Dynamic Transition Analysis with TIMES: I²CNER Initiative on Challenges in Energy Assessment and Energy Transitions

Anshuman Chaube, James Stubbins, **Kathryn Huff**

University of Illinios at Urbana-Champaign, Department of Nuclear, Plasma, and Radiological Engineering, Urbana, IL 61801

Objectives

Evaluate potential impact of novel energy technologies within Japan's energy system. Specifically:

- Guide practical near term (2010-2050) transition strategies.
- Minimize carbon emissions within realistic constraints.
- Identify high impact technologies.
- Assess role of technology readiness.
- Predict impediments to strategically optimal technology deployment.
- Identify ideal timelines for energy system deployment, infrastructure development, high impact R&D investment.

Introduction

Previous work has compared the impact of innovative energy technologies in various world regions using **static** scenario analyses [1, 2, 4, 5, 7, 8]. We will simulate **dynamic** transition scenarios [3, 9] aimed at minimizing carbon emissions in Japan by 2050. These scenarios will include realistic constraints regarding technology readiness (in terms of generation, transmission & storage) and will combine multiple technologies in a single heterogeneous system model.

Methodology

The Integrated MARKAL-EFOM System (TIMES) model generator [6] [10] optimizes energy systems using linear and mixed-linear algorithms. A user-defined objective function (such as minimizing carbon emissions or costs) is solve within user defined constraints such as energy generation demand.

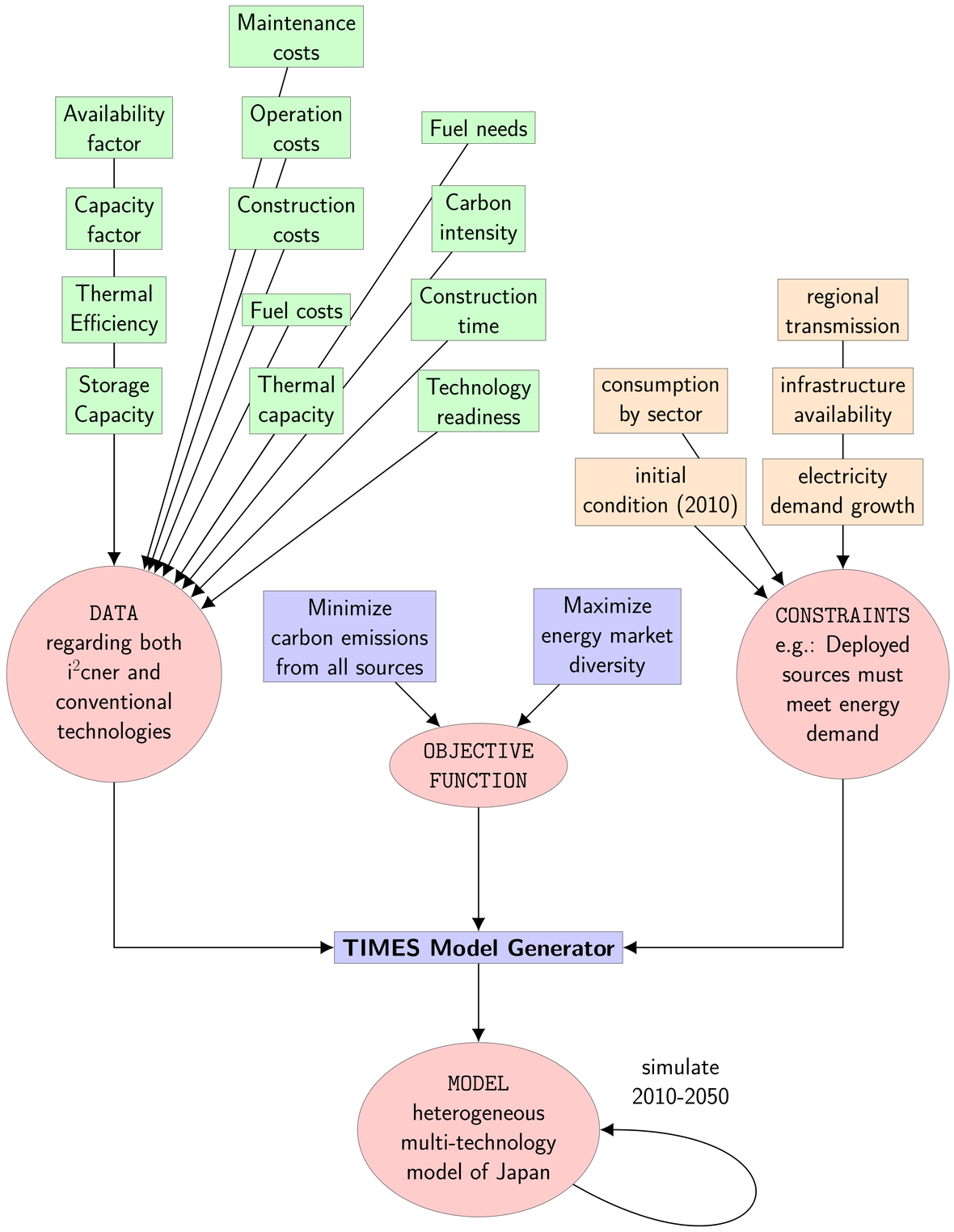

Figure: Basic methodology for dynamic simulation of Japan's energy system.

Anticipated Results

- Analysis results can be filtered by sector (commercial, industrial, residential, building etc) or by region.
- Many metrics are automatically postprocessed- such as energy intensity, thermal energy efficiency, transmission capacity.
- Technology deployment transitions driven by constrained optimization will have valuable strategic value.

Impact

Results will:

- Optimize realistic decarbonization roadmaps.
- Identify potential transition bottlenecks.
- Help Japan's policymakers create timelines for R&D investment and infrastructure development.
- Quantify system sensitivity to technology readiness.

Challenges

Reliable data for each technology's deployment and operation is required, such as:

Summary

- Dynamic simulation of Japan's energy system in TIMES model generator using a heterogeneous model and realistic constraints will help develop near-term decarbonization strategies.
- Policymakers will benefit from identification of high impact technologies, and creation of R&D investment and infrastructure development timelines.
- Simulations will quantify system sensitivity to technology readiness, and also account for secondary scenarios where decarbonization is not the main priority.

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Contact Information

- Web: arfc.github.io
- Email: kdhuff@illinois.edu

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