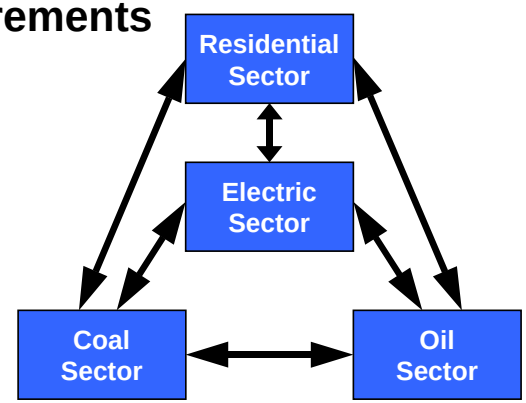
Overview of the ENergy and Power Evaluation Program (ENPEP for Windows)

The History of ENPEP Development

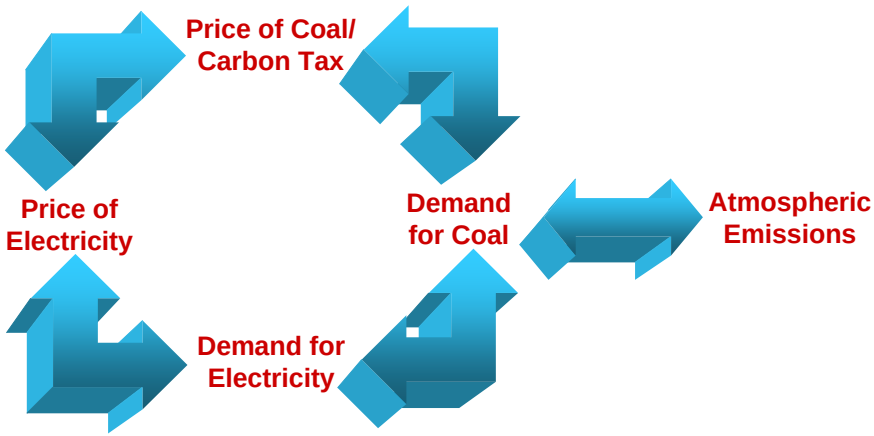
- 1985 - Development initiated by Argonne National Laboratory (ANL) under sponsorship by U.S. Department of Energy
- 1987 - Field testing under sponsorship of the International Atomic Energy Agency
- 1989 - Distribution by IAEA, World Bank, USDOE
- 2000 - New release of model called ENPEP for Windows

ENPEP is Designed to Analyze the Entire Energy System in an Integrated Framework

- **Integrated framework reveals cross-sectoral effects; implementing demand side mitigation options may affect energy supply requirements**



- **Integrated framework allows evaluation of feedback effects**



In General, ENPEP is Designed to be:

- **Useful**
- **Usable**
- **Used**

ENPEP Provides *Useful* Information to Decision-Makers

- **Electric system analysis**
  - expansion planning, demand side management
  - optimal hydro/thermal dispatch ($, environment)
  - deregulation, independent power producers, etc.

- **Total energy system**
  - overall energy sector development strategies
  - market potential for natural gas and nuclear
  - energy efficiency

- **Environmental analysis**
  - emissions projections for PM, SOX, NOX, etc.
  - emissions reduction strategies for PM, SOX and NOX
  - greenhouse gas (GHG) abatement cost studies
  - waste generation, land use, water pollution

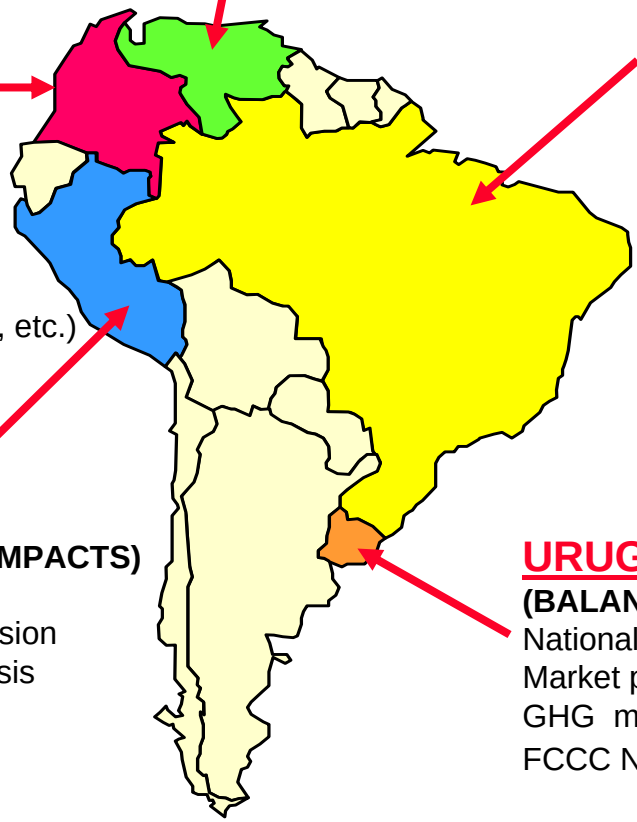
ENPEP is *Usable*

- PC-based
- New Windows interface
- Adaptable to data availability
- Established methodologies with technical credibility

ENPEP is Designed to be *Used*

- No cost
- Release agreement
- Distributed by IAEA, World Bank, USDOE
- Training provided
- Continuing applications support
- On-going enhancements

Recent ENPEP Applications in South America:



VENEZUELA
(WASP, BALANCE, IMPACTS)
National energy analysis
GHG mitigation analysis

COLOMBIA
(MAED, WASP, BALANCE, IMPACTS, VALORAGUA)
National energy analysis
Natural gas expansion
Electric system development
Air pollution (PM, SOX, NOX, GHG, etc.)
PM + SOX control cost analysis

BRAZIL
(WASP, BALANCE, VALORAGUA, IMPACTS)
State energy analysis
State electric system development
Air pollution analysis
Land use analysis
Decision analysis

PERU
(WASP, BALANCE, IMPACTS)
Load forecasting
Electric system expansion
National energy analysis
Air pollution analysis
GHG mitigation

URUGUAY
(BALANCE, IMPACTS)
National energy analysis
Market penetration of natural gas
GHG mitigation analysis
FCCC Nat Com (submitted)

Recent ENPEP Applications in Eastern Europe:

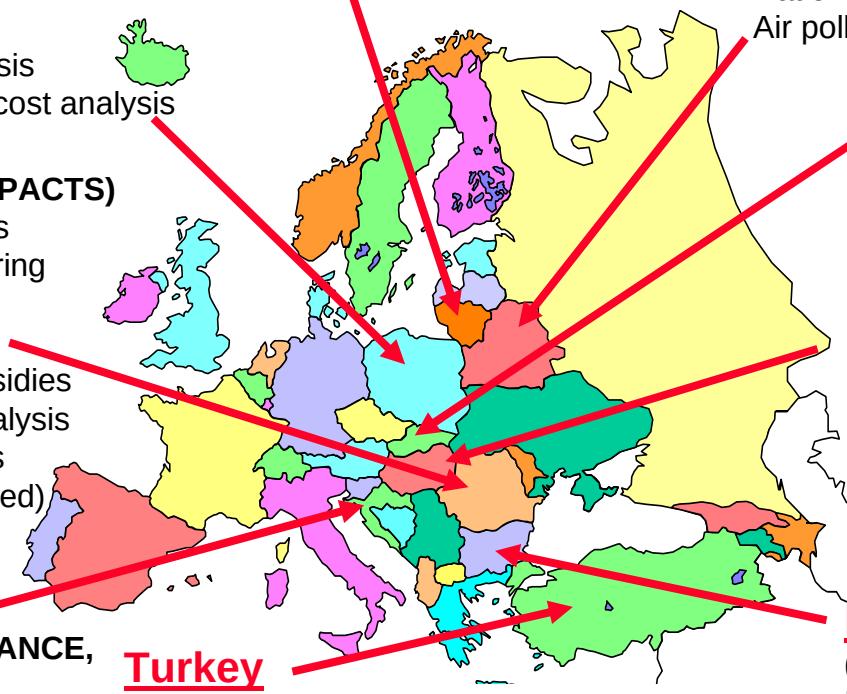
Poland
(MAED, WASP, BALANCE, IMPACTS)
Electric system expansion
National energy analysis
Air pollution analysis
GHG mitigation analysis
PM and SOX control cost analysis

Lithuania
(WASP, MAED)
Electric system analysis

Belarus
(WASP, BALANCE, IMPACTS)
Electric system expansion
National energy analysis
Air pollution analysis

Slovakia
(BALANCE, IMPACTS)
National energy analysis
GHG mitigation analysis
FCCC Nat Com (submitted)
Joint implementation

Romania
(WASP, BALANCE, IMPACTS)
National energy analysis
Energy sector restructuring
Natural gas imports
Rehabilitation, IPPs
Removal of energy subsidies
Air & water pollution analysis
GHG mitigation analysis
FCCC NatCom (submitted)
Waste generation



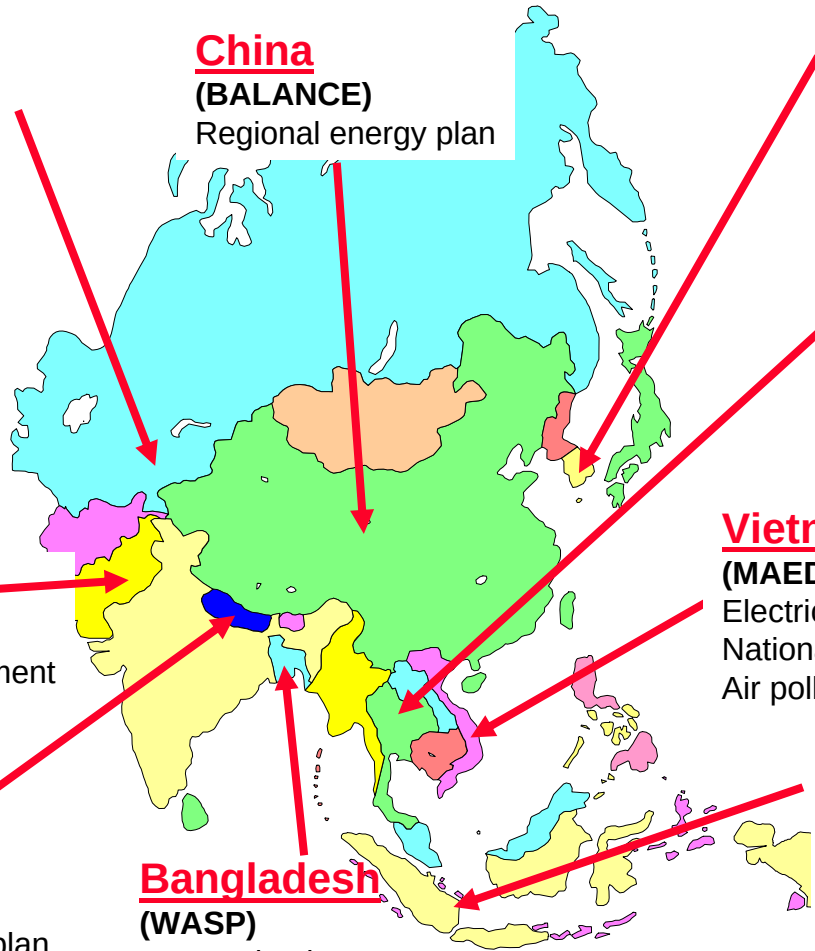
Hungary
(WASP, BALANCE, IMPACTS)
Electric sector expansion
National energy analysis
GHG mitigation analysis
IPP Bid Evaluation

Croatia
(MAED, WASP, BALANCE, IMPACTS)
National energy plan
Electric system expansion
Air pollution analysis

Turkey
(WASP, ICARUS, BALANCE, IMPACTS, etc.)
National energy plan
Electric sector dispatch and expansion
Privatization, Environmental assessments

Bulgaria
(WASP, BALANCE, IMPACTS)
National energy plan
Electric system development
GHG mitigation analysis
FCCC Nat Com submitted

Recent ENPEP Applications in Asia:



Kazakstan
(BALANCE, IMPACTS)
National energy plan
GHG mitigation analysis

China
(BALANCE)
Regional energy plan

South Korea
(WASP)
Electric system development
GHG mitigation analysis
FCCC Nat Com (submitted)

Thailand
(BALANCE, IMPACTS)
National energy plan
GHG mitigation analysis

Vietnam
(MAED, WASP, IMPACTS, BALANCE)
Electric system development
National energy plan
Air pollution analysis

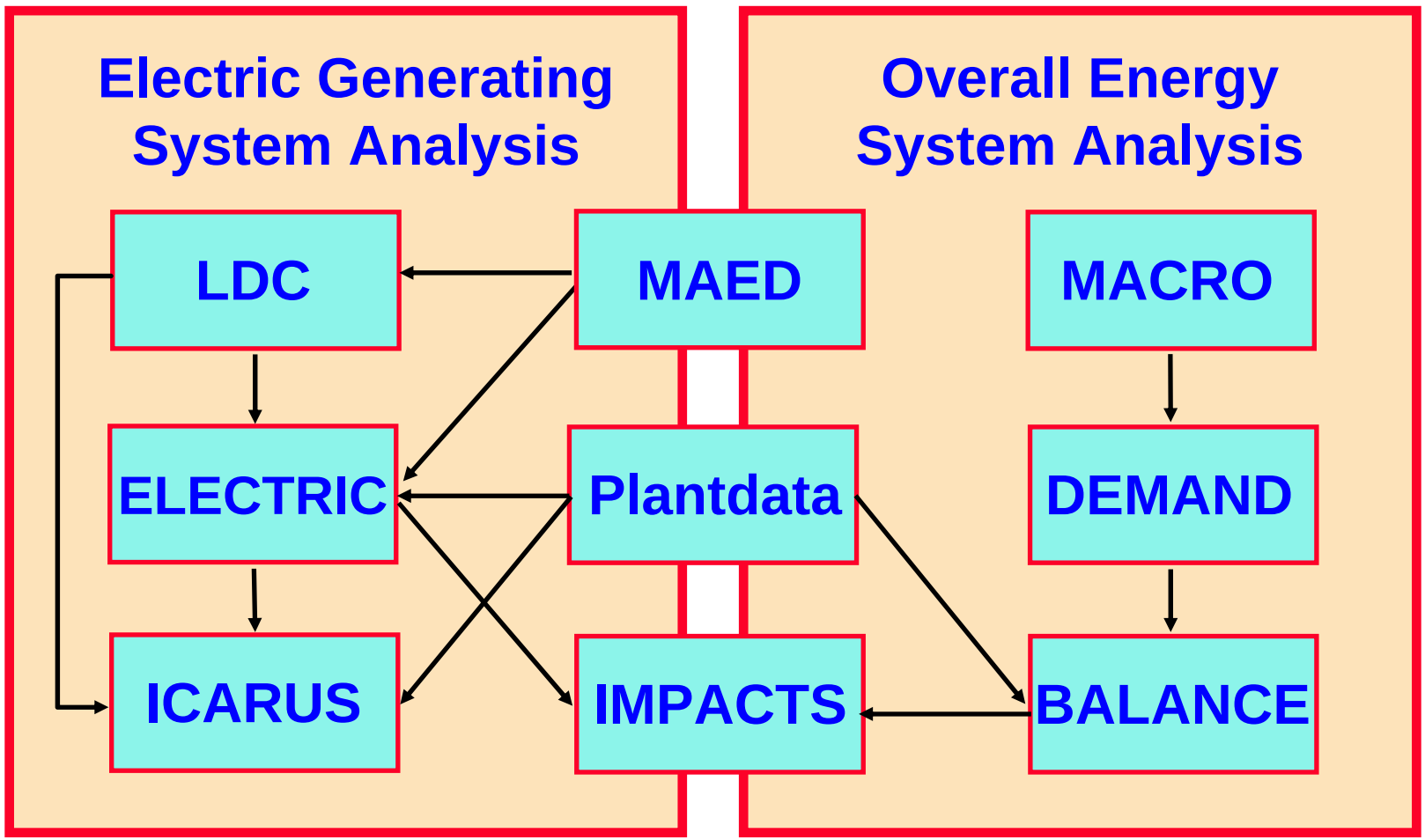
Pakistan
(WASP)
Electric system development

Indonesia
(WASP, BALANCE, IMPACTS)
Electric system analysis
National energy plan
Air pollution analysis

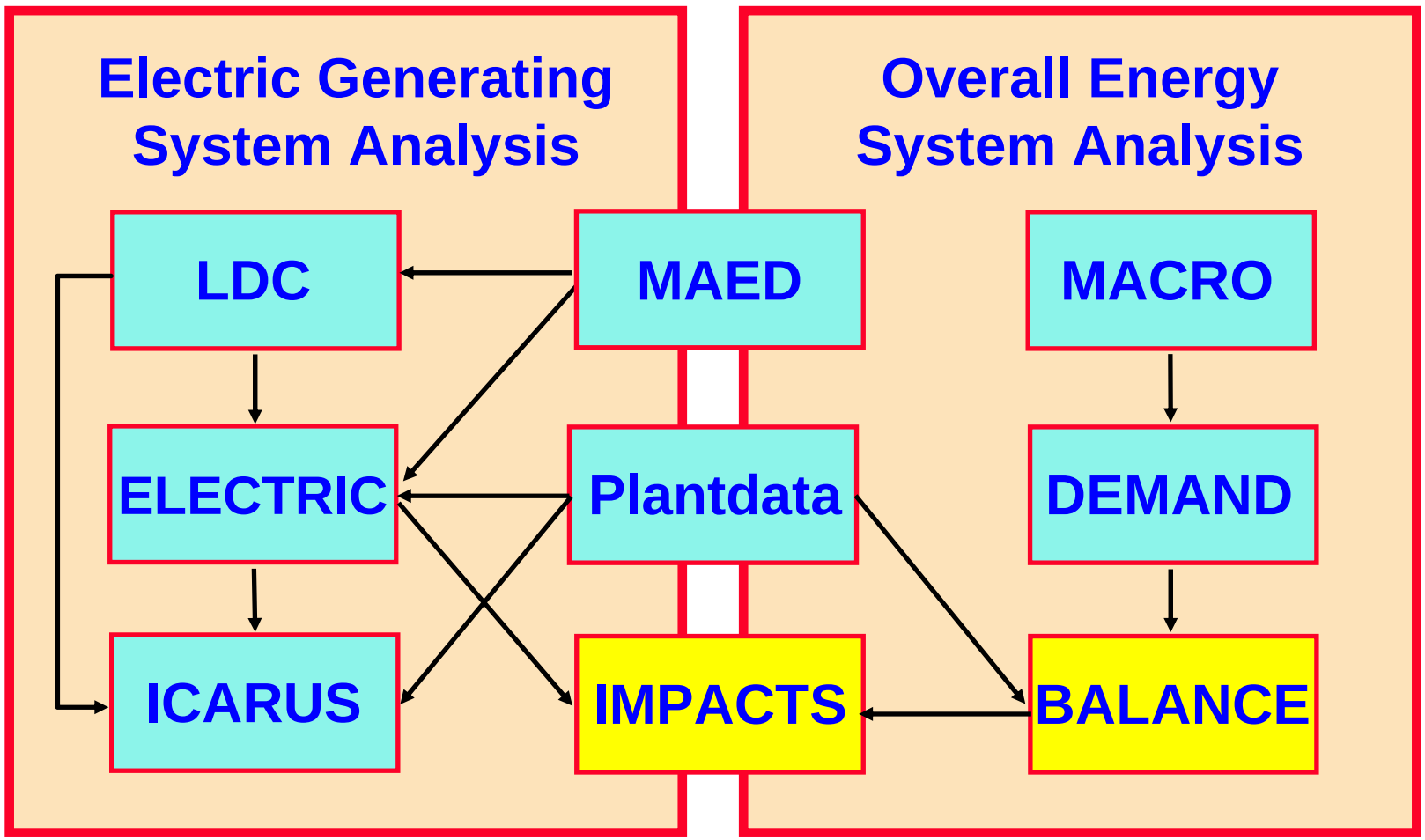
Nepal
(WASP)
National energy plan
GHG mitigation analysis

Bangladesh
(WASP)
IPP Evaluation

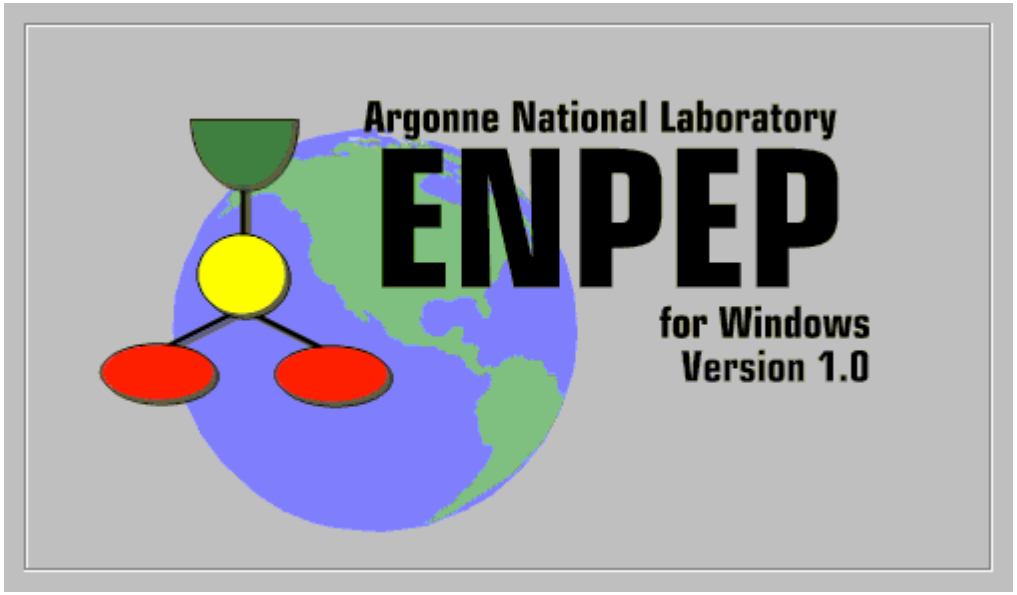
The DOS-Based Version of ENPEP Consists of Nine Integrated Technical Analysis Modules



The Energy and Environmental Modules were Combined to form ENPEP for Windows



ENPEP for Windows



Developed by Argonne National Laboratory (ANL) with support from the U.S. Department of Energy (DOE)

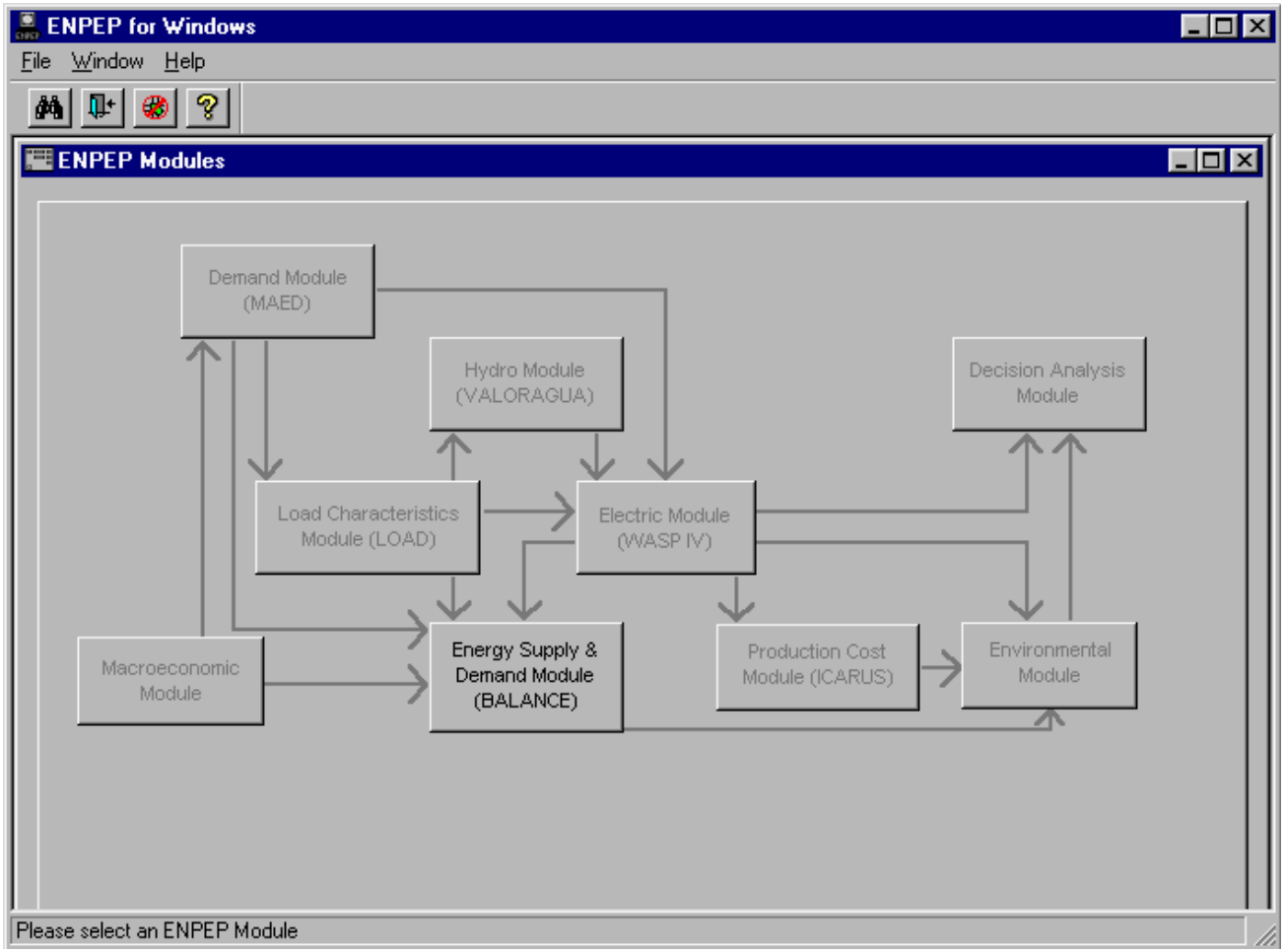
ENPEP for Windows was Designed to be User-Friendly

Developed in the PowerBuilder 7.0 programming environment and supported by the Sybase 6.0 database system.

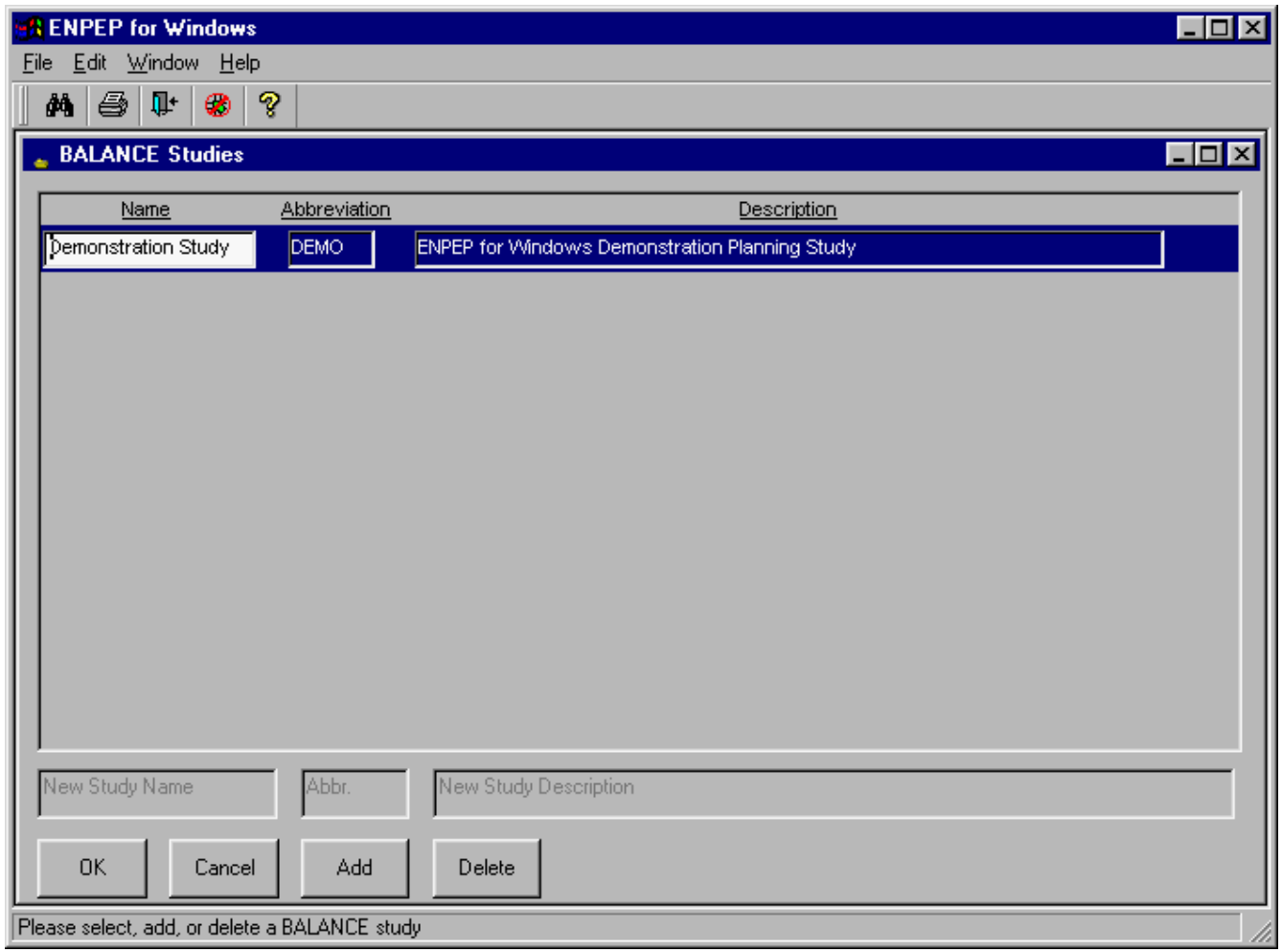
DESIGN OBJECTIVES:

- **Provide user-friendly interface under MS Windows**
- **Provide single modeling framework which integrates technical, economic, and environmental aspects of energy systems**
- **Present model results intuitively in graphical and numerical form**
- **Provide interface and data exchange with other models and and software tools.**

BALANCE is the First Implemented Module of ENPEP for Windows

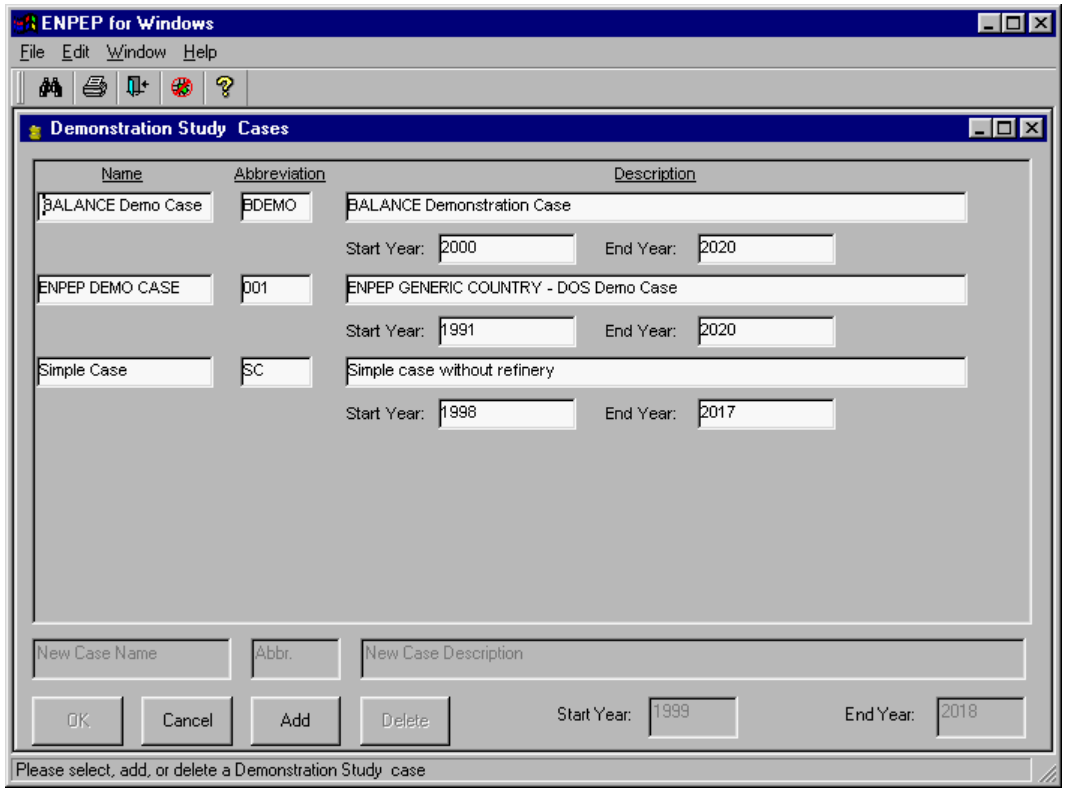


BALANCE can Accommodate Several Planning Studies

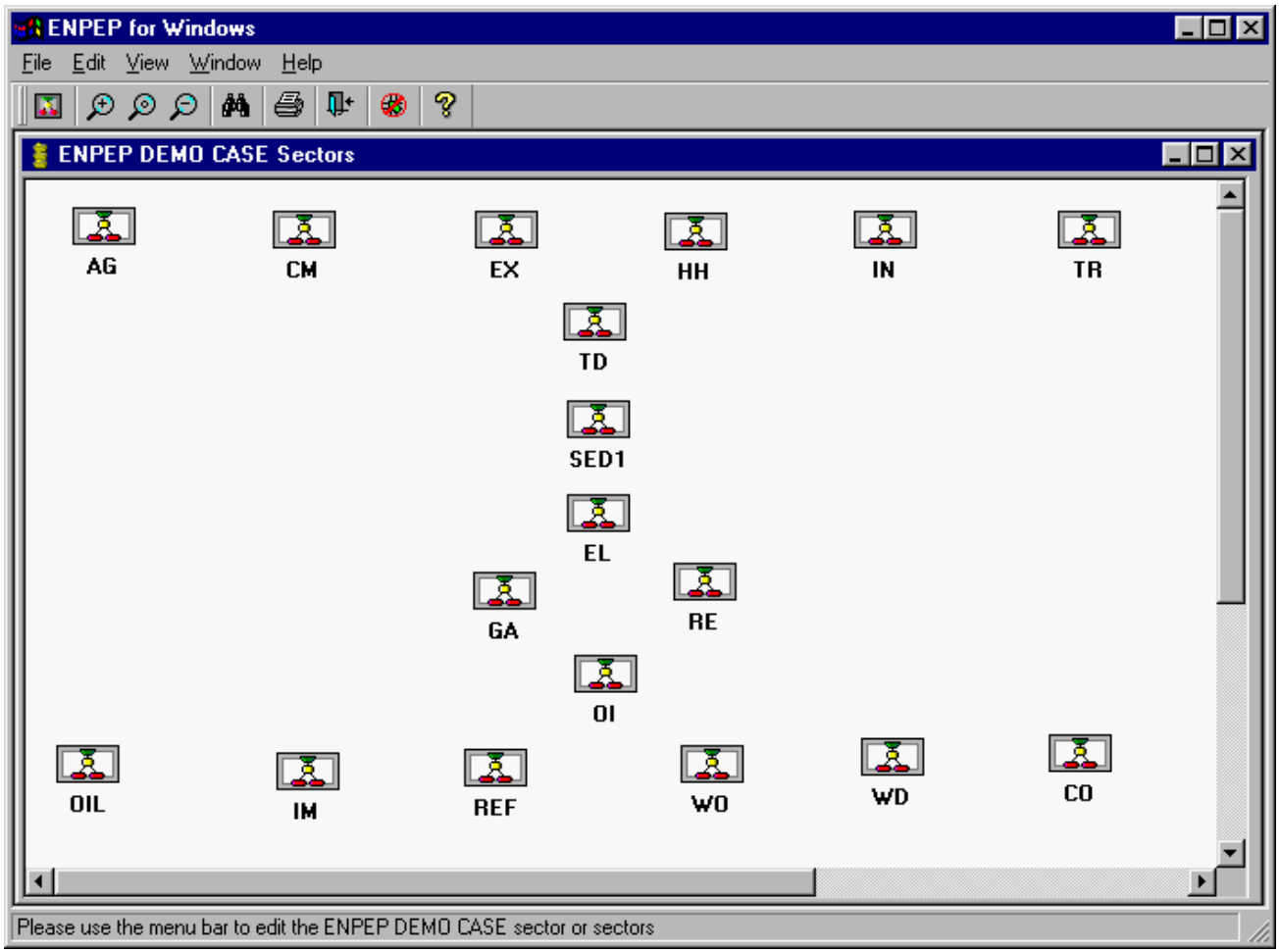


Each Planning Study can Contain Multiple Cases

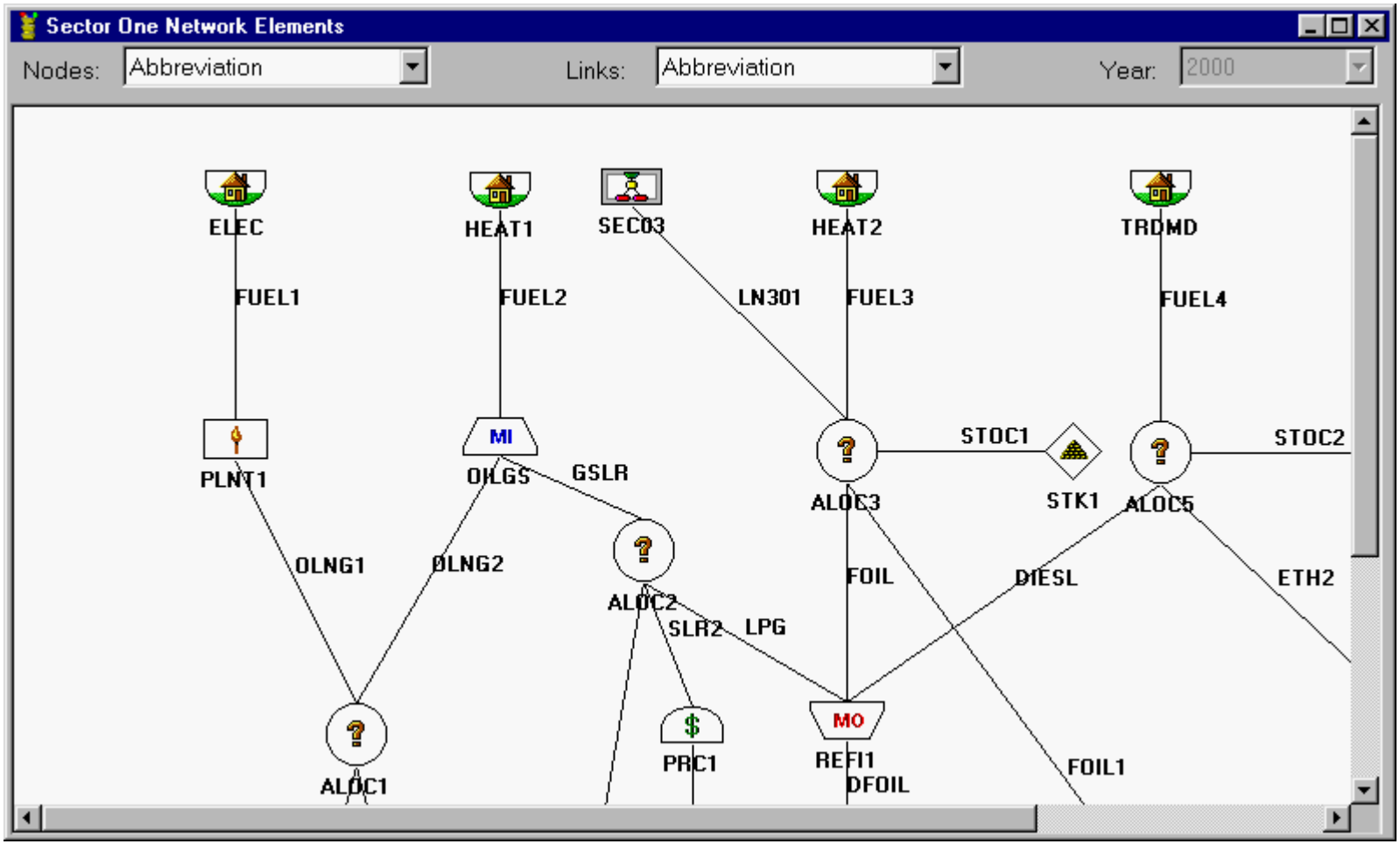
The model provides routines for import and export of cases, as well as for the import of BALANCE cases from the DOS version of ENPEP.



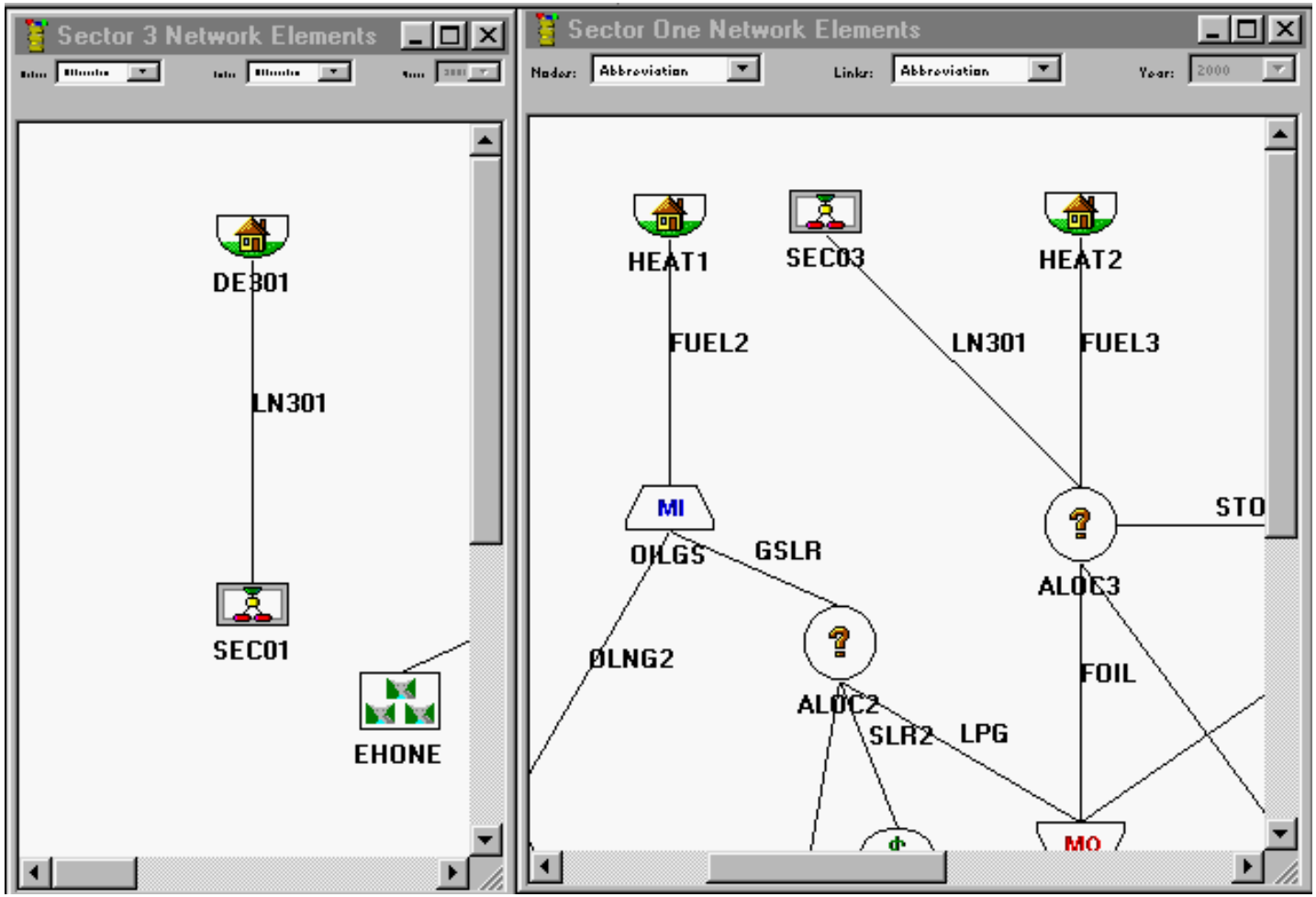
The Overall Energy System is Usually Divided into a Number of Different Sectors



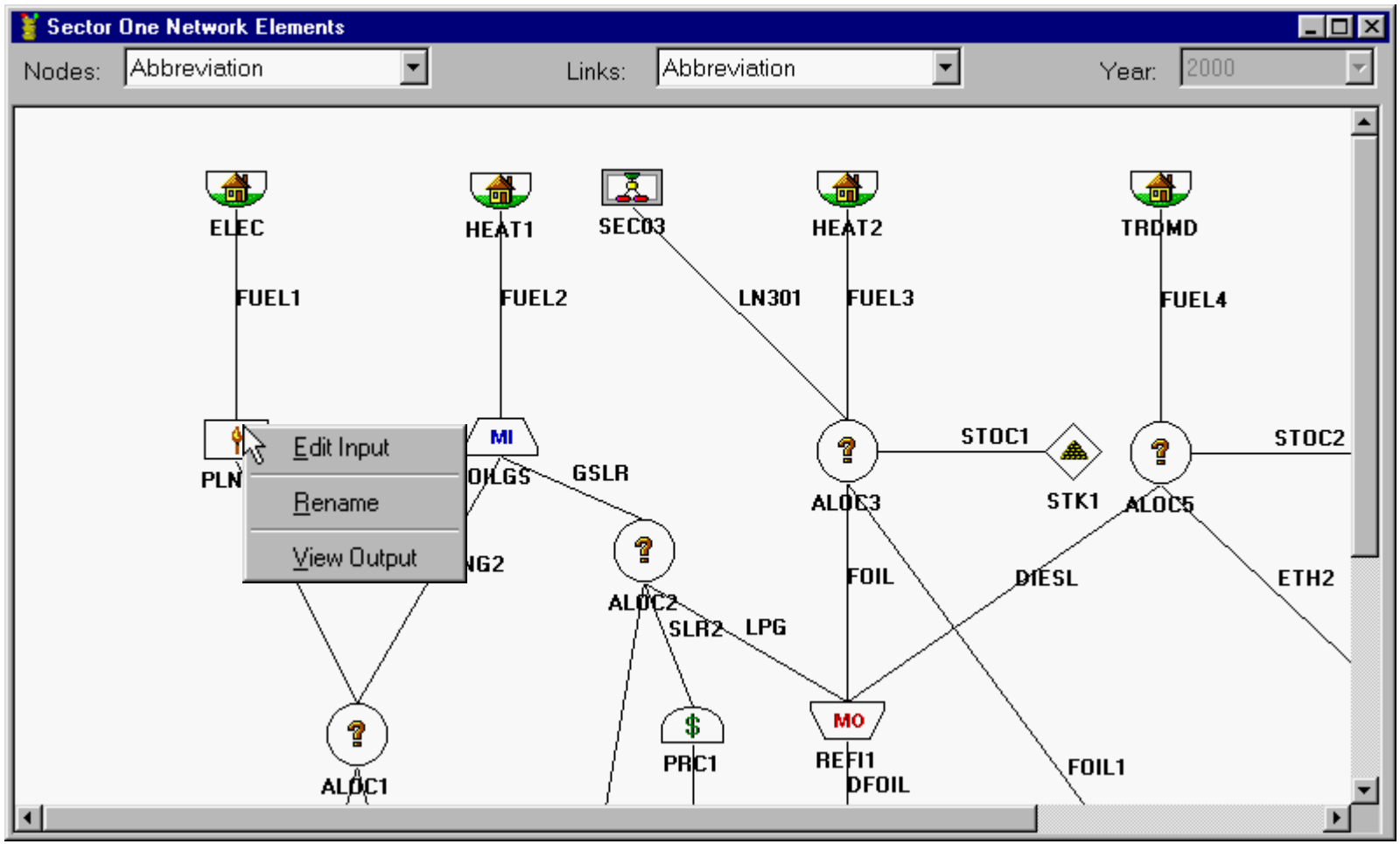
Each Sector Contains an Energy Network



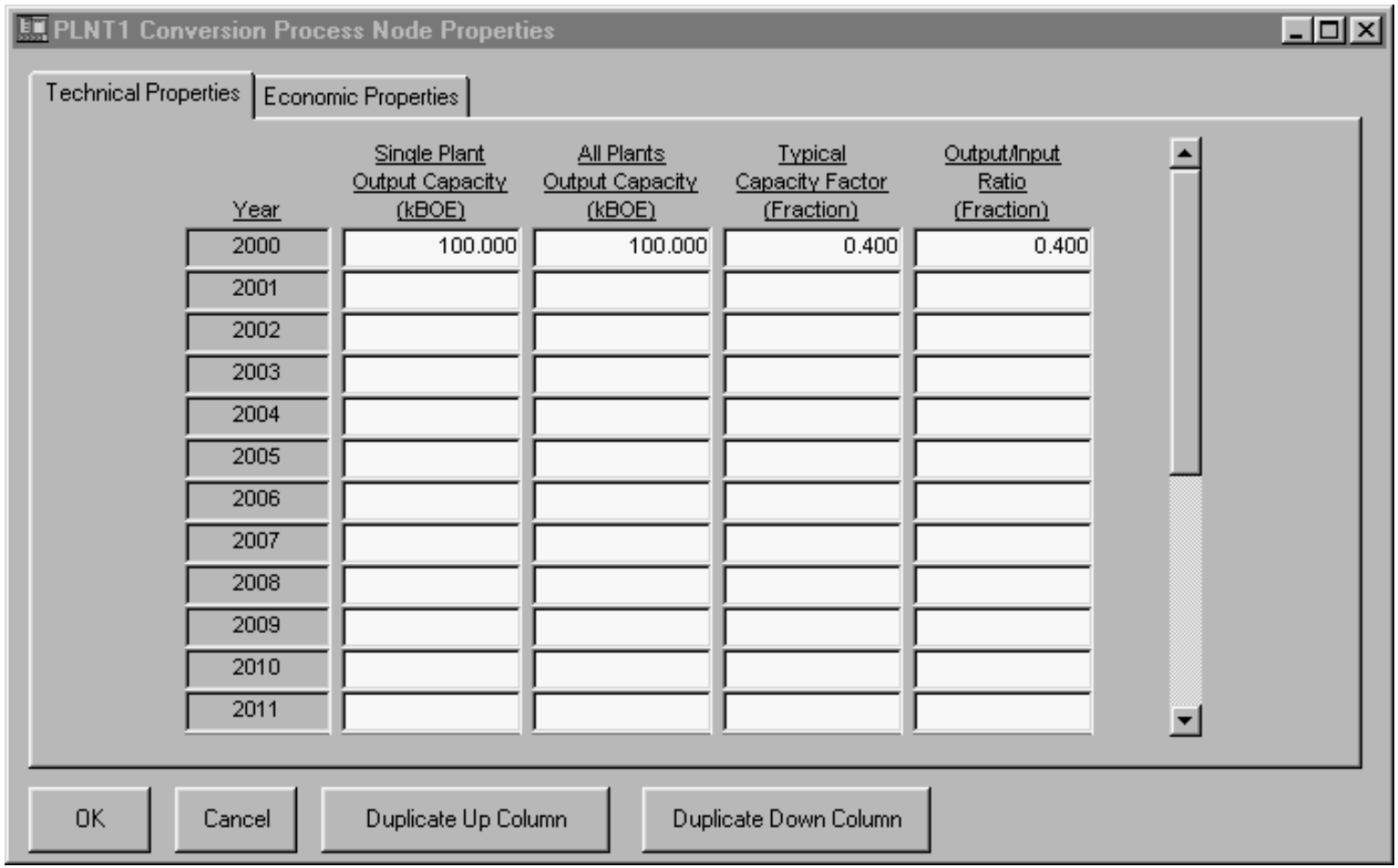
Intersectoral Links can Connect Energy Networks of Different Sectors



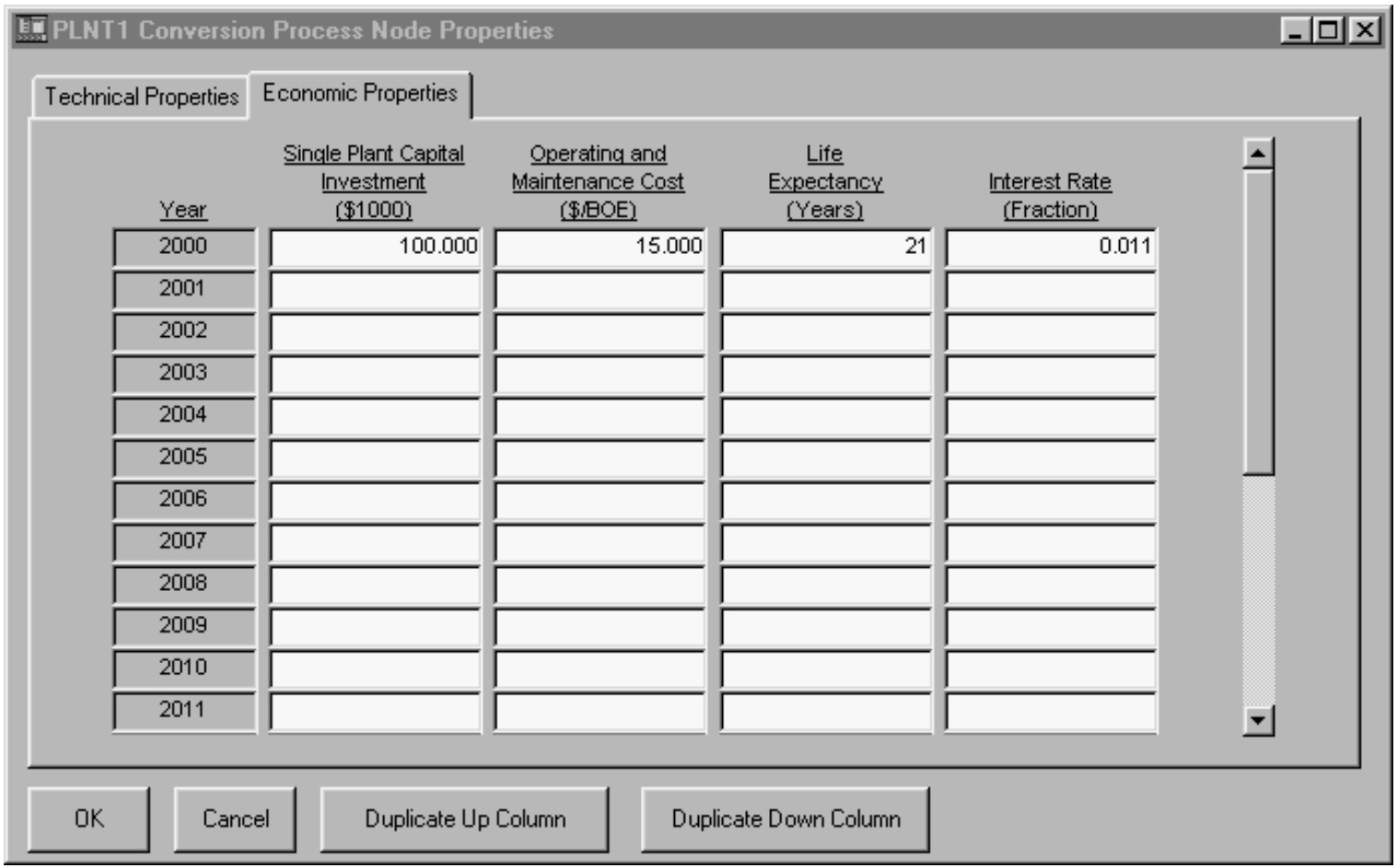
All Network Elements can be Accessed Using the Standardized Simple Menu



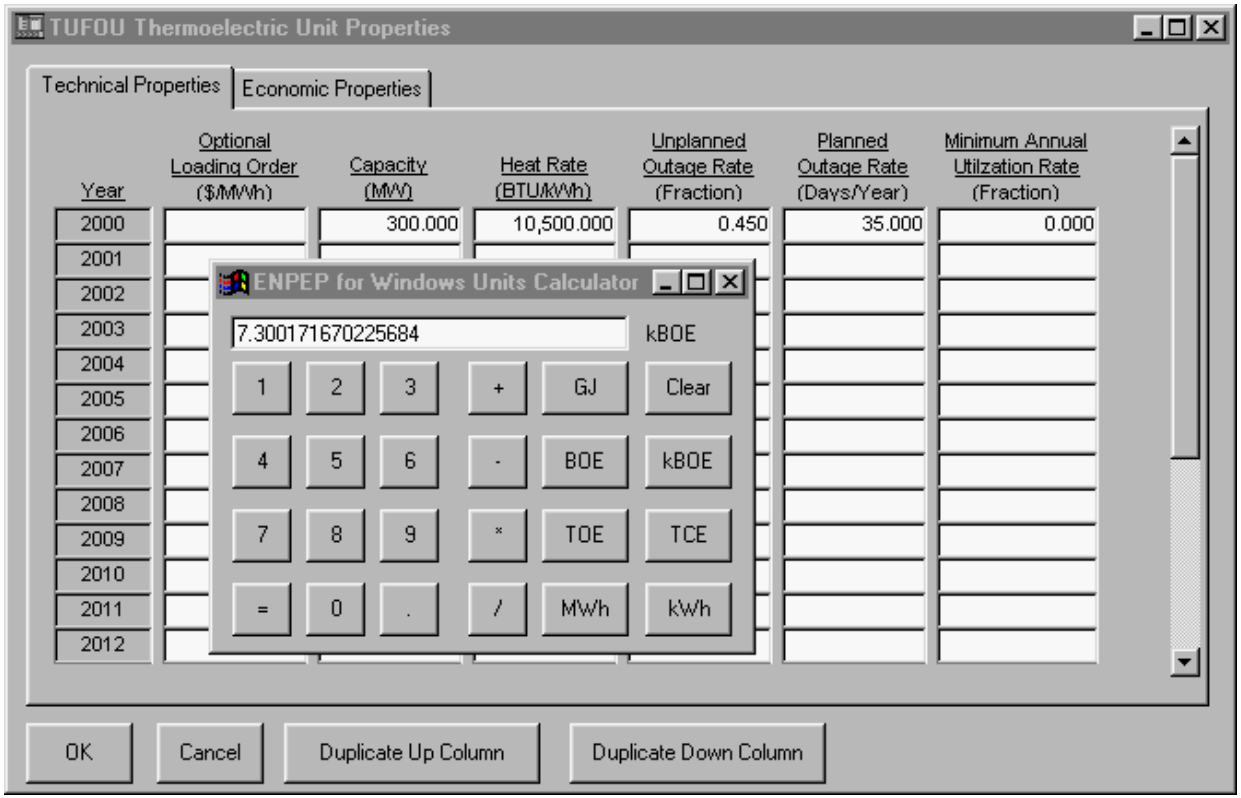
The Simple Menu Allows Viewing and Editing of Technical Data ...



…and Economic and Environmental Data

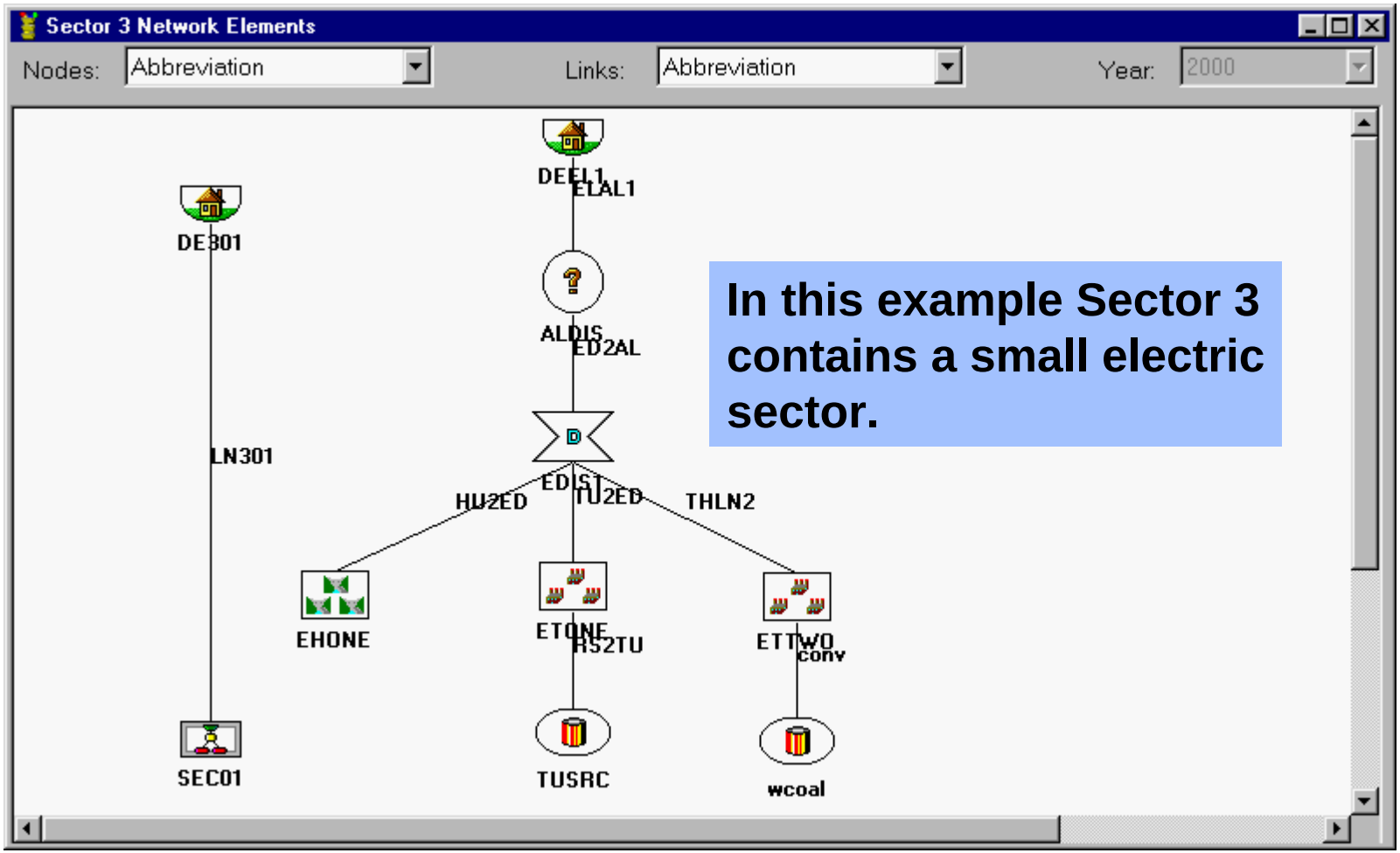


Units Calculator Facilitates Conversion of Energy Units for Data Entry Process

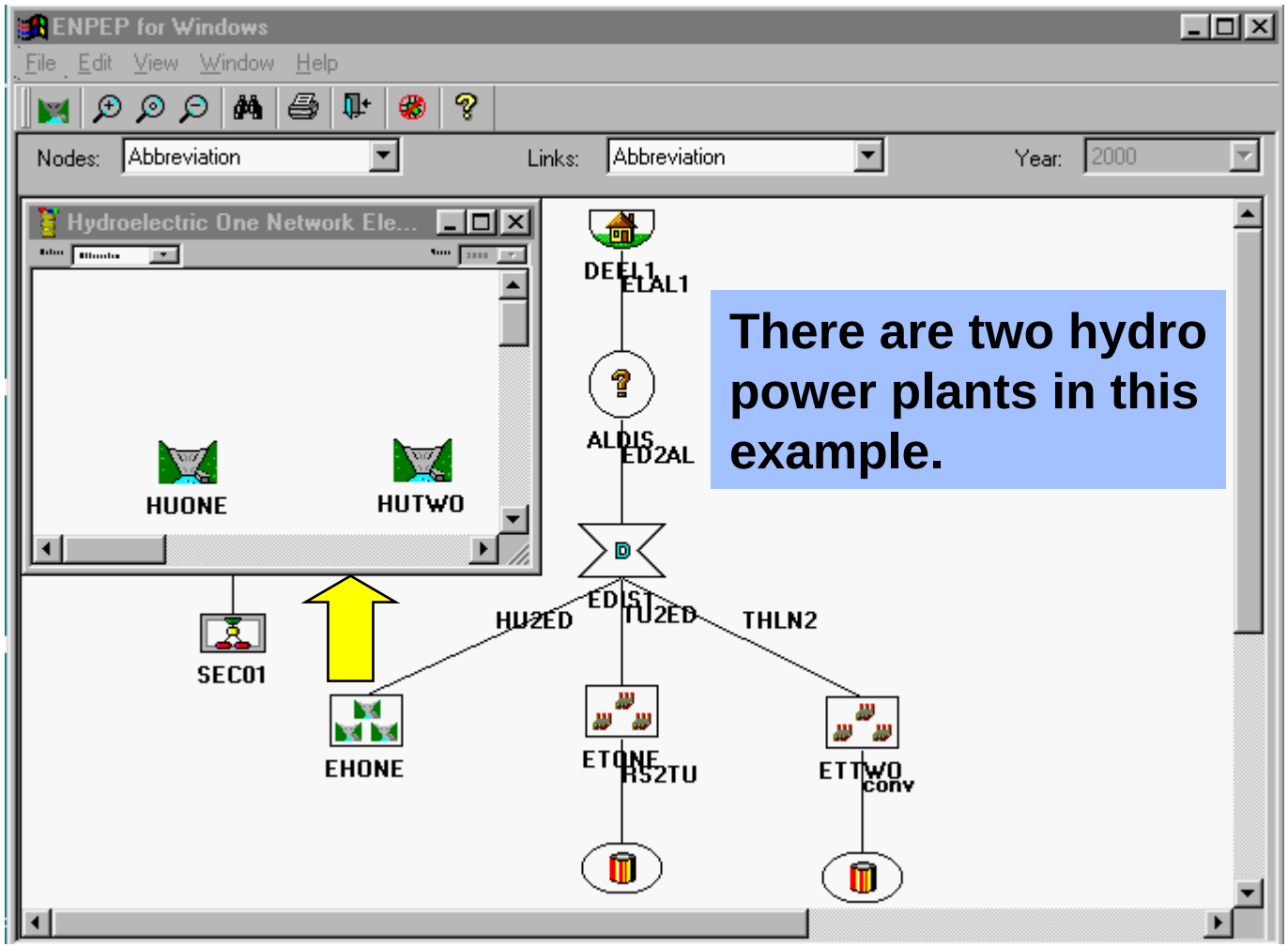


Units calculator allows for the conversion of most commonly used energy units: GJ, kBOE, BOE, tce, toe, MWh, and kWh.

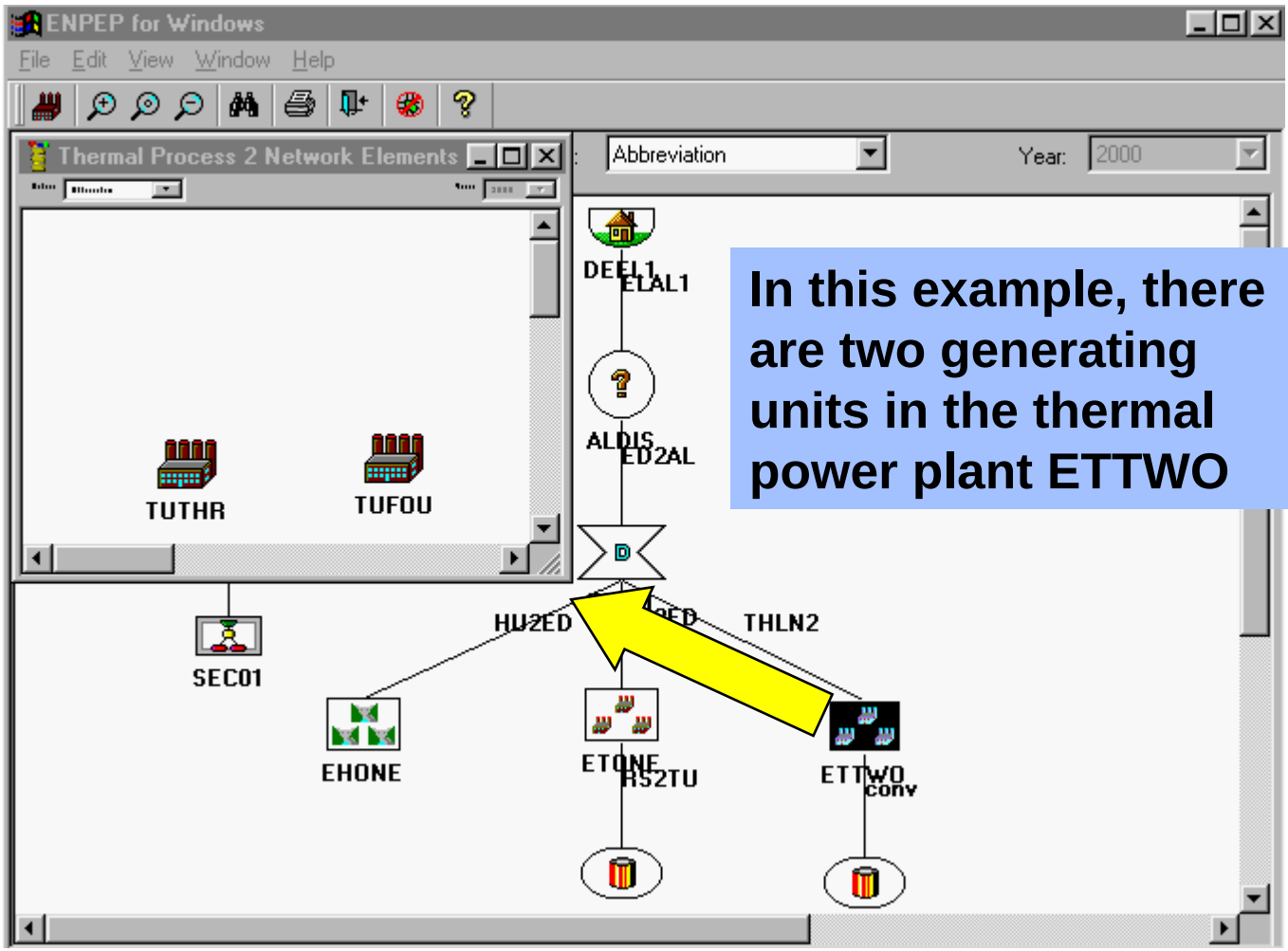
The Electric Sector is a Part of the Overall Energy Network



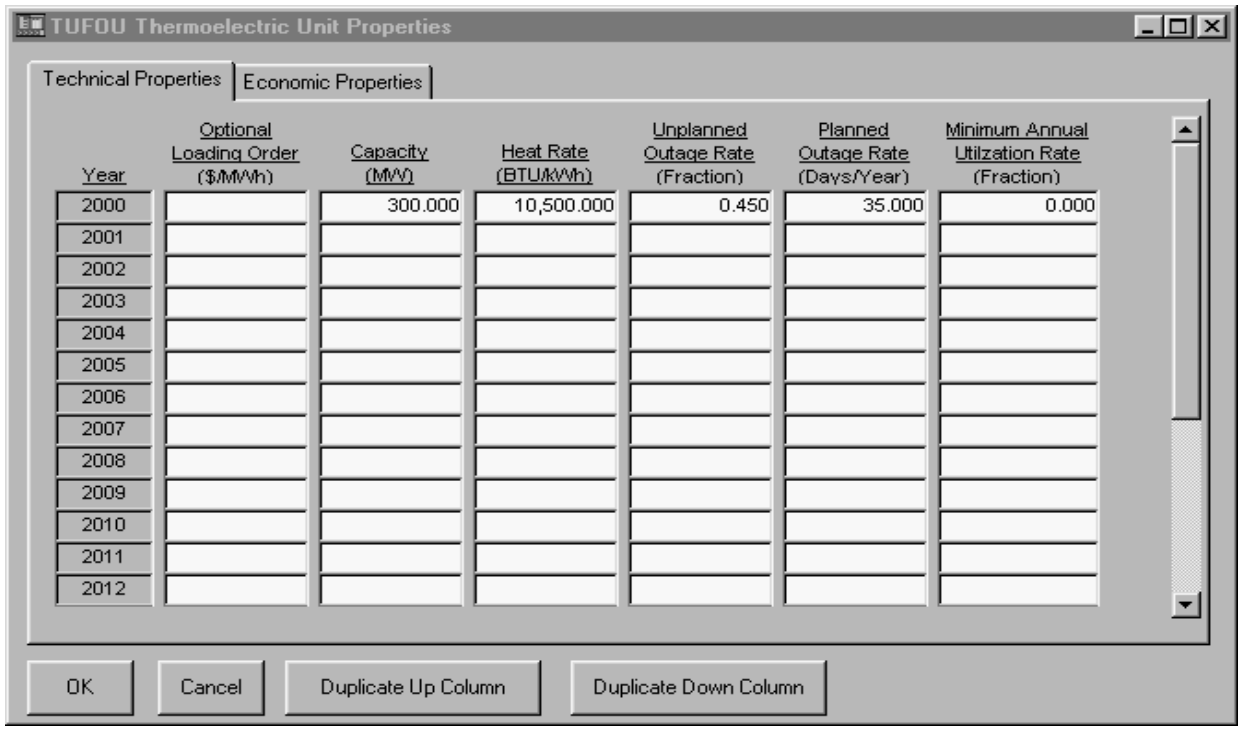
Electric Sector can Contain Multiple Hydro Power Plants



… and up to 20 Groups (Power Plants) with Multiple Number of Thermal Generating Units

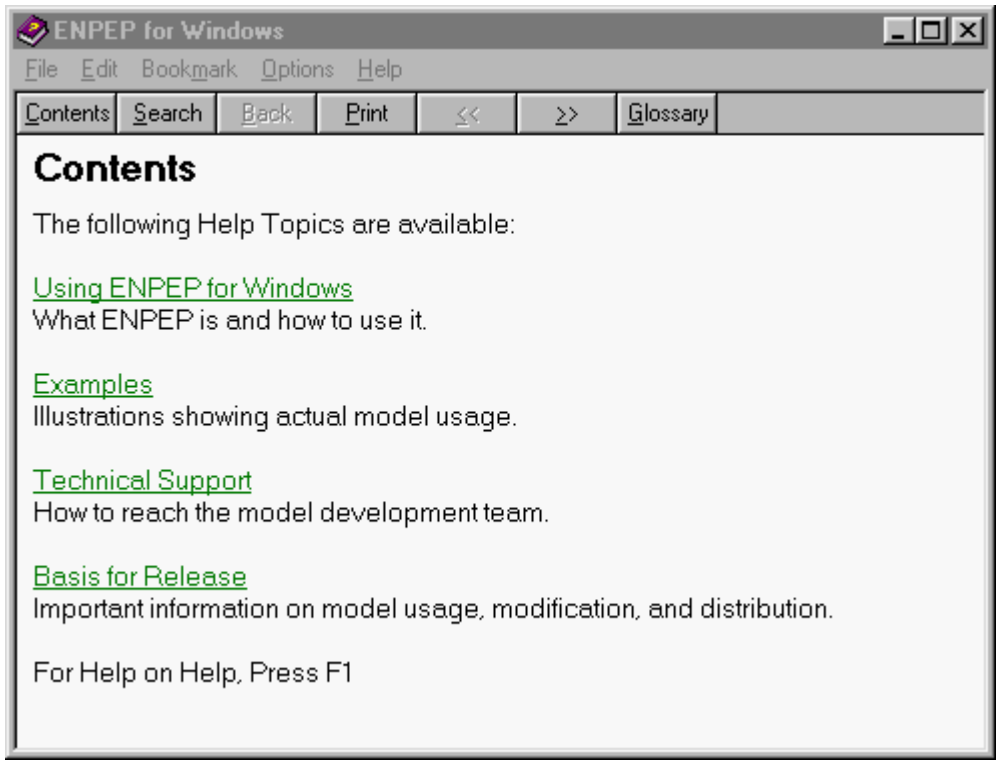


Data Entry for the Electric Sector Is Performed in the Same Manner as for the Other Sectors



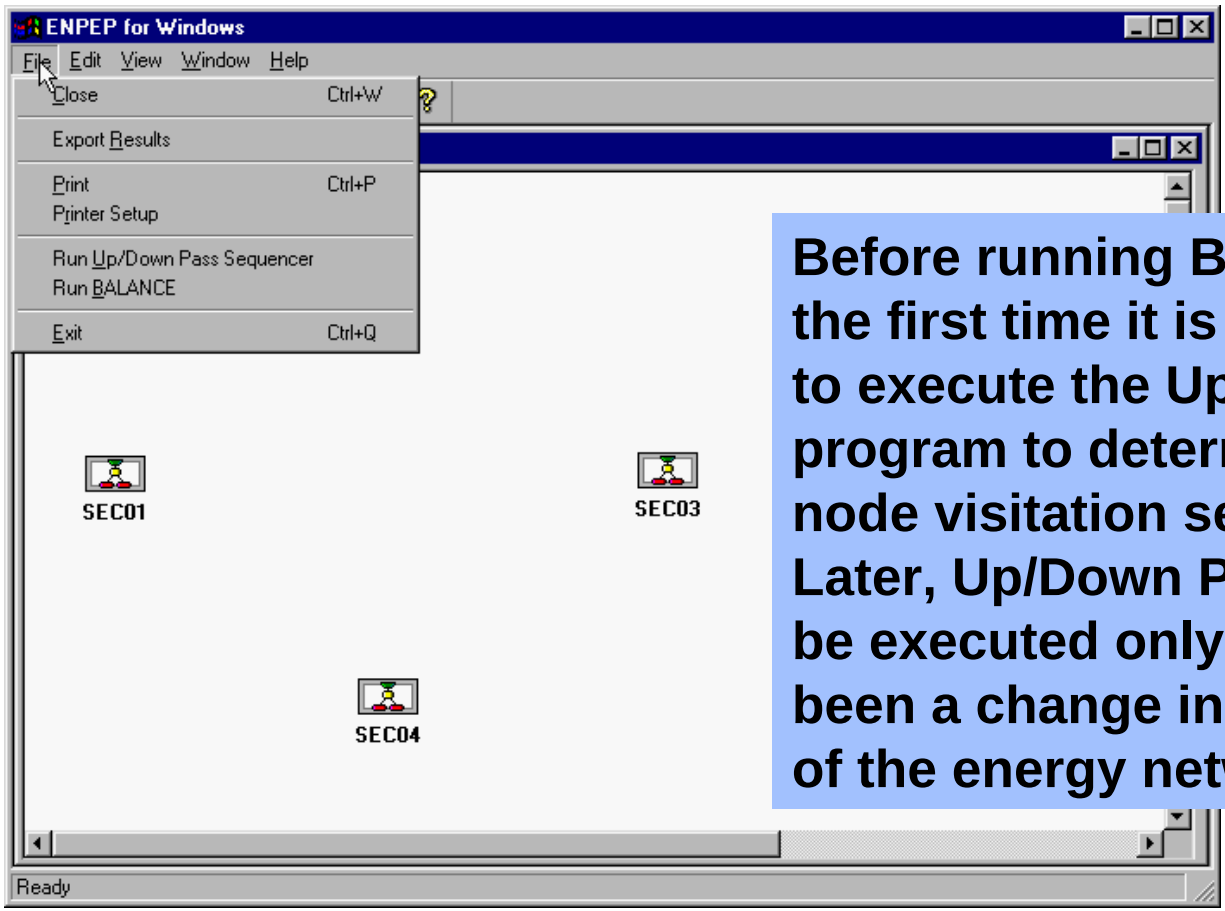
The right mouse click invokes the standardized menu that enables the user to view and/or edit data for hydro and thermal generating units and for the dispatch node.

A Help System will be Available to Provide Online Support



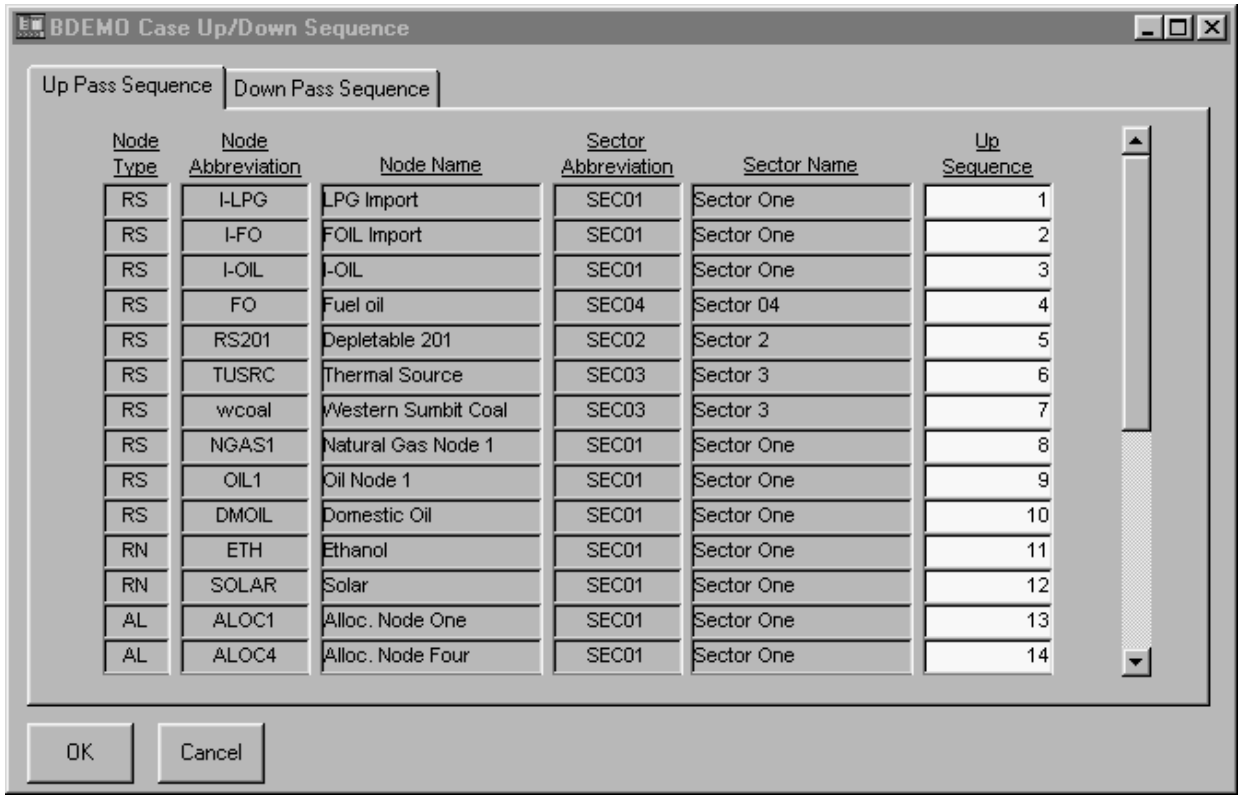
Note: The help system is under construction and some topics are currently not available.

Execution of BALANCE Module is Performed in Two Steps



Before running BALANCE for the first time it is necessary to execute the Up/Down Pass program to determine the node visitation sequence. Later, Up/Down Pass should be executed only if there has been a change in the structure of the energy network.

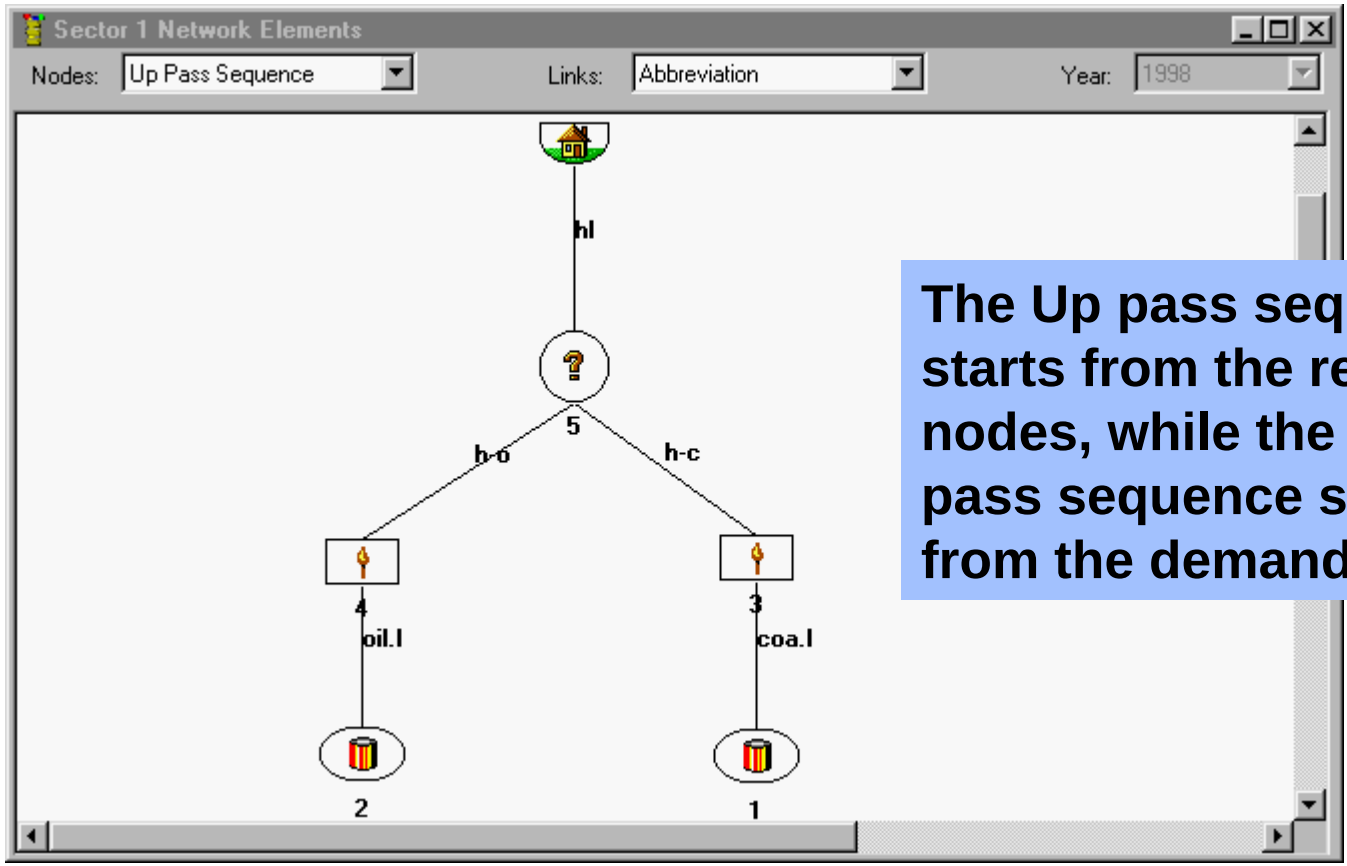
The Calculated Up/Down Node Visitation Sequence can be Viewed in a Tabular Form



Node Type	Node Abbreviation	Node Name	Sector Abbreviation	Sector Name	Up Sequence
RS	I-LPG	LPG Import	SEC01	Sector One	1
RS	I-FO	FOIL Import	SEC01	Sector One	2
RS	I-OIL	I-OIL	SEC01	Sector One	3
RS	FO	Fuel oil	SEC04	Sector 04	4
RS	RS201	Depletable 201	SEC02	Sector 2	5
RS	TUSRC	Thermal Source	SEC03	Sector 3	6
RS	wcoal	Western Sumbit Coal	SEC03	Sector 3	7
RS	NGAS1	Natural Gas Node 1	SEC01	Sector One	8
RS	OIL1	Oil Node 1	SEC01	Sector One	9
RS	DMOIL	Domestic Oil	SEC01	Sector One	10
RN	ETH	Ethanol	SEC01	Sector One	11
RN	SOLAR	Solar	SEC01	Sector One	12
AL	ALOC1	Alloc. Node One	SEC01	Sector One	13
AL	ALOC4	Alloc. Node Four	SEC01	Sector One	14

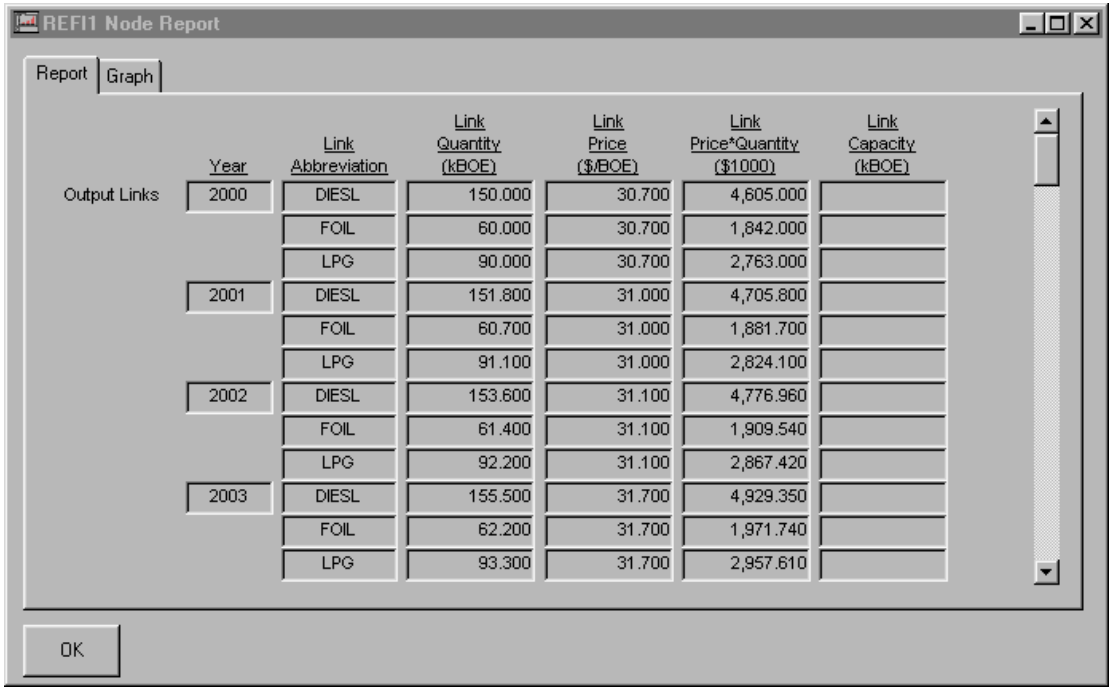
The automatically calculated node visitation sequence can be, if necessary, modified by user in this table.

The Up/Down Node Visitation Sequence can be Also Viewed Directly on the Network



The Up pass sequence starts from the resource nodes, while the Down pass sequence starts from the demand nodes.

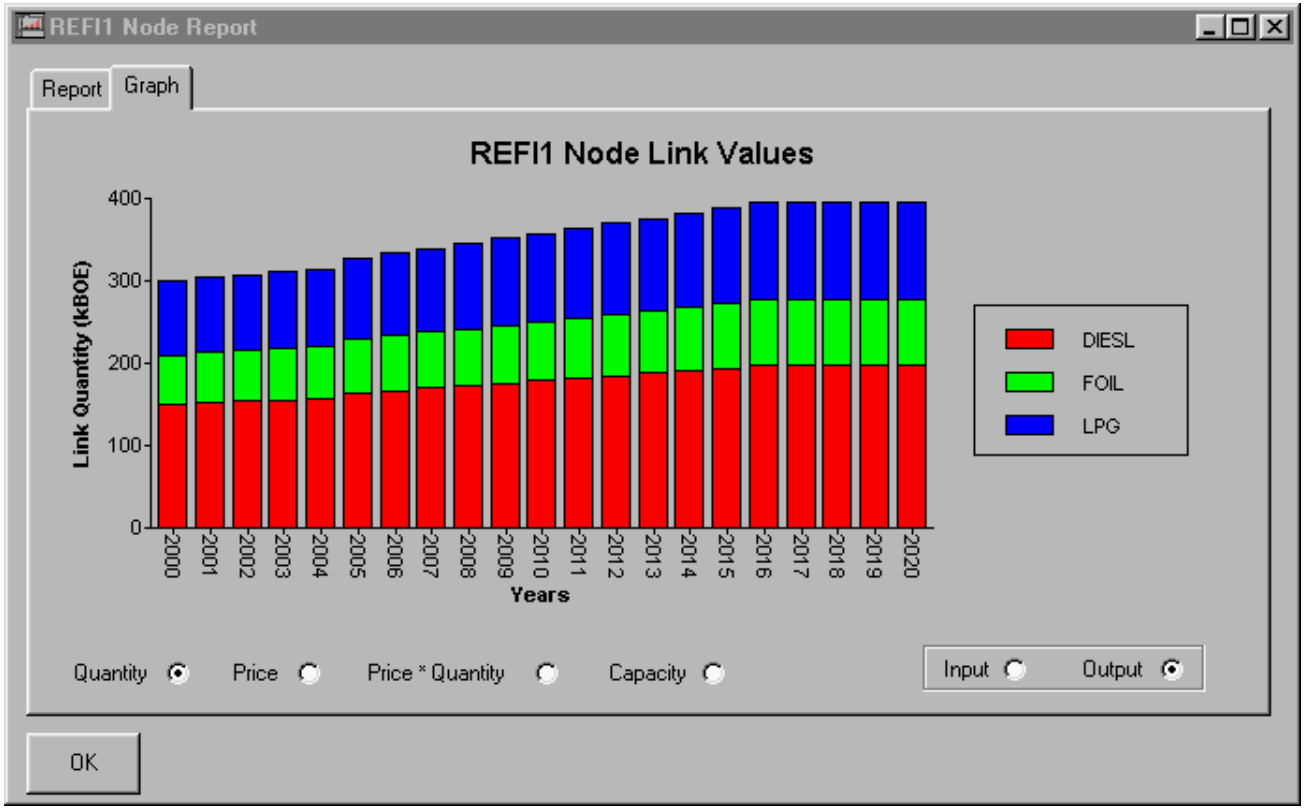
The Results of the BALANCE Run can be Presented in Tabular and Graphical Form



Year	Link Abbreviation	Link Quantity (kBOE)	Link Price ($/BOE)	Link Price*Quantity ($1000)	Link Capacity (kBOE)
2000	DIESL	150.000	30.700	4,605.000	
	FOIL	60.000	30.700	1,842.000	
	LPG	90.000	30.700	2,763.000	
2001	DIESL	151.800	31.000	4,705.800	
	FOIL	60.700	31.000	1,881.700	
	LPG	91.100	31.000	2,824.100	
2002	DIESL	153.600	31.100	4,776.960	
	FOIL	61.400	31.100	1,909.540	
	LPG	92.200	31.100	2,867.420	
2003	DIESL	155.500	31.700	4,929.350	
	FOIL	62.200	31.700	1,971.740	
	LPG	93.300	31.700	2,957.610	

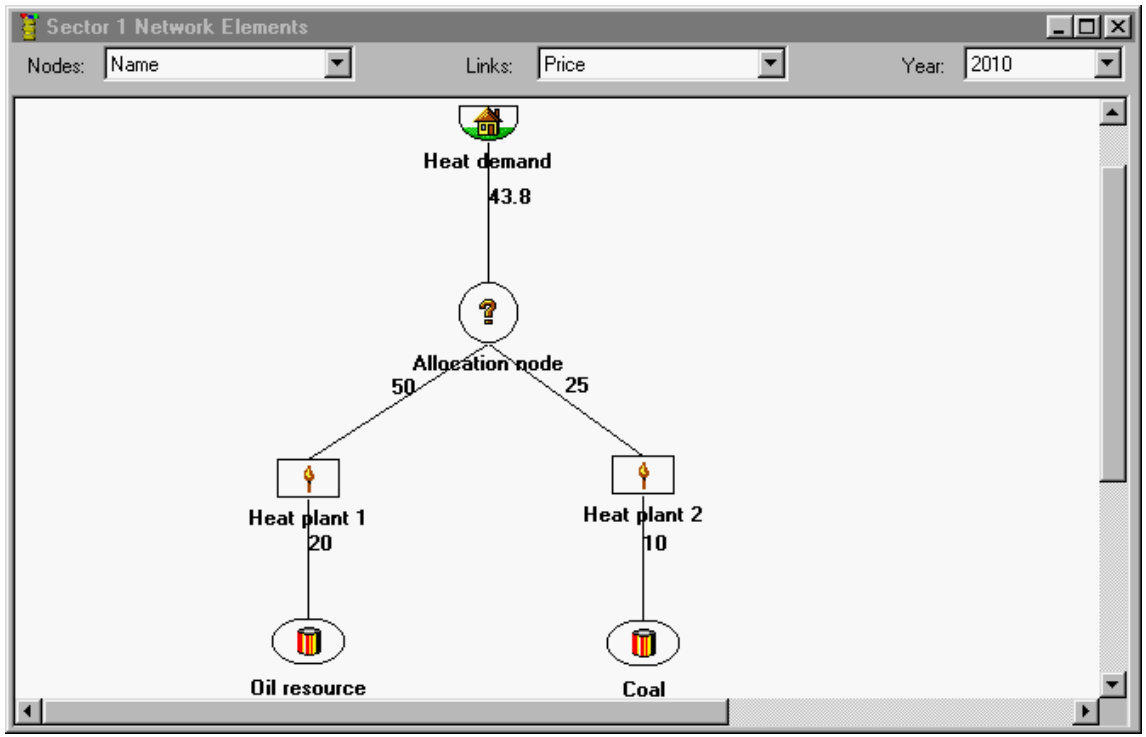
This is the report for the refinery node. Reports are created for each component of the network, for each sector, and for the whole energy network. A routine for export of textual reports to Microsoft Excel is also provided.

Results in Graphical Form are Available for Each Component of Energy Network



This graph shows the results for quantities on the output links of the refinery node REFI1. All graphs can be easily printed by clicking on the print button.

The Model Results can be Also Displayed Directly on the Energy Network



The network shows energy prices on the links in 2010. Also, the quantities and "prices x quantities" can be displayed for every year of the study period. This network can also be printed by clicking on the print button.