European Network of
Transmission System Operators
for Electricity

entsoe

Cost Benefit Analysis for Electricity Balancing – ISP harmonisation scoping paper

A paper for consultation

Prepared by Frontier Economics and Consentec

20 February 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

2. Introduction

Context and scope of paper

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** (Articles 14(3), 16(4), 18(4), 20(3)): CBAs 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);
- **Application of a TSO-BSP model** (Article 38): CBA to indicate the implications of the application of a TSO-BSP model for the exchange of balancing capacity or the exchange of balancing energy (RR and FRR) for at least the responsibility area or scheduling area when appropriate for the contracting TSO and the connecting TSO; and
- **Harmonisation of Imbalance Settlement Period** (Articles 21(2) and 21(5)): CBA on harmonisation of the imbalance settlement period (ISP) within and between synchronous areas. This CBA shall be submitted by TSOs to NRAs no later than 2 years after entry into force of the NC EB. After a decision is taken by NRAs about harmonisation of ISPs, specific CBAs might be performed by TSOs that have a proposal which deviates from the decision taken.

ENTSO-E has asked Frontier 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 draft scoping paper 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 paper focuses on those aspects of the power market directly affected by ISP duration.

[1] ENTSO-E Network Code on Electricity Balancing, Version 3.0, 06 August 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

In principle, the CBA for ISP harmonisation should follow the general methodology for performing CBAs under the NC EB. Therefore, this paper only elaborates on the specifics of the CBA for ISP harmonisation that are not defined by the general methodology.

Organisation of this paper

This paper 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 paper.
- **Section 4** describes the planning cases to use for the CBA.
- **Section 5** identifies possible costs and benefits arising from ISP harmonisation.

3. Role of ISPs

In this short 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 paper.

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 responsible for its imbalances, 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.

The TSO financially settles imbalances with the responsible market entity (or representative) at the imbalance price for the relevant ISP.

The pricing of the settlement of imbalances is typically designed to incentivise parties to reach a balanced energy position over the ISP. 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.

Since parties can only trade with the TSO in real time, 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.[2] The choice of ISP duration therefore affects the organisation of the market in terms of the definition of the finest granularity of traded products.

[2] This is different from the gas market where parties are able to trade between themselves in real time. This means that parties may wish to trade products with shorter duration that the settlement period, e.g. they may wish to trade rest of day products part way through the day in the case of a daily settlement period.

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 ISP may have other roles in some countries, although these are not necessary roles of the ISP. For example, the highest granularity of information provided to the TSO about physical production and consumption plans may be defined as the ISP duration. The ISP may also affect the definition of reserve products and the approach to the TSO procuring those products.

4. Choice of planning cases

Use of planning cases

The NC EB requires TSOs to harmonise the main features of imbalance settlement and in this context TSOs shall submit a proposal to all NRAs based on a CBA for ISP harmonisation. The Framework Guidelines for Electricity Balancing (FG EB) contemplate ENTSO-E undertaking 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.[3]

Therefore, we suggest that in the case of ISP harmonisation the CBA should extend to *all* 28 countries of the EU. If the NC EB is of EEA relevance or of relevance to the single market, the scope of the CBA would need to include further countries (i.e. Iceland, Liechtenstein and Norway in the case of EEA relevance, and in addition Switzerland in the case of relevance to the single market). The fact that the CBA must cover many countries is important for the definition of the planning cases, a point that we return to below.

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, as is contemplated by the NC EB.

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.

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

[3] 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

set of ISPs for all countries (as constrained by the requirements of the NC EB, i.e. that no ISP is greater than 30 minutes and that no country be required to increase its ISP duration). 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[4] 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).

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.

Status quo ISP durations

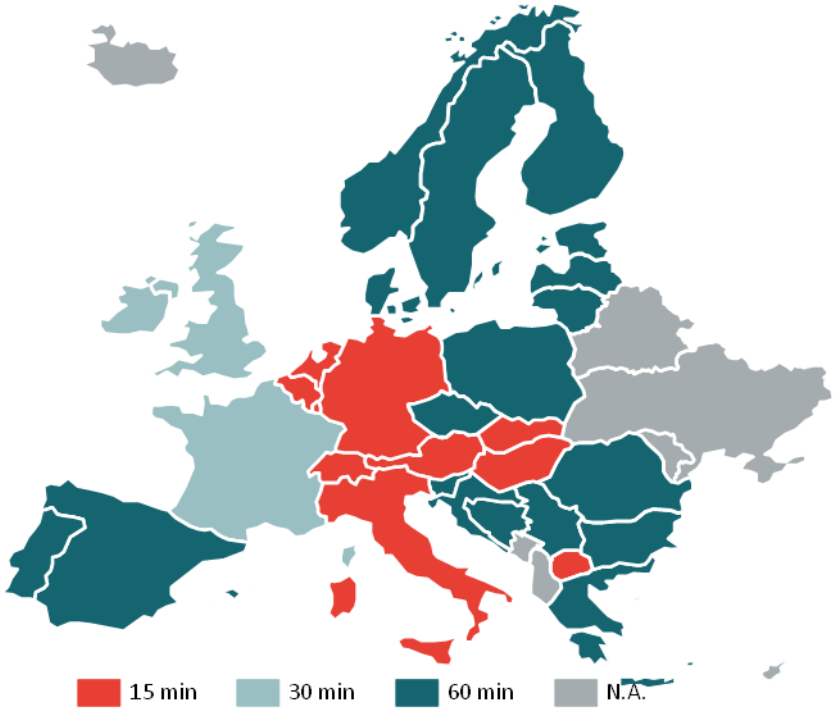
The set of ISP durations as of 2013 for all countries is depicted in **Figure 1**.[5]

[4] In the remainder of the paper 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.

[5] 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 (or possibly the EEA or EFTA region), there could be an argument for extending it further to include non-EU countries in the Balkan region or elsewhere.

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 – 2013



Source: ENTSO-E 2013 Survey on Ancillary Services and Balancing Market Design, and TSO websites
Note: Italy has a 15 minute duration ISP for generation and a 60 minute ISP for consumption

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.

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, 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 the 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.

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 or costs and benefits were true. Therefore, in what follows we consider different possible drivers of costs and benefits and select a planning case accordingly.

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

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 current shortest duration ISP is 15 minutes, and the NC 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 maximises benefits through full harmonisation by shortening ISP duration to below 15 minutes.

It is possible for a country to use a different ISP for generation and load, 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 both generation and to load.

Therefore, in total we define four planning cases. We discuss each possible planning case in more detail below.

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.

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 NC 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 either in the consultation of the CBA methodology or as the first stage of the CBA itself

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

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:

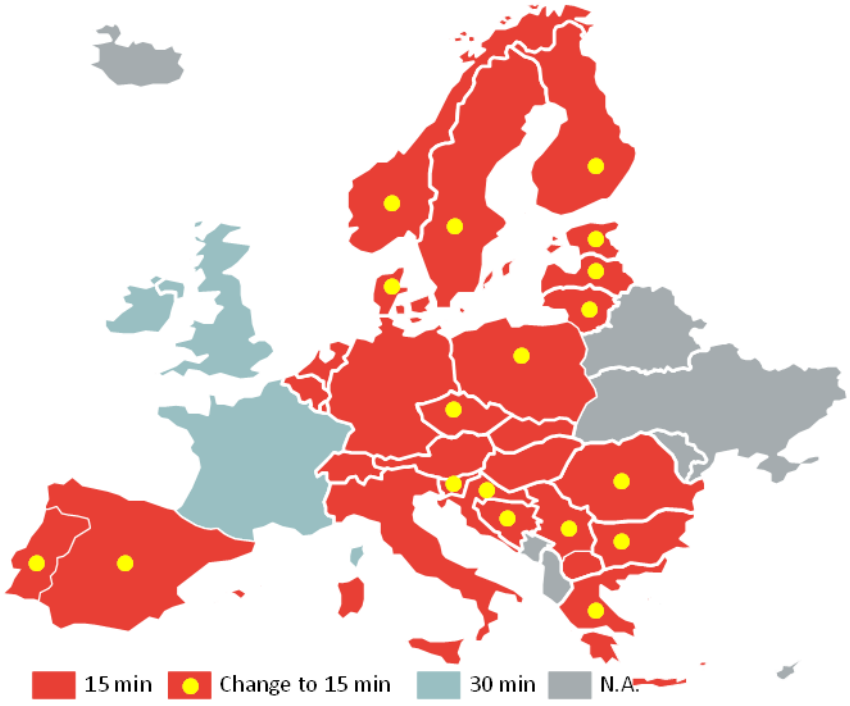
- Whether a single rule is applied to all countries or the rule can vary by country;
- Whether a 15 minute or 30 minute ISP duration likely to be the optimal solution in terms of benefits and costs;
- Whether a country's neighbour(s) has a 15 minute or 30 minute ISP duration (in order to maximise harmonisation);
- 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 currently has a 15 minute duration ISP for generation and a 60 minute ISP for consumption. Therefore, Italy would need to change the ISP for consumption to 15 minutes under this case.

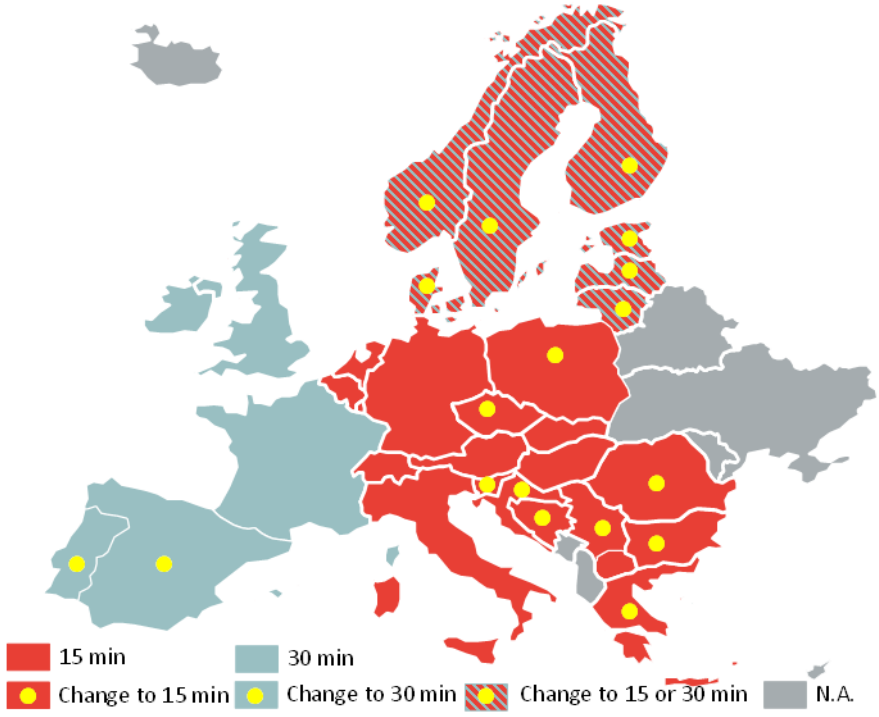
Maximize benefits by harmonising ISP duration

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 currently has a 15 minute duration ISP for generation and a 60 minute ISP for consumption. Therefore, Italy would need to change the ISP for consumption 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 either prior to the CBA or 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

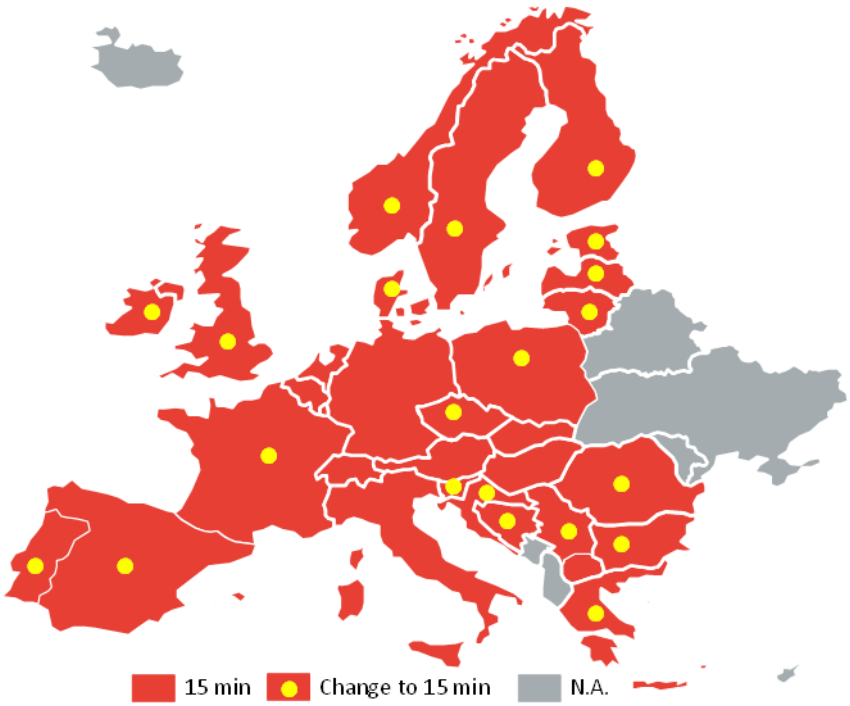
It is possible that the benefits of changing ISP duration arise both from *reducing* duration and from *harmonising* duration. This planning case attempts to maximise benefits by all countries moving to the shortest existing ISP duration, which is 15 minutes in every country. The CBA will test with this 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 currently has a 15 minute duration ISP for generation and a 60 minute ISP for consumption. Therefore, Italy would need to change the ISP for consumption 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.

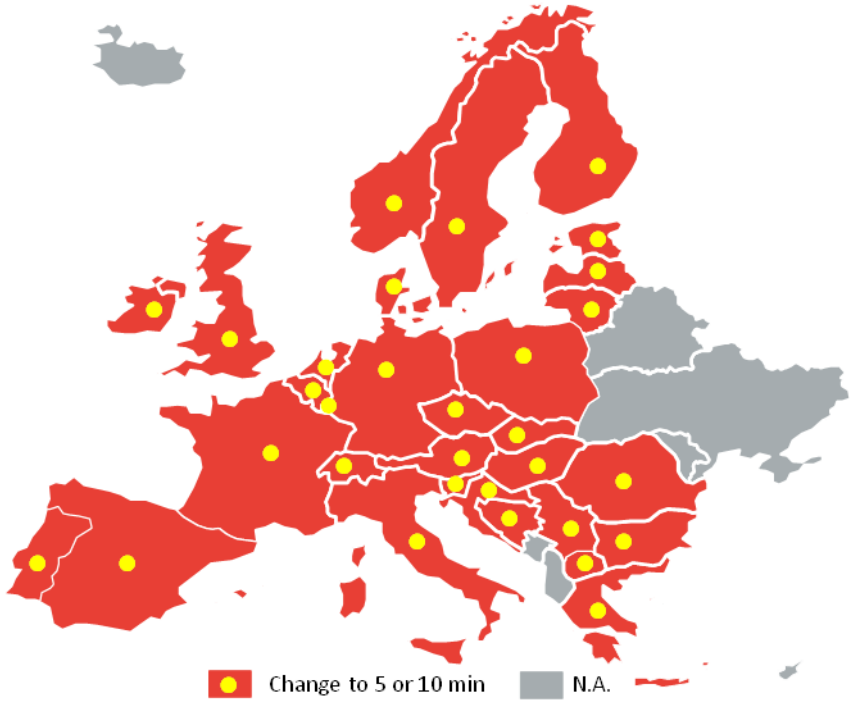
A possible advantage with a 5 minute duration ISP over, say, a 10 minute duration ISP is that current systems are based around periods that are an integer multiple of 5 minutes, e.g. traded contract durations.

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.

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 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 as part of the consultation or 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, additional costs could arise or benefits could be reduced if the transitional period reduced harmonisation and created confusion.

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

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.

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. We first provide context by giving 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.

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.

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

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 each of the planning cases.

Costs due to a change in ISP duration are likely to mainly result from cash costs (one-off costs of a change to the ISP duration and ongoing additional costs of data management) and non-cash costs.

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) are likely to include the following:

- **Scheduling and settlement systems.** TSOs, DSOs, PXs, BSPs and BRPs would need to adapt their scheduling and settlement systems to the new ISP duration. This cost largely relates to developing new IT systems or modifying existing systems.

  The incremental cost of implementing a change to ISP duration will 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 is likely to be lower for those planning cases for which fewer countries change ISP duration.

- **Metering systems.** In many cases the change in ISP duration will require a software update or a physical exchange of existing meters. However, where load profiles are used to allocate metered consumption to individual ISPs for settlement purposes, those meters would not require modification or replacement due to a change to the ISP duration (although the settlement system would need modification with respect to those meters). 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.

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 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.
- There will be additional costs of 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.

An approach to reducing costs could be to allow customers 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.

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.

– **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. 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 result in a shift of balancing effort from the TSO to market entities with respect to the reserve

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

replacement process. With a shorter ISP, BRPs might become responsible for energy balance at an earlier stage of the process of reserve provision and replacement. Balancing by the TSO and by the BRP 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. TSOs typically have their own demand and intermittent generation forecasting tools. This cost may not necessarily change with a change to ISP duration.
- A decentralised forecast by market entities has the disadvantage that it 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 individual market entities will have better insights than the TSO about their own load and generation patterns. It is possible that a shift of balancing 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). Furthermore, costs incurred by market entities might increase due to the need to implement a more complex process in order to fulfil their obligations of energy balancing for reserve replacement.
- There is also a trade-off between achieving efficient cost outcomes through competition between market participants or by regulating TSOs. Absent a clear market failure, competition is usually thought to achieve more efficient outcomes than regulation, in part due to the information asymmetries inherent in regulation.

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 would need to handle more data on an ongoing basis and this is likely to come at an increased cost of processing and storing.
- **Metering 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.

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 will add uncertainty among industry participants during the transitional phase to the new ISPs. This is particularly critical during a period of significant investment needs for the sector. In addition, there will be uncertainty during the period prior to a definitive decision having been made as to the future ISP duration. 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.

- **Loss of liquidity.** Some BRPs, particularly those with inflexible plants may find it difficult to participate in markets with finer granularities if there are no options to trade block bids, discouraging trade in those markets. In addition, the 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.

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

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. However, it is difficult to model the welfare effect of higher or lower liquidity and therefore it may be necessary to measure liquidity using a non-monetary indicator, e.g. churn rates, or to measure the effect of a planning case on liquidity using a qualitative measure such as traffic lights.

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.** A shorter ISP duration may allow less controllable generation and loads to participate in the balancing market where they could not with a longer ISP duration. 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.

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.

There are likely to be different benefits from a shorter ISP duration and from ISP harmonisation *per se*.

Benefits from shorter ISP

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

– **Improved system frequency quality.** There may be an interaction between the ISP duration and deviations in system frequency.[6] 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. Particularly in systems with high renewable generation (especially solar) penetration, these changes at hour boundaries can be of such magnitude that they are not possible to address with secondary control. They may therefore result in frequency deviations.

  By reducing ISP duration, the scale of changes by participants may be expected to reduce. This could be viewed as an improvement in frequency quality. Frequency deviations could be addressed with greater volumes of faster ramping plant on the system, so this could also be viewed as a cost saving.

  Similarly, shorter duration ISPs may be expected to result in smaller changes to cross border trades from one ISP to another, also helping to reduce frequency deviations.[7]

6 For example, see Eurelectric and ENTSO-E, Deterministic frequency deviations – root causes and proposals for potential solutions, December 2011.

7 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

- **Reduced imbalance.** Shorter ISPs tend to incentivise market entities to reduce their imbalance positions. The question is how strong the incremental incentive is and which parties are able to react to those incentives. If shorter ISPs brings a reduction in imbalance positions, it would result in:
  - Lower demand for reserve capacity. If the maximum imbalance on the system is reduced the TSO may be able to reduce the amount of reserves held.
  - 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). The better optimisation allows the TSO to reduce the costs of meeting demand. A question is how the information flow from the market entity to the TSO is related to the ISP duration.
- **Sharper price 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. 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.

  Reducing the ISP duration means that more balancing costs are imposed on those entities with unforeseen minute by minute deviations (which contributed to the additional balancing costs), because the scope for entities to offset their own minute by minute deviations within the shorter 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. Shifting balancing actions from the TSO to the market is likely to increase the efficiency of imbalance management (and ultimately meeting demand). 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 that is immediately available to change output.[8]
- **Wider access to balancing 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. However, this effect depends on the specific rules of the balancing market.

Benefits from harmonising ISPs

[8] 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

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. Although not permitted by the network code, 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 both countries. Currently, programmed transfers 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. However, we note that it may not necessarily be efficient to move to a shorter ISP, something which the choice of planning cases is intended to test.

  A generator in country A with a 30 minute ISP duration may find it difficult to use its generation to fully participate in the market in an interconnected country, country B, with a 15 minute ISP duration. When the generator delivers into country B, if it is credited with a flat profile of power over the 30 minute period (i.e. 2 x 15 minute ISPs in country B), it will be difficult for the generator to manage its balance position in country B or for its output to be used to manage another party's balance position in country B.

  This barrier depends on the granularity of interconnector products.

– **Improved secondary market outcomes.** The shortest duration wholesale market traded product in each country is equal to the duration of the ISP. Market entities cannot trade with one another in real time during the ISP and therefore they have 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. However, this benefit is likely to be small since traders participating in multiple countries are likely to have designed their systems already to cope with different ISP durations.

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