social Welfare".[17] This includes, for example, fostering competition, facilitating efficient functioning of other electricity markets, and fostering liquidity of balancing markets. This has an important consequence for the assessment. If the effect on all relevant aspects of social welfare (economic efficiency) from Art. 11 and 72 can be measured in € values the other objectives related to social welfare must only be used for information purposes. If the other objectives related to social welfare were also used for the assessment of the option, this would result in double counting of benefits.

Conversely, if social welfare cannot be measured or can only partially be measured, indicators from the other objectives related to social welfare can be used as a proxy for the total impact on social welfare. However, generally it will be difficult to derive indicators in € terms for these objectives, e.g. the HHI indicator to assess the impact on competition is stated as a number, the indicator for liquidity of the balancing market may be the number of market participants or the volume of trade relative to physical demand (churn rate). This could have implications for the appropriate CBA evaluation approach.

Facilitating the participation of renewable energy sources is a separate benefit in its own right and therefore has been given a separate metric in Layer 2.

Before discussing how to measure costs and benefits we clarify what is meant by social welfare in the context of NC EB. It is possible to apply a social welfare standard whereby consumer welfare and producer welfare are given different weights or where different consumers are given different weights (e.g. consumers with lower incomes are given higher weights than consumers with higher incomes). Although the NC EB provides no guidance as to weightings, we assume that the intention is to weight all welfare equally. We note that this is also in line with the approach applied in the CBA for PCIs/TYNDP. There is an economic rationale for not placing different weights on different consumers or on consumers and

17 We use 'social welfare' and 'economic efficiency' inter-changeably.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

producers, in aggregate. Using different weights for the CBA would imply that the NC EB is a tool for redistribution within society. However, the NC EB is likely to be a sub-optimal mechanism for redistribution and other tools designed specifically with redistribution in mind would be more appropriate in this role.

European regions or countries may be affected differently by the options that are analysed. However, the overall European social welfare is the relevant objective of the NC EB, not that of individual countries. Nevertheless, the ISP CBA shall report on regional and country effects for information purposes. Reporting on regional and country effects shall include the monetised objectives and where appropriate the non-monetised objectives.

Approach to assessing pass/fail conditions

With each of the pass/fail conditions, the information request would ask different stakeholders how they perceive the change to ISP duration affecting their ability to operate in the market, e.g. balancing on shorter timescales, access to different markets etc, their rationale for their response and how they might adapt their behaviour to be able to operate in the new market environment.

Responses from stakeholders would be compared so as to understand whether true barriers exist or whether certain stakeholders have not fully considered different approaches to operating in the new market.

Approach to assessing benefits

In this sub-section we describe a possible approach for evaluating each benefit identified in the previous section by measuring the effect of the change to ISP on the evaluation criteria. The aim is to get a sense for whether it is likely to be possible to monetise the effects of a change to ISP duration.

Benefits from shorter ISP

– **Reduced imbalance.** Shorter ISPs tend to increase incentives and is likely to help provide the tools for market entities to manage their own imbalance positions prior to gate closure. In addition, shorter ISPs reduce the average period between gate closure and delivery allowing more time for market entities to manage their own imbalance positions. This effect shifts responsibility for energy balancing from TSOs to BRPs and may bring additional benefits in the form of better and earlier price signals from the intra-day market.

  To the extent that this shift of effort led to a reduction in the net capacity on the system (reduced reserves procured by the TSO partially offset by potentially more capacity held by BRPs to manage their own positions) this benefit could be estimated by the avoided investment cost of new capacity and an assumption as to the transition from today's situation to the situation where new capacity is avoided. In addition, there would be a fuel cost saving of holding less capacity in reserve. These benefits would be estimated for selected countries using this stylised analysis and scaled to Europe.

  It would be possible to use a Europe-wide dispatch model to estimate the price and cost effects of a change to the amount of capacity held in reserve. Such an approach to the analysis would take longer and require more resources than a stylised approach.

  This analysis would need to be informed by information provided by the stakeholder information request as to the extent to which BRPs will manage their own imbalances prior to gate closure and the reduction (if any) of the quantity of reserves procured by TSOs. The information request would also

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

inform about the type of plant that would be used for incremental investments, the type of plant used to provide reserves and the type of plant that is typically marginal on the system.

In addition, improved price signals from a shorter ISP duration may lead to more efficient dispatch decisions. A ballpark estimate of this benefit could be made using stylised modelling. For a selected largely thermal based country a dispatch model could be used to minimise the cost of dispatch against day ahead demand. Integer variables (e.g. whether a plant is running) are then fixed, demand modified to actual demand for the day and the dispatch revised. The cost of the dispatch is noted. The same exercise is repeated by dispatching against the actual demand, with integer variables free to be chosen as part of the optimisation process. The difference in the dispatch cost between the two runs is indicative of the improvement in dispatch decision making due to better information. The result would be scaled down since it overstates the improvement in information since the model compares day ahead demand with actual demand.

To scale the result to Europe, it could be turned into a per MWh cost and applied to countries with a largely thermal plant park. Countries with a predominantly hydro plant park are more flexible and therefore would have a lower benefit of better information.

Alternatively, an assumption could be made as to the percentage reduction in generation costs as a result of improved information. This would be informed by the information request.

An additional benefit is that increased within day trade would increase liquidity. Much of this benefit is captured in the form of improved price signals. However, an additional indirect benefit relates to a reduction in the cost of trade as bid ask spreads would fall with increased liquidity and improved access to the wholesale market by retail suppliers and small or intermittent generators.[18]

The benefit from a reduction in the bid ask spread is the difference between the (spread) x (trade volume) in the counterfactual and in the factual. The change in trade volume and change in the bid ask spread would be informed by the information request. Depending on the level of competition in the wholesale and retail market, much of this benefit could be expected to accrue ultimately to end consumers.

Better access to the wholesale market as a result of better liquidity may manifest itself in improved retail competition or reduced retail costs, in the form of reduced retail margins. Since the intraday market is a small part of the wholesale market, we suggest that any such benefit not be calculated and be noted qualitatively.

We address additional costs to stakeholders of increased forecasting effort and increased trade in the section on costs, below.

– **Improved system frequency quality.** A reduction in ISP duration may reduce changes in market participants' positions at the boundary between ISPs, and the aggregate deterministic imbalance. Similarly, shorter duration ISPs may result in smaller changes to cross border trades from one ISP to another. To estimate the benefit, the first step would be to estimate the size of the change in the aggregate system imbalance at ISP boundaries for the counterfactual and for each of the planning cases. The quantity of reserve that must be procured or shared between TSOs to be compliant with NC LFCR

18 A shorter ISP duration would not affect many of the fundamental problems of the demand side participating in the wholesale market, e.g. settlement based on profiles, a lack of exposure to prices with the time resolution of the wholesale market etc.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

can then be estimated for each country for the counterfactual and for each of the planning cases. The monetary value of a change in the quantity of reserve held as three effects:

– Change of cost of holding reserve, which is a change in overall welfare for the system. There are two approaches to estimating this effect:

  - An integrated system planning model can be used to estimate the *change in generation investment and operating costs* from a change to the quantity of plant that must be held in reserve over the planning horizon. Note that these costs do *not* relate to the payment the TSO makes for reserves but rather to actual system costs. A reduction in system costs (given demand is met and quality is maintained) is a net increase in welfare.

    We discuss below distributional issues as to how the net welfare effect is allocated to producers and consumers – the distribution of the net increase in welfare to generators (producers) and to consumers depends on the effect of the change on price and in the way in which the TSOs costs of producing reserve are passed through.

  - Alternatively, an upper bound could be placed on the value of reducing the quantity of reserve by costing it at the annuitized investment cost (per MW) of a peaking plant such as an OCGT burning gas or distillate. This would tend to overstate the value of a change to the amount of reserve held in the case of systems with excess generation capacity.

– A change to market price outcomes. A change to the level of reserve held may result in a change to the wholesale power price since it changes the available capacity on the system and also result in a change to the procurement price for reserves. Some or all of the reduction in system costs discussed in the above bullet may be passed through to consumers through a reduction in market prices and some of the reduction in costs may be passed through to consumers through reduced TSO charges as a result of reduced reserve procurement costs. There are two approaches to estimating the wholesale price effects:

  - The integrated system planning model would report on wholesale market prices, with the change in price between the counterfactual and factual resulting in a *transfer* of welfare between producers and consumers.[19]

  - Alternatively, use historic information to estimate the relationship between demand and price and use this to estimate the price effect for a change to the reserve capacity held. This relationship would be applied to an estimate of the change to the infra-marginal capacity as a result of the change to reserve capacity held. This would need to be augmented by an assumption as to the way avoided investment costs effect price. For example, in the long run the reduction in investment costs could be assumed to be entirely passed through into prices such that all of the welfare effect accrues to consumers. However, the market would take a number of years to achieve the long run equilibrium. Therefore, over the transitional period to the equilibrium the proportion of the welfare effect due to wholesale market price changes accruing to consumers would be assumed to increase over time to 100%.

[19] We suggest that for the purposes of the CBA the demand for electricity be assumed to be perfectly inelastic.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

  - The change to the cost of procuring and calling upon the reserves. We expect these changes to cost to be small and therefore suggest they be noted qualitatively for the purposes of estimating the scale of the benefit.

- **Sharper price signals.** Reducing the ISP duration means that more balancing costs are imposed on those entities with unforeseen minute by minute deviations. To avoid imbalance prices with the shorter ISP duration, a market entity could improve its forecast and use the information to manage its imbalance position by physical actions and through trade. This benefit is effectively describing the mechanism by which the imbalances managed by TSOs are reduced, discussed above. Therefore, we do not expand on the approach to quantifying this effect.

- **Wider access to balancing, day-ahead and intra-day markets.** A shorter ISP duration may allow less controllable generation and loads to participate in the balancing, day-ahead and intra-day markets where they could not have done so with a longer ISP duration. This effect would be quantified by asking stakeholders whether they would change their participation in the BM, day-ahead and intra-day markets in response to each planning case and whether there would be an expected effect on prices in the day-ahead and intra-day markets, and asking TSOs about the expected change to balancing costs as a result of the change in behaviour.

- **Participation of renewables.** It is unclear whether a change to ISP duration would have any effect on the participation of renewable generation in the power market. Intermittent generation may be more able to participate in balancing markets with a reduced average time between gate closure and delivery with a reduction in ISP duration. However, this effect is likely to be small since at best the reduction would be on average less than one hour. An alternative issue is likely to be whether intermittent generation is made worse off as a result of a shorter ISP duration, either because renewable generators found it more difficult to trade in shorter periods or because sharper price signals increased the effective cost of being intermittent.

  We suggest that both of these issues be explored through the information request. However, we note that even if renewables were made worse off as a result of a shorter ISP duration, so long as the prices to which renewables were exposed were cost reflective, this should not be a concern and should be dealt with through the design of renewable support schemes.

Benefits from harmonising ISPs

- **Allowing efficient generation to be dispatched.** Harmonisation of ISP duration across borders allows BRP to BRP trade in place of TSO-TSO trade. As with a 'reduced imbalance', described above, this would potentially provide better and earlier price signals to the market thereby allowing plant to be scheduled ahead of real time.

  The approach to quantifying this effect is similar to that related to the reduced imbalance. However, the ability to reduce dispatch costs is greater since the dispatch can be coordinated across multiple zones. It may be possible to apply the dispatch model described above to multiple countries, in which case this effect would also be captured. However, we think this would add significantly to the complexity of the model and suggest that no further benefit be ascribed to better cross-border coordination.

- **Improved secondary market outcomes.** In addition to improved liquidity as a result of shifting the responsibility for managing imbalances from the TSO to the BRP ahead of gate closure, harmonisation of ISP duration may bring an additional benefit to liquidity by increasing the number of stakeholders trading products with that ISP duration. The effects of a change to liquidity would be informed by the

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

stakeholder information request and the approach to estimating any benefit is that as described above under 'reduced imbalance'.

- **Uniformity of information.** There may be benefits of dealing with data systems with a uniform ISP duration, which would be in the form of reduced investment and operating costs. This would be requested from stakeholders as part of the information request.
- **Other harmonisation objectives.** To the extent decisions regarding implementation of other harmonisation objectives under the NC EB can be clearly linked to ISP harmonisation then it would make sense to include these benefits in the ISP harmonisation CBA. However, this would in effect require that all of the CBAs under the NC EB and all of the decisions as to whether or not to proceed with each harmonisation objective be undertaken simultaneously. This is not contemplated in the draft NC EB and would be difficult to achieve in practice. Therefore, we suggest that a pragmatic approach is to include in the information request questions about the costs and benefits of the other harmonisation objectives, and to *qualitatively* include the resultant assessment in the ISP harmonisation CBA.

Approach to assessing costs

Costs of a change to ISP duration relate to one off and ongoing cash and non-cash costs. Cash costs include:

- Metering, scheduling and settlement systems;
- Trading platforms and systems;
- Increased effort in forecasting;
- Increased trade;
- Increases data handling; and
- Revising contracts and codes.

Information about these costs would be requested as part of the stakeholder information request. Stakeholder responses would be assessed and compared against one another for plausibility. A generic set of costs would then be developed for each country and for each type of stakeholder, which would then be scaled up to the country according to the number and size of stakeholders.

Non-cash costs relate to:

- Uncertainty during the transition to the new ISP duration;
- Loss of liquidity on some markets if some stakeholders found it difficult to trade over shorter timescales; and
- Costs of sharper price signals.

These costs would also be informed by the responses to the information request.

Overall evaluation approach

While there will inevitably be uncertainty as to the level of benefits and costs, the above description of a high level tentative approach to assessment suggests that it will be possible to place a monetary value on the

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

vast bulk of costs and benefits. Therefore, we suggest that a pure CBA be used as the overall approach to assessment. Uncertainty would be dealt with using sensitivity analysis and, where possible, placing plausible bounds on costs and benefits.

The objective of facilitating the participation of renewables is a benefit in its own right that is not related directly to welfare. If the response to the information request suggests that this would be a major concern, it could be included alongside the CBA as a separate measure. This could then create problems for ranking planning cases since there would be two dimensions (a monetary dimension of welfare and a renewable dimension) to independently consider. An alternative approach that collapses everything into a single monetary dimension would be to consider the additional cost required to retain the existing level of renewable generation in the counterfactual and each planning case of the factual.

7. CBA content

As described in the general CBA report there is a common structure for any CBA, which we describe in this section.

Factual and counterfactual

In this case the factual is the set of alternative planning cases for ISP duration described in Section 4. As noted, ACER's proposed changes to the draft NC EB require that implementation of the change to ISP duration be made by 1 July 2019. We suggest this implementation date be used for the factual.

The counterfactual is the business as usual ISP duration, i.e. the current ISP duration in each country plus any changes to ISP duration that have been decided upon at the time of the CBA.

Geographic scope for the CBA

The geographic scope of the CBA must be defined so as to capture all of the relevant cost and benefits. This means that the geographic scope of the CBA should be set to include all countries materially affected by ISP harmonisation. The scope of affected countries would be wider than solely those countries for which the ISP is changed since changing ISP duration could have cross border effects. If a change to ISP affected security of supply and frequency quality it would affect the whole synchronous network, by affecting balancing incentives the ISP is likely to affect intraday trade volumes both within a country and across borders, etc.

The NC EB applies to all transmission systems and interconnections in the EU, except for those transmission systems on islands which are not connected with other transmission systems. Cyprus is the only country in the EU which is not currently interconnected with other transmission systems. However, there are plans for an electricity interconnector between Cyprus and Greece.[20]

Therefore, we suggest that in the case of ISP harmonisation the CBA should extend at least to *all* 28 countries of the EU. However, given the interconnected nature of electricity systems, the scope of the CBA should extend to Liechtenstein and Norway (which are both in the EEA) and to Switzerland (which is in the single market), i.e. to 31 countries. Iceland is also in the EEA. However, it is currently not interconnected

[20] The EuroAsia project would link Israel, Cyprus and Greece with a 1,000km long sub-sea cable. The EC adopted the project as a project of common interest (PCI) in 2013. See http://www.euroasia-interconnector.com/Index.aspx

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

with other EEA members and, although Iceland is currently studying interconnection projects, interconnection to the rest of Europe is likely to be many years away.

Time horizon for the CBA

Many of the costs of a change to ISP duration will be one-off up-front costs whereas other costs and the benefits will emerge over time. This means that the CBA must be conducted over a time horizon sufficient to capture the relevant costs and benefits.

Normally the time horizon for the analysis would be determined by the economic lifetime of investments required to implement the relevant option. Regulatory depreciation periods tend to be used as a first cut indicator of the economic lifetime of an asset. The bulk of the up-front costs are likely to be in the form of changes to IT and data processing systems, with depreciation periods in the order of 5-10 years. We therefore suggest that a time horizon of 10 years be used.

Choice of years to analyse

The general CBA suggests defining periodical snapshot years and interpolating benefits between the years. We suggest using years 2020, 2025 and 2030 for the analysis. The years 2020 and 2030 are consistent with the years used for ENTSO-E's TYNDP.[21]

Scenarios

To the extent uncertainty as to future sector developments could affect the outcomes of the CBA it makes sense to take into account the uncertainty in the analysis using scenarios.

In this case the key driver of outcomes for the CBA is likely to be the way in which a change to ISP duration is implemented and not broader developments to the power sector. This suggests using a single scenario from the TYNDP as the basis for future developments. We suggest one of the two central scenarios be chosen, i.e. Green Transitions or Money Rules.[22]

As noted previously in this report, we suggest that for each planning case two different implementation approaches be used to estimate the cost and benefits of change, a minimum change approach (where only those systems and processes that must be changed as a result of a change to ISP duration are modified or replaced) and a maximum change approach (where all systems and processes that used the current ISP duration would be changed to use the new ISP duration).

Normally scenarios would be given equal weights and a weighted average of the results of the CBA used for the decision. In this case, the approach to change (maximum or minimum change) is a choice that can be taken by individual countries. Therefore we suggest taking the scenario with the highest net benefit (or lowest net dis-benefit) to use for the decision.

The estimates of costs and benefits may be uncertain, in particular the estimates of non-cash costs and benefits. Sensitivity analysis should be undertaken where the uncertainty could affect the CBA outcome, e.g. regarding the change to the quantity of reserve held.

Discount rate

21 https://www.entsoe.eu/major-projects/ten-year-network-development-plan/ten%20year%20network%20development%20plan%202016/Pages/default.aspx (accessed on 21 May 2015)

22 See ENTSOE, 10-Year Network Development Plan 2014.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

Cost-benefit analysis involves comparing projects with different flows of financial or economic costs and benefits occurring in different time periods. Discounting recognises that money has a time value. As described in the general CBA methodology, we suggest using the social discount rate as used for the most recent TYNDP at the time that the ISP CBA is undertaken.

Evaluation of benefits and costs

As described in the general CBA report, we suggest using the net present value (NPV) as the primary economic performance indicator and turn to other metrics such as benefit/cost ratio and internal rate of return (IRR) only if the primary measure does not sufficiently differentiate between options.

Given that the vast bulk of costs and benefits can be monetised, we suggest relying solely upon a monetary indicator.

For information purposes the CBA would report the effect on different classes of stakeholder by each country.

Data collection

The basic framework for the development of the power sector over time is the TYNDP scenario and the TYNDP dataset, covering demand, generation, interconnectors and fuel and CO_2 prices.

To inform the CBA an information request would be prepared for stakeholders. This would:

- Describe the approach stakeholders should apply to determining relevant costs and benefits including the definition of the factual (including the maximum and minimum change) and counterfactual so that stakeholders understand concepts of sunk costs and costs affected by the change between the counterfactual and the factual.
- Ask how the change to ISP duration for each planning case affects the stakeholder and the system, with examples of possible effects provided.
- For each of the benefits and cost described in Section 5 the information request would:
  - Describe the benefit or cost in detail, including the proposed way to estimate the welfare effect of the cost or benefit.
  - Ask the stakeholder for the extent of the effect of the change to ISP duration (we call this the metric), including how it would change over time and the rationale / assumptions underlying the response. For example, TSOs would be asked about the change to the quantity of reserves held as a result of a reduction in change to the aggregate system balance at the ISP boundary. To ensure consistent responses, the data being collected would be clearly defined.
  - For each of the metrics associated with each benefit and cost, ask for an estimate of the monetary value of the change to the metric and the rationale / assumptions underlying the estimate.
- Ask for stakeholder views on system settings to the extent these would deviate from the TYNDP dataset for the counterfactual and for each factual case.

A draft information request would be prepared for discussion with a selection of stakeholders before the final information request is sent out.

Following receipt, the information would be validated and processed. This would include validating whether reported data followed the data definition, whether there are data outliers and identifying the reason for the outliers. Validation should also include reporting cost ranges. Data would be aggregated into ranges or averages, with clear outliers or otherwise clearly erroneous data removed.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

8. Interpretation of results

There are various issues that arise regarding the reporting and interpretation of the final results from the CBA, which we discuss below.

When interpreting the outcome of the CBA one has to make a distinction between two types of measures:

- **Primary measures for decision making** – these measures are relevant for choosing the "best" option from among the analysed options (including the option of doing nothing). This includes, for example, the total net present value in the case of the Pure CBA and Augmented CBA, the final score from an MCA or the results from sensitivity analysis.

- **Measures for informative purpose** – these measures give further detailed information which may be of interest for stakeholders, but should not have a direct impact on decision making. This shall at least include reporting on the distributional effects on regions, countries and optionally on producers, consumers, etc., of each of the options analysed.

As the main objective of the NC EB is enhancing total pan-European welfare the net present value of the welfare effect is the primary measure for the monetary economic performance indicator for decision making. This should be used for ranking the planning cases (factuals) and for comparing the factuals to the counterfactual.

The robustness of the results, which is determined by how far the benefits exceed the costs, can be illustrated using sensitivity analysis. For example, as part of the information request we suggest asking stakeholders to provide ranges (with implied probabilities, e.g. 95 percentile) of costs or benefits and to justify their estimates. The upper and lower limits of the ranges could be used as inputs to the sensitivity analysis.

Using more than one scenario for the CBA may result in different outcomes for the NPV. This is a particular issue if the outcome for one scenario reports a positive welfare effect and for the other scenario a negative welfare effect. This is also an issue if the choice of scenario changes the ranking of planning cases. In this case, the scenarios relate to the minimum or maximum implementation of the change to the ISP duration. As noted, this allows each country to select the optimal approach to implementation which means the scenario with the highest net present value can be selected. This is instead of, for example, taking the weighted average net present value of the different scenarios.

In order to assess the robustness of the results we propose to apply sensitivity analysis. The sensitivity analysis may show that:

- The change in net benefit of all options with regard to changing one input parameter shows the same pattern. Hence, if option 1 ranks better than option 2 in the base case, the ranking does not change after the sensitivity analysis. The ranking is therefore robust to a change to the input parameter.

- The change in net benefit of with regard to changing one input parameter shows different patterns for different options. For example, option 1 may be more sensitive to changing the discount rate because the cost and revenue stream occurs later than for option 2. This may have the consequence that option 1 ranks better than option 2 in the base case but behind option 2 with a change to the input parameter. In this case understanding the expected outcomes may be appropriate. By this we don't mean setting the input parameter to its expected level and seeing the result. Rather we mean applying the sensitivity analysis to the input parameter and obtaining the range of results, and from this understand the expected result.[23] We note that this adds complexity to the analysis as explicit or implicit

[23] In the case of a non-linear process the output when the expected (average) input is applied may differ from the expected (average) output when the full range of inputs is applied.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

understanding of probability distributions for parameters used in the sensitivity analysis will be necessary.

- The net benefit of an option changes from positive to negative (or vice versa) when one input parameter is changed. For example, the positive welfare effect of option 1 is small and becomes negative with a small change to one input parameter. In this case expected measures (or confidence intervals) may be appropriate.

- The net benefit of an option changes remains positive (or negative) when one input parameter is changed. In this case the option is robust to changes in the input parameter.

We suggest that the CBA report on the welfare effect for different types of stakeholder (producers, consumers) by country, in addition to the aggregate pan-European welfare effect. However, it is outside the scope of the CBA methodology to provide guidance as to how informative measures should be used, e.g. for the design of compensation payments between countries or stakeholders.

9. Process for undertaking the CBA

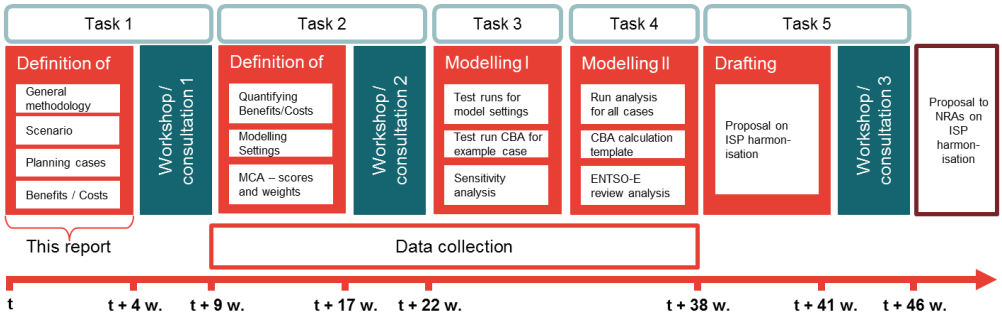
This section defines the process for undertaking the CBA, assuming a relatively compressed timescale.

As described in the General CBA Methodology, the general principle in designing the process is to consult with stakeholders when there is something to consult on rather than to leave stakeholder engagement until the end of the process.

The time schedule illustrated in **Figure 7** is relatively ambitious and hinges on various assumptions, e.g. with regard to the ease of scenario definition and availability of modelling tools, the number of public workshops held and the time required for ENTSO-E to review and approve reports. Below we note where we believe ENTSO-E may need flexibility as to the timetable.

To illustrate the entire process, the timeline begins with the definition of the CBA methodology and planning cases. Since this has already been done in the case of the CBA for ISP harmonisation (i.e. in this report), the timeline begins from task 2.

Figure 7. CBA process and timeline



Source: Frontier

- **Task 1**: includes defining the general CBA methodology, scenarios, planning cases and benefits and costs. The definition of benefits and costs mainly focuses on conceptual assessments, e.g. scoping of

benefits (costs) and identifying how they may be quantified. Task 1 ends with a consultation and a workshop. In **Figure 7** we allow 9 weeks for this task. 4 weeks are allowed for work on the content of the methodology and 5 weeks for the consultation.

- **Task 2**: is the starting point for data collection with regard to benefits, costs and scenarios. An information request would be prepared, tested and sent to stakeholders. The responses would be reviewed and analysed.

  In addition this task includes the definition of the model setting necessary to monetise benefits. With regard to model setting ENTSO-E should assess whether existing models can be used for the CBAs under the NC EB, for example, whether modelling tools used for TYNDP calculations are applicable. Defining scores and weights for a MCA is a complex task, which should be started in task 2 after the benefits and costs have been defined.

  Task 2 ends with a stakeholder consultation and a closing workshop. The consultation paper would be drafted, focussing on inputs to the analysis. The paper would present the information obtained through the information request and cover input data for the analysis, model settings, a description of effects of a change to ISP duration, and indicative costs and benefits of the effects. A workshop would be held to discuss the consultation paper and responses. The consultation paper would then be revised based on responses and this would provide the basis for the analysis of welfare effects.

  In **Figure 7** we allow 13 weeks for task 2, 8 weeks are allowed for work on the content of the methodology and 5 weeks for the consultation.

- **Task 3 – Modelling I**: includes setting up the preliminary model and undertaking test runs of the model and analysis. Test runs are necessary to evaluate the soundness of the model, analytical approach and data. In order to assess how the model works in practice selected case studies may be defined for a preliminary CBA. This should also include sensitivity analysis. The approach to analysis would then be adjusted as required before applying it to all countries at the second stage of analysis.

  Depending on the progress of task 3, a stakeholder workshop presenting preliminary modelling and CBA results could be organised. We would suggest this phase allows some flexibility over whether to hold this workshop, as it only makes sense if preliminary and reliable results can be presented. In **Figure 7** we allow 16 weeks for Task 3 and 4. We note that this time schedule depends on the assumption that existing modelling tools of ENTSO-E and/or TSOs are used for the analysis. If the development of a modelling tool is necessary, a substantial extension of the time schedule would be necessary.

- **Task 4 – Modelling II**: includes applying the final modelling tool or analytical approach, data and CBA template to all countries. There are in principle two options for this:
  - open access to the ENTSO-E modelling tool and analytical process and data which all market participants can use for their own analysis; or
  - calculation by ENTSO-E on behalf of market participants.

  ENTSO-E does not need to decide the approach to accessing the model at the start of the CBA process – it could decide this at the beginning of task 4.

  Having derived the monetary effects for different countries and different stakeholders the economic metrics (i.e. NPV) would be derived.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

- **Task 5 – Drafting proposal**: includes drafting the decision proposal to NRAs. We allow 3 weeks for this task, plus a 5 week consultation period on the draft CBA report. The draft CBA report, would describe the counterfactual and planning cases, inputs to the analysis, how a change to ISP affects outcomes, monetary and non-monetary effects, the results of the CBA for each planning case, including the results of sensitivity analysis, and draw initial conclusions about the CBA.

  Following the consultation a second workshop would be held to discuss responses and the proposed way to address the responses. The CBA report would then be finalised, including the final ranking of planning cases and the counterfactual and a recommended decision made. The report would then be presented to the NRAs.

  Some flexibility may be required in task 5 to allow for ENTSO-E's internal processes. For example, if ENTSO-E wanted to review the draft CBA report before it went to consultation this could add a further 8 weeks to this task. ENTSO-E may wish to add an additional workshop to this task, to discuss the preliminary draft report that goes to ENTSO-E for comment.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel + 32 2 741 09 50 • Fax + 32 2 741 09 51 • info@entsoe.eu • www. entsoe.eu