MECH433 Energy and the Environment Assessment Part 2 - Population 5m

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Location Info:

Offshore windmills – *Louth, Bray, Kish Banks, Wicklow, Meath Connemara, Arklow Bank, Codling, Oriel, Dublin array, Skred Rocks, Ilen, Wexford are some of the locations suitable for the project.*

On shore windmills- Suitable spots for wind farms. *Galway Wind Park*,*Tournafulla, Dunneill, Athea, Bindoo, Coomacheo, Curragh, Coomatallin, Corneen, Culliagh, Dromada, Richfield, Rathcahill, Mullananalt, Meentycat, Leanamore, Knockastanna, Kingsmountain, Gartnaneane .*
Natural gas with CCS (NGCC)- *Use of existing natural gas plants Aghada, Dublin Bay, Great Island CCGT, Huntstown, Huntstown, Marina CC , North Wall, Poolbeg, Sealrock, Sealrock, Tynagh, Whitegate power station*
empty *Kinsale Head gas field* which is a suitable spot to store Carbon.[3]
Hydroelectricity – locations *Ardnacrusha, Erne - Cathleen's Falls, Liffey – Pollaphuca, Erne – Cliff, Lee – Inniscara, Lee – Carrigadrohid*. Anarget, Ashgrove, Ballisodare, Belmont, Bennetsbridge, Boyle, Castlegrace, Celbridge, Clady, Collooney, Cottoners, Edergole, Glenlough, Golden Falls, Holy Cross, Inch Mills, Leixlip, Milford, Owenbeg. [1]
Tidal Barrage- Sites where Tidal energy can be implemented are *Galway Bay, Mayo Cost, Dublin Bay, Cork Harbor*[5] and some spots in *St. George's Channel, North Channel*. This **includes most cost line stretched from *Seven fatom banks* to *KIlkurt bank and the area between*** *Church Bay* to *Donegal Bay*
Nuclear- Nuclear plant should be near the cost or a large water body like a reservoir. The spot suitable are selected to be close to city of Dublin near the cost or large bodies of water some suggested places are banks of Lough derg, County clare, Dublin cost etc.
Geothermal DH – Project spot suitable is in the *South of Dublin* as there is very low heat under the main city so networks could be built for heat transfer.
Battery small – The charging stations are built in the city of *Dublin*.
Battery large – Situated closer to generation units like wind farms tidal generators or nuclear plants.
Pumped storage- The upgrading existing locations such *as Nendrum Monastery, Ardnacrusha , Turlough Hill , Silvermines and building deep sea or offshore pumped storages.*

Assumptions Made

Total energy requirement-

Total number of households=3125000: 2000000(singles), 750000(couples), 375000(family)

Singles are not grouped to get max possible requirement.

Used given conditions except for cooking

- Cooking equipment changes

  Oven-Bosch Serie 8 HBS573BS0B=2hrs:3000w used by 3125000 house holds

  Toaster- BOSCH TAT7203GB =15min: 11000w used by 5000000 people

  Induction cooktop-BOSCH Serie 8 PKE611D17E = 2hrs:7600w.

Wind energy- Energy calculated is for an average wind speeds of 7m/s on land and 8.5m/s [4] this wind speed is subjected to reduce and increase over the day and data used to represent that is the general wind speed data but as the value is not same at different altitudes so only the rate of change over the day is considered.

NGCC – losses other than CCS capture are 2.9MWh, Energy needed for CCS to capture 1tonn of CO_2=4MW.

Hydro – It is assumed that it is possible to increase Head, no. of turbines and flow in existing hydro electricity plants to meet the demand

Tidal- Average speeds are taken into consideration which is 2m/s, and max range 4.

Geothermal- Comparing values from a similar project made in Ile-de-France region and scaling up by increasing the piping length, selecting multiple drill locations, and increasing the depth of holes. It is also considered that the geothermal energy produce can satisfy 65% of total energy needs for domestic, public, and industrial heating. [9]

Not more than 10% of energy is lost in the generation process and the grid.

Storage capacity is determining the excess amount of energy that needs to be stored from sources like Wind, Tidal and Hydro as they cannot always be generated on demand like Nuclear and NGCC.

Possible excess amount that can be generated = 5

Max time without enough wind or tides = 7hrs

Storage capacity used = 200GWh

Excess energy produced by nuclear reactor is directed to recharge storage and used when there is a peak or drop in renewable energy generation.

Excess energy from wind farms when the wind is higher than normal speed is stored in storage.

There is no refueling of nuclear reactors in this span

Energy Mix (add columns where needed)

Generation	Energy1	Energy2	Energy 3	Energy4	Energy 4	Energy5	Energy6	Energy7
Type	Wind	Wind offshore	Tidal Barrage	Nuclear large	Nuclear small	Geothermal	Hydro	NGCC
Total Output Capacity	$5.4*10^3$ MW	$4.9*10^3$ MW	$4.2*10^3$ MW	$3.9*10^3$ MW	$3*10^3$ MW	$1.65*10^3$ MW	$1.9*10^3$ MW	$4.39*10^3$ MW
% of Total Output Capacity	20%	18%	15%	12%	10%	5%	6%	14%
Normal Output Rate	$5*10^3$ MW	$4.5*10^3$ MW	$3.75*10^3$ MW	$3.27*10^3$ MW	$2.74 *10^3$ MW	$1.25*10^3$ MW	$1.5*10^3$ MW	$3.5*10^3$ MW
Standard cost (MWh^{-1})	63	75	90	92.5	92.5	140	80	125
Weighted cost (MWh^{-1})	12.6	13.5	13.5	11.1	9.25	7	4.8	17.5

Average Cost per MWh: £89.25

The mix currently consists of 20% On shore wind, 18% Off shore wind, 15% Tidal barrage, 12% Large Nuclear, 10% Small Nuclear, 5% District and industrial geothermal heating, 6% Hydroelectricity and 14%NGCC . In the mix wind and tidal are Intermittent sources hence during summer they might have a drop in production. Hence NGCC and Nuclear could be used to compensate for drastic drop in energy in the grid. The total possible output from all the production methods is higher than required to also compensate for energy loses in grid and storage.

Specific Information Required for Different Technologies

Offshore Wind Energy- For offshore windmills **Haliade-X** is considered.

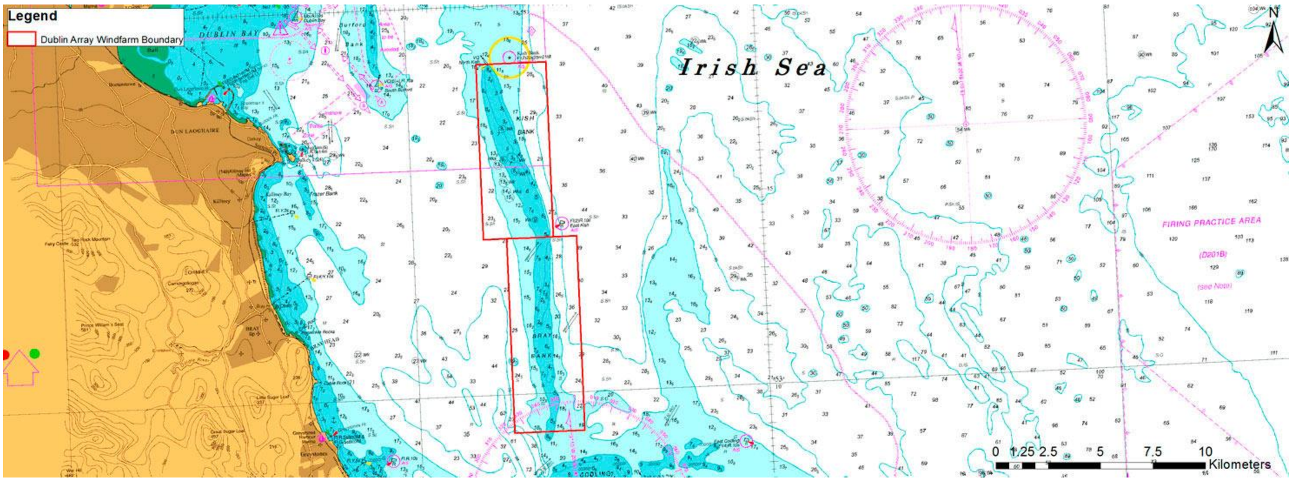
Height of 240m and diameter of 220m [8].

Speed=8-10.4m/s. [4]

No. windmills = 876

Power Efficiency = 7.8 MW

Location is Suitable due to naturally formed shallow sandbanks that can hold up to 60 windmills.



On Shore Wind Energy- For on shore windmills **EnVentus** by Vestas is considered

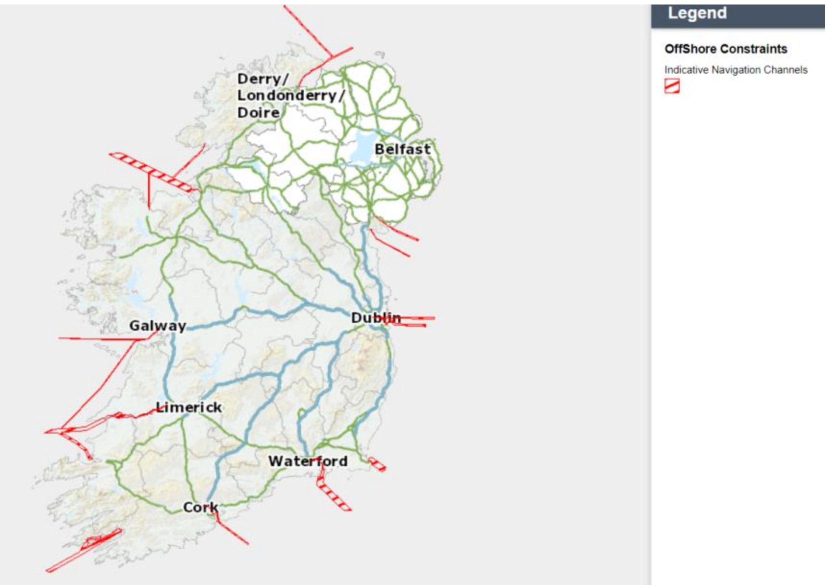
Height of 166m and Diameter of 165m [7].

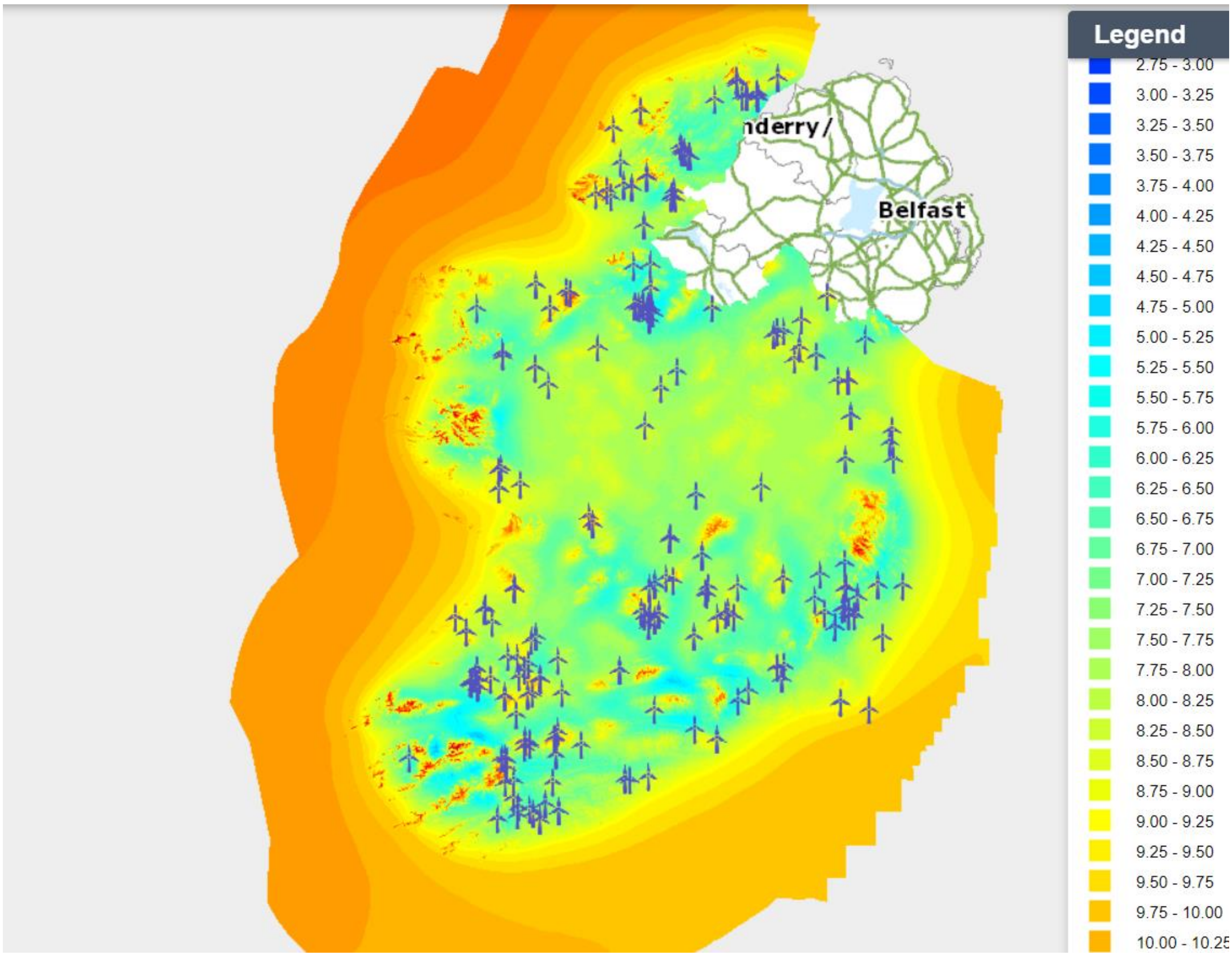
No. of windmills = 3100

Speed ranges from 7- 9.5m/s. [4]

Power Efficiency = 3.1 MW

All w0indmills are to be distributed among the locations mentioned above since they are currently functional and receive good winds.





NGCC-

In this existing Gas plants are equipped to capture co2 using CCS technology.

The number of Gas plants used = 17

With the total energy generated = 4.52GW

Energy produces after CCS= 4.39 GW

Total amount of carbon captured per year = 1894 ton

Examples below suggest CCS with potential to capture 1894-ton CO2 is possible.

Based on an old data on possible locations for Storage the carbon captured can be distributed among gas fields in Kinsale, east Irish sea, Sherwood sandstone structures in central Irish sea and the Enler Group selected structures. All of these fall within effective and practical range of storage so. it is possible to store pumping it down to the gap that is able to hold the pressure of CO2.

ASSESSMENT OF THE ALL-ISLAND POTENTIAL FOR GEOLOGICAL STORAGE OF CO_2 IN IRELAND QUANTIFIED GEOLOGICAL STORAGE CAPACITY (July 2008)				
Basin	**Structure Type**	**Capacity Classification**	**Storage Capacity Mt**	**Quantified Storage Capacity Mt**
Kinsale	Gas Field	**Effective/ Practical**	**330**	**1505**
South West Kinsale	Gas Field		**5**	
Spanish Point	Gas Field		**120**	
East Irish Sea	Oil & Gas Field		**1050**	
Portpatrick Basin	Sherwood Sandstone selected structures	**Effective** *(subset of theoretical capacity)*	**37**	**(667)**
Central Irish Sea	Sherwood Sandstone structures		**630**	
			667	
Lough Neagh Basin	Enler Group selected structures	**Effective** *(additional to theoretical capacity)*	**1940**	**2840**
Kish Bank Basin	Sherwood sandstone structures		**270**	
East Irish Sea Basin	Ormskirk structures		**630**	
			2840	
Celtic Sea -	1 structure in the Cretaceous A sand	**Theoretical**	**40**	**88770**
Portpatrick Basin/ Larne	whole basin		**2700**	
Peel Basin	Sherwood Sandstone whole basin		**68000**	
NWICB Dowra Basin	whole basin		**730**	
Central Irish Sea	whole basin		**17300**	
Kish Bank Basin	Carboniferous sandstone and coal	**Theoretical / un-quantified**		
Rathlin Basin	Sherwood Sandstone, Permian and Carboniferous			
Celtic Sea	Cretaceous A sand			
Porcupine Basin				
Slyne/Erris Basins				
Clare Basin				
Rockall Trough				
Gas prospects				
Other onshore basins				
TOTAL (PRACTICAL/ EFFECTIVE/ THEORETICAL)			**Mt**	**93,115**

The process of carbon capture is done by either Post combustion capture or oxyfuel Combustion.

The captured CO_2 is transported via trucks, ships or by large pipeline to site of capture or for small scale application.

Example for similar technology:

ExxonMobil's Shute Creek gas processing plant started CCS activities in 1986. It takes natural gas that contains a high proportion of carbon dioxide, which is separated for use in enhanced oil recovery. Capture capacity is a chunky 7 million tonnes a year[37].

The Sleipner facility in the North sea is frequently mentioned as an example of an active CCS project, as it has been operating since 1996. It has a capture capacity of 0.9 million tonnes per year and uses a saline aquifer for storage. The scheme removes carbon dioxide from natural gas and is driven by Norway's tax on CO_2. It has injected about 15 million tonnes in total since it started operation [37].

This is an offshore oil and gas field off the southern coast of Brazil. Since 2013, around 0.7 million tonnes per year of carbon dioxide stripped from the gas is being pumped back into the production reservoir to enhance oil recovery [37].

the New $96 million CCS project for Natural Gas and industries announced on 10th Feb 2022

https://www.energy.gov/fecm/articles/us-department-energy-announces-96-million-advance-carbon-capture-technologies-natural.

Hydroelectric-

Locations are existing power generating hydro plants in Ireland. They are modified by increasing height, flow rate and no. of turbines to increase the annual output. (Calculation in excel)

No. of locations used = are 5 large and 20 small hydro plants.

The head is increased by increasing the height of the fall by increasing the reservoir height.

The flow rate is increased by increasing the capacity of the Dam. Which is done by excavating the area.
The calculation to increased flow rate and generator capacity following formulas are used.

$$P = \eta * \rho * g * h * Q$$

P is the power output Watts

η is the efficiency of the turbine 0.4

ρ is the density of water, taken as 998 kg/m^3

g is the acceleration of gravity, equal to 9.81 m/s^2

h is the head, or the usable fall height.

Q is the discharge

$Q = A * v$

A is the cross-sectional area of the channel

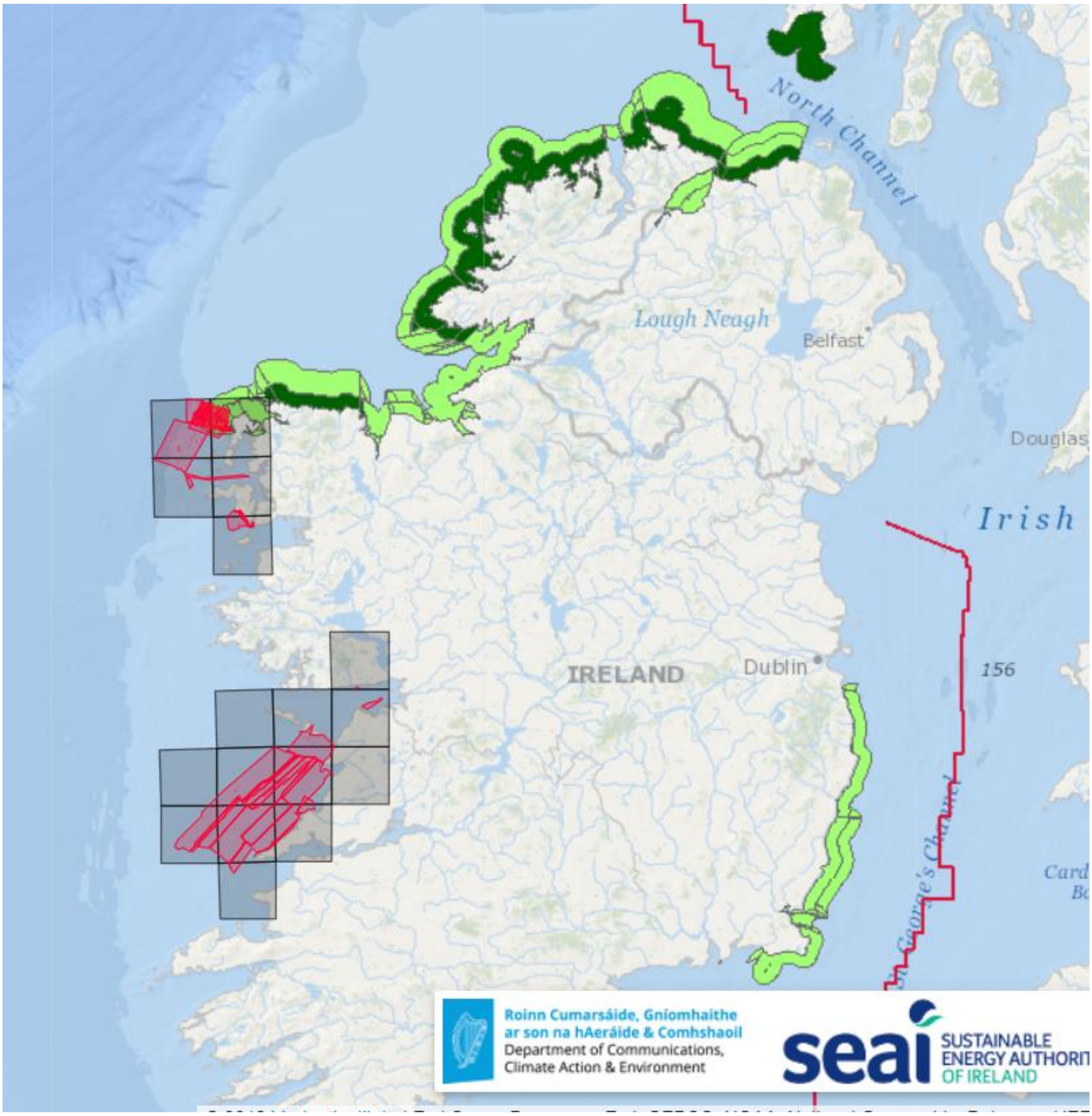
v is the flow velocity

Annual operation time is = old annual capacity GWhr/old production capacity MV

The improved capacity is determined only for time the older generators were used. Hence there is possibility to produce more than projected amount.

Tidal
For the provided location:
Min wave heigh=2m
Max wave heigh =4m
Area of the cost used for building tidal barrages= 7000Km^2
No. of turbine= 370

Total energy generated per day = 4.2GWh



Nuclear Large

Reactor type= Advanced PWR
Manufacturer= Westinghouse
Power output =1.3GW
No. of reactors = 3
Total energy output by nuclear = 3.9 GW

Nuclear Small

Reactor type= Gas Cooled Reactor (GCR)
Manufacturer= EDF Energy
Power output =0.605GW
No. of reactors = 5

Total energy output by nuclear = 3GW

In case where the reactor stops to meet the demand for a short duration stored energy is used along with NGCC at full potential.

Geothermal District Heating-
It is used to generate heat that could help reduce the dependency on electricity for heating. The heating capacity is determined from similar projects.

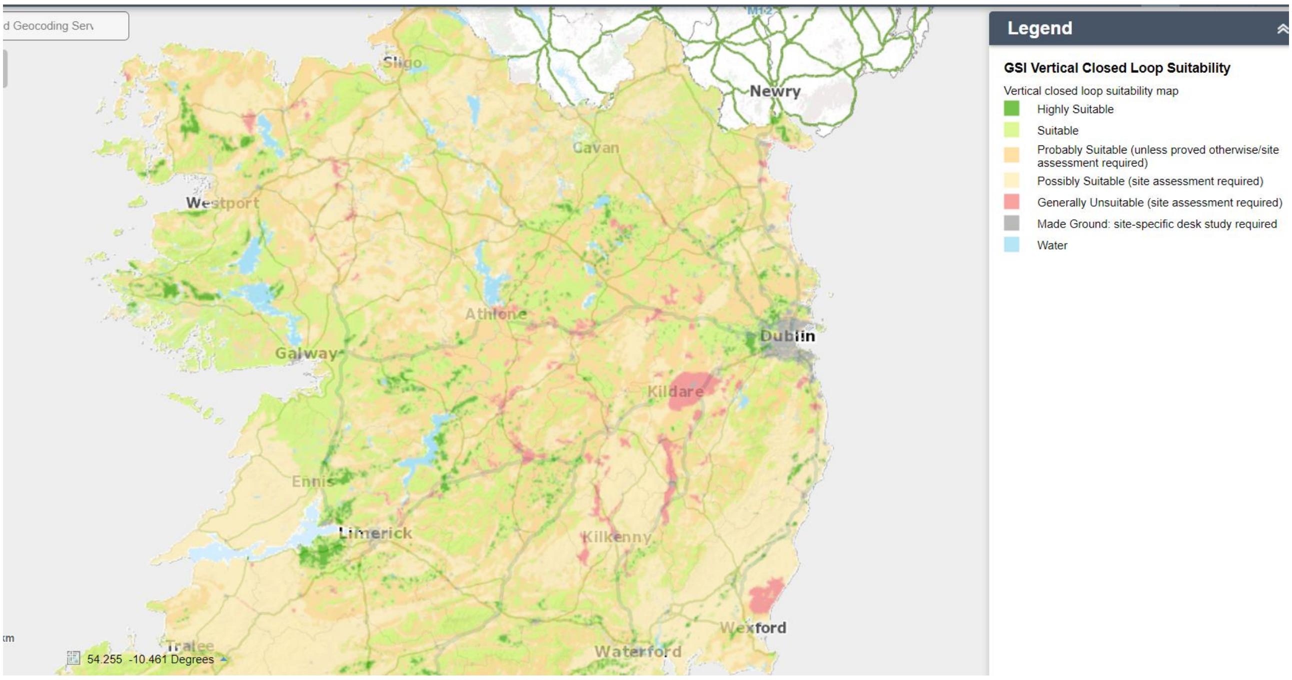
The project it is compared to is geothermal system installed in Orly Airport in the Ile-de-France. This was able to generate around 135MW heat though a 35 km spread pipeline.

Scaling up this project would mean increase the are of pipe distributed along with increase in no. drills.

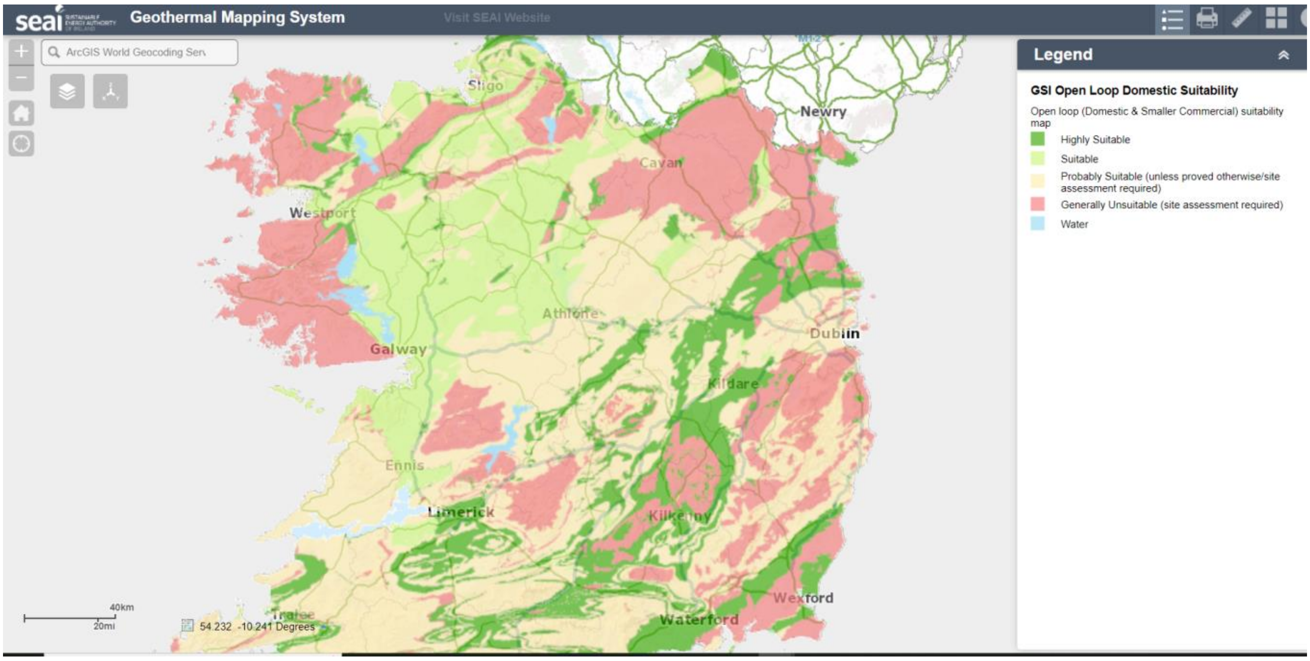
Liquid used for heat transfer= water
Depth of geo hole = 1km-5km
Location = South of Dublin
Similar expected projects in Tallaght Town Centre.

Expected energy = 1.65GW

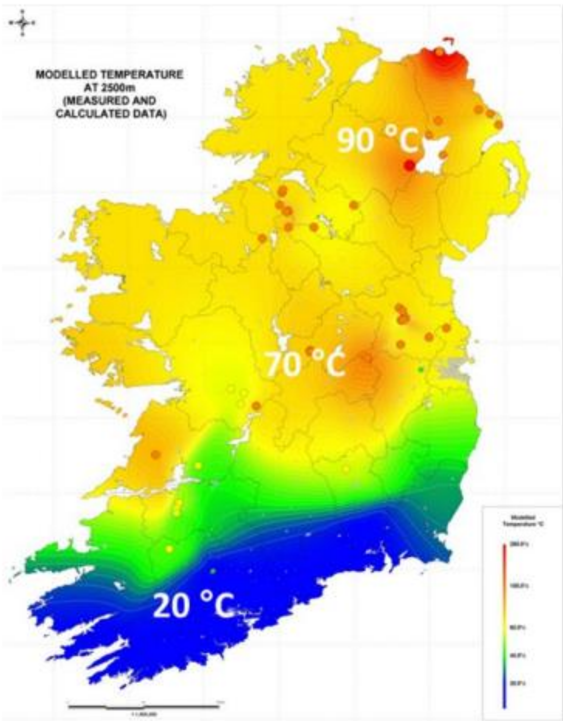
The Power Storage for the Grid is designed with a mixture of battery and Pumped storage. This is done in a ratio of 40% and 60%.

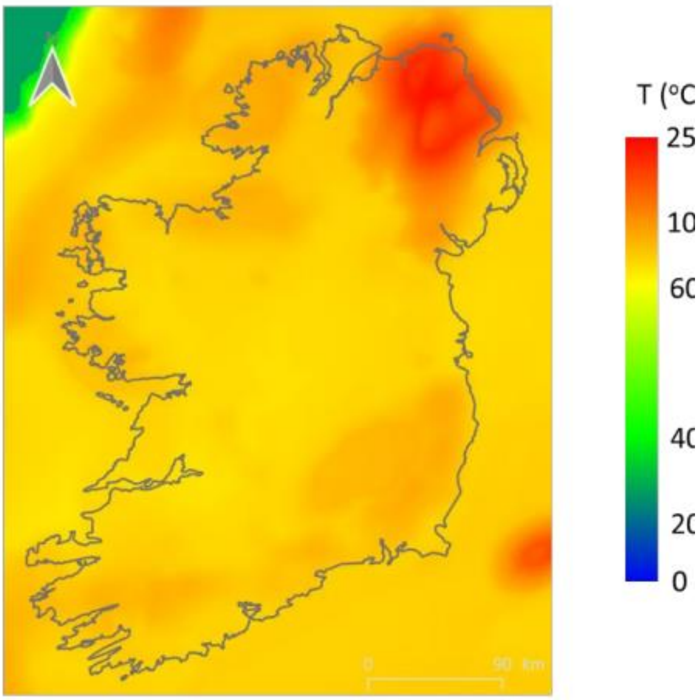


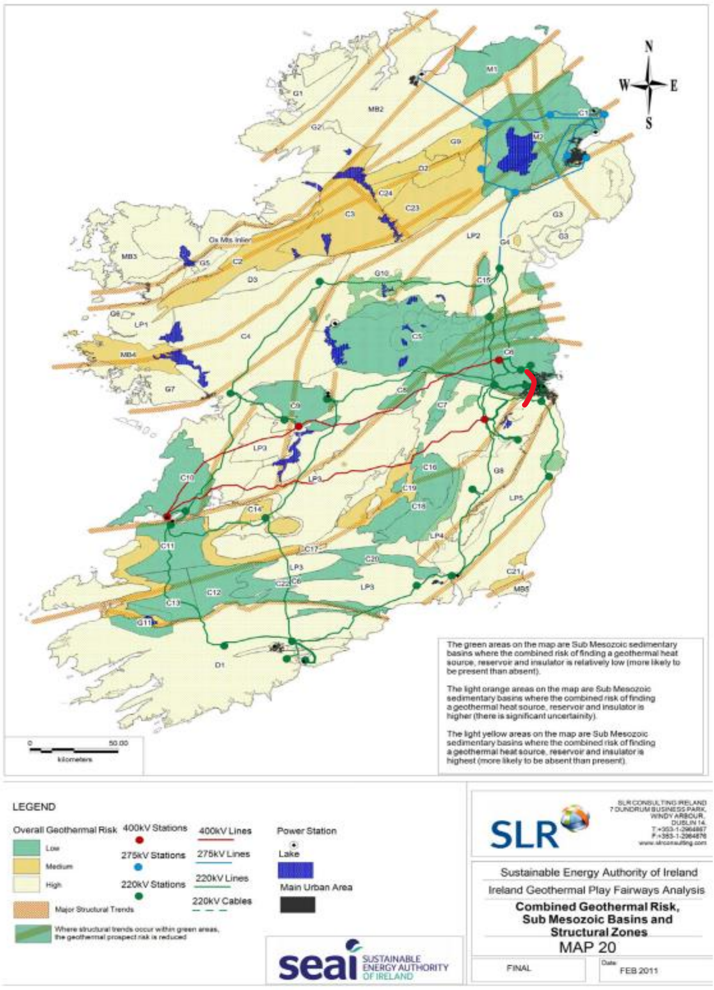
Vertical closed loop suitability



Open loop Domestic Suitability







Battery Storage large-

Container type Lithium-Ion battery storage.

Charging capacity 1MW in 2 hours

Storage density: 5 MWh per container.[23]

No. of containers needed = 8000 units.

The 8000 units can be dividing among the 5 residential areas and commercial areas.

This would help immediately supply any sudden demand in a localized area, hence reducing the sudden load.

Battery Storage large-

Container type Lithium-Ion battery storage.

Charging capacity 1MW in 2 hours

Storage density: 50 MWh per container.[23]

No. of containers needed = 1600 units.

Can be made into multiple large storage grids that can be placed closer to energy generators such as windmills and tidal barrage.

Battery storage also has the added advantage of increasing the unit size if needed.

Pumped Hydro –

Location is an existing structure Turlough hill

Storage density: 24.2GWh

Production capacity:120MWh

Mean Flow of pumping – 22.1m^3/sec.

Time for operation 70 sec.

Expected production rate – 120GWh

The storage could be spread into multiple plants with having an min 6GWh capacity.

Added advantage of excess of storage capacity in case overall demand increase without many modifications.[33]

Storage

Storage	Storage 1	Storage 2	Storage 3
Type	Battery storage large	Pumped Hydro	Battery storage small
Energy Capacity	60GWh	120GWh	20GWh
Output / Discharge Rate	12GWh	15GWh	5GWh
Lifetime	5hrs	8hrs	4hrs
% of Total	30%	60%	10%
Standard cost (MWh^{-1})	100	148	100
Weighted cost (MWh^{-1})	30	88.8	10

Average Cost per MWh : £128

The Power Storage for the Grid is designed with a mixture of battery and Pumped storage. This is done in a ratio of 30 % ,10 % and 60%. This is done to reduce the overall cost for energy storage and provide localized storage solutions for grids.

Reasons for Choosing Energy Generation Types

Onshore Wind –

- Existing infrastructure and commercial successful.
- Largest net zero contribution in Irelands current infrastructure.
- Largest contributor in current energy mix for Ireland.

Offshore Wind-

- Better performance than on shore windmills
- Higher wind speeds off the shore.
- Large amount of Shore area for the windmills to be constructed.

NGCC-

- Ireland can meet 60% of its demand using domestic Natural gas supply.
- Able to satisfy high demand when needed making it a good backup.
- Natural gas is more eco-friendly than other fossil fuels.
- Natural gas with CCS can reduce the carbon emission up to 90%.

Hydro-electricity-

- One of the most consistent sources of energy.
- Can be stopped when needed and be used according to the demand.

Nuclear-

- Most advanced forms of energy.
- Can instantly provide with large surge of energy when required.
- Could easily adapt to growing population.
- Ample amount of water bodies for nuclear plant.

Tidal-

- Is cyclic in nature.
- Dependent on lunar cycle.
- More area to implement.
- Well researched technology and potential in Ireland.

Geothermal –

- Capable to satisfy more than 40% of heating requirements.

- Can be incorporated into existing industries and infrastructures.
- Help in reducing the demand of electricity for heating application

Response to Failure Scenario 1

As shown in the image the amount of energy generated in every day of December has an excess amount of energy of about 77GWh at the end of the day. Which is distributed among the storge

Secnario 1 December							
	energy in storage when production is not able to meet demand						
			0				
6	15.7492488	6.25075122	6.2		102.122768	highest energy stored	
7	31.4609155	-9.4609155			92.6618527		
8	17.6642488	4.33575122	4.3				
9	17.7542488	4.24575122	4.2				
10	25.9454988	-3.9454988				97.216354	
11	27.3942488	-5.3942488				91.8221052	
12	36.5609155	-14.560915				77.2611897	
1am	36.5609155	-14.560915				62.7002743	
2am	13.0192488	8.98075122	8.9				
3am	13.0192488	8.98075122	8.9				
4am	13.0192488	8.98075122	8.9				
5am	13.5142488	8.48575122	8.4				
6am	20.4567488	1.54325122	1.5				
7am	24.2954988	-2.2954988	36.6	34.3045012			
8am	13.0192488	8.98075122	8.9				
9am	9.83502212	12.1649779	12.2				
10am	8.96668878	13.0333112	13				
11am	8.87668878	13.1233112	13				
12am	8.38168878	13.6183112	13				
1	28.5033555	-6.5033555	60.1	53.5966445			
2	34.9183555	-12.918355		87.9011458	74.9827903		
3	8.38168878	13.6183112	13				
4	10.1166888	11.8833112	11.8				
5	25.8600221	-3.8600221	24.8	20.9399779			
	463.273931						

systems with Pumped hydrogen having the most percentage as it is capable of quick recharge and discharge. The source of charging the storage will be from the excess energy that nuclear produces which is not accounted for in the energy mix and also from the energy generated by wind and tidal when they work at their max potential.

Scenario 1 energy requirement up by 40 and no wind or tidal availiable				
6	22.0489483	-7.1989483	94.8010517	
7	44.0452816	-29.195282	65.6057701	
8	24.7299483	-9.8799483	55.7258218	
9	24.8559483	-10.005948	45.7198735	
10	36.3236983	-21.473698	24.2461752	
11	27.3942488	-12.544249	11.7019264	
12	36.5609155	-21.710915	-10.008989	10.1
1am	36.5609155	-21.710915	-31.719905	31.8
		-133.7199		41.9
need for extra backup = 41.9 GW				

In this table energy after increasing 40% output is taken along with the peak hour requirement.

Energy stored in system before the event starting at 6 pm is 102GW.

As the event starts in the absence of wind and tidal the energy demand gradually increases.

To meet the demand the nuclear and NGCC plants must run at full potential generating about 14.85 GW. Which by it self is not enough to meet the demand so for these scenarios energy from storage is to be used.

As shown in image above the first 6 hours are easily managed by the energy stored in the storage from last 24 hrs. To meet the demand in the peak time additional energy is needed which can be met by using energy from unused storage.

The excess amount of energy stored for this scenario is 42GW.

Total storage capacity =200GW

Storage used for Daily use to meet peak demand = 105GW

And since an additional energy of 77GW is produced at end of every days in December it is very easy to meet the demand.

Response to Failure Scenario 2

Scenario 2 JULY				
5	24.71002 21			
6	9.961688 78			min. backup needed for July scenario 148.0601 58
7	25.67335 55			
8	11.87668 88			
9	11.96668 88			
10	21.30793 88	105.4963 83		
11	23.90668 88	- 8.906688 8		
12	33.07335 55	- 18.07335 5		
1am	31.92335 55	- 16.92335 5	26.09002 21	
2am	8.381688 78	6.618311 22	6.6	
3am	8.381688 78	6.618311 22	6.6	
4am	13.01924 88	1.980751 22	1.9	
5am	8.876688 78	6.123311 22	6.1	

6am	15.8191888	-0.8191888	21.2	20.3808112	
7am	19.6579388	-4.6579388		15.7228724	
8am	8.38168878	6.61831122	6.6		
9am	9.83502212	5.16497788	5.1		
10am	8.96668878	6.03331122	6		
11am	8.87668878	6.12331122	6.1		
12am	8.38168878	6.61831122	6.6		
1	28.5033555	-13.5033555	30.4	32.619517	
2	11.3766888	3.62331122	3.6		
3	31.9233555	-16.9233555		19.2961615	
4	8.96668878	6.03331122	6		
5	24.7100221	-9.7100221		15.5861394	
6	9.96168878	5.03831122	5		
7	25.6733555	-10.6733555		9.91278396	
8	11.8766888	3.12331122	3.1		
9	11.9666888	3.03331122	3		
10	21.3079388	-6.3079388		9.70484518	
11	23.9066888	-1.9066888		7.79815639	
12	33.0733555	-11.0733555		-3.2751991	3.27519906

1am	31.9233555	-9.9233555		-13.198555	13.1985545	
2am	8.38168878	13.6183112	13.6			
3am	8.38168878	13.6183112	13.6			
4am	13.0192488	8.98075122	8.9			
5am	8.87668878	13.1233112	13.23			13
6am	15.8191888	6.18081122	6.18			
7am	19.6579388	2.34206122	2.34			
8am	8.38168878	13.6183112	13.6			
9am	9.83502212	12.1649779	12			
10am	8.96668878	13.0333112	13			
11am	8.87668878	13.1233112	13			
12am	8.38168878	13.6183112	13.6			
1	28.5033555	-6.5033555	123.05	116.546645		
2	11.3766888	10.6233112	10			
3	31.9233555	-9.9233555		116.623289		
4	8.96668878	13.0333112	13	129.623289		

As shown in the table area marked in blue is energy directly being used to meet the demand

While the yellow indicates the energy in the storage while being recharged.

So in this scenario it is considered that due to the hacking nuclear plants have stopped working for 24 hrs. including the time of hacking.

In the first 6 hours the energy demand is met by using the energy in the storage system which is 105.5 GW

After the power systems turn on they wont be able to meet the demand because there is no nuclear and as it is when peak hours start. So more 26.1 GW is drawn from the storage.

Then the system is able to run smoothly for 16 hours before facing 2 more peak that to cannot be met so energy of about 16GW is drawn again from storage.

After this the nuclear is again part of the mix and the system is able to generate around 126GW excess energy in next16 hrs.

After this the system is stable again

The total energy used from storage = 149GW

Available capacity= 200 GW

Residual Energy produced till the event occurs = 126GW

Additional Energy needed apart from residual energy stored= 23GW

So to counter tis scenario without much issue it is necessary to have an minimum reserve of 23GW of unused energy for emergency.

Response to Failure Scenario 3

Scenario 3 Feb

Table1

6	13.889611	8.11038902	8.1		
7	33.5291943	-11.529194			38.8637905
8	17.48915	4.51085002	4.5		
9	22.424806	-0.424806			42.9389845
10	32.6638685	-10.663868			32.275116
11	34.474806	-12.474806			19.80031
12	45.9331393	-23.933139			-4.1328293
1am	45.9331393	-23.933139			-28.065969
2am	16.506056	5.49394402	5.49		
3am	16.506056	5.49394402	5.49		
4am	16.506056	5.49394402	5.49		
5am	17.124806	4.87519402	4.8		
6am	25.802931	-3.802931	21.27	17.467069	
7am	30.6013685	-8.6013685		8.86570054	
8am	16.506056	5.49394402	5.4		
9am	12.2937776	9.70622235	9.7		

10am	11.208361	10.791639	10.7		
11am	11.095861	10.904139	10.9		
12am	10.477111	11.522889	11.52		
1	35.6291943	-13.629194	48.22	52.3222068	
2	14.220861	7.77913902	7.7		
3	39.9041943	-17.904194		42.1180125	
4	11.495761	10.504239	10.5		
5	32.3250276	-10.325028		42.2929848	
	564.541193				
Table 2					
When nuclear and NGCC runs on full power					
6	13.889611	12.110389	8.1		
7	33.5291943	-7.5291943			70.8637905
8	17.48915	8.51085002	4.5		
9	22.424806	3.57519402			78.9389845
10	32.6638685	-6.6638685			72.275116
11	34.474806	-8.474806			63.80031
12	45.9331393	-19.933139			43.8671707
1am	45.9331393	-19.933139			23.9340314
2am	16.506056	9.49394402	5.49		
3am	16.506056	9.49394402	5.49		
4am	16.506056	9.49394402	5.49		
5am	17.124806	8.87519402	4.8		
6am	25.802931	0.19706902	21.27	21.467069	
7am	30.6013685	-4.6013685		16.8657005	
8am	16.506056	9.49394402	5.4		
9am	12.2937776	13.7062224	9.7		
10am	11.208361	14.791639	10.7		
11am	11.095861	14.904139	10.9		
12am	10.477111	15.522889	11.52		
1	35.6291943	-9.6291943	48.22	72.3222068	
2	14.220861	11.779139	7.7		
3	39.9041943	-13.904194		66.1180125	
4	11.495761	14.504239	10.5		
5	32.3250276	-6.3250276		70.2929848	

In scenario 3 there is an increase of use by 25% in electrical requirements and 30% in heating requirements.

even though there is a lockdown it is considered that charging for vehicles and services are being used at 25% increase as well as they won't be completely stopped.

Above are 2 tables in table1 where all energy sources are running at minimum usual output while in table2 the Nuclear and NGCC are working at full potential.

In table one when everything is running at regular output the system is able to run smoothly as the excess energy generated in each hour is being used where there is need for excess energy with help of storage.

But as the peak hours arrive the balance is broken and an excess of 32.1 GW of energy is required.

It is easy to meet the demand using storage if it was just for one day

But as there is an possibility for it to happen in 7 consecutive days a better approach is to increase the output of nuclear, thermal, Hydro and NGCC.

This leads to solving of the problem as well as generation of an excess of 28GW.

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