Optimal Sizing of a Nuclear Reactor for Embedded Grid Systems

Preliminary Work

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ILLINOIS

Outline

iCAP Goal and Obstacles

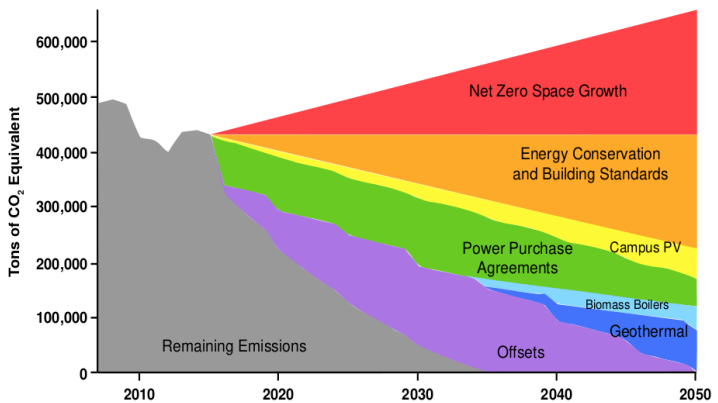


Figure: Shows projected CO_2 emissions for UIUC [2]. Offsets include shutdown of the Blue Waters Supercomputer.

Goal:
Carbon neutrality by 2050 or sooner.

Obstacles:

1. Requires *zero net space growth*.
2. Campus depends on a system of steam tunnels for heating.
3. and more...

The Nuclear Option

Nuclear energy...

1. ...produces almost no carbon emissions [1].
2. ...can produce high-temperature steam.
3. ...requires little physical space*.

*compared to solar and wind.

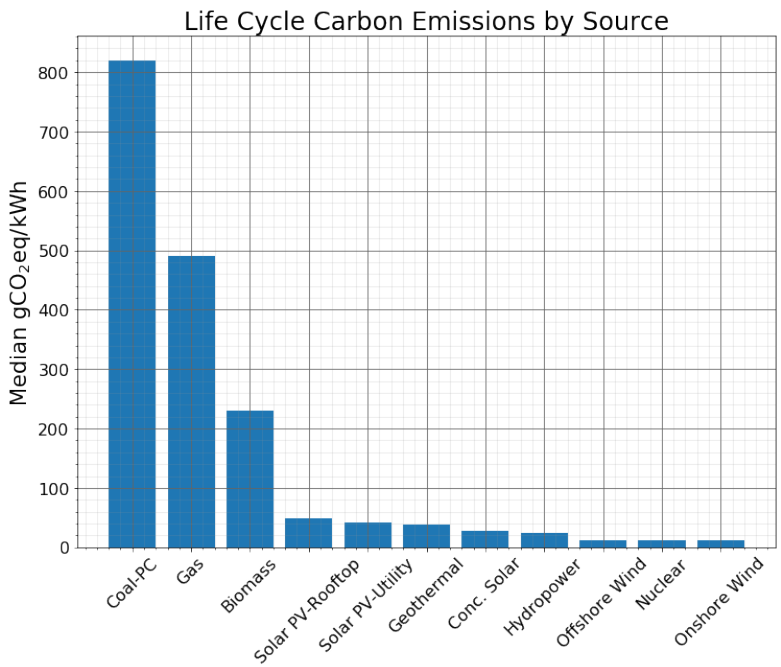


Figure: Lifetime carbon-equivalent emissions by energy source from IPCC findings [1].

What is the optimal size for a nuclear reactor on the UIUC grid?

Outline

To answer this question we considered two modeling approaches:

1. `RAVEN` (INL) - Risk Analysis and Virtual Environment
2. `TEMOA` (NCSU) - Tools for Energy Model Optimization and Analysis

Outline

Step 1: Generate Synthetic Histories

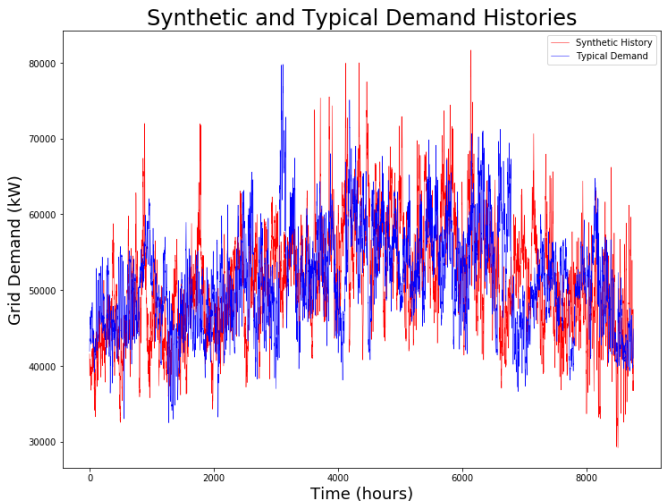


Figure: Shows the synthetic (red) vs typical (blue) hourly electricity demand at UIUC.

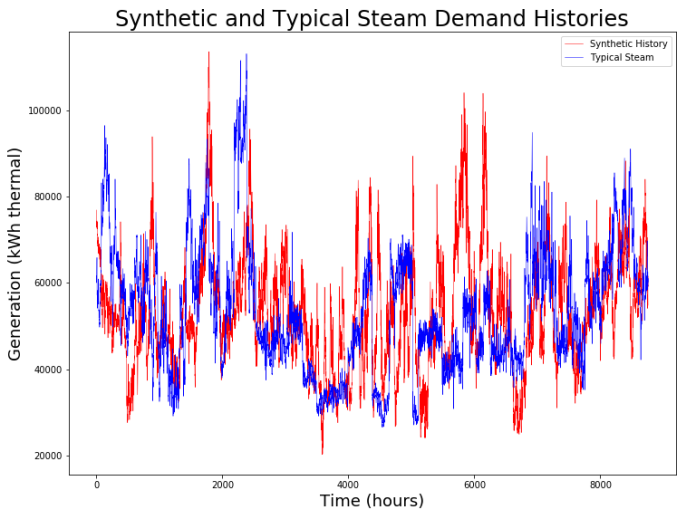


Figure: Shows the synthetic (red) vs typical (blue) hourly steam demand at UIUC.

Preliminary Results: Grid Model

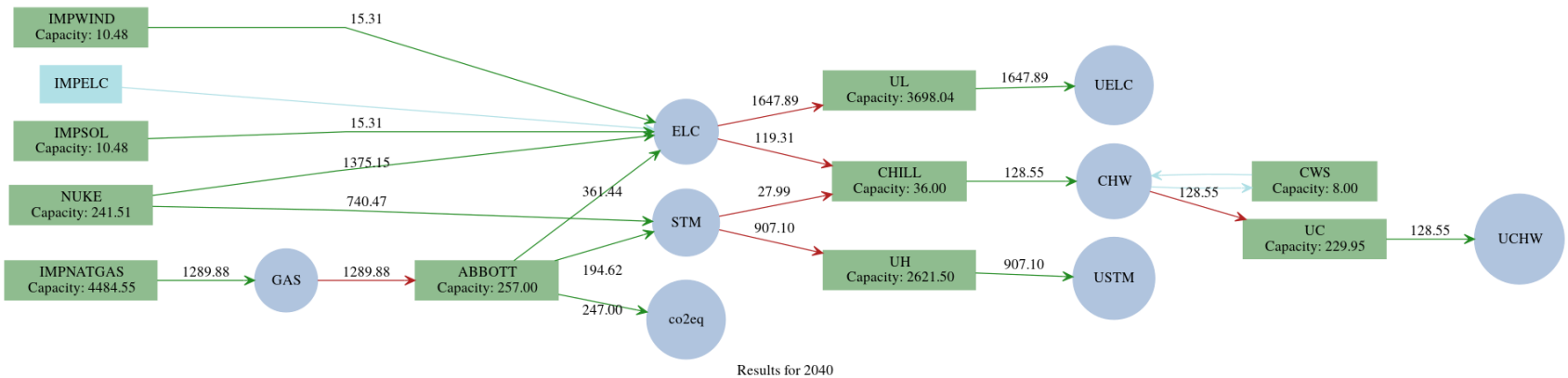
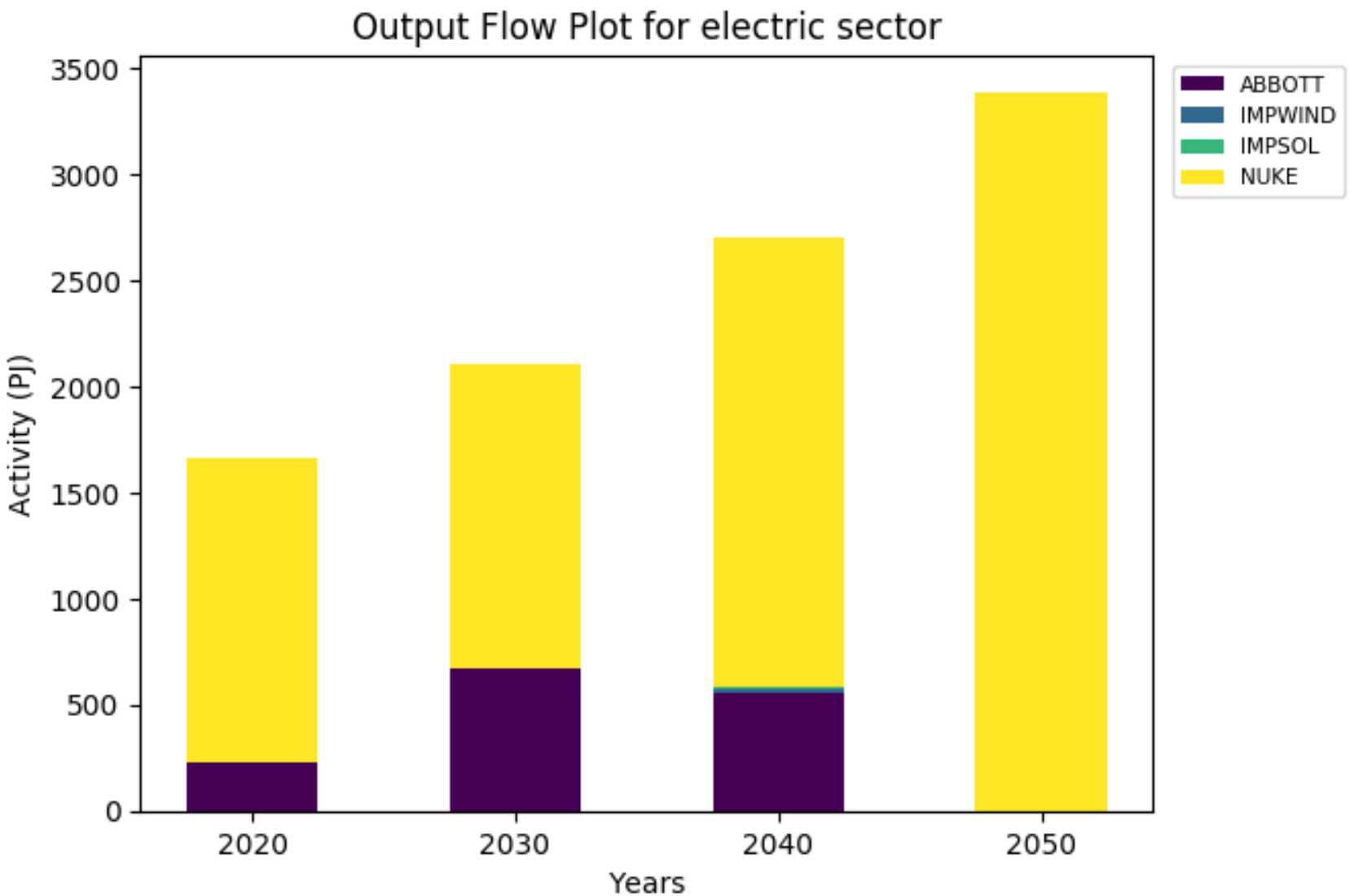


Figure: Preliminary dispatch results in year 2040 at UIUC

Preliminary Results: Acivity



Outline

Conclusion

Acknowledgement

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References I

[1] Intergovernmental Panel on Climate Change.

Climate Change 2014 Mitigation of Climate Change: Working Group III Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

Cambridge University Press.

[2] iSEE.

Illinois climate action plan (iCAP).