

HIGHER TECHNICAL INSTITUTE
NICOSIA-CYPRUS

ELECTRICAL ENERGY AND POWER DEMAND FORECASTING AT EAC

GEORGE PIERIS

Project number E 1199

The completion of this project is in part fulfillment of the technician engineer diploma awarded by the electrical engineering department of the higher technical institute.

**DATE OF SUBMISSION: JUNE 1999
INDIVIDUAL PROJECT
STUDENT: GEORGE PIERIS
SUPERVISOR: MR MARIOS KASSINOPOULOS
EXTERNAL ASSESOR: MR AHILLEAS STEPHANOU**

HIGHER TECHNICAL INSTITUTE	PROJECT NO. 9995
----------------------------------	---------------------

1.5.5.4	Magnetohydrodynamic generation.	10
1.5.5.5	Sea waves.	10
1.6.0	Electric power transmission system.	11
1.6.1	Overhead transmission lines.	12
1.6.2	Underground transmission cables.	12

CHAPTER 2 ABOUT FORECASTING

13

2.1.0	What is a forecast?	13
2.1.1	The purpose of forecasting.	13
2.2.0	Distinction between long-term and short-term forecasting.	14
2.2.1	Peak-load problem.	14
2.2.2	Electrical blackout.	15
2.2.2.1	Effects and prevention.	15
2.3.0	What are the several forecasting techniques?	16
2.3.1	Trending analysis.	16
2.3.2	Explanatory models.	17
2.3.3	End-use models.	17
2.3.4	Integrated models.	18
2.3.5	Artificial networks.	19
2.3.6	Regression analysis.	21
2.3.6.1	Linear regression.	21
2.3.6.2	Multiple regression.	22
2.3.6.3	Exponential regression.	25
2.3.7	Regression and correlation.	26
2.3.8	Forecasting techniques employing linear regression.	26
2.3.8.1	Temperature related regression.	27
2.3.8.2	Energy related regression.	27
2.4	Procedure for preparing and carrying out a forecast.	28
2.4.1	Forming a forecasting model.	29

2.4.2	Selecting what classes to model.	29
2.4.3	Defining what dependent variables can be used.	29
2.4.4	Defining what independent variables can be used.	30
2.5	How it can be determined what is the best forecasting technique to use?	31
2.5.1	The coefficients.	31
2.5.2	T-statistic.	32
2.5.3	R squared.	34
2.5.4	F-observed value test.	35
2.5.5	Graphical test.	37
2.6	Determining what is the best method to use for forecasting having in mind the data available at E.A.C.	40
CHAPTER 3 PRESENTATION OF THE FORECASTS		45
3.1	Methodology used in E.A.C for forecasting.	45
3.2	Explanation of the symbols used on tables.	45
3.3.1	Presentation of the official forecast made using Microsoft Excel.	48
3.3.2	Presentation of the official forecast made using Foretell.	52
3.4	Presentation of the long-term forecast and statistical analysis conducted by Us.	59
3.4.1	Energy sales forecast by class of consumers.	60
3.4.2	Consumers forecast by class.	65
3.4.3	Maximum demand forecasting for the whole system of E.A.C.	70
3.5	Graphical presentation of all the results of the long-term forecast.	76
	Conclusions.	90
	References.	90
	Appendix A.	92
	Appendix B.	95
	Appendix C.	96

Acknowledgements

I must confess that writing this project wasn't an easy task to do. My objective was to try to carry out this project as better as possible. As I discovered later on though, while working, to manage that an effort only from me would not be enough. So I feel the need to thank my internal supervisor, MR MARIOS KASSINOPOULOS, for his help and his time and I want to say that without his contribution this project could not be realized.

Also I want to express special thanks to the electricity authority of Cyprus and MR ANTREAS STEPHANOU in particular that provided me with all the data necessary to work with, and also some of the bibliography needed. Also I must mention that Mr. Stephanou spent as much time helping me as I ever asked for.

Lastly but not at all less important, I must mention the contribution to this project of MR C.C NEOCLEOUS, lecturer at the mechanical department of H.T.I. His help at Microsoft Excel was nevertheless of crucial importance in the completion of this task.

By ending I would like to say that I strongly believe and hope that this project will consist a great help and reference for future third year students of H.T.I trying to make their project but also that it will be a great source for anyone that want to study and learn the basics about this subject.

GEORGE PIERIS

Introduction

It has been assigned to me a project that will try to forecast the load demand at the electricity authority of Cyprus. For an electricity supplier (such as EAC) planning is very important if a reliable and more economic supply is to be achieved. When planning we must distinguish between long-term forecasting and short-term forecasting. I.e. for a short period of time or a long period of time.

If a supplier fail to plan correctly it is most probably sure that he will offer to consumers an unreliable and /or an expensive supply. Therefore the development plans of the supplier must be correct and carried out in time.

Forecasting can be made using a variety of methods such as trending analysis (by using regression which can be temperature related or energy related), Explanatory models, End use models, Integrated models, PC packages, and Neural networks (this is a rather new technique). The purpose of all these methods is the same independently of the different approach of each one and this is to forecast for energy and maximum demand needs. For example historical data can be used or the weather conditions seasonally or the industrial activity, etc.

Usually several methods are used at the EAC and when the results are obtained they are compared between them for error checking purposes. When this is done we get a better forecasting. In EAC though for long-term forecasting the methods that are used most is the regression analysis and a PC package called FORETELL.

I would like to point out that forecast, among others, is required because time is required to find sites, design and build plants that will meet the demands of future construction. Just for reference 12 years are needed for nuclear plants, 8 years for large coal-fired plants, 3 years for combustion turbine plants and 10 years for large hydroelectric plants like the one that Greece has that is situated some kilometers outside Thessaloniki.

The health, welfare and progress of a modern society depend very much on the availability of electricity that a utility (in our case EAC) offers. So the utility must make certain that sufficient generating capacity is available when required by the consumers.

Also in this project, the present situation of power generation and the current planned developments in E.A.C are being studied. A more general background on power generation and transmission is being available though to enable better comprehending of the subject.

SUMMARY

In the project

Country for

numbers

also all

country

total

total

Total

also

paper

total

total

total

total

total

total

total

total

total

total

total

total

ELECTRICAL ENERGY AND POWER DEMAND FORECASTING

AT E.A.C

BY GEORGE PIERIS

SUMMARY

In this project we will see what methodologies are available at the Electricity Authority of Cyprus for long-term forecasting. After when this is done, we will attempt to forecast ourselves. The forecast will be done the same way as at E.AC, but this time we will produce also all the additional statistical data that are needed in order for someone to say with certainty if the attempted forecast is correctly performed and whether or not it will have results that will resemble the true ones (future true values of energy consumption). The results will be charted for better visual understanding.

The above work, as it has been mentioned before, will be made having in mind long-term data. Forecasting of energy is mainly, as we will see, based on the economic growth and population growth of a country. Therefore bearing these two factors in mind and by considering the historical data of energy consumed before, we can perform the forecast.

When dealing with subjects like forecasting of energy you must have knowledge of what energy is, what are the ways for producing energy, how energy is transmitted etc. Therefore our objective also in this project is to search and provide this kind of information thus to be able to present a project that will be complete in the following sense: A reader of this project will be able to acquire a general background about electrical energy (this will also help in understanding the need for forecasting), identify the need for forecasting, learn about the several forecasting techniques, and finally be able to apply a forecast (this can be done using a commercial program called Excel).

On appendix C there are information about what is the present situation of power generation at E.A.C and what is the authority doing to deal with the future requirements of the consumers.

Objectives

1. Define electrical energy.
2. Create a general background on energy production and transmission.
3. Understand the need for forecasting electrical energy consumption and explaining what are the different forecasting techniques.
4. Differentiate between the techniques available and make a comparison between them so as to decide what is the best one to use at E.A.C.
5. Perform a long-term forecast up to the year 2010 for E.A.C and analyze the results.
6. Perform multiple regression for illustration of the technique.
7. Show the results of the forecasts on graphs so as to make it easy to understand.
8. Present all the above in a well-structured and neat report.