

# Modeling Transformation *in LEAP*

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# Transformation

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- Conversion of primary forms of energy to secondary and further transformation (e.g. coking coal to coke, crude oil to petroleum products, heavy fuel oil to electricity)\*
  - Electricity generation
  - Oil refining
  - Coal transformation
  - Heat generation
  - Liquefaction

\* IEA definition



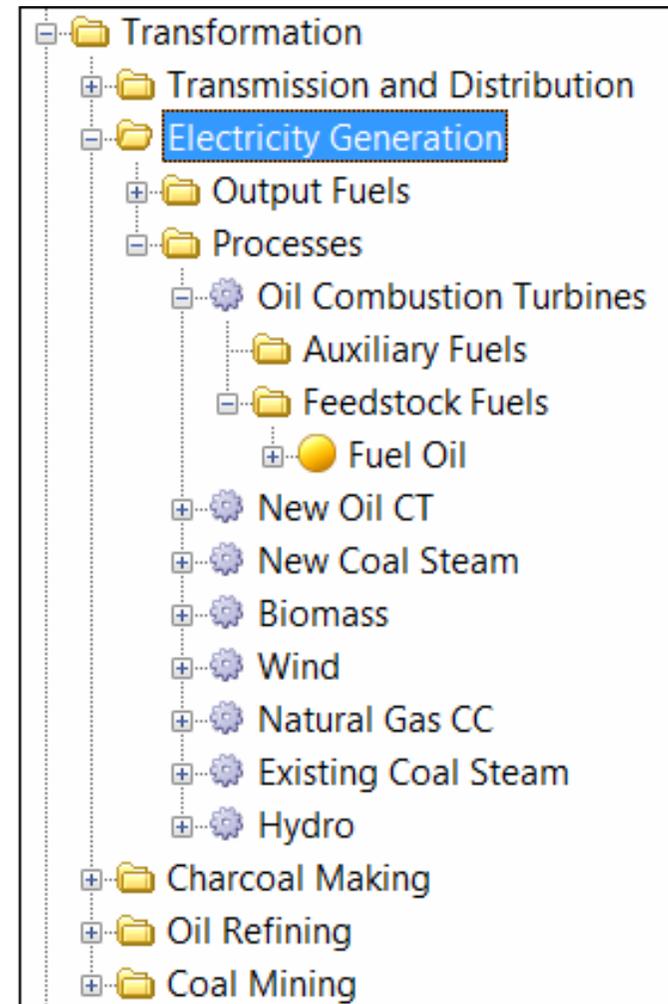
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# Transformation in LEAP

- Transmission & distribution
- Energy conversion
- Resource extraction



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# Basic parameters

**Basic Parameters**

Scope & Scale | Years | Default Units | Calculations | **Loads** | Optimization | Stocks | Internet | Charts | Folders | Security

**Area**

Name: Name of Area

Description:

**Scope**

- Transformation & Resources
- Statistical Differences & Stock Changes
- Costs
- Energy Sector Environment Loadings
- Non-Energy Sector Environment Loadings
- Indicators

[Edit List of Result Variables to Save](#)

**Scale**

- Global
- Multi-national
- National
- Sub-national

Country:

**User Information: from COMMEND**

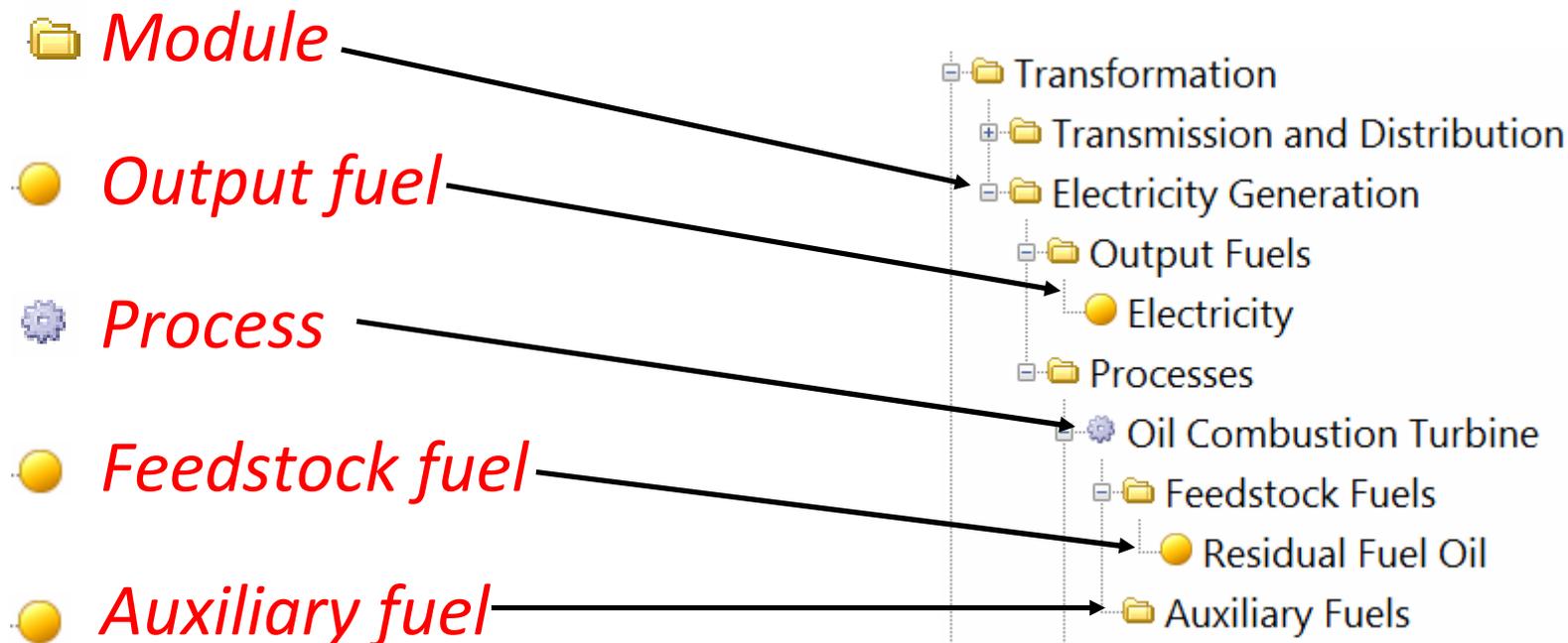
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Organization Type	Academic Organization
City	Athens
Country	Greece
Email	promitheas@kepa.uo...
Web	http://www.kepa.uoa....
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Close Help



# Branch types



**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.



# Module properties

Transformation Module Properties

Name:

Simple non-dispatched module: one output fuel per process.

Types of data to include:

Costs

Capacities

System Load Curve (required if dispatching by cost or merit order)

Planning Reserve Margin (if unchecked will be calculated endogenously)

Co-product fuel:

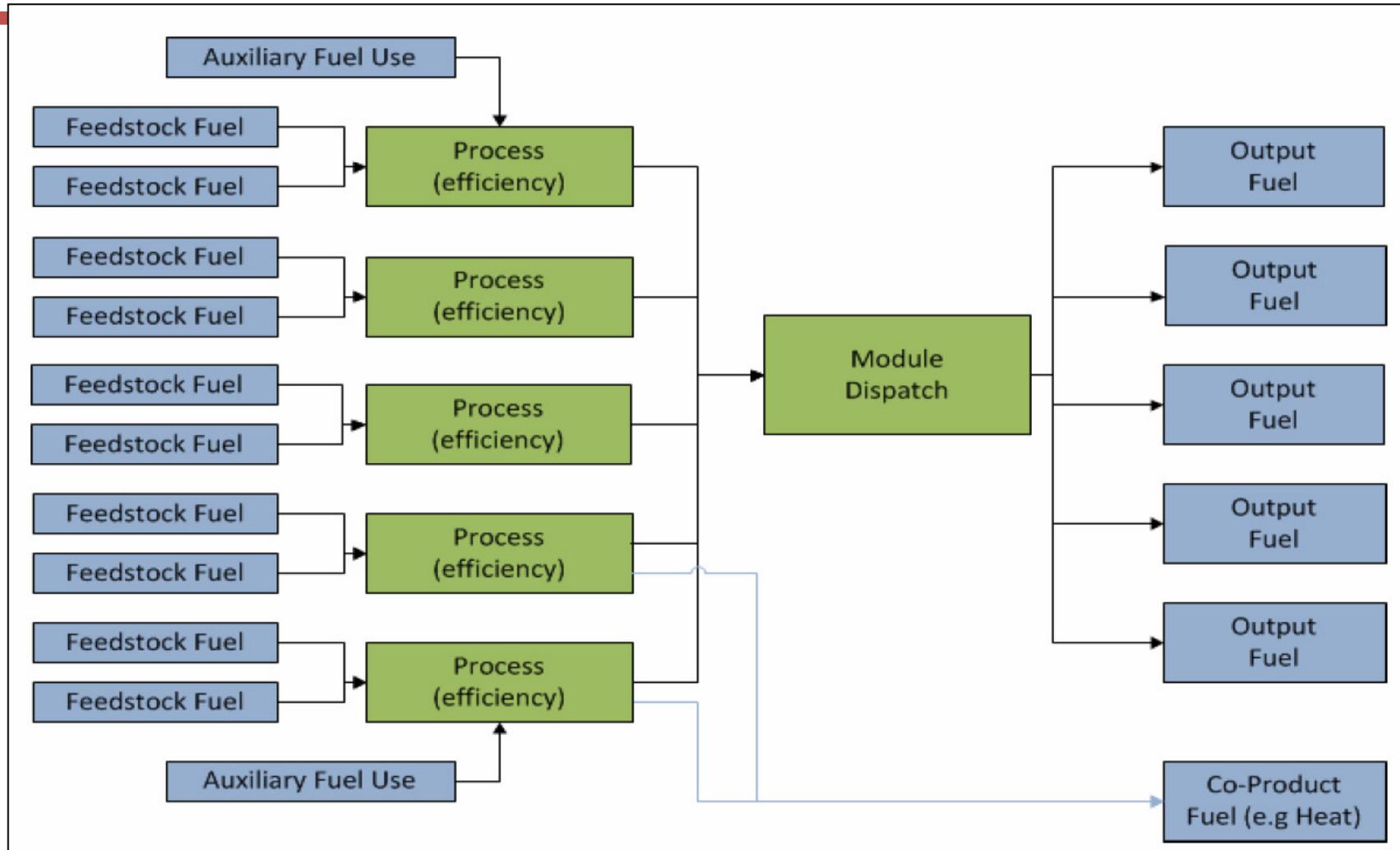
Output shares (otherwise outputs in proportion to requirements).

Enter efficiency data as:

Efficiencies  Losses  Heat rates



# General module structure



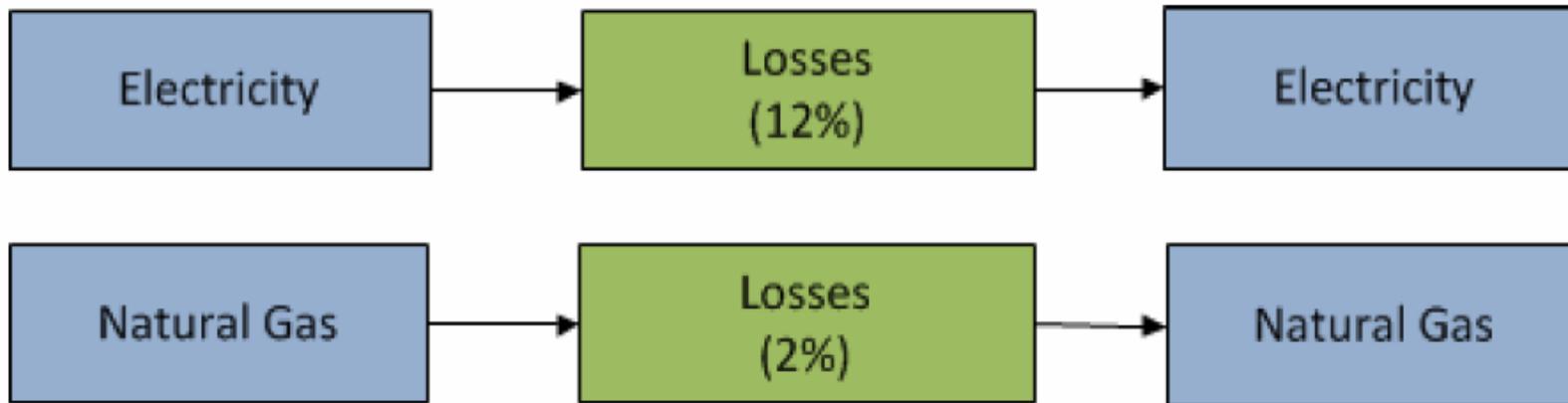
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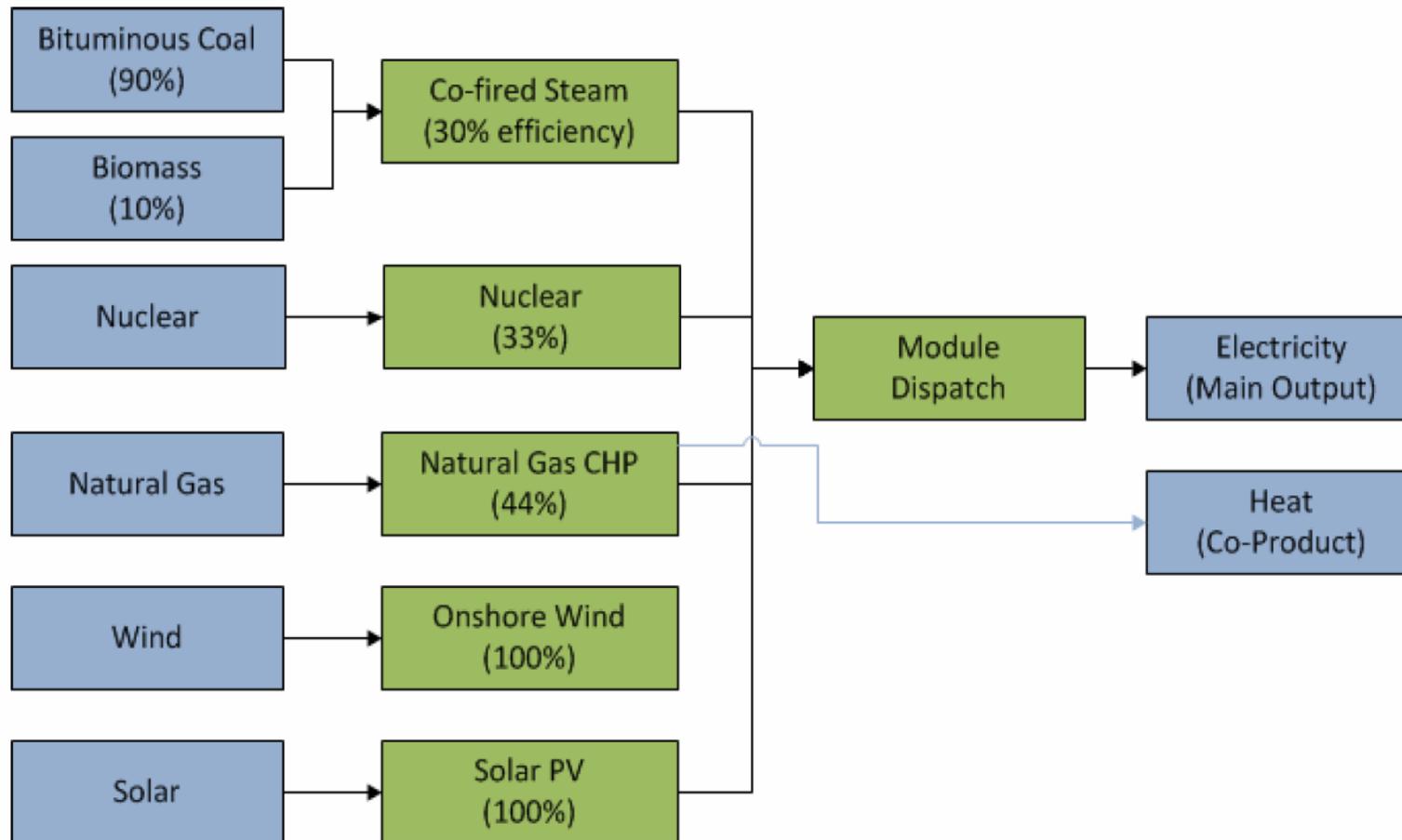
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# Example module 1: Simple non-dispatched

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# Example module 2: Electricity generation

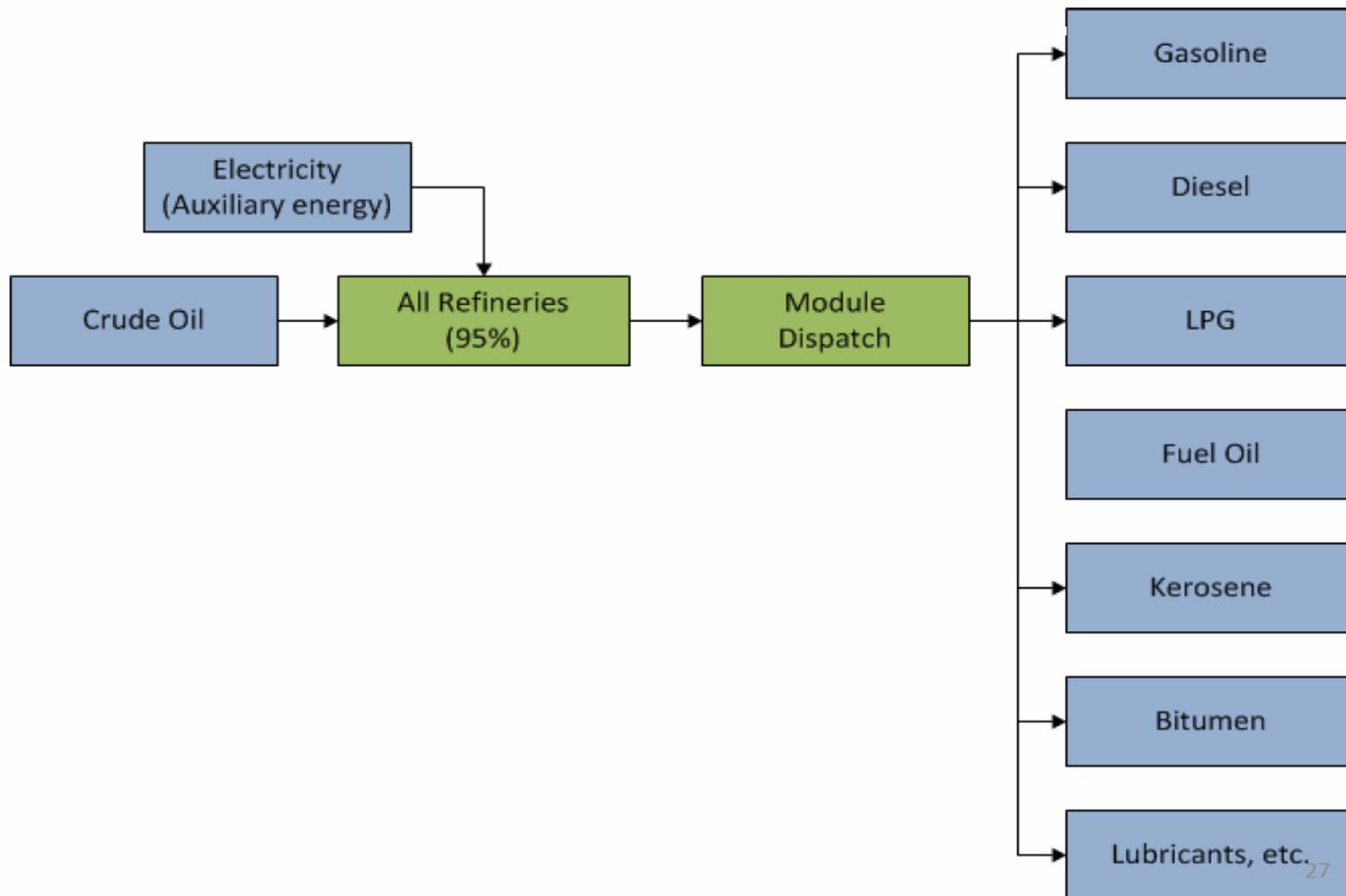


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# Example module 3: Oil refining



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# Set-up Transformation model

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1. Identify modules to include
2. Arrange modules in correct order
3. Set module properties
4. Determine level of detail
5. Enter data



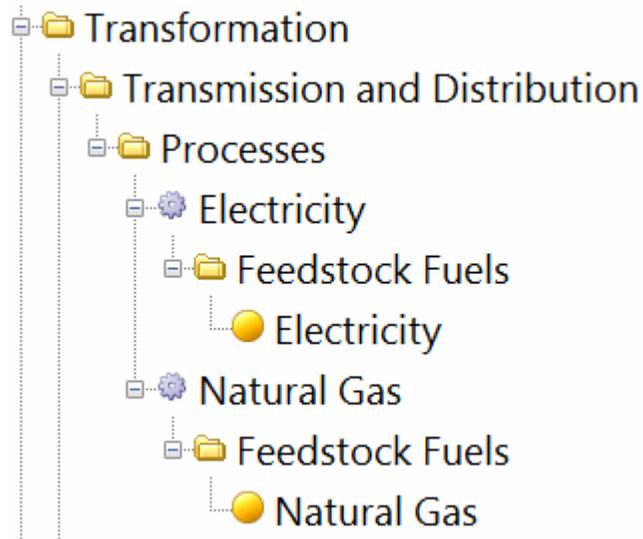
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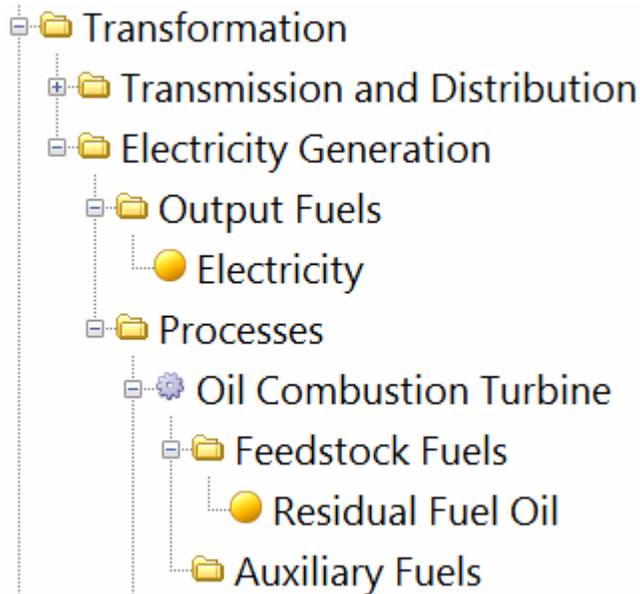
# Modeling Transmission & Distribution

1. Add Module
2. Set Module properties
3. Add Processes
4. Set Process properties
5. Enter data




# Modeling electricity generation

1. Add Module
2. Set Module properties
3. Add Processes
4. Set Process properties
5. Enter data




# Data requirements

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- Key assumptions
- Plants characteristics
  - Exogenous capacity
  - Endogenous capacity
  - Historical production
  - Maximum availability
  - Efficiency
  - Lifetime
  - Capacity credit
  - Dispatch rules
  - System load curve



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# Making a load shape

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1. Divide year into time slices
2. Make load shape with data for each time slice
3. Assign the load shape to electricity system



# Time slices

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- Seasonal and time-of-day divisions into which annual electricity loads can be divided
- Set up wizard to create seasonal, quarterly, monthly, weekly, or daily time slices



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The screenshot shows the LEAP: Freedonia software interface. The 'General' menu is open, and 'Time Slices' is highlighted. The 'Dispatch Rule' window is also open, showing a table of dispatch rules for various energy technologies.

Branch	Expression
New Oil Combustion Turbine	MeritOrder
Existing Oil Combustion Turbine	MeritOrder
New Coal Steam	MeritOrder
Existing Hydro	MeritOrder
Existing Coal Steam	MeritOrder



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The screenshot shows a software window titled "Time Slices" with a toolbar containing "Setup", "Delete", "Delete All", and "Export/Import" buttons. A "Setup Time Slices" dialog box is open, asking "What kind of time slices do you want to create?". The "Simple" option is selected, with a slice duration of 1,000 hours. The dialog indicates it will create 8 slices of 1000 hours each and one 760-hour slice. Below this, a table lists the resulting slices:

Ord Time Slice	Hours
1 Hours 0000 to 1000	1000
2 Hours 1000 to 2000	1000
3 Hours 2000 to 3000	1000
4 Hours 3000 to 4000	1000
5 Hours 4000 to 5000	1000
6 Hours 5000 to 6000	1000
7 Hours 6000 to 7000	1000
8 Hours 7000 to 8000	1000
9 Hours 8000 to 8760	760

At the bottom of the dialog, it shows "9 Slices" and "Tot=8.760". The "Year" is set to 2010, with a "leap year?" checkbox. Buttons for "Close", "Help", and "More" are visible.



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# Loads

Basic Parameters

Scope & Scale | Years | Default Units | Calculations | **Loads** | Optimization | Stocks | Internet | Charts | Folders | Security

How do you want to enter electricity load curves?

- Load shape for entire system (% of Peak Generation)
- Load shape for entire system (% of Annual Generation)
- Load shapes for each device (System load shape will be calculated)

Only show load shapes for electric technologies

Close Help

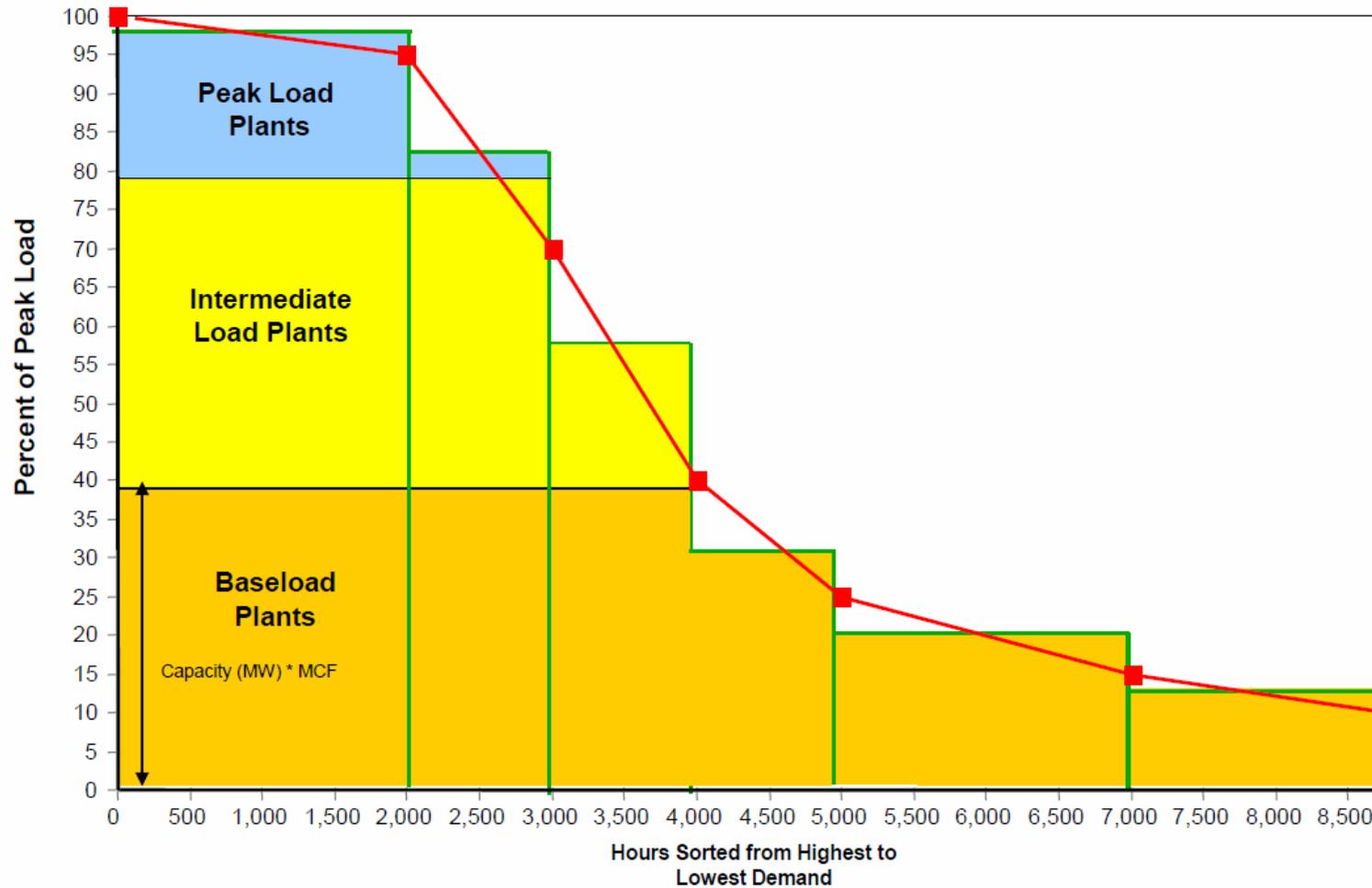


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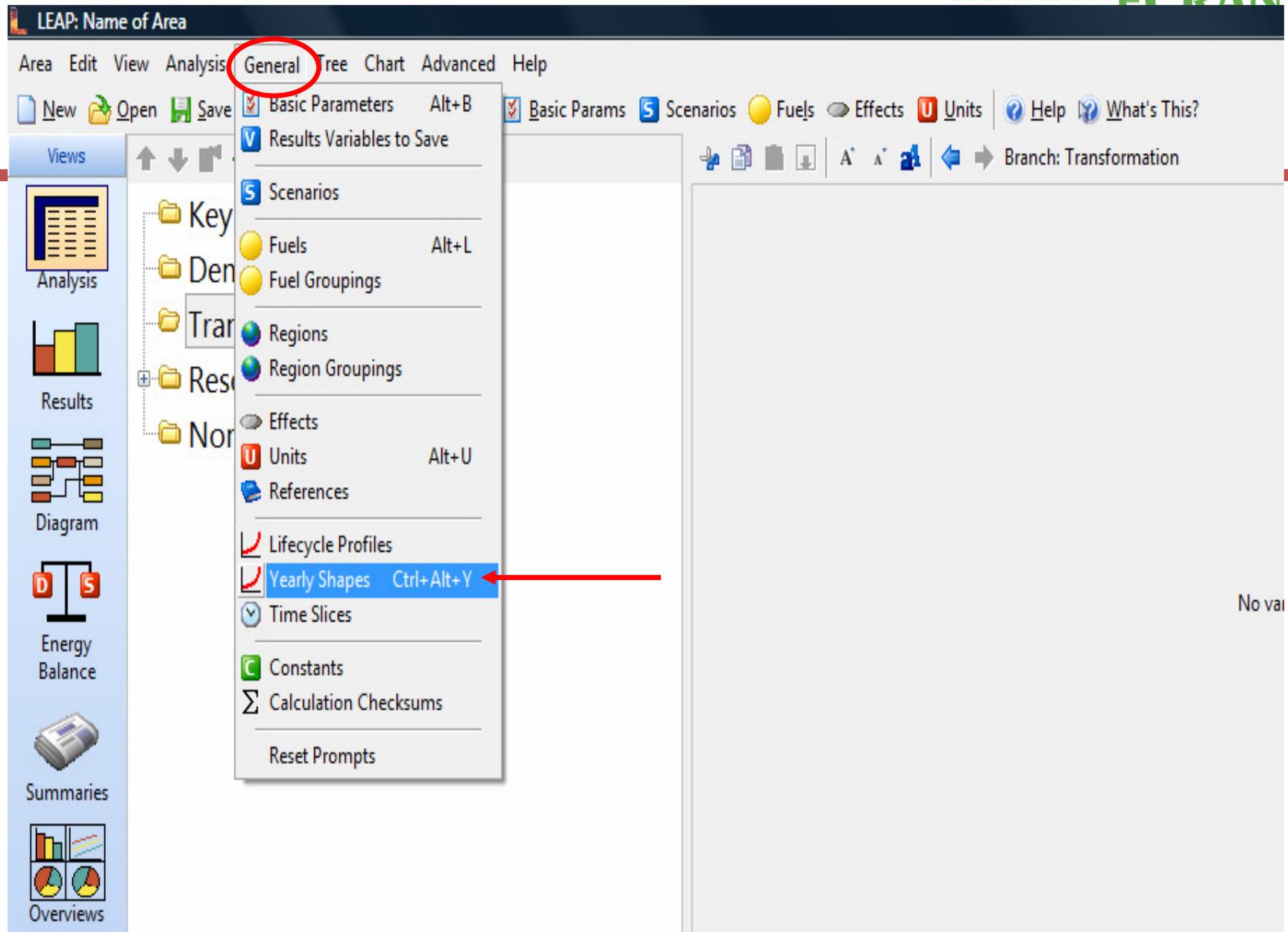
# Load duration curve



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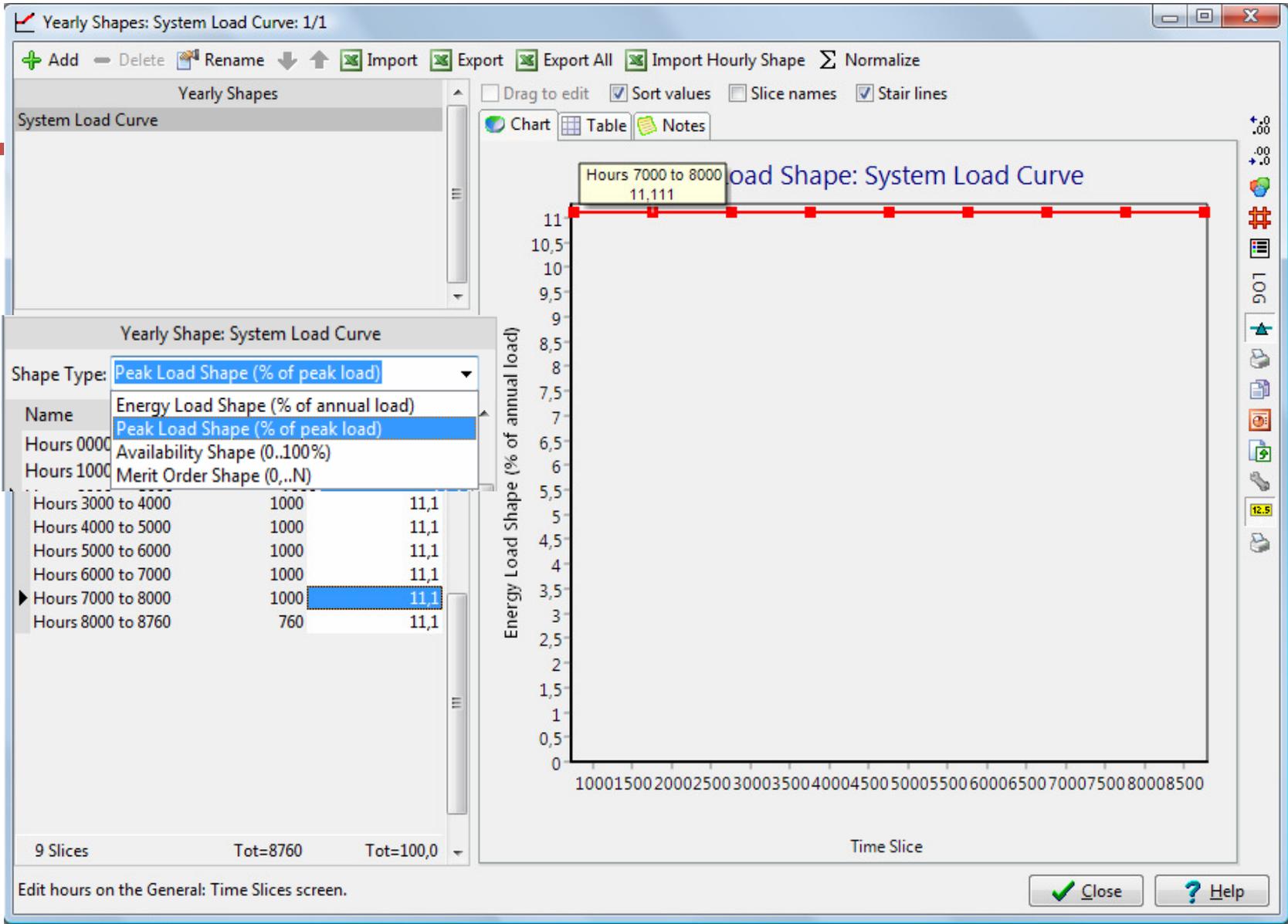
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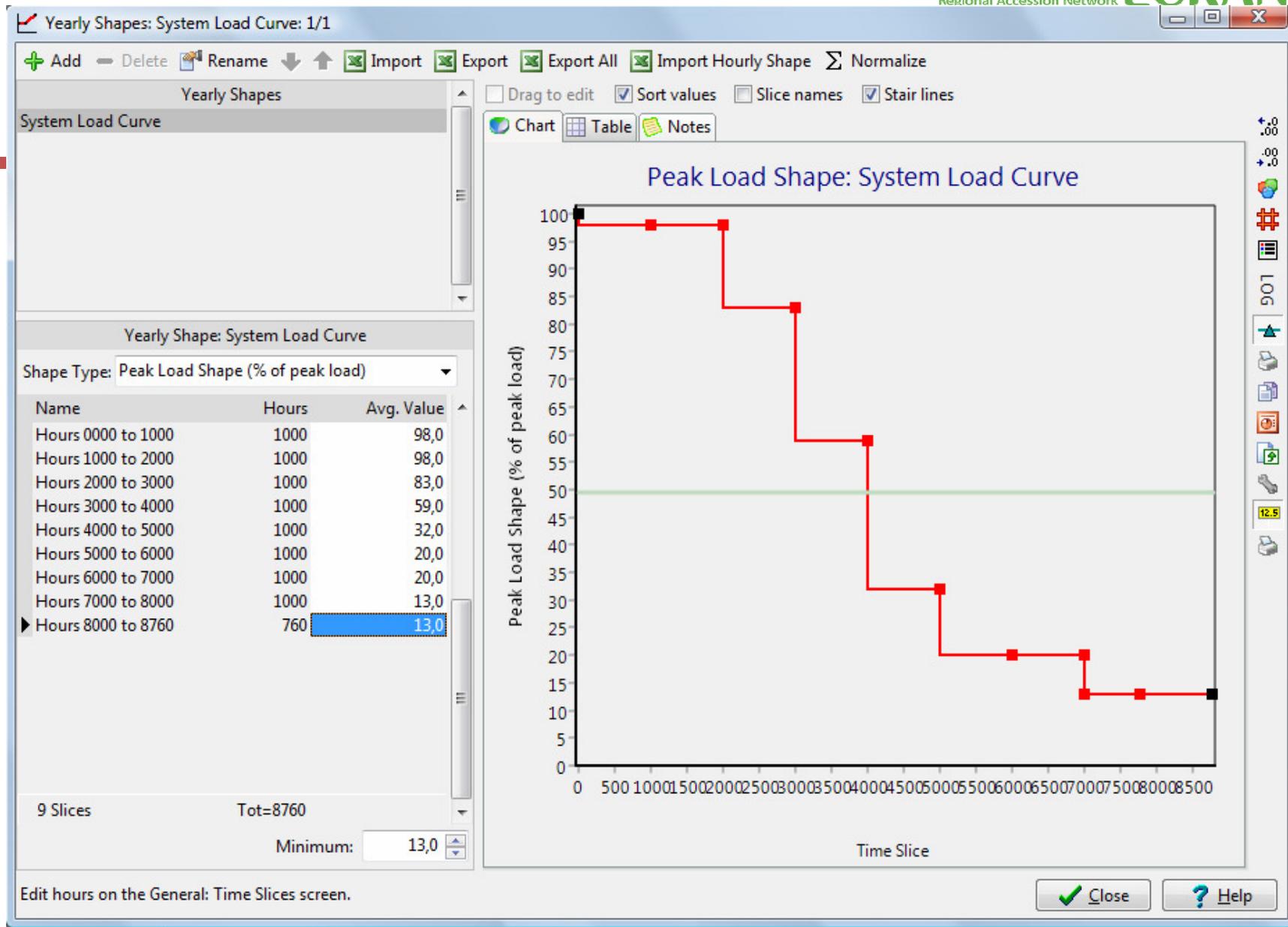
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The screenshot displays the ECRAN software interface. On the left, a tree view shows the project structure: Freedonia, Key Assumptions, Demand, Transformation, Transmission and Distribution, Electricity Generation (highlighted with a red underline), Output Fuels, Processes, and Resources. The main window shows the 'Branch: Transformation\Electricity Generation\...' path. Below this, there are dropdown menus for 'Branch: All Branches', 'Variable: System Peak Load Shape' (circled in red), and 'Scenario: Current Accounts'. A table lists variables: 'Planning Reserve Margin', 'System Peak Load Shape' (circled in red), and 'All Variables'. The 'System Peak Load Shape' variable is expanded to show its expression: 'YearlyShape(System Load Curve)'. A context menu is open over the expression, listing actions like 'Cut', 'Copy', 'Ditto', 'Reset to Inherited', 'Branch/Variable', 'Function', 'Time Series', and 'Use Aliases'. A red circle highlights the 'E' icon in the top right corner of the main window.



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# Dispatch modes

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- **Mode 1: Historical**
  - dispatch of plants based on historical generation
- **Mode 2: Simulation**
  - dispatch of plants based on various dispatch rules ranging from very simple (% of total generation) to more sophisticated (dispatch by merit order or in order of running costs)
- Set the **First Simulation Year** variable for each process to determine when to use historical mode and when to use simulation mode.
- Mix modes and dispatch rules in neighboring processes (e.g. dispatch wind by percentage to meet a renewable portfolio standard, but dispatch other processes by merit order).



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# Dispatch rules

The screenshot shows the ECRAN software interface. On the left is a tree view of the model structure for 'Freedonia', including folders for 'Key Assumptions', 'Demand', 'Transformation', 'Transmission and Distribution', 'Electricity Generation', 'Output Fuels', 'Processes', and 'Resources'. The 'Processes' folder is expanded, showing 'New Oil Combustion Turbine', 'Existing Oil Combustion Turbine', 'New Coal Steam', 'Existing Hydro', and 'Existing Coal Steam'. The main window displays a table of dispatch rules for the selected process.

Branch	Expression
New Oil Combustion Turbine	MeritOrder
Existing Oil Combustion Turbine	MeritOrder
New Coal Steam	MeritOrder
Existing Hydro	MeritOrder
Existing Coal Steam	MeritOrder

A context menu is open over the 'MeritOrder' expression for 'New Oil Combustion Turbine'. The menu items are:

- PercentShare: Runs in proportion to Process Share variable.
- ProportionalToCapacity: Runs in proportion to available capacity.
- FullCapacity: Dispatches up to full available capacity regardless of requirements.
- MeritOrder: Dispatches in order using Merit Order variable.
- Cut (Ctrl+X)
- Copy (Ctrl+C)
- Paste (Ctrl+V)
- Paste Special
- Ditto (Ctrl+D)
- Reset to Inherited
- Branch/Variable (Ctrl+B)
- Function (Ctrl+F)
- Time Series (Ctrl+T)
- Use Aliases



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# Let's practice!

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