

National Grid

Operational Forecasting

Shanti Majithia

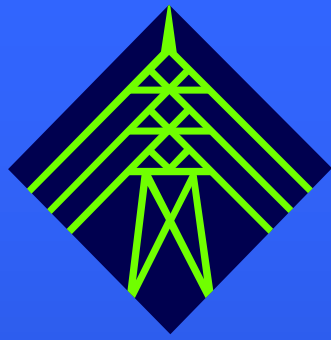


National Grid

Contents

- ◆ Electricity Demand Volatility
- ◆ Weather Drivers
- ◆ Forecasting Process
- ◆ Market information and Trends - NETA
- ◆ Normalised Demand
- ◆ Conclusion

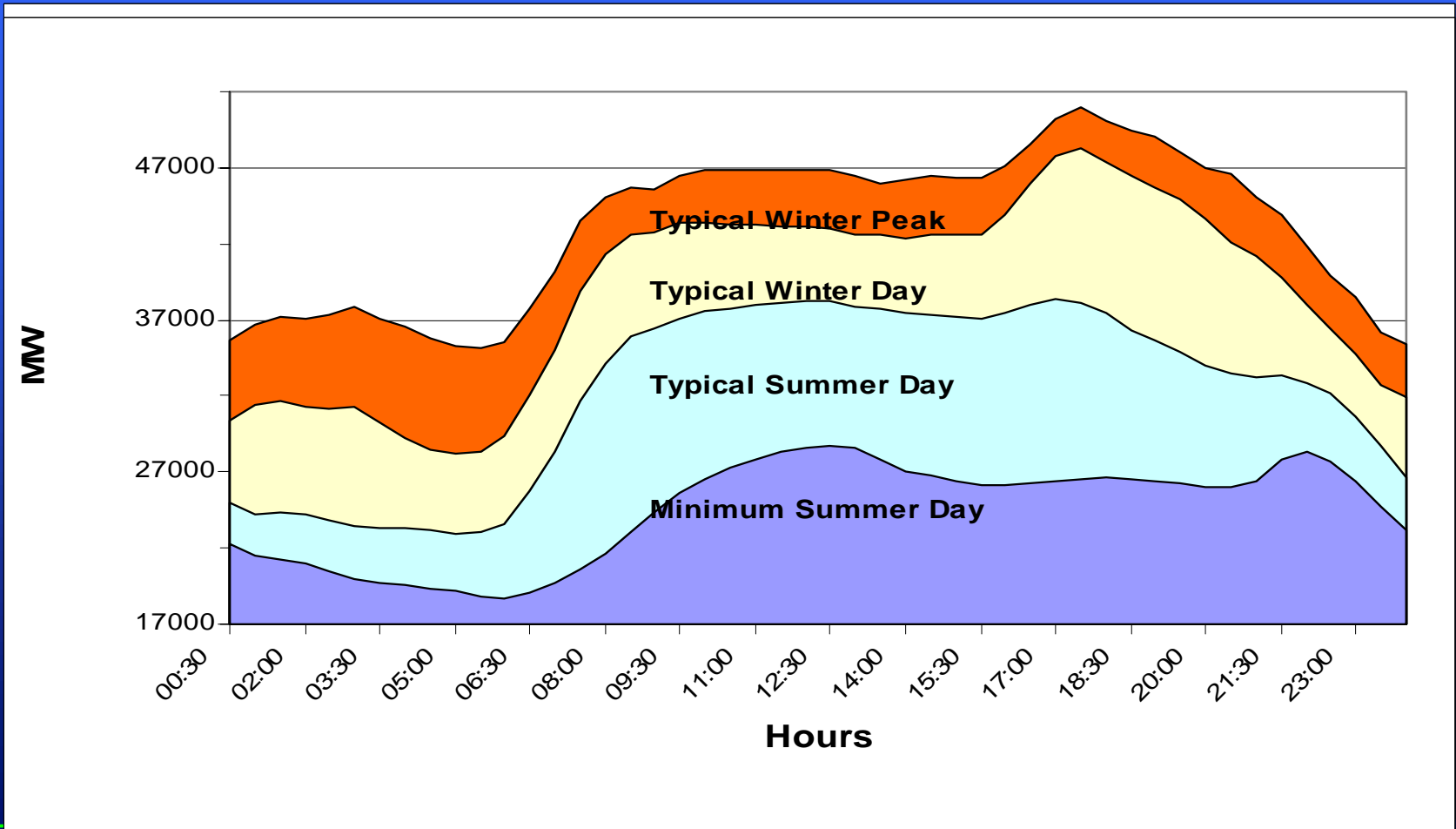




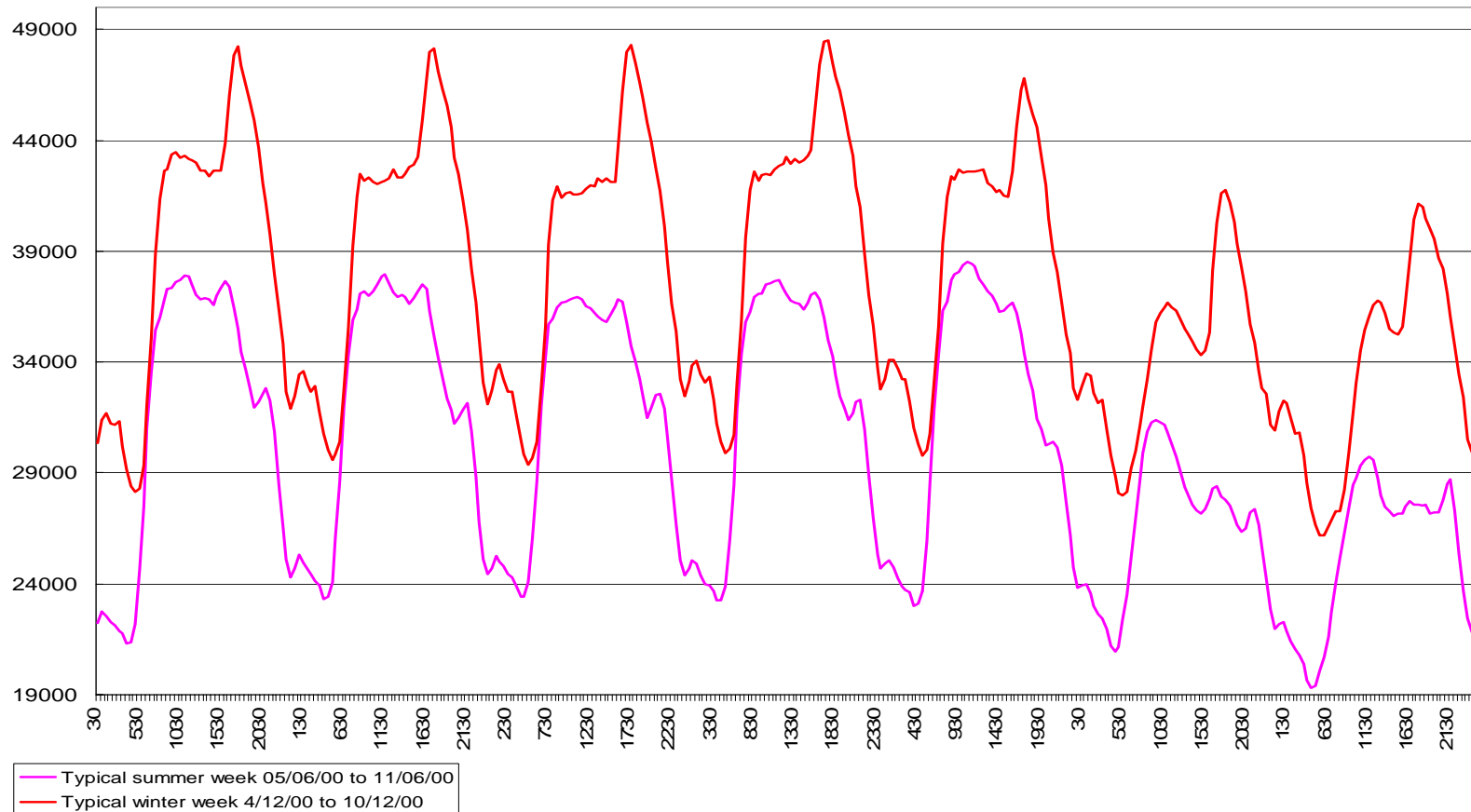
National Grid

Electricity Demand Volatility

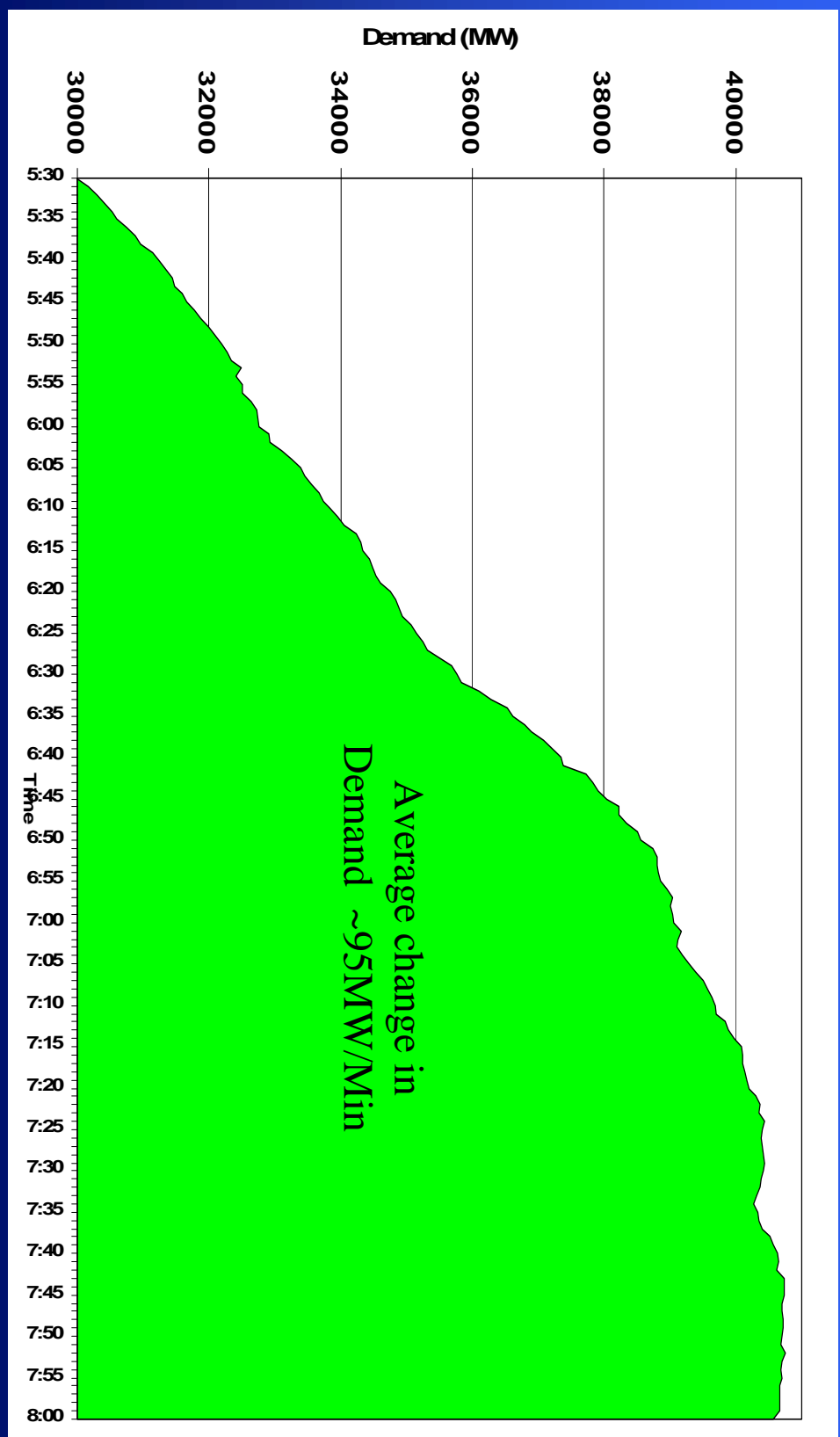
Typical Summer and Winter Demands



Demand Profile For A Typical Winter and Summer Week

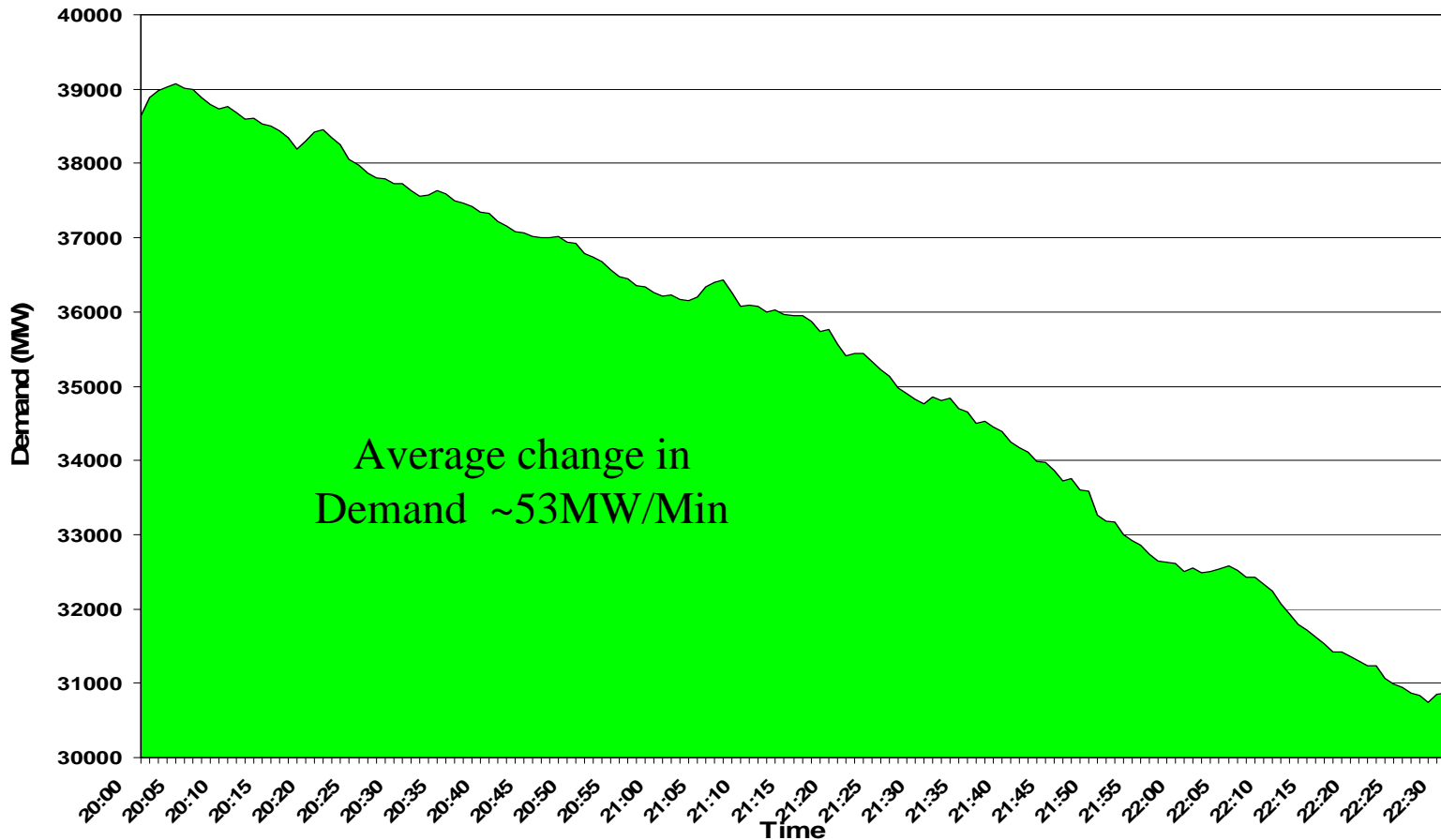


Morning Pick Up

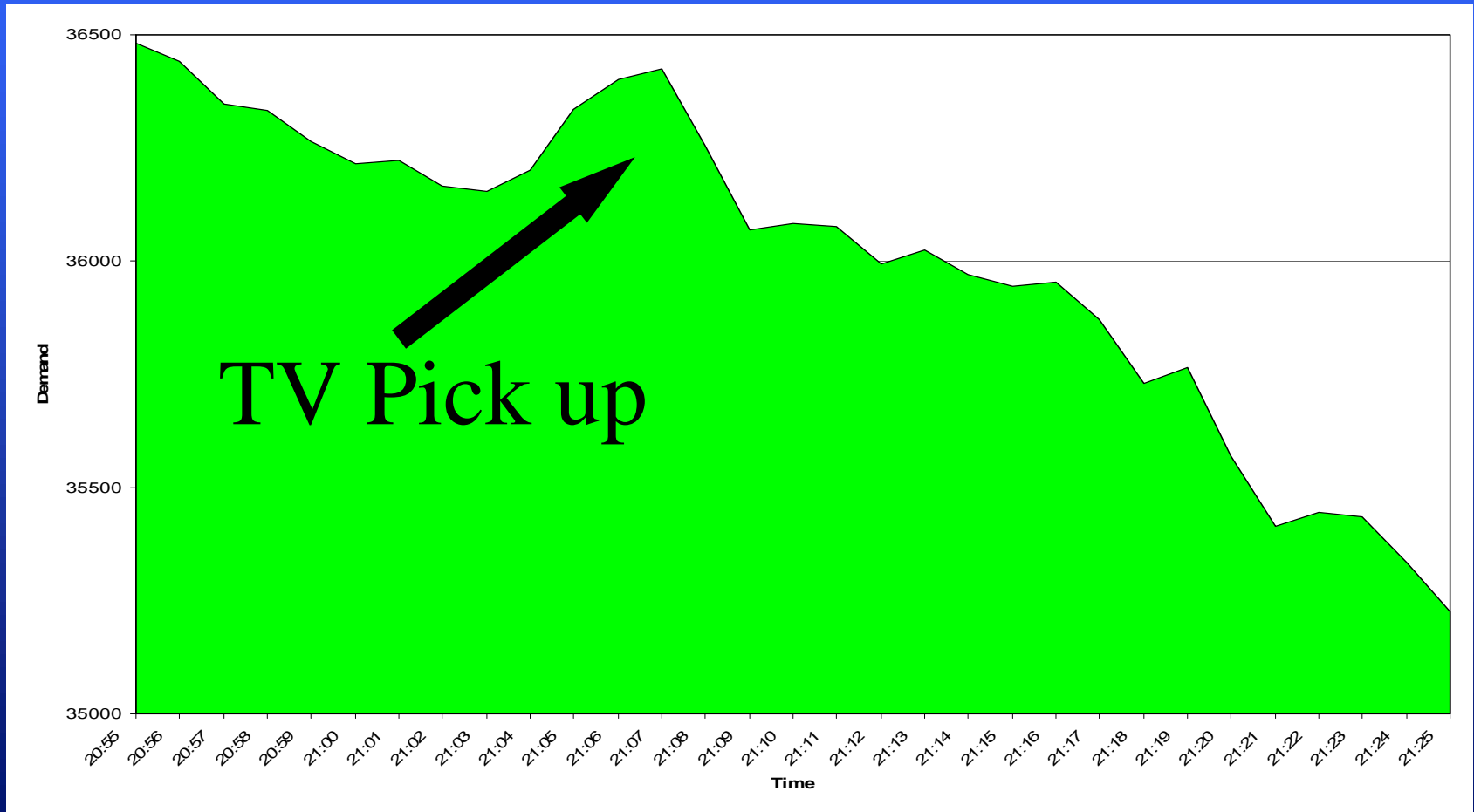


National Grid

Evening Drop Off

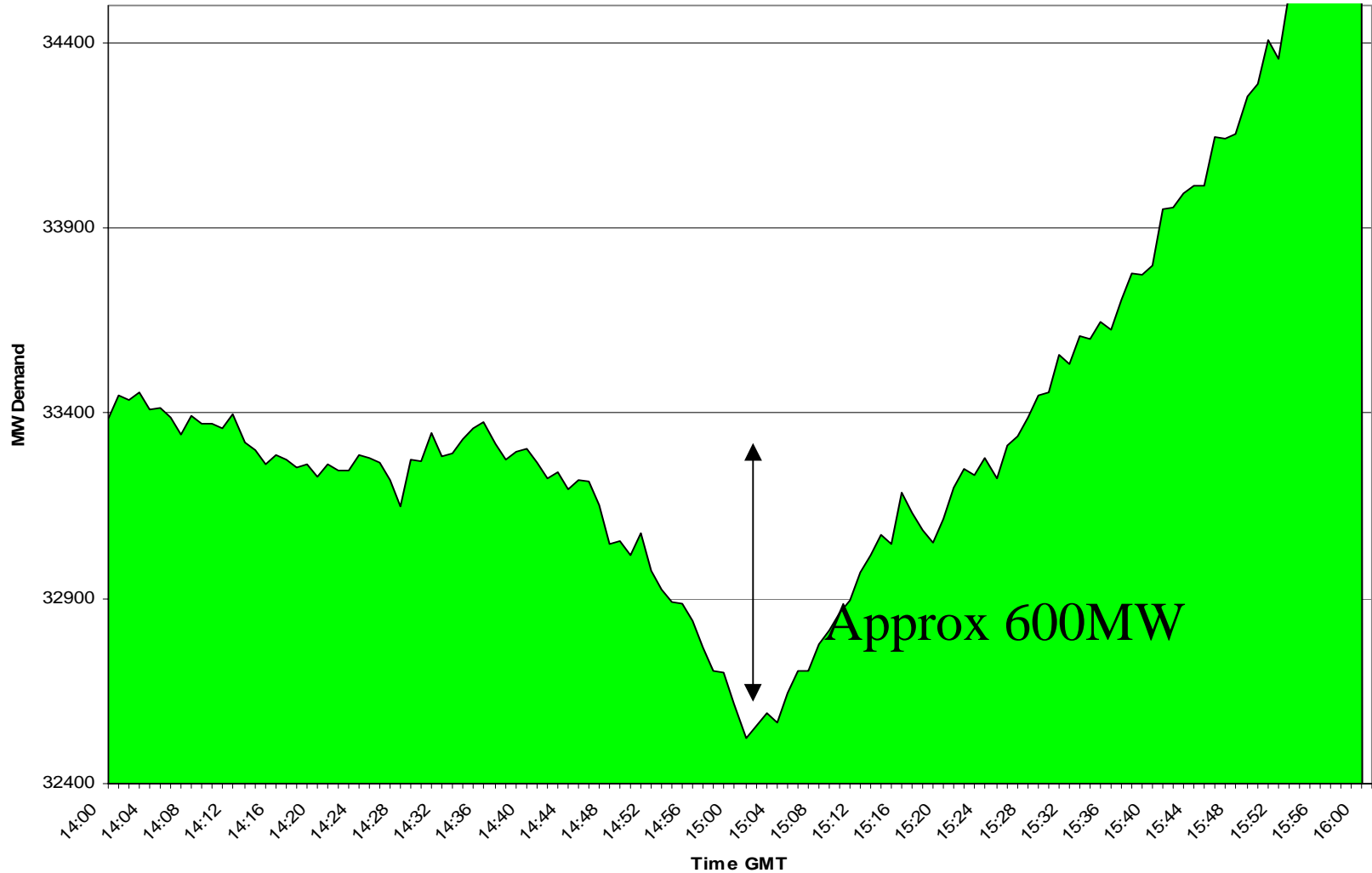


Fluctuating Demand Over a Half Hour Period



Grand National 2001

7-04-01

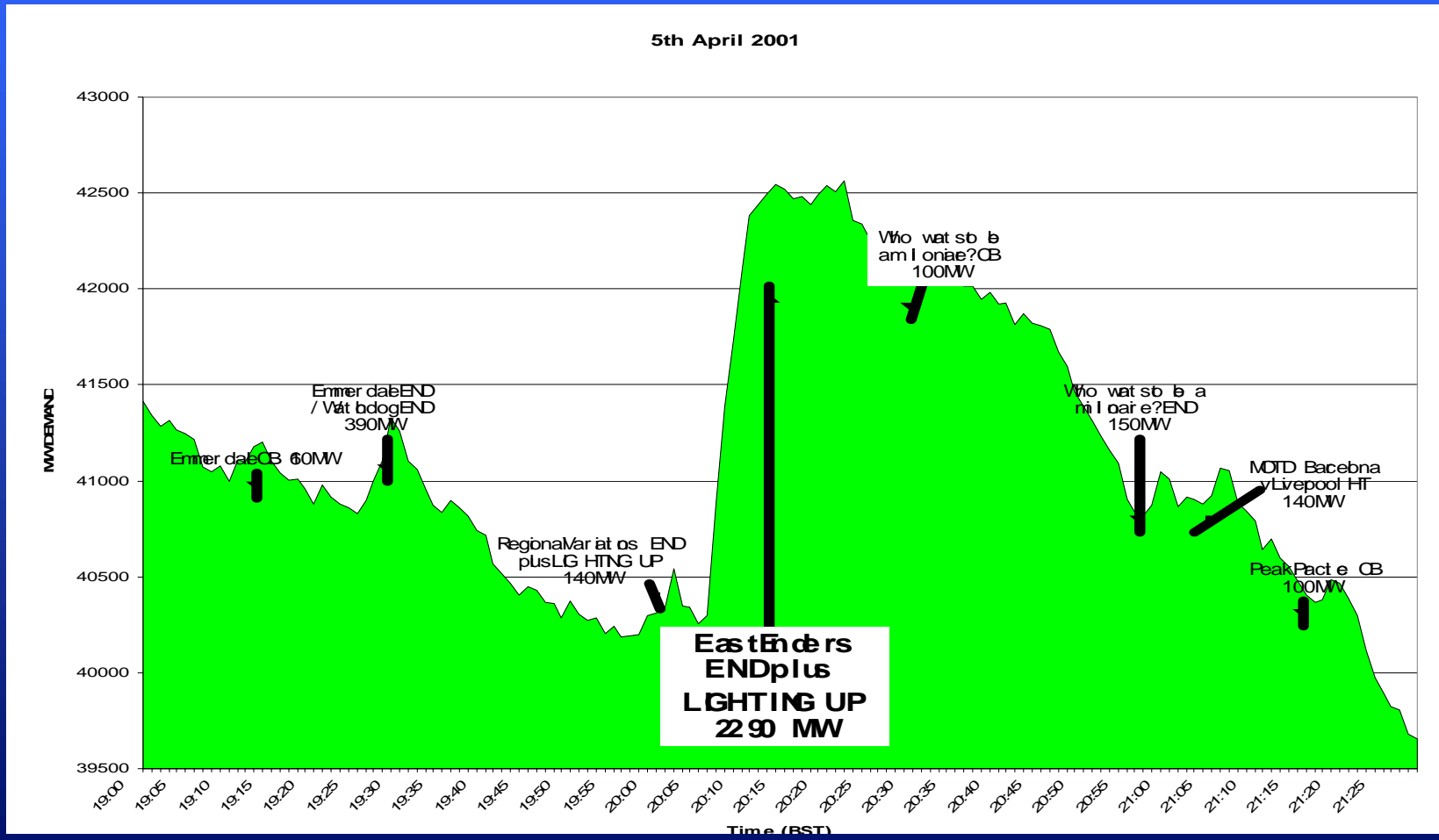


Who Shot Phil ??? ”

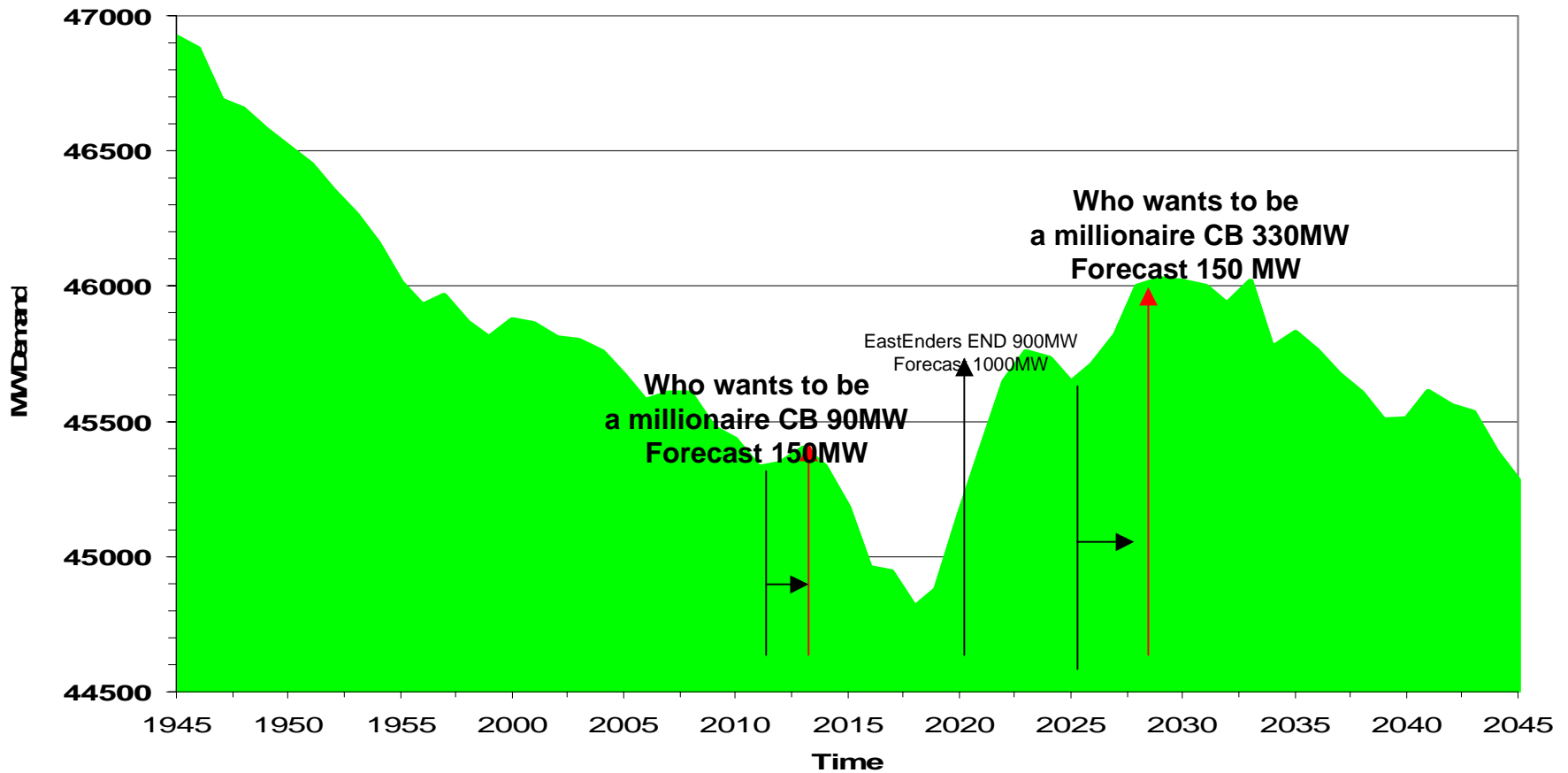


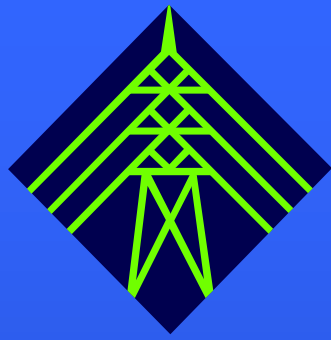
EastEnders 6th April 2001

“ Who Shot Phil ??? ”



Moving Target of TV Schedules

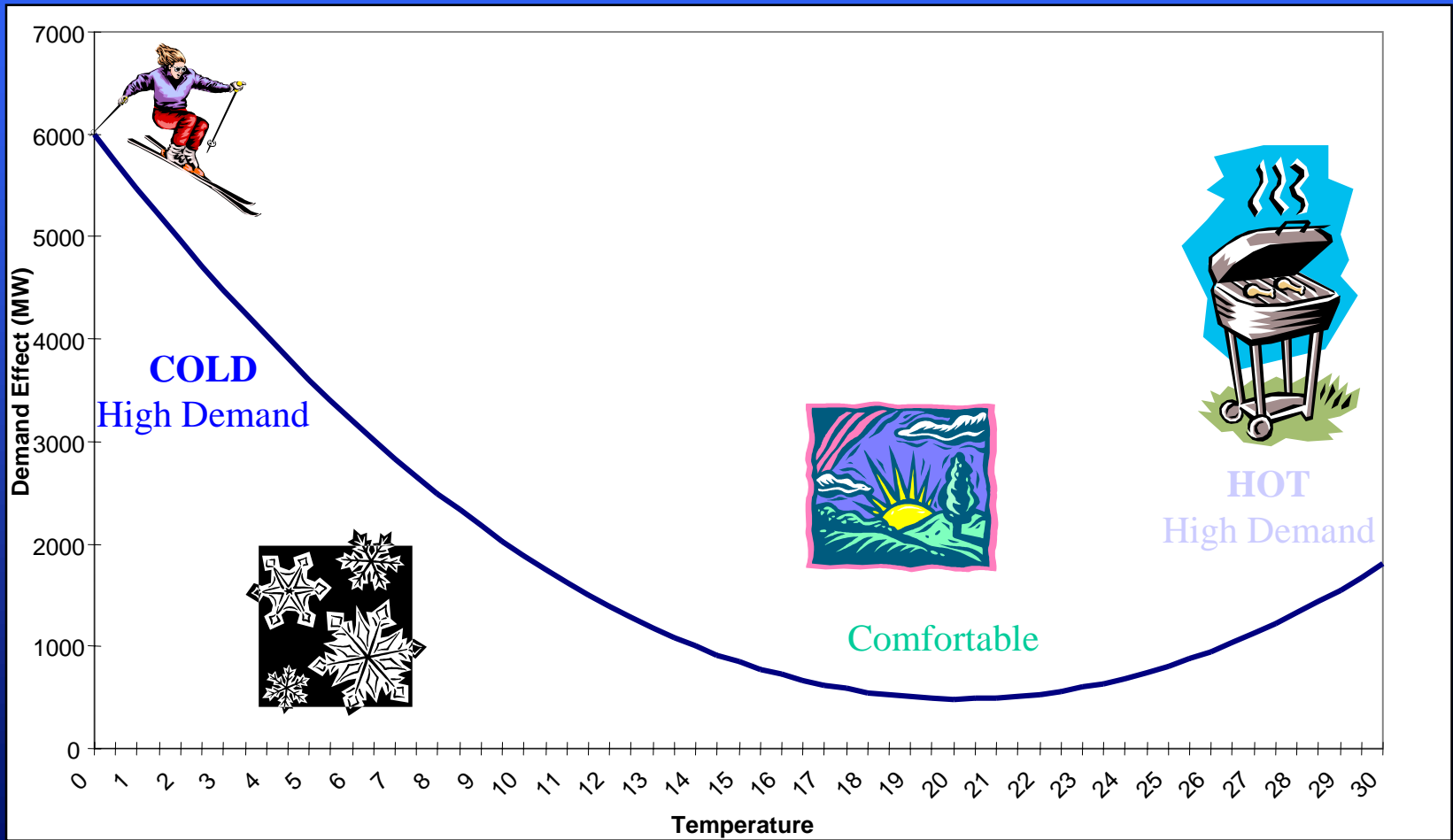




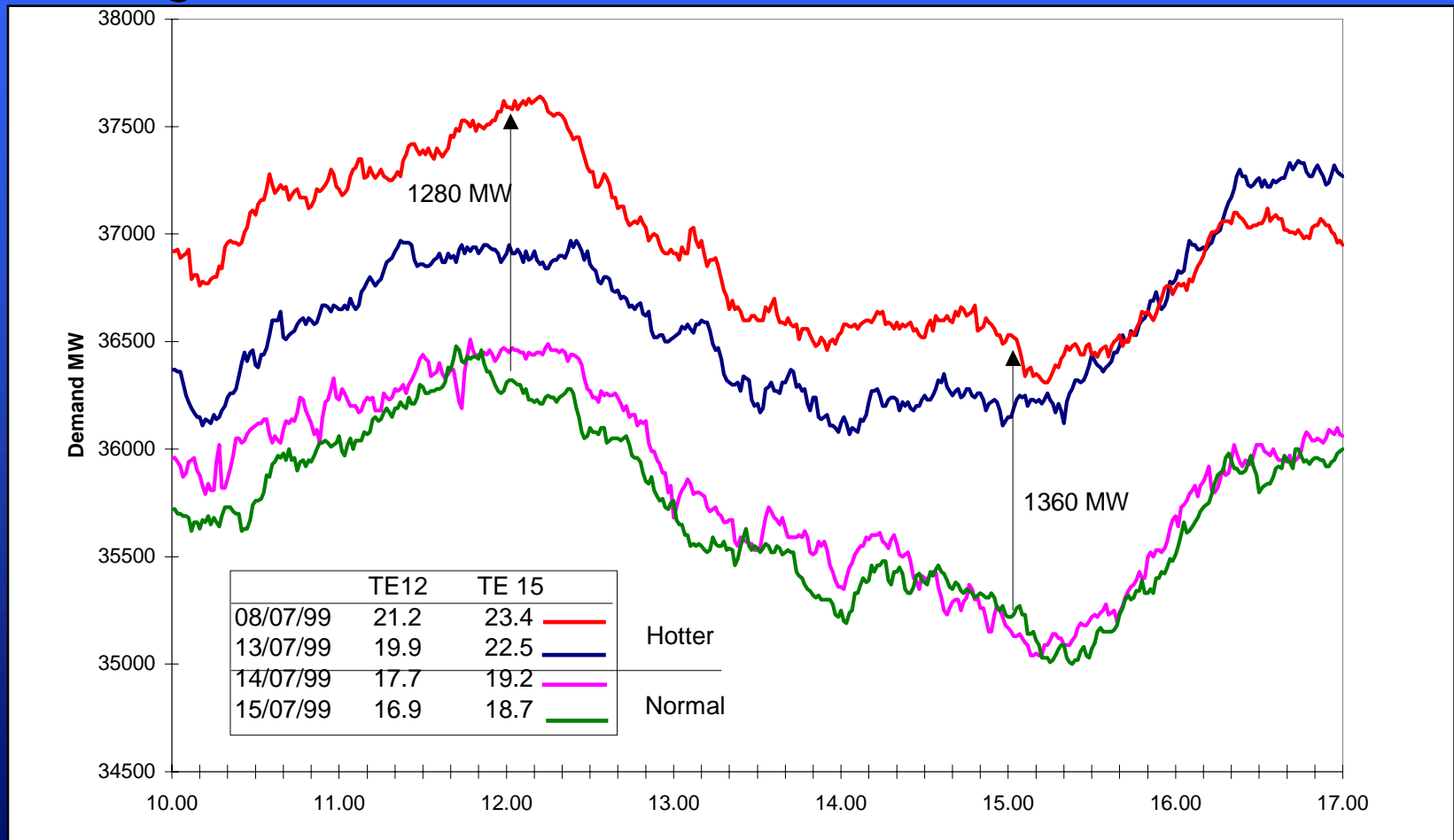
National Grid

Weather Drivers

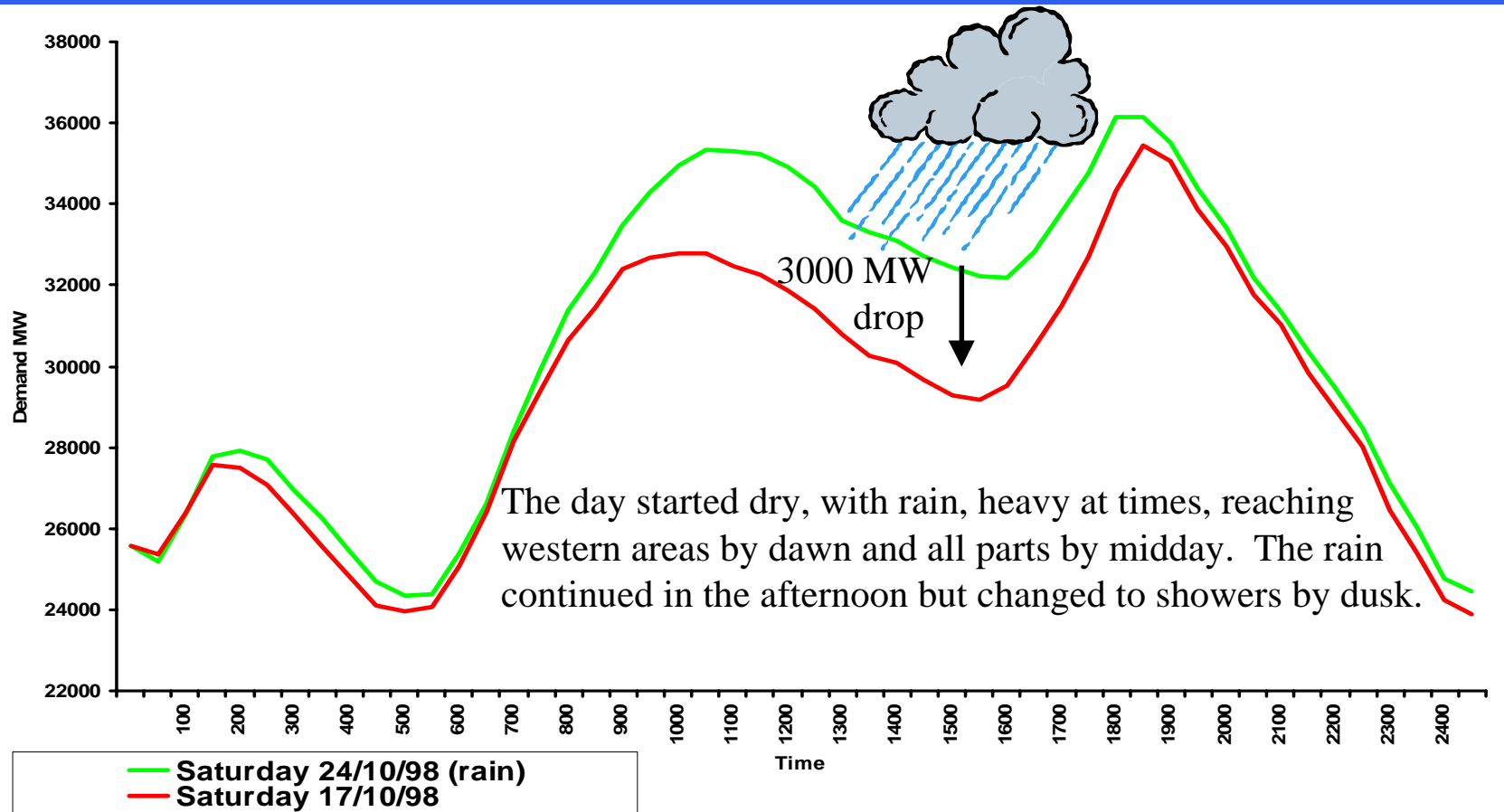
Winter Demand



Impact of Air Conditioning July 1999



The Effect of Heavy Precipitation on Demand



The Factors Influencing Demand

Embedded Generation



Electricity Market Share

Demand Management

Price of Electricity



Air-Conditioning



Cloud

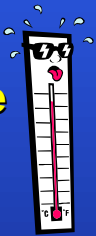


School Holidays

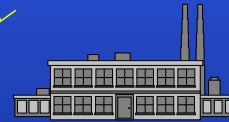


Television

Temperature



Radio-Teleswitching



Factory shut-downs

Fog

Rain



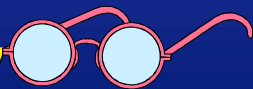
Wind



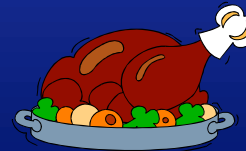
Special Events

Human Behaviour

Visibility



Bank Holidays

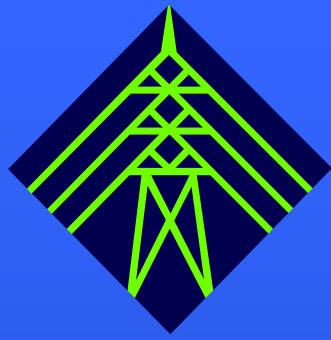


Season

Day of Week



National Grid



National Grid

Forecasting Process

Who needs forecasts?

Several key questions.

Several Key Questions Should Always Be Asked...

- ◆ **Why** is a forecast needed?
- ◆ **Who** will use the forecast, and what are their specific requirements?
- ◆ **What** level of detail or aggregation is required and what is the proper time horizon?



Forecasting Steps

All forecasting procedures involve extending the experiences of the past into the uncertain future. This leads to the identification of the following steps in the forecast process:-

- ◆ **Data Collection** Proper data and making sure that it is correct
- ◆ **Data Reduction or Condensation** Too much data
- ◆ **Model Building** Fitting data into a forecasting model
- ◆ **Model Extraction** Model extrapolated to produce forecast



Typical Mathematical Models of Demand

Quantitative

```
graph TD; Quantitative --> Statistical; Quantitative --> Deterministic; Statistical --> Decomposed[Data can be decomposed]; Statistical --> TimeSeries[Economic time series models ie Box-Jenkins, Neural Networks.]; Deterministic --> Identification[Identification and determination of relationship between variables.];
```

Statistical

TWO METHODS

Data can be decomposed

↓

Economic time series models ie Box-Jenkins, Neural Networks.

Deterministic

Identification and determination of relationship between variables.

E.g.. Regression, multiple economic models

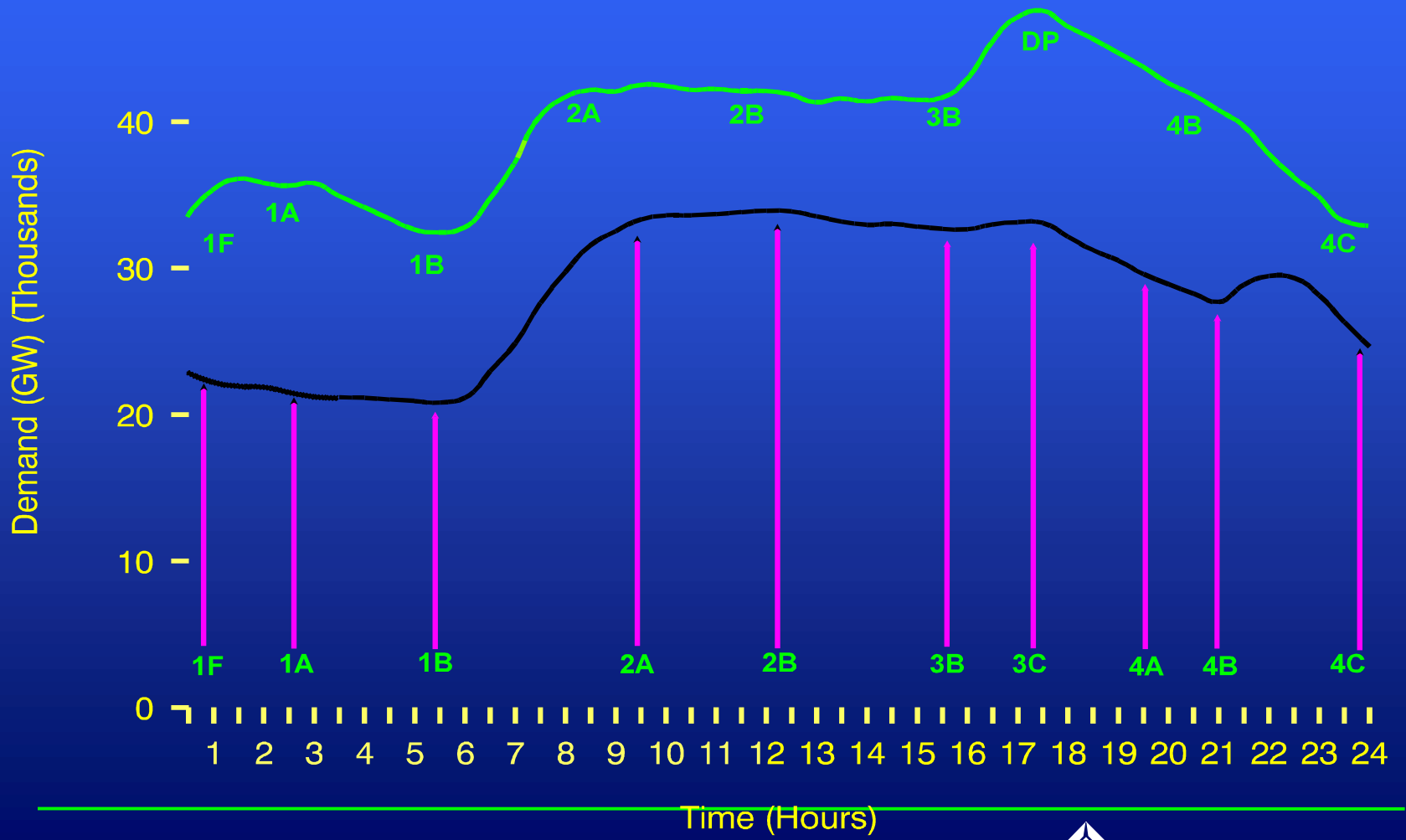


Typical Mathematical Models of Demand

- ◆ Weather Dependent Demand
- ◆ Non-Weather Dependent Demand
- ◆ Day of Week Component of Demand
- ◆ Error of Fit



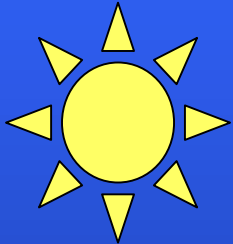
Cardinal Points For a Typical Summer and Winter Demand Curve



Weather Input



Process Weather Parameters



Average Temperature [TO]

Effective temperature [TE]



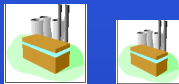


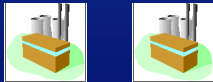
Cooling Power of the Wind [CP] - empirical combination of Temperature and Windspeed



Effective illumination of the Sky [EI] - ($EI=MI-ID$), Where ID is a function of Visibility, numbers and types of cloud layers and amounts of precipitation. MI is the Maximum illumination assuming no cloud layers



Weather Sensitivity For a Typical Summer

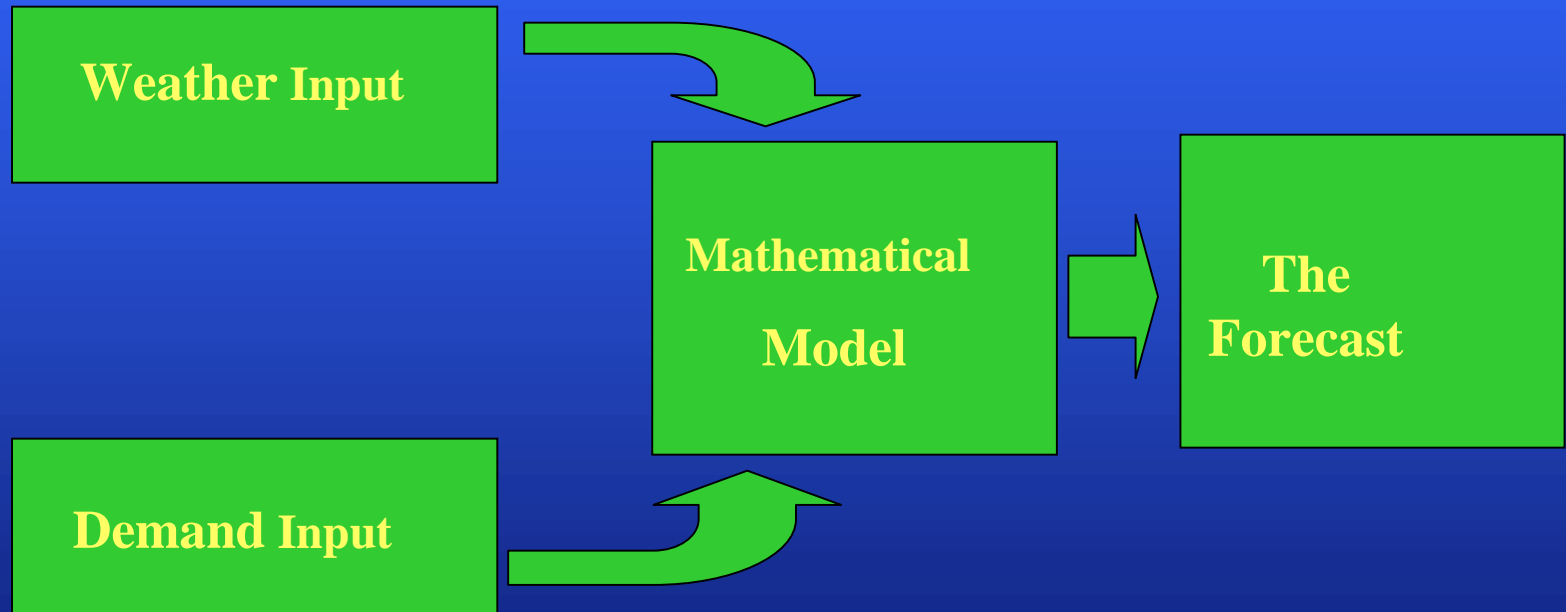
Meteorological Variable	Response (MW)	Generating Unit*
Temperature (an increase of 5°C from 10° to 15°C)	-700 (2.45%)	
Temperature (an increase of 5°C from 15° to 20°C)	+600 (2.15%)	
Cloud Cover (From clear sky to thick cloud)	+1700 (5%)	
Precipitation (from no rain to heavy rain)	+950 (3%)	

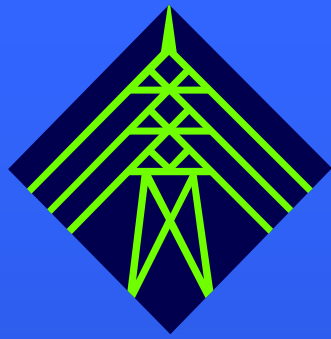
* Based on 500 MW Genset



National Grid

The Forecast Process

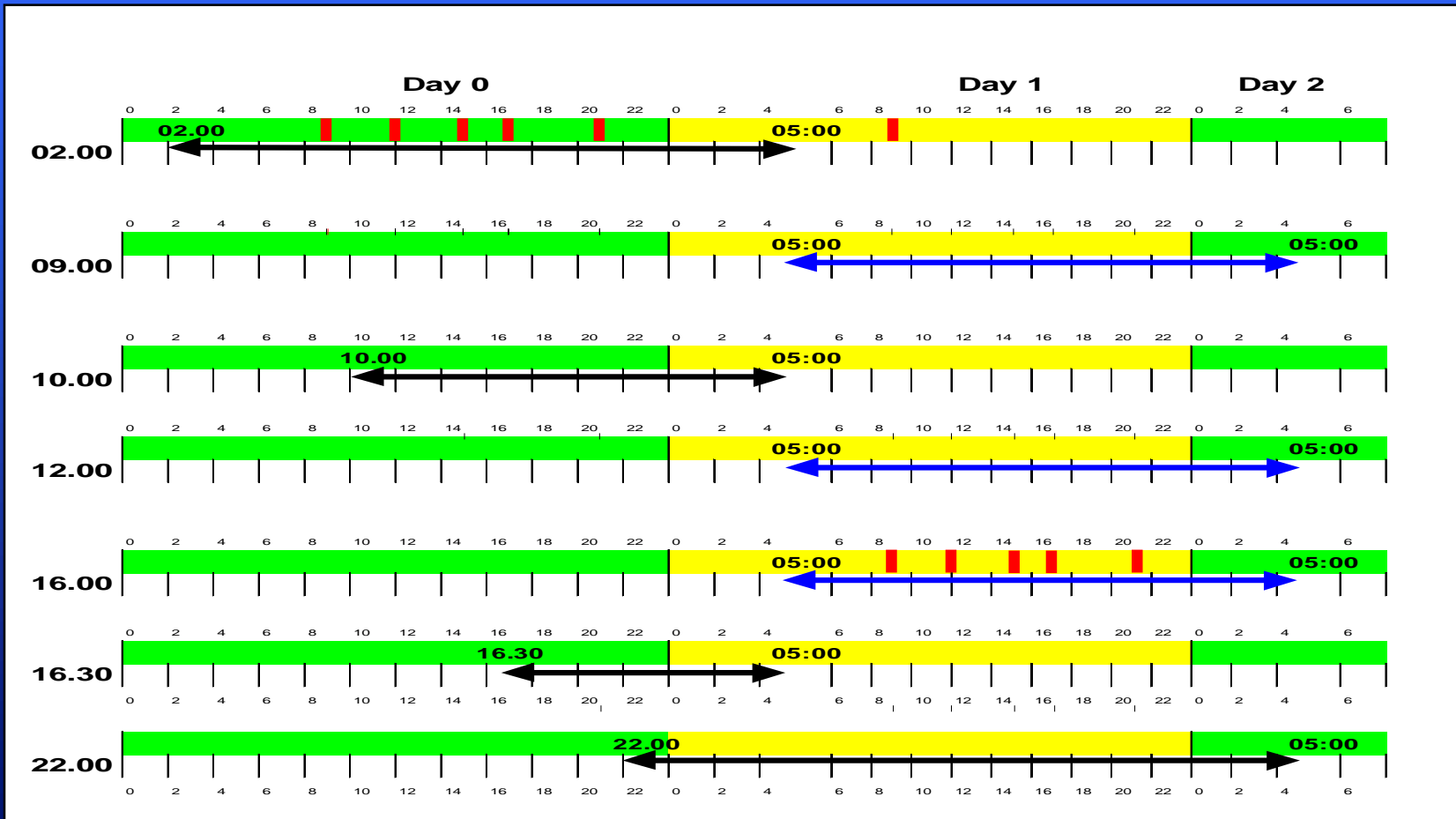




National Grid

Market Information and Trends

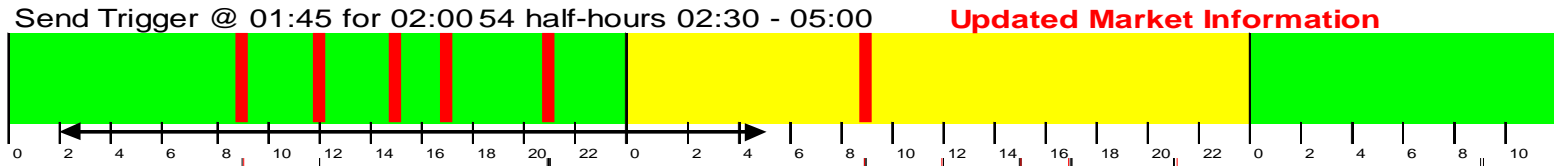
Daily Demand Forecast Information To The Market



NETA Requirements

NETA Demand Forecasting Requirements

Weather Received @ 23:30



Demand Forecast File

				Period		
DF	2001-04-03	01:45	2001-04-03	5	N	32925
DF	2001-04-03	01:45	2001-04-03	6	N	33211
DF	2001-04-03	01:45	2001-04-03	7	N	32576



Market Demand Forecasts

Difference due to Station load, pumping and interconnector demand. Also a change in the demand prediction due to an updated weather forecast.

Settlement Date	Period	Publish Time	Value
21/04/01	11	20/04/01 08:47	29168
21/04/01	12	20/04/01 08:47	28710
21/04/01	13	20/04/01 08:47	28928

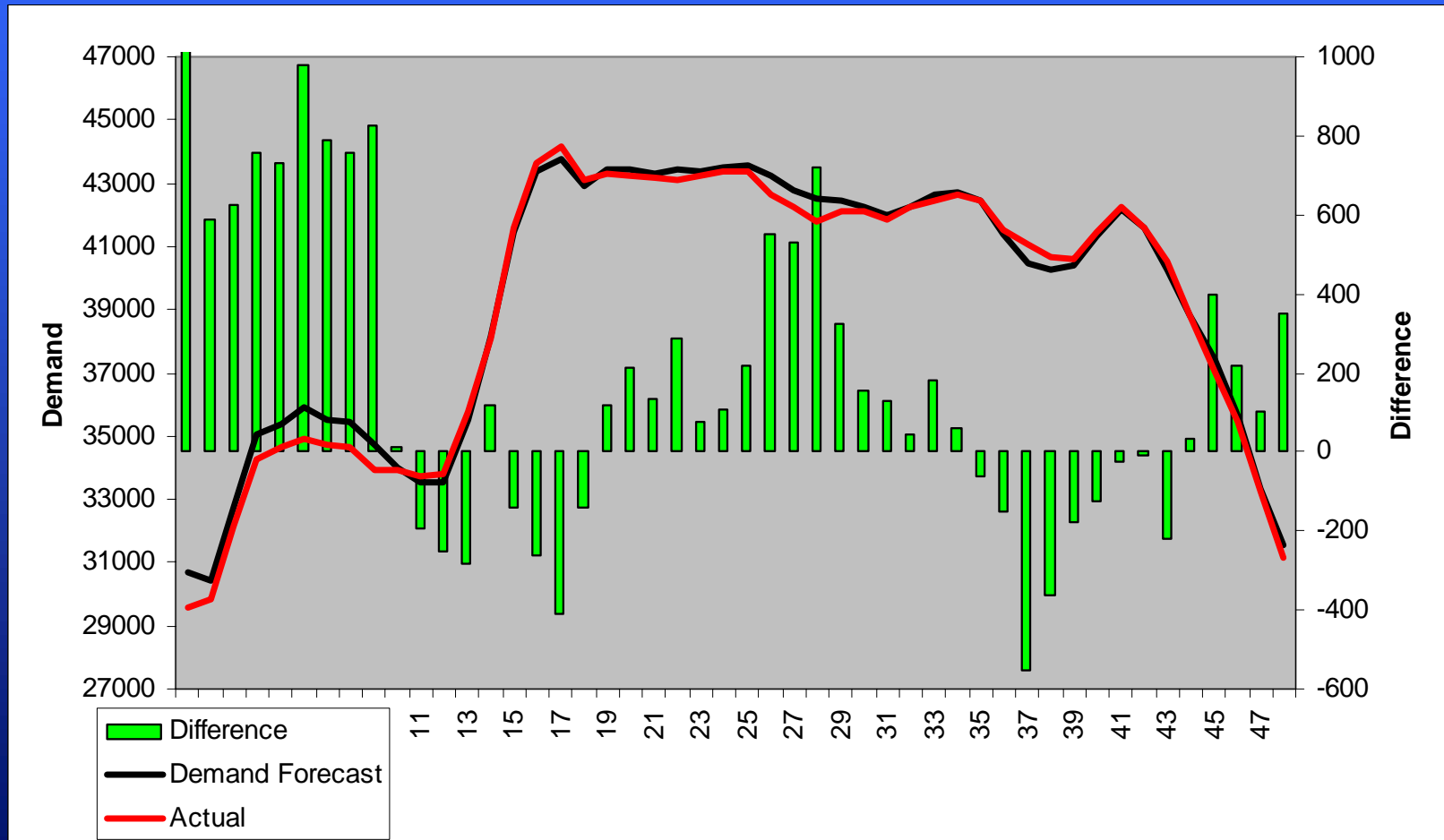
Initial market run released 08.47

Settlement Date	Period	Publish Time	Value
21/04/01	11	20/04/01 11:50	30225
21/04/01	12	20/04/01 11:50	29951
21/04/01	13	20/04/01 11:50	30235

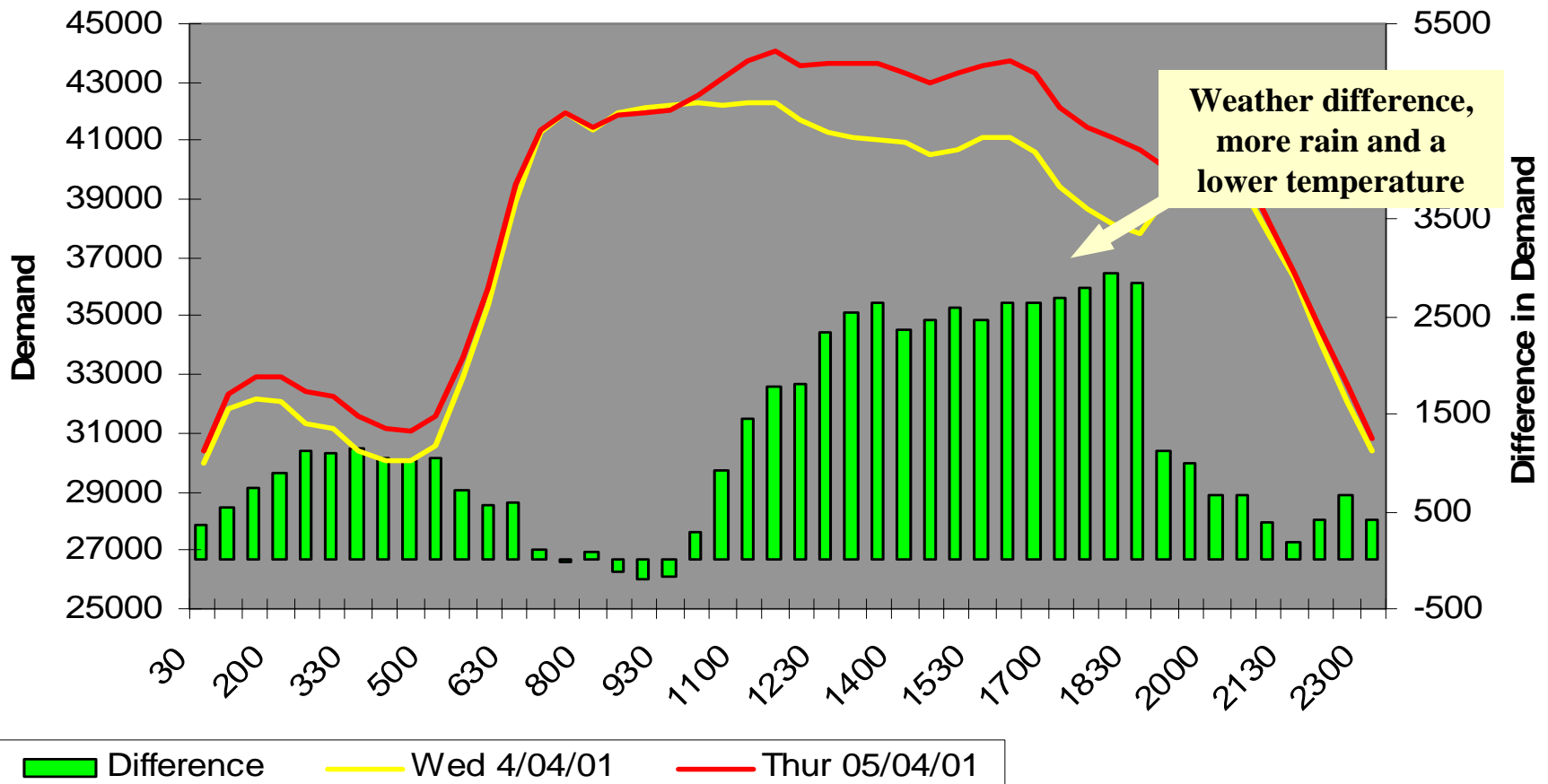
Initial National Day Ahead Market demand prediction released 11:50. This will supersede earlier demand forecast.



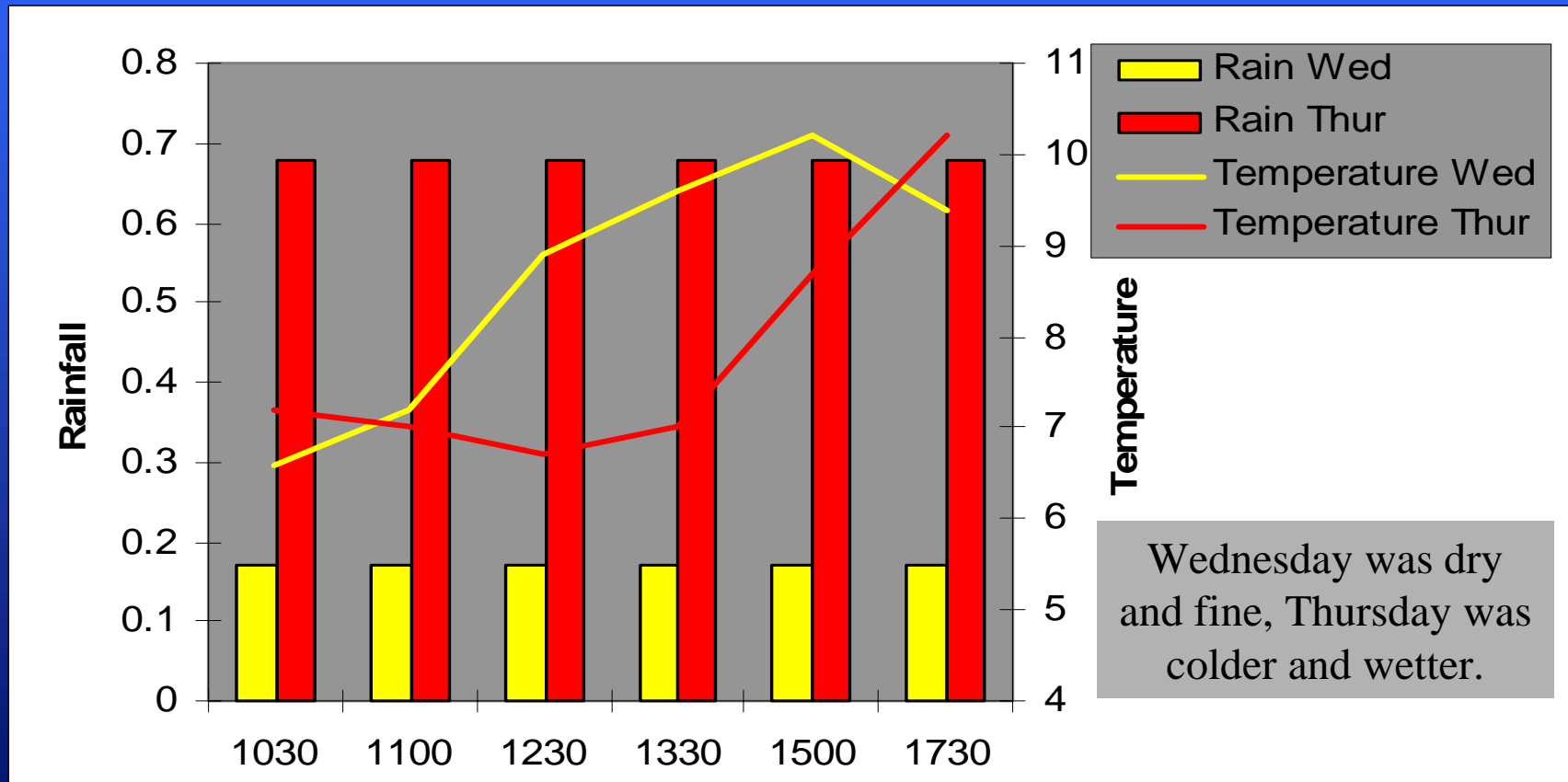
NETA Actual vs Forecast



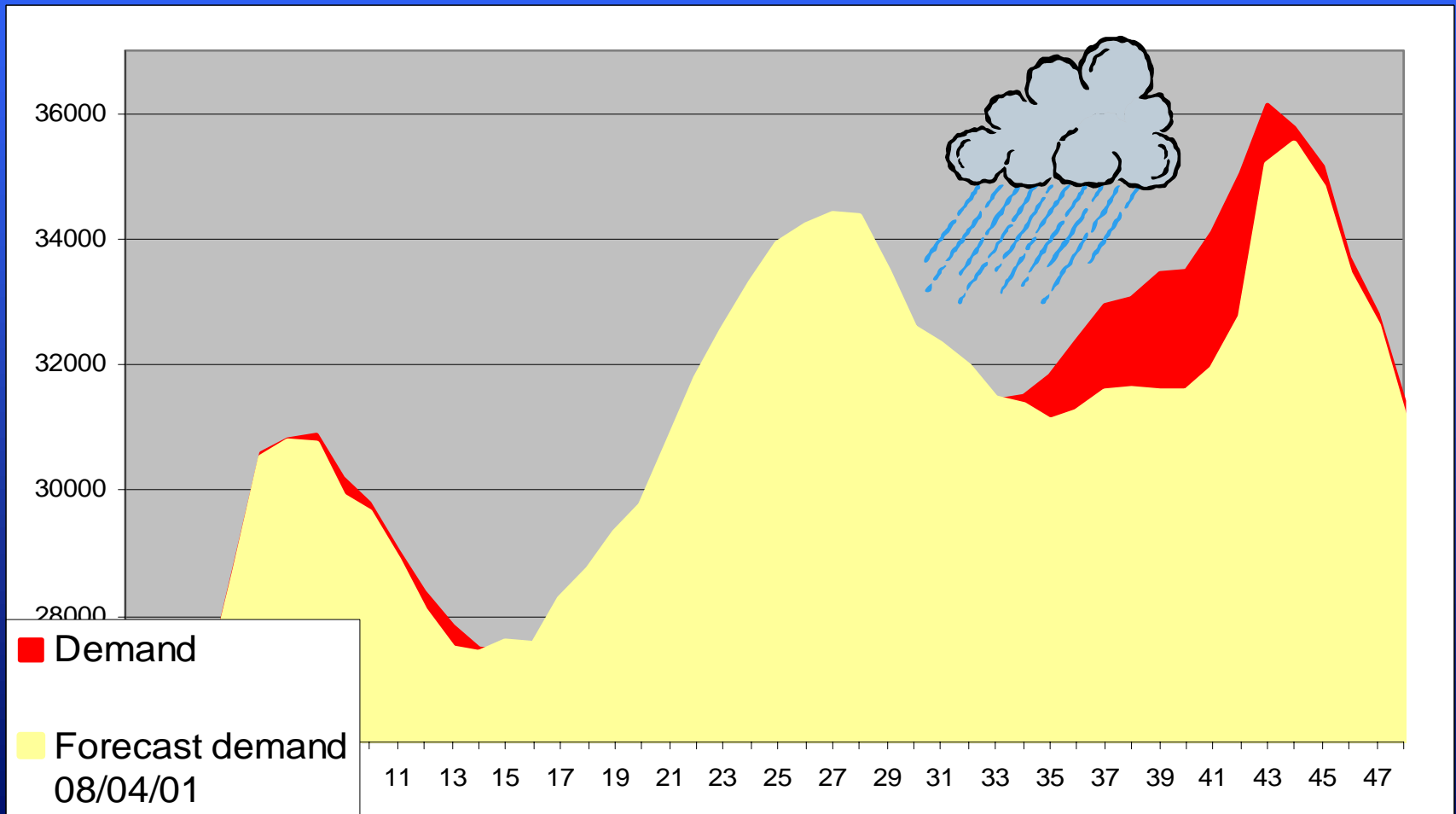
Demand Difference Between Two Consecutive Days

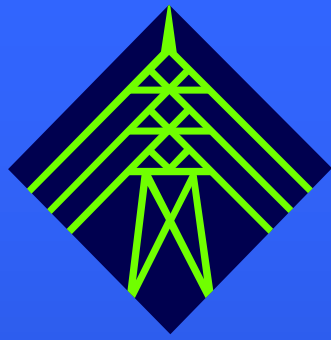


Actual Weather for Wednesday and Thursday



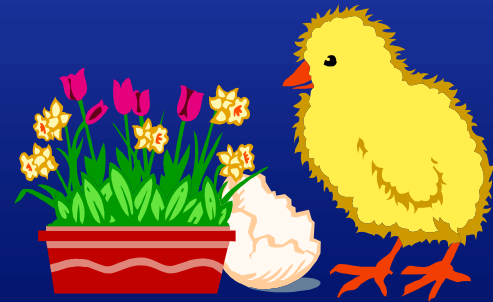
Explanation of Large Demand Forecasting Error



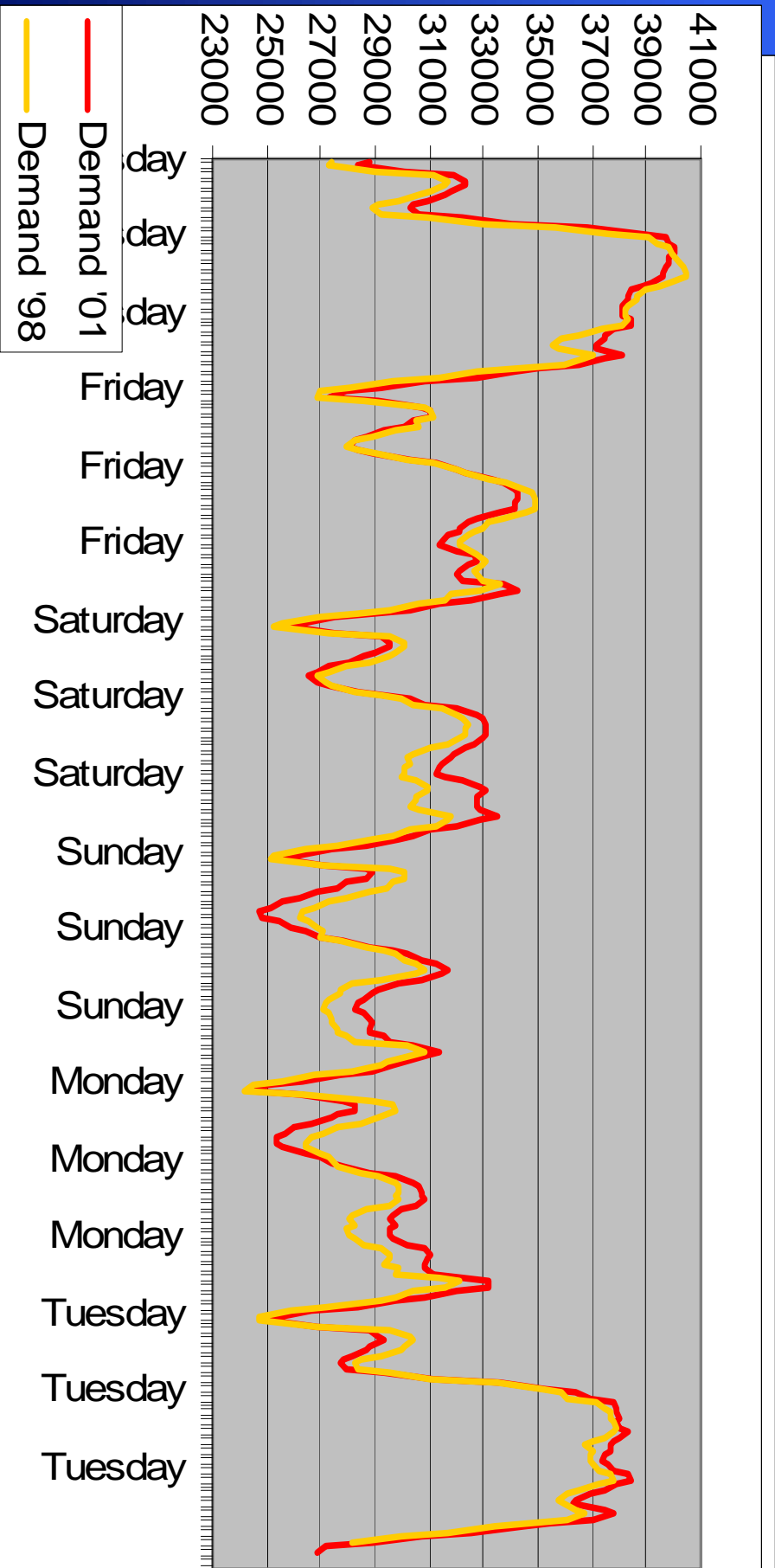


National Grid

How do you Predict
Easter Demand...

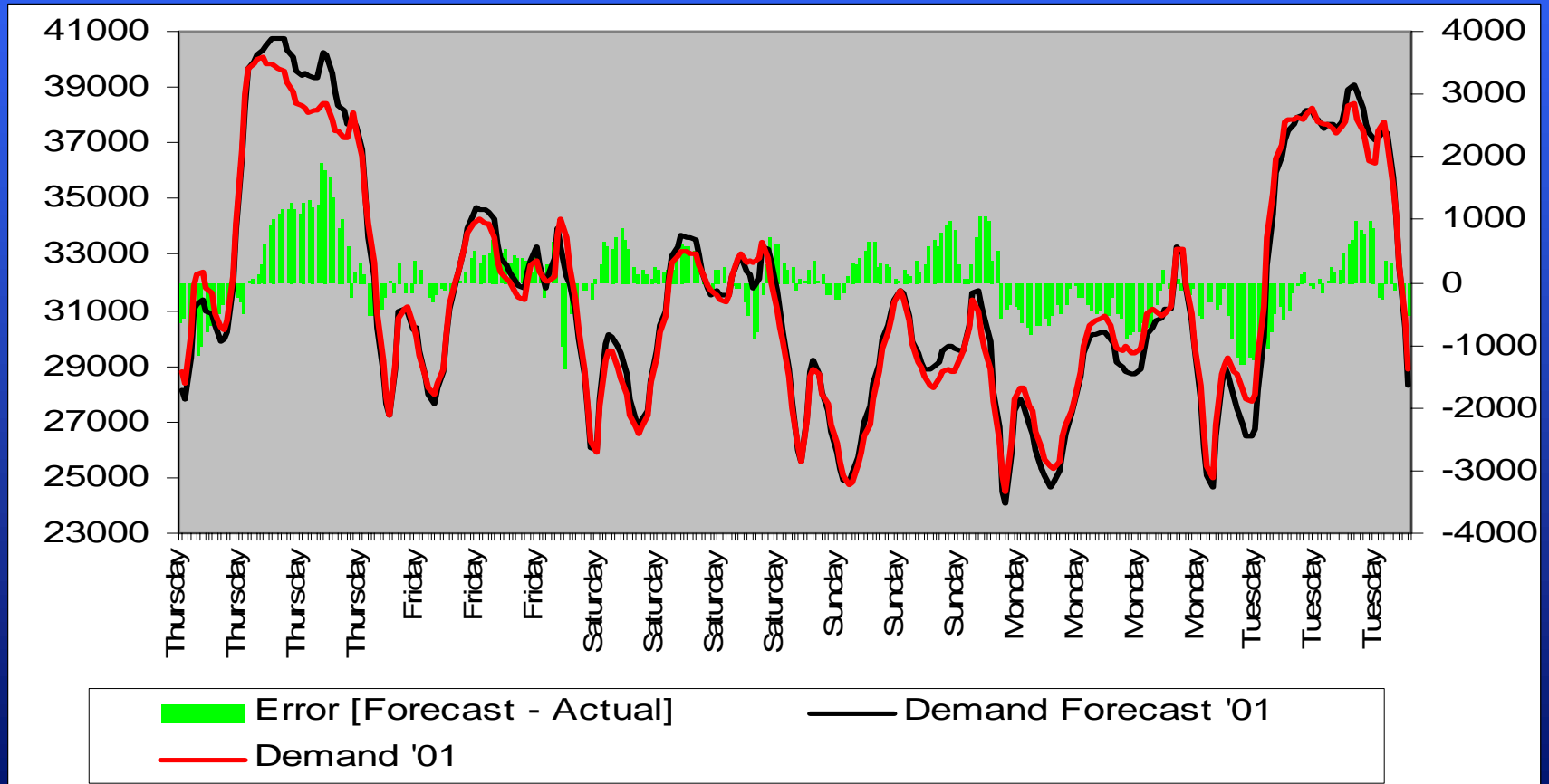


Easter Period 1998 & 2001

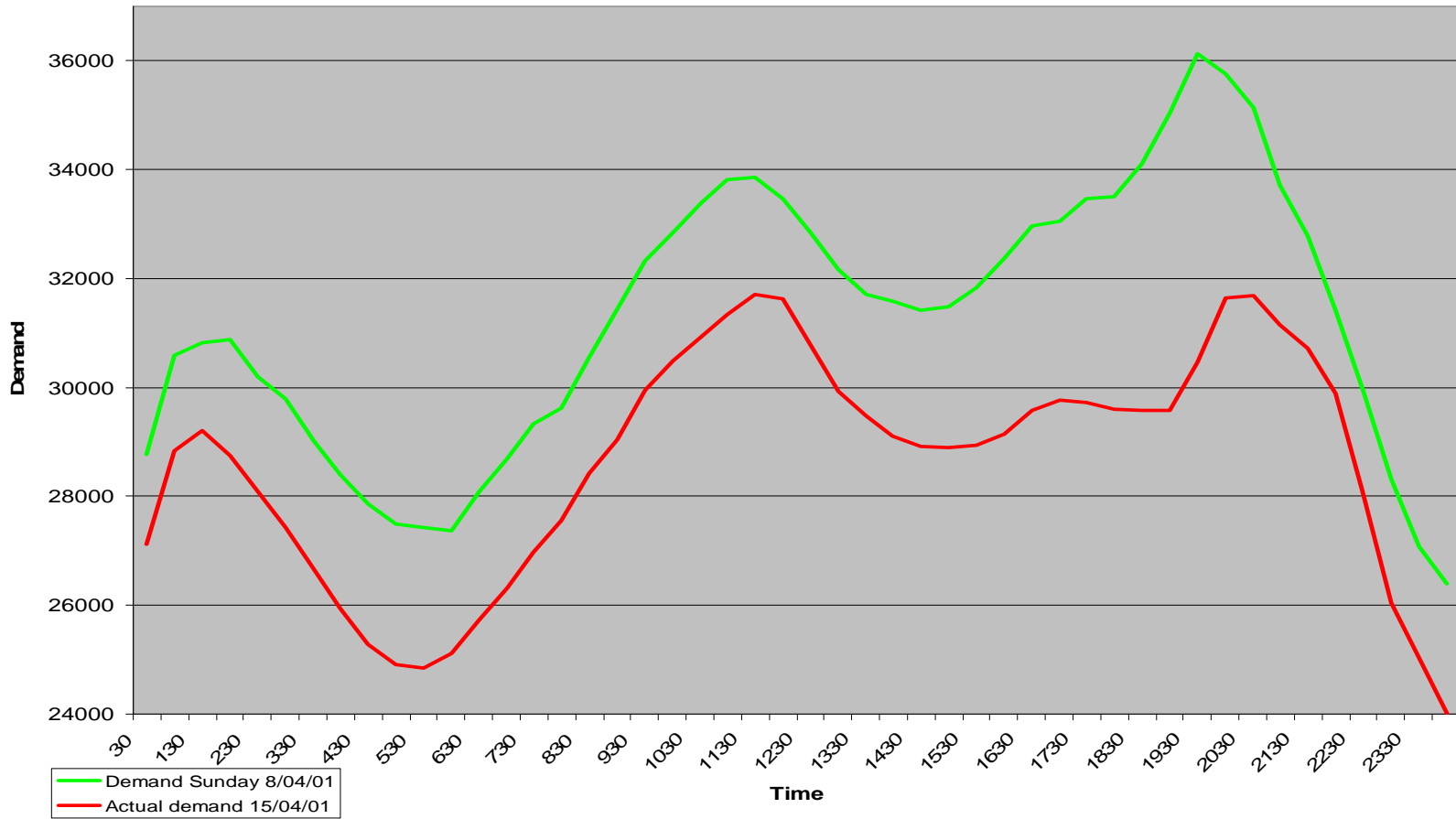


National Grid

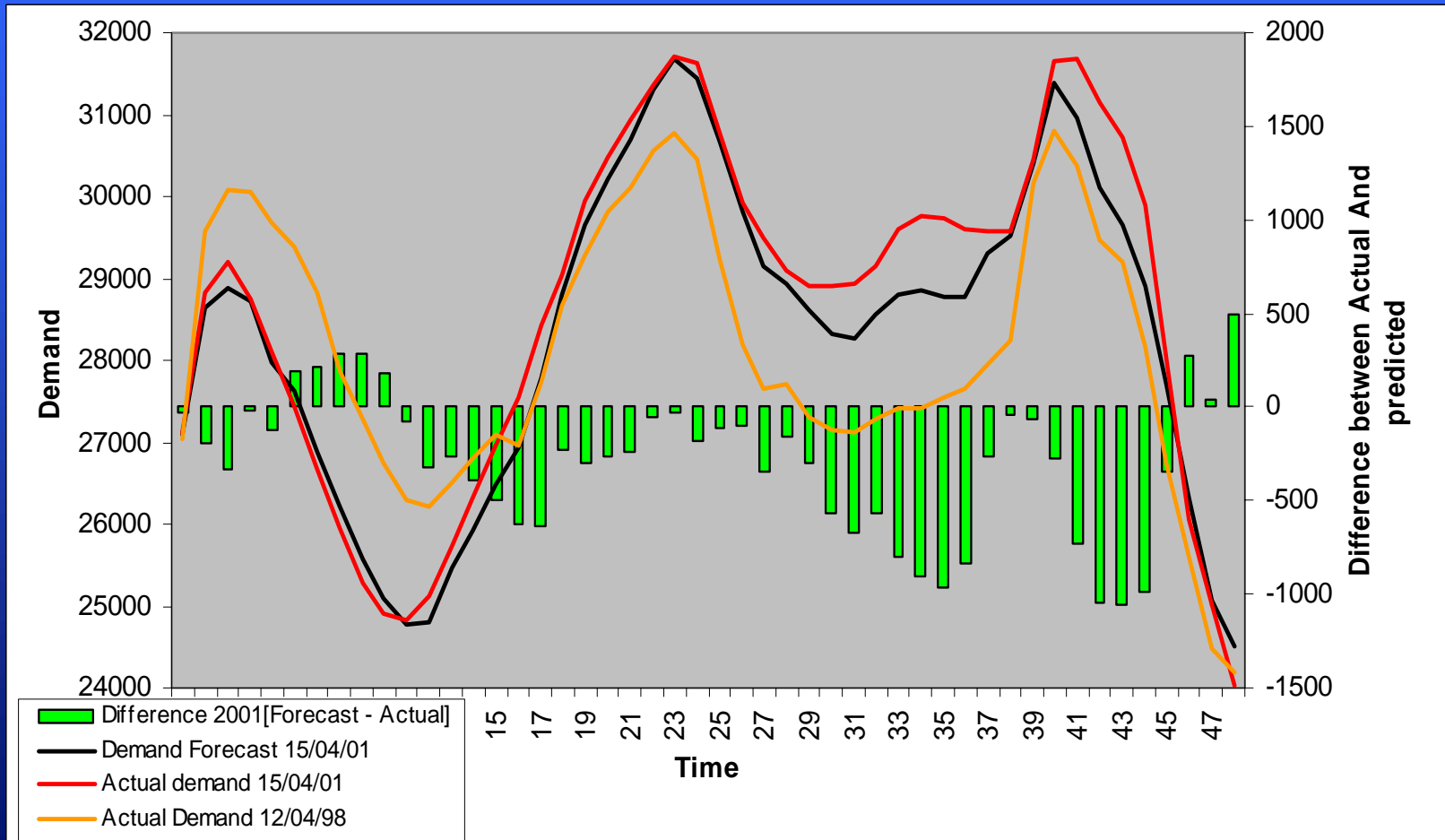
Easter 2001 Actual Demand vs Forecast Demand including Error (Forecast - Actual)

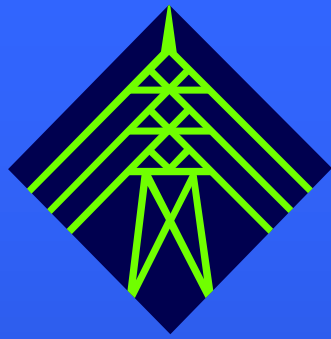


Easter Day Compared To The Previous Sunday



Easter Day

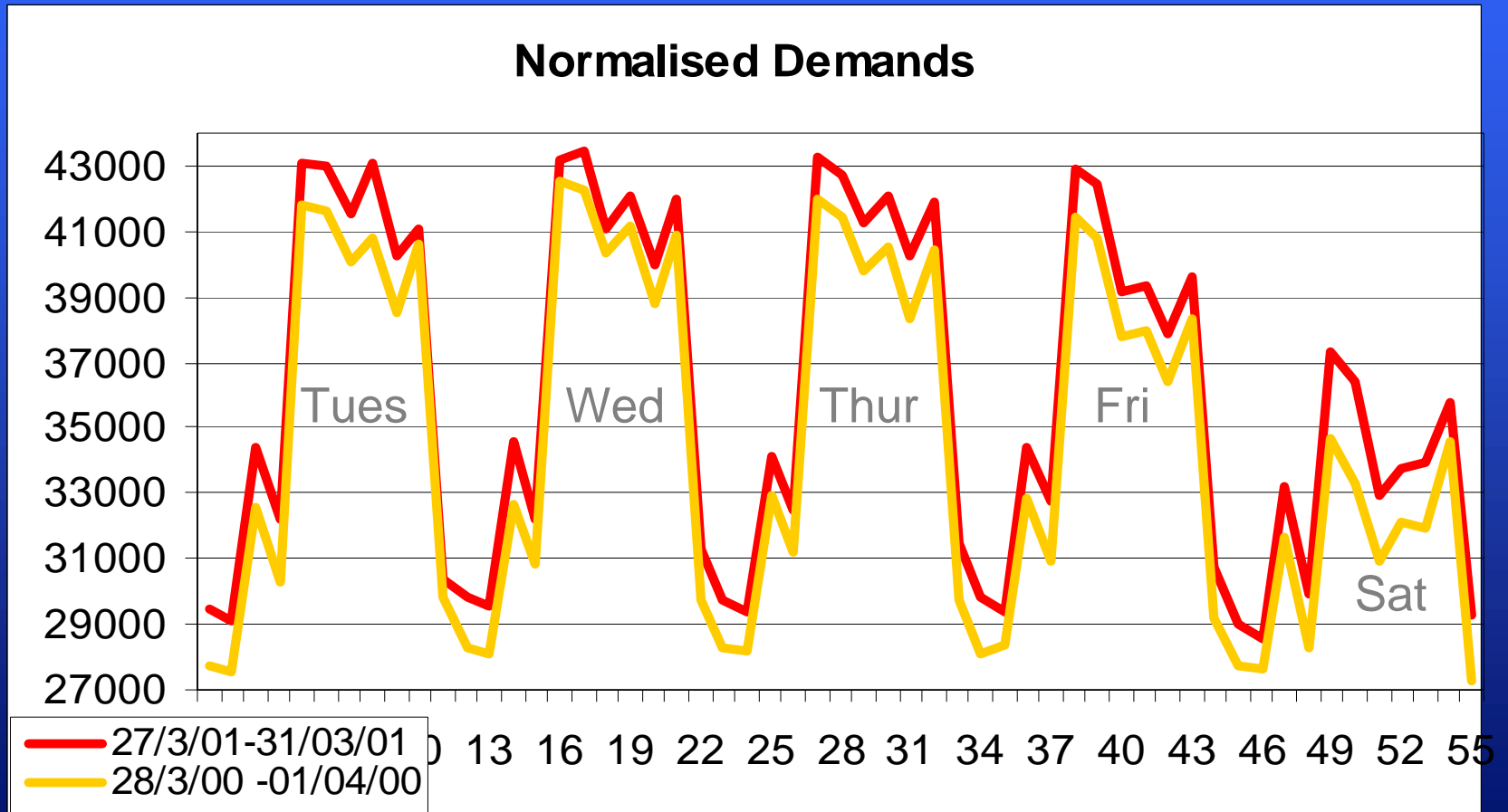




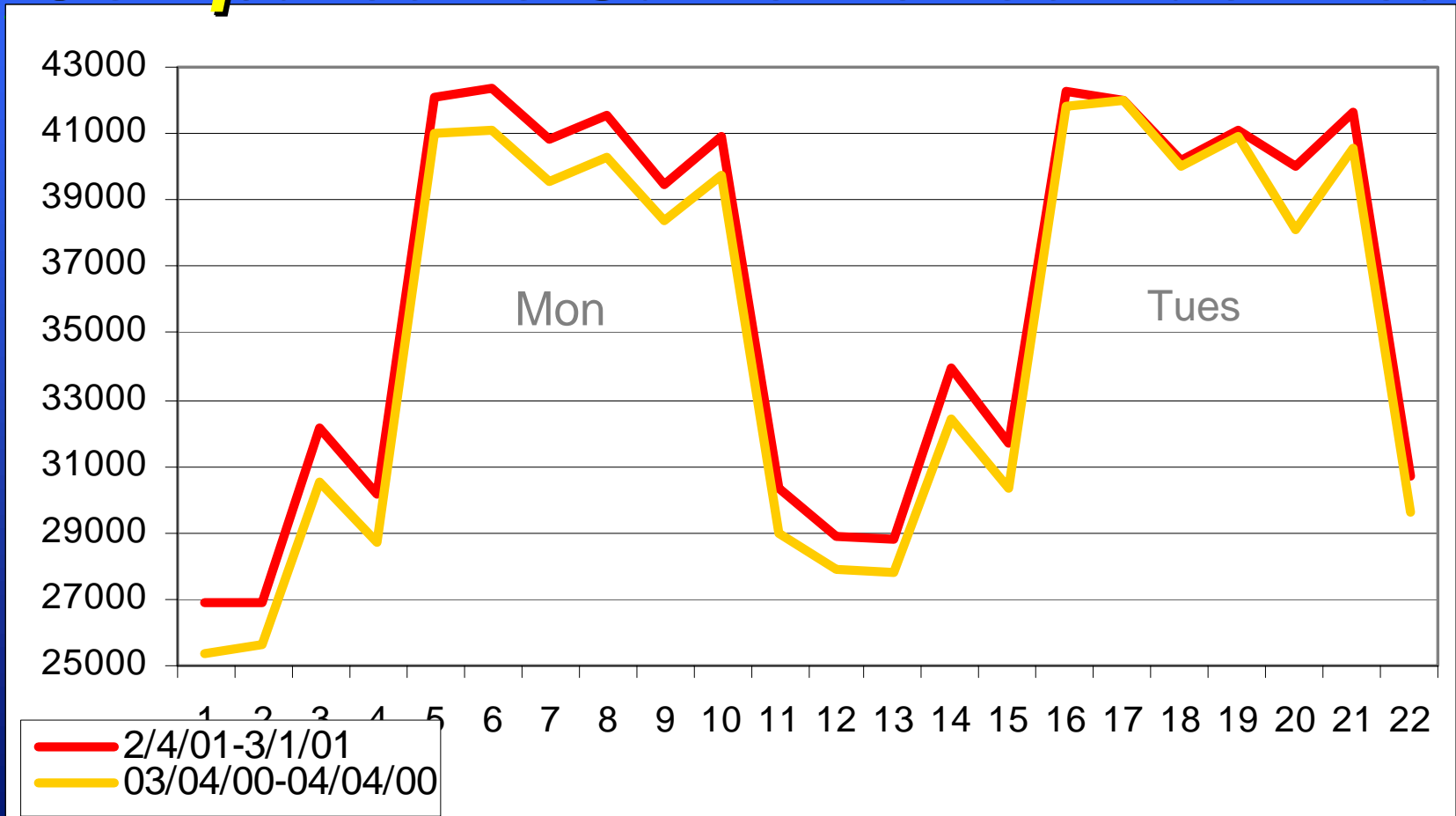
National Grid

Normalised demand

Normalised Demand Under NETA Compared to Same Period Last Year



Normalised Demand Under NETA Compared to Same Period Last Year



Conclusion

- ◆ The Volatility of Electricity demand is a Forecasting Challenge.
- ◆ Detailed Demand forecasting Process Outlined.
- ◆ Demand shape so far has remained unchanged.

