

Title Page



Training Report Presented to:
Egyptian Natural Gas Holding Company (EGAS)

Training on the use of the ENPEP for Windows Software



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Submitted by:



ADICA Consulting, LLC
The Ultimate in Strategic Analysis

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1. EXECUTIVE SUMMARY

Fourteen staff of the Egyptian Natural Gas Holding Company (EGAS) and one from the Ministry of Petroleum were trained on how to apply the Energy and Power Evaluation Program (ENPEP for Windows) software for conducting energy and environmental analyses in Egypt. The course participants were also guided through the development of an ENPEP Reference Case using country specific data from Egypt.

The training was completed in accordance with the agreed schedule from 29 October until 09 November 2006. Upon completion of the training, the course staff provided the trainees a copy of the software utilized, lectures presented, and reference case developed during the course.

2. SCOPE OF THE TRAINING

Objectives of the Training

The **main objective** of the assignment is to train EGAS staff on the use of the **ENPEP for Windows** software for conducting integrated energy-environmental analyses with a focus on modeling the use of natural gas in Egypt.

Implementation Approach

ENPEP is the premier energy system analysis software used to analyze priority energy and environmental issues in over 80 countries. The most recent version of the program, called ENPEP for Windows, employs a market-based simulation approach to determine the response of various segments of the energy system to changes in energy prices and demand levels. The model relies on a decentralized decision-making process in the energy sector and can be calibrated to different preferences of energy users and suppliers. Basic input parameters include information on the energy system structure; base year energy statistics including production and consumption levels, and prices; projected energy demand growth; and technical and policy constraints.

In ENPEP, an energy network is designed to trace the flow of energy from primary resources, through processing and conversion, to useful energy demands. Energy networks are constructed using different nodes and links, which represent various energy system components. Nodes in the network represent depletable and renewable resources, refineries, thermal and hydro power stations, cogeneration units, boilers and furnaces, marketplace competition, taxes and subsidies, various end-use conversion processes, and energy demands (**Figure 1**). Links connect the nodes and transfer information among the various nodes

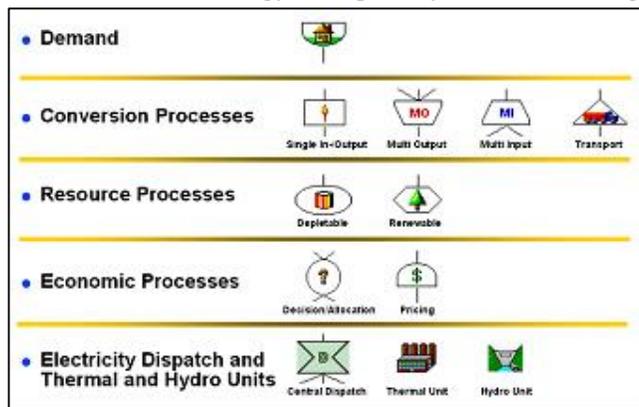


Figure 1 Node Types Available in ENPEP



ENPEP is very versatile in that the analyst starts with an empty workspace and builds an energy system configuration of nodes and links. ENPEP's powerful graphical user interface makes it as easy as “drag and drop” to build networks of regional, national, or multinational scope. **Figure 2** displays an example of a typical sectoral energy network, and **Figure 3** shows a sample representation of an industrial sector. Drop-down menus can be used to display model inputs and results directly on the energy network. Double-clicking the nodes allows access to detailed input and output information.

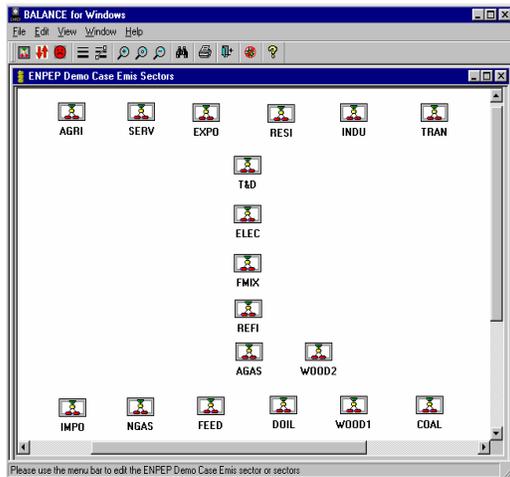


Figure 2 Sample Sectoral Representation

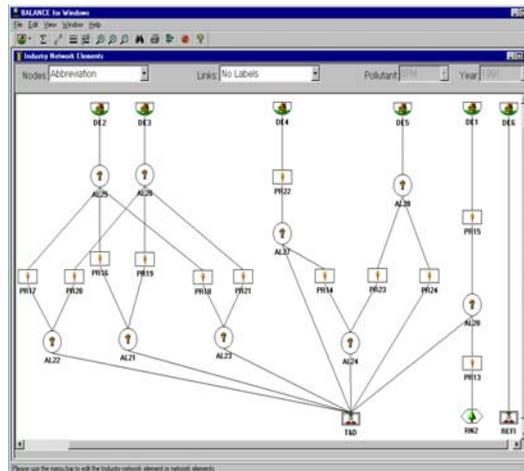


Figure 3 Sample Industrial Sector

The ENPEP model employs a market share algorithm to estimate the penetration of supply alternatives. The market share of a specific commodity is sensitive to the commodity's price relative to the price of alternative commodities. User-defined constraints (e.g., capacity limits), government policies (taxes, subsidies, priority for domestic resource over imported resource, etc.), consumer preferences, and the ability of markets to respond to price signals over time (i.e., due to lag times in capital stock turnover) also affect the market share of a commodity.

Using a market share algorithm distinguishes the non-linear equilibrium approach in ENPEP from other modeling techniques and enables the model to more accurately simulate the complex market behavior of multiple decision makers. While each sector (electric, industrial, residential, etc.) pursues different objectives and may have very different views of what is “optimum,” the equilibrium solution develops an energy system configuration that balances the conflicting demands, objectives, and market forces without postulating a false “global optimum solution” across all sectors of the economy.

ENPEP simultaneously finds the intersection of supply and demand curves for all energy supply forms and all energy uses included in the energy network. Equilibrium is reached when the model finds a set of market clearing prices and quantities that satisfy all relevant equations and inequalities.

Along with energy calculations, ENPEP computes environmental residuals associated with a given energy system configuration. The model computes the level of greenhouse gases and standard criteria air pollutants, such as particulates, SOX, NOX, CO, CO₂, methane, volatile organic compounds, lead, etc.; as well as, other residuals such as waste generation, water pollution, and land use. Greenhouse gas emissions can be reported in a format that is compatible with the reporting standards defined by the Intergovernmental Panel on Climate Change.



Organization of a Two-week Training Course on ENPEP for Windows

ADICA organized a 2-week training course on the most recent version of the ENPEP software, called ENPEP for Windows, for 15 participants selected by EGAS. The training schedule is provided in Annex I.

The first week of the training course focused on model functionality, with the course staff giving over 10 lectures on the use of the ENPEP for Windows software for integrated energy planning and the quantification of environmental burdens associated with different scenarios of energy sector development. This training was supplemented with work sessions to illustrate the model functionality using sample cases. The course participants also drew a network representation of energy supply and demand in Egypt.

The second week of the course focused on development of an ENPEP Reference Case for Egypt. The course participants received hands on experience in the use of the model by creating an ENPEP reference case for Egypt using country specific data. During the execution of this task, the course staff advised participants on how to configure the model, improve model simulations, and rectify problems that are encountered while running the software. The course participants utilized ENPEP to trace the flow of energy throughout the entire energy system from resource extraction, through processing and conversion, to meet demands for useful energy (e.g., transportation, electrical appliances) and to project future energy supply/demand balances.

ADICA provided each participant a CD containing lectures presented at the course, plus the input data and results of the ENPEP reference cases developed by the course participants.

3. FACILITIES, WORKING CONDITIONS AND PARTICIPATION

The training was organized at the EGAS Headquarters in Nasr City, Cairo, Egypt, which provided an excellent venue for the course. The Administrative and Training personnel did an excellent job in preparing the training facilities; were responsive to the evolving needs during the course; and provided daily logistical oversight, support and guidance.

The course staff is very impressed with the performance of the course participants. The group performed exceptionally well and exhibited:

1. Strong capability and commitment to learning,
2. High level of attention throughout the course,
3. Quick understanding of new concepts,
4. Skill in working together to discuss and develop best solutions, and
5. Focus on obtaining knowledge and skills necessary to provide decision-making support for Senior Management.

The course staff's evaluation of the participants' performance in the course is provided in the Annex II.

The leadership and support of EGAS Senior Management also contributed greatly to the success of this training event.



4. TRAINING STAFF

The training was carried out by two international consultants with extensive experience in the use of the ENPEP software for national planning, including:

Mr. Bruce Hamilton, President of ADICA Consulting, has an extensive background in the development of advanced computing techniques and analysis of energy systems, including the leadership he provided for energy and environmental projects conducted, in more than twenty countries, for the World Bank, USDOE, and International Atomic Energy Agency (IAEA). Mr. Hamilton's previous position was as Head of the Energy Modeling, Databanks and Capacity Building Unit at the IAEA, where he directed multi-disciplinary teams in the development of technology databases and analytical software, and conduct of technical assistance projects focused on energy sector development and environmental assessment. Mr. Hamilton organized regional projects in Africa, Asia & the South Pacific, Europe, Latin America, and West Asia to address energy/electricity planning needs of developing countries. As a course director and lecturer, he trained over 500 experts from 40 countries in the areas of demand forecasting, electricity system expansion planning, energy policy analysis and strategy development, environmental assessment, and financial analysis of energy options. In recent years, he led training and analysis activities for power sector restructuring and electricity market analysis studies in Europe, Asia and the South Pacific.

Dr. Andrzej Kerner is an international consultant who was formerly Head of the Energy Policy Planning Group at the Energy Market Agency in Poland. He is an expert user of ENPEP who has applied the software to perform national energy planning studies for over 14 years and served as Leader of two International Atomic Energy Agency (IAEA) Technical Co-operation Projects, including: Economic and Environmental Impacts of Various Energy Options during 1995-1996; and Comparative Studies on Natural Gas and Nuclear Power during 1999-2000. He is also regularly recruited by Argonne National Laboratory to assist on energy and electricity system studies.

5. ENPEP REFERENCE CASE FOR EGYPT

In developing an ENPEP Reference Case for Egypt the course participants and staff first prepared a simplified energy network that replicated the Egyptian Energy Balance for 2004 as reported by the International Energy Agency (IEA).

The simplified reference case treated refined products in an aggregate form (i.e., computing the total amount of refined products used in the electricity and various demand sectors, rather than quantifying the quantity of each refined product) – see Figure 4. This case also had a simplified representation of the electricity sector (Figure 5) and quantified final energy consumption in the various demand sectors.

While the simplified reference case accurately modeled the base year quantities reported in the IEA national energy balance for Egypt (see Table 1), a more detailed energy network is required to analyze priority issues related to the use of natural gas in Egypt.

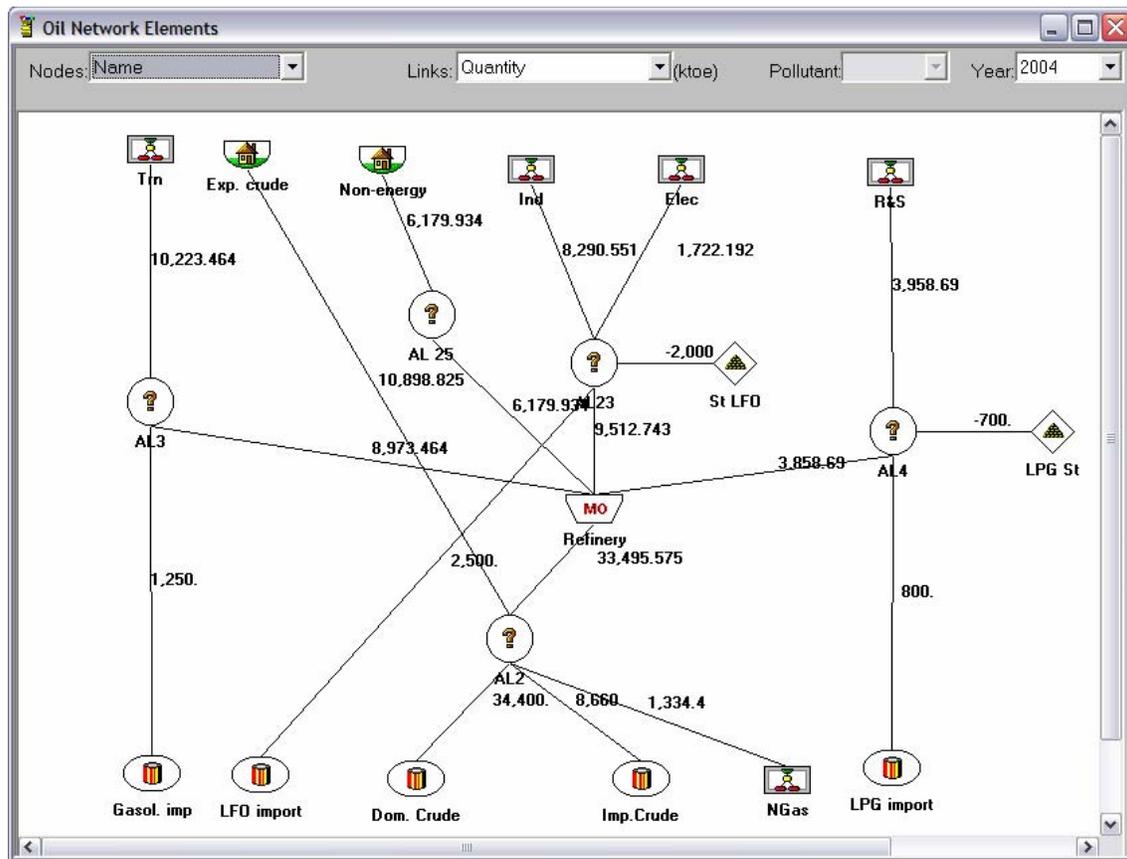


Figure 4 Simplified Reference Case for Egypt – Oil Sector

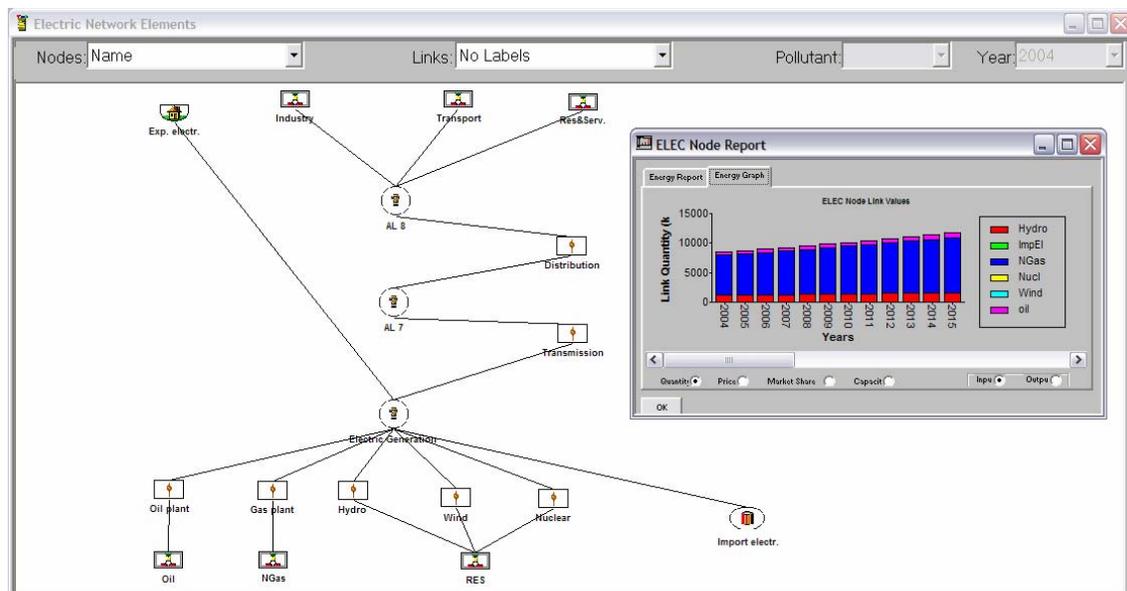


Figure 5 Simplified Reference Case for Egypt – Electricity Sector



Fuel	Sector	ENPEP	IEA	(B-E)/B%
Coal	Industry	733.2	740	-0.93
	Subtotal	733.2	740	-0.93
Oil	Industry	8290.6	8300	-0.11
	Transport	10223.5	10200	0.23
	Residential	3958.7	3960	-0.03
	Subtotal	22472.7	22460.0	0.06
Gas	Industry	5754.6	5760	-0.09
	Residential	4948.4	4950	-0.03
	Subtotal	10703.0	10710.0	-0.07
Renewables	Industry	710.64	710	0.09
	Transport			
	Residential	699.36	700	-0.09
	Subtotal	1410	1410	0.00
Electricity	Industry	2583.4	2590	-0.26
	Transport			
	Residential	4436.7	4430	0.15
	Subtotal	7020.1	7020.0	0.00
TOTAL		30902.8	30890.0	0.04

Table 1 Comparison of Energy Quantities Reported by IEA and Computed by ENPEP

At the instruction of Chairman Sherif Ismael, the course participants began to develop an enhanced reference case using official sources of information on the Egyptian energy system.

This case traced the quantity and price of energy from resource extraction, through processing and conversion, to meet end-use demand.

As illustrated in Figure 6, the sectors represented in the enhanced reference case include: Supply for Natural Gas, Oil and Renewable Energy; Transport of Fuels; Electricity Generation; Electricity Transmission and Distribution; as well as, Industrial, Transportation and Residential & Services Demand.

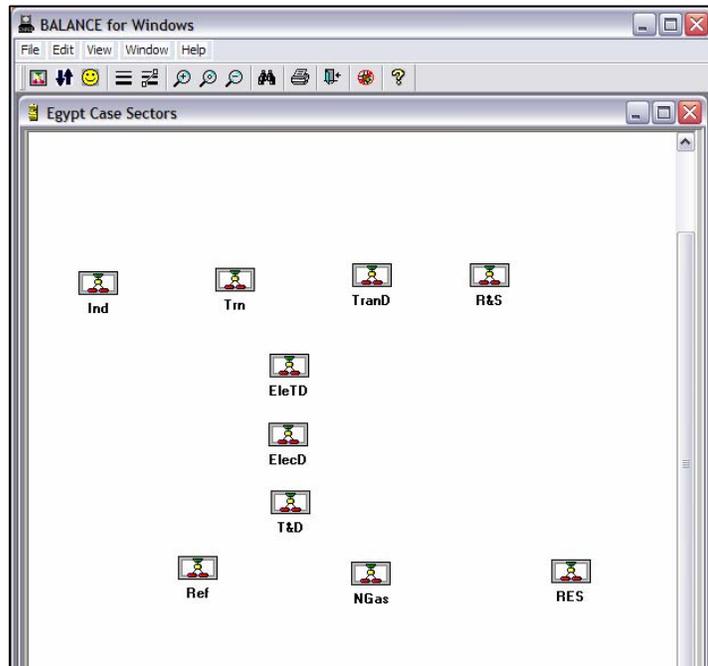


Figure 6 Enhanced Reference Case for Egypt – Sectors

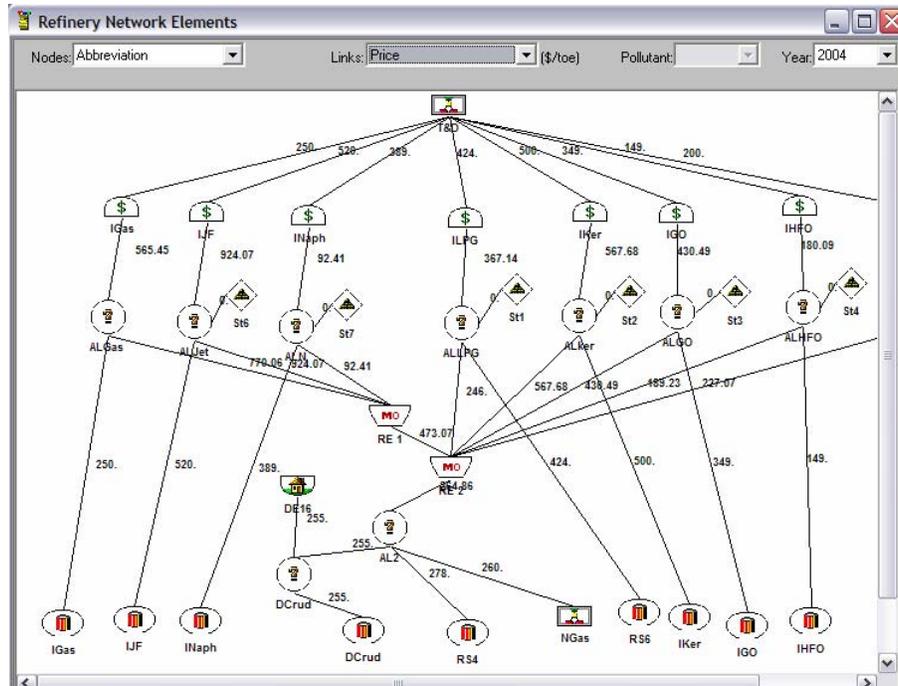


Figure 7 Enhanced Reference Case for Egypt – Oil Sector

With information provided by Eng. Wafaa Mostafa Ghanem, from the Ministry of Petroleum, the course participants attempted to accurately model the quantity and price of refined products produced in the country (Figure 7).

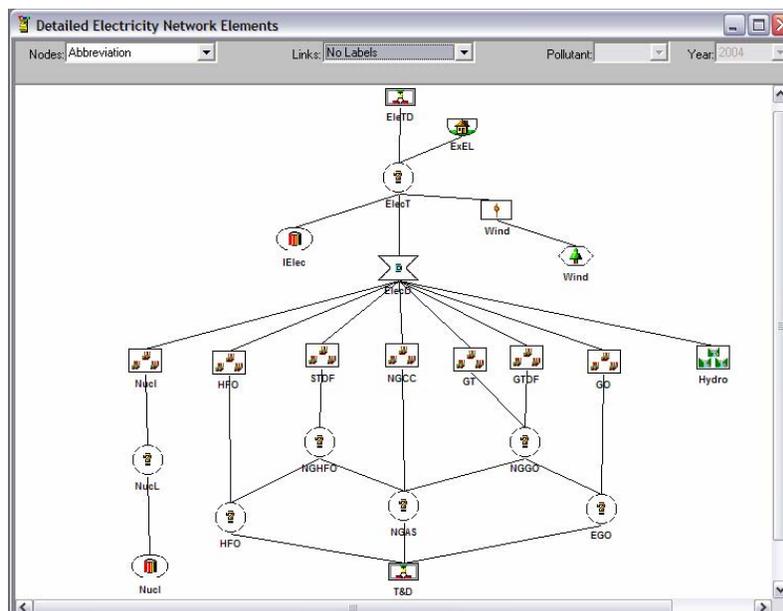


Figure 8 Enhanced Reference Case for Egypt – Electricity Sector

Using information contained in the Annual Report of the Egyptian Electric Holding Company, the course participants prepared a detailed representation of the electricity sector (Figure 8) with more than 160 individual power plants.

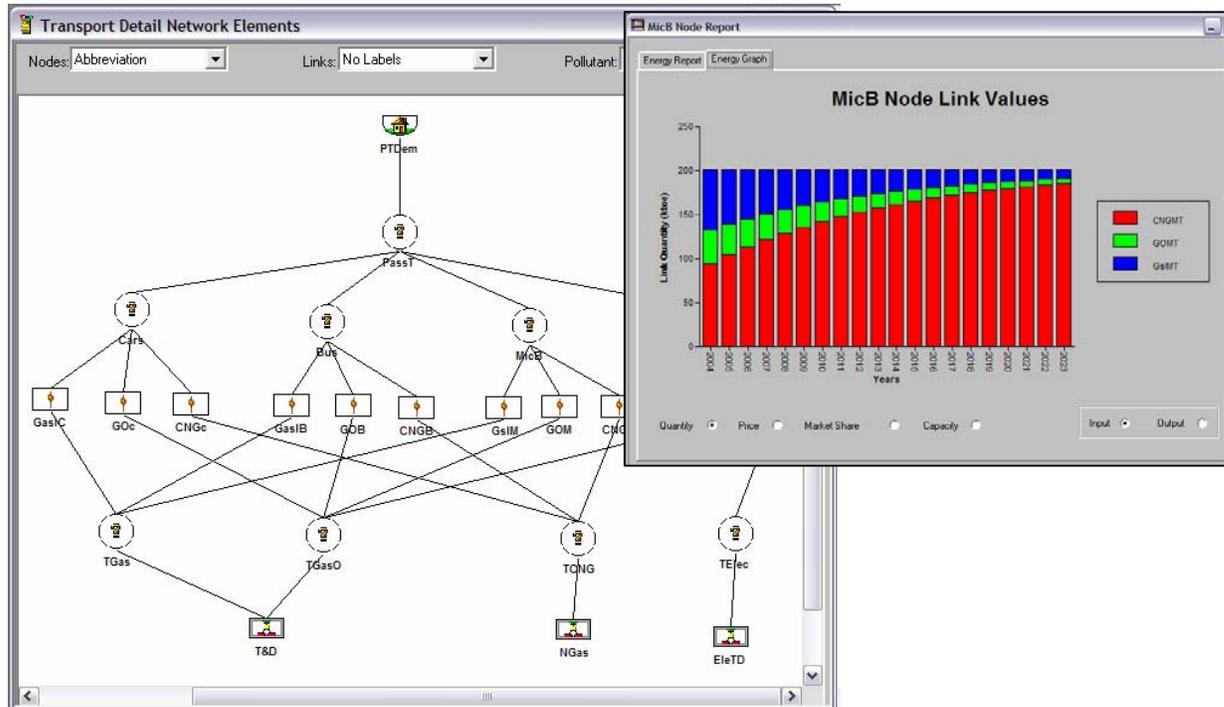


Figure 9 Enhanced Reference Case for Egypt – Transportation Sector

Using information contained in a transportation study conducted by Dr. Hamed Korkor, the course participants represented useful energy demand for Intercity Passenger Transportation (Figure 9) in order to analyze the potential for increased use of CNG vehicles. The trainees also represented the level of fuel subsidies for different categories of consumers (Figure 10).

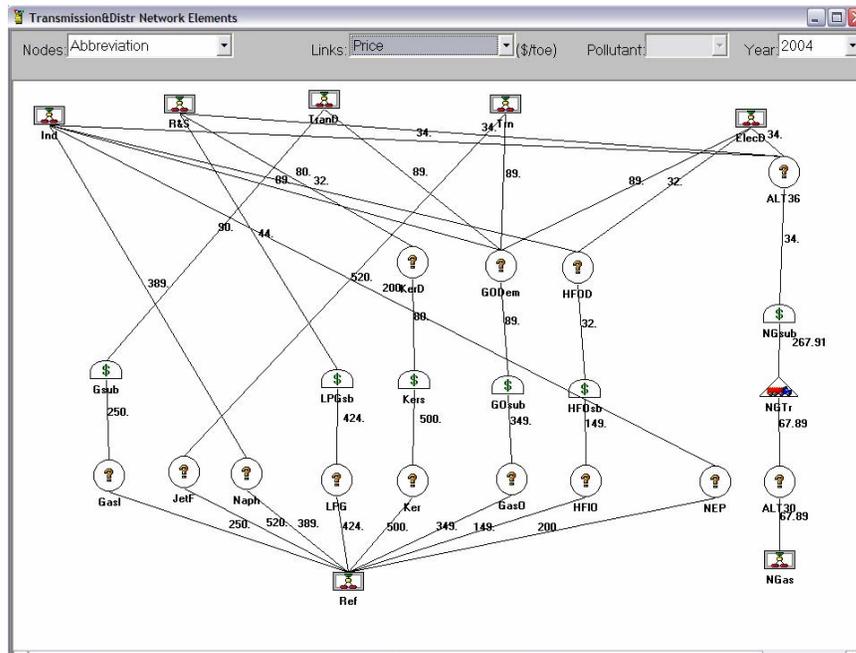


Figure 10 Enhanced Reference Case for Egypt – Subsidized Prices



Additional work is required to improve the ENPEP reference case. With an improved referenced case, EGAS staff will be able to:

1. Analyze energy system development strategies and compute:
 - a. Energy resource requirements
 - b. Energy technologies being used
 - c. Domestic versus import energy use
 - d. Cost of supplied energy & prices for consumers
 - e. Market potential for natural gas as compared with other existing or new technologies
 - f. Level of subsidies and impact of reducing subsidies on consumer choice
 - g. impact of energy efficiency and DSM programs

2. Perform environmental analyses:
 - a. Emissions projections for PM, SOX, NOX, etc.
 - b. emissions reduction strategies for PM, SOX and NOX
 - c. greenhouse gas (GHG) abatement cost studies

6. CONCLUSIONS AND RECOMMENDATIONS

We believe that the training on the use of the ENPEP software was successfully completed. However, it was concluded by both the consultant and trainees that the time period for training was too short for the trainees to fully understand how to apply the software for national planning. With the course participants' strong effort, they developed a good understanding of the ENPEP functionality and successfully produced initial model results. However, what is lacking is real work in applying ENPEP for an actual study, which requires more experience than could be achieved within two weeks.

With the above comments in mind, we offer the following recommendations for consideration by EGAS:

1. Establish a working team of 4-6 staff who are responsible for continuing work in the application of ENPEP for integrated energy-environmental analyses with a focus on modeling the use of natural gas in Egypt.
2. Collect and enter improved energy and environmental data into ENPEP, including:
 - a. Electricity system generation expansion plan
 - b. Expand Transportation sector to reflect useful energy demand (Intercity Passenger Transport is represented in current ENPEP case)
 - c. Cost and efficiency of useful energy demand conversion devices (e.g., boilers, automobiles)
 - d. Useful Energy Demand Growth Rates
 - e. Calibrate decision making parameters in ENPEP to reflect consumer buying habits in Egypt
 - f. Air pollutant emissions factors
 - g. Current regulations on emission taxes or required control equipment



3. Arrange follow-up training for the ENPEP Working Team, during the 2nd Quarter of 2007, with the objective of:
 - a. Reviewing enhanced ENPEP Reference Case for Egypt
 - b. Answering questions of ENPEP Team
 - c. Providing advanced training on electric sector representation, calibrating decision parameters, conducting environmental analyses.
4. Organize additional training for EGAS staff on the following subjects:
 - a. Energy Demand Forecasting
 - b. Power System Expansion Planning
 - c. Financial Analysis

We would like to thank EGAS for the opportunity to collaborate in this training event. We appreciate the strong effort by the course participants, excellent working conditions and logistical support, and gracious hospitality from all. It has been a pleasure working together.

We are proud of our joint success and look forward to our continued collaboration.

Sincerely yours,

Bruce P. Hamilton
President, ADICA Consulting LLC



ANNEX I

Training Schedule

Training on the use of the ENPEP for Windows

ENPEP for Windows TRAINING COURSE WEEK 1					
Time	Sunday	Monday	Tuesday	Wednesday	Thursday
09:00 - 10:30	COURSE OPENING Welcome and Course Overview	LECTURE 04 Developing an Energy Demand Network	LECTURE 06 Using Resource and Conversion Processes to Represent the Natural Gas Sector in ENPEP	LECTURE 08 ENPEP Data Requirements, Energy Unit, and Conversion Factors	LECTURE 11 ENPEP Application: Analyzing Poland's Fuel Supply Options
10:30 - 10:45	<i>Break</i>	<i>Break</i>	<i>Break</i>	<i>Break</i>	<i>Break</i>
10:45 - 12:15	LECTURE 01 Overview of Energy Planning	LECTURE 05 Energy Demand Projections	LECTURE 07 Create a Simplified Natural Gas Sector Representation in ENPEP	LECTURE 10 Using ENPEP to Create an Expanded Energy Network with Refinery	LECTURE 12 / WORK SESSION Real Network Issues: Up-Down Pass, Market Share, and Special Events in ENPEP
12:15 - 13:45	<i>Lunch Break</i>	<i>Lunch Break</i>	<i>Lunch Break</i>	<i>Lunch Break</i>	<i>Lunch Break</i>
13:45 – 15:15	PRESENTATION Course Participants Present Overview of EGAS and National Energy System in Egypt	WORK SESSION Developing an Energy Supply and Demand Network for Egypt	WORK SESSION Create a Simplified Natural Gas Sector Representation in ENPEP	WORK SESSION Using ENPEP to Create an Expanded Energy Network with Refinery	WORK SESSION Creating a Reference ENPEP Case for Egypt
15:15 – 15:30	<i>Break</i>	<i>Break</i>	<i>Break</i>	<i>Break</i>	<i>Break</i>
15:30 – 17:00	LECTURE 02 Overview of ENPEP LECTURE 03 Developing an Energy Supply Network	LECTURE 09 ENPEP Execution Procedures and Model Outputs	WORK SESSION Developing an Energy Supply and Demand Network for Egypt	WORK SESSION Creating a Reference ENPEP Case for Egypt	WORK SESSION Creating a Reference ENPEP Case for Egypt

Training on the use of the ENPEP for Windows

ENPEP for Windows TRAINING COURSE WEEK 2					
Time	Sunday	Monday	Tuesday	Wednesday	Thursday
09:00 - 10:30	LECTURE 13 Representing the Electricity Sector in ENPEP	LECTURE 17 & 18 ENPEP Environmental Calculations & Use for GHG Abatement Cost Studies	WORK SESSION Course Staff Review of ENPEP Reference Case for Egypt	WORK SESSION Creating a Reference ENPEP Case for Egypt	WORK SESSION Creating a Reference ENPEP Case for Egypt
10:30 - 10:45	<i>Break</i>	<i>Break</i>	<i>Break</i>	<i>Break</i>	<i>Break</i>
10:45 - 12:15	LECTURE 14 & 15 Representing the Utilization of Natural Gas in the Industrial, Commercial & Residential Sectors in ENPEP	LECTURE 19 Use of ENPEP for Greenhouse Gas (GHG) Abatement Cost Studies	LECTURE 16 ENPEP Application: Analyzing Natural Gas Utilization and GHG Mitigation Options in Uruguay	WORK SESSION Creating a Reference ENPEP Case for Egypt	WORK SESSION Creating a Reference ENPEP Case for Egypt
12:15 - 13:45	<i>Lunch Break</i>	<i>Lunch Break</i>	<i>Lunch Break</i>	<i>Lunch Break</i>	<i>Lunch Break</i>
13:45 – 15:15	WORK SESSION Creating a Reference ENPEP Case for Egypt	WORK SESSION Creating a Reference ENPEP Case for Egypt	WORK SESSION Course Staff Review of ENPEP Reference Case for Egypt	WORK SESSION Creating a Reference ENPEP Case for Egypt	PRESENTATION Course Participants Present Reference ENPEP Case for Egypt
15:15 – 15:30	<i>Break</i>	<i>Break</i>	<i>Break</i>	<i>Break</i>	<i>Break</i>
15:30 – 17:00	WORK SESSION Creating a Reference ENPEP Case for Egypt	WORK SESSION Creating a Reference ENPEP Case for Egypt	WORK SESSION Course Staff Review of ENPEP Reference Case for Egypt	WORK SESSION Creating a Reference ENPEP Case for Egypt	PRESENTATION Closing Ceremony and Certificate Presentation