12/10/2023

Shaping Our Electricity Future

Advisory Council Meeting 6

12 October 2023

Clayton Hotel, Cardiff Lane, Dublin

EirGrid SONI

Meeting Chair: Liam Ryan

DURATION	START TIME	TOPIC	PRESENTER/S
30 min	10:00	Introduction from the Chair	Liam Ryan Alan Campbell
30 min	10:30	SOEF v1.1 – Operations Update	Eoin Kennedy
15 min	11:00	SOEF v1.1 – Markets Update	Dave Carroll Alan Campbell
30 min	11:15	Networks – HV Interface Forum – Update	Louise O'Flanagan
15 mins	11:45	Future Markets Working Group (WEI/ESI)	Peter Harte
45 min	12:00	Workshop Round 1 (Hybrids, LDES, Renewable Hubs)	Hybrids – A. Keogh Renew. Hubs – E. Ahlund LDES – B. Murray
45 mins	**12:45**	**Lunch**	
45 mins	13:30	Workshop Round 2 (Hybrids, LDES, Renewable Hubs)	Hybrids – A. Keogh Renew. Hubs – E. Ahlund LDES – B. Murray
45 mins	14:15	Workshop Round 3 (Hybrids, LDES, Renewable Hubs)	
30 mins	15:00	SOEF v1.1 Networks – update	Derek Carroll
10 mins	15:30	SOEF Advisory Council Future Meeting Calendar	Seve Garanzuay
20 mins	15:40	Closing Remarks	Liam Ryan
	16:00	***Meeting end***	

Workshop Topics

- Hybrids
- LDES
- Renewable Hubs

* Workshops will run concurrently and repeat 3x

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SOEF Advisory Council Meeting #6

Introduction from the Chairs

30 min	10:00	Introduction from the Chairs	Liam Ryan Alan Campbell

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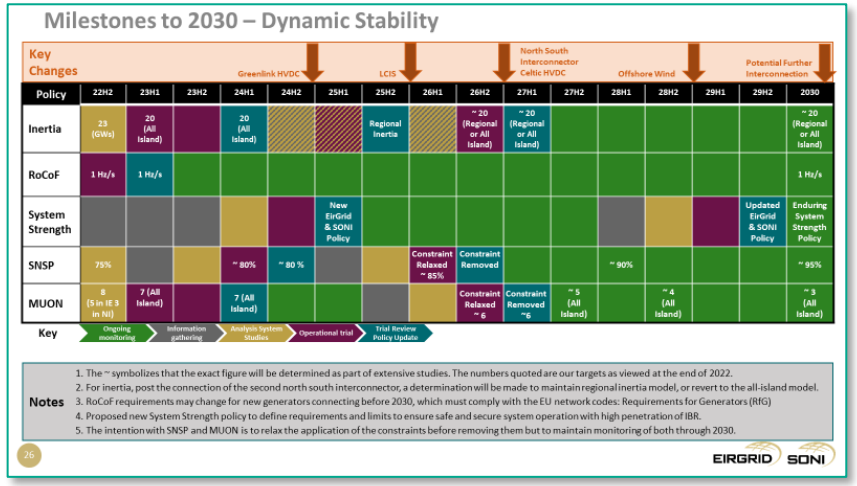
SOEF v1.1 – Operations update

30 min	10:30	SOEF v1.1 – Operations update	Eoin Kennedy

Operational Policy Roadmap Update



Key Policy Changes

- 75% SNSP ✓
- 1.0 Hz/s RocoF ✓
- MUON* 7 - Trial Underway
- NI Negative Reserve – Implementation approach under consideration
- 80% SNSP – Studies scheduled for 2024

MUON 7 Trial Update

- Commenced 30 May 2023
- IE MUON relaxed from 5 to 4 (NI MUON remains at 3)
- Periods of MUON 7 operation (to end Sept. 2023):

May	June	July	August	September	Total
0 hr	12 hrs	32 hrs	34 hrs	72 hrs	150 hrs

** Minimum number of Units ON*

Operational Tools & Capability Enhancement (OTCE) Programme

New Operational Tools & Capability Enhancement (OTCE) programme being established to deliver Control Centre of the Future as well as broader operational capability development initiatives

The Need to Re-Frame

- Act as the design authority for operational capability enhancements, while collaborating to support in-flight programmes
- More than Control Centre of the Future focused i.e. modelling capability
- Scope may change as we progress through our operational policy evolution via the Operational Policy Roadmap.

Establish a dedicated programme to focus on:
Operational
Tools
&
Capability
Enhancement

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Operational Tools & Capability Enhancement (OTCE) Programme - Initial Focus Areas

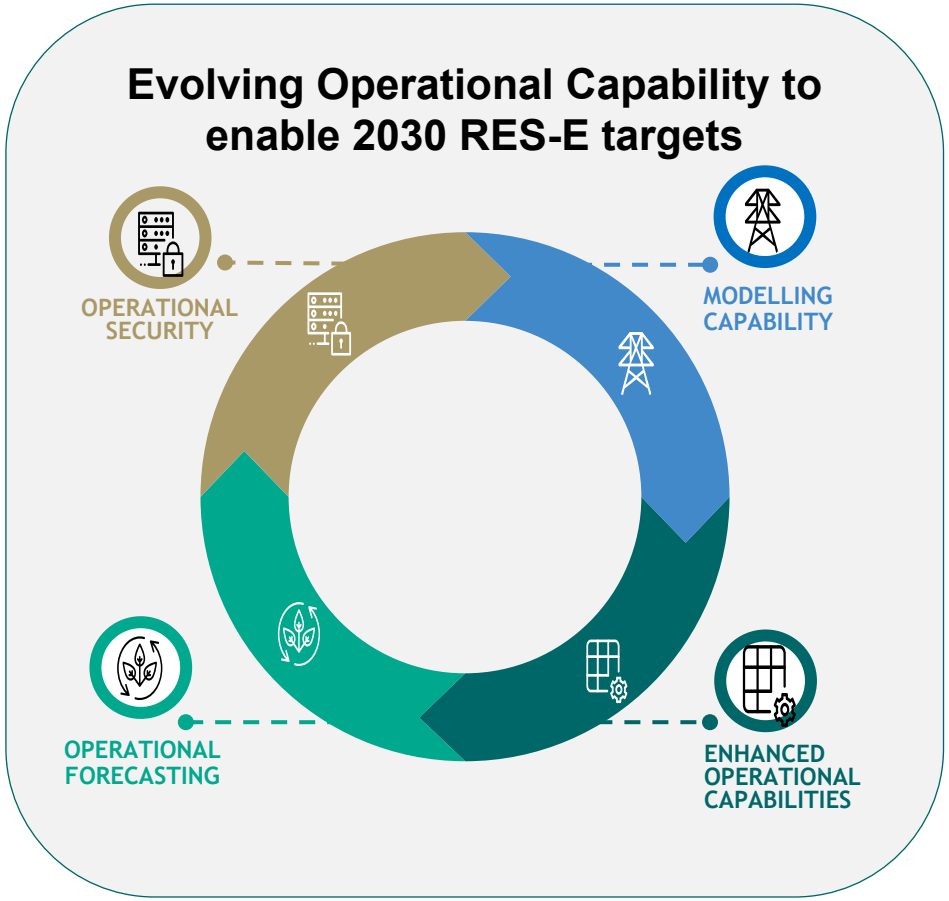
Operational capability (Resources, Tools, Processes and Facilities) will be uplifted in a phased approach to align with the new challenges and requirements introduced by the increased complexity of system operations

OPERATIONAL DATA & OBSERVABILITY

Enhance the situational awareness and decision support capability for operators of new network phenomena by improving the network monitoring and observability capability using the PMUs, DRs and WAMS system. Enable automatic dynamic model validation using high speed monitoring devices.

OPERATIONAL FORECASTING

Develop an enhanced, more accurate, and comprehensive short term regional, geographic, and nodal operational forecast. The forecast will include higher resolution demand and RES information to enable EirGrid and SONI to make accurate operational assumptions regarding network reliability and market operations.



OPERATIONAL MODELLING & SIMULATION

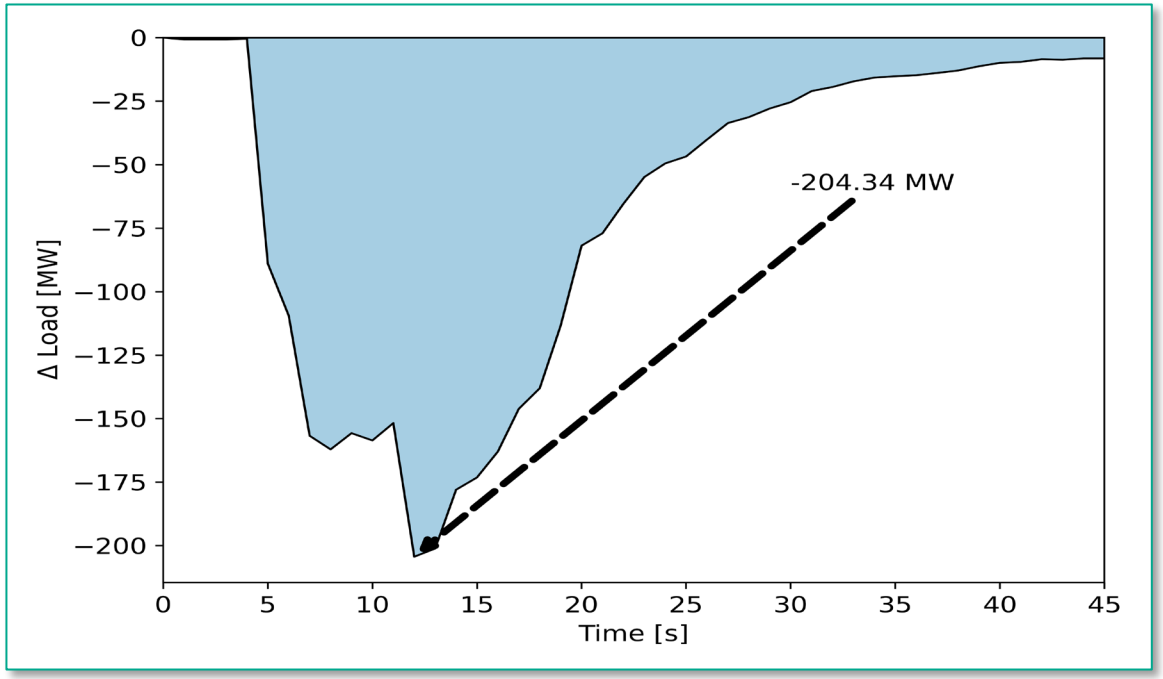
Develop enhanced modelling capability (e.g. EMT) to support operations and planning simulation requirements so more detailed models of the network and resources can be established. Enhanced modeling can be achieved by ensuring all tools are aligned across all domains and an automated validation process is established for the models relative to the asset's performance for real events.

OPERATIONAL STUDY CAPABILITY

Enhance the operational study capability in EirGrid and SONI for new operational policies and time horizons. Enhanced study capability will utilize the existing study toolkit and process streamlining to make the most efficient use of engineering resources.

Protection Settings of Large Energy Users (LEUs)

- The response of Large Energy Users (data centres in Ireland) to system faults is exacerbating disturbances on the power system through disconnection and automatic reconnection of their demand.
- The example presented here illustrates the collective response of multiple individual data centres to a remote transmission fault. These fluctuations in demand have led to significant frequency deviations on the Irish power system.
- Similar data centre performance issues have been observed by other TSOs in Europe and the USA.



13 December 2022, 220 kV fault in Dublin

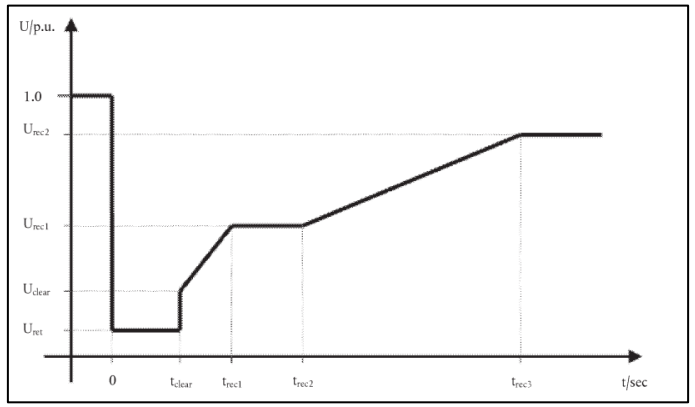
Protection Settings of Large Energy Users (LEUs)

1. TSO/DSO Review of Data Centre Protection Settings:

- Data gathering and review is now complete (including both TSO and DSO customers).
- Vast majority of customers have very sensitive voltage settings.

2. Network Code on Demand Connection (DCC 2.0):

- Latest ENTSO-E proposal to ACER consultation is to include a new data centre demand category (110 kV and above) and apply Fault Ride-Through, RoCoF and Limited Frequency Response requirements.



Voltage parameters (pu)		Time parameters (seconds)	
U_{ret}:	0	t_{clear}:	0,14-0,15 (or 0,14-0,25 if system protection and secure operation so require)
U_{clear}:	U_{ret}	t_{rec1}:	t_{clear}
U_{rec1}:	U_{clear}	t_{rec2}:	t_{rec1}
U_{rec2}:	0,85	t_{rec3}:	1,5-3,0

3. Next Steps:

- Continued engagement with customers to determine capability to change protection settings.
- Commence development of Grid Code performance standards (e.g., fault ride through) based on ENTSO-E proposals and international review (e.g., ERCOT, USA).

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Other project updates

TSO-DSO Engagement

EirGrid-ESB Networks **2024-28 Multi-Year Plan** submitted to CRU on 29 September

Significant level of engagement ongoing between SONI and NIE Networks in Northern Ireland, and between EirGrid and ESB Networks in Ireland, to agree the **TSO-DSO future operating model**

Voltage Trajectory Tool

Voltage Trajectory Tool (VTT) went **live in the Control Centres** in September

Low Carbon Inertia Service

Procurement process ongoing in Ireland and Northern Ireland

Grid Code Evolution

CRU has approved MPID 304 (incorporation of **Battery ESPS Implementation Note**). Awaiting UR approval for SPID_03_2022 for equivalent modification.

Following a call for information on the **Synchronous Condenser Implementation Note**, work is ongoing to incorporate into the grid codes in IE and NI (to follow standard modification processes).

Commenced a review of both grid codes for **Hybrid Co-Located Units and Over-Install** with a view to bringing forward modifications in 2024.

Qualification Trial Process

Planning to launch procurement process in November.

An **"Open Lot"** approach will be used.

SOEF Advisory Council Meeting #6

SOEF v1.1 – Markets update

15 min	11:00	SOEF v1.1 – Markets update	Dave Carroll Alan Campbell

Updated Agenda (following prep call #1 02 Oct 2023)

1. Ops/Mkts/Net updates (2-3 slides each – max. – crisp)
2. Hybrids discussion
3. Renewable Hubs discussion
4. “Asks” for [pragmatism on FPM projects (SDP as example)
5. Direct feedback on SOEF v1.1 – and ACM on future topics, process

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Future Markets Update

- Since the last SOEF Industry Advisory Council there have been a number of positive developments:
    - Monthly workshops with industry on details of Scheduling & Dispatch – Tranche 1 changes
    - Publication of a paper on daily system services auction design from our advisors Dotecon/AFRY, industry workshop and bilaterals on same
    - We will soon be publishing of a Call for Evidence paper in relation to market options for Long Duration Energy Storage
    - Publication of new monthly newsletter on Future Market changes, including policy developments

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Future Markets Update

- As part of the engagements on the various programmes there is a common theme of participants seeking further complexity on proposed designs (for example instruction profiling on windfarm/solar ramping in Scheduling & Dispatch) and also industry not aligned on options to resolve an issue (for example market options for long duration energy storage)

- Industry feedback is a crucial component, however how can industry support us to come with an option that does not let the perfect be the enemy of the good?

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SOEF Advisory Council Meeting #6

Networks – HV Interface Forum update

30 min	11:15	Networks – HV Interface Forum update	Louise O'Flanagan

12/10/23

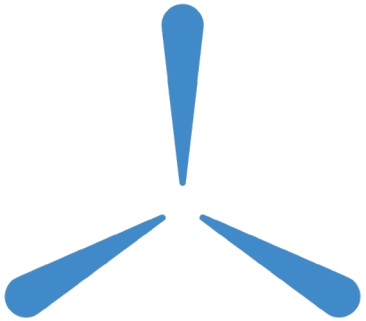
HV Interface Forum SOEF Advisory Council Update

Louise O’Flanagan

October 2023

Agenda

1. Background
2. HV Interface Forum Structure
3. Cooperation Agreement
4. Working Group Overview



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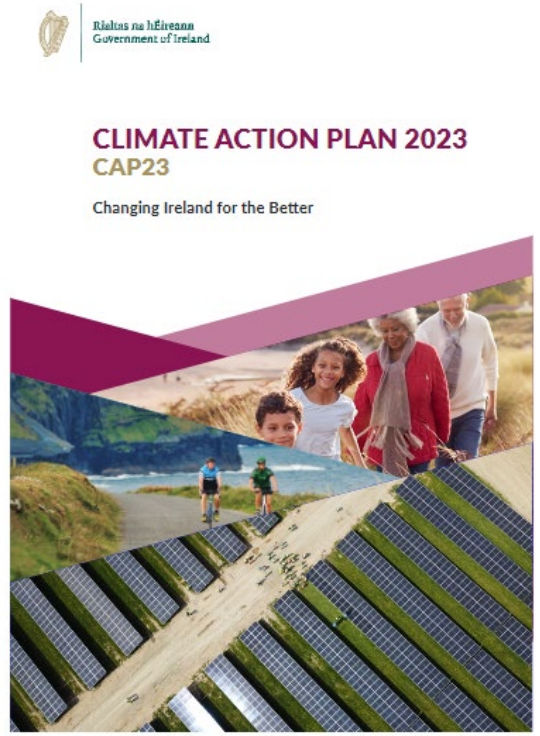
Background

Shaping Our Electricity Future recognizes that a key enabler is the use of the public road network in scenarios where a decision has been taken to install underground cable following an assessment of various options.

This use of the road network is a key enabler for timely project delivery and to minimise routing constraints.

Climate Action Plan 2023

Action 12.3.1 Accelerate Renewable Electricity Generation – enable the use of the public road and potentially the rail networks for routing of new public and private electricity circuits.



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HV Interface Forum Structure

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Chair: Jerry Grant

Cooperation Agreement Principles

Acknowledges that underground routing along public roads infrastructure, where practical, is a **key enabler of the SOEF**

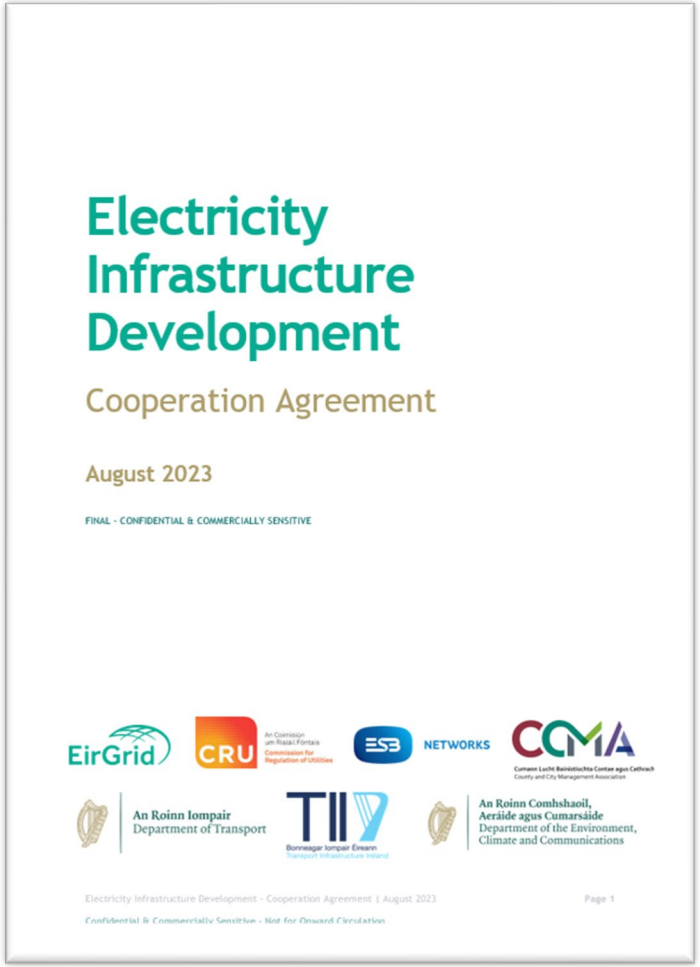
Commitment to work together to **accommodating the electricity HV infrastructure**, provided that significant roads impacts are identified and addressed.

Early engagement has been identified as a key requirement

Assess route options, including alternatives to public road where appropriate

Protocols will be developed in line with best practise so that electrical and road infrastructure for operation, maintenance and repair

Acknowledges **cost of participation and** potential **future liabilities and costs**



Working Groups

- Working Group 1 – North Connacht
- Working Group 2 – Transitional Projects
- Working Group 3 – Pre-Planning Engagement
- Working Group 4 – Costs and Liabilities
- Working Group 5 – Standards and Protocols

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Working Group 1 - North Connacht

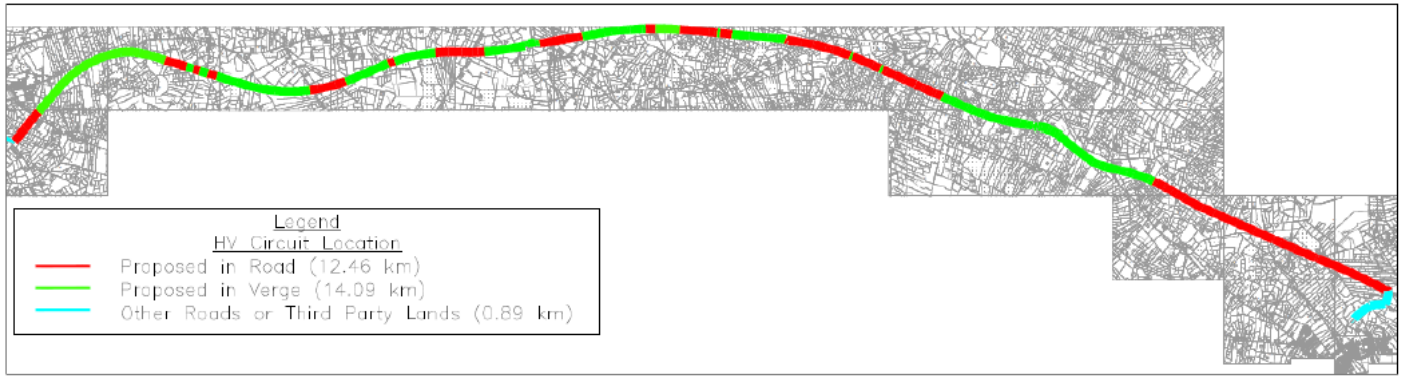
Project Scope:

- Approx 60km of UGC between existing Moy 110kV Station and new Tonroe 110kV Station
- Planning submitted to ABP in June 2022 and granted in September 2023
- LA and TII submissions made
- Further engagement with roads authorities on planning conditions and road opening licence process will be key step

North Connacht Design Changes

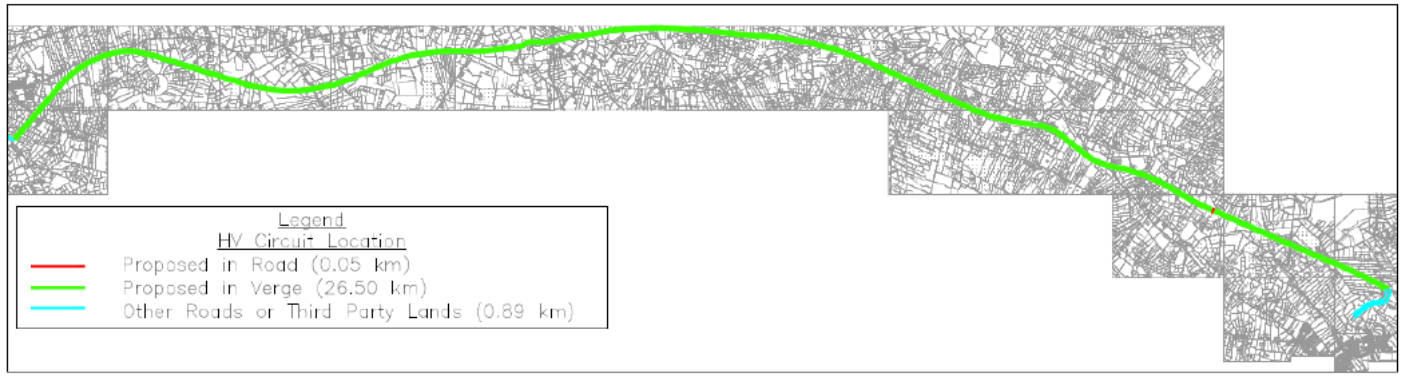
N5 – Proposed 110kV Underground Cable Route – Design Improvements

Workshop 1
8 March



ORIGINAL PROPOSAL FOR WORKSHOP NO. 1

Workshop 2
17 May



REVISED PROPOSAL FOR WORKSHOP NO. 2

NOTES:
GI & detailed design required to confirm trench location proposals

	Project Overall			
	Joint Bays		Trench	
	Total No	On Road	In Road	Off Road
Planning Design	79	65	53.4 km	5.6 km
Design Review	51	7	23 km	36 km

	Local Roads			
	Joint Bays		Trench	
	Total No	On Road	In Road	off Road
Planning Design	28	24	16.9 km	3.9 km
Design Review	17	6	16.1 km	4.4 km

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Joint bay / Cable pulling Construction Elements

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Working Group 1 - Principles and Approaches

Initial focus on national roads N5 and N26 with workshops between ESBN, EirGrid, MCC, RCC and TII.

Positive feedback from initial meetings and workshop 1; workshop 2 took on board to further refine on the local road network.

Increase cable lengths between joint bays (Up to 1400m in length) as far as technically possible.

Reducing the number of joint bays as far as technically possible.

Identified suitable off-road areas to feasibly locate joint bays where possible. Optimising the entire road corridor.

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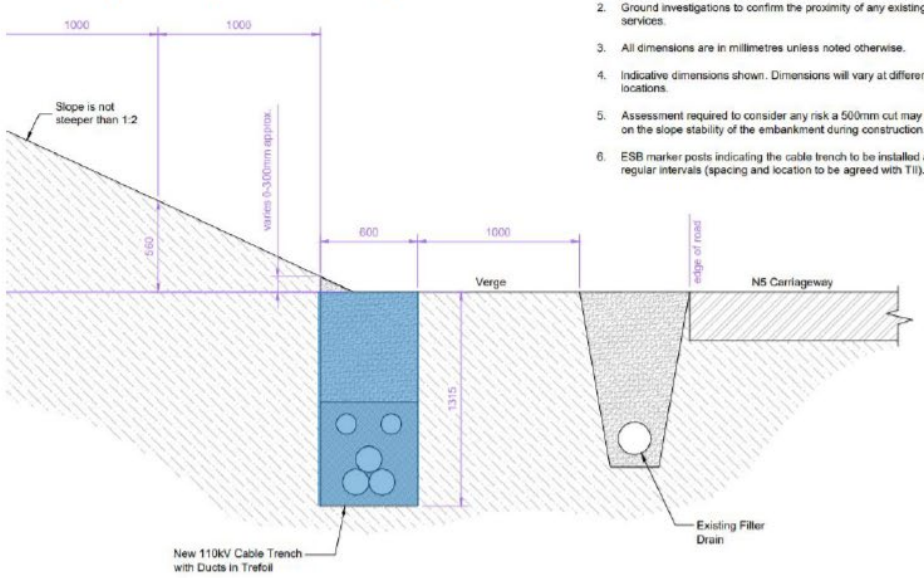
North Connacht Trenching arrangement - Design evolution

Trench at Toe of Cut Embankment

Approx length of detail required 6.3km



Notes:

1. Preliminary Design. Not for Construction.
2. Ground investigations to confirm the proximity of any existing services.
3. All dimensions are in millimetres unless noted otherwise.
4. Indicative dimensions shown. Dimensions will vary at different locations.
5. Assessment required to consider any risk a 500mm cut may have on the slope stability of the embankment during construction.
6. ESB marker posts indicating the cable trench to be installed at regular intervals (spacing and location to be agreed with TII).

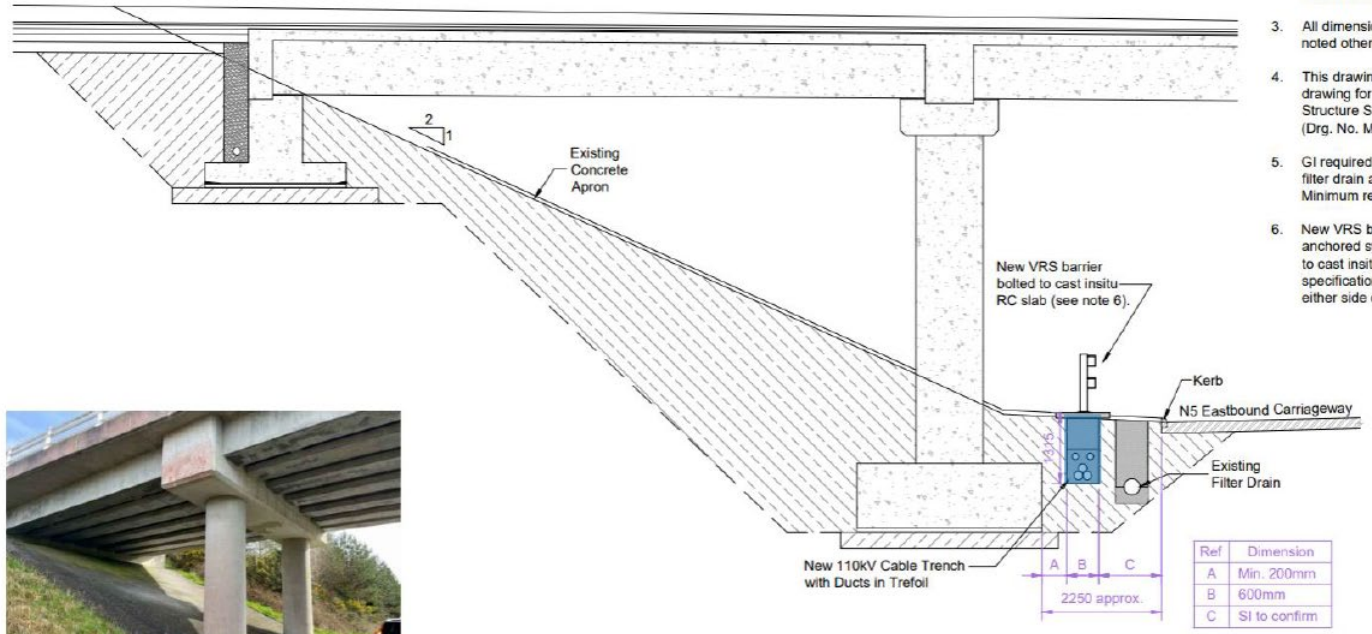
Cable Trench Cut Into the Cut Embankment

Trenching arrangement – Design evolution

Original proposal to avoid interaction with existing overbridge structure

Trench Proposal at Over Pass 1, 2, 3, 4, 5 & 6

Approx length of detail required 180m (6x30m)



Ref	Dimension
A	Min. 200mm
B	600mm
C	SI to confirm

Notes:

1. Preliminary Design. Not for Construction.
2. The preliminary design is subject to the outcome of ground investigations.
3. All dimensions are in millimetres unless noted otherwise.
4. This drawing is based on NRA "As Built" drawing for N5 Charlestown Bypass Structure S1 (Drg. No. MGT0032/BR0111 Rev 01).
5. GI required to confirm spacing between filter drain and the column foundation. Minimum required is 1000mm.
6. New VRS barrier to be reinstated with bolt anchored system. New VRS barrier bolted to cast insitu RC slab to required specification. Bolt on VRS to extend 10m either side of overpass structure.

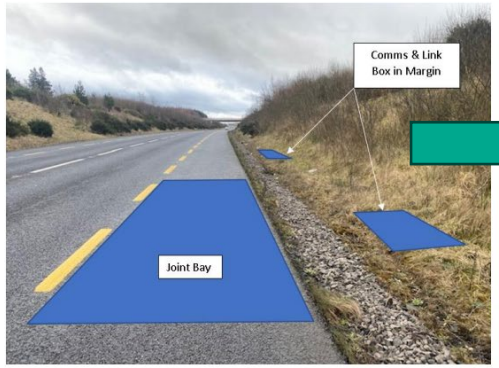
Existing Arrangement

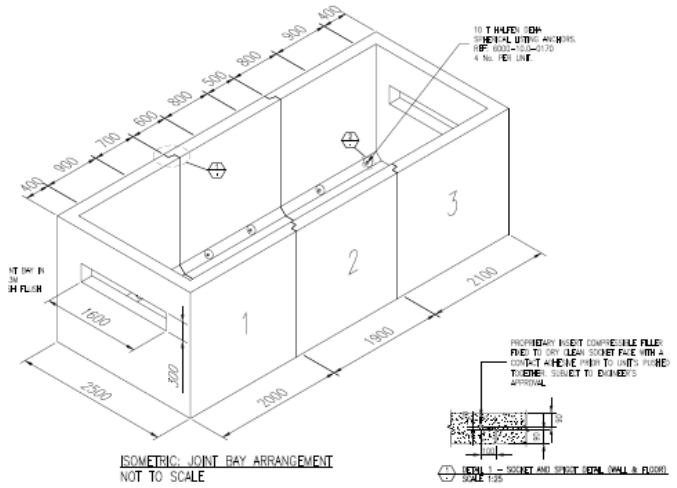
Option 1

Cable Trench Positioned Between Column Foundation & Filter Drain

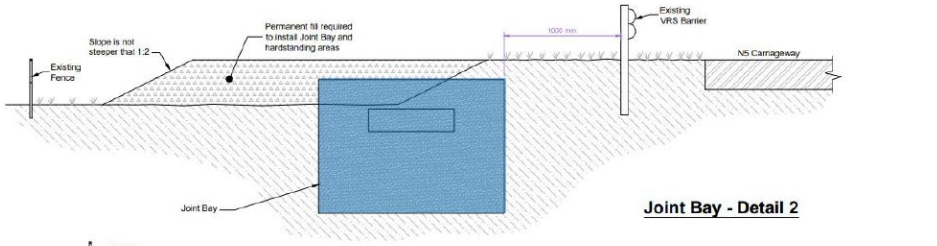
Energy for

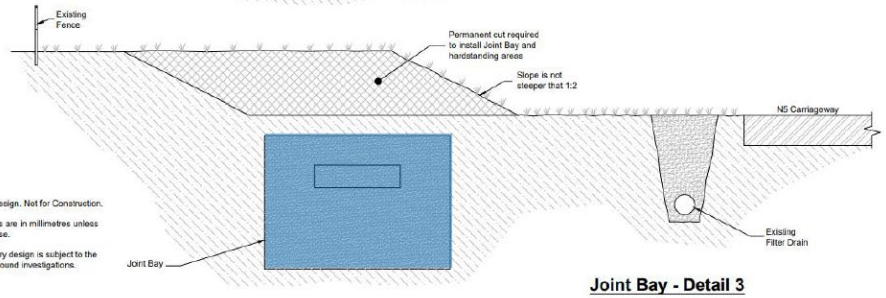
Joint Bay arrangement – Design evolution





Joint Bays





Notes:

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2. All dimensions are in millimetres unless noted otherwise.
3. The preliminary design is subject to the outcome of ground investigations.

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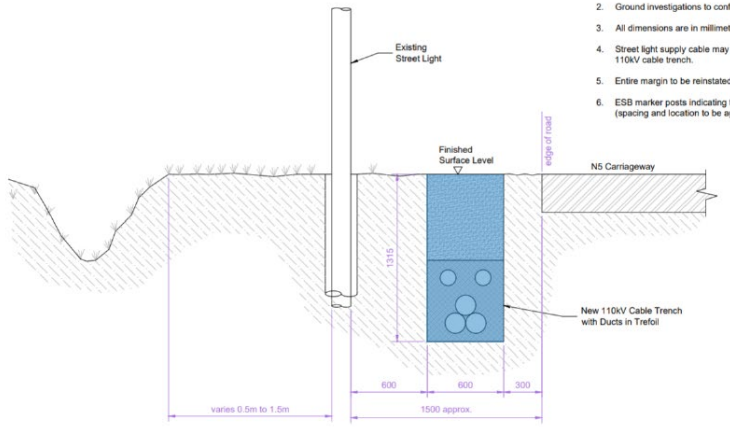
Trenching arrangement - Design evolution

Trench Position Between R375 & N26 Junction to the N5

Approx length of detail required 610m



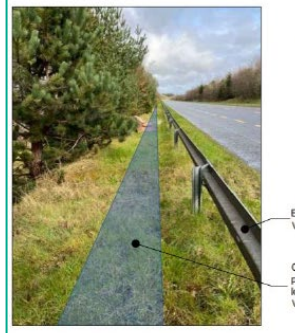
Notes:

1. Preliminary Design. Not for Construction.
2. Ground investigations to confirm the extent of street lighting foundations.
3. All dimensions are in millimetres unless noted otherwise.
4. Street light supply cable may need to be relocated if it conflicts with the line of the 110kV cable trench.
5. Entire margin to be reinstated to maintain off-road drainage, to the satisfaction of TII.
6. ESB marker posts indicating the cable trench to be installed at regular intervals (spacing and location to be agreed with TII).

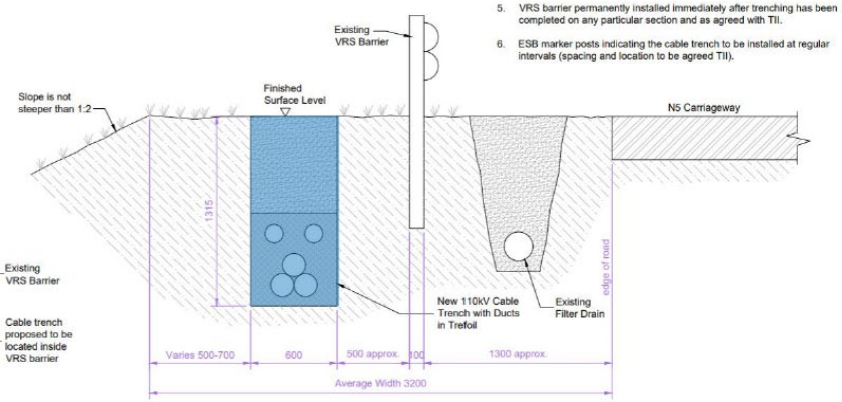
Cable Trench on N5 with Lighting Poles

Trench Position at Fill Locations on N5 – Filter drain Present

Approx length of detail required 2.75km



Proposed Arrangement



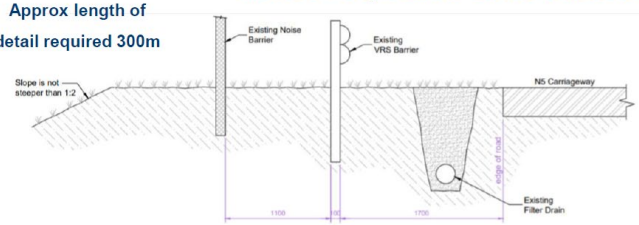
Notes:

1. Preliminary Design. Not for Construction.
2. The preliminary design is subject to the outcome of ground investigations.
3. All dimensions are in millimetres unless noted otherwise.
4. VRS barrier will need to be removed and reinstalled to facilitate construction.
5. VRS barrier permanently installed immediately after trenching has been completed on any particular section and as agreed with TII.
6. ESB marker posts indicating the cable trench to be installed at regular intervals (spacing and location to be agreed TII).

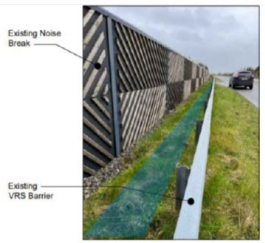
Cable Trench Positioned Between
VRS Barrier & Edge of Fill Embankment

Trench Proposal at Under Pass No1

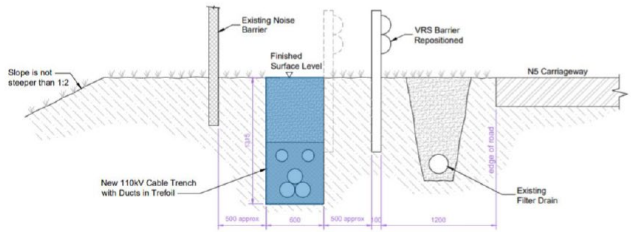
Approx length of detail required 300m



Existing Arrangement



Existing Arrangement



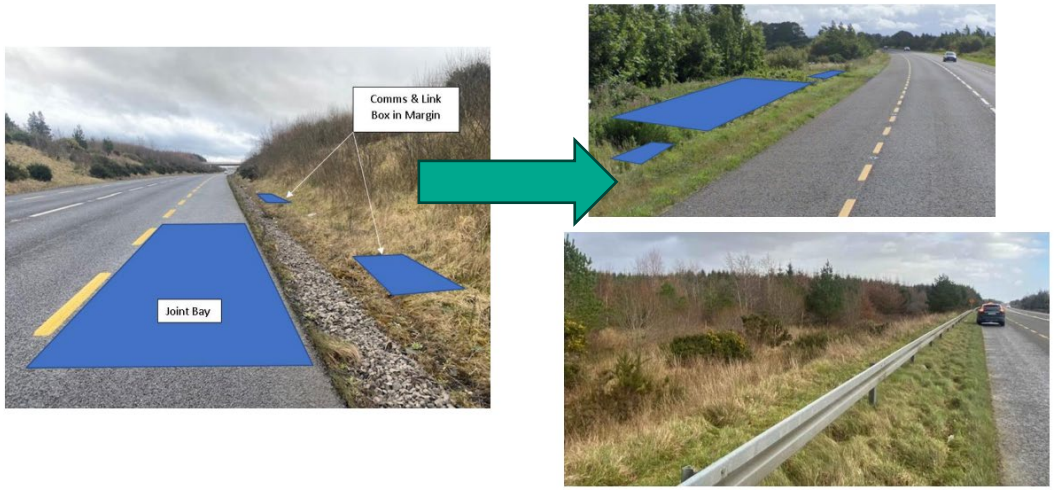
Proposed Arrangement

Notes:

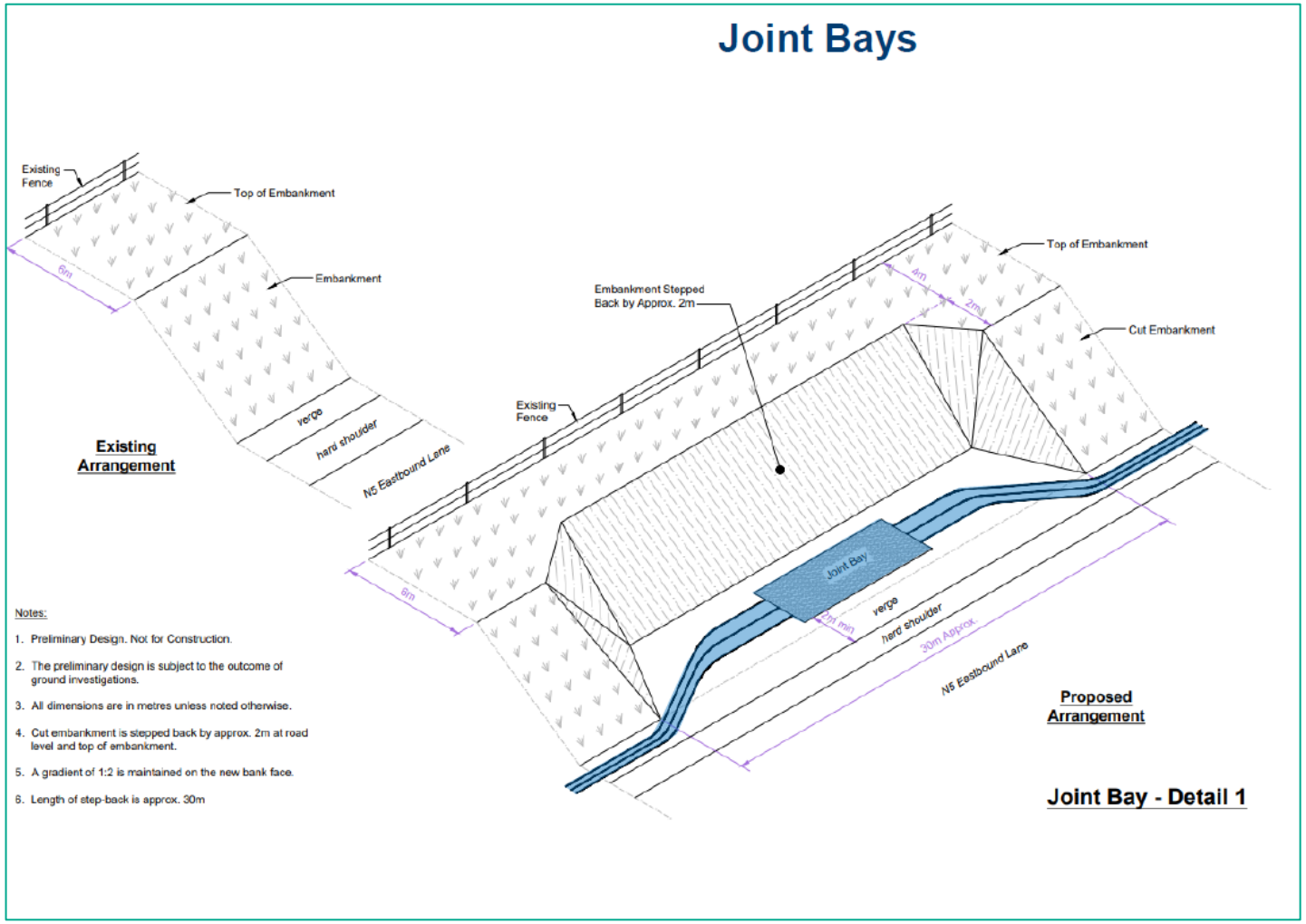
1. Preliminary Design. Not for Construction.
2. The preliminary design is subject to the outcome of ground investigations.
3. All dimensions are in millimetres unless noted otherwise.
4. Proposal to move VRS barrier towards the road by approx. 500 and install cable trench between VRS barrier and noise barrier.
5. ESB marker posts indicating the cable trench to be installed at regular intervals (spacing and location to be agreed with TII).

Cable Trench on Approach to
UP1 Where Noise Barrier is
Positioned

Joint Bay arrangement – Design evolution



Original proposal for JB locations in road/ adjacent to verge



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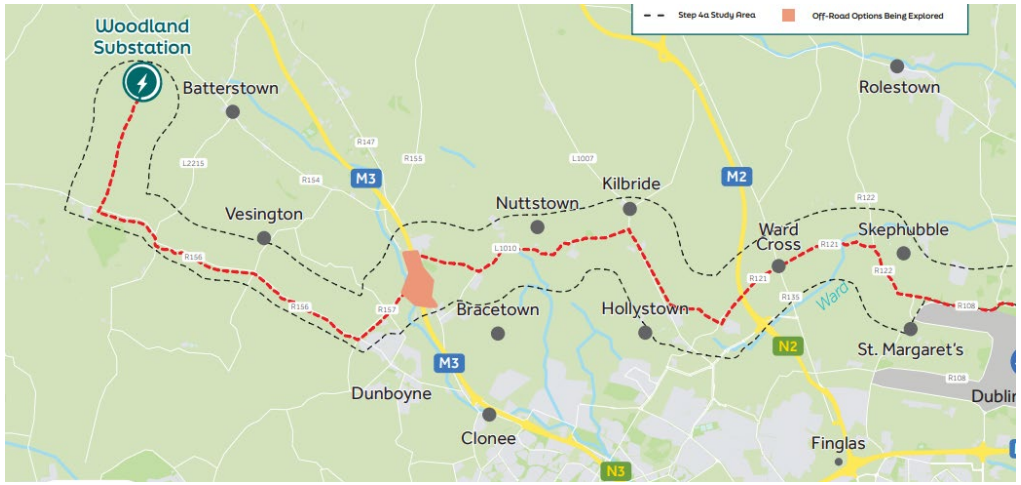
Working Group 2 – Transitional Projects

Kildare – Meath Grid Upgrade

- 54km 400kV UGC between Dunstown and Woodland Station
- Planning Application submitted to ABP in April 2023
- Letters of consent received from Roads Authorities, with further engagement required
- Ground investigations completed in focus areas with remaining ground investigations to be completed by Q2 2024

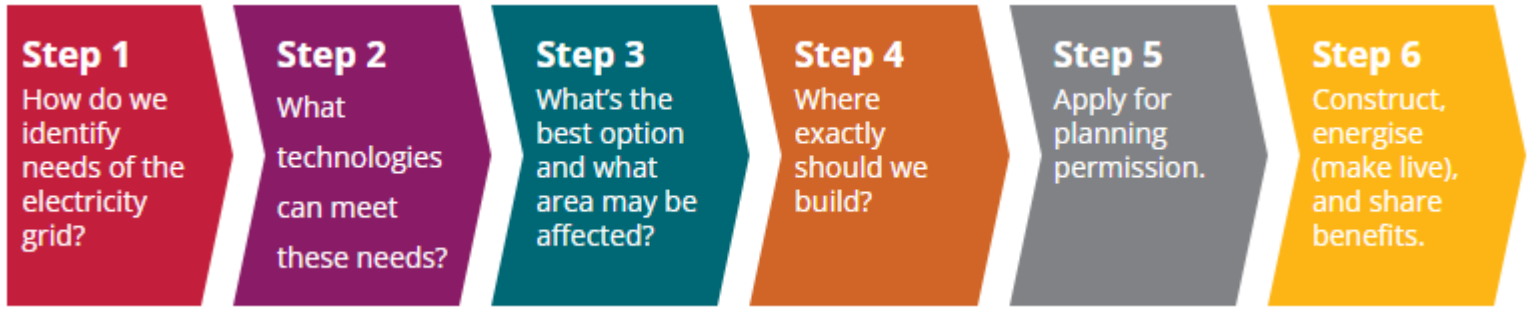
East Meath – North Dublin Grid Upgrade

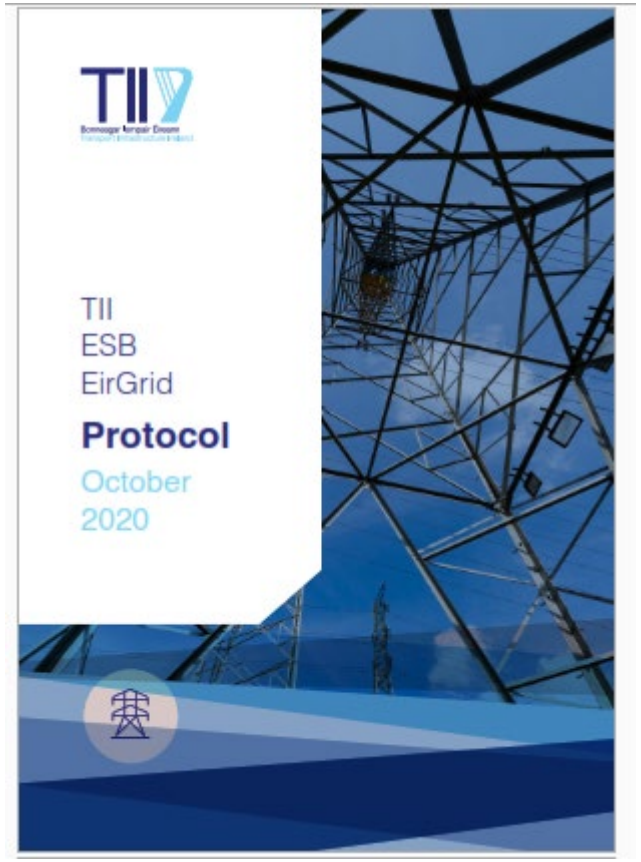
- 23km 400kV UGC between Belcamp and Woodland Stations
- Planning expected to be submitted by Q2 2024.



Working Group 3 – Early Engagement

- Specific focus on EirGrid's Grid Delivery Framework "6 Step Process"
- Integrating impact on roads into this process both in terms of route selection and constraints
- Learnings from existing TII / ESB / EirGrid Protocol (October 2020)
- Full life-cycle of both assets to be considering during this process
- Agree how that collaboration will occur





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Working Group 4 – Costs and Liabilities

- Focus on financial aspects both direct costs and potential future liabilities arising from HV projects for the road authorities.
- Initial meeting to be held in October to agree terms of reference.
- Areas for discussion are as follows:
  - Direct Costs for roads authorities' resources to enable engagement with EirGrid and ESBN design teams
  - Legacy Costs arising from long term impact on pavements ("Purple Book")
  - Operational liabilities, agrees a means for the mutual facilitation of works, operations, maintenance and repairs of both asset owners and operators.
  - Future costs arising from the presence of HV infrastructure and its impact on major road projects such as upgrades or re-alignment

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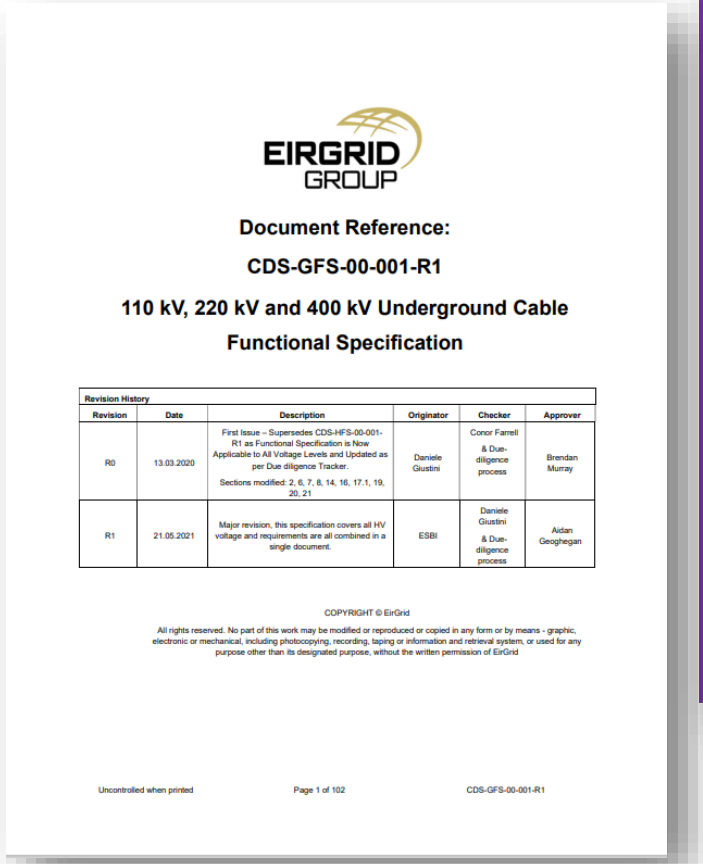
Working Group 5 – Standards and Protocols

- Develop an enduring set of protocols and standards to be applied to future projects.
- Leverage the learnings from all other working groups
- Review of existing Road's standards (Purple Book) and EirGrid / ESBN Standards
- Need for consistency across all HV projects



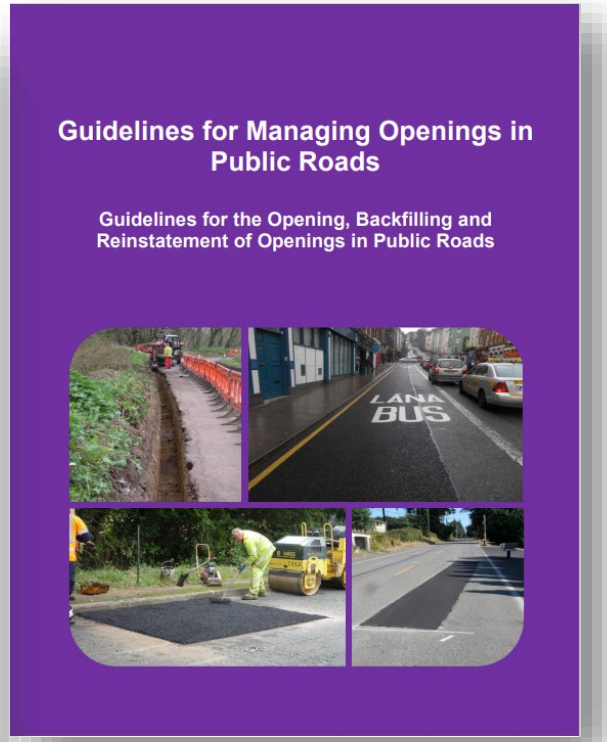
EIRGRID GROUP

Document Reference:

CDS-GFS-00-001-R1

110 kV, 220 kV and 400 kV Underground Cable Functional Specification

Revision History					
Revision	**Date**	**Description**	**Originator**	**Checker**	**Approver**
R0	13.03.2020	First Issue – Supersedes CDS-HFS-00-001-R1 as Functional Specification is Now Applicable to All Voltage Levels and Updated as per Due diligence Tracker. Sections modified: 2, 6, 7, 8, 14, 16, 17.1, 19, 20, 21	Daniele Giustini	Conor Farrell & Due-diligence process	Brendan Murray
R1	21.05.2021	Major revision, this specification covers all HV voltage and requirements are all combined in a single document.	ESBI	Daniele Giustini & Due-diligence process	Aidan Geoghegan



Thank You

SOEF Advisory Council Meeting #6

Future Power Markets Working Group - Update

Peter Harte

15 min	11:45	Future Markets Working Group (WEI/ESI) - Update	Peter Harte

EirGrid SONI

Future Markets Working Group

Update for SOEF Advisory Council

Oct 2023

windenergyireland.ie

WIND ENERGY IRELAND

Wind Energy Ireland Strategy 2022 - 2025

WEI Strategic Vision: We will lead Ireland to a zero-carbon power system by 2035.

Relevant Strategic Objectives:

- WEI will develop a roadmap for the delivery of a **zero-carbon electricity** system in Ireland and Northern Ireland by **2035**, with the purpose of establishing this as a Government endorsed target by 2025.
- WEI will advocate for all options available to increase grid capacity in Ireland and to deliver cost-effective and speedy grid connections which allow for the **targets** of 8,000 MW of onshore wind and 5,000 MW of offshore wind, together with the necessary supporting technologies, to be achieved by 2030.
- WEI will work to ensure the creation and evolution of well-functioning routes to market for renewable generation, and supporting technologies needed to deliver a zero-carbon power system, which deliver the best value to the electricity consumer including securing greater **revenue certainty** and appropriate risk allocation for development.
- WEI will advocate for legislation, policy and the most suitable design for energy markets in Ireland and Europe to support the transition to a secure zero-carbon electricity system by **2035** including the design of the **energy, capacity and system services** markets.
- WEI will continue to support the development of all forms of energy storage to minimise emissions and **dispatch down**, and to support **capacity adequacy**, through our partnership with Energy Storage Ireland.

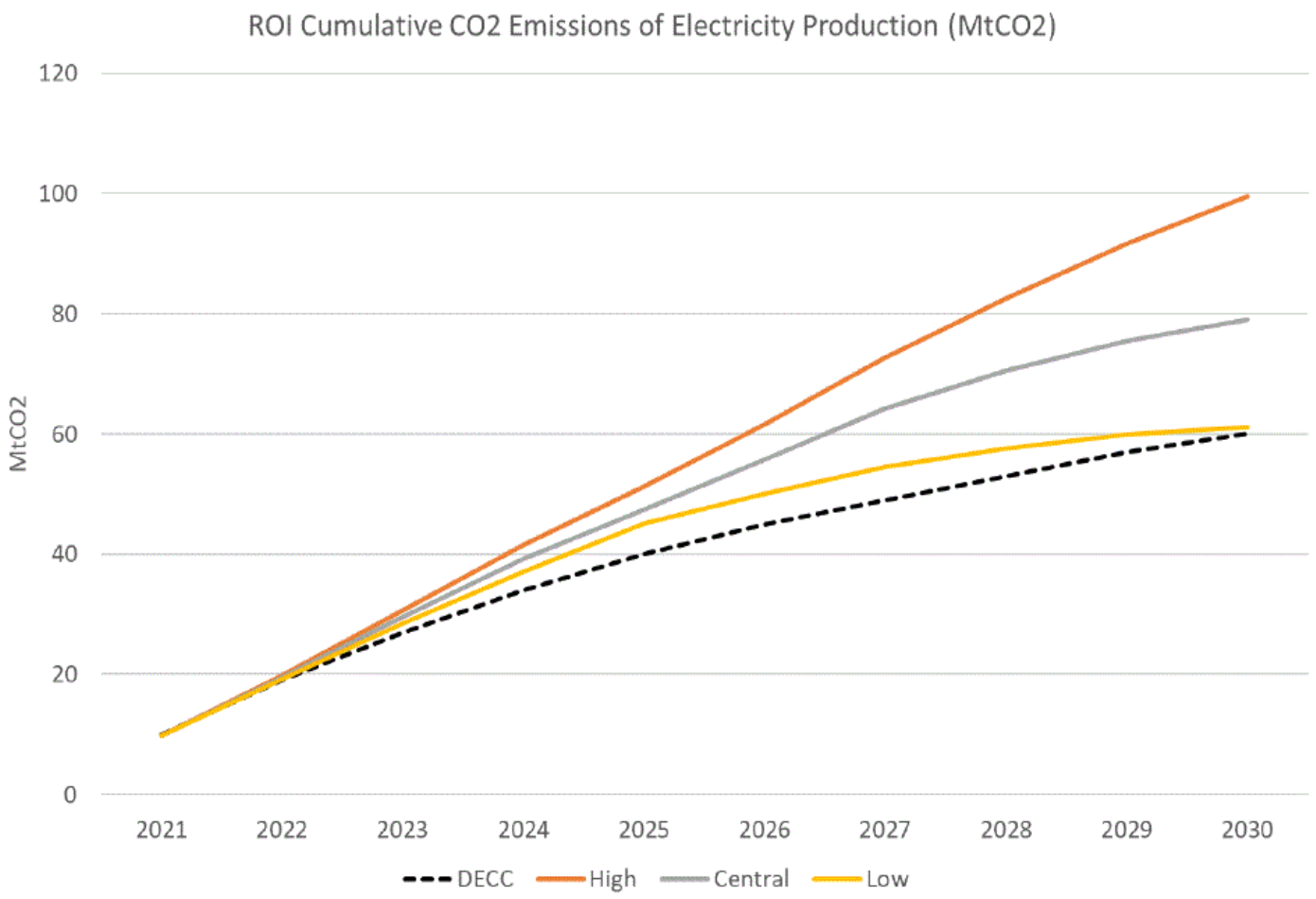
Future Market Vision working group established in early 2023 to examine the evolution of the power market over the next decade, to deliver a net zero power system.

Members include Bord na Mona, Statkraft, Energia, Enerco, ESB, FuturEnergy, Net Zero Energy, TNEI, RWE.

High Level Approach

1. Roll forward to a power system that is 100% renewable and decarbonised.
2. Assess each component of the current market and prepare “Problem Statements”.
3. Discuss idealised solution strawman.
4. Identify the transition plan and compromises around practicality.
5. Get external support from consultants to validate emerging recommendations and proposals and document in a report.
6. Target delivery date for first draft October 2023.

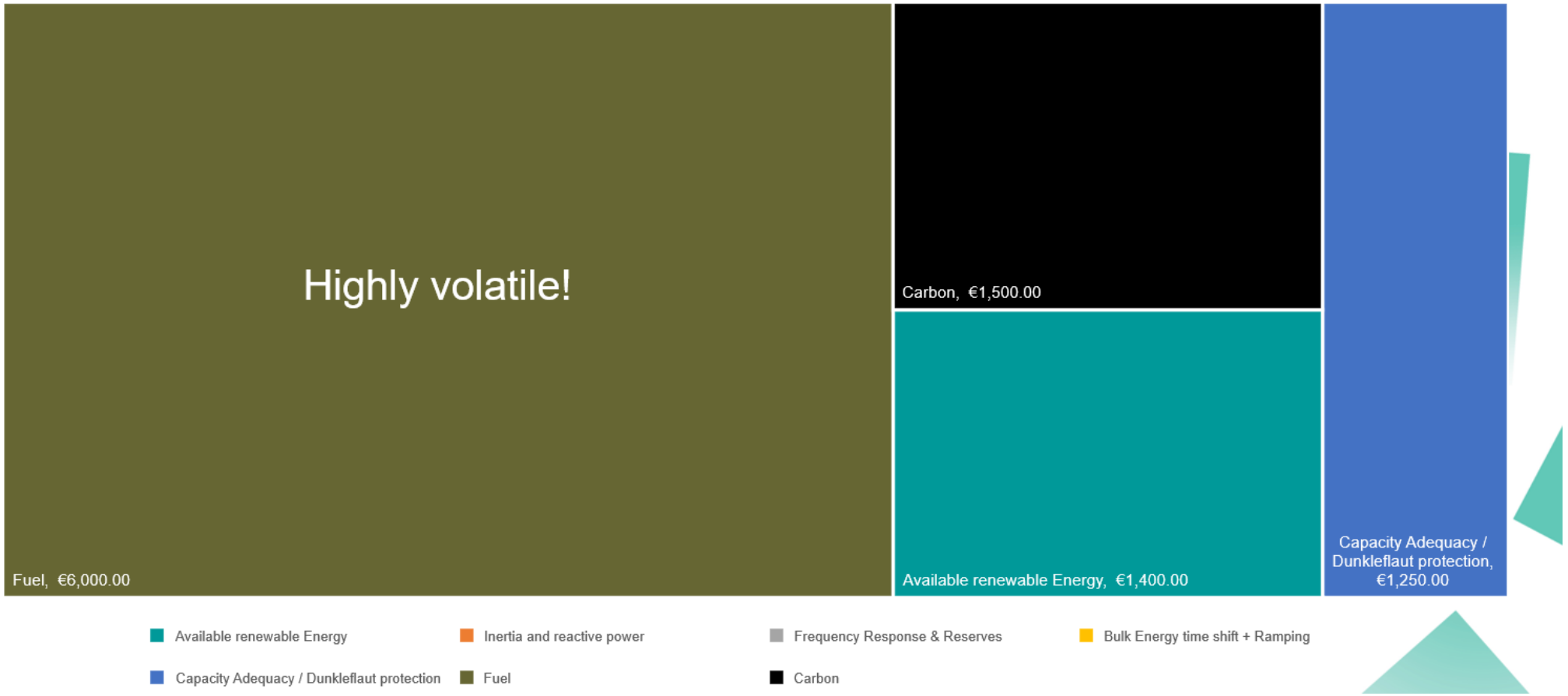
Future Market Drivers – Zero Carbon Market



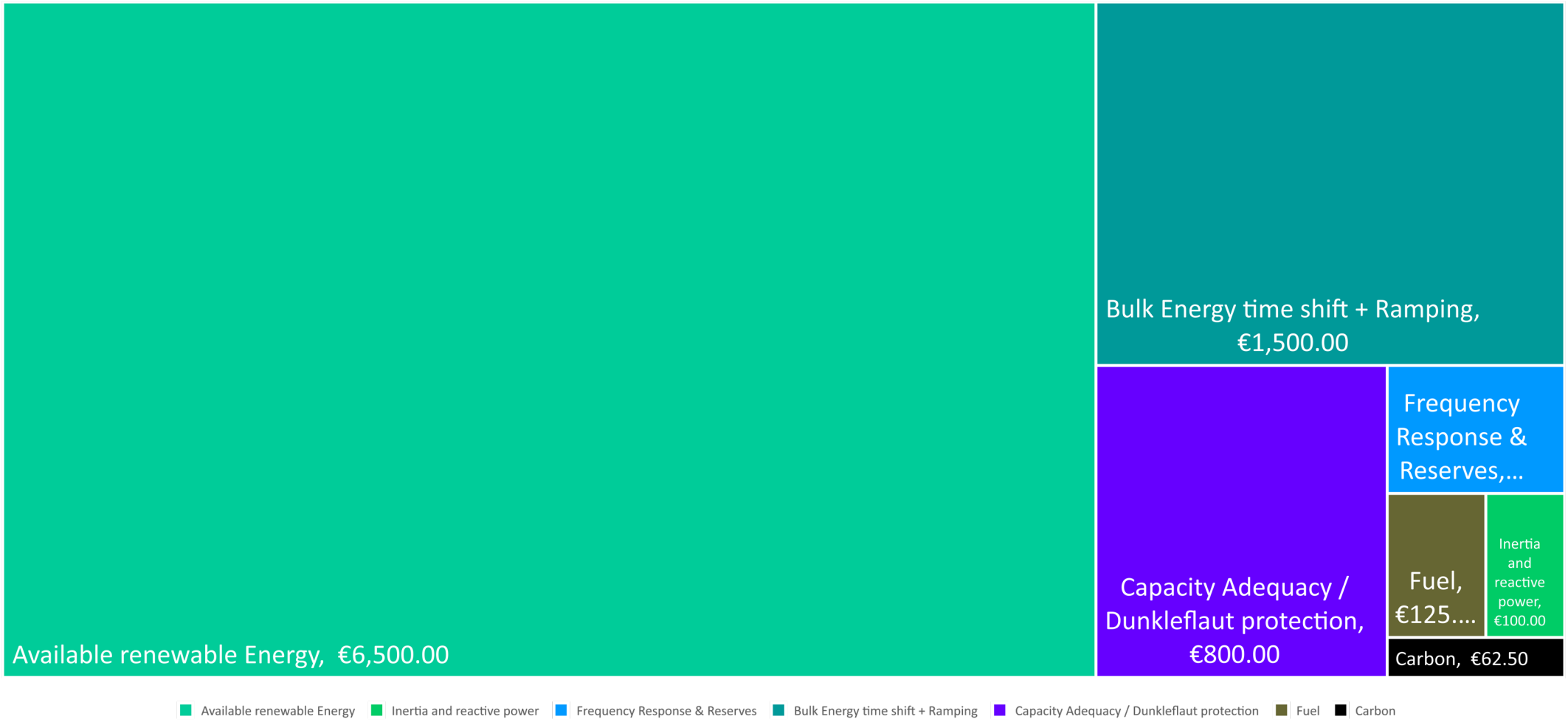
Future Market Drivers – Fossil Focus

Context:

Illustrative split of underlying costs on a 35% RES-E Power System in 2035



Future Market Drivers – Zero-Carbon Focus



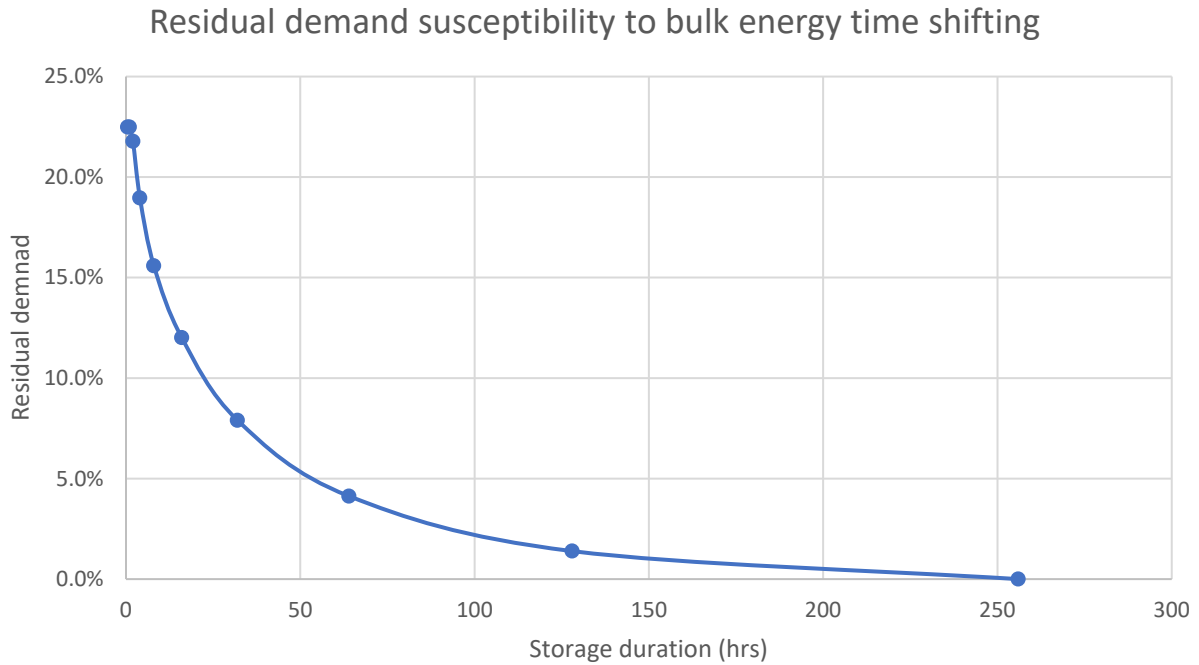
One possible zero carbon/100% RES-E system

7 GW	offshore wind
8 GW	solar
9 GW	onshore wind
2 GW	interconnection
0.7 GW	short duration batteries
x GW	long duration demand side flex or storage (BETS)
y GW	dispatchable green baseload or peaker (geothermal, CCS, nuclear, biogas, peaker on biodiesel etc.).
0 GW	unabated fossil fuel
20 GWs	low carbon inertia

The system above can be zero carbon (i.e. no more renewables than already planned for the 2030 RES-E 80% target).

Not saying this is the only possible system, volumes could vary.

But if the market could handle the mix of technology above in all hours, most bases are covered.



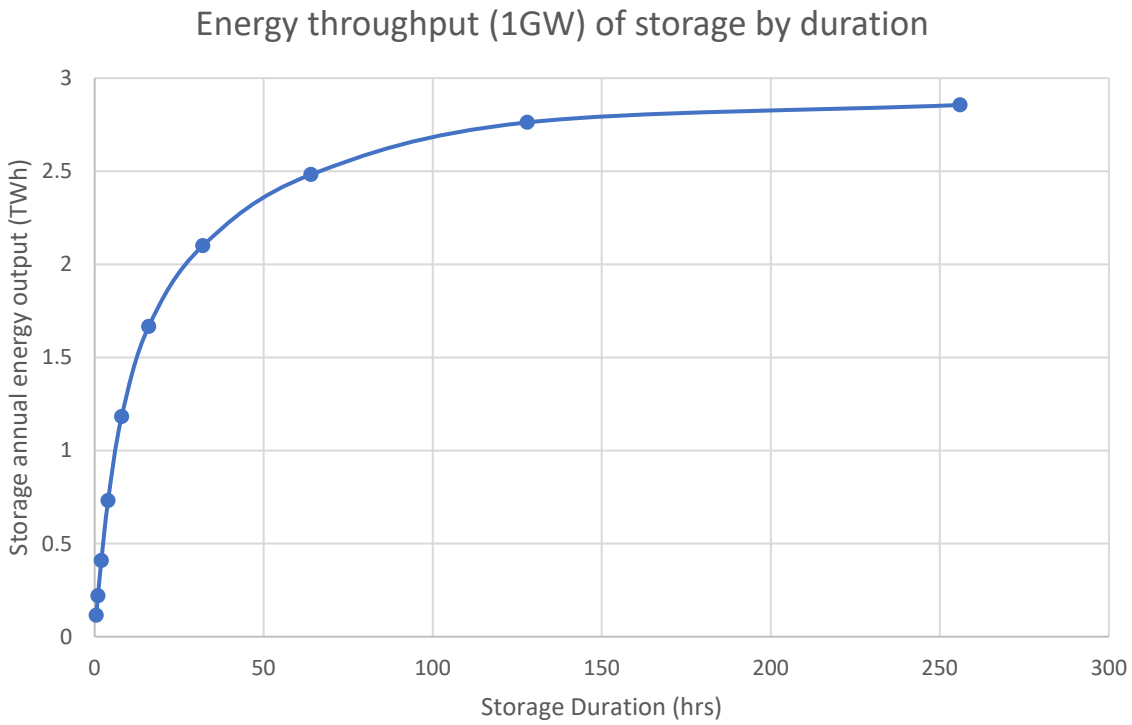
Residual demand is an hourly time series (or MWh total) representing renewables minus demand.
In high RES systems, the value is sometimes positive and sometimes negative.
The system above produces about RES-E of c.145% renewables, bulk time shifts it through a 50% round trip efficiency store. For any store duration 250 hours or longer, such a system is 100% energy balanced, and zero carbon.

Climate Action Plan 10-20%

ESB Networks did some very useful modelling to try to tease out the “10-20% Flex by 2025, 20-30% by 2030” target in Climate Action Plan 2023

This implies:

- ESB peak load calc: 1GW of flex by 2025
- Climate Action Plan: 0.86MtCO_2
- To save this volume: 3TWh of throughput.
- Simple energy model: 100hrs plus needed



To save the 0.86MtCO_2 /year called out in the CAP for this 10-20% flex action, the duration needs to be 100hrs plus. We call this “Bulk Time Shifting”.

CRU202358a_Scenarios_for_15-20_Flexible_System_Demand_ESBN_Paper.pdf

Key Principles of the Future Market Vision

Caveat: Work in progress, nothing agreed till all agreed, some points still under discussion by the Working Group and currently under assessment by external consultants.

- **Efficient market delivering the right volume of the right technologies in the right locations and dispatched in the right hours. (or simply: optimum long-term investment and short-term dispatch signals).**
- Assume the system is dominated by intermittent renewables and sufficient flex/storage to meet all demand, but don't exclude zero-carbon technologies that have a fuel cost.
- Make the best possible use of existing grid, and identify the optimum new grid reinforcements, recognising that storage/flex can complement grid.
- Work with what we have if possible.
- Technology agnostic.

<u>Out of scope:</u>

- Near term problems in today's markets.
- Grid capacity allocation, non-electricity markets.
- Strategic energy security of supply
- Very large scale (30GW+) HVDC links to Europe
- This is not a "back to basics" assessment of locational marginal pricing, nodal pricing c.f. GB review.

Capacity Market - Problem Statement

- Today's capacity market aims for capacity adequacy, but only on a "MW" or power basis. Future markets will also need to ensure adequacy on "MWh" or energy basis.
- Today's iterative derating factor methodology is not fit for purpose, as it could allow c.10GW of very cheap 6hr batteries to clear one auction, satisfying the MW, but not the MWh adequacy. This system is not reliable.
- One possible reliable system could be 7GW of batteries and 7GW of peakers. The CRM should only procure the peakers.
- In practice, as flex is added, the derating factors would/should likely tend to zero. This is actually the correct outcome for a capacity market only looking at MW.
- The Working Group is considering the need for a new standalone "Energy Adequacy" ancillary service product.

So the capacity market on its own may not deliver <u>any</u> revenue to storage, demand side or "bulk energy time shifting" in a decarbonised system.

DA/BM – Problem Statement

What sets the hourly price if you have 100% wind/solar with a zero marginal cost bidding zero?

- Further research identified markets where this is already happening (e.g., hydro dominated systems such as Nordics).
- Price formation is based on “water value” in reservoirs. Reservoir (storage) operators aim to ration their water throughout the year to maximise its value. Thus, prices rise in dry years when reservoirs are low (or projected to be low), and prices fall when storage levels are high.
- Short and long duration, and high and low efficiency technologies will bid their “storage opportunity cost”, leading to the optimum mix being dispatched. Forecasting will remain important in price formation.
- Zero or negative priced hours are unlikely to be much more frequent than today, provided sufficient Bulk Energy Time Shifting technology is procured and constructed
- Such pricing also sends an efficient long- and short-term signal to demand and interconnector flows, as well as forming basis for cPPAs, price caps, capacity market strike price, directed contracts etc. etc.

Subject to further validation, the Group is leaning towards the view that today’s DA/BM should set sensible pricing which would result in efficient short-term dispatch of bulk time shifting technologies, demand and interconnector flows.

BETS Procurement - Problem Statement

- The capacity market will not (and should not) provide an investment signal for energy limited plant.
- Ancillary services needs are largely satisfied by 700MW of Li-Ion, so should not send further investment signal.
- A long-term price signal may develop in the DA/BM markets, but for the same reasons that capacity markets have been “bolted on” to spot markets, BETS would benefit from a long-term procurement.
- A BETS procurement would
  - Reduce risk for investors, minimising cost of capital, thus reducing cost to consumers
  - Allow TSO/regulator ensure that reasonable volumes of reasonable technologies are procured in the right locations
  - Reduce/eliminate the network constraint risk seen by renewables, flowing through to RESS bids
  - Allow the TSO to target any pooled risks (curtailment and oversupply)
  - Allow policymakers to target specific CO_2 savings by specific dates and specific costs (€/tCO_2/year threshold)
- BETS is not straightforward to procure, as (unlike RESS) there is no single €/MW or €/MWh criterium to select the optimum volume in the optimum location. We believe an optimisation maybe required to clear the auction.

It is likely that BETS will be a large share (in MW or € terms) in the future energy market. We should not be afraid of complexity if that is what is required.

TLAF/TUoS - Problem Statement

- Locational signal is difficult to predict, and thus inefficient.
- Locational signal cannot be locked in at investment decision time.
- TLAF/TUoS/Charges have poor granularity in time (day night/monthly).
- TUoS/Charges does not today give any credit for assets that are not seeking a firm connection permanently.
- TUoS/Charges do not today give any credit for flex assets which actively create capacity on the grid, offsetting the need for new reinforcements.
- TUoS/TLAF/Charges tend to contradict the locational and temporal signals coming from other markets
- TLAF/TUoS do not send a strong enough signal to reward BETS offsetting new network investment

Group is considering whether or not TLAF is even necessary, if sufficiently accurate locational signal can issue through BETS and RESS procurement, and/or negative TUoS payments.

Recommendations for SOEF Advisory Council

The WEI/SEI Future Markets Group recommends to the SOEF Council:

1. Seek clarity on the “10-20% Flex” in the Climate Action Plan
2. Future SOEF system modelling should include 100% decarbonised scenario
3. Refine actions as required in upcoming Climate Action Plans
4. Review the WEI/ESI Future Markets Vision paper when published
5. Formalise the workstream around Future Markets design
6. Work with industry to design effective new products as required
7. Ensure focus is only on policy changes that deliver carbon savings

SOEF Advisory Council Meeting #6

Workshop Topic: Hybrids

EirGrid SONI

SOEF Hybrids Workstream Update

EirGrid SONI

Workstreams

Primary focus of presentation

Over install	Multiple Legal Entities	Sharing of MEC
• An Over install policy has existed in Northern Ireland and Ireland for several years which limits the installed capacity of generation to 120% of MEC. • Purpose of this workstream is to relax or remove this limit. **Submission/Publications** • SONI published a joint consultation with NIE Networks on 02 June 2023. • SONI published a joint decision paper with NIE Networks on 06 October 2023. • 120% Over Install Policy Review Recommendations Paper developed with ESBN and submitted to CRU in October 2022.	• Purpose of this workstream is to help facilitate multiple legal entities at a single connection point in Ireland. **Submission/Publications** • EirGrid and ESBN published a joint Multiple Legal Entities Consultation in September 2020. • EirGrid and ESBN published a joint Multiple Legal Entities Response to Consultation in April 2021. • EirGrid and ESBN submitted a joint Multiple Legal Entities Contractual Approach Status Update Paper in June 2022.	• Purpose of this workstream is to facilitate the sharing of Maximum Export Capacity (MEC) at a single connection point. **Submission/Publications** • EirGrid and ESBN submitted a joint Technical Assessment of Options for Sharing of MEC behind a Single Connection Point in January 2023.

EirGrid SONI

Over Install Update

Ireland

- 120% Over Install Policy Review Recommendations Paper developed with ESBN and submitted to CRU in October 2022.
- The CRU launched a consultation on Installed Capacity Cap which closed in August 2022.
- EirGrid has been engaging with the CRU.

Northern Ireland

- Joint consultation published with NIE Networks on 02 June 2023.
- Joint decision paper published with NIE Networks on 06 October 2023.

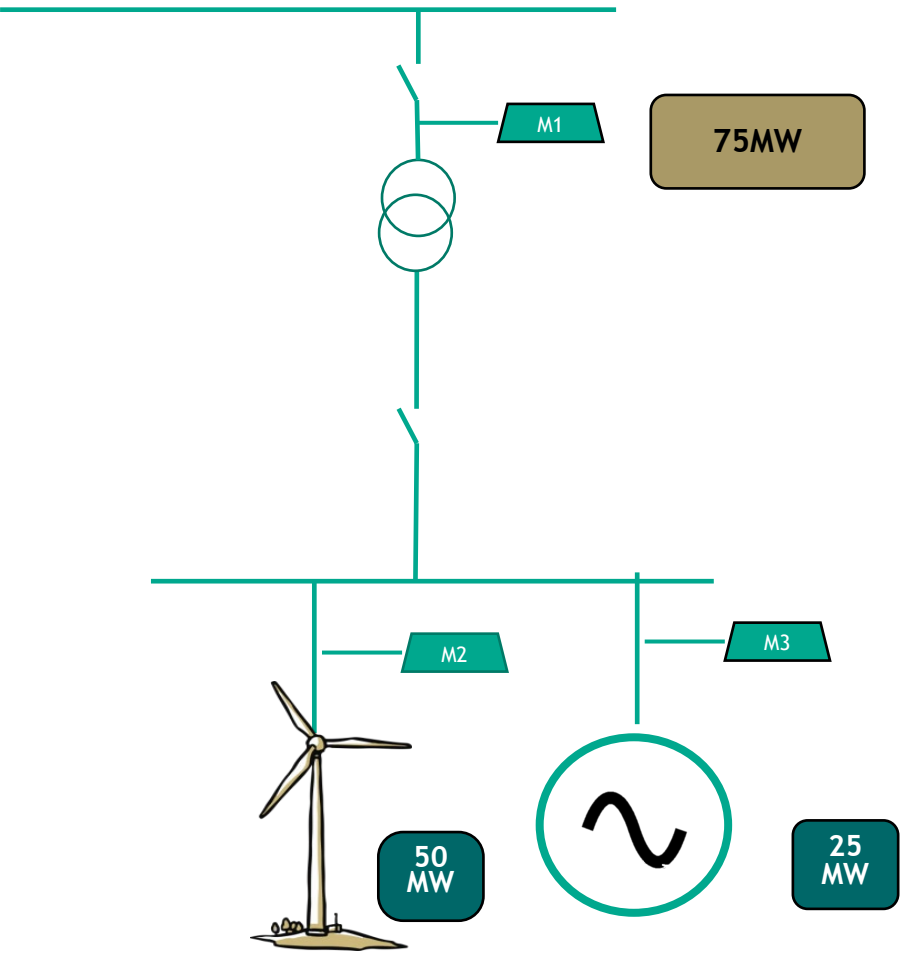
Decision:

- Go-live date for removal of Over install limit for Distribution connections on the 07 November 2023.
- For Transmission connections, a small number of items remain to be addressed, SONI expects to update on Transmission Go-live date within the coming months.

Sharing of Maximum Export Capacity (MEC) at a Single Connection Point

EirGrid ESB NETWORKS

Hybrid Co-location Current Approach



Each Generation Unit requires a **separate** MEC, which is then summated at the point of connection.

Current connection policy:

For the illustrated example 75MW MEC would be required

Changes to this connection policy could:

- Decrease connection costs,
- Increase potential for projects to evolve,
- Lead to a more efficient use of existing Grid Infrastructure.

EirGrid ESB NETWORKS

What are the Connection Options to increase flexibility

Phase 1

Hybrid Co-Located Site – is any project that combines multiple forms of technology behind a single connection point. The Generation Units within a Co-located site operate independently of one another, for market, settlement and dispatch instructions. However, compared to today, **the site shares MEC across the connected Generation Units.**

Phase 2

Hybrid Unit –is any project that has multiple generating units which utilise multiple primary energy sources or technology types in generating/storing electricity and is electrically connected behind a single defined Connection Point to a licensed System Operator. The site is registered in the market as one **single market unit** and operates as a **single unit** for the purpose of settlement and dispatch.

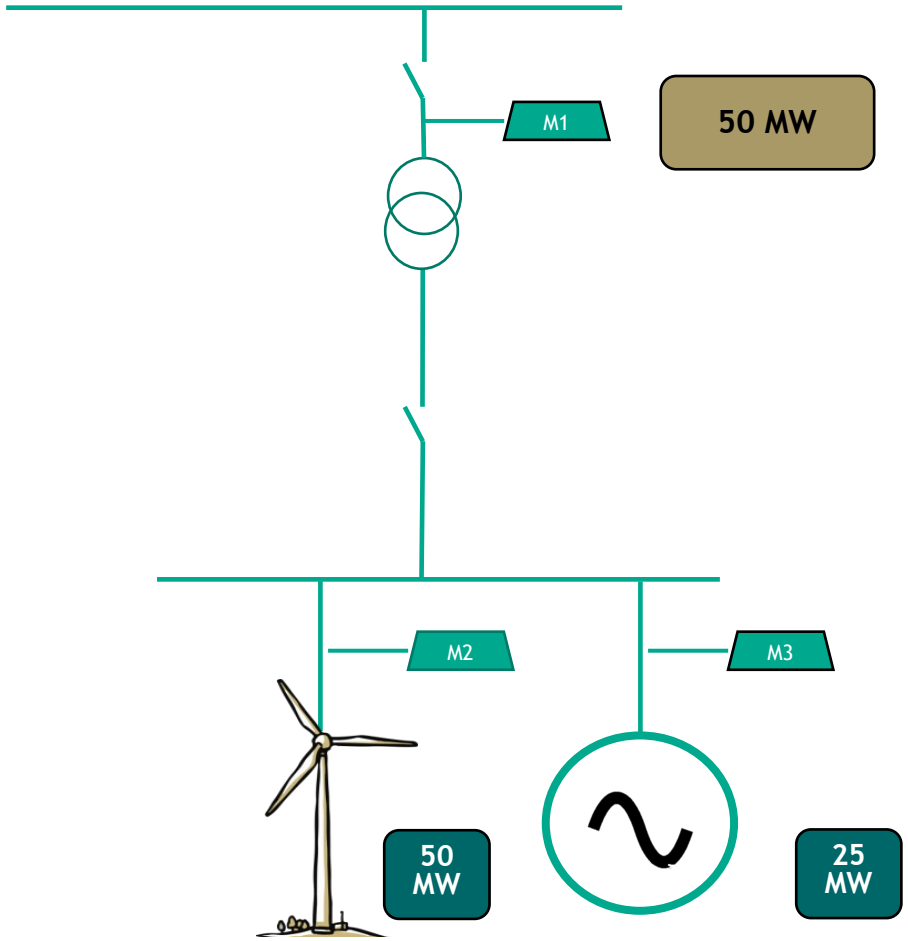
EirGrid ESB NETWORKS

Why Phased Approach?

- A single Hybrid Unit (Phase 2) will require significant modification to current systems, policies, codes and procedures to implement.

- The SOs consider that the facilitation of Hybrid Co-located generation sites (Phase 1) provides a practical first step towards optimizing hybrid technology integration, as it would not require the same level of changes to existing systems, policies and processes.

Hybrid Co-location approach to Sharing of MEC



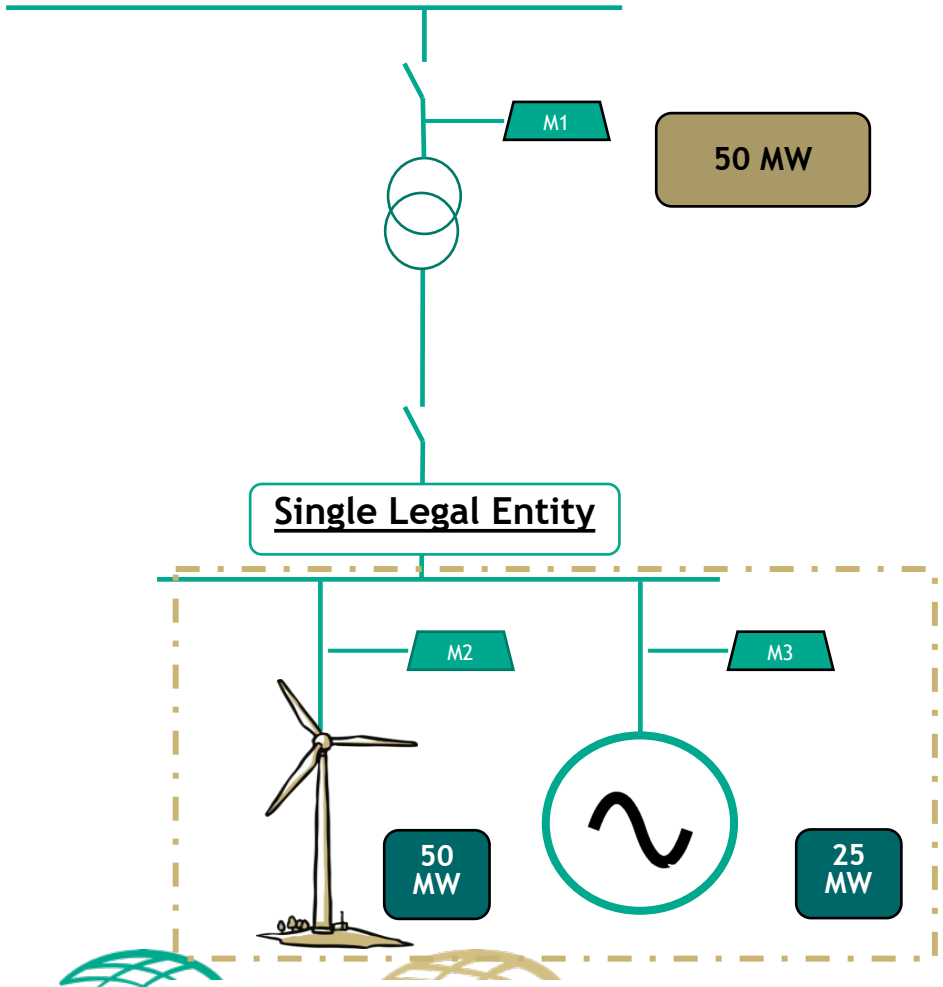
Phase 1 of stepped approach

We are proposing the MEC at the connection point will not be summated, instead the connection process will determine the appropriate MEC to make effective use of technologies connecting at Hybrid Co-located sites.

This MEC can then be shared between the two technologies, with the aim of optimising the output at the connection point based on resource availability.

The Hybrid co-located site would not be permitted to exceed the contractual MEC at the connection point, as set out in the current connection agreement.

Working principles for a ‘Hybrid Co-Located’ site



Phase 1 of stepped approach

Market Registration - Each unit at the co-located site is required to be registered as a separate market unit.

Connection Management (Modification)- Any existing unit will be required to follow existing grid connection modification process, **no increase in MEC will be permitted.**

Signals - Separate sub-metering will be required for each technology.

Grid Code - Each unit will be required to meet relevant GC requirements for each unit and POC requirements (Reactive/Voltage Control)

Market/Central Dispatch*

Wind farm – submits one offer, which is representative of wind unit

Battery – submits separate offer, onus on customer to position themselves in the market such that the contractual MEC is not exceeded.

Safeguard may be required to ensure two units aren’t run in a manner that is not feasible due to dependencies between the units.

Customer shall install internal control system to limit the generation output of the site.

Settlement- Calculated on the metered energy, as per current settlement logic

*Requirement for detailed review of IT systems, Markets, Support Schemes, and overall Hybrid Framework.

Areas to Address and Ongoing Work

Examples of Areas Requiring Possible Change

- Changes to connection agreement and possibly connection policy.
- Changes in market registration.
- Changes in operational policy focusing on ensuring real time availability signals reflect actual status of each technology.
- Ensure forecasting of both individual units and total sites is accurately captured in the control centres.
- Review of scheduling and dispatch systems to ensure no unintended consequences.
- Grid, Distribution and Trading and Settlement codes.

Ongoing Work

- In anticipation of regulatory feedback, the SOs are currently engaging in a detailed investigation of relevant systems, codes, policies and processes with the end goal of having set of implementation requirements needed to enable the sharing of MEC.

Ask

Any feedback on the proposed Sharing of MEC stepped approach?

Any areas you feel that require further clarification?

Thank you

EirGrid

SOEF Advisory Council Meeting #6

Workshop Topic: Renewable Hubs

EirGrid SONI

Advisory Council: Workshop Topic

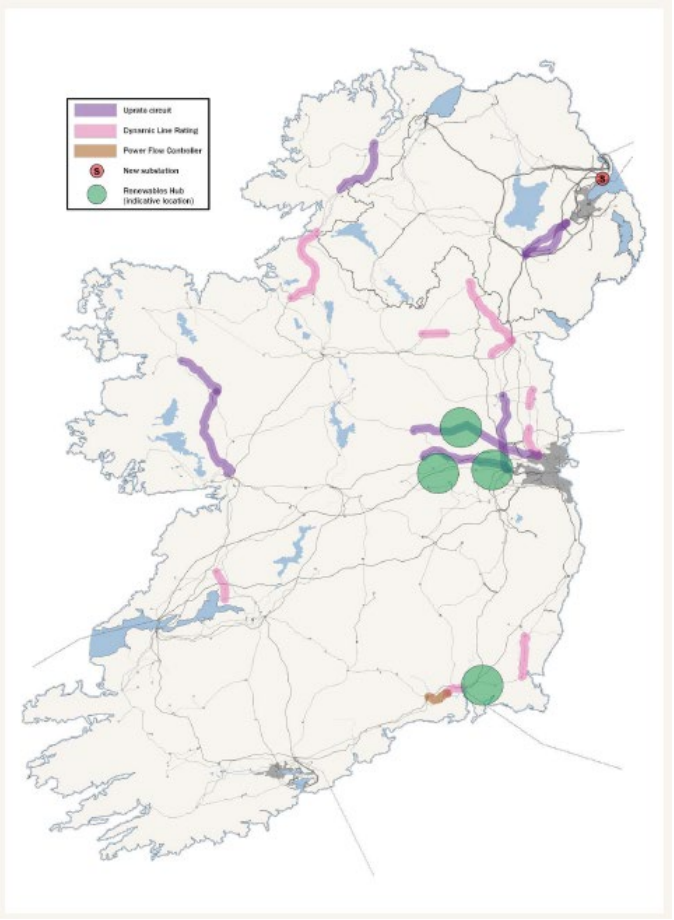
Renewable Hubs:

Presenter: Elin Ahlund, Head of transmission Power System Planning

Advisory Council: Renewable Hubs workshop

Introduction

- SOEF 1.1 indicate renewable hubs required to achieve the renewable ambition by 2030
  - Four renewable hubs or collector stations indicated initially
  - Locations informed by available transmission system capacity in combination with ECP applications and information from the industry on future projects.
  - Assumed to be contestably built by developers as part of connection method agreed with TSO
- Using renewable hubs, collector stations or clustering is not a new concept and has been used by both EirGrid and SONI previously
  - Scale of required infrastructure and required speed of delivery is different
  - Developments of HUBs are not restricted to the 4 indicated in SOEF, Where we see opportunities to gather several connections we will do so



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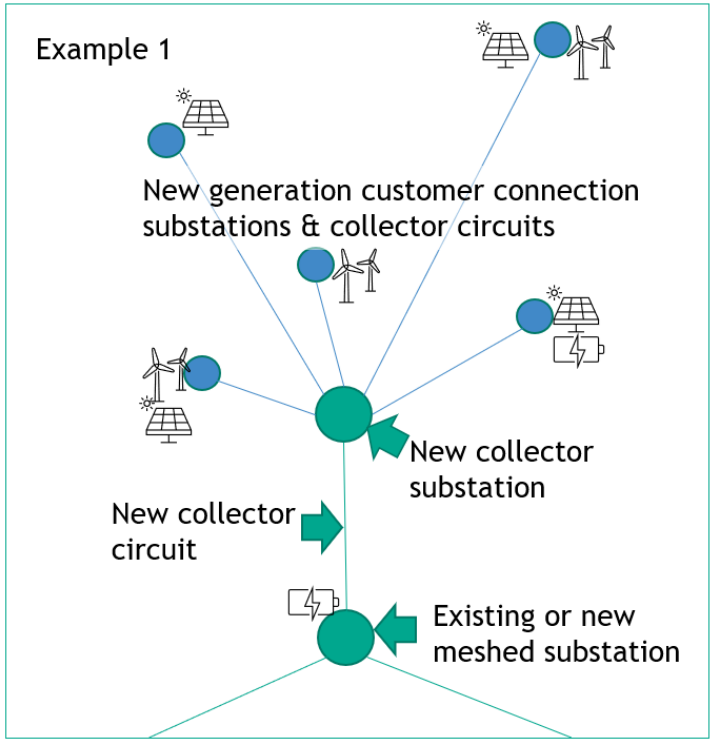
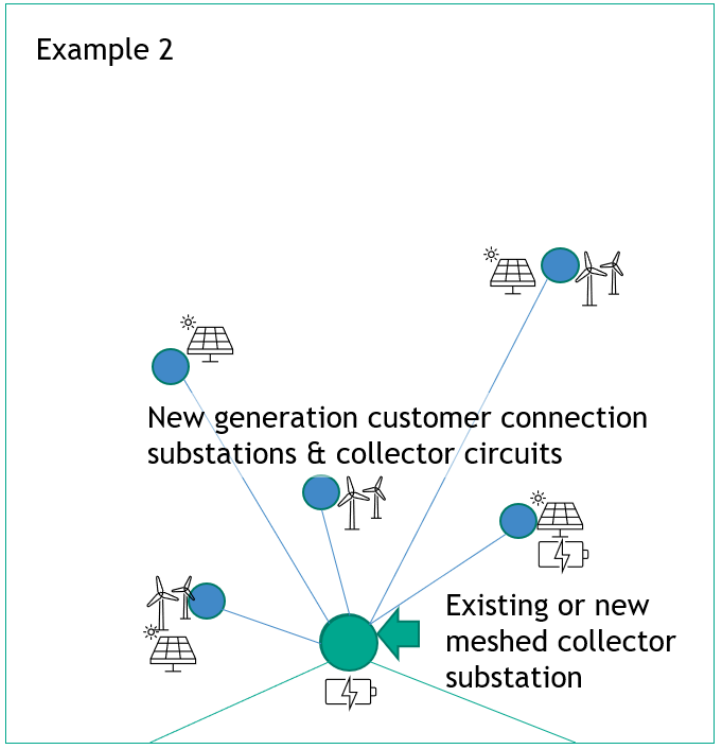
Advisory Council: Renewable Hubs workshop

What do we mean by renewable hubs?

- More MW connected in one grid development
- Gather and connect to a strong point
- Avoids connecting to already constrained grid
- Developments can use 110kV, 220 kV and/or 400 kV voltage levels for substations, and required circuits





Advisory Council: Renewable Hubs workshop

The Ask of Workshop reg Renewable Hubs

EirGrid is keen to garner views on the potential challenges associated with renewable hubs. Some example of area/questions

1. **Development:** What steps could be taken to support and advance the development of specific hubs? For example, specific approaches that could be taken to the consenting process, advanced work packages
2. **Delivery:** Are there any approaches that need to change to? For example, specific approaches to how the hubs are constructed
3. **Expediency:** Considering there is only 6 years to deliver targets are there any specific points on how hubs are optimised and delivered in a speedy manner?
4. **Process:** Have you any specific concerns for how hubs are processed? For example, funding, contestability, subgroups etc.
5. **Anything else?**

We will use this information to steer the next engagement with members of the advisory council which may be a sub-committee or further workshops

By using the provided post it notes write down 3 issues/challenges with this concept that you believe will require a resolution

EirGrid SONI

12/10/2023

Market Considerations: Long Duration Energy Storage (LDES)

Bryan Murray
Manager, Long Duration Energy Storage

A Clear Need for Storage

Needs

- SOEF v1.1 incorporated targets set in CAP23 (Ire) & Climate Change Act (NI), amongst others, and identified a high level of surplus renewables by 2030
- SOEF has identified storage as one of the key ways to better optimise renewable surplus
  - Modelling input of 2 GW of 4-8 hour Storage (AI)

Incremental volumes of Storage		
Duration	IE	NI
<2h	250	200
4h	375	125
6h	550	0
8h	750	250

Benefits

- Our Initial CBA has found incremental storage to provide the following benefits:
  - **Carbon** – Saving of 1.55 MtCO2e (4.9 to 3.35)
  - **RES** – Increases RES level from 84% to 89%
  - **Dispatch Down** – Reduce DD from 35% to 27%
  - **Production Cost** – Saving of circa €380 mill per annum

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Ok lets do it… but first

Approval - Need to get policy maker direction and funding to progress. TSOs are launching a call for evidence over coming weeks to start this process.

Additional Modelling

- More in depth modelling to identify optimal locations to maximise value
  - Drive towards plan led approach
- Modelling the impact of longer duration storage (8+) as viable technology is rapidly evolving
  - SOEF v1.1 modelled only a maximum of 8 hour storage

Other

- Need to chase efficiencies in both internal & external elements of the process
  - Prioritisation of projects
  - Connection agreements
  - Planning, etc

EirGrid SONI

What do you think?

- Do you agree that there is a need for additional storage to be procured?
- Do you think the market can deliver the levels of storage outlined in SOEF?
- Do you think we should:
  - Procure the best available Storage now, or
  - Wait until 7-10 day storage becomes available
- What do you foresee as the main barrier for storage?
- What do you think is the main opportunity for storage?
- Should we wait until the outcome of a policy decision is made before we progress with further modelling and investigation?

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Questions?

SOEF Advisory Council Meeting #6

Workshop Topic: Long Duration Energy Storage

EirGrid SONI

SOEF Advisory Council Meeting #6

SOEF v1.1 Networks Update

30 min	15:00	SOEF v1.1 Networks Update	Derek Carroll

Surplus Renewable Generation – data sharing

- Background
- Data available
- Visualisations
- Publication
- The ask – Advisory Council feedback on datasets and visualisations

Surplus Renewable Generation - data sharing

- Background
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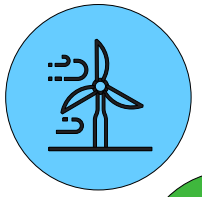
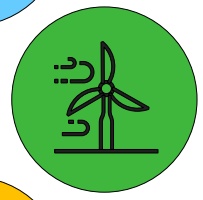
Whole of Electricity System Challenge

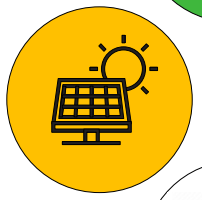
Supply



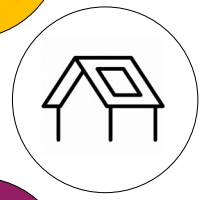
Offshore Wind
(+ 5 GW)



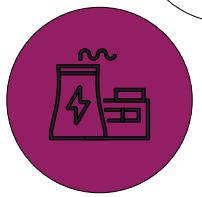
Onshore Wind
(+ 4.5 GW)



Solar
(+ 5.5 GW)



Microgen
(+ 2.5 GW)



Conventional
(+2.2 GW)

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Shaping Our Electricity Future

+ c. 350 Network Reinforcements
+ c. 25 Smart Network Devices
+ System Operation Transformation
+ Electricity Market Transformation
+ 4 HVDC Interconnectors
+ 2.8 GW Long Duration Storage
+ Over 20% demand flexibility
+ 10 GVAs Low Carbon Inertia Services

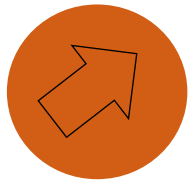
Demand (+50%)

Large Energy
Users
(~1.6 GW)

Electric Vehicles
(~950 k)

Heat Pumps
(~600 k)

Social & Economic
Growth



Surplus Renewable Generation – A Demand Opportunity

- More renewable generation available for dispatch than median forecasted demand
- Scale of opportunity identified in SOEF V1.1 – over 20% of available renewable generation
- Presents an opportunity for innovative energy usage as considered in CAP23
    - Timely development and implementation of any incentives and frameworks important
- Flexibility important - the following are already assumed in place in SOEF V1.1:
    - Further new interconnectors (Ireland – France 2, Northern Ireland – Scotland 2)
    - Significant long duration storage
    - Significant demand side flexibility

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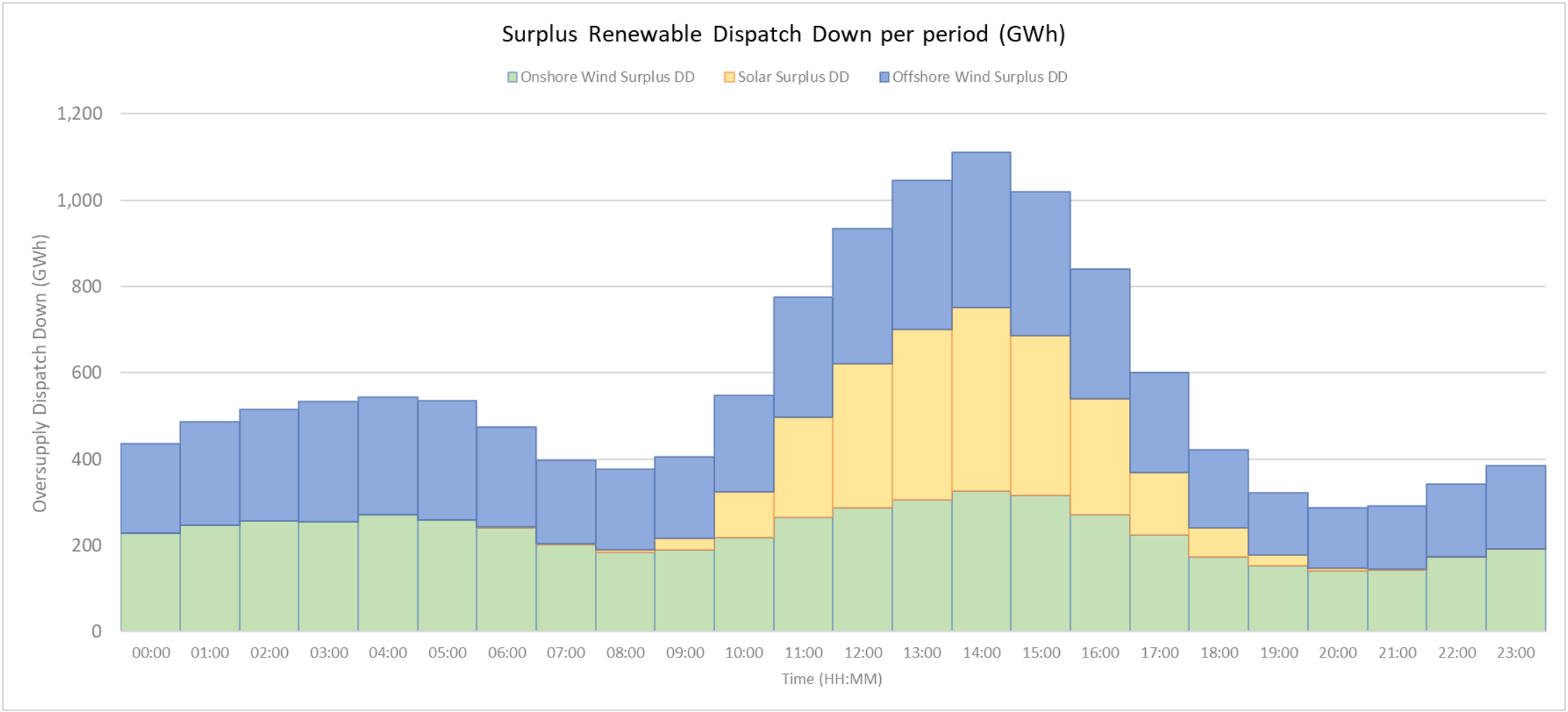
Renewable Surplus Generation – identifying opportunities

- Datasets available from SOEF v1.1 analysis
- Options for data visualisation explored
- Options for future regular publication for discussion
- Published data must add value
- Input, suggestions, feedback sought from Council members to ensure the data are of value

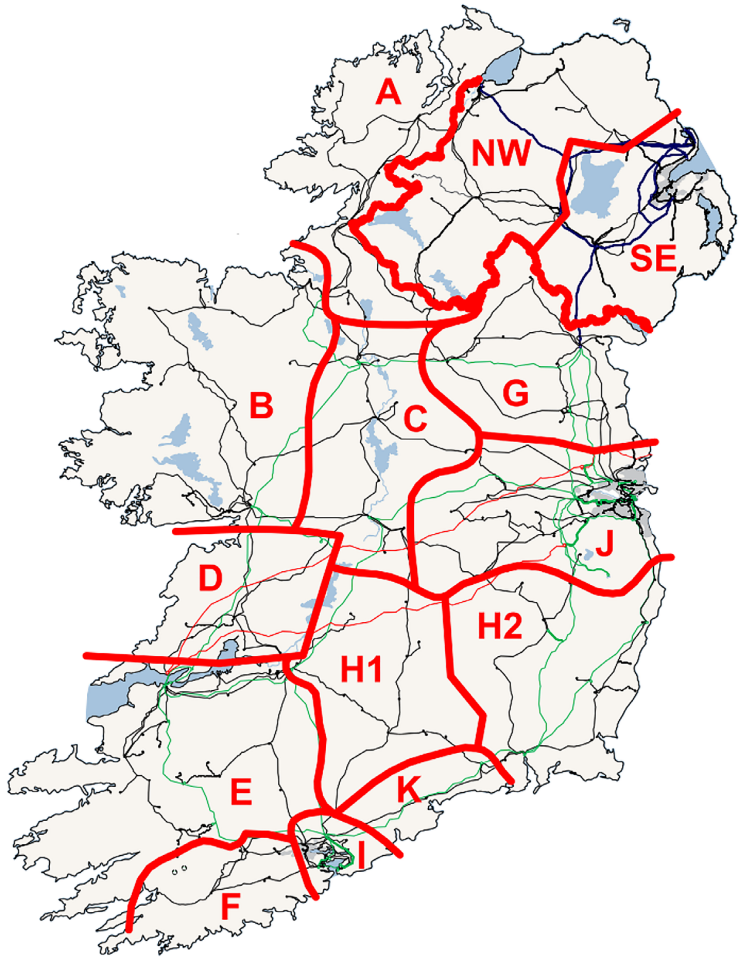
Surplus Renewable Generation - data sharing

- Background
- Data available
- Visualisations
- Publication
- The ask – Advisory Council feedback on datasets and visualisations

All Island – Hour by Hour Surplus Dispatch Down



Area Based Reporting In SOEF v1.1 - Surplus Volumes & Locations



Area	Renewable Surplus (GWhr)
A	0.616
B	1.369
C	0.927
D	0.220
E	0.676
F	0.206
G	0.776
H1	0.425
H2	1.816
I	0.526
J	4.707
K	0.202

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Surplus Renewable Generation – data sharing

- Background
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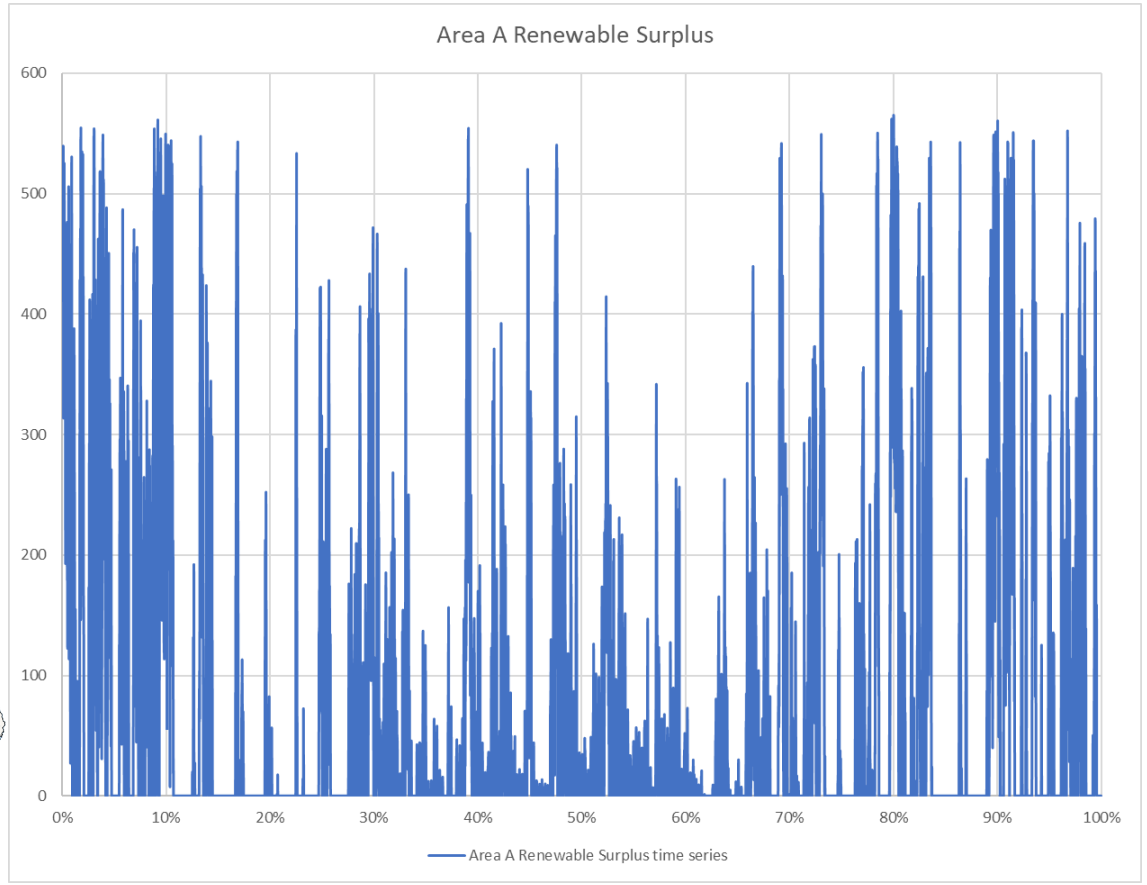
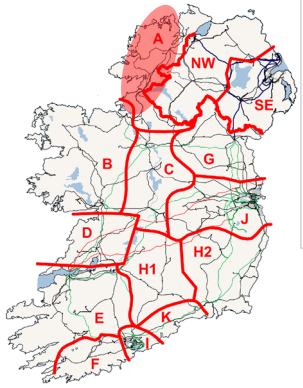
Area Based Reporting In SOEF v1.1 - Surplus Durations (1)

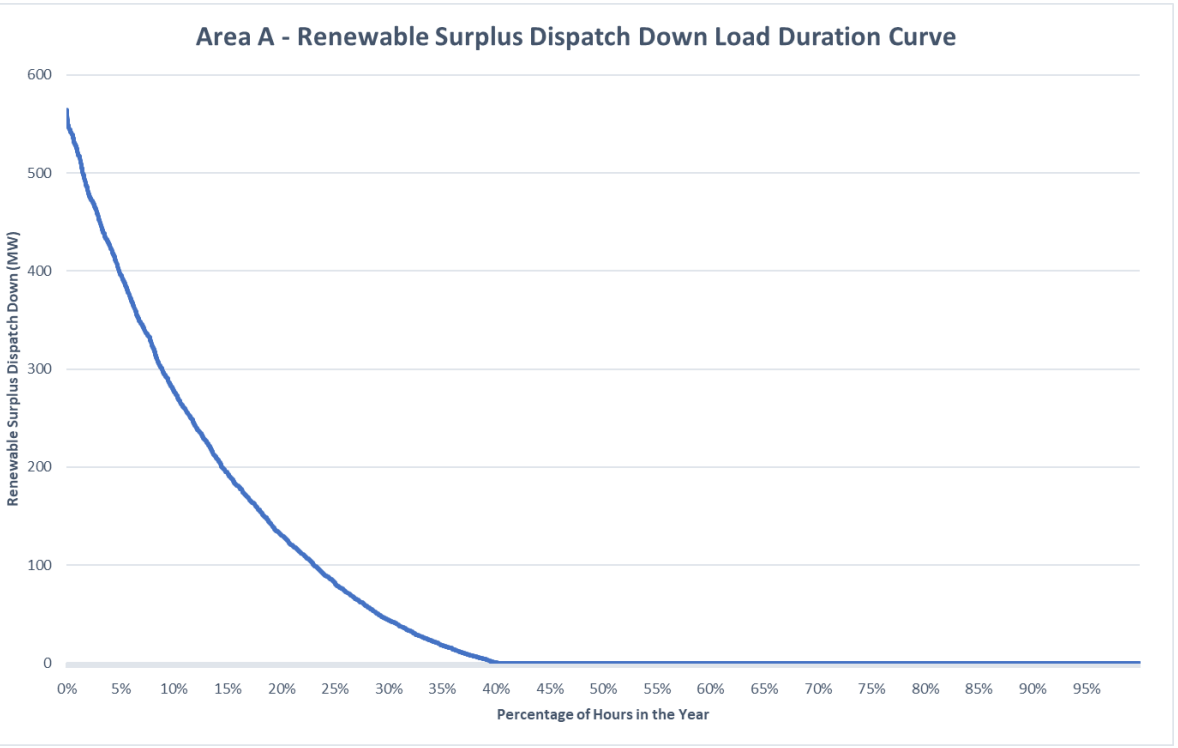
- Time series surplus data for each area
- Somewhat useful:
    - Effects of onshore, offshore, solar
- Not the most illuminating visualisation.

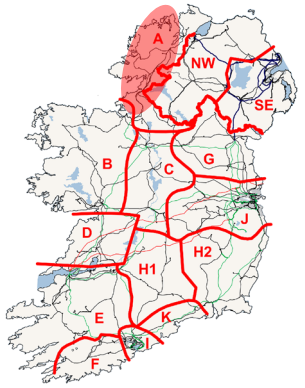




Area Based Reporting In SOEF v1.1 - Surplus Durations (2)

- Duration curves available for each region.
- Appears to be a good way to show the duration of renewable surplus.
- Other visualisations recommended?





Surplus Renewable Generation – data sharing

- Background
- Data available
- Visualisations
- Publication
- The ask – Advisory Council feedback on datasets and visualisations

Renewable Surplus – future publication of data

- Data from SOEF v1.1 are available now
    - Table of quantities for all areas described in the roadmap
    - Duration curves and time series charts for each area
    - Other visualisations could be accommodated

- Publish following feedback from council on the data and visualisations available
    - Format to be determined, i.e. standalone document, addendum to Roadmap, etc

- More enduring process
    - Value in regular updates to projected future surpluses?
    - Format, frequency, content.

Surplus Renewable Generation – data sharing

- Background
- Data available
- Visualisations
- Publication
- The ask – Advisory Council feedback on datasets and visualisations

Summary – Renewable Surplus data

- Data available from SOEF v1.1 to show location, magnitude and duration of renewable surplus
- Time series and surplus duration curves available
- Advisory Council advice and feedback is requested on the usefulness of datasets and visualisations

- Verbal feedback and suggestions now - c.5 minutes available
- Or written feedback and suggestions by end of 13 November 2023

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SOEF Advisory Council Meeting #6

Future Meeting Calendar

Meeting	Date / Time	Location
ACM #7	Tuesday, 16th January 2024	Herbert Park Hotel, Ballsbridge, Dublin, Ireland
ACM #8	Tuesday, 21st May 2024	Belfast, N. Ireland
ACM #9	Tuesday, 24th September 2024	Dublin, Ireland

10 min	15:30	Future Meeting Calendar	Seve Garanzuay

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SOEF Advisory Council Meeting #6

Closing Remarks

20 min	15:40	Closing Remarks	Liam Ryan