RES-E Forecast - Constant Growth Factor Model

Abstract

This paper presents a simple forecast of the renewable electricity generation share (RES-E) in Ireland. Historical growth rates in electricity demand and renewable electricity generation are estimated and extrapolated. The model predicts 48% RES-E in 2030, and 100% in 2051. The model also predicts that fossil fuel generation will peak in the year 2030, before dropping to zero by 2051.

Methodology

There are two key modelling assumptions:

a) Electricity Demand grows by a constant factor each year
b) Renewable Electricity Generation grows by a constant factor each year

The assumptions are simplistic but not entirely unreasonable. Growth in wind generation has slowed in recent years but may pick up again as Offshore generation takes effect from 2030. Grid level solar continues to increase rapidly and may support a high growth rate in the interim.

Empirical growth factors are estimated from eleven years of observed data covering the period 2014 to 2024. See Appendix I for tabulated input data. An average annual growth in demand of 3% is observed, and average growth in renewable generation is estimated to be 7%.

The model is initialised using 2024 data:

- Demand: 33719 GWh
- Wind + Solar Generation: 11788 GWh
- Other Renewable Generation: ~1689 GWh[1]

The estimated growth factors are then applied to this baseline, and fossil fuel generation is derived as the difference between Demand and Renewable Generation. See Appendix II for tabulated model output, and Appendix III for a graphical representation of the output.

Discussion of Results

Simplistic assumptions underpinning the model act to limit its applicability. However, **it does highlight difficulty in communicating the progress of the energy transition**. RES-E is a publicly scrutinised measure of the electricity sector's climate action progress. The model highlights that while we may well be on track for long term targets, short term growth in RES-E is lethargic. Additionally, fossil fuel generation may continue to grow for a number of years before the compounding effect of an assumed constant growth factor in renewable generation begins reversing this trend. **Highlighting the growth in renewable exported generation may help communicate progress in the interim.**

[1] Rather than use the exact 2024 data for Hydro and Biomass, an average of recent years was used (since Edenderry converted from peat to biomass). This was done to give a reasonable level of generation, which is assumed to remain constant in the model. The impact of other renewable generation is marginal in the model after 2030.

Appendix I – Input Data

Source: System and Renewables Summary Report

Figures are in GWh

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
System Demand	*25770.6911*	*26575.6235*	*27155.1602*	*27742.0433*	*28900.0840*	*29082.8817*	*29330.5234*	*30920.6273*	*31621.5076*	*32500.6084*	*33718.7165*
Wind Generation	*5058.32500*	*6536.21001*	*6061.48835*	*7227.97818*	*8683.58890*	*9496.51316*	*11070.3795*	*9506.69425*	*10879.4542*	*11397.6351*	*11128.6263*
Solar Generation	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*372.275375*	*659.038148*
Wind + Solar Generation	*5058.32500*	*6536.21001*	*6061.48835*	*7227.97818*	*8683.58890*	*9496.51316*	*11070.3795*	*9506.69425*	*10879.4542*	*11769.9105*	*11787.6644*

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024		Average
Demand Growth	*3%*	*2%*	*2%*	*4%*	*1%*	*1%*	*5%*	*2%*	*3%*	*4%*		*3%*
Wind + Solar Gen Growth	*29%*	*-7%*	*19%*	*20%*	*9%*	*17%*	*-14%*	*14%*	*5%*	*-2%*		*7%**

* This average excludes exceptionally large 2015 growth

Appendix II – Model Output

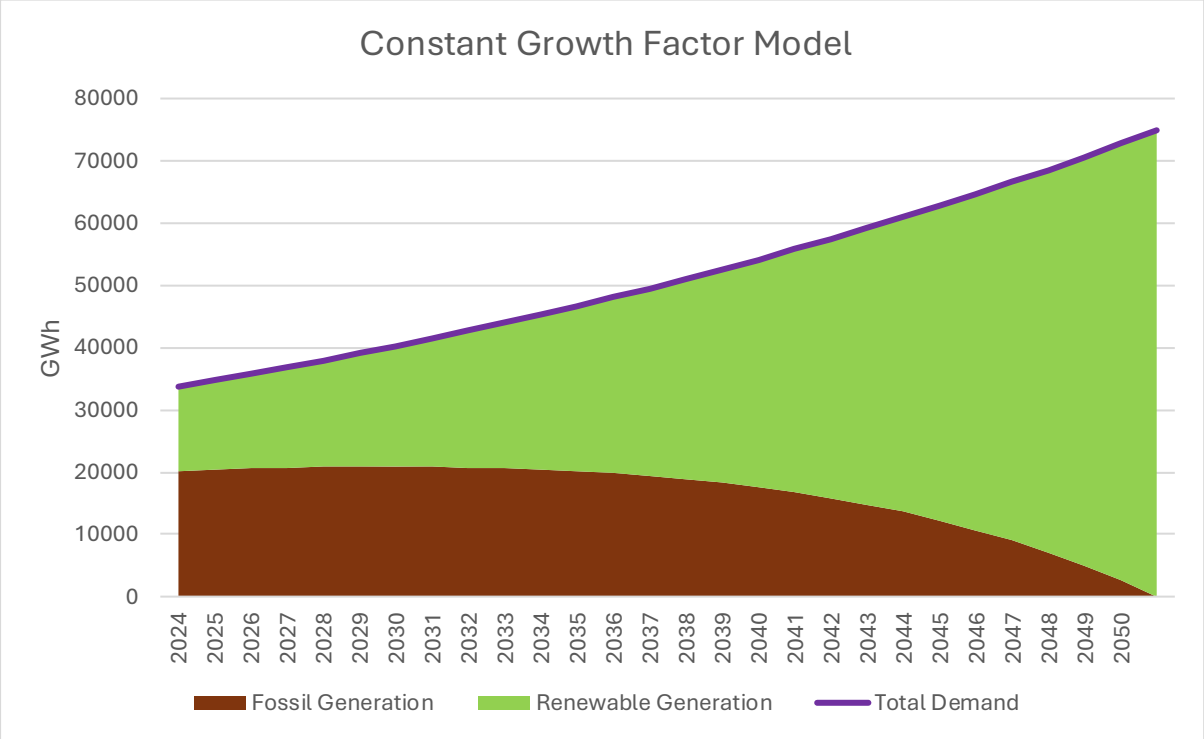
Figures are in GWh

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
Demand	*33719*	*34730*	*35772*	*36845*	*37951*	*39089*	*40262*	*41470*	*42714*	*43995*	*45315*	*46675*	*48075*	*49517*
Solar + Wind	*11788*	*12613*	*13496*	*14440*	*15451*	*16533*	*17690*	*18928*	*20253*	*21671*	*23188*	*24811*	*26548*	*28406*
Other Renew**	*1689*	*1689*	*1689*	*1689*	*1689*	*1689*	*1689*	*1689*	*1689*	*1689*	*1689*	*1689*	*1689*	*1689*
Fossil	*20242*	*20429*	*20588*	*20716*	*20811*	*20868*	*20883*	*20853*	*20772*	*20635*	*20438*	*20175*	*19838*	*19422*
Renew %	*40%*	*41%*	*42%*	*44%*	*45%*	*47%*	*48%*	*50%*	*51%*	*53%*	*55%*	*57%*	*59%*	*61%*
Growth		*1%*	*1%*	*1%*	*1%*	*1%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*	*2%*

** Other Renewables include Hydro and Biomass. The figure 1689 GWh is a rough average output of the last few years – when Edenderry converted from Peat to Biomass. The model assumes no growth in this figure

	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051
Demand	*51003*	*52533*	*54109*	*55732*	*57404*	*59126*	*60900*	*62727*	*64609*	*66547*	*68543*	*70600*	*72717*	*74899*
Solar + Wind	*30395*	*32523*	*34799*	*37235*	*39842*	*42630*	*45615*	*48808*	*52224*	*55880*	*59791*	*63977*	*68455*	*73247*
Other Renew**	*1689*	*1689*	*1689*	*1689*	*1689*	*1689*	*1689*	*1689*	*1689*	*1689*	*1689*	*1689*	*1689*	*1689*
Fossil	*18919*	*18321*	*17621*	*16808*	*15874*	*14807*	*13597*	*12231*	*10696*	*8978*	*7063*	*4934*	*2574*	*-37*
Renew %	*63%*	*65%*	*67%*	*70%*	*72%*	*75%*	*78%*	*81%*	*83%*	*87%*	*90%*	*93%*	*96%*	*100%*
Growth	*2%*	*2%*	*2%*	*2%*	*3%*	*3%*	*3%*	*3%*	*3%*	*3%*	*3%*	*3%*	*3%*	*4%*

Appendix III – Summary Graph & Sensitivity



Growth Rate Sensitivity			
Input		Output	
Demand	**Wind + Solar**	**2030 RES-E**	**100% RES-E**
1%	7%	54%	2042
1.25%	7%	53%	2023
1.50%	7%	53%	2044
1.75%	7%	52%	2045
2%	7%	51%	2046
2.25%	7%	50%	2047
2.50%	7%	50%	2048
2.75%	7%	49%	2050
3%	7%	48%	2051
3.25%	7%	47%	2053
1%	5%	49%	2050
2%	5%	46%	2060
2.50%	5%	45%	2067
3%	5%	43%	2078
1%	9%	60%	2038
2%	9%	57%	2040
2.50%	9%	55%	2041
3%	9%	53%	2042

Appendix IV – Demand Assumption

Comparison of AIRAA 2025-2034 modelled demand and the model developed in this paper:

Year	Low	Median	High	Constant Growth Factor Model
2025	*34120.7*	*36028.1*	*37414.3*	*34730.3*
2026	*34943.3*	*37720.9*	*39983.4*	*35772.2*
2027	*35705.0*	*39257.1*	*42068.6*	*36845.4*
2028	*36287.6*	*40456.9*	*43629.0*	*37950.7*
2029	*36858.8*	*41586.0*	*45080.4*	*39089.2*
2030	*37407.3*	*42658.6*	*46361.7*	*40261.9*
2031	*38091.1*	*43882.3*	*47589.1*	*41469.8*
2032	*38777.8*	*45057.7*	*48624.6*	*42713.9*
2033	*39455.3*	*46198.4*	*49610.1*	*43995.3*
2034	*40123.5*	*47285.9*	*50596.2*	*45315.1*

The Total Energy Requirement (TER) figures provided by the AIRAA have been scaled to actual demand using a historical average, calculated from the table below:

	AIRAA TER	Actual Demand	Scale
2017	*29375.86484*	*27742.04328*	*0.058893339*
2018	*29814.27664*	*28900.08398*	*0.031632872*
2019	*30616.73116*	*29082.88168*	*0.052740629*
2020	*30868.42088*	*29330.52338*	*0.052433347*
2021	*32188.82205*	*30920.62731*	*0.041014522*
2022	*33069.42307*	*31621.5076*	*0.045788945*
2023	*34044.6989*	*32500.60841*	*0.047509587*
		Average	*5%*

Assumptions of the AIRAA Scenarios:

	Low	Median	High
Number of Electric Vehicles	75% Climate Action Plan Targets	100% Climate Action Plan Targets	110% Climate Action Plan Targets
Number of Domestic and Commercial Heat Pumps	75% Climate Action Plan Targets	100% Climate Action Plan Targets	110% Climate Action Plan Targets
Data Centre and New Technology Loads	Low Ramp	Median Ramp	High Ramp
Economic Growth Projection	75% ESRI Economic Projection	100% ESRI Economic Projection	110% ESRI Economic Projection

Comparison of TES 2023 modelled demand and the model developed in this paper:

	Gas Evolution	Constrained Growth	Self-Sustaining	Offshore Opportunity	Model 1
2035	*55940*	*54099*	*68896*	*68243*	*46675*
2040	*63387*	*61539*	*79589*	*78123*	*54109*
2045	*67609*	*67350*	*81333*	*81650*	*62727*
2050	*70488*	*72078*	*82008*	*84034*	*72717*

*Scale factor of 8% between TER and demand quoted in TES report and used here