Dispatchable Demand Generation Unit

Code Mod proposal Mod_07_21

AUGHINISH ALUMINA

April 2021

AGENDA

- Aughinish background
- DDGU origin
- Opportunities and the problem
- Solutions
- The proposed Code Mod

KEY FACTS

COMPETING INTERNATIONALLY FROM THE MID-WEST

Constructed in 1983

€130M is spent in the Irish economy annually

Produces 30% of EU alumina

Purchases of €80M from Irish suppliers, many locally based

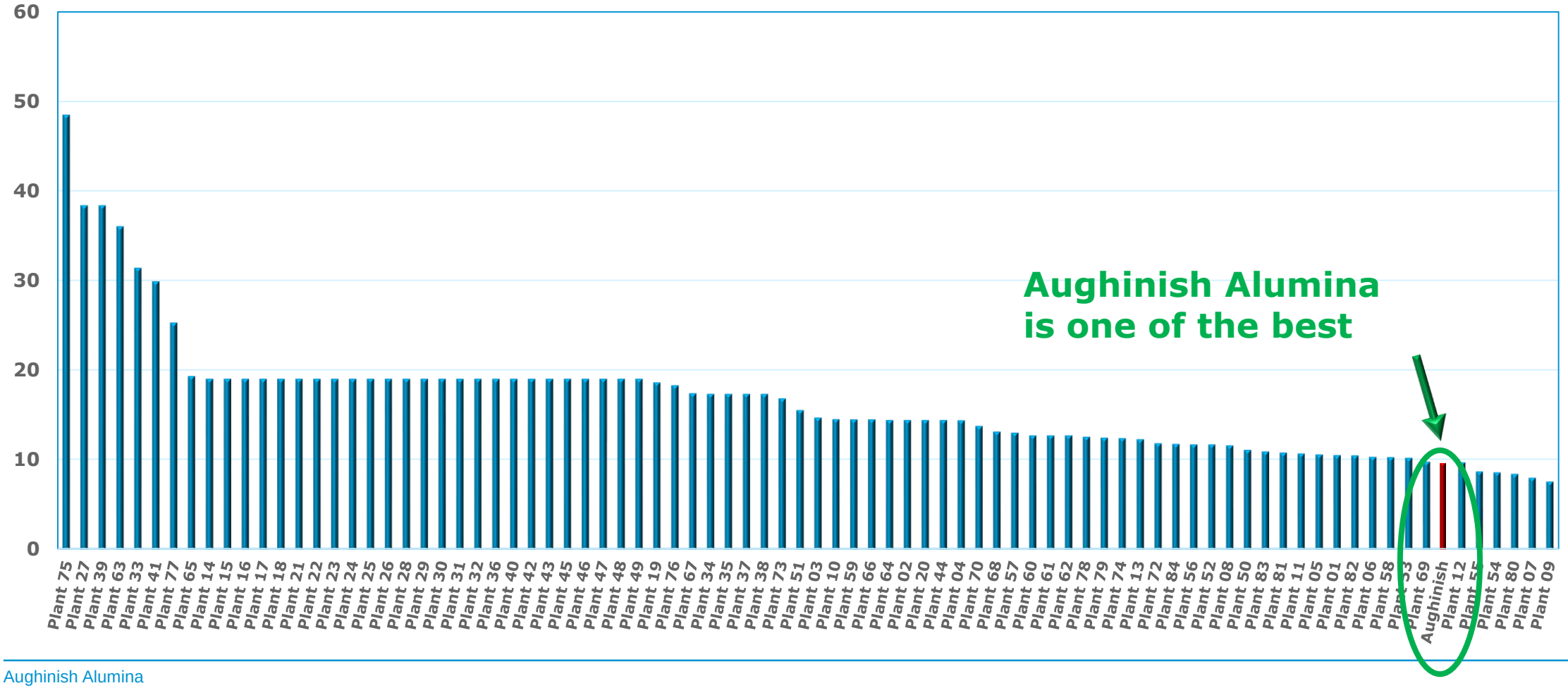
Construction Cost US$ 1 Billion

Additional US$ 750M invested in modernisation

One of the most energy efficient in the world

ALUMINA REFINERIES

WORLD WIDE ENERGY EFFICIENCY RANKING GJ/TONNES PRODUCTION



AUGHINISH DECARBONISATION

Energy Efficiency

100% Fuel Oil

1983

High Efficiency CHP

2006

Gas Calcination

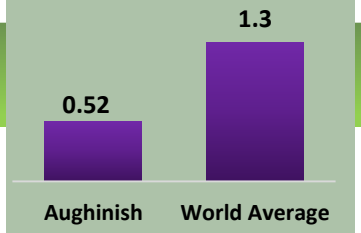
2012

Gas Boilers

2014

100% Natural Gas

Carbon Emission (t/t)



2020

Decarbonisation

Future

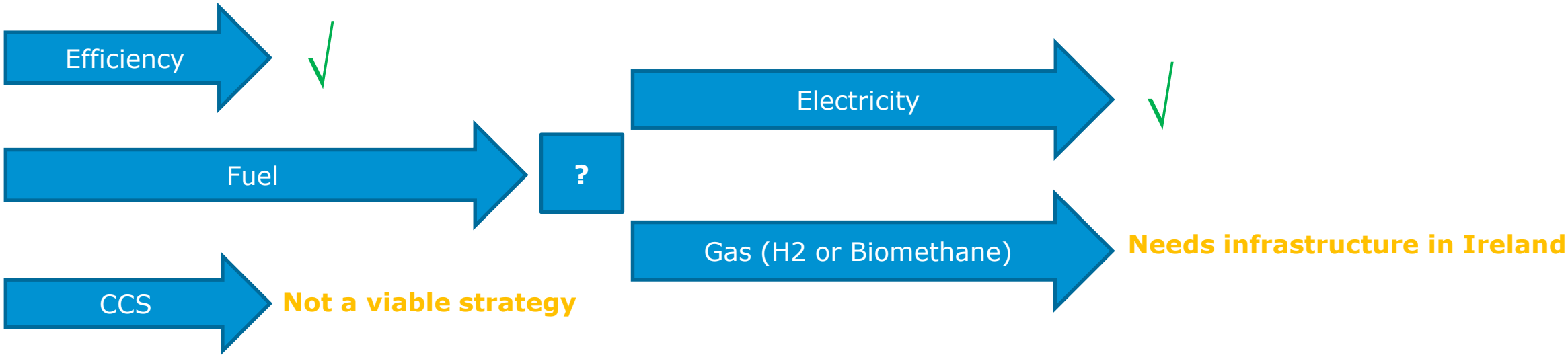
- Decarbonisation including Energy Efficiency improvements has and continues to be a key strategic goal of Aughinish
- **40%** reduction in **CO_2** emissions per ton product since 2006, as well as **100%** in **SO_2** & **90%** in **NO_2**
- Aughinish Combined Heat & Power (CHP) Plant second only to renewable generation in Ireland in CO_2 emission intensity
- Aughinish is one of the most energy efficient refineries in world through continuous improvement
- EN+ committed actively pursuing low Carbon aluminium – Aughinish central to low carbon aluminium (ALLOW)
- EN+ committed to further **35%** group reduction by 2030

DECARBONISATION ROUTE

REVIEWING TECHNOLOGY AND PLAN UNDERWAY

Decarbonise: 3 methods

- Energy Efficiency – always the first choice
- Fuel Switch – to decarbonised fuel (Gas or Electricity)
- Carbon Capture and Storage

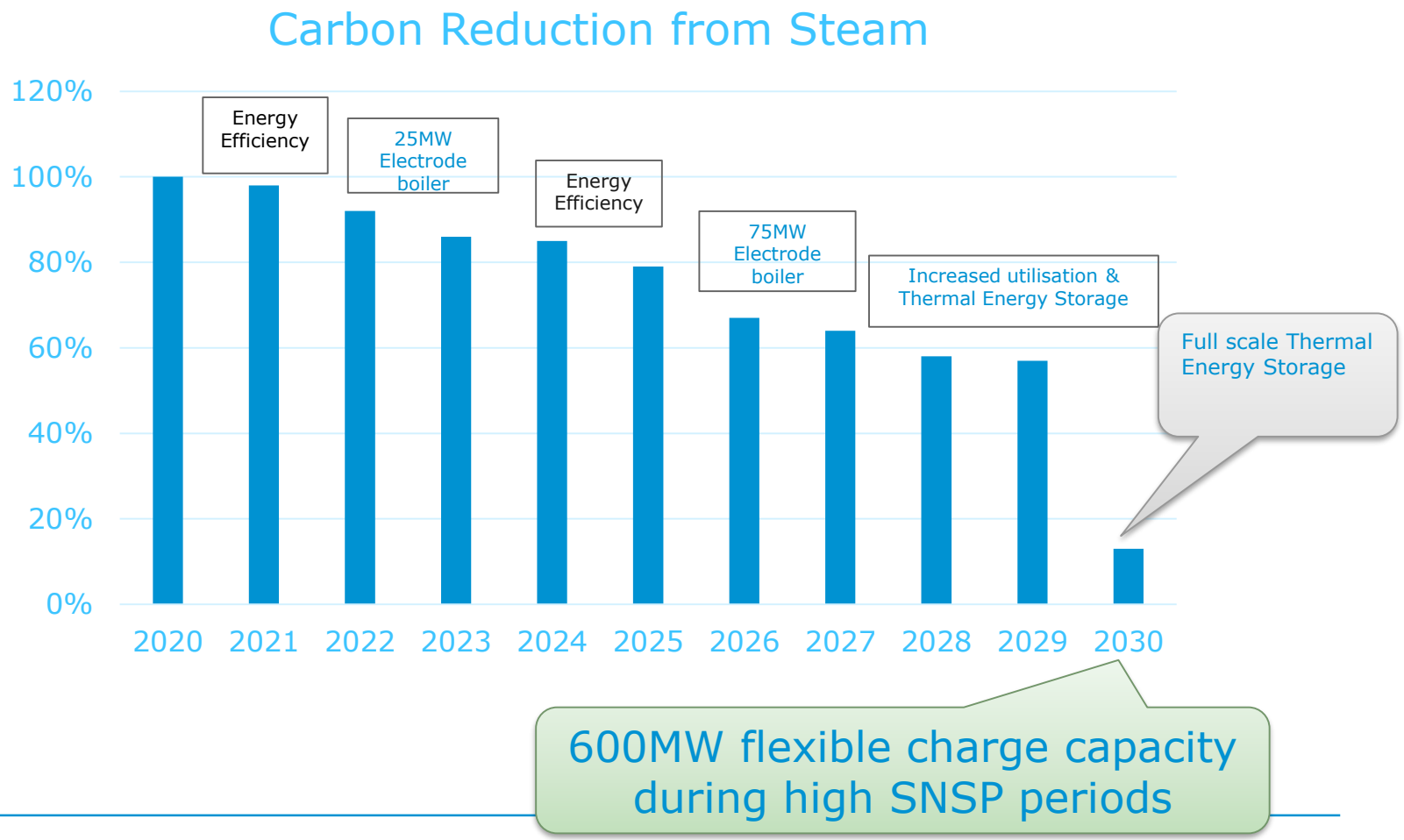


AUGHINISH DECARBONISATION VISION

ENERGY EFFICIENCY AND FUEL PATH TO REDUCE CARBON

- Working towards further Energy Efficiency improvement projects reducing Carbon by 80,000t CO_2/yr by 2025

- Options under development on alternative Fuels (Electric Boiler; Thermal storage) but significant barriers to be overcome. Up to 300,000t CO_2/yr by 2030



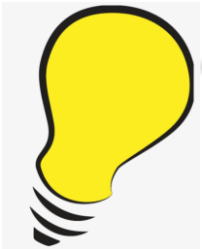
Origins of this Code Mod

June 2015 High level design of ISEM

"Wind does not cause curtailment any more than power stations cause constraint"

"negative prices are an indication of a broken market, we should all start throwing bar heaters into the river"

Industry can fix this



Origins of this Code Mod

Why now

Pull factors

- RES-E is affordable, if you can be flexible
- 5.5GW RES-E moving to 15GW with potential for 37GW by 2050 (MaREI)
- Dep for Economy “Net Zero Carbon and Affordable Energy”
- DECC Move away from fossil fuels to RES
- Eirgrid Lead the island’s electricity sector on sustainability and decarbonisation
- ESBN Electrification of heat and transport , Connecting renewables
- Europe Decarbonise Empower citizens
- Innovative use of existing mature technology
  - Help dispatch down
  - Provide Zero carbon system services
  - Reduce cost of zero carbon transition

Push factors

- Carbon leakage.
  - Industry will leave Europe due to carbon prices and no alterative fuel
  - Global emission will increase
  - Job losses in Europe
- Corporate responsibility

The Problem and the Vision

Dispatch down
11.5% dispatch down in 2020
43% dispatch down by 2030 if mitigation measures are not put in place

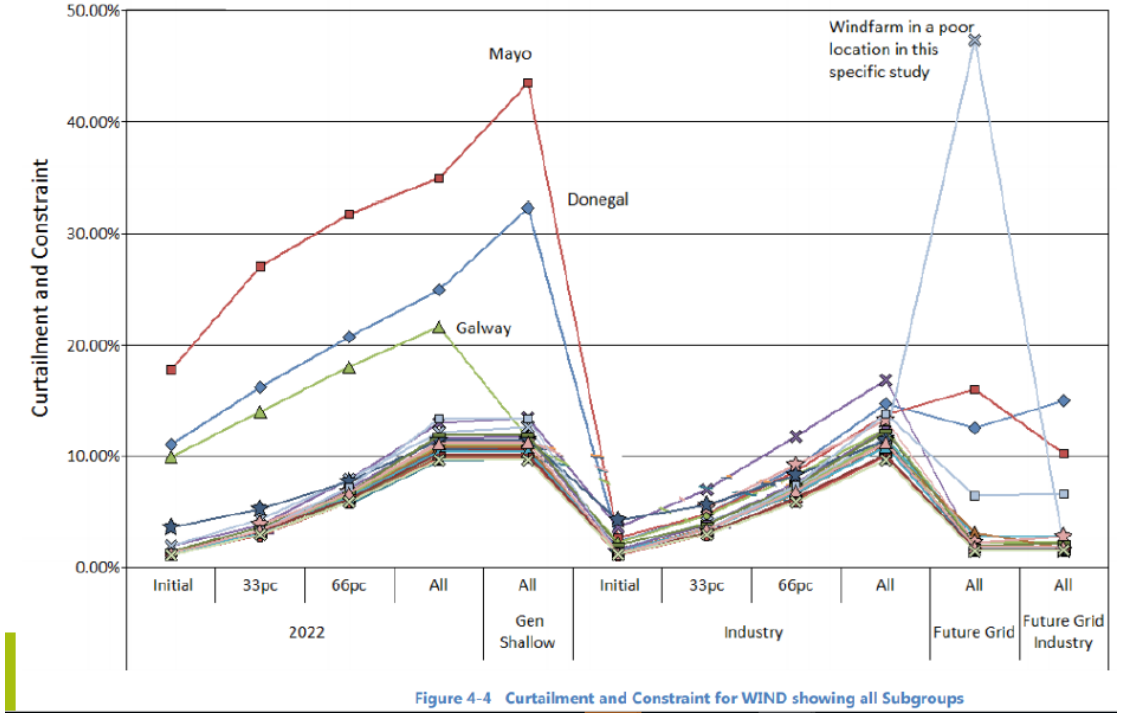


Figure 4-4 Curtailment and Constraint for WIND showing all Subgroups

Energy Revolution.
Ireland is number 1

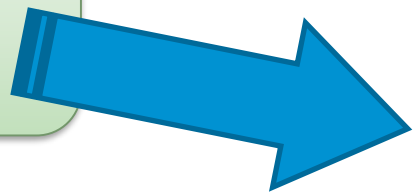
5GW → 2030 → 15GW

Solutions to dispatch down of RES-E

1. Cables & interconnection
2. Move Dublin load to the west
3. Technology and innovation – batteries, smart grid, domestic
4. Install flexible bulk load in the right location
5. Zero carbon system services
6. Higher SNSP

All needed.

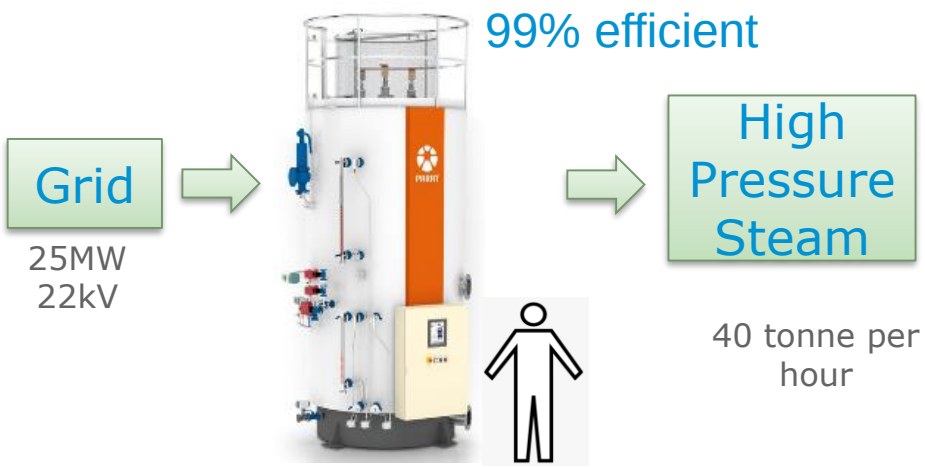
Which can be done now?
Which is easy?
Which is cheap?
Which is a zero-regret?



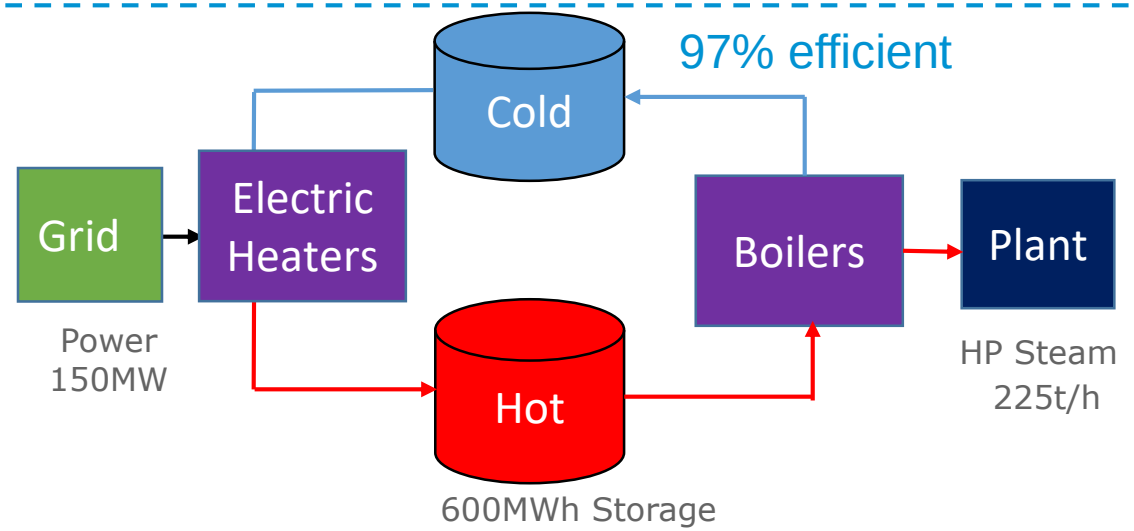
4. Bulk load
5. Zero CO2 SS
6. Higher SNSP

Solutions

25MW ELECTRODE BOILERS



THERMAL STORAGE (150MW DEMONSTRATION, 1.2GW potential)



- Zero carbon Steam
- 15minute ramp up from cold
- 0.2m second POR turn off
- Flexible demand (Dispatchable demand)
- Electrode boiler 99% efficient
- Storage 98% efficient
- Competitive advantage to Irish industry
- Secure existing jobs

- Reduce dispatch down of RES-E
- Zero carbon system services in times of high SNSP
- Aim for over 100% SNSP of base consumption
- Replace imported fossil fuel with indigenous energy
- Replicate to all industry, scale up to [2GW]
- Minimize cables needed
- Reduce customers bills (PSO, UoS, Imperfection)
- Security of supply

Locations

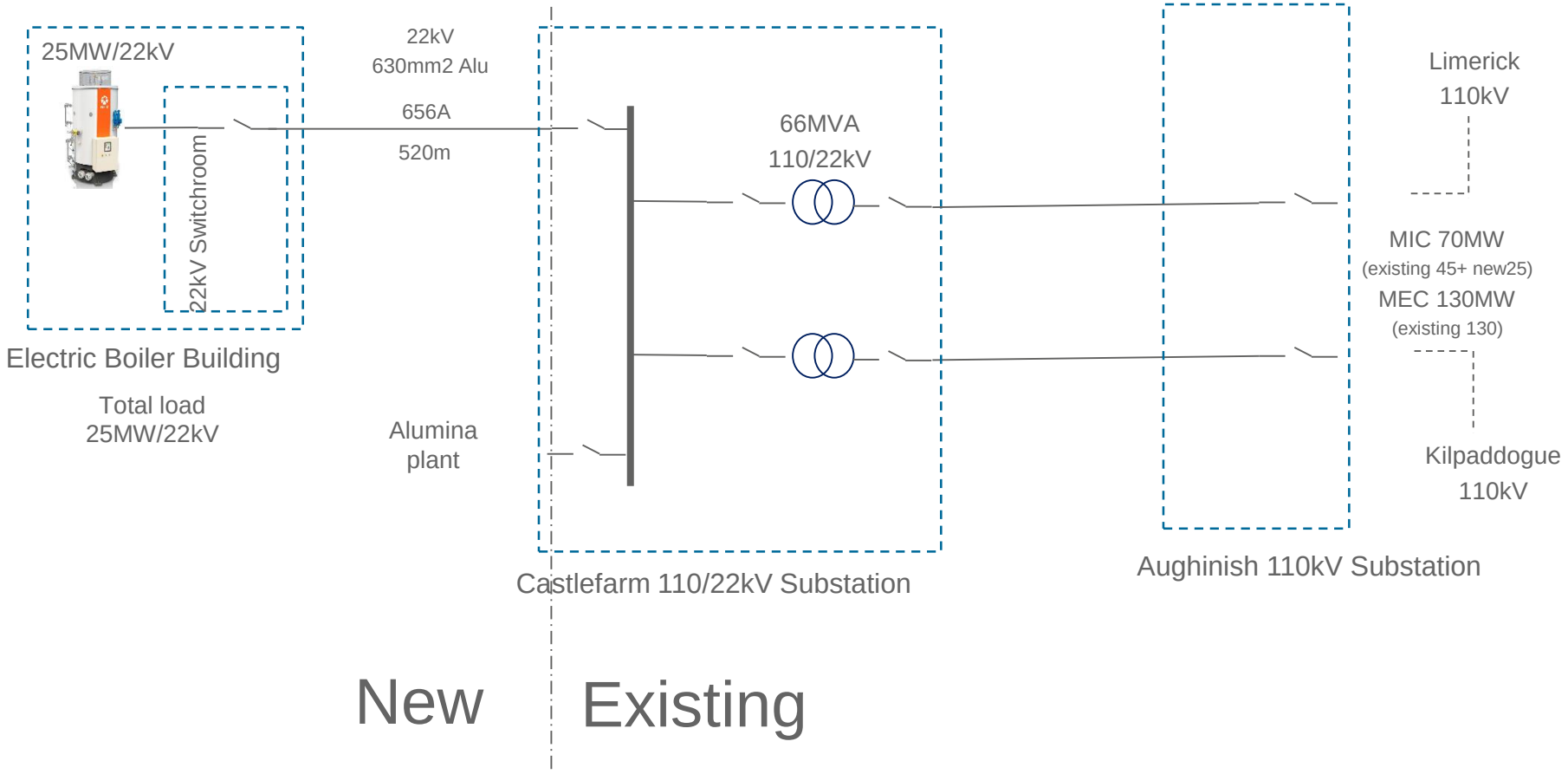
Electrification

- 1. Electric Boiler Buildings
- 2. Thermal Storage
- 3. New Station MV/HV ~200x100m
  "Poularone station"
- 4. Castlefarm station 110/22kV
- 5. Aughinish Station 110kV

Cable lengths:

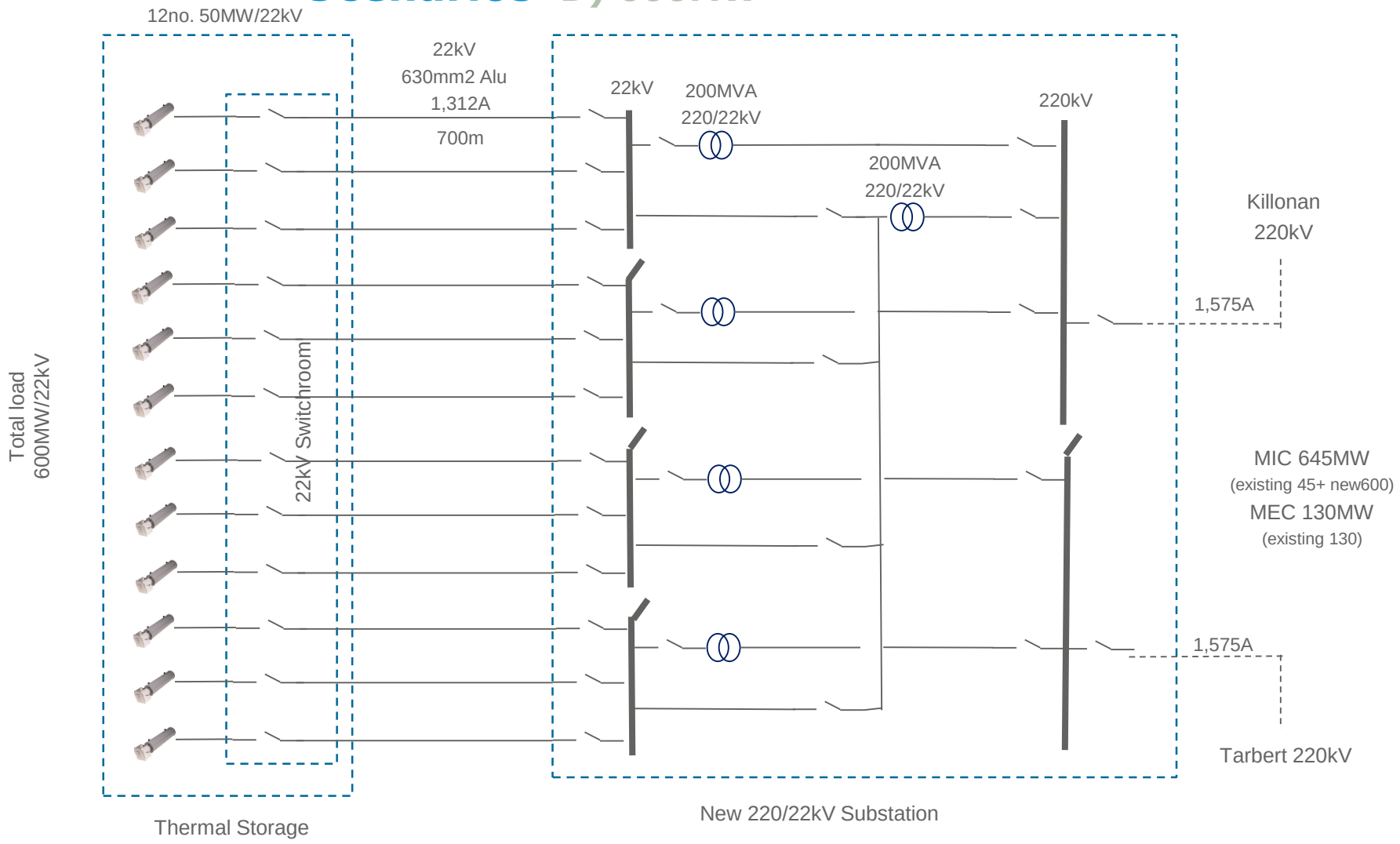
- Aughinish to New Station 550m
- New Station to Thermal Storage 700m
- New Station to Electric Boiler 700m
- Castlefarm to Electric Boiler 520m

Scenarios A) 1 x 25MW Electric Boiler



Note: above is in addition to existing Alumina plant load of 45MW

Scenarios D) 600MW

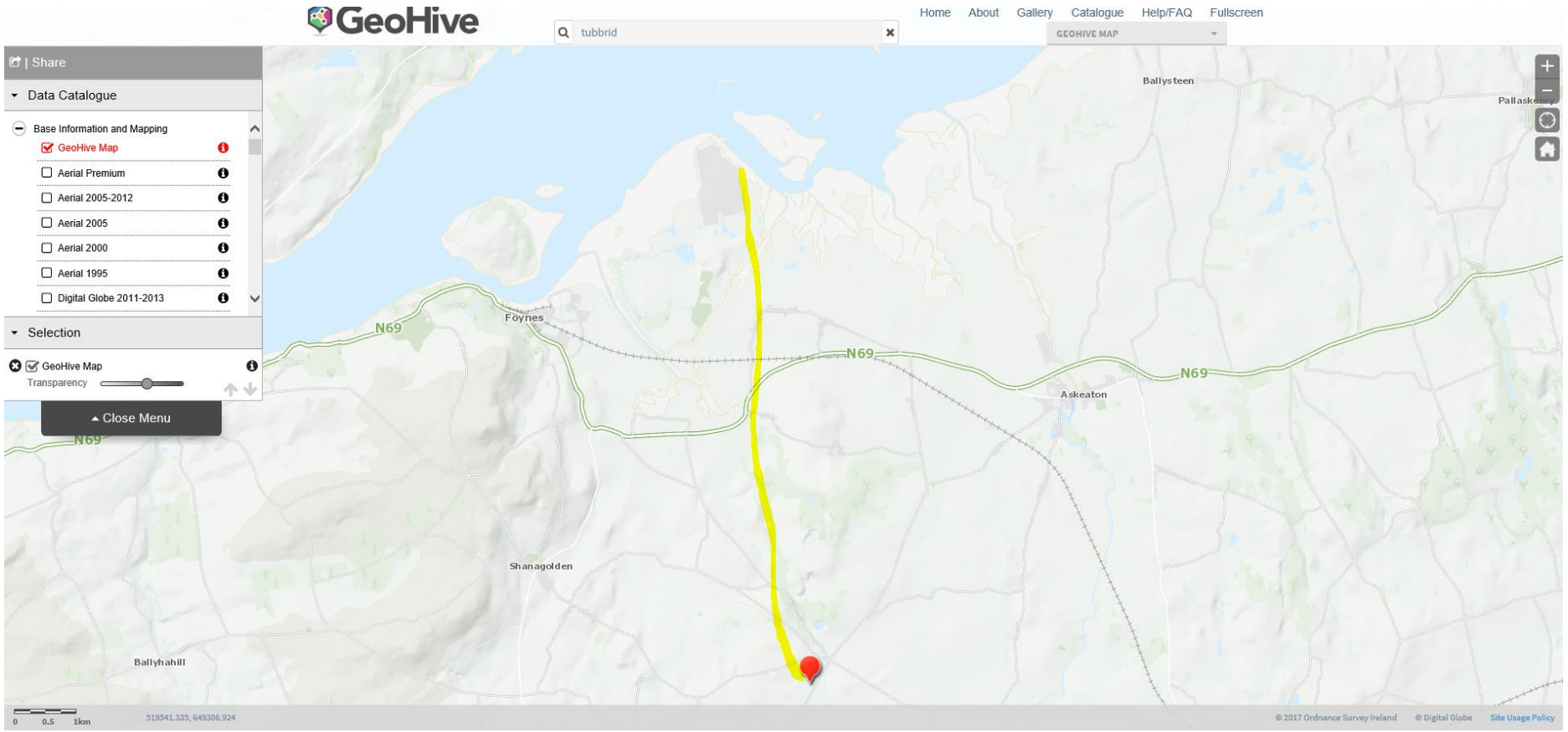


New 220kV supply

Note: above is in addition to existing Alumina plant load of 45MW

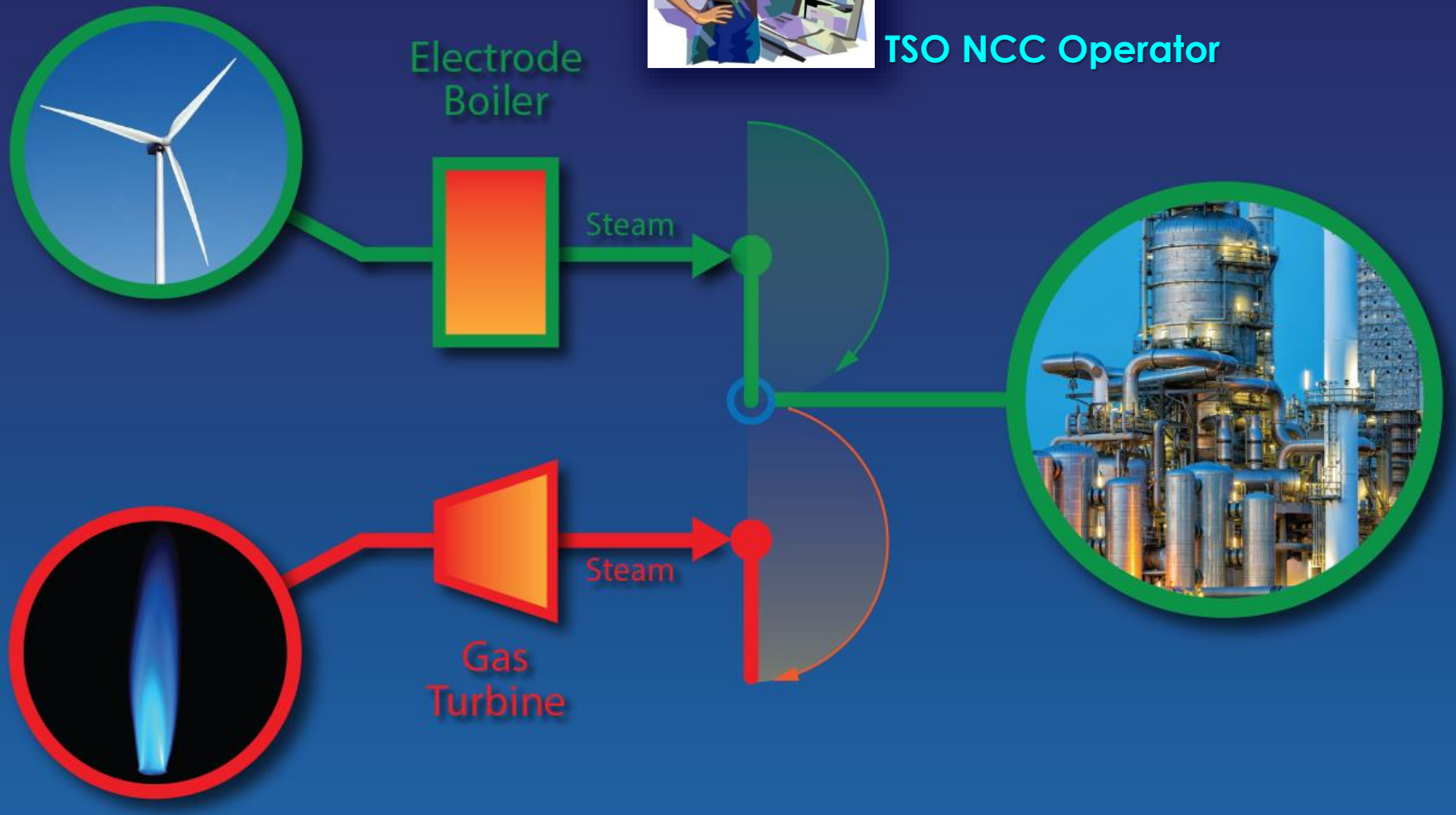
220kV Line double circuit: Tubrid to Aughinish

Tie in at Tubrid to 220kV Tarbert to Killonan line



- Length: 12km

TSO NCC Operator



Gas Turbine to Electrode Boiler Toggle Arrangement

Other Entities in T&SC

Generator Unit:
- Currently does not allow negative generation
- Currently assumes capacity can be provided

Supplier Unit:
- Does not give dispatch control to the TSO
- Assumes capacity requirement (which is not needed)

Battery:
- Consumes power (similar)
- Generates power
- Energy limited

The proposed Code Mod

Step 1 is easy

B.7.2.7, define a Dispatchable Demand Unit as a Generator Unit

Vote to approve this concept:

- Aughinish can move to remove other barriers
- Aughinish can consider the possibility of a 2022 delivery

The proposed Code Mod

Part 2 is hard:

If the concept is approved then SEMO and Eirgrid Group must work their magic to make it work

TOD, COD, Availability, negative volume PQ pair's, TLAFs, QBOA, Bias Q, Testing charge, Scheduling, Dispatch, etc

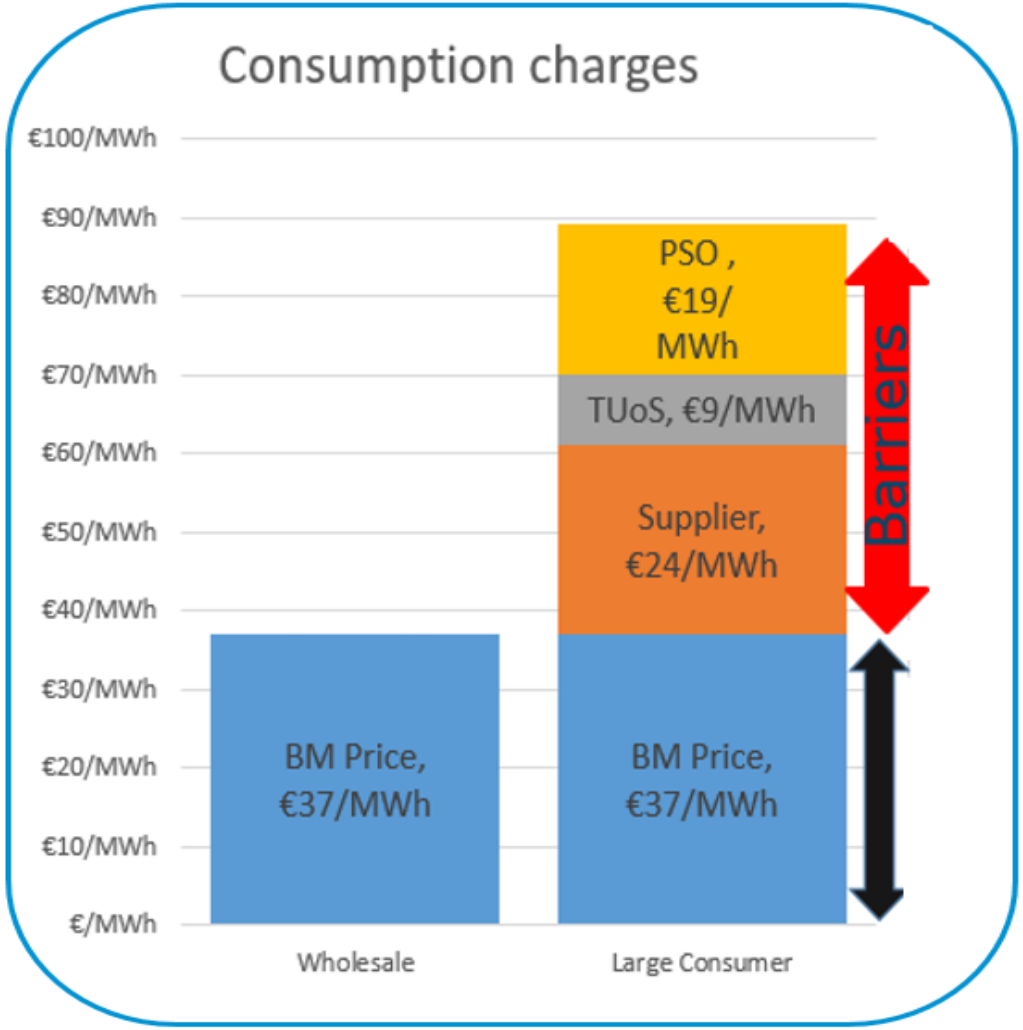
Software resilience

No unintended consequences

WHAT ARE THE BARRIERS?

1. **Regulatory Barriers (consumption charges increases)**

   - Supplier charges (€24/MWh)
   - TUoS Charges (€9/MWh) (Transmission and Use of Service)
   - PSO Levy (€4 to €19/MWh) Fixed cost €33,360/MW on Maximum Import Capacity



Modification Proposal Justification

- Stepping up to the battle against climate change
  - Reduced reliance on fossil fuels,
  - Utilise synergies between constant need for heat and variable electricity generation
- Reduce dispatch down of renewable power generation
- Provide system services to the TSO
- Reduce customer bills
  - Reduce Dispatch Balancing Costs (imperfection charge)
  - Reduce the investment needed to achieve 70% RES-E by 2030.
  - More uptime from existing RES.
  - Reduce cost of PSO, investors can assume a higher capacity factor.
  - Reduce need for transmission grid investment
- Sustainable indigenous decarbonisation of heat. Use Irish RES-E to decarbonise Irish Industry
- Secure job,
  - Secure existing jobs
  - Jobs remain on the Island of Ireland, avoid carbon leakage to China
  - Give competitive advantage to Irish industry
- Improve the profile of wind turbines within their community. Secure jobs.
- Future proof the market for Green Hydrogen

Implication of not implementing the Modification Proposal

- Not economic to build. Utalisation falls from 30% to 3%.
- Continue to burn fossil fuels for another 20 years until Hydrogen comes available
- More dispatch down
- More interconnection will be required, huge grid infrastructure
- More wind turbines will need to be built to achieve 2030 targets and compensate for [up to 43%] dispatch down
- Consumer prices will increase.
  - Increased imperfection charge,
  - Increased Use of Service charge,
  - Increased PSO charge.
- The carbon intensity of the electricity system will be higher unnecessarily
- Carbon intensity of industrial heat will be higher than is necessary
- Jobs will be lost, carbon leakage to [China]
- RES-E targets for 2030 will be harder to achieve
- Negative prices will be more prevalent in the SEM
- When hydrogen does come available this modification will have to be delivered to facilitate it anyway.

RUSAL

THANK YOU

Day in the Life of a DDGU

Day in the life of DDGU

Market & TSO Time line:

11am	Enter DAM. Available 0MW to -150MW. Bid to Buy € 5/MWh. No Offer to Sell.
12noon	Receive DAM results. Market Scheduled to -150MW from 3am to 6am. Submit Physical notification to TSO
5pm	Enter IDA1. Bid to buy €5/MWh. Offer to Sell €10/MWh. Market schedule changed to -150MW from 2am to 5am.
1am	TSO accept DEC Bid and dispatch to -150MW one hour early.
1am	DDGU follows the dispatch instruction
2:12am	Frequency event. DDGU complies with POR & SOR contract. Switch from -150MW to 0MW for 25 seconds. Return to -150MW
5am	DDGU have no dispatch instruction and moves to 0MW
8am	Enter IDA2. No change
2pm	Enter IDA3. No change
All day	Enter Continuous Market. Buy €5/MWh. Sell €10/MWh. No change

Cash Time line:

Day +1	ECC cash settlement DAM 3hr * 150MW * €5/MWh = €2,250 payment
Day +2	ECC cash settlement IDA1 1hr * -150MW * €10/MWh = € 1,500 revenue IDA1 1hr * 150MW * €5/MWh = € 750 payment Net position €750 revenue
Day 10	SEMO cash settlement 1hr accepted DEC 150MW*1hr*€5/MWh = €750 payment
Month +1	SEMO Capacity settlement €0 no capacity contract
Month +2	Eirgrid System Service 1 Day * (POR + SOR) * 150MW * scaling factor = Revenue

Collateral consideration:
Additional collateral required in ECC
Additional Collateral required with SEMO