

Paris Aligned Open Energy System Model for Ireland

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Insight



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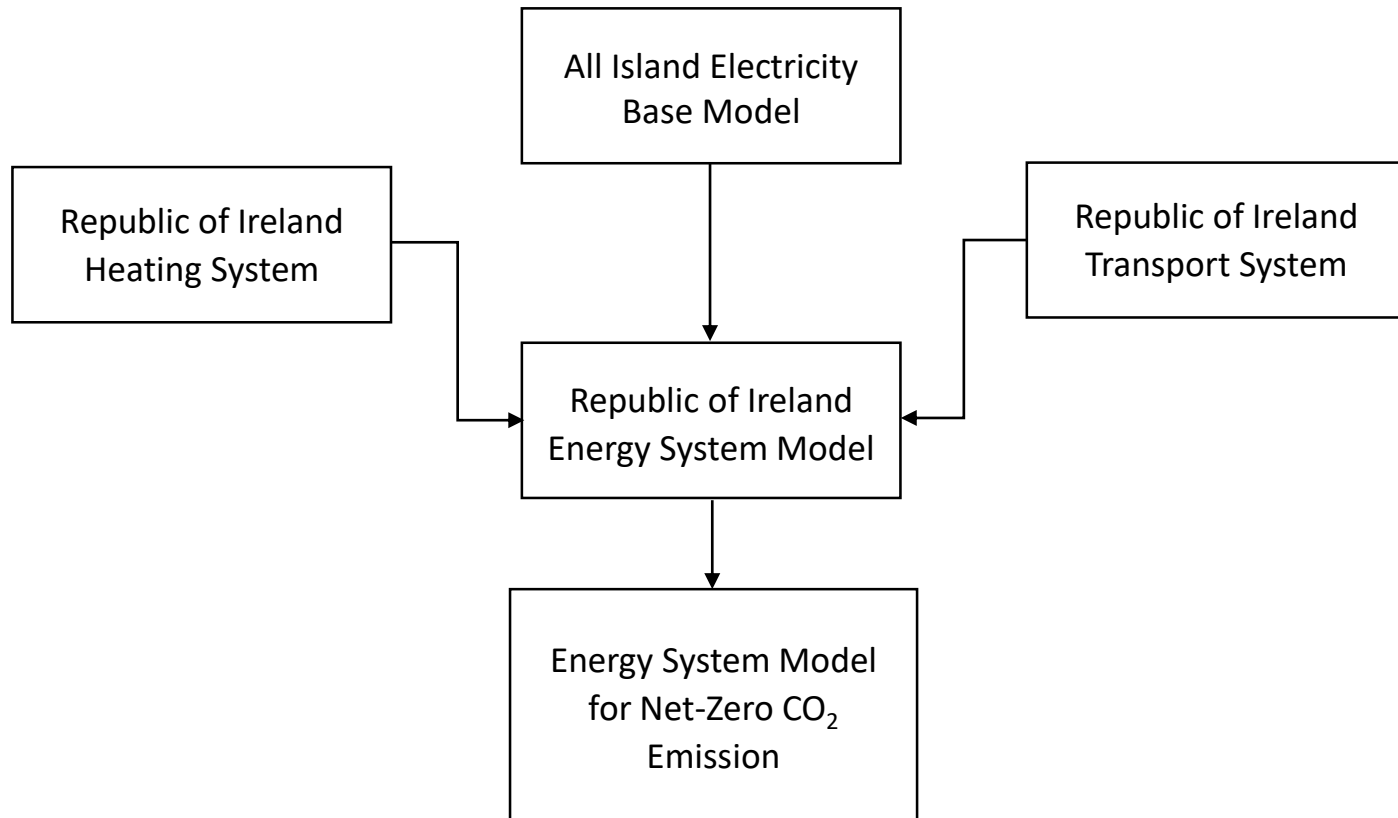
Energy System Modelling Tool Selection

Tool	Platform	Electric	Storage	CO ₂ Emission	Cost	Transport
BALMOREL	GAMS+Solver	√		√		√
Calliope	Python	√	√	√	√	
DESSTinEE	Excel/VBA	√			√	√
DIETER	GAMS +Solverver	√	√		√	
EMLab-Generation	Java & Maven	√		√	√	
EMMA	GAMS/CPLEX	√			√	
EnergyPATHWAYS	Python	√	√	√	√	
ETM2	Online Tool	√		√	√	
GCAM	BOOT, XERCES, JAVA, HECTOR	√		√	√	
oemof	Python + Solver	√	√	√	√	√
OSeMOSYS	GNU MatProg	√	√	√	√	√
PyPSA	Python	√	√	√	√	√
renpass	MySQL, R, RMySQL	√	√		√	
SIREN	Stand alone	√		√	√	
SWITCH	Python	√		√	√	
Temoa	Python + Solver	√			√	
ZERO CARBON UK	Online Tool	√	√	√		√

Energy System Modelling Tool Selection (cont.)

	Solar	Wind	Biofuel	TES/EES	H ₂	CCS (BE/NG)	Conventional Fuels
Total cost for energy transition	PyPSA OSeMOSYS oemof	PyPSA OSeMOSYS oemof	PyPSA OSeMOSYS oemof	PyPSA OSeMOSYS oemof	PyPSA	PyPSA	PyPSA OSeMOSYS oemof
Energy cost per unit	PyPSA OSeMOSYS oemof	PyPSA OSeMOSYS oemof	PyPSA OSeMOSYS oemof	PyPSA OSeMOSYS oemof	PyPSA	PyPSA	PyPSA OSeMOSYS oemof
Cumulative CO ₂ emission			PyPSA OSeMOSYS oemof			PyPSA	PyPSA OSeMOSYS oemof

Modelling Methodology



PyPSA model results are compared with the 2018 datasets from SEAI, CSO and EirGrid

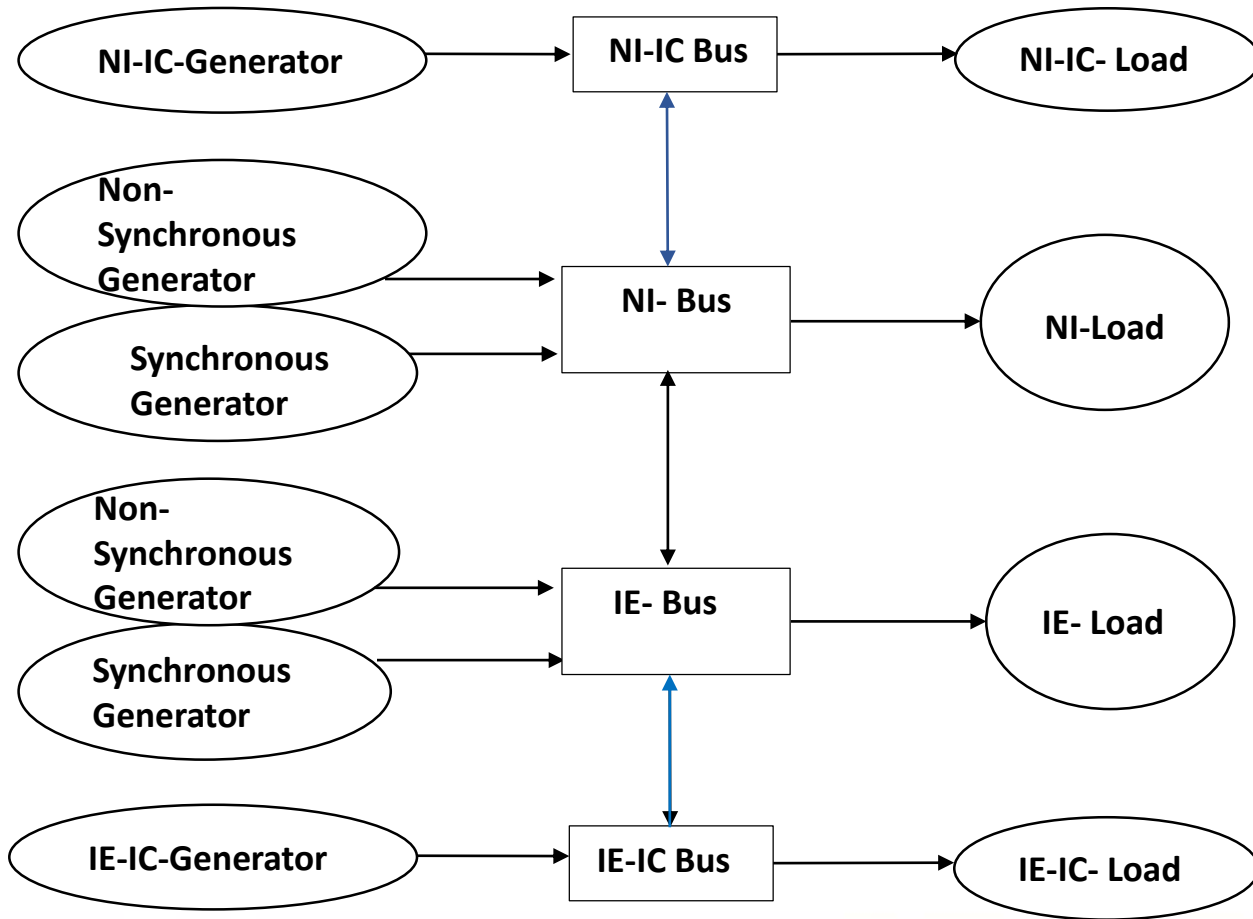
Electricity and heating:

- Obtain TPER and TFC,
- Compare TFC (SEAI) with PyPSA results,
- Estimate TPER from PyPSA,
- Estimate emissions for each fuel type.
- Compare with 2018 EirGrid data sets.

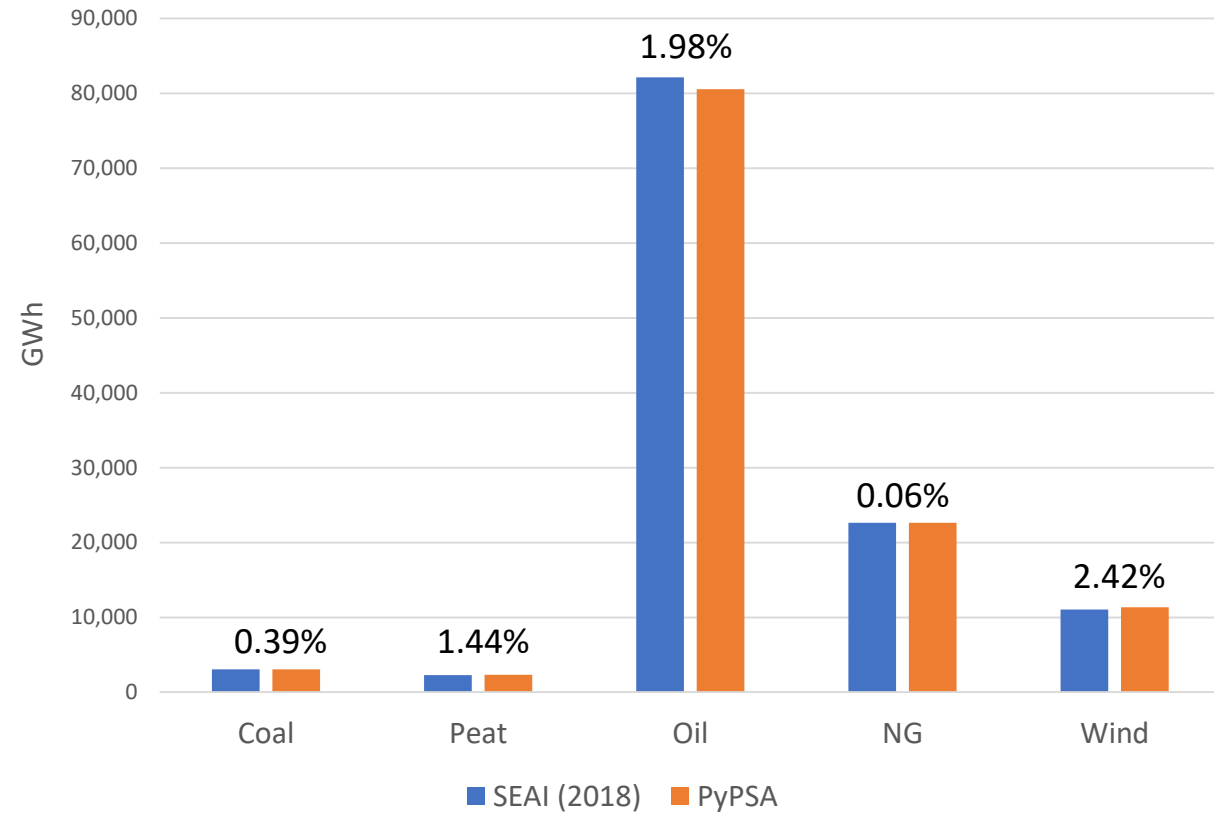
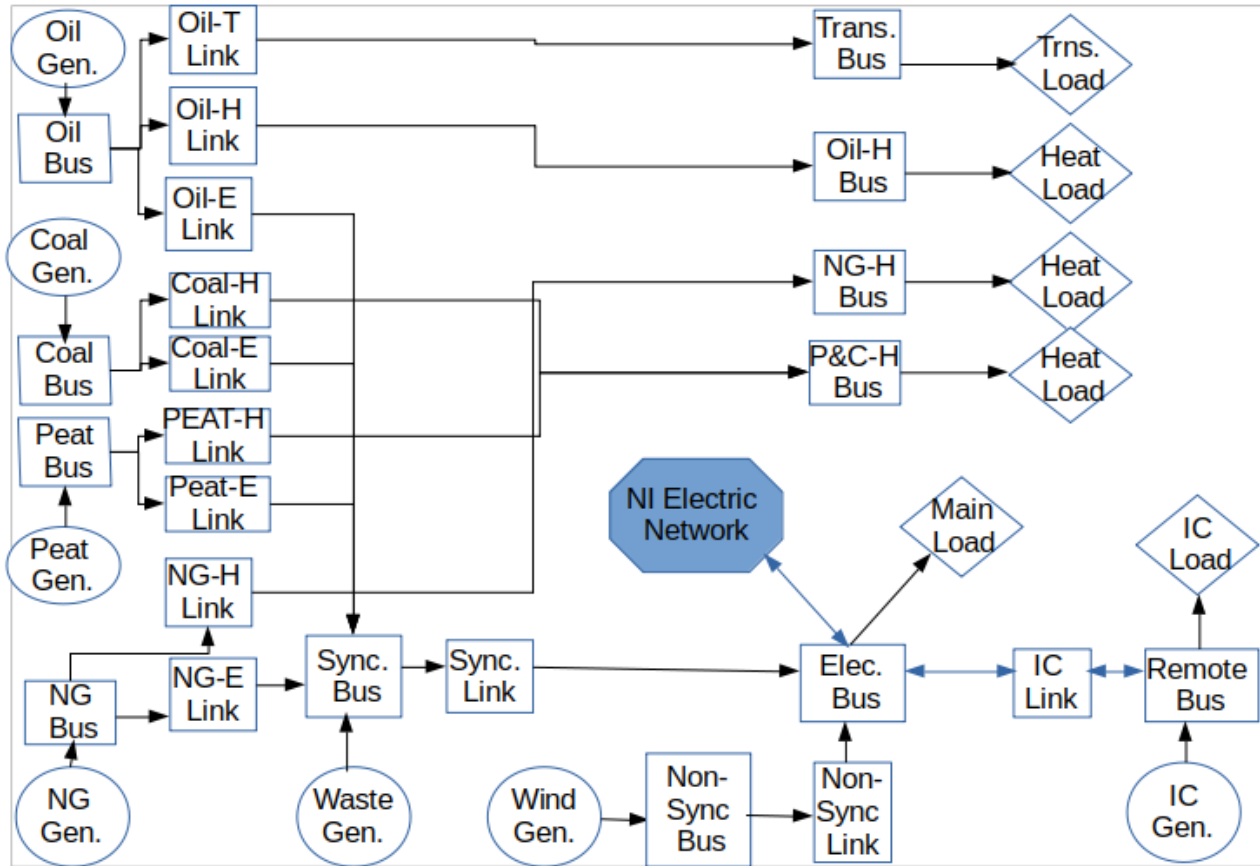
Transport:

- Compare with CSO 2018 datasets.

All Island Electricity Base Model



Irish Energy System Model



A Net-Zero Model

Assumptions

- The model considers a post-2025 scenario, when all peat and coal power plant generates are planned to phase-out,
- Natural gas and biomass power plants are deployed with both CCS and non-CCS,
- Solar energy potential is estimated to be 1.5 GW,
- Onshore and offshore wind potentials are 7.5 GW and 3.5 GW respectively by 2030.

Assumptions (cont.)

Integration of transport system

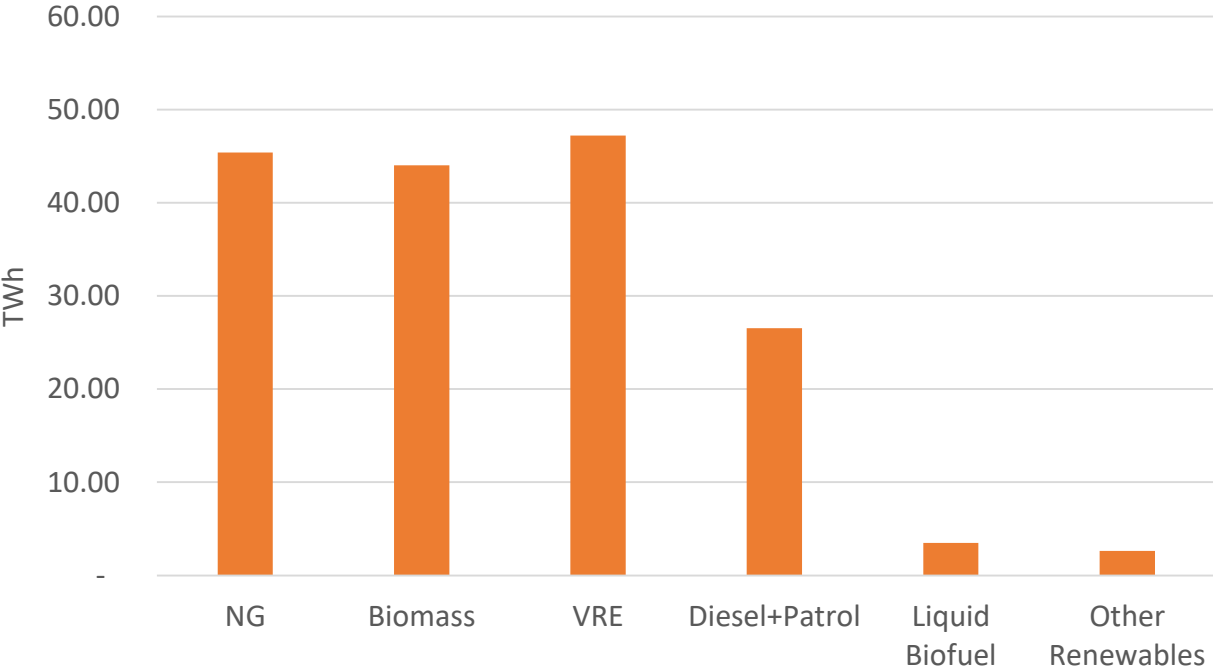
Fuel Consumption (MW) by Transport Sector-2018 (CSO, 2019).

Transport Sectors	Petrol	Jet kerosene	LPG	Diesel	Liquid Biofuel
Road freight	0	0	0	925	40
Road private car	883	0	3	1742	104
Road public passenger services	9	0	0	169	8
Road light goods vehicle	0	0	0	422	19
Rail	0	0	0	50	0
Sum of all aviation	1	1463	0	0	0
Fuel tourism	0	0	0	235	11
Navigation	0	0	0	112	0
Unspecified	198	0	0	453	27

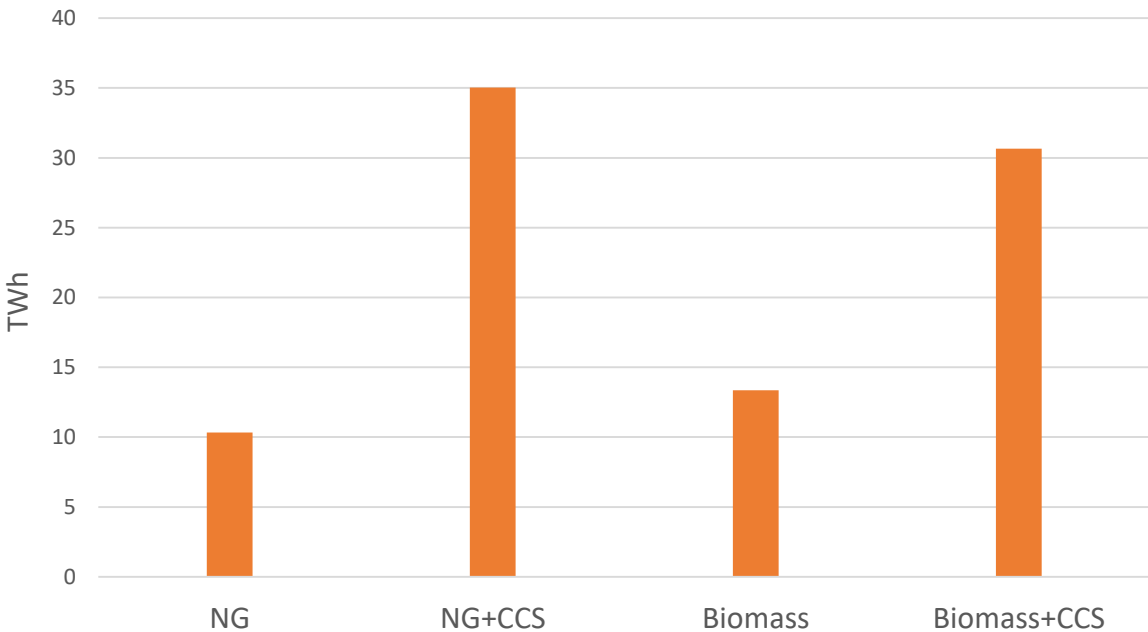
- 47.3 TWh equivalent of fossil fuels consumption in 2018,
- A 28.7% increase in car fleet by 2030, compared to 2015,
- 2.56 M of total car fleet by 2030,
- 936,000 EV projected by 2030,
- Total primary energy requirement were kept to 2018 level,
- Total transport primary energy required by 2030:
 - Conventional: 30 TWh equivalent of fossil fuels,
 - EVs: 17 TWh.

A Net-Zero Model Results

Required annual generation capacity



NG and biomass generation breakdown



Future Works..

	Presented Work	Future Work
1.	Republic of Ireland energy system model that includes electricity, heat and transport sector with fixed energy capacity. The simulation results were validated with historical data sets from SEAI, CSO and EirGrid.	The model will be extended to include capacity expansion of several primary energy carriers. Heterogeneous energy storage will be integrated.
2.	Modelled a net-zero emission energy system scenarios to estimate primary energy requirement by individual energy carriers.	A net-negative energy system scenario will be developed.

Thank you...