

# Promotion of Wind Generated Electricity Using Price Responsive Demand Side Management

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# Agenda

1. Ireland's Strive towards a Renewable Future

2. Role of DSM in Increasing Wind Penetration

3. On-Campus Case Study: Dromroe Student Village

4. Price Accuracy Analysis

5. Off-Campus Case Studies

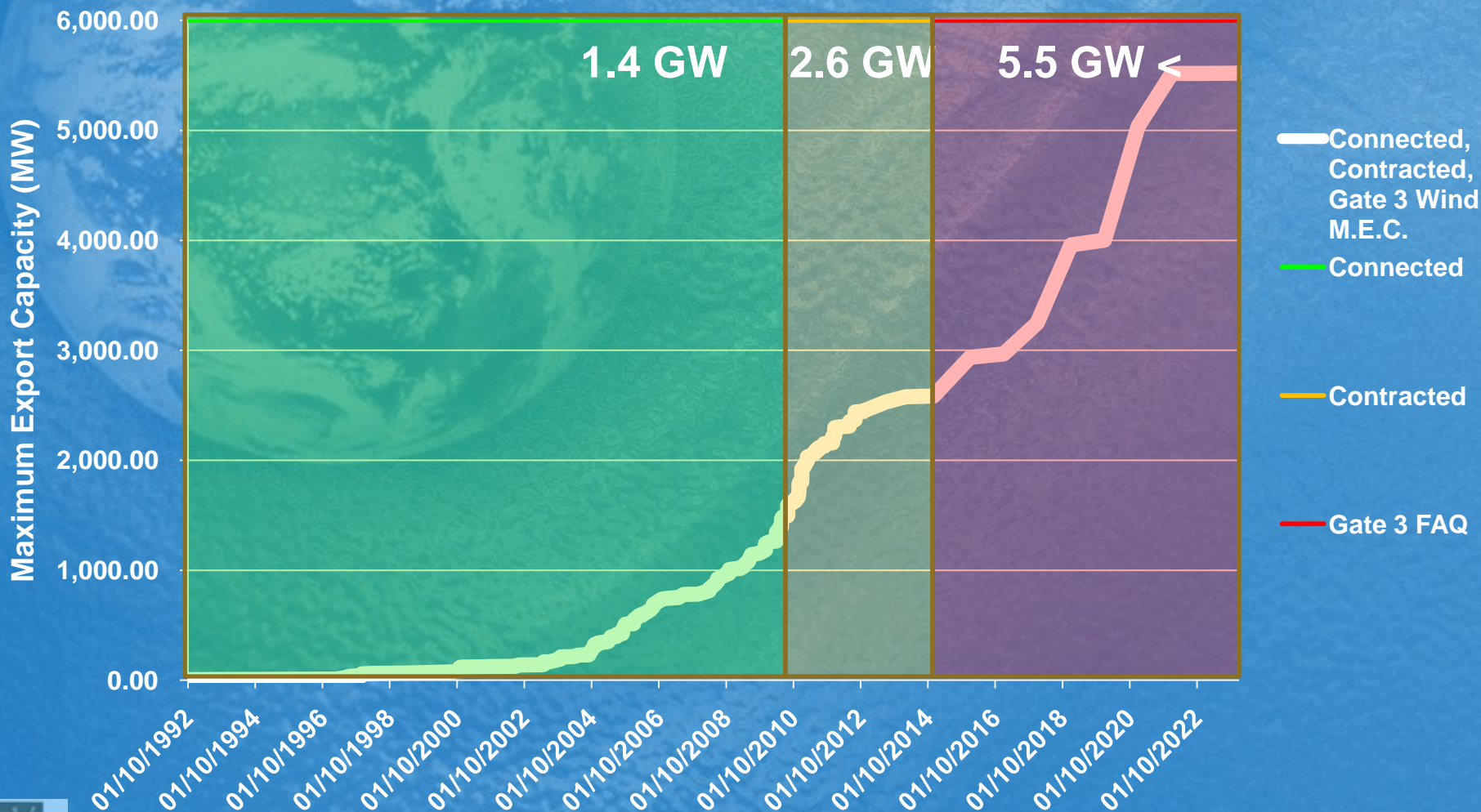
# 1. Ireland's Strive towards a Renewable Future

# Renewable Energy Policies

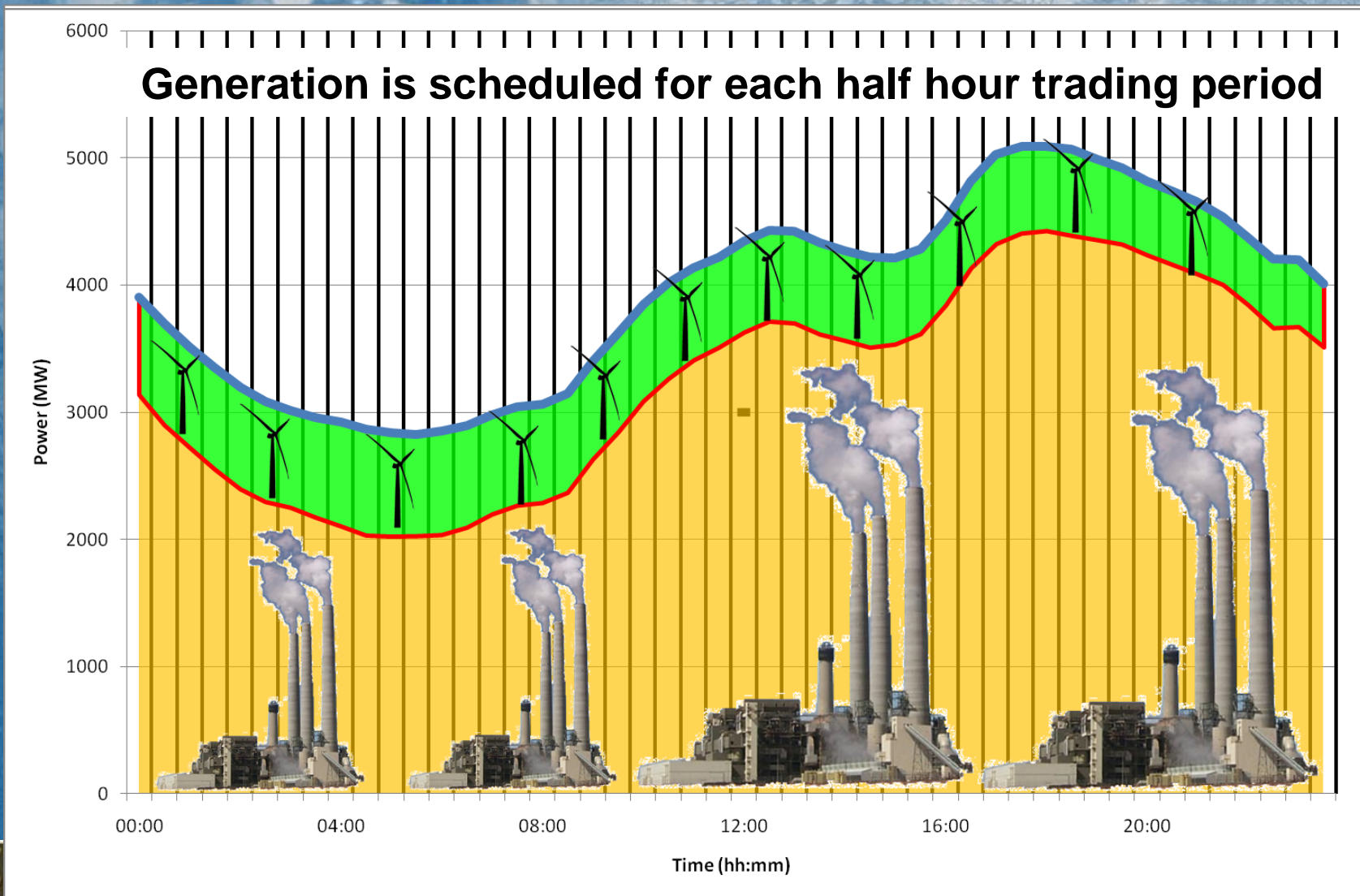
- **Achieving 12% RES-E penetration in August 2009, Ireland poised to reach EU 2010 13.2% target**
- **40GW wind in EU by 2010 – 5 years ahead of target**
- **2009 – EU Council adopts “20/20/20 Directive”**
  - **20% GHG Reduction**
  - **20% Share of Renewable Energy in EU’s total consumption**
  - **To be achieved by 2020**

# Planned RES-E Development

Wind - Connected/Contracted/Gate 3 FAQ (MEC)

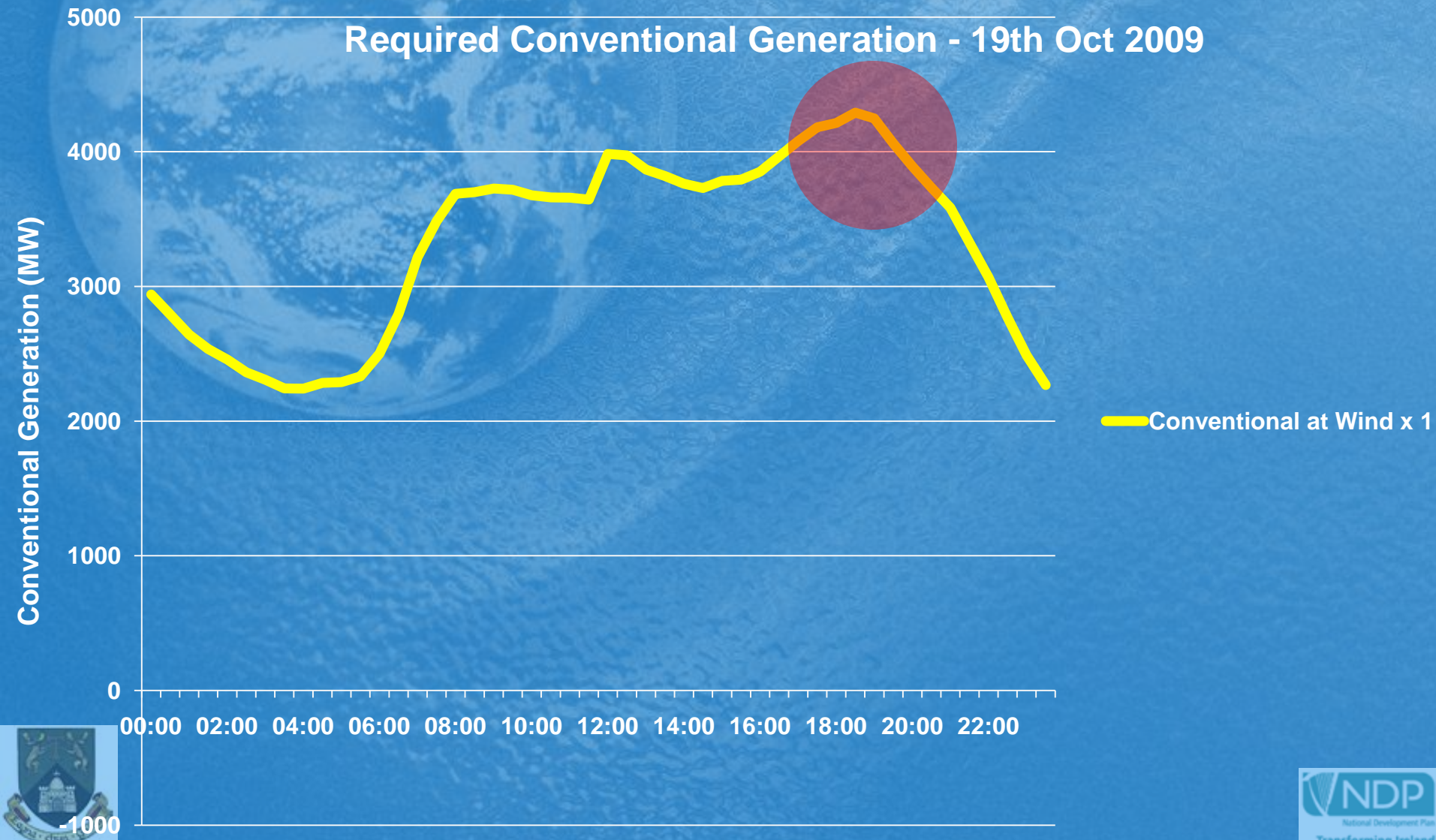


# Single Electricity Market



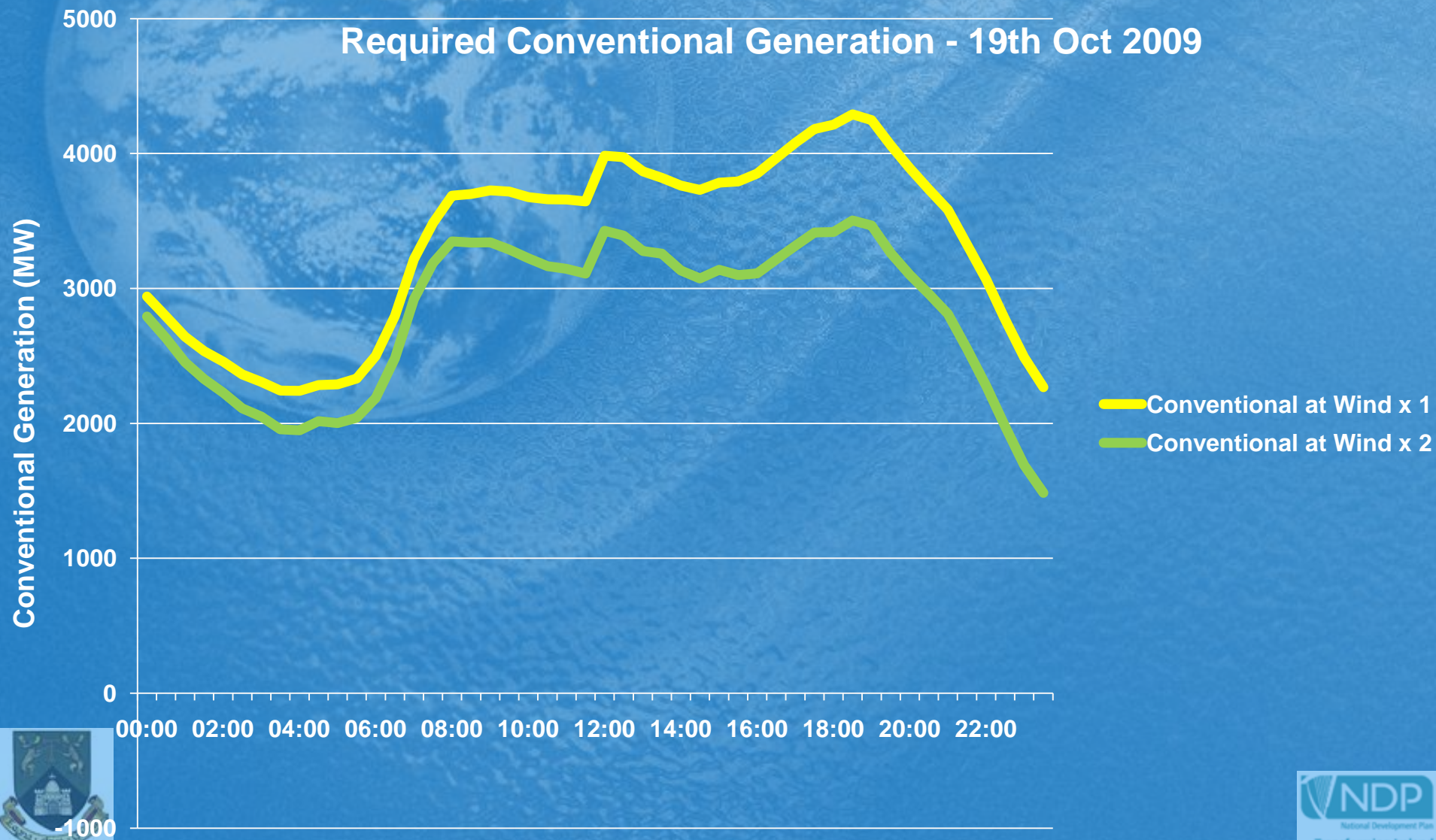
# Pricing Trends in the SEM

• **Increasing wind capacity also increases generation variability**



# Pricing Trends in the SEM

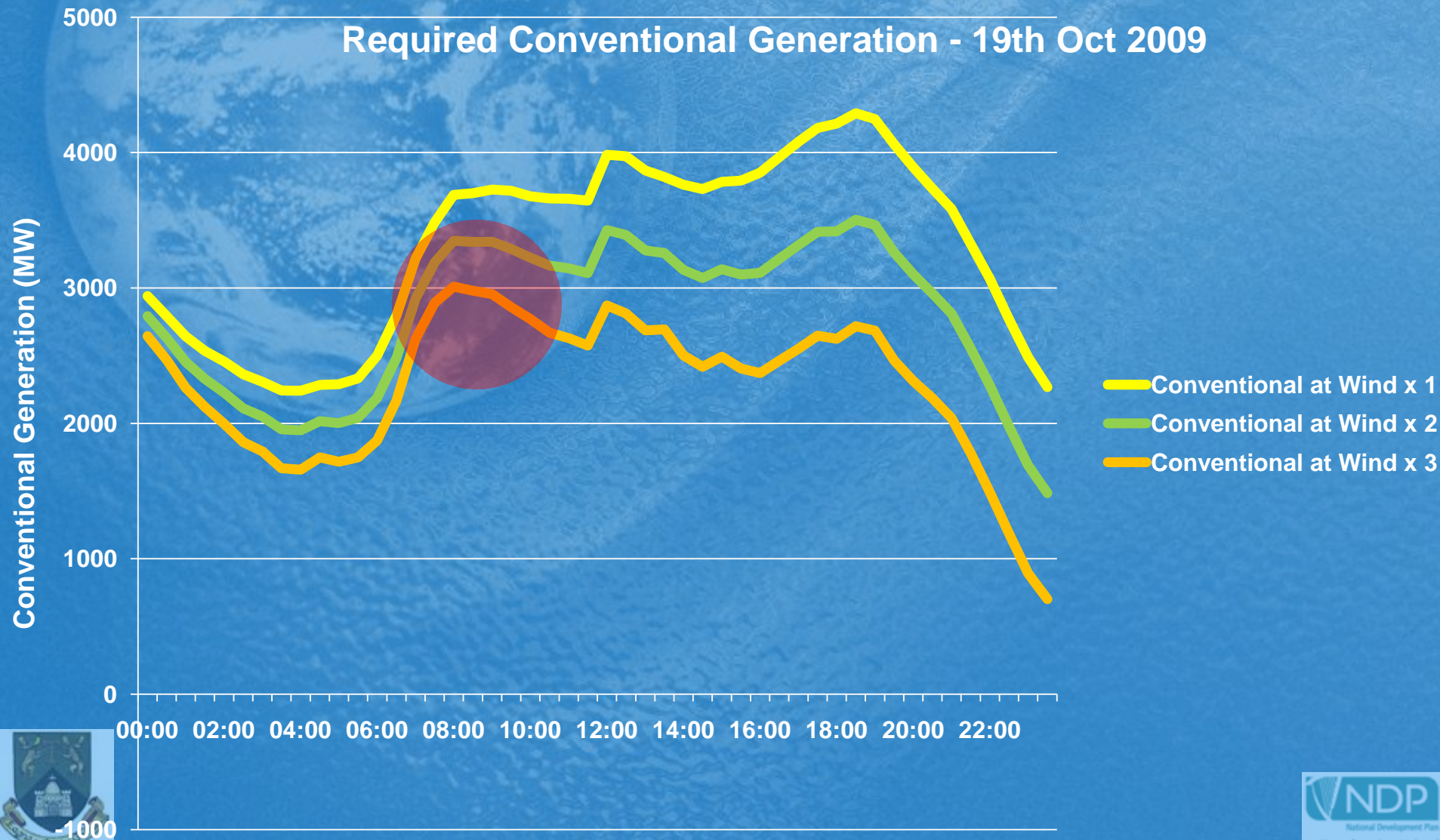
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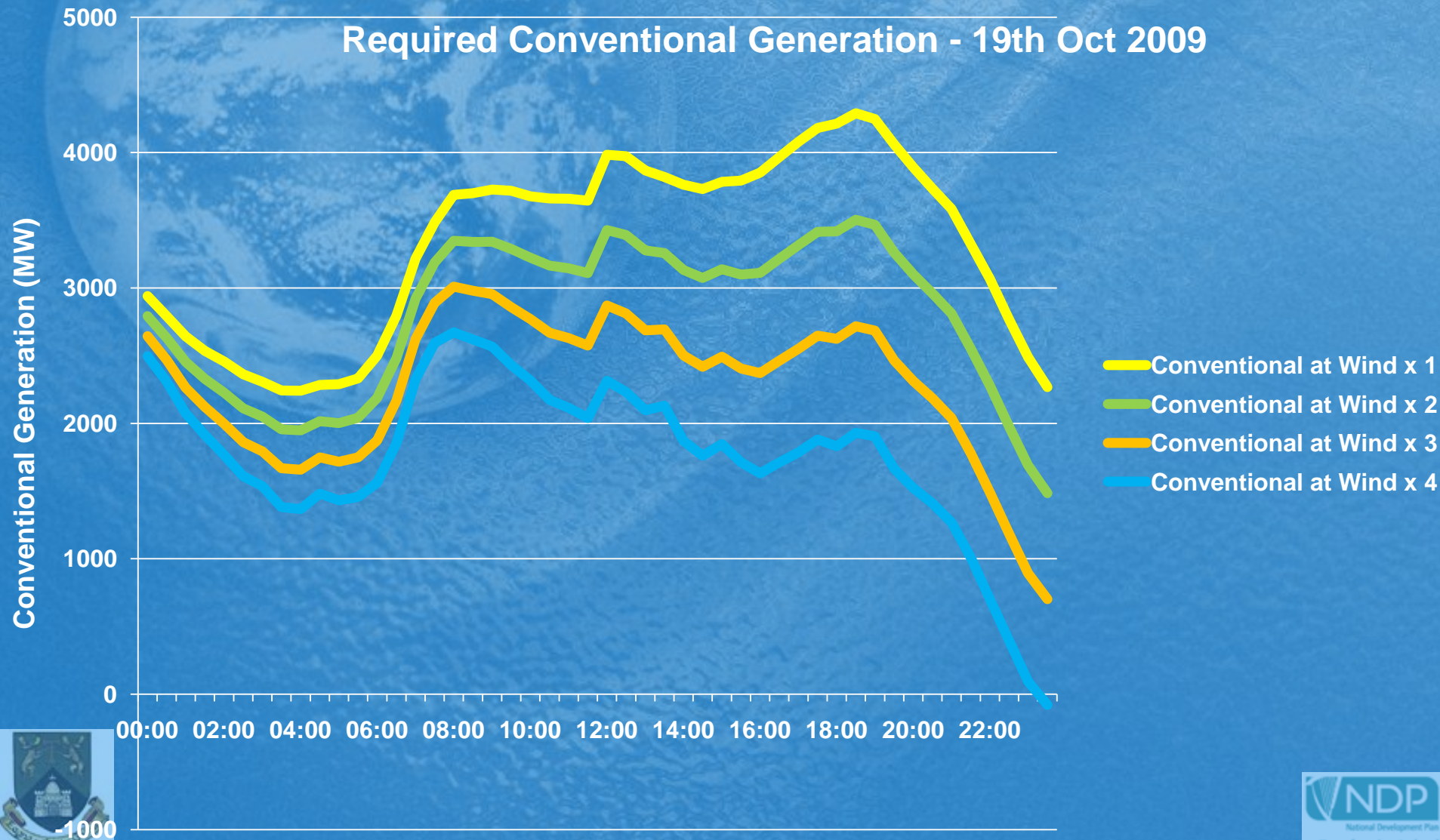
# Pricing Trends in the SEM

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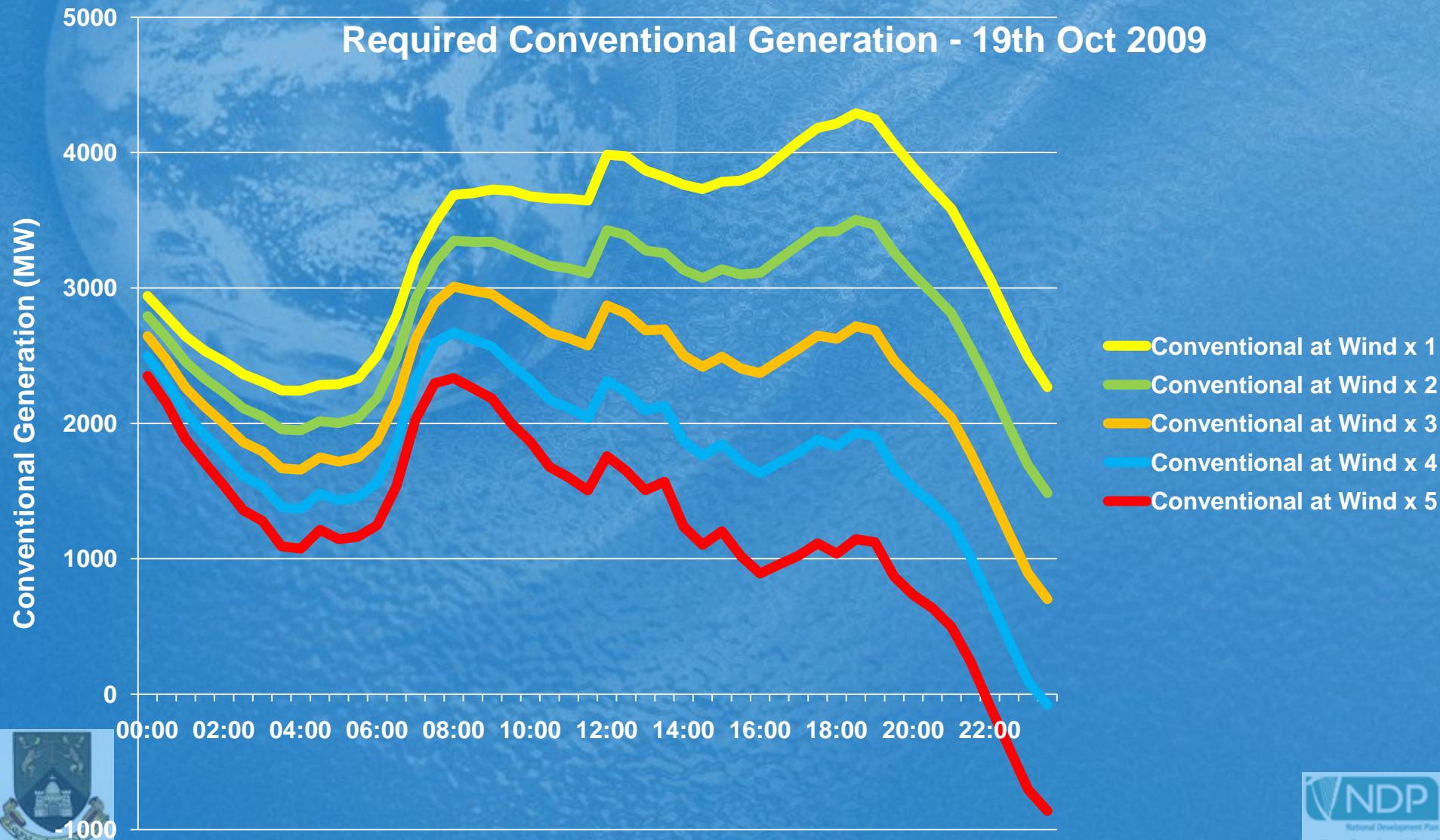
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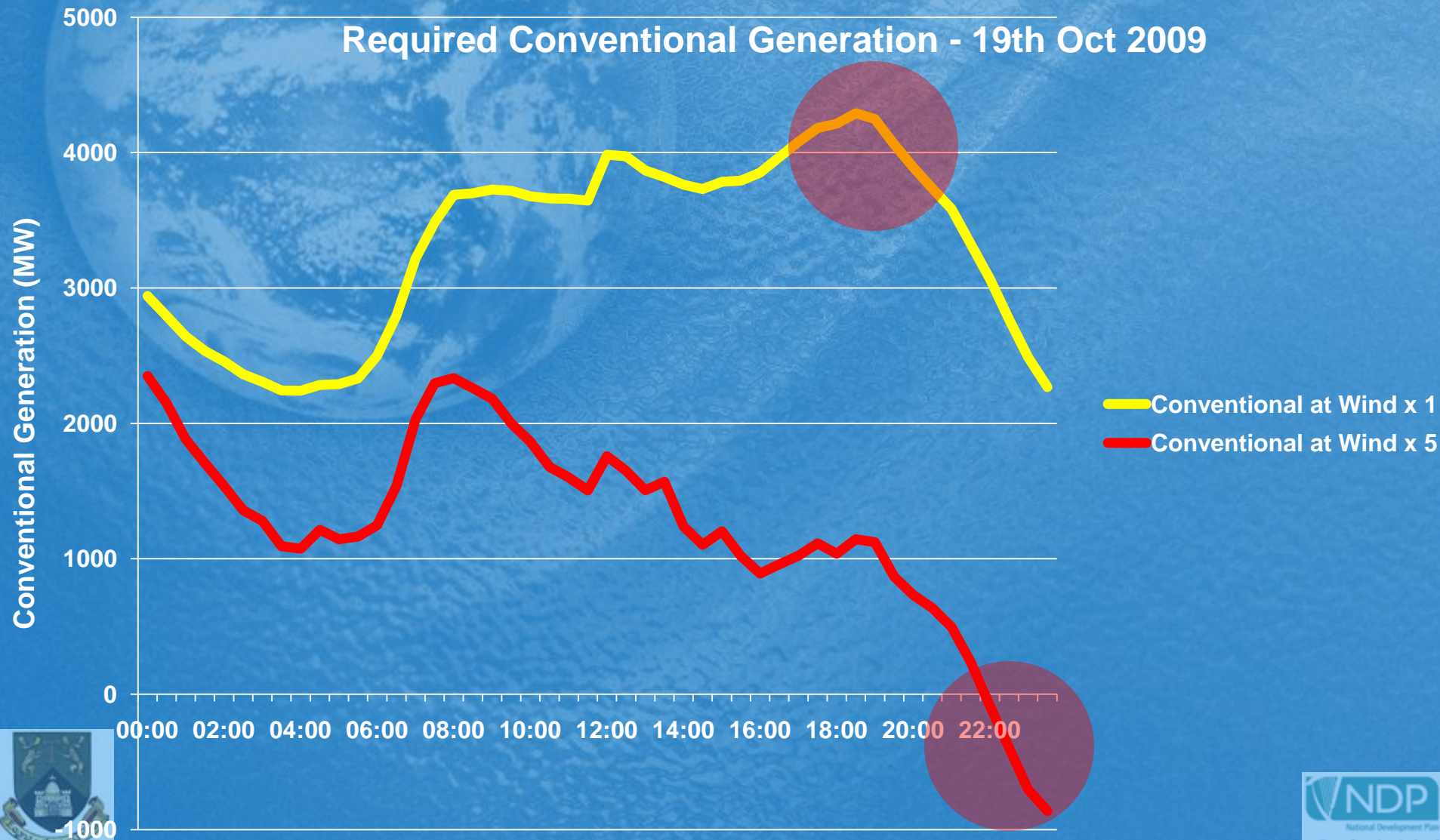
# Pricing Trends in the SEM

• **Increasing wind capacity also increases generation variability**



# Pricing Trends in the SEM

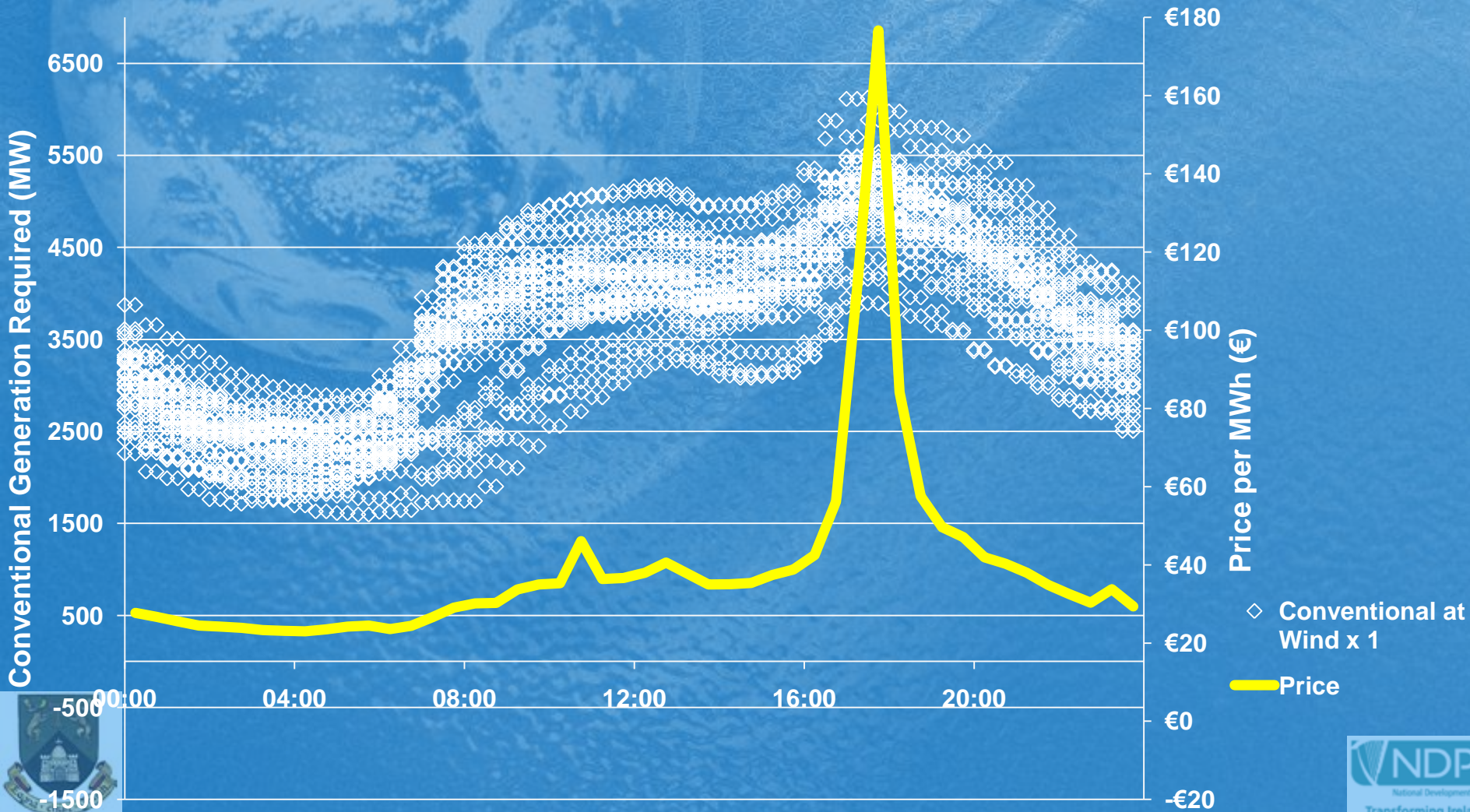
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# Pricing Trends in the SEM

• **Scatter plot of daily Conventional Generation for November 2009**

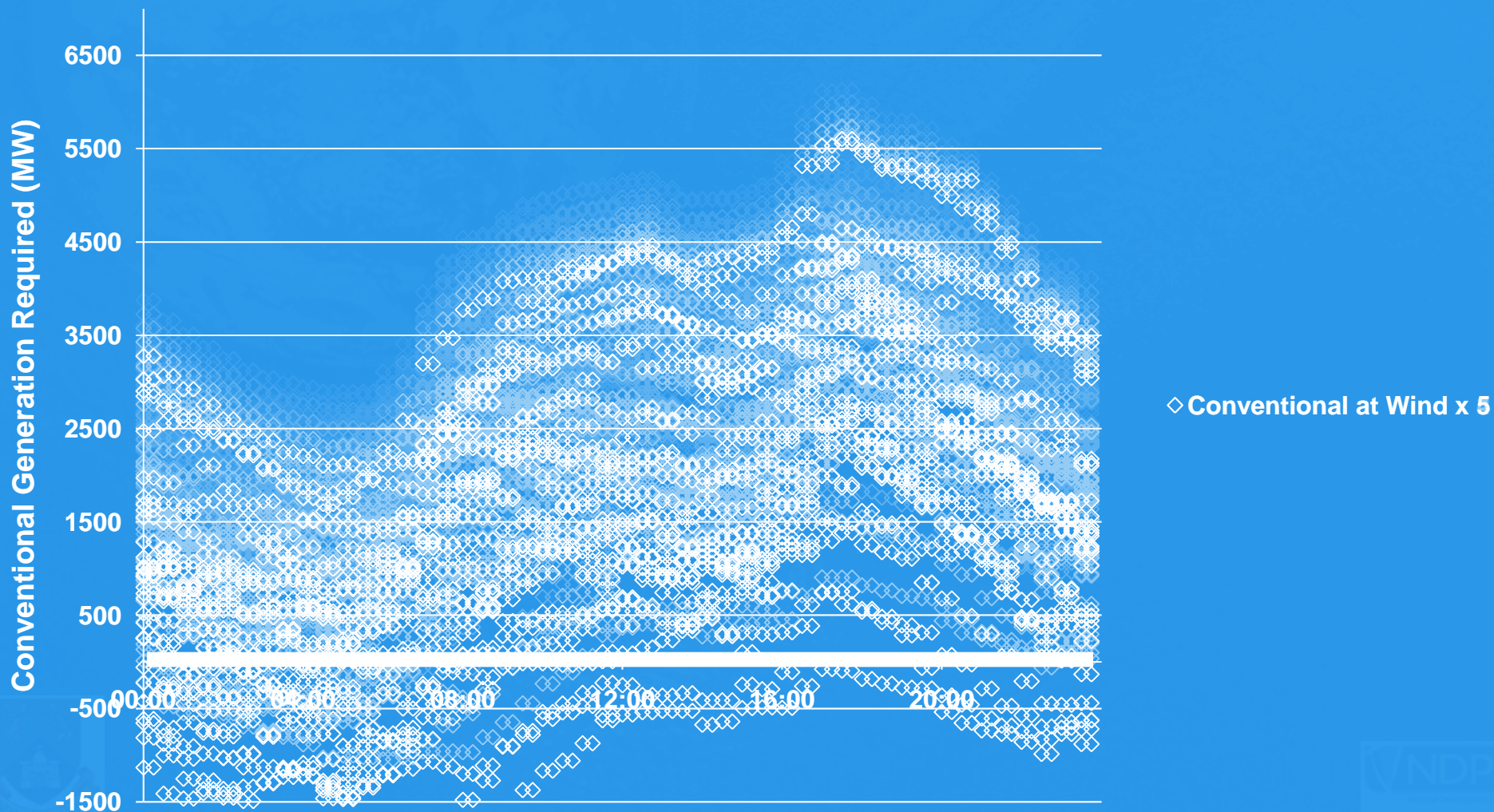
Conventional at wind x 1 + Price



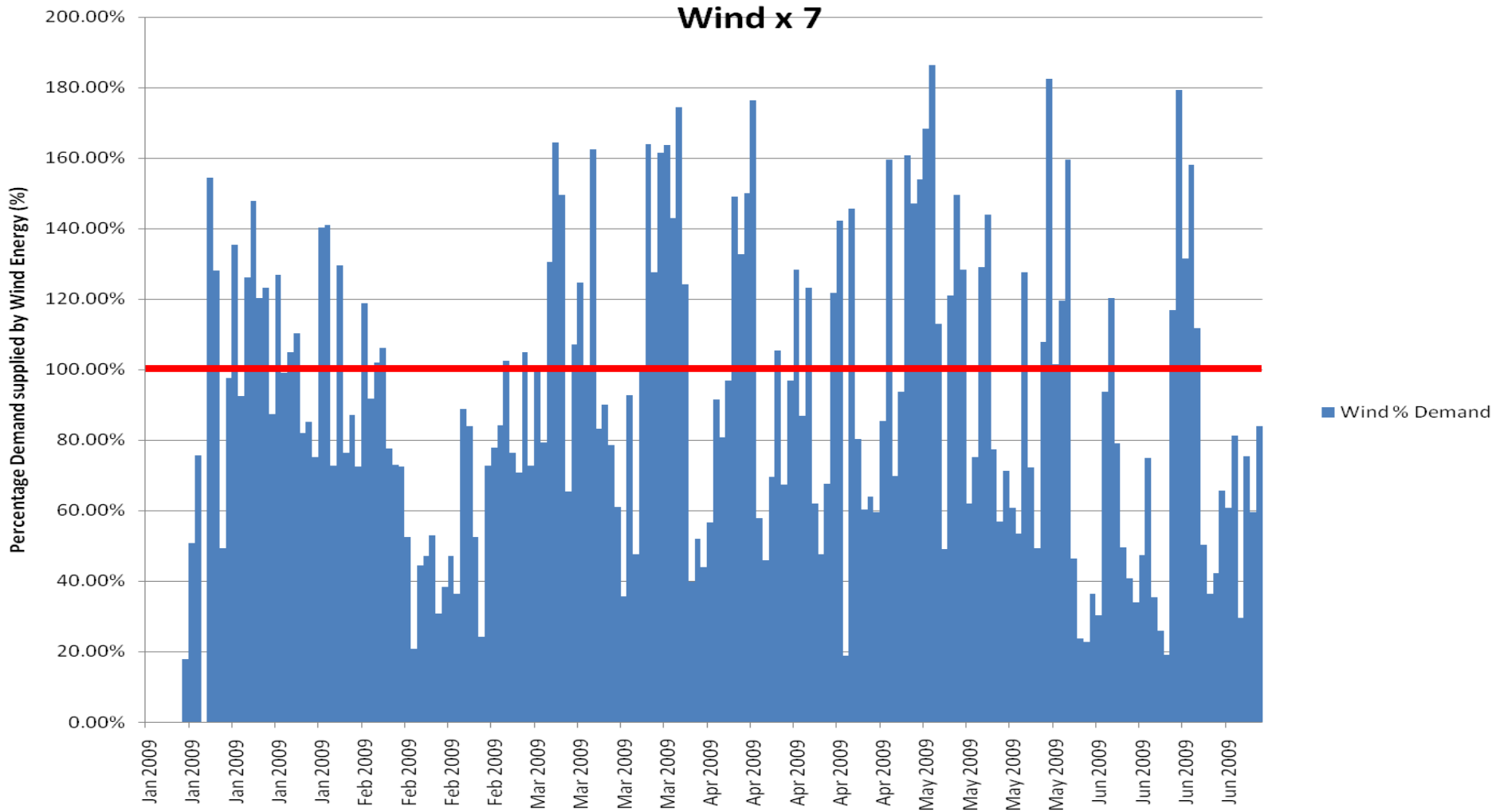
# Pricing Trends in the SEM

• **Scatter plot of daily Conventional Generation for November 2009**

Conventional at Wind x 5



# Role of DSM



## 2. Role of DSM in increasing Wind Penetration



# Role of DSM

**•RES-E from Wind/Wave/Solar etc.**

**•Not dispatchable**

**•Displaceable capacity limited by prediction accuracy & the increased requirement for spinning reserve**

**•Curtailment not economically feasible**

# Role of DSM

## • Interconnection?

- **Internal interconnection between ROI and NI**
- **2002 – Antrim to Ayrshire, Scotland. 500 MW capacity**
- **2010 – Construction begins on East-West interconnector from Dublin to North Wales. 500 MW capacity (due 2012)**

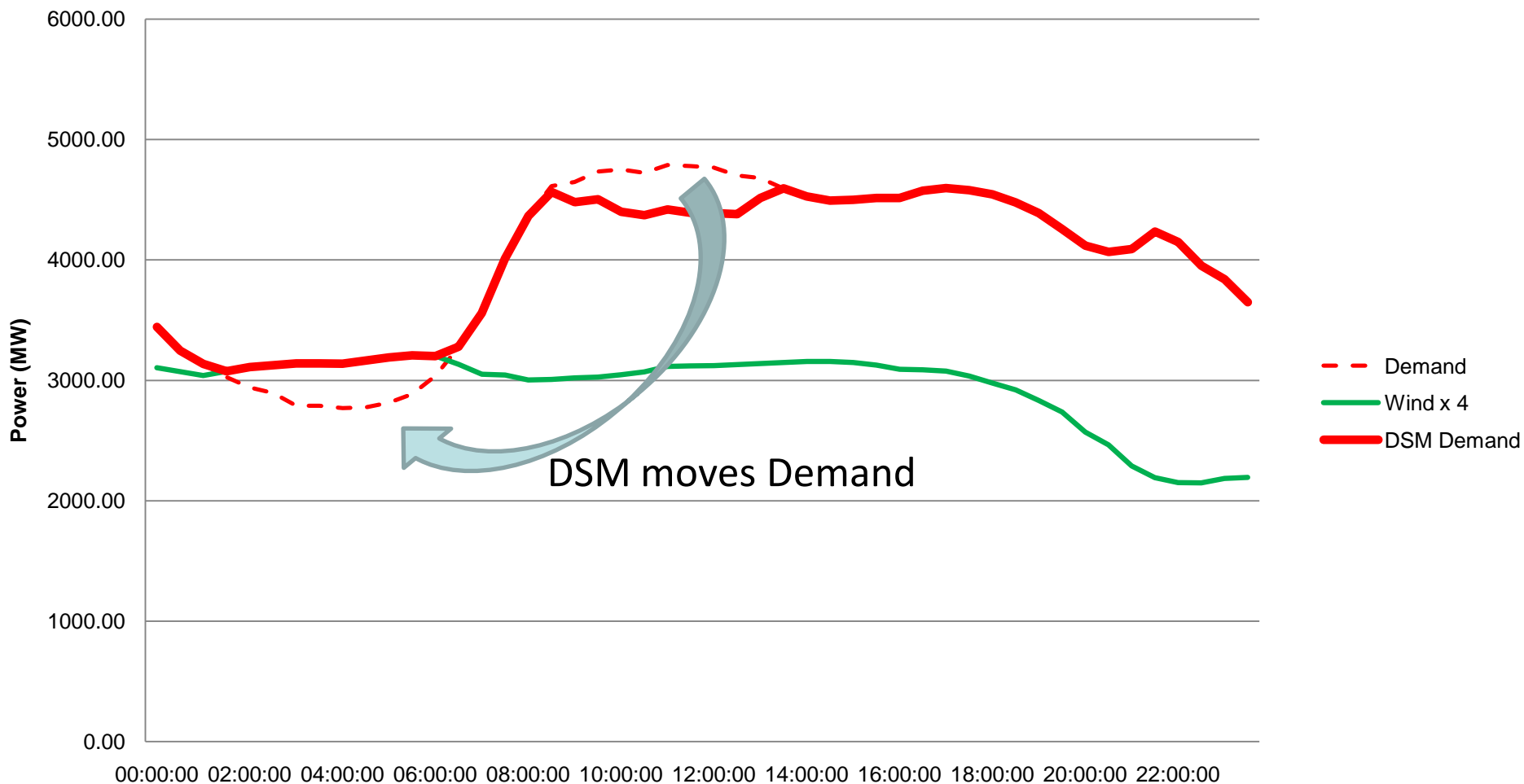
***“It is sound economic thinking to use excess wind power to produce heat when the alternative is to give away the power almost for free to our neighbouring countries.”***

**Danish Wind Energy Association**



# Role of DSM

## Supply vs Demand (DSM)



# Role of DSM

## Demand Side Management

### DEMAND RESPONSE Load Flexibility

- Allows users to self regulate
- Automatically incentivised to take part
- Enables dynamically flexible load

### ECONOMIC Price Responsive



### ENERGY EFFICIENCY Load Reduction



### EMERGENCY Load Responsive



• Yielded positive results in other countries

• AIGS Update July '09

• Indicated annual savings of €321M





National Smart Meter Plan

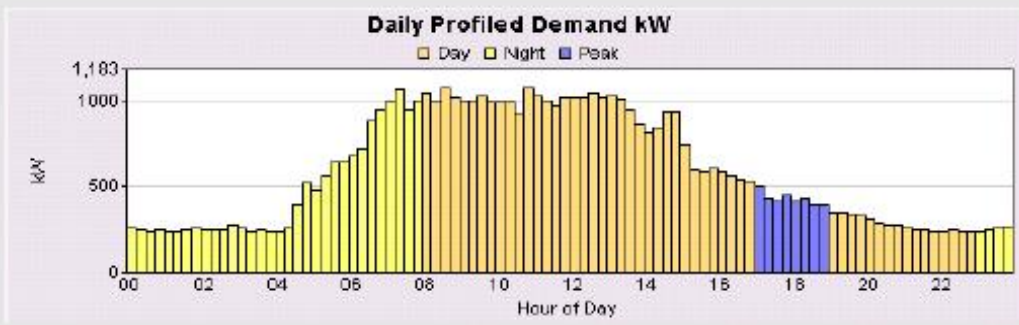
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- Account Overview
- View Bill
- View Statement
- Cost & Consumption

Select View:  Daily  Weekly  Monthly

- Display
- Export
- Print



Day	Night	Peak	Day (kWh)	Night (kWh)	Peak (kWh)	Day (€)	Night (€)	Peak (€)
01 January 2009	10	50	5	30	2.5	20	2.5	

Cost & Consumption Summary – Detailed table

Time	Total Energy Consumption (kWh)	Total Energy Amount (€)
01:00	5	10
02:00	5	10
03:00	5	10
04:00	5	10
05:00	5	10
06:00	0	0
07:00	0	0
08:00	20	20
09:00	20	20
10:00	20	20
11:00	0	0
12:00	0	0
13:00	0	0
14:00	0	0
15:00	0	0
16:00	0	0
17:00	60	100
18:00	60	100
19:00	60	100
20:00	60	100

# Real Time Pricing Tariff

- **Sets dynamic prices per half hour interval throughout the day**
  - **E.g. Pool Price Pass Through Tariff available to industry**
- **Encourage customers to shift demand towards times of high wind availability and high grid efficiency**
- **Would work well for customers willing to actively manage their consumption**
- **Some level of automation required for integration to have minimal impact on user lifestyle – critical for public acceptance**



# 3. On-Campus Case Study

## Dromroe Student Village



# On-Campus Case Study: Dromroe

## •Circuits Monitored:

•Main Incomer	
•Storage Heaters	0%
•Immersion (Water Heating)	23%
•Panel Heaters	27%
•Lights	13%
•Sockets	30%
•Cooker	5%
•Bathroom Heaters	2%

•Immersion is a large power user

•Easily Controllable

•Offers storage in the form of hot water



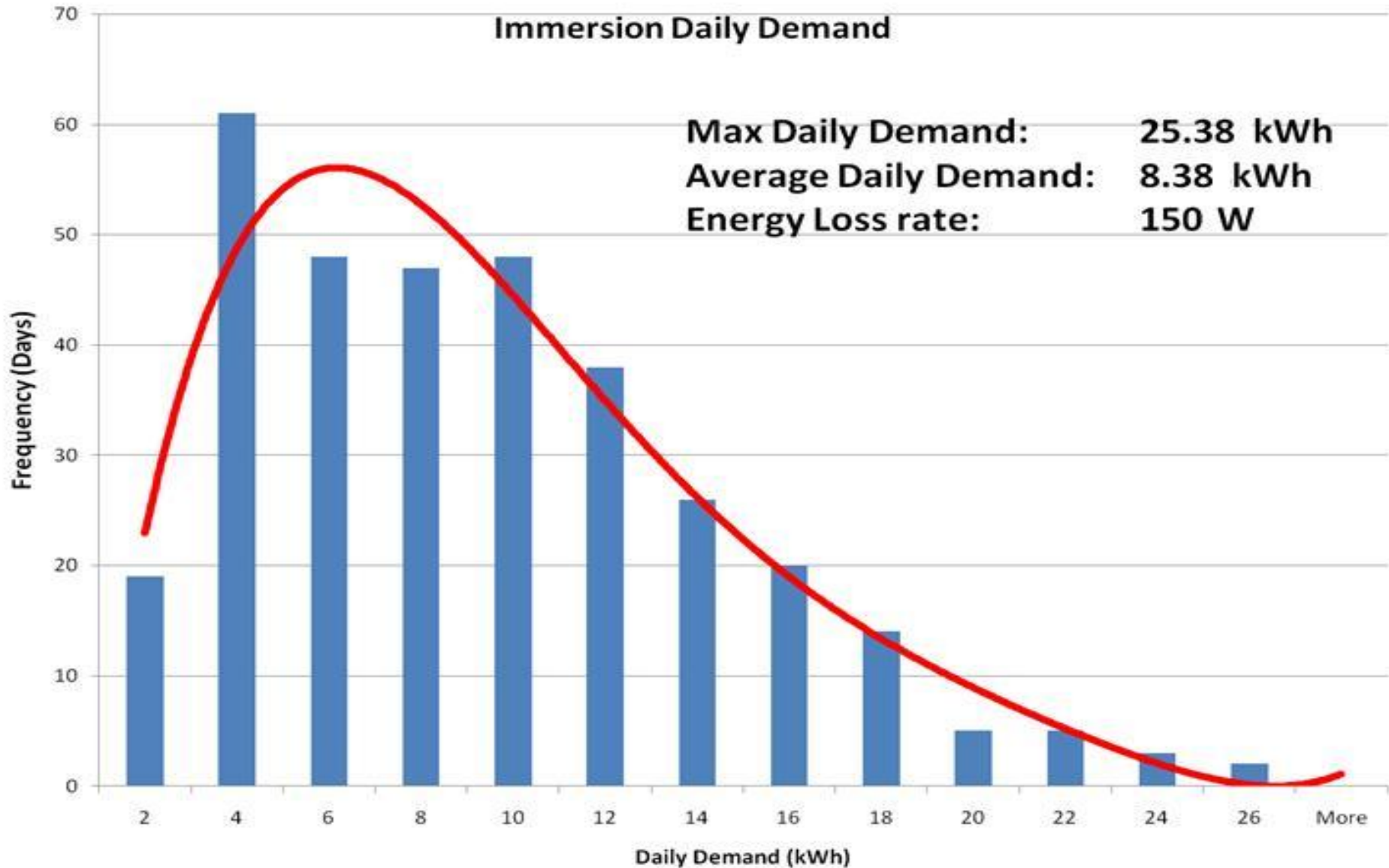
# Time Dependent



# Time Independent

- Demand Side  
Manageable

# On-Campus Case Study: Dromroe



# On-Campus Case Study: Dromroe

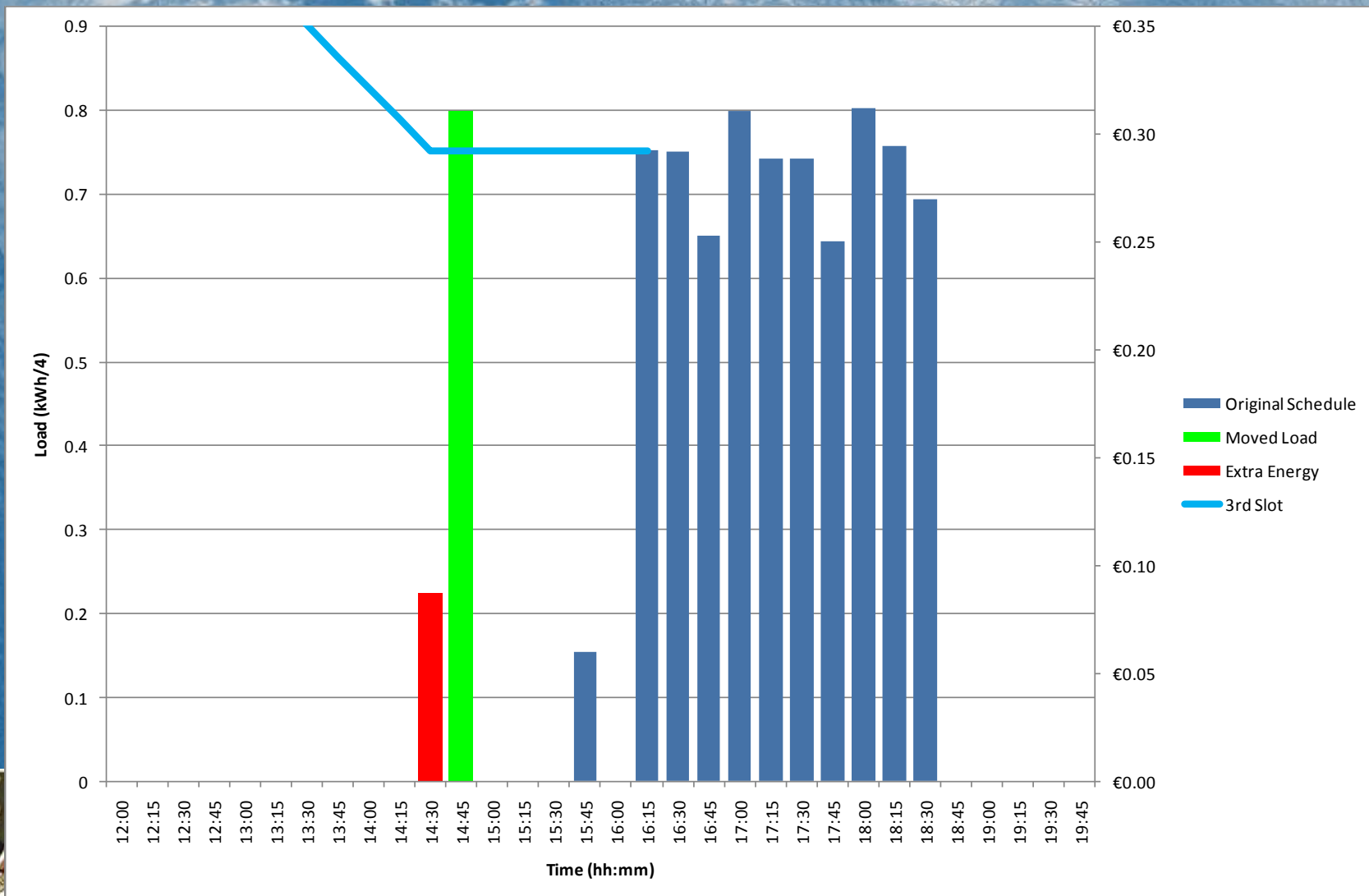
## •Price Optimised Water Heating Algorithm:

- Used to test the hypothesis that the current wholesale electricity pricing structure could be used to promote use of RES-E
- Aims to reallocate water heating to cheaper times while accounting for energy losses incurred by doing so.
- Run using one year of data (2008)
- Simulates energy loss rates from 25 W to 300 W in 25 W increments



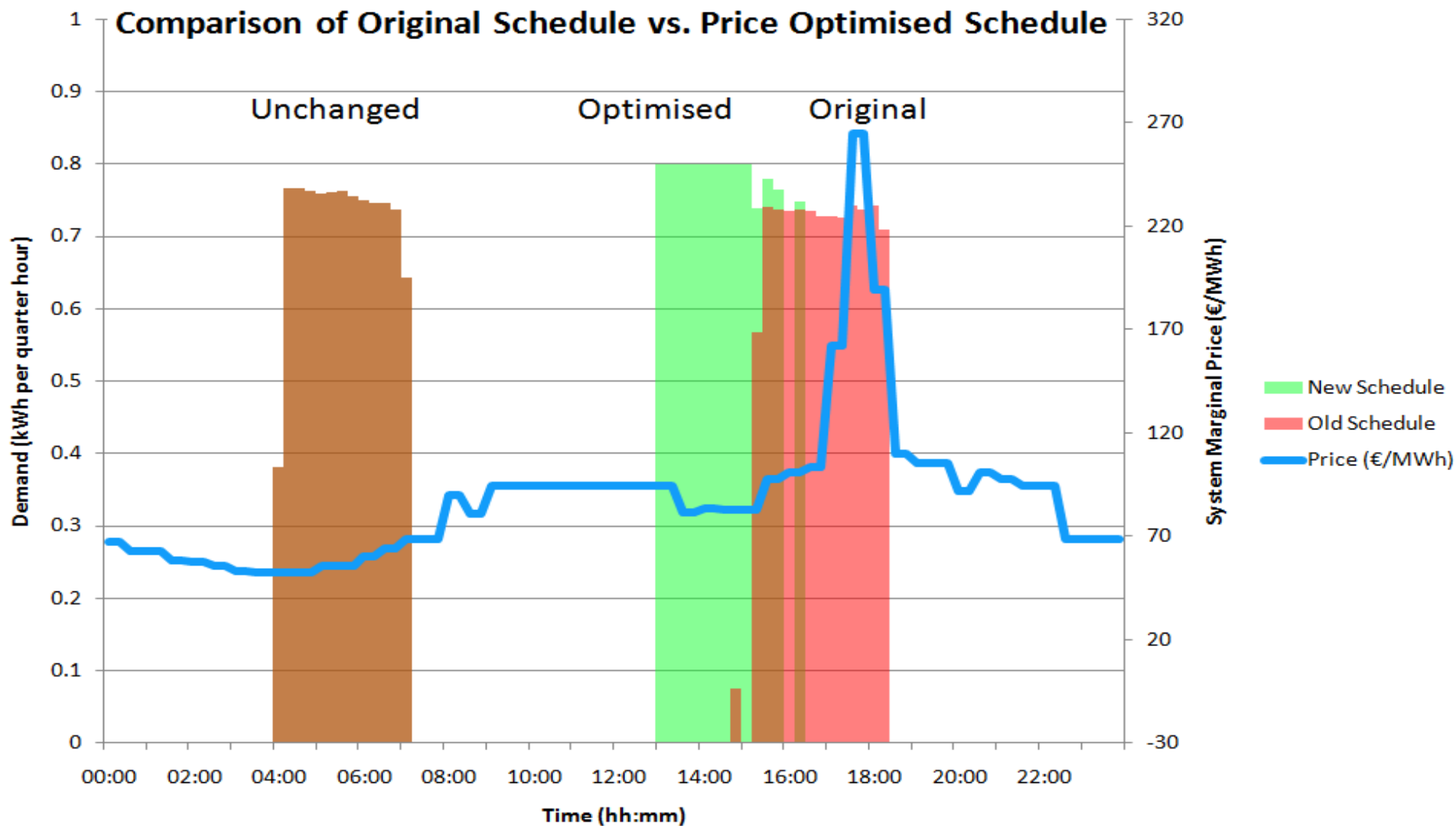
# On-Campus Case Study: Dromroe

## •Price Optimised Water Heating Algorithm:



# On-Campus Case Study: Dromroe

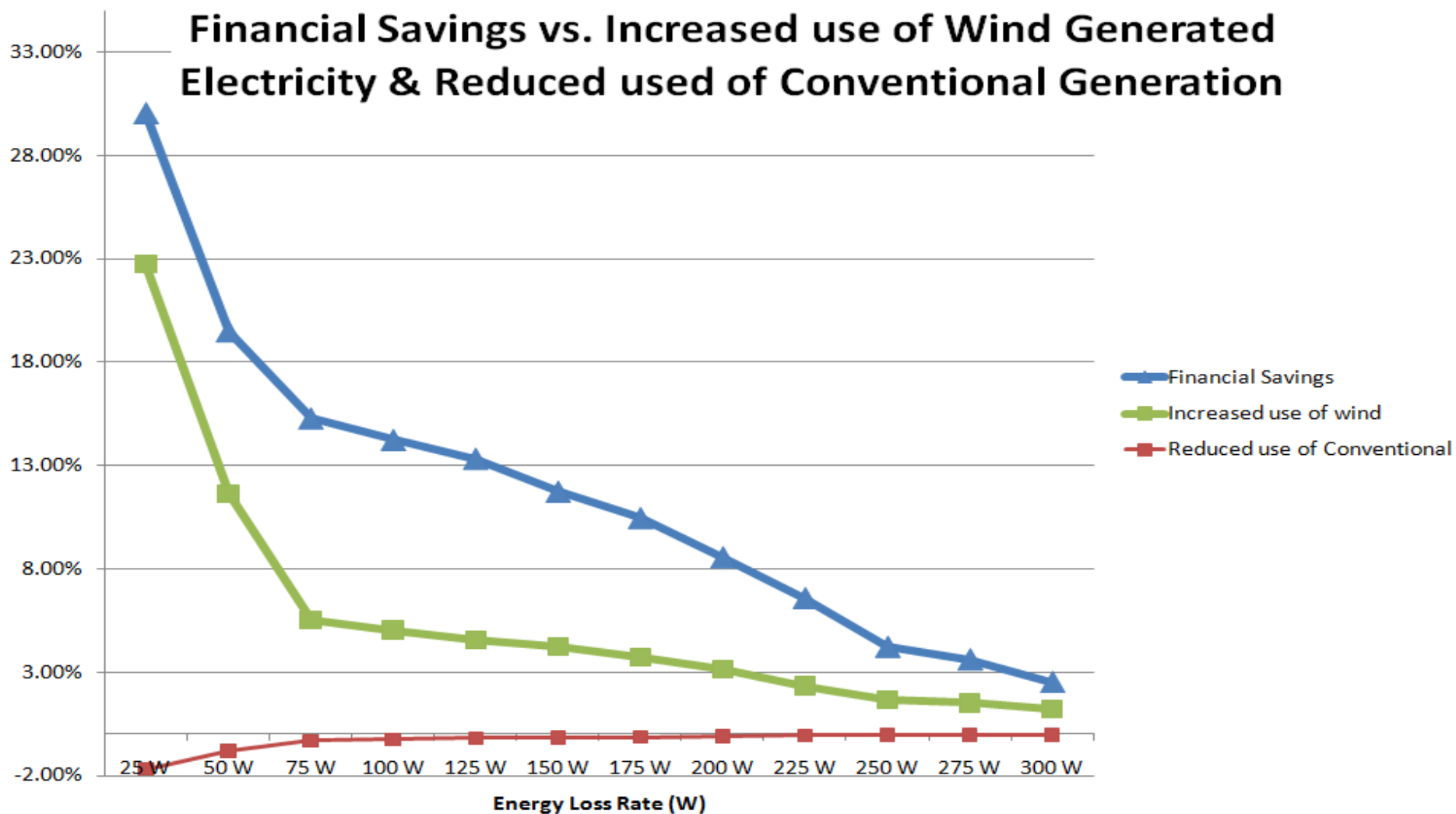
## •Price Optimised Water Heating Algorithm:



# On-Campus Case Study: Dromroe

## •Price Optimised Water Heating Algorithm:

**Financial Savings vs. Increased use of Wind Generated Electricity & Reduced used of Conventional Generation**

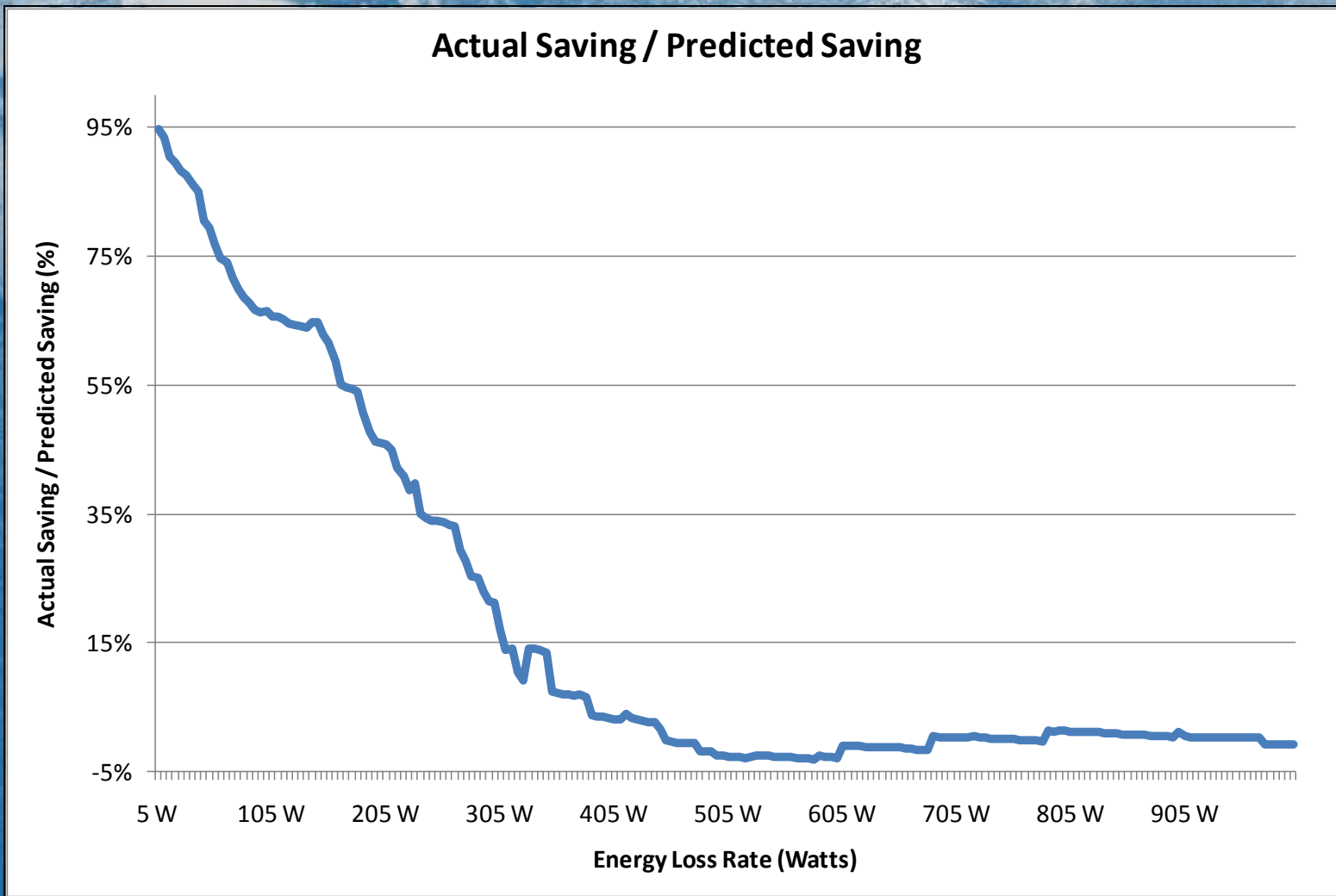


# 4. Price Accuracy Analysis



# Price Accuracy Analysis

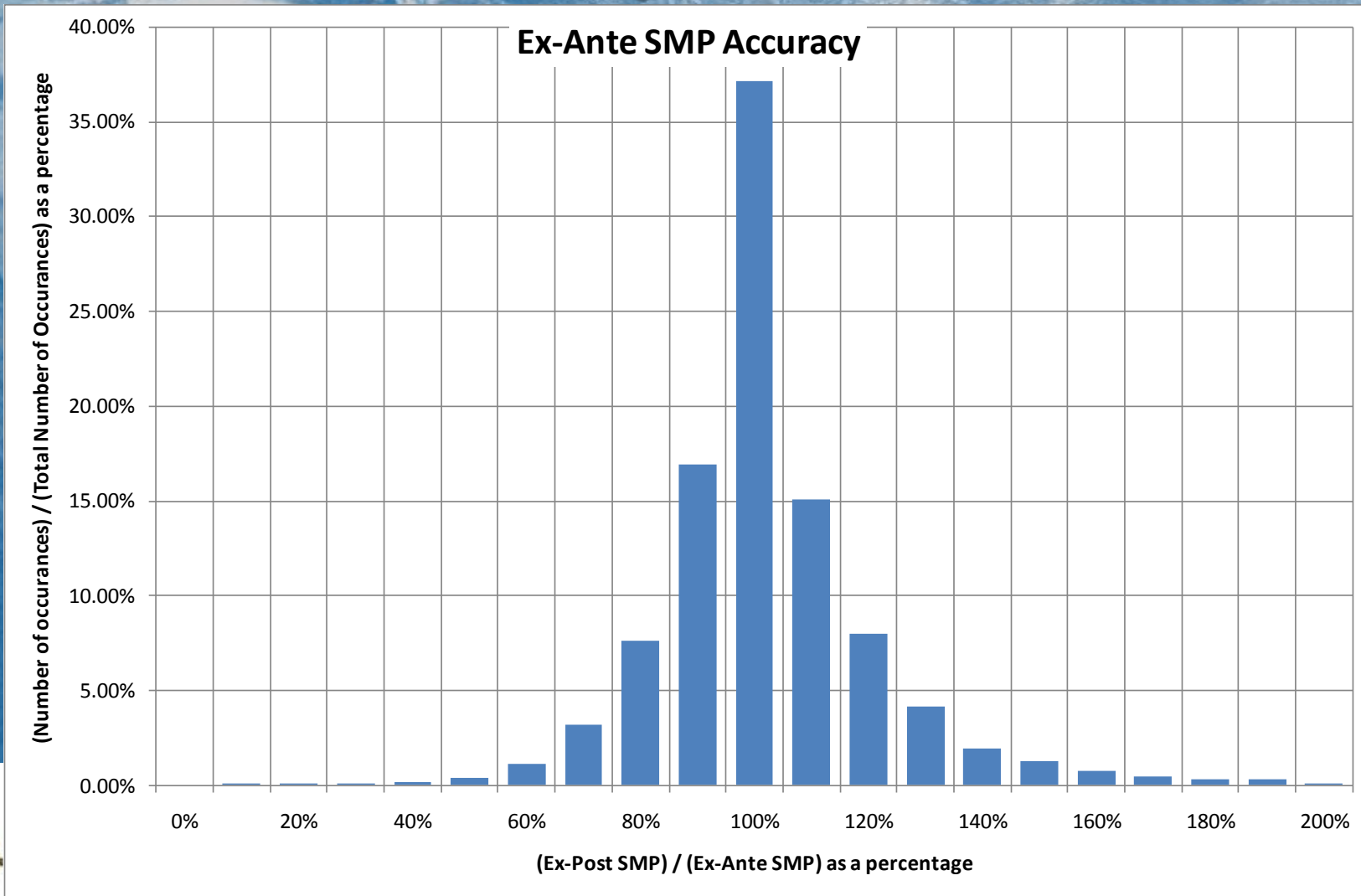
## •SEM Prediction Accuracy





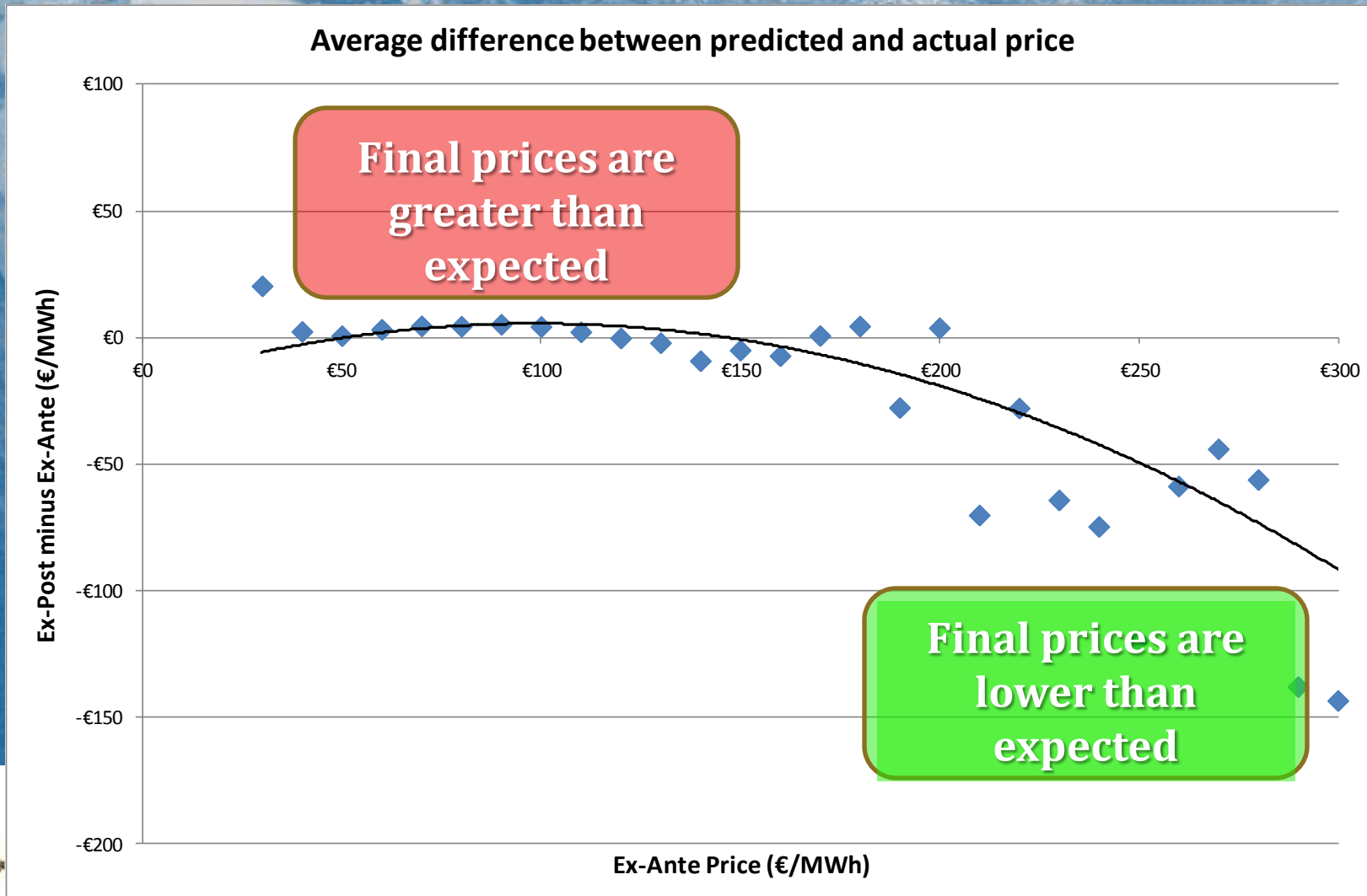
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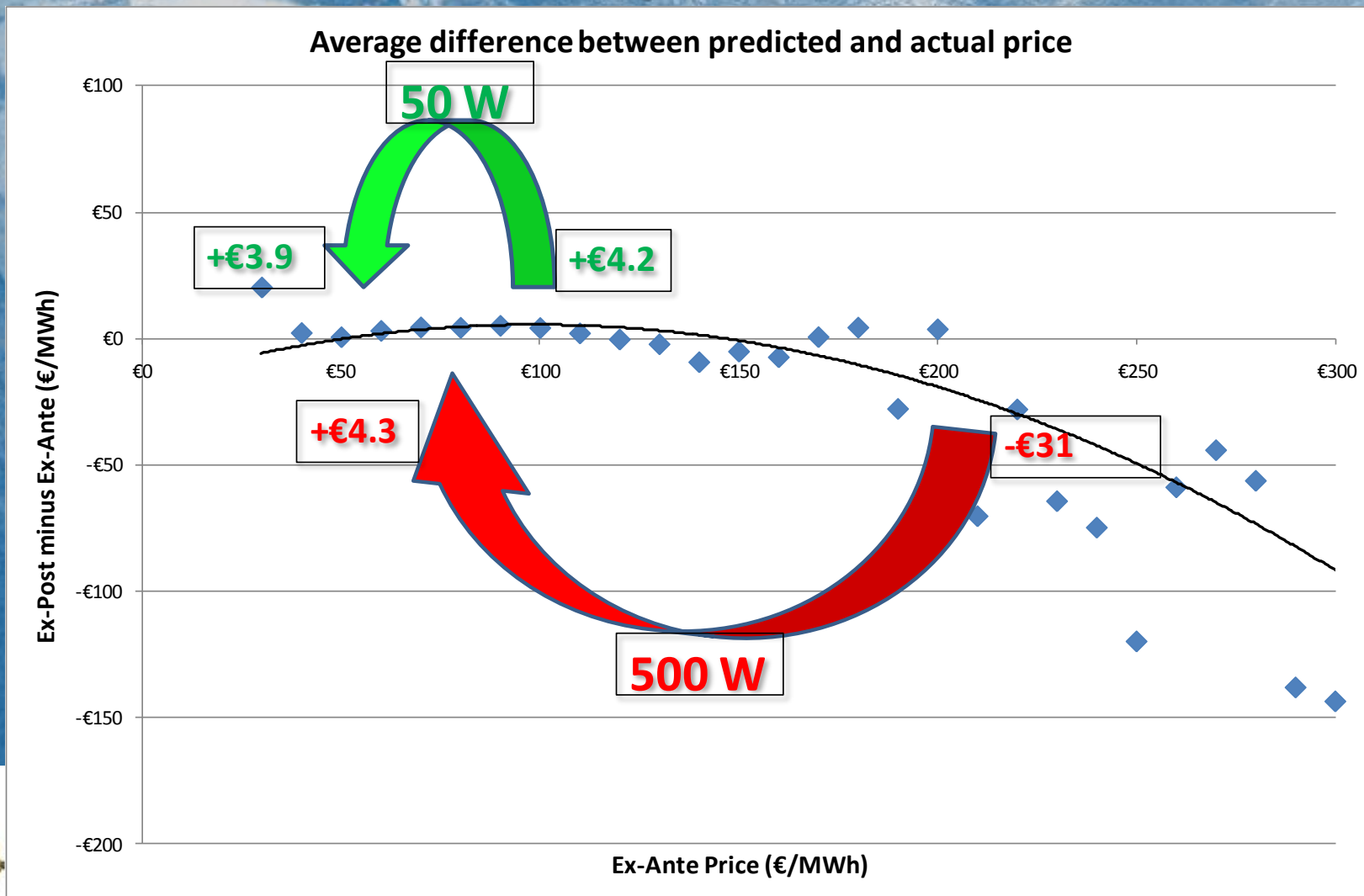
# Price Accuracy Analysis

## •SEM Prediction Accuracy



# Price Accuracy Analysis

## •SEM Prediction Accuracy



# 3. Off-Campus Case Studies

- Electric Car

- Geothermal Heating System



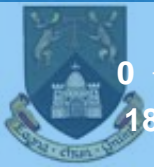
# Off-Campus Case Studies

## • Off-Campus Case Study – Electric Car Analysis

Electric Car Charging - 28th to 30th April 2010  
 Average Demand of 8.6 kWh per day



— Electric Car (kWh)



# Off-Campus Case Studies

## • Off-Campus Case Study – Geothermal Heating System

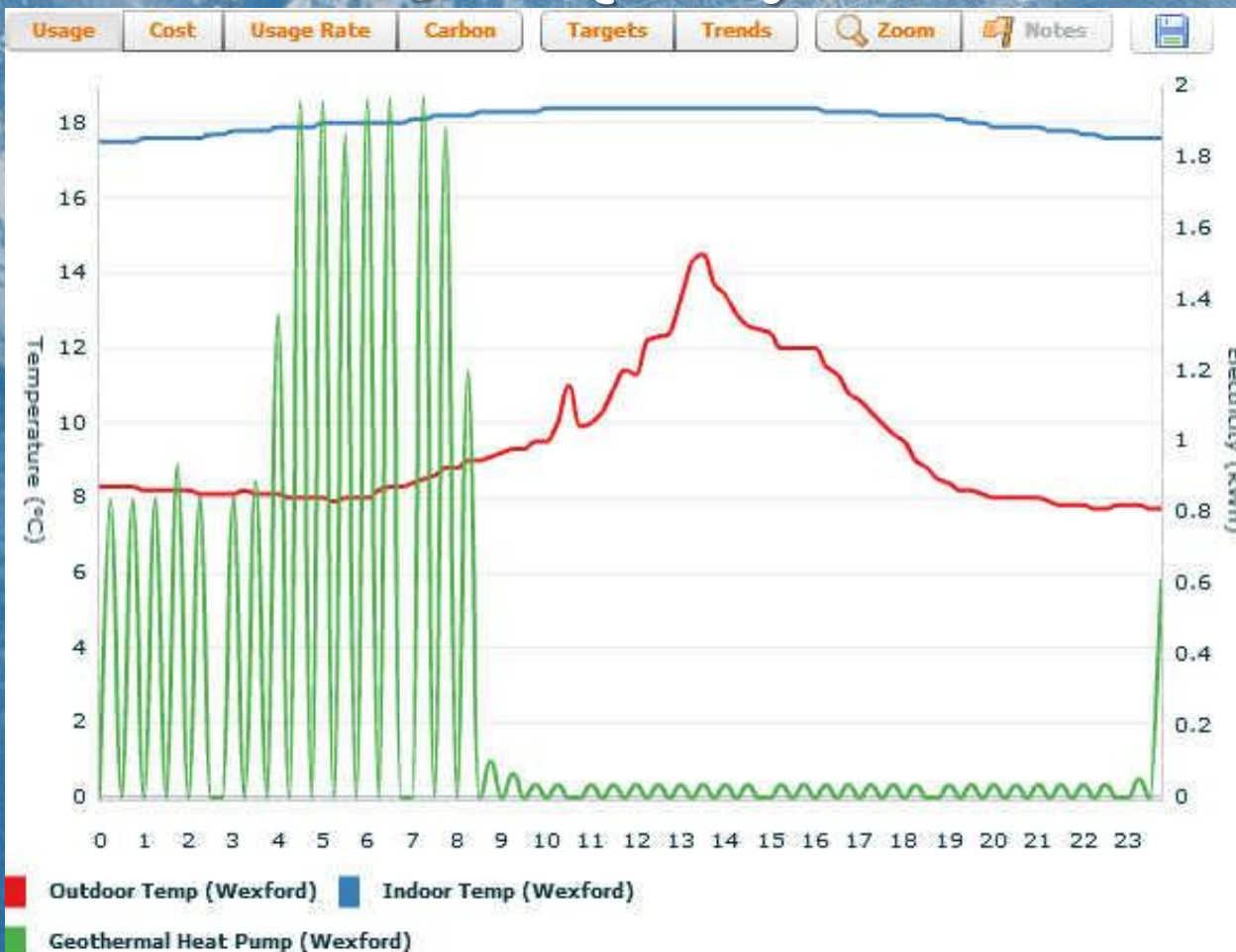
- Telemetry system installed in a house in Co. Wexford to monitor Geothermal heat pump & under floor heating system

- This monitors & records electrical load, Indoor air temperature, and outdoor air temperature



# Off-Campus Case Studies

- **Off-Campus Case Study – Geothermal Heating System**
- **Average demand of 28.5 kWh per day**



# Off-Campus Case Studies

## • Off-Campus Case Studies

- **These will be used to expand the functionality of the optimisation algorithm being developed**
- **More diverse loads will help to develop a more flexible algorithm capable of exploiting DSM potential of a wide range of appliances**
- **The data from these analyses will be compiled to demonstrate and quantify the grid benefits of demand side managing these loads on a national level**

