

# **Modeling Energy Transitions**

## ***Lessons from the Field***

Jason Veysey

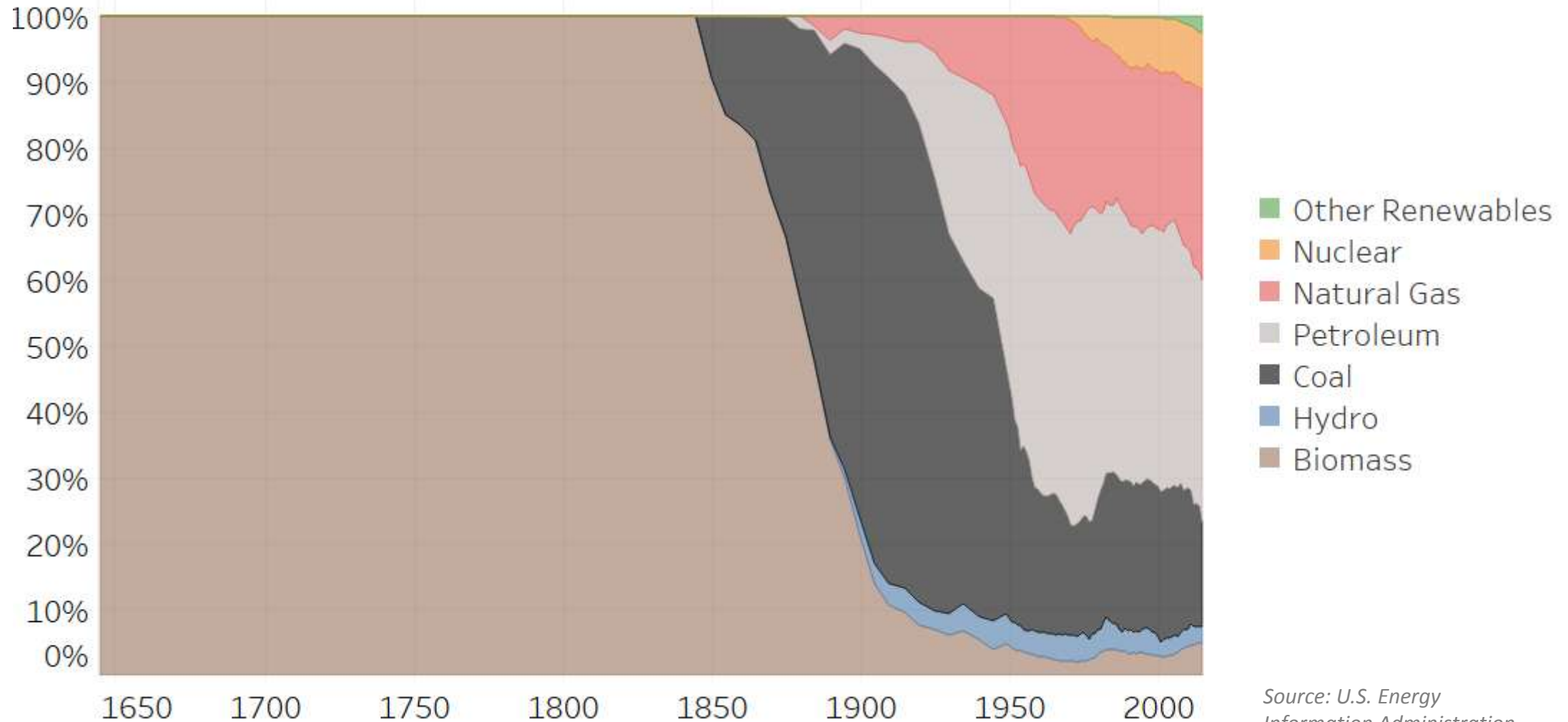
Deputy Director, Energy Modeling Program

Stockholm Environment Institute

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# Energy Transitions Don't Happen Overnight...

U.S. Primary Energy Consumption

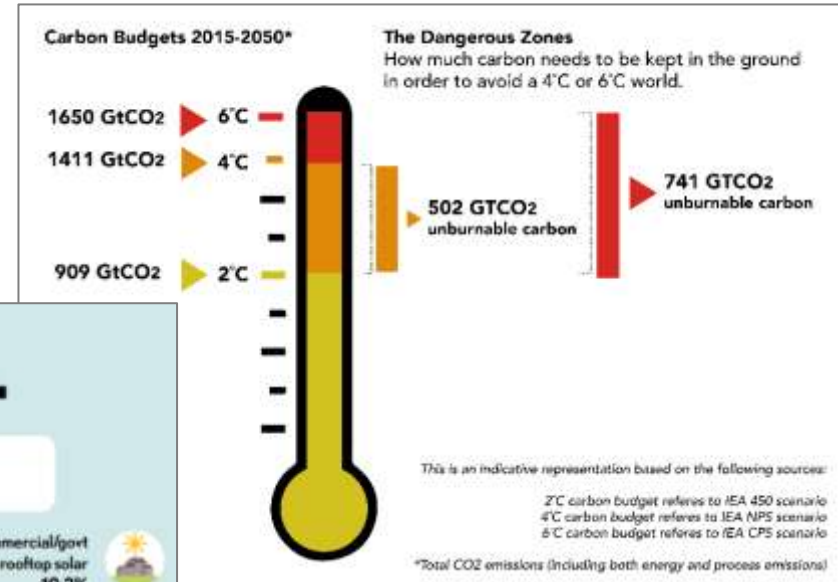


Source: U.S. Energy Information Administration

# But Climate Change Has Increased the Urgency

- Technology and market forcing

The screenshot shows the European Commission's website for the 2050 Energy Strategy. The header includes the European Commission logo and the word "ENERGY". Below the header, there are navigation tabs for "HOME", "TOPICS", "DATA & ANALYSIS", "CONSULTATIONS", "EVENTS", "FUNDING", "STUDIES", "PUBLICATIONS", and "ABOUT US". The main content area is titled "2050 Energy strategy" and features a large "2050" graphic. Below the graphic, there is a summary of the strategy: "The EU has set itself a long-term goal of reducing greenhouse gas emissions by 80-95% when compared to 1990 levels by 2050. The Energy Roadmap 2010 explores the transition of the energy system in ways that would be compatible with the greenhouse gas reductions target while also increasing competitiveness and security of supply. To achieve these goals, significant investments need to be made in new low-carbon technologies, renewable energy, energy efficiency and grid infrastructure. Because investments are made for a period of 20 to 40 years, policies that promote a stable business climate which encourages low-carbon investments must begin to be made today." There is also a "LATEST" section with three news items: "EU Energy Ministers commit to tackle together global energy and climate challenges" (4 July 2010), "Empowered consumers, advanced building materials and cutting carbon in transport - Thursday at EU Sustainable Energy Week" (16 June 2010), and "CO2 free beer, a Croatian region and a quantifiable renewable association: the EU2010 winners" (15 June 2010).



- Diversity of low-carbon fuels and technologies

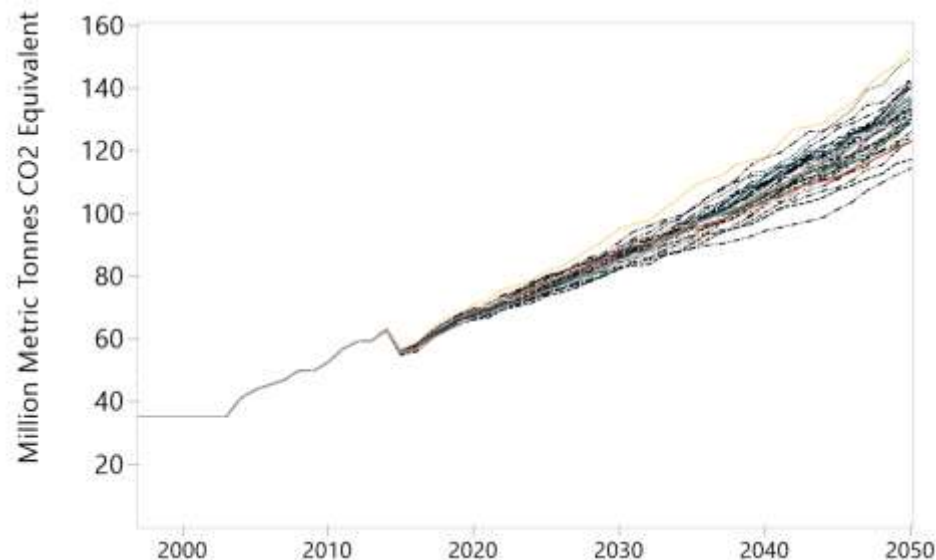
# A Role for Energy Systems Modeling

**We are *not* in the prediction business.**

# A Role for Energy Systems Modeling

*Explore possible futures through physically plausible, internally consistent scenarios*

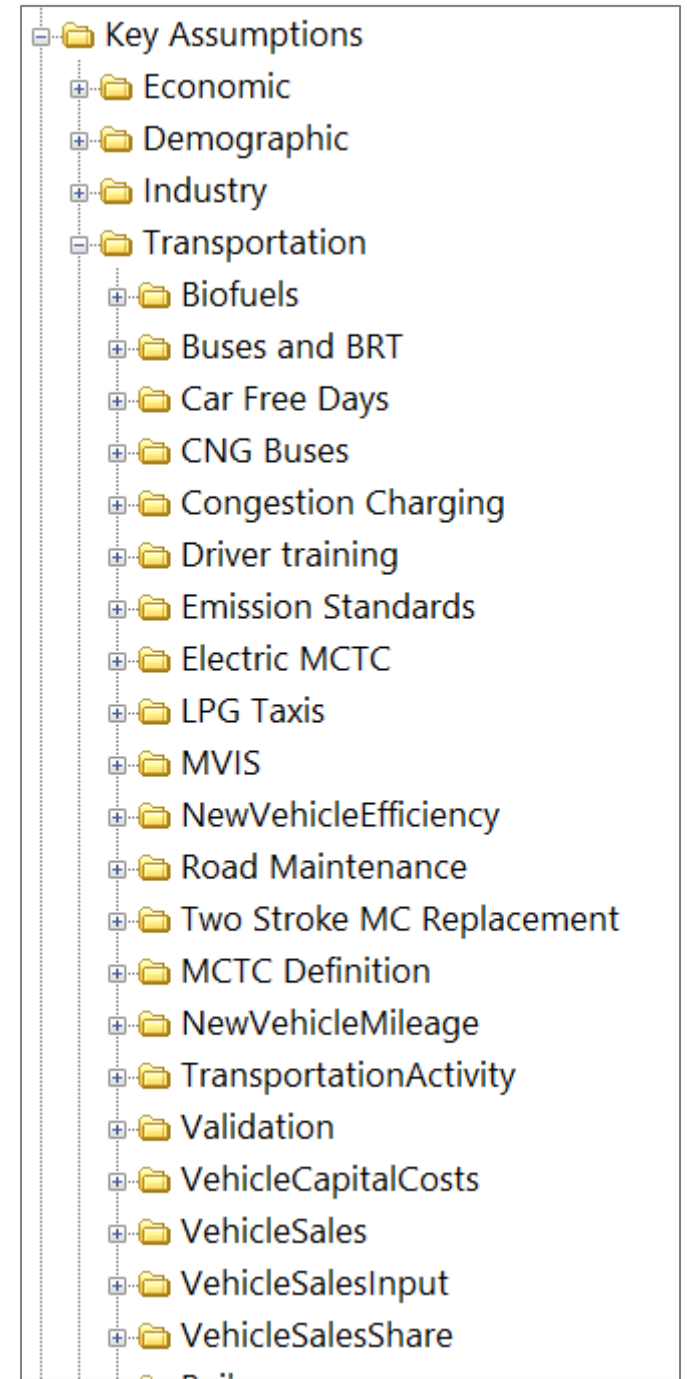
- Models are idealized mathematical representations based on:
  - Historical observations
  - Scientific laws
  - Socioeconomic theory
  - Selected boundary conditions



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

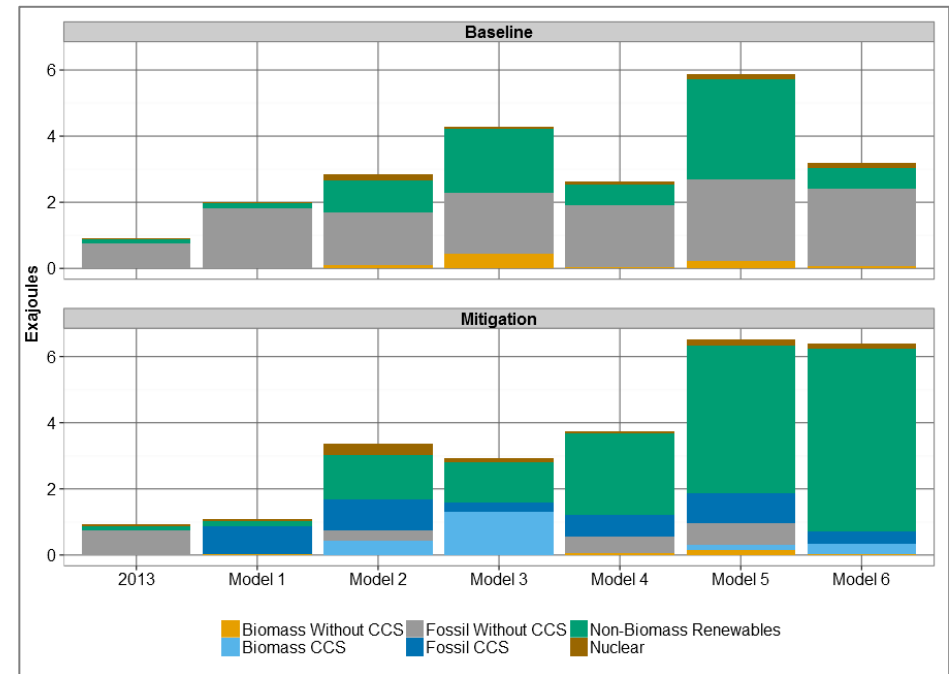
# 10,000 Assumptions

- 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***



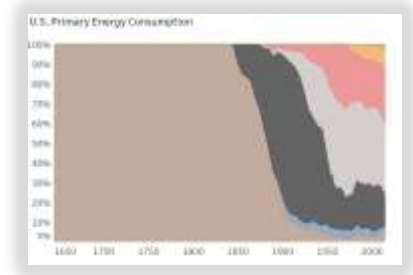
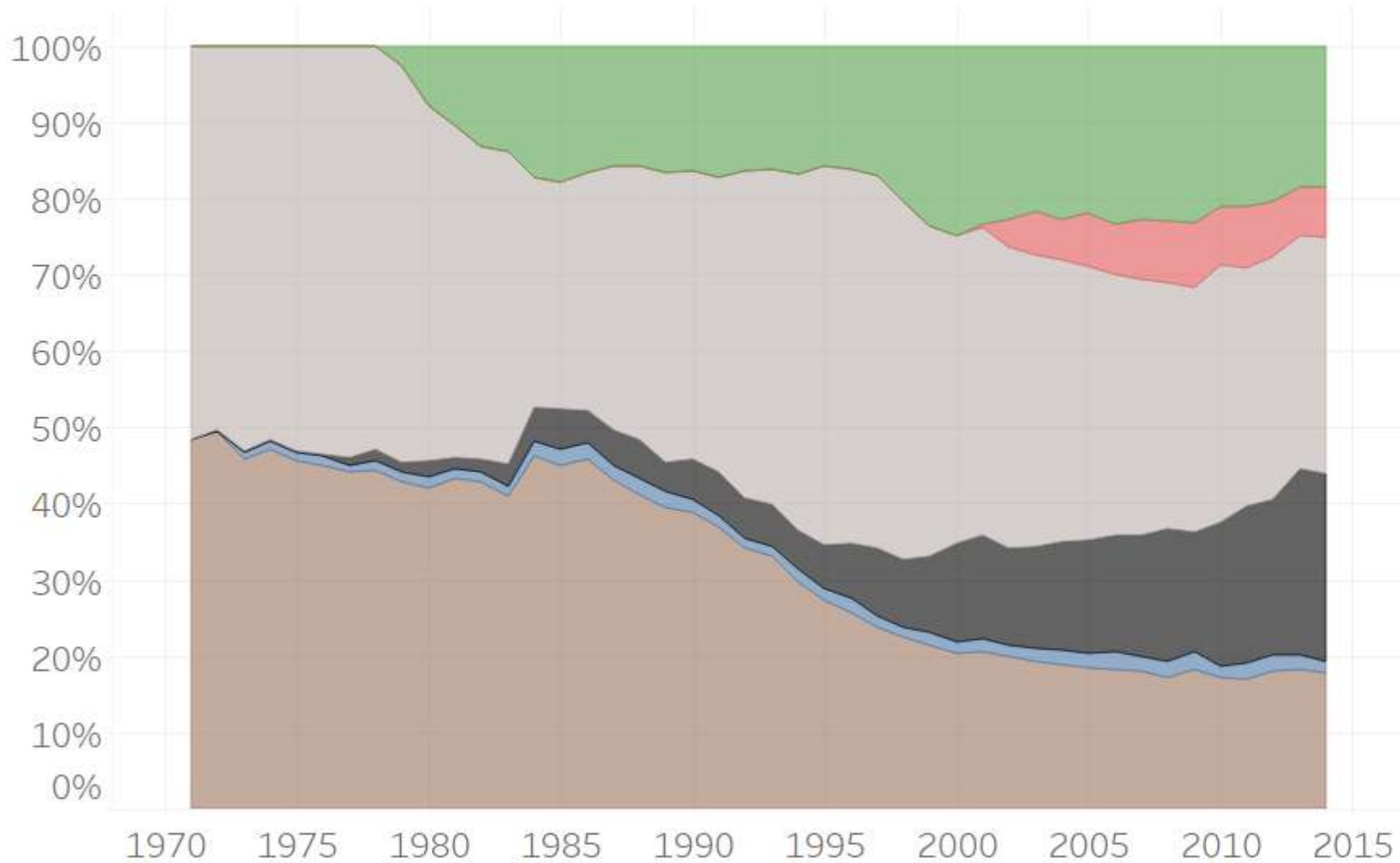
# Understanding Model Legitimacy

- 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

Philippines Primary Energy Consumption



- Other Renewables
- Natural Gas
- Petroleum
- Coal
- Hydro
- Biofuels and Waste

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

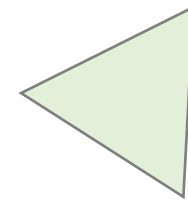


Royaume du Maroc



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

**giz**



 **SEI** STOCKHOLM  
ENVIRONMENT  
INSTITUTE

# 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

