



OLLSCOIL NA
GAILLIMHE

UNIVERSITY
OF GALWAY



Grid AI

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We have a problem...



Business

THE IRISH TIMES

Ireland needs €125bn in this decade to transition to net zero - report

the Confederation of British Industry Northern Ireland energy policy report

THE IRISH TIMES

Economy

Ireland lacks a long-term master plan for energy sector - Ibec CEO

Creator: staff | Credit: Eddie O'Hare

Copyright: Irish Examiner/The Echo

Waves break against the seawall in Carnlough in Northern Ireland on Friday. Paul Faith / AFP via Getty Images

Irish Times



THE IRISH TIMES

Business

Ireland risks fine of up to €26bn if EU climate targets missed

Report by Irish Fiscal Advisory Council and Climate Change Council sets out potential costs for State

A Myriad of Factors

8

Carbon Offset Methods

12

Power Generation Methods

70,000
km²

400,000+
Businesses

5,000,000+
People

Things that have to be considered



COST



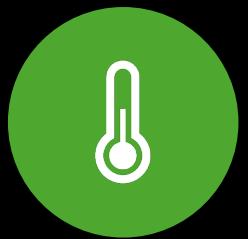
PUBLIC
OPINION



FEASIBILITY



ABILITY TO
SUPPORT
GROWING
ECONOMY

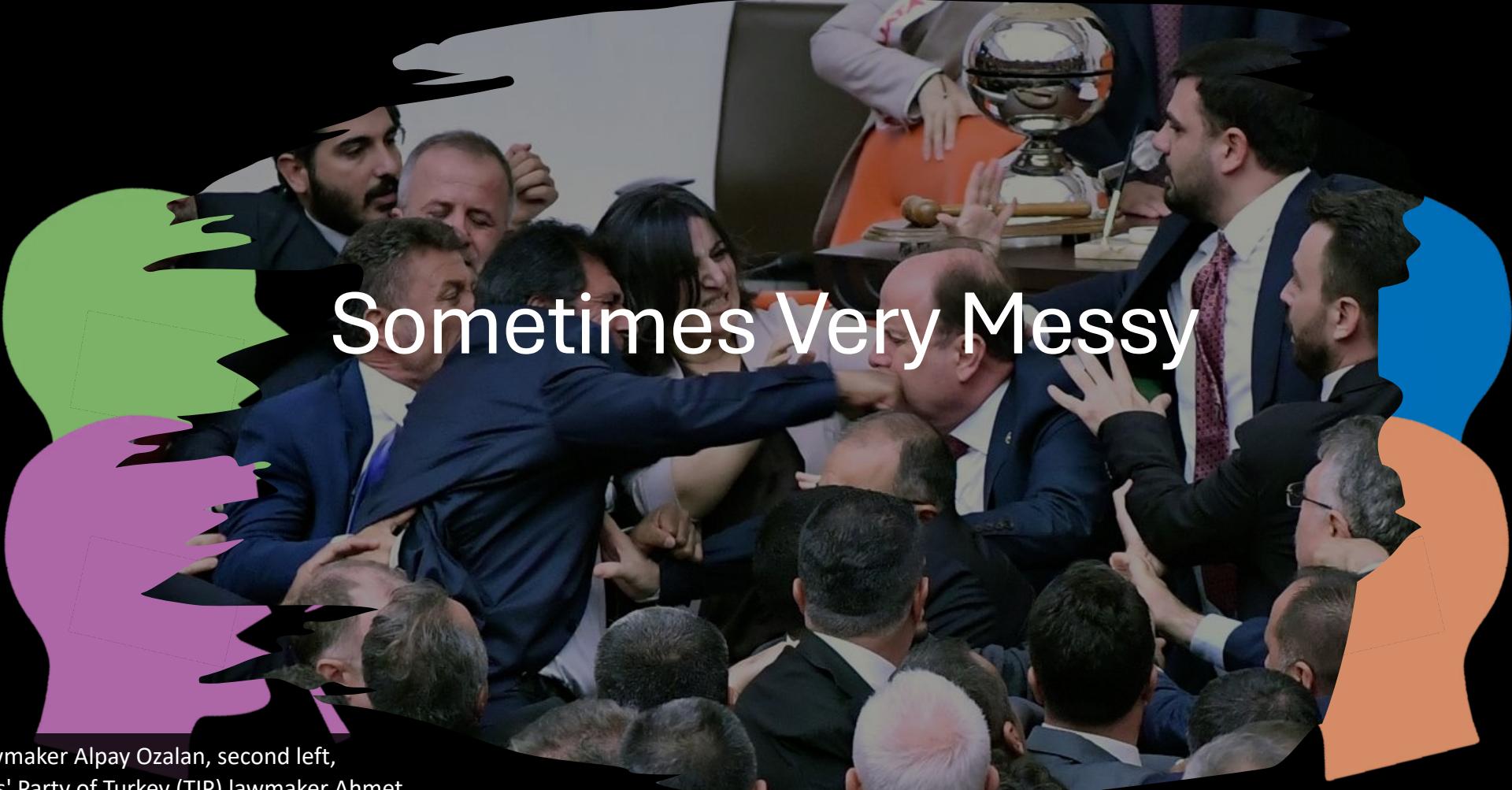


CLIMATE
GOALS

Policy discussions are messy



Policy discussions are messy

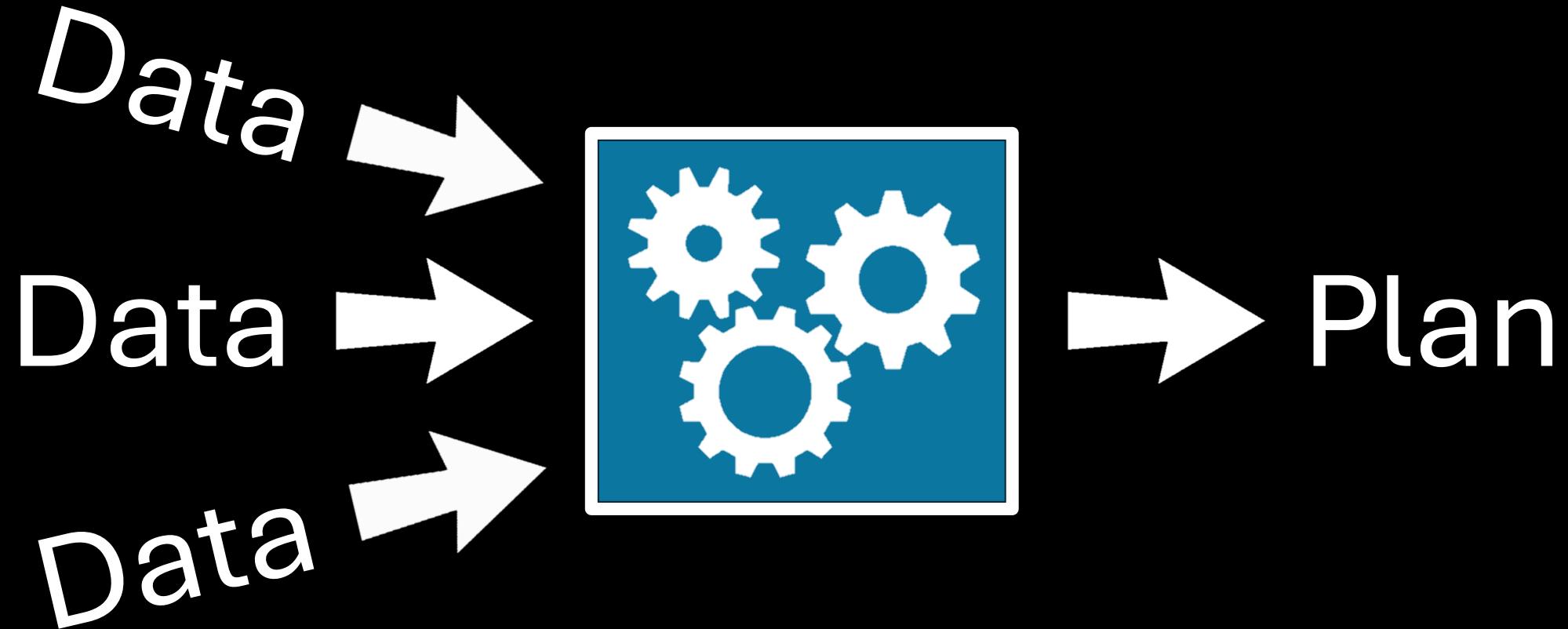


Turkey's AK Party lawmaker Alpay Ozalan, second left, scuffles with Workers' Party of Turkey (TIP) lawmaker Ahmet Sik.

DIA Images/AP

Sometimes Very Messy

The Ideal Solution



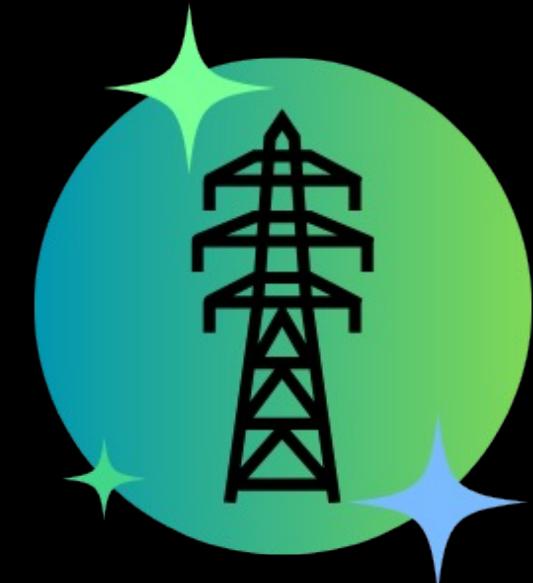
It's Real — We Have Built An AI For Planning

- 13,000 lines of code
- 100% locally run (no ChatGPT, no external tools)
- 2.5 million years of simulation in an hour
- Uses all available data
- Finds the **best** plan



The Solution — We Have Built An AI For Planning

- Policy Gradient Reinforcement Learning Training Method
- Accounts for power, cost, public opinion, planning permission, and more
- Specific generators, locations, costing

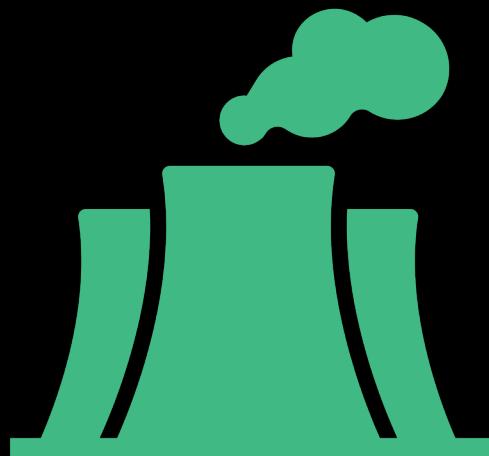


Grid AI

Current Data Sources



Settlements



Generators



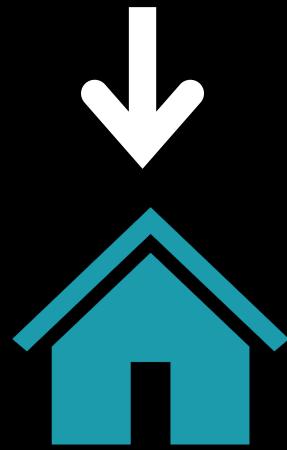
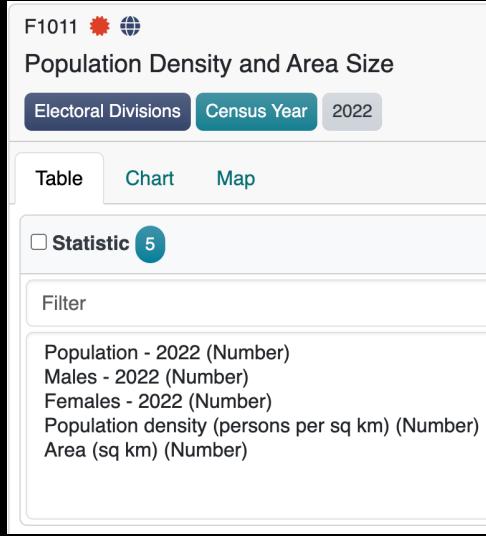
Geography



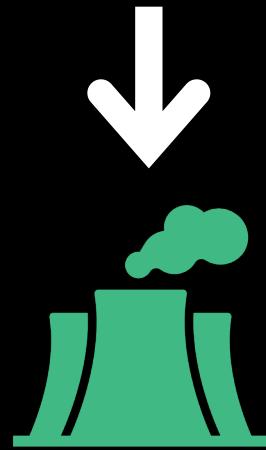
Constants



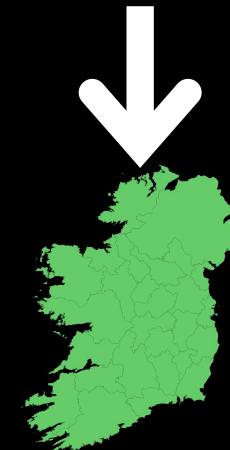
Grid AI



Settlements



Generators

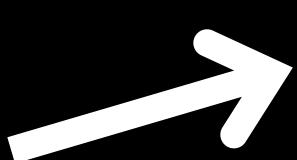


Geography

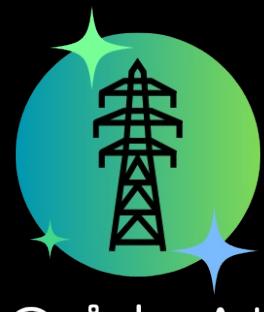
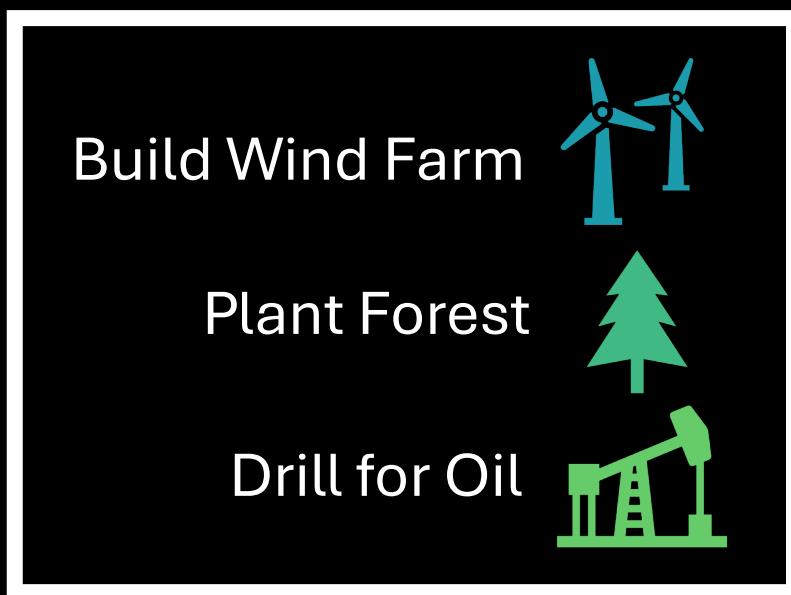


Grid AI

How the model works

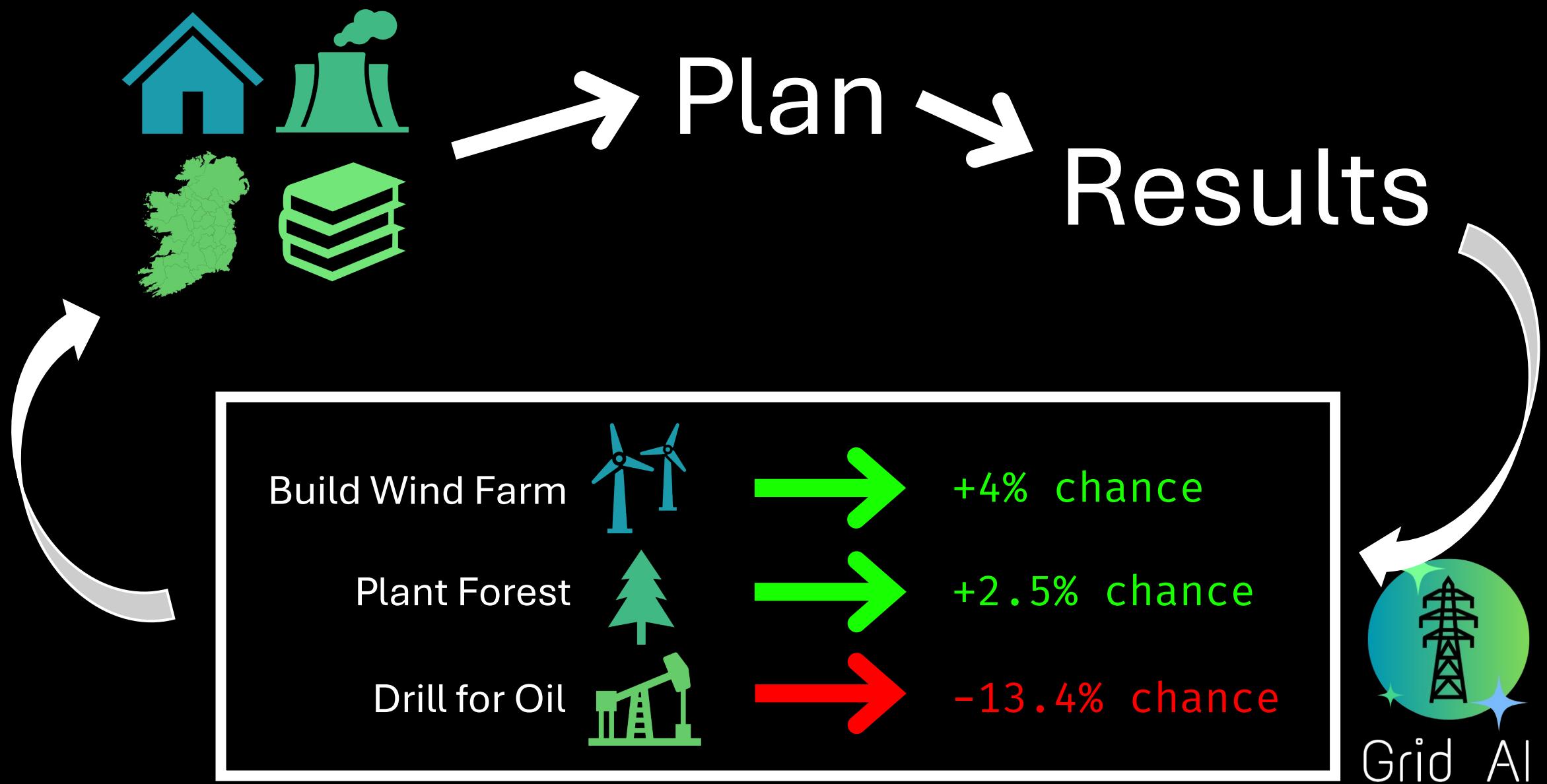


Plan → Results



Grid AI

How the model works



Results

(Artist's Rendering of
Generated Results)



Grid AI

2025-2027



Solar Panels
(Utility & Domestic)



Battery Storage



Grid AI

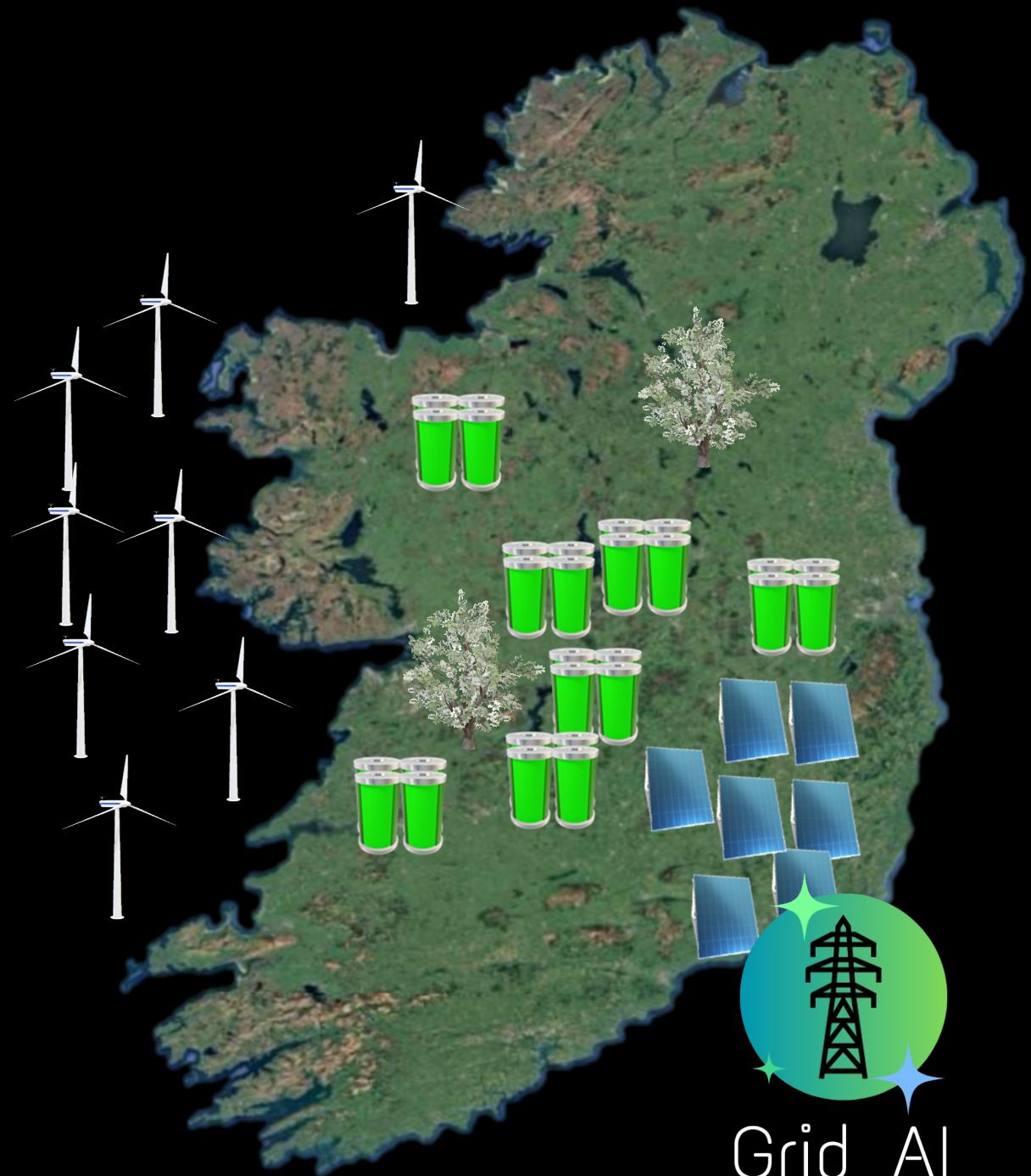
2028-2040



Wind Turbines



Carbon Offsets
(Forestry)



Grid AI

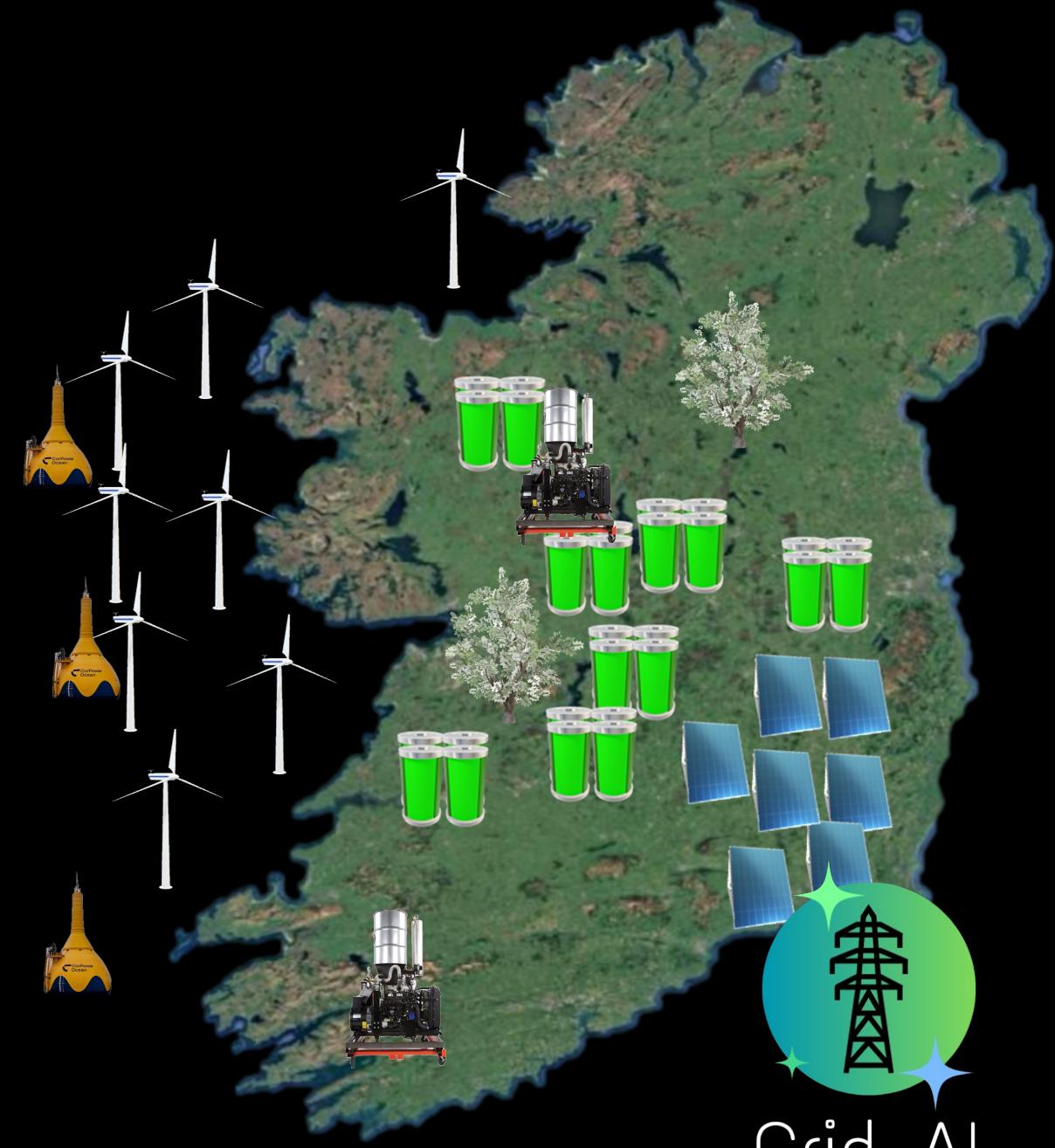
2041-2050



Wave Energy
Generators



Biomass
Generators



Final State



41,000 acres of solar farms
&
800,000 domestic panels



18TWh of Battery Plants



23,000 Wind Turbines



42TWh of Wave Energy



1.8 Mt Carbon Offset



Grid AI

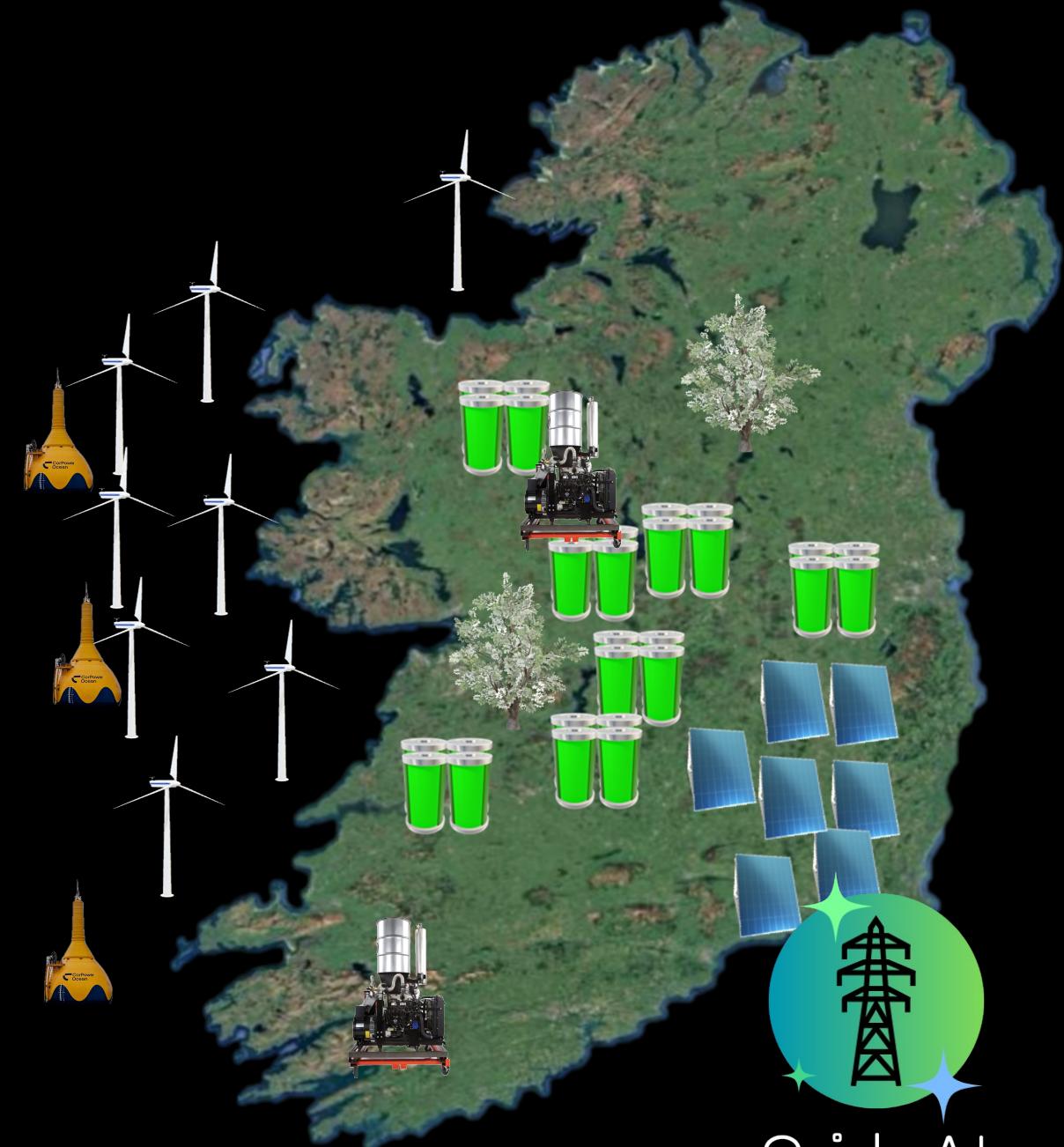
Summary

Emissions: -1.3Mt

Total Cost: €76B

Power Reliability: 100%

Public Opinion: 90%



Grid AI

```
== STARTING SIMULATION ==
✓ Best actions recorded: 0 across 0 years
✓ Best deficit actions recorded: 0 across 0 years
Action distribution per year:
✗ No best metrics recorded yet
Total iterations: 0
Iterations without improvement: 0
```

```
*****
```

```
🎉 FIRST SUCCESSFUL STRATEGY FOUND! 🎉
```

```
*****
```

```
Initial score: 0.9499
```

```
📊 INITIAL METRICS:
```

```
Net emissions: 50059.51 tonnes
Total cost: €91.22B/year
Public opinion: 72.9%
Power reliability: 100.0%
```

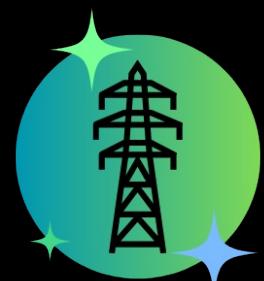
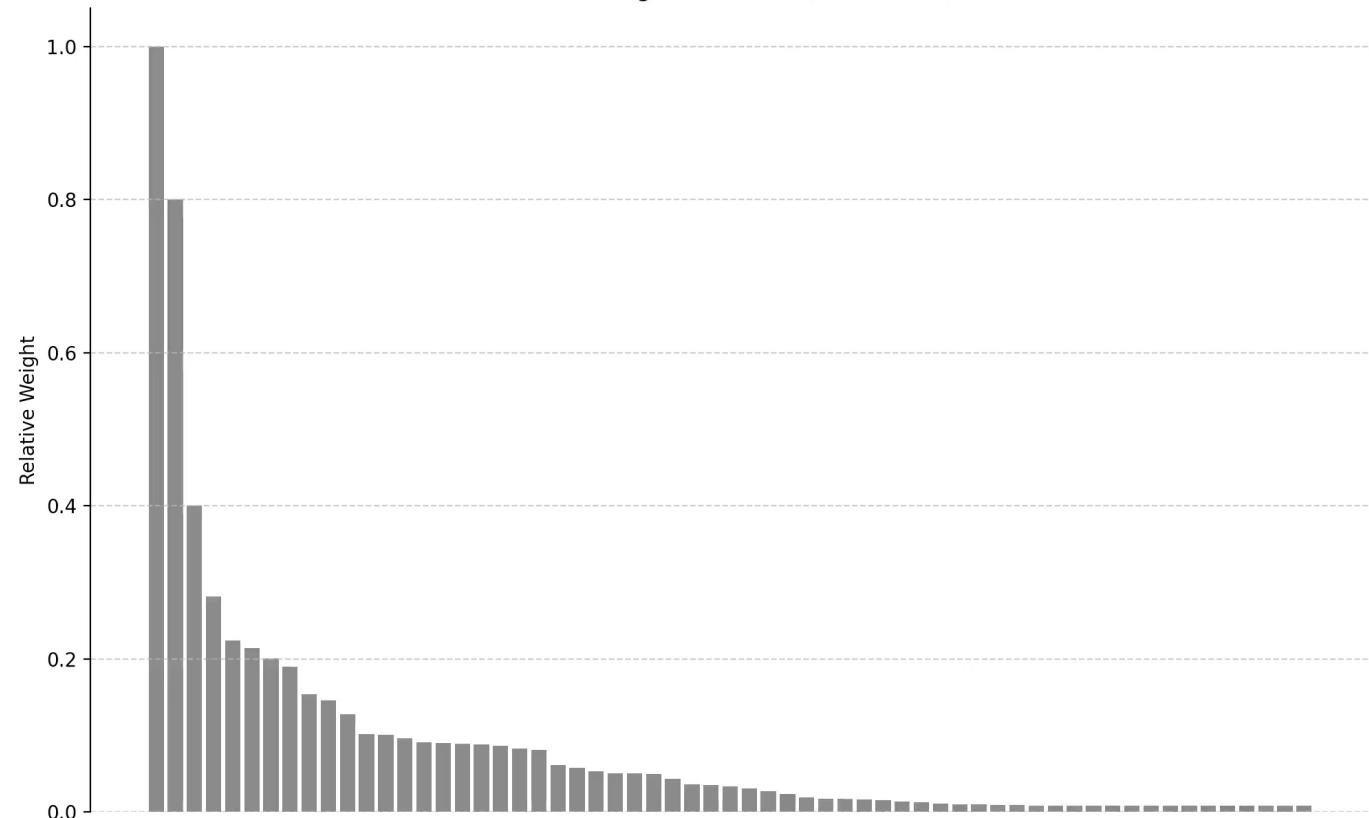
```
*****
```

```
Recording first strategy with 23 regular actions and 12 deficit actions
```

```
DIAGNOSTIC: Updating best_metrics from current metrics
```

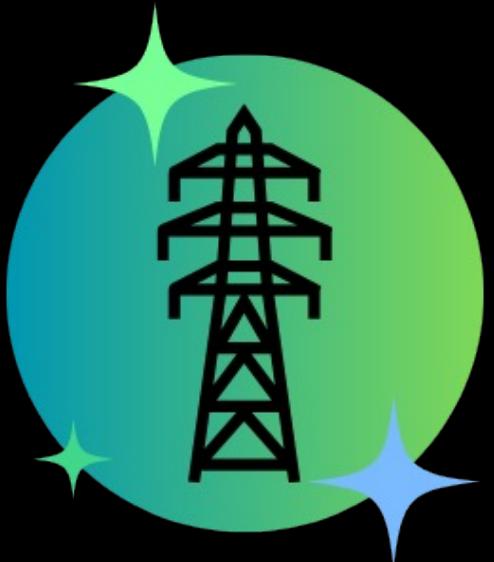
```
DEBUG: Created best_actions map with 23 actions across 10 years
```

Action Weights Evolution (Iteration 0)



Grid AI

Next Steps



Grid AI



Full-time
development



Use in other
infrastructure

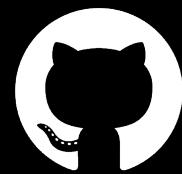
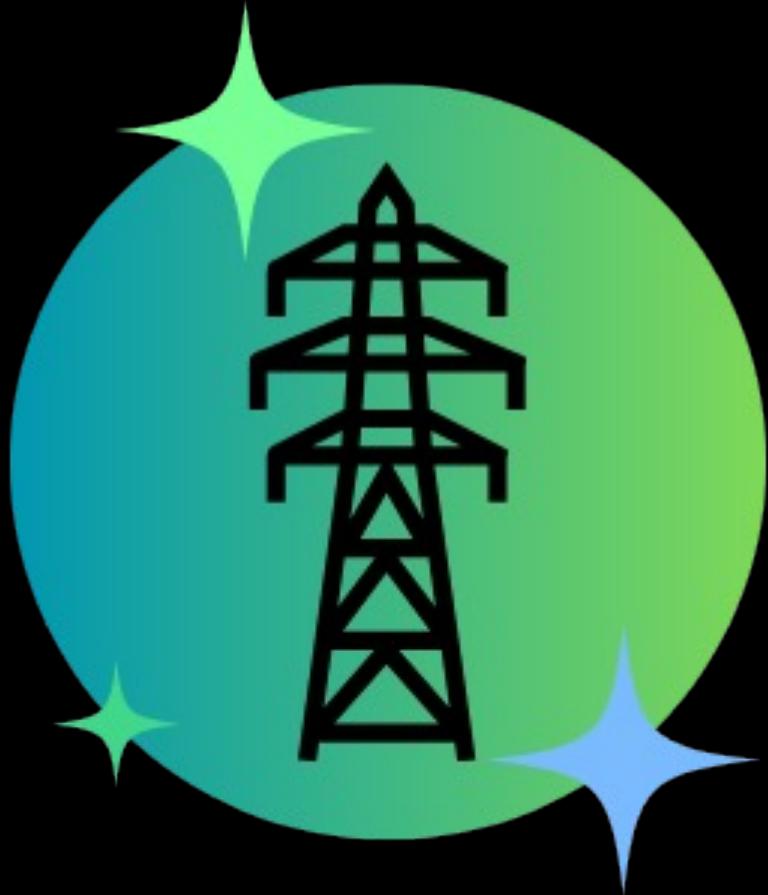


More
accurate, live
data



Individual-
Level
Accuracy

Grid AI



GitHub



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Sources

- Barbose, G., Darghouth, N., O'Shaughnessy, E., & Forrester, S. (2024). *Tracking the Sun*.
- Bombora Wave Power. (2022). *Independent Review of Cost of Energy Study for mWave Farm*.
- Brennan, J. (2023a, October 31). 5 MW Solar Power Plant Cost in Ireland. *Going Solar*.
- Brennan, J. (2023b, December 4). 1 MW Solar Panel Cost in Ireland. *Going Solar*.
- Bullis, K. (2013). Safer Nuclear Power, at Half the Price. *MIT Technology Review*.
- Central Statistics Office. (2019). *Urban and Rural Life in Ireland, 2019*.
- Central Statistics Office. (2024a). *Consumer Price Index August 2024*.
- Central Statistics Office. (2024b). *Metered Electricity Consumption 2023*.
- Central Statistics Office. (2024c). *Population and Labour Force Projections 2023-2057*.
- Energy Policy & Modelling Group. (2024). *Data centres in the context of Ireland's carbon budgets*.
- ESB. (2024, November 15). *ESB officially opens its latest battery storage project in Co Cork as part of €300m investment*.
- EURELECTRIC “Preservation of Resources” Working Group’s “Upstream” Sub-Group in collaboration with VGB. (2003). Efficiency in Electricity Generation. In *Eurelectric*.
- European Commission. (2024). *European Economic Forecast*.
- Funk, C., & Kennedy, B. (2016). *Public opinion on renewables and other energy sources*.
- GlobalData. (2025). *Wind Turbines Market Size, Share and Trends Analysis by Technology, Installed Capacity, Generation, Key Players and Forecast to 2028*.
- Government of Ireland. (2024). *Budget 2025 Expenditure Report*.

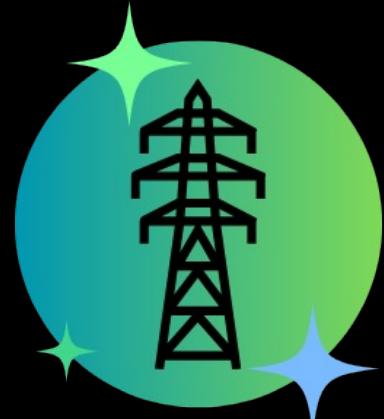
Sources

- International Energy Agency. (2024). *Energy Efficiency 2024*.
- Jenkinson, O. (2024, June 3). Nordex sells 1.6GW of wind turbines as pricing holds steady in Q2. *Windpower Monthly*.
- Kazulis, V., Vigants, H., Veidenbergs, I., & Blumberga, D. (2018). Biomass and natural gas co-firing – evaluation of GHG emissions. *Energy Procedia*.
- Mongird, K., Viswanathan, V., Alam, J., Vartanian, C., Sprenkle, V., Pacific Northwest National Laboratory, Baxter, R., & Mustang Prairie Energy. (2020). *2020 Grid Energy Storage Technology Cost and Performance Assessment*.
- Nuclear Energy Institute. (2018). *Nuclear Costs in Context*.
- Ratanakuakangwan, S., & Morita, H. (2021). Energy efficiency of power plants meeting multiple requirements and comparative study of different carbon tax scenarios in Thailand. *Cleaner Engineering and Technology*, 2.
- Rezaeimozafar, M., Eskandari, M., Amini, M., Moradi, M., & Siano, P. (2020). A Bi-Layer Multi-Objective Techno-Economical Optimization Model for Optimal Integration of Distributed Energy Resources into Smart/Micro Grids. *Energies*.
- Statista Research Department. (2024). *Average installation cost for hydropower worldwide from 2010 to 2022*.
- Subramanian, N., & Madejski, P. (2023). Analysis of CO₂ capture process from flue-gases in combined cycle gas turbine power plant using post-combustion capture technology. *Energy*.
- Sustainable Energy Authority of Ireland. (2011). *SMARTGRID Roadmap*.
<https://www.seai.ie/sites/default/files/publications/Smartgrid-Roadmap.pdf>
- Sustainable Energy Authority of Ireland. (2023). *Energy In Ireland: 2023 Report*.

Sources

- Sustainable Energy Authority of Ireland. (2024). *Energy in Ireland: 2024 Report*.
- Trading Economics. (2025a, February 17). *Coal - Price Data*.
- Trading Economics. (2025b, February 17). *Gasoline - Price Data*.
- Trading Economics. (2025c, February 24). *Ireland - Urban Population Growth*.
- Unwin, J. (2019, March 21). Potential vs. expense: is tidal energy worth the cost? *Power Technology*.
- U.S. Energy Information Administration. (2022). *Cost and Performance Characteristics of New Generating Technologies, Annual Energy Outlook 2022*.
- West, R. (2022, June 16). *Power cables: carrying capacity and loss rates?* Thunder Said Energy. <https://thundersaidenergy.com/downloads/power-cables-how-much-copper-and-aluminium/>
- Windustry. (2024, August 9). What is the Cost of Offshore Wind Energy? *Windustry*.
- World Nuclear Association. (2023, September 29). *Economics of Nuclear Power*.
- Xiong, Y., Zou, W., & Wang, Y. (2023). Estimate the City Size Threshold of Industrial Agglomeration Model: Evidence From Chinese Prefecture Level Cities. *International Regional Science Review*.

Conclusion



Grid AI


€50
Billion
Saved



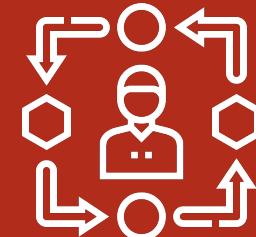
Net Zero Achieved in
the MOST efficient
way



Decades of Planning
in Minutes



13,000 Lines of
Code



Infinitely Adaptable