# A Tool for Energy Planning and GHG Mitigation Assessment

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SEI STOCKHOLM ENVIRONMENT INSTITUTE

# Stockholm Environment Institute

- An international research organization working on sustainable development.
- HQ in Stockholm: Centers in UK, US, Estonia, Kenya (Africa) & Thailand (Asia).
- Research areas: energy policy, climate mitigation and adaptation, water resources planning, atmospheric pollution, sustainable futures.
- US Center affiliated with Tufts University in Boston.
- www.sei-international.org and www.sei-us.org

# What Do We Do?

- Develop and distribute LEAP at no charge to academic, non-profit and government organizations in the developing world.
- Training  & capacity building:
- Foster a community (COMMEND) for LEAP users and other sustainability practitioners.  Now with 23,000 members in 190 countries.
- Support LEAP users around the world.
- Develop our own scenario analyses.

A participant from NEPAL at a recent LEAP Training Workshop Explaining her energy demand analysis

# SEI Support for LEDS

United Nations
Framework Convention on
Climate Change

National
Communications
Support
Programme

UNDP UNEP GEF

LOW EMISSION
CAPACITY BUILDING
PROGRAMME

MAPS
Mitigation Action Plans & Scenarios

USAID
FROM THE AMERICAN PEOPLE

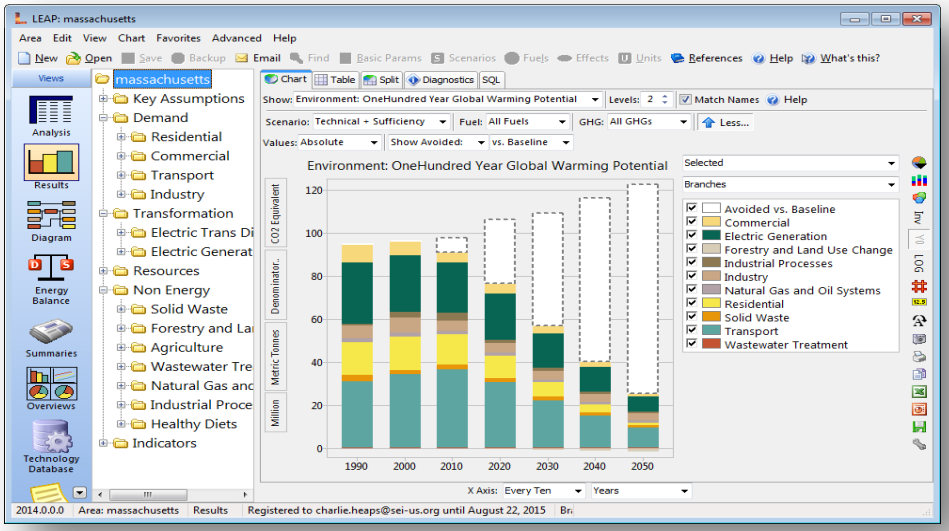
LEAD
LOW EMISSIONS ASIAN
DEVELOPMENT PROGRAM

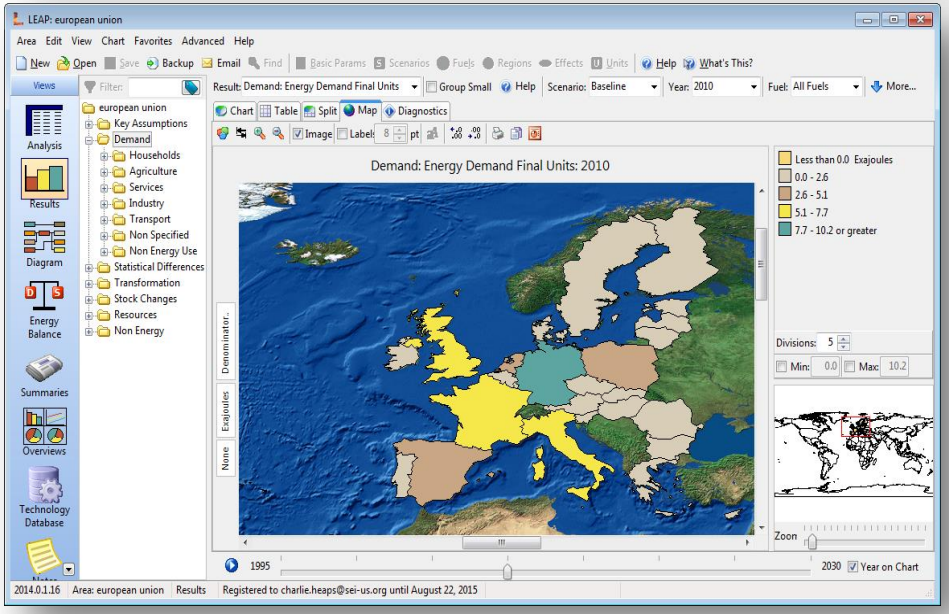
# Key Stages in LEDS

1. Organizing the LEDS Process
2. Assessing the Current Situation
3. Analyzing Options
4. Prioritizing Actions
5. Implementation and Monitoring

# Long-range Energy Alternatives Planning System

- Scenario-based modeling software for energy planning and GHG mitigation assessment.
- Broad scope, low initial data needs.
- Not a model: a decision support tool for creating models of different energy systems.
- Support for multiple modeling methodologies.
- Free to target organizations in developing countries.
- Thousands of users worldwide.
- Application Programming Interface (API): Links to Energy Information Systems.
- [www.energycommunity.org](http://www.energycommunity.org)

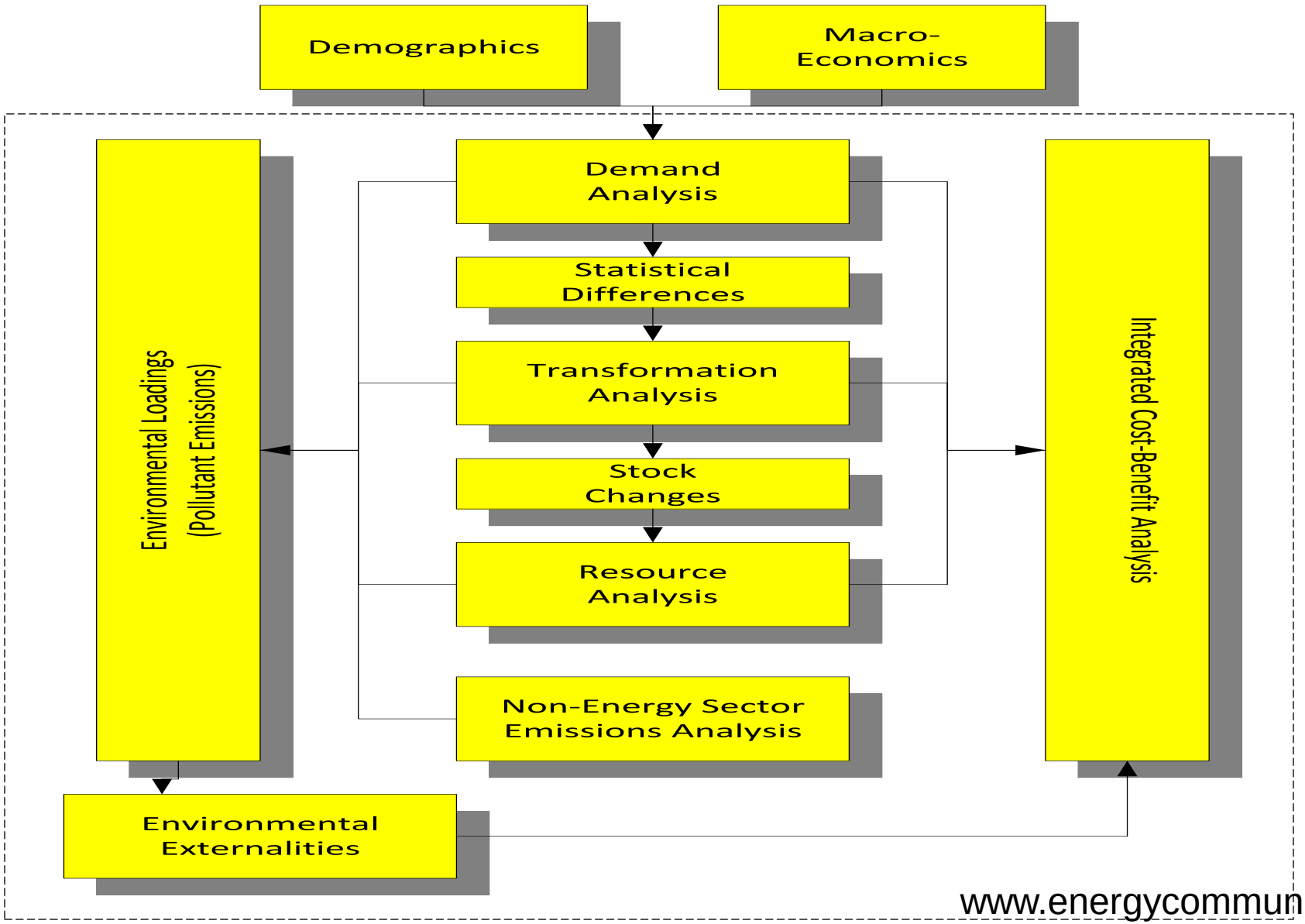


# What can you do with LEAP?

- Create national scale energy models
- Forecast demand and supply
- Create energy balances
- Assess GHGs and local air pollutant emissions forecasts
- Analyze costs and benefits of alternative policies and scenarios

# LEAP Structure & Calculation Flows



# LEAP: User Interface

The main menu and toolbar give access to major options.

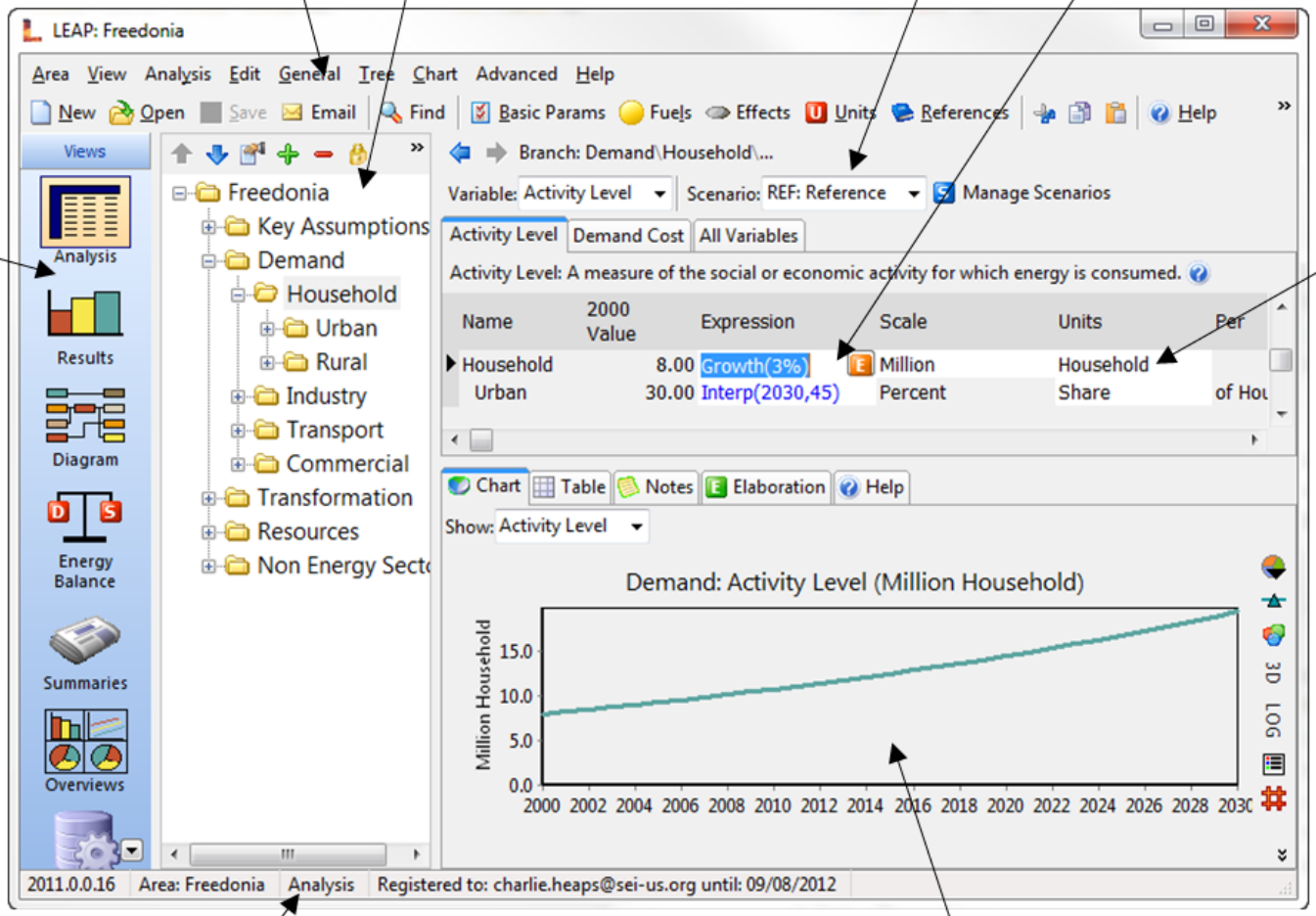
Data is organized in a tree.

Select scenarios here.

Edit data by typing here.

Switch between views of the Area here.

Select units and scaling factors here.

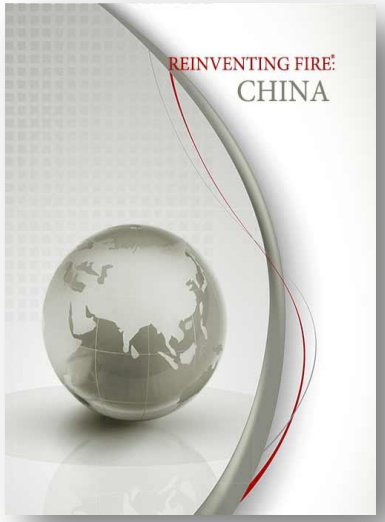



The status bar notes the current Area and View.

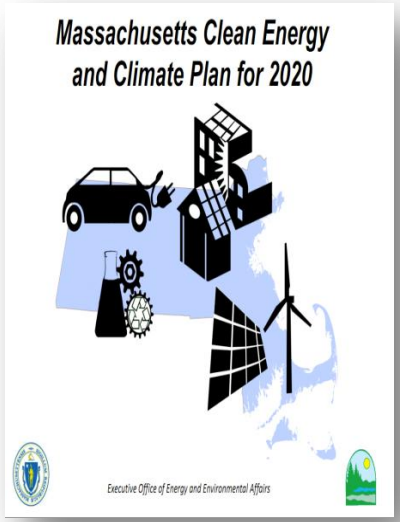
Data can be reviewed in chart or table format.

# Selected Recent Scenarios Activities

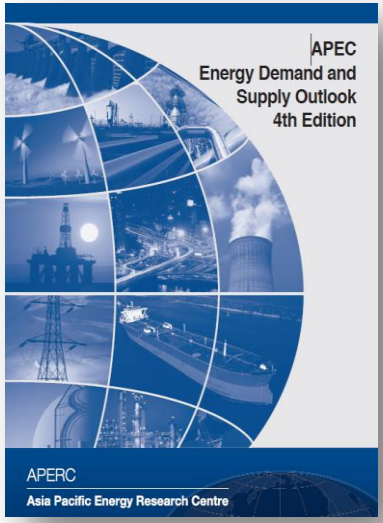












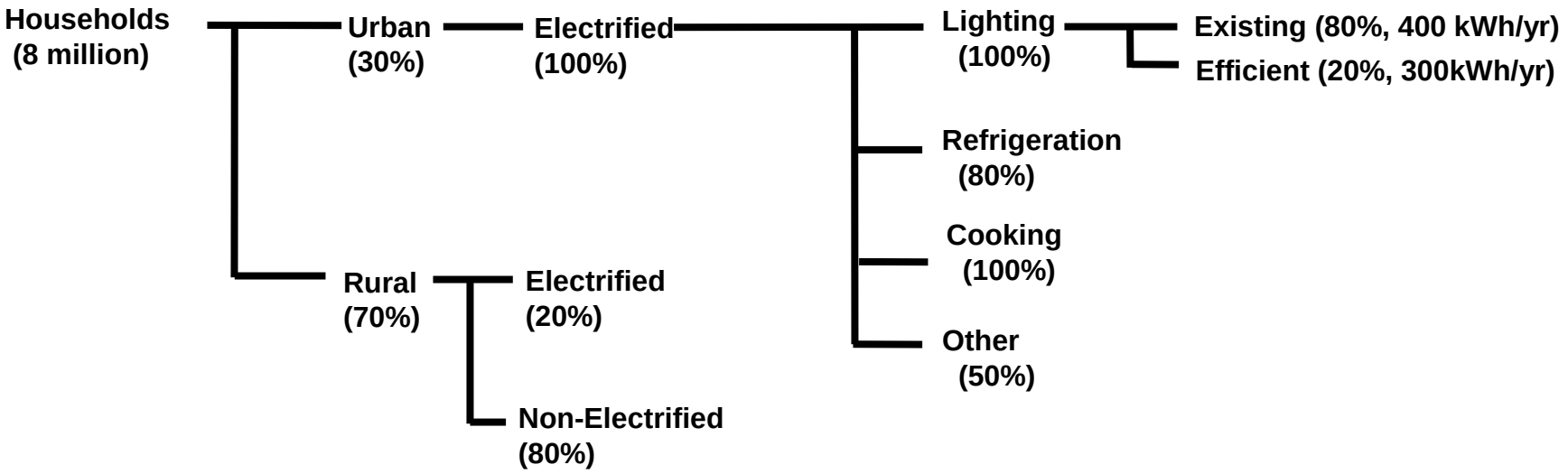
# Europe's Share of the Climate Challenge, 2009

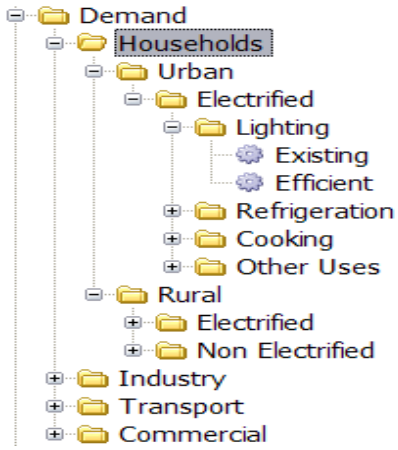
- Joint project of SEI and Friends of the Earth International, presented at COP15 in Copenhagen and at the European Parliament in 2010.
- LEAP used to create a detailed sector-by-sector mitigation scenario for 27 EU countries, which examines how to achieve GHG reductions of
  - 40% in 2020 and
  - 90% in 2050 vs. 1990 levels.
- Examines radical improvements in energy efficiency, accelerated retirement of fossil fuels and a dramatic shift toward renewables.
- Also examines the role of sufficiency and greater equity among EU nations in helping promote a transition to a low GHG future.

# Status and Dissemination

- Available at no charge to non-profit, academic and governmental institutions based in developing countries.
- Download from: www.energycommunity.org
- Technical support from web site or leap@sei-us.org
- User name and password required to fully enable software. Available on completion of license agreement.
- Most users will need training: available through SEI or regional partner organizations.
- Check LEAP web site for news of training workshops.

# Sample Demand Data Structure



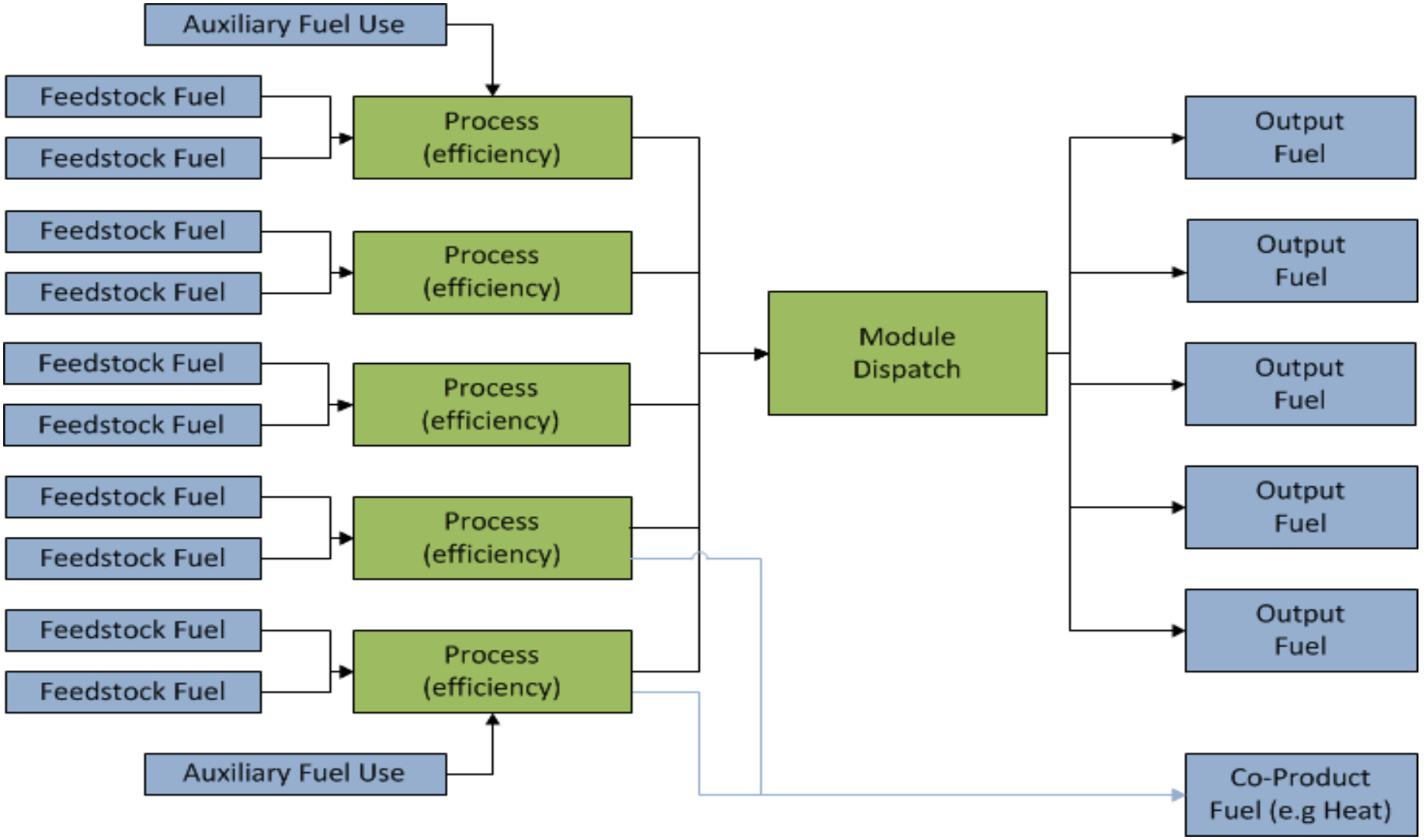




- The tree is the main data structure for organizing data and models, and reviewing results.
- Icons indicate types of data.
- Users can edit tree on-screen
- Structure can be detailed/end-use oriented, or highly aggregate.
- Detail can be varied from sector to sector.
- In multi-country models, tree can vary by country.

# Transformation Analysis in LEAP

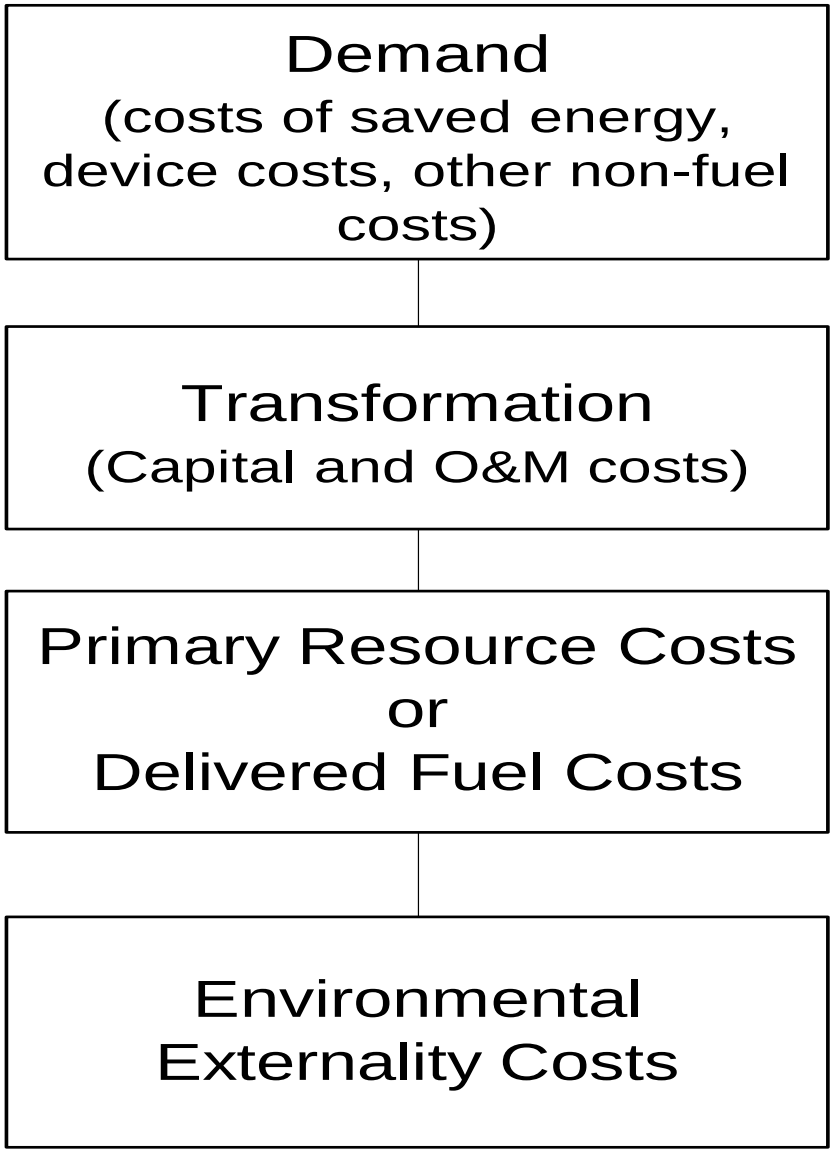
- Analysis of energy conversion, transmission and distribution, and resource extraction.
- Basic hierarchy: “modules” (sectors), each containing one or more “processes”. Each process can have one or more feedstock fuels and one or more auxiliary fuels.
- Allows for analysis of capacity expansion plans, plant dispatch, GHG and local air pollutant emissions, costs and benefits .
- Range of approaches supported
  - Simple simulation modeling (with or without capacity data) of specific plans and policies
  - Least-cost optimization modeling using linear or mixed integer programming
  - Supports analysis of renewable portfolio targets and carbon prices
  - Uses free GLPK solver. Also supports CPLEX solver.

# General Transformation Module Layout



# Social Cost-Benefit Analysis in LEAP

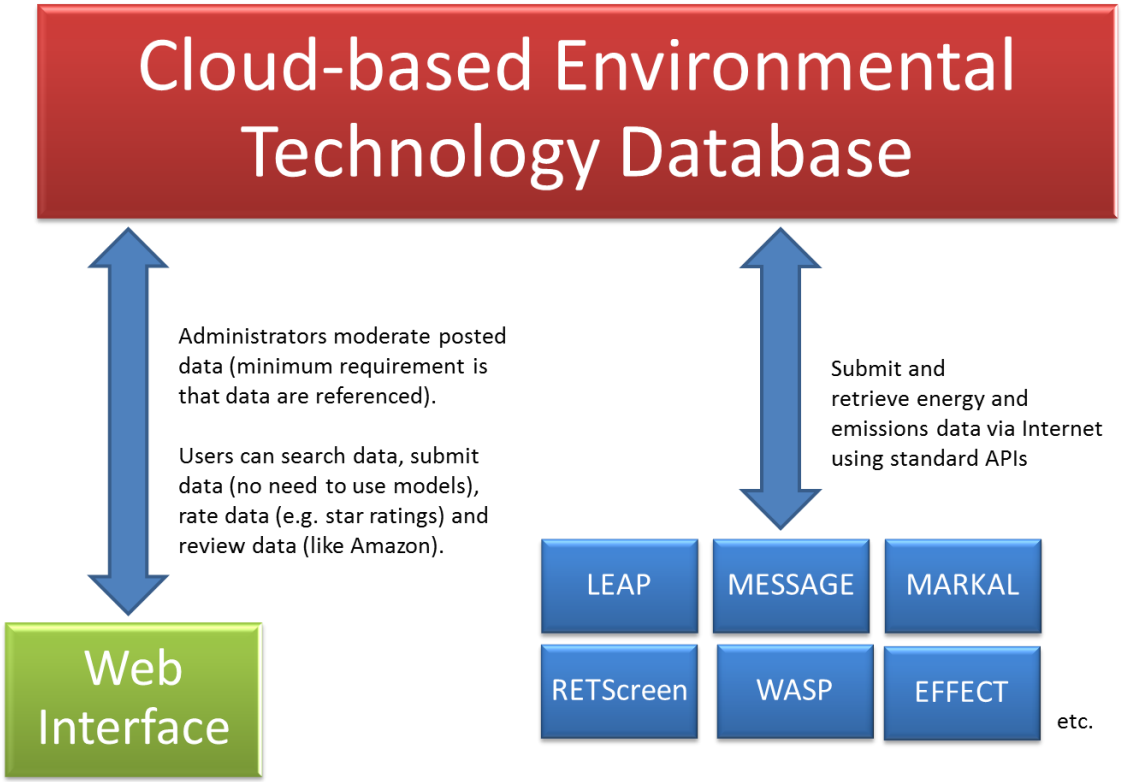
- Societal perspective of costs and benefits (i.e. economic not financial analysis).
- Avoids double-counting by drawing consistent boundary around analysis (e.g. whole system including.
- Cost-benefit analysis calculates the Net Present Value (NPV) of the differences in costs between two scenarios.
- NPV sums all costs in all years of the study discounted to a common base year.
- Optionally includes externality costs, decommissioning costs and costs of unserved demands.



# Plans for Future Development:2014-2015

- Easier to Use Version for City and Provincial-Scale Planning:
  - Targets planners rather than modelers
  - Better default data
  - Less Complex User Interface
- New Web Version
  - Allow LEAP Studies to be published online.
  - Easier Access for more stakeholders

- New Cloud-based Environmental Technology Database

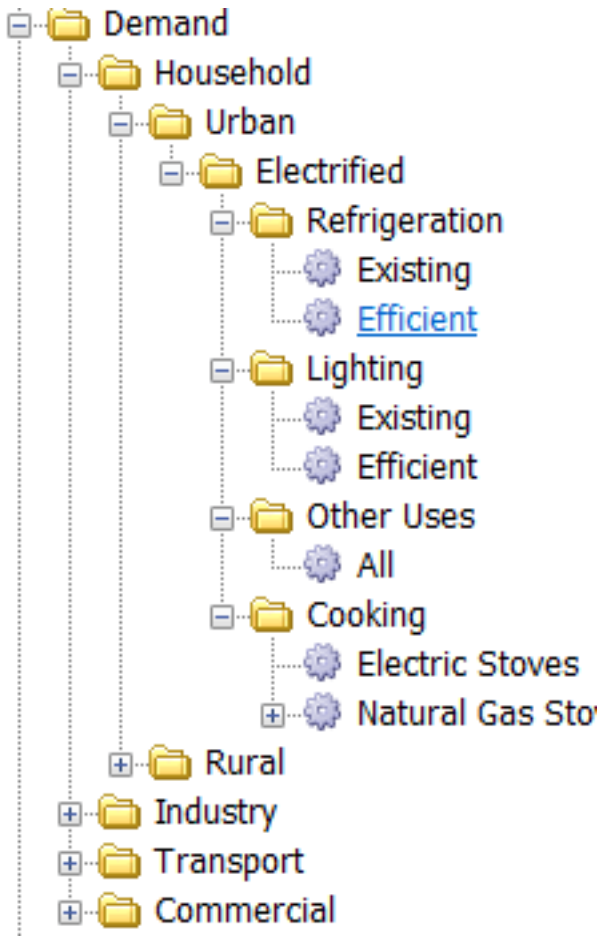


# Three Approaches for Demand Modeling in LEAP

- Bottom-Up/End-Use
- Top-down/Econometric
- Hybrid/Decoupled

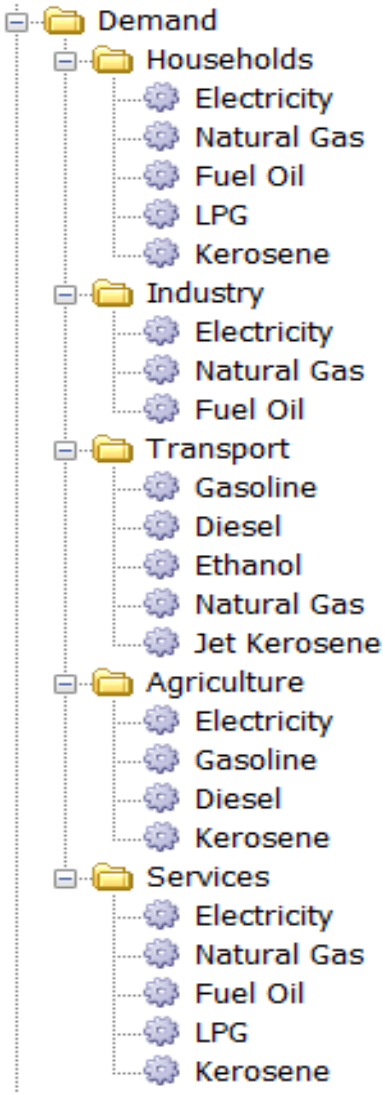
# Bottom-Up/End-Use

- Detailed accounting for all the various sectors/subsectors/end-uses/devices that consume energy.
- Pros:
  - Provides a more fundamental understanding of why energy is used in an economy: probably the best approach for thinking about long-term transitions.
  - Captures impacts of structural shifts and from technology-based policies such as energy efficiency.
- Cons:
  - Data intensive.
  - Reliant on expertise of analyst for many trends and assumptions.
  - Hard to capture impacts of fiscal policies (e.g. Carbon tax).



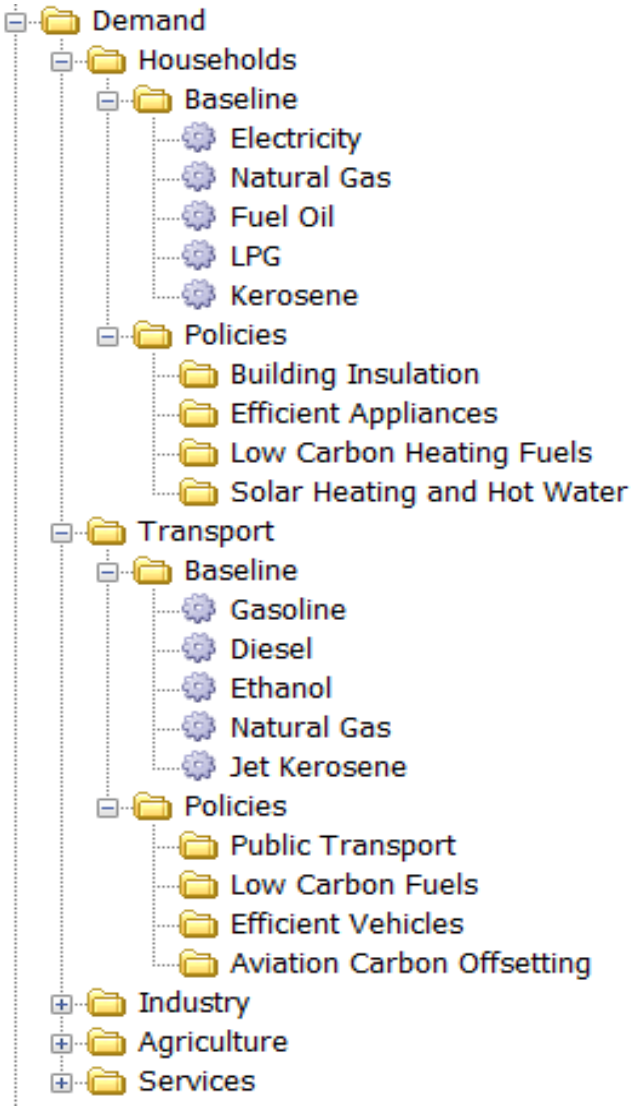
# Top-down/Econometric

- A more aggregate approach often with energy consumption broken down only into sectors and fuels.
- Less data intensive
- Relies on good historical time-series data.
- Consumption trends forecast into future using simple historical trends or aggregate econometric relationships (GDP, fuel prices,  etc.)
- Pros:
  - Captures impacts of fiscal policies (e.g. C tax)
- Cons:
  - Not well suited to long-range scenarios since the exogenous variables (e.g. prices) are themselves so poorly known.
  - Not well-suited for examining technology-based policies.



# Hybrid/Decoupled

- Baseline scenario forecast using top-down approach. Alternative scenarios modeled as policy measures that reduce energy consumption over time.
- In LEAP, these are entered as negative "wedges" of consumption: subtracted from baseline energy use in each sector.
- Pros:
  - Less data intensive than end-use approach, but able to capture technology-based policies.
- Cons:
  - Not a full end-use model, so does not give insights into how energy system structure might change in long-run. Limited to situations where measures are small vs. baseline.



# Starter Data

- National level starter data sets for use with LEAP.
- Available to qualified developing country energy analysts.
- Include aggregate historical data on energy consumption, production, energy sector emissions and non energy sector emissions.
- Based on a range of international data sources including data from the IEA, World Bank, IPCC, the UN, WEC and WRI.
- Simplified projections to 2030.
- A starting point for analysis: **not intended as complete projections.**
- Users will need to check, refine and correct these starter data sets – typically by using their own superior locally available data.
- Condition of use as stipulated by IEA: any improvements made to data must be documented and copies provided back to SEI and the IEA.
- Each data set is provided as a single ".leap" data file and can be downloaded from the COMMEND web site.