Single Electricity Market Committee

Proposals for Implementation of the European Target Model for the Single Electricity Market

Consultation Paper

SEM-12-004

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Abbreviations

ACER	Agency for the Cooperation of Energy Regulators
BETTA	British Electricity Trading and Transmission Arrangements
BSC	Balancing and Settlement Code
CACM	Framework Guidelines on Capacity Allocation and Congestion Management
CER	Commission for Energy Regulation in Ireland
CMG	Congestion Management Guidelines (Annex 1 of Regulation (EC) 714/2009)
COSMOS	Algorithm used for market coupling in the Central West region
DCENR	Department of Communications, Energy and Natural Resources in Ireland
DECC	Department of Energy and Climate Change in the United Kingdom
DETI	Department of Enterprise, Trade and Investment in Northern Ireland
EC	European Commission
ENTSO-E	European Network of Transmission System Operators for Electricity
FG	Framework Guidelines
FUI	France-UK-Ireland Regional Electricity Market
MIBEL	Mercado Ibérico de Energía
MIUN	Modified Interconnector Unit Nominations as defined in SEM Trading and Settlement Code
MSP	Market Scheduling and Pricing algorithm used in the SEM
Nordpool	Power market in the Nordic countries
NWE	North West Europe group
OFGEM	Office of the Gas and Electricity Market in Great Britain
OTC	Over the Counter
PCR	The Price Coupling of Regions project
PHLD	Proposed High Level Design
PX	Power Exchange
RAs	CER and UR
SEM	The Single Electricity Market operating in Ireland and Northern Ireland

SEMO	Single Electricity Market Operator for Ireland and Northern Ireland
TSC	Trading and Settlement Code
TSOs	Transmission System Operators
UR	Utility Regulator in Northern Ireland

1. Executive Summary

European Heads of State and Governments have pledged to create an internal market for electricity by 2014. Throughout the European Union, national electricity markets are being reviewed to align with a common European 'Target Model' for cross border capacity allocation and congestion management upon which the Internal Electricity Market is to be founded. Detailed rules that give legal effect to this Target Model will be binding on all EU internal borders by 2014. The application of these rules on the island of Ireland and the policy drivers for market change are the subject of this consultation paper.

The Single Electricity Market (SEM) operating in Ireland and Northern Ireland is likely to require significant modifications to implement the Target Model. The SEM Committee is committed to implementing these changes and integrating the island of Ireland into the Internal Electricity Market. The magnitude of change required for the SEM to achieve this is considerably greater than other markets in Europe owing to its centralised structure and gross mandatory pool design. For this reason, the Agency for the Cooperation of Energy Regulators (ACER), when it adopted the Framework Guidelines for Capacity Allocation and Congestion Management in July 2011, provided for a two year transitional period for island systems with central dispatch to meet the requirements of the Target Model.

On foot of this, the SEM Committee launched its Market Integration project, led by representatives of the Regulator Authorities and involving the Market Operator (SEMO) and the System Operators (TSOs), to explore options to enable the SEM to meet the provisions of the Target Model. This consultation paper is the first public output of that process and its purpose is to seek views on a number of options for implementing the Target Model in Ireland and Northern Ireland in a manner that is consistent with national and EU policy objectives.

Following a brief review of the SEM's origins and performance to date, the paper explains how the Target Model is expected to work and current progress in its implementation across Europe. The Target Model is not a mandatory wholesale market design for Europe and does not explicitly prescribe the form of national market; rather it requires compatible cross border trading arrangements between Member States. However, their implementation presupposes a variant of the prevailing European market design of decentralised bilateral trading with self commitment. The Target Model requires national electricity markets to conform to certain minimum criteria across each timeframe (forward, day ahead, intra day and balancing), such that there is a homogenous set of cross border rules and a single market place and rulebook for the same product; all of which is precondition for a functioning internal European electricity market.

Exploratory work undertaken by SEMO and the TSOs to develop options to evolve the SEM design to meet the Target Model is set out in as much detail as is achievable at this point, along with indicative costs and issues associated with each option. This approach is referred to as 'evolutionary', denoting an incremental approach to the development of the SEM. An alternative to addressing the issues for SEM posed by the Target Model is the 'revolutionary' approach, which involves redesigning and replacing the SEM trading arrangements with a new wholesale electricity market by 2016. The paper also proposes an indicative

assessment framework for the evaluation of options for implementing the Target Model in Ireland and Northern Ireland.

SEMO and the SOs have proposed four options for developing the SEM rules to align with the Target Model. These are included in summary form in the paper. They seek to preserve some of the fundamental characteristics of the SEM and range from very significant modifications to the market design (Options 1 and 3) to moderate but nonetheless significant changes (Option 2) to relatively modest/small changes (Option 4). The paper includes an initial evaluation of the options by SEMO/SOs against the criteria used to develop the SEM High Level Design. The full version of the SEMO/SO report to the Regulatory Authorities on these options is published in tandem with the SEM Committee consultation paper.

The consultation paper also examines a full scale market redesign of SEM, a decision which ultimately would involve the respective Member States. It considers the key attributes of the two broad classifications of market design – centralised and decentralised - and how these measure up against the SEM Committee's assessment criteria set out in Section 6 It then goes on to consider the option for further integration between the market arrangements in Ireland/Northern Ireland and the wholesale market in Great Britain. Given that the current GB market (BETTA) must also implement the Target Model, it is also useful to consider other market design options along the spectrum of market designs set out in Table 3 in Section 6. These include the Nordic and Iberian markets (MIBEL), which are described in Annex 1. The section also looks at the potential costs of replacing the SEM as opposed to developing it, as outlined in the 'evolutionary' options section.

The paper concludes with a brief overview of legal considerations that may arise with the evolution or replacement of the SEM arrangements. It also gives an indicative evaluation of both the evolutionary and revolutionary options discussed in the paper against these assessment criteria.

The SEM Committee welcomes the views of interested parties on all the issues raised in this paper. All responses will be published. If any respondent wishes all or part of their submission to remain confidential, then this should be clearly stated in their response.

Following consideration of responses received on this paper and further exploration of issues raised in this paper, the SEM Committee shall decided on the optimum next steps for this project. Where appropriate, this will be done in conjunction with respective Member States and FUI colleagues.

Comments on this paper should be sent to Philip Newsome and Jean Pierre Miura, preferably electronically, to arrive no later than noon on 20 April 2012.

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2. Introduction

The creation of an internal market for electricity is one of the key pillars of the European single market, which aims to create a homogeneous market place based on the freedom of movement for goods and services across the European Union[1]. This long established goal has been given fresh impetus both by the Third Energy Package and the announcement by European Council of February 2011 that:

'The internal market should be completed by 2014 so as to allow gas and electricity to flow freely. This requires in particular that in cooperation with ACER, national regulators and transmission systems operators step up their work on market coupling and guidelines and on Network Codes applicable across European networks'.

To complete the internal electricity market a 'Target Model' for cross border capacity allocation and congestion management has been elaborated at EU level which aims to harmonise cross border trading rules and, by implication, national market designs. Detailed codes underpinning the Target Model are expected to be legally binding from 2014.

The SEM Committee is supportive of market integration and the coming of the East West interconnector in 2012 will substantially increase cross border integration and competition in the SEM. Moreover, high levels of wind will make increased levels of interconnection and their efficient use a necessity. In short, Ireland and Northern Ireland are committed to becoming part of the Internal Electricity Market[2].

However, implementing the European cross border electricity Target Model is a significant challenge for Ireland and Northern Ireland. The Target Model does not explicitly prescribe the form of national wholesale market but it does require compatible cross border arrangements between Member States. Its implementation presupposes a variant of the prevailing European market design of decentralised bilateral trading with self commitment. The Target Model aims to build on this market design and to organise the internal market through mostly voluntary power exchanges, though it stops short of making participation mandatory. The market arrangements on the island of Ireland, by marked contrast, take the form of a centralised mandatory electricity pool with central commitment, through which all generation and cross border flows must be scheduled.

This purpose of this paper is to set out options for implementing the Target Model in Ireland and Northern Ireland in a manner that is consistent with national and EU policy objectives. The SEM Committee has worked with ACER to acknowledge the difficulty associated with reaching the Target Model considering the present SEM design and reached agreement that the SEM would be permitted to evolve to the Target Model by 2016, if so required[3] and that this would be reflected in the relevant network codes.

This paper examines the key challenges facing Ireland and Northern Ireland of how to implement the electricity Target Model by 2016 – i.e., whether this is best achieved through

[1] The Free movement of people and capital are the other pillars of the internal market.

[2] Previous consultation papers have set out the benefits to Ireland and Northern Ireland of further and deeper integration of the SEM with its neighbouring markets. These include: increased producer and consumer welfare, enhanced security of supply, promoting competition in the wholesale electricity market, facilitating the penetration of renewables in the market, by enhancing the opportunity to export wind power and reducing operating costs for the system operators, through the provision of operating reserve across the interconnectors.

[3] See CACM Section 1.2

the ‘bottom up’ approach of developing the current SEM legal framework, rules and market systems (evolution) or instead through a ‘top down’ full scale review and replacement of the market arrangements with an entirely new legal structure and market design (revolution).

This paper is intended as first step in the process of reaching the goal of European market integration by 2016. It is a discussion document to stimulate debate and inform SEM Committee and government policy. Given the fundamental policy and legislative responsibilities of the respective Government Ministries in Ireland and Northern Ireland in establishing the SEM and considering EU Member States’ adoption of the Third Package, any decision which would lead to new market arrangements will be made by means of the SEM Committee making a recommendation to the Department of Communications, Energy and Natural Resources (DCENR) in Ireland and the Department of Energy, Trade and Investment (DETI) in Northern Ireland. In view of this, the SEM Committee will continue to keep Government Ministries informed on project developments generally and on the outcome of this consultation. Depending on the outcome of this process, a recommendation to the respective Governments will follow from the SEM Committee.

After this consultation future SEM Committee decisions on implementing the Target Model will establish the broad direction of travel for the development of the market on the island and give the necessary degree of certainty to investors and customers that policy decisions are being measured against an established and agreed assessment framework and within the overarching policies set by government.

During the consultation on this paper there will be additional engagement with ACER, the European Commission, FUI colleagues from Government Departments and Regulators, SEM and FUI market participants, as appropriate, on specific elements of this paper which require further exploration. These include but are not limited to, discussions on the incorporation of section 1.2 of the CACM into the relevant network code; the necessity of central dispatch of generation plant within SEM, the suitability of the current SEM legal framework for future market designs, the implications of changing bidding structure in SEM and the implication of trading closer to real time given increasing amounts of renewables on the Island.

Following this work and consideration of the responses received the SEM Committee will make a decision on the next steps in this project including what options to explore further to enable a decision to be made on whether top down/revolution or bottom up/evolution is the most appropriate course of action[4]. SEM Committee will not be deciding on an amended high level design for the market for 2016 at this point; rather it will decide on the next steps in the project and the most efficient process and timetable for making that decision in the future.

This paper has been produced by the Regulatory Authorities’ team set up in August 2011 to develop options for market integration. Section 7 has been provided by the all-island project team of the SEM TSOs and the SEM Market Operator (SEMO) who were tasked by the SEM Committee with the identification of feasible evolutionary options for SEM to pursue to implement the Target Model. This paper:

[4] See conclusions and recommendations for proposed next steps.

- Outlines the context and activities to date of the SEM Market Integration Project (section 3);
- describes the origins and operation of the SEM (section 4);
- sets out the overall European policy context and implementation vehicles for the creation of the internal market and gives an overview of the Target Model for electricity and the 'shadow' European standard market design on which it is based (section 5);
- examines the issues faced by the SEM in implementing the Target Model including disparities with the current SEM design; describes the broad spectrum of market designs and proposes an assessment framework for evaluating options for implementing the Target Model (section 6);
- presents a number of means of evolving the SEM design to implement the internal market and alternatively the policy decisions and some options for new market arrangements if the SEM arrangements were to be revoked and replaced (sections 7 and 8);
- sets out the legal considerations for both evolving and replacing the SEM, and concludes with the SEM Committee's conclusions, recommendations and next steps as well as an indicative evaluation of the evolutionary and revolutionary options discussed in the paper measured against the assessment criteria proposed in section 6(sections 9 and 10);
- provides a list of the specific questions posed in the paper and on which the SEM Committee welcomes responses from interested parties (section 11); and,
- contains annexes on market designs in selected European countries, a brief recap of the benefits of market integration and further detail on the Target Model and the disparities between it and the SEM design.

3. European Market Integration Project

The paper has been produced as part of the SEM Committee's European Market Integration Project which was established in August 2011 in response to the following related developments:

- In June 2011, the FUI Region submitted to ACER and the European Commission their plans to meet the CACM targets models. These commitments now form part of the ACER cross regional roadmaps for the implementation of the Target Model that were presented at the Florence Forum on 05 December 2011.[5]

- On 29th July 2011, ACER adopted the Framework Guidelines for Capacity Allocation and Congestion Management for Electricity (CACM) which allows the island of Ireland the option of implementing the Target Model through a transitional process, extending to 2016.[6]

Following this, and under the aegis of the FUI region, the SEM Committee established in July 2011 a project to explore options that would enable the SEM to evolve its rules to implement the provisions of the CACM Network Codes for Day Ahead and Intra Day as well as the other elements of the Target Model. The SEM Market Integration Project Initiation Document, published at the beginning of August 2011, sets out the scope, deliverables, timetable, organisation and resources of this project.[7]

Accordingly, the SEM Committee set up an all-island project team (led by the Regulatory Authorities) of the SEM TSOs and the SEM Market Operator (SEMO) with the initial objective of providing a report to the Regulatory Authorities and the SEM Committee by December 2011 on the identification of feasible evolutionary options for SEM to implement the Target Model. The SEM Committee also requested that the Regulatory Authorities consider whether a more radical redesign was necessary and whether it would be a more cost effective means of meeting policy objectives and capturing benefits for end consumers.

European Engagement

Between September and November 2011, the SEM/SEMO/SO joint project team organised a series of meetings with key stakeholders in Europe including regulatory authorities, power exchanges and TSOs who are active in the NWE and PCR projects and with those in Europe facing similar challenges to SEM in relation to the Target Model. Key meetings included:

[5] See: http://ec.europa.eu/energy/gas_electricity/forum_electricity_florence_en.htm

[6] Section 1.2 of the CACM 'The CACM Network Code(s) may provide for transitional arrangements for the day-ahead and the intra-day markets of island systems with central dispatch, as long as these transitional arrangements:
- are justified on the basis of a cost-benefit analysis;
- do not unduly affect other jurisdictions;
- guarantee a reasonable degree of integration with the markets in adjacent jurisdictions;
- do not extend beyond 2016.
The transitional arrangements shall be proposed by the relevant NRA(s) for inclusion by ENTSO-E in the CACM Network Code(s). The NRA(s) shall provide ACER with the information required for assessing that the above conditions are met'.

[7] SEM-11-068: SEM Market Integration Project, Project Initiation Document, 8 August 2011

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  The meeting considered two elements of the challenge for SEM in implementing the Target Model:
  - Making changes to SEM such that it is compatible with the day ahead market coupling algorithm and intraday shared order book
  - Deciding what to couple to, i.e. who provides the shipping agent and which PX on the other side supplies bids and offers and

  Discussion also took place on the CfD option (see section 7) and the potential for a pilot project.

- **Operador del Mercado Ibérico de Energía (OMEI) and La Comisión Nacional de Energía (CNE).**

  The Iberian market (MIBEL) has central dispatch and the authorities are attempting to adopt continuous intraday trading and yet retain their six/eight implicit auctions at the intraday stage. SEM is facing a similar challenge. Bid formats in MIBEL, which are less complex by comparison with those in the SEM, are also believed to be compatible with the requirements of the Target Model.

- **National Grid UK**

  The key issue discussed with National Grid was development of the GB hub and how SEM might link into this in the future. Attendees agreed that it was crucial that SEM market is compliant with the chosen algorithm for European market coupling before the Target Model can be implemented. There was some discussion on the proposed CfD solution.

Stakeholder Engagement

Since the project was initiated there has been a considerable level of engagement with market participants and other interested parties. The following key interactions have taken place to date:

- During September 2011, bilateral meetings between the Regulatory Authorities/SEMO/SO and industry participants on the scope, timeframes and objectives of the Market Integration Project
- On 3rd October 2011, **Stakeholder Workshop 1** was held in Dundalk. The purpose of this workshop was to provide a forum for interested parties to assist in the development of design option for the SEM to align with the CACM. The workshop was well attended by both market participants, energy consultants and interested parties.
- On 22nd November 2011, **Stakeholder Workshop 2** was held in Dundalk. The purpose of this workshop was to update market participants generally on the project and to provide an opportunity for discussion on the potential options for aligning the SEM with the Target Model. This workshop was also well attended

- Regular bilateral meetings with industry organisations such as the National Electricity Association of Ireland (NEAI), the Irish Business and Employers Confederation (IBEC) and the Irish Wind Energy Association (IWEA).

Having established the background and context for the Market Integration project, the paper now outlines origins and development of the SEM.

4. The Single Electricity Market in Ireland and Northern Ireland

4.1 The Origins of the Single Electricity Market

Beginning in 2005, the following process led to the implementation of the SEM in 2007:

- In response to a request from their respective governments, the Regulatory Authorities (CER and NIAUR) set out a Proposed High Level Design (PHLD) of the SEM in March 2005[8].

- The PHLD discussed the relative merits of decentralised (bilateral) and centralised (gross pool) trading arrangements before deciding that the latter was the preferable design for Ireland and Northern Ireland. The Paper concluded that:

  'The Regulatory Authorities are minded to introduce a gross mandatory pool in light of the benefits this offers over a bilateral market. It presents a number of advantages in terms of liquidity, transparency, dispatch efficiency, its suitability for a market as small as the SEM, the added incentives for new investment and fostering renewables and CHP'

- Following responses to this proposal, the Regulatory Authorities issued their decision on the High Level Design for the SEM in June 2005 setting out the fundamental design features of the market[9]:

  - *the SEM is to be a central commitment market with a single clearing energy price and an explicit capacity payment mechanism.*
  - *the single clearing price shall be set ex-post on an unconstrained basis, with constrained on and constrained off payments made to participants in defined circumstances.*
  - *the SEM shall apply static locational loss factors to all generator outputs*
  - *a shallow connection policy shall be applied in the SEM*

- The detailed rules of the market were developed by the Regulatory Authorities, System Operators and market participants from both jurisdictions and set out in the SEM Trading and Settlement Code (TSC).

- In addition, a work-stream on the mitigation of market power established a range of measures to complement the TSC in establishing robust rules to deal with potential abuse of dominant position in the SEM.[10]

The above design of the SEM was judged by the Regulatory Authorities to be a robust, internally consistent set of rules that meet the regulatory and government objectives and under which the new wholesale market could successfully operate. The decision to go-live on 1 November 2007 was made on the basis of these design features.

[8] Proposed High Level Design, 31/03/2005: http://www.allislandproject.org/en/high-level-design-consultation.aspx?article=f87b8dba-3fd8-48cb-9562-6a9e278a1830

[9] Note the High Level Design and the subsequent Trading and Settlement Code do not deal with Market Power Mitigation. This was to be the subject of a separate simultaneous workstream

[10] Note that a range of other workstreams including legislation, participant readiness, legislation, licences etc. etc. contributed to the establishment of the SEM.

4.2 The Single Electricity Market 2007 to 2011

It is the SEM Committee's view that the SEM has served electricity customers in Ireland and Northern Ireland well. This is due to a number of reasons including market prices closely reflecting costs, new entry which has been forthcoming and the penetration of renewables which has reached a high level. There are also high levels of grid connections planned in the coming years, reserve margins have risen and the lights have stayed on. Furthermore, the SEM has substantially mitigated market power and provided a liquid and transparent spot market which has contributed to market stability. These benefits are tangible and a direct result of the market design that was chosen in 2005.

The SEM Committee, in its 2010 Annual Report, asserted its belief that 'the market has worked well over the last three years and continues to deliver benefits to consumers through the use of efficient generation plant to meet demand across the whole island. The SEM model of setting prices in a transparent and cost reflective manner is not only assisting to promote competition and attract new investment, it has also resulted in improvements in the availability of generation plants'.

The SEM Committee also pointed out that clear market rules and transparency has encouraged new Investments in the SEM, both completed, planned and under construction including:

- 1000 MW of new generation in 2010
- Authorisation to construct granted to Endesa Ireland for a 450 MW CCGT at Great Island, County Wexford.
- Interest in pumped storage and other flexible generation technologies
- Continued connection to the grid of renewable generation

As with previous years, the SEM Committee noted that 'the System Marginal Price (SMP) in 2010 tended to rise and fall in alignment with rises and falls in the key underlying fuels (notably gas) and carbon price'. This suggests that SEM energy prices are as would be expected in an efficient market and reflect the underlying marginal costs of generation.

It is also worth noting several independent studies that have concluded that the SEM is meeting its strategic objectives of promoting competition, ensuring supply security and the promotion of renewable generation:

- The Economic and Social Research Institute in Ireland (ESRI) in its recent *Review of Irish Energy Policy* (Research Series No. 21 April 2011) argues that the SEM has been one of the key successes of Irish energy policy in recent years and the transparent wholesale price of electricity in the SEM reflects long run marginal cost of production on the island. The report noted that a premature abandonment of the SEM in order to integrate fully with the emerging European internal market could 'fatally undermine the credibility of the Irish market, with the prospect of a long delay before a new regime could be put in place. In turn, this would make investment more difficult to finance and, hence, more expensive'.

- The recent ESRI report '*the Internal EU Electricity Market: Implications for Ireland, Paul K. Gorecki, ESRI (Research Series Number 23), October 2011'* which noted that 'the SEM has worked well for consumers'.

- Cambridge Economic Policy Associates' independent review of *Market Power and Liquidity in the SEM, a report to the CER and Utility Regulator* (December 2010) stressed that 'the SEM wholesale market appears to be working well and that competition is increasing'.

- *Reforming Competitive Electricity Markets to Meet Environmental Targets*, David Newbery (August 2011). The paper refers to the SEM and notes that 'the attraction of a pool model is ease of entry for new generators, the simultaneous provision of balancing and dispatch services, a highly liquid reference price, and the option for managing wind farms better'.

4.3 Development of the SEM to date

Since 2007, the SEM Committee has undertaken a number of development projects, some of which have concluded (Dispatch and Scheduling, Demand Side Vision) and others which the SEM Committee is expected to make a decision on in early 2012. Most of these projects, which are listed below, have referred to expected changes to the SEM design as a result of European market integration and in some cases have recommended that no policy action should be taken as a result. Clearly, the issues raised in these workstreams will have relevance to any development of the SEM and potentially also for replacement market designs. Thus, the SEM Committee will bear in mind the outcomes of these projects along with participants views on the issues raised when making its decision on the integration options for SEM set out in this paper.

The projects are described below:

Dispatch and Scheduling

On 26th August 2011, the SEM Committee's issued a decision regarding twelve specific matters raised in a Consultation Paper issued in July 2009 on *Principles of Dispatch and the Design of the Market Schedule in the Trading and Settlement Code* (SEM-09-073).

The Dispatch Scheduling Decision paper noted that 'no fundamental changes to the SEM High Level Design are envisaged in the interim period given the prospective of significant changes to the market as a result of market integration'.

Regional Integration

The precursor to the SEM Committee's Market Integration project was the Regional Integration workstream from 2008 to 2011. The key outputs from the workstream were:

- Publication of a SEM Committee Information Paper in April 2009 on interconnector issues in the SEM which explored the reasons as to why the Moyle Interconnector had not responded as fully as might have been expected to differences in prices between the SEM and the electricity market in Great Britain. The paper made a number of recommendations for removing barriers to cross border trade.

- Publication of a SEM Committee Consultation Paper in September 2009 on a roadmap for regional market integration. This consultation paper examined the short-medium term question of how best to coordinate the allocation of available transfer capacity on interconnectors across various time frames - from long to medium term through to day ahead, intra-day and balancing markets.

- Publication of a SEM Committee Decision Paper in March 2010 on plans for regional integration. This paper considered the responses of interested parties to the Consultation Paper and proposed a programme of work for the Regulatory Authorities to achieve the SEM Committee's overall aim of maximising the efficient use of existing and future interconnectors between the SEM and its neighbouring markets over the coming years.

- Approval by the SEM Committee in March 2011 of the High Level Design on Intra Day Trading in the SEM. This modification has the aim of meeting the compliance requirements of the Congestion Management Guidelines (CMG) that are annexed to (EC) Regulation 714/2009 and increasing the overall efficiency of flows of interconnectors on SEM borders.

- The approval of the East West and Moyle Access Rules in September 2011 by the SEM Committee and Ofgem following an process of coordination of rules between interconnectors in the France-UK-Ireland region as required by the CMG.

Demand Side Management (Demand Side Vision)

The Regulatory Authorities have undertaken a programme of work with industry and other stakeholders to develop a Strategic Demand Response Programme for the Island of Ireland. The Decision Paper, published in May 2011, set out the SEM Committee's view of the 2020 Demand Side Vision and a prioritised list of measures to enable it to be delivered.

In its Demand Side Vision, the SEM Committee pledged to ensure that 'consideration is given in any modification to the Trading and Settlement Code to introduce firm day ahead pricing in the SEM, allowing the support of demand side participation. Demand side participation in the market will be integrated as a key driver into the project going forward'. The impetus for introducing day ahead firm pricing does not therefore come from the Target Model alone.

Market Power & Liquidity

In November 2011 the SEM Committee published a draft decision paper on market power and liquidity, following earlier consultations. Along with other proposals the paper decided that 'in relation to contract liquidity, not to establish a market maker or to mandate contracts from generators at this time as liquidity is generally best developing "organically" through industry/market initiatives. However, there may be a case for proceeding with such an approach in the future, in the context of the integration of SEM into European markets. The RAs' Market Integration Project Team will lead this work and any initiatives in this area will be fully consulted on by the Regulatory Authorities at the appropriate time'.

Generator Locational Signals

In September 2011 the SEM Committee published its decision to harmonise all island generator transmission use of system tariff (G-TUoS). The SEM Committee has also been engaged in a project to implement an improved solution for the allocation of transmission loss adjustment factors (TLAFs) to generators.

From the Market Integration perspective, thought will need to be given to how losses are treated once market coupling is implemented[11].The SEM Committee decisions on the allocation of loss factors to generators will inform the approach to locational issues that arise from the implementation of the Target Model.

Capacity Payment Mechanism Review

A draft decision on the SEM Committee Capacity Payments Medium (CPM) Term Review was published in November 2011. It did not propose any substantive changes to the CPM. A final Decision on this area is due in Quarter 1 2012.

In parallel to considering if and how the SEM's CPM should be developed and tailored to the needs of the internal market, a discussion is taking place across Europe as to whether a capacity payment mechanism is required to deliver the substantial incentive investment needed over the coming years. The proposed introduction of a capacity mechanism in Great Britain[12] and other Member States is being followed at European level by a European Commission report due out in mid 2012 that will review long term investment signals and may consider the compatibility of capacity payment mechanisms with the Target Model.

Ancillary Services and Facilitation of Renewables

A joint Regulatory Authority/TSO project was carried out throughout 2008 and 2009 resulting in harmonisation of the arrangements for the procurement of Ancillary Services across the island from 1st February 2010.

Following on from the Facilitation of Renewables Studies the TSOs provided to the SEM Committee in May 2011 a considered position on the implications that results of this study would have on the secure, reliable and efficient operation of the all-island power system in the coming years. It also contains the TSOs' proposed plan of actions to systematically address the challenges posed by the changing composition of the generation portfolio arising from EU and national policies regarding climate change and renewable targets. This will be further progressed by the TSOs and Regulatory Authorities.

Having reviewed the origins of the SEM and its operation to date, the next section examines the history of the European Internal Electricity Market, sets out the legal framework of framework guidelines and Network Codes on which it is being constructed and describes the four marketplaces that make up the Target Model and related legal and governance issues.

[11] At a European level, the inclusion of losses in the market coupling algorithm has not been envisaged as the Inter TSO Compensation Scheme (ITC) is intended to compensate national TSOs for losses caused by international transit flows. The ITC does not however cover HVDC losses.

[12] See DECC White Paper and recent announcement on 'technical update on capacity mechanism: http://www.decc.gov.uk/en/content/cms/legislation/white_papers/emr_wp_2011/tech_update/tech_update.aspx

Section Consultation Questions:

1. Do you agree that the SEM has met its objectives to date?
2. Do you think that any further work should be done on the above projects separate to or as part of the Market Integration Project?

5. European Context – the Building of the Internal Electricity Market

5.1 Background

By removing barriers and setting fair rules for cross-border exchanges in electricity, the EU plans to forge a competitive and transparent wholesale electricity market with a high level of security of supply that serves the interests of electricity consumers and increases the welfare of European citizens[13]. While all EU Member States opened their electricity markets to competition in July 2007, the European Commission have continued to be concerned that 'Market integration has still not developed to a sufficient extent. This is demonstrated by price differences, regional monopolies and persistent cross-border congestion between Member States.'[14] The Third Energy Package was launched, in part, as a result of these concerns.

Efficient use of Europe's cross border transmission links is crucial if market integration is to be achieved. The historic underuse or uneconomic use of these interconnectors and resulting poor price correlation between regional markets was identified by the European Commission's Directorate General for Competition in its enquiry into the electricity sector as a major reason for uncompetitive and segmented wholesale markets throughout the European Union[15]. Building on the first two rounds of internal energy market legislation, the Third Energy Package aims at breaking down cross border impediments to trade and establishes the institutional framework in which the internal market is to operate[16]: Its key provisions relating to the internal market are:

- Ensuring adequate network development,
- Unbundling of the network operator function,
- Strengthened national regulatory powers for cross border matters and
- The creation of community level regulatory and system operator bodies to implement the internal market and promote market integration[17].

The Third Package does not specify the rules of the Internal Electricity Market but instead establishes an institutional framework for its development. This market framework is necessary 'because of the special features of electricity, requiring instantaneous last minute balancing by the system operator, the need to maintain security and quality of service given the laws of physics and the constraints in the transmission system as well as the natural monopolies inherent in the networks, and the need to resolve information asymmetries'[18]. Challenges are faced across Europe for policymakers, regulatory authorities, system operators and market participants. These include using this institutional framework to

[13] The European Commission estimates that achieving a fully functioning and competitive European electricity and gas market can add an extra 0.6 percent to 0.8 percent to EU gross domestic product (GDP) by 2020: Source, European Commission.
[14] *Progress in creating the internal gas and electricity market SEC(2008)-460*), European Commission, 2008
[15] The DG Competition Electricity Sector Enquiry, which was published in 2007, was the origin of many of the provisions of the Third Package. See: http://ec.europa.eu/competition/sectors/energy/inquiry/index.html
[16] The Third Package consists of the following internal electricity market legislation: Directive 2009/72/EC Concerning common rules for the internal market in electricity, Regulation 713/2009 Establishing an Agency for the Cooperation of Energy Regulators, and Regulation 714/2009 on conditions for access to the network for cross-border exchanges in electricity.
[17] The Agency for the Cooperation of Energy Regulators (ACER) and the European Network Transmission System Operators for Electricity (ENTSO-E) were established in Q1 2011.
[18] *Physical and Financial Capacity Rights for Cross Border Trade* (14), prepared for the European Commission's Directorate-General for Energy by Booz and Company and Professors David Newberry and Goran Strbac, London and Cambridge, 30th September 2011. See: http://ec.europa.eu/energy/gas_electricity/studies/doc/electricity/2012_transmission.pdf

develop and implement the rules and market mechanisms that complete the internal market through the establishment of a Target Model for cross border capacity allocation and congestion management. This Target Model has been under development for several years (though ad hoc advisory groups - such as the Project Coordination Group (PCG) and the Ad Hoc Advisory Group of Stakeholders (AHAG) [19] - operating under the aegis of the European Electricity Regulatory Forum or 'Florence Forum' as it is commonly known) and were formally agreed as the blueprint for the internal market when ACER adopted the Framework Guidelines for Capacity Allocation and Congestion Management on 29th July 2011.

The Third Package (Article 6 of Regulation 714/2009) places specific responsibilities on ENTSO-E, ACER, and the European Commission in the drawing up and approval of guidelines and codes to implement the Internal Electricity Market including the Target Model. It is ACER's responsibility to draft non-binding Framework Guidelines such as the CACM for the development by ENTSO-E of detailed and legally enforceable Network Codes subject to the approval of the European Commission.

Following approval by the European Commission, the CACM Framework Guidelines were passed to ENSTO-E in September 2011 to work up into enforceable Network Codes that will be annexed to Regulation (EC) 714/2009. The deadline for the implementation of the Target Model is 2014, though some existing cross border trading mechanisms that are not in line with the Target Model are permitted as transitional arrangements until full implementation can be achieved[20]. These Network Codes will be incorporated into European law once adopted by Member States through the EU's commitology process, planned for 2013.

5.2 Building the Internal Market: Framework Guidelines, Network Codes

The Network Codes that regulate access to cross-border transmission infrastructure will impact upon national markets and lead to increased harmonisation of those markets. Each set of Framework Guidelines will specify detailed areas for network code development. Regulation (EC) 714/2009 sets ENTSO-E's responsibility for developing Network Codes in 12 areas including:[21]

- Network security and reliability rules including rules for technical transmission reserve capacity for operational network security;
- Network connection rules;
- Capacity-allocation and congestion-management rules;
- Balancing rules including network-related reserve power rules.

[19] For more information see:
http://www.energyregulators.eu/portal/page/portal/EER_HOME/EER_ACTIVITIES/Input_to_Framework_Guidelines/Electricity/Congestion%20Management/AHAG_expert_group

[20] See CACM Section 1.2. These include transitional arrangements for SEM until 2016 and for OTC access for intra day for an undefined period.

[21] Other planned network codes are envisage for: third-party access rules; data exchange and settlement rules; interoperability rules; operational procedures in an emergency; rules for trading related to technical and operational provision of network access services and system balancing; transparency rules; rules regarding harmonised transmission tariff structures including locational signals and inter-transmission system operator compensation rules; and Energy efficiency regarding electricity networks.

Framework Guidelines and Network Code Process

The process for the drafting and adoption of Framework Guidelines and Network Codes operates as follows:

- The European Commission directs ACER to produce Framework Guidelines in relation to certain aspects of the Network Code, which must be consulted on, and are then adopted the EC if they are deemed to be acceptable.
- The EC then directs ENTSO-E to produce Network Codes in line with the Framework Guidelines.
- ENTSO-E submits the draft Network Codes to ACER, which may require them to be amended if they are not in line with the Framework Guidelines.
- ACER then submits the draft Network Codes to the EC, with or without a recommendation that they be adopted.
- The EC may choose to adopt a Network Code recommended to it. If no Network Code is recommended, there are procedures that allow the EC to draft and adopt a Network Code.

Since the establishment of ACER and ENTSO-E, the following Framework Guidelines have been initiated:

5.3 The Framework Guidelines for Capacity Allocation and Congestion Management

The Framework Guidelines that are of most relevance to the Target Model and wholesale market design, the CACM deal, with 'the integration, coordination and harmonisation of congestion management regimes, insofar as such harmonisation is necessary in order to facilitate electricity trade within the EU'.

The key requirements for the Target Model set out in the CACM are:

- Capacity Calculation method using either a Flow-Based (FB) or an Available Transfer Capacity (ATC) method based on a Common Grid Model;
- Definition of zones and bidding areas;
- Harmonised set of rules for borders and a single platform for the allocation of long-term transmission rights (Physical Transmission Rights or Financial Transmission Rights) at the European level;
- Implicit auctions via a single price coupling algorithm which simultaneously determines volumes and prices in all relevant zones, based on the marginal pricing principle;
- Continuous implicit trading that may be complemented by regional auctions where there is sufficient liquidity;

- Requirements for firmness of cross border capacity and provision for force majeure.

The European Commission formally asked ENTSO-E to start working on two CACM Network Codes in September 2011. The first of these Network Codes on Day Ahead, Intra Day and Capacity Calculation is now being developed by ENTSO-E with a final draft to be sent to ACER by September 2012. The second set of CACM Network Codes shall focus on forward markets and the allocation of long term transmission rights and is due to be sent to ACER by end 2013.

5.4 The Framework Guidelines on Balancing (EBFG)

The Framework Guidelines on Electricity Balancing are currently being developed by ACER and it is expected that an impact assessment and draft Framework Guidelines will be published for consultation in the first half of 2012.[22.]

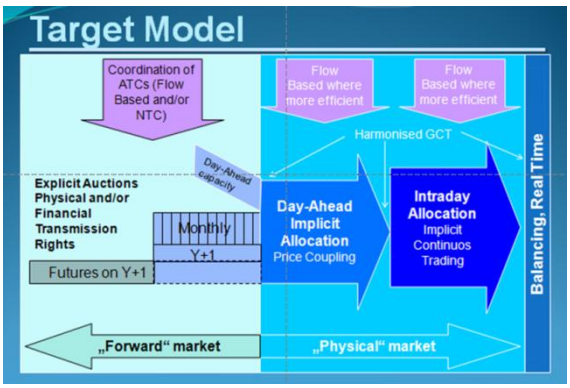
Harmonisation of rules and integration of national balancing markets therefore requires prior investigation and debate to best define the relevant focus of the Framework Guideline. Some of the policy options to be investigated include:

- roles and responsibilities of stakeholders involved;
- cross-border exchanges of the balancing service products (e.g. balancing energy, automatic and manual reserves) and the opportunity to reserve interconnection capacities for balancing services;
- balancing service procurement mechanisms (including pricing);
- imbalance settlement rules;
- TSO-TSO trades with common merit order as a possible Target Model.

5.5 The European Electricity Target Model

The Target Model requires national electricity markets of EU Member States to conform to certain minimum criteria across each timeframe such that a homogenous set of market rules are in place across Europe. The Target Model reflects the prevailing market design in Europe, which is the bilateral contracts market model. Their key elements are summarised in Table 1 and described in some more detail below:

Table 1: The Target Model (Source: ENTSO-E)



[22] As part of the development of the Framework Guidelines, ACER held an industry workshop in Ljubljana in October 2011. Information from the workshop is available on the ACER website.

How does the Target Model market work in practice?

Under this model, of which Nord Pool is the prime example, trading takes place in four distinct though inter-related time frames:

First, physical bilateral contracts are traded in a **forwards** (or futures market) between market participants. These are then notified to the market operator before the day ahead market opens.[1]

Second, the gate closure for bids in **day ahead market** is at 12 noon Central European Time (CET). The day ahead spot market covers all five countries in the Nordic Region.[1] It is the main platform for trading energy in the Nordic region. The trading day runs from midnight to midnight CET and the products traded are hourly products. Generators, suppliers and large industrial loads submit simple bids, these are aggregated into demand and supply curves and the regional price is simply set at where the curves intersect. Interconnector capacities between the five countries (and within them) are implicitly allocated (or auctioned) in the spot market. In other words, energy and transmission are traded together. No explicit auctions of transmission capacity take place. A participant does not need to have bought capacity on an interconnector within the region before it can trade in the spot market

Third, once the day ahead market has cleared, the continuously traded **intraday market** opens and closes one hour ahead of real time. Prices are set on a first-come, first-served principle, where the best prices come first – highest buy price and lowest sell price. Again, transmission capacity is implicitly allocated along with the energy traded.

Finally, the **balancing** or real time market takes over in the hour before real time. The system operator accepts offers to sell and bids to buy energy from market participants to balance the system and keep the frequency stable. Imbalances between contracted volumes and actual load and generation are settled at an imbalance price. There are various options for how that price(or prices) are calculated.

So the Target Model requires specific arrangements for:

1. A forwards market, which clears before the day ahead stage
2. A day ahead market, which is capable of being coupled through implicit auctions with other day ahead markets in the region
3. A continuously traded intraday market, which is capable of being coupled implicitly with neighbouring markets[23]
4. A balancing or real time market

For further details on the Target Model for each of these marketplaces see Annex 4.

[23] Continuous implicit trading may be complemented by regional auctions where there is sufficient liquidity.

5.6 Implementation of the Target Model

Cross Regional Roadmaps

ACER has been given overall responsibility for the implementation of the Target Model by 2014.To achieve this goal it has elaborated regional and cross regional 'roadmaps' for each element of the CACM market timeframes. The purpose of cross-regional roadmaps is to identify key milestones and accountabilities at EU and regional level and to increase consistency across the regions and pave the way for the completion of the Internal Electricity Market by 2014. The cross regional roadmaps were presented at the 21st Florence Forum on 5th December 2011[24].

Day Ahead Market Coupling

For Day Ahead market coupling, the cross regional roadmap focuses on the North West Europe (NWE) project which aims to implement market coupling simultaneously across the whole of the NWE region by end 2012. This will include the possibility of other borders joining when ready if they do not impact on the delivery of the NWE project

Key to the implementation of market coupling is the finalisation and certification of the algorithm which will perform the optimisation for day ahead market coupling throughout the Internal Electricity Market. The algorithm is currently being developed by the PXs through the Price Coupling of Regions (PCR) project and will be assessed by ENTSO-E[25]. The market coupling algorithm will need to be approved in each Member State. The process for approval is to be set out in the Day Ahead Governance Guideline (see below).

Intra Day Continuous Trading

For Intra Day continuous trading, again the implementation path that is set out in the cross regional roadmap is focussed on the NWE region. Implementation of the intra day element of the Target Model is less developed than the Day Ahead stage and as a result a stepwise process is planned in NWE whereby an interim solution will be put in place in 2012 with an enduring solution implemented by 2014.

The current proposed approach for the interim solution is to implement an "Elbas-like" solution for the Shared Order Book (SOB) and Capacity Management Module (CMM), with hub-to-hub shipping for standard hourly products and coordinated capacity determination[26]. The priority is to keep the interim solution as simple as possible to avoid delay.

The enduring solution will be an 'evolution' of continuous implicit trading, featuring:

» reliable capacity pricing reflecting congestion

» automatic matching

» appropriate block bids and sophisticated products

[24] See http://ec.europa.eu/energy/gas_electricity/forum_electricity_florence_en.htm

[25] The Cosmos algorithm used by Central Western Europe has been chosen as a starting point for the development of the algorithm. See: http://www.apxendex.com/uploads/tx_abdownloads/files/COSMOS_public_description.pdf

[26] For a description of Elbas see Annex 1.

The design of the enduring solution requires considerable agreement and development, particularly on the issue of capacity pricing. This is likely to be particularly important for markets where there is a lot of activity in the intra day market due to high levels of intermittent generation. The potential to retain 'implicit auctions' as a complement to continuous trading is being considered by the Iberian Market and explicit access will be allowed on an interim basis for some borders[27].

Forward and Long Term Capacity Allocation

Implementation of the Long Term element of the Target Model will be advanced in 2012 by ACER, which has established a working group on long term transmission rights, in conjunction with ENTSO-E which is due to begin work on the Forward Network Code in Q4 2012. The following are the main challenges to be met in meeting the CACM requirements for long term capacity allocation:

- Harmonisation of allocation rules
- Harmonisation of allocation platform
- Harmonisation of nomination process
- Decision on implementation of Financial or Physical Transmission Rights (FTRs/PTRs)

Regarding the decision on the implementation of FTRs or PTRs. Provisional key milestones in 2012 are:

- Assessment of legal consequences of possible move to FTRs
- Public consultation by ACER on harmonisation of allocation rules
- Analysis of possible design of FTRs by ACER and ENTSO-E
- Public consultation by ACER on possible design and implementation of FTRs

Market Coupling Governance Guideline

On 28th November 2011, the European Commission published a public consultation on a governance framework to 'enable an efficient market coupling system based on a sustainable and efficient organisational structure'. As the flagship market of the Target Model, it is considered that day ahead market coupling requires EU level governance arrangements to ensure that it meets the objective of achieving the Internal Electricity Market. The European Commission considers that such a framework is necessary in order to provide legal certainty, allow market coupling to be extended across the entire EU, enable speedy implementation and provide a robust process for making future changes.

The EC Governance Guideline, following consultation, will be passed directly in law through the comitology process rather than through the Framework Guidelines/Network Code process followed for the Target Model's technical rules[28]. The main focus of the Governance Guideline is the allocation of roles and responsibilities for market coupling (e.g. Power Exchanges, TSOs, shipping agents). It covers the following areas:

[27] See CACM sections 5and 1.2
[28] The comitology process for the Governance Guideline is expected to conclude by Q3 2012.

- Four broad options are considered for governance arrangements
- Roles and responsibilities of parties involved in market coupling.
- How the detailed rules of market coupling are agreed upon and amended when necessary.
- Procedures of entry and exit of a party including the rights and obligations.
- Regulatory oversight structures.
- Cost sharing principles.

Neither of the following Framework Guidelines concern the Target Model per se but each will have an impact on the operation of the Internal Electricity Market.

The Framework Guidelines on Grid Connection and System Operation

The **Framework Guidelines for Grid Connection** covers all issues relating to establishing and maintaining a physical connection between the transmission and or distribution grid and grid customers. The Guideline sets out requirements which the transmission and distribution grid operators, as well as the grid users have to meet. The Grid Connection Framework Guideline was adopted by ACER on 20 July 2011 and ENTSO-E have begun work on the Network Codes.

The aim of the **Framework Guideline on System Operation** aim at setting out clear and objective principles for the development of Network Code(s) on system operation covering the complete area of activities for operating an electric power network, including security, control and quality in terms of fixed technical standards, principles and procedures, but also the synchronous operation of interconnected power systems. The Framework Guideline was published on 3 December 2012 ENTSOE will begin drafting of the Network Codes in 2012.

This section has considered the background, institutional framework, key features and implementation steps for the Internal Electricity Market. The next section considers the challenge of implementing the Target Model in Ireland and Northern Ireland given the current structure of the SEM.

Section Consultation Questions:

1. What elements of the Target Model are most relevant for the island of Ireland and the France-UK-Ireland region?
2. Are there other aspects of the European Internal Electricity Market that should form part of this consultation?
3. Is continuous trading as applied in the Elbas market in Scandinavia an appropriate model for Ireland given the levels of wind expects on the system by 2020? What elements of the emerging design of the NWE Intra Day project (e.g. congestion pricing) are most relevant for Ireland?
4. What is your opinion on FTRs versus PTRs as the best approach for interconnectors on Ireland and Northern Ireland borders?

6. SEM Integration into the Internal Electricity Market

6.1 Difficulties that SEM has with implementing Target Model

As explained in Section 4, the Single Electricity Market (SEM) that fully integrated the then existing wholesale markets in both jurisdictions in 2007 was chosen to take account of the unique features of electricity production on the island of Ireland, including its relative geographic isolation, size of generator units relative to peak demand and the commitment to deliver a progressively high proportion of electricity consumption from renewable energy sources (a target of 40% by 2020 for Ireland and Northern Ireland having been set by the respective Governments).

Tackling market power, facilitating large-scale investment in renewable generation and ensuring adequate security of supply were the key policy rationales for the design and implementation of the SEM. The core features of the SEM that were judged to meet these challenges were a gross mandatory pool with transparent, cost-reflective prices, complex bidding, central unit commitment and dispatch and a capacity payments mechanism.

There are a number of seams issues that will require changes to the SEM design to make it possible to implement the Target Model set out in CACM[29]. This section sets out the issues that require resolution before the SEM can be incorporated into day ahead market coupling. Intra day is also considered.

Differences

Table 2 below sets out the main differences between the SEM and the European Target Model.

[29] Seams issues' is the term used to describe difficulties that may occur across interconnectors between different markets with different rules and procedures – e.g. 'seams issues' between the PJM market and its neighbouring 'bilateral' market arrangements in the eastern United States.

Table 2: SEM and the European Target Model

Characteristic	*SEM Design*	*European Target Model*
Market Design	Pool	Bi-lateral Contracts
Trading Day	06AM for 24 hours	23PM for 24 hours
Trading Period	30 minutes	1 hour (for Day Ahead and Intra-Day contracts)
Gate Closure	Trading Day – 20.5hrs (EA1)	Trading Day – 12hrs (Day- 1)
Offers/Bids	Generator Complex Offers (with Commercial and Technical components) Demand does not bid.	Simple Offers and Bids Sophisticated Offers (Block Bids, Linked Bids, Minimum Revenue, Energy Limited)
Intra-Day	2 Implicit Auctions	Continuous Implicit Trading
Form of dispatch	Central Dispatch	Self Dispatch
Firm Pricing	Ex-Post	Day Ahead and Intraday
Financial Contracts	Limited contracts market	Forwards financial and physical markets
Cross Border Settlement	Interconnector Units settle cross border trades.	Shipping agent settles cross border trades.
Capacity Payment	Explicit Capacity Payments	Not considered in the FG CACM

The key differences are:

- That the SEM has central commitment and dispatch; the Target Model assumes self-commitment and dispatch (see insert in section 7)
- that the SEM has *ex post* pricing; the Target Model has *ex-ante* pricing
- the SEM has no day ahead market with firm prices and quantities, so is incapable in its current form of coupling to any other market at the day ahead stage; price coupling at the day ahead stage in the Target Model is predicated on a liquid day ahead market that clears with firm prices and quantities
- the SEM has only two discrete opportunities after EA1 for intraday trading (EA2 and WD1); the Target Model has continuous intraday trading
- the latest time that participants can trade in the SEM is at least 9 hours before real time; the latest time in the Target Model for intra-day is likely to be one hour[30]
- the SEM has no real time or balancing market

[30] This reflects self-commitment in the target model and central commitment in the SEM. This also explains why optimisation is done individually for each trading period in the target model and for 30 hours in the SEM.

So the options for modifying the SEM will have to include introducing a day ahead market with firm quantities and prices; and continuous trading between the point when the day ahead market closes and shortly before real time.

For more detail on the difference between SEM and the Target Model see Annex 3.

6.2 Spectrum of Options for SEM and Internal Electricity Market

In view of the above disparities between the Target Model and the SEM High Level Design, the SEM Committee will need to reach a conclusion as to whether the SEM can be developed such that it is compatible with the rest of the internal market at the forward, day ahead, intra day and balancing timeframes. If this were not possible in an efficient and cost effective manner, or without compromising other energy policy objectives in either jurisdiction, a recommendation to Government Ministries will be made to replace the SEM with a new set of electricity trading arrangements.

The following sections of the paper explore a range of different sets of policy options for developing the SEM through an evolutionary approach which builds on aspects of the current SEM design. The alternative top down or revolutionary approach of transitioning to a new market by 2016 is examined at a high level so as to provide a reference for future SEM Committee decisions and elicit initial views from stakeholders as to their preferences for maintaining elements of the SEM's high level design.

The differences, advantages and disadvantages of the evolutionary and revolutionary approaches are set out below:

Evolution

As the name suggests this involves developing the SEM using one of the options in section 7 below or other variants of these that respondents may propose during the consultation process. The advantages of the evolutionary approach are as follows:

Advantages

- Given that the SEM is considered to have been operating successfully since it began, the evolutionary options have the potential to ensure that the elements of the SEM that deliver the most benefits to consumers are retained.
- Presents a good opportunity to simplify and improve the SEM, minimise regulatory uncertainty for investors and transition to an enhanced market design.
- Potentially fewer systems changes for the market and system operators and participants than would be required for a new market, though this could depend on whether the existing central market systems vendor is retained.
- Potentially fewer changes to the legal framework than the revolution option, is likely to lead to fewer legal changes and would mean that the fundamental underlying legal structure could be retained.
- Greater certainty and maintenance of the core elements of the SEM may provide more a more stable investment framework and give some degree of certainty for market participants and consumers

Disadvantages

- Care will need to be taken to avoid over-complicating the market. Bridging the significant gaps between the SEM and the Target Model may engender a market design that is neither internally consistent nor easily understandable. This risks hampering new entry and ultimately raises efficiency and competition concerns.
- May be more difficult to reach consensus on the optimal design as the existing change control process in SEM (the Modifications Committee) reflects the interests of only domestic market participants whereas the primary purpose of the Target Model is to increase cross border competition.
- Existing features of the SEM such as central dispatch may be greater impediments to reaching the Target Model. Thus, there is a risk that a chosen evolutionary option may not be compatible with the Internal Electricity Market.

Revolution

Advantages

- If an entirely new market is put in place, it may prove easier to introduce market coupling, intra -day continuous trading etc. on SEM-GB borders
- Allows high level decisions to be made on market design for 2016 without undue interference from existing operation of SEM
- May allow for a more internally consistent design than evolutionary approach as it would be starting from scratch.
- May afford greater opportunity to address other current or future policy concerns or perceived shortcomings of the SEM, e.g., effects of intermittency on market schedule, demand side vision, contract liquidity and market power
- Potential to base new arrangements on 'off the shelf' market designs that are Target Model compliant[31].

Disadvantages

- Could be costly, given how much some commentators claim it cost to move from a pool market to bilateral market in GB in 2001
- May mean that the gains from a SEM style market are lost and that issues such as market dominance, security of supply and renewable penetration are no longer dealt with adequately. Without the safeguards that a centralised pool offers in these areas, a suite of other measures may be required outside the market to protect against the abuse of market power, ensure supply security and meet renewable targets[32].
- There is a risk that in undertaking a full scale and costly market redesign, the end result will be that a market design similar to the SEM is chosen, owing to the fundamentals of market design and system operation on a small island system[33].

[31] Note: the SEM design was based almost entirely on the England and Wales Pool that operated in England and Wales from 1990-1999).
[32] c.f. Department of Energy and Climate Change - Electricity Market Reform and Ofgem's recent Liquidity Review.
[33] Of course, the new market design would need to meet the legal requirements of the European Target Model.

The Spectrum of Electricity Market Design Choices

In considering views on section 7 and 8 of this consultation paper, respondents should bear in mind this spectrum of market types and reflect on how each design characteristic meets the policy assessment criteria set out below. Table 2 provides a guide to the common features of the classes of electricity market designs in Europe as a guide for considering the options presented in the following sections[34].

Table 3: Market Architecture - The Spectrum of European Designs

Timeframe or feature:	Decentralised	Hybrid Decentralised	Target Model	Hybrid Centralised	Centralised
Notable Examples	BETTA, French & German markets	Nord Pool	EU from 2014	MIBEL (Iberia), GME (Italy)	SEM, England and Wales Pool
Forward Market	Mostly Physical Some Financial based on PX spot price	Some Physical Mostly Financial based on PX spot price	Financially cleared products	Limited Physical Financial Futures and Forwards based on PX spot price	Financial Forward CfDs based on ex-post spot price
Day Ahead Spot Market	Power Exchange auction, OTC	Bilateral contracts, brokered OTC, voluntary PX	Physical implicit auctions	Multiple, mainly through PX auction	Spot market is ex-post
Intra Day Market	Continuous until 1hr ahead	Elbas (Continuous until 1 hr ahead)	Evolution of Elbas with congestion pricing	Centralised auction, to combine with continuous	Centralised auction
Balancing Market	Imbalance mechanism	Imbalance market	TSO-TSO with or w/o Common Merit Order	Imbalance/constraints	Ex-post pool constraints
Dispatch	Self Commitment	Self Commitment	Not specific	Central Commitment	Central Commitment
Bidding	Simple Bids for organised markets	Simple Bids	Simple and some complex Bids	Simple and semi-complex Bids	Complex Bids
Mandatory	Voluntary markets	Some mandatory markets – e.g. spot market for cross border	Not specific	Quasi mandatory PX (capacity payments linked)	Entirely Mandatory

[34] This paper assumes that the US Standard Market Design of centralised pool with locational marginal pricing are not compatible with the European Target Model and therefore not worth considering.

6.3 The Determinants of Electricity Markets on the Island of Ireland

As noted by the Regulatory Authorities in its PHLD consultation paper in 2005, geology and topography have been as important in determining the nature of the electricity market as geographical, demographic and strategic factors. This is particularly pertinent when considering the process of market integration for Ireland and the UK.

The nature of electricity supply and demand in both parts of the island of Ireland has a markedly distinct history to the experience of Great Britain. Ireland and Northern Ireland lack any comparable fossil fuel reserves and both parts of the island share a geographical position at the end of Western Europe's gas supply chain with concentration of load in two east coast areas. The rise of renewable and in particular onshore wind power as an economic renewable technology has changed the energy paradigm on the island of Ireland with Ireland and Northern Ireland both committed to targets of 40% for the production of electricity from renewable sources by 2020.

A historically concentrated market structure on both parts of the island has meant that there is a continued need to mitigate market power. The primary duty of the SEM Committee to protect **the interest of consumers across the island of Ireland** through the promotion of competition where appropriate is the overarching long term policy priority that all decisions and other policy considerations will be measured against.

6.4 Original Assessment Criteria

An assessment framework was used in deciding the high level design of the SEM during the process of arriving at a high level design for the SEM in 2004 and 2005. The Commission for Energy Regulation and the Utility Regulator (NIAER as it was then), developed the following primary objective for the SEM, in light of their statutory duties and functions:

> *The wholesale electricity trading arrangements should deliver an efficient level of sustainable prices to all customers, for a supply that is reliable and secure in both the short and long-run on an all-island basis.*

This primary objective in choosing a suitable design for the wholesale market was supplemented by the following five objectives:

Key Assessment Objectives for SEM Design

Security of Supply

The chosen wholesale market design should facilitate the operation of the system that meets relevant security standards.

Competition

Competition amongst profit maximising market participants incentivises participants to increase output, reduce costs, increase availability and invest in new capacity. The market design should not create barriers to entry /exit and should promote transparency.

Environmental

The Regulatory Authorities accepted that a market cannot be designed specifically around renewable generation. Nonetheless, the selected wholesale market design should be conducive to renewable energy generation involvement.

Stability

It is important for reasons of investor confidence and cost of capital considerations that the trading arrangements should be stable and predictable throughout the lifetime of the market.

Efficiency

Market design should, in so far as it is practical to do so, result in the most economic (i.e., least cost) dispatch of available plant.

Practicality/Cost

Transaction costs of interacting with the market should not act as a barrier to participation in the market and an implementation that is well defined, timely and reasonably priced.

Equity

The market design should allocate the costs and benefits associated with the production, transportation and consumption of electricity in a fair and reasonable manner.

Adaptive

The governance arrangements should provide an appropriate basis for the development and modification of the arrangements in a straightforward and cost effective manner.

6.5 New Assessment Criteria

These criteria are as relevant in 2012 as they were in 2005. This is due to the fact that the size of the market on the island of Ireland is still relatively small. This means that the size of the largest generating unit in the market is still large relative to peak demand. And, with the commissioning of the East West interconnector in 2012, the capacity interconnections between the SEM and GB will be relatively large (at around 15%) compared with peak demand. Both of these have implications for system security, which would not be the case in larger markets such as in GB or Spain or Scandinavia.

Objectives such as security of supply, efficiency of dispatch, price transparency, liquidity and the cost of participation are as relevant now as they were in 2005.

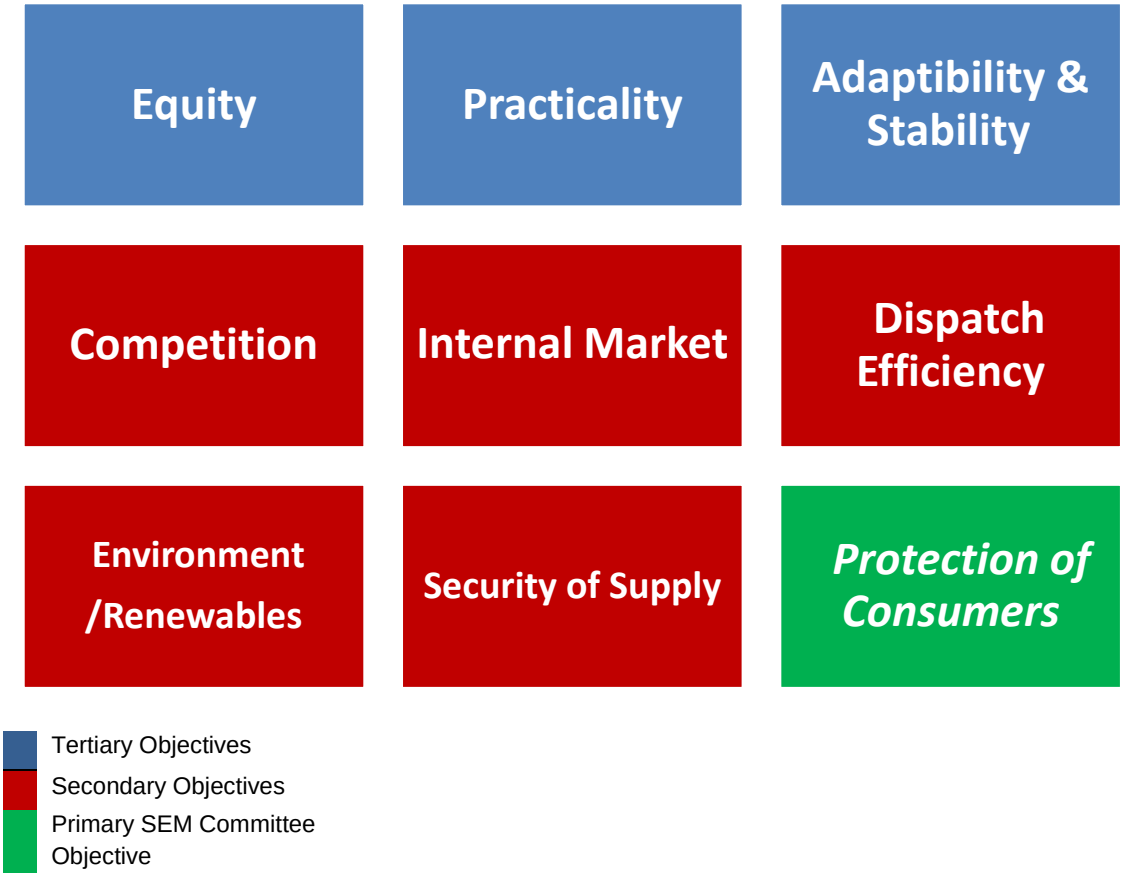
Implementation of Target Model

One factor that has changed since 2005 that will impact on the assessment criteria is the legal requirement to integrate SEM into the Internal Electricity Market and to implement the Target Model in Ireland and Northern Ireland by 2016. Section 6 described the difficulties that the SEM in its current design will have in complying with the European Target Model for day ahead and intraday trading. A replacement for the SEM will have to be designed in such a way that it can comply from the start. This requirement for compliance with the European Target Model is a binding constraint on any new design and must be considered within the assessment criteria

6.6 Assessment Framework for Decisions on Implementing the Target Model

The proposed Assessment Criteria to be used by the SEM Committee for the implementation of the Target Model for the internal electricity market on the island of Ireland are therefore:

Table 4: Proposed Assessment Criteria



Note: the assessment above does not denote ranking within each category (primary, secondary, tertiary) of objectives.

This section has considered the challenge that the SEM faces in meeting the European Target model and indicated two broad pathways for responding to these challenges. It has also proposed an assessment framework for evaluating options for implementing the Target

Model in Ireland and Northern Ireland. The next section outlines initial proposals for developing the SEM, the so called ‘evolutionary’ options.

Section Consultation Questions:

1. What elements of the SEM design are in your opinion not compatible with the Target Model?
2. What elements of the SEM design can and should be retained when implementing the Target Model in Ireland and Northern Ireland?
3. What point on the spectrum of market designs is most suited to Ireland?
4. Do you agree with the SEM Committee assessment framework proposed above?
5. Is the ranking of criteria/objectives the right one? Is the application of weighting factor appropriate? What weighting would you give each one?
6. What other criteria, if any, should the SEM Committee apply when making its decision on implementing the Target Model?

7. Evolution –Maintain some key elements of SEM Design

As explained in Section 3, the SEM Committee set up the Market Integration Project in August 2011.The project team was established to include TSOs and the SEM Market Operator (SEMO) who were given the specific task of providing a report to the SEM Committee in December 2011. This report identified feasible options for SEM to pursue to give effect to compliance with the Target Models for the internal electricity market. Reflecting their role as operators of the system and market, their role in drafting the Network Codes and obligations under Regulation (EC) 714/2009 regarding congestion management, the TSOs and SEMO have been given responsibility for delivering this key input into this project.

Any views or expressed evaluations carried out in this section are those of the TSOs and SEMO and not the SEM Committee[35]. These options have not been legally reviewed against the provisions of the CACM Framework Guidelines and the expected requirements of the Network Codes.

This section looks at whether the current SEM arrangements could be modified in such a way as to make the SEM compliant with the Target Model. It sets out the four options that have been identified by the SEMO/TSO project team for developing the existing SEM structures over time to meet the Target Model. It also aims to promote other key SEM policy objectives, discusses the advantages and disadvantages of each option and suggests some questions that respondents to this Consultation Paper might address in considering these options.

7.1 The four options

Four options for developing the SEM to meet the requirements of the Target Model are presented here. There may be others and variants of the ones presented here, but these illustrate a range of possibilities considered by SEMO /TOs project team. The four options are:

1. A limited bilateral contracts market in the forwards timeframe to allow for the use of Physical Transmission Rights (PTRs) (or forward financial contracts only if Financial Transmission Rights (FTRs) are adopted for the long term Target Model) with a day ahead market at EA1, implicit continuous intraday trading and a balancing market.

2. A pool market in the forwards timeframe, with a day ahead market at EA2, implicit continuous intraday trading and a balancing market

3. A limited bilateral contracts market and a pool market in the forwards timeframe, with a day ahead market at EA2, implicit continuous intraday trading and a balancing market

4. Largely maintaining the current SEM structure and putting in place a discrete day ahead contracts for differences (CfD) market and a continuously traded intraday CfD market.

[35] Other than the consultation questions at the end which have been posed by the SEM Committee

Possible variants might include adding implicit intraday auctions (as in MIBEL) and substituting an *ex post* real time market for a balancing market.[36]

Central dispatch

The Target Model emanates from (and is compatible with) larger systems on mainland Europe (e.g., Nord Pool). These systems are several orders of magnitude larger than the all-island system. This needs to be kept in mind when considering which evolutionary option best meets the requirements of European legislation but also best meets the reliability and security standards for the island of Ireland.

Many of the larger European systems operate a self-scheduling model with generators and suppliers effectively managing exchanges of power between themselves, with the system operators only dispatching balancing plant in real time. The TSOs point out that this approach has never existed in Ireland. It was not considered appropriate at the time the SEM was designed, for the following reasons:

- The size of the largest infeed relative to the size of the demand is a measure of the granularity of the system. For a large system, the loss of the largest infeed is much less of an issue than it is for the all island system. This is because on the all-island system, the loss of a large CCGT or the interconnector may result in a loss of up 20% of the controllable generation that is running at the time.
- The impact of this characteristic is that the TSOs argue that they first need to dispatch all generation on the system to provide reserve (potentially constraining their output); and second, if the largest infeed should trip then all that reserve needs to be called upon either automatically or through the issue of dispatch instructions.
- Because of the relative size of generating units to system demand, transmission constraints on the all island system, planned or unplanned, can have a significant impact on the technically feasible generation pattern, thus requiring centralised control of the output of all generation.

The TSOs point to a further issue relating to central dispatch that has emerged since SEM was designed:

- The level of intermittent generation in Ireland has already reached up to 50% of system demand on windy days, adding unique operational challenges not experienced in other power systems. Centralised control of the output of all generation on the island is required to manage this intermittency.

As such, it is believed by the TSOs that the requirement for central dispatch of all generation remains a core requirement of the all-island system. The options presented reflect this.

[36] The difference between a balancing market and an *ex post* market lies in the prices at which imbalances between contracted quantities and actual quantities are settled. In a balancing market, imbalances are settled at the price of the most expensive generator dispatched to ensure that the system is in balance in real time. The *ex post* market makes use of perfect hindsight and optimises available generation (that is, those who are physically available and have spare capacity) around the deltas in the system load. Using the marginal pricing principle, this will determine the price.

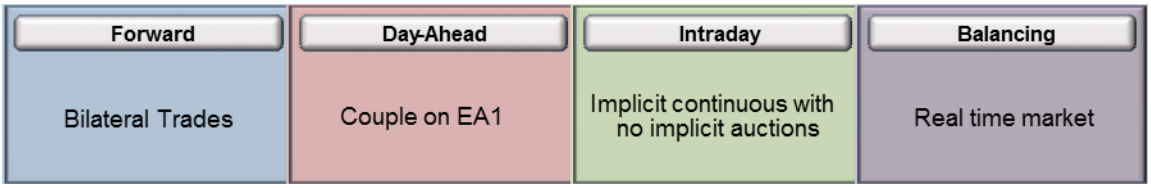
In all the options, participation would be mandatory in one of the four time frames but voluntary in each individually.

These four options are described in more detail in the rest of this section.

Option 1: Limited Forward bilateral contracts, day ahead coupling at EA1, implicit continuous intraday trading, balancing market

This option is made up of a limited bilateral contracts market in the forward timeframe, with a day-ahead price coupled market at EA1, continuous implicit intraday trading and real-time pricing of imbalances.[37]

Forwards market



The design of the forward market will be a limited physical bilateral contracts market with PTRs on the ICs or a forward CfD market with FTRs. This will be a voluntary market.[38] Participants will be able to enter into bilateral contracts for the purchase and sale of electricity and to notify these contracted quantities to the market operator in advance of a defined gate closure[39]. This would be expected to be in line with the current EA1 gate timings.

These contracted quantities will be considered as "price taker" nominations from a market and system operator point of view. This option will allow interconnector users with explicit interconnector capacity holdings to nominate their traded quantities in advance of the coupling of the day ahead and intraday markets. So this option is intended to provide market participants with an opportunity to use explicit interconnector capacity rights in advance of the day ahead implicit auctions. It is anticipated that this option would be similar to the arrangements in Nord Pool or MIBEL, where, although most trade goes through the day-ahead market, there is an opportunity to trade outside these arrangements beforehand. It is for discussion whether this should be achieved by putting a limit on the physical trades that go through the bilateral contracts market, with the aim of concentrating liquidity in the day ahead market. Clearly, the provision of unlimited physical bilateral trading in advance of the day ahead market would be more of a revolutionary than an evolutionary option.

If bilateral trades ahead of the day ahead market were restricted, this would raise questions about the value of explicit interconnector capacity rights if there was no complementary energy trading mechanism in the forwards market. However, PTRs with UIOSI or FTRs would provide a hedge against the capacity price in the day-ahead stage. Forwards could be

[37] The SEM will still need to provide for circumstances where a generator is dispatched away from their firm market position. This is best achieved through the retention of explicit payments for constraints and uninstructed imbalances. Hence the inclusion of an imperfections mechanism in the balancing timeframe

[38] Given the retention of central dispatch in all these options, generators will still be required to submit technical offer data and make their capacity available to the TSOs such that they can make a decision to dispatch the generators if so required.

[39] Products as submitted to the Market Operator need a minimum duration of 30 minutes and a maximum of 24 hours. These can be apportioned out in the settlement timelines.

solely financial, i.e., CfDs for energy and capacity (FTRs), leaving all physical trades to occur in the day-ahead and intraday timeframes.

The use of bilateral trades in this timeframe could be restricted by a number of means including limited bilateral trades to the holders of PTRs on the interconnectors.

Complex and Simple Bidding

Any move in the SEM away from the current system of complex three part bids to a simplified bidding structure that is compatible with the PCR algorithm and the Target Model will have implications in a number of areas:

- The uplift mechanism which recovers the start up and no load costs of generators. These would be internalised under a system of simple bids or dealt with through block bids or a minimum income condition as in in MIBEL.
- A review and potentially modifications will be required to the CPM to ensure that 'double payment' of fixed costs does not occur
- The monitoring of market power will need to be modified to reflect any change in the bidding rules and framework. A simplified bidding structure would be more difficult to monitor

These issues will need to be tackled as part of any High Level Design if one of the evolutionary options is progressed.

Day-ahead market

While this is called "couple on EA1", the timing will be in line with the current proposals for European day-ahead markets (i.e., gate closure at 11:00 UTC[40]). This is considered to be coupled on the EA1 because there would be no explicit running of the SEM in this option before the implicit auction at 11.00.

The trading day would run from 23.00 to 23.00 UTC. Products would be hourly.

Simple and sophisticated offers and bids would be submitted to the designated power exchange before 11.00.[41] Bids that are feasible would be transferred to the single European price coupler for inclusion. [42] The results, in the form of firm day ahead prices and quantities, would be issued back to the market operator[43]. Results will then be published from the market operator to the system operators and all participants who have participated.

[40] UTC: Coordinated Universal Time

[41] Currently the price coupling algorithm will be able to accept include price/quantity pairs, block bids and minimum income conditions. Three-part complex offers, as used in the SEM, will not be permissible.

[42] Offers and bids in the day-ahead and intraday timeframes must be feasible. This means that a generator with a notice time of 12 hours with an initial position of off cannot submit a bid to trade in the next trading hour. This will prevent firm quantities being awarded to generators in the day-ahead and intraday timeframes where the generator is clearly unable to meet these trades with the result that the system operators must find replacement energy with very short notice.

[43] Market operator and power exchange are used interchangeably in this section. The CACM provides that 'the function of a power exchange may also be performed by a pool operator'.

SEMO are currently applying for associate membership of the PCR and will be engaging with the PCR group on the inclusion in the algorithm design of forms of offers that retain as much of the complexity that is relevant to the SEM design[44].

A shipping agent would be required to give effect to all the trades coming out of the price coupled solution, since market participants in each jurisdiction have a relationship only with their local power exchange (see inset below). In the SEM, the shipping agent would take the place of the interconnector units and would settle imports and exports in the different markets.

The Shipping Agent

It is expected that a shipping agent will also be required in this process to ensure correct financial settlement of trades across different markets. Currently, interconnector units are shipping agents for individual trades between the SEM and GB. In the day-ahead and intraday timeframes, all trades will be coordinated via local market operators and therefore there is a need for a single shipping agent between markets to settle imports and exports to and from each market.

An export will be seen as a purchase of electricity from the SEM and will be settled by the market operator as a payment to a generator and a charge on the shipping agent. The shipping agent will equally be paid by the importing market operator in another market where the consumer of the electricity is charged.

An import will be seen as a purchase of electricity by the SEM and will be settled by the market operator as a payment to a generator and a charge on the shipping agent. The shipping agent will equally be paid by the importing market operator in another market where the consumer of the electricity is charged. It is common for TSOs or PXs (have we used this term before?) to fulfil this role.

Intraday timeframe

Once past the day-ahead timeframe, intraday trading opens. Again, this will be through submission of simple/sophisticated bids to the market operator on a continuous basis. Feasible orders will be collected and submitted to the shared order book function (SOBF) where, in conjunction with the capacity management module (CMM), purchases and sales will be matched. It is assumed that the shipping agent responsible for the cross border elements of trade will be a Participant in the SEM and will be included at this point. Hourly products would be traded.

It is not obvious how continuous intraday trading with short gate closures of an hour before real time begins can be compatible with the central commitment in the SEM.

One option is to allow the system operators to filter offers and bids for technical feasibility before passing them onto the shared order book function. The drawback of this is that they may reject bids not because of technical infeasibility but because of the cost consequences of having to unwind trades that come out of the continuous implicit coupling process.

[44] SEMO have taken steps with respect to the Price Coupling of Regions (PCR) initiative through their recent membership of Europex. The PCR has developed the preferred model for the coupling algorithm.

An alternative would be to require the system operators to counter-trade (i.e., unwind positions) in the event that firm trades across the interconnectors jeopardise their ability to maintain security of supply. It is difficult (if not impossible) to estimate what the costs of such counter-trading would be, since it would depend on a number of factors, including how much interconnector capacity was available for intraday trading, intraday market conditions in the region and how close to real time technically infeasible trades take place.

Balancing market

Contracted quantities from the forwards, day ahead and intraday markets would be considered market firm. In other words, all purchases by suppliers will be met by their own *ex post* demand. The physical delivery of quantities is provided by the system operator who will dispatch the system in real-time, taking note of the contracted quantities of generators but also of their own obligations with respect to managing the system.

To ensure quality information is available for the system operators in terms of formulating an economic dispatch of the system, generators will be required to submit complex commercial offers into the balancing market. These would include both incremental and decremental prices.

Gate closure for the balancing market could align with the gate closure for the bilateral trading arrangements, i.e., at 09.00 D-1. This will ensure that enough commercial data are available to the system operator with enough notification that they can determine a feasible operations schedule, taking account of notified contract positions as well as deviations in terms of actual system load and wind generation.

However, it is recognised that requiring generators to commit to commercial offers up to 45 hours ahead of real time, when trades can take place in the intraday at very different prices, could prove difficult. It is for consideration whether it would be possible for gates for balancing offers to be closer to real-time. This would allow for multiple sets of balancing offers. Gate closure of the balancing market could evolve over time and as required by the Framework Guidelines for Electricity Balancing currently being developed by ACER.

After their use by the system operators for real time dispatch, these offers will be used in the determination of the prices in the balancing market. Generators unable to meet their contracted positions due to other circumstances, such as a station trip, will be charged in the balancing market on the difference between their market positions and their actual delivery. The balancing price will be determined through a real-time market where the actual dispatch quantities are used to set balancing prices.

Final settlement in the SEM will be based on the results of the day-ahead, intraday and balancing markets. (Bilateral contracts will be settled between the counter parties to the trade outside the SEM.) Depending on the volume of trade settled in the bilateral market, this could see a marked reduction in the collateral requirements of the SEM.

Continuous implicit intraday trading

In the intraday timeframe, the SEM will be linked to other European markets on the basis of continuous implicit trading

This could be implemented in the SEM by creating a platform for participants to submit commercial orders in a format compatible with the European standard. This is assumed to follow the standard of the day-ahead market coupling orders (simple and sophisticated). It is also assumed that feasibility checks will also be applied to these orders to ensure that offers of physical flow can be met.

Submissions will be passed through to the Shared Order Book Function managed at a European level. In conjunction with the Capacity Management Module, this function will match all submissions making use of a single pan-European algorithm. This will take the form of matching energy sales orders (generation bids) to energy purchase orders (supplier offers), possibly on a first come first served basis. This matching will be done against trading blocks of a minimum of one hour; however, block bids covering multiple hours will also be considered. When bids are matched in the Shared Order Book function and this results in an allocation of cross border capacity between zones, the Capacity Management Module will recalculate the remaining available cross border capacity for trade.

The outputs of the Shared Order Book function will be a Contracted Quantity for a Participant (either a sale or a purchase) and a Contracted Price at which this trade takes place. Firm quantities will be returned to the local Market Operator and advised to the Participant and System Operator.

The framework guidelines allow for the retention of implicit auctions to run alongside the intraday arrangements where there is sufficient liquidity in these auctions. However, as cross border capacity can only be allocated after the day-ahead timeframe through the Capacity Management Module, it is not clear how implicit auctions will be able to allocate firm capacity flows though the framework guidelines do allow for explicit access to cross border capacity as a transitional step.

It is also uncertain how interconnector capacity that is implicitly traded outside auctions will be priced.

It is assumed that additional energy flows assigned in the intraday timeframe will be managed by a Shipping Agent carrying out the same function as in the day-ahead timeframe. It should also be noted that the framework guidelines expect intraday trade and capacity allocation to be coordinated by the System Operators through re-dispatch of the system or through countertrade mechanisms to be defined in the balancing network code.

The trading period

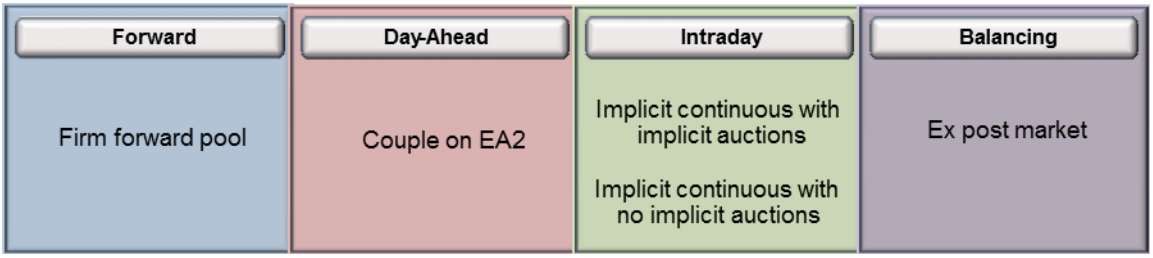
A significant open issue in terms of final settlement across all the market timeframes is the different trading periods: half hourly in the balancing market and hourly in the day ahead and intraday timeframes.

It is as yet not clear how constraints can be calculated where this is the difference between market positions and the dispatch position when the dispatch position is calculated on a half-hourly trading period, as is the balancing market, while the day-ahead and intraday markets are resolved on an hourly basis. It will be necessary to at some point to convert either the hourly values into half-hourly averages or aggregate the half-hourly values into hourly values. While the second option may look easier at first sight, it represents a more significant change from the current SEM trading arrangements for all marketplaces to settle at an hourly resolution rather than retaining the half-hour for internal trades.

Emerging developments across Europe with respect to frequency issues relating to the transition from one hour to the next and the consideration that these may be the result of firm trades at one hour resolution must also be taken into account. This may lead to European standards changing to a shorter trading period and, in this light, it would be unwise increase the SEM trading period at this time.

Option 2: Forward pool, day ahead market coupling on EA2, continuous intraday trading with implicit auctions, real time balancing market

This option comprises a pool market in the forwards timeframe, market coupling on EA2, intraday auctions with or without implicit auctions. The option can work with either of the proposed balancing market designs, although the pool model in the forwards timeframe would make it more suitable to the *ex post* balancing market with a pool price.



Forwards market

The design of the forward market will be a pool market which is referred to as the 'forward pool'. This will be a voluntary market. Participants will submit complex commercial and technical offers for their generation (including interconnector units and demand side units) in the same manner as under the current T&SC. Participants will also be able to submit purchase bids in respect of their suppliers. Suppliers will also be able to act as price takers and submit nominations which would be in respect of their own demand forecasts.

Submissions would need to be made to the market operator in advance of a defined gate closure. This would be expected to be in line with the current EA1 gate closure (i.e., 09.00 on D-1). However, to align with the earlier timelines for market coupling on EA2 (i.e., 11.00 D-1), changing these gates earlier than 09.00 D-1 might be necessary.

The forward pool would have the following features:

- it will resolve a schedule based on the marginal pricing principal using submitted data from suppliers to determine the schedule demand.

- quantities and prices that result from the EA1 run of the MSP software are firm for all generators and suppliers

- the design of the market schedule will be consistent with the current design, i.e., marginal pricing based on economic merit order with no modelling of system constraints

- generators will be scheduled to meet a forecast system load, which will be determined from supplier unit nominations or supplier side bidding.

To purchase energy in the forward pool, suppliers would be required to submit commercial bid data or price taker type nominations of their load profile. Commercial bid data for suppliers would be of the form of a simple purchase bid, made up of a single set of price/quantity pairs. While participation is voluntary, if suppliers do not actively participate or if they provide inefficient or incorrect forecasts of their consumption, they will then be exposed to prices in subsequent timeframes.

This could result in inefficient flows on the interconnectors. This is because without the active participation of suppliers, system load would be infeasibly low and the interconnector would be scheduled into export based on nominated renewable generation forecasts. Even without these, once interconnector export bids have been submitted, in merit generation will be scheduled on to meet exports at a given shadow price. With supplier participation, the forward pool market will clear when nominated and bid-in supplier load is matched against the generation curve.

On completion of the EA1 run, the market operator would publish firm quantities and prices for generation, load and interconnector units. The publication of firm forward prices should encourage more active demand side participation in the day-ahead and intraday markets as demand customers seek to amend their load profile to avail of better prices from the earlier markets rather than be exposed to balancing prices, which may be less beneficial. This results in generators and suppliers having firm market positions in advance of the first run of the European markets.

The firm price in the forward pool would be only the shadow price. It would not include uplift. Uplift is required to ensure that all generators recover their entire running costs when they run. So it would not be appropriate to calculate uplift until a full picture (i.e., *ex post*) is available of all generators who are in fact running. For example, there may be generators that are not be committed in the EA1 MSP run but may come on in a later timeframe.

While uplift will not make up a component of the price in the forward pool, it will be calculated after the completion of the balancing markets based on the total cost of running of generators across all timeframes. In this manner, settlement will be calculated separately for all participants based on their market quantities with an Uplift Price applied as a separate payment. In this manner, regardless of the market in which a participant has traded, they will still receive this.

An alternative option would be to have no uplift calculation and allow any start up and no load costs that are unrecovered at SMP to be remunerated through a make whole payments mechanism, as in PJM and other restructured markets in the US[45].

Day ahead market

Because EA1 is used as the forward pool, this option couples on EA2. This would be a voluntary market. Simple and sophisticated orders would be submitted to the market operator in advance of the 11.00 gate closure. Bids that are feasible would be transferred to the single European price coupler for inclusion. The results would be issued back to the market operator. Results would then be published from the market operator to the system operators and all participants who have been successful in the implicit auction. The interactions with the market coupler and the shipping agent would be the same here as with Option 1.

Intraday timeframe

Once past the day-ahead timeframe, trading opportunities are open via the intraday bidding. Again, this will be through submission of simple/sophisticated bids to the market operator. Feasible bids will be collected and submitted to the SOBF where, in conjunction with the CMM, purchases and sales will be matched on a continuous, first-come-first-served basis.

Because this Option allows for a voluntary forward pool, it could work more easily with intraday auctions than the bilateral contracts model. These intraday auctions could take the form of an incremental net pool providing an opportunity to suppliers and generators to refine their positions between the forward pool and day-ahead markets and the balancing market, without interfacing with the implicit market coupler at the European level. This provides levels of stability with respect to the design for participants in that:

- participants can refine their trade in a pool mechanism, retaining some of the core SEM design approaches
- trading days in the intraday auctions can still align with the existing SEM trading day
- participants will not be required to convert their complex bids into simple/sophisticated orders
- it retains existing design elements of the SEM;

However, it must be noted that once the day-ahead coupling is complete the Capacity Management Module coordinates available cross border energy flows in conjunction with the Shared Order Book Function. As a result, this means that there is no cross border capacity available to these intraday auctions. They would become auctions that are purely internal to the SEM.

[45] PJM refers to the wholesale electricity market in all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia and the District of Columbia.

Balancing timeframe

As with the other options, a set of complex commercial and technical offer data is required by a specified gate closure for the balancing market. The TSOs would make use of these additional incremental and decremental prices to balance the power system in real time.

As with Option 1, generators unable to meet their contracted positions due to other circumstances, such as a station trip, *would* be charged in the balancing market on the difference between their market positions and their actual delivery. The method by which this can be achieved is the same as in Option 1.

Because this design option retains a number of elements of the pool approach, this offers the option to use *ex post* pricing to determine the balancing price. This would be calculated with perfect hindsight rather than based on the real time dispatch costs (See box below). The intention here is that as the different markets build a running order based on the economic merits of the trading generators, using a pool option in the balancing timeframe should mean that the individual optimisations of each timeframe would result in a similar overall schedule to a single ex-post optimisation. This also retains elements of the current SEM design such as ex-post perfect hindsight. As such, it may have advantages in terms of transparency which may be missing in other options.

But this may lead to increased divergence between the market schedule (from the firm forward pool) and dispatch. For the system operator to meet obligations with respect to security of supply, it would not be prudent to base real time dispatch decisions on the forecasts from suppliers. So the current practice of producing indicative schedules based on TSO forecasts would continue.

However, once both the dispatch and the forward pool are scheduled on the principle of least cost production, it would be very likely that the final *ex post* schedule in the market would follow the same pattern of unit commitment as the dispatch schedule. Therefore, divergence between the two may be no worse than in the current design.

All markets *would* be settled *ex post* as part of the SEM. This *would* mean that collateral requirements *would* continue to be on the gross quantities of the combined markets that make up the SEM.

***Ex post* balancing market**

Ex post balancing prices can be achieved by retaining the existing *ex post* MSP run with some alterations:

MSP Demand calculation:

- The first pass of the MSP demand calculation sets the demand to be met equal to contracted demand from all the pre-real time markets;
- Residual MSP demand is then calculated based on delivered quantities calculated according to the rules set out in the current design;

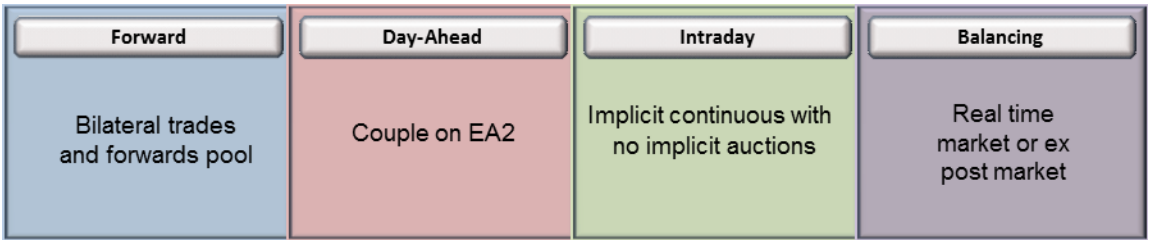
Treatment of Price Maker generators:

- Price Makers with Contracted Quantities from the earlier markets will have their Availability values set to their summed Contracted Quantities;
- This will mean the *ex post* MSQ will at least equal their Contracted Quantities while allowing these generators to be scheduled to a higher output if available and in merit;
- Equally, generators who have tripped or re-declared availability at short notice will have an *ex post* MSQ of zero or their lower delivered output. Each scenario will mean that this generator is exposed to the balancing prices for their imbalance quantities.
- Generators who are available will have their output increased/decreased based on their position in the merit order subject to the incremental and decremental bids as well as the load balance requirement in any given trading period.

This will be separate from settlement of Constraints and Uninstructed imbalances.

Option 3: Bilateral contracts <u>and</u> a forward pool, price couple on EA2, implicit continuous intraday trading without implicit auctions, a balancing market with real time pricing <u>or</u> *ex post* pricing

This option is made up of a bilateral trading market and a forward pool in the forward timeframe, market coupling on EA2, implicit continuous trading (with or without intraday auctions) and either of the proposed balancing market designs.



Forward Timeframe

This option combines elements of the first two options to provide participants with two opportunities to trade in advance of the day-ahead coupled market. This would be achieved by first having a set of bilateral trading arrangements suitably in advance of the day-ahead market. (The gate closure for submission of bilateral contract volumes would need to be at

D-2 to allow sufficient time for the running of a forward pool and coupling on EA2.) Both markets would be voluntary and substitutes rather than complements.

Participants could take part in the pool by submitting complex commercial and technical offer data into the forward pool; or they could enter into bilateral agreements. Once the gate for the bilateral market has passed, submitted firm contracted quantities would be imported into the forward pool. In resolving the forward pool, the market would exclude offered quantities from generators where these have already been met by bilateral contracts. The forward pool would assume that, if an amount of energy from a submitted bid stack is already contracted, it was the cheapest quantities that were contracted first.

Supplier values would be treated differently. Whereas the market would have visibility of the total availability of a generator from its technical data, it would have no visibility of the proposed off take of a supplier. Therefore, it would be assumed that when a supplier submits commercial offer data and/or nominations into the forward pool that this is in addition to any firm contracted quantities from the bilateral market.

The gate closure for the forward pool would be at D-1 in advance of the day-ahead market at 11:00.

Day-Ahead timeframe

Once the forward pool is cleared and results published, submissions to the day-ahead market would be reviewed in terms of feasibility. As with the other options, simple and sophisticated bids and offers would be collected by the market operator and, if feasible, passed to the central market coupler. Firm quantities and prices are returned and published to participants, including the shipping agent, and the system operators.

Complex commercial offer data would be received for the *ex post* market and would be used by the system operators to adjust the dispatch from the firm quantities resolved in the different marketplaces.

Intraday timeframe

After the completion of the day-ahead market, participants would be free to submit bids and offers into the intraday market. These are again assessed for feasibility in the same manner as in the other options.

The ability to integrate within day auctions into this option is dependent on the liquidity in the earlier pool. If trade moves to the bilateral contracts market, then there is little benefit to additional within-day auctions. As such, they are not considered appropriate with this option.

Balancing timeframe

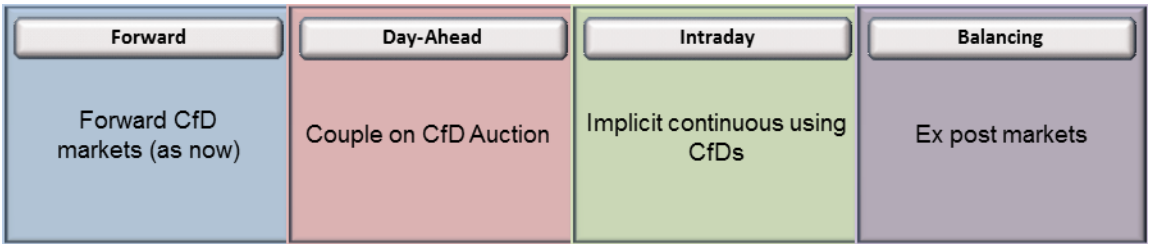
In the balancing timeframe, incremental and decremental quantities would be calculated as already set out in the other options.

Final settlement in the SEM would be based on the results of the forward pool, day-ahead, intraday and balancing markets. Bilateral trade arrangements would be settled between the counterparties to the trade outside the SEM.

The greater the volume of trade settled in the bilateral market, the larger the reduction in the collateral requirements of the SEM. Like option 2, because this option retains a number of elements of the pool approach, this offers the option to use *ex post* pricing to determine the balancing price rather than a real time market.

Option 4: Keep the SEM as is, couple on CfD auction day ahead and on CfDs intraday

This option uses an arrangement similar to the current contracts for difference trading to interface with the European systems. The intention here is retain SEM arrangements to a significant degree and overlay a financial cross border coupling arrangement at the day-ahead and intraday stages.



Market coupling was designed for, and works with, trading in physical products through a centralised power exchange, i.e., the auction of contracts which involve the physical delivery of energy in a specified hour on the trading day. But all energy bought and sold in the SEM has to be transacted through the SEM mandatory physical pool. It cannot be bought and sold twice over. Nonetheless, contracts are routinely struck outside the SEM by participants. But these are financial, not physical, contracts, in the form of two-way contracts-for-differences (CfDs), which essentially allow the generator and the supplier to hedge against *ex post* SMP.

As explained above, to achieve market coupling the auction format for day ahead auctions in the SEM would need to be amended to conform with PX physical auctions in other jurisdictions. This is not to say that it must be a physical power auction. A financial contracts auction performs essentially the same function as physical power auctions in Europe. It combines a 'strike price' and a price difference (hence contract for difference) between the strike price and the actual price which the generator (supplier) gets paid (pays) in the SEM (i.e., *ex post* SMP). The fundamentals of a multi-unit, double sided auction for hourly contracts are the same, whether it is a financial derivative or the underlying physical commodity itself that is being auctioned.

A financial auction of contracts for difference combined with physical *ex post* settlement in the SEM can be used to synthesise a purely physical day ahead auction of the sort that exists in the rest of Europe. The issue for CfD market coupling is whether a CfD daily auction in the SEM can operate using the standard PCR algorithm but as a financial rather than physical product and produce outputs that are respected by and compatible with the SEM pool arrangements.[46] If so, the main advantage of the option is that the SEM can stay largely as it is and compliance with the Network Codes can be achieved through auction of CfDs which are then made physical in the SEM.

[46] These are the key technical issues. Liquidity, governance and wider policy issues are considered below.

Forward timeframe

This option adds no explicit forward arrangements except for the current ones that exist in the SEM (explicit auctions of capacity across the interconnectors and trading forward CfDs). As is currently the case in the SEM, generators would submit offers into EA1. This would remain an indicative schedule with the exception that interconnector trades would be fixed at this stage, as in the current arrangements.

Day-ahead timeframe

Generators and suppliers would submit simple offers and bids before 11:00 for the coupled implicit auction. Participation would be voluntary. Bids and offers would be sent to and matched by the central coupler. The trading day would run from 23.00 – 23.00 UTC. Hourly products would be traded.

The prices and quantities returned by the coupler would be as in the other options. But in this case, buyers and sellers would enter into a CFD contract, which would be settled at the coupled (i.e., the strike) price, such that the CfDs bought and sold by participants in the implicit auction would be cashed out at the difference between the CfD day ahead auction strike price and the *ex post* SEM price (i.e. SMP), i.e., the reference price. Quantities would be firm (not subject to force majeure) and positions would be guaranteed via clearing (i.e., collaterals would held by the PX).

As in the previous options, a shipping agent would be responsible for settling the cross-border flow on each PX. So the shipping agent would have a physical position on, for example, a PX in GB and would balance this by flowing energy over the interconnectors and trading in the SEM as an interconnector user. The shipping agent would have a balanced position and would therefore be able to settle in relevant markets at reference prices and able to recover the marginal costs of cross border flows (e.g., technical losses on DC interconnectors, Balancing Services Use of System (BSUoS) charges in GB, capacity payments in the SEM).

The cross border flows determined in the coupled day ahead markets would need to flow in the *ex post* unconstrained schedule in the SEM. If they did not, the shipping agent would bear the commercial risk of mismatches/imbalances. This fixing of flows might be achieved in the same way that Modified Interconnector Unit Nominations (MIUNs) in the ex-ante market schedule are fixed in the *ex post* market schedule in the SEM or through treating the shipping agent as a (must run) price taker. This would be done in EA2, which would need to run after the results of the day ahead price coupled auction at 11.00 UTC.

Compensation mechanisms may or may not be required to protect market participants against volume risk between the day ahead and *ex post* SEM volumes.[47]

Intraday timeframe

In the intraday timeframe, continuous trading would occur via the same central counterparty. Bids and offers would be submitted by generators and suppliers on a continuous basis and these would be submitted by the central counterparty to the pan-European Shared Order Book Function. This function would continuously match offers and bids and matched trades

[47] See Pöyry 'Day Ahead Market Coupling Options for the SEM' Paper, February 2011.

would be sent back to the central counterparties in each zone to settle accordingly. These prices and quantities would be the strike prices of CfDs in a similar manner to those traded at the day-ahead stage.

Firm cross border flows from continuous trading would then need to get into the *ex post* SEM schedules. This might be done in a number of within day implicit auctions.

Balancing timeframe

In the balancing timeframe, *ex post* pricing would take place as it currently does in the SEM and the CfDs would be settled as they currently are outside of the SEM.

Issues to be considered

As with all the options set out in this section, there would be different trading days in each of the timeframes. For example, in the forward pool and balancing markets the trading day would continue to be 06.00 to 06.00, while in the day ahead and intraday timeframes, the trading day would be 23.00 to 23.00. This might cause problems.

For example, the outputs of EA1 and EA2 are relevant to a trading day that begins at 06.00 the following day; while the outputs of the day ahead implicit auction would be relevant to one that starts seven hours earlier, i.e., at 23.00 during a SEM trading day that has already begun. So outputs relating to the first seven hours of the market coupling auction (i.e., from 23.00 to 06.00 UTC) cannot affect the SEM, which was effectively fixed in EA2 the previous day or in WD1 earlier that day.

Unless a way can be found to incorporate the market coupling results from the market coupling auction both in the SEM trading day that is in progress as well as in the one to start the next day, the trading days in the SEM would have to align with that elsewhere in Europe, i.e., 23.00 to 23.00 UTC. This would have implications not only for gas-fired generators who may be happy with a trading day that coincides with the GB gas trading day; but also for the timings of EA1, EA2 and WD1.

A key advantage of the CFD option is that it retains the attractive features of the SEM while also allowing Ireland and Northern Ireland to comply with the European Target Model in the day ahead and intraday timeframes. To the extent that it has drawbacks, such as the difficulty of ensuring that continuous implicit intraday trades that are concluded close to real time are compatible with the requirements of the system operators for central dispatch, it is no different from the other options.

It is also worth noting that in the CfD option, the *ex post* market is the spot market and the CfDs are derivatives of the spot price. On the other hand, in the other pathways, the ex-post market features as a balancing market only and the intention of the design would incentivise trading in the earlier timeframes.

7.2 Preliminary Cost Estimates of Evolutionary Options

A comprehensive Cost Benefit Analysis was not possible given the time constraints present in developing this paper. This should be considered in the next phase of the development of the SEM options for compliance with the European Target Model. There are a number of elements that feed into the cost of designing a new market or alternatively making significant changes to the existing design. At a high level these include:

- Vendor design, software, hardware costs
- Regulatory Authorities' project costs
- TSO/MO project costs
- Market Participant costs
- Legal costs

The development of the SEM and launch of the market in 2007 is the most recent and relevant example to consider for cost analysis. The SEM total Market Operator costs were approximately **€54 million** to implement and of that vendor costs for the core market engine were approximately **€12 million**. Total implementation costs of the SEM regulatory and system operator costs and an estimate of market participants costs were about **€110 million**. This is illustrative in that it indicates quite clearly that the biggest cost in the market development are the creation of the processes and procedures, the legal arrangements and the resources required to deliver the project. Effectively there was a ratio of 1:4 of the market engine costs to the market operator implementation costs and 1:10 of market engine costs to total project costs.

For the options considered here SEMO/TSOs contacted three vendors, two of which covered the provision of the underlying market engine solution and one covering the delivery of a CFD and coupling option (Option 4 above). In order to understand the relative merits of each option a detailed costing of the entire cost of the market delivery would be required.

Two vendors provided a cost indication for the delivery of the required systems to deliver the market engine to support the options described. One vendor gave a range of **€6 to €12 million** depending on things such as the requirement to deliver a new trading day which is a relatively expensive change to the current systems. The second vendor estimated a cost of approximately **€6 million** for the delivery of a market engine based on the designs described. They presume that they do not have to design special interfaces for linkages to the European mechanisms; additional effort here would require additional cost. The second vendor also suggested ongoing support and maintenance costs of **€1.3 million per annum**.

The CFD option (coupled with the market engine changes) based on service provider costs and our understanding of the central systems costs that would be necessary, was estimated at approximately the lower end of the vendors' cost ranges of **€6.5 million.**

As mentioned above this market engine cost is only one element of the total cost of delivering a market solution and in the case of SEM it was approximately 25% of the cost of the overall market operator costs delivery which excludes other project and participant costs. Given the experienced gained in operating the SEM since 2007, competitive pressures and changed economic circumstances it is expected that these non market engine costs would

be substantially lower than vendors indicative estimates. Of course, any costs will be part of a cost benefit analyses of options being considered.

7.3 Initial Assessment of Evolutionary Options against SEM High Level Design Criteria

Table 5 below sets out how each of these four options score against the criteria used to determine the high level design for the SEM in 2005, namely:

- Transparency
- Risk management
- Price formation and liquidity
- Dispatch efficiency
- New entrants
- Renewables

Together with:

- Compliance with European Target Model

This sectioned has presented a number of means of evolving the SEM design to implement the internal market. The next section examines some options and issues arising for new market arrangements if the SEM arrangements were to be revoked and replaced.

Table 5: SEMO/TSO Initial Evaluation of Evolutionary Options

Criterion	Option 1	Option 2	Option 3	Option 4
Transparency	Low in the forward timeframe Medium in the day-ahead and intraday timeframe (owing to simplification of bids) Medium in the balancing timeframe. Decisions taken by the system operator in real time would be published	The forward pool would provide greater transparency of pricing over the bilateral contracts option. But the practicality of this is dependent on the volume of trade that passes through this market; Limited in day-ahead (due to simplification of bids) Low in intraday Visibility of inputs to ex post pricing; however, transparency really depends on the volume of trade in this timeframe	While transparency of pricing is low in the bilateral part of this design, the forward pool mechanism would provide greater transparency of pricing. Again, the practicality of this is dependent on the volume of trade that passes through this market Limited in day-ahead (due to simplification of bids) Low in intraday Visibility of inputs to ex post pricing; however, transparency really depends on the volume of trade in this timeframe	Medium. Retains mandatory nature of gross pool Depends on how much information from CfD process is visible to other market participants. The liquidity of the day-ahead and intraday CfD markets is important here
Risk management	Participants seeking long-term contracts would need a liquid day ahead spot market for reference prices. This would take time to evolve in this option. This depends on limitation on bilateral trades and choice of	As this is closer to the centralised model, participants are open to greater risk due to volatility of market price. However, as with current arrangements, a CfD market	The inclusion of both options in the forward timeframe gives greater opportunity to participants to manage the risk of price volatility in the ex post market.	Medium. On the other hand, participants will be exposed to volume risk to the extent that their ex-post quantity is different to their CfD quantity. The liquidity of the day-

Criterion	Option 1	Option 2	Option 3	Option 4
	PTRs and FTRs.	would allow participants to hedge positions against these price issues.	A CfD market would still be needed to allow participants to hedge positions against these price issues if the Forward Pool is selected as the trading platform.	ahead and intraday CfD markets is important here
Price formation and liquidity	The bilateral component of this pathway would need to be limited to avoid a wholesale move to a bilateral market.	SEM price formation exists in the forward and ex-post timeframes but liquidity depends on participation.	SEM price formation exists in the forward and ex post timeframes but liquidity depends on participation.	Low. As all physical trading will be concentrated in EP2, the price would be reflective of the marginal cost of producing energy on the day with perfect hindsight. It is likely however that the CfD price may be considerably different than the SMP for the following reason. Any generator that has variable or unreliable output will not want to play in the CfD markets. This is because they cannot guarantee their output to back their financial contracts. In addition, the large and increasing amount of priority dispatch is guaranteed (insofar as is possible) their quantity in EP2 as prices takers. So they will not be likely to trade in the

Criterion	Option 1	Option 2	Option 3	Option 4
				earlier stages as it is of no value to them (except if they were going to be curtailed). As such the day-ahead schedule may look very different than the ex-post schedule. So long as the ex-post schedule exists, priority dispatch units will not be inclined to take volume risk ex-ante. It may be possible to force them into the schedules by socialising their volume risk through constraints
Dispatch efficiency	Market forces should drive an efficient dispatch in that lower cost generators should be contracted before more expensive ones However, because there is no transparency of pricing in the bilateral market and there is a distinct possibility that much of the trade could move to this timeframe, the ability of this design to produce a least cost dispatch is debatable (though limiting bilateral trade to holders	Basing the forward pool on complex commercial and technical data should provide greater efficiency in dispatch with generators being brought on in the forward and ex post markets according to their position in the merit order. As with any design option, the offer structures for the day-ahead and intraday markets carry a risk of increasing inefficiency in dispatch; however, the ability of the	Basing the forward pool on complex commercial and technical data should provide greater efficiency in dispatch with generators being brought on in the forward and ex post markets according to their position in the merit order. As with any design option, the offer structures for the day-ahead and intraday markets carry a risk of increasing inefficiency in dispatch; however, the ability of the	Low. Interconnector flows day ahead and intraday may not be reflective of ex post prices as the wind and other priority dispatch generators would only want to play in the ex post market. All technical and most commercial offer data would be available to the SOs by 9:00am to enable them to carry out operational scheduling;

Criterion	Option 1	Option 2	Option 3	Option 4
	of PTRs would largely mitigate this point). The degree of competition would be important.	dispatch to reflect the simplified trades within the short timeframes allowed in intraday may mean dispatch would have to occur based on complex bids into the balancing market. This should be reflected in an economically efficient dispatch but would likely result in divergence from the market contracted quantities.	dispatch to reflect the simplified trades within the short timeframes allowed in intraday may mean dispatch would have to occur based on complex bids into the balancing market. This should be reflected in an economically efficient dispatch but would likely result in divergence from the market contracted quantities.	however, MIUNs would be governed by incomplete market information.
New entrants	While new entrants would have access to four marketplaces in which to trade. If most trade moves to the bilateral timeframe this would mean that new entrants would need long term contracts established before joining the market. Otherwise they would potentially be exposed to the ex post market prices or dependent on being successfully able to trade on the day-ahead and intraday markets with counter-parties outside of the SEM.	Access to pool markets such as the forward pool would increase opportunities for new entrants to join the market without the need of pre-existing contracts with buyers/sellers. As such, this would minimise potential barriers to new entrants.	Access to pool markets such as the forward pool would increase opportunities for new entrants to join the market without the need of pre-existing contracts with buyers/sellers. As such, this would minimise potential barriers to new entrants .	High. Pool mechanism is attractive to new entrants. Transparency of CfD trading would be important here.

Criterion	Option 1	Option 2	Option 3	Option 4
Renewables	Renewable generators in a bilateral contracts market are likely to be contracted by suppliers at prices that may be below the market average. This is because, with no fuel costs, they are reliant on market prices set by other generators but also because with unpredictable output, long term fixed contracts would be attractive in this market design rather than trading on the day-ahead or intraday markets. While the proximity to real time may provide the benefit of better forecasts, there is increased risk on generators with regards to the firmness of any volumes allocated in these markets.	The pool option means that market prices are fully available to renewable generators and they can access these without being limited in bilateral contracts. This design affords four trading opportunities for generators which are open to renewable and non-renewable generators alike. Therefore, a renewable generator can opt to trade in the forward pool through submission of a nomination and be scheduled at that price. Any variance between forecasts and actual delivery must be settled in the balancing market. Alternatively, a generator without capability of forecasting efficiently can simply allow their entire output be settled in the balancing market at the balancing price. Support scheme payments should ensure sufficient compensation where the balancing price has been detrimental.	The pool option means that market prices are fully available to renewable generators and they can access these without being limited in bilateral contracts. This design affords four trading opportunities for generators which are open to renewable and non-renewable generators alike. Therefore, a renewable generator can opt to trade in the forward pool through submission of a nomination and be scheduled at that price. Any variance between forecasts and actual delivery must be settled in the balancing market. Alternatively, a generator without capability of forecasting efficiently can simply allow their entire output be settled in the balancing market at the balancing price. Support scheme payments should ensure sufficient compensation where the balancing price has been detrimental.	Good/Medium. As priority dispatch would guarantee the available renewables their full quantity in the ex post schedule, they would not be subject volume risk and their price risk is likely to be mitigated by long term contracts such as ReFIT or through ROCs.

Criterion	Option 1	Option 2	Option 3	Option 4
Compliance	To be determined	To be determined	To be determined	To be determined

Section 7 Consultation Questions:

1. Do you support any of the above evolutionary options for the SEM?
2. Are there any other options that you think would better meet the objectives?
3. Are these options, in your opinion, consistent with the Target Model?
4. Are these options presented in sufficient detail for a high level design decision to be made?
5. Do you agree with the assessment made above by SEMO and how do the above options measure up against the assessment criteria set out in Section 10?
6. Should a pilot project be set up to explore the possibility of Option 4 (CFD) by end 2012?

8 Replacing the SEM: a 'Clean Slate'

This section looks at how the design of a new wholesale electricity market in Ireland and Northern Ireland might be chosen using a 'top-down' approach. In other words, rather than start with the SEM as it is and see how it might be changed in an incremental way to implement the European Target model, this section considers how a suitable replacement design for the SEM might be arrived at by starting with a 'clean slate'.

It first considers the key attributes of the two classifications of market design, centralised and decentralised, and how these measure up against the SEM Committee's Assessment Criteria set out in Section 6. It then goes on to consider the option of further integration between the market arrangements in Ireland/Northern Ireland and the wholesale market in Great Britain. Given that the current GB market (BETTA) must also implement the Target Model, it is also useful to consider other market design options along the spectrum of market designs set out in Table 1 in Section 6. Nord Pool and the Iberian market (MIBEL) are described in Annex 1. The section also looks at the potential costs of replacing the SEM as opposed to developing it as outlined in the previous section.

Clearly, as discussed earlier in the paper, replacing the SEM arrangements in their entirety is a matter for Member States on the recommendation of the SEM Committee and also involving other FUI Member States and regulatory authorities (i.e. Ofgem) where appropriate. Any legislative changes and new cross border institutional frameworks required would need to be agreed, firstly by governments and secondly between relevant regulatory authorities. As such, the below options presented are for illustrative purposes only at present.

8.1 The Choice of Market Design

The market for the physical trading of energy represents the central feature of any wholesale electricity market. Over time, different countries have developed a variety of market models with different features. However, despite these differences in detail, all markets can be grouped into two basic market models, namely (centralised) pools; and (decentralised) bilateral contracts markets.

Centralised pools versus bilateral contracts markets The bilateral contracts market model emphasises direct transactions between buyers and sellers. All market participants are free to engage in any type of contractual obligations for the physical delivery of energy, which then provide the basis for the self-commitment of generators. As a result, a bilateral contracts market allows all market participants to act as traders which may both buy and sell energy from/to any other party in the bilateral contracts market.

In pool markets, the emphasis is on the need for tight coordination of the electricity system to ensure efficiency, feasibility and reliability on the grounds that feasible flows of electricity may not easily be achieved by bilateral transactions. So, in this model, all energy has to be sold to and bought from the pool; and this is achieved by the centralised commitment of all generation units through the pool and the requirement that all suppliers must purchase their entire load from the pool.[48]

[48] Subject to *de minimis* exceptions.

When differentiating between these two basic models, it helps to consider four main design choices:

- Central or self-commitment
- Gross or net pools
- Unit or portfolio-based markets
- Participation of load

Central or self-commitment[49]

The key difference between the pool and bilateral contracts market models relates to the choice of either central or self-commitment.

Unlike other commodities, electricity has a number of technical constraints which must be met to ensure that the system can be run securely and reliably. These include the fact that electricity cannot be stored; that the use of the transmission system for the injection and withdrawal of energy must be coordinated; and that generating units are subject to technical constraints. These technical constraints include the time it takes to start up and shut down and the rate at which they can adjust their output. These physical realities have given rise to a debate about whether competitive pressures in a bilateral contracts market can lead to efficiency and reliability of the system; or whether a centrally managed system is better at achieving those objectives.

In the pool model, such as the SEM, the final dispatch schedule of all producers is centrally committed by the system based on mandatory participation in the pool. The system/market operator decides both on the half-hourly schedule of each unit and the price to be paid for energy, calculated using a central algorithm. The calculation of an efficient dispatch schedule market is critically dependent on the system operator receiving detailed and accurate information from generators, on both their technical characteristics as well as commercial offer data on start-up and no load costs and a number of monotonically increasing price quantity pairs. These are typically submitted once a day to apply during the following trading day.

Dispatch schedules are then derived by the system operator by optimising unit commitment and generation to meet the forecast system demand at the lowest cost optimised over the given horizon period, which can be a relatively long time (30 hours in the SEM). The timescale over which the system is optimised has to be relatively long to ensure that inter-temporal constraints are met and hence that feasible generation schedules are attained. This optimisation respects transmission constraints as well as the technical and commercial offer data submitted by the generators.

Gate closure marks the point prior to dispatch when participants can no longer change their offers to generate or consume electricity. In the central commitment model, gate closure needs to be sufficiently far in advance of the beginning of the trading day to allow sufficient

[49] Unit commitment is the process of identifying the optimal combination of units to be on-load over a given time frame, usually a day or a week. Least cost dispatch is the process of identifying the optimal combination of on-load units to meet demand in the half-hour. Scheduling is generally taken to mean both unit commitment and dispatch, although it is sometimes used interchangeably with unit commitment.

time for the determination of dispatch instructions, and possibly prices, and for the system operation functions to be carried out where a single price setting and dispatch algorithm is used.

The market price is generally determined *ex-post* (i.e., after real-time for each trading period) in the central commitment model. This has the advantage that the market price accurately represents the actual system demand and plant availability during each trading period.

By contrast, the bilateral contracts market allows for self-commitment, where each generator may freely decide on the generation schedule of each of its generating units. All participants are considered available for dispatch, based upon the offers that they make for the relevant dispatch interval. The generators themselves are responsible for the commitment of their generating units and signal this through their offers, which include only one-part energy offers (i.e., price-quantity pairs).[50] Self-commitment provides participants (both generation and load) with multiple opportunities before real time to refine their offers and bids with the aim of achieving their preferred operating schedule in real time.[51] Ultimately the System Operator still dispatches the units but to their nominated schedule. However the System Operator then has ancillary services and a balancing market where they can take actions to ensure system security,

To the extent that demand side bidding is allowed, demand participants may submit offers to reduce load. These offers will also consist of a number of price-quantity pairs that the participant is willing to accept for reducing demand.

The frequency of offers is a function of the dispatch and trading period. If prices are calculated on a daily basis, as they are in the central commitment model, then there is no need for offers to be submitted more frequently. However, prices in a self-commitment market would generally be calculated at least hourly and most probably every half-hour, requiring the ability on the part of generators frequently to change their offers. The frequency of offers coupled with an indicative pre-dispatch schedule will provide generators with sufficient feedback to adjust their offers to arrive at a feasible operating schedule. Typically self-commitment markets have short gate closure times (e.g., an hour ahead of real time, as in GB) so that participants can change their offers as close as possible to real time to achieve their desired dispatch.

Generation units are dispatched by the system operator in real time to meet the system demand in each trading period, respecting transmission constraints and static loss factors at the lowest cost, based on generator offers. The trading intervals do not take account of one another, apart from the constraint that movements in generator output from one period to another cannot exceed certain technical characteristics, e.g., unit ramp rates.

The pricing in the self-commitment market can be *ex-ante*, i.e., the price is set prior to the trading period but after gate closure. The *ex-ante* price would be based on a projection of system demand during the trading period and be set as close as possible to when the dispatch schedule is issued. It would be a single price that is set by the price of the marginal unit on an unconstrained basis.

[50] There will be a record of some limited technical information relating to each generator and this will be used to ensure that the submitted price quantity offers are technically feasible for each plant or unit.

[51] This is why bilateral contracts markets generally have either continuous trading (as in GB) or a combination of a day ahead market and continuous intraday trading (as in Nord Pool).

To maintain system security it may be necessary for the system operator to dispatch units that are not in this simple stack and not dispatch units that are in this simple stack. Where this arises the issue of constrained on and constrained off payments arises.

Gross or net pools

In this context, it is important to note that pool markets can be further differentiated into gross pools and net pools.

In a gross pool, such as the SEM, the entire output of each generating unit is determined by the market operator, i.e. the generator has no direct influence on the schedule. Gross pools are usually applied to wholesale trading markets such as the SEM with central commitment.[52]

By contrast, a net pool allows the generator to determine at the very least an initial production schedule, which then provides the basis for offering any modifications to this initial schedule into the centralised market. As a result net pools are more typical for the design of balancing mechanisms in bilateral contracts markets.

Unit or portfolio based markets

In practice, most gross pools are based on unit-based offers, i.e. generators have to submit separate offers for each individual generating unit, as in the SEM. To solve the market whilst ensuring the technical feasibility of the resulting schedule, gross pool markets typically also take account of a number of detailed technical characteristics of each unit, which results in considerably increased mathematical complexity. The SEM is a good example of a gross pool in this context.

Bilateral trading, on the other hand, considers energy as a commodity, whilst all technical unit constraints have to be managed by the generator itself. By definition, bilateral contracts markets are therefore based on portfolios of plant. Net pools (i.e., balancing markets such as BETTA) may also be based on either unit or portfolio offers and bids.

Participation of load

In most pools price and quantity offers are submitted only by price-setting generators and the market is subsequently cleared at the day ahead stage on the basis of a centrally provided forecast of load and of intermittent generation. The participation of load is normally allowed, and indeed actively encouraged, in bilateral contracts markets, where the market is cleared on the combined supply and demand curves from generation and load.

[52] This is inevitably a simplification. In some pools, generators are allowed to nominate bilateral contracts when submitting their offers to the market operator. For example, in Italy market participants notify bilateral contracts when submitting their daily bids and offers to the pool. All bilateral contracts receive priority dispatch, which is then taken into account during market clearing. Unless a transmission constraint is violated, these priorities ensure that the market system first satisfies the bilateral transactions and only then accepts other generation offers. In PJM in the US, market participants may self-schedule their units and submit offers only for modifications to this based schedule. However, this is only possible for generation and load at the same nodes, or where market participants have sufficient transmission rights between different nodes in the system.

Intra-day trading

Most wholesale markets, whether central commitment pools or self-commitment bilateral contracts, have a central mechanism (typically operating one day ahead of the trading day) where the great majority of power has been traded by the time that the market closes.

In pools this is organised by the system operator/market operator. In bilateral contracts market, participants can usually trade both customised contracts over-the-counter market and standardised contracts on a power exchange before nominating these matched trades to the system/market operator at gate closure.

However, forecast real time demand and anticipated plant availability inevitably deviate from the day-ahead schedule. To cope with this, markets have developed arrangements based either on a series of intra-day auctions or on continuous trading up until a short period before real time begins. These markets are designed to allow participants to adjust their contractual positions derived in earlier markets, and hence to ensure that their contractual commitments are compatible with the latest forecast of demand and individual generating unit technical characteristics.[53]

Balancing mechanisms

Whatever the design of the day-ahead or intraday markets, it will always be necessary to put in place arrangements to allow the system operator to adjust the final generation schedule in real time.

In the case of most pools, balancing is simply performed through a real-time adjustment of generation schedules, which is based on the same offers as originally submitted for the day-ahead market. This approach is essentially that used in the SEM. In some pools, in Spain for example, generators submit separate bids and offers to increase or decrease the amount of generation, relative to the agreed schedule of their generating units.

In the case of virtually all bilateral contracts markets, separate balancing mechanisms have been introduced to give the system operator the necessary flexibility. These balancing mechanisms often take the form of net pools. In these cases, generators offer their available generation capacities (net of contracted quantities) for balancing purposes, i.e. either upward or downward, at the latest at the time of final gate closure.

8.2 Assessment

From this brief discussion, it is clear that there are a number of design choices that can be taken under the two basic market models. Moreover, these choices are not necessarily mutually exclusive. It is possible that the same wholesale market may combine several of the options explained above. For example, it is quite common that a self-commitment bilateral contracts market is combined with a centrally dispatched net pool for the purposes of real time balancing. Nonetheless, the basic choice for the day ahead and intraday

[53] In Nord Pool there is a continuous intraday market (Elbas) operating on a first-come-first-served basis that allows participants to adjust positions previously notified in the day ahead spot market (Elspot). In the Spanish market, generators can adjust their day ahead scheduled quantities through six discrete 'adjustment markets' between the initial day-ahead market and real time operations. The market operator OMIE in Spain has plans to extend the number of intraday auctions from six to eight.

wholesale electricity market is between a self-scheduled bilateral contracts market on the one hand and a centrally scheduled gross pool on the other.

Section 9 below discusses the criteria against which this choice might be assessed. This section briefly assesses these two basic models against those criteria.

Security of Supply

Security of supply can be addressed under two time-frames: the short-term, when adequate volumes of the existing portfolio of generation plant must be made available to meet demand at any given time (reliability); and the long-term, when adequate generation capacity must be available to meet peak demand on a year-to-year basis (adequacy).

Short term

In a self-commitment bilateral contracts market, where nominations by generators lead to under or over nominations, the system operator can issue dispatch instructions on the basis of generator offer prices to maintain system stability in real time. The market model also allows generators to achieve a feasible schedule through a number of iterative bidding rounds. However, there are concerns relating to its operation in a small system like the SEM, with large amounts of interconnection relative to peak demand. These include that in the event that iterative bidding rounds do not converge on a feasible solution, the system operator has little or no time to re-dispatch units to ensure feasibility given the short gate-closure times inherent in a self-commitment market.

The centralised gross pool market generally requires the system to be dispatched in a manner that is reflective of the underlying supply/demand balance. The relatively long gate closures seen in centrally committed gross pools provide the system operator with a greater flexibility to ensure that the system is dispatched in a secure manner. This may, however, came at the cost of economic efficiency in the short term.

Longer term

In the longer-term, lack of price transparency in a bilateral contracts market can pose a problem for new entrants and act as a barrier to entry. In addition, a small net pool of balancing energy may similarly pose problems for new entrants and for intermittent generation such as wind as it may provide very volatile balancing prices which increases risk.

By contrast, a centralised gross pool offers new entrants a better opportunity to buy and sell their energy at transparent market prices by making it easier to evaluate investment opportunities. This should facilitate new entrants including intermittent generation.

Capacity adequacy can be encouraged in the longer term with the addition of a capacity payments mechanism in either a centrally committed gross pool or a self-committed bilateral contracts market, though it is fair to say that the bilateral contracts markets seen in Europe tend to be energy-only markets where generators fixed costs are internalised and recovered

through the energy price.[54] Spain is an exception as it combines a centrally committed pool with fixed capacity payments for generators.

Dispatch Efficiency

The clear advantage of having a system operator make unit commitment decisions is that a centralised market will, at least in theory, find the most efficient commitment and dispatch of generating units. However, this is critically dependent both on the system operator having accurate pricing and technical information on which to base its unit commitment and dispatch decisions and on the accuracy of the central algorithm it uses to generate a schedule. If the Lagrangian Relaxation algorithm is used to solve the unit commitment, the solution is by its very nature inexact and can yield different near-optimal solutions with the same total commitment costs but with very different payoffs to individual generators[55]. This can give rise to an incentive compatibility problem. The outcome of the scheduling process, both in terms of quantities and system marginal prices, is such that generators would, given the three-part offers submitted, have preferred a different outcome.[56]

Self-commitment markets avoid these incentive compatibility problems since generators must internalise their operating constraints while minimising production costs. Indeed, the self-commitment market is based on the premise that generating participants are best placed to make decisions about the commercial operation of their plant.

Generators acting independently of each other, as required in a bilateral contracts market, may not be able to find the most efficient commitment and dispatch of units. This is partly because the nature of the technical constraints affecting generating units mean that there are efficiencies to be gained from co-ordination amongst generators and partly because the internalisation of fixed costs such as start-up and no load costs into one-part energy offers is necessarily imprecise. Self-commitment markets may, for these reasons, find it more difficult than a central commitment market to find a feasible solution.

Environment and renewables

It is received wisdom that bilateral contracts markets, which have inherently volatile balancing prices, discriminate against intermittent generation sources such as wind, by comparison with central commitment gross pools with *ex post* pricing. This is not because of the intermittent nature of their generation, but because outputs are not predictable close to real time.

While there are ways in which the risk of being in imbalance in a bilateral contracts market can be diversified, e.g., by contracting with thermal generators or by aggregating intermittent

[54] This shows signs of changing. The British government has published proposals to introduce capacity payments in the GB market. And there are suggestions that the authorities in Germany are also considering introducing incentives to build new capacity in the German wholesale market.

[55] Using Mixed Integer Programming (MIP), if allowed to solve to complete optimality does not have this problem. MIP runs can, however, take a long time to reach the optimal solution, which may be a drawback where quick solutions are required.

[56] The simplest version of the economic dispatch model produces a well-defined solution in the form of prices determined by the intersection of the supply (i.e., short run marginal cost) curve and the demand curve. These marginal cost prices are said to support the equilibrium solution in the sense that - at these prices - generators would have no incentive to change their bids and would have an incentive to follow dispatch instructions, i.e., prices set equal to short run marginal costs are 'incentive compatible.' However, the simple model ignores the discrete nature of unit commitment and the existence of fixed costs such as start-up and no load costs. This means that uniform market prices set equal to short run marginal costs will not be incentive compatible and will not support the quantities determined in economic dispatch. While uplift (or make whole) payments will ensue that generators are not out-of-pocket, they cannot in themselves resolve the incentive incompatibility of the dispatch schedule.

generation across areas with less than perfect wind correlations, it is acknowledged that these may still leave intermittent generation worse off in a bilateral contracts market than in a pool[57].

Internal market

As explained in Section 5, the European Target Model that lies behind the CACM Framework Guidelines and which will be embodied in the Network Codes are essentially as follows.

Day ahead

At the day ahead stage, markets will be integrated (or coupled) using implicit auctions, which will allow market participants to benefit automatically from cross-border exchanges. This will remove the need to explicitly acquire the corresponding cross-border transmission capacity. The implicit auction methodology has been chosen as the Target Model broadly to reflect the predominant European market design, which is the self-commitment bilateral contracts market.[58]

Intraday

The Target Model for cross border intraday trading will be continuous implicit trading. This means that, market participants will be able to trade energy and cross border transmission capacity implicitly on a continuous basis (rather than in discrete auctions). This can only occur once the day ahead market closes and until final gate closure. While quite how this will work in practice has yet to be worked out, it is clear that a central commitment pool market will have difficulty accommodating any form of continuous bilateral trading due to its requirement to solve the unit commitment algorithm and dispatch schedule in advance based on complex offers submitted by generators. In particular, difficulties may arise the closer to real time such trading is allowed to occur.[5960] Meeting the objective of compliance with the Target Model would therefore argue decisively in favour of a self-commitment bilateral contracts market for the SEM.

Competition

It is generally considered that central commitment markets are more favourable to competition and the entrance of new participants than self-commitment markets. This is particularly so in illiquid markets with few participants because of the difficulty that independents may face in finding counterparties to buy and sell energy from and to.

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[57] For more on the relative merits of the two market designs in accommodating intermittent generation see, for example:
- *Reforming Competitive Electricity Markets to Meet Environmental Targets,* David Newbery (August 2011),
- *Balancing and Intraday Market Design: Options for Wind Integration ,* Frieder Borggrefe and Karsten Neuhoff, DIW Berlin (2011)
- *Adequate intraday market design to enable the integration of wind energy into the European power systems,* Weber, C., Energy Policy, Volume 38, Issue 7, pp. 3153-3163, (July 2010)

[58] Spain, Portugal, Italy and Ireland are the main exceptions. Each have either gross or net pools

[59] A critical requirement of the Network Code is likely to be a harmonised rolling gate closure of one hour ahead of real time. So intraday trading would take place continuously from when the implicit day ahead auction results are known at some point shortly after 12 noon CET until one hour ahead of real time beginning at 23.00 CET.

[60] The Iberian market is a central commitment pool market. The Iberian authorities are intending to retain their six intraday auctions for internal trading purposes while simultaneously allowing continuous intraday trading across the interconnectors with France. It remains to be seen if this can be achieved.

By contrast a centralised pool market gives all generator and supply companies access to a market for energy, even if there is still likely to be an incentive to strike financial contracts to hedge participants given a volatile market price. The published pool price in a central commitment market gives potential new entrants a strong indication of the prices that are likely to prevail in the market. Price transparency also gives existing participants a basis on which to negotiate efficient hedge contracts. The lack of price transparency in a bilateral contracts market and its likely illiquidity in a small market like the SEM would by comparison create greater barriers to entry.

Furthermore, experience in some markets, such as that in GB, suggests that vertical integration of generation and supply continues to be a powerful means of risk diversification in electricity markets and that incentives to integrate vertically may be more powerful in a bilateral contracts market than in a pool. In a small market such as the SEM, the minimum economic size of an integrated generation/supply company may be such that there would not be room for more than one or two such entities. If that proved to be the case, it suggests that a bilateral contracts market would score less highly than a pool market in terms of fostering competition.

Finally, in the presence of market power, the ability to monitor behaviour and to put in place effective mitigation strategies is likely to be more effective in a central commitment pool market than in a bilateral contracts market. This is due to the transparency of market prices and the requirement to make auditable three part offers.

Adaptability and stability

Adaptability refers to the ability of the trading rules to adapt through time as circumstances change. This is a question of the detailed governance arrangements. There is no suggestion that one market design is better than another in this respect.

It is likely that both central and self-commitment markets will result in significant price variability, which in itself is required for the proper functioning of the market, so long as market participants can predict and model such variability. However, it is more difficult to predict price variability in a self-commitment market due to a lack of price transparency.

Practicality

The cost of participating in either type of market may depend on the frequency with which generating schedules are produced or offers are submitted. Therefore both markets present practical challenges.

Equity

For a market to be equitable it should present the same set of challenges to all participants. In reality the market model on its own is unlikely to be the only factor determining equity: the characteristics of the participant will also have a significant bearing. However to the degree that the market model has some bearing on equity, one of the key features of market design is market access.

A self-commitment bilateral contracts market poses a greater challenge as it requires participants to have in place physical contracts with buyers/sellers, whereas a centrally

committed gross pool market guarantees participants the opportunity to sell/buy from a single source.

8.3 Integration with the Market in Great Britain

Since the SEM is physically interconnected with only one other electricity market ,that in Britain, an obvious top-down option is either to adopt wholesale the trading arrangements in GB or, more radically, for the SEM formally to join the British Electricity Trading and Transmission Arrangements (BETTA). This section looks at these two options. It concludes that each would have its advantages and disadvantages and that the more radical of the two would have legal, practical and economic problems[61].

The "expanding BETTA option" would potentially entail oblige all SEM market participants to become parties to the Balancing and Settlement Code (BSC).[62] The current trading and ancillary services arrangements in GB may then apply across both islands taking into account the needs of the separate synchronous systems. Market participants from the island of Ireland would be able to trade bilaterally, or via power exchanges with market participants in GB. Zonal prices could be implemented between GB and the island of Ireland.

This option could also require a review of the system and market operation arrangements across the islands and may mean that the island of Ireland and Great Britain system would be operated by a single system operator.

An alternative, the "BETTA Equivalent option", would potentially entail putting in place essentially identical market arrangements to those in GB on the island of Ireland. This would involve Ireland and Northern Ireland adopting the self-commitment bilateral contracts market structure that is currently in place in GB, as described in Annex 1.

The replacement for the SEM would have its own BSC with the same principles and high level design. In this case the SEM could be said to be "twinned" with BETTA. The connection between the two markets would take place through

- forward/futures contracts (contingent on interconnector capacity bought forward in explicit auctions).
- market coupling at the day ahead stage (using the power exchanges in GB or a designated power exchange in Ireland/Northern Ireland)
- continuous intraday trading across the Moyle and EW interconnectors (again using a shared order book function supplied by the PXs in GB).

Market participants from the island of Ireland would also be able to trade physical bilateral forward contracts within the local market.

. Whereas the "Expanding BETTA option" would allow long term hedging and trading transactions across the Moyle and East West Interconnectors, the BETTA equivalent option would align the two markets only at the day ahead, intraday and balancing stages.

[61] A more radical option again would be to form a new all-islands market between GB, Ireland and Northern Ireland that meets all the requirements of the Target Model.

[62] Subject to completing the application forms, any person may become a party to the BSC by acceding to the Framework Agreement. Prior to accession, they need to pay an application fee and provide certain party details, including whether they hold any Licences.

For the “Expanding BETTA option”, institutions in GB (including the UK Government, Ofgem, National Grid and Elexon) would have to be persuaded of the merits of the integration between SEM and BETTA, whereas in the “BETTA Equivalent” Option, the NI and ROI governments would have the autonomy to implement.

Benefits

The rational for these proposals are:

- Currently the Regulatory Authorities from both jurisdictions are considering options to either evolve or redesign the SEM to make it feasible to integrate the SEM with neighbouring markets. If harmonised trading arrangements across Ireland and GB were in place, the SEM would be much closer to a market design that is compatible with the European Target Model. This is subject to the important caveat that BETTA, in its current form, has some not insignificant disparities with the Target Model which need to be addressed.

- Currently prices in BETTA are typically lower than in the SEM. Closer integration should lead to an increase in volumes traded across the Moyle and EW interconnectors and harmonisation of prices across both islands. Key design differences between SEM and BETTA are currently acknowledged to be a barrier to trading on Moyle and potentially to the future East West interconnector, especially the lack of alignment of gate closures and *ex-post* pricing in SEM. This is considered by many participants to create an unacceptable and significant degree of uncertainty.[63] The harmonisation of trading arrangements between SEM and BETTA would increase the efficient use of the interconnectors between the two islands.

- BETTA’s annual consumption is about 340TWh a year. The SEM’s market size is about 35 TWh a year. The BETTA market could therefore provide a large marketplace for SEM generators and suppliers, particularly as intermittent generation increases as a proportion of generation in both jurisdictions. The elimination of the barriers to trade associated market design misalignment could lead to a maximisation of the use of arbitrage opportunities between SEM and BETTA. Harmonised system and market operations could also bring some economies of scale (a single system and market operator may suffice).

- The UK Government recently published an Energy White Paper.[64] The Paper sets out a package of reforms to the United Kingdom (UK) and Great Britain’s (GB) electricity policy. These reforms were proposed to ensure a more effective and affordable way to achieve the UK’s target for renewable generation (15 per cent renewable energy target by 2020 and 80 per cent carbon reduction target by 2050). Northern Ireland is currently considering the introduction of equivalent measures. The harmonisation of incentives for renewable generation could be an advantage for the island of Ireland as investment decisions would be made based on local resources as opposed to

[63] http://www.allislandproject.org/en/TS_Decision_Documents.aspx?article=8ab12afb-d1e4-413e-bc33-7e17a5683755
[64] http://www.decc.gov.uk/en/content/cms/legislation/white_papers/emr_wp_2011/emr_wp_2011.aspx

local incentives. Having better wind resources, it is fair to expect that the island of Ireland would attract more investment in this area.

- To implement coordinated price coupling as will be required by the CACM Network Codes, National Grid will create a hub which will provide the interface between GB and the single European coupling algorithm. It could provide open access to all regional interconnectors and all regional power exchanges. Harmonised trading arrangements with GB could facilitate the use of this platform by market participants from the island of Ireland without the necessity of creating a local power exchange.

Issues

Harmonising the trading arrangements in GB and the island of Ireland would have drawbacks:

BETTA Market Design may not be appropriate for either Ireland or the Target Model

- The BETTA market is not entirely consistent with the Target Model. The focus in BETTA on physical bilateral long term trading and resulting low liquidity levels in the day ahead and intra day spot markets differs from the Target Model which is built upon the market coupling of liquid physical day ahead auctions which in turn supports long term financial contracting, as is the case in Nord Pool. Thus, adopting the current BETTA design in Ireland could mean a suite of market changes are still required to implement the Target Model.

- When the SEM was implemented, the Regulatory Authorities were of the view that the gross mandatory pool model was the more appropriate choice for the SEM than a BETTA-style market. This decision was made mainly because it was thought that the centralised model would be more advantageous in terms of liquidity, transparency, barriers to entry and dispatch efficiency and because it would ultimately provide lower prices and greater choice to consumers. These conclusions stem from the different nature of the Irish market, principally its size and ownership structure. The paper also concluded that a gross pool would be easier to implement and administer than a bilateral contracts market both from the perspective of market participants and regulators.

- The UK Government's Electricity Market Reform White Paper sets out a number of possible reforms to support the BETTA market in meeting UK energy policy objectives, principally transitioning to a low carbon economy and ensuring adequate investment in (nuclear) generation. If a BETTA-style market was to be implemented in Ireland and Northern Ireland, consideration will need to be given to what extent such reforms would be required and their relative merits assessed in meeting Irish policy objectives compared to the SEM and existing SEM related instruments[65].

- Concerns have been raised by Ofgem over liquidity issues in BETTA.[66] The GB wholesale market might not be delivering the products and signals that all market

[65] For latest on this see Technical Update on Electricity Market Reform: http://www.decc.gov.uk/en/content/cms/legislation/white_papers/emr_wp_2011/tech_update/tech_update.aspx

[66] http://www.ofgem.gov.uk/Pages/MoreInformation.aspx?docid=163&refer=Markets/WhlMkts/CompandEff

participants need to operate their businesses effectively. In particular, independent suppliers and generators have expressed concerns that they find it difficult to manage risk with the wholesale products currently available. Liquidity is under investigation in the SEM context as well. Although the effect on liquidity of either BETTA option is a factor to be considered, liquidity has recently increased substantially in the day ahead auctions on N2eX in GB[67].

Governance and Regulatory Concerns

- The effective operation of the "Expanded BETTA" market could be hampered by capacity constraints on the interconnectors between the island of Ireland and GB. In these circumstances the market could become vulnerable to undue exploitation of market power, when there are constraints on the electricity transmission system.

- The current licensing arrangements for local market participants would have to be extensively reviewed to accommodate a market arrangement which is radically different from the SEM. Nonetheless, any revolutionary option to evolve the SEM would require the same level of licensing review.

- The arrangements for electricity trading in the island of Ireland are embedded in primary legislation in both jurisdictions of the market. Therefore, extensive review of primary legislation would have to be undertaken. Nonetheless, any revolutionary option to evolve the SEM would require the same level of primary legislation review. A complicating factor for the Expanding BETTA option is that five different political zones may have to be consulted (England, Wales, Scotland, Ireland and Northern Ireland), though given that energy is not a devolved power in Wales and Scotland this drawback may be overstated.

- In terms of regulatory authorities, given the devolved powers for energy regulation in Northern Ireland, the current responsibilities in terms of economic regulation should be maintained as applied currently. With regard to regulation of the wholesale energy market, DETI and UR would have to be embedded in the UK governance arrangements for BETTA. Appropriate international institutional arrangements would then need to be developed between the UK and Irish governments and regulators for the new cross border UK-Ireland wholesale market. These cross-jurisdictional arrangements could operate in a similar fashion to those between regulators of the Nordic or Iberian markets.

8.4 Potential Costs of Implementing a New Market

This section briefly summarises some information gathered on the costs of setting up the SEM in the period between 2004 and 2007; and of replacing the old England and Wales Pool in 2001 with the so-called New Electricity Trading Arrangements (NETA). Meaningful cost estimates are difficult to come by, partly because they should be net of any recurring or capital costs that would have been incurred if business had carried on as usual. Those

[67] N2EX is a power exchange in Great Britain owned by NASDAQ OMX Commodities and Nord Pool Spot. Among other services, it runs a day ahead physical auction of power contracts. It was launched 12 January 2010.

forward-looking estimates are inevitably subject to wide margins of error. Also, while outturn central system costs and the costs of the regulatory authorities are comparatively easy to come by, the costs to market participants are harder to obtain.

Nonetheless, the information below suggests that the central set-up costs (i.e., the implementation costs incurred by Ofgem and the market operator) of replacing the old England and Wales Pool with NETA amounted to as much as £100 million in 2001 prices (equivalent to €160 million at then current exchange rates). No estimates are available of the additional recurring costs incurred by Ofgem or the market operator, though these are likely to be marginal either way. Similarly no estimates are available of the set-up or additional recurring costs incurred by the system operator, National Grid.

Prior to the implementation of NETA, Ofgem estimated the total costs of participating in NETA, both in terms of set-up costs and operating costs, could amount to as much as £580 million (€900 million) over the first 5 years, and for participants to incur operating costs of £30 million (€50 million) a year thereafter[68] Ofgem considered that these estimates were likely to overstate the costs, because they did not take into account any costs that would be saved by switching from the Pool to NETA, nor any costs that would have been incurred regardless of the change in trading arrangements. Nonetheless, this suggests that set up costs were expected to amount on average to £6 million (€9 million) and recurring costs £0.3 million (€0.5 million) per market participant.

The information that is available on the costs of setting up the SEM are also summarised below. Central implementation costs (incurred by the regulators, the market operator and the system operators) amounted to about €90 million. Market participants were expected to incur set up costs of about €20 million. Given that there are at least 10 generating companies in the SEM and 5 major suppliers, this estimate looks low if the Ofgem per participant estimated averages are used.[69]

All in all, this suggests that replacing the SEM might cost as much as €150 million-€200 million. This would have a direct cost impact on consumers of electricity in Ireland and Northern Ireland during economically very challenging times for the island.

Section 8 Consultation Questions:

1. Should the SEM be replaced by a completely new set of electricity trading arrangements in 2016?
2. What are the advantages and disadvantages of the revolution approach discussed above?
3. What are your views on the BETTA options discussed in this section?
4. What are your views on implementing a Nord Pool or MIBEL-style market in Ireland and Northern Ireland?

[68] OFGEM's figures were based on a survey of 100 market participants.

[69] Generators include: Endesa Ireland, ESB, Synergen, Coolkeeragh, Bord Gaís, Bord na Mona, AES, Ballylumford, Tynagh, Aughinish Alumina, Viridian and Scottish and Southern. Suppliers include: ESB, NIE, BGE, Airtricity and Viridian

9. Legal Framework and Governance Issues

This section sets out initial views on the implications of making changes to the SEM as part of compliance with the CACM. It would appear that the legal implications may be different depending on the particular route to compliance that is taken.

The SEM was established through the enactment of the Electricity Regulation (Amendment) (Single Electricity Market) Act 2007 in Ireland and the Electricity (Single Wholesale Market) (Northern Ireland) Order 2007 in Northern Ireland. In these instruments, the Single Electricity Market is defined as follows;

> *'the Single Electricity Market' means the new arrangements in the State and Northern Ireland which are—*
>
> *(a) described in the Memorandum of Understanding, and*
>
> *(b) designed to promote the establishment and operation of a single competitive wholesale electricity market in the State and Northern Ireland;*

Evolution of the SEM

This consultation paper looks at options potentially to evolve the SEM to achieve compliance with the EU Target Model. It would appear that the need for primary legislation changes for this evolution will depend on the level of change to the SEM. One of the key indicators will be whether the SEM continues to constitute a gross mandatory pool. The question of whether primary legislation is required may depend upon the final design of any evolutionary option.

Leaving aside the issue of primary legislation, the evolution of the SEM to align with the Target Model may require a number of changes to other legal documents. For example the Trading and Settlement Code could require significant changes, the Grid Code could be impacted and the various participant licences (Generation, Supply, System Operation, Interconnector Owner, etc.) may need to be amended.

Trading and Settlement Code Changes

Section 2 of the Trading and Settlement Code (TSC) sets out the current Modifications Process for the SEM rules[70]. This process allows changes to be proposed to the Code by interested parties. The proposals are discussed at Modifications Committee meetings where they are ultimately voted upon by the Committee with the proposal going to the SEM Committee for a final decision. The Modifications process exists within the framework of the existing TSC and SEM design. However, for extensive changes to the SEM it is unclear whether the Modifications Committee is the appropriate body to process such changes. For example it may be preferable for the wider market that the process is removed from the existing framework and is consulted upon by the SEM Committee. The implementation of the changes could be progressed through the Modifications Committee once the high level principles are agreed. Another possibility might be the creation of a SEM Committee Policy Modification provision in the TSC which would allow major policy modification to be progressed outside of the general process.

[70] See http://www.sem-o.com/MarketDevelopment/Pages/MarketRules.aspx

Licence Changes

For the implementation of SEM, specific legislative provision was made to allow the CER and the UR to amend licences outside of the general amendment process. In order to effect major licence changes such as those to ensure a Target Model compliant market, it is likely that a similar provision would be required by the SEM Committee. It is possible that such provisions could be enabled through primary legislation required to implement the Third Package. Alternatively, it is possible that an implementing regulation could be made under Section 3 of the European Communities Act 1972 in Ireland and Section 2(2) of the European Communities Act 1972 in Northern Ireland. This would be a matter for the Departments in the two jurisdictions.

Revolution of the SEM

If the SEM Committee were to conclude that the SEM cannot be adapted to achieve compliance with the Target Model and a recommendation to Government Ministries is made to replace the SEM, then it is likely that primary legislation will be required to implement a new market. The detail of the legislation required will ultimately depend on the scope and design the new market. For example, if an all-islands market (GB, NI and Ireland) was to be developed, a new suite of governance arrangements would need to be put in place. This would have significant implications for GB and Ofgem in particular since they are the sole regulator and controller of BETTA at present, Scotland and Wales do not have devolved energy powers. Significant discussions and agreements would need to be put in place by relevant Governments on any such arrangements. If a decision is made that the underlying SEM framework is retained, albeit with a new market design, new primary legislation will likely be required to be passed by the Assembly in Northern Ireland and the Oireachtas in Ireland. However, it may be possible that implementing regulations under the European Communities Act could be employed; this would be an issue for Government Ministries in Ireland and Northern Ireland.

EU Governance Guidelines for Market Coupling

Implementation of the Target Model is likely to require Ireland and Northern Ireland becoming part of the market coupling governance framework. This is currently subject to consultation by the European Commission and may have legal/legislative implications.

10. Conclusions, Recommendations and Next Steps

10.1 Conclusions

The following are the draft conclusions for consultation:

- The SEM has met its original design objectives and is operating as planned. However it faces a number of key challenges in the future, specifically incorporating large levels of intermittent generation and integrating into the European Internal Electricity Market.

- Implementation of the European Electricity Target Model is both desirable for the SEM and will be mandated by EU law from 2014/2016.

- The SEM Committee potentially faces a decision on two pathways to implementing the Target Model, revolution or evolution. There are advantages and disadvantages of both. A broad spectrum of options for evolution and revolution of the SEM exist, as presented in this paper. The indicative assessment framework presented in Section 6 is used below to give an initial evaluation of these options with the intention of eliciting views from respondents.

- The SEM Committee is aware that it cannot make this decision in isolation. Implementation of the Target Model in the SEM will be developed in collaboration with respective Government Ministries as well as the European Commission, ACER, and FUI Regulatory and Government colleagues, as appropriate.

10.2 Recommendations and Next Steps

As stated earlier, this paper is intended as first step in the process of reaching the goal of European market integration by 2016. It is a discussion document to stimulate debate and inform SEM Committee and government policy. Given the fundamental policy and legislative responsibilities of the respective Government Ministries in Ireland and Northern Ireland in establishing the SEM and considering EU Member States' adoption of the Third Package, any decision which would lead to new market arrangements will be made by means of the SEM Committee making a recommendation to the Department of Communications, Energy and Natural Resources in Ireland and the Department of Enterprise, Trade and Investment in Northern Ireland. In view of this, the SEM Committee will continue to keep Government Ministries informed on project developments generally and on the outcome of this consultation. Depending on the outcome of this process, a recommendation to the respective Governments will follow from the SEM Committee.

During the consultation there will be further engagement with Government Ministries, ACER, the European Commission and FUI Regulatory and Government colleagues as appropriate. The time will also be used by the project team to explore further issues raised in this paper, including but not limited to; implications of central dispatch, amending bidding behaviour in SEM to simple bids, changing the trading day in SEM and the implications of trading closer to real time in SEM in light of increased renewables.

Following the consultation and consideration of responses received, the SEM Committee expects to issue a decision in Q2 2012 on the next steps in the process to implement the Target Model in SEM.

The next phase of the project after April 2012 is envisaged to comprise the following steps and address the following issues:

- Decision by SEM Committee in Q2 012 on what options to advance to address market integration requirements;
- Potential engagement of economic and legal project advisors, as required;
- Establishment of project office resourced to deliver project by 2016;
- Continued engagement with ACER and European Commission on compliance;
- Work with Ofgem and other FUI regulators, as appropriate on SEM / BETTA coupling and implementation of Target Model generally;
- Interaction with Member States on issues and legal powers required;
- Continued interaction with market participants on issues through working groups and workshops;
- Work involving MO and SOs on options being advanced and issues arising; and,
- Following potential additional work on options; SEM Committee consultation and decision on future high level design by end 2012.

10.3 Initial Evaluation of Options

Table 4 below compares in summary fashion all the options discussed in this paper against the criteria proposed in Section 6. This is an initial assessment and is not intended to prejudge SEM Committee decisions on the next steps in the project.

Table 6: Initial SEM Committee Assessment of Options

	Evolutionary Options				Revolutionary Options		
Criterion	**Option1**	**Option 2**	**Option 3**	**Option 4**	**MIBEL-style market**	**Bilateral Contracts Market**	**Nord Pool - style market**
Description	Limited bilateral forward contracts, day ahead coupling on EA1.	Forward pool, day ahead coupling on EA2.	Limited bilateral forward contracts price couple on EA2.	Keep the SEM as is, couple on CfD auction day ahead.	Limited bilateral forward contracts, day ahead coupling using quasi mandatory PX. Market splitting intra –zones	Unlimited bilateral contracting, day ahead coupling using PX.	Bilateral forward physical and financial contracts, day ahead coupling using mandatory PX. Market splitting intra –zones
Security of supply *Short Term*	Central commitment retained which is a benefit for short term supply security in particular with high wind levels. Limitation on bilateral contracts to XB	Central commitment retained which is a benefit for short term supply security in particular with high wind levels. Centralised pool offers new entrants liquid	Central commitment retained which is a benefit for short term supply security in particular with high wind levels. Given that these markets are	Central commitment retained which is a benefit for short term supply security in particular with high wind levels. Given that SEM is largely retained this	Central commitment retained which is a benefit for short term supply security in particular with high wind levels	Self-commitment unrestricted bilateral markets could cause supply security issues for a small island with large amount of interconnection and wind relative to peak demand.	Self-commitment unrestricted bilateral markets could cause supply security issues for a small island with large amount of interconnection and wind relative to peak demand.

	Evolutionary Options				Revolutionary Options		
Criterion	**Option1**	**Option 2**	**Option 3**	**Option 4**	**MIBEL-style market**	**Bilateral Contracts Market**	**Nord Pool - style market**
Long Term	PTRs/FTRs and emphasis on organised physical day ahead and intra day market means high price transparency and liquidity for new entrants	and transparent marketplace. Splitting market into two day ahead spot market (fwd pool and EA2) could reduce reliability of spot markets and jeopardise liquidity of long term financial hedging contracts which could undermine investment.	voluntary, this option has the drawbacks of Option 2 without the benefits of Option 1 in terms of supply security.	option performs reasonable well for long term supply security. Concerns are on the complexity of this option and whether it would perform efficiently intra day.		Concerns over security of supply in GB have led to proposals to introduce targeted capacity payments. For market coupling purposes they would have to be predictable.	Nord Pool is a large market (total annual volume of more than 340TWh) and has substantial volumes of predictable hydroelectric power. This means that it does not face the supply security concerns of a small island system with high levels of intermittent generation. Its design reflects this.
	Capacity payments can be retained in this option, though some changes needed for market coupling.	Capacity payments can be retained in this option, though some changes needed for market coupling.	Capacity payments can be retained in this option, though some changes needed for market coupling.	Capacity payments will be retained in this option though some changes needed for market coupling.	MIBEL has an explicit capacity payments mechanism, which is fixed and therefore compatible with implicit auctions.	Energy-only bilateral contracts markets in Europe do not typically have explicit capacity payments.	

	Evolutionary Options				Revolutionary Options		
Criterion	**Option1**	**Option 2**	**Option 3**	**Option 4**	**MIBEL-style market**	**Bilateral Contracts Market**	**Nord Pool - style market**
Dispatch efficiency	Market forces should drive an efficient dispatch in that lower cost generators should be contracted before more expensive ones; and the design avoids incentive incompatibility problems. However, the ability of this design to	Basing the forward pool on complex commercial and technical data should provide greater efficiency in dispatch with generators being brought on in the forward and *ex post* markets according to their position in the merit order. But this	Basing the forward pool on complex commercial and technical data should provide greater efficiency in dispatch with generators being brought on in the forward and *ex post* markets according to their position in the merit order. But this	By retaining the SEM largely in its existing form, dispatch efficiency will be as good as is currently the case. However, interconnector flows day ahead may not be reflective of SMP as intermittent generators may	Market forces should drive an efficient dispatch in that lower cost generators should be contracted before more expensive ones; and the design avoids incentive incompatibility problems. However, the ability of this	Self-commitment markets avoid incentive compatibility problems of centralised markets since they assume that participants are best placed to make decisions about the commercial operation of their plant.	Self-commitment markets avoid incentive compatibility problems of centralised markets since they assume that participants are best placed to make decisions about the commercial operation of their plant.

	Evolutionary Options				Revolutionary Options		
Criterion	**Option1**	**Option 2**	**Option 3**	**Option 4**	**MIBEL-style market**	**Bilateral Contracts Market**	**Nord Pool - style market**
	produce a more efficient dispatch depends on the degree of lack of co-ordination amongst generators and on the difficulty of internalising start-up and no load costs into one-part energy offers. The degree of competition in the market will also be important.	depends on the accuracy of the algorithm used to determine unit commitment and it can give rise to incentive compatibility problems.	depends on the accuracy of the algorithm used to determine unit commitment and it can give rise to incentive compatibility problems.	Not participate in the day ahead CfD auctions. So MIUNs in EA2 will be governed by incomplete market information.	design to produce a more efficient dispatch depends on the degree of lack of co-ordination amongst generators and on the difficulty of internalising start-up and no load costs into one-part energy offers. The degree of competition in the market will also be important.	But there inefficiencies may arise from generators acting independently of each other and because the internalisation of fixed costs such as start-up and no load costs into one-part energy offers is necessarily imprecise.	But there inefficiencies may arise from generators acting independently of each other and because the internalisation of fixed costs such as start-up and no load costs into one-part energy offers is necessarily imprecise.
Environment and renewables	The day ahead pool and limited bilateral trading means that market prices are	The pool option means that market prices are fully available to renewable	The pool option means that market prices are fully available to renewable	In this option priority dispatch will guarantee the available renewables	The day ahead MIBEL pool means that market prices are available to	Bilateral contracts markets, with their emphasis on bilateral trading and	Low volumes of intermittent generation mean that the Nordic intraday market (Elbas)

	Evolutionary Options				Revolutionary Options		
Criterion	**Option1**	**Option 2**	**Option 3**	**Option 4**	**MIBEL-style market**	**Bilateral Contracts Market**	**Nord Pool - style market**
	available to renewable generators and they can access these without being limited to bilateral contracts. With unpredictable output, long term fixed contracts will be attractive in this option. Proximity to real time may provide the benefit of better forecasts, there is increased risk on generators with regards to the firmness of any volumes allocated in the	generators and they can access these without being limited in bilateral contracts. A renewable generator can opt to trade in the forward pool through submission of a nomination and be scheduled at that price. Any variance between forecasts and actual delivery must be settled in the balancing market.	generators and they can access these without being limited in bilateral contracts. A renewable generator can opt to trade in the forward pool through submission of a nomination and be scheduled at that price. Any variance between forecasts and actual delivery must be settled in the balancing market.	their full quantity in the *ex post* schedule. So they would not be subject volume risk and their price risk is likely to be mitigated by long term contracts such as ReFIT or through ROCs.	renewable generators and they can access these without being limited to bilateral contracts. A renewable generator can opt to trade in the pool through submission of a nomination and be scheduled at that price. Any variance between forecasts and actual delivery must be settled in the balancing market.	exposure to volatile balancing prices, discriminate against intermittent generation sources such as wind. While there may be ways in which the risk of being in imbalance in a bilateral contracts market can be diversified, e.g., by contracting with thermal generators or by aggregating intermittent generation across areas with less than perfect wind correlations, it	has very low volumes traded. There is no intra pricing of congestion in Elbas which operates on a first come first served basis. This is not an efficient means of valuing cross border capacity win cases where high intermittent volumes means intraday flows could be large.

	Evolutionary Options				Revolutionary Options		
Criterion	**Option1**	**Option 2**	**Option 3**	**Option 4**	**MIBEL-style market**	**Bilateral Contracts Market**	**Nord Pool - style market**
	day ahead and intraday markets.					is generally acknowledged that these may still leave intermittent generation worse off in a bilateral contracts market than in a pool.	
Market integration	This option will be compatible with the day ahead target model, based as it is on simple bids at 11.00 UTC D-1. It remains to be seen whether it will be compatible with continuous intraday trading if the retention of central	This option may be compatible with the day ahead target model, based as it is on simple bids at 11.00 UTC D-1 but may cause concern that it creates two day ahead spot markets in the SEM. It remains to be seen whether it will be	This option will be compatible with the day ahead target model, bases as it is on simple bids at 11.00 UTC D-1 but may cause concern that it creates two day ahead spot markets in the SEM. . It remains to be seen whether it will be compatible	By coupling using CfDs with simple offers and bids, this option is fully compatible with the target day ahead market.	Compatible with target model for long term and day ahead but issues remain over how to combine intraday auctions with continuous trading.	The European target model is based on the bilateral contracts markets which prevail in Europe. So this option is fully compliant with both the day ahead and intraday target models.	Compatible with target model for long term and day ahead but issues remain over intraday congestion pricing which is required by the CACM but is not compatible with the Nordic continuous trading model (Elbas)

	Evolutionary Options				Revolutionary Options		
Criterion	**Option1**	**Option 2**	**Option 3**	**Option 4**	**MIBEL-style market**	**Bilateral Contracts Market**	**Nord Pool - style market**
	dispatch means that non-technically feasible trades are rejected by the system operator. The alternative – of requiring the system operator to counter-trade in the event of a technically infeasible trade – could be costly.	compatible with continuous intraday trading if the retention of central dispatch means that non-technically feasible trades are rejected by the system operator. The alternative – of requiring the system operator to counter-trade in the event of a technically infeasible trade – could be costly.	with continuous intraday trading if the retention of central dispatch means that non-technically feasible trades are rejected by the system operator. The alternative – of requiring the system operator to counter-trade in the event of a technically infeasible trade – could be costly.				
Competition	This option (provided it limits bilateral contracts) is favourable to	Retention of a pool makes this option more favourable to	Retention of a pool makes this option more favourable to	This option scores well on this criterion since it retains the SEM, with	Retention of centralised market may mean market power issues	Lack of price transparency would create a barrier to entry. Experience	Liquid and transparent day ahead market with long term

	Evolutionary Options				Revolutionary Options		
Criterion	**Option1**	**Option 2**	**Option 3**	**Option 4**	**MIBEL-style market**	**Bilateral Contracts Market**	**Nord Pool - style market**
	competition as it concentrates liquidity in the day ahead physical spot market to generate a robust and transparent reference price around which trading in long term CfDs can take place. Illiquid bilateral contracts markets inhibit competition and new entry. Restricting bilateral trade to IC capacity holders (for PTRs) would limit this problem and a move to FTRs would mean the only	competition and new entrants by giving all generators and suppliers access to a market for energy.	competition and new entrants by giving all generators and suppliers access to a market for energy.	complex bidding, thus making market monitoring easier and more effective.	can be dealt with more effectively. There are market power concerns in Spain though these are managed through a form of directed contract for difference.	suggests that vertical integration is a powerful means of risk diversification and that incentives to integrate vertically may be more powerful in a bilateral contracts market. This would be unfortunate in a small market such as the SEM. Ability to monitor behaviour is also low.	financial forward and futures market. Competition effects dependent on industry structure.

	Evolutionary Options				Revolutionary Options		
Criterion	**Option1**	**Option 2**	**Option 3**	**Option 4**	**MIBEL-style market**	**Bilateral Contracts Market**	**Nord Pool - style market**
	bilateral trade would be financial with all physical volumes going through EA1.						
Adaptability & stability	Adaptability refers to the ability of the trading rules to adapt through time as circumstances change. This is a question of the detailed governance arrangements. No suggestion that one market design is better than another in this respect.	Adaptability refers to the ability of the trading rules to adapt through time as circumstances change. This is a question of the detailed governance arrangements. No suggestion that one market design is better than another in this respect.	Adaptability refers to the ability of the trading rules to adapt through time as circumstances change. This is a question of the detailed governance arrangements. No suggestion that one market design is better than another in this respect.	No change from the current arrangements in the SEM	MIBEL has evolved over time and is currently adapting to Target Model	Adaptability refers to the ability of the trading rules to adapt through time as circumstances change. This is a question of the detailed governance arrangements. No suggestion that one market design is better than another in this respect.	Nord Pool has evolved over time since its inception. It is one of the oldest restructured electricity markets in the world. (It was initiated in 1991.)
Practicality	Definite implementation and recurring central market	Definite implementation and recurring central market	Definite implementation and recurring central market	This option would require the SEM trading day to	Costs unknown. Costs of re-design are	Costs of re-design are likelier to be higher than	Costs unknown. Costs of re-design are

	Evolutionary Options				Revolutionary Options		
Criterion	**Option1**	**Option 2**	**Option 3**	**Option 4**	**MIBEL-style market**	**Bilateral Contracts Market**	**Nord Pool - style market**
	system cost not yet available. For initial central system cost estimates see section 7.2.	system cost not yet. For initial central system cost estimates see section 7.2.	system cost not yet available. For initial central system cost estimates see section 7.2.	move to 23.00 – 23.00, which might have significant cost implications. Otherwise, implementation costs would be low (€7 million), by comparison with all the other options.	likelier to be higher than any of the evolutionary options	any of the evolutionary options.	likelier to be higher than any of the evolutionary options
Equity	Design is unlikely to be the deciding factor in considerations of equity, which is interpreted to mean presenting the same set of challenges to all generators and suppliers and traders. A bilateral	Design is unlikely to be the deciding factor. But retention of a pool guarantees market participants the opportunity to sell/buy from a single source.	Design is unlikely to be the deciding factor. But retention of a pool guarantees market participants the opportunity to sell/buy from a single source.	Retention of the SEM in its current form would continue to guarantee market participants the opportunity to sell/buy from a single source	Design is unlikely to be the deciding factor. But retention of centralised market guarantees market participants the opportunity to sell/buy from a single source.	Design is unlikely to be the deciding factor. A bilateral contracts market poses a greater challenge in terms of equity because of potentially weaker access to the market for participants.	Design is unlikely to be the deciding factor.

	Evolutionary Options				Revolutionary Options		
Criterion	**Option1**	**Option 2**	**Option 3**	**Option 4**	**MIBEL-style market**	**Bilateral Contracts Market**	**Nord Pool - style market**
	market poses a challenge in terms of access as it requires participants to have in place physical contracts with buyers/sellers.						

11. Consultation Questions

A Summary of SEM Committee Consultation Questions:

Consultation Questions:

1. Do you agree that the SEM has met its objectives to date?
2. Do you think that any further work should be done on the above projects separate to or as part of the Market Integration Project?
3. What elements of the Target Model are most relevant for the island of Ireland and the FUI region?
4. Are there other aspects of the European Internal Electricity Market that should form part of this consultation?
5. Is continuous trading as applied in the Elbas market in Scandinavia an appropriate model for Ireland, given the levels of wind expected on the system by 2020? What elements of the emerging design of the NWE Intra Day project (e.g. congestion pricing) are most relevant for Ireland?
6. What is your opinion on Financial Transmission Rights versus Physical Transmission Rights as the best approach for interconnectors on Ireland and Northern Ireland borders?
7. What elements of the SEM design are in your opinion not compatible with the Target Model?
8. What elements of the SEM design can and should be retained when implementing the Target Model in Ireland and Northern Ireland?
9. What point on the spectrum of market designs is most suited to Ireland and Northern Ireland?
10. Do you agree with the SEM Committee assessment framework proposed in Section 6?
11. Is the ranking of criteria/objectives the right one? Is the application of weighting factor appropriate? What weighting would you give each one?
12. What other criteria, if any, should the SEM Committee apply when making its decision on implementing the Target Model?
13. Do you support any of the evolutionary options for the SEM in Section 7?
14. Are there any other options that you think would better meet the objectives?
15. Are the options in Section 7, in your opinion, consistent with the Target Model?

Consultation Questions:

16. Are these options presented in sufficient detail for a high level design decision to be made?
17. Do you agree with the assessment made by SEMO in Section 7 and how do the above options measure up against the assessment criteria set out in Section 6?
18. Should a pilot project be set up to explore the possibility of Option 4 (CFD) by end 2012?
19. Should the SEM be replaced by a completely new set of electricity trading arrangements in 2016?
20. What are the advantages and disadvantages of the revolution approach discussed in Section 8?
21. What are your views on the BETTA options discussed in Section 8?
22. What are your views on implementing a Nord Pool or MIBEL-style market in Ireland and Northern Ireland?
23. Do you agree with the summary assessments in Table 4 of each of the 7 options against the listed criteria?
24. Which option, if any, do you think best meets the criteria?

Annex 1: Three Examples of European Markets

A.1 Great Britain - BETTA

The trading arrangements

The British Electricity Trading and Transmission Arrangements (BETTA) were introduced on 1 April 2005. They replaced the previous New Electricity Trading Arrangements (NETA) in England and Wales and the separate arrangements that existed in Scotland.

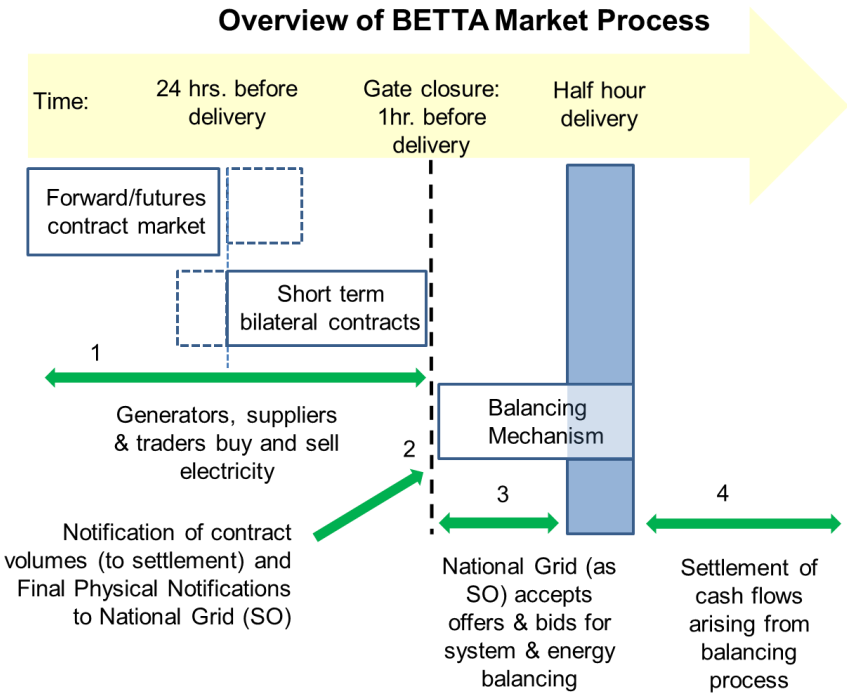
BETTA is the only market to which the SEM is physically interconnected. Alongside other options of evolution or redesign of the SEM, close integration or harmonization of trading arrangements with BETTA deserves serious consideration. This is just a theoretical discussion. The question to be addressed by this section is whether Ireland and Northern Ireland would ever want to join. This section briefly explores this possibility.

The trading arrangements under BETTA are based on bilateral trading between generators, suppliers, traders and customers across a series of markets operating on a rolling half-hourly basis. Under these arrangements generators self schedule their plant rather than being centrally scheduled by the system operator. There are four stages to the wholesale market in BETTA. These are illustrated in the diagram below.

Participation in the bilateral markets (i.e. the forward/futures contract market and the short-term bilateral OTC and power exchange markets) and the balancing mechanism (i.e. offer/bid submission) is optional. Participation in settlements is mandatory. In addition, certain categories of generator are required to provide National Grid (as the system operator) with physical notifications. The Balancing and Settlement Code (BSC) provides the framework within which participants comply with the balancing mechanism and settlement process. The BSC is administered by a non-profit making entity (Elexon) which effectively fulfils the role of market operator.[71]

The guiding principle of BETTA's design is that electricity should be treated as much like a commodity as possible. National Grid ensures that demand and generation are kept in balance and transmission constraints are respected.

[71] The BSC also specifies the process for modifying the BSC itself. All modifications to the BSC are approved by Ofgem and must, to be approved, better facilitate achieving the applicable BSC objectives, which are: Modifications are evaluated by reference to the Applicable BSC Objectives, which are: (a) the efficient discharge by the Transmission Company of the its Transmission Licence obligations; (b) the efficient, economic and co-ordinated operation of the GB Transmission System; (c) promoting effective competition in the generation and supply of electricity, and (so far as consistent therewith) promoting competition in the sale and purchase of electricity; (d) promoting efficiency in the implementation and administration of the balancing and settlement arrangements.



Source: National Grid

Futures/forward contract markets

BETTA is characterised by unrestricted bilateral contract trading. The bilateral contracts markets for firm delivery of electricity operate from a year or more ahead of real time and typically up to 24 hours ahead of real time. The markets provide the opportunity for a seller (generator) and buyer (supplier) to enter into contracts to deliver/take delivery, on a specified date, of a given quantity of electricity at an agreed price. The markets are optional with participants having complete freedom to agree contracts of any form. Formal disclosure of price is not required.

Short term bilateral contract markets (power exchanges)

Power exchanges tend to be used to add 'shape' to the baseload volumes contracted in the forward/futures market to meet the expected demand on a specific day. This 'shape' tends to be traded closer to real time when the conditions at the point of delivery are better known. Hence there is a meaningful complementarity between futures and spot markets.

Trading on the power exchanges tends to be concentrated in the last 24 hours. This allows generators and suppliers to fine-tune their rolling half hour trade contract positions as their own demand and supply forecasts become more accurate as real time is approached. The markets are firm bilateral markets and participation is optional. One or more published reference prices are available to reflect trading on the power exchanges.

Balancing Mechanism

The Balancing Mechanism operates from gate closure through to the end of real time and is managed by National Grid. It exists to ensure that supply and demand can be continuously

matched or balanced in real time. The mechanism is operated with National Grid acting as the sole counter party to all transactions. [72]

Suppliers and generators try to match their demand and generation, respectively, to their contract levels so that they do not have a surplus or deficit of electricity. It is one of the key objectives of the trading arrangements to encourage all participants to have pre-notified contracts covering all of their generation and/or demand and thereby to avoid exposure to the Balancing Mechanism.

The Balancing Mechanism involves participants (generators, suppliers and traders) submitting 'offers' (proposed trades to increase generation or decrease demand) and/or 'bids' (proposed trades to decrease generation or increase demand). Participation in the Balancing Mechanism is optional. The mechanism operates on a 'pay as bid' basis. National Grid will, in real-time, and as required, match supply and demand in each half an hour by accepting bids or offers and by purchasing other balancing services, depending on whether it needs to increase or reduce electricity generation to meet demand, resolve transmission constraints and thereby balance the system.

Imbalances and Settlements[73]

Power flows are metered in real time to determine the actual quantities of electricity produced and consumed at each location. The size of any imbalance between participants' contractual positions (as notified at gate closure), including accepted offers and bids in the balancing mechanism, and the actual physical flow is then determined. Imbalance volumes are settled at one of two imbalance prices: the System Buy Price (SBP) and the System Sell Price (SSP).

The SBP is the price at which deficits are charged and, when the system is short, reflects the average cost of the marginal 500MWh of actions that National Grid had to take to resolve the energy imbalance.[74] The SSP is the price at which surpluses are charged and, when the system is long, reflects the average cost of the marginal 500MWh of actions that National Grid had to take to dispense with the surplus spill energy.

The so-called "reverse prices," i.e. SBP when the system is long and SSP when the system is short, are based upon a forward market price derived from power exchange trades.

Imbalance (or cash out) prices are designed to provide market participants with strong commercial incentives to balance their contractual and physical positions ahead of gate closure and thereby avoid exposure to cash out prices, either by contracting for supply ahead of time or by maintaining the reliability of their generating plant.

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[72] As the market moves towards the balancing stage, the system operator needs to be able to assess the physical position of market participants to ensure security of supply is maintained effectively and efficiently. All market participants are therefore required to inform National Grid of their planned net physical flows onto and/or from the system. Initial physical notifications are submitted at 11.00 a.m. at the day ahead stage. These are continually updated until Gate Closure when they become final physical notifications (FPNs) at gate closure an hour ahead of real time.

[73] Ofgem is currently consulting on potential changes to the cash out 'cash out' arrangements in the electricity market in GB. See http://www.ofgem.gov.uk/Markets/WhlMkts/CompandEff/CashoutRev/Pages/CashoutRev.aspx

[74] Some bids and offers are excluded from the averaging calculations if they were related to system balancing (e.g. resolving transmission constraints) as opposed to energy balancing.

A.2 The Iberian Electricity Market - MIBEL

The wholesale electricity market in Spain was set up at the beginning of 1998. An Iberian electricity market – MIBEL - was created in 2007 when Portugal effectively adopted the markets that were created in Spain in 1998, with the addition of a derivatives market (run by OMIP) located in Lisbon. The market began operation in 2010.

The Iberian market is organised as a sequence of markets: a forward bilateral contracts market, a voluntary day ahead market, several mandatory intraday markets, a real time (i.e., balancing) market, a financial derivatives market and an ancillary services (reserves) market.

The day ahead and intraday markets are pool-type markets into which generators and load submit offers and bids and some complex economic and technical conditions.[75] While participation in the day ahead pool market is not compulsory, since market participants are allowed to enter into bilateral contracts, generators have an incentive to participate since they are eligible for capacity payments only if they participate in the day ahead market.

The day ahead market

The day ahead market is the most important part of the electricity market. Four-fifths of the total system demand traded through the day ahead market in 2009.

The day ahead market is formed of twenty-four hourly auctions that are cleared simultaneously between 10:00 and 10:30 am CET on day D-1. Generators submit offers of up to 25 price quantity pairs and, if relevant, minimum income bids. Load submits demand functions specifying the maximum price at which they are willing to buy a given amount of electricity. The demand functions can include up to 25 price quantity pairs. The trading day runs from midnight to midnight, CET. Products traded are hourly.

Bilateral contracts are notified to the market operator by gate closure, including firm contracts for purchase/sale of energy to France across the interconnectors. Additionally, forward physical open positions can be converted into physical positions as this stage. Open financial positions on OMIP for the following day can also be converted into physical positions and nominated at the day ahead stage.[76]

Dispatch and the uniform day ahead market price (the system marginal price) is determined through market clearing by computing the intersection of the between the aggregated offer and bid curves.

Once the day ahead market closes, the system operator studies the feasibility of the day ahead dispatch schedule and, on the basis of the bids and offers submitted by market participants in the day ahead market, adjusts the dispatch schedule if it is infeasible as a result of transmission constraints. Constrained on generators are paid their offer prices; constrained off generation is paid nothing.

Congestion on the tie-lines between Spain and Portugal are dealt with by market splitting.

[75] These include minimum income conditions, production capacity variations, maximum load gradient conditions, indivisibility conditions and scheduled stop conditions.

[76] These opportunities to convert open physical and financial positions are not much used by participants.

Intraday markets

Market participants can adjust their physical positions in either direction after the day ahead market has cleared. This takes place in a sequence of six intraday implicit auctions.[77] The auctions apply to trade only within the Iberian market. They do not include cross-border trades. The auctions are implicit because capacity on the Spain-Portugal ties is not explicitly allocated.

The bidding and market-clearing processes in these intraday markets are similar to the ones in the day-ahead market, though the matching mechanism accepts more technical constraints than the day ahead market. As in the day ahead market, all MWhs in the intraday auctions are bought or sold at the highest matched selling bid.

Balancing market

As in other European markets, the system operators buy and sell energy in real time to ensure that the system remains stable. Those participants who help the system operator to balance the system (e.g., are long when the system is short) are paid the day ahead price. Those who contribute to the imbalance (e.g., are short when thy system is short) are charged the cost the system operator incurs in managing the imbalance.

A.3 The Nordic Electricity Market - Nord Pool

In 1996 Norway and Sweden set up a common market in electricity for the Nordic region. The Norwegian and Swedish system operators, Statnett Marked and Svenska Kraftnät, set up Nord Pool, the world's first multinational power exchange, as a joint venture. Finland joined Nord Pool in 1997, Denmark West followed in 1999 and Denmark East in 2000. Estonia joined in 2010. Nord Pool set up Nord Pool Spot in 2002 to administer the spot markets in the Nordic area.

There are five inter-related markets for trading electricity in the Nordic area:

- A bilateral contracts market
- A day ahead spot market – Elspot
- An intraday market – Elbas
- A financial derivatives market - run by Nasdaq OMX
- A balancing market – the 'regulating power market' – run by the system operators

The bilateral contracts market

Trading between market participants takes place outside the power exchange over-the-counter market. Prices and volumes are not made public. Trades can be and are made well in advance of real time and can be for short, medium or long term periods.

[77] Currently there are six of these auctions, with the first taking place at 21.00 on D-1 (i.e., 28 hours ahead of the end of the trading day) and the last at 15.00 on day D (i.e., 9 hours ahead of the end of the trading day). There are plans to increase the number to eight and to allow trading one hour closer to real time.

The day ahead spot market - Elspot

The day-ahead physical market – Elspot - is the main platform for trading power in the Nordic region. There are about 340 participants on Elspot. Most of them trade every day, placing a total of around 1,500 offers/bids on a daily basis. The total annual volume transacted on Elspot amounts to more than 340TWh a year and comprises more than 80% of all electricity generated in the Nordic area.

All interconnector capacity between the thirteen Nordic bidding areas is dedicated to Nord Pool Spot for implicit auction in the Elspot price calculation.[78] There are no explicit capacity auctions on these interconnections and no single party has sole access to any of the trading capacity.

Gate closure on Elspot is 12:00 CET. Contracts are for hourly products and the trading day runs from midnight to midnight.

Offers and bids can be simple price/quantity pairs and block bids.[79] All purchase and sell orders in the Nordic area are aggregated into two curves for each delivery hour: an aggregate demand curve and an aggregate supply curve. The uniform system day ahead price is set where the demand and supply curves intersect.[80] The day ahead price is typically announced to the market between 12:30 and 12:45 CET, at which point trades are settled. The day ahead price is used as the reference price for the futures and forwards markets at Nord Pool Spot.[81]

Market splitting

While supply and demand are the key factors determining the price, transmission capacity also plays a role. To relieve this congestion, the Nordic area is divided into two or more different price areas. The participants' bids in the bidding areas on each side of the congestion are aggregated into supply and demand curves in the same fashion as in the system price calculation and bidding area prices are determined.

Curtailment

Curtailment of bids in Elspot takes place when the aggregated offer and bid curves within a price area do not intersect. This may be the case where there is significant over- or under-supply.

To arrive at a price in an area with over supply, the algorithm curtails offers so that the supply curve intersects with the demand curve at minimum price – currently -€200/MWh. To settle the price in an area with under supply, purchase bids are curtailed so that the demand curve intersects with the supply curve at maximum price – currently €2000/MWh. The total

[78] There are currently 13 Elspot bidding areas in the Nordic area: five in Norway (though this can vary), four in Sweden, two in Denmark, one each in Finland and Estonia. The system operators are responsible for determining the number and scope of the bidding areas.

[79] A block bid is a bid with two characteristics: it refers to more than one hour; and the bid is to be accepted or not accepted as a whole (kill-or-fill). This changes the nature of a bid from being continuous to being one of a discrete nature, i.e. the answer to the problem is not "how much" (within an interval) but "all" or "nothing".

[80] The system price denotes an unconstrained market clearing price since the trading capacities between the bidding areas have not been taken into account in determining the price.

[81] The majority of the standard financial contracts traded in the Nordic region use the system price as reference price. There are also standard financial contracts with reference to specific area prices.

curtailment in a price area is divided among the affected participants *pro rata* based on their bids for sale or purchase at minimum or maximum price (respectively).

Intraday market - Elbas

Elbas is an intraday marketplace for trading power. It is also operated by Nord Pool Spot. It covers Germany in addition to the five countries participating in Elspot. Elbas allows participants to adjust their bilateral contract and Elspot positions close to real time.

Elbas is a continuous implicit market. Trading takes place after Elspot closes until one hour before delivery.[82] Prices are set based on a first-come, first-served principle. Financial market

Financial contracts are used for price hedging and risk management. They are traded in the Nordic region on Nasdaq OMX. The contracts have a time horizon up to six years, covering daily, weekly, monthly, quarterly and annual contracts. The Elspot system price calculated by Nord Pool Spot is used as the reference price.

The regulating power market

The 'regulating power market' is managed by the system operators to maintain a stable frequency in the transmission grid. When the system is short, the system operators buys energy from generators with spare capacity (i.e., it procures "up-regulation"). And when the system is long it procures "down-regulation." Both generators and load can participate in the regulating power market.

All regulating power bids and offers submitted to the TSO's are ranked with increasing price (merit-order). The price of the last "up-regulated" MW sets the up-regulation price; and vice versa to set the down-regulation price. Normally the up-regulating price will be higher than the day ahead spot market price and the down-regulating price will be lower than the day ahead spot market price in that hour.

The principle for settling imbalances is that participants contributing to the imbalance will pay their share of the costs for re-establishing the balance. Imbalances are cashed out as follows:

- If a generator is long in a particular hour (i.e., it has generated more than it notified the system operator it would at the end of intraday trading) and the system operator had to procure up-regulation during the hour, the system operator will pay the generator the up-regulating price for the imbalance
- If a generator is long during a down-regulation hour, it gets paid the down-regulating price for the imbalance
- If a generator is short and the SO had to procure up-regulation during this hour, the SO will invoice the generator the up-regulating price for the difference

If a generator is short during a down-regulation hour, it will be charged the day ahead price, not the down-regulating price.

[82] Interconnection capacities available for Elbas trading are published at 14:00 CET.

Annex 2: The Benefits of Market Integration

Previous SEM Committee consultation papers have set out the benefits to Ireland and Northern Ireland of further and deeper integration of the SEM with its neighbouring markets[83]. These include:

- Increased producer and consumer welfare
- Enhanced security of supply
- Promoting competition in the wholesale electricity market
- Facilitating the penetration of renewables in the market, by enhancing the opportunity to export wind power
- Reducing operating costs for the system operators, through the provision of operating reserve across the interconnectors

Moreover, market coupling through implicit auctions and implicit continuous intraday trading has particular benefits, including:

- Making more efficient use of the interconnectors
- Reducing the risk of trading across the interconnectors, thus making it easier for smaller market participants to benefit from cross-border trade
- Making the pricing of capacity on the interconnectors more efficient, thereby giving more efficient investment and consumption price signals
- Equalising wholesale prices across neighbouring markets, thus representing a major step towards a more integrated European market
- Eliminating the potential for the hoarding of capacity on the interconnectors

[83] See *SEM-09-096 SEM Committee Consultation Paper on SEM Regional Integration, 10th September 2009.*

Annex 3: SEM and the Target Model Market Design

The following sets out the significant disparities between the SEM design and the 'shadow' market design that the Target Model is based on:

Ex-post Pricing

There can be no physical day-ahead market in the SEM, since all physical trades between generators and suppliers must by law take place through the SEM. Even if this legal constraint were to be removed, it is difficult to see how the price coupling requirement of firm day-ahead volumes and prices could be combined with the centralised unit commitment and dispatch nature of the SEM.

For example, if such a day-ahead market was *mandatory*, it would effectively replace the SEM and constitute a completely new market, and one which would not necessarily meet the original objectives of the SEM. If the SEM was kept alongside this mandatory day-ahead market, compensatory arrangements would have to be put in place to keep participants financially whole, were the day-ahead contracts incapable of being fulfilled owing to circumstances which were not the responsibility of either party to the day ahead contract (i.e., generator or supplier). These circumstances might include, for example, design differences between the day-ahead and *ex-post* markets or the actions of the market operator. Devising a compensatory arrangement that is both adequate to compensate market participant for risks that they cannot manage while at the same time minimising the cost to consumers would be a challenge and not one that is demonstrably easy to solve.

If participation in the day-ahead market was *voluntary*, the success of the market would be dependent on the arrangements put in place to protect participants in the day-ahead market from unmanageable commercial risks arising from discrepancies between their day-ahead contracted volumes and volumes in the *ex-post* unconstrained market schedule. It can be argued that in a voluntary market, any risks which arise from design differences should not be compensated, since participants are not obliged to trade day-ahead. However, adhering to this principle would be likely to impair the level of market liquidity, if these risks are seen to be unmanageable by market participants.

Bidding Structure and Central Unit Commitment

The types of bid currently accepted by power exchanges in various European countries include simple bids, which cover the operation of the generator in a single hour; a standard block bid (combining bid prices and volumes for a consecutive number of single hours); profiled block bids (with quantities differing across hours); maximum payment conditions (buy side) or minimum income conditions (sell side); and linked block bids (whether complementary or mutually exclusive).

In common with other power pools around the world, the SEM uses a system of complex bids where generators submit their costs (including non-convex costs such as start-up costs) to a central algorithm. As most power exchanges have relatively simple products, rules and procedures, the full complexity of technical and commercial offer data used in the SEM may not be acceptable to the exchange based market coupling algorithm currently being developed.

A related point is that complex bids that include generator start up and no load costs are essential to efficient unit commitment and dispatch, which ultimately is the role of power pools such as the SEM. The market software required to solve unit commitment involves considerable mathematical complexity and relatively lengthy solver times compared to power exchange auctions. Together with the data processes and checking involved, this means that central scheduling and dispatch results in long gate closures.

If, as seems likely, the SEM bids were not to be accepted by the single market coupling algorithm that is currently being developed by the PCR group of power exchanges SEM's complex bids will have to change to simple or block bids for the day ahead market.[84]

Explicit Capacity Payments

The price produced by a market coupling process will be an 'all-in' energy price (i.e., a price which remunerates both energy and capacity) and will be the only applicable price per bidding area. The *ex-post* pricing structure in the SEM includes an explicit capacity payment (€/MW) and a separate energy price (€/MWh), which covers variable production costs, including start-up and no-load costs. To produce an efficient market coupling result, the bid and offer prices in all coupled day-ahead markets must be for a comparable product. It is likely that all bids into the central market coupling algorithm in the region will cover both energy and capacity, since this is consistent with the approach in the other European markets.[85] So SEM price bids and the resulting day-ahead price would seem artificially low from the perspective of the market coupling.

Trading Day

For energy products in the SEM, the trading day is currently 06:00 to 06:00 UTC, while that in GB is midnight to midnight UTC and will likely change to 23:00 to 23:00 UTC to align it with the continental trading day of midnight to midnight CET. Therefore, throughout the Internal Electricity Market, both energy and capacity products for the Target Model are therefore aligned to the 'calendar day'.

Aligning all capacity products on SEM - GB interconnectors with those on GB – France interconnectors, i.e. to the 'calendar day', would also mean aligning energy products in the SEM with those in GB in order to ensure efficient use of cross border capacity. The would involve advancing the beginning of the trading day by 7 hours with implications for the timing of the day ahead gate closure, which is currently 10:00. If current lead in times were adhered to, this would imply a gate closure in the SEM at 3 am. Not only would this have resource implications; it would also affect the fuel hedging possibilities currently open to gas-fired generators in the SEM.

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[84] The SEM unit commitment algorithm determines which plant should be committed in both the market and in dispatch based on the consideration of start-up and no load costs as well as incremental costs (i.e., price quantity pairs). The algorithm uses non-linear programming and is likely to be problematic for the central price coupling algorithm which would need to incorporate these non-convexities as part of its optimisation processes.

[85] Both France (under the NOME law) and GB (under the EMR proposals) are proposing to introduce explicit capacity mechanisms into their market designs. However, these capacity mechanisms will not necessarily be based around an explicit capacity payment for the whole market, as in the SEM. The capacity mechanism in France may be based around a capacity obligation on suppliers The Electricity Market Reform (EMR) proposals in GB are considering a range of options, including the introduction of a targeted capacity mechanism (CPM) and market-wide options. For latest on this see Technical Update on Electricity Market Reform: http://www.decc.gov.uk/en/content/cms/legislation/white_papers/emr_wp_2011/tech_update/tech_update.aspx

Hourly and Half Hourly Products

All trade that takes place through the SEM is based on half hourly products. The Target Model is predicated on trade in hourly products in both the day ahead and intra day timeframes.

Intra Day Design

For the intra day timeframe, the SEM's central commitment does not appear to be compatible with implicit continuous trading (the same applies to the MIBEL in Iberia which is considering how to combine continuous trading on its borders with a system of implicit intra-day auctions). The key discrepancies relating to intra day between the SEM design and that of the Target Model are:

- Gate Closure which is hour ahead in many European intra day markets is 20-44 hrs ahead in SEM
- Market clearing auction at intra day in SEM (from mid 2012) whereas most intra day markets in Europe are continuous first come first served marketplaces with no optimisation or pricing of volumes.

The evolution of the intra day Target Model and its relationship to implicit auctions will be an important factor in determining how the SEM implements the cross border intra day requirements of the CACM Network Code.

Annex 4: The Target Model in Detail

The Forward Market

The Target Model for long term capacity allocation and congestion management obliges TSOs to sell cross border capacity forward but leaves open whether this should be Financial Transmission Rights (FTRs) or Physical Transmission Rights (PTRs)[86]. The Target Model (like Nord Pool) is based on a preference for financially clearly forward products based on a liquid day ahead implicit auction. This may fit better with a system of FTRs, as may centralised pool arrangements such as the SEM and MIBEL, which are more suited to financial rather than physical forward markets.

Physical Transmission Rights

Under the present system of PTRs, a capacity holder is given the right to nominate a flow (or an intended flow in the case of the SEM as the flow must be in merit in the SEM ex-ante algorithm) across an interconnector with any unused capacity released by UOISI into the day ahead market. With PTRs, the amount of rights issued cannot exceed the capacity of the line.

PTRs are the dominant form of cross border transmission right in existence in Europe at present[87] and are designed to work with bilateral contracts markets as they allow for trade between a generator and a customer over a congested line based on a nominated flow between two parties. It is this feature of PTRs that makes it difficult for the SEM to align long term auction rules with other interconnectors in its region as the SEM does not have a physical bilateral contracts markets or nomination process.

Financial Transmission Rights

A system of FTRs, on the other hand, involves the entire capacity of the interconnector being included in the day ahead market coupling auction and long term capacity auctioned as financial options or obligations. FTRs are a claim on the congestion surplus that results from day ahead market coupling process. FTR obligations are considered preferable to PTRs or FTR options as they allow for netting of capacity rights which can dramatically increase the competition effect of cross border links. By contrast, the use of PTRs, combined with conservatism on the part of system operators in calculating available transfer capacities, can stifle the extent of trade across boundaries.

The recent consultancy report to the European Commission on Physical and Financial Capacity Rights for Cross Border Trade[88] argues that FTR obligations are a preferable to PTRs options or FTR options as a model for the Internal Electricity Market as:

[86] 'The objective of long-term transmission rights, physical or financial, is to provide market participants with long-term hedging solutions against congestion costs and the day-ahead congestion pricing, compatible with zone delimitation'

[87] FTRs exist mainly in US nodal markets.

[88] See: http://ec.europa.eu/energy/gas_electricity/studies/doc/electricity/2012_transmission.pdf

- they increase competition and efficiency compared with PTRs
- Netting of FTRs allows more competitors into each market
- FTRs netting ability may be more suited to systems with high levels of intermittent generation.

The Day Ahead Market

This is the centrepiece of the Target Model. The capacity allocation method for the day-ahead market in the CACM Framework Guidelines provides for implicit auctions – or market coupling - as a means of integrating electricity markets at the day ahead stage in different jurisdictions. With market coupling the daily cross-border transmission capacity between the various jurisdictions is not explicitly auctioned among the market parties, as is generally the case now in Europe, but is implicitly made available via energy transactions on the power exchanges (PXs) on either side of the border (hence the term implicit auction).

It is important to note that the cross border capacity that is made available for day ahead market coupling is net of any cross-border forward bilateral trading (combined with the use of previously bought physical transmission capacity rights). If capacity bought in long term interconnector auctions is not nominated by the day ahead stage as a result of a cross border trade, the capacity is automatically made available to the day ahead auction under the EU requirement for 'Use it or Lose It'. Therefore, if the current system of physical cross border transmission rights is retained and interconnector capacities are mostly taken up with bilateral physical contracts, the volume of capacity available for market coupling may be low.

An implicit auction means that buyers and sellers on a power exchange benefit automatically from cross-border exchanges without the need explicitly to acquire the corresponding interconnector capacity. Market prices and schedules of the connected power exchanges are simultaneously determined with the use of the available cross border transmission capacity defined by the TSOs. The net result is that market coupling will equalise day ahead prices across adjacent countries where there is sufficient interconnector capacity. This leads to a more efficient use of the daily capacity of the interconnections between the networks of the involved jurisdictions.

Market coupling comprises three essential elements:

- Co-ordinated estimation by TSOs of available transfer capacities on all the interconnectors in the region for the following trading day, which is given to the PXs
- Simultaneous determination by the PXs of prices in the coupled markets and quantities flowing across the interconnectors in the region, using a single pricing algorithm, whose objective function of the algorithm will be to maximise social welfare, defined as: consumer surplus + producer surplus + congestion revenue across the region.
- Cross border clearing and settlement.

The single algorithm will be run by the PXs across Europe, perhaps on a rotating basis, to calculate:

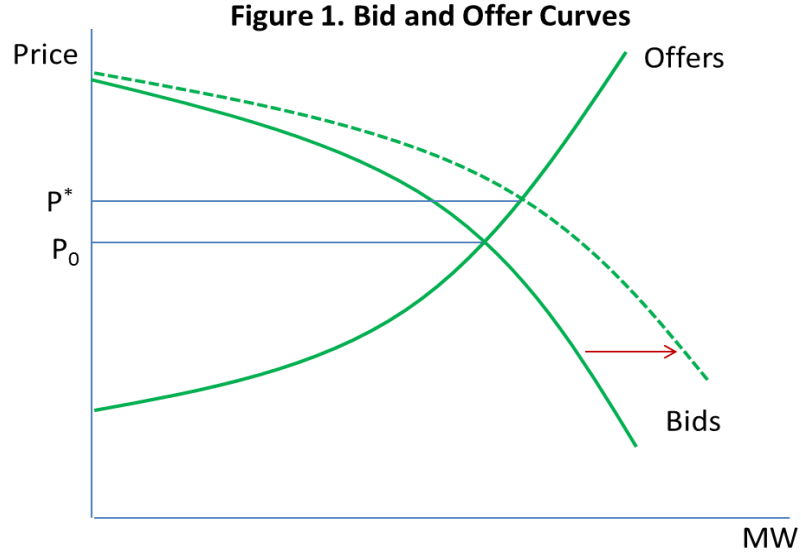
- net export positions and market clearing prices on each market and for each hour;
- the set of executed orders; and
- congestion prices on each congested interconnector.

Economics of Market Coupling

Market coupling involves handling the respective supply and demand curves of each participating power exchange jointly according to the overall merit order - i.e., matching the highest purchase bids and lowest sales bids, regardless of where they have been introduced - but taking into account the available interconnection capacities. The overall aim of market coupling is to maximise the total surplus of all participants, including congestion rent.

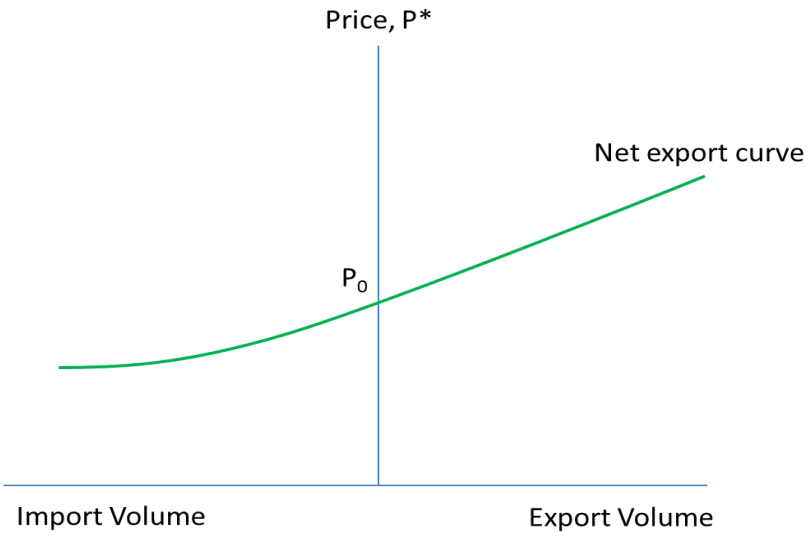
This can be achieved by considering that one zone/jurisdiction will export to another for as long as the marginal offered price in one is lower than the marginal bid price in the other, until the point that prices converge or available cross-border capacity is exhausted. The marginal offer price for exports from one zone is represented by a net export curve. This is derived from the bids and offers by market participants in the zone's power exchange (PX). For each hourly period in the coming day, the PX can represent its received bids and offers as ascending bid and offer curves. An export can be treated as a market bid, moving the overall bid curve across by the export volume. The market-clearing price will increase to from P0 to P*, as shown in Figure 1 below.

Figure 1. Bid and Offer Curves



The relationship between the export volume and P* defines the net export curve. (Imports are treated as negative exports.) The isolated market clearing price, P0, is the price at which the market would clear without market coupling, i.e., where export volume is zero, as shown in Figure 2 below.

Figure 2. Net Export Curve



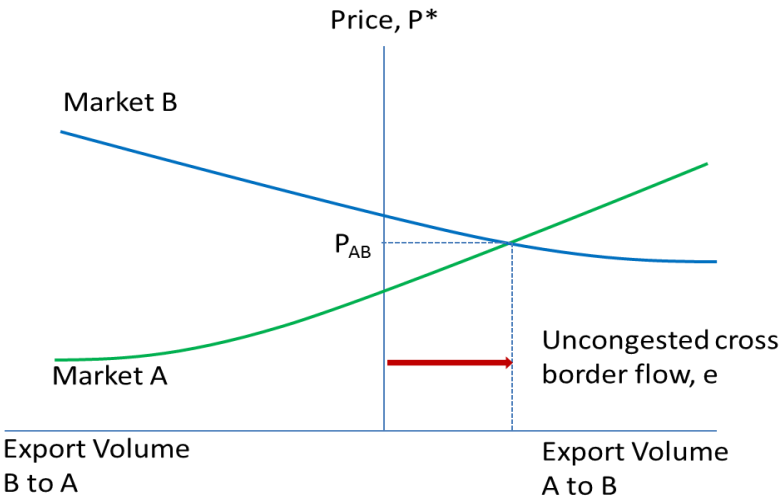
In the two-market example, the export from one market equals the imports of the other. The net export curves for each period from each market can be superimposed to identify the prices that would result in each market corresponding to a particular cross-border volume.

There are two possible outcomes.

Unconstrained Coupling

In this case, the capacity on the interconnector (s) between the two markets/zones is not a binding constraint. So day ahead prices in the two zones will be equalised, as shown in Figure 3. The intersection of the two net export curves for the two markets, A and B, gives the equalised price, P_{AB}, and the corresponding cross border flow that achieves that common price.

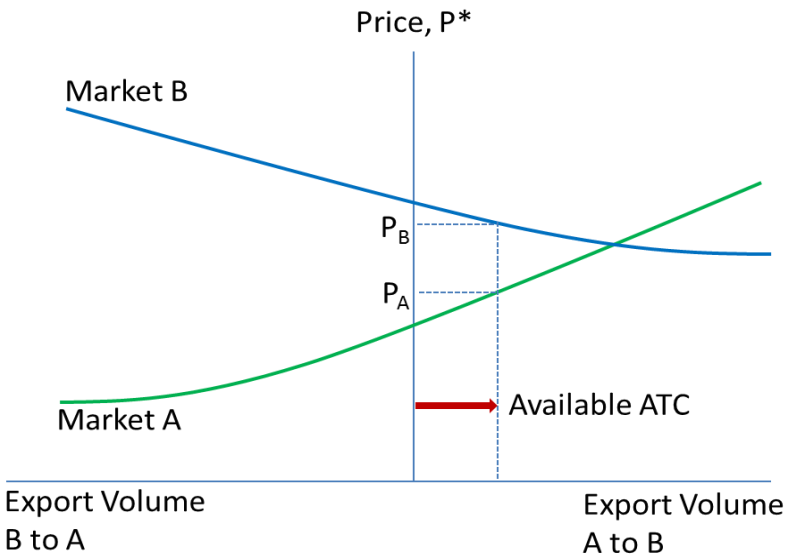
Figure 3. Unconstrained Coupling



Constrained Coupling

Transmission constraints may limit the necessary cross border flows, preventing complete price convergence, as shown in Figure 4. In this case, the day ahead market in the exporting country (A) will continue to clear at a price below that in the importing country (B). The difference (P_B - P_A) times the constrained flow of cross border energy (equal to the available transfer capacity (ATC) on the line) constitutes congestion rent, which will accrue to the interconnector capacity owner, as shown in Figure 4.

Figure 4. Constrained Coupling



Market coupling is an automated process and participants on local power exchanges are not aware, and do not care, that their bids (offers) may be matched with offers (bids) from participants in another bidding zone. While power will flow between zones as a result of coupling, the local power exchange participant has no role in that process. It continues to have a relationship only with its local power exchange, not with the foreign participant or with the owner of the interconnector capacity.

To insulate the local power exchange participant from the market coupling process requires someone to take on the role of the shipping agent. The shipping agent is responsible for nominating in each constituent local market the physical cross border flows resulting from the algorithm's outputs in each market. Effectively, the shipping agent takes title to the cross border energy bought and sold in each constituent market and ensures that the flows corresponding to those executed orders take place. The local power exchange generally acts as the shipping agent.

The Intra Day Market

As a general rule, intra-day markets can be defined as those markets operating after the day ahead spot market closes and before physical gate closure. While intra-day markets have to date been of secondary or tertiary importance in most of continental Europe, there is a growing recognition that they will become one of the cornerstones of the single European electricity market. As intermittent generation (mainly wind and solar) increases as a percentage of the European generation mix, it will be imperative for efficient market

outcomes that market designs allow for shorter gate closure times and adequate intra-day arrangements.

European national and cross-border markets for intraday trading are generally less well developed than equivalent forward or day-ahead markets. However, intraday markets are important as they provide market participants with a wider range of options to balance their position in response to unanticipated changes in production and consumption.

The anticipated increase in renewable generation is a key driver of the need for an efficient intraday market solution. Renewable generation can be difficult to forecast on a day-ahead basis and becomes more predictable closer to real time. As a consequence, intraday markets are likely to see an increase in activity as market participants may trade out imbalances as close to real time as possible.

The intra day target model of Implicit continuous allocation means that market participants are able to match visible (dependent on the transmission capacity) bids and offers on a single European trading platform, the Shared Order Book, on a first come first served basis.

In a continuous trading system, capacity is allocated as the needs of market participants appear. This implies that no congestion occurs until the last trade possible, if any. Consequently, such a mechanism does not require nor provide for any congestion pricing, especially as TSOs are not allowed to set a reserve price. This issue of congestion pricing is a significant outstanding aspect of the Target Model that requires resolution.

An outstanding issue for the intra day market is congestion pricing which is required by the Target Model. With high levels of intermittent generation expected in many European countries in the coming years, the CACM requirement that intra day capacity is subject to congestion pricing will be important in order to ensure that intra day flows are efficient and that both cross border capacity and wind is correctly valued, in particular considering national support schemes for renewable energy.

As an interim measure, ENTSO-E and Europex have proposed to implement an “Elbas-like” solution for the Shared Order Book (SOB) and Capacity Management Module (CMM), with hub-to-hub shipping for standard hourly products and coordinated capacity determination

Interim model in 2012

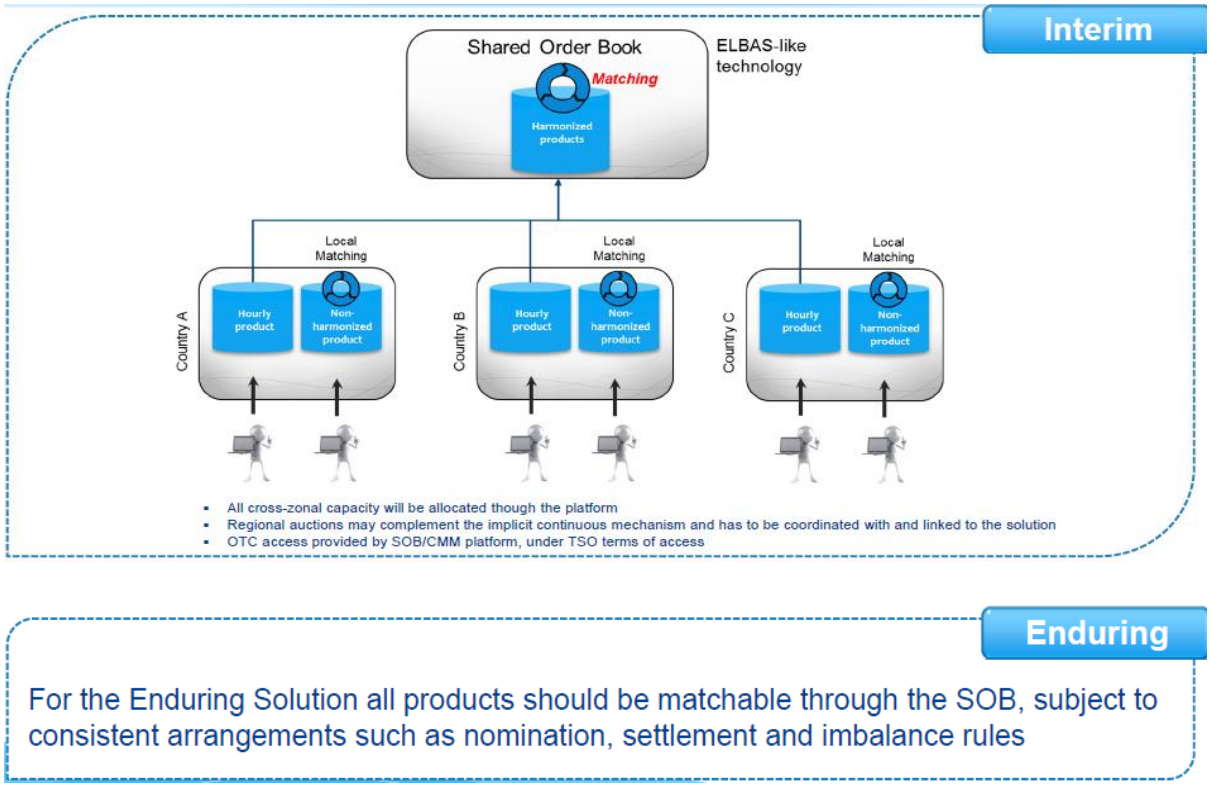
- Market parties able to trade on a continuous basis between participating Member States
- Real time energy transactions between Finland and France
- Enduring model in 2014

Enduring Model 2014

- Implemented on a European wide basis and included additional features
- Reliable capacity pricing reflecting congestion (i.e. in case of scarce capacity)
- Sophisticated products to meet market participants needs

- set out all necessary provisions for the implementation of the pan-European intraday target model supporting continuous implicit trading, with reliable pricing of intraday transmission capacity reflecting congestion[89]

Figure 5 Interim and Enduring Intra Day (Source: ACER Cross Regional Roadmap for Intra Day)



The Balancing Market

The main drivers of European action for the integration of balancing markets should be the contribution to system security and the increase of balancing market efficiency at EU level. The traditional approach whereby balancing is performed at control-area level and which does not allow for the sharing of balancing resources may hamper the further integration of renewable energy sources, and the efficient use of the available generation capacities. As previously stated, ACER are currently drafting Framework Guidelines for Electricity Balancing which will form a key part of the Target Model.

[89] It also:
- defines a harmonised gate closure time for intraday cross-zonal trade
- where there is sufficient liquidity, regional auctions may complement the implicit continuous allocation mechanism.
- require the development of a pan-European shared order book function and a pan-European capacity management module.
- ensures that all cross-zonal intraday capacity is allocated via the pan-European platform