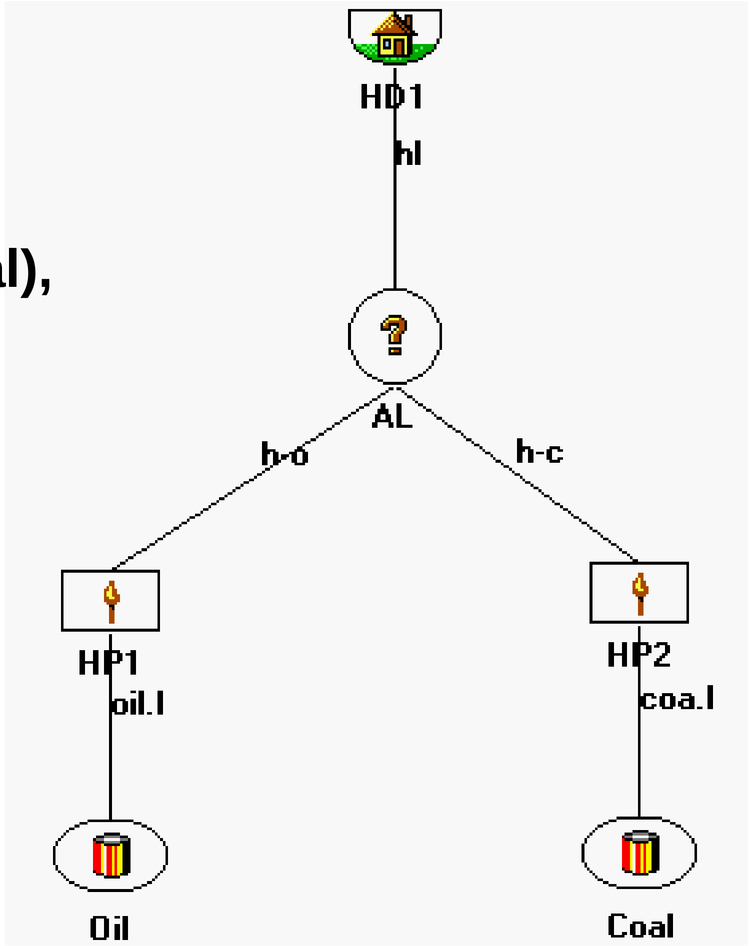
Creating a Simple Network With ENPEP for Windows

Creating a Simple Network

In this Exercise you will create a Simple network consisting of:

1. two resource nodes (oil & coal),
2. two conversion processes (boilers HP1 and HP2),
3. one decision node (AL), and
4. one demand node (HD1).

Study period: 1998-2017

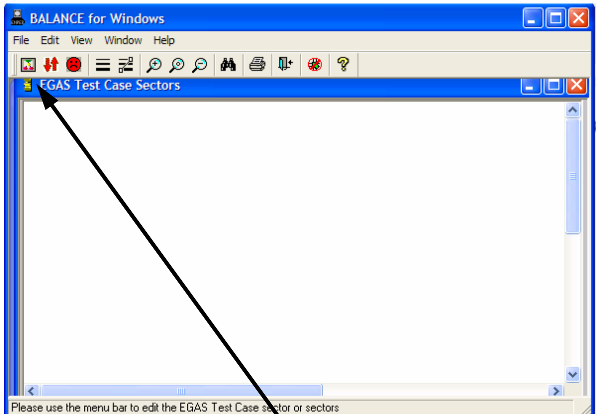


Steps in Network Development

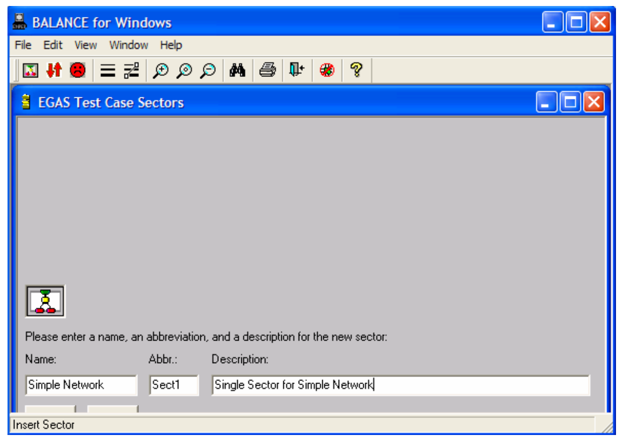
1. Network/data preparation:
    - network drawing & labeling
    - data definition
    - check of base year quantities & prices
2. Prepare (run/check) the node visitation sequence
3. Run BALANCE
4. Check/printout the results (tables/graphs/DOS files)

Creating a Sector within a Network

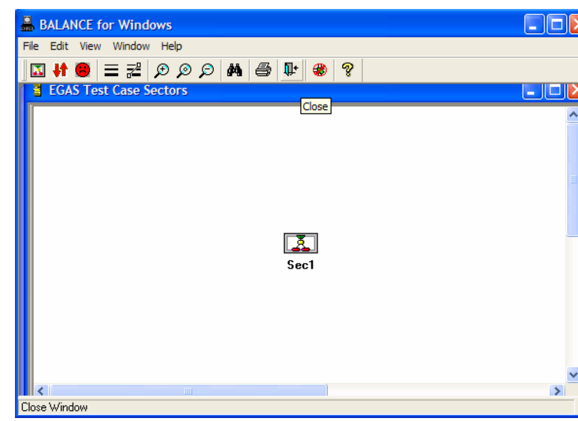
1. Open new test case.



2. Click on <u>sector icon</u>, then click in center of EGAS Test Case to create a sector .

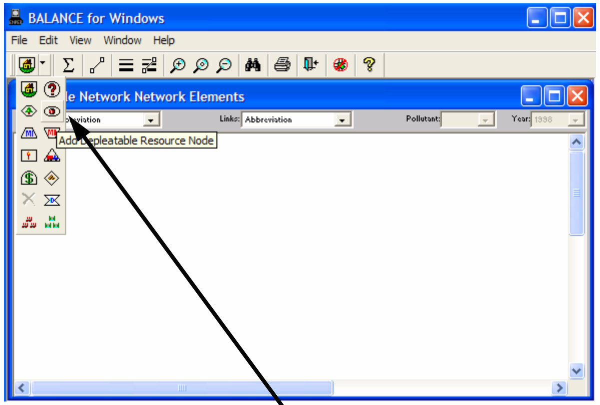


3. Enter sector Name, Abbr. and Description, then click "OK" .

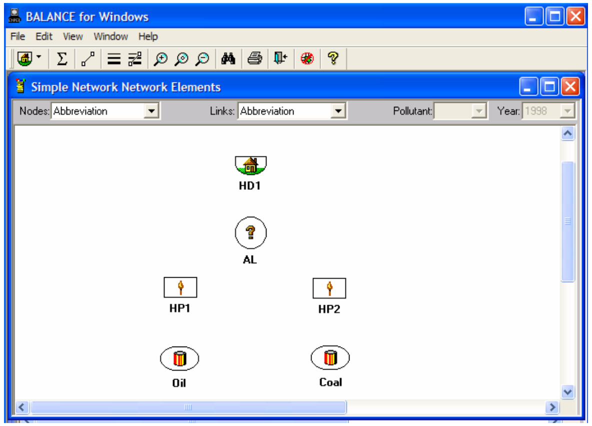


4. Double-click on Sect1 sector icon to open this sector.

Creating Nodes within a Sector

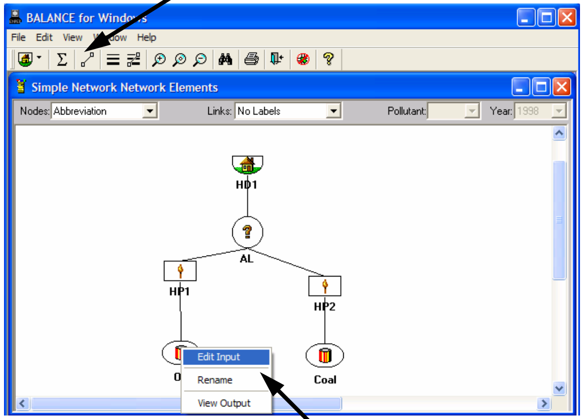


1. Click on <u>depletable resource node</u>, then click in center of Sect1 sector to add two resource nodes.



2. Enter all nodes with Name, Abbreviation and Description.

3. Click on <u>Add Link icon</u>, then draw links between the nodes.



4. Right-click on each node to add the data specified in the following tables for different cases (i.e. for different runs of the model).

Data Sheet for Simple Network

Depletable Resources Data

Case	Resource	Annual Capacity Limit (kBOE)	Base Year Production (kBOE)	Intercept of Supply Curve (price) ($/BOE)	Slope of Supply Curve	Price Growth Rate (Fract.)
1-16	Oil	1000000	500	20	0	0
	Coal	1000000	500	10	0	0
17	Oil	1000000	500	20	0	0.02
	Coal	1000000	500	10	0	0.04

Data Sheet for Simple Network

Conversion Process Data

Case	Process Name	Single Plant Capacity (kBOE)	All Plant Capacity (kBOE)	Capacity Factor (Fract.)	Efficiency (Fract.)	O&M Cost ($/BOE)	Single Plant Inv. ($1000)	Econ. Life (Years)	Int. Rate (Fract.)
1-8	HP1	100	100000000	0.8	0.8	0	0	30	0.1
	HP2	100	100000000	0.8	0.8	0	0	30	0.1
9	HP1	100	100000000	0.8	0.8	0	0	30	0.1
	HP2	100	100000000	0.8	0.8	2	0	30	0.1
10	HP1	100	100000000	0.8	0.8	0	0	30	0.1
	HP2	100	100000000	0.8	0.8	2	5000	30	0.1
11	HP1	100	100000000	0.8	0.8	0	0	30	0.1
	HP2	100	100000000	0.4	0.8	2	5000	30	0.1
12	HP1	100	100000000	0.8	0.8	0	0	30	0.1
	HP2	100	100000000	0.4	0.6	2	5000	30	0.1
13	HP1	100	100000000	0.8	0.8	0	0	30	0.1
	HP2	100	100000000	0.4	0.6	2	5000	30	0.05
14	HP1	100	100000000	0.8	0.8	0	0	30	0.1
	HP2	100	100000000	0.4	0.6	2	5000	40	0.05
15	HP1	100	100000000	0.8	0.8	0	0	30	0.1
	HP2	100	100000000	0.4	0.6	2	+10000	40	0.05
16-17	HP1	100	100000000	0.8	0.8	0	0	30	0.1
	HP2	100	100000000	0.8	0.8	0	0	30	0.1

Data Sheet for Simple Network

Decision Node Data (AL)

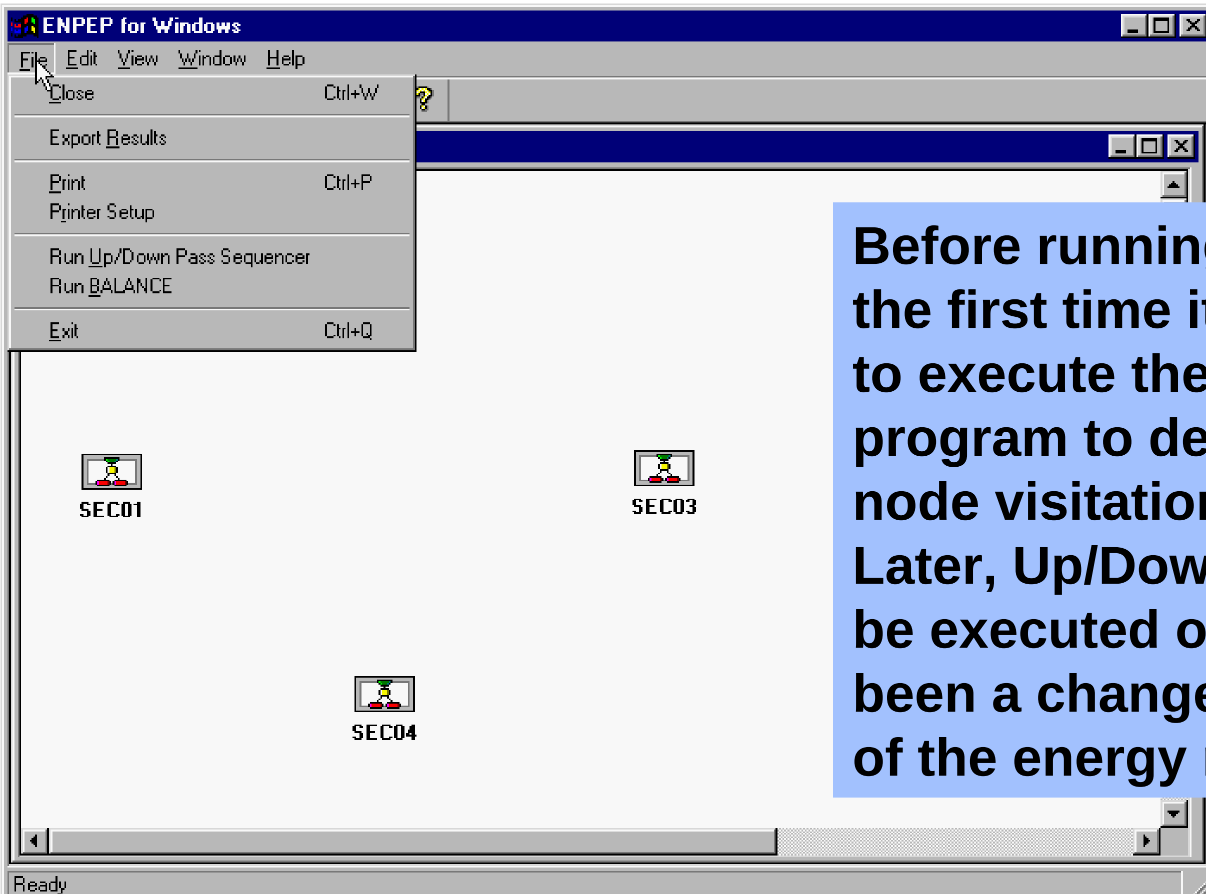
Case	Base Year Split (Fract.)	Priority Link		Premium Multiplier		Price Sensit. (0-15)	Lag Parameter (0-1)
		H-C	H-O	H-C	H-O		
1-3	1	0	0	0	0	0	0
4	1	0	0	0	0	5	0.5
5	1	0	0	0	0	2	0.1
6	1	0	0	0	0	2	0.9
7	1	0	0	1	0.8	5	0.5
8	1	1	2	0	0	2	0.9
9-17	1	0	0	0	0	5	0.5

Data Sheet for Simple Network

Demand Node Data

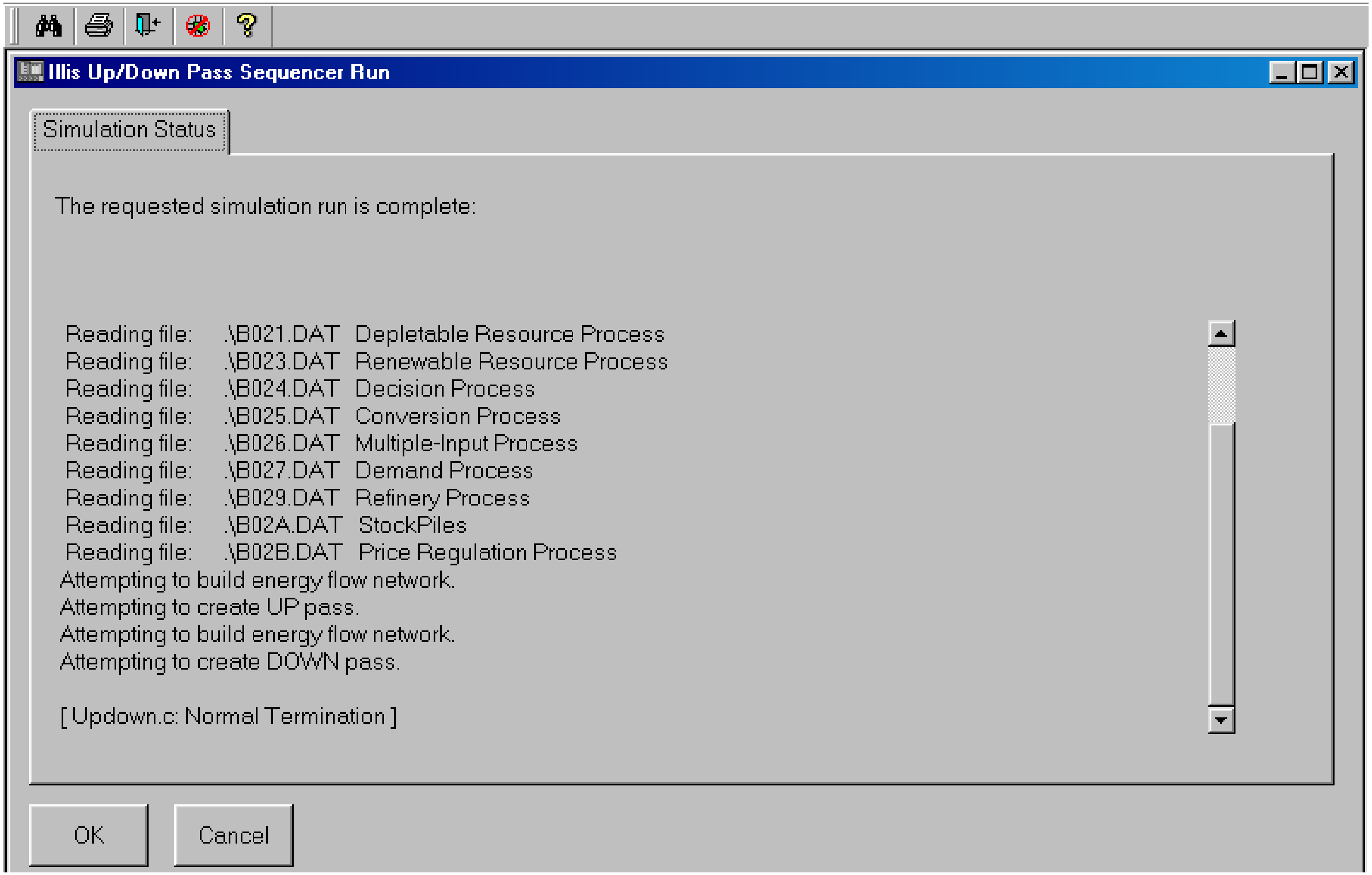
Case	Demand Node	Growth Rate (Fraction)
1	HD1	0
2	HD1	0.05
3-17	HD1	0

Execution of BALANCE Module is performed in two steps: node visitation => network calculation

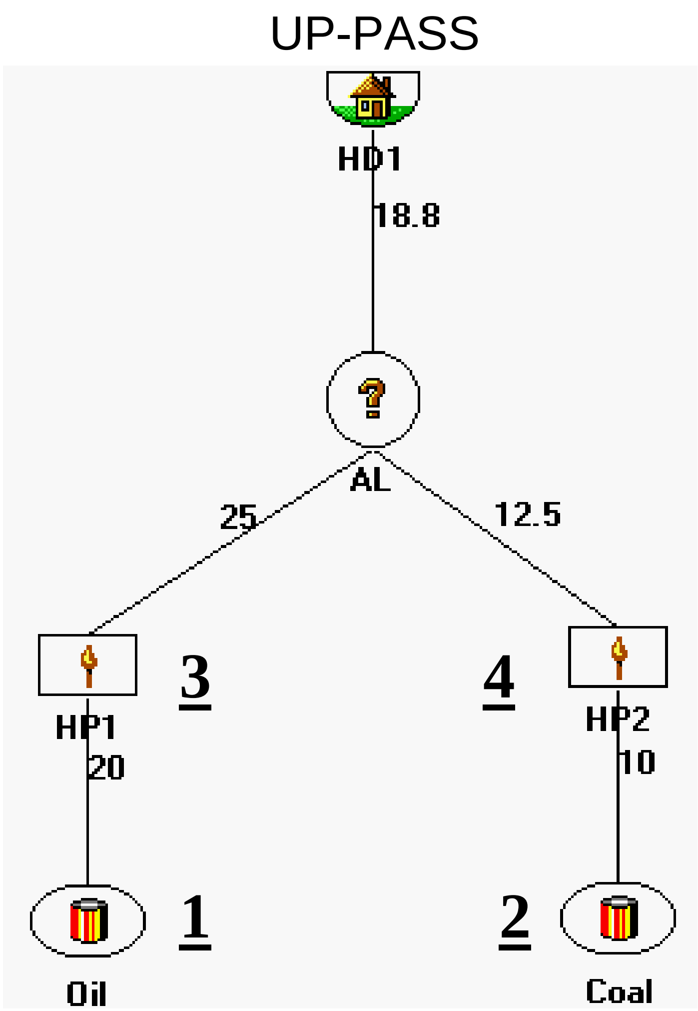


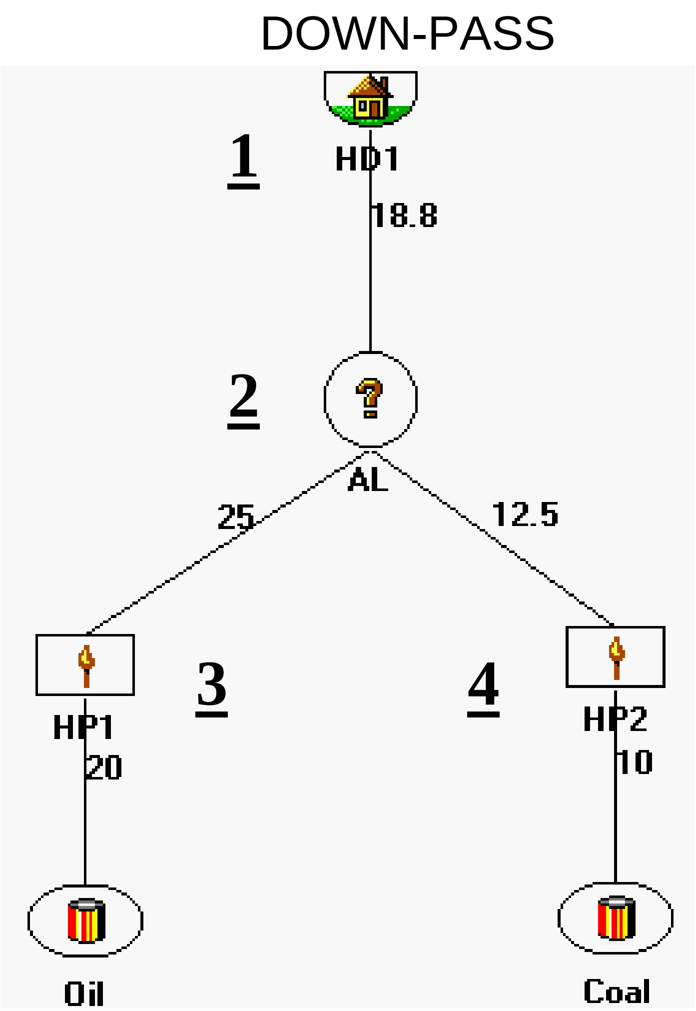
Before running BALANCE for the first time it is necessary to execute the Up/Down Pass program to determine the node visitation sequence. Later, Up/Down Pass should be executed only if there has been a change in the structure of the energy network.

BALANCE Produces a Simulation Status Report for the Up/Down Pass Sequencer

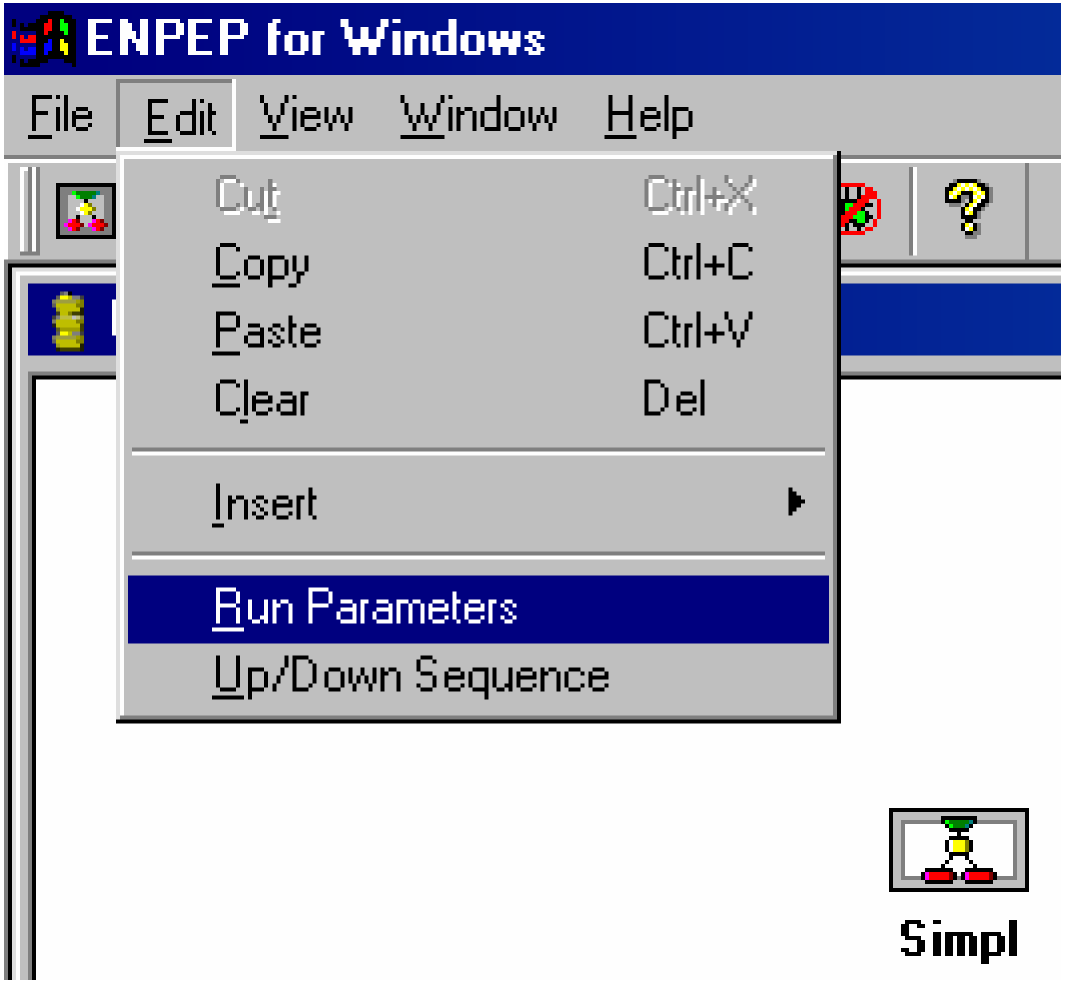


Case 1: Definition of node visitation sequences

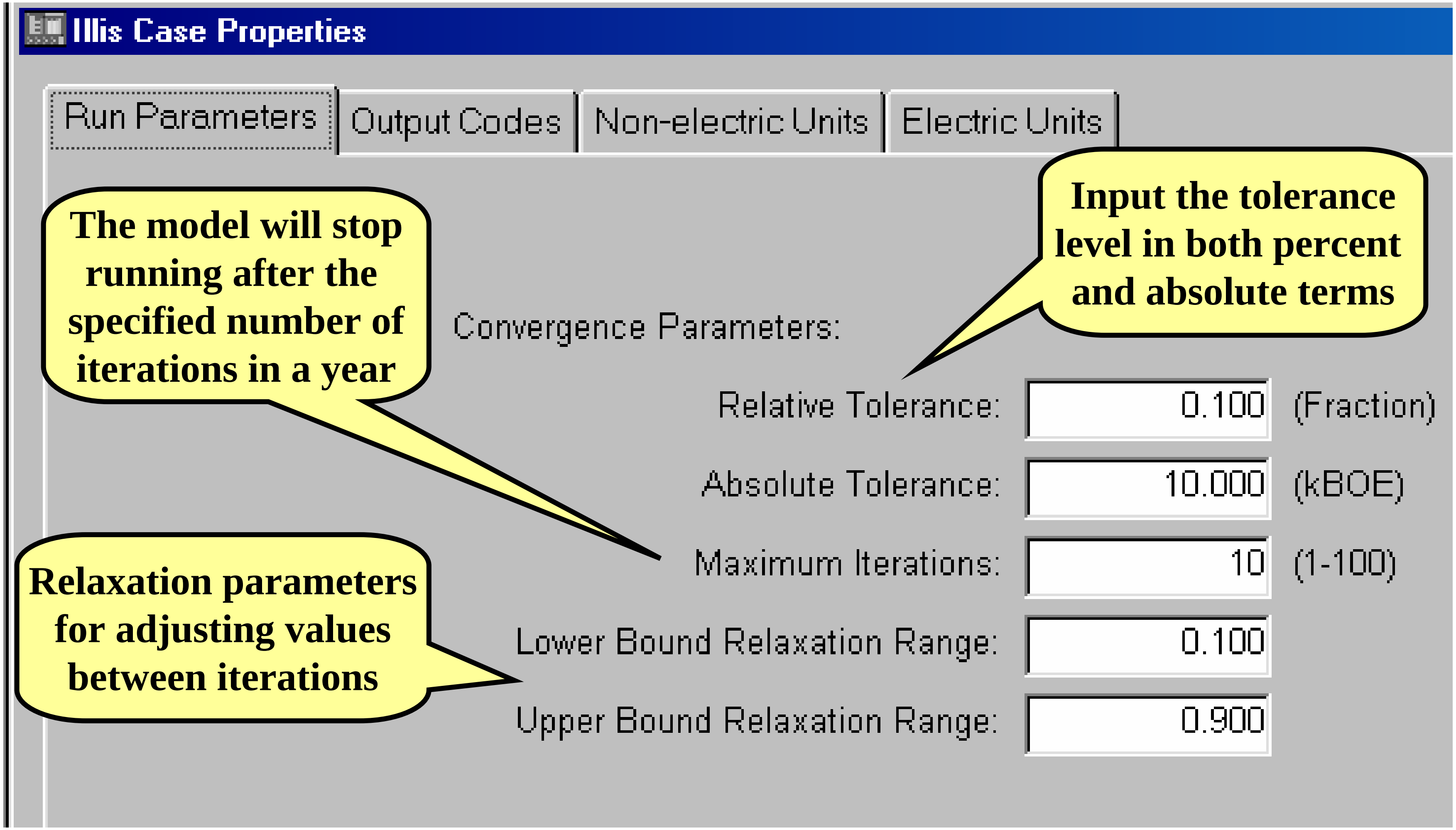




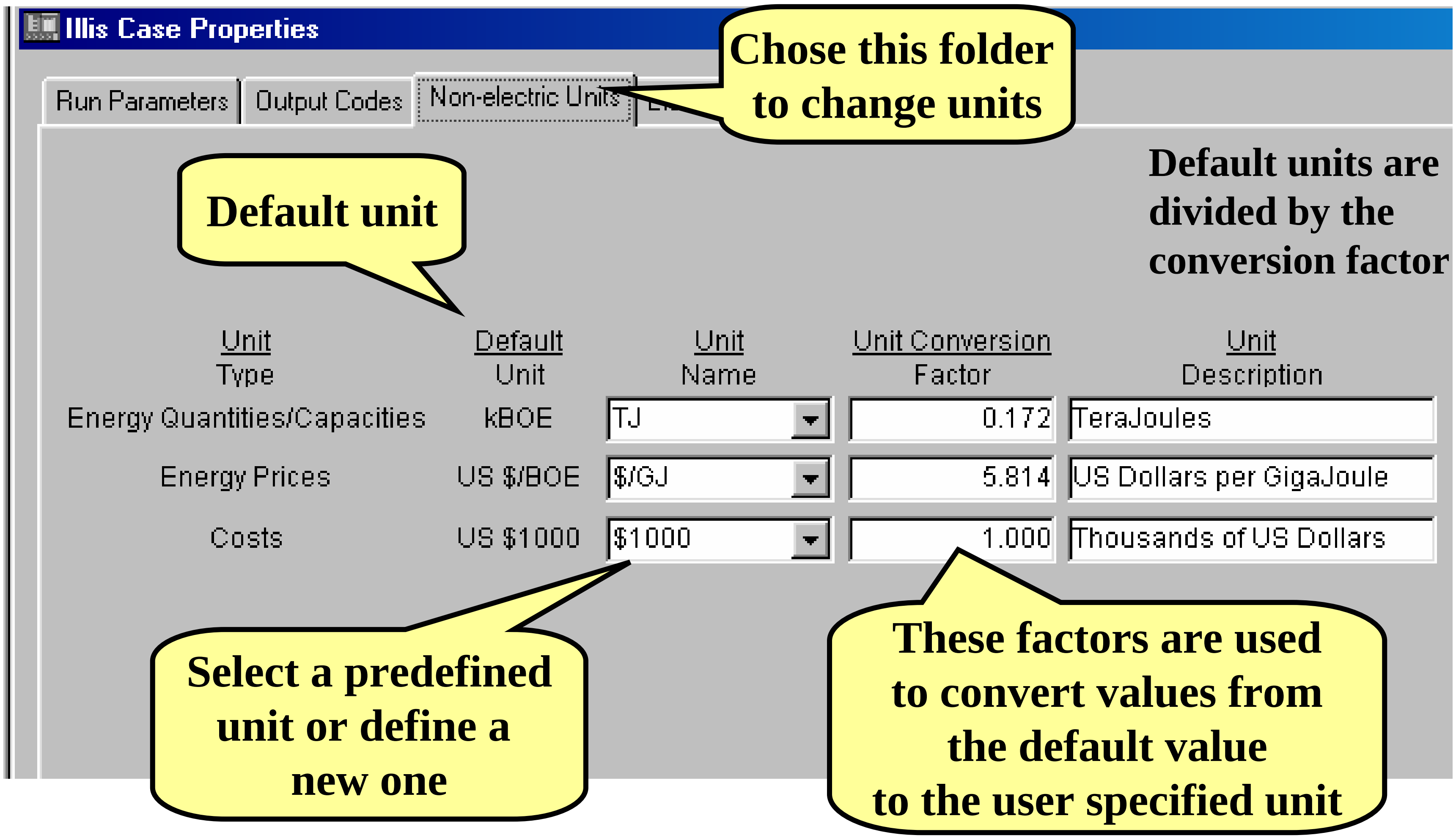
In addition to the Up/Down sequence, Run parameters may be necessary to check/modify



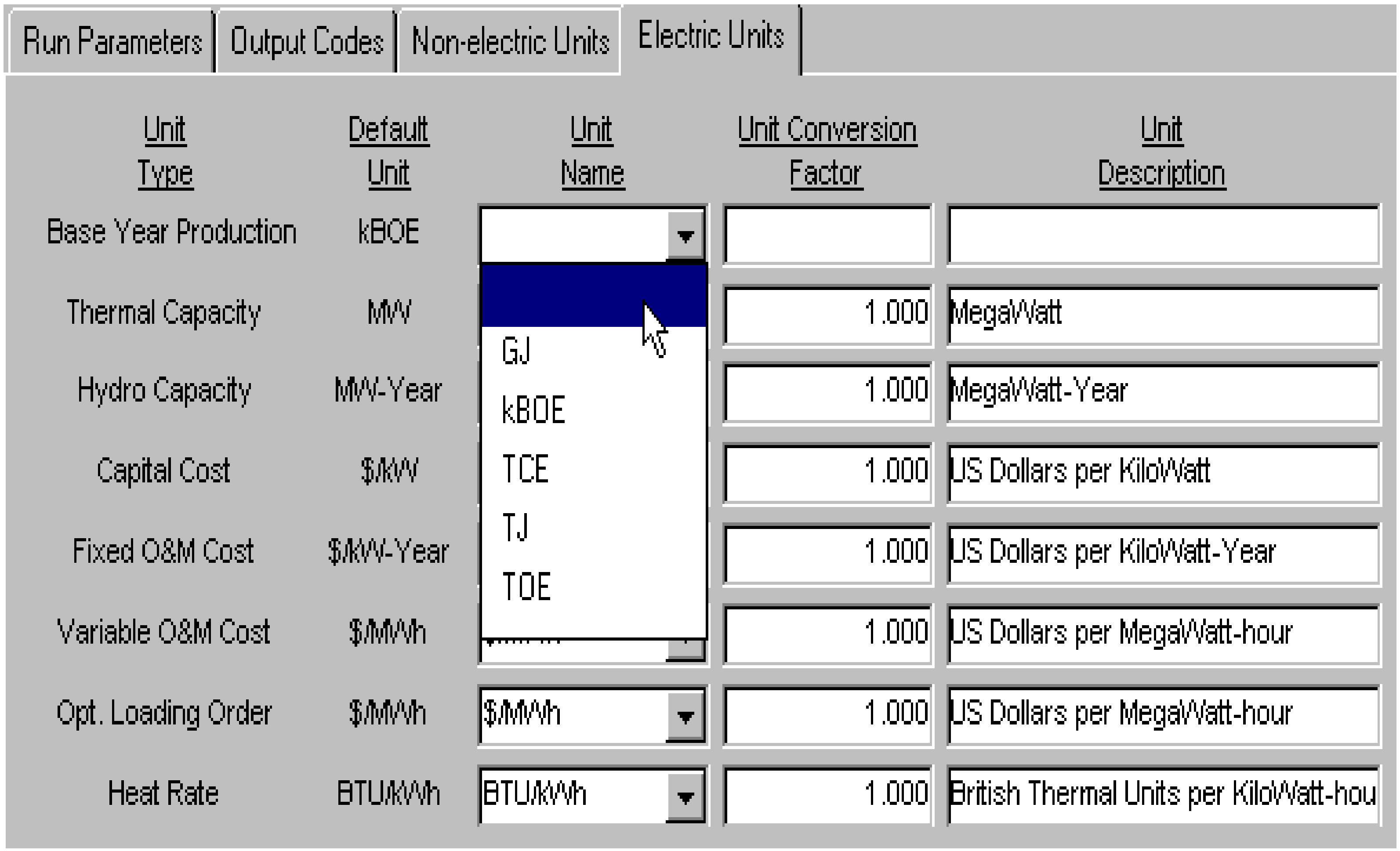
Run Parameters Allow the User to Select The Convergence Tolerance Level



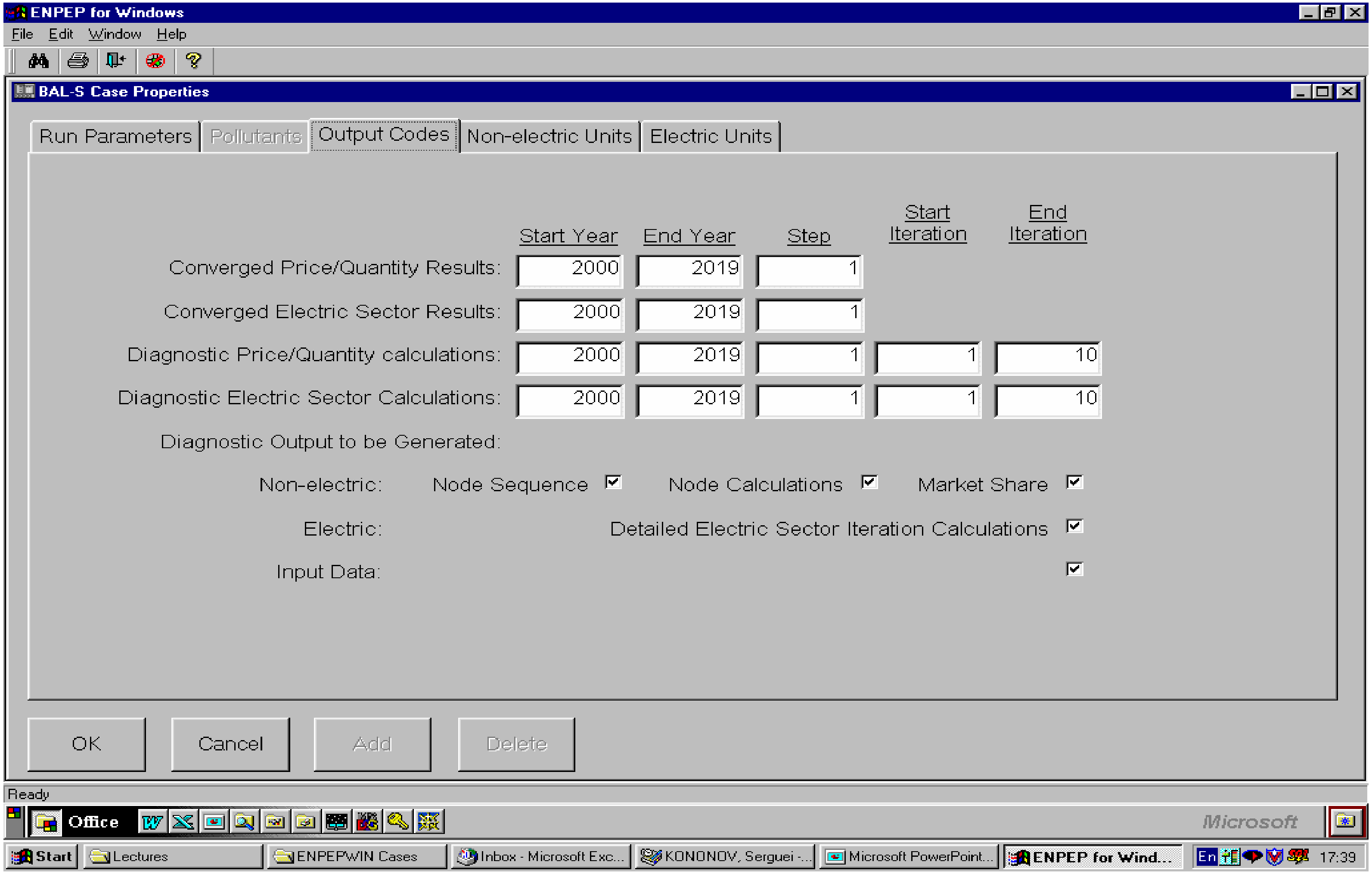
The User Can Specify the Units To Be Displayed



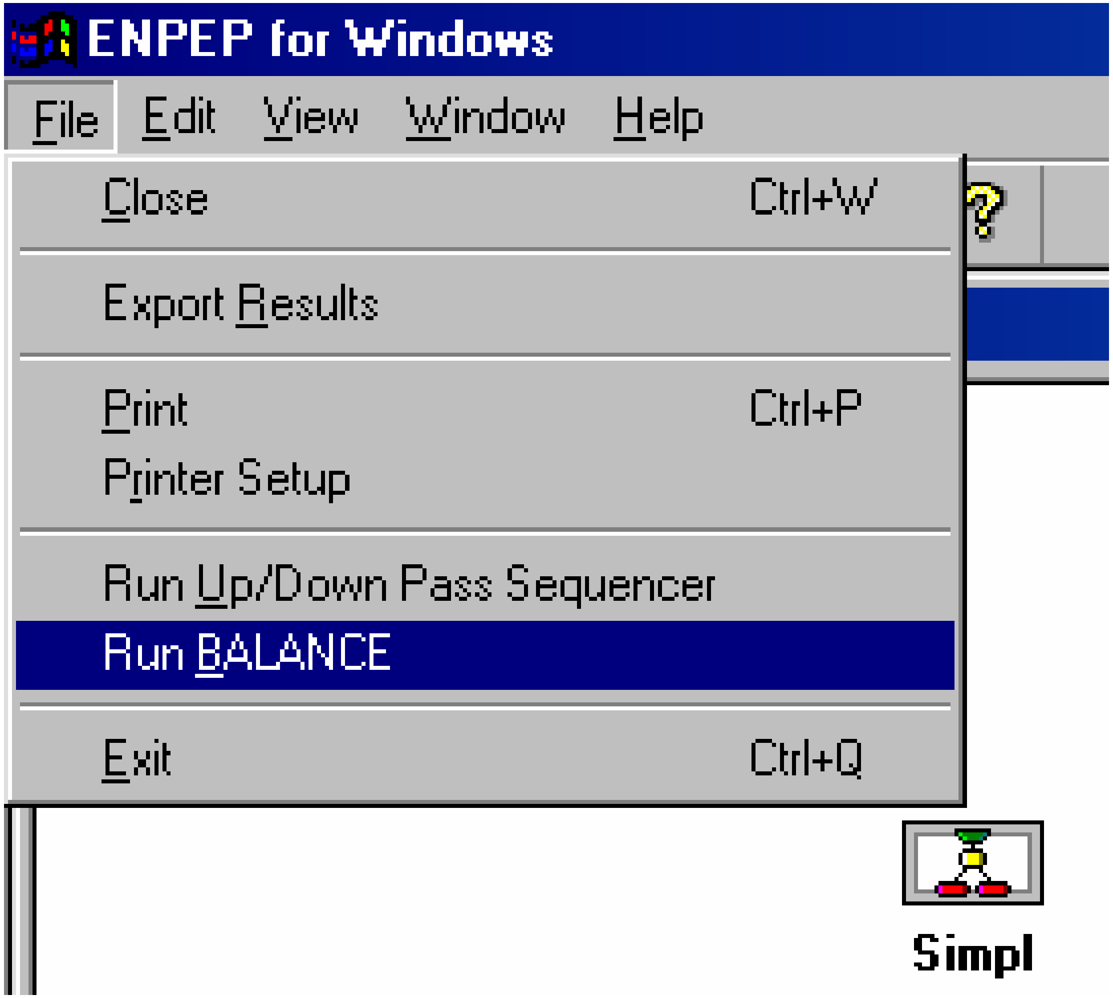
Similar procedure is used for both non-electric and electric units



Reporting can be managed by output codes



To Run the Model Select *Run BALANCE* Under the *File* List When You Are in the Sector Window



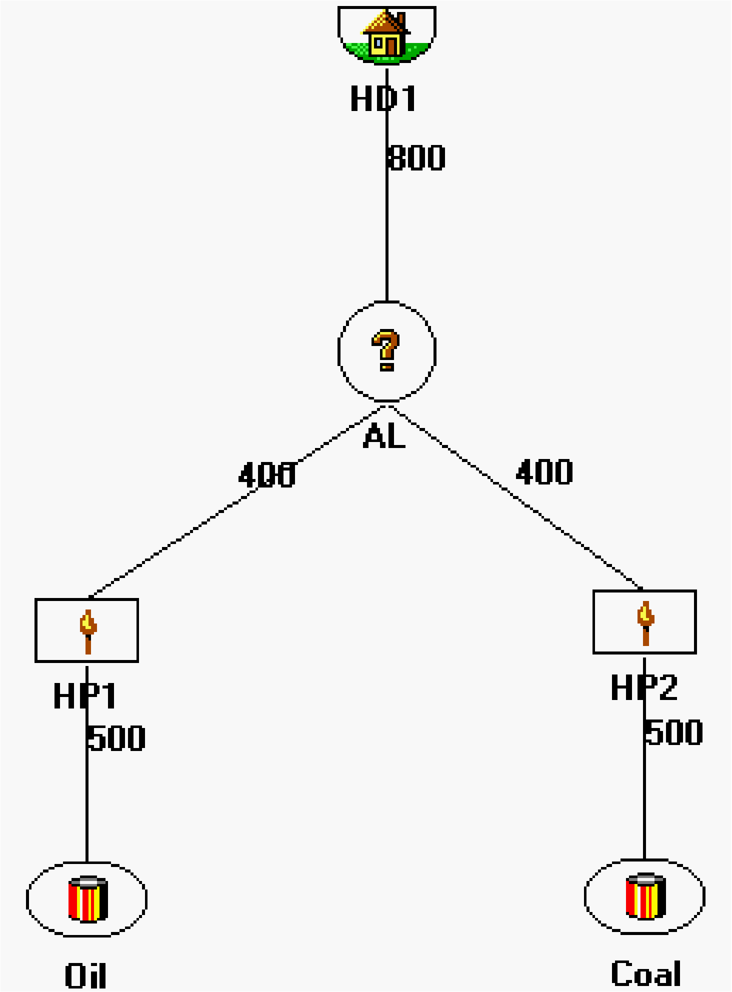
Case 1: Check of Base Year Energy Flows

Base Year energy flows in kBOEs.

AL: $Qout_t = \Sigma Qin_{(t,l)} = 400+400 = 800$

PR: $Qout_t = Qin_t \times f$
$= 500 \times 0.8 = 400$

RS: $Qout_0$ = user-specified = 500



Case 1: Check of Base Year Energy Prices

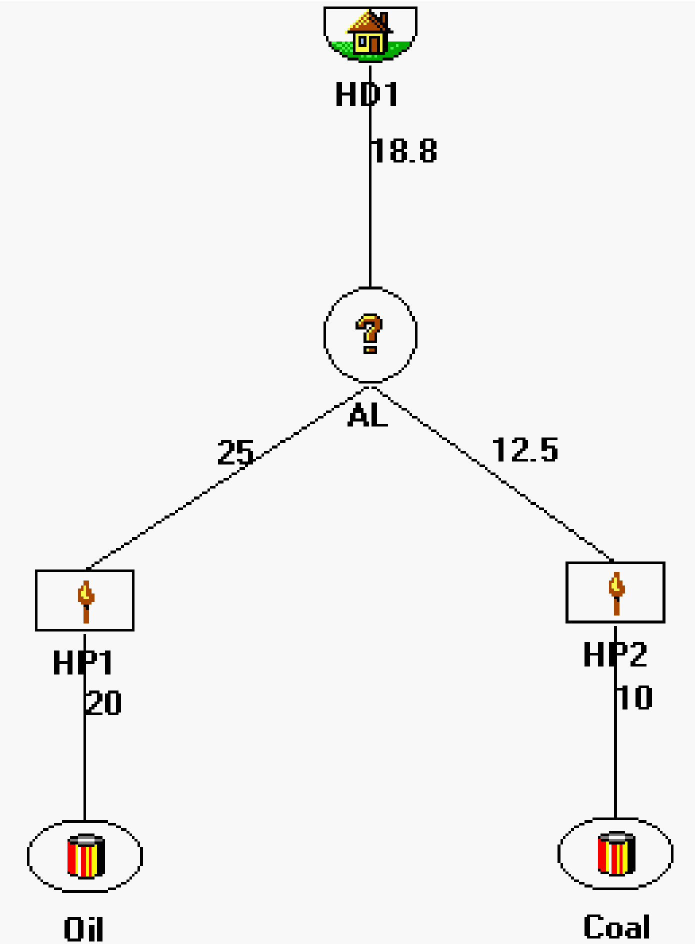
Base Year energy prices
in U.S.$/BOE

AL: $Pout_t = \Sigma\, [P_l \times S_l]$

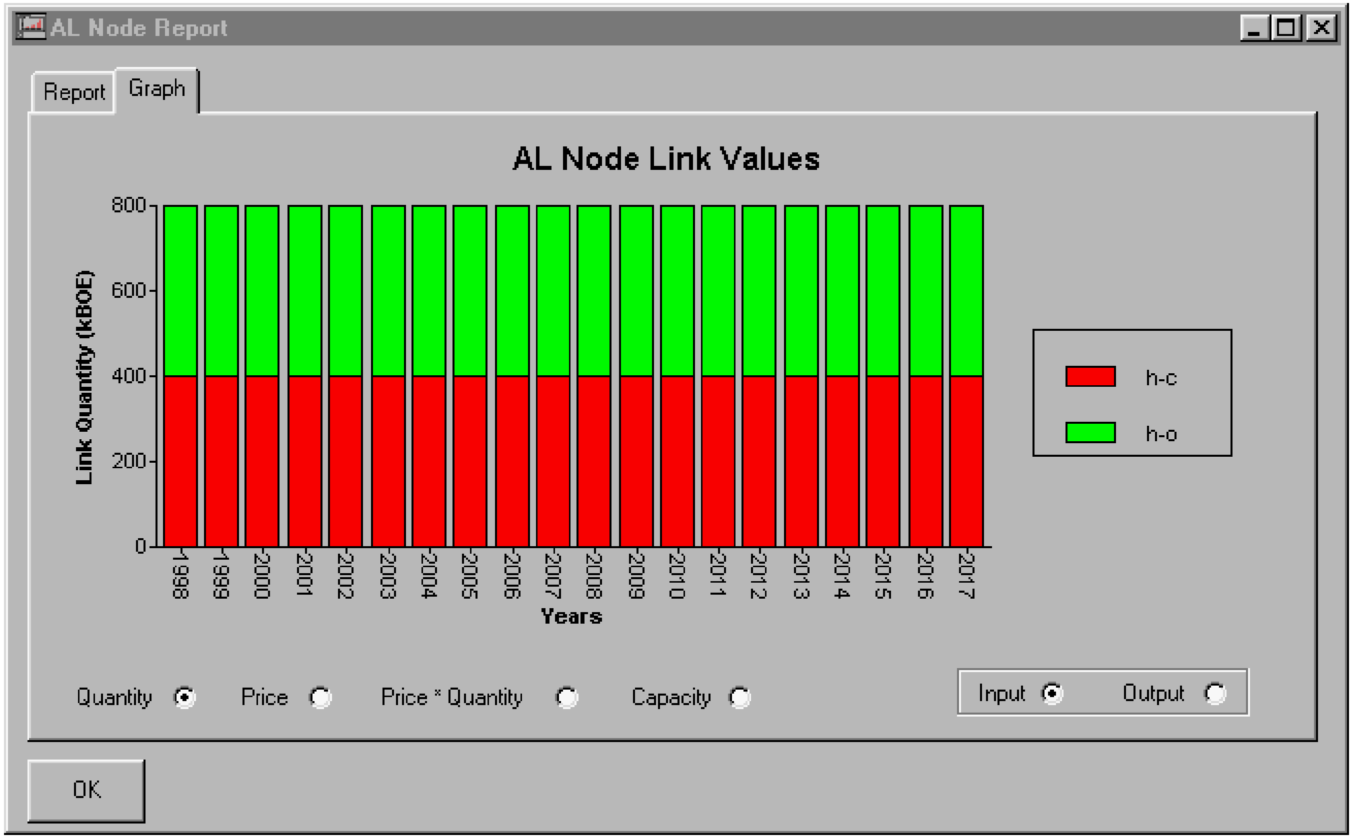
$= 25 \times 0.5 + 12.5 \times 0.5 = 18.75$

PR: $Pout_t = Pin_t/f + OM +$
$+ [TCI/(CAP \times CF)] \times CRF(i,n)$
$= 20/0.8 = 25$

RS: $Pout_t = A(Qout_{t-1}) \times (1+R_t) +$
$+ B \times Qout_t + C \times Qout_t^2$
$= 20 \times (1+0) = 20$

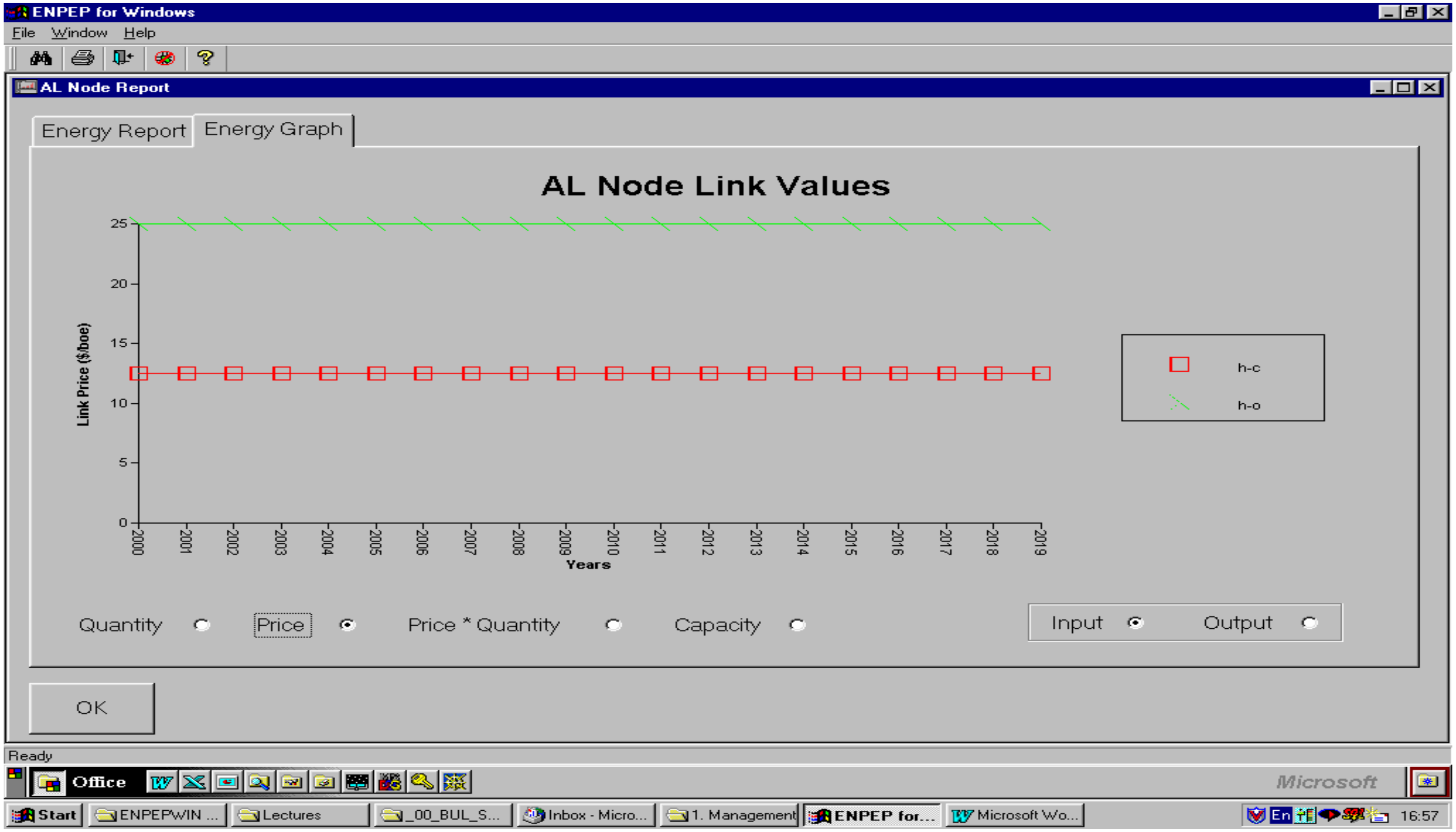


Case 1 Results:
a) Check of the QUANTITIES in the Allocation Node



No demand growth specified over the study period; the quantities are equally distributed on input links (equal market shares) because no price sensitivity was specified.

Case 1 Results:
b) Check of the PRICES in the Allocation Node

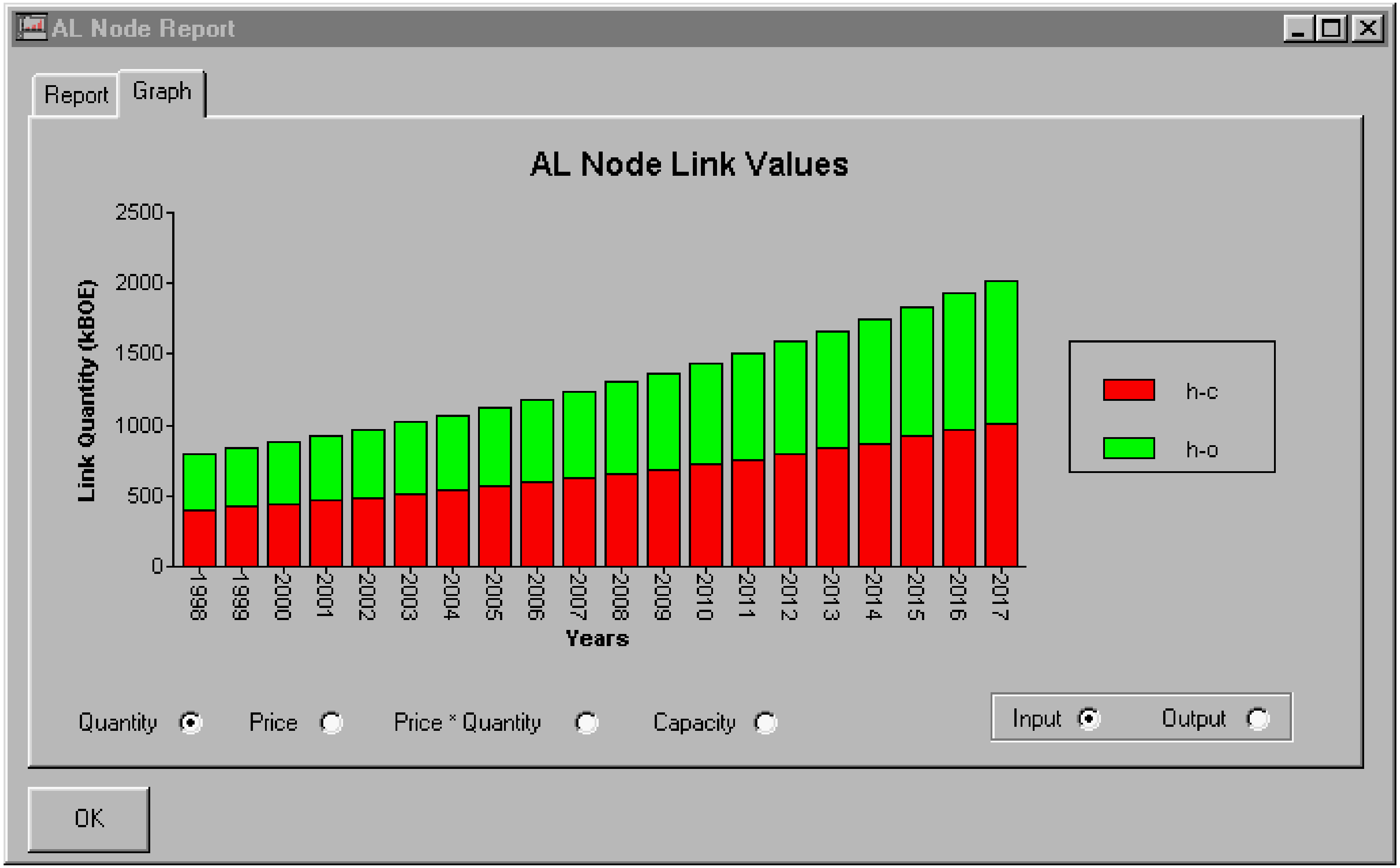


The prices of heat generated using coal (12.5 $/BOE) and oil (25 $/BOE) are different, but the quantities are not affected.

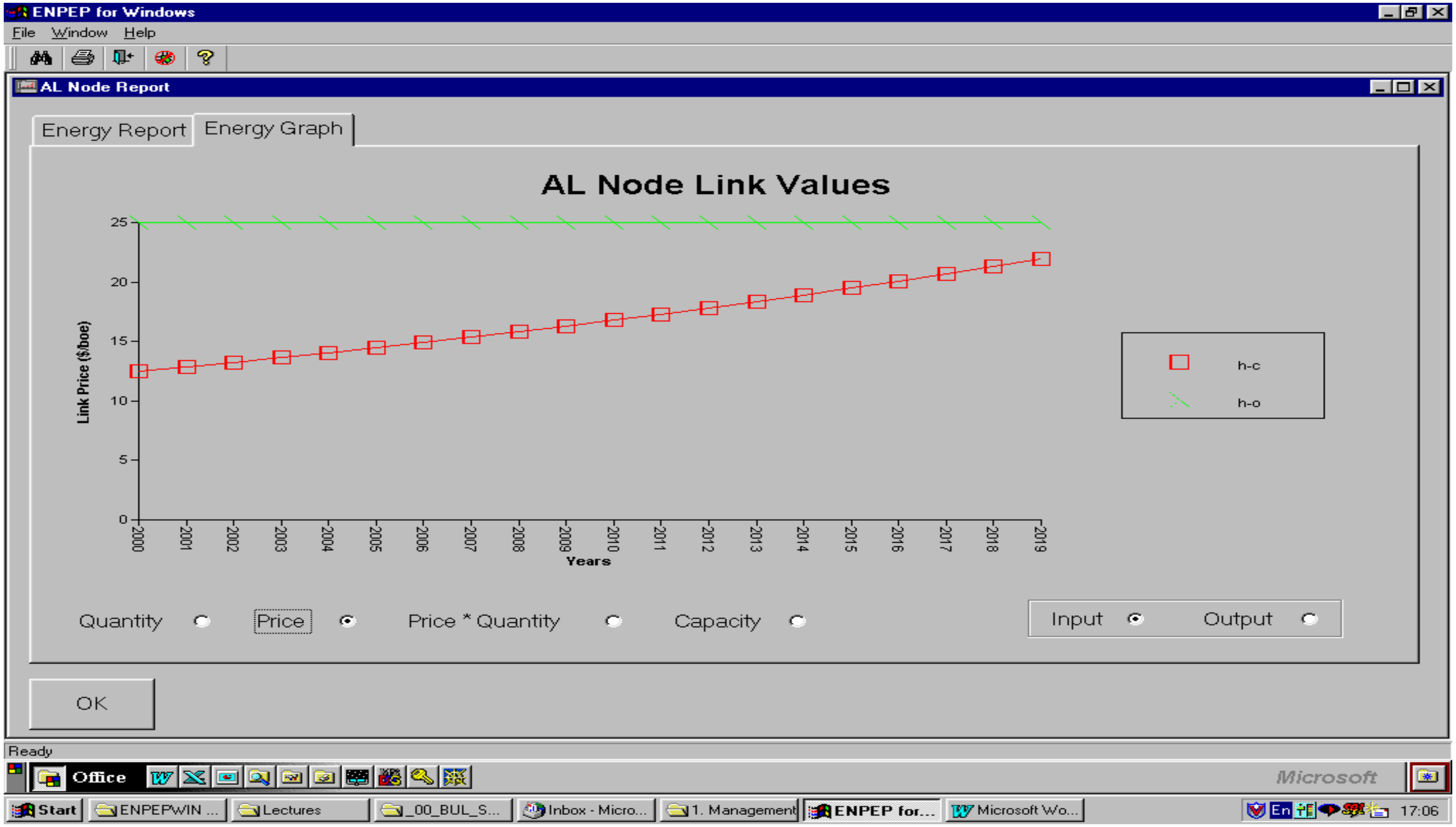
Changes in Case 1: cases 1-6

Case	*1*	*2*	*3*	*4*	*5*	*6*
Demand growth	0	5%	0	0	0	0
Price sensitivity	0	0	0	5	2	2
Lag factor	0	0	0	0.5	0.1	0.9
Resource (coal) price growth	0	0	3%	0	0	0

Case 2: Demand Growth Rate Specified at 5%

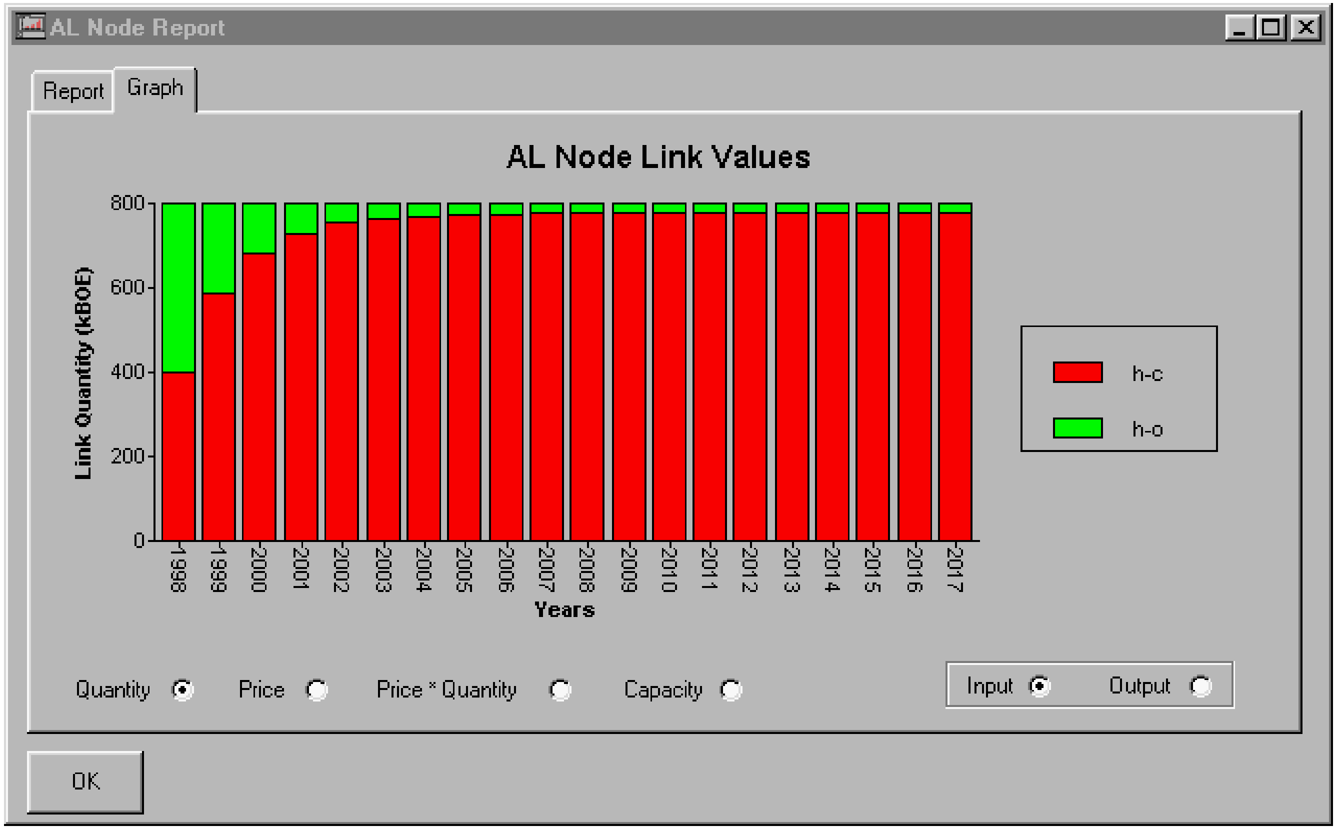


Case 3: Coal Price Increase 3% Per Year; No Demand Growth



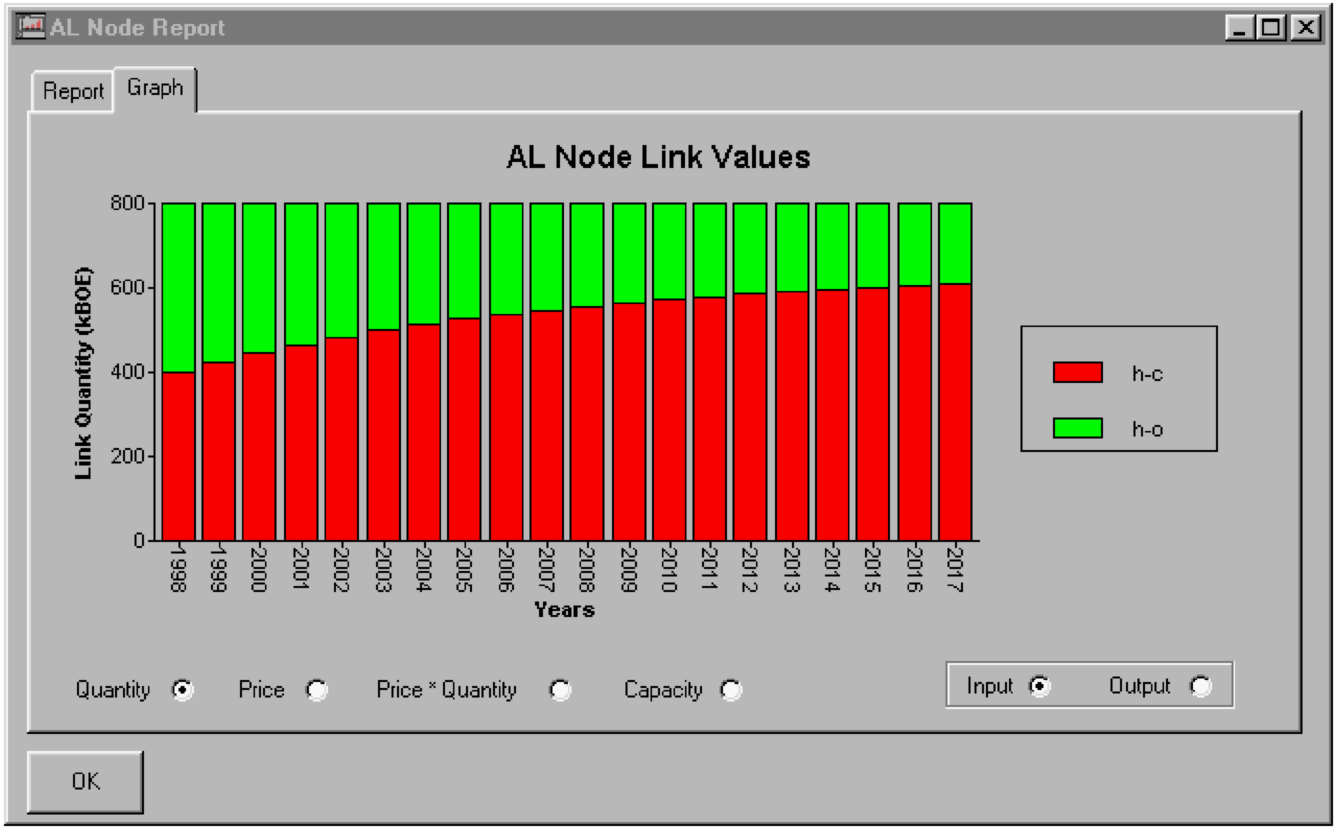
Coal price increases 3% per year, oil prices remain constant. The quantities of heat produced from both fuels remain equal because there is no price sensitivity specified.

Case 4: Price Sensitivity = 5; Lag Parameter = 0.5



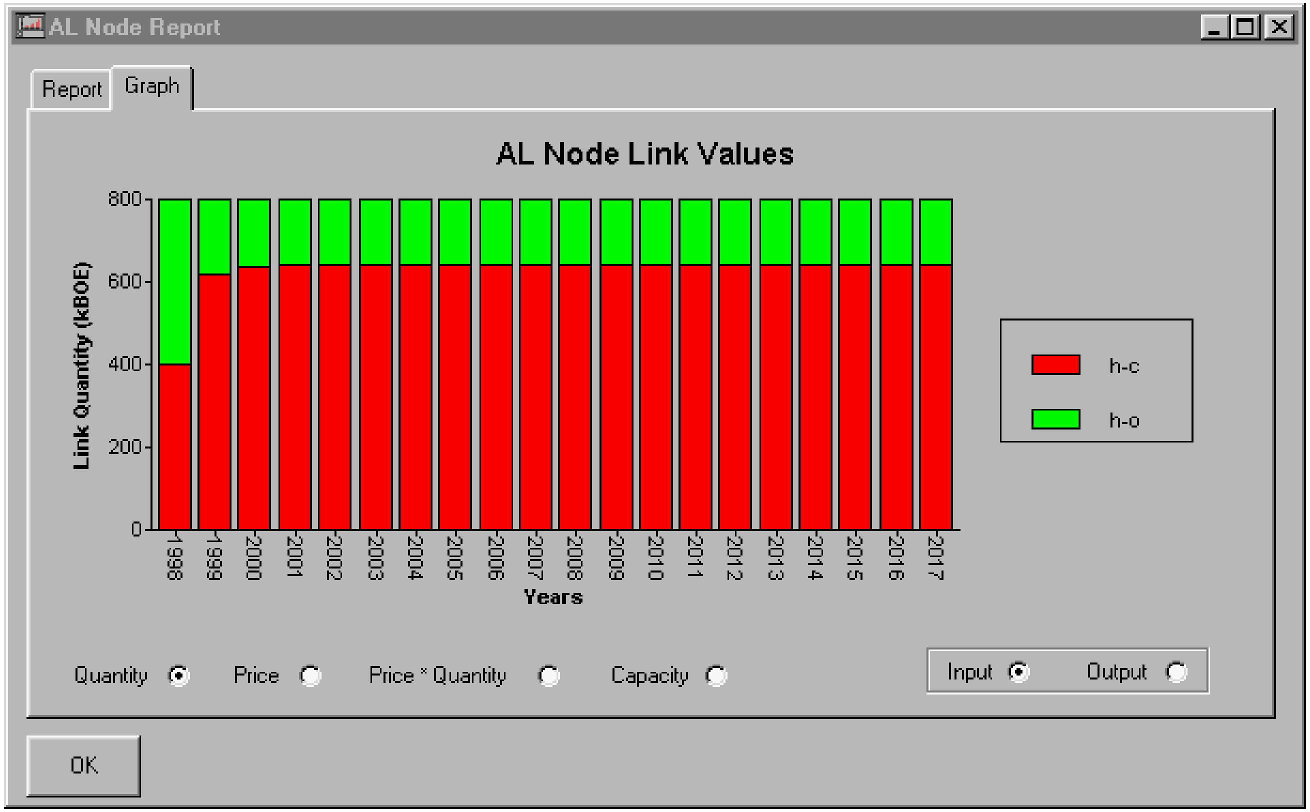
If the price sensitivity is specified, the cheaper fuel soon takes most of the market share.

Case 5: Price Sensitivity = 2; Lag Parameter = 0.1



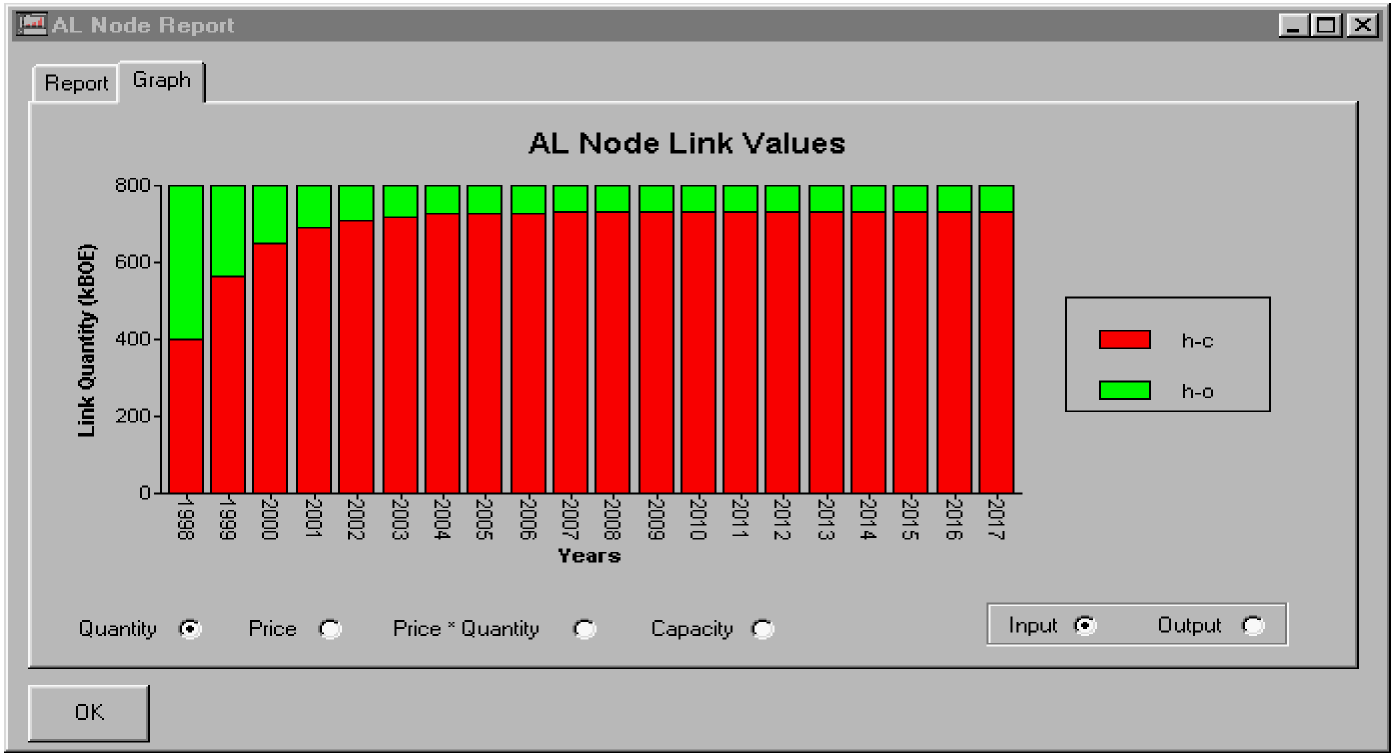
If the price sensitivity is low, the cheaper fuel does not completely dominate the market; the changes are slow because lag=0.1.

Case 6: Price Sensitivity = 2; Lag Parameter = 0.9



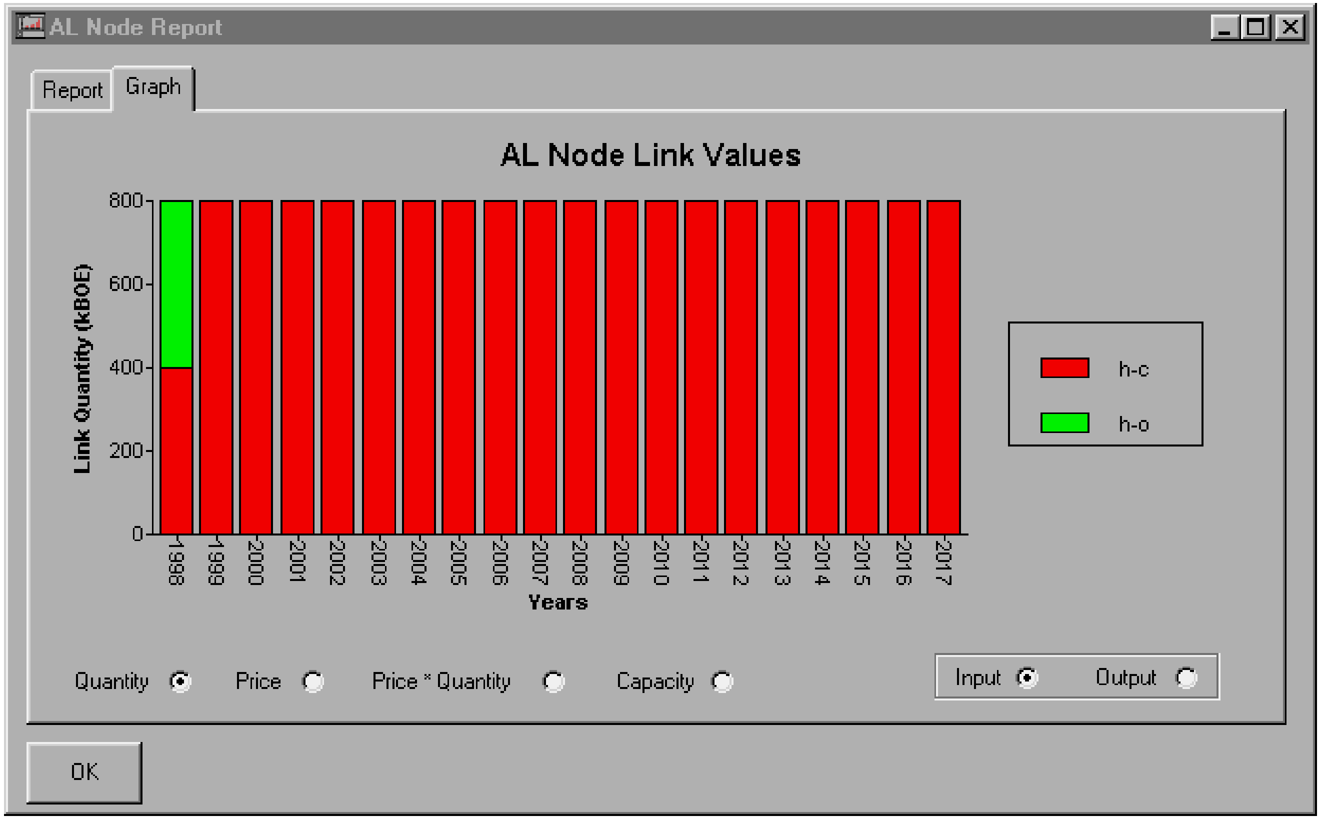
If the lag parameter is specified close to 1, the changes in the market share are achieved more quickly (but they are smaller than under γ=5 above).

Case 7: Premium Multipliers for Coal = 1, Oil = 0.8; Price Sensitivity = 5, Lag Parameter = 0.5



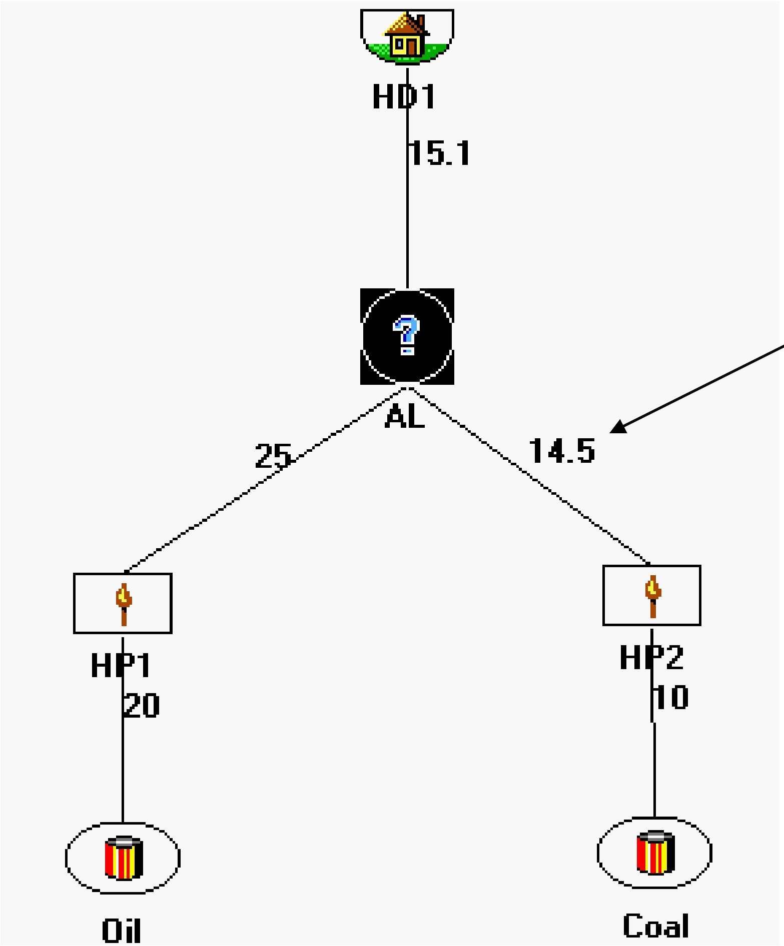
Because of the premium multiplier 0.8 specified for oil, its market share is now larger than in the Case 4.

Case 8: Priority Link H-C = 1



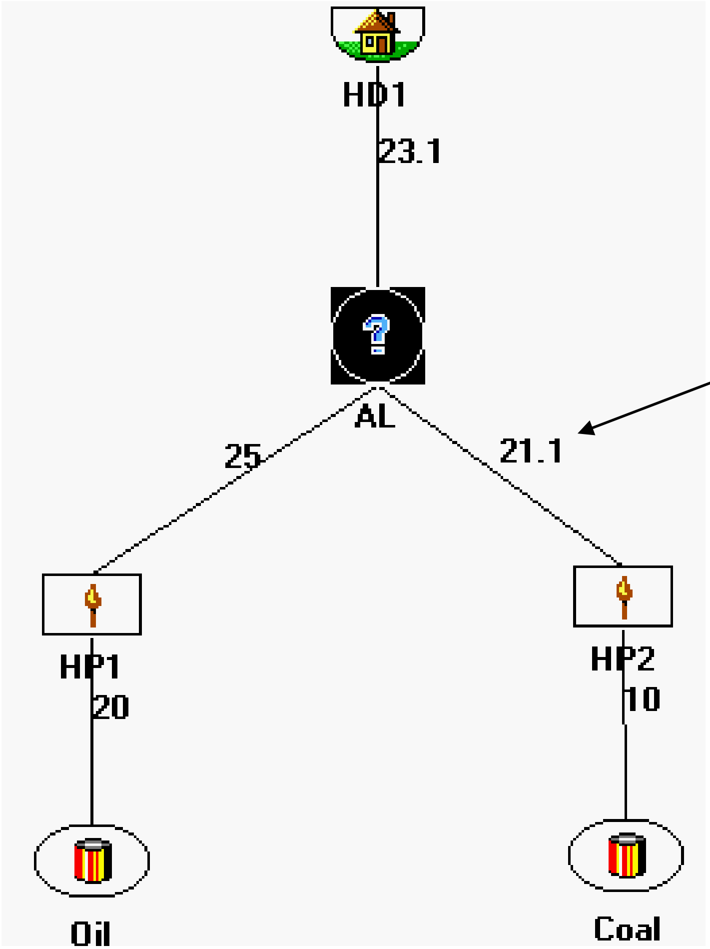
Except for the base year, for which the quantities are predefined, the priority link will be used up to its maximum capacity.

Case 9: Heat Plant 2 O&M Cost = 2 $/BOE



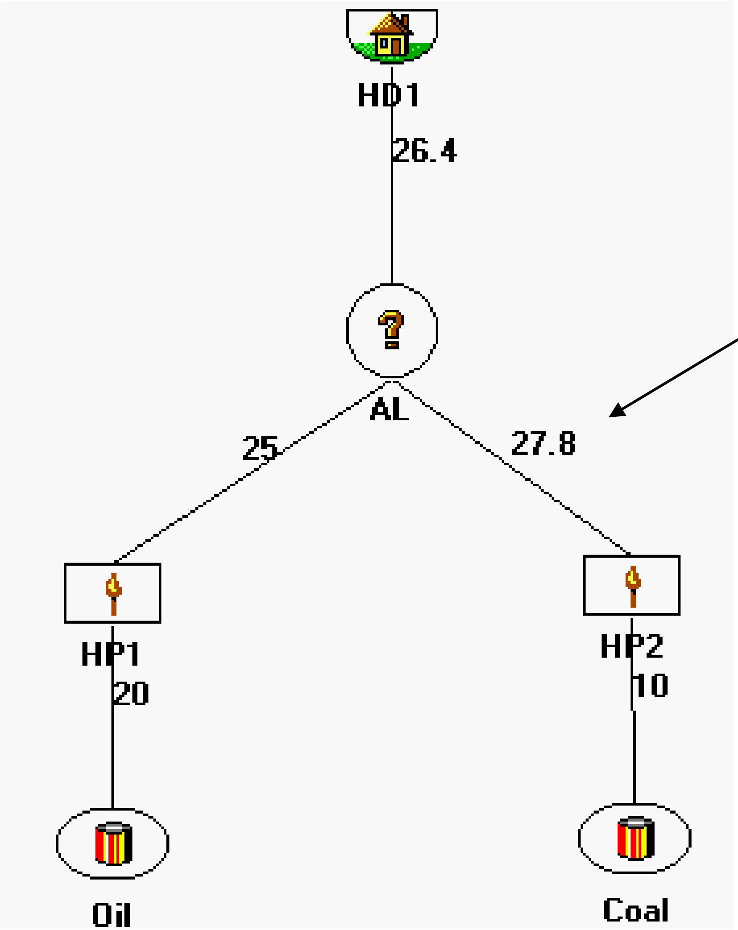
The price on the link h-c increased from 12.5 to 14.5 $/BOE.

Case 10: Single Plant Investment Cost = 5 Million Dollars, O&M = 2$/BOE



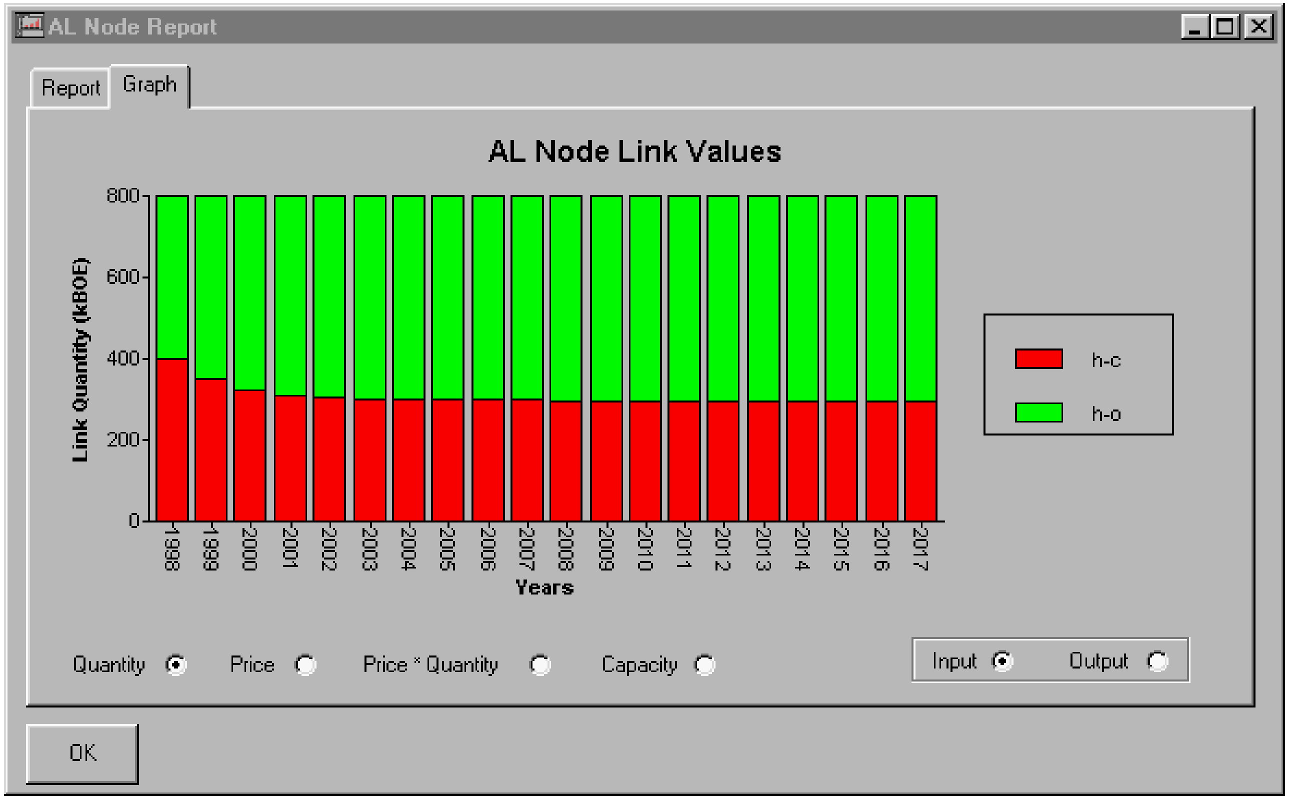
The price on the link h-c increased from 14.5 to 21.1 $/BOE.

Case 11: HP2 Capacity Factor = 0.4



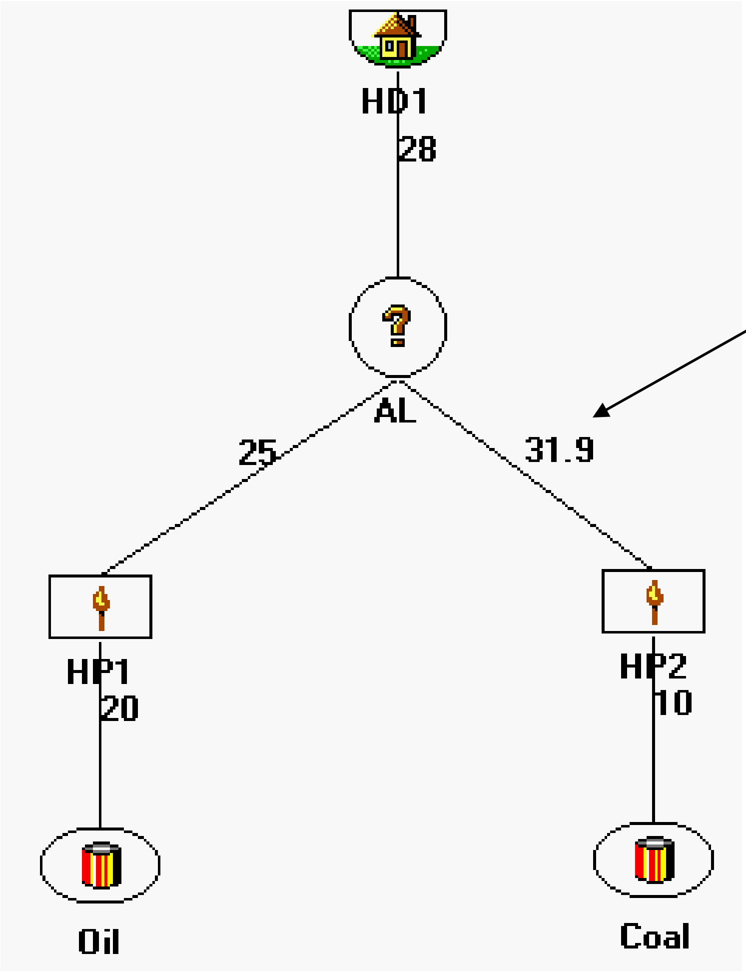
The price on the link h-c increased from 21.1 to 27.8 $/BOE.

Case 11: HP2 Capacity Factor = 0.4



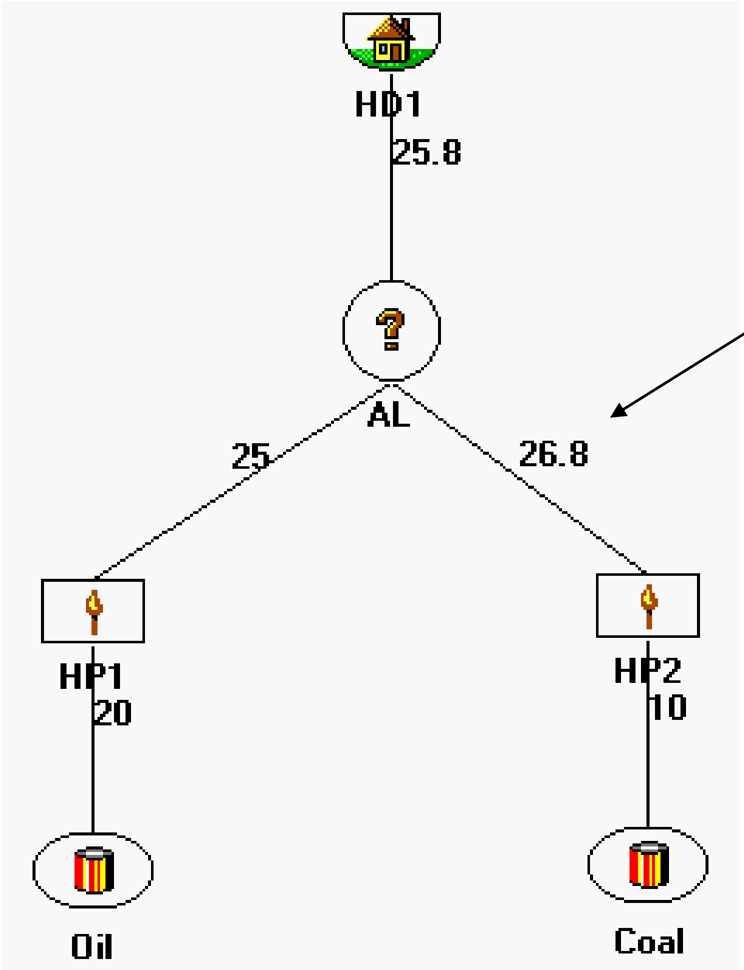
The price on link h-c is now higher than that on link h-o, so its market share decreases.

Case 12: HP2 Efficiency = 0.6, Capacity Factor 0.4



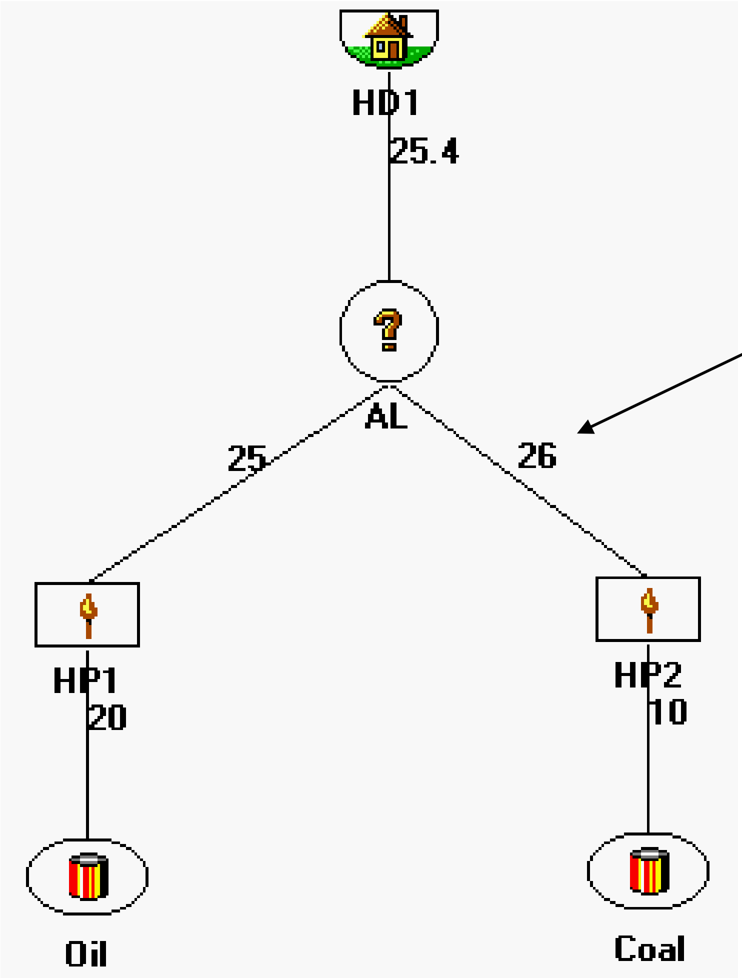
The price on the link h-c increased from 27.8 to 31.9 $/BOE.

Case 13: HP2 Interest Rate Decreases from 10% to 5%



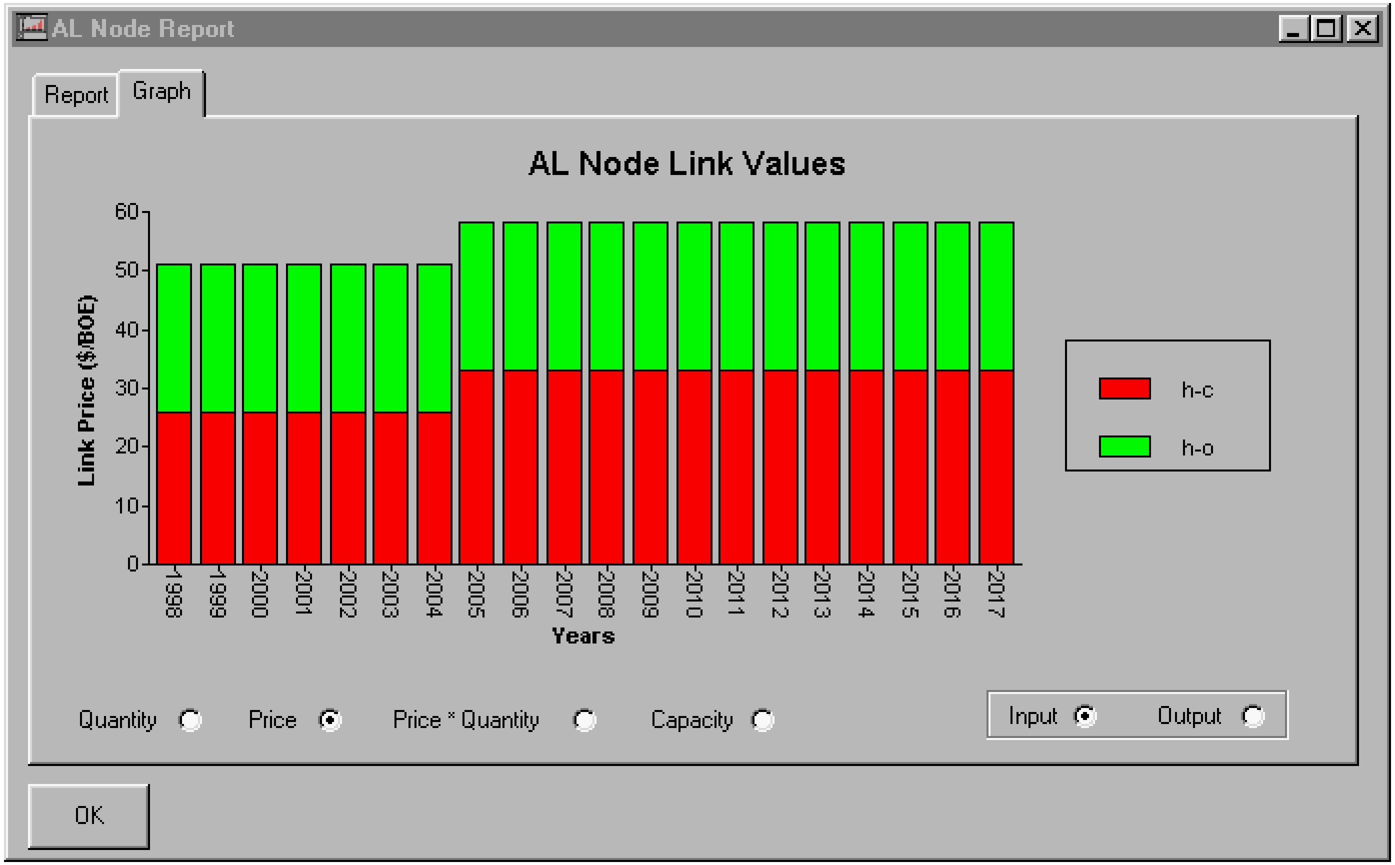
The price on the link h-c decreases from 31.9 to 26.8 $/BOE.

Case 14: HP2 Economic Lifetime Increased from 30 to 40 Years



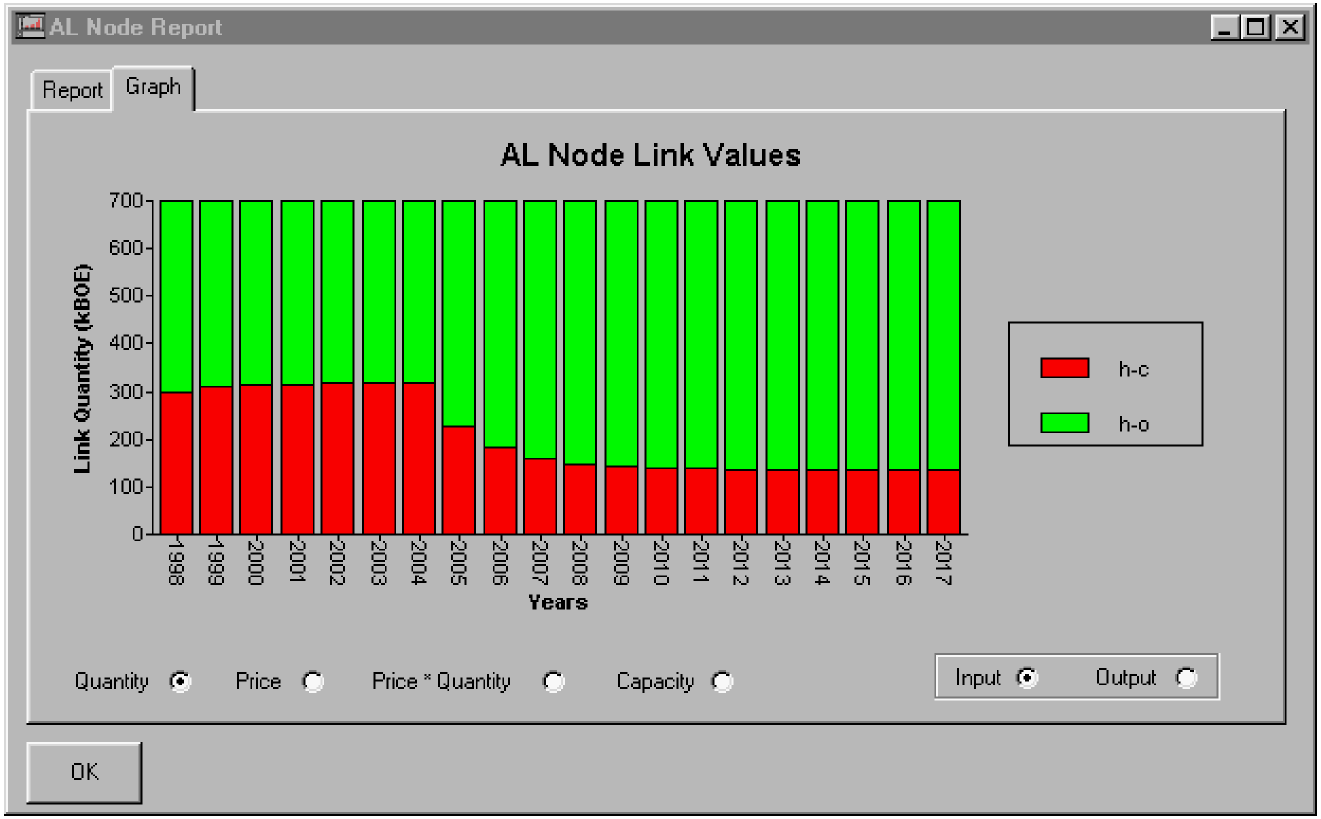
The price on the link h-c decreases from 26.8 to 26.0 $/BOE.

Case 15: Addition of a New HP2 Unit in 2005, Investment Cost = 10 Million Dollars



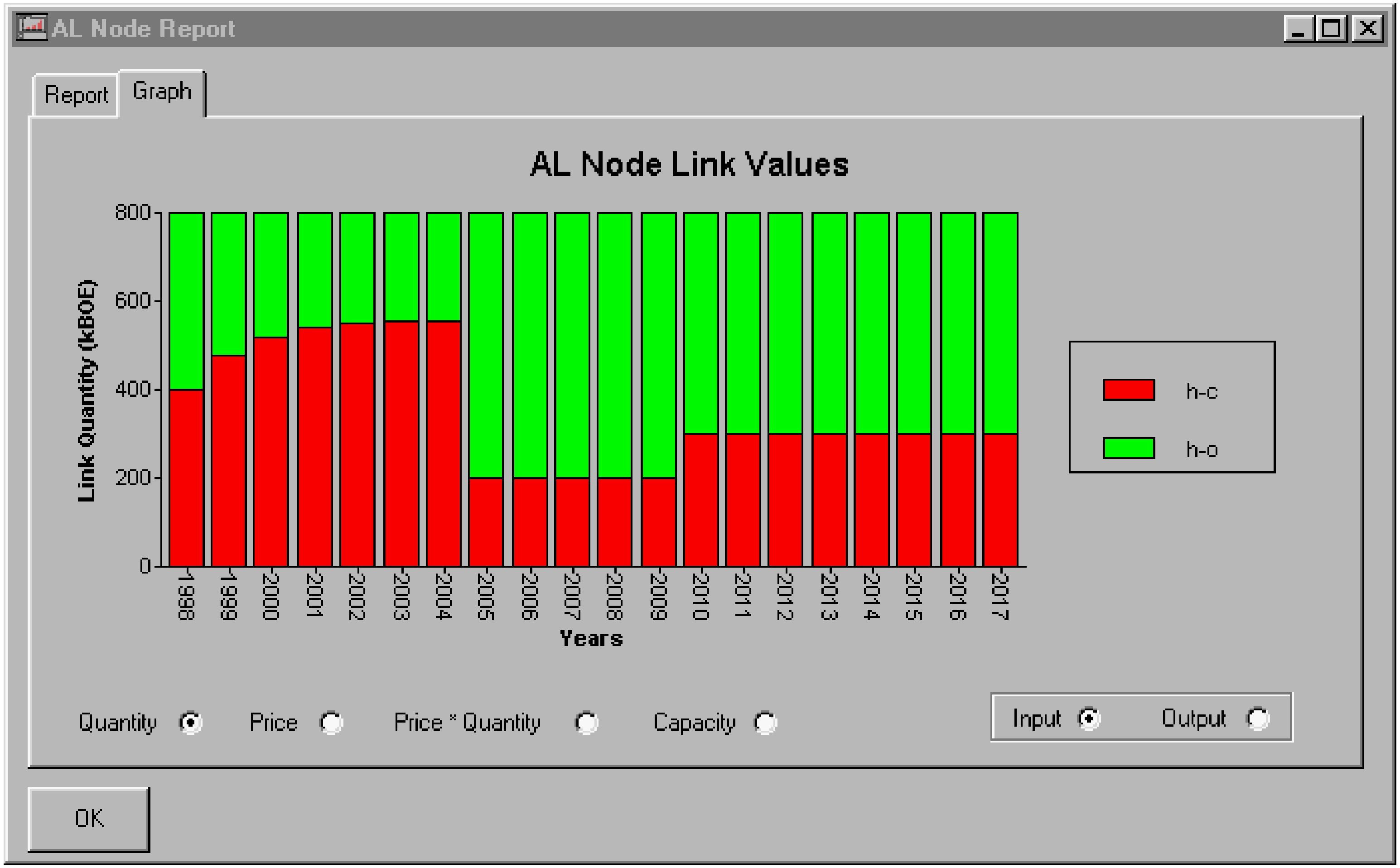
The price on the link h-c increases from 2005.

Case 15: Addition of a New HP2 Unit in 2005



Because the price on the link h-c becomes higher in 2005 and after, its market share decreases.

Case 16: H-C Link Capacity Limits
1998: No Limit, 2005: 200 kBOE, 2010: 300 kBOE



Case 17: Price Growth Rates of Energy Resources Oil 2%, Coal 4%