Modeling Energy Transitions

Lessons from the Field

Jason Veysey
Deputy Director, Energy Modeling Program
Stockholm Environment Institute
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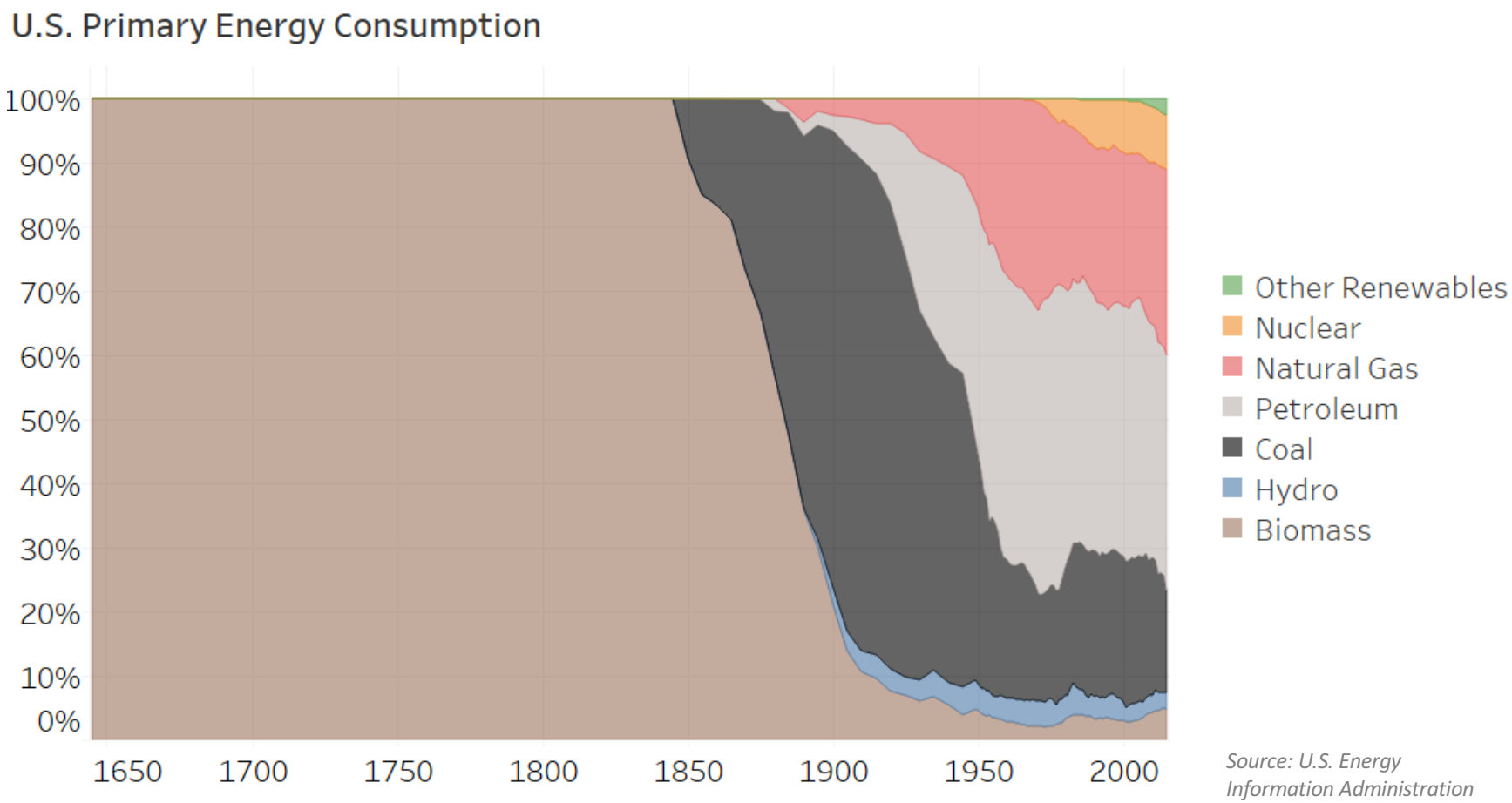
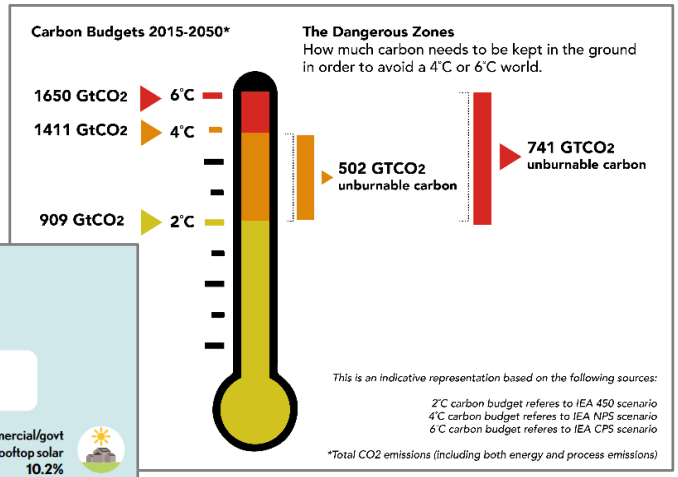
Energy Transitions Don’t Happen Overnight…

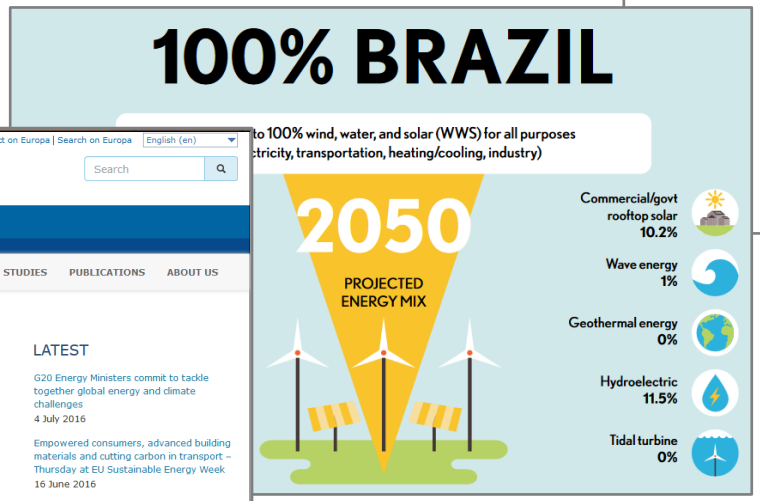


Source: U.S. Energy Information Administration

But Climate Change Has Increased the Urgency

- Technology and market forcing





- Diversity of low-carbon fuels and technologies

Sources: European Commission, The Solutions Project, Carbon Tracker Initiative, La Nouvelle Tribune

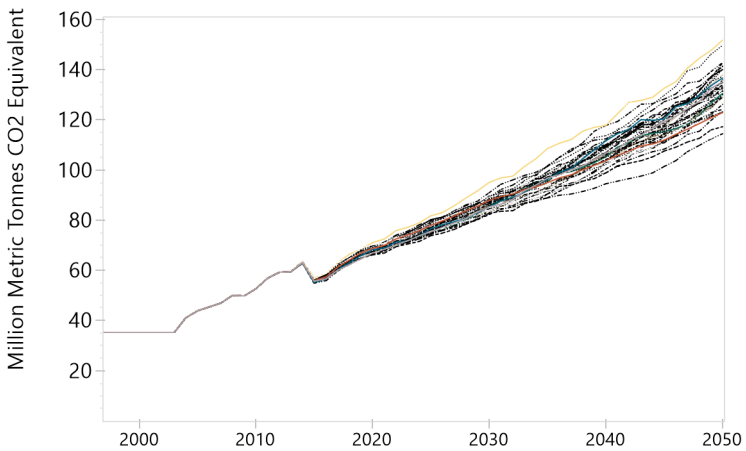
A Role for Energy Systems Modeling

We are *not* in the prediction business.

A Role for Energy Systems Modeling

Explore possible futures through physically plausible, internally consistent scenarios

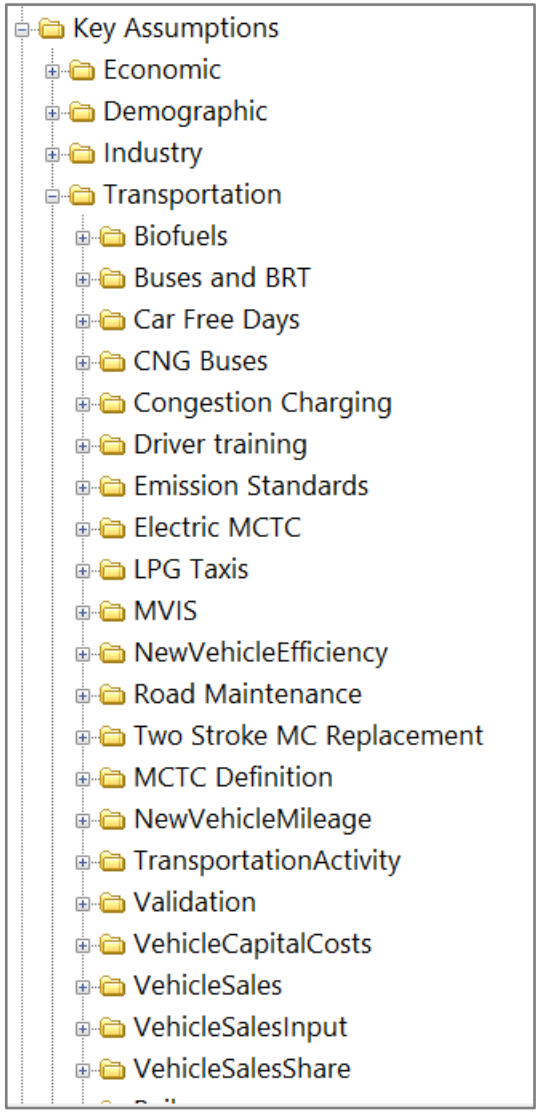
- Models are idealized mathematical representations based on:
  - Historical observations
  - Scientific laws
  - Socioeconomic theory
  - Selected boundary conditions



- Provide best available information to decision makers
- Spark imagination!
- Avoid dead ends and improve planning outcomes

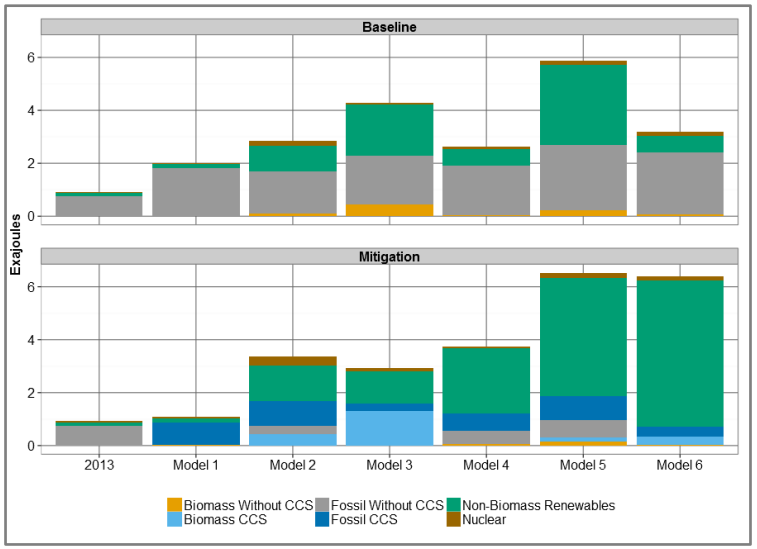
10,000 Assumptions

- Stakeholder input is important but generally insufficient
  - Solicit comments through presentations and reports
  - Conduct facilitated exercises to identify key assumptions
  - Focus on high-impact variables – e.g., GDP, population, technology availability and costs
- Other sources fill gaps
  - Roadmaps and forecasts from industry and technology researchers
  - Other modeling studies
  - ***Modeler judgment***

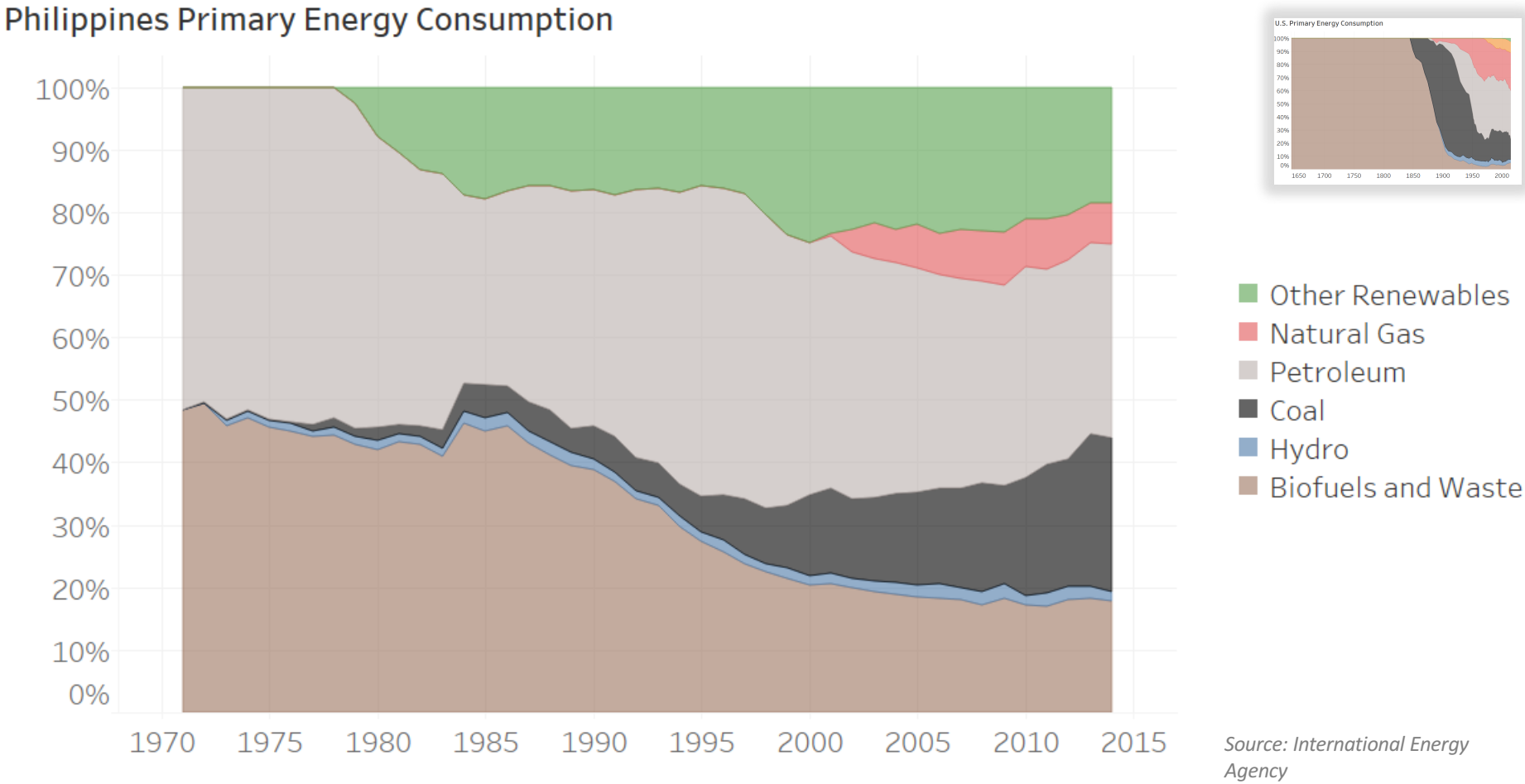


Understanding Model Legitimacy

- Transparency of algorithms and assumptions
- Calibration to historical record
- Stakeholder consultations and refinement based on stakeholder input
- Inclusion of relevant policies and a “sufficient” systems view
- Validation by comparison to other models



Unique Challenges in Developing Countries



Source: International Energy Agency

Developing Country Modeling Capacity Needed

- Access to tools
- Experience and technical knowledge
- Institutional support
- Data availability
- Staff continuity

LEAP

- Technical training
- Coalitions of modelers and stakeholders
- Participatory/joint modeling
- Flexible and freely available tools

OSeMOSYS
Open Source Energy Modelling System

A Local Example: Energy Modeling in Morocco

Joint modeling for capacity building and policy analysis

Key Objectives

- Develop a national energy system model owned, maintained, and operated by Ministry of Energy, Mines, Water and Environment
- Enhance capacity of Ministry team in energy modeling and systems analysis
- Provide tools to support contributions to climate and energy planning processes

Royaume du Maroc

Ministère de l'Energie, des Mines, de l'Eau et de l'Environnement

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A Parting Thought… Electricity May Be the Easy Part

- Decarbonization of air transport, freight transport, industry will likely require non-electric solutions
- Poses problems for energy modelers, too – uncertainty about technologies, emission factors, resource availability

Sources: Jeff Kubina, Arivaran Ravichantar, Richard Croft