**CONSULTANCY SUPPORT**
**ON MARKET INTEGRATION AND SYSTEM OPERATION**

**REVIEW OF TSO REPORT ON THE DISPATCH MODEL**
**FOR THE ALL ISLAND MARKET/ TRANSMISSION SYSTEM**

# Final Report

**Submitted to:**
**THE COMMISSION FOR ENERGY REGULATION and**
**THE UTILITY REGULATOR, ELECTRICITY, GAS & WATER**

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# TABLE OF CONTENTS

# LIST OF FIGURES

# 1. EXECUTIVE SUMMARY

This Review of the TSO Report on the Dispatch Model for the All Island Market/ Transmission System has been produced for the Commission for Energy Regulation (CER) of the Republic of Ireland and the Utility Regulator (UR) of Northern Ireland, together the Regulatory Authorities (RAs), under the consultancy assignment, *Consultancy Support on Market Integration and System Operation*.

## 1.1. Purpose of Report

The purpose of this report is to provide an independent expert consideration of the TSOs' findings and recommendations relating to system operation issues, and in particular relating to the issue of central dispatch vs. self-dispatch in the context of the European Electricity Target Model for cross-border capacity allocation and congestion management. This report also sets out critical analysis of key points raised by the TSOs.

## 1.2. Background

The Target Model does not explicitly prescribe the form of national wholesale market but it does require compatible cross-border arrangements between Member States. The SEM Committee published a Consultation Paper in January 2012 (SEM-12-004) which set out a number of options for implementing the Target Model in Ireland and Northern Ireland. The consultation responses were reviewed as part of this assignment. The SEM Committee also requested that the project team responsible for this task carry out further exploratory work relating to a number of key issues. One of these key issues relates to the question of the mechanism of dispatch, its relationship to the emerging Target Model, and in particular to explore the issue of central dispatch vs. self-dispatch and the implications for implementation of the Target Model on the island of Ireland.

It is against this background that the TSOs have prepared their report to the RAs on system operations issues, *Dispatch Model for the All Island Market/ Transmission System, 29 August 2012*. Written consideration and critical analysis of that report is contained herein.

Interaction with the TSOs consisted of five iterations of draft reports being provided, with four sets of review and feedback being provided in turn between each version. These responses were provided in written form and verbally in meetings.

## 1.3. The TSOs' Analysis

The TSOs' explain that their report follows on from a previous analysis which shows the SEM is not compliant with the European Target Model, and that the question of self-dispatch vs central dispatch arose from a discussion of future market design options.

Key conclusions of the TSO report are that:

1. Market participants seeking self-dispatch seem to be seeking firmness of their bilateral trading positions (something not related to compliance with the Target Model);
2. Self-dispatch is not a requirement of the Target Model;
3. Central dispatch can operate efficiently in compliance with the Target Model; and
4. The TSOs do not recommend self-dispatch on the island of Ireland, however the TSOs can work with self-dispatch and the system can be feasibly operated under that model. The purpose of their report is essentially to highlight the issues of doing so.

The main technical analysis set out in the report is that self-dispatch on the island of Ireland would involve a high level of interventions (i.e. redispatch actions taken by the TSOs to ensure that the system is operated safely and securely). Interventions, by definition, interfere with the physical firmness of bilateral trading positions in a self-dispatch market model. An illustrative range of 28% to 33% is produced, which represents an estimate of the percentage of the total market as measured by MWh trading volume which would be subject to intervention.

An attempt was made to calculate the level of interventions currently occurring in Great Britain, which is an operative self-dispatch market, for purposes of comparison. A representative value of 8% was produced, although it appears there are several reasons why a fully like-for-like comparison has not been obtained and is perhaps not possible.

The analysis set out in the report also investigates reasons why a smaller market (the island of Ireland) would be expected to have a larger proportion of interventions than a larger market (Great Britain). The impact of a high percentage of renewables and physical isolation are also investigated.

The report points out that compensation mechanisms could be added to a self-dispatch model to achieve "financial firmness", and that financial firmness is already achieved through mechanisms existing in the SEM today under central dispatch.

The report argues that self-dispatch is by definition more expensive than central dispatch, that the dispatch model is one of many considerations of market design for the Target Model, and that the core of the Target Model is in fact a centralised auction.

## 1.4. Main Conclusions from Review and Critical Analysis of the TSO Report

In the Consultant's opinion there are parts of the TSOs' analysis which leave some questions somewhat open-ended. Nevertheless, the TSOs' report is valuable and informative, and is sufficient for the decision-making purpose for which it was required. The Consultant agrees with the main conclusions the TSOs reached.

The main conclusions from this assignment, from the independent review and critical analysis of the TSO report, are as follows:

- There is no compelling need to change the method of electricity system operation on the island of Ireland from a central dispatch model to a self-dispatch model.

- Such a change is not required for compliance with the Target Model. This principle has been agreed by ACER and is consistent with the current drafts of the documents defining the Target Model which do not require a self-dispatch model for Member State trading arrangements.

- Further, while a system of self-dispatch would be feasible on the island of Ireland, the advantages of moving to self-dispatch anyway would not outweigh the disadvantages – for the following reasons:

  - Complying with the requirements of the Target Model will incur an implementation cost. However the level of cost specifically attributable to Target Model compliance should be broadly the same regardless of whether a central dispatch or a self-dispatch model underlies the trading arrangements. This is because the implementation requirements are broadly the same regardless of which model is used.

  - Moving to a self-dispatch model as the underlying basis for market trading would incur significant additional implementation costs that would not be incurred by staying with the central dispatch model. Moving to a self-dispatch model concurrently with complying with the Target Model would be more costly to implement than staying with central dispatch because such a move would require greater changes to the status quo. It would require a fundamental reset of the way that electricity is traded and dispatched on the island of Ireland.

  - There is widespread agreement that the SEM, with central dispatch, has been a success and has served the island of Ireland well. Moving to a self-dispatch model would be risky because it would involve a significant change to the status quo. There is a risk that any new trading arrangements based on self-dispatch would not serve the needs of the island of Ireland as well as the current arrangements do.

  - It does appear that some consultation respondents who favoured self-dispatch in their submissions have not favoured it for reasons associated with the Target Model. They appear to have different motivations, based on a desire for increased firmness in their bilateral transactions. However physical firmness (a guarantee that X MW can be moved from A to B) cannot be guaranteed under either self-dispatch or central dispatch. Physical deliverability is a function of the physical system, and not of the trading model used. The TSOs have produced a reasonable estimate of the level of interventions that would be necessary to ensure system security under self-dispatch in order to convert forecast trading schedules into feasible energy flows.

- Financial firmness is financially equivalent to physical firmness (and therefore has the same value as physical firmness) and is available under either self-dispatch or central dispatch. Under self-dispatch, however, implementation of side-payments would be necessary to ensure financial firmness and this could increase market costs.

- In principle, market efficiency should be good under either self-dispatch or central dispatch. There has been considerable debate on this subject internationally for decades. The debate has not been resolved definitively (in Europe at least) and will not be resolved here. International examples of good and poor markets exist for each market model. Central dispatch was evaluated five years ago as being the best choice for the island of Ireland at the outset of the SEM, and nothing appears to have changed in the meantime that would change that conclusion. Self-dispatch is, however, more consistent with the island of Ireland's nearest neighbour – Great Britain.

- Increasing wind capacity would become increasingly problematic under self-dispatch compared to central dispatch because wind is inherently unpredictable and difficult to balance. Wind output must be balanced in order to ensure system stability, and if the level of wind output is a high proportion of total system generation then the task of wind balancing is increasingly difficult and important. It requires a correspondingly high proportion of dispatchable thermal generation available to manage fluctuations in the wind output. As wind penetration gets to even higher levels it points increasingly to central dispatch which provides the maximum availability of dispatchable thermal generation, necessary to maintain system control.

- Market power mitigation would be problematic under self-dispatch:

    - The Bidding Code of Practice could not be used, because bids would no longer be used as the basis to schedule energy production. Market power would still exist however, so some new market power mitigation mechanism would need to be devised to replace the Bidding Code of Practice. There is no obvious candidate for what that mechanism would be. Increased levels of directed contracts would be a possibility.

    - Price transparency would unambiguously be reduced as a result of self-dispatch. Price-transparency is good for regulatory efficiency including efficient mitigation of market power. Price transparency is also a key contributor to market efficiency and market fairness (allowing small market participants to have the same price information as large market participants).

The rationale underlying each of the above conclusions is expanded upon in the body of this report.

In addition there is significant international precedent supporting a decision to remain with central dispatch:

- The main electricity markets throughout North America are centrally-dispatched and have introduced elements similar to those contained in the Target Model while promoting cross-border efficiency: forward trading; a day-ahead market; intra-day trading; and an imbalances market.
    - They have also evolved following a similar process to the SEM, by starting with a spot market (ex-post market) alone and introducing other forwards markets (such as day-ahead markets) later.
    - A key feature of the transition process in a number of US markets, which has been successful, and which is directly applicable to the SEM, is that the initial centrally-dispatched real-time market with ex-post pricing was left largely unchanged, and a centralised day-ahead market was introduced to support it. Much of the trading liquidity moved to the day-ahead market, and most of the efficiency gains in cross-border trade were achieved in the day-ahead market. However the real-time market remains vital in that it is used for the settlement of deviations between day-ahead volumes and real-time market positions, and the real-time market ultimately drives all market prices.
    - In several cases these new market arrangements have evolved alongside neighbouring self-dispatch markets with which market participants trade.
- Other European markets are staying with central dispatch and intend to comply with the Target Model – most notably Spain and Italy, but also others.

In summary:

- A self-dispatch model is not required to comply with the Target Model. By itself, self-dispatch is not a solution to any issue that has been raised by the requirements of the Target Model.
- The over-arching concern must be what is best for Ireland and Northern Ireland. The disadvantages of self-dispatch outweigh the advantages.
- International experience provides templates for how the Target Model can be implemented in the context of central dispatch.
- The Target Model is continually evolving with new drafts of key documents being produced. It is clearly influenced, in terminology at least, by drafters who are more familiar with self-dispatch models than central dispatch models. It is therefore essential for the RAs to remain part of the process and help ensure that no language be introduced in the future which could be interpreted as *requiring* self-dispatch.

## 1.5. Report Outline

In addition to this Executive Summary, this report contains the following sections:

- Section 2 describes the background to this assignment, the interaction with the TSOs that has occurred, and a summary of the key points of the TSOs' report;
- Section 3 describes the Consultant's assessment of the TSOs' report; and
- Section 4 contains a critical analysis of the key points raised by the TSOs.

# 2. BACKGROUND

The SEM Committee published a Consultation Paper in January 2012 (SEM-12-004) which set out a number of options for implementing the Target Model in Ireland and Northern Ireland. The consultation responses were reviewed as part of this assignment. The SEM Committee requested that the project team carry out further exploratory work in relation to a number of key issues. One of these issues relates to system operation and the interrelations with the emerging Target Model; in particular the issue of central dispatch and the implications for implementation of the Target Model on the island of Ireland. The TSOs compiled a report to the project team on these system operations issues, *Dispatch Model for the All Island Market/ Transmission System, 29 August 2012*.

The purpose of this report (here) is to provide an independent expert consideration of the TSOs' findings and recommendations, considering the possibilities and implications of moving to a less centralised dispatch.

The relevant deliverables set out in the Specification of Requirements for this assignment and for which this report applies are as follows:

- Expert consideration of a report from TSOs on system operation issues; and
- Critical analysis of the key points raised by the TSOs. Points may include necessity for central dispatch, implications in moving to decentralised dispatch, and gate closure times.

This section describes the background to the assessment of the TSO report and the critical analysis of the key points raised by the TSOs, which follow. It summarises the interaction with the TSOs as part of this assignment, and then summarises the main points of the TSOs report.

## 2.1. Interaction with TSOs

Interaction with the TSOs consisted of five iterations of draft reports being provided, with four sets of review and feedback being provided in turn between each version. These responses were provided in written form and verbally in meetings.

### 2.1.1. Draft 1 (received 11 May, 2012, written response on 29 May 2012)

Summary of feedback:

- Suggested a better link to the Target Model – explaining why the issue of self-dispatch is "in play";

- Questioned the relevance of a self-dispatch option where schedules are not required to be balanced;
- Suggested analysis regarding issues of managing congestion under self-dispatch;
- Questioned whether timing differences between SEM and the coupling algorithm are related to the form of market model used; and
- Other: e.g. suggested analysis of market concentration and consequences of self-dispatch on market power mitigation.

#### 2.1.2. Draft 2 (received 20 June 2012 with meeting at the CER offices, written response on 20 June 2012 in form of redline comments reflecting meeting minutes)

Summary of feedback:

- Suggested format for an Executive Summary and key points on which we expect TSO conclusions (as discussed in meeting);
- Requested expanded and detailed analysis regarding interventions, the reasons for interventions, and the correct interpretation of the intervention statistics estimated by the TSOs;
- Requested more detail on objectives of market participants, as understood by the TSOs;
- Requested clarification on the TSOs definitions of self-dispatch and central dispatch;
- Queried criteria used to conclude the island of Ireland is too small for self-dispatch – how small is too small?;
- Requested that a distinction be made between financially firm and physically firm, and that central dispatch and self-dispatch are compared on that basis;
- Suggested major reorganisations to the paper to improve its clarity; and
- Reiterated feedback on draft 1.

#### 2.1.3. Draft 3 (received 18 July 2012, written response on 30 July 2012)

Summary of feedback:

- Requested a deeper analysis supporting the conclusion that 30% of transactions (as measured by MWh volume) would require intervention. Requested the use of additional measurements and the provision of additional supporting calculations;

- Requested that the TSOs attempt to quantify and compare interventions with interventions in Great Britain on a like-for-like basis;

- Requested that the TSOs attempt to isolate the impact of reserve and other ancillary services on interventions (since these interventions could potentially be mitigated by alternative reserve/ ancillary services arrangements);

- Requested analysis of specific hours and circumstances with interventions;

- Requested a number of clarifications to specific statements in the TSO report;

- Requested clarification on why heavy interconnectivity in small systems such as Belgium is interpreted as an advantage for self-dispatch rather than a disadvantage; and

- Reiterated feedback from earlier drafts.

#### 2.1.4. Draft 4 (received 8 August 2012, feedback provided at meeting at SONI's office on 13 August 2012)

Summary of feedback:

- Discussed feedback provided on the 18 July draft;

- Discussed steps to improve the comparability of the 'interventions' measure between the SEM and Great Britain; and

- Suggested a modelling basis for predicting how the level of interventions is expected to change over time, and how to include wind generation in the overall measure of interventions;

Draft 5 (the final draft received as of the date of this report) was received on 29 August 2012.

## 2.2. Summary of TSO Report

The following is a brief summary of the main points of the final (5th Draft) version of the TSOs report. This is a summary conducted on an independent basis for the purposes of this assignment, and does not necessarily reflect the choice of words or emphasis used by the TSOs. The summary is provided in bullet point form, for simplicity.

### 2.2.1. Background

- The report follows on from an analysis that shows the SEM is not compliant with the European Target Model. The most significant differences are a lack of a day-ahead market, and a lack of *continuous* intra-day trading.

- The question of self-dispatch vs central dispatch arose from a discussion of future market design options.

### 2.2.2. Conclusions

- The market participants seeking self-dispatch seem to be seeking firmness of their dispatch decisions. (Other market participants, however, recognise the importance of central dispatch and have not sought a change.)
- The level of interventions required to securely manage the system under self dispatch is high. It is higher on a percentage basis than Great Britain, and is not comparable to smaller self-dispatch market in Central Europe.
- The high level of interventions required to securely manage the system will lead to significant inefficiencies in providing necessary reserve margins.
- These interventions also mean that self-determination of the firmness of bilateral market positions (i.e. physical bilateral contracts) is not achievable.
- The impracticality of self-dispatch will increase over time as the proportion of wind capacity increases.
- Self-dispatch is therefore unattractive and ineffective.
- Self-dispatch is not a requirement of the Target Model, and central dispatch can operate efficiently in compliance with the Target Model.

### 2.2.3. Analysis

- The report defines central dispatch and self-dispatch (and also considers a variation in which the TSO accepts generator nominations which are not required to be balanced with demand).
- The report defines factors that require the TSO to deviate from market nominations ("interventions") and provides detailed descriptions of each. These consist of:
  - Provision of system services (reserve and reactive);
  - System constraint management;
  - Wind and demand forecast errors;
  - Generator availability redeclarations (the report sets out an analysis of historical changes in availability); and
  - Renewables.

- The report conducts an analysis to estimate the likely level of interventions that would occur. A comparison is made between the SEM schedules (MSQs) and dispatch quantities (DQs) for 2010 and 2011.
  - The SEM schedule represents a possible schedule that market participants would arrive at under self-dispatch because it represents the most efficient matching of supply to demand where system constraints are not taken into account. (The SEM schedule contains no wind or demand forecasting errors however because the SEM schedule is produced after the event.)
  - The dispatch schedule represents the minimum-cost deviation from the SEM schedule necessary for secure operation of the system.
  - The difference between the dispatch schedule and the SEM schedule is therefore a measure of the degree to which the TSOs would need to intervene for the reasons listed above (except wind and demand forecast errors and differences from other renewables, since these are already taken into account in the SEM schedule).
- The results are (broadly) that in an average hour:
  - 17% of thermal energy, as measured by MSQ, was redispatched in 2010 and 21% in 2011. I.e. if 1000 MWh was scheduled to be produced by thermal generators in 2011, then 210 of those MWh would be reallocated to solve system constraints. One subset of thermal generators would have their dispatch quantities increased by 210 MWh and another subset would have their dispatch quantities decreased by 210 MWh.
  - Measured as a percentage of total system demand (i.e. including wind and the interconnector) the 17% and 21% values fall to 14% and 16.5% respectively for 2010 and 2011. The TSO analysis reports a headline figure of 28% in 2010 and 33% in 2011, being that (in 2011 for example) 16.5% of change is thermal generation increasing its output, and 16.5% of change is thermal generation decreasing its output.
- A detailed analysis is provided for a specific week (the week starting February 19 2012) which investigated specific instances of difference between MSQ and DQ for specific generating units, and the likely (predominant) reasons for those differences. The overall level of intervention for that week was 30% (using the same metric above that arrived at 28% for the 2010 year and 33% for the 2011 year).
- The report points out that in practice the interventions would need to take the form of a balancing mechanism/ balancing contracts. The TSOs would need access to dispatchable capacity to ensure that the transmission system was securely operated in real-time.
- The report attempts to calculate the equivalent level of intervention currently occurring in the self-dispatch market in Great Britain, for purposes of comparison. An analysis is

performed on published GB data for "balancing services". An exact comparison is not possible since the published data appears to exclude some items, and the underlying data was not made available. The most comparable figure appears to be a value of 8% (estimated for 2011/2012) for the UK, which is compared to the range of 28% to 33% described above for the island of Ireland.

- The report describes, quantifies and compares key technical factors in the Great Britain and island of Ireland market, and in particular those which contribute to the need for interventions quantified above. The report emphasises that the SEM is often compared to Great Britain, however the SEM is small, isolated, and has a higher percentage of renewables.
- The report comments on technical factors influencing the choice of dispatch model, which are listed as:
  - System frequency;
  - Demand;
  - Size of the largest single credible contingency;
  - Capacity of the transmission network; and
  - Market participant behaviour.
- The report discusses the implications of physical vs. financial firmness for market participants. Compensation mechanisms could be developed to achieve "financial firmness" under self-dispatch.
- The report argues that self-dispatch is not a requirement of the Target Model, that the TSOs have previously demonstrated feasible compliance options that keep central dispatch, that Spain and Italy have developed options to maintain intraday auctions to comply with the Target Model, and that the TSOs and MO are confident that both:

  (a) Central dispatch can be maintained for compliance with the Target Model; and

  (b) Central dispatch is the best choice for the island of Ireland.

#### 2.2.4. Bottom Line

The TSOs argue that:

- Self-dispatch is less efficient than central dispatch;
- The dispatch model is one of many considerations of market design;
- The core of the Target Model is in fact a centralised auction (i.e. the day-ahead coupling algorithm);

- The current SEM will need to change to comply with the Target Model, and the requirement for continuous intra-day trading is a particularly difficult issue. This is a problem all European markets are facing. It is not a question that the SEM will change as a result of compliance with the Target Model – this is taken as given – but rather that central dispatch is not one of the factors that is required to change;
- Further, the TSOs do not recommend changing to a self-dispatch model on the island of Ireland (for any other reason);
- The TSOs can, if required, work with self-dispatch and the system can be feasibly operated under that model; and
- The purpose of their report is to highlight the issues of doing so.

# 3. ASSESSMENT OF THE TSO REPORT

The TSOs' report is valuable and informative, and the TSOs have responded to most of the assessments, concerns, queries, requests for gaps to be filled, and requests for clarifications that have been requested of them throughout the iterative process. Nevertheless in the Consultant's opinion there are parts of the TSOs' analysis which leave some questions somewhat open-ended.

This section discusses the focus on interventions in the TSOs report and lists some aspects of the report which ideally would have been expanded upon.

## 3.1. Interventions

The main quantitative output provided by the TSOs' analysis is the level of interventions expected in a self-dispatch market model on the island of Ireland.

The level of interventions is the right metric to be evaluating because:

1. It represents the extent to which self-dispatched bilateral transactions cannot be physically firm for technical reasons (i.e. for reasons of network topography and maintaining security standards); and

2. It is reasonable to infer that market efficiency could decrease as the level of interventions increases. This is because the intervention mechanisms for congestion management, for provision of ancillary services, and for provision of imbalance energy are by definition separated from the mechanism for energy scheduling in the self-dispatch model. To the extent the magnitude of these interventions increases and encroaches on the energy schedule, it becomes less likely that the overall solution will be the least-cost one. At low levels of intervention there might be no material difference, but at higher levels of intervention the differences could be material.

Estimating the level of interventions is nevertheless an imprecise science. For example, the starting point for comparison in the TSOs' analysis is the SEM schedule. The SEM schedule is an optimised match of supply with demand (using known production costs) and ignoring system constraints. It is unlikely that decentralised market participants could arrive at exactly the same most-efficient matching of supply to demand with incomplete information on each others' bid and offer prices and quantities, and with no requirement for generators to reveal actual production costs. It isn't clear though whether a less-efficient market schedule would lead to more interventions or less.

Also, the level of interventions to expect in a self-dispatch market is a function of the form of the balancing mechanism/ balancing contracts that are used to procure energy for use in interventions. The TSO analysis implicitly assumes that they are procured in the most

efficient manner possible – i.e. with all system generating capacity offered to support interventions, and with all such capacity being offered at its actual cost. This might result in a conservative estimate of the volume of interventions, meaning that it might result in an under-estimate the volume of interventions required in practice.

Overall however, the intervention metric is the appropriate metric to focus on, and the TSOs' methodology for estimating the volume of interventions is reasonable given the limitation of not having actual historical data on self-dispatch on the island of Ireland.

## 3.2. Open-Ended Questions

Ideally the TSO report would have expanded upon the following points:

- The conceptual basis for the need for interventions is clear, as is the rational for the island of Ireland requiring a greater rate of interventions than Great Britain. What is less clear is the question of: at what point does the level of interventions move from being manageable or reasonable, to being "inefficient, unattractive and ineffective"? Using the numbers calculated it seems that 8% is manageable, but that 28% to 33% would not be. By implication the threshold is somewhere in between. It is certainly a difficult question to answer, yet implicitly the TSOs have concluded a threshold has been crossed without defining what that threshold is.
- The comparison with the level of interventions in Great Britain is valuable, but it is difficult to be clear about the extent to which the two calculations are comparable. As the TSOs acknowledge, some of the component values making up the 8% are not clear.
    - For example, if a separate arrangement (such as a forward market for reserves contracts) was put in place on the island of Ireland to set aside generating capacity for operating reserves so that energy from this capacity could not be self-dispatched, this would presumably decrease the level of interventions subsequently required. (It would also presumably increase overall system dispatch costs because reserves would no longer be co-optimised with energy dispatch.) It is not clear how this might be evaluated, however, or whether might this be a more relevant comparison to the case of Great Britain.
- It would have been useful to evaluate how the rate of interventions (reported as 28% in 2010 and 33 in 2011%) is expected to change in the long-term – e.g. in 2020 – using PLEXOS modelling, particularly given the apparent increase between 2010 and 2011 and given the expected increase in wind capacity by 2020.
- It would have been useful to analyse how the rate of interventions changes in the short-term – e.g. the hourly maximum intervention, minimum intervention, and the volatility of intervention levels. This is of interest because if the rate of interventions is unpredictable or otherwise highly volatile then it means the TSOs would need access to

more dispatchable capacity to manage system security than would otherwise be the case. If the average rate of interventions in 2011 necessitates that 16.5% of system load must be reconfigured to be produced by a specific subset of generators, then it stands to reason that in some hours the value will be higher than 16.5% and in others it will be lower. The TSOs would need to access dispatchable capacity to accommodate the *maximum* level of interventions that might be required in a given dispatch period – not just the *average* level of interventions. Also, the identity of which generators are needed to provide this energy may change from hour to hour and otherwise over time – meaning that there might need to be further safety margins built in to ensure that not just the right total amount of dispatchable capacity is available, but also that it is in the right locations.

- It would have been helpful to more fully consider the consequences of wind in the calculation of interventions (and how increased wind capacity over time affects that calculation). The calculation appears to be under-estimating the level of interventions required to manage the system because the calculations assume wind is perfectly predictable. This could mean that the overall rate of interventions has been significantly under-estimated.

- The report describes that small systems within Europe, which could be compared to the island of Ireland, are interconnected with AC interconnectors. These systems become an area within a very large system as opposed to a synchronous island system which has to control frequency with its own indigenous plant. In essence the small systems in Europe are part of one bigger system, whereas on an island with DC interconnection the SEM is described as not having this advantage. However the TSOs have not explained clearly why a high level of interconnection is necessarily an advantage.

- The discussion of an option where generators could self-dispatch schedules that don't have to be balanced is at best unclear, and in any event is seemingly irrelevant. It does not seem like it could be a feasible option under any reasonable scenario. Someone would have to purchase the power (at some price) and there would have to be some restriction on the energy that generators could force onto the system.

- A fuller understanding of how the TSOs envisage financial firmness would be achieved in a self-dispatch model would have been helpful. It is not clear how financial firmness under self-dispatch would best work in practice on the island of Ireland, particularly when generators' prices for contracted energy are not revealed to the TSOs. It would also have been helpful to evaluate any impact on market efficiency of offering financial firmness under self-dispatch.

- As an extension of the point above, it would have been useful to contrast how financial firmness could be obtained in a self-dispatch model (on one hand) with the case of CFDs (on the other hand) – since CFDs can be used with central dispatch to achieve financial firmness. The TSO report does discuss the use of constraint payments (based on actual production cost) for the difference between a generator's dispatch and its market

schedule. However the more general mechanism for achieving financial firmness in the SEM is to enter into a CFD:

- The CFD quantity does not need to reflect MSQ and can be arranged at any time in advance of real-time.

- If a generator matches its CFD quantity with its production availability it can be confident that, if available, either:

  (a) It will generate energy, in which case its net proceeds will equal the CFD price for the quantity concerned; or

  (b) It will not generate, which must mean that the market price is lower than its production costs. In this case it will effectively purchase from the market instead of contracting to match the contract quantity, and its profit will be higher as a result (since the market price is less than its production costs).

The case of MSQ is an interesting case for two reasons. First, MSQ is a reasonable estimate of the contract positions that participants in a self-dispatch market would reach. Second, the SEM ensures that MSQ is financially firm since any interventions which cause dispatch quantities to differ from MSQ are paid for. But the ability to use CFDs in the centrally-dispatched model (they are not available in the self-dispatch model) goes beyond MSQs and allows market participants to be financially firm at any quantity level.

- Further linkage or discussion of the elements of the Target Model which gave rise to the discussion of self-dispatch would have been helpful in the TSOs report. For example: illustration of how key issues such as intraday gate closure give rise to equivalent implementation issues under central dispatch or self dispatch. It would also have been useful to have the TSO's insight on the day-ahead coupling algorithm of the Target Model, how that is a centralised process, and potential linkages between that and central dispatch at the SEM level.

- There are a number of important implications for market power mitigation which the TSOs have not reported on in their analysis. In particular, the Bidding Code of Practice could no longer be used in its current form with self-dispatch because bids would no longer be used as the basis to schedule energy production. Market power mitigation is not a TSO responsibility but nevertheless it is a relevant factor.

In summary, the Consultant believes there are a number of items which could have been clearer or which would have been useful to expand upon in the TSO report. Nevertheless, the approach used by the TSOs in their analysis is reasonable. In the opinion of the Consultant the output is valuable and informative and is sufficient for the decision-making purpose for which it was required.

The following section sets out some critical analysis of key points raised by the TSOs.

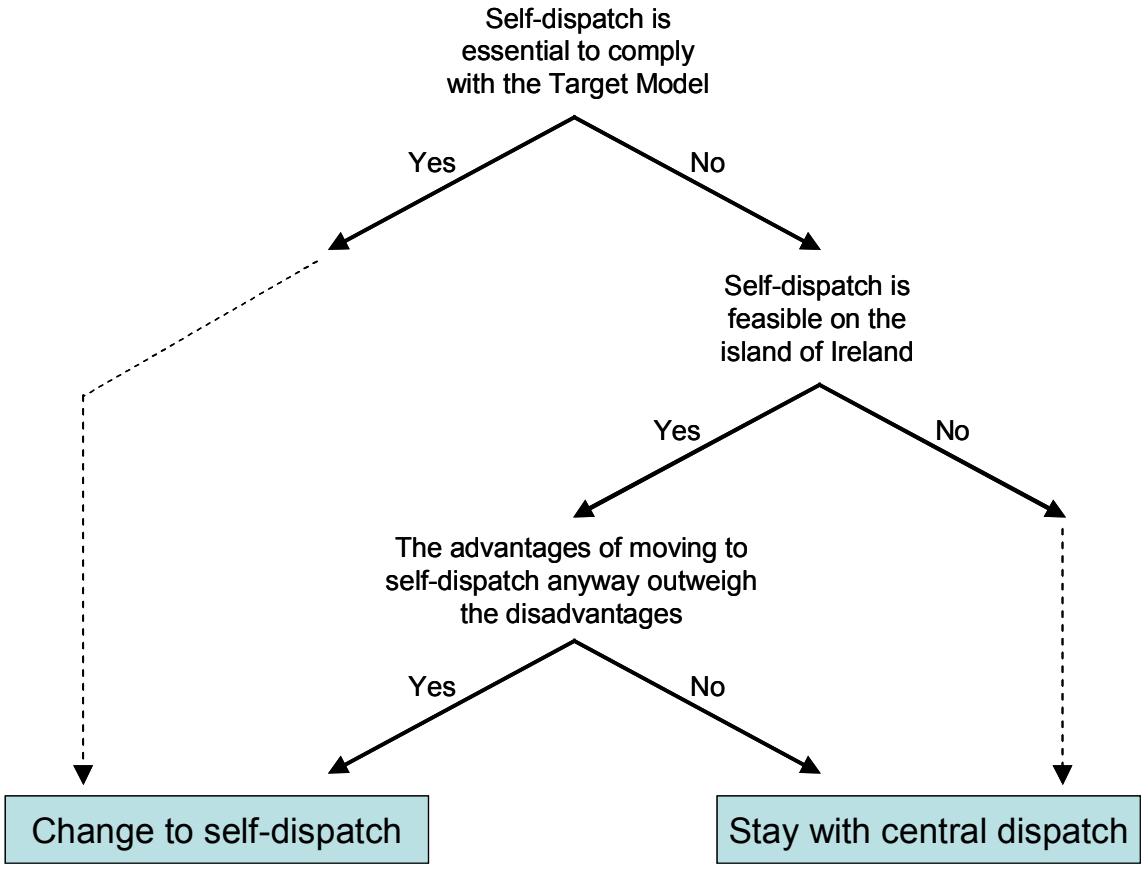
# 4. CRITICAL ANALYSIS OF KEY POINTS RAISED BY THE TSOs

## 4.1. Decision-Making Framework

Discussions regarding the decision of central dispatch vs. self-dispatch have at times been clouded by simultaneously mixing the issue of compliance with the Target Model with an analysis of the implications of self-dispatch.

The decision tree illustrated in Figure 4.1 is a suggested approach for parsing the decision-making process. In summary, the decision tree starts with the question of whether *self-dispatch is essential to comply with the Target Model?* If it is essential, then it is essential that the SEM should change to self-dispatch (assuming that compliance with the Target Model is non-negotiable). If self-dispatch is not essential, then a threshold question is whether *self-dispatch is feasible on the island of Ireland?* If it is not feasible, then it is inevitable that the SEM must retain central dispatch. If self-dispatch is not essential but is feasible, then there remains only one relevant question: *do the advantages of moving to self-dispatch anyway outweigh the disadvantages*?

**Figure 4.1: Decision Tree for Evaluation of Method of Dispatch**



### 4.1.1. Is self-dispatch is essential to comply with the Target Model?

The TSOs have clearly responded to the first question in the decision tree in the negative. Self-dispatch is *not* essential to comply with the Target Model. The TSOs are the entities most qualified to address this question because the TSOs operate the system and have first-hand knowledge of the system's dispatch requirements.

It is also the expert opinion of the Consultant that self-dispatch is not essential to comply with the Target Model. The reasons for that opinion are as follows:

- By itself, self-dispatch is not a solution to any issue that has been raised by the requirements of the Target Model.
- *If* the Target Model required matched physical transactions (the defining characteristic of self-dispatch) for cross-border trade, this could be accommodated without necessitating that the internal trades in the SEM also be based on self-dispatch. Self-dispatch, as a market model, can be thought of as a subset of central dispatch. In principle, central dispatch is convertible to self-dispatch in whole or in part by dropping the Bidding Code of Practice and requiring generators who want to schedule energy to nominate themselves as must-run and to specify and match off-take counterparties. The TSOs must nevertheless retain some proportion of central dispatch – they must always do this – because they need a mechanism to ensure they have enough dispatchable generation still bidding so they can manage the necessary interventions in real time to securely operate the system. The only other difference is a change in settlement arrangements.
- International experience provides templates for how the key features of the Target Model can be implemented in the context of central dispatch. This point is discussed in more detail in Section 4.3.5.

Notwithstanding the above, the Target Model is continually evolving with new drafts of key documents being produced. It is clearly influenced, in terminology at least, by drafters who are more familiar with self-dispatch models than central dispatch models. It is therefore essential for the RAs to remain part of the process and help ensure that no language be introduced in the future which could be interpreted as *requiring* self-dispatch.

Returning to the decision tree then, the far left arm can be cut. The next (threshold) question is whether *self-dispatch is feasible on the island of Ireland?*

### 4.1.2. Is self-dispatch feasible on the island of Ireland?

This is a purely technical question, to which the TSOs have answered in the affirmative. Self-dispatch *is* feasible on the island of Ireland. So the far right arm of the decision tree can be cut.

The only remaining relevant issue then is: do the advantages of moving to self-dispatch anyway outweigh the disadvantages? Put differently: *what is best for Ireland and Northern Ireland?*

If the advantages of self-dispatch outweigh the disadvantages then the market should move to self-dispatch. If, on the other hand, the disadvantages outweigh the advantages then the market should stay with central dispatch.

A sensible approach to answering the question is to define relevant criteria based on the key points raised by the TSOs, and other criteria as appropriate, and to evaluate how each of the two options is expected to perform on each criterion. The best choice is the option which performs best overall in the evaluation.

## 4.2. Relevant Criteria

The Consultant believes the relevant list of criteria is as follows:

1. *Cost to comply with the requirements of the Target Model*: Meaning the cost, all other things aside, of meeting the specific new requirements that have been imposed by the Target Model;
2. *Cost to implement market trading arrangements*: Meaning the cost of implementing any new trading arrangements that impact the way electricity is traded within the island of Ireland;
3. *Risk*: Meaning the risk of worse than expected cost outcomes, market efficiency outcomes, market power outcomes, or system security outcomes – or the risk of other negative outcomes as a result of changes to the market rules;
4. *Market efficiency*: Meaning short-term and long-term market efficiency. Short-term efficiency is the efficiency of dispatch and consumption decisions (for dispatch, in particular, it is the question of whether the truly least-cost set of generators is running in a given moment). Long-term market efficiency is linked to short-term efficiency and refers to the extent to which the market signals efficient investment incentives – particularly for new generation;
5. *Consistency with international best-precedent*: Meaning consistency with other markets that have demonstrated themselves as being workable and efficient, in particular for comparable functions that will be introduced by the Target Model;
6. *Consistency with neighbours*: Meaning the extent to which the resultant trading arrangements will be consistent with Great Britain, and to a lesser (but still important) extent with the other Member State European countries;
7. *Control of market power*: Meaning the extent to which market power can be efficiently mitigated;

8. *Price-transparency and regulatory visibility*: Meaning the extent to which prices are clear and available to all market participants and market observers. This is important so that some market participants – e.g. small ones – are not at a competitive disadvantage to others – e.g. large ones. It is also important so that the RAs have a clear picture of how the market is performing, which is particularly important for protecting final consumers, observing market power, and for mitigating market power – and for taking other regulatory actions as necessary;
9. *Ability to cope with increasing wind penetration*: Meaning the ability of the market to remain efficient, workable and secure if the percentage of wind generation on the island of Ireland increases as it is expected to do in the next decade and more;
10. *Ability to allow participants to be physically-firm*: Meaning the extent to which participants can be guaranteed that X MW can be generated at location A (by a nominated generator) and moved to location B (to a nominated load) if requested by the market participants concerned. Put differently, the extent to which a market participant can nominate a physical position and have the TSOs guarantee that it will be honoured;
11. *Ability to allow participants to be financially-firm*: Meaning the extent to which participants can be guaranteed the financial equivalent of physical firmness. Put another way, the extent to which a market participant (normally a generator) will be no worse off financially if the TSO does modify its desired position; and
12. *Cost (as measured by market efficiency) of making participants financially firm*: Meaning the cost of ensuring financial firmness, and any implications that might have for market efficiency.

## 4.3. Evaluation of Dispatch Models

The following is an evaluation of self-dispatch vs. central dispatch for each of the criteria just listed. Figure 4.2 contains a summary of the evaluation. Overall, central dispatch is preferred – being preferred to or broadly equivalent to self-dispatch on all criteria except consistency with neighbours.

**Figure 4.2: Summary of Evaluation of Options**

| | | Options | |
|---|---|---|---|
| Criteria | | Change to Self-Dispatch | Stay with Central Dispatch |
| 1 | Cost to comply with the requirements of the Target Model | Same | Same |
| 2 | Cost to implement market trading arrangements | High cost | Low cost |
| 3 | Risk | High risk | Low risk |

| Criteria | | Options | |
|---|---|---|---|
| | | Change to Self-Dispatch | Stay with Central Dispatch |
| 4 | Market efficiency | Good | Good |
| 5 | Consistency with international best-precedent | Good | Good |
| 6 | Consistency with neighbours | More consistent | Less consistent |
| 7 | Control of market power | An inherent problem | Market power already mitigated |
| 8 | Price-transparency and regulatory visibility | Low visibility | High visibility |
| 9 | Ability to cope with increasing wind penetration | Poor ability | Better ability |
| 10 | Ability to allow participants to be physically-firm | Poor | Poor |
| 11 | Ability to allow participants to be financially-firm | Good | Good |
| 12 | Cost (as measured by market efficiency) of making participants financially firm | High cost | Low cost |

#### 4.3.1. Cost to comply with the requirements of the Target Model

Complying with the requirements of the Target Model will incur an implementation cost. However the level of cost specifically attributable to Target Model compliance should be broadly the same regardless of whether a central dispatch or a self-dispatch model underlies the trading arrangements. This is because the implementation requirements are broadly the same regardless of which model is used.

For this reason the two options score (broadly) evenly on this criterion.

Key items that are entirely new and/or require change under either market model include:

- A day-ahead market (incorporating a day-ahead coupling algorithm);
- Continuous intra-day trading; and
- Different gate closure times.

In the context of a Target Model-compliant centrally-dispatched model, the existing SEM market clearance (ex-post) is the balancing market and this would be largely unchanged.

The balancing market is the most important market for price-formation in centrally-dispatched systems because the alternative to participating in a forward market is always to participate in the balancing market.

#### 4.3.2. Cost to implement market trading arrangements

Moving to a self-dispatch model as the underlying basis for market trading would incur significant implementation costs that would not be incurred by staying with the central dispatch model. Moving to a self-dispatch model concurrently with complying with the Target Model would be more costly to implement than staying with central dispatch because such a move would require greater changes to the status quo. It would require a fundamental reset of the way the SEM is dispatched within the island of Ireland, and in the way that electricity is traded. As described above, staying with central dispatch would mean that, under the Target Model, the current SEM market clearance would be the balancing market (in the terminology of the Target Model) and the method of dispatch would be unchanged.

For this reason central dispatch scores higher on this criterion.

#### 4.3.3. Risk

There is widespread agreement that the SEM, with central dispatch, has been a success and has served the island of Ireland well. A self-dispatch model would be more risky because it would involve a significant change to the status quo. It would represent a fundamental reset of the existing dispatch and market arrangements, and there is a risk that any new arrangements based on self-dispatch might not work as well.

There is a risk that market power mitigation, which also appears to be working well under central dispatch, would not work as well under self-dispatch. This point is discussed in more detail below.

For these reasons central dispatch scores higher on this criterion.

#### 4.3.4. Market efficiency

Good market efficiency should be achievable under either self-dispatch or central dispatch. International examples of good and poor markets exist for each. This debate has been almost philosophical in nature and has been continuing now for more than 15 years. A review of that debate is beyond the scope of this paper and many stakeholders at this time have taken entrenched positions. For the record, the Consultant's view is that central dispatch is more efficient because the highest value set of trades is arranged in a single and efficient market-clearing auction. There is no restriction of information (e.g. an expensive generator being dispatched because it wasn't known that a cheaper one was available) or asymmetry of information (e.g. bigger participants having better price information than

smaller participants). Further, energy schedules are co-optimised with congestion management, ancillary services and imbalances. The decision-making process leading to the implementation of the SEM reached a similar conclusion. Arguments in favour of self-dispatch also exist – for example that generation companies understand the economics of their facilities better than system operators do, or that bidding functions are insufficiently representative of true cost functions. However, for the purpose of this paper, this point can probably best be set aside – given the long history of debate on the subject.

The two options therefore score evenly on this criterion.

#### 4.3.5. Consistency with international best-precedent

Consistency with international best-precedents can similarly be debated. Most of the genuinely competitive wholesale markets in the world, as measured by MWh traded, use central dispatch. Much of Europe – Northern and Central Europe in particular – use a form of self-dispatch.

Central dispatch markets in North America, especially, have already been demonstrated to be working successfully and efficiently, with full competition (i.e. market concentration reduced to very low levels), inclusive of many comparable functions that will be introduced by the Target Model.

A good example is the implementation of day-ahead markets, which are in place in many parts of the United States:

- The typical progression in United States electricity markets was to start with a centrally-dispatched spot market in which prices were determined ex-post – just as in the SEM today.
- Day-ahead markets were added later for a variety of reasons (one of which included improving the efficiency of cross-border trade).[1]
- The day-ahead markets involve a forward settlement for energy cleared in a day-ahead auction. (Cross-border transactions/ external market participants also participate in that auction.)
- The existing spot market was retained and used for settlement of deviations between the day-ahead settlement and real-time consumption/ production. (Mechanically the day-

[1] Another reason in the United States was to tie unit commitment decisions (for thermal units with high start-up costs) to an assurance that start-up costs would be recovered in the following day. I.e. if a unit is selected in the day-ahead market (where its bid price can be inclusive of a start-up component) then it receives a forward commitment that all of its costs as offered will be recovered by the price received so long as it follows dispatch instructions from the system operator the following day.

ahead process works much like a day-ahead market for CFDs: the CFD strike price is the day-ahead market price, the CFD quantity is the day-ahead market-cleared quantity, and the CFD is settled against the real-time price – in practice the mechanism is not referred to as a CFD, but rather as a "two settlement system".)

Electricity Markets in the United States additionally allow for physical bilateral transactions on a cross-border basis (i.e. self-dispatched cross-border transactions) using a system called OASIS.[2] Various gate closures exist in different markets for these transactions depending on system operator requirements.

Consistency with international self-dispatch markets which comply with the Target Model can be assumed to be achievable, if not today: Northern and Central European markets will eventually demonstrate compliance with the requirements of the Target Model because they have to.

Like market efficiency, international comparisons can be a highly-charged issue. In any event it should be assumed that workable and efficient precedents for both central dispatch and self-dispatch can be found internationally and for this reason the two options score evenly on the international best-precedent criterion.

#### 4.3.6. Consistency with neighbours

Self-dispatch is more consistent with the island of Ireland's nearest neighbour – Great Britain. For this reason self-dispatch scores higher on this criterion.

Consistency with neighbours is not, by itself, a critical criterion however. The over-arching objective of the Target Model is to maximise the efficiency of cross-border trade, and if consistency with neighbours was a strong driver of that efficiency then it would be important. But there is no reason to believe that central dispatch would have a material effect on the efficiency of trading with a self-dispatched neighbour. The same mechanisms for cross-border trade under the Target Model could exist, regardless of whether the island of Ireland is internally dispatched on a centralised basis or using self-dispatch.

For example, many of the efficiency benefits of improved cross-border trading are expected to come in the day-ahead timeframe. The day-ahead coupling algorithm can work in exactly the same manner to schedule interconnector flows regardless of whether central dispatch or self-dispatch is subsequently used to dispatch the internal market. In either case the result of the coupling algorithm is the same set of day-ahead scheduled flows on the interconnector(s).

[2] Open Access Same-time Information System

The situation is similar for cross-border transactions arranged on a forward (pre day-ahead) and intraday (post day-ahead basis). The mechanisms for trading in these timeframes haven't been established yet, and in the case of intra-day at least they are likely to necessitate physical capacity reservations on cross-border interconnectors in situations where the transactions are between member states.[3] Regardless of dispatch model, the interconnector flow position eventually scheduled as of real-time represents a physical position that the dispatch process must accommodate – like extra load in the case of exports, or a reduction in load in the case of imports. The dispatch process for the internal market (whether it be central dispatch or self-dispatch) then matches the net local load with local generation.[4]

The United States doesn't have a continent-wide day-ahead coupling algorithm and in that respect Europe will be making an advance on United States electricity markets. The United States does have a variety of other mechanisms, however, for arranging physical cross-border transactions on a wide range of time-frames under OASIS. Experience from the United States shows these transactions being efficiently arranged between central dispatch markets and other central dispatch markets (for example PJM and MISO), between self-dispatch markets and central dispatch markets (for example PJM and SERC states such as Georgia), and also between self-dispatch markets and other self-dispatch markets (for example Georgia and Florida).[5]

#### 4.3.7. Control of market power

Market power mitigation would be problematic under self-dispatch.

The Bidding Code of Practice could not be used, because bids would no longer be used to dispatch the system. Market power would still exist however, so some new market power mitigation mechanism would need to be devised to replace the Bidding Code of Practice. There is no obvious candidate for what that mechanism would be. Increased levels of directed contracts would be a possibility, although this might go directly against the objectives of some market participants which is for increased physical firmness of their contract position. Another partial solution might be to regulate any "inc" or "dec" bids, or bids in any market for reserve that might exist in a self-dispatch model.

For this reason central dispatch scores higher on this criterion.

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[3] This might also be true in the forward market, but it need not necessarily be the case. The use of a European-wide coupling algorithm for the day-ahead market gives rise to the possibility that forward transactions can be arranged and hedged using Financial Transmission Rights (FTRs) instead of Physical Transmission Rights (PTRs). If FTRs are used there is no need (although there is still the option) for physical scheduling across cross-border interconnectors prior to the day-ahead market.

[4] Some of this local generation might have already been nominated, if applicable, to serve scheduled exports.

[5] The latter tend to be the least efficient markets in the case of the United States because these markets typically lack liquidity.

#### 4.3.8. Price-transparency and regulatory visibility

Price transparency would unambiguously be reduced as a result of self-dispatch. Price-transparency is good for regulatory efficiency including efficient mitigation of market power. Price transparency is also a key contributor to market efficiency and market fairness (allowing small market participants to have the same price information as large market participants).

For this reason central dispatch scores higher on this criterion.

#### 4.3.9. Ability to cope with increasing wind penetration

Increasing wind capacity would become increasingly problematic under self-dispatch compared to central dispatch because wind is inherently unpredictable and difficult to balance. Wind output must be balanced in order to ensure system stability, and if the level of wind output is a high proportion of total system generation then the task of wind balancing is increasingly difficult and important. It requires a correspondingly high proportion of dispatchable thermal generation available to manage fluctuations in the wind output. As wind penetration gets to high levels it points increasingly to central dispatch which provides the maximum availability of dispatchable thermal generation, necessary to maintain system control.

For this reason central dispatch scores higher on this criterion.

#### 4.3.10. Ability to allow participants to be physically-firm

Some consultation respondents who favoured self-dispatch in their submissions do not appear to have favoured it for reasons associated with the Target Model. They appear to have different motivations, based on a desire for increased firmness in their transactions. However physical firmness (a guarantee that X MW can be moved from A to B) cannot be guaranteed under either self-dispatch or central dispatch. Physical deliverability is a function of the physical system, and not of the trading model used.

The two options therefore score evenly on this criterion.

#### 4.3.11. Ability to allow participants to be financially-firm

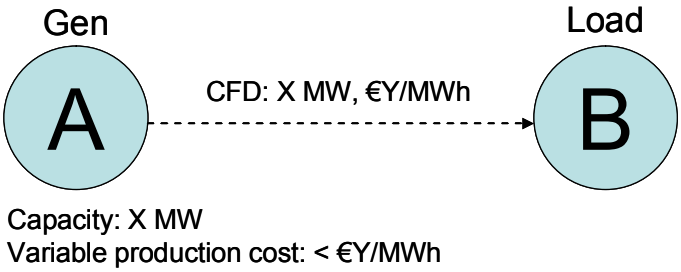
Financial firmness is financially equivalent to physical firmness (and therefore has the same value as physical firmness).

Financial firmness is available under central dispatch with CFDs:

- Generator A can sign a CFD with Load B for X MW at €Y/MWh. (Generator A would typically only do so if its generation cost is less than €Y/MWh, because otherwise it

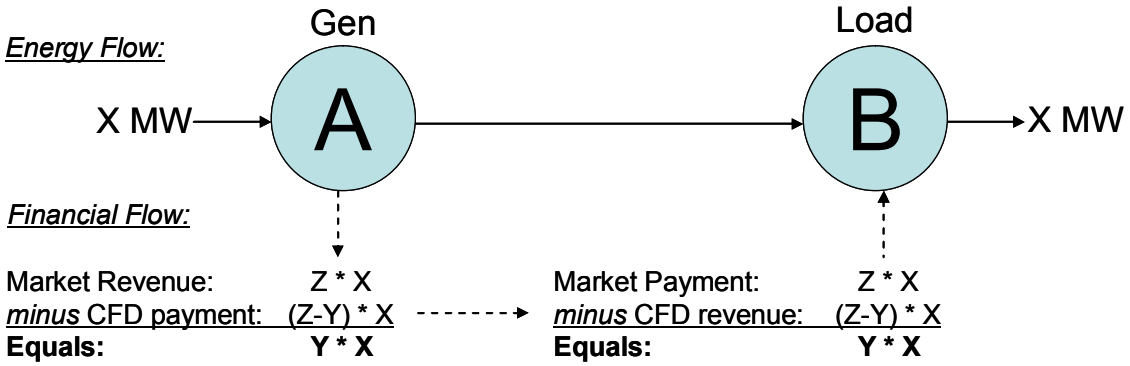
would not be profitable, and if its capacity is less than or equal to X MW.) Refer to Figure 4.3.

**Figure 4.3: Illustrative CFD**



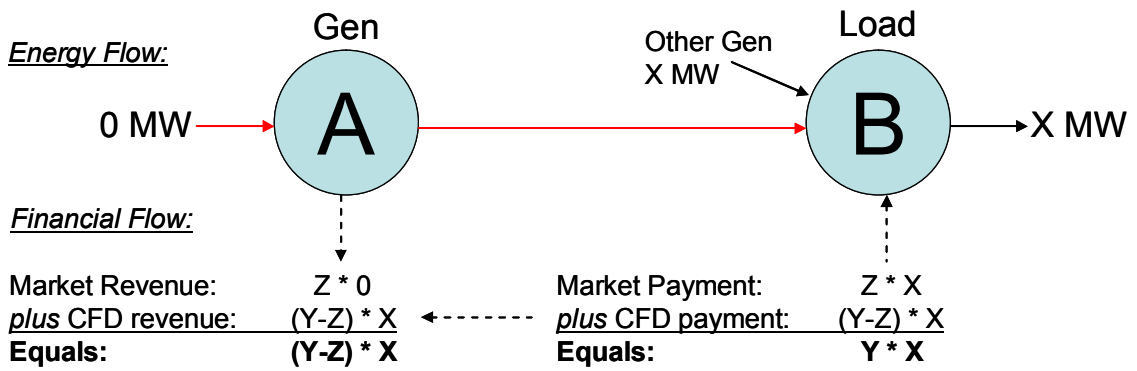

- When the TSO subsequently schedules the system, it will typically dispatch A up to X MW if the market price (€Z/MWh) is greater than or equal to A's production cost. In this case, A sells X MW for €Z/MWh to the market, and owes B (€Z/MWh minus €Y/MWh) for the X MW under the CFD contract. The net effect is therefore that A receives €Y/MWh for the X MW sold to B, which was its intention. B pays €Y/MWh for the X MW, which was its intention. Refer to Figure 4.4.

**Figure 4.4: Illustrative Market Outcome: Market Price (€Z/MWh) > €Y/MWh**




- If, alternatively, when the TSO subsequently schedules the system, the market price (€Z/MWh) is *less* than A's production cost, then Generator A will typically *not* be dispatched to produce any output. In this case, A receives no market revenue, but B owes A an amount equal to (€Y/MWh minus €Z/MWh) for the X MW under the CFD contract. B has paid €Z/MWh for X MW purchased from the market, and has paid (€Y/MWh minus €Z/MWh) for the X MW under the CFD contract. The net effect is therefore that B pays €Y/MWh for the X MW, which was its intention. A receives (€Y/MWh minus €Z/MWh) for X MW, which is greater than the profit it would have received by running since (€Z/MWh) is *less* than A's production cost. Refer to Figure 4.5.

**Figure 4.5: Illustrative Market Outcome: Market Price (€Z/MWh) < €Y/MWh**




- Finally, to the extent the dispatch quantity (DQ) differs from the schedule quantity (MSQ) in the above situation, generators receive a make-whole payment – so they are financially firm from the CFD position to DQ.

Financial firmness is also available under self-dispatch. The TSOs did not put forward a methodology for how they envisage this working on the island of Ireland in the event of a self-dispatch model, but in principle it can be achieved. For example if Generator A self-dispatches X MW but the TSO subsequently decreases (or increases) X for system security purposes, a make-whole payment of some sort could be paid to the generator concerned.

Financial firmness is available under either self-dispatch or central dispatch. The two options therefore score evenly on this criterion.

### 4.3.12. Cost (as measured by market efficiency) of making participants financially firm

CFDs impose no operational impact on the system and so the cost of financial firmness of central dispatch is measured by the cost of moving from MSQ to DQ – i.e. the actual and minimised cost of market interventions necessary to securely operate the system. Put another way: the cost of moving from an unconstrained schedule to a least-cost security-constrained dispatch.

Under self-dispatch, however, the cost of financial firmness could be different. CFDs would not exist, and so there would need to be some limits on the extent to which make-whole payments would be made. Further, make-whole payments would ideally be limited, like in the case of central dispatch, to the cost of moving from a least-cost but unconstrained schedule, to a least-cost dispatch taking into account system constraints.[6] However it would

[6] The Bidding Code of Practice would need to be retained for this purpose, if not for market power purposes, to ensure that make-whole payments were cost-reflective and fair.

be difficult, or perhaps impossible, to limit the cost to this level under self-dispatch because neither the starting schedule nor the final dispatch could be guaranteed to be least-cost.

For this reason central dispatch scores higher on this criterion.

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