

Consultation on DS3 System Services Enduring Tariffs

DS3 System Services Implementation Project

4 July 2017



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Glossary of Terms

Availability: the payment basis for DS3 System Services. If a volume of a given system service, from a DS3 System Services contracted party, is technically realisable in a trading period, then that volume is deemed 'available' for that trading period and is eligible for remuneration. This applies irrespective of the TSOs' real-time requirement for that service.

Demand Side Unit (DSU): a demand side unit, i.e. a unit which can reduce its energy consumption in response to a relevant signal or event, e.g. a frequency deviation for Fast Frequency Response, or a dispatch instruction for energy provision.

New Technologies: any technologies that are new to System Services provision, i.e. technologies that have not previously provided system services, on a system with similar characteristics to that of the all-island system, (and thus are required to undergo the Qualification Trial Process) or have only done so to a limited extent.

Non-Synchronous Technologies: any technologies that are mainly focused on system services provision as opposed to participation in the energy and capacity markets. It is assumed that such devices are connected to the system via power electronics and are thus non-synchronous.

Post-Product-Scalar Volume: For a given system service, the eligible remuneration volume following the application of product scalars for a given system dispatch, i.e. the volumes prior to the application of scarcity scalars.

Remuneration Volume: For a given system service, the volumes that are remunerated, i.e. these are the volumes following the application of all scalars (including product, performance and scarcity scalars).

Executive Summary

EirGrid and SONI are the Transmission System Operators (TSOs) in Ireland and Northern Ireland. We are responsible for maintaining a safe, secure, reliable and economical electricity system. We are also required to facilitate increased levels of renewable energy arising from energy policy objectives in Northern Ireland and Ireland.

In 2011, we established our 'Delivering a Secure Sustainable Electricity System (DS3)' programme. The objective of the DS3 Programme, of which System Services is a part, is to meet the challenges of operating the electricity system in a safe, secure and efficient manner while facilitating higher levels of renewable energy.

The aim of the System Services work stream is to put in place the correct structure, level and type of services in order to ensure that the system can operate securely with higher levels of non-synchronous renewable generation (up to 75% instantaneous penetration). The development of DS3 System Services is therefore a necessary and critical component to facilitate the integration of large scale variable non-synchronous renewable generation by 2020.

To help drive the necessary investment in System Services provision to meet this objective, the SEM Committee has determined that enduring regulated tariff arrangements should be employed at least to 2019. The longer term System Services market mechanisms are being developed separately by the Regulatory Authorities.

In this consultation, we present the analysis that we have undertaken on a range of designs for these enduring regulated tariff arrangements. Our analysis explores the changes to revenue for distinct system service products and service provider technology types as well as total expenditure for the different designs. As there are a number of potential ways that the System Services market may evolve over the next few years, our analysis considers two different portfolio scenarios both of which would allow the 2020 governmental renewable objectives to be met.

Discussion is provided on the challenges and issues for investment certainty and overall expenditure. These challenges include consideration of annual tariff reviews, contract length certainty, progress on the broader DS3 programme, and future European obligations. In all cases, options for mitigation are presented and discussed. Based on the analysis and discussion, we provide our view on the appropriate balance of considerations to meet the outlined challenges and constraints.

The designs are developed consistent with the overarching SEM Committee direction, in particular the linear increase in the DS3 System Services expenditure cap out to €235 million in 2020. Furthermore, designs are presented which place significantly greater value on needed new services with appropriate expenditure allocation to cover the loss of system services capability and new technical scarcities that are created as existing service providers are displaced.

We propose to:

- leverage the existing interim tariff rates as a baseline set of tariffs to work from for the length of the enduring regulated tariff arrangements;
- introduce a new temporal scarcity scalar which results in multiples of the rate being paid for system services provision at times when the System Non-Synchronous Penetration (SNSP) level exceeds 60%;
- design this scarcity scalar as “stepped” rather than “linear”;
- link the level of the scalar to the certainty that can be provided in these arrangements in the final decision by the SEM Committee – we examine scarcity scalar values that would ensure that up to €235 million will be paid out, and propose that in any event, the scalar values should not be lower than a particular set of minimum values;
- Introduce a new set of product scalars to incentivise enhanced provision of services where this is of value to the system.

In this consultation, we are seeking stakeholders’ views on the proposals. SONI and EirGrid welcome feedback on the questions posed within this paper, which will be used to inform the decision paper that will be submitted to the SEM Committee for approval.

Responses should be submitted to DS3@soni.ltd.uk or DS3@EirGrid.com before 21 August 2017 using the associated questionnaire template.

To facilitate stakeholder engagement we will host an industry workshop during the consultation period. This workshop, which is scheduled for 1 August 2017 in Dundalk, will provide an opportunity for discussion on the details of the consultation paper.

Note: This consultation paper should be read in conjunction with the DS3 System Services Enduring Scalar Design consultation paper, which has been published in parallel. The product scalar designs assumed in our modelling were based on those set out in that Scalar Design consultation paper.

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1. Introduction and Background

1.1. EirGrid and SONI

EirGrid and SONI are the Transmission System Operators (TSOs) in Ireland and Northern Ireland. It is our job to manage the electricity supply and the flow of power from generators to consumers. Electricity is generated from gas, coal, peat and renewable sources (such as wind, solar and hydro power) at sites across the island. Our high voltage transmission network then transports electricity to high demand centres, such as cities, towns and industrial sites.

We have a responsibility to enable increased levels of renewable sources to generate on the power system while continuing to ensure that the system operates securely and efficiently. In 2010, we published the results of the *All Island TSO Facilitation of Renewables studies*¹. Those studies identified a metric, the System Non-Synchronous Penetration (SNSP), as a proxy for the capability to operate the power system safely, securely and efficiently with high levels of renewable generation. SNSP is a real-time measure of the percentage of generation that comes from non-synchronous² sources, such as wind generation, relative to the system demand.

The studies identified 50% as the maximum level of non-synchronous infeeds allowable on the power system until solutions could be found to the various technical challenges identified. Should this limit not be increased out to 2020, the curtailment of generation from installed wind could rise to over 25% per annum³.

1.2. The DS3 Programme

Our Delivering a Secure Sustainable Electricity System (DS3) programme seeks to address the challenges of increasing the allowable SNSP up to 75% by 2020, whereby the curtailment of wind would be reduced to approximately 5% per annum. Operating in this manner should deliver significant savings to consumers through lower wholesale energy prices.

¹ All-Island TSO Facilitation of Renewables studies - <http://www.eirgridgroup.com/site-files/library/EirGrid/Facilitation-of-Renewables-Report.pdf>

² Non-synchronous infeeds (generator output or High Voltage Direct Current (HVDC) imports) inject power into the electrical grid via power electronics. Power electronics are used to convert the injected current to match the frequency of the transmission network.

³ DS3: System Services Consultation Finance Arrangements – http://www.eirgridgroup.com/site-files/library/EirGrid/System-Services-Consultation-Financial-Arrangements-December_2012.pdf

DS3 incorporates mutually reinforcing innovative technical, engineering, economic and regulatory initiatives. It is divided into three pillars:

- System Performance
- System Policies
- System Tools

DS3 is not only making the operational changes necessary to manage higher levels of renewable generation, but is also aiming to evolve the wider electricity industry and implement changes that benefit the end consumer. From the onset, the integration of wind generation presented a range of challenges previously unseen in the power sector. Through collaboration with the Regulatory Authorities and the wider electricity industry, DS3 has developed a number of innovative and progressive solutions.

The results of the programme are now beginning to deliver benefits to the consumer. In recent months the maximum SNSP level allowable has been increased to 60%, following the successful conclusion of a 60% SNSP operational trial. It is expected that similar trials will be conducted in the coming years with a view to achieving the overall goal of a maximum 75% SNSP limit by 2020.

1.3. DS3 System Services Process

A key work stream in the DS3 programme is the System Services work stream. The aim of the System Services work stream is to put in place the correct structure, level and type of services in order to ensure that the system can operate securely with higher levels of non-synchronous infeeds.

In December 2014, the SEM Committee published a decision paper on the high-level design for the procurement of DS3 System Services (SEM-14-108)⁴.

The SEM Committee's decision paper aims to achieve the following:

- Provide a framework for the introduction of a competitive mechanism for system services procurement;
- Provide certainty for the renewables industry that the regulatory structures and regulatory decisions are in place to secure the procurement of the required volumes of system services;
- Provide certainty to new providers of system services that the defined procurement framework delivers a mechanism against which significant investments can be financed;

⁴ DS3 System Services Procurement Design and Emerging Thinking Decision Paper (SEM-14-108): <http://www.semcommittee.eu/GetAttachment.aspx?id=c0f2659b-5d38-4e45-bac0-dd5d92cda150>

- Provide clarity to existing providers of system services that they will receive appropriate remuneration for the services which they provide;
- Provide clarity to the TSOs that the required system services can be procured from 2016 onwards in order to maintain the secure operation of the system as the level of renewables increases;
- Provide clarity to the Governments in Ireland and Northern Ireland (and indeed the European Commission) that appropriate structures are in place to assist in the delivery of the 2020 renewables targets;
- Ensure that Article 16 of Directive 2009/EC/28 is being effectively implemented (duty to minimise curtailment of renewable electricity);
- Provide assurance to consumers that savings in the cost of wholesale electricity, which can be delivered through higher levels of renewables on the electricity system, can be harnessed for the benefit of consumers;
- Provide assurance to consumers that they will not pay more through system services than the benefit accrued from System Marginal Price (SMP) savings arising from higher levels of marginally low cost renewable generation⁵.

1.4. Overview of System Services

EirGrid and SONI have licence and statutory obligations to procure sufficient system services to enable efficient, reliable and secure power system operation. The contractual arrangements and payment rates in Ireland and Northern Ireland were harmonised following the introduction of the SEM, with 7 products (POR, SOR, TOR1, TOR2, SSRP, RRS, and RRD) procured under these Harmonised Ancillary Services (HAS) arrangements.

New services are required to support a move to higher levels of non-synchronous generation. Four services (SIR, RM1, RM3, and RM8) were introduced from 1 October 2016 following the commencement of the new DS3 System Services arrangements. The later 4 services, together with the former 7 services are referred to herein as the '11 existing services'. A further 3 services (FFR, DRR, FPFAPR), referred to herein as the '3 new services', will be introduced in 2018. All services are required to maintain the resilience of the power system as the SNSP levels increase. Table 1 provides a high-level summary of the DS3 System Services products.

The Grid Codes do not oblige service providers to deliver the new services. However through the DS3 System Services arrangements, the standards to which providers will

⁵ Note that the composition of the price that will be paid by end consumers for wholesale electricity will change significantly following the introduction of the I-SEM trading arrangements. The savings delivered by DS3 will be split across the imbalance settlement, balancing costs, the price in the ex-ante markets and the Capacity Remuneration Mechanism.

offer these on a commercial basis are being developed. This will necessitate a consideration of a range of issues including standards, performance monitoring and settlement issues. These issues are being dealt with outside the scope of this paper.

Table 1: Summary of DS3 System Services⁶

Service Name	Abbreviation	Unit of Payment	Short Description
Synchronous Inertial Response	SIR	MWs ² h	(Stored kinetic energy)*(SIR Factor – 15)
Fast Frequency Response	FFR	MWh	MW delivered between 2 and 10 seconds
Primary Operating Reserve	POR	MWh	MW delivered between 5 and 15 seconds
Secondary Operating Reserve	SOR	MWh	MW delivered between 15 to 90 seconds
Tertiary Operating Reserve 1	TOR1	MWh	MW delivered between 90 seconds to 5 minutes
Tertiary Operating Reserve 2	TOR2	MWh	MW delivered between 5 minutes to 20 minutes
Replacement Reserve – Synchronised	RRS	MWh	MW delivered between 20 minutes to 1 hour
Replacement Reserve – Desynchronised	RRD	MWh	MW delivered between 20 minutes to 1 hour
Ramping Margin 1	RM1	MWh	The increased MW output that can be delivered with a good degree of certainty for the given time horizon.
Ramping Margin 3	RM3	MWh	
Ramping Margin 8	RM8	MWh	
Fast Post Fault Active Power Recovery	FPFAPR	MWh	Active power (MW) >90% within 250 ms of voltage >90%
Steady State Reactive Power	SSRP	Mvarh	(Mvar capability)*(% of capacity that Mvar capability is achievable)
Dynamic Reactive Response	DRR	MWh	MVAr capability during large (>30%) voltage dips

⁶ Further detail on the DS3 System Services can be found at: <http://www.eirgridgroup.com/how-the-grid-works/ds3-programme/>

1.5. Enduring Regulated Arrangements

In its SEM-14-108 decision paper, the SEM Committee decided that the implementation of the DS3 System Services arrangements would be divided into two phases. The enduring arrangements will deliver competitive procurement, where appropriate, for the 14 system services. A tariff will be applied to services where there is insufficient competition.

During the interim period (until 2019 at the earliest), the TSOs will contract for services with all eligible providers, who will be paid at a rate, approved by the RAs, for the volume of services they are able to deliver in each trading period.

Under both arrangements, potential providers are required to participate in a procurement exercise.

In October 2016, the TSOs completed the procurement of 11 system services (including four new services) resulting in 107 providing units being added to separate Interim Tariff Framework Agreements in Ireland and Northern Ireland.

On 23 March 2017, the SEM Committee published an information paper on the DS3 System Services Future Programme Approach⁷. This paper sets out the SEM Committee's approach to the completion of the delivery and implementation of the new System Services arrangements as set out in the High Level Design (SEM-14-108). The SEM Committee's approach takes into account the experience of the interim arrangements, responses to the public consultations on the various elements of the detailed design, developments with the EU Electricity Balancing Guideline and the recent I-SEM Stocktake.

In its paper, the SEM Committee set out its view that:

- The 107 existing Interim Framework Agreements for the 11 existing services, due to expire in October 2017, will be extended until the end of April 2018 – note that procurement regulations mean that during this period no new entrants will be allowed onto the framework nor will existing providers be able to increase their contracted volumes – in order to facilitate learnings from the Qualification Trial Process to be integrated into the enduring Regulated Arrangements, and in order to facilitate the introduction of a new panel-based procurement process;
- The TSOs will run a Regulated Tariff procurement process in Q4 2017 for the 11 existing services so as to enable new contracts to be executed on 1 May 2018. Note that these arrangements will be open to a wider range of service providers; and
- The TSOs will run a further Regulated Tariff procurement process for the 3 new services, with a contract execution date of 1 September 2018⁸;

⁷ SEM Committee Information Paper on DS3 System Services Future Programme Approach: <https://www.semcommittee.com/sites/semcommittee.com/files/media-files/SEM-17-017%20DS3%20System%20Services%20Future%20Approach%20Information%20Paper.pdf>

⁸ The TSOs informed the SEM Committee of the necessity to stagger the introduction of the 3 new services (FFR, FPFAPR and DRR). This longer implementation timeline will allow for learnings from the Qualification Trial Process to be integrated into the arrangements, and also

- The Regulatory Authorities will review the options for competitive procurement for enduring implementation in the coming years. This initial investigative work on competitive procurement options started in Q1 2017.

In May 2017, the TSOs published a consultation paper⁹ that focused on the tariff payment rates to apply to the existing Interim Framework Agreements for the 11 existing services that are being extended to the end of April 2018. A decision paper on the final tariff rates for this period will be published in the coming weeks following approval by the Regulatory Authorities.

With this July 2017 consultation paper, the TSOs are separately engaging on the enduring tariff framework and the proposed enduring tariff rates to apply to all 14 services following execution of the new system services contracts in May and September 2018.

1.6. Transition to New Technologies

Given that system services should be procured in an efficient manner, system services should only be paid for where delivery and quality of performance can be measured. Therefore, there is a need to establish reliable methods for measuring the quality of service provision for all 14 services.

Over many years of proven experience, confidence has been built in traditional power system technologies, such as conventional synchronous generation. While the deployment of new technologies through the DS3 System Services enduring arrangements is intended to reduce total costs and facilitate the delivery of public policy objectives, the TSOs need to be confident that the deployment of new technologies will not inadvertently undermine the resilience and security of the power system. As TSOs, we have a duty to maintain system stability and avoid loss of supply. We therefore need to take steps to identify the associated risks, obtain information about the capability of new types of service providers and manage this transition in a prudent fashion.

The interim arrangements have provided an opportunity to establish the mechanisms by which the characteristics of new technologies can become “Proven” and “Measureable” for the widest range of non-energy system service providers possible.

allows for the TSOs to develop the appropriate contractual definitions for technical product delivery, product response criteria, and settlement and performance monitoring system requirements for these services.

⁹ Consultation Paper on tariffs for “rollover contract” period: http://www.eirgridgroup.com/site-files/library/EirGrid/OPI_INV_Paper_DS3-SS-Rollover-Tariffs-Consultation-FINAL.pdf

We are currently engaged in a Qualification Trial Process¹⁰ which aims to give technologies that have not previously provided system services, on a system with similar characteristics to that of the all-island system, an opportunity to demonstrate their capabilities. The Qualification Trial Process is the mechanism by which new, as of yet unproven, technologies can ultimately gain access to DS3 System Services contracts in future central procurement processes.

It is also necessary to measure the quality of provision of “fast” services (FFR, FPFAPR, DRR) when these are procured in 2018. As part of the Qualification Trial Process, “measurability” aspects will also be explored during the interim phase.

Following an open competitive procurement process, the Qualification Trial Process began on 1 March 2017 and will run through to 31 August 2017. A total of 12 contracts were executed covering 15 trials (of which 7 were “provenability” trials and 8 were “measurability” trials).

The learnings gained from the Qualification Trial Process will be reflected in the enduring Regulated Tariff contractual and commercial arrangements. We plan to separately consult on the proposed contractual arrangements in September 2017 ahead of commencement of the next procurement process later this year.

In addition, we will use the learnings from this year’s Qualification Trial Process as well as the on-going Interim Arrangements to inform the format and focus of next year’s Qualification Trial Process.

1.7. Purpose of the Paper

The purpose of this consultation paper is to set out the principles and high-level approach that we are minded to use to establish the DS3 System Services payment structures for the contracts executed in May and September 2018. The paper will set out the challenges in implementing the enduring regulated tariff arrangements and our proposals for how to mitigate these challenges.

1.8. Structure of the Paper

The remainder of the paper is structured as follows:

- Section 2 discusses the principles and high-level approach to implementing the regulated tariffs.

¹⁰ DS3 System Services Qualification Trial Process Decision Paper:
<http://www.eirgridgroup.com/site-files/library/EirGrid/DS3-System-Services-Decision-Paper-on-Qualification-Trial-Process-FINAL.pdf>

- Section 3 sets out the results of the analysis carried out to develop the regulated tariff payment structures.
- Section 4 discusses the challenges and constraints in designing the regulated tariff arrangements and puts forward a number of mitigation measures which the TSOs are consulting on.
- Section 5 outlines the next steps in the consultation process and describes the planned stakeholder engagement activities.
- Further information on the detailed modelling assumptions can be found in the Section 6 appendix.

Note: This consultation paper should be read in conjunction with the DS3 System Services Enduring Scalar Design consultation paper, which has been published in parallel. The product scalar designs assumed in our modelling were based on those set out in that Scalar Design consultation paper.

2. Regulated Tariffs: Principles and High-Level Approach

2.1. Introduction

The introduction of four system services in October 2016 (SIR, RM1, RM3, RM8), and the associated increase in expenditure on DS3 System Services, has contributed to the recent increase in the maximum SNSP allowable to 60% and delivers a benefit to consumers through reduced wind curtailment.

In the longer term, with the introduction of the three new system services in September 2018 (FFR, FPFAPR, DRR), and with investment in needed DS3 System Services provision, more savings will be made through further increases in SNSP. Savings are also expected to be obtained across a number of areas including the Capacity Remuneration Mechanism, ex-ante trading of wholesale electricity, the imbalance price and in the cost of balancing the system.

In the recent SEM Committee Information Paper on the DS3 System Services Future Programme Approach¹¹, the SEM Committee *“provided for the establishment of a glide path for the years 2016-2020. The SEM Committee has decided that this will be a straight-line glide path”* and stated that this will *“provide industry with increased certainty of income and signals to invest, in the absence of a competitive procurement mechanism before 2019.”*

The SEM Committee’s annual cap “glide path” is shown in Figure 1. In its Information Paper, the SEM Committee sets out its position as follows:

- *“the expenditure cap limits expenditure to a maximum level but does not guarantee that this level of monies will be spent; tariff rates will not increase for services where there is no additional system need and where additional investment is not required.”*
- *“modifications to the payment rules and use of scarcity scalars may be required to ensure that monies are targeted to new investment while respecting the principle of technology neutrality.”*
- *“the expenditure cap in a given year will not be reached unless it is required; and where it is required the budget will be allocated in such a way as to maximise consumer benefit budget.”*

¹¹ SEM Committee Information Paper on the DS3 System Services Future Programme Approach: <https://www.semcommittee.com/sites/semcommittee.com/files/media-files/SEM-17-017%20DS3%20System%20Services%20Future%20Approach%20Information%20Paper.pdf>

- Tariffs would be reviewed and consulted on annually.

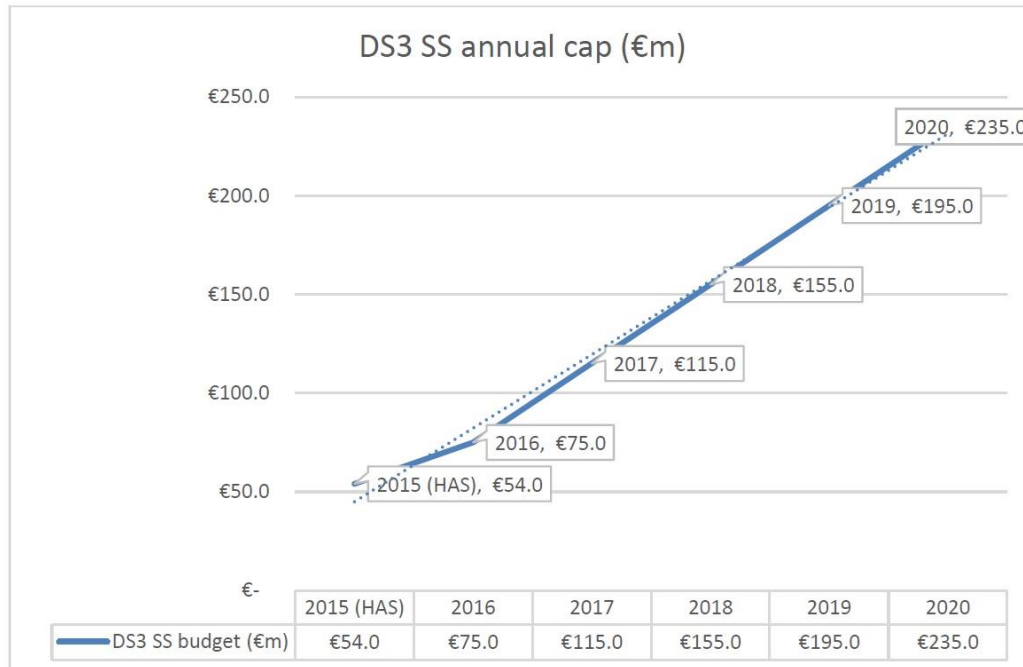


Figure 1: SEM Committee's DS3 System Services Annual Cap¹²

2.2. Principles and High-Level Approach

The following bullet points set out the principles and high-level approach to determination of the enduring tariff payment structures and associated tariff rates for DS3 System Services:

- The TSOs envisage an increase in DS3 System Services payments following execution of the new contracts in May and September 2018. The enduring regulated tariff payment structures and associated tariff rates have been designed with the purpose of ensuring payments stay within the overall expenditure “glide-path” set out by the SEM Committee.
- In order to meet the long terms needs of the power system, the enduring regulated tariff arrangements need to drive investment in necessary system services provision. We believe that both contract length and revenue certainty are critical to ensuring investor confidence in the arrangements, thereby enabling (i) new providers to enter the market and (ii) existing providers to increase their capability.

¹² Our understanding is that the annual caps apply on a tariff year basis as opposed to calendar year basis i.e. the “2016, €75m” cap illustrated in the graph applies from 1 October 2016 through 30 Sept 2017 and so on.

- The system service weightings should reflect the relative requirement and contribution each service will make to the TSOs' ability to operate a safe, secure and reliable system.
- The TSOs are seeking to develop the enduring tariff design to be robust against a number of risks which may result in over-expenditure beyond the "glide-path" expenditure set out by the SEM Committee. These risks, along with a number of possible mitigations, are discussed in Chapter 4.
- The approach taken to currency issues for the enduring regulated arrangements will be consistent with that applied for the 2016/17 tariff year and it is proposed that the arrangements continue for the 2017/18 tariff year. The proposed payment rates will be initially calculated in Euros. In determining the associated Sterling rates, we will apply the same methodology as used before, which is also consistent with that applied under the Trading and Settlement Code for the calculation of the annual capacity exchange rate, i.e. the average of the forwards rates for the forthcoming year as taken over a period of 5 days prior to tariff setting. We propose that the Sterling rates will be updated every tariff year to reflect any movements in the exchange rates, irrespective of whether there are any changes to the Euro tariff rates in a given year.
- The TSOs have assumed that investments in DS3 System Services capability will not necessarily be fully recovered by these specific arrangements, in particular for providing units active in the energy and capacity markets. To that extent there needs to be appropriate co-ordination between energy, capacity and system services payments. However, for providing units that predominately rely on DS3 System Services revenues, we acknowledge that DS3 System Service remuneration is the most relevant and our analysis reflects this.

2.3. Remuneration Volumes Issue

When operating the power system today, there are sufficient quantities of necessary system services in every hour to maintain the resilience that society has come to expect. There may be little change in the total real time requirement for many services in a system operating up to 75% SNSP when compared to today. With remuneration volumes based on real time availability and not installed capability, remuneration volumes may not necessarily increase for many services either. However, there is likely to be a need for these services to come from new or enhanced providers (as conventional plant is increasingly displaced from the system), and to also cover technical scarcities which were previously unknown as a result of the loss of this plant.

For example, the real-time requirement for Primary Operating Reserve (POR) is currently calculated as 75% of the largest single infeed on the island at a moment in time. This real-time requirement for POR is unlikely to significantly change in the period to 2020 which in turn means that the overall remuneration volumes for this service are

unlikely to increase (subject to the considerations set out in Section 4.3.1). For other services, such as the Ramping Margin services, the real-time requirement may increase substantially due to the associated variability as additional renewable generation is installed and increased uncertainty due to forecast errors.

To integrate increasing levels of renewable generation, there will be a growing requirement to obtain services from new or enhanced plant. Services have traditionally been provided by conventional generators; however, as we move toward operating the system closer to 75% SNSP, there will be a reduced number of conventional generators connected to the system and hence a reduced number of conventional generators available to provide these services. In effect, some amount of the real-time requirement will be met by new or enhanced service providers with an associated level of remuneration volumes transferred from existing providers to new or enhanced providers, as illustrated in Figure 2.

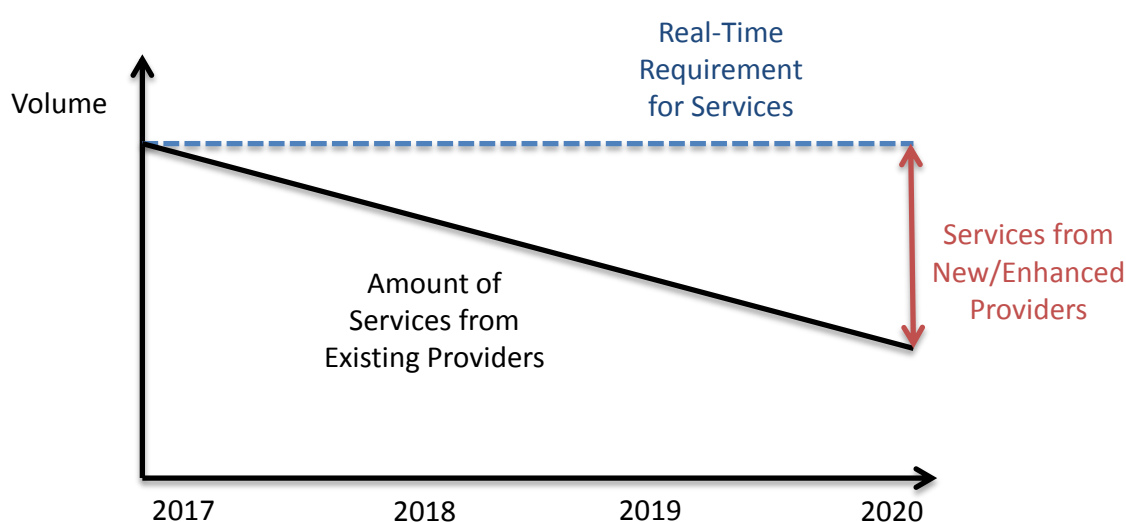


Figure 2: Real-time volume requirement for services over time

The following question then arises: if the volumes do not increase significantly for many services, how can tariff rates ensure that (i) the SEM Committee’s expenditure “glide-path” is adhered to and (ii) the over-expenditure risks are managed, while still providing a reasonable level of investment certainty?

To do this, the TSOs are proposing a Scarcity Scalar framework that uses base rates which are increased at times of service scarcity, i.e. at times when system services are most required, available providers will be rewarded with higher payments.

2.4. Scarcity Scalar Framework

The SEM Committee decision paper SEM-14-108 directed that scalars should be implemented to incentivise flexibility, reliability, value for money and performance.

Scalars were categorised under four headings: Performance, Scarcity, Product and Volume. Figure 3 illustrates how scalars will apply to regulated tariffs.

Details of all of the proposed scalar designs are described in the DS3 System Services Enduring Scalar Design consultation paper, which has been published in parallel and which should be read in conjunction with this paper. We believe that the implementation of the scalars, in an informed and structured manner can assist in ensuring that the required flexibilities and levels of performance will be incentivised and delivered. Additionally we believe that the use of scalars should ensure that the service providers will be remunerated appropriately for the value these services provide to the system. This is in keeping with the primary objectives for the four scalars set out in the SEM-14-108 decision paper and further elaborated on in the TNEI / Pöyry report¹³.

We believe that a balance must be achieved between seeking greater granularity in payments and keeping the design and implementation simple and clear. We would intend therefore to only implement scalars that would provide demonstrable benefits in terms of operational flexibility or savings for the energy consumer, and are relatively easy to implement and to understand.

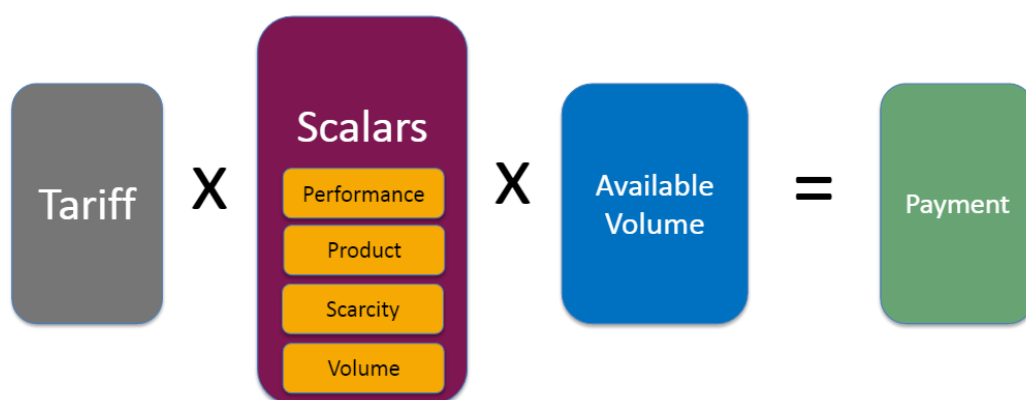


Figure 3: Application of scalars to regulated tariffs

In this section, we focus solely on the scarcity scalar¹⁴, the purpose of which the SEM Committee described as follows:

¹³ TNEI / Pöyry Report on High Level Principles of Scalars for DS3 System Services – A report to EirGrid and SONI: <http://www.eirgridgroup.com/site-files/library/EirGrid/High-Level-Principles-of-Scalars-for-DS3-System-Services-FINAL.pdf>

¹⁴ It should be noted that for the purposes of this paper, the term scarcity scalar refers to a 'temporal scarcity scalar' rather than a 'locational scarcity scalar'. As outlined in the DS3 System Services Enduring Scalar Design consultation paper, which has been published in parallel with this paper, the SEM Committee has directed that we include a 'locational scarcity scalar' in the arrangements. A locational scarcity scalar will therefore be allowed for in contracts for the duration of the Regulated Arrangements. However, we do not intend to apply scalars greater than 1 in the foreseeable future. Any future implementation will be subject to the TSOs establishing a strong requirement for incentivising the provision of services from particular locations. We have set this scalar to a value of 1 for the purposes of the modelling and it is not discussed further in this paper.

"To create marginal incentives for providers to make themselves available during periods or in locations of scarcity, therefore enhancing the performance of the system where it is most needed."

The use of scarcity scalars will allow the TSOs to comply with the SEM Committee's stated position on expenditure increases as set out in Section 2.1. In particular, the use of scarcity scalars should ensure that monies are targeted toward service providers that are available during times of scarcity in a manner that is technology neutral.

We propose to apply the scarcity scalar on a sliding scale, linked to the SNSP level in a given trading period as measured in the National Control Centres and made public¹⁵. This ensures the scarcity scalar value increases at higher SNSP levels due to the reduced numbers of conventional plant online. In time, the use of SNSP as the metric for the scarcity scalar may evolve or change if a more efficient mechanism for tackling System Service scarcity is found. This will be assessed further once the challenges of operating the power system beyond 2020 are better understood.

It is proposed that a scarcity scalar design is applied to three groups of System Services:

- The 11 existing System Services (SIR, POR, SOR, TOR1, TOR2, RRS, RRD, RM1, RM3, RM8, SSRP);
- FFR; and
- FPFAPR and DRR.

Given that the system has been operating securely to date at SNSP levels $\leq 60\%$, it is proposed that when the SNSP levels is below 60%, a scalar of 1 will be applied to the existing services while a scalar of 0 will be applied to FFR, FPFAPR, and DRR. The rationale for this is as follows:

- **Existing 11 services:** the existing 11 System Services are important at all SNSP levels, thus even at low SNSP levels the scarcity scalar should not decrease the payment for such services.
- **FFR:** at $\leq 60\%$ SNSP, the system has been, to date, operated in a safe, secure and reliable manner without FFR. Thus, we propose to only pay for FFR at SNSP levels above 60%. Further, at lower SNSP levels, the level of online system synchronous inertia is sufficient such that the value of FFR decreases.
- **FPFAPR and DRR:** The system stability issues that these services are aimed to address (voltage-dip induced frequency dip and transient stability respectively) are not seen until very high wind levels are reached. Thus, we propose to only pay for FPFAPR and DRR at SNSP levels above 70%.

¹⁵ The SNSP metric indicates the ability to operate the power system safely, securely and efficiently with high levels of renewable generation. A higher allowable percentage indicates that a greater amount of electricity demand can be supplied by wind and solar generation

We believe that the above will create the desired targeting of investment and also protect the consumer from over-expenditure of System Service payments. In the longer term, there may be merit to exploring whether the provision of FPFAPR and DRR should become Grid Code requirements.

As well as applying differing scaling factors to the aforementioned three groups of System Services, we have assessed two scarcity scalar implementation methods. The first method proposes a 'linear' scarcity scalar design, as shown in Figure 4, and the second method proposes a 'stepped' scarcity scalar, as shown in Figure 5.

The linear scarcity scalar has one design parameter, $\gamma_{line}^{75\%SNSP}$, which defines the maximum scaling factor applied when the SNSP is at 75%.

The stepped scarcity scalar has two design parameters, which define the steps at which the scaling factor increases. The step points chosen are 60% and 70% SNSP, defined as $\gamma_{step}^{60\%SNSP}$ and $\gamma_{step}^{70\%SNSP}$ respectively. The scarcity scalar parameters arising from the analysis completed are shown in Table 2.

The relative merits of the linear and stepped approaches are assessed in Chapter 3 and discussed further in Chapter 4.

Note that two sets of scalar parameters are included in Table 2 for the stepped scarcity scalar design. The first parameter set, labelled "Full Spend", was chosen such that total expenditure in the 2019/20 New Providers base case is €220 million. The budget cap is €235 million, but €15 million is reserved to cover the additional expenditure that could arise as a result of the SEM Committee decision to pay based on the higher volumes arising from a unit's market position or physical dispatch position¹⁶, and to cover the cost of the Qualification Trial Process.

The second parameter set, labelled "Min Spend", was chosen such that some of the new technologies would be likely to receive sufficient revenue in order to invest in the 2019/20 New Providers base case (assuming minimum of four year contract and revenue certainty). However, the scalars could only be set this low if there is a high level of certainty in the arrangements in terms of duration and revenue certainty. There is further discussion on this issue in Chapter 4.

¹⁶ Further information on this is contained in Section 4.3.2.

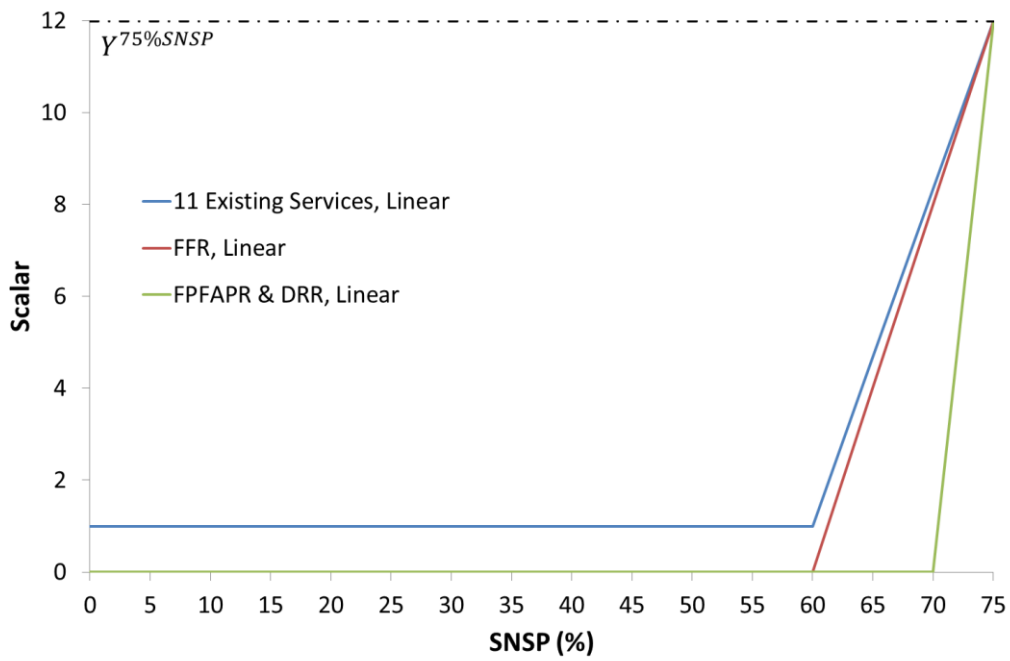


Figure 4: “Linear” scarcity scalar design, using full spend parameters.

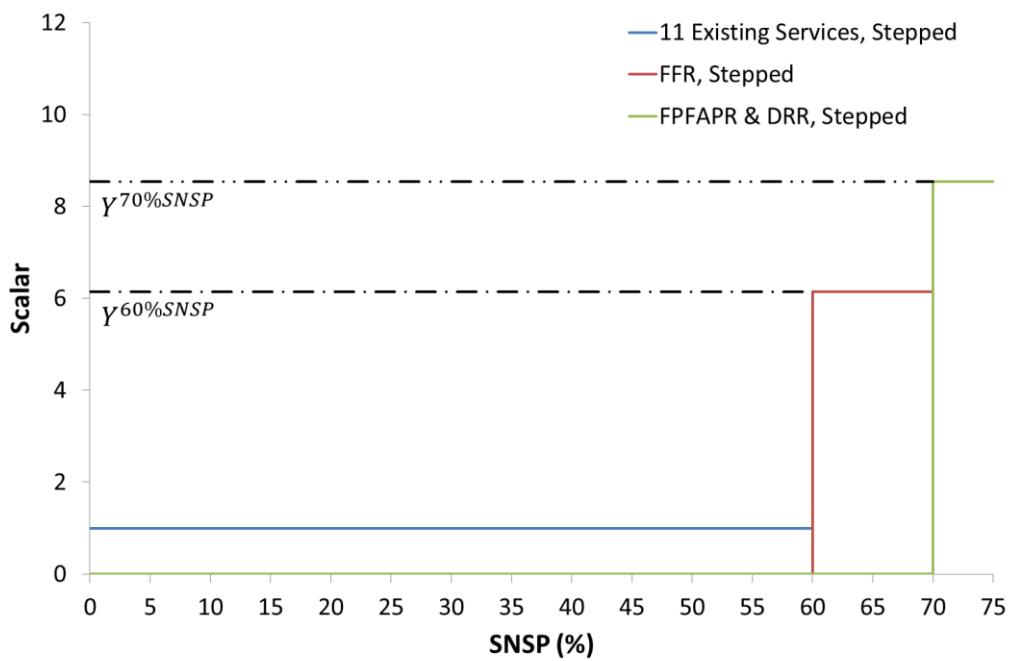


Figure 5: “Stepped” scarcity scalar design, using full spend parameters

Table 2: Scarcity scalar parameters arising from the analysis completed

Case	Rationale	Parameters		
		Stepped		Linear
		$\gamma_{step}^{60\%SNSP}$	$\gamma_{step}^{70\%SNSP}$	$\gamma_{line}^{75\%SNSP}$
Full Spend	Scarcity scalar parameters chosen such that the total expenditure in the 2019/20 New Providers base case is €220 million. Note that although the budget cap is €235 million, €15 million is reserved to cover the additional expenditure that could arise as a result of the SEM Committee decision to pay based on the higher volumes arising from a unit's market position or physical dispatch position, and to cover the cost of the Qualification Trial Process.	6.2	8.5	12
Min Spend	Scarcity scalar parameters chosen such that some of the new technologies are likely to receive sufficient revenue in order to invest in the 2019/20 New Providers base case (assuming minimum of four year contract and revenue certainty).	3.1	4.3	N/A

3. Modelling Analysis

3.1. Introduction

Service provider portfolios have been developed in order to determine the potential System Services expenditure. Portfolios for both the 2017/18 and 2019/20 tariff year have been modelled. For each year modelled, the starting point for the installed capacities of fossil fuel-fired and renewable generation as well as the system demand is taken from the *All-Island Generation Capacity Statement 2017-2025*¹⁷. Further detail regarding the modelling and study methodology can be found in Section 6.

3.1.1. 2017/18 Portfolio Scenario

We have based the 2017/18 tariff year portfolio predominantly on the capabilities of the existing service providers with a relatively small amount of new service providers included. However, the inclusion/ exclusion of any service provider or technology in/from any of the portfolio scenarios should not be construed as predetermining or forecasting the technologies which will be, or should be, successful in the system services procurement process.

New service providers using technologies unproven from a DS3 System Services provision perspective will enter the procurement framework through the Qualification Trials Process, while proven technologies will be eligible to qualify for full DS3 System Services contracts through the Central Procurement Process.

3.1.2. 2019/20 Portfolio Scenario

There are a number of potential ways that the portfolio of System Services providers may evolve. Different portfolios of service providers will likely result in different system services volumes. Consequently, two diverse 2019/20 portfolios are modelled in an effort to understand the likely volumes for a variety of potential eventualities:

- **2019/20 Enhanced System Service Capability Scenario**

In the 'Enhanced' portfolio, it is assumed that the majority of the required services will be obtained from the enhancement of the existing portfolio. A relatively small number of new service providers were also included.

¹⁷ All-Island Generation Capacity Statement 2017-2025: http://www.eirgridgroup.com/site-files/library/EirGrid/4289_EirGrid_GenCapStatement_v9_web.pdf

- **2019/20 New System Service Providers Scenario**

In the 'New Providers' portfolio, new technologies contribute significantly to the additional volume of System Services required. It is assumed that there is limited investment in enhanced performance by existing service providers (predominantly conventional generators) and as a consequence investment in alternative sources delivers the system capability required to securely manage higher levels of renewable generation.

The all-island installed capacities for both 2019/20 portfolio scenarios are shown in Table 3. Table 4 summarises the differences between the 2019/20 portfolios with regards to system service provision.

Table 3: Installed capacities assumed in the two portfolio scenarios modelled

	Existing Installed Capacity	2019/20 Enhanced Capability Scenario	2019/20 New Providers Scenario
CCGT (MW)	4,278	4,278	4,278
Fossil Steam (MW)	2,527	2,527	2,527
DSU (MW)	414	335 ¹⁸	335
Non-Synchronous Tech. (MW)	10	50	250
SIR Network Device (MWs)	0	400	1,200
Peaker (MW)	1,104	1,104	1,304
HVDC Interconnection (MW, Import Capacity)	942	942	942
Wind (MW)	3,800	5,350	5,350

¹⁸ Note that this is the amount of DSU capacity assumed to be able to provide at least one DS3 System Service.

Table 4: Key Differences between the Enhanced Capability and New Providers Portfolios

	Enhanced System Service Capability Scenario	New System Service Providers Scenario
DSUs	335 MW available for energy arbitrage, of which 70 MW provides FFR-TOR2 capability	335 MW available for energy arbitrage, of which 120 MW provides FFR-TOR2 capability
Non-Synchronous Tech.	50 MW	250 MW
SIR Network Devices	1 new unit (400 MWs stored kinetic energy)	3 new units (1200 MWs stored kinetic energy)
Min. Load Reductions	3 units (reducing their minimum load from between 65-50% to 35% of maximum capacity)	None
Reserve Enhancements	5 CCGTs and 6 OCGTs increase their FFR-TOR1 capability resulting in the following additional capability: 24 MW FFR, 40 MW POR, 45 MW SOR and 56 MW TOR1.	None
Start-Up Time Reductions	4 CCGTs assumed to have shorter start-up times, enabling RM8 capability from an offline state.	None
Additional Plant Build (above that estimated in the Generation Capacity Statement 2017-2026)	None	2 OCGTs

The majority of the results presented herein are for the 2019/20 tariff year simulations. Details on the simulations and sensitivities undertaken for the 2019/20 tariff year are outlined in Figure 6. The methodology developed was then applied to the 2017/18 tariff year in order to ensure that the methodology respects the system service “glide path” for that year.

It should be noted that the TSOs have assumed that investment in an enhanced generation portfolio is remunerated from energy, capacity and System Services payments, and not only System Services payments. However, for predominately system service-only providing units, we acknowledge that DS3 System Services remuneration is the most relevant and our analysis reflects this. Only DS3 System Services revenues/expenditure have been included in the analysis.

For each initial 2019/20 portfolio (New Providers and Enhanced Capability), sensitivity analysis is conducted on the:

- wind time series and capacity factor;
- HVDC interconnector flows; and
- level of investment unforeseen in the base portfolio.

The base cases for both the Enhanced Capability portfolio and the New Providers portfolio achieve the 40% electricity generation from renewable energy sources (RES-E) target with wind curtailment below 5%. The base case uses a 31% wind capacity factor (CF) and a 2:1 export:import HVDC interconnector flow ratio.

The RES-E and wind curtailment levels for all simulations are presented in Figure 7. For clarity, the blue and pink components of each column shown in the graph are not cumulative. For example, in the Base Case for 2019/20 New Providers scenario, the RES-E penetration is 42% while the wind curtailment level is 2%. The 40% RES-E target is reached in all scenarios except the two low wind sensitivities. The wind curtailment levels remain below 5% except for the two high wind sensitivities.

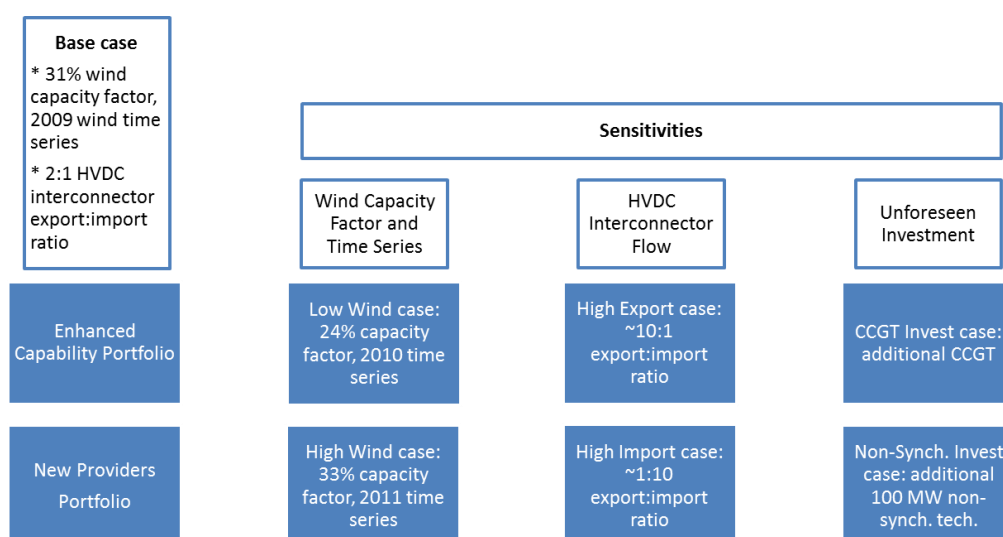


Figure 6: 2019/20 tariff year simulation cases

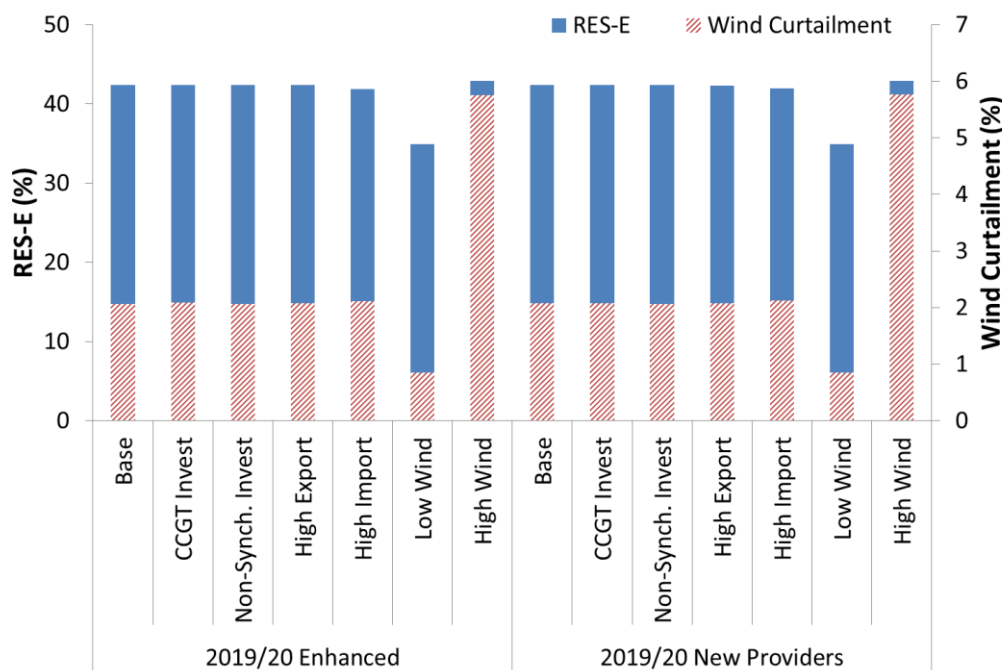


Figure 7: 2019/20 tariff year RES-E (% all-island demand) and wind curtailment (% available wind energy)

3.2. Remuneration Volumes

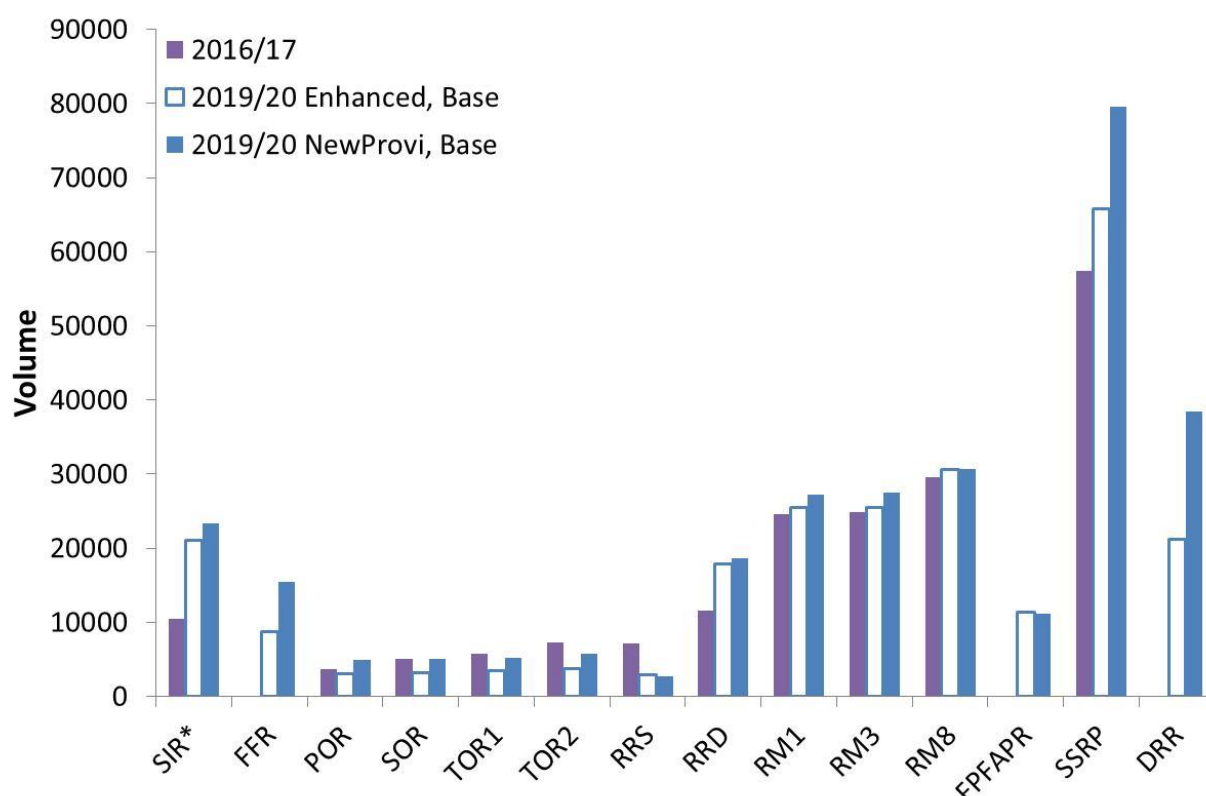
System dispatch and the resulting system services remuneration volumes are fundamentally dependent on the portfolio. For example, if a CCGT lowers its minimum load capability, it may increase its time spent online, thus impacting on its availability for system services and energy payments. Conversely, if a new (non-generation) technology is available to provide multiple reserves, its presence may result in the decommitment of a conventional unit that was the marginal reserve provider (assuming all security constraints are met in the absence of said conventional unit).

Furthermore, if additional new technologies are available for reserve provision, some base load units may increase their energy output (and hence decrease their reserve availability) as such plant are no longer required to provide the same levels of reserve in some time periods.

Each of these examples will result in different annual system services volumes. To illustrate such a difference, arising from differing dispatches, *SIR volumes divided by 100 for graphical purposes

Figure 8 presents the capability volumes for the 2019/20 Enhanced Capability scenario and the 2019/20 New Providers scenario. Note that the volumes presented in *SIR volumes divided by 100 for graphical purposes

Figure 8 are following the application of the product scalars but prior to application of the scarcity scalars. Volumes for the 2016/17 year (from previous simulations) for the existing 11 services are shown for comparative purposes.



*SIR volumes divided by 100 for graphical purposes

Figure 8: 2019/20 system service post-product-scalar volumes, i.e. the system service volumes prior to the application of scarcity scalars

The volumes represent the system service volumes that are derived from the system dispatch and the application of the product scalars. However, such volumes, while potentially sufficient on an aggregate basis, may not be available at the correct times. For example, if System Service capability volumes are low during times of high SNSP, system security may be compromised. Consequently, we propose to use the scarcity scalars to increase the weighting of System Service volumes that are available at high SNSP levels as outlined in Section 2.4.

3.3. Proposed Tariff Rates for 2017/18

The base tariff rates assumed in the modelling and proposed for use in the enduring regulated tariff arrangements are as follows:

- **Existing 11 services:** The rates for the existing 11 services that we propose to use in the enduring regulated tariff arrangements are the same as the proposed “rollover contract” tariffs recently consulted on¹⁹ during May 2017 (to apply for the period 1 October 2017 through 30 April 2017). A decision paper on these rates will be published in July 2017.
- **3 new services:** The proposed rates for the 3 services (FFR, FPFAPR, and DRR) to be introduced in 2018 are the same as those included in the original Interim Tariffs decision paper²⁰ published in August 2016.

These rates were originally set based on consideration of the following:

1. A forecast of the relative value of the services in 2020;
2. The immediate importance of each service when making the next step change in SNSP.

With regard to the relative value of the services in the longer term, we used the relative values as set out in the DS3 System Services TSO Recommendations Paper²¹ published in May 2013. This was based on extensive modelling by the TSOs, which received broad support from stakeholders at the time.

We have not conducted a new assessment of the relative importance of the services. However, when comparing the tariffs for each service, it should be noted that the overall expenditure for each service is dependent not just on the tariff rates but also on the scalars that apply to the services as well as the volumes eligible for remuneration. In particular, there are multiple product scalars that apply to some services but not others that significantly affect the overall relative expenditure across the 14 services. This has the effect of moving expenditure between services relative to the original weightings which did not have the same scalars applied.

The proposed tariff rates are set out in Table 5.

Question 1: Have you any comments on the proposed tariff rates for the Enduring Regulated Tariff arrangements?

¹⁹ Consultation on DS3 System Services Tariffs (1 Oct 2017 – 30 April 2018):
http://www.eirgridgroup.com/site-files/library/EirGrid/OPI_INV_Paper_DS3-SS-Rollover-Tariffs-Consultation-FINAL.pdf

²⁰ DS3 System Services Interim Tariff Rates Decision Paper:
<http://www.eirgridgroup.com/site-files/library/EirGrid/DS3-System-Services-Decision-Paper-on-Interim-Tariffs-FINAL.pdf>

²¹ DS3 System Services - TSO Recommendations Paper:
<http://www.eirgridgroup.com/site-files/library/EirGrid/System-Services-TSO-Recommendations-May2013.pdf>

Table 5: Proposed Tariff Rates for Enduring Regulated Arrangements

Service Name	Unit of Payment	Proposed Rate €
Synchronous Inertial Response (SIR)	MWs ² h	0.0048
Primary Operating Reserve (POR)	MWh	3.09
Secondary Operating Reserve (SOR)	MWh	1.87
Tertiary Operating Reserve (TOR1)	MWh	1.48
Tertiary Operating Reserve (TOR2)	MWh	1.18
Replacement Reserve – Synchronised (RRS)	MWh	0.24
Replacement Reserve – Desynchronised (RRD)	MWh	0.53
Ramping Margin 1 (RM1)	MWh	0.11
Ramping Margin 3 (RM3)	MWh	0.17
Ramping Margin 8 (RM8)	MWh	0.15
Steady State Reactive Power (SSRP)	MVarh	0.22
Fast Frequency Response (FFR)	MWh	2.06
Fast Post Fault Active Power Recovery (FPFAPR)	MWh	0.14
Dynamic Reactive Response (DRR)	MWh	0.04

3.4. Expenditure

The impact of (i) the portfolio and (ii) the scarcity scalar design are shown in Figure 9 – Figure 11 for the sensitivities documented in Section 3.1.2.

Figure 9 – Figure 11 are normalised against the 2019/20 New Providers base case with the ‘full spend’ scarcity scalars. As documented in Section 2.4, although the budget cap is €235 million, €15 million is reserved to cover the additional expenditure that could arise as a result of the SEM Committee decision to pay based on the higher volumes arising from a unit’s market position or physical dispatch position²², and to cover the cost of the Qualification Trial Process. Therefore, the baseline of ‘1’ for Normalised Expenditure shown in the graph represents spend of €220 million, while the ‘budget cap’ shown in black is set at approximately 1.07 and represents spend of €235 million.

Due to the ‘availability’ payment definition, some system services providers, e.g. DSUs and Non-Synchronous Technologies, may qualify for payment for a very large number of hours. Therefore, the expenditure in the New Providers cases is consistently higher than that for the relevant Enhanced case. This is also evidenced in Figure 11, which presents the total expenditure for cases in which additional

²² Further information on this is contained in Section 4.3.2.

investment is assumed, i.e. investment that is unforeseen or not included in the base portfolios.

Figure 9 demonstrates the impact of a high and low wind capacity factor on the overall system services expenditure. The low wind sensitivities result in significant under expenditure as the low wind capacity factor results in comparatively low SNSP levels compared to the other sensitivities. As expected, the opposite occurs for the high wind sensitivities as the SNSP levels are increased in comparison to the other cases. In both cases, the reduced or increased levels of SNSP have a knock-on implication for the quantity of time in the year when the scarcity scalar is increased. This resultant impact on overall expenditure is evident in the graph. Further information on the percentage of time high SNSP levels occur in each case is presented in Table 6.

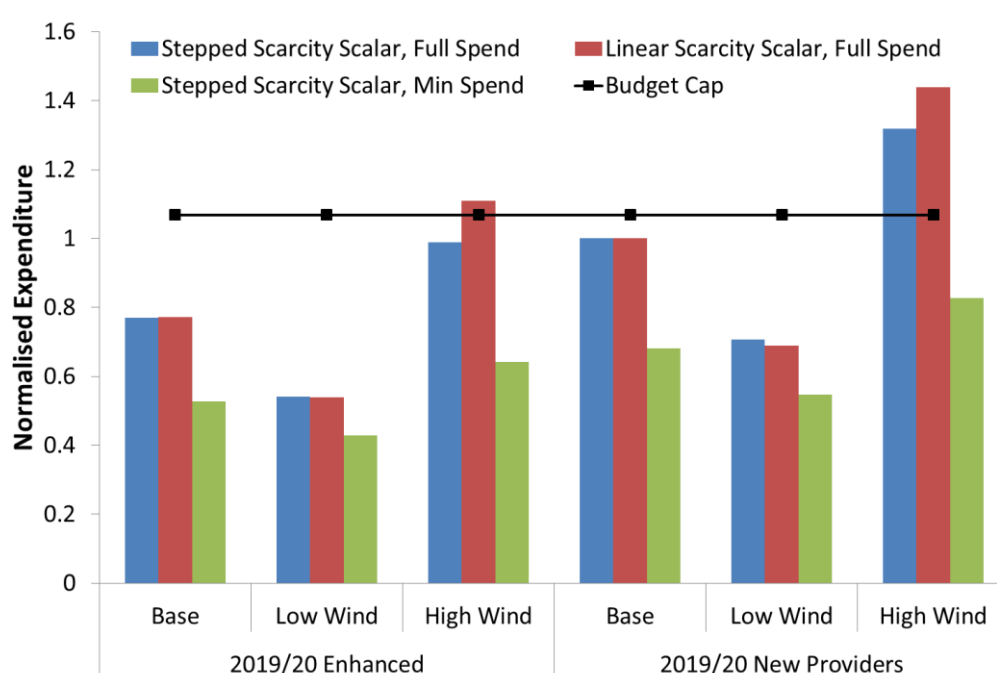


Figure 9: Impact of wind time series and capacity factor on system services expenditure (normalised with respect to the 2019/20 New Providers case with full spend)

Figure 10 demonstrates the impact of interconnector flow sensitivities. It is clear that the overall expenditure is more robust to changes in the interconnection flows compared to the variation in wind capacity factor. The overall expenditure has a minimal change for the high export sensitivity cases but sees an increase in both high import cases. This is due to a high import level contributing to higher overall levels of non-synchronous sources on the system, resulting in an increased SNSP, and therefore an increased percentage of the year with a high scarcity scalar. Further

information on the percentage of time high SNSP levels occur in each case is presented in Table 6.

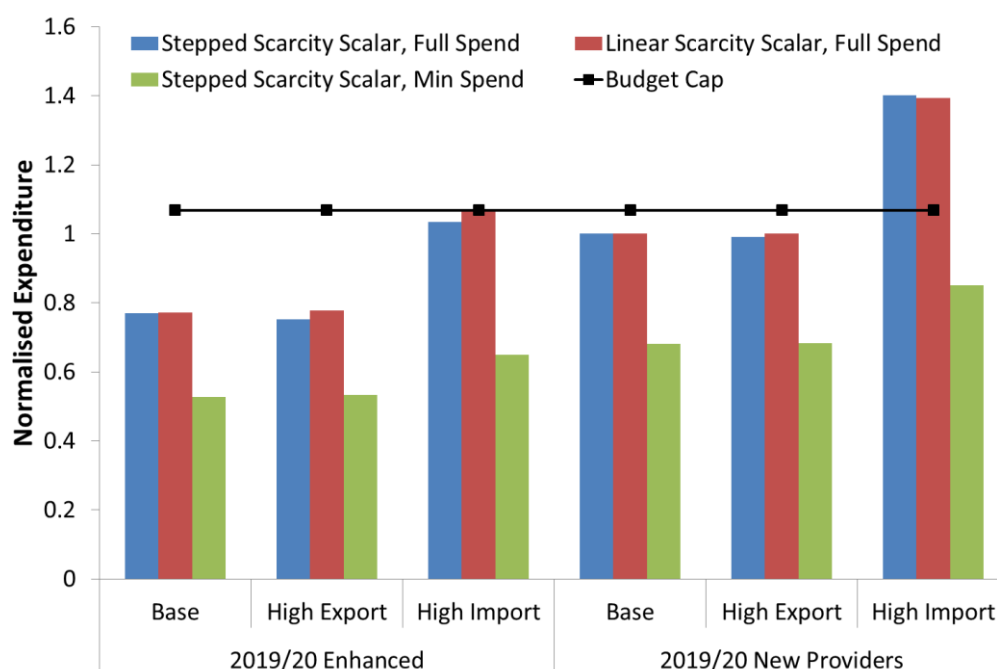


Figure 10: Impact of HVDC interconnector flow assumptions on system services expenditure (normalised with respect to the 2019/20 New Providers case with full spend)

One of the design goals of the scarcity scalar, in addition to the primary goal of sending sufficient investment signals for additional volumes from system service providers that are available at high SNSP levels, is to aid in lowering the sensitivity of the system service total expenditure to uncertainties.

Figure 11 demonstrates that the scarcity scalar design is reasonably robust to unforeseen investment such as a new CCGT or an additional 100 MW capacity of Non-Synchronous Technologies. There is minimal change in the overall expenditures when a new CCGT is modelled. This is due to the new CCGT merely displacing an existing CCGT in the merit order, which results in approximately the same overall dispersion of revenue. There is a greater difference seen when 100 MW of new Non-Synchronous Technologies are modelled. This is due to the high 'availability' levels of this technology type. Further discussion on this is included in section 4.4.1.

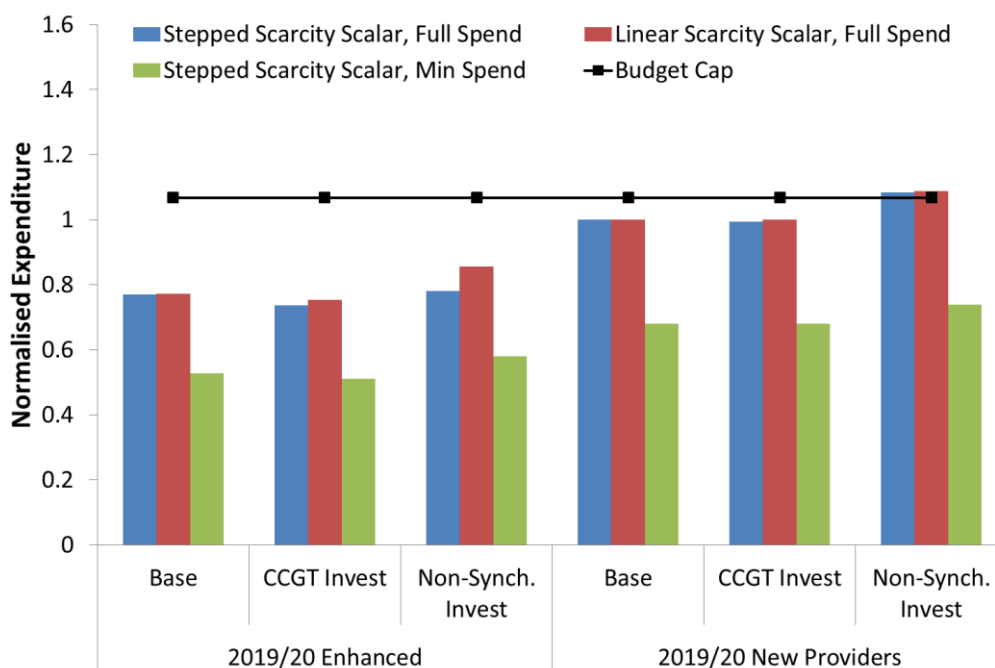


Figure 11: Impact of investment, unforeseen in initial portfolios on system services expenditure (normalised with respect to the 2019/20 New Providers case with full spend)

Table 6: Percentage of time at high SNSP levels

Simulation Case	%Time above 60% SNSP	%Time above 70% SNSP
2019/20 Enhanced, Base	15.2	7.5
2019/20 Enhanced, Low Wind	7.9	3.0
2019/20 Enhanced, High Wind	22.2	14.6
2019/20 Enhanced, High Export	14.9	7.5
2019/20 Enhanced, High Import	29.0	12.7
2019/20 New Providers, Base	15.1	7.4
2019/20 New Providers, Low Wind	7.8	3.0
2019/20 New Providers, High Wind	22.3	14.5
2019/20 New Providers, High Export	14.8	7.4
2019/20 New Providers, High Import	28.7	12.5

The expenditure per service, shown in Figure 12, illustrates the expenditure distribution across the services for both the Enhanced Capability and New Providers cases for the 2019/20 tariff year.

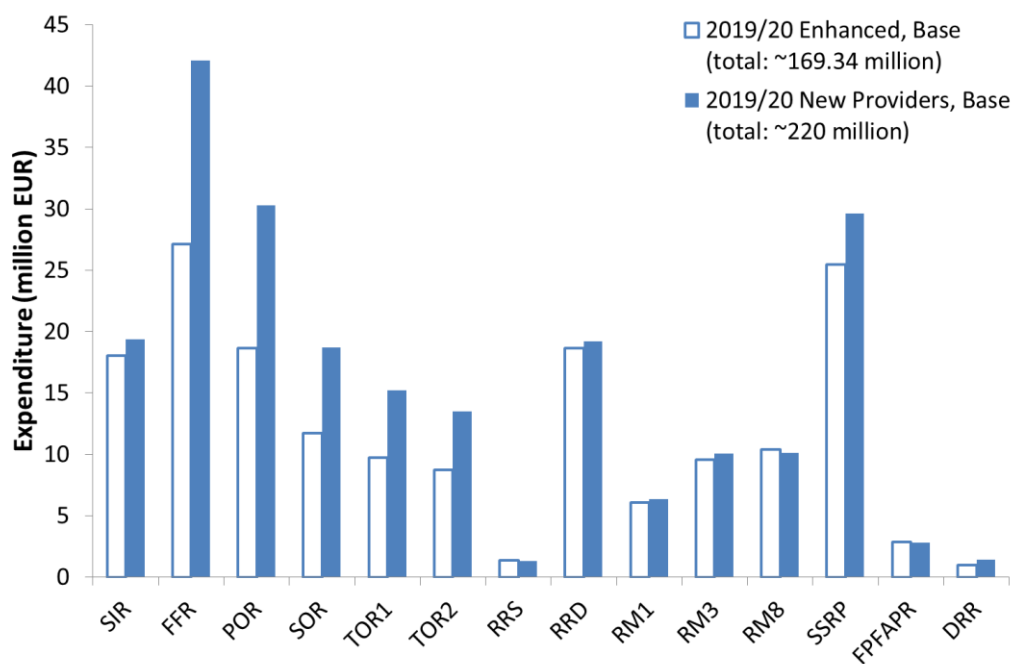


Figure 12: 2019/20 expenditure per system service, using the stepped scarcity scalar with ‘full spend’ parameters in each case (see Table 2 for parameter values)

3.5. Revenue Flows

The annual revenues per technology type for the Enhanced and New Providers base cases are shown in Figure 13 for both the “Full Spend” and “Min Spend” scenarios previously set out in Table 2.

The revenues shown are annual and represent Thousands of Euro per MW of Installed Capacity. These are average values calculated using the entire installed capacity of the portfolio and do not indicate what each individual unit would necessarily earn. Two CCGTs, for example, would earn very different revenues from DS3 System Services depending on the amount of run hours each one experiences in a given year.

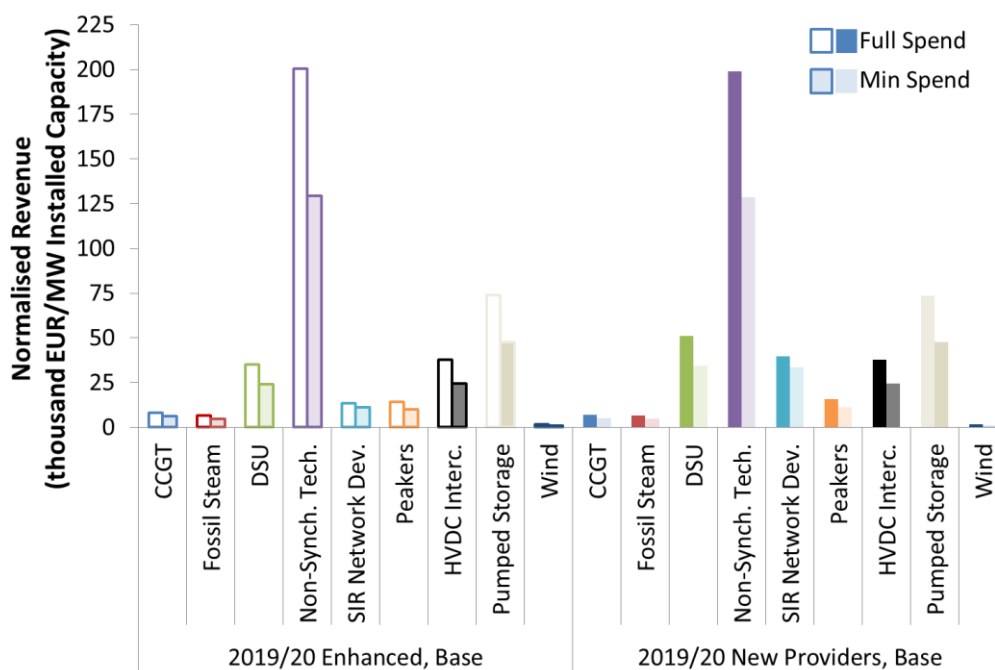


Figure 13: Technology revenue (normalised with respect to the installed capacity of each technology)

3.6. Application of Methodology to 2017/18 Tariff Year

The proposed methodology will only apply from 1 May 2018. Furthermore, the FFR, FPFAPR and DRR services will only go-live from 1 September 2018, i.e. for only one month in the 2017/18 tariff year. Between 1 October 2017 and 30 April 2018, the existing Interim Tariff contracts will continue using the final “rollover contract” tariff rates.

Based on PLEXOS simulations using an assumed 2017/18 portfolio scenario, the system services expenditure for the 2017/18, for both Full Spend and Min Spend scarcity scalar parameters has been assessed. The results are shown in Table 7.

Table 7: Breakdown of simulated 2017/18 tariff year expenditure, utilising ‘Min Spend’ and ‘Full Spend’ stepped scarcity scalar parameters

Time Period	“Min Spend” Scarcity Scalars	“Full Spend” Scarcity Scalars
October 2017 to April 2018	42.4	42.4
May 2018 to September 2018	45.1	60.1
Total	87.5	102.5

4. Regulated Tariff Discussion

4.1. Introduction

In this chapter, we present and discuss a range of challenges and issues associated with the arrangements relating to the following:

- Investment certainty (Section 4.2);
- Operational risk (Section 4.3); and
- Expenditure risk (Section 4.4).

For each issue identified, potential mitigation options are presented and explained. In Section 4.5, we provide our view on the appropriate balance of considerations to meet the outlined challenges and constraints.

These recommendations represent our “minded-to” position. They are the subject of this consultation paper and we are seeking stakeholders’ views on the proposals.

4.2. Investment Certainty

There are numerous challenges to achieving investment certainty for new or enhanced system service providers, including contract length of service provision and price certainty for system service tariffs. These challenges, and possible mitigation options to contract length and price certainty challenges, are discussed in this section.

Timing of Introduction of Long-Term Market Mechanisms

As outlined in the recent SEM Committee Information Paper on the DS3 System Services Future Programme Approach²³, the Regulatory Authorities “*are in the process of reviewing options*” for the long term market mechanism options which will be implemented on an enduring basis in the coming years. The “*initial investigative work*” on long term market mechanism options “*started in Q1 2017 with the detailed design phase anticipated to start in Q3 2017.*”

This “*initial investigative work*” is focused on four main work-streams:

²³ SEM Committee Information Paper on the DS3 System Services Future Programme Approach: <https://www.semcommittee.com/sites/semcommittee.com/files/media-files/SEM-17-017%20DS3%20System%20Services%20Future%20Approach%20Information%20Paper.pdf>

- EU Balancing Guideline
- Evidence from other jurisdictions
- Ongoing interaction with I-SEM design
- Future European legislation

As outlined in the Information Paper, several of these work-streams will take a number of months to be assessed. However, there is currently no definitive start date for the introduction of the long-term System Services market mechanism, other than the Regulatory Authorities stated position that it will not be introduced before 2019.

The TSOs agree that the design and construction of the appropriate long term market mechanism will at least take until 2019 to work out and implement. This design will need to consider many facets including EU Electricity Balancing Guideline obligations, the objectives and the intent of system services at that stage (meet the needs of the system in 2020 or some future date) and the economic nature of system services (whether they are a commodity or a public good).

While the TSOs understand the difficulties in definitively stating the go-live date of these long term mechanisms, we would note that this means at this stage there is only a limited two year duration certainty for the Enduring Regulated Arrangements. In that context, the TSOs consider that it would be beneficial if the Regulatory Authorities could provide further information on the timing of the introduction of long-term market mechanism arrangements in order to provide greater contract certainty which would facilitate greater investment certainty in the interim period.

Proposed Annual Tariff Review

Historically, there has been an annual review of tariffs under the HAS arrangements as well as the DS3 System Services arrangements, and as per the recent Information Paper on the DS3 System Services Future Programme Approach, this approach has been reaffirmed by the SEM Committee. The annual tariff review was proposed by the SEM Committee in order to examine and control system services tariff pricing over the initial years of operation.

An annual review has many benefits, including allowing the Regulatory Authorities to ensure that the tariffs are driving the correct investment signals, and that the result delivered is driving value for the electricity consumer. It also ensures that the System Services expenditure is continuously channelling investment in capability which most benefits the system. The TSOs fully agree with these objectives.

However, an annual review without scope or bounds leads to uncertainty for investors. In order to drive the necessary levels of investment in new technologies capable of supplying system services and/or enhancements to existing plant, a degree of certainty must be made available for investors.

Potential Mitigation Options:

- 1) To mitigate contract uncertainty challenges in the absence of a defined timeline for the introduction of a long-term market mechanism arrangement for System Services** – it would be beneficial if there was increased certainty around the duration of the regulated arrangements. This set duration would commence from the beginning of the proposed panel framework.

As outlined above, the TSOs consider that it would be beneficial for the Regulatory Authorities to provide further information on the timing of the introduction of long-term market mechanism arrangements in order to provide greater contract certainty which would in turn facilitate greater investment certainty in the interim period. The TSOs would request that, if possible, the Regulatory Authorities consider including a “no earlier than” clause in future decisions on the timing of introduction of the long term system service market mechanism. Recent procurements in other jurisdictions would indicate that a minimum of four year contract certainty is required.²⁴

Furthermore consideration should be given to retaining these regulated arrangements for a minimum number of years for any system services products that are not covered by the EU Balancing Guideline.

- 2) To mitigate price uncertainty challenges raised by the proposed annual tariff review** – the tariff rates could be set once at the beginning of the regulated arrangements, with the use of a scarcity scalar (which weights service availability at times when SNSP is above 60%) to control payments, and the tariffs would only be adjusted if specific conditions are met. The TSOs consider it prudent that a conditional review of the tariff and scarcity scalar structure should be initiated within the duration of the regulated arrangements should any of the following situations occur:

- The risk of over-expenditure is considered high or actual expenditure is over the “glide-path” expenditure, set out by the SEM Committee, in a particular tariff year (for reasons other than a high annual wind capacity factor – discussed further in Section 4.4.3) – this may highlight a potential unbalanced tariff pricing, an inappropriate scarcity scalar design, or it could be as a result of an Operational Risk as is further outlined in Section 4.3.
- There is a significant under expenditure in a particular tariff year – this may highlight a potential unbalanced tariff pricing or scarcity scalar structure.

²⁴ For example, National Grid completed the procurement of an Enhanced Frequency Response service in August 2016. National Grid awarded a four contract to successful tenderers. The Invitation to tender for pre-qualified parties can be viewed here: <http://www2.nationalgrid.com/WorkArea/DownloadAsset.aspx?id=8589934901>

- Significant overinvestment in specific new technologies within a particular year which may lead to over-expenditure beyond the 'glide-path' expenditure set out by the SEM Committee. Further details on this are provided in Section 4.4.

4.3. Operational Risk for Investment

In order to set the enduring regulated tariffs and scarcity scalars, the TSOs have made assumptions regarding the future operation of the power system. In this section, a number of operational risks are discussed which may impact on these assumptions and have a resultant impact on the regulated tariffs and scalars. Mitigation options are proposed to minimise the impact of these risks should they occur.

SNSP timeline and ability to operate above 60%

The DS3 Programme sets out a programme of work to enable the SNSP limit on the power system to increase from its current value of 60% up to 75% by 2020. The programme has been successful in moving the SNSP limit from 50% to 55% in 2016, and then subsequently to 60% in 2017 through provisional and then official operating policy. Currently there is an official operating policy of 60% SNSP. This means that unless there are exceptional circumstances, the TSOs are confident that we can operate up to 60% SNSP at all times while all other operational constraints are met.

While every action is being taken by the TSOs to continue progressing the SNSP limit to 75% by 2020, it must be highlighted to investors that there could be unforeseen operational risks encountered which may force the TSOs to review the planned SNSP limit increase timeline.

As outlined in Section 2.4, it is initially proposed to link the scarcity scalar to the SNSP level on the system at any particular point in time, in order to value service availability at times when it is required on the system. Any review of the planned SNSP limit increase timeline will take into consideration the potential impact to the scarcity scalar design.

In addition, there is currently no other synchronous system managing the same high levels of wind and solar generation. To that extent, while every effort is being made to manage all the issues, circumstances may arise that challenge our perceived understanding of the operation of the system. If this situation occurs it is conceivable that operation of the system at levels below 60% SNSP may be required for periods of time to establish and re-baseline our understanding. While the TSOs do not envision this happening, and should it occur we will do everything we can to speedily resolve the issue, we believe it is appropriate to identify the risk to investors.

Potential Mitigation Options:

- 1) **To ensure the timely delivery of SNSP increases** – the communications on the programme of work required to increase SNSP is currently managed through the DS3 Programme, and any issue related to the timely delivery of an SNSP increase will be communicated to stakeholders as speedily as possible. This programme is oversighted by the Regulatory Authorities, has DSO involvement and has active industry involvement through the DS3 Advisory Council and Public Fora.
- 2) **To reduce the revenue risk from delays to SNSP increases** – the use of a ‘Stepped’ rather than ‘Linear’ scarcity scalar design limits the exposure to delays in SNSP increases, as shown in Figure 5. Service providers will receive increased payments, for the majority of services, at system conditions above 60% SNSP and 70% SNSP; therefore a delayed increase to 75% will have a reduced impact on the revenues received by the investor.
- 3) **To reduce the risk of operating the power system at high SNSP levels** – the TSOs currently operate the power system in a safe, secure and reliable manner in line with the current SNSP Operational Policy. This policy mitigates operational risks at high levels of SNSP. This policy will continue to be prudently reviewed on an ongoing basis.

4.4. Expenditure Risks and Mitigations

There are a number of issues that affect the TSOs’ ability to forecast remuneration volumes, to set robust tariff rates, and consequently to ensure that overall payments remain within the “glide-path” set out by the SEM Committee.

For the new services of which we have little experience, we can estimate the capability of existing and new plant to provide the services. However, there is a risk that the volumes that will need to be remunerated are different to those forecasted, particularly in the early years.

Specific details on these issues, along with potential mitigation options, are outlined in the following subsections.

4.4.1. Availability-based Payments for New Non-Synchronous and DSU Technologies

The TSOs expect that the introduction of the enduring system service tariffs will drive investment in new technologies which provide system services. The Qualification Trial Process is the mechanism by which any new unproven technology (unproven from a system services provision perspective) can demonstrate its capabilities to deliver system services prior to gaining access to DS3 System Services contracts in

the future central procurement processes. If the new technology meets technical standards, the technology becomes proven and individual service providers using that technology can be added to the framework provided they meet all of the other technical standards set out in the procurement process.

Payments for DS3 System Services will be on an “availability” basis. The direction by SEM Committee is that this should be interpreted as payment based on “*technical realisability*”. This means that some types of service providers could be available and eligible for payments for every hour of the year assuming they are not forced out or on maintenance, even if the service is not required from those providers at all of these hours. For the purposes of this paper, we have classified these technologies as DSUs and ‘Non-Synchronous Technologies’²⁵. The scale of overall payments will therefore increasingly depend on the portfolio of service providers and the expected availability of individual service providers.

The use of “*technical realisability*” gives very high levels of certainty to new technology investors that they will receive a stable and predictable rate of return on their investment. The risk then arises that the level of certainty may be too high for the DSUs and Non-Synchronous Technologies, and there will be an overinvestment in new technology service providers. Mitigation options therefore need to be considered to manage this risk – three potential options are discussed below.

Noting that there is currently no limit on the volume that can be added to the procurement framework, there is a risk of over-expenditure should there be substantial overinvestment in specific new technologies. The current “availability” payment rules offer the TSOs little control or corrective actions should this happen, other than the conditional annual review to tariffs set out in Section 4.2. The variation in total system services expenditure is evident for the two portfolios – ‘Enhanced’ and ‘New Providers’ – considered in the modelling results in Chapter 3.

It is the TSOs’ view, that in order to manage potential cash flow deviations, the TSOs will need to have appropriate contingent capital facilities, supported by an appropriate regulatory framework, in place should over expenditure occur within a particular year. It is the TSOs’ assumption that the funding and the required financing facilities for all system services provision for each tariff year can be put in place.

Three potential mitigation options to manage the risk of over-expenditure linked to overinvestment in technologies with high ‘availability’ levels are now set out.

Potential Mitigation Options:

- 1) To reduce the risk of overinvestment in service providers with high ‘availability’ levels leading to over-expenditure** – after a certain point (which would need to be defined at the start of the arrangements), it may be appropriate

²⁵ See Glossary of Terms for more information.

to review the definition of 'availability' for any further new entrants classified as DSUs and Non-Synchronous Technologies (or any other technology with high 'availability' levels).

The TSOs understand that these payment rules provide a good level of investment certainty for DSUs and Non-Synchronous Technologies, which may be fitting given the relative immaturity of the arrangements and the other risks borne by service providers. However, as the regulated arrangements evolve, and depending on the level of investment and its nature, it may be appropriate to review the definition of 'availability' for further new entrants classified as DSUs and Non-Synchronous Technologies.

For example, a potential change to the 'availability' definition may provide for payments to these technologies to be made only during times when the service is required by the TSO (i.e. only at times when the TSO would instruct the service provider to make the service available).

- 2) **To reduce the risk of overinvestment in service providers with high 'availability' levels leading to over-expenditure** – a volume scalar could be introduced on a trading period basis. This would mean that the payments for a specific volume of service in a trading period would be pro-rated across all available new DSUs and Non-Synchronous Technologies should an overinvestment in these technologies occur. This would add further complexity to the arrangements and impact on the level of investment certainty.
- 3) **To reduce the risk of overinvestment in service providers with high 'availability' levels leading to over-expenditure** – a limit may be placed on the volume of new DSUs and Non-Synchronous Technologies (or other technologies which have very high levels of availability) that can qualify to provide services. This limit would mitigate the risk of overinvestment, as only a specified quantity of these new technologies would be eligible to qualify for each service in the procurement process. This approach could encourage a phased approach to the introduction of the new technologies. This approach could be introduced through the procurement process in a number of ways, for example:
 - (i) Apply a 2020 'volume cap' on the level of new DSUs and Non-Synchronous Technology service providers which are eligible for payments. New DSUs and Non-Synchronous Technologies can connect to the system and obtain system services payments at any stage between now and 2020. While this may ensure the 'volume cap' is not breached for 2020, it risks over-expenditure between now and 2020, as a large volume of Non-Synchronous Technology may connect between now and then.
 - (ii) Apply a 'glide-path' volume limit to new DSUs and Non-Synchronous Technology service providers each year based on the SEM Committee's overall system services expenditure 'glide path'. New providers may be added

to a service procurement framework on a first come, first served basis up to the volume limit each year.

- (iii) DSUs and Non-Synchronous Technology service providers bid into a competitive arrangement to be added to the service procurement framework. The least cost service provider is added to the service procurement framework. This method ensures the cheapest possible outcome for the electricity consumer.
- (iv) A separate tender process could be used to determine which service providers receive a contract. The successful tenderers may be placed on a separate procurement framework to the rest of the providers with different contractual terms and conditions.

While the TSOs acknowledge this may be considered discriminatory to DSUs and Non-Synchronous Technologies, the impact of high levels of these new technologies can have a dramatic impact on the distribution of system service payments, as outlined in the 'New Providers' system service expenditure graphs in Chapter 3, Figure 9 – Figure 11. Therefore, the TSOs view these measures as not unduly discriminatory and justified in order to reduce the risk of over-expenditure.

For this mitigation option to be implemented, further consultation and considerations would need to be taken into account.

4.4.2. Market Dispatch vs Physical Dispatch

The SEM Committee decision on the DS3 System Services procurement design provided the following direction with regard to determining the amount that a system service provider should be paid in any given trading period: *"The SEM Committee has decided that a provider with a system services contract will be paid for the volume of the service that has actually provided or made available in that trading period to the TSO regardless of the TSO's real-time requirement for that service. The higher of a unit's market position or physical dispatch will be used to determine the available volume."*

The Regulatory Authorities' DS3 Project Board meeting on 4th July 2016 approved the TSOs' proposal to use the Final Physical Notification (FPN) as the appropriate market position in calculating a unit's available volume for system service provision.

The TSOs proposed that the FPN should be used as the 'market position' for the following reasons:

- The use of any other market position as the basis for determining payment would be problematic. For example, a service provider could position itself to provide

services at the day-ahead or intra-day stage thereby locking in system services payments. However, the service provider could decide to trade out of these positions in the remaining time to gate closure. The TSOs would subsequently be required to increase or decrease that service provider (or another provider) in order to get the services for physical dispatch, thereby incurring additional costs in the balancing market.

- The Security-Constrained Unit-Commitment and Economic Dispatch (SCUC/SCED) tool is currently being developed and will replace the existing RCUC scheduling tool upon I-SEM go-live. To produce the dispatch, the SCUC/SCED tool will use the Physical Notifications (PNs)/FPNs and optimisation algorithms to minimise the cost of deviation from the PN/FPN to deliver the system services required to secure the power system. SCUC/SCED will not use the Day-Ahead and Intraday market positions (which may be physically different from the PN/FPN). This is consistent with the I-SEM ETA Detailed Design – Markets Decision Paper which states that “*The SEM Committee has decided to proceed with an option under which the ex-ante markets are left to resolve the energy supply/demand balance, with participants’ physical notifications at gate closure representing their ex-ante market position. The TSOs will then seek to minimise the cost of dispatching the system given these Final Physical Notifications (FPNs)*”. The paper also separately states that “*The SEM Committee considers that a one hour gate closure timeframe remains valid for the I-SEM...*”

Following implementation of the decision, the scale of payments will depend on the actions of system service providers and not just the TSOs. The behaviour and actions of participants following I-SEM go-live will have a large impact on the remuneration volumes of these services, and consequently on the overall level of expenditure for system services. However, the exact magnitude of the impact is difficult to forecast ahead of I-SEM go-live.

In order to account for the uncertainty of the impact of market dispatch and physical dispatch intricacies and payments required for the Qualification Trial Process, the TSOs have applied a margin of error of €15 million when optimising the scarcity scalar designs. This can be seen in modelling results in Chapter 3, as the scarcity scalar for the base case New Providers scenario has been optimised to meet €220 million expenditure, rather than the expenditure limit of €235 million.

In addition, implementation of the proposed payment arrangements will require consideration of a broad set of issues including the different nature of the 14 services, I-SEM/DS3 System Services interactions, and settlement calculation design. These issues may require consideration by the RAs

Potential Mitigation Option:

- 1) **To reduce the risk of over-expenditure as a result of forecast error relating to the variation between market and physical dispatch** – the implementation of taking the higher of a service provider's market position or physical dispatch, to determine the available volume of a service, should be delayed for a minimum of 12 months post I-SEM go-live.

This period will allow the Regulatory Authorities and TSOs to make the necessary policy and design decisions and engage with stakeholders, and for the TSOs to put in place adequate measurement and settlement systems. The TSOs will however seek to monitor and track the relative market positions of all service providers during this time. If an implementation period is required, interim measures will be explored to allow for appropriate payments in advance of the implementation of any required systems. It may be appropriate to conduct a re-settlement of the system service payments for the 12 month period following the implementation of the required systems.

4.4.3. Wind Capacity Factor and Interconnection Flows

Interconnector Flows

Interconnector units are important service providers, with the capability to provide many of the new and existing system services. Interconnector units can also often be the largest single infeed and thus have a large impact on the quantity of services required for secure system operation – in particular for FFR, POR, SOR, TOR 1 and TOR 2. In addition, the amount of services provided by an interconnector unit at any given time can be impacted by the direction and magnitude of the flow.

Estimates on the level of flows on the interconnectors have been used to forecast the remuneration volumes of these services. However, depending on a large number of variables, such as fuel and carbon pricing in neighbouring countries and interconnector availability levels, the actual interconnector flows may be different to those forecasted and thus have an impact on the remuneration volumes of these services.

Potential Mitigation Option:

- 1) **To reduce the risk of over-expenditure due to variations in interconnector flows** – the use of the 'Stepped' rather than 'Linear' scarcity scalar design should be considered. The Stepped scarcity scalar limits the exposure to variations in interconnector flows and increases robustness against potential over-expenditure, more so than the 'Linear' scalar. As per Section 3.4, and Figure 10 specifically, the TSOs have considered sensitivities on interconnector flows to assess the impact on total system services revenue.

Analysis indicates that the design of the 'Stepped' scarcity scalar mitigates the risk of over-expenditure beyond the "glide-path" set by the SEM Committee better than the 'Linear' scarcity scalar. The greatest impact on the level of expenditure would occur due to high levels of imports, which in turn lead to higher levels of SNSP throughout the year. This would result in the scarcity scalar having a higher value for longer in the year, and thus more payments are given to service providers.

Wind Capacity Factor

Wind generation output has a large impact on the SNSP level on the power system due to its non-synchronous nature. Annual wind generation capacity factors vary every year. Therefore, there is uncertainty over what the annual capacity factor for wind generation will be and what the resultant SNSP levels will be.

Should a high wind capacity factor occur in any given year, there would be a risk of over-expenditure beyond the 'glide-path' set by the SEM Committee due to the high SNSP levels which would be seen that year as per Figure 9. Consistent levels of high SNSP would lead to the increased scarcity scalar value being active for longer in the year, as it is activated above 60% SNSP.

Potential Mitigation Options:

- 1) To reduce the risk of over-expenditure due to variations in wind capacity factor** – the use of the 'Stepped' rather than 'Linear' scarcity scalar design should be considered. As per Section 3.4, the TSOs have considered sensitivities on wind capacity factors to assess the impact on total system services revenues. The capacity factors chosen for these sensitivities are based on the range of capacity factors seen on the power system over the last ten years as per Figure 14. Following an assessment of these results, Figure 9 clearly highlights the robustness of the 'Stepped' scarcity scalar to the risk of over-expenditure beyond the 'glide-path' set by the SEM Committee, when compared to the 'Linear' scarcity scalar. Nevertheless, there is still a risk of over-expenditure should there be a 'high' wind year.
- 2) To mitigate price uncertainty challenges raised by variations in wind capacity factor** – over-expenditure as a result of a high annual wind capacity factor should not be considered as cause to initiate a conditional review of the regulated tariff structure, as outlined in Section 4.2. Should a high annual wind capacity factor occur, the over-expenditure of system services will likely be more than negated by the decrease in energy prices seen in that year.

The core principle of the DS3 Programme is to enable high levels of non-synchronous renewable generation on the power system. If over-expenditure were to occur in these circumstances, the core principles behind which the

system service tariffs are set remain valid and, therefore should not be considered for a conditional review.

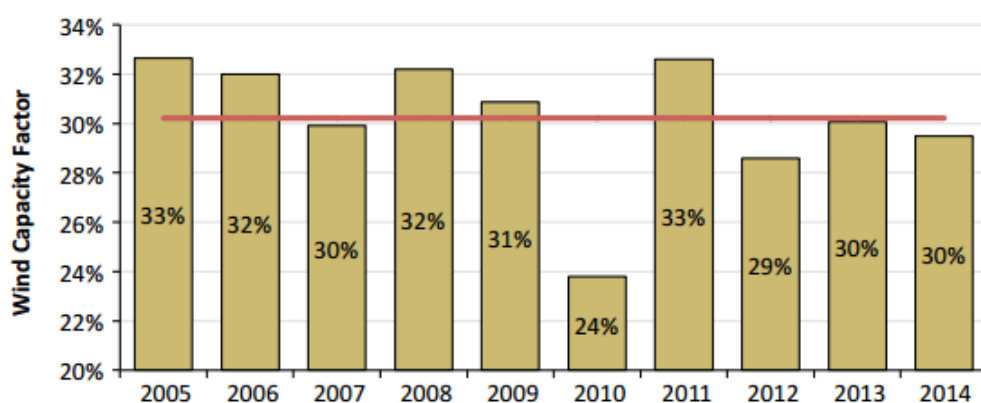


Figure 14: Historical all-island wind capacity factors for 2005-2014 (the red line is the average over the period)²⁶

²⁶ Generation Capacity Statement 2016 – 2025:

http://www.eirgridgroup.com/site-files/library/EirGrid/Generation_Capacity_Statement_20162025_FINAL.pdf

4.5. TSOs' Opinion on Mitigation Options

The TSOs are minded to recommend the following mitigations to address the suite of challenges. These recommendations are the subject of this consultation paper and we are seeking stakeholders' views on the proposals. SONI and EirGrid welcome feedback on the questions posed, which will be used to inform the decision paper that will be submitted to the SEM Committee for approval.

Contract Uncertainty Mitigation Recommendations:

- **In the absence of a defined timeline** for the introduction of a long-term market mechanism arrangement for System Services, that there is a clear and unambiguous commitment for these regulated arrangements to remain in place for a minimum defined time duration. This would commence from the beginning of the proposed panel framework.
- **To commit to as long a period as possible** before a change is to be required. The TSOs would request that, if possible, the Regulatory Authorities consider including a "no earlier than" clause in future decisions on the introduction of the long term system services market mechanism.

Recent procurements in other jurisdictions would indicate that a minimum of four year contract certainty is required to deliver investment²⁷. Furthermore, consideration should be given to retaining these regulated arrangements for a minimum number of years for any products that are not covered by the EU Balancing Guideline. Based on experience in other jurisdictions and the lower investment certainty in these arrangements relative to those elsewhere, the TSOs are minded to recommend a minimum of six year contract certainty for these products.

Question 2: Have you any comments on the TSOs' recommendation that the regulated arrangements be put in place for a minimum defined time duration until such a time as there is greater information available on the timeline for implementing a long-term market mechanism for System Services?

Question 3: With respect to contract certainty, are there other considerations which we should take account of or other options that we should explore further?

²⁷ For example, National Grid completed the procurement of an Enhanced Frequency Response service in August 2016. National Grid awarded a four contract to successful tenderers. The Invitation to tender for pre-qualified parties can be viewed here: <http://www2.nationalgrid.com/WorkArea/DownloadAsset.aspx?id=8589934901>

Price Uncertainty Mitigation Recommendations:

To mitigate price uncertainty challenges raised by the proposed annual tariff review, the TSOs recommend that the tariff rates be set once at the beginning of the regulated arrangements only. The use of a scarcity scalar (which weights service availability payments at times when SNSP is above 60% and 70%) to control payments and focus investment is also proposed. Furthermore we recommend that any reviews of the arrangements should be conditional. The conditions for such a review would include:

- **The risk of over-expenditure is considered high or actual expenditure is over the 'glide-path' expenditure**, set out by the SEM Committee, in a particular tariff year (for reasons other than a high annual wind capacity factor) – this may highlight a potential unbalanced tariff pricing, an inappropriate scarcity scalar design, or it could be as a result of an operational risk as is further outlined in Section 4.3.
- **A lack of investment in needed services** demonstrated by significant under expenditure in a particular tariff year. This may highlight a potential unbalanced tariff pricing or scarcity scalar structure.
- **Significant overinvestment in specific new technologies** within a particular year which may lead to over-expenditure beyond the 'glide-path' expenditure set out by the SEM Committee. Further details on this are provided in Section 4.4.

The TSOs recommend that the Regulatory Authorities do not consider over-expenditure as a result of a high annual wind capacity factor to be a cause to initiate a conditional review of the regulated tariff structure. Should a high annual wind capacity factor occur, the over-expenditure of system services will likely be more than negated by the decrease in energy prices seen in that year.

The core aim of the DS3 Programme is to enable integration of high levels of non-synchronous renewable generation on the power system. If over-expenditure were to occur in these circumstances, the core principles behind which the system service tariffs are set remain valid, and therefore it is recommended that this situation should not be considered for a conditional tariff review.

Question 4: Have you any comments on the TSOs' recommendation to replace an annual tariff review with a conditional tariff review, or are there alternative approaches that you think are better?

Question 5: Are there other considerations on the conditions under which a conditional review would be triggered?

Question 6: Have you any comments on the proposal to exclude a high annual wind capacity factor as a consideration for triggering a conditional tariff review?

Over-Expenditure Risk Mitigation Recommendations:

- Scarcity Scalar Recommendations to mitigate over-expenditure:

The TSOs are minded to recommend the use of the 'Stepped' scarcity scalar rather than 'Linear' scarcity scalar design in the Enduring Regulated Tariff arrangements. The TSOs recommend that a 'Stepped' scarcity scalar of 6.2 from 60% up to 70% SNSP, and 8.5 above 70% SNSP, be implemented which would ensure that up to €235 million would be paid out. Based on experience in other jurisdictions, the scalar should not be lower than 3.1 from 60% up to 70% SNSP, and 4.3 above 70% SNSP, as it will not drive sufficient investment in new Non-Synchronous Technologies. However, the scalars can only be set this low if there is an equivalent increase in certainty of the arrangements for over four years.

The 'Stepped' scarcity scalar offers increased robustness and certainty on numerous issues in comparison to the 'Linear' scalar. These include:

- **To reduce the revenue risk from delays to SNSP increases:** The use of a 'Stepped' scarcity scalar design limits the exposure to delays in SNSP increase, as shown in Figure 5. Service providers will receive increased payments, for the majority of services, at system conditions above 60% SNSP and 70% SNSP; therefore a delayed increase to 75% will have a reduced impact on the revenues received by the investor.
- **To reduce the risk of over-expenditure due to variations in interconnector flows:** The use of the 'Stepped' scarcity scalar design limits the exposure to variations in interconnector flows and increases robustness against potential over-expenditure, in comparison to the 'Linear' scalar. As per Section 3.4, and Figure 10 specifically, the TSOs have considered sensitivities on interconnector flows to assess the impact on total system services revenue. Analysis indicates that the design of the 'Stepped' scarcity scalar mitigates the risk of over-expenditure beyond the "glide-path" set by the SEM Committee better than the 'Linear' scarcity scalar.
- **To reduce the risk of over-expenditure due to variations in wind capacity factor:** The use of the 'Stepped' scarcity scalar design limits the exposure to variations in wind capacity factor and increases robustness against potential over-expenditure to the extent possible. Following an assessment of these results, Figure 9 clearly highlights the robustness of the 'Stepped' scarcity scalar to the risk of over-expenditure beyond the 'glide-path' set by the SEM Committee, when compared to the 'Linear' scarcity scalar. The 'Stepped' scalar still leads to over-expenditure in the 2019/20 New Providers High Wind scenario but as outlined above, the TSOs recommended that this situation should not be considered for a conditional tariff review as it remains in line with the core principles of the DS3 Programme.

Question 7: Have you any comments on the TSOs' recommendation to use the 'Stepped' scarcity scalar design rather than the 'Linear' scarcity scalar design?

Question 8: Should we decide to use a ‘Stepped’ scarcity scalar, are there other considerations which we should consider in its design?

- Recommendations to mitigate over-expenditure as a result of overinvestment in new DSUs and Non-Synchronous Technologies:

To reduce the risk of overinvestment in service providers with high ‘availability’ levels, which may lead to over-expenditure, the TSOs recommend that a limit be placed on the volume of services which can be provided by new DSUs and Non-Synchronous Technologies (or any other technology that might qualify for payment at all hours of the year irrespective of the TSOs’ requirements). This limit would mitigate the risk of overinvestment, as only a specified quantity of these new technologies would be eligible to qualify for each service. This approach could encourage a phased approach to the introduction of the new technologies. This approach could be introduced through the procurement process in a number of ways as outlined below:

(i) Apply a 2020 ‘volume cap’ on the level of new DSUs and Non-Synchronous Technology service providers which would be eligible for payments. New DSUs and Non-Synchronous Technologies could connect to the system and obtain system services payments at any stage between now and 2020. While this may ensure the ‘volume cap’ is not breached for 2020, it would risk over-expenditure between now and 2020, as a large volume of Non-Synchronous Technology may connect between now and then.

(ii) Apply a ‘glide-path’ volume limit to new DSUs and Non-Synchronous Technology service providers each year based on the SEM Committee’s overall system services expenditure ‘glide path’. New providers may be added to a service procurement framework on a first come, first served basis up to the volume limit each year.

(iii) DSUs and Non-Synchronous Technology service providers bid into a competitive arrangement to be added to the service procurement framework. The least cost service provider is added to the service procurement framework. This method ensures the cheapest possible outcome for the electricity consumer.

(iv) A separate tender process could be used to determine which service providers receive a contract. The successful tenderers may be placed on a separate procurement framework to the rest of the providers with different contractual terms and conditions.

While the TSOs acknowledge this may be deemed discriminatory to DSUs and Non-Synchronous Technologies, the impact of high levels of these new technologies can have a dramatic impact on the distribution of system service payments, as outlined in the ‘New Providers’ system service expenditure graphs in Chapter 3, Figure 9 – Figure 11. Therefore, the TSOs view these measures as not unduly discriminatory and as justified in order to reduce the risk of over-expenditure.

For this recommendation to be implemented, further consultation and considerations would need to be taken into account. However the TSOs are of the view that

managing this complication in the procurement approach is likely to give better investor certainty than in the settlement calculations on a trading period basis (whether that is redefining the “availability” definition or in the application of a service volume scalar).

We would also favour procurement options (i) – (iii) above over option (iv). While potentially having the benefit of providing greater investment certainty, the TSOs consider that the use of tenders as envisaged in option (iv) would result in segmentation of the system services market, and would have the effect of locking out new lower cost technologies that may arise in the coming years.

Question 9: Do you agree with the TSOs’ recommendation on the method by which to mitigate over-expenditure as a result of potential overinvestment by high availability technologies?

Question 10: Have you any comments on a preferred method to implement a procurement-based volume limit on the level of high availability technologies to obtain system service contracts?

- **Recommendations to mitigate the risk of over-expenditure as a result of forecast error relating to the variation between market and physical dispatch:**

To reduce the risk of over-expenditure as a result of forecast error relating to the variation between market and physical dispatch, the TSOs recommend delaying the implementation of taking the higher of a service provider’s market position or physical dispatch, to determine the available volume of a service, for a minimum of 12 months post I-SEM go-live.

This will allow for an impact assessment to be carried out on revenue payments and improved long-term forecasting of the variation. Furthermore, it will allow the Regulatory Authorities and TSOs to make the necessary policy and design decisions and engage with stakeholders, and for the TSOs to put in place adequate measurement and settlement systems to implement this decision. The TSOs will however seek to monitor and track the relative market positions of all service providers during this time. It may be appropriate to conduct a re-settlement of the system service payments for the 12 month period following the implementation of the required systems.

Question 11: Do you agree with the TSOs’ recommendation to delay the implementation of taking the higher of a service provider’s market position or physical dispatch, to determine the available volume of a service, for a minimum of 12 months post I-SEM go-live?

Question 12: Do you have any comments on the method by which a resettlement between market and physical dispatch could occur following the 12 month delay?

5. Next Steps

5.1. Consultation Responses

SONI and EirGrid welcome feedback on the questions posed within this paper, which will be used to inform the payment rates that are submitted to the RAs for approval.

Responses should be submitted to DS3@soni.ltd.uk or DS3@EirGrid.com before 21 August 2017 using the associated questionnaire template. It would be helpful if answers to the questions include justification and explanation. If there are pertinent issues that are not addressed in the questionnaire, these can be addressed at the end of the response.

It would be helpful if responses are not confidential. If you require your response to remain confidential, you should clearly state this on the coversheet of the response. We intend to publish all non-confidential responses. Please note that, in any event, all responses will be shared with the Regulatory Authorities to inform their approval of the enduring tariff framework and the final payment rates for 2017/18.

5.2. Stakeholder Workshop

To facilitate stakeholder engagement we will host an industry workshop during the consultation period. This workshop, which is scheduled for 1 August 2017 in Dundalk, will provide an opportunity for discussion on the details of the consultation paper. The workshop will also focus on other core aspects of the interim arrangements (e.g. contracts and procurement). Should you wish to register, please contact DS3@soni.ltd.uk or DS3@EirGrid.com

5.3. List of Consultation Questions

Question 1: Have you any comments on the proposed tariff rates for the Enduring Regulated Tariff arrangements?

Question 2: Have you any comments on the TSOs' recommendation that the regulated arrangements be put in place for a minimum defined time duration until such a time as there is greater information available on the timeline for implementing a long-term market mechanism for System Services?

Question 3: With respect to contract certainty, are there other considerations which we should take account of or other options that we should explore further?

Question 4: Have you any comments on the TSOs' recommendation to replace an annual tariff review with a conditional tariff review, **or are there alternative approaches that you think are better?**

Question 5: Are there other considerations on the conditions under which a conditional review would be triggered?

Question 6: Have you any comments on the proposal to exclude a high annual wind capacity factor as a consideration for triggering a conditional tariff review?

Question 7: Have you any comments on the TSOs' recommendation to use the 'Stepped' scarcity scalar design rather than the 'Linear' scarcity scalar design?

Question 8: Should we decide to use a 'Stepped' scarcity scalar, are there other considerations which we should consider in its design?

Question 9: Do you agree with the TSOs' recommendation on the method by which to mitigate over-expenditure as a result of potential overinvestment by high availability technologies?

Question 10: Have you any comments on a preferred method to implement a procurement based volume limit on the level of high availability technologies to obtain system service contracts?

Question 11: Do you agree with the TSOs' recommendation to delay the implementation of taking the higher of a service provider's market position or physical dispatch, to determine the available volume of a service, for a minimum of 12 months post I-SEM go-live?

Question 12: Do you have any comments on the method by which a resettlement between market and physical dispatch could occur following the 12 month delay?

6. Appendix 1 – Modelling Approach

8.1. High Level Methodology

A high-level schematic of the modelling approach undertaken for the analysis is shown in Figure 15. The system dispatch schedule, the payment basis and the product scalars are used to calculate the system service volumes. These volumes are then used in conjunction with the tariff rates and scalars in order to calculate the system service expenditure.

The glossary included at the beginning of this document should be referenced if clarification is required for terms mentioned throughout the document.

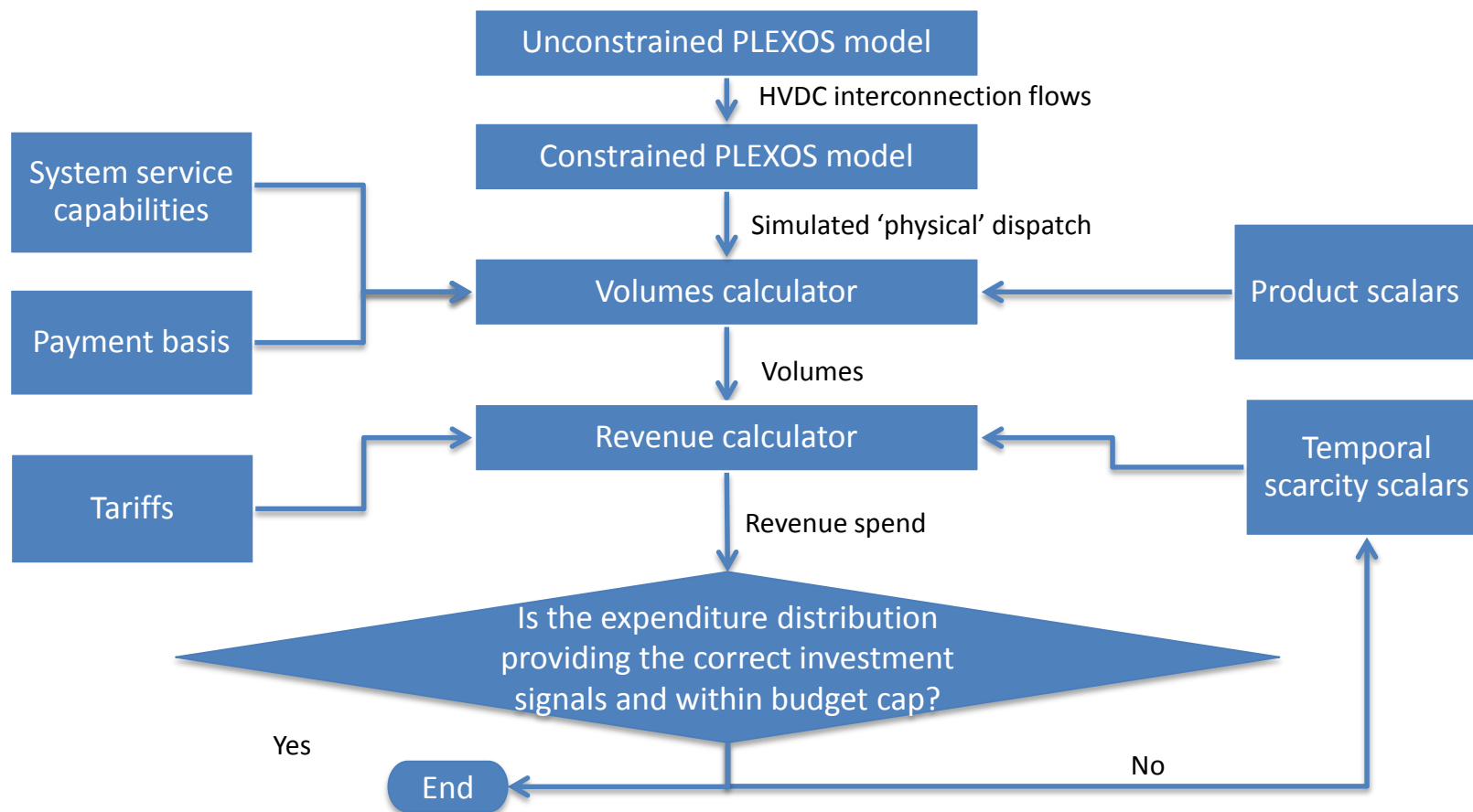


Figure 15: System services study methodology

6.1.1. Portfolio Assumptions

Given that, in so far as is possible, it is the TSOs' aim to treat all technologies and system service providers in a fair and impartial manner, the inclusion/ exclusion of any service provider or technology in/from any of the portfolio scenarios should not be construed as predetermining or forecasting the technologies which will be, or should be, successful in the system services procurement process. As such, the portfolios do not represent preferred, expected or optimal portfolios; the *actual* future system portfolio will be driven by market forces. Further, the presence of a plant in the portfolio scenarios does not give said plant a right to the provision of system services.

6.1.2. System Service Capability Assumptions

With respect to system service provision capabilities, the following assumptions have been taken as the starting point:

- All current conventional plant capability data is taken from the 2016/17 Interim Tariff contracts. Note that more recent capability data is used, if available.
- The assumed non-conventional system service provider capabilities are outlined in Table 8. Note that the capabilities assumed for the purposes of the modelling do not preclude these technology types from providing some of the other services in the future. For example, we have assumed that non-synchronous technologies will not provide Replacement Reserve. However, if a service provider using a non-synchronous technology has sufficient storage capacity to provide energy for an hour then it may qualify to provide Replacement Reserve. The assumptions set out here and used in the modelling are based on discussions the TSOs have had with different types of service providers in recent years.
- For the purposes of the modelling, we have assumed no service provision from solar, small-scale hydro, biomass, biogas and landfill gas. However, this does not preclude these technologies from providing DS3 System Services in the future.

Table 8: Assumed System Service Capability from Non-Conventional System Service Providers

	SIR	FFR	POR	SOR	TOR1	TOR2	RRS	RRD	RM1	RM3	RM8	SSRP	DRR	FPFAPR
DSU	<i>N</i>	<i>Y</i> *	<i>Y</i> *	<i>Y</i> *	<i>Y</i> *	<i>Y</i> *	<i>N</i>	<i>Y</i>	<i>Y</i> *	<i>Y</i> *	<i>Y</i> *	<i>N</i>	<i>N</i>	<i>N</i>
Non-Synch. Tech. [^]	<i>N</i>	<i>Y</i>	<i>Y</i>	<i>Y</i>	<i>Y</i>	<i>Y</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>
LCC HVDC	<i>N</i>	<i>Y</i>	<i>Y</i>	<i>Y</i>	<i>Y</i>	<i>Y</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>Y</i> **
VSC HVDC	<i>N</i>	<i>Y</i>	<i>Y</i>	<i>Y</i>	<i>Y</i>	<i>Y</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>Y</i>	<i>Y</i>	<i>Y</i> **
SIR Network Dev. ^{^^}	<i>Y</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>Y</i>	<i>Y</i>	<i>N</i>
Wind	<i>N</i>	<i>Y</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>N</i>	<i>Y</i>	<i>Y</i>	<i>Y</i>

*A subset of total installed capacity is assumed eligible

[^]A 30-min energy storage capability is assumed.

**Eligible only during times of import

^{^^} The energy cost of operating a SIR Network Device is assumed to be covered outside of system services.

6.1.3. Plexos Modelling Assumptions

The PLEXOS modelling high-level assumptions are as follows:

- **2017/18 tariff year model**

Operational constraints as per *Operational Constraints Update Version 1-51* (19/04/2017), save for:

- RoCoF constraint: increase from 0.5 Hz/s to 0.65 Hz/s to 0.8 Hz/s to 1 Hz/s as per RoCoF project timeline
- SNSP: 65%
- FFR, FPFAPR and DRR included from 1 September 2018

- **2019/20 tariff year model**

Relaxed constraint set:

- RoCoF constraint: 1 Hz/s
- SNSP: 75%
- Inertia floor: 17.5 GWs
- Minimum number of sets online: 5
- FFR, POR and SOR requirements are set as a function of the penetration of non-conventional reserve sources.