40,000x Speedup in Domestic PV and Storage Sizing

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1 Introduction

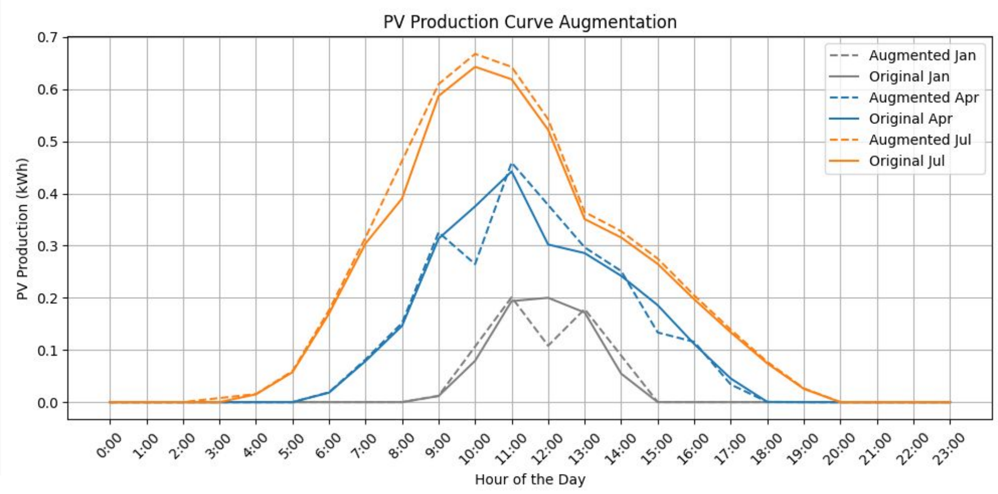
Current methods determine optimal PV system sizes based on time-consuming simulations [1]. We present a neural network-based approach to deliver **near-instant** recommendations for PV and battery sizes.

2 Dataset

We train on 10,000 samples consisting of:

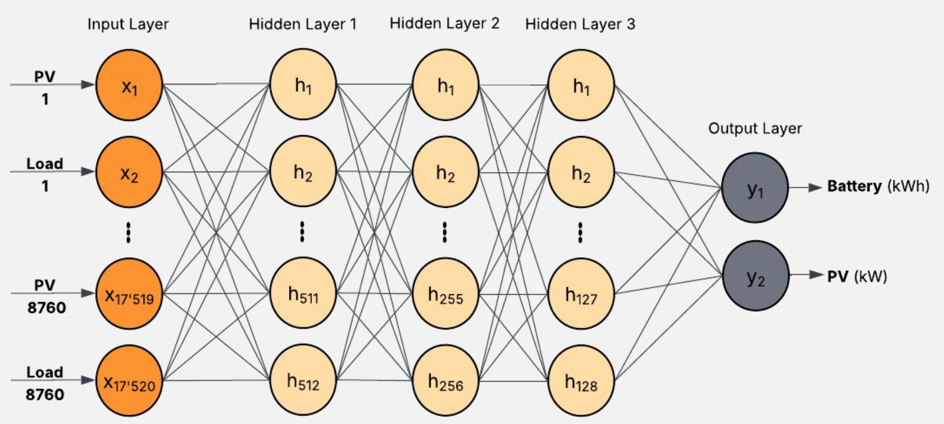
- Hourly **PV generation** over one year, PVWatts [2].
- Synthetic UK-based **Load** curves, Faraday [3].
- The dataset is grown by creating and bridging gaps, adding noise and scaling the curves.

Simulations are used to create labels for supervised learning consisting of the battery and PV size [4].



3 Model

A fully-connected **multilayer perceptron** (MLP) is used for its strong ability to learn robust mappings, even when trained on limited data where complex architectures are prone to overfitting. Additionally, we train a baseline model using XGBoost.



4 Results and Discussion

Model	Battery (kWh)		PV (kW)		Duration (ms)
	MSE	MAE	MSE	MAE	
MLP	0.664	0.614	0.241	0.364	1.08 (± 0.077)
XGBoost	1.057	0.734	0.630	0.601	0.29 (± 0.032)
Simulator	–	–	–	–	40,580 (± 1,180)

PV system components can be bought in discrete sizes:

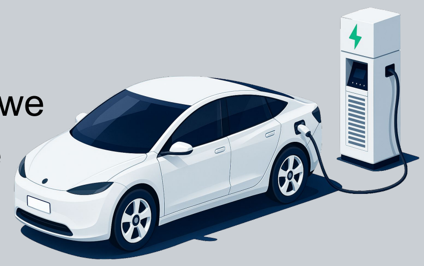
➔ **PV**: 350W - 450W per panel
➔ **Battery**: >2 kWh increments depending on brand

In this context, the model is sufficiently accurate while achieving a speedup of almost 40,000x.

5 Future Work

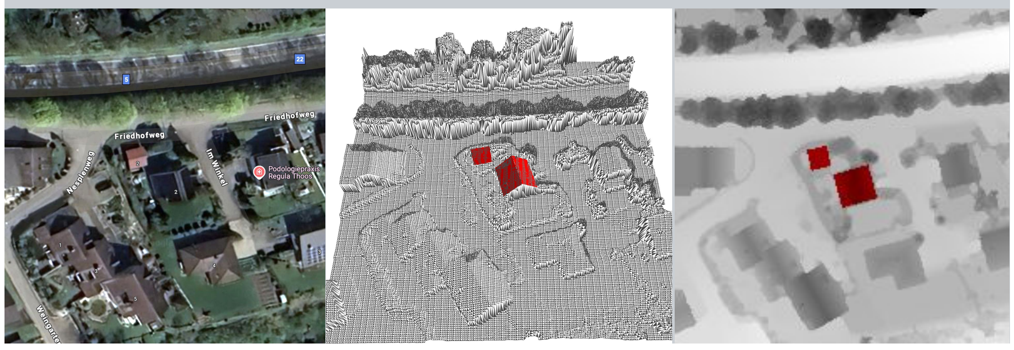
Effect of Electric Car Usage on Load

Electric cars are significantly altering load curves. Therefore, we are building a model to compute optimal sizing while considering car usage patterns.



Effect of Panel Placement on PV generation

We aim to predict sizing while taking into account roof characteristics such as orientation, tilt and shading and compute the optimal panel positions. Swiss height and landscape models are used for training [5].



References

[1] Berkes, A. & Keshav, S. SOPEVS: Sizing and Operation of PV-EV-Integrated Modern Homes.
[2] A Performance Calculator for Grid-Connected PV Systems. https://pvwatts.nrel.gov/
[3] Faraday: Synthetic Smart Meter Generator for the Smart Grid.
[4] Brad Huang. https://github.com/BradHuang1999/Robust-Sizing
[5] Federal Office of Topography. https://www.swisstopo.admin.ch/en

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