CBA OF A CHANGE TO THE IMBALANCE SETTLEMENT PERIOD

A report for ENTSO-E

29 April 2016

CONTENTS

Exhibits

1 INTRODUCTION

1.1.1 The draft Network Code for Energy Balancing (NC EB) requires all TSOs to develop a proposal to harmonise the main features of imbalance settlement, subject to approval by all NRAs. However, the Imbalance Settlement Period (ISP) duration falls outside this proposal and may be drafted into the final version of the NC EB.

1.1.2 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 be assessed by ENTSO-E using a cost benefit analysis (CBA) to be undertaken before the NC EB enters the Comitology process.

1.1.3 ENTSO-E 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. The two reports have been published on ENTSO-E's website:

- Cost Benefit Analysis for Electricity Balancing – general methodology.
- Cost Benefit Analysis for Electricity Balancing – ISP harmonisation methodology.

1.1.4 Following on from the development of these documents, ENTSO-E has asked Frontier to support the process of undertaking a CBA of a change in ISP duration. This document sets out our findings of that analysis.

1.1.5 The analysis presented demonstrates that, under a range of assumptions, the net benefits could be either weakly positive or strongly negative. Although we would caution against placing too much emphasis on the absolute magnitude of estimates it is the case that the potential downside would be significant (relative to doing nothing) if the benefits turn out to be towards the low end of our estimates. In considering the results of our analysis policymakers should not assume that either the upper estimate or lower estimate of net benefits is more likely. Instead, they should focus on the range of possible outcomes and consider the outcome equally likely within this range.

1.1.6 The remainder of this report is structured as follows:

- In section 3 we set out the overall scope of our analysis and the process followed to undertake the CBA;
- In section 4 we set out our conceptual analysis of the potential effects resulting from a change to the ISP and therefore the analysis potentially required;
- In section 5 we set out details of the data request issued to stakeholders based on this conceptual analysis;
- In section 6 we consider costs, and describe the nature of responses to the questionnaire, the approach taken to estimating costs given the data received, and the results obtained;

- In section 7 we consider benefits, and describe the nature of the responses to the questionnaire, the approach taken to estimating benefits given the data received, and the results obtained;

- In section 8 we present the net CBA findings across the countries studied, and on a country by country basis; and

- In section 9, we summarise our conclusions from the analysis and highlight the key limitations of this analysis from a policymaking perspective.

1.1.7 The Annex provides further details of the analysis of costs associated with a change to ISP duration and provides results of the cost benefit analysis for a sensitivity to the planning cases defined in section 3.2.

2 OVERALL SCOPE AND PROCESS FOLLOWED

2.1 Introduction

2.1.1 In this section, we describe:

- the scope of the CBA; and
- the process we followed to carry out the CBA, including:
  - □ our conceptual analysis;
  - □ the approach taken to collecting data;
  - □ the approach taken to analysing stakeholder responses; and
  - □ our approach to developing conclusions.

2.2 Scope of the CBA

2.2.1 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 multiple factual scenarios were defined and considered, rather than a single scenario of moving to 15 minute ISPs throughout Europe.

2.2.2 Four factual planning cases were defined, which are compared in the CBA. The CBA for each planning case is assessed by comparison to the counterfactual planning case – where ISPs remain as of today. The CBAs for the four planning cases (relative to the status quo) are then compared against each other.

Exhibit 1. Five alternative planning cases
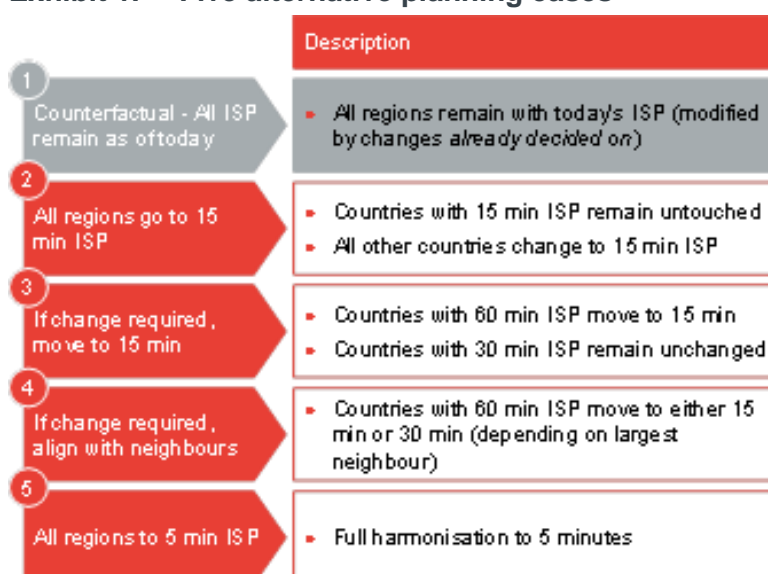
Source: Frontier Economics

2.2.3   Below, we:

- describe each planning case in more detail;

- set out some further overarching assumptions which form the scope of the
  CBA; and

- set out the approach taken to defining a geographical and temporal scope for
  the CBA.

Status quo – all ISPs remain as today

2.2.4   As a starting point, the CBA requires a thorough understanding of the status quo,
that is to say, the state of the world that will prevail absent ISP harmonisation.

2.2.5   In the status quo, ISP durations would be assumed to be equal to those observed
as of 2014 for all countries, as depicted in Exhibit 2.

Exhibit 2.   ISP duration in the status quo
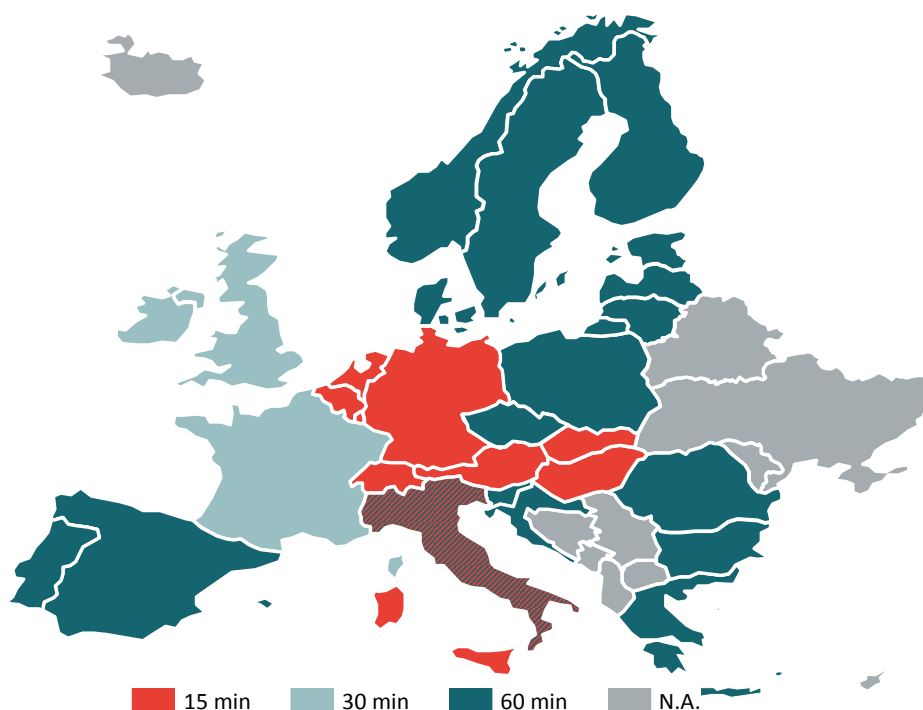
| 15 min | 30 min | 60 min | N.A. |

*Source: ENTSO-E WGAS, Survey on Ancillary services procurement, Balancing market design 2014, Jan
2014. 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*

2.2.6   The CBA also considers as part of the status quo any changes decided prior to
the CBA being carried out. This includes any changes to ISP duration as well as
other changes potentially driving the costs and benefits of changes to ISP
durations, such as:

- smart meter roll-out;

- changes to metering rules;

- changes to imbalance price setting rules;

- definition of ancillary services products;

- physical notification rules;
- etc.

Planning case 1 – full harmonisation to 15 minutes

2.2.7 Under full harmonisation, all ISP durations are aligned to 15 minutes across the EU+3 countries. As Exhibit 3 shows, in this planning case a change of ISP will be required in 20 countries (including Italy).

Exhibit 3.   ISP duration under harmonisation to 15 minutes
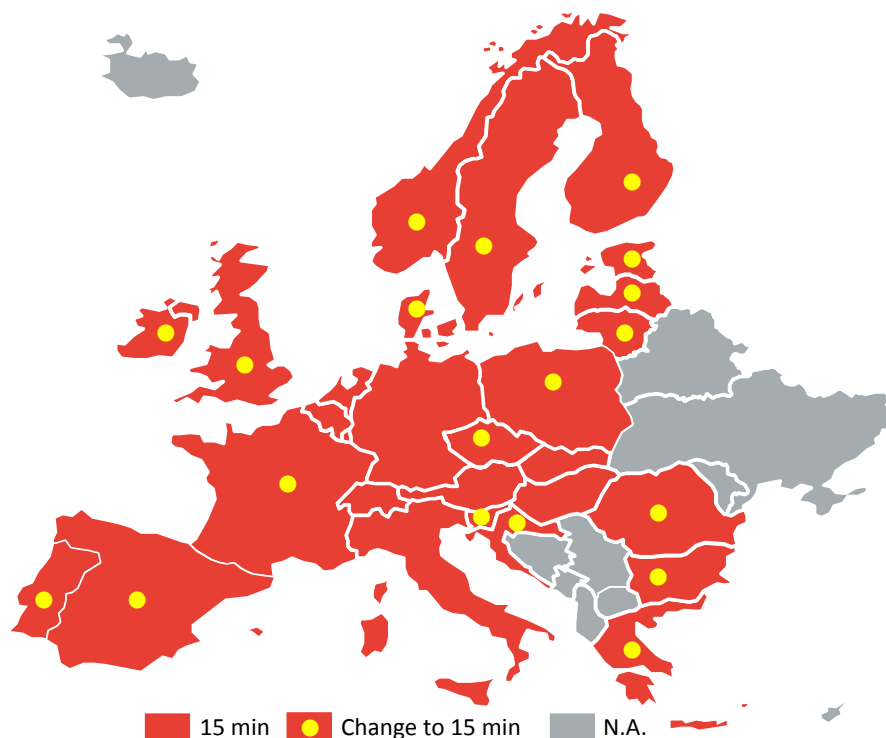
15 min   Change to 15 min   N.A.

Source: ENTSO-E WGAS, Survey on Ancillary services procurement, Balancing market design 2014, Jan 2014. Also TSO websites

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

Planning case 2 – harmonise to 15 minutes only those currently at 60 minutes

2.2.8 In this case, all countries currently with an ISP of 30 minutes or shorter retain their ISP duration, while countries currently with an ISP of more than 30 minutes reduce their ISP duration to 15 minutes.

2.2.9 This planning case has been derived with the potential expectation that it might minimize costs by changing ISP duration for as few countries as possible, while conforming to the framework guideline proposal of a maximum ISP of 30 minutes. This planning case will thereby test whether net benefits in the CBA are maximised by trying to minimise costs. The rationale for this planning case should however not influence stakeholders' views on costs and benefits.

2.2.10   As Exhibit 4 shows, in this planning case the ISP would be changed in 17
countries (including Italy).

**Exhibit 4.   ISP duration under harmonisation to 15 minutes of only those
currently at 60**
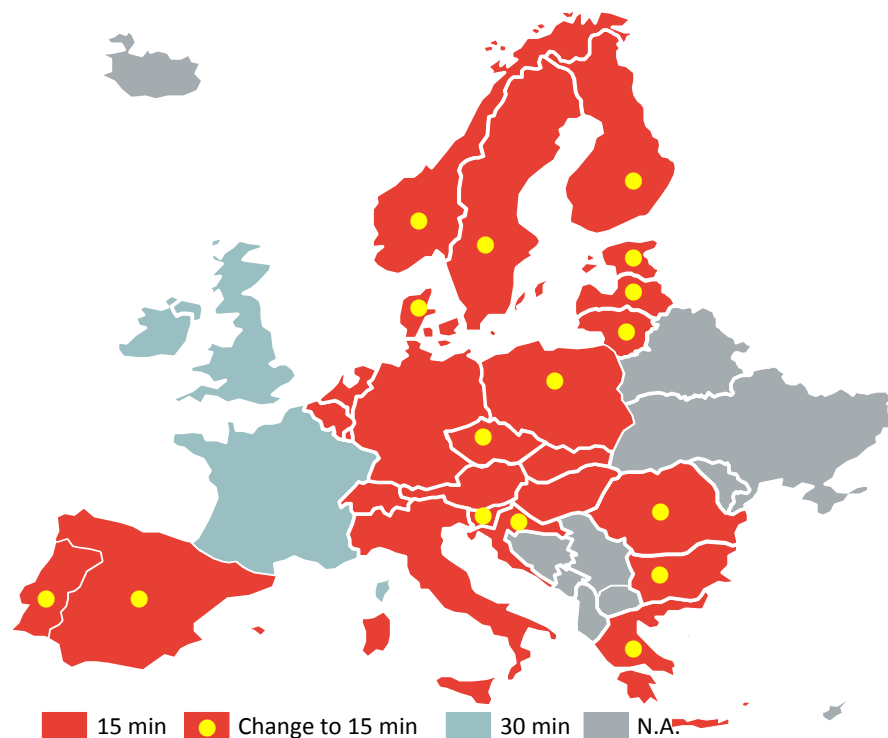
🟥	15 min	🟡	Change to 15 min	🟦	30 min	⬜ N.A.

*Source: ENTSO-E WGAS, Survey on Ancillary services procurement, Balancing market design 2014, Jan
2014. Also TSO websites*

*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*

Planning case 3 – harmonisation by matching ISPs in neighbouring countries

2.2.11   In this planning case, countries that currently have an ISP duration greater than
30 minutes would change ISP. However, they would 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 as with the previous planning case.

2.2.12   As Exhibit 5 shows, in this planning case the ISP would be changed in 17
countries (including Italy):

- Spain and Portugal would align their ISPs with France, resulting in one
harmonised south-western region with 30 minute ISPs;

- 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; and

- The Nordic and Baltic countries would shorten their ISP to 15 minutes.

Exhibit 5.   ISP duration under harmonisation to largest neighbouring country
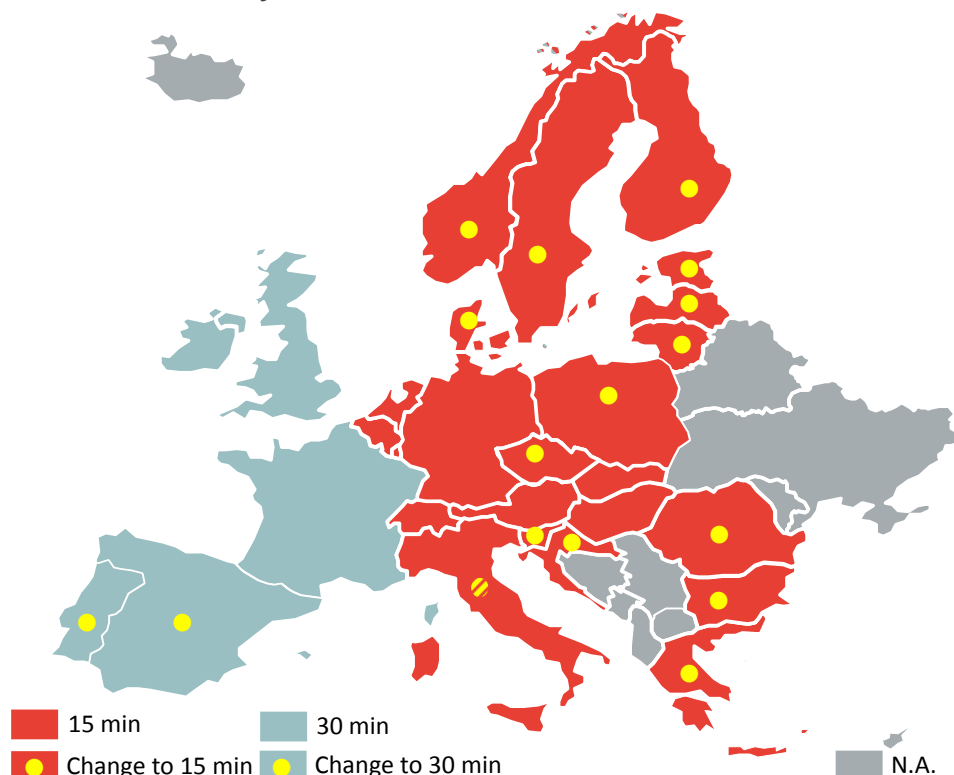
🟥 15 min	🟦 30 min	
🟥 Change to 15 min	🟡 Change to 30 min	⬜ N.A.

Source: ENTSO-E WGAS, Survey on Ancillary services procurement, Balancing market design 2014, Jan 2014. Also TSO websites

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

Planning case 4 – harmonise and all regions reduce to 5 minute-ISP

2.2.13   In this planning case, all ISPs are both harmonised and reduced in duration. The CBA considers the impact of ISPs being reduced to 5 minutes across countries. The reason for including this ISP is to test whether there are benefits to a very short ISP (consistent with the despatch time horizon used in some markets outside Europe) over and above those of complete harmonisation to a 15 minute ISP.

2.2.14   As Exhibit 6 shows, this requires that all 31 countries in the scope of the CBA change their ISP.

Exhibit 6.   ISP duration under harmonisation to 5 minutes
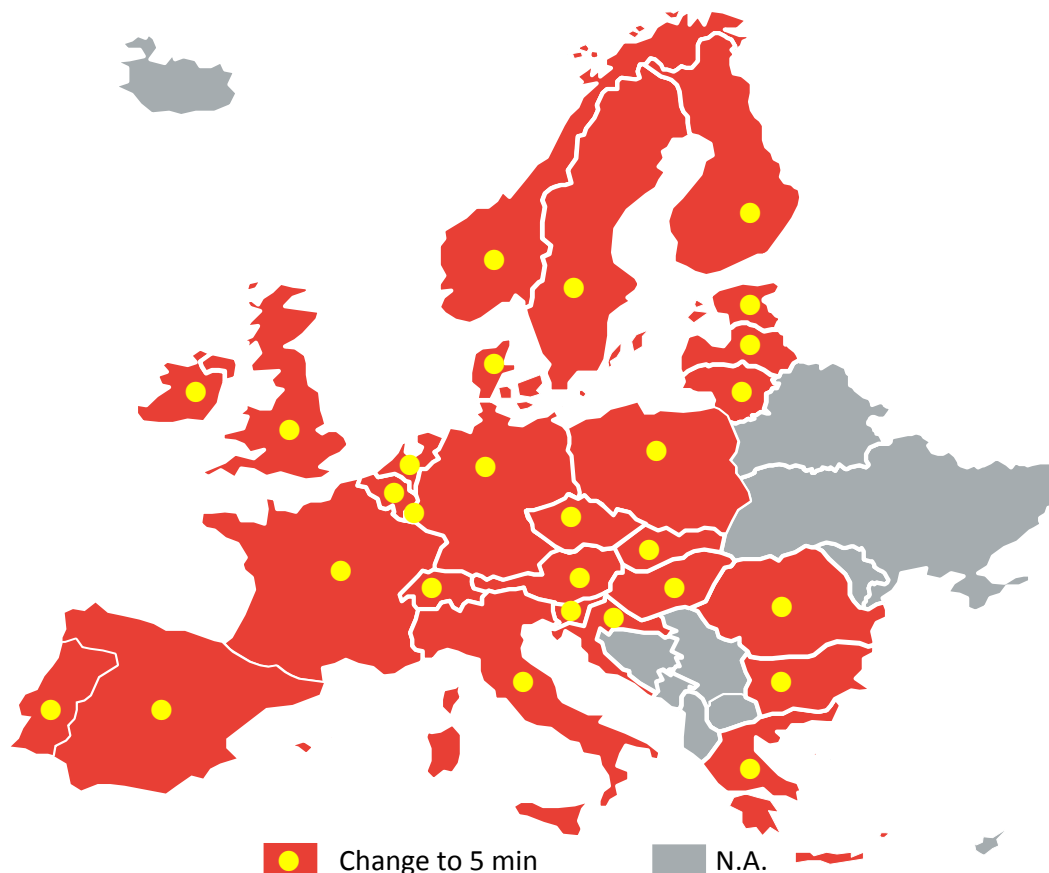
Source: *ENTSO-E WGAS, Survey on Ancillary services procurement, Balancing market design 2014, Jan 2014. Also TSO websites*

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*

2.2.15 It was also envisaged to consider the costs and benefits of harmonising and reducing ISP duration to 10 minutes across all countries. In order to contain the amount of information asked from stakeholders it was decided that the survey would focus on the 5-minute planning case.

Overarching assumptions for all planning cases

2.2.16 For each planning case, the only change assessed in the CBA is that of the ISP duration alone. In particular, the CBA assumes:

- No change in the actual imbalance pricing algorithm or more generally in any other part of the imbalance settlement process;

- No change in the balancing mechanism gate closure time;

- No change in Final Physical Notification content, process or timing;

- A fully functional target model with coupled intraday markets;

- The market time unit (MTU) for the intra-day market changes in line with the ISP duration; and

- The MTU for the day-ahead market remains as it is today.

2.2.17 In practice, if we consider the example of the move from a 30-minute to a 15-minute ISP duration, the CBA assumes that:

■ A number of trading products become available on the intraday market with delivery windows equal to 15 minutes (e.g. 14.15 to 14.30); and

■ The amount of time elapsed between gate closure time and the start of each delivery period does not change – if this was 30-minutes previously, then in the planning case it is still the case that gate closure occurs 30 minutes before the start of delivery. This will require new gate closures to be created across the day (e.g. 13.45 for the delivery period starting at 14.15).

Geographical scope

2.2.18 The geographic scope of the CBA includes the EU+3 (i.e. the EU + Switzerland, Norway and Lichtenstein).

Time frame

2.2.19 The analysis of costs and benefits is carried out over a time horizon of c. 10 years after implementation date. ACER's recommendation is that any changes to ISP duration are made by 1 July 2019. For simplicity, the CBA assumes that the necessary actions to implement the change are taken by the end of 2019.

2.2.20 Therefore, we estimate:

■ one off capital costs relating to the implementation of a change in ISP, which may be incurred in the years leading up to the change. We assume that the NC EB would have passed through the Comitology process and entered into force at the end of 2016. This would give stakeholders two and a half years from when they knew the requirements of any change imposed by the NC EB to the date by which the change had to be implemented; and

■ ongoing costs and benefits for the years 2020 and 2030, and interpolate between the results for these years.

2.3 Process followed

Conceptual analysis

2.3.1 At the outset, we undertook conceptual analysis to identify the areas of possible costs and benefits which we believed it would be worth considering, and the data required from stakeholders in order to assess them.

Collecting data

2.3.2 The analysis of the costs and benefits of a change to the ISP relies heavily on input from stakeholders representing market participants of various different classes across Europe. This is because:

■ The costs incurred as a result of changes to the ISP are likely to depend on the conditions in specific countries and even in specific companies. For example, if a particular country has relatively few meters that measure and

record data by the ISP, or if a particular company has installed meters which can be remotely reconfigured, then costs of change may be significantly lower than in other situations.

■ The benefits are likely to depend on the behaviour of participants. For example, if participants engage in active trading of shorter energy products to achieve a close balance between physical and contracted positions, a shorter ISP may reduce TSO costs in a way which would not happen if participants were less engaged (e.g. because of a different imbalance settlement regime).

2.3.3 As a result, based on our conceptual analysis, we designed and circulated a questionnaire to a wide range of European stakeholders to understand their views in detail of the likely costs and benefits of changes to the ISP. The survey asked questions in relation to each stakeholder's:

■ Role in the market (i.e. aggregator, broker, data provider, DSO, end consumer (metered), generator (metered), imbalance settlement agency (non-TSO), market operator, meter provider, metering service provider, power exchange, retail supplier, trader and TSO);

■ Scale, in order to allow responses to be scaled up to allow a view to be formed on costs and benefits for individual countries and for Europe as a whole;

■ Views on costs (quantitatively and qualitatively); and

■ Views on benefits (quantitatively and qualitatively).

2.3.4 Prior to issuing the data questionnaire, we held discussions with ENTSO-E's Working Group and we held a stakeholder workshop setting out our views on cost and benefit categories and outlining our proposed overall approach to the analysis.

2.3.5 The questionnaire was made public by ENTSO-E and was distributed to industry groups in order that they could make their members aware of its existence. As a result of the overall timescale for the project, stakeholders had a relatively short (7 working week) period to respond to the questionnaire. During this period we held two teleconferences with stakeholder representatives to respond to questions about the questionnaire and the overall approach. We responded in writing to questions submitted as part of this process. ENTSO-E also maintained an up to date questions and answers document on its website to help stakeholders to understand the questionnaire.

2.3.6 As part of the questionnaire process, we recognised that we would receive data which was confidential to the companies concerned. We therefore committed that information gathered through the survey could only be published in an aggregated form, e.g. by stakeholder group and by country.

Analysis of stakeholder responses

2.3.7 In total we received 131 surveys from a variety of stakeholder types and market areas. Surveys differed significantly from one another in terms of the scope of questions answered; we discuss the representativeness and level of documentation of responses separately for costs and benefits below (see sections 5 and 6).

2.3.8 Upon receipt of the stakeholder responses, we undertook a number of activities. In particular, we:

- Collated the quantitative and qualitative information submitted;

- Identified significant "extreme" data points and areas where there were ambiguities in relation to responses; and

- Contacted respondents to clarify these points, and in some cases edited the data submitted to address differences in interpretation of questions. We contacted over 70 respondents to clarify aspects of their submissions.

2.3.9 Some responses were received after the deadline for submission. We have tried to take the information from these responses into account in the analysis although in some cases it was not possible in the time available.

2.3.10 It is important to note that we did not undertake a full "due diligence" activity on each data item submitted. This would not have been possible within the time available for the project, and in many cases, we would not have had the necessary insight to assess whether every aspect of costs and benefits being submitted by parties could be fully justified. Nor was the dataset submitted sufficient to allow a process of removal of all but the most clear statistical outliers. Therefore our "data cleansing" process is best understood as one of removing extreme points, and sense checking remaining data against other responses (within country and across Europe).

2.3.11 Even prior to this data cleansing activity, the dataset from respondents had material gaps. In particular:

- Very few respondents provided a complete quantification of individual benefit expectations, although qualitative comments were helpful in understanding the broad scale of the expected impact, and helpful partial quantification (e.g. of the price effect without the volume effect) was provided in some cases;

- A material number of submissions on costs had data gaps, where we needed to understand whether zero costs or benefits were expected or whether stakeholders expected a non-zero value but were simply unsure of magnitudes; and

- The data required to "scale up" estimates of cost to a country-wide and Europe wide level were incomplete.

Approach to developing conclusions

2.3.12 As a result of the nature of the dataset received, we needed to "fill in" data gaps in a number of areas:

- In relation to costs, the key area in which we had to fill in data related to the scaling up of costs. We relied on public source data for proxies for cost drivers for a number of key cost items to allow us to scale up estimates to individual countries and to the EU+3; and

- In relation to benefits, we had to rely on public source data to develop stylised illustrations of the potential benefits which could be expected in areas where respondents had qualitatively agreed that a benefit could be expected.

2.3.13 We discussed our approaches in these areas with ENTSO-E's WGAS.

2.3.14 We then carried out analysis to fill gaps in the stakeholder dataset. Again, the time available for this activity was constrained by the overall timeline for the project. Having carried out this analysis we discussed our initial findings on costs and benefits with ENTSO-E's WGAS and with stakeholders.

3 CONCEPTUAL ANALYSIS OF ISP CHANGE

3.1 Introduction

3.1.1 In this chapter, we set out our conceptual analysis of the potential changes to costs and benefits that an ISP change could be considered to have. This analysis formed the framework of our data collection exercise.

3.1.2 We consider separately the potential impact of a change to the ISP on:

- costs; and
- benefits.

3.1.3 We then also consider the distributional issues associated with these costs and benefits, i.e. how the costs and benefits fall to different stakeholders.

3.1.4 For the purposes of considering the size and distribution of costs and benefits we assume that demand for electricity is perfectly inelastic, i.e. the quantity demanded does not change with a change to price. For a small change to price, which would be the likely extent of any average price effect due to a reduction in ISP, we take the view that this is a reasonable assumption.

3.2 Impact on costs

3.2.1 A change to the ISP could have a one-off impact on costs (e.g. capital expenditure on IT systems or meters associated with the implementation of change) and ongoing costs (e.g. increased trading costs).

3.2.2 Our analysis relates to *incremental* costs of either type. Conversely, any costs incurred in the status quo should be ignored, including where the costs will be incurred in future under the status quo. In particular, costs of any changes decided prior to the CBA (e.g. changes to metering rules, imbalance setting rules etc.) are not related to a change to ISP duration.

3.2.3 We envisaged seven possible categories of cost resulting from a change to the ISP. These were:

- Trading platforms;
- Metering and notification systems;
- Scheduling and settlement;
- Billing systems;
- BRP forecasting, trading and scheduling;
- Documentation; and
- Network-related costs.

3.2.4 Below we describe each briefly in turn.

Trading platforms

3.2.5 This cost item corresponds to the cost of modifying systems and processes to support intraday trading. The cost arises because the reduction in ISP duration will mean that platforms used for trading in intra-day timescales will need to be adapted to allow trade of shorter duration products.

3.2.6 This cost item could include costs in relation to:

- The cost of updates to systems and processes to support trading in shorter time windows. For power exchanges, this could include trading support systems, and for participants, this could include trading and risk management systems;

- Development of new trading algorithms: beyond updating existing systems, there could be a need for new algorithms supporting the change in market clearing processes.

Metering and notification systems

3.2.7 This cost item corresponds to the need to update the software or physically exchange the existing meters, update software related to providing the meter data to the operator of the settlement systems, update software related to the notification of physical plans for generation or consumption to the TSO and / or operator of the settlement systems and update the software related to the notification of contractual quantities to the operator of the settlement systems.

3.2.8 It also relates to the incremental ongoing operating costs of handling additional data from meters, and providing additional data on physical plans and contractual quantities.

3.2.9 These costs arise because a shorter ISP duration means consumption data needs to be read over a shorter period and data required by the TSO and data required for settlement must be provided over a shorter period. We assume here that:

- the meters considered here are only those that are read for the purpose of imbalance settlements; and

- a meter is changed/reconfigured to match the new ISP duration only if prior to the ISP reduction the meter reading period matched ISP duration, and there is a clear ongoing business case for it to remain at the prevailing ISP duration.

3.2.10 In practice, this would typically mean that the meters that are changed/reconfigured are meters for:

- generators connected directly to the transmission network, and larger generators connected to the distribution network;

- larger end-consumers connected directly to the transmission network; and

- meters that can be found at the points of exit from the transmission network to the distribution network.

3.2.11 These meters would be changed / updated only if they were being read on the same periodicity as the imbalance settlement period duration in the status quo (counterfactual). Meters installed on the premises of smaller customers (which

are billed based on profiling) would not be expected to be changed because of the change in ISP duration. Even those smaller customers that currently are billed based on metering at ISP frequency need not necessarily have their meters updated with a change to ISP duration unless there was a clear business case for doing so. We also understand that in a number of markets imbalance settlement and other billing actions use non-ISP metered data (e.g. use profiling) despite the fact that it is technically possible for the corresponding meters to be read at ISP granularity. In this type of case, we assume that these meters will not be changed.

3.2.12 This cost item could include:

- the one-off cost of replacing/updating the meters, which could in turn include changing meters, updating meters on site, remotely updating meters, changing meter reading (data collection) systems, and changing meter management systems (validation, storage and processing of data);

- incremental operating costs of managing new meters, including the cost of sending the increased amount of data from the metering responsible party to other market parties including the settlement system, the cost of changes to customer reporting systems etc.

- the cost of incremental change to processes required to provide shorter timeline data relating to contract volume notifications for each ISP to the operator of the settlement system. Where relevant, this notification would normally take place prior to gate closure and could be made by generator and load BRPs and in some cases by power exchanges;

- the cost of incremental change to processes required to provide shorter timeline data relating to notifications of physical generation and consumption plans to the TSO (or other service provider) prior to gate closure. In some cases the shorter ISP duration would require a higher frequency of notifications without changing the granularity of the data provided and in other cases the granularity of the data provided would decrease as the ISP duration is reduced; and

- the cost of changing the systems and processes used to allocate volumes associated with non-ISP based metering to ISPs.

Scheduling and settlement

3.2.13 This cost item corresponds to the need for TSOs, PXs, BSPs, BRPs, imbalance settlement responsible organisations and other stakeholders to adapt their scheduling and settlement systems to the new ISP duration. This cost will likely relate to developing new IT systems or modifying existing systems.

3.2.14 This could include:

- the incremental cost of changing the systems and processes used to schedule plant over a shorter period of time (e.g. increased frequency in scheduling data);

- the incremental cost of changing the systems and processes to calculate and settle imbalances to deal with the shorter ISP, and the participant systems which interact with these;

- the incremental cost of changing the systems and processes to facilitate the settlement of trades (bilaterally and on exchange) on a shorter ISP basis; and

- incremental costs incurred by the TSOs and imbalance settlement responsible organisations and other relevant parties to adjust the frequency of data publication to the new ISP duration.

Billing systems

3.2.15 Stakeholders billing their 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 cost is expected to occur for retail suppliers, the operator of the central imbalance settlement, TSOs and possibly DNOs.

3.2.16 This is likely to include the incremental cost of changing systems and processes to facilitate billing of customers based on the shorter ISP duration.

BRP forecasting, trading and scheduling

3.2.17 This cost item corresponds to the increased effort made by BRPs to reduce their imbalance position by taking more actions with a finer granularity pre gate closure due to the shorter ISP[1] (Note: it is assumed that Gate Closure Time remains unchanged from the status quo). This encompasses developing new forecasting tools as well as developing new trading and data handling systems.

3.2.18 For BRPs, this includes a one-off cost of developing new forecasting tools or adapting old ones to reduce imbalances. For all stakeholders, there is a one-off cost of developing trading and data handling systems if the reduction in ISP results in increased trading on the intra-day market to manage imbalance positions, and ongoing costs associated with the maintenance of these associated systems and processes.

Documentation

3.2.19 This cost item corresponds to the one-off cost associated with updating "central" country-specific documentation (balancing codes, network codes, ancillary services codes and agreements, documented procedures underlying codes (e.g. for profiling), transportation charging agreements etc). The incidence of this cost will vary by country: in some jurisdictions this could fall principally on the TSO, in others it may fall to imbalance settlement responsible organisations (as is the case in GB), or on the association of market parties (as is the case in Finland for some parts of the documentation).

3.2.20 The cost should also include the one-off cost associated with decentralised bilateral agreements (e.g. standard contracts for the sale and purchase of power or options to sell or buy power).

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[1] See section 3.3 for a detailed description of this impact.

Network-related costs

3.2.21 This cost item relates to the one-off and ongoing costs incurred by the DNOs and TSOs to adapt their network to the shorter ISP. This might include:

- upfront and ongoing costs associated with adapting the loss procurement system to the new ISP duration; and
- up front and ongoing costs associated with adapting network optimisation systems to the new ISP duration.

3.3 Impact on benefits

3.3.1 We have broken potential benefits down into five separate areas:

- Reduced balancing costs;
- Increased secondary trading volumes;
- Improved investment outcomes;
- Other benefits; and
- Pass/fail criteria.

3.3.2 We discuss each in turn below.

Reduced balancing costs

3.3.3 The first category of benefits relates to a reduction in the costs of balancing the system as a result of greater activity by participants to manage their own position and, as a result of doing so, to better balance national supply and demand pre gate closure.

Shift from balancing energy to intraday energy

3.3.4 In the status quo, Balancing Responsible Parties (BRPs) submit physical notifications and balancing bids and offers to the TSO, leading to balancing actions by the TSO post gate closure. Subsequent to a reduction in the ISP duration, there may be scope for BRPs to use the information on forecast generation at ISP duration granularity and take an increased number of trading actions in the intraday market (pre-gate closure) or physical actions (also pre-gate closure) to reduce their imbalance position in each ISP. This would in turn reduce the need for TSO balancing actions post gate closure. At the same time there could be a shift between manual and automatic reserves leading to a cost reduction (or increase) resulting from the reserve dimensioning methodology.

3.3.5 The existence of a benefit as a result of this change in behaviour rests on there being a difference in the price (or cost) achieved by the BRP when taking actions at a finer granularity on the intraday market relative to the balancing price achieved by the TSO (in EUR or local currency/MWh). This may be because of differences in the resources available in intraday and balancing markets, and could also be because of differences in trading strategy.

3.3.6 The net impact on welfare associated with this benefit would equal the sum of:

- changes in total balancing costs; and
- changes in wholesale costs.

Lower reserve capacity cost

3.3.7 Similarly, TSOs may hold reserve to be activated post gate closure to manage system balance. Subsequent to a reduction in ISP duration, BRPs may instead withhold more capacity in the relevant market area (i.e. deliberately withhold it from forward markets) in order to allow for it to be sold on the intraday market with finer granularity or to be used for physical actions with finer granularity in the period leading up to gate closure. This may allow TSOs to hold less reserve capacity.

3.3.8 The net impact on total welfare would equal the sum of:

- the change in total balancing costs via the reduction in capacity held in reserve by the TSO for balancing purposes; and
- the change in wholesale costs.

3.3.9 In addition, structural or deterministic imbalances related to BRP ramping at the breakpoint between ISPs may be reduced due to a reduction in ISP duration, potentially reducing the reserve capacity held by the TSO.

Greater intraday competition from cross border BSPs

3.3.10 Where ISPs are not currently harmonised across a border, it is likely to be difficult for BRPs in one country to sell energy in intraday markets at the lower ISP granularity. This is because this would cause balancing costs for the TSO in the market with the longer ISP which would not be targeted on those gaining from the trade.

3.3.11 Harmonisation of the ISPs across borders would therefore allow greater competition for the provision of intraday energy at a shorter MTU in one of the interconnected markets. This should in turn reduce the cost of serving energy in that market. This could also lead to an increase in the volume of energy sourced from intraday markets.

3.3.12 The welfare effect would equal the difference between the dispatch cost achieved cross-border and that achieved on the local market.

3.3.13 We assume that this benefit is not relevant to trading in balancing timescales. This is because during balancing timescales, TSOs could manage the interconnector flow over time periods significantly shorter than the ISP, and so in theory could exchange blocks of energy with any duration irrespective of the ISP definition.

3.3.14 There could be a further benefit as a result of BRPs withholding reserve capacity across borders rather than in national markets. If this were to exist, the welfare benefit would come from the difference in cost of withholding capacity on a cross-border basis, rather than domestically.

Greater entry of BSPs to intraday markets

3.3.15   A reduction in the ISP could allow more technologies to participate in intraday markets.

3.3.16   For instance, Demand-Side-Response (DSR) capacity that currently finds it difficult to commit to hourly or half-hourly offers could potentially make quarter-hourly or five minute offers on the intraday market. This might lead to reduced prices in intraday markets from existing demand response capacity.

3.3.17   Similarly, shorter ISPs might make it easier for any particular renewable energy sources to participate as Balancing Service Providers (BSPs) – this might be the case for instance where RES providers are able to commit to volumes on the shorter ISP duration where they might not have been able to for the longer ISP duration.

3.3.18   There could be an impact on competition in balancing markets as well. However, this would depend on their structure. If TSOs were already willing to purchase balancing energy in blocks of time less than the ISP duration, the impact could be negligible. We assume that, if it were felt beneficial, TSOs could encourage greater participation within balancing markets without a general change to the ISP.

3.3.19   The welfare effect of greater competition from new sources of flexible power should be the reduced the cost of serving demand.

Increased secondary trading volumes

3.3.20   Liquidity is important for a number of reasons, for example, a liquid market is likely to:

- involve lower search costs for participants;
- allow participants to hold less collateral, as price should be less volatile and transacting can take place more quickly; and
- allow participants to take decisions on a firmer basis because the price signal is more reliable.

3.3.21   For all of these benefits, it is liquidity relative to likely physical delivery volumes which is important. The absolute level of secondary trading in a given product is less important than the level of liquidity relative to the demand for that product. In general, there will be lower demand for trading in shorter granularity products. Therefore while the absolute level of liquidity of MTU products may reduce with a shorter ISP, it is likely to be more important to understand whether the level of liquidity increases or decreases *relative to demand for the shorter MTU product*[2].

3.3.22   While aggregate liquidity on products with a shorter MTU may reduce, there are reasons to believe that, using a definition of liquidity relative to demand, a reduction in the ISP could result in an increase in liquidity on intraday markets:

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[2]   Markets can always aggregate MTU products into longer products if those suit market participants better.

- as we note above, a reduction in ISP duration may be expected to lead BRPs to undertake trading actions with finer granularity on intraday markets in order to be less in imbalance after the gate closure time;

- harmonising ISP and MTUs across markets should lead to trading becoming more uniform, which should in turn reduce transactions costs. This should result in more marginal trades becoming economic and hence greater liquidity; and

- harmonising ISPs and allowing greater cross-border trading should result in liquidity from more liquid markets being translated easily into less liquid markets[3].

3.3.23 The magnitude of benefits will depend on how increases in liquidity translate into system costs and prices. Liquidity translates into a bid-ask spread which reflects the cost to market participants of searching to make a transaction in that particular market. The welfare effect should be measured as the impact of a lower bid-ask spread on the volumes of trade in the relevant market.

Improved investment outcomes

3.3.24 In the status quo, it is assumed that flexible capacity receives price signals for investment from the combination of reserve, balancing and wholesale prices, subject to the plant's ability to participate in each market.

3.3.25 All else equal, a transfer of revenues from the balancing or reserve markets to the wholesale market could lead to more efficient investment outcomes. This might be, for example, because of a greater transparency and ability to forecast wholesale day ahead and intraday prices compared to balancing and reserve prices.

3.3.26 The welfare effect would be equal to the reduced investment costs arising from better investment decisions meeting a given demand level.

Other benefits

3.3.27 There are a number of other benefits which may be relevant to considering a change in ISP. These include that:

- it is possible that reducing ISP duration improves frequency quality, by reducing the number and extent of frequency excursions (as a result of a reduction in structural or deterministic imbalances at ISP boundaries);

- it results in an improvement in security of supply as a result of:
  - greater effort on short term balancing by BRPs; and
  - greater availability of flexible sources (e.g. cross-border BSPs, new investment in BSPs) which are available at an earlier point in time.

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[3] Joining an illiquid market to a less liquid market is not likely to result in an average level of liquidity across both markets. It is more likely to lead to a bigger market with liquidity levels at (or even beyond) the liquidity levels on the more liquid of the two markets.

Pass / fail criteria

3.3.28 There are also a number of pass / fail conditions set out in the Energy Balancing Network Code which should be met by a change in ISP. These include:

- Facilitating participation of demand side response;
- Facilitating participation of RES sources;
- Ensuring operational security;
- Fostering non-discrimination and transparency in balancing markets
- Ensuring that the procurement of balancing services is fair, objective, transparent and market based;
- Avoiding undue barriers to entry for new entrants;
- Being technically feasible; and
- Allowing TSOs and BRPs to fulfil their obligations.

3.3.29 From the above conceptual analysis, it appears likely that a change in ISP would pass these criteria.

3.4 Distribution among geographies

3.4.1 The above costs and benefits will accrue to different parties and jurisdictions across the EU + 3. It is also relevant to consider the distribution of such costs and benefits.

3.4.2 There will clearly be different distributions of costs among Member States depending on the planning case under consideration. For example, a number of Member States already have a 15 minute ISP, and so the costs for them in a move to a harmonised 15 minute ISP would be negligible.

3.4.3 Benefits may also be unevenly distributed among Member States. For example, while Member States currently with a 15 minute ISP might not have costs, they may secure benefits as a result of greater cross-border trading opportunities from neighbours currently on a longer ISP.

3.4.4 As a result of differences in the geographic distribution of costs and benefits, there may be jurisdictions with net costs or net benefits which are significantly different from the average.

3.5 Distribution among stakeholders

Costs

3.5.1 For each of the cost categories above, it is possible to identify who bears the initial cost. We can make some additional assumptions to form conclusions about where the costs are likely to fall eventually.

3.5.2 These assumptions include:

- Regulation: TSO costs (or imbalance settlement agency costs) can be assumed to be passed through in full to end consumers (possibly after a period of time as existing price controls end).

- Competition:
  - □ Prices on balancing and wholesale markets are reflective of marginal costs of the marginal installation, and so increases in the marginal cost of the marginal source will be borne by customers;
  - □ Longer term fixed and investment costs are expected to be borne by generators in the short term and progressively passed on to customers over time, as the wholesale price adjusts to reflect the entry cost. Therefore, any variations in generation fixed costs are assumed to be split 50/50 across generators and customers;
  - □ Power prices are incurred by retailers and passed on to customers in full.

3.5.3 Based on these assumptions, we have set out in Exhibit 7 the original party bearing costs and where we would expect the cost finally to fall.

Exhibit 7.   Distribution of costs

Cost category	Likely channel of cost pass through	Cost ultimately borne by…
Trading platforms	Trading platforms will recover increased costs through trading fees. A change to trading and internal costs faced by trading parties will be passed on through wholesale and retail prices to end consumers	Consumers
Metering and notification systems	Generation meter costs could be assumed to be split 50:50 between generators and consumers via the wholesale price. Network meter costs could be assumed to be passed on through regulated prices to end consumers and costs of end consumer meters are borne by end consumers	Consumers and, to a lesser extent, generators
Scheduling and settlement	Increased costs for TSOs, PXs, BSPs, BRPs will be passed on through network charges, the wholesale price (e.g. partial cost pass-through by generator BRPs) and the retail price to end consumers	Consumers and, to a lesser extent, generators
Billing systems	Directly borne by large customers or passed on to smaller customer via retail prices	Consumers
BRP forecasting and trading	Increased BRP costs will be passed on through the wholesale price (e.g. partial cost pass-through by generator BRPs) and the retail price to end consumers	Consumers and, to a lesser extent, generators
Document-ation	Generation documentation costs can be assumed to be split 50:50 between generators and consumers via the wholesale price. Network documentation costs are assumed to be passed on through regulated prices to end consumers and costs of retail documentation are borne by end consumers	Consumers and, to a lesser extent, generators
Network related costs	Increase in network charges to network users (load/generators, depending on the national regulation).	Mostly borne by consumers, with a small share borne by infra-marginal generators

Source: Frontier Economics

Benefits

3.5.4 Similarly, it is possible to consider the distribution of the potential benefits. Below we consider this separately for each of the benefits, based on similar assumptions to those used for costs.

Reduced balancing costs: reduced TSO energy actions

3.5.5 A reduced volume of TSO actions could result in a number of different distributional impacts:

- TSOs or imbalance settlement parties. TSOs will no longer have to take a number of balancing actions, reducing payments related to bids accepted in the balancing market. We assume that any cost savings are transferred to end consumers (unless incentive mechanisms provide for the TSO to retain some of the cost saving);

- Consumers. Changes in consumer surplus will reflect variations in prices in the wholesale and balancing markets, multiplied by the volumes of energy dispatched in each market (in the status quo and subsequent to the change in ISP duration). The direction of the change in surplus in each market will vary depending on the system status in a given ISP period. The overall yearly effect on consumer surplus can therefore be considered to be an increase by the average price difference between the price achieved by the BRP when taking actions at a finer granularity on the intraday market relative to the balancing price achieved by the TSO price times the corresponding volume of power shifted from the balancing to the intraday market. This assumes that the difference in prices reflects the difference in underlying costs; and

- Generators. Producer surplus will decrease with the reduction of trades in the balancing market and this will be offset by the increase in producer surplus from additional actions in the wholesale market. As with consumer surplus, the direction of the change in producer surplus in each market will depend on whether upward or downward balancing actions are being reduced in each period. Similarly with consumer surplus we consider that upward and downward effects net out across the year. The outstanding variation in producer surplus therefore stems from any changes in costs of serving demand.

Reduced balancing costs: reduced TSO capacity withholding

3.5.6 A reduced volume of TSO reserve capacity procurement could result in a number of different distributional impacts:

- TSOs see a reduction in the cost of reserves held for balancing purposes. This reduction in costs is likely to be passed on to network users, and eventually to end-users;

- Generators. Generators may see reduced revenues from TSO reserve contracts, which we would expect over time to be passed on in part to customers in the form of higher prices. To the extent generators then withheld different volumes of capacity than TSOs, we would also expect a change in wholesale prices which would impact producer surplus. They also

may see a change in production costs which would need to be taken into account. Any such effects on wholesale prices and production costs would be considered as taken into account in the previous sub-benefit item, as the analysis carried out there does not distinguish between different sources for price changes. However, responses to the questionnaire have indicated that they do not think generators would change their behaviour in terms of which market their capacity is made available to. Therefore, a reduction in the capacity procured by TSOs would reduce generator revenues in the short term and in the long run generators could be expected to react by having less capacity on the system (again we assume the resulting price effect is taken into account in the previous sub-benefit item); and

- End-users. We would expect end-users to see reduced network charges, and some changes in wholesale prices as described above.

Reduced balancing costs: cross-border

3.5.7 A increased use of cross-border resources intraday could result in a number of different distributional impacts:

- Consumers will be impacted on both sides of the border. Consumer surplus will change in line with changes in prices; and

- Generators will also be impacted both sides of the border. Producer surplus will change in line with changes in prices. Generators may also face a change in dispatch costs which will also need to be taken into account, although this would potentially be shared between consumers and generators.

Reduced balancing costs: new BSPs

3.5.8 Increased entry or activity by new BSPs could result in a number of different distributional impacts:

- Consumer surplus will increase by the product of the average reduction in intraday prices times total demand; and

- Generator surplus will decrease by the average reduction in intraday price times the volume of balancing energy, net of the reduction in the cost of serving demand.

Increased secondary trading volumes

3.5.9 It is likely that the benefits of any increased liquidity will be passed on to consumers through retail prices.

Improved investment outcomes

3.5.10 We would assume that changes in investment costs are partly passed onto consumers and partly borne by generators.

4 DETAILS OF DATA REQUEST

4.1.1 Based on this conceptual analysis, we circulated a data request to stakeholders across Europe in order to capture data to facilitate a quantified CBA.

4.1.2 This questionnaire was divided into four sections, as described in Exhibit 8.

Exhibit 8. Structure and content of data request

Section	Content
Respondent details	Details of the roles(s) undertaken by the respondent, and the relevant jurisdictions in which they operate
Current system	Details of the current system within which the stakeholder operates, covering arrangements for imbalance settlement, procurement of balancing and ancillary service products, and arrangements for metering
Costs	Estimates of costs to be incurred by the stakeholder for each of 30, 15 and 5 minute ISP duration, split across all of the cost categories identified above, and broken down into capex and opex to be incurred in the run-up to 2020 (capex), and estimated values for 2020 and 2030. The questionnaire allowed for a low, medium and high value for each cost item.
Benefits	As for costs, estimates of the benefits relevant to each stakeholder for each of 30, 15 and 5 minute ISP duration, in 2020 and in 2030.

Source: Frontier Economics

4.1.3 Accompanying this data request was a guidebook, setting out the context of the CBA and a description of the data items being requested.

4.1.4 We noted that the questionnaire requested confidential data. We therefore made it clear that ENTSO-E would treat all information provided by individual stakeholders as part of the survey as confidential. We committed that information gathered through the survey would only be published in an aggregated form, e.g. by stakeholder group and by country. Hence, details on individual submissions or data items are not provided in this report.

5 ANALYSIS OF COSTS

5.1 Introduction

5.1.1 In this section, we set out the quantitative analysis of costs based on the responses from the questionnaire (see section 4) and our approach to deriving cost inputs to the CBA from the responses for the different planning cases (see section 2.2).

5.1.2 We proceed in five steps:

- We first provide an overview of responses to our questionnaire with respect to data coverage and quality of data;

- We then describe the approach used to get from a data set consisting of responses which represent only a proportion of stakeholders and countries to costs that represent EU + 3;

- We define two scenarios for metering costs to reflect two different approaches to adapting smart metering to reflect the change to ISP (profiling or replacement / reconfiguration);

- We provide an overview of the resulting total costs by line item and country; and

- We conclude with remarks as to how these costs can be interpreted.

5.1.3 Throughout this section all costs are presented in real terms and as a net present value (NPV) in 2019. We do not refer to the names of individual respondents to respect confidentiality.

5.2 Overview of responses to the questionnaire

5.2.1 Responses to the questionnaire constitute the starting point to determine costs inputs for the CBA. In this section we

- outline data quality and data coverage by country and line item; and

- provide an overview of reported cost estimates.

Data coverage and data quality

5.2.2 We received 131 responses to the questionnaire in total. This includes 21 responses that did not contain any cost information and multiple responses by some stakeholders that submitted a separate response by business activity (e.g. one stakeholder from GB submitted 5 different responses).

5.2.3 The number of non-zero estimates of cost varied significantly by planning case. We received 28 non-zero responses with cost information for a change to a 30 minute ISP, 70 non-zero responses for a 15 minute ISP and 75 non-zero responses for a 5 minute ISP. This reflects the need for more countries to change with the shorter ISP duration.

5.2.4   Exhibit 9 provides an overview of the number of non-zero cost responses by country. Note that a non-zero observation may contain very different degrees of information: it ranges from an almost complete set of cost estimates for relevant line items and for the low/central/ high case (this is the case for 17 responses) to a single central cost estimate for one out of eight line items.

Exhibit 9.   Number of non-zero cost responses by country
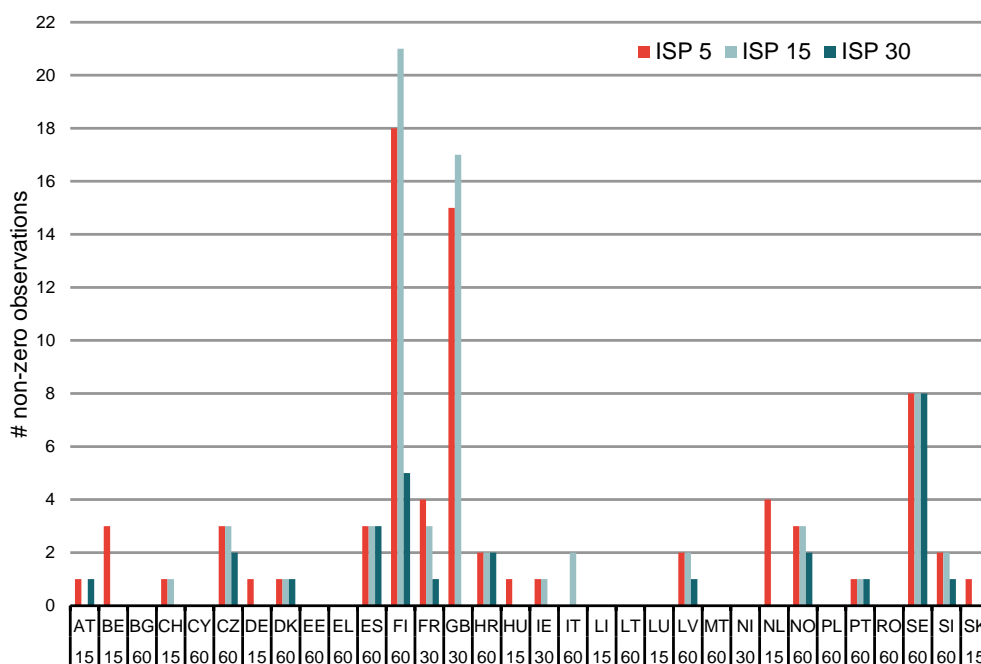
Source: Frontier

Note: Number below country code represents current ISP period (in minutes).
Note that a single questionnaire response can account for up to three observations (one for each ISP period). A non-zero observation means that at least one single value is entered.

5.2.5   The overview by country shows that three countries stand out in terms of data coverage: Great Britain (up to 17 responses), Finland (up to 21 responses) and Sweden (8 responses). These three countries combined account for 66% of all responses for ISP 15. This high response rate is partly due to multiple separate responses being made by a single company, i.e. one response for each of several different business activities (retail, trading, generation, etc.).

5.2.6   There can be several reasons as to why a country has no non-zero responses:

- No response from a country;
- No response for the current ISP period (e.g. BE for ISP 15); and
- No significant cost expected by respondents from that country.

5.2.7   Exhibit 10 provides an overview of the share of responses for a change to an ISP period of 5/15/30 minutes (columns) by the current ISP period of respondents.

Exhibit 10. Share of non-zero responses by current ISP duration

	Change to ISP 5	Change to ISP 15	Change to ISP 30
Current ISP 15	16%	1%	4%
Current ISP 30	27%	30%	4%
Current ISP 60	57%	69%	93%

Source: Frontier

Note: There are 2 respondents with positive costs reported for an ISP period equal to the current ISP period – these values have been removed from our analysis. Costs of changing from an ISP of 15 minutes to a longer ISP duration have been reported in some cases but are not relevant for our planning cases.

5.2.8 The shares of responses show a clear tendency for countries which currently have a longer ISP period of 30 or 60 minutes to have a greater number of non-zero responses. One explanation is that these countries are more likely to be affected by one of the planning cases presented in section 2.2 than a country that currently has a shorter ISP duration.

5.2.9 In summary, we have incomplete geographic coverage with responses received from 22 out of 31 countries in our geographic scope. However, responses cover the largest power markets in Europe and the countries with no non-zero responses are mostly smaller countries. The data coverage is mixed, with only 20% of responses (17 out of 104 responses that provided any cost information) providing an almost complete coverage by line item and ISP case.

Reported costs by respondents

5.2.10 In this section we provide an overview of total expenditure (Totex) reported by respondents for the three different ISP durations. Respondents were asked to provide estimates for three different cases: low case, central case, high case. In this section we provide an overview of responses for the central case due it having the best data coverage.[4]

5.2.11 The values in this section are shown in their raw form. This means they include outliers and data errors (see section 5.3) and all responses for a change to ISP 30, which are apart from Spain and Portugal not relevant for the planning cases we have defined in section 2.2.

5.2.12 Exhibit 11 provides an overview of aggregate reported Totex by cost item for the central case.

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[4] Between 16% and 33% of responses (depending on the ISP duration) only submitted cost data for the central case.

**Exhibit 11. Aggregate reported Totex by line item (central case) – all ISP
cases**
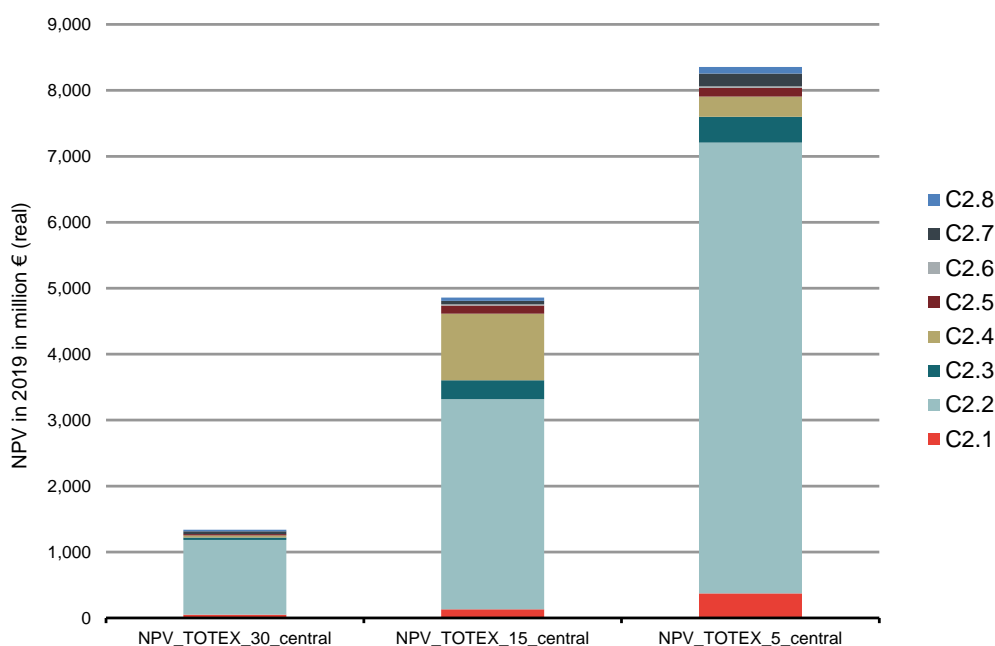
Source: Frontier

Note: Values are based on raw data and therefore include outliers.

5.2.13   The net present value in 2019 (NPV 2019) of reported Totex varies significantly
between ISP 30 and ISP 5:

- ISP 5 Totex is more than three times as high as ISP 30 Totex due to

  □ (i) higher reported Totex by country; and

  □ (ii) more countries being affected by a change to ISP 5;

- Metering and notification costs (2.2) are by far the largest cost item,
accounting for 66% (ISP 15) and 82% (ISP 5) of aggregate reported Totex.

5.2.14   Exhibit 12 illustrates reported Totex by retail customer.

**Exhibit 12. Total reported Totex per retail customer by costs by country –
all ISP cases**
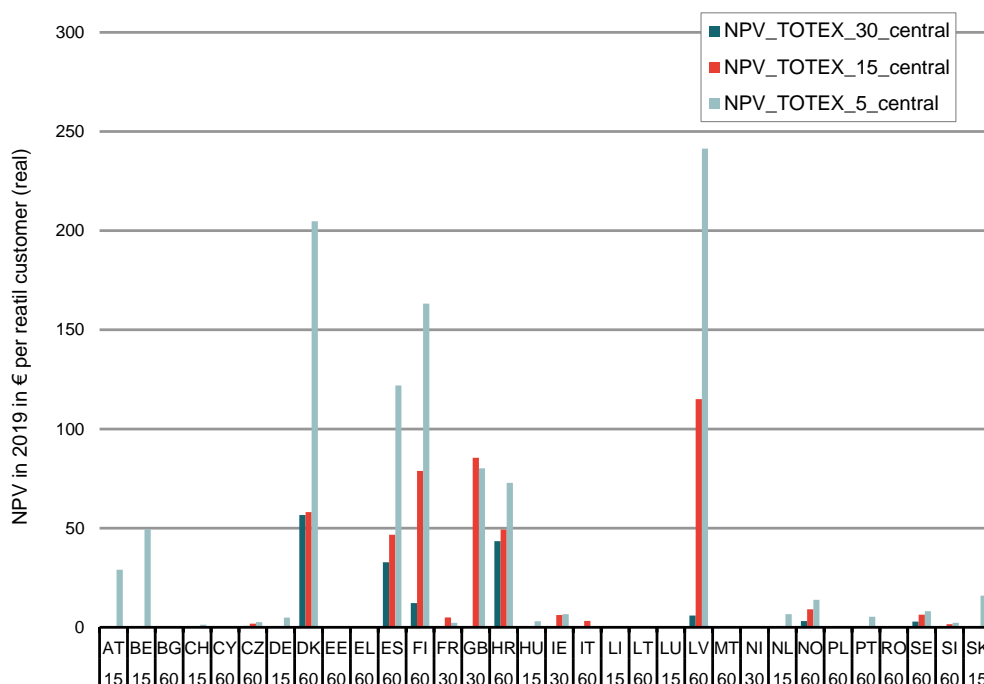
Source: Frontier

Note: *Aggregate reported Totex by country is divided by the number of retail customer (see Annex A).
Values are based on raw data and include outliers. The numbers below the country codes represent
the current ISP period (in minutes).*

5.2.15   The reported Totex per retail customer shows a large variation between the
countries in our sample, ranging from, for example for a change to ISP 15, 2
€/customer (Czech Republic, Slovenia) to 115 €/customer (Latvia).

5.2.16   However, when interpreting these values one should keep in mind that they
represent total costs for countries to very different degrees. Reported Totex may
stem from a response by a stakeholder that only represents a small fraction of
the total market and who submitted estimates only for minor cost items. Other
respondents may have provided estimates for their entire power system and for
several line items (including metering costs which is the line item with the largest
costs).

5.2.17   We describe in the next section how we processed the data to deal with
imperfections and gaps.

5.3 Approach to data processing

5.3.1   The overview of responses has shown, that the data set based on the raw
responses to the questionnaire contains two types of data imperfections:

■   Incomplete representivity of a country – For the countries where we have
responses to the questionnaire, in many cases the responses are not fully
representative of the whole country[5].

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[5]   For example, not all retailers and generators which could be affected by a change to the ISP period have
provided a cost estimate.

■ Gaps – There are 10 smaller countries for which we have not received any response. Even for countries for which responses were provided, there are some cost items for which no estimates were provided[6].

5.3.2 To derive cost estimates as an input to the CBA, we proceed in three steps, as shown below.

Exhibit 13. Steps of data processing

1 Compile useable data from questionnaire	2 Scale up within countries to be fully representative	3 Close gaps for countries without information
● Collect useable data from the questionnaire □ Non-zero observations □ Removal of outliers and costs reported for ISP durations exceeding current ISP duration	● Scaling up to country-level data □ Only information from within each country is used for this step □ Scaling up, also using external info (e.g. retail market shares)	● Closing gaps for countries w/o cost information □ Average information across countries used □ Scaling up, also using external info (e.g. retail market shares)

Source: Frontier

5.3.3 Each of the three steps is explained in more details below.

Compile usable data (step 1)

5.3.4 As a first step, we compile all available responses into a data set. In doing this we have validated the data by: analysing each questionnaire individually to identify ambiguities and data errors, sending more than 60 emails to respondents with queries about their responses, and making more than 40 manual corrections to responses.

5.3.5 Given the limitations of the dataset, a formal statistical outlier analysis is not feasible due to:

■ the low number of observations by line item and/or country; and

■ the possibility that cost differences between countries relate to fundamental drivers (e.g. a higher share of meters that have to be replaced (C2.1), differences in the need to update software (C2.4)) which could be erroneously identified as outliers.

5.3.6 We have therefore only identified a few "extreme" cost estimates which could not be explained by fundamental differences between countries and which would have a significant influence on the results of the CBA if left in the sample. The data outliers and how we have dealt with them are listed in Exhibit 14.

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6   E.g. for Germany (relevant only for ISP 5), only the four TSOs have submitted a response. Their responses do not include distribution metering costs which would be relevant for retail companies.

Exhibit 14. Outlier analysis for reported costs

No.	Line item	ISP 5	ISP 15	ISP 30
C2.1	Trading platforms	One observation for DE: OPEX moved to benefit side (impact on liquidity)		
C2.2	Metering and notification systems	One observation for ES: OPEX removed	One observation for ES: OPEX removed	One observation for ES: OPEX removed
C2.3	Scheduling and settlement			
C2.4	Billing systems	One observation for GB removed		
C2.5	BRP forecasting, trading and scheduling			
C2.6	Documentation			
C2.7	Network related costs	One observation for HR: CAPEX removed	One observation for HR: CAPEX removed	
C2.8	Other costs			

Source: Frontier

Note: Names of respondents and individual values are not listed due to confidentiality requirements.
In addition, we have removed reported cost values if the current ISP period is shorter or equal to the new ISP period (i.e. observations from FR and AT on ISP 30 and CH for ISP 15).

5.3.7 In addition we have removed reported cost values if the current ISP period is shorter or equal to the new ISP period (i.e. observations from France and Austria on moving to ISP 30 and for Switzerland for moving to ISP 15) since we do consider planning cases where countries would have to increase their ISP duration compared to the status quo.

Scaling up (steps 2 & 3)

5.3.8 The data set based on the questionnaires contains two types of information gaps that have to be filled by assumptions based on information provided:

- Within our sample (incomplete representativity) – Cost estimates which only partially represent costs in a country are scaled up based on information provided by respondents where available (e.g. their market share) and external scaling variables otherwise;

- Outside our sample (gaps) – We have applied a sample average for a certain cost item to close gaps for countries without observations, applying scale variables to control for differences in size of countries.

5.3.9 Exhibit 15 provides an overview of the scale variables used by line item. Further details on the magnitude of scaling by country and cost item are provided in Annex A.

Exhibit 15. Scale variables used for the cost analysis

No.	Line item	Scale variable within sample (full country representativity	Scale variable out-of-sample (gaps without observation)
C2.1	Trading platforms	None	100% (i.e. apply sample average)
C2.2	Metering and notification systems	Transmission network: None Distribution network: Market share of reported costs where available (proxy: no. of large DNOs divided by no. of observations, source: Eurostat)	No. of retail customers (source: Eurelectric, 2013)
C2.3	Scheduling and settlement	No. of main retailers and generators (source: Eurostat)	No. of main retailers and generators (source: Eurostat)
C2.4	Billing systems	No. of customers with ISP readable meters (0.8.2) (proxy: retail market share)	No. of retail customers (source: Eurelectric, 2013)
C2.5	BRP forecasting, trading and scheduling	No. of main retailers and generators (source: Eurostat)	No. of main retailers and generators (source: Eurostat)
C2.6	Documentation	None	100% (i.e. apply sample average)
C2.7	Network related costs	None	No. of TSOs
C2.8	Other costs	None	None

Source: Frontier

Note: Tables with the scale variables are provided in Annex A.

5.3.10 We have used the following scale variables by line item:

- Trading platforms (C2.1) – This cost item corresponds to the cost of modifying systems and processes to support intraday trading. Costs have mainly been reported by large international energy companies, TSOs and an international power exchange. Responses are treated as representative for the countries within our sample and no scaling is applied. For countries with no observation we have applied the sample average. To ensure consistency across the ISP cases, we have set the costs for a change to ISP 5 at least as high as for ISP 15.

- Metering and notification systems (C2.2) – This cost item corresponds to the need to update the software for metering and notification systems or physically exchange existing meters in the transmission and distribution network. Transmission network costs are provided by TSOs and are treated as representative for the country. Distribution metering costs, mainly provided by DSOs, are scaled up by their respective market share where available. Where this information could not be determined, we scaled up by the number of large DSOs (source. Eurelectric (2013)) divided by the number of observations in our sample. To fill the gap for countries outside our sample,

we applied the number of retail customers to the sample average cost per retail customer[7].

- Scheduling and settlement (C2.3) – This cost item corresponds to the need for stakeholders to adapt their scheduling and settlement systems. To scale up costs for countries within our sample, we have applied the ratio between the number of domestic large retailers and generators (source: Eurostat) and the number in our observation. The sample average is scaled by the number of large retailers and generators for countries outside our sample.

- Billing systems (C2.4) – This cost item captures the impact of a shorter ISP on changing systems and processes to facilitate billing of customers. Reported costs are scaled up by the total number of customers with ISP meters (item 0.8.2 of the questionnaire). Where this information was not provided, we rely on retail market shares of respondents. For countries outside the sample, we apply the number of retail customers to the sample average.

- BRP forecasting, trading and scheduling (C2.5) – This item reflects the incremental costs for balancing responsible parties (BRPs) of changing the systems and processes to accommodate a shorter ISP. Since our sample contains a subset of the main retailers and generators, reported costs are scaled up by the ratio of the number of large retailers and generators in a country to the number in our observation for the country. For countries with no observation, the number of large retailers and generators is used to scale the sample average.

- Documentation (C2.6) – This cost item corresponds to the cost of modifying codes and agreements affected by a change to ISP duration. Since there is no obvious scale variable and reported costs are relatively small, no scaling is applied and the sample average is applied uniformly to countries with no observation.

- Network related costs (C2.7) – This cost of adapting networks to a shorter ISP is mainly a TSO-related costs and no scaling variable is applied to responses. The sample average is then applied to the number of TSOs for countries with gaps.[8]

- Other costs (C2.8) – This category is a residual item for any incremental costs that do not fit under any of the categories above. Since it captures specific cost items that may not occur in other countries no scaling is applied.

5.4 Definition of two scenarios for metering costs

5.4.1 In this section we describe how and why, based on the comments received from respondents and the interaction with stakeholders, we define two different scenarios for metering costs:

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[7] The sample average is adjusted for country-specific high costs per retail customer in the Scandinavian countries and GB, see section 5.4 for details.

[8] This is equivalent to uniform scaling since all countries outside our sample have only a single TSO.

- Scenario "Profiling" – in this scenario we assume that some of the reported costs can be avoided by introducing profiling, instead of reading all smart meters according to the ISP, they are read at a longer time interval (typically the current ISP) and consumption is allocated to ISP periods using an algorithm ("load profile"). In this scenario we have modified the costs for the Scandinavian countries and GB (and Spain for ISP 5) using the sample average while for all other countries we rely on reported costs where available; and

- Scenario "Unadjusted stakeholder data" – this scenario directly relies on the information provided to us by market participants in the questionnaires. The only adjustment is to the sample average used to fill gaps where we have not included the Scandinavian countries and GB (and Spain for ISP 5).

5.4.2   We proceed as follows: we first review the cost concept we require in the CBA, and then review reported costs for distribution metering (line item 2.2) which reveals a large degree of variation. Based on the information revealed by respondents, we then derive cost values for the two scenarios above.

Review of cost concept: incremental economic cost

5.4.3   Before we get into the details of metering costs it is useful to recall the cost definition set out in section 3.2. Our analysis relates to *incremental economic* costs of changing the current ISP to a shorter period of 30, 15 or 5 minutes, depending on the respective planning case. This means we focus only on costs that are:

- *Incremental* – This means that any costs incurred in the status quo should not be included, including future costs that will be incurred under the status quo. This means that costs related to any changes decided prior to the CBA are ignored since they are not influenced by the decision to change the ISP. For example, if smart meters were already rolled out, only costs for reconfiguration (or if not possible earlier replacement) should be considered. Therefore, incremental costs can be no greater than the Totex reported for a shorter ISP.

- *Economic* – "Economic" here means that costs should reflect an optimisation when there are different options available to react to a change in the ISP. This is particularly relevant for metering costs: if existing smart meters (which can have a significant cost impact if replaced due to the large number of sites affected) are read at the current ISP period it might not be cost-efficient to replace them instantaneously under a shorter ISP but rely on *profiling* (i.e. allocation of the measured load to the shorter ISP period using an algorithm) until the meters reach the end of their life time.

Reported metering costs for distribution show high level of variation

5.4.4   We have shown in section 5.2 that metering costs (line item 2.2) account for the vast majority of reported costs in our sample – between 65% (ISP 15) and 82% (ISP 5). This implies that particular attention should be paid to this line item as it

has a significant impact on total costs and therefore on the overall result of the CBA.

5.4.5 Exhibit 16 shows metering costs for the distribution network[9] per retail customer. These costs have been determined based on the reported costs (after removal of outliers), scaled up to the full country level. Apart from the scaling variables where we have partly relied on external data (e.g. market shares of distribution network operators in a country, see Annex A for details), these costs are only determined based on the information provided by respondents from the respective countries. A positive cost number indicated that at least one observation for line item 2.2 was available in the data set.

Exhibit 16. Scaled-up reported metering costs (distribution) per retail customer for ISP 15 and ISP 5
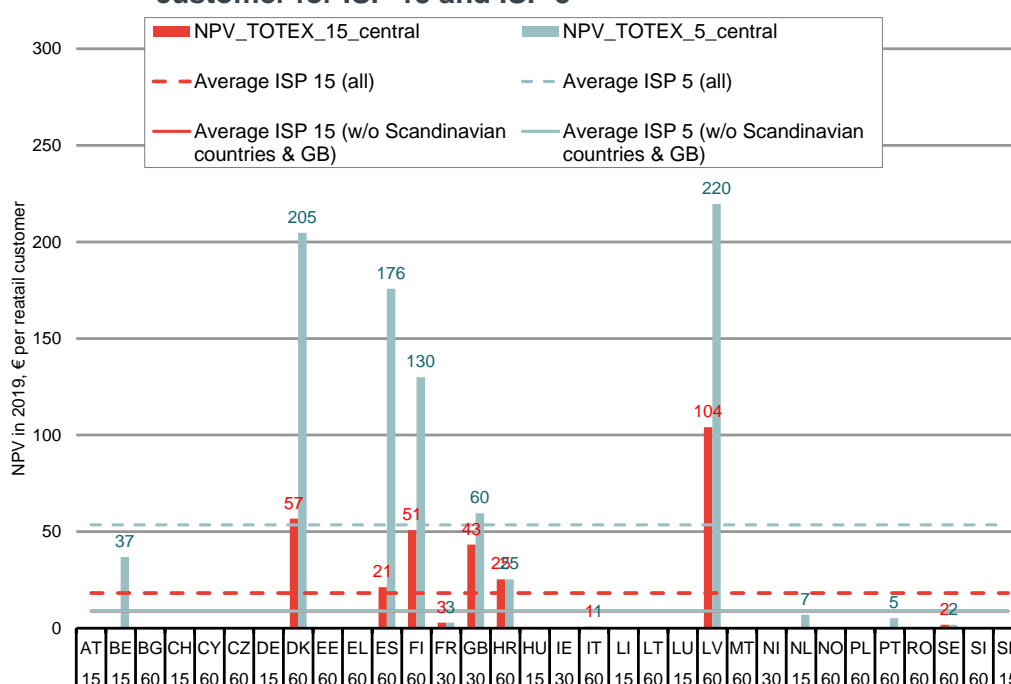
Source: Frontier

Note: *This graph contains reported metering costs (2.2) for distribution networks, scaled up to be fully representative for the countries with observations and divided by the number of retail customers. Number below country code represents current ISP period (in minutes)*

5.4.6 Exhibit 16 shows a large variation between the countries for which we have reported metering costs. For ISP 15 these range from below 10 € per retail customer for France, Italy, the Netherlands, Portugal and Sweden to 60 € per retail customer in GB and the Scandinavian countries (including Finland). It is important to note that very high or low values in the sample have a twofold effect: (i) they directly lead to high/low cost inputs for the respective country in the CBA and (ii) they influence the sample average which is used to fill gaps for countries without observations (most notably Germany as the largest country in our sample for ISP 5).

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[9]   We treat metering costs for the transmission network reported by transmission system operators (TSO) separately.

5.4.7 There are several potential reasons for the large variation:

- Differences in unit costs per meter replaced/reconfigured – respondents might have used different estimates for unit costs to determine overall costs. Due to limited data availability (only a few stakeholders set out assumptions on unit costs) it is not possible to trace back the variation of this cost driver.

- Share of meters that require replacement/remote reconfiguration – the share of meters that have to be replaced (incurring high costs) compared to share of meters that can be reconfigured (remotely) is another key driver for cost differences, for example, in Italy and Portugal smart meters are can be read by 15 minute intervals and in Sweden smart meters can be reconfigured remotely.

- Number of meters affected – Countries with a higher number of meters that are read at ISP scale should lead to higher costs. This is particularly the case for Scandinavian countries which have started the smart meter roll-out and have already achieved either full (Finland, Sweden) or partial roll-out (Denmark at 55%).

5.4.8 In countries with an advanced smart meter roll-out, assumptions on the treatment of smart meters are crucial for the estimate of metering costs. As part of the information gathering and validation process, we engaged in discussions with stakeholders on the interpretation of the results of the questionnaire. These interactions revealed a significant difference as to how metering costs (item 2.2) are determined. Stakeholders from GB and Scandinavian countries (including Finland) reported high costs per retail customer compared to the sample average because they assume that a large share of the infrastructure (including smart meters themselves) has to be replaced. For example, one stakeholder from Denmark reported that:

> "*1.8 million meters [out of 3.3 million] need to be changed or reconfigured in order to handle 15 min. […] 15 min meters can also handle 30 min, but all 3.3 million meters will have to be changed in order to handle 5 minutes*".

5.4.9 This suggests that irrespective of the benefits from such a replacement, a full change to all existing smart meters would be assumed. However, the same stakeholder acknowledged that profiling would be an alternative:

> "*All the end-user meters, does not necessary have to be on 15 min. resolution in order to go to 15 min. ISP, a profiled solution can still work. Or consumption can be on 60 min. and production on 15 min.*"

Resulting metering costs for ISP 15

5.4.10 In this section we present the scaled-up costs for the two scenarios for a change to ISP 15. The results for ISP 5 are determined in a similar fashion and are presented subsequently. Metering costs for ISP 30 apply only to Portugal and Spain and are provided in Annex A.

5.4.11 To determine total metering costs we distinguish between:

- Distribution metering costs reported by distribution network operators and – to a lesser extent – other stakeholders[10]; and

- Transmission network costs reported by TSOs[11].

5.4.12 Both cost components are summed to derive total costs.

Metering cost for distribution networks

5.4.13 For metering costs for the distribution network, which include all costs in relation to smart meters, we mainly rely on responses by DSOs. For Denmark, Latvia and Portugal, TSOs provide system-level cost estimates that include distribution metering costs for the entire network.

5.4.14 As described in section 5.3, scaling up is done in two steps:

- Step 1: Scaling up to full country representativity where we have observations – the light blue bars in Exhibit 17 and Exhibit 18 represent responses from all stakeholders to our questionnaire on line item 2.2 that are in relation to the distribution network. Where responses are not fully representative, we scale up observations according to the share of the distribution network represented by respondents. Fully scaled values are represented by the teal bars.[12]

- Step 2: Gaps for countries were we do not have a response are filled by the sample average per retail customer, scaled by the number of retail customers. To determine the sample average of 8€/retail customer (NPV 2019), we have included all countries other than GB and Scandinavian countries since they are subject to high country-specific costs. Final cost results are represented by the red bars.

5.4.15 The only difference between the two scenarios below is the treatment of GB and Scandinavian countries. In scenario "Profiling", the sample average for all other countries is applied while in scenario "Unadjusted stakeholder data" responses for GB and the Scandinavian countries (including Denmark) are used unadjusted.

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[10] For some countries (Denmark, Latvia and Portugal) TSOs provide system level cost estimates that include distribution metering costs for the entire network.

[11] Reported costs by stakeholders other than TSOs for ISP meters connected to the transmission grid (e.g. by generators with power plants connected to the extra high voltage grid) are included in distribution metering costs.

[12] Where the teal and the light blue bar are of equal size, responses were considered fully representative, for example, for Denmark and GB.

**Exhibit 17. Total metering costs of the distribution network for ISP 15 –
scenario "Profiling"**

NPV_TOTEX_15_central: Metering and notification systems (C2.2) - Distribution
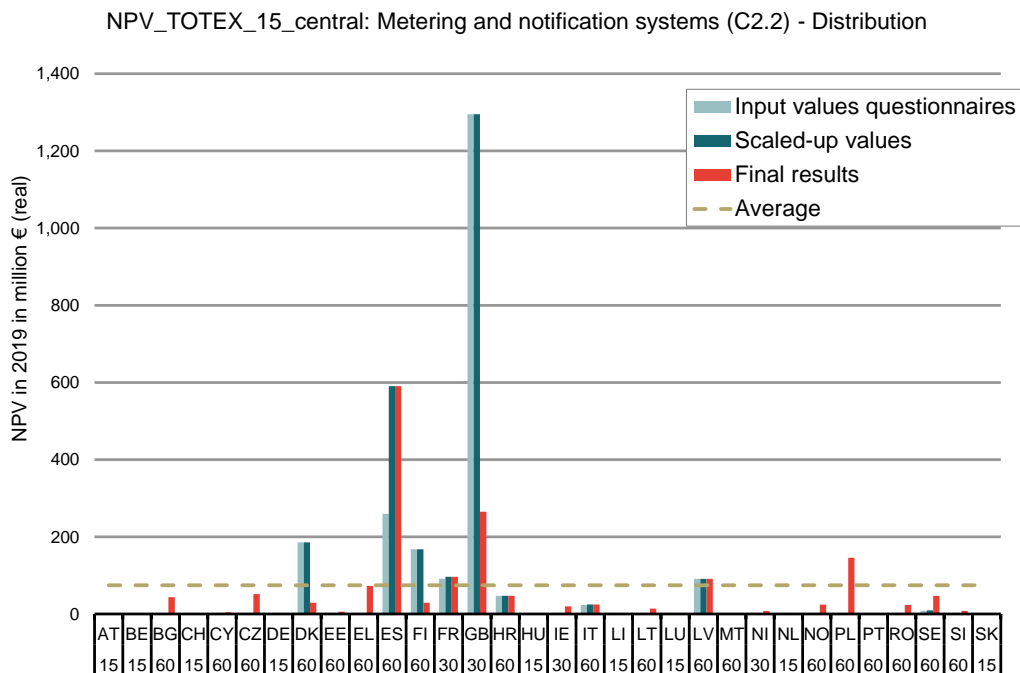
Source: Frontier

Note: See Annex A for further details.

5.4.16   Scenario "Profiling" leads to total distribution metering costs of € 1.6 billion across
all 32 regions.   Spain, with € 590 million, accounts for almost 40% of the total
cost, followed by GB with adjusted costs of around € 265 million.

**Exhibit 18. Total metering costs of the distribution network for ISP 15 –
scenario "Unadjusted stakeholder data"**

NPV_TOTEX_15_central: Metering and notification systems (C2.2) - Distribution
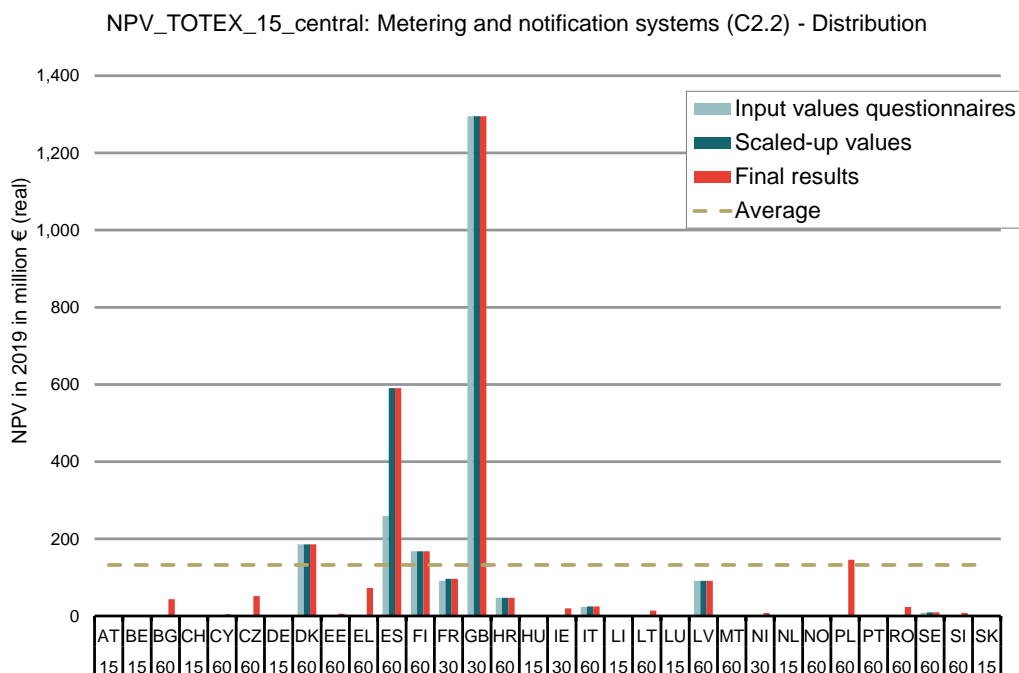
Source: Frontier

Note: See Annex A for further details.

5.4.17 Total distribution metering costs in scenario "Unadjusted stakeholder data"
amount to € 2.9 billion, almost double the costs of scenario "Profiling". This
difference is only driven by higher costs for GB and the Scandinavian countries,
of which GB accounts for the vast majority of additional costs of more than € 1
billion. Denmark, a country with just 3.3 million customers – a tenth of size of
France, has the third highest absolute costs, being € 670 million in NPV 2019
terms (more than six times the cost for France).

Metering costs for the transmission network

5.4.18 Exhibit 19 shows the resulting metering costs for the transmission network for all
countries. For transmission metering costs we do not define scenarios since
"profiling" is not a viable option for meters connected to the extra high voltage
grid. Generators and large customers connected to this voltage level are
typically metered in shorter periods than the ISP period, e.g. minute-by-minute.

5.4.19 As described in section 5.3, scaling up is done in two steps:

■ Scaling up to full country representativity where we have observations – the
light blue bars in Exhibit 19 represent responses from TSOs to our
questionnaire on line item 2.2. Since TSO responses are fully representative,
there is no need to scale up (i.e. a scaling factor of 100% is applied, see
Annex A for a complete overview of all scaling factors by line item) and the
teal bars which represent the scaled up values are equal to the value of
responses.

- Gaps for countries were we do not have a response are filled by the sample average of € 5.0 million, scaled by the number of retail customers (i.e. accounting for differences in the size of respective national power systems). Final cost results are represented by the red bars.

5.4.20 Exhibit 19 shows the results for all countries. On average, metering costs for the transmission network in countries which are affected by a change to an ISP period of 15 minutes amount €3.4 million, slightly below the within-sample average of €5 million since on average countries outside our sample are smaller in terms of the number of connected customers. Countries which are currently already at an ISP period of 15 minutes (see values below the country code) would not incur any *incremental* cost.

Exhibit 19. Total metering costs of the transmission network for ISP 15
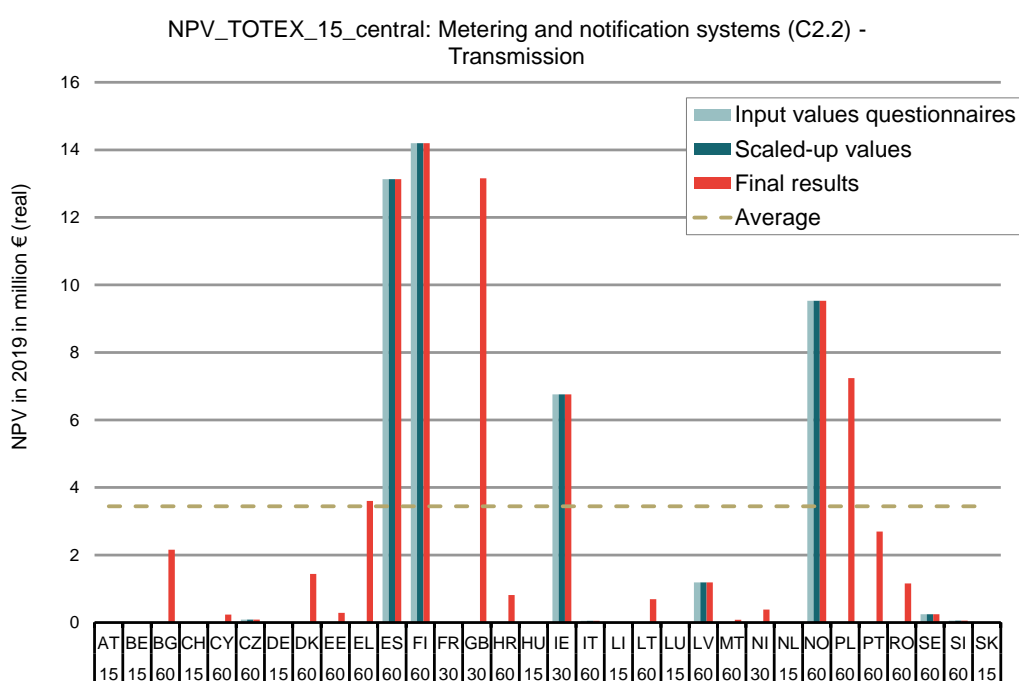
NPV_TOTEX_15_central: Metering and notification systems (C2.2) -
Transmission

Source: *Frontier*

Note: *Based on responses by TSOs. Costs reported by other stakeholders for meters in the transmission network (item 2.2.1a) are included in distribution metering costs.*
RTE has reported zero incremental metering costs for the transmission network in France – therefore the sample average is not applied here.
Numbers below the country code represent the current ISP duration (in minutes).

Resulting metering costs for ISP 5

5.4.21 Incremental metering costs for a change to an ISP of 5 minutes are determined in the same way as for ISP 15. The main difference to ISP 15 is the total cost level for the two scenarios which is significantly higher since:

- respondents reported higher cost estimates for a change to ISP 5 (72 €/customer compared to 34 €/customer for ISP 15[13]), for example because more meters have to be replace instead of reconfigured remotely; and

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[13] The unweighted average across all countries with positive observations, including GB, the Scandinavian countries and Spain. Note that Exhibit 16 shows the weighted averages which are significantly lower.

- a higher number of countries are affected by a change to ISP 5, including 9 countries in our sample that are currently at an ISP of 15 minutes.

5.4.22 We proceed in the same way as for ISP 15: we first present two scenarios ("Profiling", and "Unadjusted stakeholder data") for distribution metering costs and then estimate incremental metering costs for the transmission network.

Metering cost for distribution networks

5.4.23 Exhibit 20 provides the fully scaled-up costs for scenario "Profiling" where the sample average of 9 €/retail customer[14] is applied to GB, Spain and the Scandinavian countries.

Exhibit 20. Total metering costs of the distribution network for ISP 5 – scenario "Profiling"

NPV_TOTEX_5_central: Metering and notification systems (C2.2) - Distribution
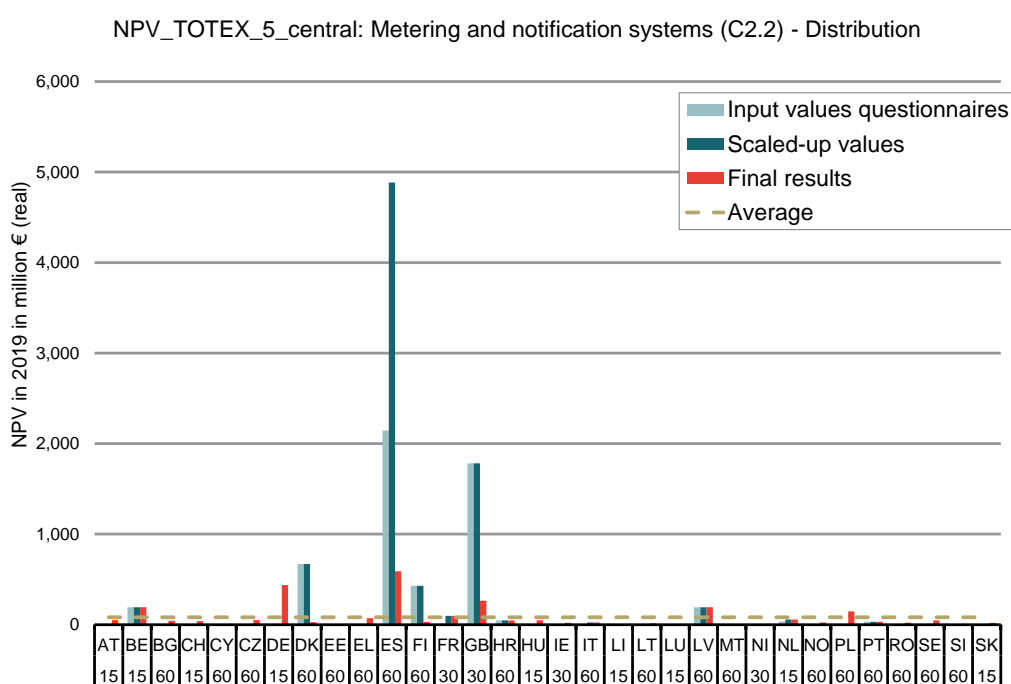
Source: *Frontier*

Note: *See Annex A for further details.*

5.4.24 Total distribution metering costs in scenario "Profiling" are €2.6 billion, an increase by 60% compared ISP 15, which is driven by a larger number of countries being affected by a change to ISP 5. Exhibit 20 shows that reported costs – after being scaled up to full country representativity for Spain and GB – are significantly lower when the sample average per retail customer is applied to them.

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[14] Based on all observations but for GB, Spain and the Scandinavian countries. Countries with a current ISP of 15 minutes which were not included in a change to ISP 15 have reported relatively low costs such that the weighted average decreased slightly from 9 to 7 €/customer. For consistency, we have therefore applied that same average as for ISP 15.

**Exhibit 21. Total metering costs of the distribution network for ISP 5 –
scenario "Unadjusted stakeholder data"**

NPV_TOTEX_5_central: Metering and notification systems (C2.2) - Distribution
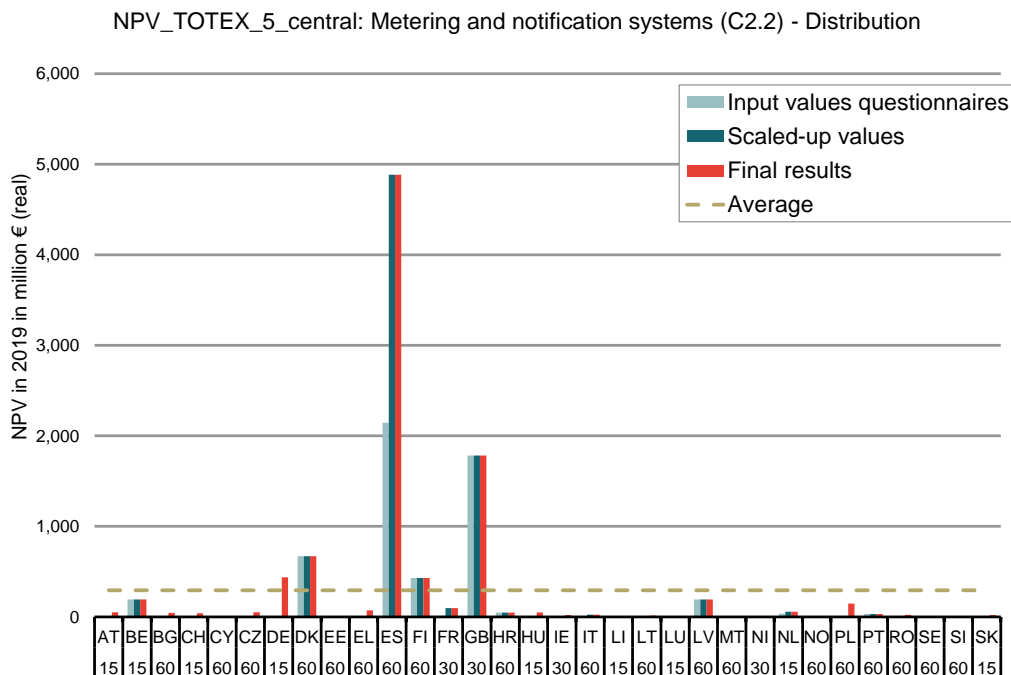
Source: *Frontier*

Note: *See Annex A for further details.*

5.4.25   Total distribution metering costs in scenario "Unadjusted stakeholder data" are
€9.4 billion, an increase of 224% compared ISP 15, and almost four times the
cost of scenario "Profiling". This difference is mainly driven by high costs for
Spain, which when scaled up to full country representativity account for more
than 50% of total costs across all 31 countries. GB is the country with the
second highest costs in our sample, reporting costs of €1.8 billion.

Metering cost for the transmission network

5.4.26   Exhibit 22 displays the total cost for metering for transmission networks based on
TSO cost estimates.

Exhibit 22. Total metering costs of the transmission network for ISP 15
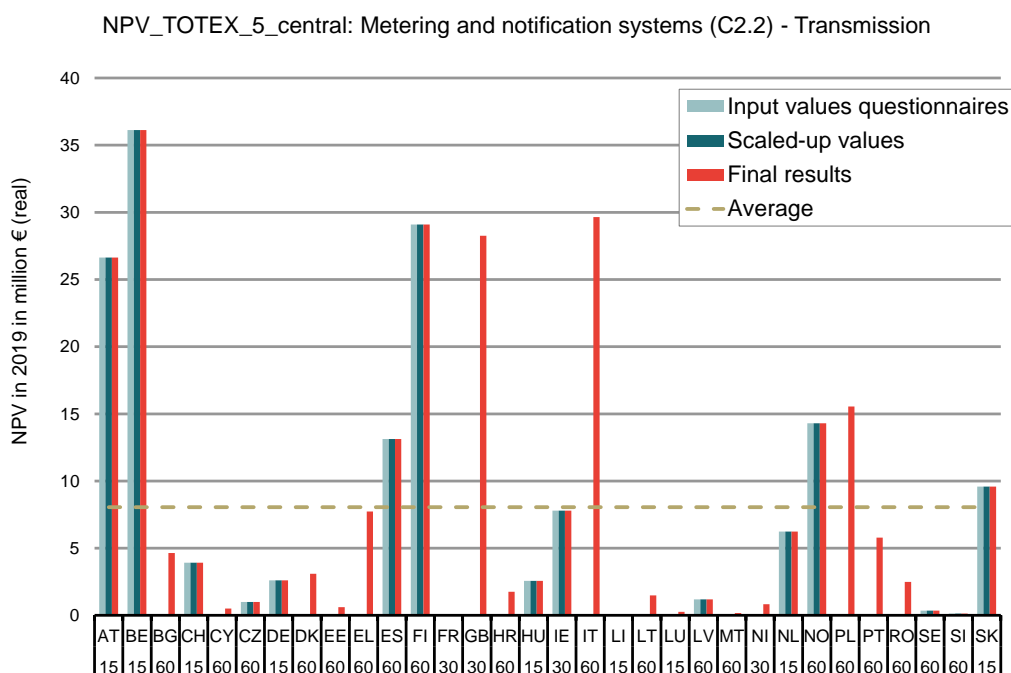
NPV_TOTEX_5_central: Metering and notification systems (C2.2) - Transmission

Source: *Frontier*

Note: *Based on responses by TSOs. Costs reported by other stakeholders for meters in the transmission*
network (item 2.2.1a) are included in distribution metering costs.
RTE has reported zero incremental metering costs for the transmission network in France – therefore
the sample average is not applied here.
See Annex A for further details.

5.4.27 Total costs for all 31 countries are €258 million, an increase of 125% compared
to ISP 15 which is mainly driven by additional countries being affected by moving
to ISP 5. The sample average of reported costs has gone up from €5.0 million to
€9.7 million).

5.5 Summary of results

5.5.1 In this subsection we provide a summary of total costs by scenario and ISP case
used for the CBA. As set out in the previous subsections, to get to fully
representative costs, we have first scaled-up reported costs from the
questionnaires to full country representativity where we have observations for a
line item, and then used information from within-sample countries to fill the gaps
for countries where no observation is available for a line item. All detailed
calculations by line item are presented in Annex A.

5.5.2 In the remainder of this section we proceed as follows:

■ We first present a summary of results for a change to ISP 15 for which we
have the best data coverage and which applies only to a subset of countries
with a current ISP period longer than 15 minutes;

■ We then summarise the results for a change to ISP 5 which would affect all
countries in our sample; and

■ We then present the results for a change to ISP 30 which is only applicable to
Spain and Portugal under the planning case set out in section 2.2.

Change to an ISP period of 15 minutes

5.5.3 We first present total costs by line item, followed by an overview of total costs by country.

Total costs by line item

5.5.4 Exhibit 23 shows total costs by line item for scenario "Profiling".

Exhibit 23. Total costs for ISP 15 by line item – Scenario "Profiling"
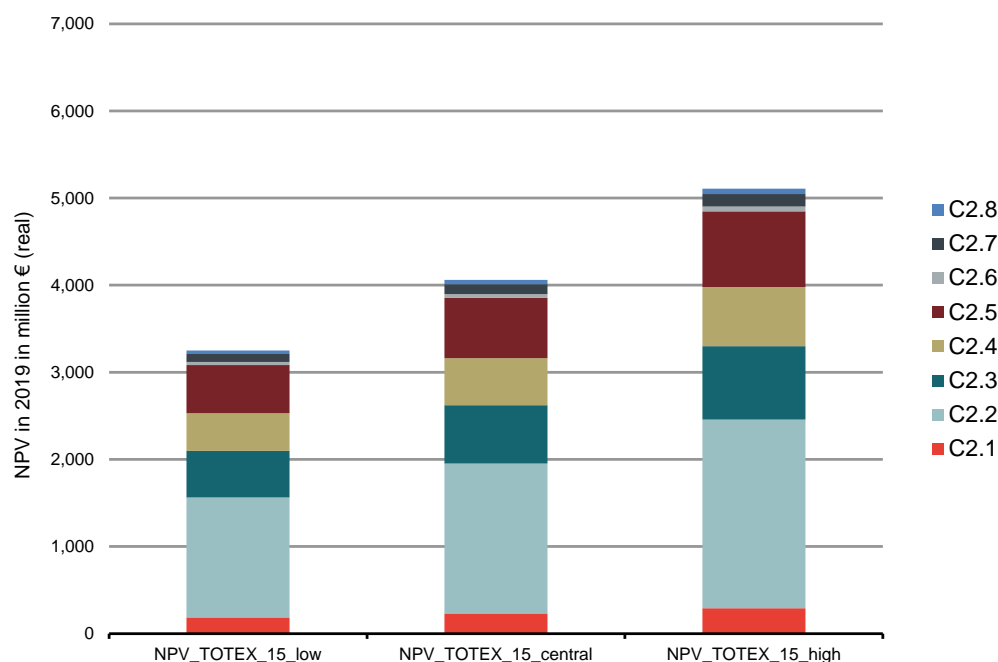
Source: *Frontier*

Note: *The underlying data table can be found in Annex A*

5.5.5 Total costs amount to € 4 billion in total for the central case. The variation to the low and high case is determined based on all responses where all three cases are contained. This leads to

- Low case costs of € 3.2 billion (20% discount on the central case); and
- High case costs of € 5.1 billion (26% uplift on the central case).

5.5.6 Metering costs (item C2.2) account for 42% of total costs, ranging from € 1.4 billion (low case) to € 2.2 billion (high case). This is below the share in reported costs (see Exhibit 11) where metering costs accounted for 66% due to higher data coverage in the initial data set and adjustments to reported metering costs for GB and the Scandinavian countries.

5.5.7 Line items C2.3 to C2.5 (scheduling and settlement, billing systems and BRP forecasting) combined account for 47% of total costs.

5.5.8 Exhibit 24 presents total costs for scenario "Unadjusted stakeholder data" which differs from scenario "Profiling" only with respect to metering costs (item C2.2).

Exhibit 24. Total costs for ISP 15 by line item – Scenario "Unadjusted stakeholder data"
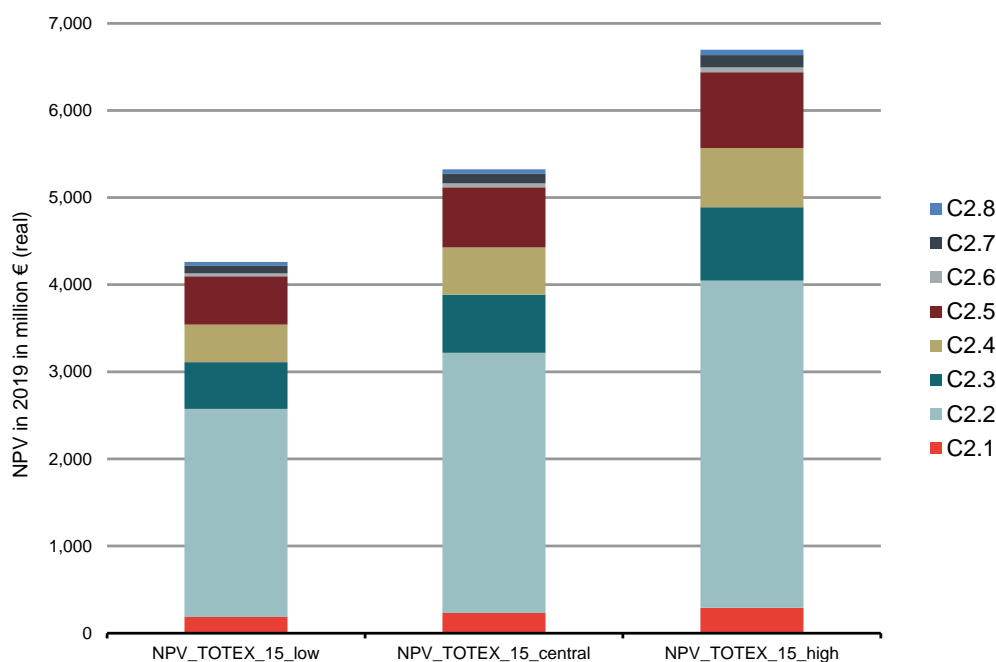
Note: The underlying data table can be found in Annex A

5.5.9 Total costs for the central case are € 5.3 billion, an increase compared to the "Profiling" scenario of almost € 1.3 billion. The variation of the low (-20%) and high case (+26%) remains unchanged in relative terms, based on the variation on responses to the questionnaire.

Total costs by country

5.5.10 A change to an ISP period of 15 minutes is relevant for Planning Cases 2, 3 and 4 (see section 2.2). In this section we present the costs associated with change to ISP period to 15 minutes for all countries. Whether individual countries are affected by such a change depends on the respective planning case.

5.5.11 Exhibit 25 provides a break-down of total costs for the "Profiling" scenario by country.

Exhibit 25. Total costs for ISP 15 by country – Scenario "Profiling"

5.5.12   The five countries with highest costs for a change to ISP 15 account for 58% of total costs:

- Spain ranks first, with total costs of € 813 million (central case);
- GB ranks second, with total costs of € 786 million (central case);
- Followed by Poland (€ 311 million), Italy (€ 265 million) and France (€ 185 million).

5.5.13   It is worth noting that France, the largest country in terms of the number of connected customers that are affected by a change to ISP 15, accounts only for the fifth largest cost.

5.5.14   Exhibit 26 provides the same cost break-down by country for scenario "Unadjusted stakeholder data".

Exhibit 26. Total costs for ISP 15 by country – Scenario "Unadjusted stakeholder data"
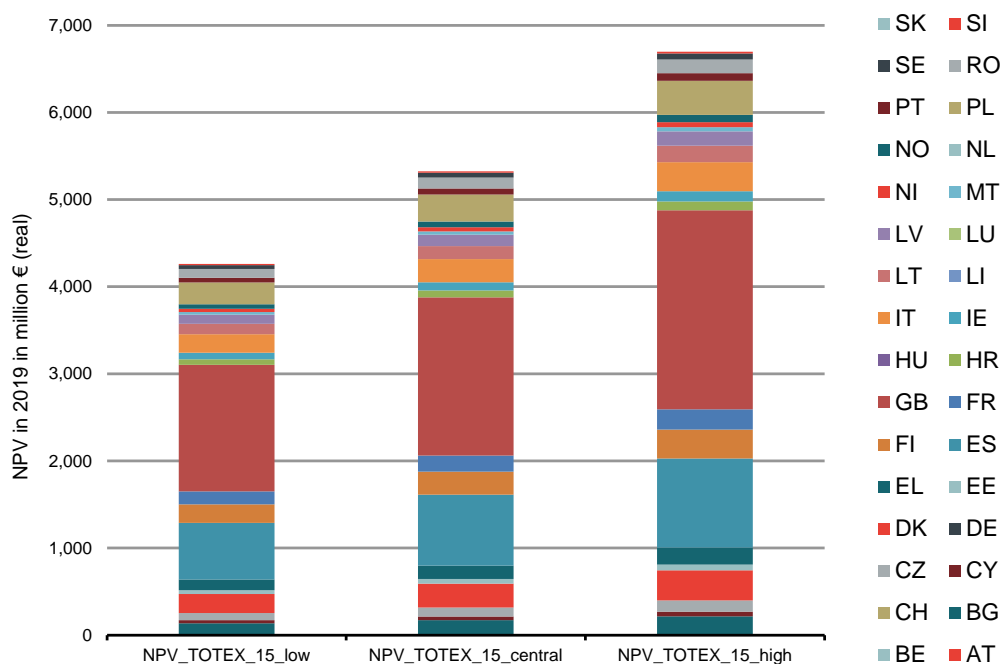
Source: Frontier

Note: The underlying data can be found in Annex A. Countries in each column are presented in alphabetical order from bottom to top, i.e. starting from Austria and ending with Slovenia.

5.5.15   The five countries with the highest cost account for 65% to total costs, a slight increase by seven percentage points compared to scenario "Profiling".

5.5.16   Directly using reported costs by country (only scaling it up to full representativity) has a significant impact on the order of countries by cost:

- GB, which ranked second in the previous scenario, now ranks first with € 1.8 billion (more than twice the cost as in the "Profiling" scenario);

- Spain moved to second place with unchanged cost of € 813 million, less than half of GB's costs; and

- Denmark with € 274 million is ranked fourth, replacing France in the top five, a country with ten times as many connected customers as Denmark.

Change to ISP period of 5 minutes

5.5.17   A change to an ISP period of 15 minutes is relevant for Planning Case 5 (see section 2.2) and would affect all countries in our geographic scope since there is no country in Europe which has implemented an ISP period shorter than 15 minutes.

Total costs by line item

5.5.18   Exhibit 27 provides a break-down of total costs by line item for scenario "Profiling".

Exhibit 27.   Total costs for ISP 5 by line item – Scenario "Profiling"
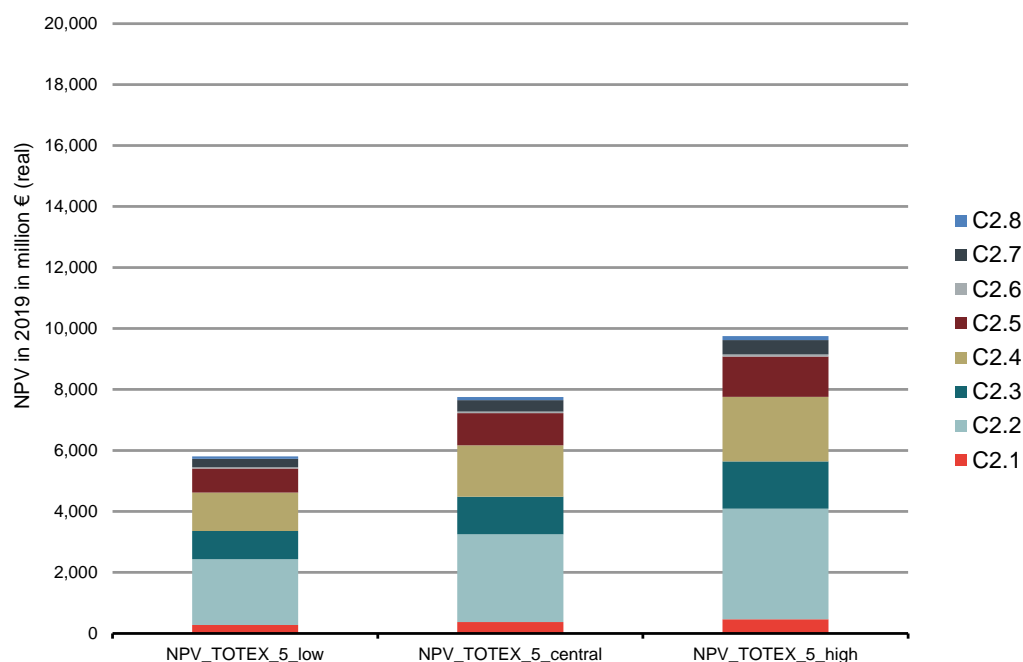
Source: Frontier

Note: The underlying data table can be found in Annex A

5.5.19   Total costs amount to € 7.8 billion in total for the central case, an increase by more than 90% compared to a change to an ISP of 15 minutes, presented above. The variation to the low and high case is again determined based on all responses where all three cases are available and is in a similar range in percentage terms to the ISP 15 case:

- Low case costs of € 5.8 billion (25% discount on the central case); and

- High case costs of € 9.8 billion (26% uplift on the central case).

5.5.20   As for ISP 15, metering costs (item C2.2) are by far the largest cost item, accounting for 37% of total costs. This is below the share of reported costs (see Exhibit 11) where metering costs accounted for 82% due to higher data coverage in the initial data set and adjustments to reported metering costs for GB, Spain and the Scandinavian countries.

5.5.21   Line items C2.3 to C2.5 (scheduling and settlement, billing systems and BRP forecasting) combined account for 51% of total costs, a slight increase by 4 percentage points compared to ISP 15.

5.5.22   Exhibit 28 presents total costs for scenario "Unadjusted stakeholder data" which differs from scenario "Profiling" only with respect to metering costs (item C2.2).

Exhibit 28. Total costs for ISP 5 by line item – Scenario "Unadjusted stakeholder data"
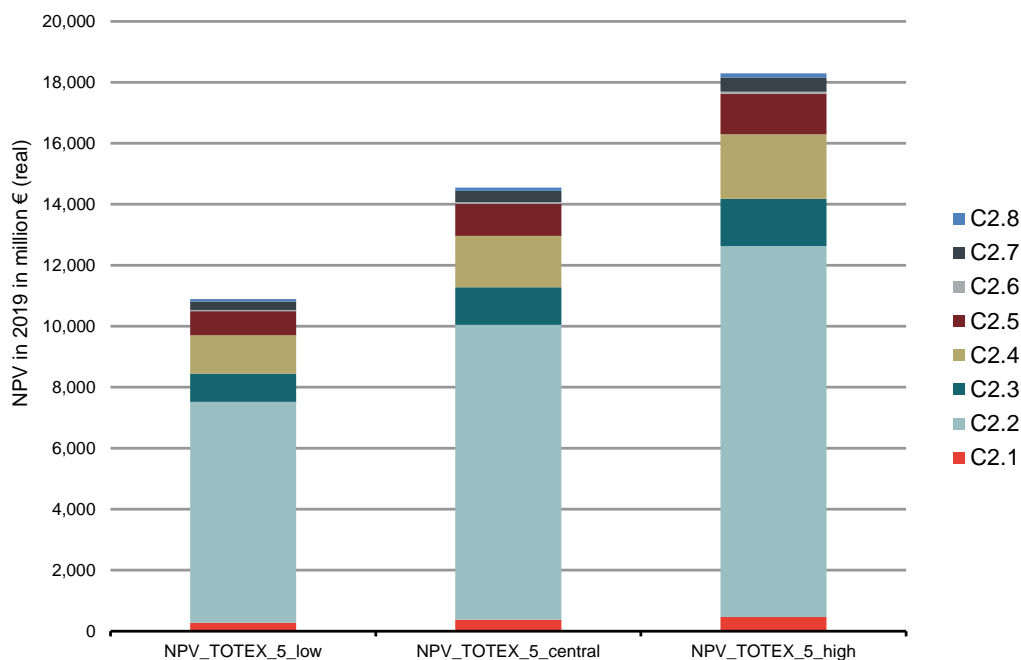
Note: The underlying data table can be found in Annex A

5.5.23   Total costs for the central case amount to € 14.5 billion, an increase compared to the "Profiling" scenario of € 6.8 billion. The variation of the low (-20%) and high case (+26%) remains unchanged in relative terms, based on the variation on responses to the questionnaire.

Total costs by country

5.5.24   A change to an ISP period of 5 minutes is relevant for Planning Case 5 (see section 2.2) and affects all countries. Exhibit 29 provides a cost break-down by country for scenario "Profiling".

Exhibit 29. Total costs for ISP 5 by country – Scenario "Profiling"
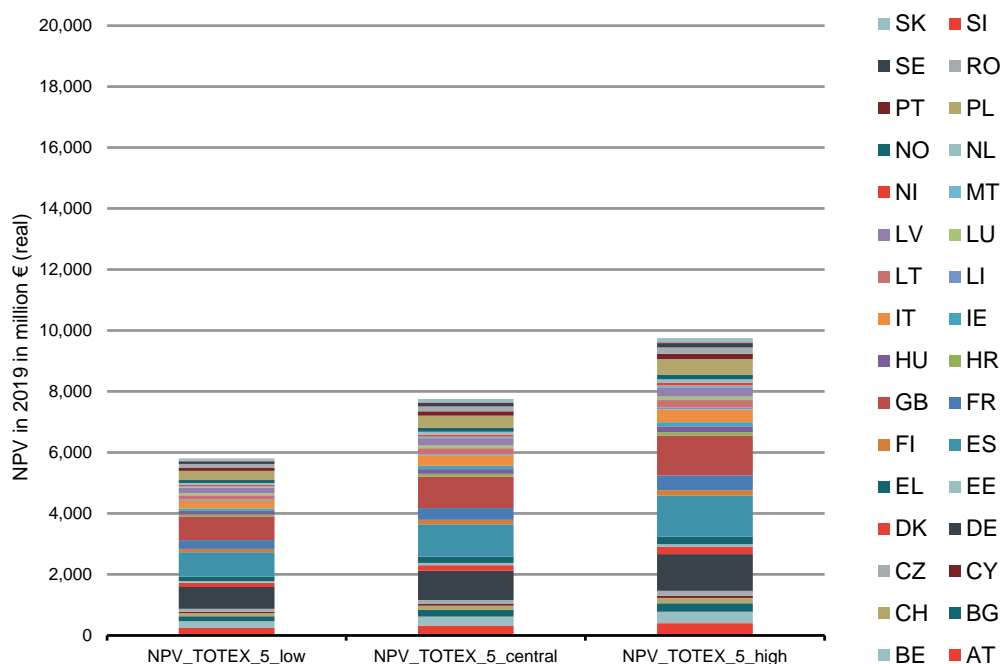
Note: The underlying data table can be found in Annex A. Countries in each column are presented in
           alphabetical order, i.e. starting from Austria and ending with Slovenia.

5.5.25   The five countries with the largest costs for a change to ISP 5 account for 50% of
         total costs (-8 percentage points compared to ISP 15 since more countries are
         affected):

- Spain again ranks first, with total costs of € 1.1 billion in the central case (an
  increase by € 250 mn compared to ISP 15);

- GB ranks second, with total costs of € 1 billion for the central case (an
  increase by € 250 mn compared to ISP 15);

- Followed by Germany (€ 956 mn), Poland (€ 407 mn) and France (€ 386 mn).

5.5.26   Exhibit 30 provides the same cost break-down by country for scenario
         "Unadjusted stakeholder data".

Exhibit 30. Total costs for ISP 5 by country – Scenario "Unadjusted stakeholder data"
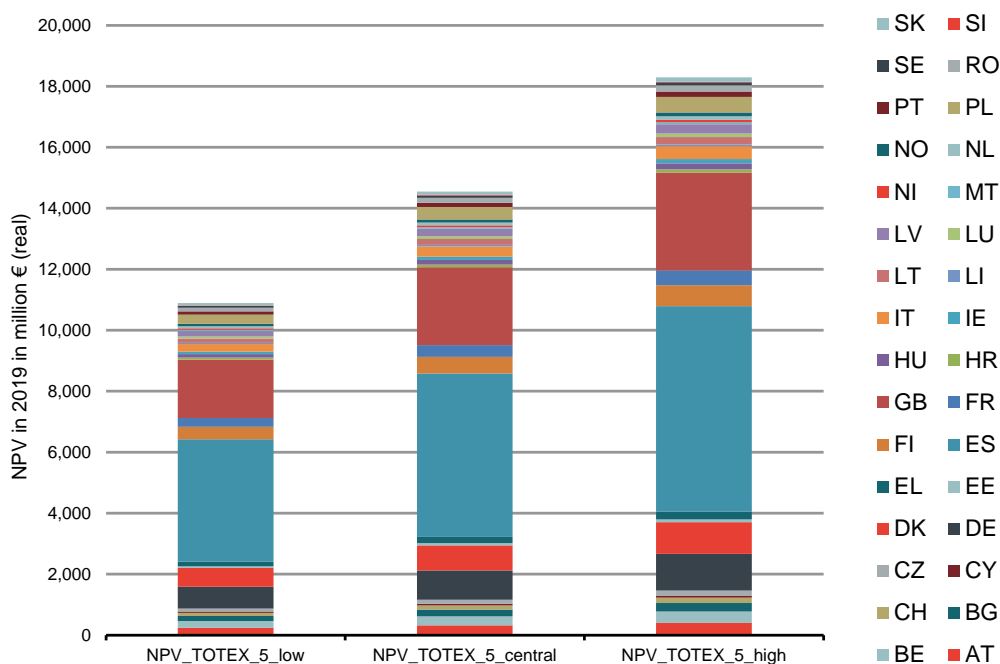
Source: Frontier

Note: The underlying data table can be found in Annex A. Countries in each column are presented in alphabetical order, i.e. starting from Austria and ending with Slovenia.

5.5.27 The five countries with the largest costs account for 70% to total costs, 20 percentage points more than in scenario "Profiling", since two countries (Spain and GB) dominate if metering costs are unadjusted for the possibility of profiling.

5.5.28 Directly using reported costs by country (only scaling costs up to full representativity) has a significant impact on total costs for Spain and GB:

- Spain continues to rank first among all countries at total cost of € 5.4 billion (almost five times the cost in scenario "Profiling");

- GB continues to rank second at total cost of € 2.6 billion (more than twice the cost as in the "Profiling" scenario); and

- Spain and GB combined account for more than 50% of total costs for all 31 countries, and are more than 8 times as high as costs for Germany which has almost the same number of retail customers as these two countries combined.

Change to ISP period of 30 minutes

5.5.29 A change to an ISP period of 30 minutes is only applicable to Spain and Portugal under Planning Case 4 (harmonisation by matching ISPs in neighbouring countries) as set out in section 2.2.

5.5.30 For a change to ISP 30 there is no differentiation between different metering costs scenarios since we only analyse two countries.

Exhibit 31. Total costs for ISP 30 for Portugal and Spain (NPV 2019, million € real)

Country	Line item	Low case	Central case	High case
ES	C2.1	18.5	18.5	18.5
PT	C2.1	0.3	0.3	0.3
ES	C2.2 (transmission network)	33.4	33.4	33.4
ES	C2.2 (distribution network)	97.7	70.3	122.9
PT	C2.2	0.0	0.0	0.0
ES	C2.3	20.0	20.0	20.0
PT	C2.3	6.7	8.4	10.6
ES	C2.4	62.7	78.4	98.6
PT	C2.4	13.9	17.3	21.8
ES	C2.5	17.8	34.8	52.3
PT	C2.5	29.1	36.3	45.7
ES	C2.6	0.0	0.0	0.0
PT	C2.6	1.5	1.9	2.4
ES	C2.7	3.9	4.9	6.2
PT	C2.7	3.9	4.9	6.2
ES	C2.8	0.7	0.8	0.9
PT	C2.8	0.0	0.0	0.0
ES	All	254.8	261.2	352.9
PT	All	55.4	69.2	87.0

Source: Frontier

Note: See Annex A for further details.

5.5.31 The main difference between Portugal and Spain lies in metering costs (C2.2): for Portugal, the TSO REN expects no significant costs since current smart meters can already be read at 15 minutes while for Spain, respondents report costs of up to € 156 million in the high case.

5.6 Concluding remarks on interpretation of costs

5.6.1 There are several indications that our final cost results could be interpreted as an upper bound for the incremental costs resulting from a change to ISP duration:

- Non-incremental cost included – Several comments by respondents suggest that what they reported is Totex under a new ISP period, i.e. not netting off costs which they would also occur under the status quo – rather than incremental costs. This is most notably the case for metering costs which is the largest line item where several respondents reported replacement costs based on the price of a new meter, not taking into account that the old meter would have to be replaced also under the status quo, but with a time lag equal to the remaining life time. This is particularly relevant for countries that have started their smart meter roll-out, for example Italy and the Scandinavian countries.

- Respondents with ISPs of 30 minutes or longer are more likely to respond. If their costs are systematically higher, applying the sample average to out-of-sample countries with an ISP duration of 15 minutes (e.g. for a move to ISP 5) would overestimate costs.

- For Germany, we do not have an observation on metering costs for the distribution network (the largest cost item) and we therefore applied the sample average to fill this gap for ISP 5. However, since Germany has not started a significant smart meter roll-out – in contrast to many other countries that are part of the basis for the sample average – this could lead to an overestimation of costs for the largest country within the geographic scope.

- Shared infrastructure – We have analysed each country individually and applied sample averages to fill the information gaps. This is also the case for cost items with a significant share of fixed costs (e.g. 2.4 billing system[15]) that can be shared across different countries by the same stakeholder.[16] It is not clear the degree to which this is reflected by the reported costs for a subset of countries and might lead to overestimated costs, especially for small countries.

5.6.2 For metering costs – by far the largest cost item in our analysis – we have defined two scenarios which differ with respect to the required changes to existing ISP meters of which the majority is installed in private households. Respondents from GB and Scandinavian countries have reported metering costs under the assumption that all smart meters will also under a new ISP period be read at in the same time period (i.e. consumption is read and reported in 15 or 5-minute intervals) as is the case in the status quo. These costs enter scenario "Unadjusted stakeholder data". An alternative to costly replacements or reconfiguration of existing smart meters would be profiling where consumption meters would continue to be metered at the current ISP period (spanning multiple new ISP periods) and the meter readings would be allocated to the new ISP

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[15] Changing the software system of billing systems is a one-time fixed costs and largely independent of the number of customers.

[16] In at least one case, a large retailer who is active in Belgium and France (two countries that do even not share the same ISP period) reflected shared infrastructure costs explicitly in reported costs.

period by applying a profile. This effect is captured by lower costs in scenario "Profiling".

5.6.3 We assume that a relatively simple profile would be applied (e.g. a 30 minute metered quantity is split evenly between two equal 15 minute ISPs, in the case of a move from a 30 minute to a 15 ISP) in order to minimise additional systems costs. However, to the extent profiling leads to further incremental costs (e.g. in settlement systems), these costs should at least partly be reflected by the sample average of all other countries which is applied to GB and Scandinavia. It is worth noting that the information from the questionnaires does not allow us to distinguish on a country-by-country basis whether a profiling solution has been considered or that lower metering costs than in GB and Scandinavian countries are the outcome of low unit costs and/or a low share of meters that need replacement (e.g. if remote reconfiguration is sufficient and existing smart meters do not need to be replaced). This implies that total costs in the scenario "Profiling" could even be lower if there are further countries (in addition to GB and Scandinavia) where profiling could be applied to alleviate some of the distribution metering costs. The assumption of a simple profile has implications for the benefits of changing ISP duration, which we discuss in the next section.

6 ANALYSIS OF BENEFITS

6.1 Introduction

6.1.1 In this section we summarise the views received from respondents with respect to the likelihood of benefits materialising subsequent to changes in ISP durations. Where respondents have provided indicative values for the benefits, we review these as well. In the majority of cases, responses to the survey do not suffice to quantify the scale of potential benefits across the geographical scope for the CBA. We therefore draw on qualitative responses and, if applicable, quantitative estimates, to carry out our own analysis of the potential size of benefits. We describe below the approach used to carry out this analysis and present our estimates for the net present value of potential benefits.

6.1.2 For simplicity, we have considered here the potential benefit associated with a move to 30 minutes, 15 minutes or 5 minutes across Europe. We also show results by planning cases.

6.1.3 The exhibit below provides an overview of the estimated range for the net present value of potential benefits associated with changes in ISP durations. In total, benefits would be expected to range between €0.75bn and €1.7bn in the case of a move to 30 minute ISPs (where the ISP is currently higher), between €1.8bn and €4.0bn in the case of a move to 15 minute ISPs (where the ISP is currently higher), and between €2.5bn and €5.0bn in the case of a move to 5 minute ISPs. The shift from balancing energy to intraday energy is by far the largest driver of this estimate, as we discuss in the remainder of this section. The benefit associated with harmonisation of ISP durations on both sides of a number of borders also accounts for a significant share of the overall benefit value.

Exhibit 32. Estimated net present value of benefit (€bn)

	Low Case			High Case		
	30 minutes	**15 minutes**	**5 minutes**	**30 minutes**	**15 minutes**	**5 minutes**
Reduced balancing costs – shift from balancing energy to intraday energy	0.41	0.64	0.68	1.35	2.06	2.42
Reduced balancing costs – lower reserve capacity cost	0.04	0.04	0.07	0.04	0.04	0.07
Reduced balancing costs – greater intraday competition from cross-border BSPs	0.04	0.80	0.80	0.08	1.59	1.59
Reduced balancing costs – Further impact on prices	0	0	0	0	0	0
Reduced balancing costs – Greater entry of BSPs to intraday markets	0.00	0.01	0.00	0.01	0.01	0.01
Reduced balancing costs – Further impact on balancing	0	0	0	0	0	0
Increased secondary trading volumes	0.26	0.34	0.91	0.26	0.34	0.91
Improved investment outcomes	0	0	0	0	0	0
Other benefits – frequency excursions	na	na	na	na	na	na
TOTAL	**0.75**	**1.8**	**2.5**	**1.7**	**4.0**	**5.0**

Source: Frontier Economics

6.1.4 The following exhibit breaks down these overall benefits for each of the countries under investigation. The results are presented for each of the four planning cases covered in the analysis. As such, the results shown below can be interpreted as the country-specific net impact of a change in ISP duration associated with each planning case compared to the country-specific status quo ISP duration.

Exhibit 33. Estimated net present value (2019) of benefit by country and by planning case (in €mn)

	Low Case (€mn)				High Case (€mn)			
Country	PC 1	PC 2	PC3	PC4	PC 1	PC 2	PC3	PC4
Austria	47	47	47	119	93	93	93	184
Belgium	22	0	0	48	44	0	0	91
Switzerland	272	236	236	283	544	472	472	594
Germany	185	111	111	655	370	223	223	1072
Hungary	53	53	53	68	106	106	106	132
Lichtenstein	0	0	0	2	0	0	0	2
Luxemburg	0	0	0	4	0	0	0	5
Netherlands	84	0	0	107	167	1	1	235
Slovakia	93	93	93	103	185	185	185	203
France	154	0	9	173	380	0	18	434
Great Britain	135	0	0	140	282	0	0	294
Ireland	15	0	0	14	29	0	0	27
Northern Ireland	7	0	0	6	11	0	0	11
Bulgaria	26	26	26	24	61	61	61	56
Czech Republic	46	46	46	42	109	109	109	99
Denmark	9	9	9	11	28	28	28	28
Estonia	6	6	6	7	14	14	14	14
Greece	33	33	33	31	75	75	75	68
Spain	169	169	152	159	410	410	360	375
Finland	18	18	18	22	60	60	60	62
Croatia	8	8	8	10	30	30	30	22
Italy	187	187	187	179	441	441	441	418
Lithuania	8	8	8	7	15	15	15	14
Latvia	7	7	7	6	12	12	12	11
Norway	30	30	30	30	58	58	58	58
Poland	99	99	99	92	237	237	237	216
Portugal	33	33	30	31	78	78	68	71
Romania	37	37	37	40	88	88	88	96
Sweden	25	25	25	26	81	81	81	75
Slovenia	15	15	15	10	35	35	35	22
Cyprus	3	3	3	3	3	3	3	3
Malta	2	2	2	2	2	2	2	2
Total	*1827*	*1302*	*1291*	*2460*	*4049*	*2917*	*2875*	*4997*

Source: Frontier Economics

6.2 Reduced balancing costs

Shift from balancing energy to intraday energy

Views of respondents

6.2.1 The vast majority of respondents have not provided an answer to this question. Around 20 stakeholders provided an estimate for the expected annual volume of pre-gate closure trading actions BRPs would themselves undertake on the intraday market or through pre-gate closure physical actions instead of the TSO having to balance post gate-closure. The majority of these stakeholders were TSOs, and others are generators and/or retailers.

6.2.2 Some TSOs flagged that they do not believe this effect can be modelled appropriately, as evidenced by the following selected quotes from responses:

- One respondent stated that "values are available only for actual ISP duration. No forecast can be calculated; too many variables enter in the result to find a suitable result years ahead"; and

- A second respondent stated that "It is difficult to estimate whether there will be a net transfer of volume from the Balancing Mechanism to wholesale markets. The short answer is with limited affect expected in ISP around central scenarios then the increase in trading would be small. […E]ven if wholesale market trading numbers and volumes increased and Net Imbalance Volume (market length) were to get tighter to a balance position, there is no guarantee that wider SO system management costs would go down."

- Some TSOs said that "load and most generation profiles are linear and do not relate to ISP duration or the resolution of the Minimum Tradable Unit size" with BRP imbalance relating more "to forecasting and trading limitations ahead of time" and "physical limitations of the generation and demand control flexibility."

6.2.3 Of the respondents that did provide a quantitative response, the number that consider the effect to be zero and the number that consider a non-zero effect was roughly split evenly. Indeed, some TSOs have highlighted differences between current market roles and approaches to balancing as well as operating approaches across and between the various market areas which may account for these differences. Some countries have shorter gate closure times and additional may permit BRPs to continue adjusting their balance position to real-time, whilst in other areas responsibility for balancing by BRPs ends at market gates with longer lead times; from whence balancing issues and management of congestion drive the needs and actions of TSOs and not the Deterministic Frequency Deviations related features seen in other areas.

6.2.4 Among those respondents who provided a MWh value for the expected volume of avoided balancing actions (these respondents were mostly TSOs):

- For the move to a 30-minute ISP, the volume effect ranged between 2% and 6% of the volume of balancing actions in the status quo;

- For the move to a 15-minute ISP the volume effect ranged between 9% and 20% of the volume of balancing actions in the status quo;

- For the move to a 5-minute ISP the volume effect ranged between 14% and 26% of the volume of balancing actions in the status quo[17].

6.2.5 Other respondents suggested a material volume change:

- A vertically integrated player expected a potential reduction of 5-10% of total balancing volumes. They stated that corresponding impact on intraday trading cannot be estimated precisely;

- A retailer expected "5% more trading to better anticipate volume; extreme reduction in imbalance prices compared to current situation. Relative[ly] small price difference";

- A generator stated that "as the products on the intraday trading is assumed to follow the ISP, everything else equal activated volumes will shift from balancing market to intraday market.;"

- A generator stated that "we suspect the overall benefits of a reduction in the existing 30 minute imbalance settlement period in GB would be relatively small, but have no firm evidence or analysis of what they might be."

6.2.6 Some respondents linked the likely reduction in imbalance volumes to ramping:

- One TSO indicated that when only hourly energy blocks can be exchanged and a linear ramp is assumed, the imbalance volume is related to the length of the ISP, with a shorter ISP reducing the imbalance;

- An industry association noted that the Swedish and Norwegian TSO require that BRPs with portfolio changes exceeding 200 MW between two hours to smooth out changes before and after the hour shift. A shift towards for example a 15 minutes settlement period would from this perspective facilitate a more transparent methodology and an also imply an equal treatment of all BRPs.

6.2.7 In contrast, a GB based respondent noted that deterministic frequency deviations are not present in GB and Ireland due to the market design and operating rules, e.g. the use of minute by minute information for final physical notifications in GB.

6.2.8 A number of stakeholders discussed potential implications related to the ability to act on incentives created by a shorter ISP:

- An industry association noted that the higher the level of time aggregation of production schedules, the more deviation on a real time scale. Shortening the ISP (with more real-time date from TSO) would provide BRPs with more time in order to manage unplanned and unpredictable deviations. In this regard, intra-hour would allow the TSO to manage the system balance with an increased accuracy as there is a clear trend towards more dispersed and smaller generation units without real time measurement. To allow for an efficient and practically feasible settlement of these units shorter settlement periods will be necessary. Moreover, it would allow the TSO to better control the delivery of Replacement Reserves and manual Frequency Restoration Reserves by BSPs; and

- A generator noted that "various practical restrictions … suggest the economic benefit of shorter imbalance periods might arise mainly from changes in

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[17] This is based on central case estimates provided by those respondents.

collective behaviour of smaller participants responding to time-of-use prices, with an assumption they can deliver more efficient supply/demand equilibrium in response to imbalance prices determined at finer resolution than currently. Smaller participants, including individual consumers and small generators, are generally less constrained in their real time activity by industry rules… The larger flexible generators which currently provide most of the balancing services … are instructed by the System Operator at a resolution of minutes, subject to individual physical characteristics. Being subject to pay-at-bid balancing payments at prices and volumes fixed at gate closure, their ability to respond to shorter imbalance periods would be limited. Traded flows across interconnectors could be varied at finer resolution, but restrictions on trading affecting flows after gate closure limits the extent of this… Notification of wholesale contractual volumes currently ceases at gate closure, limiting the opportunity for trading activity close to real time to respond to expected imbalance prices at finer resolution. These considerations suggest benefits would come mainly from changes in collective behaviour of smaller participants who are less constrained in their real time activity by industry rules, including consumers, with an assumption they can deliver more efficient supply/demand equilibrium in response to imbalance prices determined at finer resolution than currently."

6.2.9 A number of respondents commented on the benefits of a shorter ISP for imbalance pricing and for the incentives on parties to balance:

- One TSO stated that "the time to restore frequency for TSOs is 15 minutes. Therefore, if the ISP is > 15 minutes, no accurate price signals can be given to BRPs to help balancing the system. Therefore, a single marginal pricing system with allowed self-balancing, where BRPs are allowed to help reduce the system imbalance by reacting on price signals on the condition that they are able to restore their balance at any time … is not of use if the ISP is higher than the time to restore frequency." The respondent noted that the benefits of such a mechanism have been observed in the past. They gave the example of Belgium, which switched from a dual pricing mechanism to a single marginal pricing mechanism with self-balancing in 2012. In Belgium, a reduction of 40%, or 500 GWh, of net (to exclude potential counter activations) R2 and R3 balancing actions have been observed between 2012 and 2015. A reduction of 30 % of the SI can be observed and a reduction by 40 % of the ACE after balancing actions;

- A generator provided an example of how the price signal might improve: "for example, an expensive generator which is called to run to balance a residual demand which only lasts 16 minutes might set an imbalance price which is paid by all residual uncontracted demand during the 30 minutes, and paid to all residual uncontracted surpluses during the 30 minutes. That price might be correct for the time for which the expensive generator is required, but could be inefficiently high for other times in the period. Consumers of uncontracted energy at those other times will pay more than they should, and uncontracted generation at those other times will receive more than it should"; and

- An industry association stated that "with long settlement period, the costs incurred by the TSO to balance the system in real time cannot always be properly allocated to the responsible market party because BRPs that have

been out of balance within a settlement period (e.g. 15 or 30 min) may be balanced over the whole period. Short settlement periods contribute to a more cost-reflective imbalance settlement. It has been observed that the activation of both upward and downward balancing energy bids increase for longer settlement periods, especially in power systems under high penetration of renewable generation. Under a single imbalance pricing system, that would mean that it is unlikely that balancing energy costs can be fully recovered when upward and downward balancing energy bids are activated within a single settlement period since imbalance prices are determined by the net amount of activated balancing energy)."

6.2.10 Other stakeholders linked the likelihood of achieving benefits to the maturity of their current market design, although we note this is not necessarily consistent with the assumption discussed above of a fully functional target model:

- A Slovenian stakeholder expected that BRPs will not have lower costs for imbalances, rather higher. Already now there is a lack of data on the level of consumption, and on the level of ISP;

- Another respondent stated that "as there is no operating organised intraday market yet, no estimation could be provided";

- An Irish respondent noted that "the SEM is an ex-post pool market and does not have balancing arrangements currently. As such, it is not possible to quantify the potential impact on the future market"; and

- Another respondent indicated that they did not expect a significant increase in self-balancing performed by the BRPs in the ID markets as a result of the mere reduction of ISP. They stated that "this effect may arise (but it is difficult to estimate) as a result of the gate closure time reduction on the ID markets. The impact in the ID market should consist in the internalization of the dynamic constraint of dispatchable plants within ID markets while today these constraints are solved within ancillary services market (ASM). This shift is not necessarily a benefit because the price of the action performed may be the same in ID market as in the ASM."

6.2.11 A number of other stakeholders indicated that they did not expect changes in behaviour:

- A supplier reported that they "do not believe that a decrease in ISP duration would result in us undertaking any significant increase in trading volumes."

- A vertically integrated player expected that the change in ISP would purely lead to a split of current trades over the MTU period into two trades; and

- A generator said that "the extent to which the market(s) can balance itself through the actions of competing participants, rather than rely on the system operator who has significant analytical and operational resources dedicated to achieving a balance in aggregate, is uncertain."

6.2.12 A TSO commented that the expectation of benefit from a move to a 5 minute ISP would be much lower. They stated that:

- it is expected that a reaction from BRPs towards a 5-min price signal will be operationally and technically infeasible; and

- there is a risk of creating inefficiency in balancing: "since the time to restore frequency for TSOs remains 15 minutes, the TSO would need to make a choice to align the balancing products to an ISP of 5 minutes or not. If the mFRR product would still be activated until the end of the quarter-hour (on a 15 min basis), this could increase the necessary counter-activations by aFRR in the 2nd and 3rd 5 minute time period, if it is assumed that BRPs will react to the 5 min price signal, and could even distort the price signal making it less accurate and potentially worsen the global SI. If the mFRR product would be activated on a 5 minute basis, this would increase the requirements of this product and therefore drastically reduce available volumes and liquidity (for mFRR from production as well as load) and also increase price (the ramps that create an imbalance will need to be priced in on a smaller time step).

6.2.13   On average those that suggested a non-zero effect considered a reduction in TSO balancing actions of 1,800 GWh for the 5 minute ISP and 1,100 GWh for the 15 and 30 minute ISP duration.

6.2.14   A limited number of stakeholders argue that a reduction in ISP duration would lead to a decrease in average wholesale prices. A larger number of respondents consider that the change in ISP duration would not lead to a significant impact on wholesale prices.   A number of respondents, including TSOs, generators and suppliers indicated that they had no basis for estimating a price effect.

6.2.15   A slightly clear picture emerged in relation to balancing prices. A significant number of respondents suggest that balancing prices could decrease following a reduction in ISP duration. However, this view is far from universal:

- A reasonable number of respondents indicated they expected no change in balancing prices (although some suggested that volatility may increase); and

- A smaller number of respondents (including two TSOs) suggested that balancing prices could increase, largely because of reduced liquidity in balancing markets.

6.2.16   The chart below displays the average price difference between the balancing and intraday price as estimated by those stakeholders that provided an answer, in 2020. These estimates range from close to 0 €/MWh up to a discount of over 12 €/MWh in the price achieved on the intraday market by BRPs relative to that achieved by the TSO in the balancing market.

Exhibit 34. Average price difference, 2020 (€/MWh)
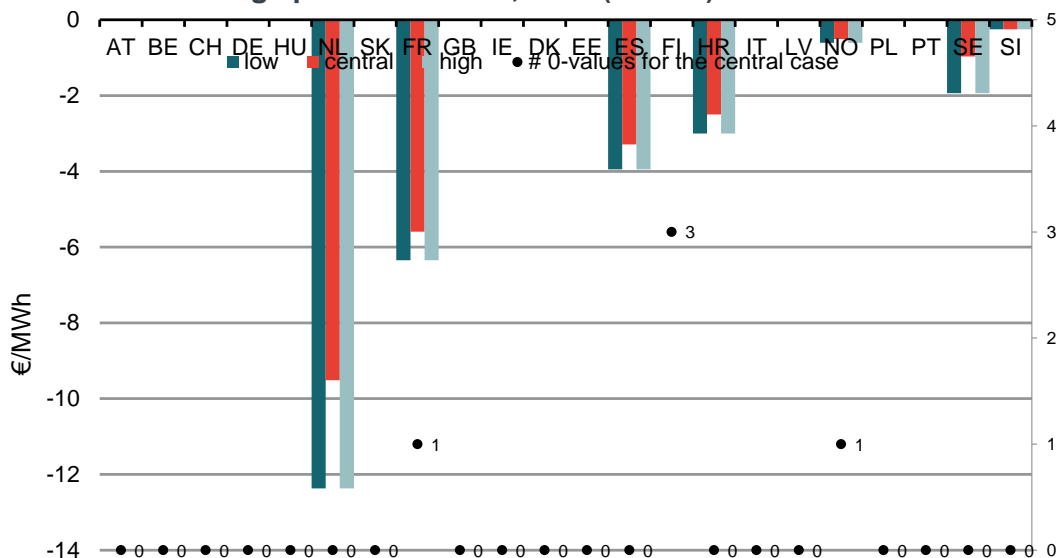
Source: Frontier Economics based on survey responses

Our analysis

6.2.17   We have carried out stylised analysis to assess the magnitude of a potential
benefit resulting from a shift of balancing activities from the balancing to the
intraday market. Our aim is to quantify the monetary impact that this reduction in
balancing activities will have on social welfare. The size of this impact will
depend on two effects that we aim to model in our stylised analysis:

- Volume effect – A shorter ISP duration will allow BRPs to use information on
forecast generation and consumption to trade at finer granularity on the
intraday market and achieve lower imbalances eventually. As such, the TSO
will then need to engage in a lower number of actions on the balancing
market compared to the status quo.

- Price effect – The monetary impact associated with shifting volumes away
from the balancing market and onto the intraday market will depend on the
price differential, all else equal, between the balancing and the intraday
market.

Volume effect

6.2.18   To estimate the potential impact of a reduction in ISP duration on balancing
volumes, we have collected the most granular demand and generation profiles
available (typically five or fifteen minutes) for a given market area over a full year.
Then:

- We derived 15, 30 and 60 minute profiles by averaging the more granular
data over the relevant period;

- We calculate balancing actions required in the status quo, assuming BRPs
are perfectly balanced at ISP granularity and the TSO has to take balancing
actions to adjust for imbalances within the ISP period relative to the average
load over that period;

- Then, for each potential ISP duration (5, 15, 30), we calculate required balancing actions by the TSO to adjust for within-ISP period deviations from average load;

- We aggregate the volume of all modelled balancing upward and balancing downward actions, and compare this against the volume of actions estimated for the status quo ISP duration.

6.2.19 The TSO takes actions to manage the net imbalance of its system (the TSO also takes locational specific actions to manage flows - we do not consider these types of actions here since the quantity of these actions are broadly unaffected by the extent to which BRPs are balanced). Therefore, we aggregate the generation profiles over all generation and aggregate the demand profiles over all demand. We do not take a view as to whether the net system imbalance should be calculated from generation or from demand. Therefore, we take the average of the net system imbalance calculated from generation and from demand independently.

6.2.20 This analysis was implemented for 11 market areas where data was available. For other countries, we estimate the average volume of avoided balancing actions from those 11 market areas where the analysis has been implemented (depending on status quo and target ISP duration) and we scale this up or down to the rest of other countries depending on the annual volume of demand and generation in each market area (source: ENTSO-E).

6.2.21 We discuss below the impact of the assumptions made in our stylised analysis on how the results should be interpreted:

- We note that the analysis was done at the average of the aggregate demand and generation level in each market area. It could be the case that estimated balancing volumes are lower at this aggregate level than the sum of all balancing actions taken by the TSO to adjust for individual BRP's imbalance positions.

- The change in balancing actions also relies on BRPs trading at fine granularity on intraday markets in order to reduce their imbalance position as far as possible. A number of respondents have argued that this is not realistic given the current state of intraday markets in certain areas. While the CBA assumes the Target Model will have been implemented in the status quo, we have considered the sensitivity of our estimates to a lack of liquidity preventing the benefit from materialising in certain market areas. For those countries without an intraday market today, we assume a benefit of 0 in 2020 and progressively ramp up the benefit value up to 2030. We find this would reduce the total net benefit across the EU+3 by €0.05bn (in NPV terms, as of 2019, and for all ISP durations).

- The above point assumes market and operating behaviours of BRPs and TSOs as well as existing MW balancing behaviour in each country to be driven by ISP and MTU size in both the counterfactual and factual. This stylistic assumption is a good approximation to BRP and TSO behaviour in countries incentivising block trade and alignment of physical load and generation with block shapes. Countries which do not incentivise or exhibit these features will not necessarily experience the assumed ISP related

imbalances or deterministic frequency deviations derived in the counterfactual and factual model results and thus our approach may over-estimate volume effects for those countries.

- Our analysis does not reflect potential future changes in the power sector. For instance, we do not consider demand growth or imports and exports in the benefit quantification. An increase in overall demand or generation volumes in the status quo would lead to a pro-rata increase in volumes that switch from the balancing to the intraday market when the ISP duration is reduced. This could be a potential source of underestimation of the benefit value in our analysis. Similarly, we do not consider potential changes in the power mix at the 2030 horizon and implications for the volume of balancing actions.

- Finally, the stylised analysis which we have undertaken is, in terms of volumes, based on aggregated historic ISP period metered data. As such we have no information as to the actual profile of BRPs' production or demand during these periods, or what that production or load profile would have been like with a shorter or longer ISP. Our analysis assumes that generators change their production profile as a result of intraday trades, and this changes the volume to be purchased by TSOs. However, if generators were profiling their output for reasons unrelated to imbalance settlement incentives (e.g. for example due to technical flexibility restrictions of their equipment, to ramp up to meet a morning pickup or based on wider physical MW optimisation of aggregated supply and generation portfolios at sub-ISP resolution) then the change in volume to be purchased might be lower. Similarly, if generators were profiling their output in ways unrelated to residual demand trends, the change in volumes might be higher.

- It is difficult to assess the impact of within ISP profiling. Some TSOs have cited literature which suggests that the actual changes in generation and load profiles might be optimised and controlled by BRPs in some areas, in the resolution of minutes irrespective of ISP duration. Other TSOs have indicated that the issues they have with frequency quality (i.e. due to so called deterministic frequency deviations) at the change in ISPs is evidence that profiles are mainly driven by imbalance settlement incentives in those areas. Given this mix of evidence, we believe it would be difficult to make a strongly evidenced adjustment to our analysis, though we do not disagree with the argument that the final volume change does depend upon profiling.

- Additionally, some TSOs noted that the size of the benefit would vary based on other factors, such as whether the TSO engaged in balancing actions prior to gate closure (e.g. if precisely the same output from the same units resulted from BRPs organising dispatch in place of the TSO's balancing actions, there would be no change to costs and no gain in social welfare from the shift of actions from the TSO to BRPs). We agree with this, although given the diversity of operational processes in use across Europe it is difficult to make straightforward adjustments to reflect country specific arrangements.

- The assumption that load profiles (see the discussion of metering costs in the previous section) are used to avoid the need to adapt or replace meters for smaller commercial and household consumers when ISP is reduced

potentially reduces the benefit of reducing ISP. We take the view that there would be little material effect on the size of benefits when load profiles are used:

- There is little lost in the way of DSR from small consumers since they are unlikely to have provided additional DSR if metered according to the shorter ISP period than they would provide according to the status quo ISP.

- The BRP (retail supplier) manages its balance position according to the forecast of the profile instead of the forecast of actual metered consumption for the shorter ISP, in the case of those consumers with a profile. To the extent that there is no systematic bias between the forecast profile and the forecast actual metered consumption, there would be no loss of benefit. If there are reasons for a systematic bias between the profile and the actual, there would be a loss of forecast accuracy – in this case either the benefit of ISP reduction would fall or the profile would be improved, increasing costs.

6.2.22 In seeking to apply a common modelling method across the EU there will naturally be market and control areas which align with the approach used more than others. Whilst some areas may have had balancing volume effects over or under estimated, we believe the models yield a good indication of the range of benefits that could be achieved on the whole.

6.2.23 We also note that the analysis was performed at market area level for 44 countries, based on data availability. As described above, an average volume effect is estimated on this basis and read across to other market areas. We obtain similar orders of magnitude for the volume effect across the eleven countries where it has been estimated. In particular, there is no pattern in the distribution of results according to current ISP duration. This provides confidence in the validity of the estimate.

6.2.24 It could however be the case that the effect is over or under estimated for a given country, depending on local drivers of required balancing actions in the status quo and how these would change with a change in ISP. In order to identify those countries where the risk is highest that the stylised analysis yields biased results, we have compared the stylised estimate for the reduction in the volume of balancing actions at the level of the volume of balancing actions in the status quo[18]. We find that the stylised approach estimated a reduction in balancing actions in excess of status quo volumes for six countries.   For those countries we cap the volume effect at the level of status quo balancing actions. We would note that this results in identical levels for the volume effect across the various planning cases for those countries[19].

6.2.25 Finally, we have compared the stylised estimates of reductions in balancing actions with the volumes indicated by those respondents who provided an answer to the survey. We find that stakeholders' central estimates range between 4% and 79% of stylised estimates. We would emphasise here that the

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[18] This cross-check has been performed for fourteen market zones, based on data availability.

[19] Based on data availability this sense-check has been performed for 16 of the countries in the sample. The test found that the estimated volume effect overpassed balancing actions in the status quo in Switzerland, Denmark, Finland, Italy, Norway and Sweden. The fact that the cap imposed on the volume effect in those countries is identical across all planning case is reflected in the estimated values for the net welfare effect in those countries in the high case in Exhibit 36 below.

documentation of survey responses does not suffice to disentangle the drivers for the gap between stylised estimates and survey responses nor allow for the consideration of other factors such as existing market and operating rules and behaviours. We believe that to some extent the gap is likely to be driven by survey respondents' views on the BRP and TSO behaviours which are described above and would influence the potential scale of the expected benefit. But it is also clear from some responses that the gap is due to hypotheses made by respondents which the stylised analysis does not aim to capture. Overall, we conservatively use survey responses as a lower bound for the volume effect for those countries where a volume effect has been quantified[20]. This is one of the drivers of the wedge between our estimated low and high range for this benefit.

6.2.26 The Annexe provides further information on the scale of the volume effect.

Price effect

6.2.27 We have separately estimated the average balancing to intraday price premium by:

- Calculating the difference between either the upwards or downwards balancing price and the intraday price in the same period depending on whether the system as a whole is short or long in every hour of a year; and then by

- Deriving the resulting average premium for upwards or downwards balancing actions over the whole year.

6.2.28 This analysis has been carried out in those market areas where intraday price data availability allowed it[21]. For other countries, we have used the average estimated price differential[22].

6.2.29 The Annexe provides further information on the scale of the estimated price effect.

6.2.30 The price differential measured between the balancing market and the intraday market in corresponding periods is likely to capture the sum of several effects:

- Supply curve effects, e.g. where the marginal costs of generators are higher when dispatched on the balancing market than on the intraday market (all else equal) due to the shorter lead time for dispatch;

- Merit order effects, e.g. where units called on the balancing markets display higher marginal cost than the marginal plant on the intraday market; and

- Market imperfection effects, e.g. where market structure and arrangements drive the prices in either the wholesale or balancing to include a premium on marginal cost.

6.2.31 The supply curve effect is likely to be the main driver of the net welfare effect. As a result an adjustment would seem to be required to be made to the price effect to capture only the net welfare effect associated with this benefit.

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[20] The survey responses retained here concern Switzerland, Germany, Denmark, Finland, Croatia, the Netherlands, Norway, and Sweden.

[21] France, Great Britain, and Romania.

[22] Subsequent to a request by Nordic TSOs a specific estimate of the price differential was derived in Denmark, Finland, Norway and Sweden based on comparing balancing prices with day-ahead prices.

6.2.32   The transfers between consumers and producers will be driven by the combination of the supply curve effect and the merit order effect in each period. We note that, as discussed above, the merit order effect would typically lead to an increase (resp. decrease) in consumer surplus and a decrease (resp. increase) in producer surplus in those periods where upward (resp. downward) balancing actions are avoided.   It could be the case that over the course of the year the merit order effect is neutral for both consumers and producers.

6.2.33   We have also compared our estimate of the price effect with the estimated average price difference between the balancing and the intraday market indicated by stakeholders in their survey responses. We find that our estimate of the price effect is significantly larger than that indicated by the few stakeholders who provided an answer. This would suggest there is a risk that we have overestimated the price effect.

6.2.34   However, we note that we have not assumed any other change in either wholesale or balancing prices over the CBA period. Should energy prices globally increase at the 2030 horizon then the absolute price premium paid on the balancing market as opposed to the intraday market would also rise. We would therefore be underestimating the benefit value from a change in ISP duration.

6.2.35   In the round, we have reflected the uncertainty around the price effect by taking a more conservative approach when deriving the net welfare effect associated with this benefit. We have assumed that:

- The change in consumer surplus is equal to the product of the estimated delta in price times the volume effect;

- In the low case, the net welfare effect is equal to 25% of the change in consumer surplus;

- In the high case, the net welfare effect is equal to 75% of the change in consumer surplus.

6.2.36   We report below the corresponding value for the benefit associated with shifting volumes from the balancing market to the intraday market.

Results

6.2.37   We estimate the total benefit would range between €0.6bn and €2.1bn (in NPV 2019 terms) for a harmonised reduction of the ISP duration to 15 minutes across market areas where it is currently longer than 15 minutes. This benefit would increase to €0.7bn to €2.4bn if the ISP duration was to be further reduced to five minutes. We have summarised these results below. We note that, in light of the discussion on BRP and TSO behaviour summarised above, some TSOs have expressed a view that the low end of our benefit range is more realistic.

Exhibit 35. NPV(2019) of the potential benefit from a shift of balancing energy to intraday energy

ISP duration	Low (€ mn)	High (€ mn
30 minutes	413	1,349
15 minutes	641	2,061
5 minutes	682	2,418

Source: *Frontier Economics*

6.2.38   The exhibit below shows how the benefit associated with a reduction in balancing actions is distributed between the countries and ISP durations that we consider in the cost-benefit analysis.

Exhibit 36. NPV of the potential benefit from a shift of balancing energy to intraday energy by country (in €mn)

Country	Benefit 3.1.1 low case (€mn)			Benefit 3.1.1 high case (€mn)		
	30 min	15 min	5 min	30 min	15 min	5 min
Austria	0.0	0.0	9.3	0.0	0.0	27.9
Belgium	0.0	0.0	10.3	0.0	0.0	30.8
Switzerland	0.0	0.0	3.6	0.0	0.0	42.6
Germany	0.0	0.0	21.4	0.0	0.0	252.5
Hungary	0.0	0.0	5.4	0.0	0.0	16.3
Lichtenstein	0.0	0.0	0.0	0.0	0.0	0.0
Luxemburg	0.0	0.0	0.6	0.0	0.0	1.8
Netherlands	0.0	0.0	0.9	0.0	0.0	44.7
Slovakia	0.0	0.0	3.6	0.0	0.0	10.7
France	0.0	91.6	109.4	0.0	274.8	328.3
Great Britain	0.0	73.0	76.4	0.0	219.1	229.1
Ireland	0.0	7.3	6.6	0.0	21.9	19.8
Northern Ireland	0.0	2.5	2.2	0.0	7.4	6.7
Bulgaria	15.0	17.4	15.7	45.0	52.3	47.2
Czech Republic	27.1	31.5	28.4	81.3	94.5	85.2
Denmark	6.2	2.8	2.8	18.7	21.7	19.4
Estonia	3.3	3.9	3.5	10.0	11.7	10.5
Greece	18.1	21.1	18.9	54.4	63.2	56.6
Spain	103.3	120.1	108.0	310.0	360.2	323.9
Finland	0.8	2.9	3.8	43.9	43.9	43.9
Croatia	0.4	2.1	4.3	21.3	24.7	16.3
Italy	115.0	126.4	119.1	345.0	379.3	357.3
Lithuania	3.0	3.5	3.1	9.1	10.6	9.4
Latvia	2.5	2.9	2.6	7.4	8.6	7.7
Norway	9.9	3.6	4.0	29.8	31.4	31.9
Poland	59.2	68.9	61.9	177.7	206.6	185.8
Portugal	19.0	22.0	19.8	56.9	66.1	59.4
Romania	21.7	25.0	27.9	65.1	75.1	83.7
Sweden	0.7	2.0	2.7	49.6	57.6	52.1
Slovenia	8.1	10.0	5.6	24.3	29.9	16.8
Cyprus	0.0	0.0	0.0	0.0	0.0	0.0
Malta	0.0	0.0	0.0	0.0	0.0	0.0
Total	*413.5*	*640.6*	*681.7*	*1,349.4*	*2,060.5*	*2,418.3*

Source: Frontier Economics

6.2.39   In the majority of countries, the wedge between the low and high case for this benefit is driven by the assumption made when deriving the net welfare effect from the consumer surplus.

6.2.40 For Switzerland, Germany, Denmark, Finland, Croatia, the Netherlands, Norway, and Sweden, an additional wedge between the low and high case is due to the fact that the volume effect in the low case is based on survey responses.

6.2.41 Italy currently has a 15 minute ISP for balancing services providers and a 60 minute ISP for other wholesale market participants. We do not explicitly take this into account in our quantitative analysis and therefore we are likely to overstate this benefit for Italy. However, we do not think this would have a material effect on conclusions for a number of reasons. Although faced with a 15 minute ISP, balancing services providers cannot trade in 15 minute timescales today since the intra-day MTU is 60 minutes. Therefore, a move to a 30, 15 or 5 minute ISP for the entire market would open up opportunities for balancing services providers to trade in intra-day timescales at 15 minutes (since we assume the MTU in intra-day timescales changes with ISP). This creates some additional benefit from a move to a shorter ISP in the case of balancing services providers. In the case of non-balancing services providers the benefits would be similar to those faced in other countries. Overall therefore the benefit would be lower in Italy than in the case of a country whereby all participants currently faced a 60 minute ISP.

6.2.42 Finally, we note that the estimated benefit is higher in some countries when moving to a 5-minute ISP than when moving to a 15-minute ISP. This is due to the sample used to derive the stylised volume effect in each case:

- The stylised estimate of the volume effect when moving to a *five* minute ISP is based on data from those countries where five-minute load and generation data has been provided (GB, RO, HU, FR, CH, DE, FI, NO).

- The stylised estimate of the volume effect when moving to a *fifteen* or *thirty* minute ISP is based on a larger dataset as two additional TSOs were able to provide load and generation profiles at 15-minute granularity (SI and IT).

6.2.43 The load and generation profiles in SI and IT suggest a lower size for the volume effect when moving to fifteen and thirty minutes (relative to local demand and generation) than the average effect estimated based on the other seven countries listed above. Therefore, the inclusion of those two countries in the sample for the 15-minute and 30-minute volume effect drives the value down, to a level that is below the average 5-minute effect estimated from the reduced sample size.

Lower reserve capacity cost

Views of respondents

6.2.44 The large majority of respondents to the survey have not provided any quantitative or qualitative evidence. However, 36 stakeholders have provided input as to how a change in ISP duration could, in principle, lead to an impact on the capacity withheld from forward markets by the BRPs and/or a reduction in the reserves held by the TSO. The majority of respondents that have provided evidence on this benefit are TSOs, while some aggregators, retail suppliers and generators have also given answers.

6.2.45 It is interesting to note that a range of stakeholders have pointed out the difficulty to estimate and quantify some or all of the effects associated with this benefit. In particular, an ES vertically integrated player, a GB retail supplier, as well as GB and FR TSOs all explicitly consider cost differences difficult to evaluate.

6.2.46 The majority of respondents has pointed out that they expect little or no incentive for BRPs to withhold capacity from forward markets following a reduction in ISP duration. This is mainly driven by the market designs in place in the different countries or balancing areas. Additionally, some stakeholders have pointed out that capacity decisions by BRPs are taken with respect to the way in which imbalances are priced and settled and how balancing energy is paid for.

6.2.47 When asked to provide an estimate for the potential reduction in TSO reserve capacity requirements, a large number of stakeholders have also indicated doubt as to the extent to which the ISP duration will influence the reserve dimensioning that is undertaken by TSOs:

- While some respondents have argued that a reduction of reserve capacity following a reduction in ISP duration could, in principle, be possible, in practice it is the case that the majority of stakeholders estimate there not to be a significant reduction in the quantity of reserves held (with this being driven more by imbalance pricing);

- According to the responses received, this is driven by reserve dimensioning being mainly influenced by criteria other than ISP duration, such as N-1 or additional factors of system security like congestion issues or frequency excursions;

- Additionally, respondents have argued that the potential benefit, if any, would be lower following a reduction of ISP duration to under 15 minutes because this would not allow enough time to restore frequency and could lead to increases in uncertainty and forecast errors. In such a scenario, TSOs might actually be required to increase their reserve capacity requirements and withdraw additional capacity from forward or intraday markets; and

- Finally, respondents noted that changes in ISP duration could cause changes in the behaviour of some BRPs (uncertainty on behaviour, forecast errors) creating periods of additional variability or uncertainty, which would increase the need for TSOs to hold reserves.

6.2.48 Some stakeholders did provide limited quantification (or at least analysis) of a potential effect:

- A Swiss respondent quoted a research paper (Abbaspourtorbati, F.; Zima, M., "The Swiss Reserve Market: Stochastic Programming in Practice," in IEEE Transactions on Power Systems, vol. no.99, pp.1-7) to argue that a reduction in reserve capacity might, in principle, be possible but does not provide any value;

- A supplier considers that the reduction in ISP duration could lead to 'a sharp decline' in reserves held by TSOs and also provides a quantitative estimate;

- A vertically integrated player indicated that a reduction in ISP duration should lead to a reduction in reserve capacity held by TSOs and provided estimates of its expectations on reserves held in 2020 and 2030 for the different scenarios;

- A TSO expected a potential for reserve capacity reduction by 100 to 500 MW when moving to an ISP duration of five minutes, without providing details on the underlying methodology used.

Our analysis

6.2.49   As noted above, there are potentially two effects on benefits:

- BRPs withholding capacity from forward markets in order to have the capacity available in intraday timescales to manage imbalances, either for their own use or by trading the capacity in intraday timescales; and

- TSOs changing reserve dimensioning as a result of there being smaller imbalances to manage, as a result of any shift from balancing energy to intraday energy (described in the previous sub-section).

6.2.50   Many stakeholders have clearly stated they do not believe the BRPs face incentives to withhold capacity from forward markets as a result of a change to ISP duration. In addition, no stakeholders have quantified the impact from BRPs withholding capacity from forward markets. Therefore, we conclude that we should not consider in the CBA the cost or benefit of any change to the way BRPs choose to sell capacity in the forward market and intraday market. Either the scale of the behavioural effect is not material or the consequence of any change to behaviour is not material.

6.2.51   We do however conclude that at least in some countries the may be a material effect of the TSO changing its reserve dimensioning as a result of a reduction in ISP duration.

6.2.52   The first part of our approach to analysis is as follows:

- For 2020 we would assume that any effect on reserve dimensioning is not material for those countries for which the TSO has clearly stated that their dimensioning methodology is such that they do not expect an impact. The estimated benefit will be zero in all scenarios for those countries.

- For countries where the TSO has indicated a potential to reduce the quantity of reserves held or where the TSO has remained silent, we would assume that there is a potential for the quantity of reserves held in 2020 to be reduced.

- By 2030 we assume there is scope for changes in the reserve dimensioning methodology for all countries. Intraday markets will be better functioning by then, and BRPs and TSOs will have learned how to operate under the conditions of the new ISP.

6.2.53   The second part of our approach is described below:

- We first categorise countries into those where reserve dimensioning is unlikely to be affected and those where it may be affected by ISP duration by considering whether or not N-1 security requirements are driving reserve dimensioning. We do this by comparing the size of reserves held to the estimated N-1 security requirement. Where the N-1 security requirement is close to 100% of reserves held, we assume reserve dimensioning would not

be affected by ISP duration.   For other countries we assume reserve dimensioning would be affected by ISP duration.

■ For those countries where reserve dimensioning may be affected we:

□ take the minimum value of the reduction in balancing energy (both upwards and downwards) per factual ISP across one year from the analysis of the change to reserve energy actions (the benefit sub-section immediately above); and

□ convert this into MW as the reduction in reserve capacity held that is consistent with the reduction in balancing actions.

■ We estimate the cost saving per MW of reduction in reserve held by the TSO. We provisionally estimate this to be 15 €/MW based on cost data submitted by TSOs[23].

■ We multiply the cost saving per MW by the reduction in reserve capacity, and multiply by 8760 hours to estimate the saving for a year.

■ We interpolate linearly between 2020 and 2030 in the case of those countries whose savings differ between the two years.

6.2.54 The minimum value for the reduction in balancing energy across the year is low, in the order of 0 – 0.33 MW, depending on the country, when converted into MW quantities. We therefore use a value of 1 MW as the reduction for the reserve quantity up and down for each hour for those countries that we assume change their reserve capacity.

6.2.55 We note that this estimate is materially lower (by a factor of 100-300) than the two quantitative indications provided by survey respondents. This implies that it could be taken as an extremely conservative estimate of the scale of the benefit.

6.2.56 The exhibit below shows the countries with a potential saving in 2020 and 2030, based on a combination of information provided by the TSO as to whether reserve dimension would change in 2020, and the N-1 analysis for 2020 and 2030.

6.2.57 Applying the above analysis, the present value of the benefit in 2019 amounts to:

■ €36 million in moving to a 30 minute ISP;

■ €41 million in moving to a 15 minute ISP; and

■ €57 million in moving to a 5 minute ISP.

6.2.58 In the exhibit below, we show how these results break down for each country under investigation in our analysis.

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[23] We would note that there is some uncertainty around this estimate given the diversity of data provided by TSOs. However, the analysis indicates that the order of magnitude for this benefit remains negligible compared to other benefit items, therefore we have not investigated this further.

Exhibit 37. Break-down of the present value of the benefit associated with lower reserve capacity cost by country and by ISP duration

Country	30 minutes	15 minutes	5 minutes
Austria	0 €mn	0 €mn	2 €mn
Belgium	0 €mn	0 €mn	0 €mn
Switzerland	0 €mn	0 €mn	1 €mn
Germany	0 €mn	0 €mn	2 €mn
Hungary	0 €mn	0 €mn	2 €mn
Lichtenstein	0 €mn	0 €mn	2 €mn
Luxemburg	0 €mn	0 €mn	2 €mn
Netherlands	0 €mn	0 €mn	1 €mn
Slovakia	0 €mn	0 €mn	2 €mn
France	0 €mn	0 €mn	0 €mn
Great Britain	0 €mn	0 €mn	0 €mn
Ireland	0 €mn	2 €mn	2 €mn
Northern Ireland	0 €mn	2 €mn	2 €mn
Bulgaria	2 €mn	2 €mn	2 €mn
Czech Republic	2 €mn	2 €mn	2 €mn
Denmark	0 €mn	0 €mn	0 €mn
Estonia	1 €mn	1 €mn	1 €mn
Greece	2 €mn	2 €mn	2 €mn
Spain	0 €mn	0 €mn	0 €mn
Finland	0 €mn	0 €mn	0 €mn
Croatia	2 €mn	2 €mn	2 €mn
Italy	2 €mn	2 €mn	2 €mn
Lithuania	2 €mn	2 €mn	2 €mn
Latvia	2 €mn	2 €mn	2 €mn
Norway	2 €mn	2 €mn	2 €mn
Poland	2 €mn	2 €mn	2 €mn
Portugal	2 €mn	2 €mn	2 €mn
Romania	2 €mn	2 €mn	2 €mn
Sweden	2 €mn	2 €mn	2 €mn
Slovenia	2 €mn	2 €mn	2 €mn
Cyprus	2 €mn	2 €mn	2 €mn
Malta	2 €mn	2 €mn	2 €mn
Total	*36 €mn*	*40 €mn*	*71 €mn*

Source: Frontier Economics

Exhibit 38. Countries whose reserve dimensioning is potentially affected by ISP

Country	2020	2030
Austria		
Belgium	No impact	No impact
Switzerland	No impact	
Germany		
Hungary		
Lichtenstein		
Luxemburg		
Netherlands	No impact	
Slovakia		
France	No impact	No impact
Great Britain	No impact	No impact
Ireland		
Northern Ireland		
Bulgaria		
Czech Republic		
Denmark	No impact	No impact
Estonia	No impact	
Greece		
Spain	No impact	No impact
Finland	No impact	No impact
Croatia		
Italy		
Lithuania		
Latvia		
Norway		
Poland		
Portugal		
Romania		
Sweden		
Slovenia		
Cyprus		
Malta		

Source: Frontier based on TSO information and N-1 analysis

Greater intraday competition from cross border BSPs

Views of respondents

6.2.59   The vast majority of respondents have not provided an answer for this question. Compared to previous benefits, we would also note that they provided fewer qualitative comments.

6.2.60 Those respondents that have provided the most comments tend to be generators, retailers and traders. TSO have not produced quantified analysis. A number of players have clearly stated they did not feel concerned by this benefit because they do not trade cross-border.

6.2.61 Where a value has been indicated in the survey, most of the time this value is equal to zero. Respondents suggested other barriers to cross-border trading than market design:

- A TSO suggested that "the Nordic ID trade with Germany (ISP=15 min) is liquid. Limiting factor is capacity, not Market design (ISP)";

- A vertically integrated player stated that no effect was expected because of levels of interconnection;

- A generator stated that as interconnectors are limited and at full capacity, there is likely to be very little intra-day volume/spare capacity available.

6.2.62 One TSO also noted that the social welfare may be less than the value of the pure energy trade under an unlimited capacity/unlimited rate-of-change wholesale market exchange model, at least in the case of HVDC interconnectors. This is because the maximum total change between periods and/or rate-of-change will need to be controlled by market-rules, increased reserve holding and domestic re-despatch or firm rights for TSO-buy-back and SO-SO actions to reduce flow changes and levels that would harm system security.

6.2.63 Some players were not committal:

- A TSO stated that "it depends on market design and behaviour of BSP";

- Another TSO stated: "we are not able to compute";

- A retailer stated that "we do not know if any price discount would be achieved";

- A TSO said the effect is: "unknown"; and

- A generator stated that it was "unable to provide a response without significant additional modelling and analysis that could not be completed within the timescales of this CBA".

6.2.64 Some players were more positive:

- Two TSOs agreed that increased ISP harmonization across borders would lead to more efficient and liquid cross-border trade as long as harmonization is accompanied by appropriate harmonization schemes (such as XBID); and

- A generator stated that "the harmonisation of ISPs would also have a significant impact on the ability to exchange cross-border volumes on the intraday".

6.2.65 Two players suggested some quantification of a potential positive effect:

- A retailer / trader suggested that "trading for specific small periods will push the imbalance prices to a similar level for connected countries" and suggested a discount of €5/MWh (with a range of €0/MWh to €10/MWh). This respondent also indicated a €1/MW capacity related benefit in a 5 minute ISP scenario (this was the only suggested impact in relation to capacity); and

- A retailer expected a trading discount of €5/MWh (with a range of €3/MWh to €6/MWh), corresponding to the difference between trading cross-border at 15 minutes and 5 minutes.

6.2.66 The majority of other respondents did not indicate whether a price discount could be achieved by trading cross-border at finer granularity, and about 15 respondents specifically indicated that they expected no discount to be achievable.

Our analysis

6.2.67 Our stylised analysis focuses on those borders where the ISP duration is currently different on either side of the border and therefore where a change in ISP duration would potentially lead to harmonised ISPs.

Exhibit 39. Borders potentially affected by change in ISP duration
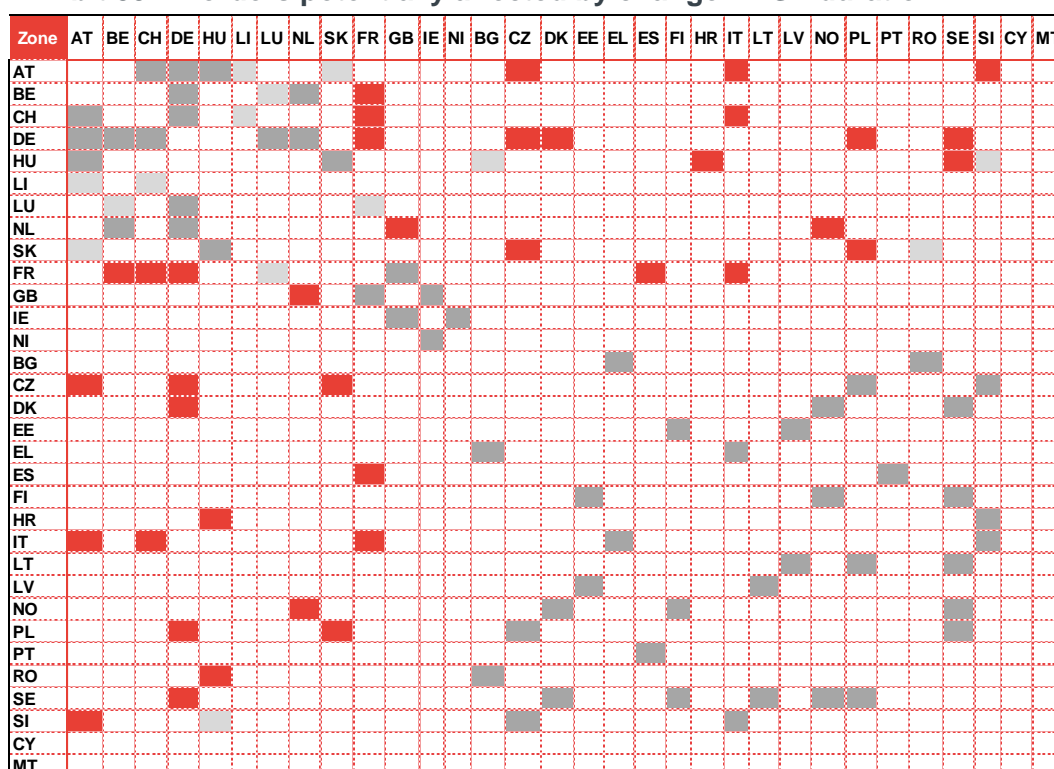
LEGEND
No physical border
No electric interconnection
ISP already harmonised
Potential harmonisation

Source: Frontier Economics

6.2.68 For each potentially affected border, we collected data on hourly flows from the ENTSO-E platform. We identified net flow direction in each hour and assessed the utilisation ratio (measured as flow over capacity) in each hour. In hours where the interconnector is already full, we expect no further benefit from a reduction in the ISP duration. Where there is spare capacity however, we consider the potential benefit from increased cross-border trading at the new ISP duration. To quantify this, we estimate the increase in cross-border flow in each hour.

- In 2020, we assume this is equal to the minimum of:

  □ Additional flows assuming the interconnector is fully used in this hour; and

  □ Additional flows corresponding to a 10% increase in flow.

- In 2030, we consider total interconnection capacity is likely to have increased across the EU in line with a target of each country having interconnection capacity equal to 15% of local generation capacity. We then calculate potential increased flows due to ISP harmonisation as the minimum of:

  □ Additional flows assuming the interconnector is fully used in this hour; and

  □ Additional flows corresponding to a 15% increase in flow.

6.2.69 We estimate additional flows across potentially affected borders ranging from 6.6 to 10.4 TWh per year between 2020 and 2030 in the case of a move to a harmonised 5- or 15-minute ISP duration across Europe.

6.2.70 We then turn to price and cost effects to consider the benefit and distributional effects associated with this increase in cross-border trading. As indicated earlier, the welfare effect will be equal to the difference between the dispatch cost achieved cross-border and that achieved on the local market. Consistently with the approach used for other benefit item, we reflect the uncertainty around the shape of the supply curve and therefore the degree to which the price effect will be the reflection of an underlying change in cost by introducing a low and a high case for the benefit value. In the low case we assume a sloping supply curve and estimate the producer surplus as the product of the price reduction times demand divided by 2; in the high case where we assume the price effect fully stems from a reduction in cost.

6.2.71 Our first estimate of the potential price effect is drawn from intraday price data for Germany and Austria, available at 15-minute granularity. We compute an average 30-minute price for Germany and Austria based on this data, and assume this would be the price observed both in those market areas and interconnected market areas with an ISP higher than 15 minutes where the interconnector is not full in the corresponding period (ie level where cross-border prices converge absent congestion). We then compare the 30-minute price with the 15-minute price in each quarter in Germany: where the 30-minute price is lower than the quarterly price in Germany, we assume that if interconnected countries also had a quarterly ISP period and intraday products, then the cross-border prices would converge at that granularity as well. We assume the estimate price reduction for quarterly products in Germany would be equal to the current differential between quarterly and half-hourly products. This indicates that a price reduction of 3.2€/MWh would be achieved on quarterly products if it were possible for Germany to trade intraday and cross-border in that time unit.

6.2.72 We then consider price data for Great Britain, available at 30 minute granularity, and replicate the analysis there in the case of cross-border exchanges with neighbouring interconnected countries with current ISP duration equal to one hour. We obtain an estimated price reduction of 1.1€/MWh.

6.2.73 We are only able to carry out the analysis for those two markets due to data availability constraints. We therefore propose to retain an average estimate price effect of 2.15 €/MWh.

6.2.74   The net welfare effect will be driven by the corresponding cost effect, multiplied by traded volumes. To estimate this, we assume a sloping supply curve, so that consumer surplus is equal to the price effect times volumes, and the producer surplus is equal to the negative of the price effect times volumes divided by 2.

6.2.75   In the low (respectively high) case we estimate a net welfare effect of net present value €0.80bn (respectively €1.59bn) over the CBA horizon in the case of a harmonised move to either 5 or 15 minute ISP durations, and net present value €0.04bn (respectively €1.08bn) in the case of a harmonised move to 30 minute ISP durations across Europe. The large gap in estimates is due to the fact that, with a move to 30 minutes, only two borders would be affected.

6.2.76   The exhibit below shows the breakdown of this benefit for each of the countries covered in the analysis.   Since the benefit in relation to cross-border harmonisation cannot be investigated on an isolated by-country basis, we provide below an overview of what border between two countries is affected by a planning case. In addition, we then provide the breakdown of the cross-border benefit by country and planning case.

Exhibit 40. Overview of whether a cross-border benefit from ISP duration harmonisation is expected to occur by border under investigation and planning case

Border from	Border to	Planning case 1	Planning case 2	Planning case 3	Planning case 4
Austria	Czech Republic	yes	yes	yes	yes
Austria	Italy	yes	yes	yes	yes
Austria	Slovenia	yes	yes	yes	yes
Belgium	France	yes	no	no	yes
Switzerland	France	yes	no	no	yes
Switzerland	Italy	yes	yes	yes	yes
Germany	France	yes	no	no	yes
Germany	Czech Republic	yes	yes	yes	yes
Germany	Denmark	yes	yes	yes	yes
Germany	Poland	yes	yes	yes	yes
Germany	Sweden	yes	yes	yes	yes
Hungary	Croatia	yes	yes	yes	yes
Hungary	Romania	yes	yes	yes	yes
Netherlands	Great Britain	yes	no	no	yes
Netherlands	Norway	yes	yes	yes	yes
Slovak Republic	Czech Republic	yes	yes	yes	yes
Slovak Republic	Poland	yes	yes	yes	yes
France	Spain	yes	no	yes	yes
France	Italy	yes	no	no	yes

Source: Frontier Economics

Exhibit 41. Net present value of the cross-border benefit broken down by country covered in the analysis and by planning case (in €mn)

Country	Low Case (€mn)				High Case (€mn)			
	PC 1	PC 2	PC3	PC4	PC 1	PC 2	PC3	PC4
Austria	47	47	47	47	93	93	93	93
Belgium	22	0	0	22	44	0	0	44
Switzerland	272	236	236	272	544	472	472	544
Germany	185	111	111	185	370	223	223	370
Hungary	53	53	53	53	106	106	106	106
Netherlands	84	0	0	84	167	1	1	167
Slovakia	93	93	93	93	185	185	185	185
France	41	0	9	41	83	0	18	83
Total	*796*	*540*	*549*	*796*	*1592*	*1080*	*1097*	*1592*

Source: Frontier Economics

Further impact on prices

Views of respondents

6.2.77   Largely based on responses, we now take the view that the net effect on prices will be negligible since volumes are potentially transferring from one market to another (i.e. from the balancing market to the intraday market) and that the overall effect on the demand and supply balance from a change to ISP is negligible. Reserve dimensioning may allow more capacity to supply the market although this effect is expected to be very small relative to overall supply.

6.2.78   We do not consider this benefit further.

Greater entry of BSPs to intraday markets

Views of respondents

6.2.79   About 20% of respondents provided an answer to this question. Overall the expectation appears to be that there will be little effect.

6.2.80   Some participants indicated that they thought an effect was possible:

- A TSO indicated that they assumed a BSP capacity increase could be linked to possibilities for aggregation of DSR. However, they noted that reduced balancing prices might on the other hand reduce the incentives;

- A vertically integrated respondent stated that "in case of a reduction in ISP, we assume that it will also result in a change of Standard Products as defined by the TSOs… [This] may result in new BSPs entering the market but also existing BSPs exiting the market (or at least have a reduction in available capacity) as they are no longer able to provide the Standard Product. We refer in this case to the aFRR study by E-Bridge/IAEW as an example of how a change in balancing product characteristic may impact the available capacity";

- A retailer noted that ISP reduction could lower the barriers for households to undertake demand response and to participate in intraday markets and balancing mechanisms;

- a vertically integrated respondent described how they would expect the change in ISP (and MTU) to lead to both the intraday and balancing price better reflecting the value of energy.

6.2.81 Other respondents indicated they did not believe any effect was likely:

- Two TSOs indicated they expected little change; and

- One TSO suggested that "ISP 10 or 5 mins will sterilize BRP flexibility and kill presently functioning Aggregator business";

- Another respondent indicated they expected "technical challenges" to limit opportunities for offers on a shorter ISP basis; and

- A vertically integrated respondent indicated that products demanded by TSOs were more significant than the duration of the ISP.

6.2.82 In the round, whilst responses received do not allow quantifying the value of the potential benefit across countries and ISP durations, they provide indicative orders of magnitude for the potential size of the benefit.

6.2.83 As shown in the charts below, where respondents have estimated a volume of new BSP capacity, the expectation would be for this to amount to up to 14% of installed capacity in the corresponding market area.

Exhibit 42. 3.1.5 a) Average change in the total volume of BSP capacity by 2020 – scaled with the installed capacity in MW, in the case of a move to 15-minutes
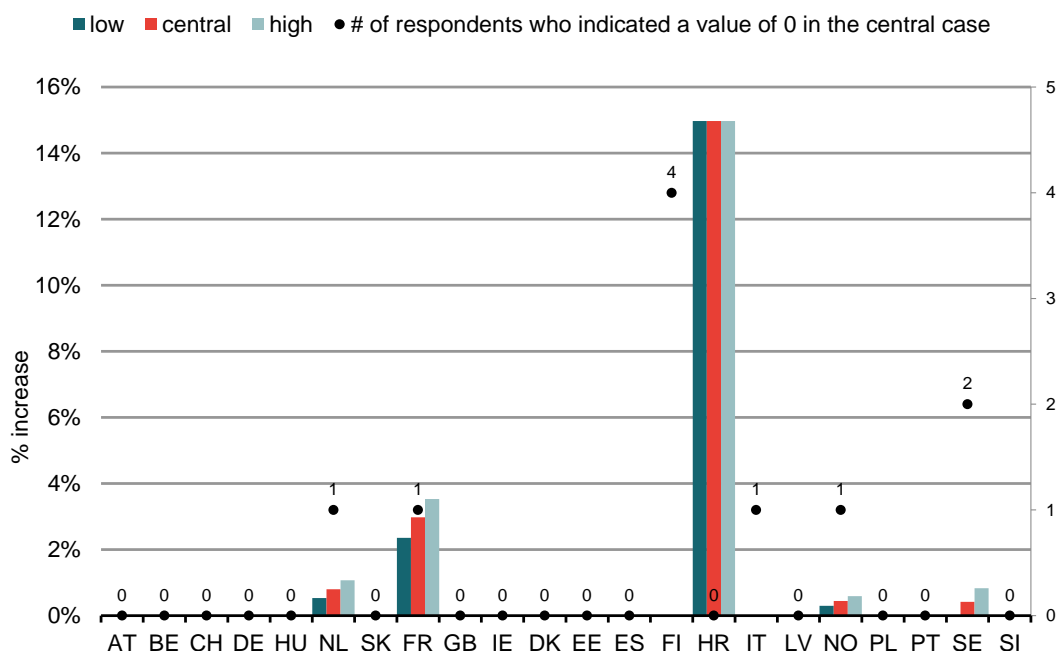
Source: Frontier Economics based on survey responses

6.2.84 The chart below displays the expected order of magnitude of the price impact in the wholesale market, where respondents have quantified this.

Exhibit 43. 3.1.5 c) Impact on average intraday price by 2020
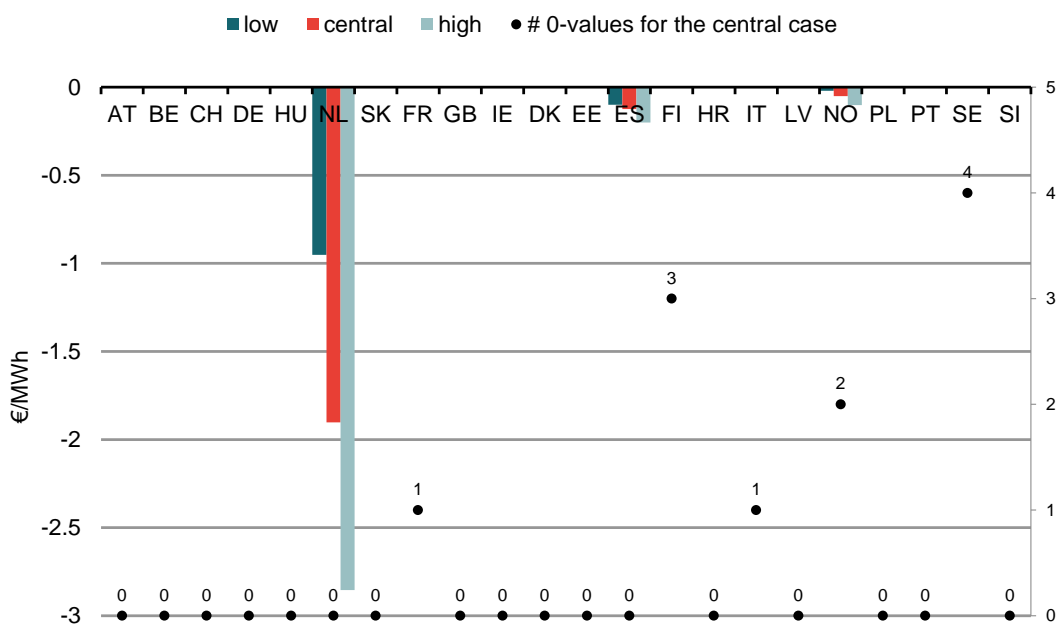
Source: Frontier Economics based on survey responses

Our analysis

6.2.85   We have carried out stylised analysis to assess the potential magnitude of the benefit associated with greater entry of BSPs to intraday markets. In this analysis, we estimate the potential reduction in the average wholesale price (in €/MWh) associated with increased entry. We then estimate the corresponding increase in consumer surplus by multiplying this price reduction by local power demand. Finally we net off the reduction in producer surplus to derive the net welfare effect. The size of the change in producer surplus for a given observed level of price reduction will depend on the shape of the supply curve. In order to reflect the uncertainty around this we derive a low range in which we assume a sloping supply curve and estimate the producer surplus as the product of the price reduction times demand divided by 2 and a high case where we assume the price effect fully stems from a reduction in cost.

6.2.86   Stakeholder responses to the survey have emphasised the potential technical barriers of greater BSP entry into the wholesale market, with those barriers being highest in the case of a move to 5-minute ISPs. We reflect this in the stylised analysis by making the following assumptions:

■   Where the ISP is reduced to 15 or 30 minutes, we estimate the average price impact of new entrants reducing the price by 10% in the 10% trading periods with the highest power price in the year;

■   Where the ISP is reduced to 5 minutes, we estimate the average price impact of new entrants reducing the price by 10% in the 5% trading periods with the highest power price in the year.

6.2.87 We display the results of our analysis below. For simplicity we display the estimated net welfare effect of moving all countries included in the scope of the analysis to a 30-minutes, 15-minute and 5-minute ISP (only for countries where the current ISP duration is higher than the target ISP duration).

6.2.88 We note that the size of the potential reduction in wholesale prices is consistent with the orders of magnitude indicated in survey responses.

Exhibit 44. Potential benefit from greater entry of BSPs to intraday market

	Low Case			High Case		
	Move to 30 minutes	Move to 15 minutes	Move to 5 minutes	Move to 30 minutes	Move to 15 minutes	Move to 5 minutes
Average wholesale power price reduction (€/MWh)	0.44-0.81	0.44-0.81	0.24-0.45	0.44-0.81	0.44-0.81	0.24-0.45
Annual benefit (k€)	428	731	552	856	1,461	1,104
NPV of benefit (k€)	*3,750*	*6,400*	*4,835*	*7,499*	*12,800*	*9,670*

Source: Frontier Economics

6.2.89 In the low case, we estimate a potential benefit ranging from € 3.8m to € 6.4m across all countries included in the scope of the study. In the high case, estimate a potential benefit ranging from € 7.5m to € 12.8. The highest benefit value would be expected to arise for a move to 15-minute ISP. The exhibit below presents the breakdown of these results by country covered in the analysis.

Exhibit 45. **Net present value of the benefit related to greater entry by BSPs to the intraday market by country and ISP duration (in €mn)**

Country	Low Case (€mn)			High Case (€mn)		
	30 min	15 min	5 min	30 min	15 min	5 min
Austria	0.0	0.0	0.1	0.0	0.0	0.2
Belgium	0.0	0.0	0.1	0.0	0.0	0.3
Switzerland	0.0	0.0	0.1	0.0	0.0	0.2
Germany	0.0	0.0	0.7	0.0	0.0	1.4
Hungary	0.0	0.0	0.1	0.0	0.0	0.1
Lichtenstein	0.0	0.0	0.0	0.0	0.0	0.0
Luxemburg	0.0	0.0	0.0	0.0	0.0	0.0
Netherlands	0.0	0.0	0.2	0.0	0.0	0.3
Slovakia	0.0	0.0	0.0	0.0	0.0	0.1
France	0.0	1.4	0.8	0.0	2.7	1.5
Great Britain	0.0	1.2	0.7	0.0	2.4	1.3
Ireland	0.0	0.1	0.0	0.0	0.1	0.1
Northern Ireland	0.0	0.0	0.0	0.0	0.1	0.0
Bulgaria	0.1	0.1	0.0	0.2	0.2	0.1
Czech Republic	0.2	0.2	0.1	0.3	0.3	0.2
Denmark	0.1	0.1	0.0	0.2	0.2	0.1
Estonia	0.0	0.0	0.0	0.0	0.0	0.0
Greece	0.1	0.1	0.1	0.3	0.3	0.2
Spain	0.7	0.7	0.4	1.4	1.4	0.8
Finland	0.2	0.2	0.1	0.5	0.5	0.3
Croatia	0.0	0.0	0.0	0.1	0.1	0.1
Italy	0.9	0.9	0.5	1.7	1.7	0.9
Lithuania	0.0	0.0	0.0	0.1	0.1	0.0
Latvia	0.0	0.0	0.0	0.0	0.0	0.0
Norway	0.4	0.4	0.2	0.7	0.7	0.4
Poland	0.4	0.4	0.2	0.8	0.8	0.5
Portugal	0.1	0.1	0.1	0.3	0.3	0.1
Romania	0.1	0.1	0.1	0.2	0.2	0.1
Sweden	0.3	0.3	0.2	0.6	0.6	0.3
Slovenia	0.0	0.0	0.0	0.1	0.1	0.0
Cyprus	0.0	0.0	0.0	0.0	0.0	0.0
Malta	0.0	0.0	0.0	0.0	0.0	0.0
Total	*3.8*	*6.4*	*3.8*	*7.5*	*12.8*	*9.7*

Source: Frontier Economics

Further impact on balancing

Views of respondents

6.2.90 Very few responses to the questionnaire considered there to be any additional benefit not already captured by the benefit related to the shift from balancing energy to intraday energy. Therefore, we do not consider this benefit further.

6.3 Increased secondary trading volumes

Views of respondents

6.3.1 Between three and 14 respondents have answered this question quantitatively, with up to a third of responses indicated an expected benefit of zero in each case. As with section 6.2, it may be possible that the differences in the views of stakeholders as outlined below may be the result of differing market and operating rules and practices existing in different areas across the EU currently. However, the need for a common modelling approach to be applied to the EU means that differences in incentives driving current or future trading behaviour of BRPs has not been included in our analysis.

6.3.2 Some respondents suggested a positive impact on liquidity:

- A TSO commented that shorter ISP may increase trading on the intraday market. However they noted it was "not possible to make reliable estimation of increase";

- A generator stated that "All else equal we expect a shift of volumes from Balancing market towards ID market";

- A retailer expected a slight decrease in prices following an increase in liquidity on wholesale markets;

- A generator commented that "harmonization would definitively increase liquidity as intraday coupling is lacking at the moment between core markets" (although it is not clear that this is a benefit to harmonisation as opposed to integration around the target model); and

- A vertically integrated respondent stated that "The increase of liquidity in cross border exchange should arise as a result of the harmonization of the ID market products duration".

6.3.3 A number of respondents expect a reduction in liquidity as a result of splitting of products (as we noted above, while this may relate to absolute liquidity this may not be the most appropriate measure):

- An industry associated expected that splitting volumes across shorter products will lead to reduced liquidity per product;

- A retailer commented that "we expect a reduction in ISP duration to have an adverse effect on liquidity with liquidity being reduced due to existing liquidity being spread over multiple products"; and

- A vertically integrated respondent commented "liquidity could also decrease as an effect of segmentation (1 hourly product may be more liquid of 4 products of 15' duration)".

6.3.4 A small number of respondents flagged a risk of increased complexity in trading due to multiple products / MTUs.

6.3.5 A number of other respondents indicated they did not foresee a change in liquidity:

- A TSO commented "limited impact expected";

- Another TSO commented "increased volumes due to uniformity of information is probably marginal and not related to ISP harmonization";

- An industry association stated "No change expected. The change in ISP will not affect trading volumes nor market liquidity";

- A vertically integrated respondent stated "no change expected" in any planning case; and

- Another vertically integrated respondent stated "overall volume required to buy/sell would be unchanged".

6.3.6 A small number of respondents provided some quantification of effects. The most comprehensive response came from a vertically integrated respondent which has forecast balancing volumes on various ISP durations and assumes gaps with the counterfactual (no change in ISP duration) will transfer to the intraday market. A TSO also provided estimates in this area.

6.3.7 We provide below an overview of estimated increases in traded volume subsequent to a change in ISP duration. To ensure comparability, these estimates have been expressed in % of current intraday trading volumes.

- None of the respondents indicated an expected increase in traded volumes subsequent to a move to 30-minute ISP duration;

- Respondents expect increases in traded volumes ranging from 0.04% to 0.69% subsequent to moving to 15-minute ISP durations; and

- Respondents expect increases in traded volumes ranging from 0.22% to 21% subsequent to moving to 15-minute ISP durations.

Exhibit 46. Overview of estimated increases in liquidity subsequent to changes in ISP duration

Country	Benefit item	Introduction of 15 minute ISP - 2020 Low Benefits_2020_15 _low	Introduction of 15 minute ISP - 2020 Central Benefits_2020_15 _central	Introduction of 15 minute ISP - 2020 High Benefits_2020_15 _high	Introduction of 5 minute ISP - 2020 Low Benefits_2020_5_ low	Introduction of 5 minute ISP - 2020 Central Benefits_2020_5_ central	Introduction of 5 minute ISP - 2020 High Benefits_2020_5_ high
CH	3.2.1.a)				0.37%	0.48%	0.60%
FI	3.2.1.a)		0.04%			0.22%	
SE	3.2.1.a)		0.30%	0.61%		0.30%	0.61%
CH	3.2.2.a)				8.05%	8.78%	9.33%
GB	3.2.2.a)	0.00%	0.35%	0.69%	0.00%	0.69%	1.04%
NL	3.2.2.a)					21.08%	

Source: Frontier Economics based on survey responses

Our analysis

Does the introduction of shorter term products reduce liquidity?

6.3.8 We look to understand whether a reduction in ISP and alongside this the introduction of shorter duration traded products on the intra-day market alongside longer duration products might affect liquidity. We do this by considering

evidence from markets where shorter term products have been introduced alongside longer term products. Specifically we look at Germany, Austria and Switzerland.

6.3.9 Germany introduced 15 minute intraday products on December 14th, 2011. Previously, the shortest available intraday products were hourly and hourly products do remain available to market participants. The 15 minute products were initially available from two hours before the start of the delivery hour and trading closed 45 minutes before the start of delivery.

6.3.10 Austria introduced an intraday market in mid-October 2016, without 15 minute products. This is in effect a joint market with Germany since the market sees no commercial transmission congestion between the two countries.

6.3.11 In March 2013, EPEX Spot announced more flexible trading rules for 15 minute products on the German intraday market. These products could be traded from 4pm the previous day up until 45 minutes before the start of the delivery period.

6.3.12 A Swiss intraday market was launched on June 26th 2013, including 15 minute traded products. These products could be traded across borders.

6.3.13 On December 9th, 2014 EPEX Spot launched a 15 minute auction on the German intraday market that takes place every day at 3pm for each 15 minute period on the next day. This auction is in addition to the continuously traded intraday market.

6.3.14 On July 16th, 2015 EPEX Spot reduced the lead time (i.e. gate closure time) by 15 minutes on all intraday markets to 30 minutes before the start of the delivery period for Germany, France and Austria, and to 60 minutes for Switzerland and for cross-border trades.

6.3.15 Finally, Austria introduced 15 minute intraday products on October 2nd, 2015.

6.3.16 Since the introduction of 15 minute products in Germany in 2011, intraday volumes for hourly and 15 minute products for trade on the German / Austrian markets have been increasing. However, this is in the context of a broader increase in day ahead and intraday traded volumes, see exhibit below.

Exhibit 47. Day-ahead and intraday traded volumes for Germany, Austria, Switzerland and France
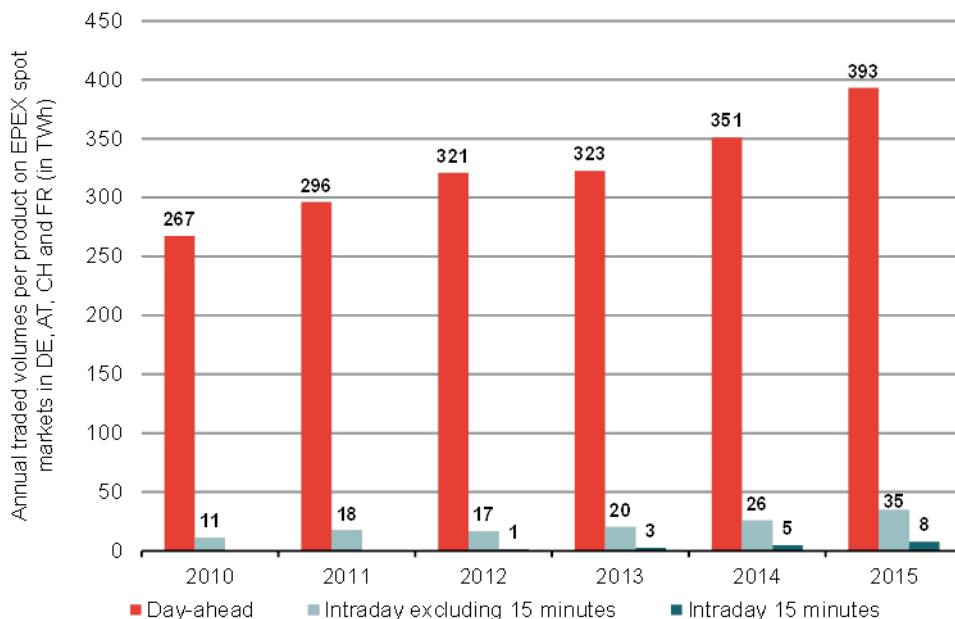
Source: EPEX Spot, Frontier Economics

6.3.17   For context the exhibit below shows the breakdown of trade by market for each of the three markets: Germany/Austria, France and Switzerland.

Exhibit 48. Split of annual traded volumes on EPEX Spot by product in 2015
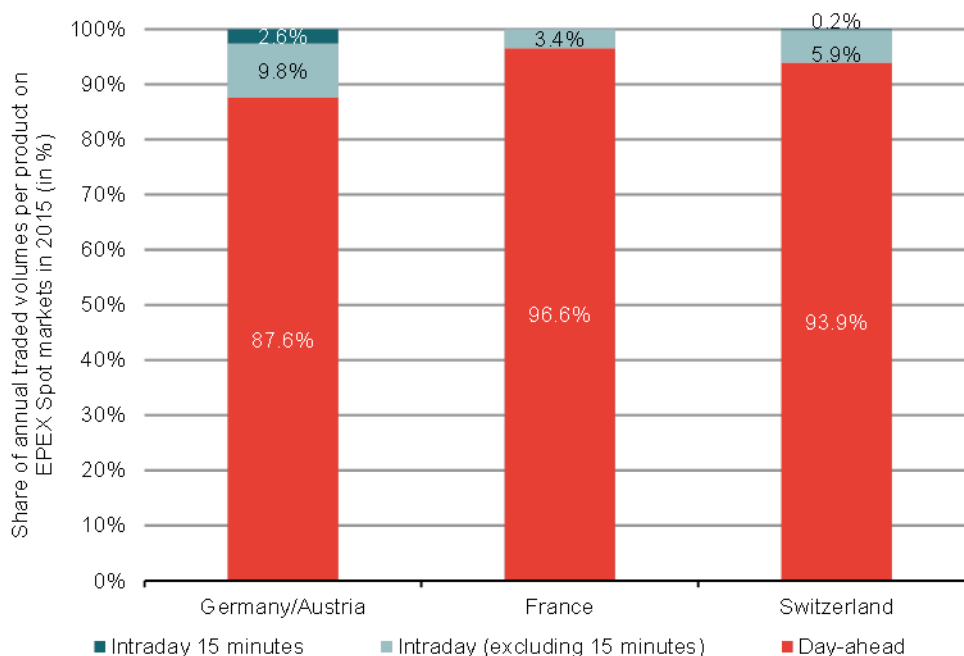
Source: EPEX Spot, Frontier Economics

6.3.18   Across the German, Austrian and Swiss markets, traded volumes on the intraday market have established themselves at a level of roughly 10-14% of traded volumes on day-ahead market.

6.3.19   The share of 15 minute products in overall intraday volumes has increased from
13% in 2013 to 24% in 2015, which suggests some degree of substitution
between hourly and 15 minute intraday products. The exhibit below shows the
increase in intraday volumes and 15 minute intraday volumes.

**Exhibit 49. Intraday traded volumes for Germany, Austria, Switzerland and
France**
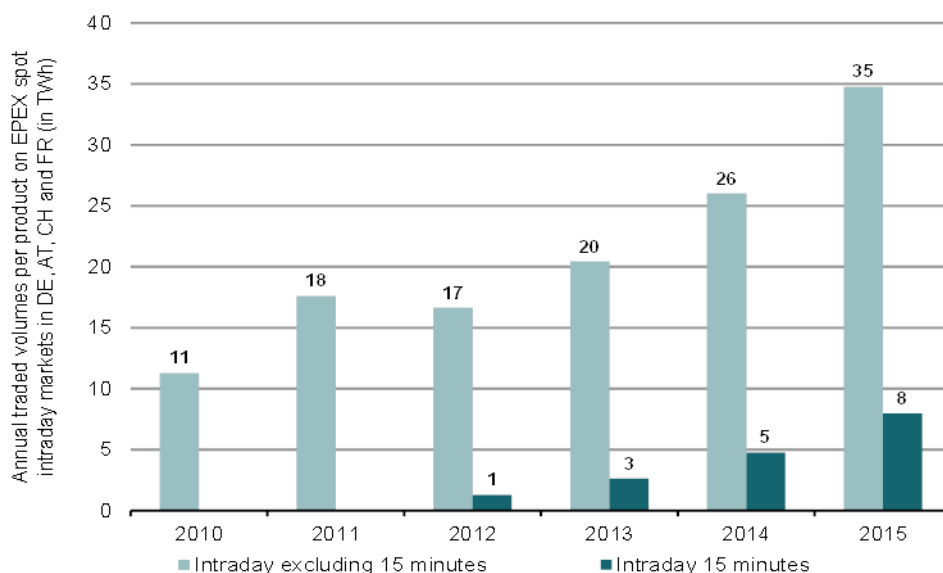
Source: EPEX Spot, Frontier Economics

6.3.20   The increase in overall intraday traded volumes does not suggest there to be a
reduction in liquidity after the introduction of shorter duration products on intraday
markets.

6.3.21   As an aside, it is interesting to observe that the PX has been adapting over time
to better meet the needs of the market, e.g. by increasing the time during which a
product may be traded and introducing an auction. These developments help to
reinforce the idea that initially the intraday market may not allow the full benefits
of ISP changes to be captured but that this is likely to improve over time.

How would the increase in intraday trade affect liquidity?

6.3.22   We previously noted that some volumes will move from the balancing market to
the intraday market. We also note that harmonisation of ISP across borders
would allow for more cross border trade.

6.3.23   We estimated that throughout Europe about 20 TWh of volumes would move
from the balancing market to the intraday market, i.e. about 2500 MWh per hour,
in moving to a 5 minute ISP. For a country such as Germany, the volume shift
was estimated as a little under 2 TWh or a little over 200 MWh per hour. For the
combined markets of Germany, France, Austria and Switzerland, the volume shift
is about 5 TWh or a little over 550 MWh per hour.

6.3.24   We estimated the increase in intraday trade as a result of increased cross border
trade as 6-10 TWh for Europe as a whole (per year) in moving to a 15 or 5
minute ISP. Based on generation volumes, for the groups of countries Germany,
France, Austria and Switzerland this would imply an increase in intraday volumes
of around 2-3 TWh.

6.3.25 Some of the volume shift may be reflected in solely a change to physical production or demand plans and may not pass through the traded market. Even if only half of the increase in volumes was traded in the intraday market, this would be relatively large (about one sixth) compared to the total intraday traded volumes for Germany, France, Austria and Switzerland in 2015 on EPEX Spot, 35 TWh.

What is the effect on price spreads and the resultant benefit?

6.3.26 An increase in traded volumes of this order of magnitude is likely to reduce bid ask spreads in the intraday market. It is difficult to know how much spreads would be affected. However, suppose they were reduced by 10%.

6.3.27 Currently, the difference between high and low prices for a delivery period on relatively well developed intraday markets is €9.94/MWh in Switzerland, €11.85/MWh in France and €30.86/MWh in Germany and Austria. The average is about €21/MWh. Some of this spread relates to changes in expectations of the supply and demand balance over the course of the continuously traded intraday market and some relates to the bid – ask spread. We assume half of the difference between high and low prices relates to the bid – ask spread, i.e. €4.97/MWh in Switzerland, €5.92/MWh in France and €15.43/MWh in Germany and Austria, and €10.44/MWh for other a countries (based on 50% of the average).

6.3.28 Applying 10% to this bid – ask spread implies a reduction in bid – ask spread of €0.50/MWh in Switzerland, €0.59/MWh in France and €1.54/MWh in Germany and Austria, and €1.04/MWh for other countries.

6.3.29 Not all countries currently have intraday markets. However, we expect such markets to be developed in line with the target model. We therefore need an estimate of intraday volumes for countries with intraday markets and countries without. Germany / Austria, France and Switzerland intraday traded volumes are 6.4%, 0.8% and 2.3% of demand respectively – we use these volumes to calculate the benefits for these countries. It would be reasonable to assume that intraday volumes were 2% of demand in a relatively well developed market in the case of other countries.

6.3.30 Based on the above assumptions, the present value benefit from increased liquidity at the end of 2019 would be €906 million if all countries moved to an ISP of 5 minutes. In the case of a 15 minute ISP, the benefit for those countries that needed to change would be €343 million and in the case of a 30 minute ISP €256 million. The exhibit below shows the breakdown of this benefit for each of the countries under investigation.

Exhibit 50. Net present value of the benefit in relation to an increase in liquidity by country and by ISP duration (in €mn)

Country	30 minutes	15 minutes	5 minutes
Austria	0 €mn	0 €mn	61 €mn
Belgium	0 €mn	0 €mn	15 €mn
Switzerland	0 €mn	0 €mn	6 €mn
Germany	0 €mn	0 €mn	446 €mn
Hungary	0 €mn	0 €mn	7 €mn
Lichtenstein	0 €mn	0 €mn	0 €mn
Luxemburg	0 €mn	0 €mn	1 €mn
Netherlands	0 €mn	0 €mn	21 €mn
Slovakia	0 €mn	0 €mn	5 €mn
France	0 €mn	20 €mn	20 €mn
Great Britain	0 €mn	61 €mn	61 €mn
Ireland	0 €mn	5 €mn	5 €mn
Northern Ireland	0 €mn	2 €mn	2 €mn
Bulgaria	6 €mn	6 €mn	6 €mn
Czech Republic	12 €mn	12 €mn	12 €mn
Denmark	6 €mn	6 €mn	6 €mn
Estonia	1 €mn	1 €mn	1 €mn
Greece	9 €mn	9 €mn	9 €mn
Spain	48 €mn	48 €mn	48 €mn
Finland	15 €mn	15 €mn	15 €mn
Croatia	3 €mn	3 €mn	3 €mn
Italy	58 €mn	58 €mn	58 €mn
Lithuania	2 €mn	2 €mn	2 €mn
Latvia	1 €mn	1 €mn	1 €mn
Norway	24 €mn	24 €mn	24 €mn
Poland	28 €mn	28 €mn	28 €mn
Portugal	9 €mn	9 €mn	9 €mn
Romania	10 €mn	10 €mn	10 €mn
Sweden	21 €mn	21 €mn	21 €mn
Slovenia	2 €mn	2 €mn	2 €mn
Cyprus	1 €mn	1 €mn	1 €mn
Malta	0 €mn	0 €mn	0 €mn
Total	*256 €mn*	*343 €mn*	*906 €mn*

Source: Frontier Economics

6.3.31 We do not differentiate this benefit between ISPs of different duration, other than that we apply the benefit only to those countries that change ISP in moving from the counterfactual to the factual.

6.4 Improved investment outcomes

Views of respondents

6.4.1 About 10 stakeholders have provided an answer in their surveys, though only two have provided quantitative responses. The majority of other stakeholders have taken the view that there would be no impact.

6.4.2 Some respondents suggested a positive impact:

- A retailer stated that "especially small customers will be added to reserve markets like cars, batteries, smart buildings"; and

- A trader stated that "this is certainly a positive impact, but difficult to measure, since it is marginal compared to other legislative hurdles."

6.4.3 In contrast, others suggested a negative impact:

- A TSO stated that "ISP 10 or 5 mins will sterilize BRP flexibility and kill presently functioning Aggregator business"; and

- Another TSO stated that it "cannot quantify. If shorter ISP transfers revenues to the wholesale market via new market products and this means increased (intraday) trade then the increasing amount of traded electricity should break down wholesale prices which leads to a negative impact on investments."

6.4.4 A more significant number suggested little impact:

- A TSO stated that "currently … investments in new capacity are not primarily motivated by balancing purposes. Wholesale market is the investment driver";

- Another TSO stated that "investment decisions are based on information on forward and DA markets given the larger volumes traded on those markets with respect to the ID or balancing market and no significant impact from potential volumes shifting from the balancing market to the DA market are expected";

- Another TSO stated "impact negligible compared to 15min period";

- Another TSO stated "currently investment in new capacity is not primarily motivated by balancing purposes."

- A vertically integrated respondent stated "no benefit foreseen";

- A retailer stated "no evidence to suggest there will be a transfer of revenues"; and

- A generator stated "the application of small scale units will require 15 minutes settlement as real time measurement is not realistic for distributed generation."

6.4.5 The exhibits below show the magnitude of new investment expected in the two countries where a stakeholder has quantified this. We do not present any data on the corresponding cost or price effect because none of the respondents have quantified this.

**Exhibit 51. 3.3.1 a) Transfer of revenues from the balancing stream to the
wholesale stream - Impact on volume of new investment in
2030 - scaled with Installed capacity in MW**
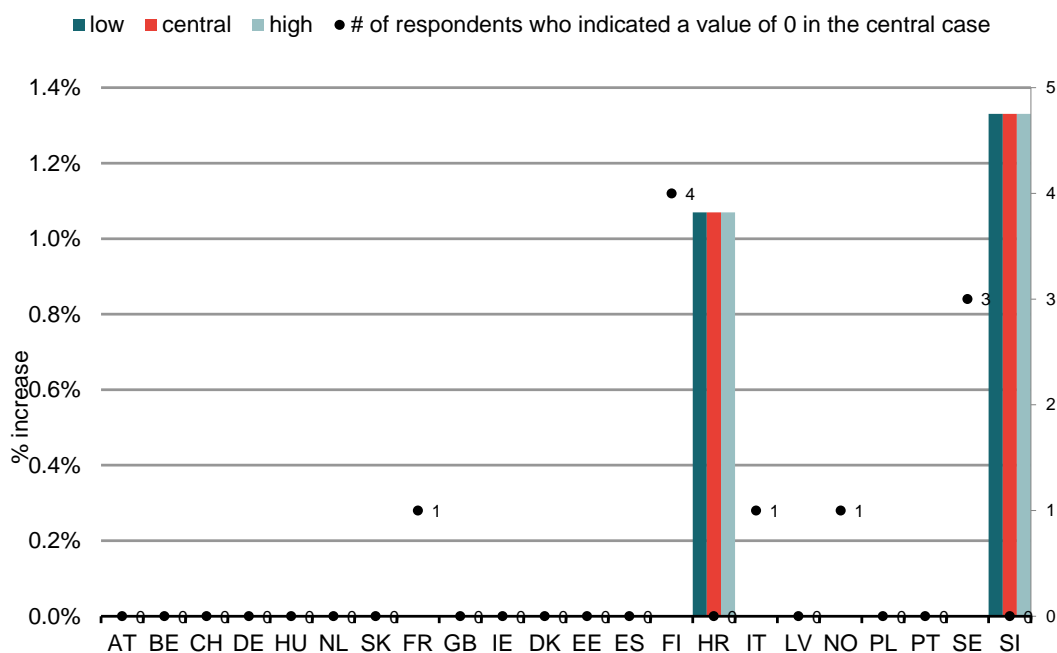
Source: Frontier Economics based on survey responses

**Exhibit 52. 3.3.2 a) Lower barrier to market entry for some technologies -
Impact on volume of new investment in 2020 - scaled with
Installed capacity in MW**
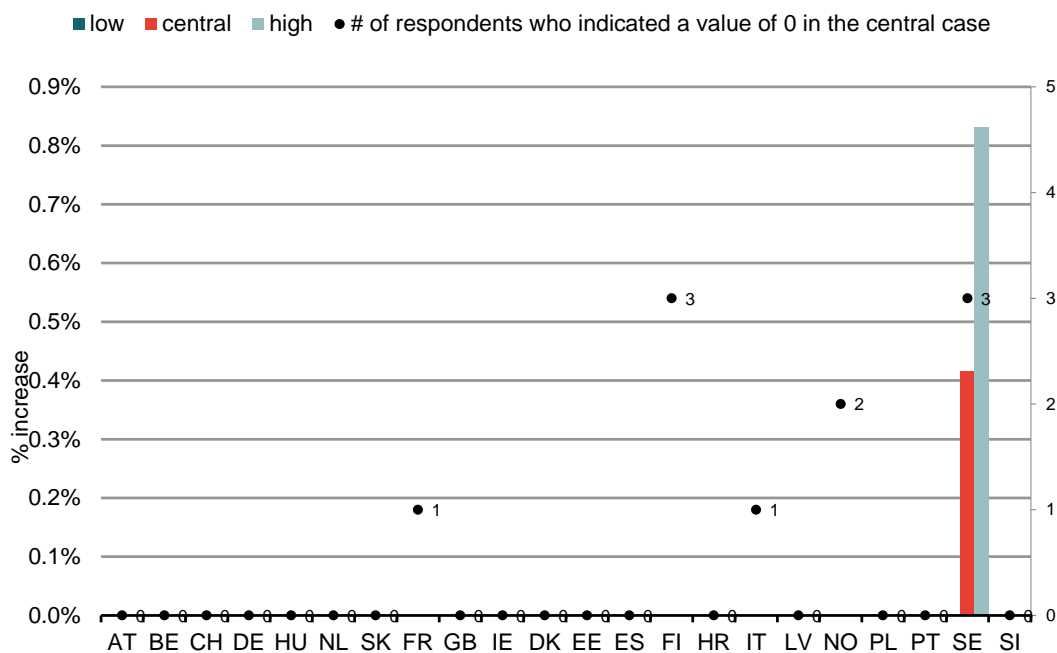
Source: Frontier Economics based on survey responses

Our analysis

6.4.6   Overall the survey responses provide little information on the assumptions under which we would see a benefit arise in this area. Only three stakeholders have provided quantification of expected volumes of investment with very little comments around them and no indication on potential associated price and cost effects. 10 respondents stated that they expect no benefit.

6.4.7   We believe it would be difficult to quantify the potential scale of this benefit in any meaningful way.   The relationship between the strength of price signals (particularly those from short term markets) and investment decisions is clearly complex, and may evolve over time as participants understand better the frequency, scale and reliability of price spikes. We have not therefore sought to quantify this effect.

6.5   Other benefits

Frequency excursions

6.5.1   Between four and ten answers have been provided for this benefit category (depending on the planning case considered), with just above 50% of values indicated there being non-zero effect. A majority of players expect a benefit even if they don't quantify it:

- A TSO cites a paper on the issue ("Influence of 15-minute contracts on frequency deviations and on the demand for balancing energy" International ETG Congress 2015, November 2015, Bonn);

- The Nordic TSOs also agreed that shorter ISPs may improve frequency quality;

- A generator also noted that frequency quality was expected to improve, and grid costs to go down; and

- A vertically integrated respondent cited analysis suggesting that an ISP lower than 30 minutes would appear not to improve quality.

6.5.2   Other responses were less positive:

- A TSO noted that their existing 15 minute ISP implied there were few additional gains to be made;

- Another TSO indicated that frequency quality issues were not prevalent today; and

- Another TSO indicated that their analysis showed a null impact.

6.5.3   One TSO provided a quantified estimate of the reduced risk of blackout/brownout at the current level of frequency quality.

6.5.4   Overall the survey responses provide little information on the assumptions under which we would see a benefit arise in this area, and what the size of the benefit might be in that case. The relationship between the ISP and frequency quality is also clearly complex and will be driven by very specific behavioural changes by participants. As a result we have not have not therefore sought to quantify this effect.

6.6 Non-monetary benefits

Increased participation as BSP and increased exposure to imbalance prices for RES

6.6.1 The majority of stakeholders that have provided comments on the potential for an increased participation of renewable energy sources (RES) are TSOs, vertically integrated players and generators. However, some DSOs and retail suppliers have also responded on this sub-benefit.

6.6.2 The first point commented on by stakeholders is whether or not production forecast quality at ISP granularity would be improved with a reduction in ISP duration. There is no consensus among respondents that this would be the case:

- some respondents point that there are technical limitations to real-time measurement for small-scale installations; and

- others argue the quality of forecasts can reduce beyond a certain degree of granularity.

6.6.3 Where there is an expectation of improved forecasts at ISP granularity, then stakeholders go on to discuss separately:

- Implications for RES trading on wholesale markets; and

- Implications for RES participation in balancing market.

6.6.4 In both cases, stakeholders identify a number of conditions that would need to be met in order for a change to materialise:

- Some players flag that for now RES are by default not allowed to participate in balancing markets given market arrangements;

- Some TSOs or vertically integrated players state that they do not believe the liquidity in both markets to be sufficient for RES participation to increase;

- Other stakeholders have emphasised that a reduction in gate closure would be required to see material benefits. We note that under the assumptions retained for the CBA it is the case that the average time between gate closure and delivery is reduced, suggesting that this condition will be met for a large share of the time.

6.6.5 Finally, in relation specifically to participation in balancing markets, some stakeholders have flagged that, even with improved forecasts, RES will still face significant risk of facing large imbalances between actual production and forecasts. In fact, the reduction in ISP duration would rather reduce the opportunity for smoothing such large and unexpected jumps in production. This would be likely to deter RES generators from committing to participate in balancing markets.

Security of supply

6.6.6 Only 32 stakeholders have provided comments on the potential for increasing security of supply through a larger amount of cross-border balancing actions. A

third of them are TSOs, a few other are generators or retail suppliers. Some DSOs, metering service providers, NRAs, and traders have also provided an answer. However, part of the non-TSOs stakeholders have answered that security of supply is a TSO responsibility and they cannot comment on this matter.

6.6.7 Some stakeholders agree with the idea that a reduction in ISP may increase security of supply through fostering cross-border trade. However, the majority of them are sceptical on the possibility to increase security of supply thanks to an ISP alignment across countries.

6.6.8 The disagreement seems to stem from the following reasons:

- Some stakeholders state that they see no clear evidence of the linkage between increased cross-border balancing and security of supply.

- Some stakeholders point to the fact that TSOs are already able to trade balancing products and share reserves across countries with different ISP durations. Stakeholders argue that this signals that the ISP duration does not constitute a major obstacle to security of supply.

- Whilst this is recognised by all stakeholders, some believe that cross-border balancing, albeit possible today, would be facilitated and fostered with harmonised ISP durations, further reducing security of supply.

6.6.9 We would note that some stakeholders expect a beneficial impact not due to cross-border balancing trades but due to the general reduction in imbalances (see benefit on reduced balancing costs).

7 ANALYSIS OF NET BENEFITS

7.1 Introduction

7.1.1 In this section we use the cost and benefit information described in Sections 6 and 7 to develop costs and benefits for each of the four planning cases we are considering, relative to the counterfactual. We do this:

- in aggregate for the EU + 3 to show the net benefit or net welfare effect of each factual planning case;

- in aggregate by country; and

- in aggregate by stakeholder group (producers and consumers).

7.1.2 We provide the information for the two cost scenarios (profiling and unadjusted) with central cost estimates, and for the high and low benefit cases.

7.1.3 As a reminder, the four planning cases are:

- Planning case 1 – all countries move to a 15 minute ISP;

- Planning case 2 – all countries with a current ISP of 60 minutes move to an ISP of 15 minutes;

- Planning case 3 – countries change their ISP to match their neighbours; and

- Planning case 4 – all countries move to a 5 minute ISP.

7.1.4 The Annex shows results for the cost benefit analysis of a sensitivity to the four planning cases whereby all countries apart from Great Britain, Northern Ireland and Ireland move to a 15 minute ISP.

7.2 Mapping cost and benefit information to planning cases

7.2.1 To determine the costs and benefits for each of the planning cases, we map the cost and benefit information from Sections 6 and 7 to each planning case according to the ISP duration to which a country changes (if there is a change) and whether any borders of a country are affected by the change to ISP.

7.2.2 Exhibit 53 shows the ISP duration for each of the four factual planning cases and for the counterfactual (status quo) for each country.

Exhibit 53. ISP duration for each planning case and each country

Country	Current ISP duration	Planning case 1	Planning case 2	Planning case 3	Planning case 4
Austria	15	15	15	15	5
Belgium	15	15	15	15	5
Switzerland	15	15	15	15	5
Germany	15	15	15	15	5
Hungary	15	15	15	15	5
Lichtenstein	15	15	15	15	5
Luxemburg	15	15	15	15	5
Netherlands	15	15	15	15	5
Slovakia	15	15	15	15	5
France	30	15	30	30	5
Great Britain	30	15	30	30	5
Ireland	30	15	30	30	5
Northern Ireland	30	15	30	30	5
Bulgaria	60	15	15	15	5
Czech Republic	60	15	15	15	5
Denmark	60	15	15	15	5
Estonia	60	15	15	15	5
Greece	60	15	15	15	5
Spain	60	15	15	30	5
Finland	60	15	15	15	5
Croatia	60	15	15	15	5
Italy	60	15	15	15	5
Lithuania	60	15	15	15	5
Latvia	60	15	15	15	5
Norway	60	15	15	15	5
Poland	60	15	15	15	5
Portugal	60	15	15	30	5
Romania	60	15	15	15	5
Sweden	60	15	15	15	5
Slovenia	60	15	15	15	5
Cyprus	60	15	15	15	5
Malta	60	15	15	15	5

Source: Frontier

7.2.3 Exhibit 54 shows the borders that are affected for each of the planning cases.

Exhibit 54. Borders affected by each planning case

Border from	Border to	Planning case 1	Planning case 2	Planning case 3	Planning case 4
Austria	Czech Republic	yes	yes	yes	yes
Austria	Italy	yes	yes	yes	yes
Austria	Slovenia	yes	yes	yes	yes
Belgium	France	yes	no	no	yes
Switzerland	France	yes	no	no	yes
Switzerland	Italy	yes	yes	yes	yes
Deutschland	France	yes	no	no	yes
Deutschland	Czech Republic	yes	yes	yes	yes
Deutschland	Denmark	yes	yes	yes	yes
Deutschland	Poland	yes	yes	yes	yes
Deutschland	Sweden	yes	yes	yes	yes
Hungary	Croatia	yes	yes	yes	yes
Hungary	Romania	yes	yes	yes	yes
Netherlands	Great Britain	yes	no	no	yes
Netherlands	Norway	yes	yes	yes	yes
Slovak Republic	Czech Republic	yes	yes	yes	yes
Slovak Republic	Poland	yes	yes	yes	yes
France	Spain	yes	no	yes	yes
France	Italy	yes	no	no	yes

Source: Frontier

7.3 Planning case 1 – all harmonise on 15 minute ISP

7.3.1 If all countries harmonise their ISP durations at 15 minutes it is ambiguous as to whether there is a neutral or negative net benefit for the EU + 3, as is shown by Exhibit 55.

Exhibit 55. Planning case 1 – net welfare (split by costs and benefits)

	Total benefit (€bn)	Total cost (€bn)	Net welfare (€bn)
Profiling with high benefits	4.0	-4.1	0.0
Profiling with low benefits	1.8	-4.1	-2.2
Unadjusted with high benefits	4.0	-5.3	-1.3
Unadjusted with low benefits	1.8	-5.3	-3.5

Source: Frontier

7.3.2   If metering costs are reduced by using profiling where it would not be economic to adapt meters to the new ISP and where we use the higher estimate of benefits, the net welfare effect would be neutral in moving to a 15 minute ISP. However, even were profiling to be used there would be a significant net welfare loss if we use the lower estimate of benefits.

7.3.3   If profiling was not used to reduce metering costs, there would be a net welfare loss from moving to a 15 minute ISP whether high or low benefits were used.

7.3.4   Individual countries are affected differently by the move to harmonise ISP duration across Europe at 15 minutes. Exhibit 56 shows total benefits, costs and net welfare by country for planning case 1, with profiling and high benefits.

7.3.5   Net benefits accrue to those countries that already have a 15 minute ISP – these countries incur no material costs and accrue some cross border benefits related to harmonisation. This is shown clearly for the countries Austria to Slovakia, towards the top of Exhibit 56.

7.3.6   Some countries that change ISP duration in this planning case have a net benefit, e.g. France, the Czech Republic, Italy etc. However, most countries that require a change to ISP duration would see a net welfare loss.

Exhibit 56. Planning case 1 – net welfare by country (profiling and high benefits)

Country	Total benefit (€m)	Total cost (€m)	Net welfare (€m)
Austria	93.3 €mn	0.0 €mn	93.3 €mn
Belgium	44.4 €mn	0.0 €mn	44.4 €mn
Switzerland	543.8 €mn	0.0 €mn	543.8 €mn
Germany	369.7 €mn	0.0 €mn	369.7 €mn
Hungary	105.6 €mn	0.0 €mn	105.6 €mn
Lichtenstein	0.0 €mn	0.0 €mn	0.0 €mn
Luxemburg	0.0 €mn	0.0 €mn	0.0 €mn
Netherlands	167.1 €mn	0.0 €mn	167.1 €mn
Slovakia	185.2 €mn	0.0 €mn	185.2 €mn
France	379.8 €mn	184.7 €mn	195.1 €mn
Great Britain	282.4 €mn	786.0 €mn	-503.6 €mn
Ireland	29.3 €mn	93.3 €mn	-64.0 €mn
Northern Ireland	11.5 €mn	46.5 €mn	-35.1 €mn
Bulgaria	60.8 €mn	171.4 €mn	-110.6 €mn
Czech Republic	108.7 €mn	102.7 €mn	6.0 €mn
Denmark	27.7 €mn	117.7 €mn	-90.0 €mn
Estonia	14.3 €mn	53.3 €mn	-39.0 €mn
Greece	75.1 €mn	154.2 €mn	-79.0 €mn
Spain	409.8 €mn	813.1 €mn	-403.3 €mn
Finland	59.6 €mn	126.4 €mn	-66.8 €mn
Croatia	30.2 €mn	80.3 €mn	-50.1 €mn
Italy	440.9 €mn	265.3 €mn	175.6 €mn
Lithuania	15.0 €mn	149.9 €mn	-134.9 €mn
Latvia	12.3 €mn	130.8 €mn	-118.5 €mn
Norway	58.3 €mn	89.4 €mn	-31.1 €mn
Poland	237.3 €mn	311.4 €mn	-74.1 €mn
Portugal	77.7 €mn	68.7 €mn	9.0 €mn
Romania	87.7 €mn	124.8 €mn	-37.2 €mn
Sweden	81.2 €mn	93.4 €mn	-12.2 €mn
Slovenia	34.8 €mn	16.4 €mn	18.4 €mn
Cyprus	3.2 €mn	42.4 €mn	-39.2 €mn
Malta	2.3 €mn	38.1 €mn	-35.8 €mn
Total	*4,049.1 €mn*	*4,060.3 €mn*	*-11.2 €mn*

Source: Frontier

7.3.7 Exhibit 57, Exhibit 58, and Exhibit 59 show country specific net welfare for profiling with low benefits, unadjusted costs with high benefits, and unadjusted costs with low benefits, respectively. In each case those countries that do not need to change ISP duration have a positive net welfare and most, or in some cases all, countries that change ISP duration have a negative net welfare.

Exhibit 57. Planning case 1 – net welfare by country (profiling and low benefits)

Country	Total benefit (€m)	Total cost (€m)	Net welfare (€m)
Austria	46.6 €mn	0.0 €mn	46.6 €mn
Belgium	22.2 €mn	0.0 €mn	22.2 €mn
Switzerland	271.9 €mn	0.0 €mn	271.9 €mn
Germany	184.9 €mn	0.0 €mn	184.9 €mn
Hungary	52.8 €mn	0.0 €mn	52.8 €mn
Lichtenstein	0.0 €mn	0.0 €mn	0.0 €mn
Luxemburg	0.0 €mn	0.0 €mn	0.0 €mn
Netherlands	83.6 €mn	0.0 €mn	83.6 €mn
Slovakia	92.6 €mn	0.0 €mn	92.6 €mn
France	153.9 €mn	184.7 €mn	-30.8 €mn
Great Britain	135.2 €mn	786.0 €mn	-650.8 €mn
Ireland	14.6 €mn	93.3 €mn	-78.7 €mn
Northern Ireland	6.5 €mn	46.5 €mn	-40.0 €mn
Bulgaria	25.9 €mn	171.4 €mn	-145.5 €mn
Czech Republic	45.5 €mn	102.7 €mn	-57.2 €mn
Denmark	8.8 €mn	117.7 €mn	-108.9 €mn
Estonia	6.5 €mn	53.3 €mn	-46.8 €mn
Greece	32.8 €mn	154.2 €mn	-121.3 €mn
Spain	168.9 €mn	813.1 €mn	-644.2 €mn
Finland	18.4 €mn	126.4 €mn	-108.0 €mn
Croatia	7.6 €mn	80.3 €mn	-72.7 €mn
Italy	187.2 €mn	265.3 €mn	-78.1 €mn
Lithuania	7.9 €mn	149.9 €mn	-142.0 €mn
Latvia	6.6 €mn	130.8 €mn	-124.3 €mn
Norway	30.1 €mn	89.4 €mn	-59.3 €mn
Poland	99.2 €mn	311.4 €mn	-212.2 €mn
Portugal	33.5 €mn	68.7 €mn	-35.2 €mn
Romania	37.5 €mn	124.8 €mn	-87.4 €mn
Sweden	25.3 €mn	93.4 €mn	-68.1 €mn
Slovenia	14.8 €mn	16.4 €mn	-1.6 €mn
Cyprus	3.2 €mn	42.4 €mn	-39.2 €mn
Malta	2.3 €mn	38.1 €mn	-35.8 €mn
Total	*1,826.9 €mn*	*4,060.3 €mn*	*-2,233.4 €mn*

Source: Frontier

Exhibit 58. Planning case 1 – net welfare by country (unadjusted costs and high benefits)

Country	Total benefit (€m)	Total cost (€m)	Net welfare (€m)
Austria	93.3 €mn	0.0 €mn	93.3 €mn
Belgium	44.4 €mn	0.0 €mn	44.4 €mn
Switzerland	543.8 €mn	0.0 €mn	543.8 €mn
Germany	369.7 €mn	0.0 €mn	369.7 €mn
Hungary	105.6 €mn	0.0 €mn	105.6 €mn
Lichtenstein	0.0 €mn	0.0 €mn	0.0 €mn
Luxemburg	0.0 €mn	0.0 €mn	0.0 €mn
Netherlands	167.1 €mn	0.0 €mn	167.1 €mn
Slovakia	185.2 €mn	0.0 €mn	185.2 €mn
France	379.8 €mn	184.7 €mn	195.1 €mn
Great Britain	282.4 €mn	1,816.2 €mn	-1,533.8 €mn
Ireland	29.3 €mn	93.3 €mn	-64.0 €mn
Northern Ireland	11.5 €mn	46.5 €mn	-35.1 €mn
Bulgaria	60.8 €mn	171.4 €mn	-110.6 €mn
Czech Republic	108.7 €mn	102.7 €mn	6.0 €mn
Denmark	27.7 €mn	274.5 €mn	-246.7 €mn
Estonia	14.3 €mn	53.3 €mn	-39.0 €mn
Greece	75.1 €mn	154.2 €mn	-79.0 €mn
Spain	409.8 €mn	813.1 €mn	-403.3 €mn
Finland	59.6 €mn	265.0 €mn	-205.4 €mn
Croatia	30.2 €mn	80.3 €mn	-50.1 €mn
Italy	440.9 €mn	265.3 €mn	175.6 €mn
Lithuania	15.0 €mn	149.9 €mn	-134.9 €mn
Latvia	12.3 €mn	130.8 €mn	-118.5 €mn
Norway	58.3 €mn	65.7 €mn	-7.4 €mn
Poland	237.3 €mn	311.4 €mn	-74.1 €mn
Portugal	77.7 €mn	68.7 €mn	9.0 €mn
Romania	87.7 €mn	124.8 €mn	-37.2 €mn
Sweden	81.2 €mn	55.7 €mn	25.5 €mn
Slovenia	34.8 €mn	16.4 €mn	18.4 €mn
Cyprus	3.2 €mn	42.4 €mn	-39.2 €mn
Malta	2.3 €mn	38.1 €mn	-35.8 €mn
Total	*4,049.1 €mn*	*5,324.4 €mn*	*-1,275.3 €mn*

Source: Frontier

Exhibit 59. Planning case 1 – net welfare by country (unadjusted costs and low benefits)

Country	Total benefit (€m)	Total cost (€m)	Net welfare (€m)
Austria	46.6 €mn	0.0 €mn	46.6 €mn
Belgium	22.2 €mn	0.0 €mn	22.2 €mn
Switzerland	271.9 €mn	0.0 €mn	271.9 €mn
Germany	184.9 €mn	0.0 €mn	184.9 €mn
Hungary	52.8 €mn	0.0 €mn	52.8 €mn
Lichtenstein	0.0 €mn	0.0 €mn	0.0 €mn
Luxemburg	0.0 €mn	0.0 €mn	0.0 €mn
Netherlands	83.6 €mn	0.0 €mn	83.6 €mn
Slovakia	92.6 €mn	0.0 €mn	92.6 €mn
France	153.9 €mn	184.7 €mn	-30.8 €mn
Great Britain	135.2 €mn	1,816.2 €mn	-1,681.0 €mn
Ireland	14.6 €mn	93.3 €mn	-78.7 €mn
Northern Ireland	6.5 €mn	46.5 €mn	-40.0 €mn
Bulgaria	25.9 €mn	171.4 €mn	-145.5 €mn
Czech Republic	45.5 €mn	102.7 €mn	-57.2 €mn
Denmark	8.8 €mn	274.5 €mn	-265.7 €mn
Estonia	6.5 €mn	53.3 €mn	-46.8 €mn
Greece	32.8 €mn	154.2 €mn	-121.3 €mn
Spain	168.9 €mn	813.1 €mn	-644.2 €mn
Finland	18.4 €mn	265.0 €mn	-246.6 €mn
Croatia	7.6 €mn	80.3 €mn	-72.7 €mn
Italy	187.2 €mn	265.3 €mn	-78.1 €mn
Lithuania	7.9 €mn	149.9 €mn	-142.0 €mn
Latvia	6.6 €mn	130.8 €mn	-124.3 €mn
Norway	30.1 €mn	65.7 €mn	-35.6 €mn
Poland	99.2 €mn	311.4 €mn	-212.2 €mn
Portugal	33.5 €mn	68.7 €mn	-35.2 €mn
Romania	37.5 €mn	124.8 €mn	-87.4 €mn
Sweden	25.3 €mn	55.7 €mn	-30.4 €mn
Slovenia	14.8 €mn	16.4 €mn	-1.6 €mn
Cyprus	3.2 €mn	42.4 €mn	-39.2 €mn
Malta	2.3 €mn	38.1 €mn	-35.8 €mn
Total	*1,826.9 €mn*	*5,324.4 €mn*	*-3,497.5 €mn*

Source: Frontier

7.3.8 Different stakeholders are affected differently by the change to ISP duration. Here we show the effect on producer and consumer welfare in aggregate for the EU + 3 and for individual countries.

7.3.9 Exhibit 60 shows the breakdown of net welfare for the EU + 3 by producers and consumers. Unambiguously consumers are made better off by a move to a shorter ISP and producers are made worse off. Even though consumers bear the cost of the change to meters, they are made better off overall since they see most of the benefit from reductions in TSO balancing costs. Conversely, producers see reduced revenues from a reduction in TSO balancing actions. This is why the use of high or low benefit estimates has a large effect on producer welfare.

Exhibit 60. Planning case 1 – net welfare (split by producer and consumer welfare)

	Producer net welfare (€bn)	Consumer net welfare (€bn)	Net welfare (€bn)
Profiling with high benefits	-1.3	1.3	0.0
Profiling with low benefits	-3.4	1.1	-2.2
Unadjusted with high benefits	-1.6	0.3	-1.3
Unadjusted with low benefits	-3.6	0.1	-3.5

Source: Frontier

7.3.10 Exhibit 61 shows the breakdown of net welfare by producer and consumer surplus for each country. We show this only for the first sub-case, profiling with high benefits since the pattern of the breakdown is consistent across all four sub-cases. This clearly shows that where ISP changes producers see a welfare reduction. Consumers see a welfare gain in countries with no change to ISP duration and might or might not see a welfare gain in countries that change ISP.

Exhibit 61. Planning case 1 – net welfare by producer and consumer welfare and country (profiling and high benefits)

Country	Producer net welfare (€m)	Consumer net welfare (€m)	Net welfare (€m)
Austria	0.0 €mn	93.3 €mn	93.3 €mn
Belgium	0.0 €mn	44.4 €mn	44.4 €mn
Switzerland	0.0 €mn	543.8 €mn	543.8 €mn
Germany	0.0 €mn	369.7 €mn	369.7 €mn
Hungary	0.0 €mn	105.6 €mn	105.6 €mn
Lichtenstein	0.0 €mn	0.0 €mn	0.0 €mn
Luxemburg	0.0 €mn	0.0 €mn	0.0 €mn
Netherlands	0.0 €mn	167.1 €mn	167.1 €mn
Slovakia	0.0 €mn	185.2 €mn	185.2 €mn
France	-119.6 €mn	314.8 €mn	195.1 €mn
Great Britain	-188.2 €mn	-315.4 €mn	-503.6 €mn
Ireland	-24.2 €mn	-39.8 €mn	-64.0 €mn
Northern Ireland	-8.3 €mn	-26.8 €mn	-35.1 €mn
Bulgaria	-45.9 €mn	-64.6 €mn	-110.6 €mn
Czech Republic	-47.6 €mn	53.6 €mn	6.0 €mn
Denmark	-27.8 €mn	-62.2 €mn	-90.0 €mn
Estonia	-11.2 €mn	-27.8 €mn	-39.0 €mn
Greece	-44.3 €mn	-34.8 €mn	-79.0 €mn
Spain	-262.2 €mn	-141.1 €mn	-403.3 €mn
Finland	-28.7 €mn	-38.2 €mn	-66.8 €mn
Croatia	-18.5 €mn	-31.6 €mn	-50.1 €mn
Italy	-166.3 €mn	341.9 €mn	175.6 €mn
Lithuania	-29.6 €mn	-105.3 €mn	-134.9 €mn
Latvia	-25.8 €mn	-92.7 €mn	-118.5 €mn
Norway	-22.9 €mn	-8.2 €mn	-31.1 €mn
Poland	-118.9 €mn	44.8 €mn	-74.1 €mn
Portugal	-31.3 €mn	40.3 €mn	9.0 €mn
Romania	-45.5 €mn	8.4 €mn	-37.2 €mn
Sweden	-32.9 €mn	20.6 €mn	-12.2 €mn
Slovenia	-12.6 €mn	30.9 €mn	18.4 €mn
Cyprus	-5.2 €mn	-34.0 €mn	-39.2 €mn
Malta	-4.5 €mn	-31.3 €mn	-35.8 €mn
Total	*-1,321.9 €mn*	*1,310.6 €mn*	*-11.2 €mn*

Source: Frontier

7.4 Planning case 2 – those with 60 minute ISP move to 15 minutes

7.4.1 If all countries that currently have a 60 minute ISP duration were to move to a 15 minute ISP, again it is ambiguous as to whether there is a neutral or negative net benefit for the EU + 3, as is shown by Exhibit 62.

Exhibit 62. Planning case 2 – net welfare (split by costs and benefits)

	Total benefit (€bn)	Total cost (€bn)	Net welfare (€bn)
Profiling with high benefits	2.9	-2.9	0.0
Profiling with low benefits	1.3	-2.9	-1.6
Unadjusted with high benefits	2.9	-3.2	-0.3
Unadjusted with low benefits	1.3	-3.2	-1.9

Source: Frontier

7.4.2   Compared to panning case 1, benefits have fallen but costs have fallen relatively more. Therefore, the net benefit is higher than with planning case 1.

7.4.3   If metering costs are reduced by using profiling where it would not be economic to adapt meters to the new ISP and where we use the higher estimate of benefits, there would be a neutral welfare effect from moving to a 15 minute ISP. However, even were profiling to be used there would be a net welfare loss if we use the lower estimate of benefits.

7.4.4   If profiling was not used to reduce metering costs, there would be a net welfare loss from moving to a 15 minute ISP whether high or low benefits were used.

7.4.5   Exhibit 63 shows the breakdown of net welfare for the EU + 3 by producers and consumers for planning case 2. As with planning case 1, unambiguously consumers are made better off by a move to a shorter ISP and producers are made worse off.

Exhibit 63. Planning case 2 – net welfare (split by producer and consumer welfare)

	Producer net welfare (€bn)	Consumer net welfare (€bn)	Net welfare (€bn)
Profiling with high benefits	-1.0	0.9	0.0
Profiling with low benefits	-2.4	0.8	-1.6
Unadjusted with high benefits	-1.0	0.8	-0.3
Unadjusted with low benefits	-2.5	0.6	-1.9

Source: Frontier

7.4.6   Exhibit 64 shows the breakdown of net welfare by producer and consumer surplus for each country for planning case 2. Again, we show this only for the first sub-case, profiling with high benefits since the pattern of the breakdown is consistent across all four sub-cases. Where the ISP changes, producers see a welfare reduction. Consumers see a welfare gain in countries with no change to ISP duration and might or might not see a welfare gain in countries that change ISP.

Exhibit 64. Planning case 2 – net welfare by producer and consumer welfare and country (profiling and high benefits)

Country	Producer net welfare (€m)	Consumer net welfare (€m)	Net welfare (€m)
Austria	0.0 €mn	93.3 €mn	93.3 €mn
Belgium	0.0 €mn	0.0 €mn	0.0 €mn
Switzerland	0.0 €mn	471.7 €mn	471.7 €mn
Germany	0.0 €mn	222.7 €mn	222.7 €mn
Hungary	0.0 €mn	105.6 €mn	105.6 €mn
Lichtenstein	0.0 €mn	0.0 €mn	0.0 €mn
Luxemburg	0.0 €mn	0.0 €mn	0.0 €mn
Netherlands	0.0 €mn	1.0 €mn	1.0 €mn
Slovakia	0.0 €mn	185.2 €mn	185.2 €mn
France	0.0 €mn	0.0 €mn	0.0 €mn
Great Britain	0.0 €mn	0.0 €mn	0.0 €mn
Ireland	0.0 €mn	0.0 €mn	0.0 €mn
Northern Ireland	0.0 €mn	0.0 €mn	0.0 €mn
Bulgaria	-45.9 €mn	-64.6 €mn	-110.6 €mn
Czech Republic	-47.6 €mn	53.6 €mn	6.0 €mn
Denmark	-27.8 €mn	-62.2 €mn	-90.0 €mn
Estonia	-11.2 €mn	-27.8 €mn	-39.0 €mn
Greece	-44.3 €mn	-34.8 €mn	-79.0 €mn
Spain	-262.2 €mn	-141.1 €mn	-403.3 €mn
Finland	-28.7 €mn	-38.2 €mn	-66.8 €mn
Croatia	-18.5 €mn	-31.6 €mn	-50.1 €mn
Italy	-166.3 €mn	341.9 €mn	175.6 €mn
Lithuania	-29.6 €mn	-105.3 €mn	-134.9 €mn
Latvia	-25.8 €mn	-92.7 €mn	-118.5 €mn
Norway	-22.9 €mn	-8.2 €mn	-31.1 €mn
Poland	-118.9 €mn	44.8 €mn	-74.1 €mn
Portugal	-31.3 €mn	40.3 €mn	9.0 €mn
Romania	-45.5 €mn	8.4 €mn	-37.2 €mn
Sweden	-32.9 €mn	20.6 €mn	-12.2 €mn
Slovenia	-12.6 €mn	30.9 €mn	18.4 €mn
Cyprus	-5.2 €mn	-34.0 €mn	-39.2 €mn
Malta	-4.5 €mn	-31.3 €mn	-35.8 €mn
Total	*-981.6 €mn*	*948.3 €mn*	*-33.3 €mn*

Source: Frontier

7.5 Planning case 3 – harmonisation with neighbours

7.5.1 If all countries that currently have a 30 or 60 minute ISP duration were to move to the same (shorter) ISP duration of their neighbours, it is ambiguous as to whether there is a positive net benefit for the EU + 3, as is shown by Exhibit 65.

Exhibit 65.   Planning case 3 – net welfare (split by costs and benefits)

	Total benefit (€bn)	Total cost (€bn)	Net welfare (€bn)
Profiling with high benefits	2.9	-2.4	0.5
Profiling with low benefits	1.3	-2.4	-1.1
Unadjusted with high benefits	2.9	-2.6	0.2
Unadjusted with low benefits	1.3	-2.6	-1.3

Source: Frontier

7.5.2   Compared to planning case 1, benefits have fallen but costs have fallen relatively more.

7.5.3   Profiling adds to net welfare. However, the larger effect on net welfare is whether we use high or low benefits. Using low benefits results in a net welfare loss and high benefits results in a net welfare gain, with and without profiling.

7.5.4   Exhibit 66 shows the breakdown of net welfare for the EU + 3 by producers and consumers. As with planning cases 1 and 2, unambiguously consumers are made better off by a move to a shorter ISP and producers are made worse off.

Exhibit 66.   Planning case 3 – net welfare (split by producer and consumer welfare)

	Producer net welfare (€bn)	Consumer net welfare (€bn)	Net welfare (€bn)
Profiling with high benefits	-0.9	1.3	0.5
Profiling with low benefits	-2.3	1.1	-1.1
Unadjusted with high benefits	-0.9	1.1	0.2
Unadjusted with low benefits	-2.3	1.0	-1.3

Source: Frontier

7.5.5   Exhibit 67 shows the breakdown of net welfare by producer and consumer surplus for each country. Again, we show this only for the first sub-case, profiling with high benefits since the pattern of the breakdown is consistent across all four sub-cases.   Where the ISP changes, producers see a welfare reduction. Consumers see a welfare gain in countries with no change to ISP duration and might or might not see a welfare gain in countries that change ISP.

**Exhibit 67. Planning case 3 – net welfare by producer and consumer
welfare and country (profiling and high benefits)**

Country	Producer net welfare (€m)	Consumer net welfare (€m)	Net welfare (€m)
Austria	0.0 €mn	93.3 €mn	93.3 €mn
Belgium	0.0 €mn	0.0 €mn	0.0 €mn
Switzerland	0.0 €mn	471.7 €mn	471.7 €mn
Germany	0.0 €mn	222.7 €mn	222.7 €mn
Hungary	0.0 €mn	105.6 €mn	105.6 €mn
Lichtenstein	0.0 €mn	0.0 €mn	0.0 €mn
Luxemburg	0.0 €mn	0.0 €mn	0.0 €mn
Netherlands	0.0 €mn	1.0 €mn	1.0 €mn
Slovakia	0.0 €mn	185.2 €mn	185.2 €mn
France	0.0 €mn	17.8 €mn	17.8 €mn
Great Britain	0.0 €mn	0.0 €mn	0.0 €mn
Ireland	0.0 €mn	0.0 €mn	0.0 €mn
Northern Ireland	0.0 €mn	0.0 €mn	0.0 €mn
Bulgaria	-45.9 €mn	-64.6 €mn	-110.6 €mn
Czech Republic	-47.6 €mn	53.6 €mn	6.0 €mn
Denmark	-27.8 €mn	-62.2 €mn	-90.0 €mn
Estonia	-11.2 €mn	-27.8 €mn	-39.0 €mn
Greece	-44.3 €mn	-34.8 €mn	-79.0 €mn
Spain	-135.2 €mn	233.5 €mn	98.3 €mn
Finland	-28.7 €mn	-38.2 €mn	-66.8 €mn
Croatia	-18.5 €mn	-31.6 €mn	-50.1 €mn
Italy	-166.3 €mn	341.9 €mn	175.6 €mn
Lithuania	-29.6 €mn	-105.3 €mn	-134.9 €mn
Latvia	-25.8 €mn	-92.7 €mn	-118.5 €mn
Norway	-22.9 €mn	-8.2 €mn	-31.1 €mn
Poland	-118.9 €mn	44.8 €mn	-74.1 €mn
Portugal	-28.3 €mn	27.5 €mn	-0.7 €mn
Romania	-45.5 €mn	8.4 €mn	-37.2 €mn
Sweden	-32.9 €mn	20.6 €mn	-12.2 €mn
Slovenia	-12.6 €mn	30.9 €mn	18.4 €mn
Cyprus	-5.2 €mn	-34.0 €mn	-39.2 €mn
Malta	-4.5 €mn	-31.3 €mn	-35.8 €mn
Total	*-851.6 €mn*	*1,327.9 €mn*	*476.3 €mn*

Source: Frontier

7.6 Planning case 4 – all harmonise on 5 minute ISP

7.6.1 If all countries changed ISP duration to harmonise on a 5 minute ISP duration,
net welfare unambiguously falls for the EU + 3, as is shown by Exhibit 68.

Exhibit 68. Planning case 4 – net welfare (split by costs and benefits)

	Total benefit (€bn)	Total cost (€bn)	Net welfare (€bn)
Profiling with high benefits	5.0	-7.8	-2.8
Profiling with low benefits	2.5	-7.8	-5.3
Unadjusted with high benefits	5.0	-14.5	-9.6
Unadjusted with low benefits	2.5	-14.5	-12.1

Source: Frontier

7.6.2   Compared to planning case 1, benefits have increased somewhat and costs have increased significantly.

7.6.3   As before, profiling brings added net welfare, and the largest effect on net welfare is whether we use high or low benefits. However, in all cases moving to a 5 minute ISP results in a net welfare loss.

7.6.4   Exhibit 69 shows the breakdown of net welfare for the EU + 3 by producers and consumers.   Both producers and consumers are made worse off with this planning case, even if profiling is used to reduce the cost of meter adaptation and high benefits are assumed.

Exhibit 69. Planning case 4 – net welfare (split by producer and consumer welfare)

	Producer net welfare (€bn)	Consumer net welfare (€bn)	Net welfare (€bn)
Profiling with high benefits	-1.9	-0.9	-2.8
Profiling with low benefits	-3.9	-1.4	-5.3
Unadjusted with high benefits	-3.2	-6.3	-9.6
Unadjusted with low benefits	-5.3	-6.8	-12.1

Source: Frontier

7.6.5   Exhibit 70 shows the breakdown of net welfare by producer and consumer surplus for each country. Again, we show this only for the first sub-case, profiling with high benefits since the pattern of the breakdown is consistent across all four sub-cases.   Producers see a welfare reduction in all countries (since ISP changes in all countries) and consumers see a welfare reduction in most countries.

Exhibit 70. Planning case 4 – net welfare by producer and consumer welfare and country (profiling and high benefits)

Country	Producer net welfare (€m)	Consumer net welfare (€m)	Net welfare (€m)
Austria	-47.7 €mn	-86.8 €mn	-134.6 €mn
Belgium	-65.3 €mn	-141.7 €mn	-207.0 €mn
Switzerland	-31.5 €mn	489.2 €mn	457.7 €mn
Germany	-208.3 €mn	324.1 €mn	115.8 €mn
Hungary	-27.9 €mn	6.9 €mn	-21.0 €mn
Lichtenstein	-5.2 €mn	-40.9 €mn	-46.1 €mn
Luxemburg	-13.5 €mn	-69.8 €mn	-83.3 €mn
Netherlands	-30.1 €mn	171.7 €mn	141.6 €mn
Slovakia	-17.0 €mn	110.1 €mn	93.2 €mn
France	-141.5 €mn	189.5 €mn	48.0 €mn
Great Britain	-217.2 €mn	-526.1 €mn	-743.2 €mn
Ireland	-25.3 €mn	-56.9 €mn	-82.2 €mn
Northern Ireland	-9.1 €mn	-42.3 €mn	-51.4 €mn
Bulgaria	-49.8 €mn	-117.3 €mn	-167.1 €mn
Czech Republic	-45.8 €mn	14.4 €mn	-31.4 €mn
Denmark	-34.9 €mn	-122.0 €mn	-156.9 €mn
Estonia	-12.3 €mn	-43.9 €mn	-56.2 €mn
Greece	-44.9 €mn	-89.5 €mn	-134.4 €mn
Spain	-280.7 €mn	-408.3 €mn	-689.0 €mn
Finland	-32.1 €mn	-51.7 €mn	-83.8 €mn
Croatia	-16.1 €mn	-50.7 €mn	-66.8 €mn
Italy	-142.9 €mn	227.1 €mn	84.2 €mn
Lithuania	-35.5 €mn	-144.5 €mn	-180.0 €mn
Latvia	-46.1 €mn	-187.1 €mn	-233.2 €mn
Norway	-28.0 €mn	-38.1 €mn	-66.1 €mn
Poland	-118.6 €mn	-72.2 €mn	-190.9 €mn
Portugal	-37.8 €mn	-30.2 €mn	-68.0 €mn
Romania	-52.7 €mn	-13.7 €mn	-66.4 €mn
Sweden	-34.0 €mn	-4.9 €mn	-38.9 €mn
Slovenia	-8.2 €mn	10.1 €mn	1.9 €mn
Cyprus	-6.2 €mn	-47.3 €mn	-53.5 €mn
Malta	-5.5 €mn	-43.2 €mn	-48.7 €mn
Total	*-1,871.5 €mn*	*-886.0 €mn*	*-2,757.5 €mn*

Source: Frontier

7.7 Comparison of planning cases

7.7.1 Exhibit 71 summarises the total net benefits and net benefits by producer and consumer for the four planning cases and for each of the sub-cases that we consider

Exhibit 71. Net benefits by planning case and sub-case

	Planning case 1 (€bn)	Planning case 2 (€bn)	Planning case 3 (€bn)	Planning case 4 (€bn)
Profiling with high benefits	0.0	0.0	0.5	-2.8
Profiling with low benefits	-2.2	-1.6	-1.1	-5.3
Unadjusted with high benefits	-1.3	-0.3	0.2	-9.6
Unadjusted with low benefits	-3.5	-1.9	-1.3	-12.1

Source: Frontier

7.7.2 Exhibit 72 and Exhibit 73 show the net producer benefit and net consumer benefits respectively. As noted above, producers show a net dis-benefit in all planning cases and sub-cases. Consumers show a positive net benefit, with the exception of planning case 4.

Exhibit 72. Net producer benefit by planning case and sub-case

	Planning case 1 (€bn)	Planning case 2 (€bn)	Planning case 3 (€bn)	Planning case 4 (€bn)
Profiling with high benefits	-1.3	-1.0	-0.9	-1.9
Profiling with low benefits	-3.4	-2.4	-2.3	-3.9
Unadjusted with high benefits	-1.6	-1.0	-0.9	-3.2
Unadjusted with low benefits	-3.6	-2.5	-2.3	-5.3

Source: Frontier

Exhibit 73. Net consumer benefit by planning case and sub-case

	Planning case 1 (€bn)	Planning case 2 (€bn)	Planning case 3 (€bn)	Planning case 4 (€bn)
Profiling with high benefits	1.3	0.9	1.3	-0.9
Profiling with low benefits	1.1	0.8	1.1	-1.4
Unadjusted with high benefits	0.3	0.8	1.1	-6.3
Unadjusted with low benefits	0.1	0.6	1.0	-6.8

Source: Frontier

7.7.3 The Annex shows results for a sensitivity to the four planning cases whereby all countries apart from Great Britain, Northern Ireland and Ireland move to a 15 minute ISP. The net benefits for this planning case are similar to planning case 3 for the two high benefits sub-cases and similar to planning case 2 for the two low benefits sub-cases.

8 CONCLUSIONS AND LIMITATIONS

8.1 Introduction

8.1.1 In this final section, we consider the conclusions which policymakers could draw from our analysis, and then set out some important limitations which should be borne in mind as decisions on the ISP are made.

8.2 Conclusions

8.2.1 The analysis presented above demonstrates that, under a range of assumptions, the net benefits of the different planning cases could be either weakly positive or strongly negative. For reasons we will return to below, we would caution against placing too much emphasis on the absolute magnitude of estimates. Notwithstanding this caution, however, we do believe it is possible to draw some conclusions from our analysis.

8.2.2 We have assessed two cost cases. However, from our perspective, it would seem that the profiling case is more realistic:

- It seems highly unlikely that there will be a material difference between the engagement of households in relation to demand management across 60, 30, 15 or 5 minute periods. It is therefore most likely that the benefit of having actual meter readings for small customers on a basis different from that today will be small. We would presume that national regulators or governments would be slow to sign-off on material expenditure, for example, to install or configure universal 5 minute metering; and

- Relative to the complications of profiling annual, quarterly or monthly meter readings into current ISP periods, where a range of variables (e.g. day of the week, sunrise / sunset times, temperature etc.) need to be taken into account, the approach to profiling even a 60 minute ISP into 15 or 5 minute intervals for small customers would appear simple. There would be little basis to do anything other than assume consumption was constant over the new smaller ISP intervals. Profiling of this nature is unlikely to be expensive to implement – it is hard to believe that ensuring that actual meter readings are divided by 4 or 12 during the settlement process will constitute a major programme of work, or lead to the broader customer engagement complications of current profiling approaches.

8.2.3 For these reasons, we would suggest focusing on the profiling sub-cases shown in Exhibit 74.

Exhibit 74. Net benefits by planning case and for profiling sub-cases

	Planning case 1 (€bn)	Planning case 2 (€bn)	Planning case 3 (€bn)	Planning case 4 (€bn)
Profiling with high benefits	0.0	0.0	0.5	-2.8
Profiling with low benefits	-2.2	-1.6	-1.1	-5.3

Source: Frontier Economics

8.2.4   From these cases, it is clear that planning case 4 is the least beneficial, resulting in a detriment to net welfare irrespective of whether low or high benefits are assumed. This suggests that, on the basis of this CBA, a move to harmonise on a 5 minute ISP could be rejected

8.2.5   Among the remaining cases, the choice is less clear cut.

8.2.6   In the high benefit case, it would appear that planning case 3 is more beneficial than planning cases 1 and 2. It would be safest to assume that planning cases 1 and 2 effectively have an equal net benefit, with planning case 3 slightly higher. Similarly, with the low benefits case, while all of the net benefits are negative, it could be reasonable to assume that planning case 3 is preferable to planning case 1, and also to planning case 2 though by a smaller amount.

8.2.7   It could therefore be argued that planning case 3 could be preferred. Given uncertainty over benefits, it has an upside greater in scale to planning case 1 and 2, and the downside risk is lower. In this sense, based on our analysis it constitutes the change with the greatest potential upside and least potential regret. Equally, the risk involved in a change from the *status quo* appears to be asymmetric. The downside net cost is larger in absolute size than the upside net benefit.

8.2.8   It is clearly the case that the potential downside would be significant (relative to doing nothing) if the benefits turn out to be towards the low end of our estimates. This is a risk which policymakers will need to consider. In particular, we emphasise that in considering results policymakers should not assume that either high benefits or low benefits is more likely – they should focus on the range of possible outcomes and consider the outcome equally likely within this range.

8.2.9   It is also important to note that there are some benefits which we have not measured quantitatively. Based on their qualitative description, policymakers will need to form a judgement of the likely magnitude of these benefits relative to any estimated disbenefit. The relevant non-measured benefits are:

- benefits of improved investment efficiency;
- benefits of improved frequency quality;
- benefits from increased participation / imbalance exposure for RES; and
- benefits in relation to security of supply.

8.2.10 Turning to distributional issues, while planning case 3 is positive across the countries studied (with profiling and high benefits), Exhibit 67 shows that we estimate the impact for some countries to be negative. It also shows that, as is systematically the case, there is a net producer disbenefit, although the asymmetry between producer and consumer net benefit is greatest in planning

case 3 (i.e. the ratio between the amount by which consumers are better off and the amount by which producers are worse is larger).

8.2.11 It is not clear how the typical disbenefit for a country or producers could be compensated. Similarly, given the logic of planning case 3 involves harmonisation across borders, it may be difficult to mitigate the impact on individual countries by exempting them from the change. Phasing in of any change may, however, be worth further consideration.

8.2.12 The sensitivity to the planning cases shown in the Annex considers the effect of all countries but Great Britain, Northern Ireland and Ireland moving to a 15 minute ISP. The net benefits for this planning case are similar to planning case 3 for the two high benefits sub-cases and similar to planning case 2 for the two low benefits sub-cases. Therefore, planning case 3 would appear to be preferable to this sensitivity.

8.3 Limitations

8.3.1 Assessing the net impact of a change in ISP is clearly a complex and uncertain undertaking. We have made efforts to engage with stakeholders across Europe in relation to both the collection of data on expected costs and benefits and its interpretation. Our engagement has been constrained by the overall limited timescale provided for the work.

8.3.2 It should be clear from the preceding sections that the information we received from stakeholders was insufficient in many areas to permit an assessment which can be treated as highly robust in terms of quantitative accuracy.

8.3.3 Information provided in relation to costs was significantly more complete than for benefits, and we have attempted to address various issues of interpretation in survey responses during the course of our work. Stakeholders have been highly co-operative throughout this exercise. However, other than by cross-comparison between responses and addressing extreme outliers, we have not undertaken work to assess whether all responses have included reasonable estimates of comparable cost items. It may be that some respondents have over- or under-estimated costs in a way which has affected the overall estimates.

8.3.4 Information provided in relation to benefits was much less complete. This is in no way a criticism of stakeholder efforts. It is clear that assessing likely benefits of a change in ISP is highly subjective, as it requires assumptions on stakeholder behaviour in market conditions for which there are few benchmarks and then an assessment of market outcomes given new behaviour. It is therefore not surprising that the majority of responses to our survey did not suffice to quantify fully the scale of potential benefits.

8.3.5 As a result, however, our estimates of benefits have had to rely on stylised modelling, using existing data where possible to ensure that the broad magnitude of inputs to our analysis were reasonable. While we have tried to ensure relevant factors are taken into account in our estimations, in many cases we have had to rely on highly selective evidence, or in some cases on judgement rather than evidence to derive results.

8.3.6   Given this, it is critical to understand that our estimates should have broad confidence intervals placed around them.   Drawing conclusions based on small differences between estimated effects would, given the nature of our analysis, be unwise.

ANNEX A   DETAILS OF COST ANALYSIS

A.1.1   In this annex we provide additional details on the cost analysis. We first present the scaling variables which are used to scale up reported costs to full representativity and to fill gaps for countries outside the sample of responses received.

Scaling variables

Exhibit 75. Scaling variables for the cost analysis (section 5)

Country	Total Number of Connected Customers	Number of households (2014)	Number of main electricity generating companies	Number of main electricity retailers
	Source: Eurelectric (2013)	Source: Eurostat	Source: Eurostat	Source: Eurostat
AT	5,870,000	3,768,200	4	7
BE	5,243,796	4,651,800	2	4
BG	4,915,497	2,759,900	5	5
CH	4,500,000	-	3	3
CY	535,050	288,800	1	1
CZ	5,837,119	4,606,900	2	3
DE	49,294,962	39,709,600	4	4
DK	3,277,000	2,360,200	3	6
EE	652,000	561,100	1	2
EL	8,195,725	4,344,500	3	1
ES	27,786,798	18,328,900	4	3
FI	3,309,146	2,595,000	4	3
FR	33,999,393	28,718,200	2	2
GB	29,949,462	27,358,713	7	6
HR	1,860,921	1,518,900	2	3
HU	5,527,463	4,129,700	2	6
IE	2,237,232	1,707,200	6	4
IT	31,423,623	25,767,600	3	2
LI	18,958	15,474	1	1
LT	1,571,789	1,308,900	6	6
LU	275,175	224,600	2	3
LV	873,856	830,300	1	2
MT	183,777	150,000	1	1
NI	878,804	717,287	1	1
NL	8,110,000	7,594,600	4	3
NO	2,747,253	2,349,460	3	6
PL	16,478,000	13,927,600	4	6
PT	6,137,611	4,062,600	4	4
RO	2,639,318	7,470,200	3	5
SE	5,309,000	4,590,900	3	4
SI	925,275	862,200	2	9
SK	2,392,418	1,837,100	1	4
UK	30,828,266	28,076,000	7	6

Note: *Total number of connected customers for Norway based on http://www.energinorge.no/english/, for Switzerland: https://www.news.admin.ch/message/index.html?lang=de&msg-id=51090; other missing*

values are estimated by applying the average ratio of households and retail customers where this data is available for our sample. Companies are considered as "main" if they produce at least 5% of the national net electricity generation. Retailers are considered as "main" if they sell at least 5% of the total national electricity consumption. The number of retailers and generators for Switzerland and Northern Ireland are based on our own assumptions; the number for GB is set equal to the UK value from Eurostat.

Exhibit 76. Detailed results of Spain and Portugal for ISP 30 (NPV 2019, € real terms)

Country	Line item	No non-zero observations	Step 1 - Reported Totex (NPV)			Step 2 - Scaling factor		Results - Totex		
		Central Case	Low case	Central case	High case	Scaling factor		Intermediary result	Intermediary result	Intermediary result
ES	C2.1	2	4,123,417	18,513,699	7,813,747	100%	No scaling for central case, High/Low set equal due to lack of observations	18,513,699	18,513,699	18,513,699
PT	C2.1	1	0	324,480	0	100%	No scaling for central case, High/Low set equal due to lack of observations	324,480	324,480	324,480
ES	C2.2 - TN	1	177,779	33,413,495	3,722,515	100%	No scaling for central case, High/Low set equal due to lack of observations	33,413,495	33,413,495	33,413,495
ES	C2.2 - DN	2	42,912,376	30,870,320	53,987,748	228%	Total connected customers in ES devided by total meters of respondent	97,675,150	70,265,583	122,884,395
PT	C2.2	0	0	0	0	100%	TSO reports zero costs for moving to ISP 30 for TN	0	0	0
ES	C2.3	3	1,564,115	8,566,879	2,449,886	233%	Based on No main retailers and generators, High/Low set equal due to lack of observations	19,989,384	19,989,384	19,989,384
PT	C2.3	1	0	0	0	0%	Reported costs are very small and not seen as representative - therefore set equal to ISP 15 costs	6,723,227	8,403,200	10,571,162
ES	C2.4	0	0	0	0	0%	No observation - set equal to ISP 15 costs	61,031,081	76,281,282	95,961,276
PT	C2.4	0	0	0	0	0%	No observation - set equal to ISP 15 costs	13,480,684	16,849,183	21,196,144
ES	C2.5	2	5,098,319	9,951,020	14,954,796	350%	0	17,844,118	34,828,571	52,341,786
PT	C2.5	0	0	0	0	0%	No observation - set equal to ISP 15 costs	29,058,326	36,319,303	45,689,410
ES	C2.6	1	35,693	35,693	35,693	100%	No scaling	35,693	35,693	35,693
PT	C2.6	0	0	0	0	0%	No observation - set equal to ISP 15 costs	1,512,043	1,889,866	2,377,438
ES	C2.7	0	0	0	0	0%	No observation - set equal to ISP 15 costs	3,938,387	4,922,495	6,192,461
PT	C2.7	0	0	0	0	0%	No observation - set equal to ISP 15 costs	3,938,387	4,922,495	6,192,461
ES	C2.8	1	678,912	848,640	935,168	100%	No scaling	678,912	848,640	935,168
PT	C2.8	0	0	0	0	100%	No gaps filled	0	0	0
ES	All		54,590,611	102,199,746	83,899,551			253,119,918	259,098,841	350,267,357
PT	All		0	324,480	0			55,037,146	68,708,527	86,351,095

Source: Frontier

Note: For ISP 30, we only determine costs for Spain and Portugal which are the only affected countries by such a change in our Planning Cases. TN= transmission network, DN = distribution network.

Calculations and results

A.1.2   In this section we show all details of the results and the underlying calculations in table form.

Exhibit 77.   Total scaled up cost number by country in million € (NPV 2019, real terms) - Scenario "Profiling"

Country	Current ISP	Change to ISP 30			Change to ISP 15			Change to ISP 5		
	minutes	Low case	Central case	High case	Low case	Central case	High case	Low case	Central case	High case
AT	15							239	319	401
BE	15							223	298	375
BG	60				137	171	216	167	223	280
CH	15							102	136	172
CY	60				34	42	53	42	57	71
CZ	60				82	103	129	98	131	164
DE	15							716	956	1,203
DK	60				94	118	148	138	185	232
EE	60				43	53	67	53	71	89
EL	60				123	154	194	152	203	255
ES	60	255	261	353	651	813	1,023	797	1,064	1,338
FI	60				101	126	159	109	146	183
FR	30				148	185	232	289	386	486
GB	30				629	786	989	776	1,037	1,304
HR	60				64	80	101	66	89	111
HU	15							114	153	192
IE	30				75	93	117	82	109	138
IT	60				212	265	334	250	334	420
LI	15							36	48	61
LT	60				120	150	189	145	194	244
LU	15							66	89	112
LV	60				105	131	165	183	245	308
MT	60				31	38	48	38	51	64
NI	30				37	47	59	47	62	78
NL	15							70	93	117
NO	60				72	89	112	93	125	157
PL	60				249	311	392	305	407	512
PT	60	55	69	87	55	69	86	104	139	175
RO	60				100	125	157	122	162	204
SE	60				75	93	118	86	114	144
SI	60				13	16	21	15	20	25
SK	15							82	110	138
All		310	330	440	3,249	4,060	5,107	5,807	7,754	9,751

Source: Frontier

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*

**Exhibit 78. Total scaled up cost number by country in € per retail customer (NPV
2019, real terms) - Scenario "Unadjusted stakeholder data"**

Country	Current ISP	Change to ISP 30			Change to ISP 15			Change to ISP 5		
	minutes	Low case	Central case	High case	Low case	Central case	High case	Low case	Central case	High case
AT	15							239	319	401
BE	15							223	298	375
BG	60				137	171	216	167	223	280
CH	15							102	136	172
CY	60				34	42	53	42	57	71
CZ	60				82	103	129	98	131	164
DE	15							716	956	1,203
DK	60				220	274	345	619	827	1,039
EE	60				43	53	67	53	71	89
EL	60				123	154	194	152	203	255
ES	60	255	261	353	651	813	1,023	4,013	5,359	6,738
FI	60				212	265	333	409	546	687
FR	30				148	185	232	289	386	486
GB	30				1,453	1,816	2,285	1,913	2,554	3,212
HR	60				64	80	101	66	89	111
HU	15							114	153	192
IE	30				75	93	117	82	109	138
IT	60				212	265	334	250	334	420
LI	15							36	48	61
LT	60				120	150	189	145	194	244
LU	15							66	89	112
LV	60				105	131	165	183	245	308
MT	60				31	38	48	38	51	64
NI	30				37	47	59	47	62	78
NL	15							70	93	117
NO	60				53	66	83	76	101	127
PL	60				249	311	392	305	407	512
PT	60	55	69	87	55	69	86	104	139	175
RO	60				100	125	157	122	162	204
SE	60				45	56	70	57	77	96
SI	60				13	16	21	15	20	25
SK	15							82	110	138
All		**310**	**330**	**440**	**4,260**	**5,324**	**6,698**	**10,893**	**14,547**	**18,292**

Source: Frontier

*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*

Exhibit 79. Detailed results for line item 2.1 (trading platforms) for ISP 5 and ISP 15 (NPV 2019, € real terms)

Country	Step 1 - Reported Totex (NPV)		Main scale variable	Step 2 - Scaling factor - within-sample			Step 3 - Scaling factor to fill gaps			Results - Totex	
	ISP 15 (central case)	ISP 5 (central case)		ISP 15 (central case)	ISP 5 (central case)	Source/comment	ISP 15 (central case)	ISP 5 (central case)	Source/comment	ISP 15 (central case)	ISP 5 (central case)
AT	0	26,637,543		0%	100%		none	none		0	26,637,543
BE	0	1,252,766		0%	100%		none	none		0	1,252,766
BG	0	0		0%	0%		100%	100%		10,052,072	11,419,430
CH	0	0		0%	0%		none	100%		0	11,419,430
CY	0	0		0%	0%		100%	100%		10,052,072	11,419,430
CZ	2,925,590	3,150,058		100%	100%		none	none		2,925,590	3,150,058
DE	0	600,900		0%	100%		none	none		0	600,900
DK	696,904	0		100%	0%		none	100%		696,904	11,419,430
EE	0	0		0%	0%		100%	100%		10,052,072	11,419,430
EL	0	0		0%	0%		100%	100%		10,052,072	11,419,430
ES	19,015,606	19,266,560		100%	100%		none	none		19,015,606	19,266,560
FI	31,226,414	32,054,538		100%	100%		none	none		31,226,414	32,054,538
FR	862,242	1,381,141		100%	100%		none	none		862,242	1,381,141
GB	46,454,067	65,403,869		100%	100%		none	none		46,454,067	65,403,869
HR	34,611	151,424	None	100%	100%	No scaling up - where available observations are treated as fully representative	none	none	Uniform scaling (i.e. sample average is applied)	34,611	151,424
HU	0	4,898,601		0%	100%		none	none		0	4,898,601
IE	3,118,800	4,158,401		100%	100%		none	none		3,118,800	4,158,401
IT	18,113,252	0		100%	0%		none	100%		18,113,252	11,419,430
LI	0	0		0%	0%		none	100%		0	11,419,430
LT	0	0		0%	0%		100%	100%		10,052,072	11,419,430
LU	0	0		0%	0%		none	100%		0	11,419,430
LV	0	0		0%	0%		100%	100%		10,052,072	11,419,430
MT	0	0		0%	0%		100%	100%		10,052,072	11,419,430
NI	0	0		0%	0%		100%	100%		10,052,072	11,419,430
NL	0	3,058,575		0%	100%		none	none		0	3,058,575
NO	4,916,864	7,300,296		100%	100%		none	none		4,916,864	7,300,296
PL	0	0		0%	0%		100%	100%		10,052,072	11,419,430
PT	324,480	324,480		100%	100%		none	none		324,480	324,480
RO	0	0		0%	0%		100%	100%		10,052,072	11,419,430
SE	2,966,473	2,954,917		100%	100%		none	none		2,966,473	2,966,473
SI	21,632	122,573		100%	100%		none	none		21,632	122,573
SK	0	25,430,821		0%	100%		none	none		0	25,430,821
All	**130,676,937**	**198,147,464**		**13**	**17**					**231,197,657**	**369,450,475**

Source: Frontier

Exhibit 80. Detailed results for line item 2.2 (metering and notification systems) for the transmission network (NPV 2019, € real terms)

Country	Step 1 - Reported Totex (NPV)		Main scale variable	Step 2 - Scaling factor - within-sample			Step 3 - Scaling factor to fill gaps			Results - Totex	
	ISP 15 (central case)	ISP 5 (central case)	No. of retail customers	ISP 15 (central case)	ISP 5 (central case)	Source/comment	ISP 15 (central case)	ISP 5 (central case)	Source/comment	ISP 15 (central case)	ISP 5 (central case)
AT	0	26,637,543	5,870,000	0%	100%		none	none		0	26,637,543
BE	0	36,126,503	5,243,796	0%	100%		none	none		0	36,126,503
BG	0	0	4,915,497	0%	0%		43%	48%		2,159,046	4,638,145
CH	0	3,922,135	4,500,000	0%	100%		none	none		0	3,922,135
CY	0	0	535,050	0%	0%		5%	5%		235,011	504,860
CZ	88,053	992,608	5,837,119	100%	100%		none	none		88,053	992,608
DE	0	2,601,493	49,294,962	0%	100%		none	none		0	2,601,493
DK	0	0	3,277,000	0%	0%		29%	32%		1,439,365	3,092,098
EE	0	0	652,000	0%	0%		6%	6%		286,380	615,211
EL	0	0	8,195,725	0%	0%		72%	80%		3,599,828	7,733,289
ES	13,132,474	13,132,474	27,786,798	100%	100%		none	none		13,132,474	13,132,474
FI	14,198,060	29,090,870	3,309,146	100%	100%	No scaling up - where available observations are treated as fully representative	none	none	Scaling by the number of retail customers (source: Eurelectric)	14,198,060	29,090,870
FR	0	0	33,999,393	100%	100%		none	none		0	0
GB	0	0	29,949,462	0%	0%		262%	292%		13,154,776	28,259,591
HR	0	0	1,860,921	0%	0%		16%	18%		817,377	1,755,921
HU	0	2,564,897	5,527,463	0%	100%		none	none		0	2,564,897
IE	6,757,401	7,797,001	2,237,232	100%	100%		none	none		6,757,401	7,797,001
IT	50,000	0	31,423,623	100%	0%		none	307%		50,000	29,650,574
LI	0	0	18,958	0%	0%		none	0%		0	17,889
LT	0	0	1,571,789	0%	0%		14%	15%		690,381	1,483,102
LU	0	0	275,175	0%	0%		none	3%		0	259,648
LV	1,186,677	1,186,677	873,856	100%	100%		none	none		1,186,677	1,186,677
MT	0	0	183,777	0%	0%		2%	2%		80,721	173,407
NI	0	0	878,804	0%	0%		8%	9%		385,999	829,218
NL	0	6,243,200	8,110,000	0%	100%		none	none		0	6,243,200
NO	9,529,301	14,293,951	2,747,253	100%	100%		none	none		9,529,301	14,293,951
PL	0	0	16,478,000	0%	0%		144%	161%		7,237,672	15,548,244
PT	0	0	6,137,611	0%	0%		54%	60%		2,695,838	5,791,302
RO	0	0	2,639,318	0%	0%		23%	26%		1,159,274	2,490,397
SE	244,520	355,666	5,309,000	100%	100%		none	none		244,520	355,666
SI	56,137	129,137	925,275	100%	100%		none	none		56,137	129,137
SK	0	9,588,053	2,392,418	0%	100%		none	none		0	9,588,053
All	45,242,622	154,662,208		10	16					79,184,290	257,505,103

Source: Frontier

Exhibit 81. Detailed results for line item 2.2 (metering and notification systems) for the distribution network in scenario "Profiling" (NPV 2019, € real terms)

Country	Step 1 - Reported Totex (NPV)		Main scale variable	Step 2 - Scaling factor - within-sample			Step 3 - Scaling to fill gaps			Results - Totex	
	ISP 15 (central case)	ISP 5 (central case)	No. of retail customers	ISP 15 (central case)	ISP 5 (central case)	Source/comment	ISP 15 (central case)	ISP 5 (central case)	Source/comment	ISP 15 (central case)	ISP 5 (central case)
AT	0	0	5,870,000	0%	0%		none	average of 9 €/customer		0	51,959,655
BE	0	192,998,407	5,243,796	0%	100%	No upscaling necessary since TSO provides system level data	none	none		0	192,998,407
BG	0	0	4,915,497	0%	0%		average of 9 €/customer	average of 9 €/customer		43,510,652	43,510,652
CH	0	0	4,500,000	0%	0%		none	average of 9 €/customer		0	39,832,785
CY	0	0	535,050	0%	0%		average of 9 €/customer	average of 9 €/customer		4,736,118	4,736,118
CZ	494,611	494,611	5,837,119	0%	0%	Very small observation, not seen as representative	average of 9 €/customer	average of 9 €/customer		51,668,602	51,668,602
DE	0	0	49,294,962	0%	0%		none	average of 9 €/customer		0	436,345,695
DK	185,757,006	670,878,755	3,277,000	100%	100%	No upscaling necessary since TSO provides system level data	average of 9 €/customer	average of 9 €/customer		29,007,119	29,007,119
EE	0	0	652,000	0%	0%		average of 9 €/customer	average of 9 €/customer		5,771,328	5,771,328
EL	0	0	8,195,725	0%	0%		average of 9 €/customer	average of 9 €/customer		72,546,345	72,546,345
ES	259,400,216	2,146,123,141	27,786,798	228%	228%	Total connected customers in ES devided by total meters of reporting DSO	average of 9 €/customer	average of 9 €/customer		590,434,680	590,434,680
FI	167,890,140	429,926,028	3,309,146	100%	100%	18 DSOs, including larger ones, assumed to be representative	average of 9 €/customer	average of 9 €/customer		29,291,667	29,291,667
FR	91,684,294	13,258,531	33,999,393	105%	105%	1 devided by market share of 95% for responding DSO	average of 9 €/customer	average of 9 €/customer		96,509,784	96,509,784
GB	1,295,279,871	1,782,225,473	29,949,462	100%	100%	100% representitive (one stakeholder provides system level data)	average of 9 €/customer	average of 9 €/customer		265,104,556	265,104,556
HR	46,941,440	46,941,440	1,860,921	100%	100%	No upscaling necessary since single DSO provides system level data	none	none	sample average applied to number of retail customers (source: Eurelectric)	46,941,440	46,941,440
HU	0	0	5,527,463	0%	0%		none	average of 9 €/customer		0	48,927,610
IE	0	0	2,237,232	0%	0%		average of 9 €/customer	average of 9 €/customer		19,803,374	19,803,374
IT	23,269,687	0	31,423,623	105%	0%	1 devided by market share of 95% for responding DSO	average of 9 €/customer	average of 9 €/customer		24,494,407	24,494,407
LI	0	0	18,958	0%	0%		none	average of 9 €/customer		0	167,815
LT	0	0	1,571,789	0%	0%		average of 9 €/customer	average of 9 €/customer		13,913,052	13,913,052
LU	0	0	275,175	0%	0%		none	average of 9 €/customer		0	2,435,773
LV	90,895,310	191,971,994	873,856	100%	100%	No upscaling necessary since TSO provides system level data	none	none		90,895,310	191,971,994
MT	0	0	183,777	0%	0%		average of 9 €/customer	average of 9 €/customer		1,626,740	1,626,740
NI	0	0	878,804	0%	0%		average of 9 €/customer	average of 9 €/customer		7,778,932	7,778,932
NL	0	35,958,898	8,110,000	0%	156%	1 devided by market share of 64% for two responding DSOs	none	average of 9 €/customer		0	56,185,778
NO	636,480	0	2,747,253	100%	100%	Reported costs , no upsaling due since no significant cost expected by TSO	average of 9 €/customer	average of 9 €/customer		24,317,940	24,317,940
PL	0	0	16,478,000	0%	0%		average of 9 €/customer	average of 9 €/customer		145,858,807	145,858,807
PT	0	31,428,160	6,137,611	100%	100%	No upscaling necessary since TSO provides system level data	none	none		0	31,428,160
RO	0	0	2,639,318	0%	0%		average of 9 €/customer	average of 9 €/customer		23,362,530	23,362,530
SE	8,330,438	5,460,714	5,309,000	111%	111%	7 observations assumed to be 90% representative	average of 9 €/customer	average of 9 €/customer		46,993,835	46,993,835
SI	0	0	925,275	0%	0%		average of 9 €/customer	average of 9 €/customer		8,190,284	8,190,284
SK	0	0	2,392,418	0%	0%		none	average of 9 €/customer		0	21,177,038
All	2,170,579,492	5,547,666,150		12	14	0				1,642,757,502	2,625,292,901

Source: Frontier

Exhibit 82. Detailed results for line item 2.2 (metering and notification systems) for the distribution network in scenario "Unadjusted stakeholder data" (NPV 2019, € real terms)

Country	Step 1 - Reported Totex (NPV)		Main scale variable	Step 2 - Scaling factor - within-sample			Step 3 - Scaling to fill gaps			Results - Totex	
	ISP 15 (central case)	ISP 5 (central case)	No. of retail customers	ISP 15 (central case)	ISP 5 (central case)	Source/comment	ISP 15 (central case)	ISP 5 (central case)	Source/comment	ISP 15 (central case)	ISP 5 (central case)
AT	0	0	5,870,000	0%	0%		none	average of 9 €/customer		0	51,959,655
BE	0	192,998,407	5,243,796	0%	100%	No upscaling necessary since TSO provides system level data	none	none		0	192,998,407
BG	0	0	4,915,497	0%	0%		average of 9 €/customer	average of 9 €/customer		43,510,652	43,510,652
CH	0	0	4,500,000	0%	0%		none	average of 9 €/customer		0	39,832,785
CY	0	0	535,050	0%	0%		average of 9 €/customer	average of 9 €/customer		4,736,118	4,736,118
CZ	494,611	494,611	5,837,119	0%	0%	Very small observation, not seen as representative	average of 9 €/customer	average of 9 €/customer		51,668,602	51,668,602
DE	0	0	49,294,962	0%	0%		none	average of 9 €/customer		0	436,345,695
DK	185,757,006	670,878,755	3,277,000	100%	100%	No upscaling necessary since TSO provides system level data	none	none		185,757,006	670,878,755
EE	0	0	652,000	0%	0%		average of 9 €/customer	average of 9 €/customer		5,771,328	5,771,328
EL	0	0	8,195,725	0%	0%		average of 9 €/customer	average of 9 €/customer		72,546,345	72,546,345
ES	259,400,216	2,146,123,141	27,786,798	228%	228%	Total connected customers in ES devided by total meters of reporting DSO	average of 9 €/customer	average of 9 €/customer		590,434,680	4,884,905,456
FI	167,890,140	429,926,028	3,309,146	100%	100%	18 DSOs, including larger ones, assumed to be representative	none	none		167,890,140	429,926,028
FR	91,684,294	13,258,531	33,999,393	105%	105%	1 devided by market share of 95% for responding DSO	average of 9 €/customer	average of 9 €/customer		96,509,784	96,509,784
GB	1,295,279,871	1,782,225,473	29,949,462	100%	100%	100% representitive (one stakeholder provides system level data)	none	none		1,295,279,871	1,782,225,473
HR	46,941,440	46,941,440	1,860,921	100%	100%	No upscaling necessary since single DSO provides system level data	none	none	sample average applied to number of retail customers (source: Eurelectric)	46,941,440	46,941,440
HU	0	0	5,527,463	0%	0%		none	average of 9 €/customer		0	48,927,610
IE	0	0	2,237,232	0%	0%		average of 9 €/customer	average of 9 €/customer		19,803,374	19,803,374
IT	23,269,687	0	31,423,623	105%	0%	1 devided by market share of 95% for responding DSO	average of 9 €/customer	average of 9 €/customer		24,494,407	24,494,407
LI	0	0	18,958	0%	0%		none	average of 9 €/customer		0	167,815
LT	0	0	1,571,789	0%	0%		average of 9 €/customer	average of 9 €/customer		13,913,052	13,913,052
LU	0	0	275,175	0%	0%		none	average of 9 €/customer		0	2,435,773
LV	90,895,310	191,971,994	873,856	100%	100%	No upscaling necessary since TSO provides system level data	none	none		90,895,310	191,971,994
MT	0	0	183,777	0%	0%		average of 9 €/customer	average of 9 €/customer		1,626,740	1,626,740
NI	0	0	878,804	0%	0%		average of 9 €/customer	average of 9 €/customer		7,778,932	7,778,932
NL	0	35,958,898	8,110,000	0%	156%	1 devided by market share of 64% for two responding DSOs	none	average of 9 €/customer		0	56,185,778
NO	636,480	0	2,747,253	100%	100%	Reported costs , no upsaling due since no significant cost expected by TSO	none	none		636,480	636,480
PL	0	0	16,478,000	0%	0%		average of 9 €/customer	average of 9 €/customer		145,858,807	145,858,807
PT	0	31,428,160	6,137,611	100%	100%	No upscaling necessary since TSO provides system level data	none	none		0	31,428,160
RO	0	0	2,639,318	0%	0%		average of 9 €/customer	average of 9 €/customer		23,362,530	23,362,530
SE	8,330,438	5,460,714	5,309,000	111%	111%	7 observations assumed to be 90% representative	average of 9 €/customer	average of 9 €/customer		9,256,042	9,256,042
SI	0	0	925,275	0%	0%		average of 9 €/customer	average of 9 €/customer		8,190,284	8,190,284
SK	0	0	2,392,418	0%	0%		none	average of 9 €/customer		0	21,177,038
All	2,170,579,492	5,547,666,150		12	14	0				2,906,861,924	9,417,971,339

Source: Frontier

Exhibit 83. Detailed results for line item 2.3 (scheduling and settlement) (NPV 2019, € real terms)

Country	Step 1 - Reported Totex (NPV)		Main scale variable	Step 2 - Scaling factor - within-sample			Step 3 - Scaling factor to fill gaps			Results - Totex	
	ISP 15 (central case)	ISP 5 (central case)	No. of large retailers and generators	ISP 15 (central case)	ISP 5 (central case)	Source/comment	ISP 15 (central case)	ISP 5 (central case)	Source/comment	ISP 15 (central case)	ISP 5 (central case)
AT	0	26,637,543	11	0%	100%	No upscaling necessary since TSO provides system level data	none	none		0	26,637,543
BE	0	7,929,654	6	0%	300%		none	none		0	23,788,963
BG	0	0	10	0%	0%		136%	134%		49,573,630	67,213,198
CH	0	1,772,362	6	0%	600%		none	none		0	10,634,173
CY	0	0	2	0%	0%		27%	27%		9,914,726	13,442,640
CZ	2,970,193	3,423,171	5	167%	167%		none	none		4,950,321	5,705,285
DE	0	21,779,794	8	0%	800%		none	none		0	174,238,350
DK	3,484,522	0	9	900%	0%		none	121%		31,360,698	60,491,878
EE	0	0	3	0%	0%		41%	40%		14,872,089	20,163,959
EL	0	0	4	0%	0%		54%	54%		19,829,452	26,885,279
ES	8,620,730	8,647,655	7	233%	233%		none	none		20,115,036	20,177,863
FI	21,527,402	19,599,087	7	100%	100%		none	none		21,527,402	21,527,402
FR	26,749,135	41,660,112	4	133%	100%		none	none		35,665,513	41,660,112
GB	183,614,782	242,604,482	13	100%	118%	Set at 100% since number of observations exceeds scale variable	none	none		183,614,782	286,714,388
HR	1,318,228	1,318,228	5	250%	250%		none	none	Based on number of large retailers and generators	3,295,569	3,295,569
HU	0	5,442,890	8	0%	800%		none	none		0	43,543,123
IE	1,039,600	1,039,600	10	1000%	1000%		none	none		10,396,002	10,396,002
IT	30,295,615	0	5	250%	0%		none	67%		75,739,039	33,606,599
LI	0	0	2	0%	0%		none	27%		0	13,442,640
LT	0	0	12	0%	0%		163%	161%		59,488,356	80,655,837
LU	0	0	5	0%	0%		none	67%		0	33,606,599
LV	2,341,769	2,341,769	3	300%	300%		none	none		7,025,308	7,025,308
MT	0	0	2	0%	0%		27%	27%		9,914,726	13,442,640
NI	0	0	2	0%	0%		27%	27%		9,914,726	13,442,640
NL	0	3,791,095	7	0%	233%		none	none		0	8,845,889
NO	436,718	590,077	9	450%	450%		none	none		1,965,232	2,655,348
PL	0	0	10	0%	0%		136%	134%		49,573,630	67,213,198
PT	644,800	1,050,400	8	800%	800%		none	none		5,158,400	8,403,200
RO	0	0	8	0%	0%		109%	107%		39,658,904	53,770,558
SE	2,389,291	743,235	7	117%	175%		none	none		2,787,506	2,787,506
SI	492,461	492,461	11	550%	550%		none	none		2,708,537	2,708,537
SK	0	0	5	0%	0%		none	67%		0	33,606,599
All	285,925,246	390,863,618		4	4		7	7		669,049,583	1,231,728,822

Source: Frontier

Exhibit 84. Detailed results for line item 2.4 (billing systems) (NPV 2019, € real terms)

Country	Step 1 - Reported Totex (NPV)		Main scale variable	Step 2 - Scaling factor - within-sample			Step 3 - Scaling factor to fill gaps			Results - Totex	
	ISP 15 (central case)	ISP 5 (central case)	No. of retail customers	ISP 15 (central case)	ISP 5 (central case)	Source/comment	ISP 15 (central case)	ISP 5 (central case)	Source/comment	ISP 15 (central case)	ISP 5 (central case)
AT	0	0	5,870,000	0%	0%		none	89%		0	35,997,738
BE	0	10,405,333	5,243,796	0%	208%	Based on market share of retailer	none	none		0	21,677,778
BG	0	0	4,915,497	0%	0%		40%	74%		13,862,696	30,144,255
CH	0	140,090	4,500,000	0%	0%		none	68%		0	27,596,222
CY	0	0	535,050	0%	0%		4%	8%		1,508,949	3,281,191
CZ	356,981	356,981	5,837,119	0%	0%		47%	88%		16,461,856	35,796,096
DE	0	5,339,267	49,294,962	0%	0%		none	744%		0	302,301,047
DK	139,381	0	3,277,000	0%	0%	Observation too small, no ISP meter values provided which could be used	26%	49%		9,241,803	20,096,182
EE	0	0	652,000	0%	0%		5%	10%		1,838,772	3,998,386
EL	0	0	8,195,725	0%	0%		66%	124%		23,113,602	50,260,232
ES	0	0	27,786,798	0%	0%		224%	419%		78,364,390	170,402,365
FI	19,820,049	20,431,090	3,309,146	119%	119%	Based on number of ISP meters provided by respondents in 0.8.2	none	none		23,506,446	24,345,247
FR	27,597,689	6,249,682	33,999,393	100%	0%	100% coverage for ISP 15, for ISP 5 no scaling variable available by single respondent	none	513%		27,597,689	208,501,065
GB	144,249,830	237,619,641	29,949,462	111%	111%	All major players have reported values. Assumption: 90% coverage	none	none		160,277,589	264,021,823
HR	21,632,000	21,632,000	1,860,921	111%	111%	Based on retail market share of >90% by respondent	none	none		24,035,556	24,035,556
HU	0	54,429	5,527,463	0%	0%	Observation too small, no ISP meter value	none	83%	Based on number of retail customers	0	33,897,132
IE	831,680	831,680	2,237,232	100%	100%	TSO data (also covering 2.5), no upscaling	none	none		831,680	831,680
IT	8,742,830	0	31,423,623	493%	0%	Based on retail market share of c. 20% in the "free market" by respondent	none	474%		43,068,127	192,705,172
LI	0	0	18,958	0%	0%		none	0%		0	116,262
LT	0	0	1,571,789	0%	0%		13%	24%		4,432,763	9,638,986
LU	0	0	275,175	0%	0%		none	4%		0	1,687,507
LV	1,170,885	1,170,885	873,856	100%	100%	TSO data, no upscaling.	none	none		1,170,885	1,170,885
MT	0	0	183,777	0%	0%		1%	3%		518,287	1,127,009
NI	0	0	878,804	0%	0%		7%	13%		2,478,404	5,389,257
NL	0	887,575	8,110,000	0%	385%	Based on retail market share of c. 26% of respondent	none	none		0	3,413,751
NO	694,310	786,465	2,747,253	2500%	2500%	Based on retail market share of c. 4% of respondent	none	none		17,357,744	19,661,617
PL	0	0	16,478,000	0%	0%		133%	249%		46,471,292	101,051,232
PT	0	0	6,137,611	0%	0%		49%	93%		17,309,304	37,638,861
RO	0	0	2,639,318	0%	0%		21%	40%		7,443,411	16,185,601
SE	2,063,851	2,063,850	5,309,000	833%	833%	Based on retail market share of > 12% of respondents	none	none		17,198,756	17,198,756
SI	0	0	925,275	0%	0%		7%	14%		2,609,463	5,674,243
SK	0	0	2,392,418	0%	0%		none	36%		0	14,671,488
All	227,299,485	307,968,968								540,699,461	1,684,514,622

Source: Frontier

Exhibit 85. Detailed results for line item 2.5 (BRP forecasting, trading and scheduling) (NPV 2019, € real terms)

Country	Step 1 - Reported Totex (NPV)		Main scale variable	Step 2 - Scaling factor - within-sample			Step 3 - Scaling factor to fill gaps			Results - Totex	
	ISP 15 (central case)	ISP 5 (central case)	No. of large retailers and generators	ISP 15 (central case)	ISP 5 (central case)	Based on number of observations in relation to number of large retailers and generators	ISP 15 (central case)	ISP 5 (central case)	Source/comment	ISP 15 (central case)	ISP 5 (central case)
AT	0	0	11	0%	0%		none	151%		0	58,653,035
BE	0	5,619,645	6	0%	300%		none	none		0	16,858,936
BG	0	0	10	0%	0%		132%	137%		45,399,129	53,320,941
CH	0	0	6	0%	0%		none	82%		0	31,992,565
CY	0	0	2	0%	0%		26%	27%		9,079,826	10,664,188
CZ	0	0	5	0%	0%		66%	69%		22,699,565	26,660,471
DE	0	851,534	8	0%	800%		none	none		0	6,812,274
DK	0	0	9	0%	0%		119%	124%		40,859,216	47,988,847
EE	0	0	3	0%	0%		40%	41%		13,619,739	15,996,282
EL	0	0	4	0%	0%		53%	55%		18,159,652	21,328,377
ES	24,645,047	68,245,022	7	350%	350%	Based on number of observations in relation to number of large retailers and generators	none	none	Based on number of large retailers and generators	86,257,666	238,857,576
FI	2,324,142	2,527,226	7	117%	117%		none	none		2,711,500	2,948,430
FR	2,144,171	8,445,727	4	200%	200%		none	none		4,288,343	16,891,453
GB	62,132,050	20,728,092	13	118%	144%		none	none		73,428,786	73,428,786
HR	77,875	542,963	5	250%	250%		none	none		194,688	1,357,408
HU	0	2,177,156	8	0%	800%		none	none		0	17,417,249
IE	0	0	10	0%	0%		132%	137%		45,399,129	53,320,941
IT	18,823,597	0	5	500%	0%		none	69%		94,117,986	26,660,471
LI	0	0	2	0%	0%		none	27%		0	10,664,188
LT	0	0	12	0%	0%		159%	165%		54,478,955	63,985,130
LU	0	0	5	0%	0%		none	69%		0	26,660,471
LV	0	0	3	0%	0%		40%	41%		13,619,739	15,996,282
MT	0	0	2	0%	0%		26%	27%		9,079,826	10,664,188
NI	0	0	2	0%	0%		26%	27%		9,079,826	10,664,188
NL	0	328,822	7	0%	350%		none	none		0	1,150,878
NO	8,772,950	15,095,417	9	300%	300%		none	none		26,318,851	45,286,251
PL	0	0	10	0%	0%		132%	137%		45,399,129	53,320,941
PT	0	0	8	0%	0%		106%	110%		36,319,303	42,656,753
RO	0	0	8	0%	0%		106%	110%		36,319,303	42,656,753
SE	3,587,736	6,631,917	7	117%	117%		none	none		4,185,692	7,737,237
SI	2,163	2,163	11	1100%	1100%		none	none		23,795	23,795
SK	0	212,160	5	0%	500%		none	none		0	1,060,800
All	122,509,734	131,407,845	214							691,039,645	1,053,686,087

Source: Frontier

Exhibit 86. Detailed results for line item 2.6 (documentation) (NPV 2019, € real terms)

Country	Step 1 - Reported Totex (NPV)		Main scale variable	Step 2 - Scaling factor - within-sample			Step 3 - Scaling factor to fill gaps			Results - Totex	
	ISP 15 (central case)	ISP 5 (central case)		ISP 15 (central case)	ISP 5 (central case)	Based on number of observations in relation to number of large retailers and generators	ISP 15 (central case)	ISP 5 (central case)	Source/comment	ISP 15 (central case)	ISP 5 (central case)
AT	0	0		0%	0%		none	100%		0	1,621,196
BE	0	1,040,533		0%	100%		none	none		0	1,040,533
BG	0	0		0%	0%		100%	100%		1,930,673	1,621,196
CH	0	58,058		0%	100%		none	none		0	58,058
CY	0	0		0%	0%		100%	100%		1,930,673	1,621,196
CZ	24,215	24,215		100%	100%		none	none		24,215	24,215
DE	0	361,410		0%	100%		none	none		0	361,410
DK	197,088	0		100%	0%		none	100%		197,088	1,621,196
EE	0	0		0%	0%		100%	100%		1,930,673	1,621,196
EL	0	0		0%	0%		100%	100%		1,930,673	1,621,196
ES	35,693	35,693		100%	100%		none	none		35,693	35,693
FI	861,225	861,225		100%	100%		none	none		861,225	861,225
FR	909,498	409,498		100%	100%		none	none		909,498	909,498
GB	15,837,494	15,586,598		100%	100%		none	none		15,837,494	15,837,494
HR	62,425	62,425		100%	100%		none	none		62,425	62,425
HU	0	6,629	None	0%	100%	No scaling up - where available observations are treated as fully representative	none	none	Uniform scaling (i.e. sample average is applied)	0	6,629
IE	1,039,600	1,039,600		100%	100%		none	none		1,039,600	1,039,600
IT	0	0		0%	0%		100%	100%		1,930,673	1,621,196
LI	0	0		0%	0%		none	100%		0	1,621,196
LT	0	0		0%	0%		100%	100%		1,930,673	1,621,196
LU	0	0		0%	0%		none	100%		0	1,621,196
LV	0	0		0%	0%		100%	100%		1,930,673	1,621,196
MT	0	0		0%	0%		100%	100%		1,930,673	1,621,196
NI	0	0		0%	0%		100%	100%		1,930,673	1,621,196
NL	0	3,529,102		0%	100%		none	none		0	3,529,102
NO	30,968	46,452		100%	100%		none	none		30,968	46,452
PL	0	0		0%	0%		100%	100%		1,930,673	1,621,196
PT	0	0		0%	0%		100%	100%		1,930,673	1,621,196
RO	0	0		0%	0%		100%	100%		1,930,673	1,621,196
SE	308,523	148,155		100%	100%		none	none		308,523	308,523
SI	0	0		0%	0%		100%	100%		1,930,673	1,621,196
SK	0	0		0%	0%		none	100%		0	1,621,196
All	19,306,729	23,209,593								44,405,476	53,302,391

Source: Frontier

Exhibit 87. Detailed results for line item 2.7 (network related costs) (NPV 2019, € real terms)

Country	Step 1 - Reported Totex (NPV)		Main scale variable	Step 2 - Scaling factor - within-sample			Step 3 - Scaling factor to fill gaps			Results - Totex	
	ISP 15 (central case)	ISP 5 (central case)	No. of TSOs	ISP 15 (central case)	ISP 5 (central case)	Based on number of observations in relation to number of large retailers and generators	ISP 15 (central case)	ISP 5 (central case)	Source/comment	ISP 15 (central case)	ISP 5 (central case)
AT	0	63,999,330	1	0%	100%		none	none		0	63,999,330
BE	0	0	1	0%	100%		none	none		0	0
BG	0	0	1	0%	0%		100%	77%		4,922,495	10,981,937
CH	0	0	1	0%	0%		none	77%		0	10,981,937
CY	0	0	1	0%	0%		100%	77%		4,922,495	10,981,937
CZ	2,660,118	4,522,199	1	100%	100%		none	none		2,660,118	4,522,199
DE	8	33,051,865	4	0%	100%		none	none		0	33,051,865
DK	0	0	1	0%	0%		100%	77%		4,922,495	10,981,937
EE	17	0	1	0%	0%		100%	77%		4,922,495	10,981,937
EL	0	0	1	0%	0%		100%	77%		4,922,495	10,981,937
ES	25	0	1	0%	0%		100%	77%		4,922,495	10,981,937
FI	1,560,834	1,560,800	1	100%	100%		none	none		1,560,834	1,560,834
FR	16,009,577	1,463,866	1	100%	100%		none	none		16,009,577	16,009,577
GB	3,540,967	3,013,567	1	100%	100%		none	none		3,540,967	3,593,144
HR	1	0	1	0%	0%	No scaling up - where available observations are treated as fully representative	100%	77%	Based on number of TSOs	4,922,495	10,981,937
HU	0	1,632,867	1	0%	100%		none	none		0	1,632,867
IE	0	0	1	0%	0%		100%	77%		4,922,495	10,981,937
IT	0	0	1	0%	0%		100%	77%		4,922,495	10,981,937
LI	0	0	1	0%	0%		none	77%		0	10,981,937
LT	0	0	1	0%	0%		100%	77%		4,922,495	10,981,937
LU	0	0	1	0%	0%		none	77%		0	10,981,937
LV	4,943,648	14,227,300	1	100%	100%		none	none		4,943,648	14,227,300
MT	0	0	1	0%	0%		100%	77%		4,922,495	10,981,937
NI	0	0	1	0%	0%		100%	77%		4,922,495	10,981,937
NL	16	0	1	0%	0%		none	77%		0	10,981,937
NO	17	0	1	0%	0%		100%	77%		4,922,495	10,981,937
PL	0	0	1	0%	0%		100%	77%		4,922,495	10,981,937
PT	8	0	1	0%	0%		100%	77%		4,922,495	10,981,937
RO	0	0	1	0%	0%		100%	77%		4,922,495	10,981,937
SE	26	0	1	0%	0%		100%	77%		4,922,495	10,981,937
SI	819,824	1,293,197	1	100%	100%		none	none		819,824	1,293,197
SK	8	2,874,872	1	0%	100%		none	none		0	2,874,872
All	29,535,096	127,639,862								113,217,379	373,385,866

Source: Frontier

Exhibit 88. Detailed results for line item 2.8 (other costs) (NPV 2019, € real terms)

Country	Step 1 - Reported Totex (NPV)		Main scale variable	Step 2 - Scaling factor - within-sample			Step 3 - Scaling factor to fill gaps			Results - Totex	
	ISP 15 (central case)	ISP 5 (central case)		ISP 15 (central case)	ISP 5 (central case)	Based on number of observations in relation to number of large	ISP 15 (central case)	ISP 5 (central case)	Source/comment	ISP 15 (central case)	ISP 5 (central case)
AT	0	26,637,543		0%	100%		none	none		0	26,637,543
BE	0	4,165,533		0%	0%		none	none		0	4,165,533
BG	0	0		0%	0%		none	none		0	0
CH	0	0		0%	0%		none	none		0	0
CY	0	0		0%	0%		none	none		0	0
CZ	1,209,354	2,152,697		0%	0%		none	none		1,209,354	2,152,697
DE	0	0		0%	0%		none	none		0	0
DK	0	0		0%	0%		none	none		0	0
EE	0	0		0%	0%		none	none		0	0
EL	0	0		0%	0%		none	none		0	0
ES	848,640	848,640		0%	0%		none	none		848,640	848,640
FI	1,551,619	3,879,047		0%	0%		none	none		1,551,619	3,879,047
FR	2,809,440	3,697,293		0%	0%		none	none		2,809,440	4,517,733
GB	24,569,060	34,559,969		0%	0%		none	none	No scaling up - where available observations are treated as fully representative (2.8 is a residual cost position)	24,569,060	34,559,969
HR	0	0	None	0%	0%	No scaling up - where available observations are treated as fully representative (2.8 is a residual cost position)	none	none		0	0
HU	0	0		0%	0%		none	none		0	0
IE	1,039,600	0		0%	0%		none	none		1,039,600	1,039,600
IT	2,840,967	0		0%	0%		none	none		2,840,967	2,840,967
LI	0	0		0%	0%		none	none		0	0
LT	0	0		0%	0%		none	none		0	0
LU	0	0		0%	0%		none	none		0	0
LV	0	0		0%	0%		none	none		0	0
MT	0	0		0%	0%		none	none		0	0
NI	0	0		0%	0%		none	none		0	0
NL	0	0		0%	0%		none	none		0	0
NO	0	0		0%	0%		none	none		0	0
PL	0	0		0%	0%		none	none		0	0
PT	0	0		0%	0%		none	none		0	0
RO	0	0		0%	0%		none	none		0	0
SE	13,841,402	24,908,515		0%	0%		none	none		13,841,402	24,908,515
SI	40,377	40,377		0%	0%		none	none		40,377	40,377
SK	0	0		0%	0%		none	none		0	0
All	48,750,458	100,889,614								48,750,458	105,590,621

Source: Frontier

ANNEX B DETAILS OF BENEFIT ANALYSIS

B.1 Benefit 1.1 – Detail of the volume effect

B.1.1 We describe below how we have arrived at the estimated reduction in the volume of balancing actions taken by the TSO (replaced by BRP trading pre-gate closure to achieve balance at ISP granularity). The results are then presented in the table at the end of this section.

Stylised analysis

B.1.2 To estimate the potential impact of a reduction in ISP duration on balancing volumes, we have collected the most granular demand and generation profiles available (typically five or fifteen minutes) for a given market area over a full year. Then:

- We derived 15, 30 and 60 minute profiles by averaging the more granular data over the relevant period;

- We calculated balancing actions required in the status quo, assuming BRPs are perfectly balanced at ISP granularity and the TSO has to take balancing actions to adjust for imbalances within the ISP period relative to the average load over that period;

- Then, for each potential ISP duration (5, 15, 30), we calculate required balancing actions by the TSO to adjust for within-ISP period deviations from average load;

- We aggregate the volume of all modelled balancing upward and balancing downward actions, and compare this against the volume of actions estimated for the status quo ISP duration.

Scope

B.1.3 This analysis was implemented for 11 market areas where data was available: these are the countries where the column "Country specific results" states "Yes" (see Exhibit 89).

B.1.4 For other countries, we estimate the average volume of avoided balancing actions from those 11 market areas where the analysis has been implemented (depending on status quo and target ISP duration) and we scale this up or down to the rest of other countries depending on the annual volume of demand and generation in each market area[24].

Sense-checking and adjustments

B.1.5 We have compared the stylised estimate for the reduction in the volume of balancing actions at the level of the volume of balancing actions in the status quo. This was agreed and we circulated a data request to TSOs to enable this

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[24] This data is provided by ENTSO-E.

check. Based on responses to this request we were able to check the result for 16 market zones[25].

B.1.6 We find that the stylised approach estimated a reduction in balancing actions in excess of status quo volumes for six countries: Switzerland, Denmark, Finland, Italy, Norway and Sweden. For those countries we cap the volume effect at the level of status quo balancing actions.

B.1.7 Finally, we have compared the stylised estimates of reductions in balancing actions with the volumes indicated by those respondents who provided an answer to the survey. We find that stakeholders' central estimates range between 3% and 39% of stylised estimates. We would emphasise here that the documentation of survey responses does not suffice to disentangle the drivers for the gap between stylised estimates and survey responses. In particular, it is clear that some survey responses factor in hypotheses about BRP behaviour which the stylised analysis does not aim to capture. However, we conservatively use survey responses as a lower bound for the volume effect for those countries where a volume effect has been quantified. This concerns Switzerland, Germany, Denmark, Finland, Croatia, the Netherlands, Norway, and Sweden[26].

Exhibit 89. Estimated volume effect (in MWh) – low and high scenario

Country code	Country name	Current ISP	Country specific results?	Is the cap on balancing volume binding?	Total reduction in balancing - low			Total reduction in balancing - high		
					30	15	5	30	15	5
AT	Austria	15	no	no	-	-	217,531	-	-	217,531
BE	Belgium	15	no	no	-	-	240,166	-	-	240,166
BG	Bulgaria	60	no	no	350,848	407,891	368,451	350,848	407,891	368,451
CH	Switzerland	15	yes	yes	-	-	85,400	-	-	332,471
CY	Cyprus	N.A	no	no	-	-	-	-	-	-
CZ	Czech Republic	60	no	no	634,332	737,394	665,107	634,332	737,394	665,107
DE	Deutschland	15	yes	no	-	-	500,000	-	-	1,970,793
DK	Denmark	60	no	yes	273,594	125,000	125,000	273,594	317,927	285,078
EE	Estonia	60	no	no	78,260	90,966	81,920	78,260	90,966	81,920
EL	Greece	60	no	no	424,364	493,104	441,826	424,364	493,104	441,826
ES	Spain	60	no	no	2,419,160	2,811,662	2,528,300	2,419,160	2,811,662	2,528,300
FI	Finland	60	yes	yes	20,000	70,000	90,000	350,000	350,000	350,000
FR	France	30	yes	no	-	2,144,630	2,562,111	-	2,144,630	2,562,111
GB	Great Britain	30	yes	no	-	1,711,187	1,790,813	-	1,711,187	1,790,813
HR	Croatia	60	yes	no	10,000	50,000	100,000	166,357	192,526	127,056
HU	Hungary	15	yes	no	-	-	127,082	-	-	127,082
IE	Ireland	30	no	no	-	170,915	154,871	-	170,915	154,871
IT	Italy	60	yes	yes	2,692,447	2,960,000	2,789,140	2,692,447	2,960,000	2,789,140
LI	Lichtenstein	15	no	no	-	-	-	-	-	-
LT	Lithuania	60	no	no	71,248	82,737	73,395	71,248	82,737	73,395
LU	Luxemburg	15	no	no	-	-	14,427	-	-	14,427
LV	Latvia	60	no	no	57,928	67,305	60,218	57,928	67,305	60,218
MT	Malta	N.A	no	no	-	-	-	-	-	-
NI	Northern Ireland	30	no	no	-	57,510	52,062	-	57,510	52,062
NL	Netherlands	15	no	no	-	-	20,000	-	-	348,524
NO	Norway	60	yes	yes	1,101,954	400,000	440,000	1,101,954	1,164,279	1,182,473
PL	Poland	60	no	no	1,387,276	1,612,358	1,449,860	1,387,276	1,612,358	1,449,860
PT	Portugal	60	no	no	443,942	515,951	463,678	443,942	515,951	463,678
RO	Romania	60	yes	no	508,360	586,271	652,812	508,360	586,271	652,812
SE	Sweden	60	no	yes	50,000	150,000	200,000	1,212,734	1,409,948	1,274,236
SI	Slovenia	60	yes	no	189,589	233,250	131,468	189,589	233,250	131,468
SK	Slovak Republic	15	no	no	-	-	83,153	-	-	83,153
ALL	TOTAL				10,713,303	15,478,131	16,508,791	12,362,395	18,117,812	20,819,021

Source: Frontier Economics

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

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[25]   Belgium, Switzerland, Denmark, Finland, France, Great Britain, Croatia, Hungary, Italy, Netherlands, Norway, Portugal, Romania, Sweden, Slovenia, Slovakia.

[26]   Note that in Denmark and Norway the survey responses did not include an estimate in the case of a move to 30 minutes we have therefore not been able to implement the adjustment in this case – this is why the volume effect is larger in the 30-minute case for those countries.

B.2 Benefit 1.1 – Detail of the price effect

Stylised analysis

B.2.1   We have separately estimated the average balancing to intraday price premium by:

- Calculating the difference between either the upwards or downwards balancing price and the intraday price in the same period depending on whether the system as a whole is short or long in every hour of a year; and then by

- Deriving the resulting average premium for upwards or downwards balancing actions over the whole year.

B.2.2   This analysis has been carried out in those market areas where intraday price data availability allowed it[27]. For other countries, we have used the average estimated price differential[28]. The exhibit below gives an overview of the country-specific balancing to intraday price premiums applied in the analysis.

Exhibit 90. Country-specific balancing to intraday price premiums in €/MWh

Country	Current ISP	Direction	Unit of	Premium (€/MWh)
FR	30	Downward	Generation	7.73
FR	30	Upward	Generation	11.86
GB	30	Downward	Generation	17.09
GB	30	Upward	Generation	28.62
RO	60	Downward	Generation	20.79
RO	60	Upward	Generation	30.93
NO	60	Downward	Generation	3.91
NO	60	Upward	Generation	4.31
FI	60	Downward	Generation	12.60
FI	60	Upward	Generation	25.55
SE	60	Downward	Generation	5.74
SE	60	Upward	Generation	6.70
DK	60	Downward	Generation	6.96
DK	60	Upward	Generation	13.80

Source: Frontier Economics

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[27]   France, Great Britain, and Romania.

[28]   Subsequent to a request by Nordic TSOs a specific estimate of the price differential was derived in Denmark, Finland, Norway and Sweden based on comparing balancing prices with day-ahead prices.

ANNEX C   ADDITIONAL SENSITIVITY TO THE PLANNING CASES

C.1.1   We did the cost benefit analysis for a sensitivity to the four planning cases.

C.1.2   In this sensitivity, all countries apart from Great Britain, Northern Ireland and Ireland will move to an ISP of 15 minutes. Great Britain, Northern Ireland and Ireland will instead remain at a 30 minute ISP. Additionally, of those countries changing their ISP, not all countries will immediately complete the move in 2020. All Scandinavian and Baltic countries[29] will move to 15 minutes two years later, i.e. by 2022. We provide an overview of pre- and post-move ISP durations in Exhibit 91.

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[29]   Norway, Sweden, Finland, Denmark, Latvia, Lithuania and Estonia.

Exhibit 91. Current and new ISP durations (in minutes) in the sensitivity scenario

Country	Current ISP duration	Sensitivity
Austria	15	15
Belgium	15	15
Switzerland	15	15
Germany	15	15
Hungary	15	15
Lichtenstein	15	15
Luxemburg	15	15
Netherlands	15	15
Slovakia	15	15
France	30	15
Great Britain	30	30
Ireland	30	30
Northern Ireland	30	30
Bulgaria	60	15
Czech Republic	60	15
Denmark	60	15
Estonia	60	15
Greece	60	15
Spain	60	15
Finland	60	15
Croatia	60	15
Italy	60	15
Lithuania	60	15
Latvia	60	15
Norway	60	15
Poland	60	15
Portugal	60	15
Romania	60	15
Sweden	60	15
Slovenia	60	15
Cyprus	60	15
Malta	60	15

Source: Frontier Economics

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

C.1.3 In undertaking the quantitative analysis, we have not differentiated between implementing the change to ISP duration in 2019 and 2022 for the Scandinavian and Baltic countries, i.e. we have used an implementation date of 2019 for the sensitivity.

C.1.4 A delay to implementation would have two effects on costs. Firstly, the size of costs is likely to decrease because of the longer lead time to the change to ISP, i.e. it allows more time to plan and optimise costs. Secondly, delaying when costs are incurred reduces the present value of those costs due to the time value of money.

C.1.5 Conversely, a delay to implementation would reduce benefits in two ways. Firstly, within country and cross border benefits within the group of seven

countries with delayed implementation would not accrue for 2020 and 2021. Secondly, cross border benefits between those seven countries and countries neighbouring the group would not accrue for 2020 and 2021.

C.1.6 The overall effect on the net benefit of the delay is therefore ambiguous. However, in general where there is a positive net benefit from change a delay to implementation would tend to reduce the size of the positive net benefit. Conversely, where there is a negative net benefit from change, a delay to implementation would tend to reduce the size of the negative net benefit.

C.1.7 As shown by Exhibit 92, it is ambiguous as to whether there is a positive net benefit for the EU+3 if the ISP durations are reduced and harmonised as according to the additional sensitivity discussed here.

Exhibit 92. Additional sensitivity – net welfare (split by costs and benefits)

	Total benefit (€bn)	Total cost (€bn)	Net welfare (€bn)
Profiling with high benefits	3.6	-3.1	0.4
Profiling with low benefits	1.6	-3.1	-1.5
Unadjusted with high benefits	3.6	-3.4	0.2
Unadjusted with low benefits	1.6	-3.4	-1.8

Source: Frontier Economics

C.1.8 If metering costs are reduced by using profiling where it would not be economic to adapt meters to the new ISP and where we use the higher estimate of benefits, there would be a clear net welfare gain. However, even were profiling to be used there would be a net welfare loss if we use the lower estimate of benefits.

C.1.9 If profiling was not used to reduce metering costs, the net welfare gain from would be reduced, and there could be a significant welfare loss if the lower bound estimates were used to quantify benefits.

C.1.10 The net welfare impact following an adjustment of ISP duration as proposed by this additional sensitivity differs significantly between countries as is shown by Exhibit 93.

C.1.11 Exhibit 94, Exhibit 95 and Exhibit 96 show country-specific net welfare for profiling with low benefits, unadjusted costs with high benefits and unadjusted costs with low benefits, respectively.

C.1.12 Most countries that do not change ISP duration experience net benefits from the reduction and harmonization of ISP duration. Most countries that do change ISP duration experience net costs from the change.

Exhibit 93. Additional sensitivity – net welfare by country (profiling and high benefits)

Country	Total benefit (€m)	Total cost (€m)	Net welfare (€m)
Austria	93.3 €mn	0.0 €mn	93.3 €mn
Belgium	44.4 €mn	0.0 €mn	44.4 €mn
Switzerland	543.8 €mn	0.0 €mn	543.8 €mn
Germany	369.7 €mn	0.0 €mn	369.7 €mn
Hungary	105.6 €mn	0.0 €mn	105.6 €mn
Lichtenstein	0.0 €mn	0.0 €mn	0.0 €mn
Luxemburg	0.0 €mn	0.0 €mn	0.0 €mn
Netherlands	1.0 €mn	0.0 €mn	1.0 €mn
Slovakia	185.2 €mn	0.0 €mn	185.2 €mn
France	379.8 €mn	184.7 €mn	195.1 €mn
Great Britain	0.0 €mn	0.0 €mn	0.0 €mn
Ireland	0.0 €mn	0.0 €mn	0.0 €mn
Northern Ireland	0.0 €mn	0.0 €mn	0.0 €mn
Bulgaria	60.8 €mn	171.4 €mn	-110.6 €mn
Czech Republic	108.7 €mn	102.7 €mn	6.0 €mn
Denmark	27.7 €mn	117.7 €mn	-90.0 €mn
Estonia	14.3 €mn	53.3 €mn	-39.0 €mn
Greece	75.1 €mn	154.2 €mn	-79.0 €mn
Spain	409.8 €mn	813.1 €mn	-403.3 €mn
Finland	59.6 €mn	126.4 €mn	-66.8 €mn
Croatia	30.2 €mn	80.3 €mn	-50.1 €mn
Italy	440.9 €mn	265.3 €mn	175.6 €mn
Lithuania	15.0 €mn	149.9 €mn	-134.9 €mn
Latvia	12.3 €mn	130.8 €mn	-118.5 €mn
Norway	58.3 €mn	89.4 €mn	-31.1 €mn
Poland	237.3 €mn	311.4 €mn	-74.1 €mn
Portugal	77.7 €mn	68.7 €mn	9.0 €mn
Romania	87.7 €mn	124.8 €mn	-37.2 €mn
Sweden	81.2 €mn	93.4 €mn	-12.2 €mn
Slovenia	34.8 €mn	16.4 €mn	18.4 €mn
Cyprus	3.2 €mn	42.4 €mn	-39.2 €mn
Malta	2.3 €mn	38.1 €mn	-35.8 €mn
Total	*3,559.7 €mn*	*3,134.5 €mn*	*425.3 €mn*

Source: Frontier Economics

frontier economics

Exhibit 94. Additional sensitivity – net welfare by country (profiling and low benefits)

Country	Total benefit (€m)	Total cost (€m)	Net welfare (€m)
Austria	46.6 €mn	0.0 €mn	46.6 €mn
Belgium	22.2 €mn	0.0 €mn	22.2 €mn
Switzerland	271.9 €mn	0.0 €mn	271.9 €mn
Germany	184.9 €mn	0.0 €mn	184.9 €mn
Hungary	52.8 €mn	0.0 €mn	52.8 €mn
Lichtenstein	0.0 €mn	0.0 €mn	0.0 €mn
Luxemburg	0.0 €mn	0.0 €mn	0.0 €mn
Netherlands	0.5 €mn	0.0 €mn	0.5 €mn
Slovakia	92.6 €mn	0.0 €mn	92.6 €mn
France	153.9 €mn	184.7 €mn	-30.8 €mn
Great Britain	0.0 €mn	0.0 €mn	0.0 €mn
Ireland	0.0 €mn	0.0 €mn	0.0 €mn
Northern Ireland	0.0 €mn	0.0 €mn	0.0 €mn
Bulgaria	25.9 €mn	171.4 €mn	-145.5 €mn
Czech Republic	45.5 €mn	102.7 €mn	-57.2 €mn
Denmark	8.8 €mn	117.7 €mn	-108.9 €mn
Estonia	6.5 €mn	53.3 €mn	-46.8 €mn
Greece	32.8 €mn	154.2 €mn	-121.3 €mn
Spain	168.9 €mn	813.1 €mn	-644.2 €mn
Finland	18.4 €mn	126.4 €mn	-108.0 €mn
Croatia	7.6 €mn	80.3 €mn	-72.7 €mn
Italy	187.2 €mn	265.3 €mn	-78.1 €mn
Lithuania	7.9 €mn	149.9 €mn	-142.0 €mn
Latvia	6.6 €mn	130.8 €mn	-124.3 €mn
Norway	30.1 €mn	89.4 €mn	-59.3 €mn
Poland	99.2 €mn	311.4 €mn	-212.2 €mn
Portugal	33.5 €mn	68.7 €mn	-35.2 €mn
Romania	37.5 €mn	124.8 €mn	-87.4 €mn
Sweden	25.3 €mn	93.4 €mn	-68.1 €mn
Slovenia	14.8 €mn	16.4 €mn	-1.6 €mn
Cyprus	3.2 €mn	42.4 €mn	-39.2 €mn
Malta	2.3 €mn	38.1 €mn	-35.8 €mn
Total	*1,587.5 €mn*	*3,134.5 €mn*	*-1,547.0 €mn*

Source: Frontier Economics

Exhibit 95. Additional sensitivity – net welfare by country (unadjusted costs and high benefits)

Country	Total benefit (€m)	Total cost (€m)	Net welfare (€m)
Austria	93.3 €mn	0.0 €mn	93.3 €mn
Belgium	44.4 €mn	0.0 €mn	44.4 €mn
Switzerland	543.8 €mn	0.0 €mn	543.8 €mn
Germany	369.7 €mn	0.0 €mn	369.7 €mn
Hungary	105.6 €mn	0.0 €mn	105.6 €mn
Lichtenstein	0.0 €mn	0.0 €mn	0.0 €mn
Luxemburg	0.0 €mn	0.0 €mn	0.0 €mn
Netherlands	1.0 €mn	0.0 €mn	1.0 €mn
Slovakia	185.2 €mn	0.0 €mn	185.2 €mn
France	379.8 €mn	184.7 €mn	195.1 €mn
Great Britain	0.0 €mn	0.0 €mn	0.0 €mn
Ireland	0.0 €mn	0.0 €mn	0.0 €mn
Northern Ireland	0.0 €mn	0.0 €mn	0.0 €mn
Bulgaria	60.8 €mn	171.4 €mn	-110.6 €mn
Czech Republic	108.7 €mn	102.7 €mn	6.0 €mn
Denmark	27.7 €mn	274.5 €mn	-246.7 €mn
Estonia	14.3 €mn	53.3 €mn	-39.0 €mn
Greece	75.1 €mn	154.2 €mn	-79.0 €mn
Spain	409.8 €mn	813.1 €mn	-403.3 €mn
Finland	59.6 €mn	265.0 €mn	-205.4 €mn
Croatia	30.2 €mn	80.3 €mn	-50.1 €mn
Italy	440.9 €mn	265.3 €mn	175.6 €mn
Lithuania	15.0 €mn	149.9 €mn	-134.9 €mn
Latvia	12.3 €mn	130.8 €mn	-118.5 €mn
Norway	58.3 €mn	65.7 €mn	-7.4 €mn
Poland	237.3 €mn	311.4 €mn	-74.1 €mn
Portugal	77.7 €mn	68.7 €mn	9.0 €mn
Romania	87.7 €mn	124.8 €mn	-37.2 €mn
Sweden	81.2 €mn	55.7 €mn	25.5 €mn
Slovenia	34.8 €mn	16.4 €mn	18.4 €mn
Cyprus	3.2 €mn	42.4 €mn	-39.2 €mn
Malta	2.3 €mn	38.1 €mn	-35.8 €mn
Total	*3,559.7 €mn*	*3,368.4 €mn*	*191.4 €mn*

Source: Frontier Economics

Exhibit 96. Additional sensitivity – net welfare by country (unadjusted costs and low benefits)

Country	Total benefit (€m)	Total cost (€m)	Net welfare (€m)
Austria	46.6 €mn	0.0 €mn	46.6 €mn
Belgium	22.2 €mn	0.0 €mn	22.2 €mn
Switzerland	271.9 €mn	0.0 €mn	271.9 €mn
Germany	184.9 €mn	0.0 €mn	184.9 €mn
Hungary	52.8 €mn	0.0 €mn	52.8 €mn
Lichtenstein	0.0 €mn	0.0 €mn	0.0 €mn
Luxemburg	0.0 €mn	0.0 €mn	0.0 €mn
Netherlands	0.5 €mn	0.0 €mn	0.5 €mn
Slovakia	92.6 €mn	0.0 €mn	92.6 €mn
France	153.9 €mn	184.7 €mn	-30.8 €mn
Great Britain	0.0 €mn	0.0 €mn	0.0 €mn
Ireland	0.0 €mn	0.0 €mn	0.0 €mn
Northern Ireland	0.0 €mn	0.0 €mn	0.0 €mn
Bulgaria	25.9 €mn	171.4 €mn	-145.5 €mn
Czech Republic	45.5 €mn	102.7 €mn	-57.2 €mn
Denmark	8.8 €mn	274.5 €mn	-265.7 €mn
Estonia	6.5 €mn	53.3 €mn	-46.8 €mn
Greece	32.8 €mn	154.2 €mn	-121.3 €mn
Spain	168.9 €mn	813.1 €mn	-644.2 €mn
Finland	18.4 €mn	265.0 €mn	-246.6 €mn
Croatia	7.6 €mn	80.3 €mn	-72.7 €mn
Italy	187.2 €mn	265.3 €mn	-78.1 €mn
Lithuania	7.9 €mn	149.9 €mn	-142.0 €mn
Latvia	6.6 €mn	130.8 €mn	-124.3 €mn
Norway	30.1 €mn	65.7 €mn	-35.6 €mn
Poland	99.2 €mn	311.4 €mn	-212.2 €mn
Portugal	33.5 €mn	68.7 €mn	-35.2 €mn
Romania	37.5 €mn	124.8 €mn	-87.4 €mn
Sweden	25.3 €mn	55.7 €mn	-30.4 €mn
Slovenia	14.8 €mn	16.4 €mn	-1.6 €mn
Cyprus	3.2 €mn	42.4 €mn	-39.2 €mn
Malta	2.3 €mn	38.1 €mn	-35.8 €mn
Total	*1,587.5 €mn*	*3,368.4 €mn*	*-1,780.9 €mn*

Source: Frontier Economics

C.1.13 Different stakeholders are affected differently by the change to ISP duration. Here we show the effect on producer and consumer welfare in aggregate for the EU + 3 and for individual countries. Exhibit 97 shows the breakdown of net welfare for the EU+3 by producers and consumers.

Exhibit 97. Additional sensitivity – net welfare (split by producer and consumer welfare)

	Producer net welfare (€bn)	Consumer net welfare (€bn)	Net welfare (€bn)
Profiling with high benefits	-1.1	1.5	0.4
Profiling with low benefits	-2.9	1.3	-1.5
Unadjusted with high benefits	-1.1	1.3	0.2
Unadjusted with low benefits	-2.9	1.2	-1.8

Source: Frontier Economics

C.1.14 Exhibit 98 shows the breakdown of net welfare by producer and consumer surplus for each country. This is shown for the first sub-case, profiling with high benefits.

Exhibit 98. Additional sensitivity – net welfare by producer and consumer welfare and country (profiling and high benefits)

Country	Producer net welfare (€m)	Consumer net welfare (€m)	Net welfare (€m)
Austria	0.0 €mn	93.3 €mn	93.3 €mn
Belgium	0.0 €mn	44.4 €mn	44.4 €mn
Switzerland	0.0 €mn	543.8 €mn	543.8 €mn
Germany	0.0 €mn	369.7 €mn	369.7 €mn
Hungary	0.0 €mn	105.6 €mn	105.6 €mn
Lichtenstein	0.0 €mn	0.0 €mn	0.0 €mn
Luxemburg	0.0 €mn	0.0 €mn	0.0 €mn
Netherlands	0.0 €mn	1.0 €mn	1.0 €mn
Slovakia	0.0 €mn	185.2 €mn	185.2 €mn
France	-119.6 €mn	314.8 €mn	195.1 €mn
Great Britain	0.0 €mn	0.0 €mn	0.0 €mn
Ireland	0.0 €mn	0.0 €mn	0.0 €mn
Northern Ireland	0.0 €mn	0.0 €mn	0.0 €mn
Bulgaria	-45.9 €mn	-64.6 €mn	-110.6 €mn
Czech Republic	-47.6 €mn	53.6 €mn	6.0 €mn
Denmark	-27.8 €mn	-62.2 €mn	-90.0 €mn
Estonia	-11.2 €mn	-27.8 €mn	-39.0 €mn
Greece	-44.3 €mn	-34.8 €mn	-79.0 €mn
Spain	-262.2 €mn	-141.1 €mn	-403.3 €mn
Finland	-28.7 €mn	-38.2 €mn	-66.8 €mn
Croatia	-18.5 €mn	-31.6 €mn	-50.1 €mn
Italy	-166.3 €mn	341.9 €mn	175.6 €mn
Lithuania	-29.6 €mn	-105.3 €mn	-134.9 €mn
Latvia	-25.8 €mn	-92.7 €mn	-118.5 €mn
Norway	-22.9 €mn	-8.2 €mn	-31.1 €mn
Poland	-118.9 €mn	44.8 €mn	-74.1 €mn
Portugal	-31.3 €mn	40.3 €mn	9.0 €mn
Romania	-45.5 €mn	8.4 €mn	-37.2 €mn
Sweden	-32.9 €mn	20.6 €mn	-12.2 €mn
Slovenia	-12.6 €mn	30.9 €mn	18.4 €mn
Cyprus	-5.2 €mn	-34.0 €mn	-39.2 €mn
Malta	-4.5 €mn	-31.3 €mn	-35.8 €mn
Total	*-1,101.2 €mn*	*1,526.5 €mn*	*425.3 €mn*

Source: Frontier Economics