# SEM PLEXOS Model Validation

# Information Seminar

# RAs' Market Modelling Group

*11:30am, 7th June 2012, CER Office*

# Agenda

- Background to PLEXOS Validation Project
- Andrew Ebrill

- Calibration of Backcast Model
- Kevin Hagan

- Validation of Forecast Model
- Fergus O'Toole

- Next Steps & DCs
- Andrew Ebrill

# Background

- PLEXOS is used by RAs to model SMP, DC quantities, prices & other SEM outcomes

- PLEXOS is regularly updated by its owner, Energy Exemplar

- In order to be robust for modelling to end 2013 and beyond, esp. for DCs, the RAs have:
  - Calibrated a backcast PLEXOS model to ensure that the model configuration chosen is the best replication of SEM outcomes
  - Validated the PLEXOS model for new input data, using the calibrated model, including latest demand, generator technical data and outage patterns

# Background

- PLEXOS validation carried out by the MMG, audited by the MMU
- Main uses of a validated PLEXOS model are:
    - DC quantities and prices
    - Setting the reserve price for the PSO-related CfDs
    - Forecasting the SMP
    - Modelling to inform RA policy on the SEM
- New quarterly rolling approach being applied to DCs, as decided in SEM-12-026 following consultation with industry

# PLEXOS Backcast

- Overview / Changes
- Data
- Results – Moyle Fixed
- Moyle
- Results – Moyle Free
- SMP Results Summary
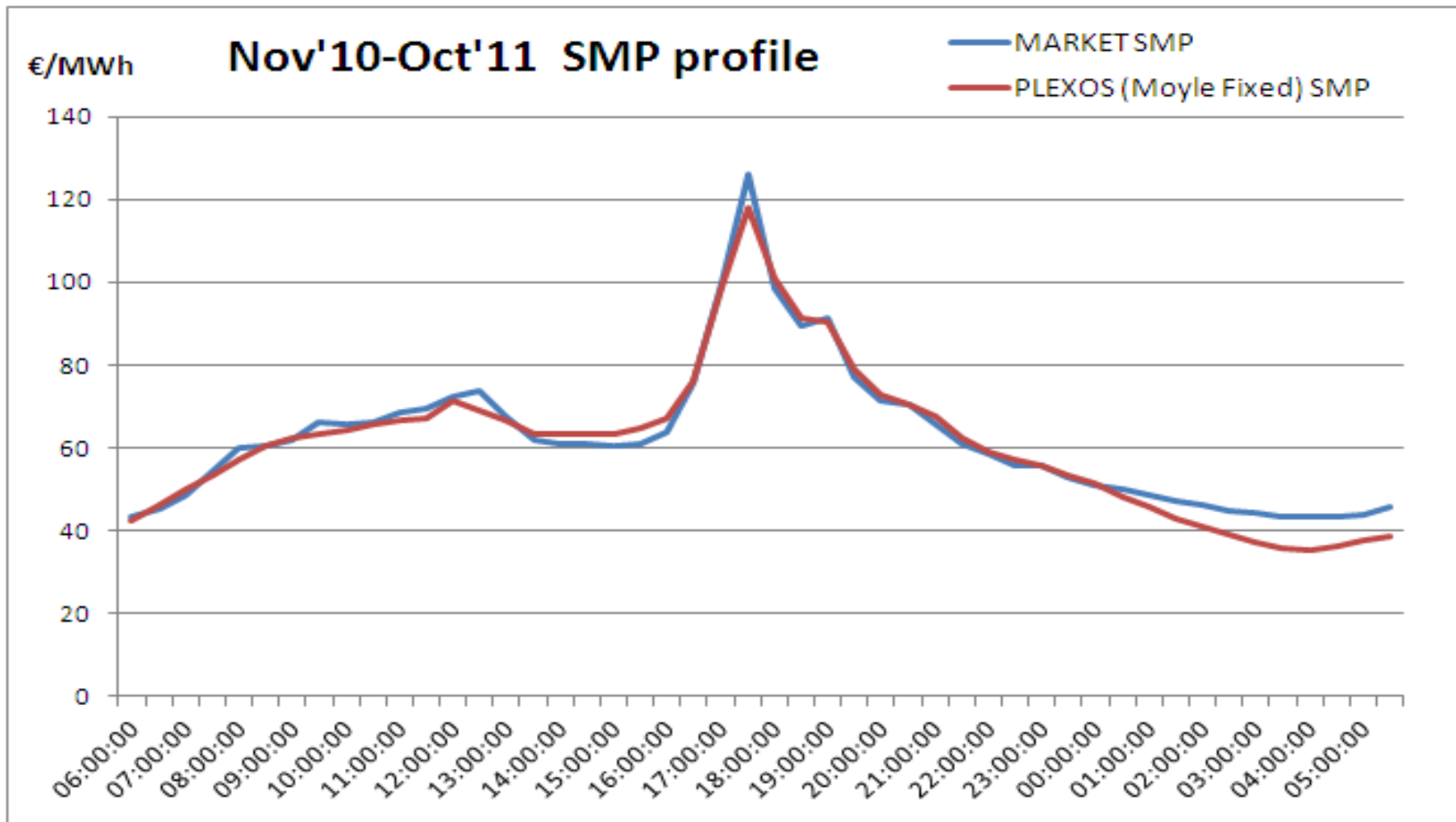- Recommended Settings

# Overview / Changes

- Backcast period
    - 12 months
    - November 2010 to October 2011

- PLEXOS 6 – Version 6.205R07
    - XML based
    - Relatively small solution files

- "3 State" starts

- Rounded Relaxation "Self Tune"
    - Tests for different values of the "Rounding Up Threshold" before each day
    - Finds the Threshold value that returns the best objective function value
    - Start Threshold, End Threshold, Threshold Increment
    - Longer run times but better results

# Data

- Half-Hourly
  - Load
  - Availability
  - Minimum Stable Level
- Daily
  - Price-Quantity Pairs
    - New Quantity format for handling bands
  - No-Load Cost
  - Start Costs (Hot/Warm/Cold)
  - Start Times
    - Incremental for PLEXOS
- Technical Offer Data
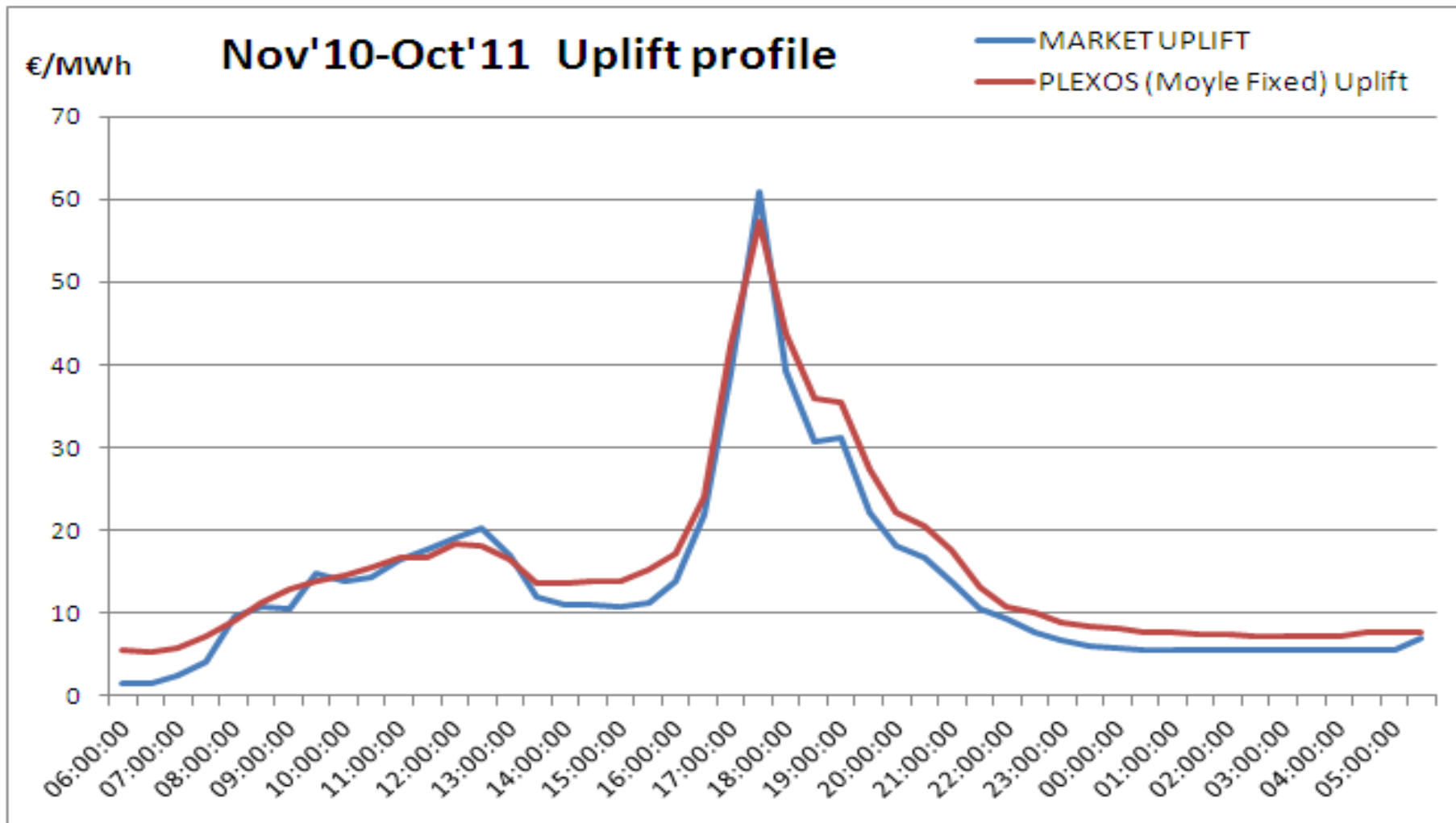  - Ramp Up/Down Rates
  - Minimum On/Off Times

# Data (2)

- Hydro Daily Energy
  - Exactly as given to the Market Software
  - Hydro Energy Limits and Metered Generation
- Turlough Hill
  - On outage for entire period of Backcast this year
- Hours Up/Down
  - Backcast can be started on any day with the same starting conditions as the Market
- Units Under Test
  - Fixed Load
- Hydro Unit Commitment
  - Minimum On/Off Times – included
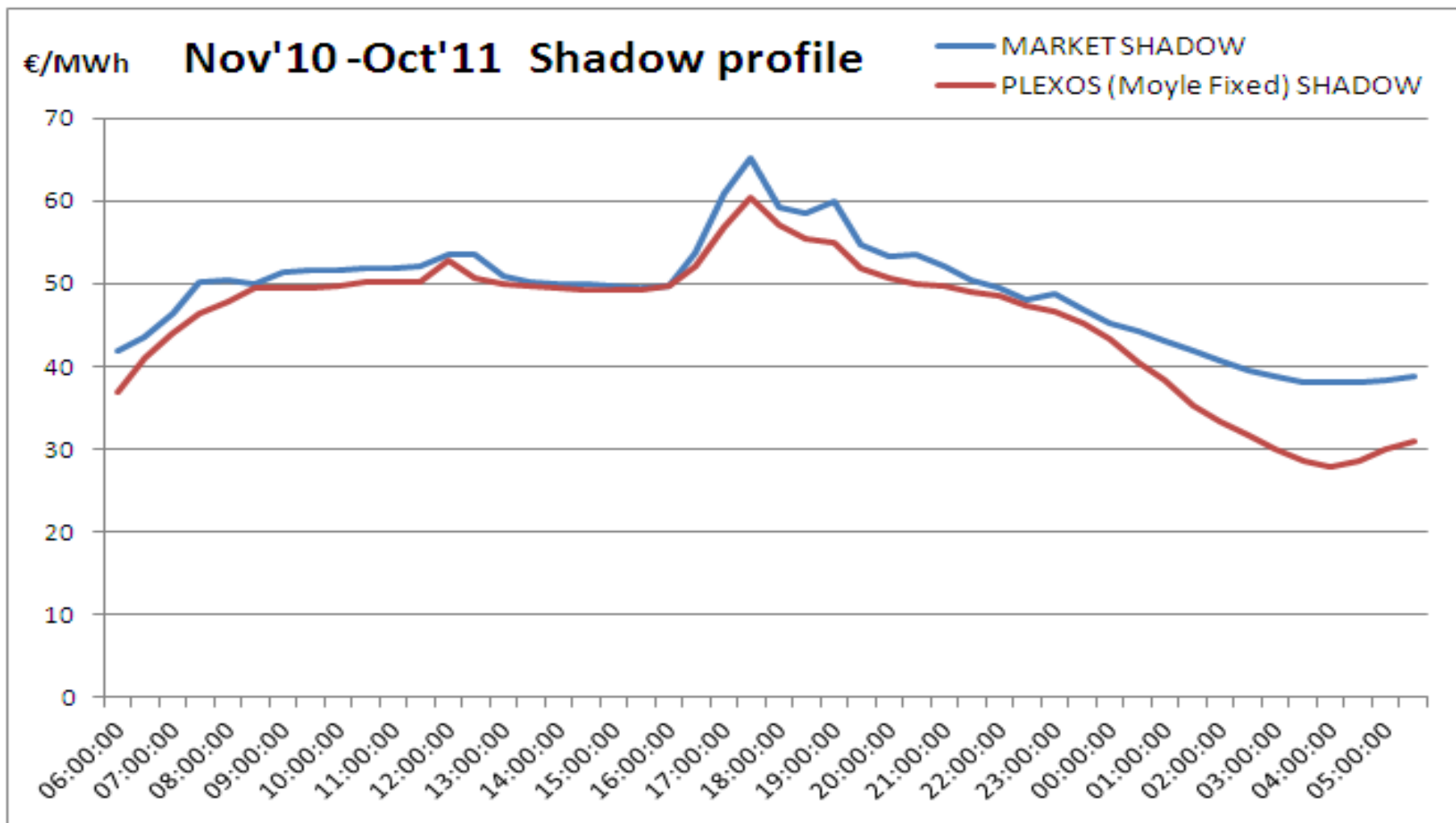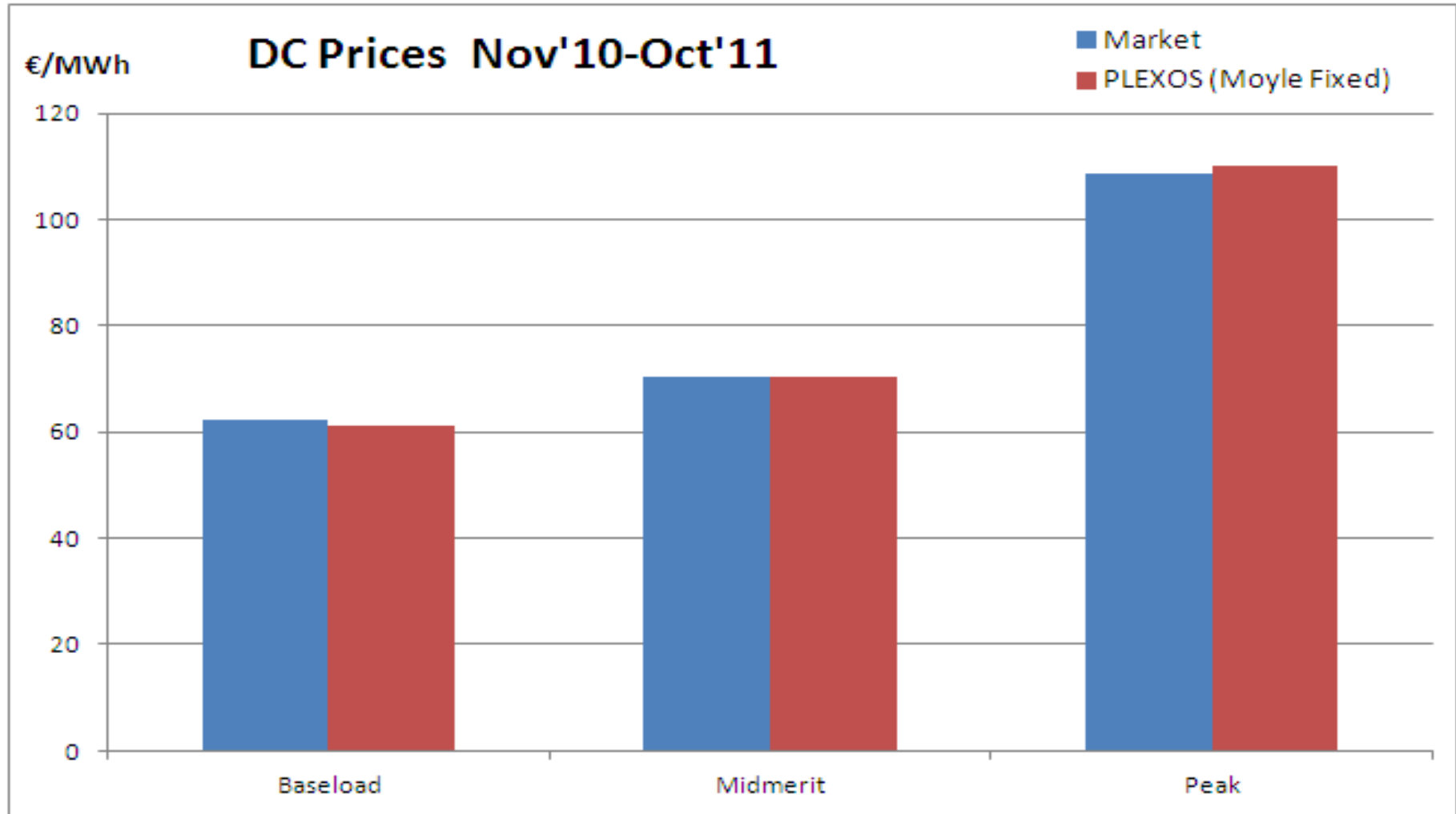  - Ramp Rates – not included
  - Start Costs – not included
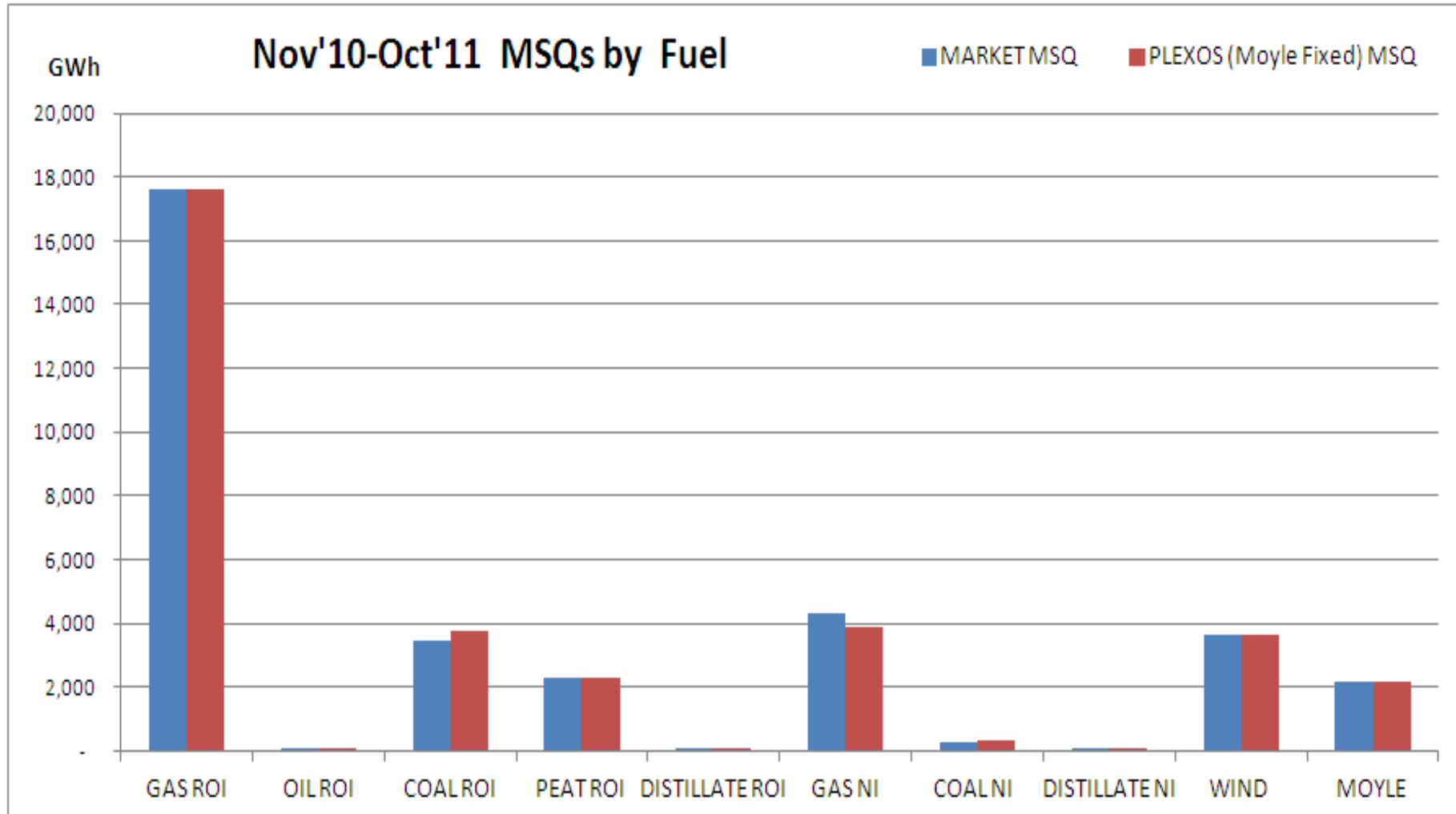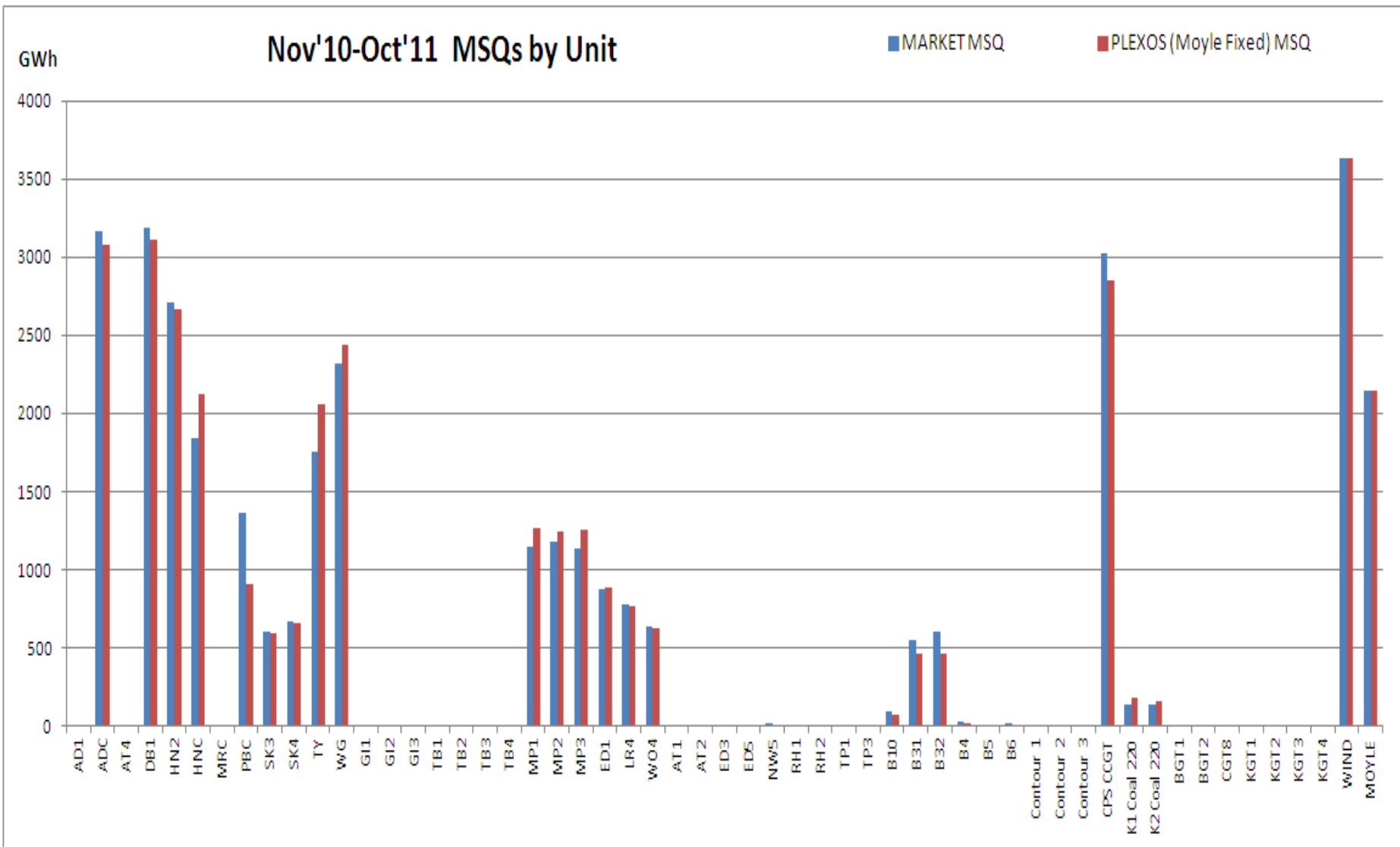
# Moyle Fixed

# Moyle Fixed



Nov'10-Oct'11 Uplift profile

# Moyle Fixed



Nov'10 -Oct'11 Shadow profile

# Moyle Fixed

# Moyle Fixed

Moyle Fixed

# Moyle Fixed



Nov'10-Oct'11 Hydro profile
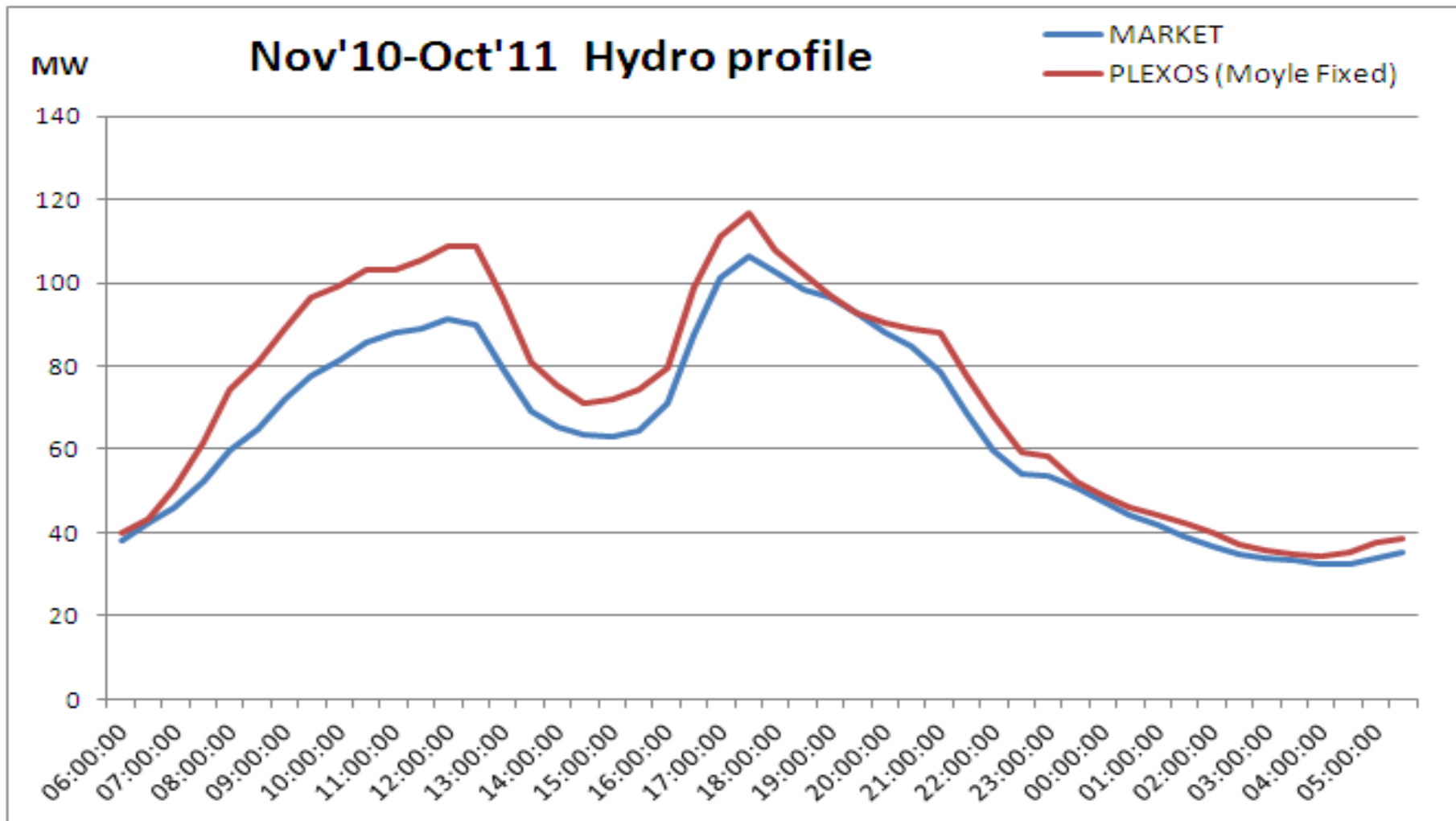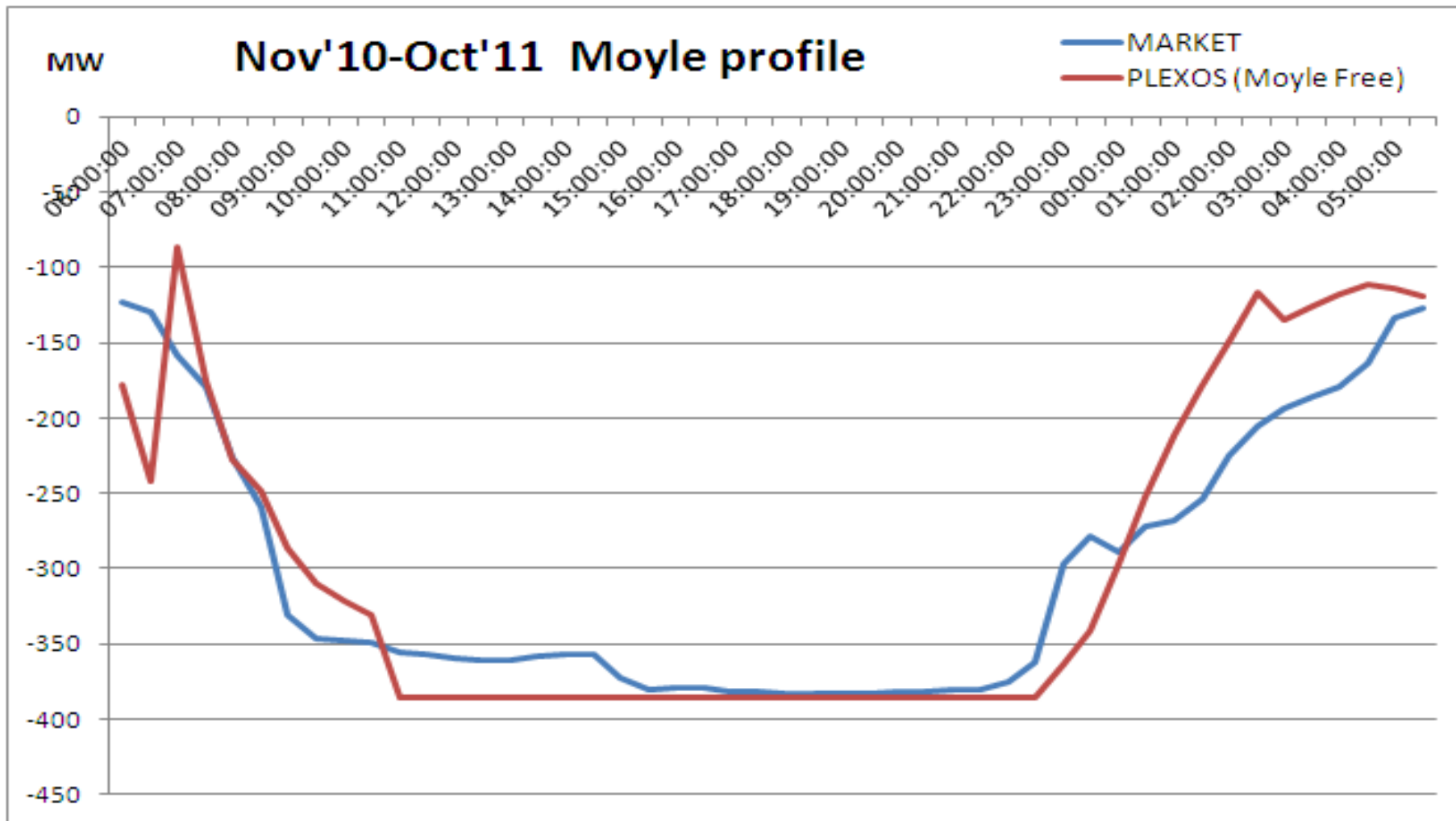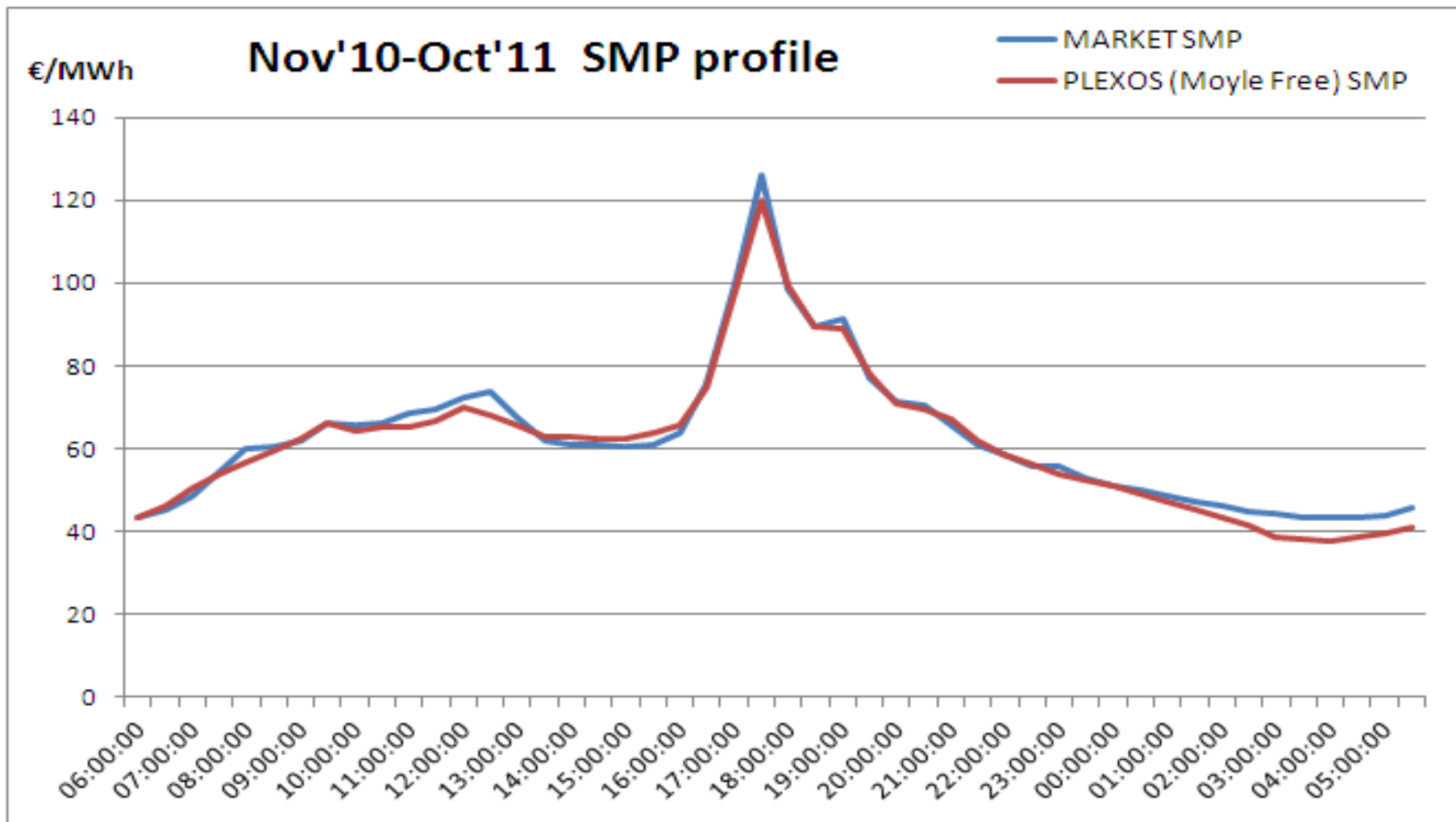
# Moyle

- GB Prices
  - Same methodology as last year
  - Single GB generator
  - Regression of GB price series against daily gas and carbon prices (November 2010 – October 2011)
  - GB prices defined over 4-hour EFA blocks for both summer and winter
  - Regression with zero intercept
  - GB Generator Heat Rates represent regression coefficients
- Applying Wheeling Charges directly to the GB price as V&OMs
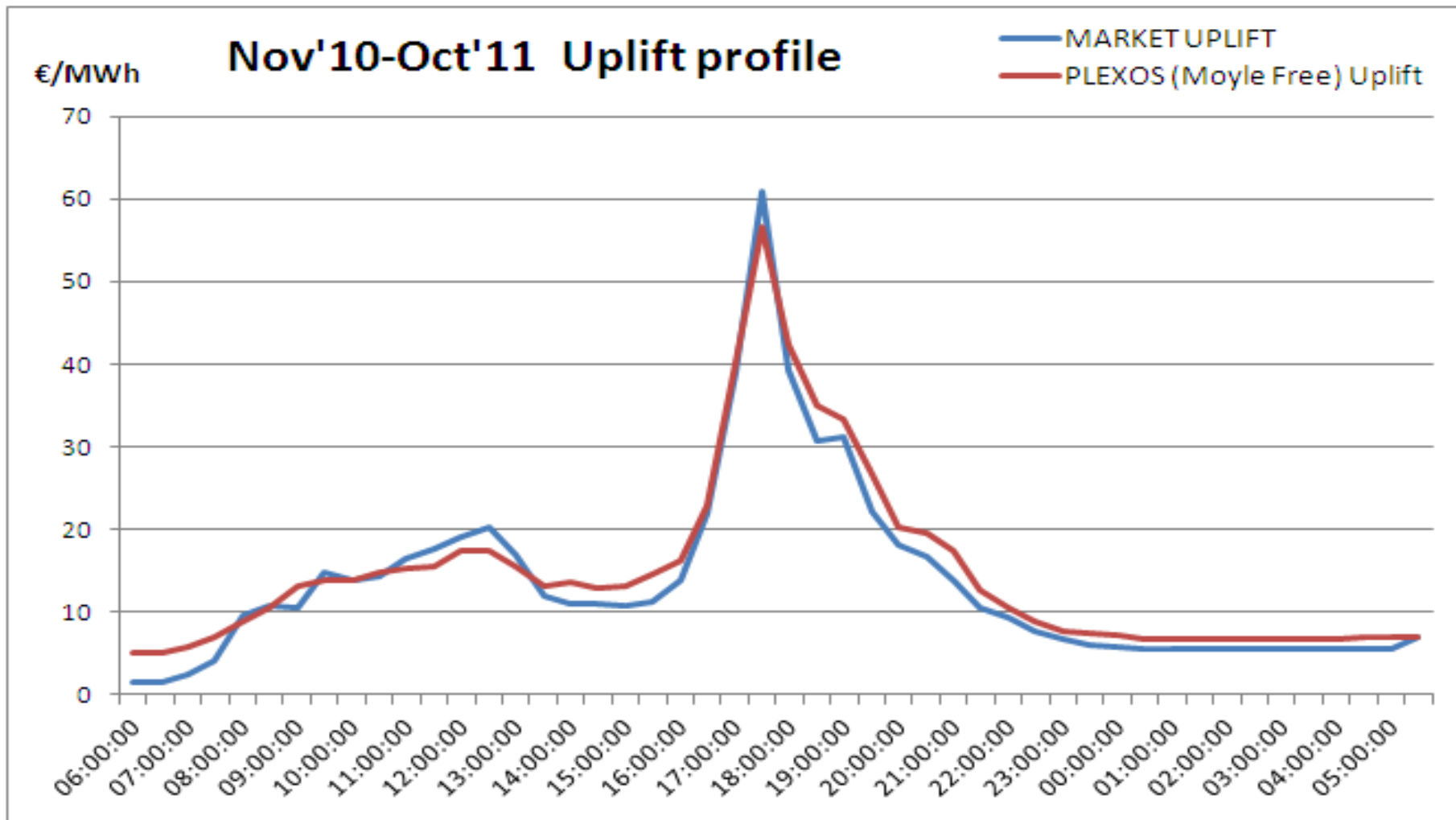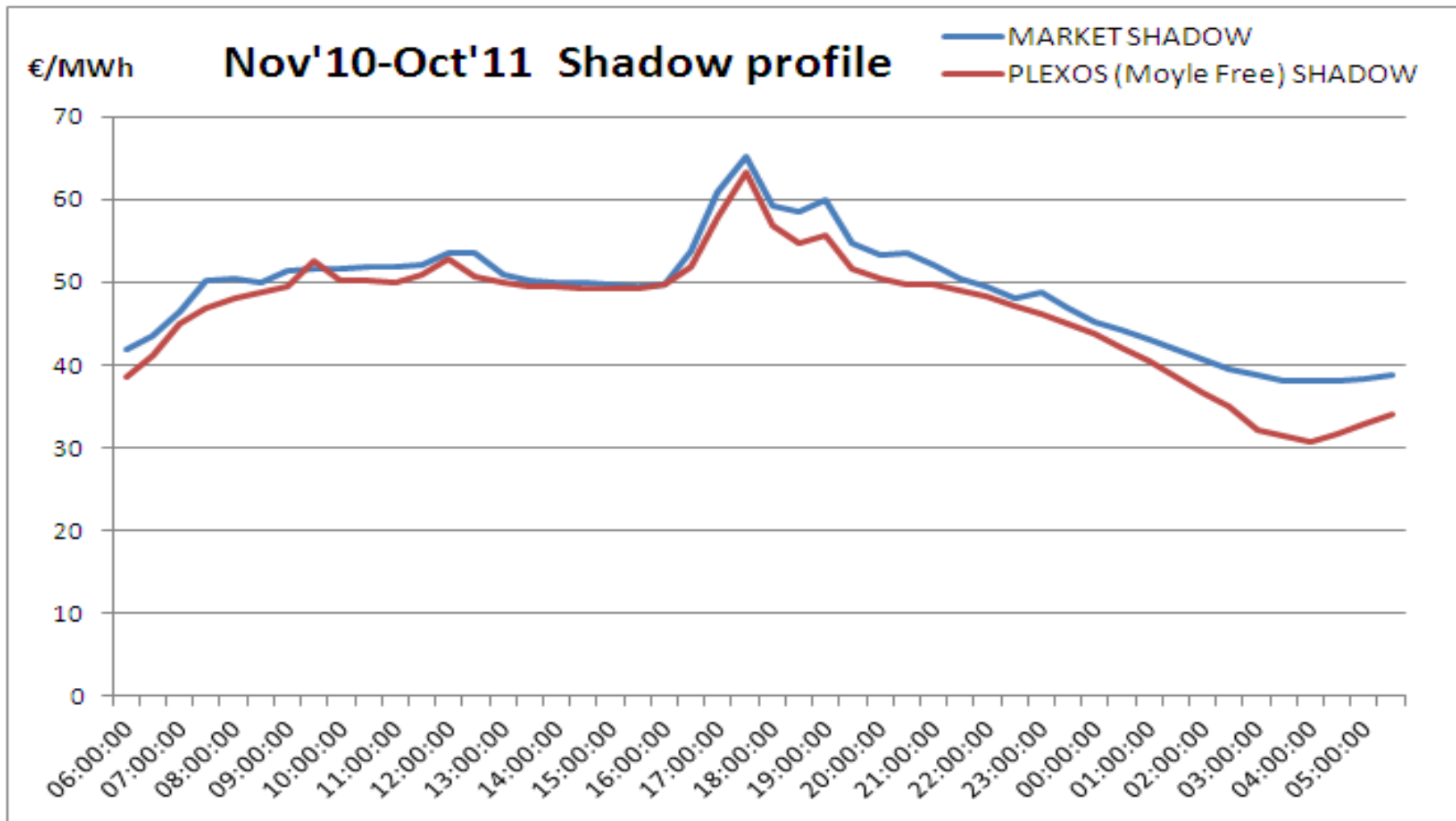  - Based on analysis of Average Interconnector Bids vs GB Prices
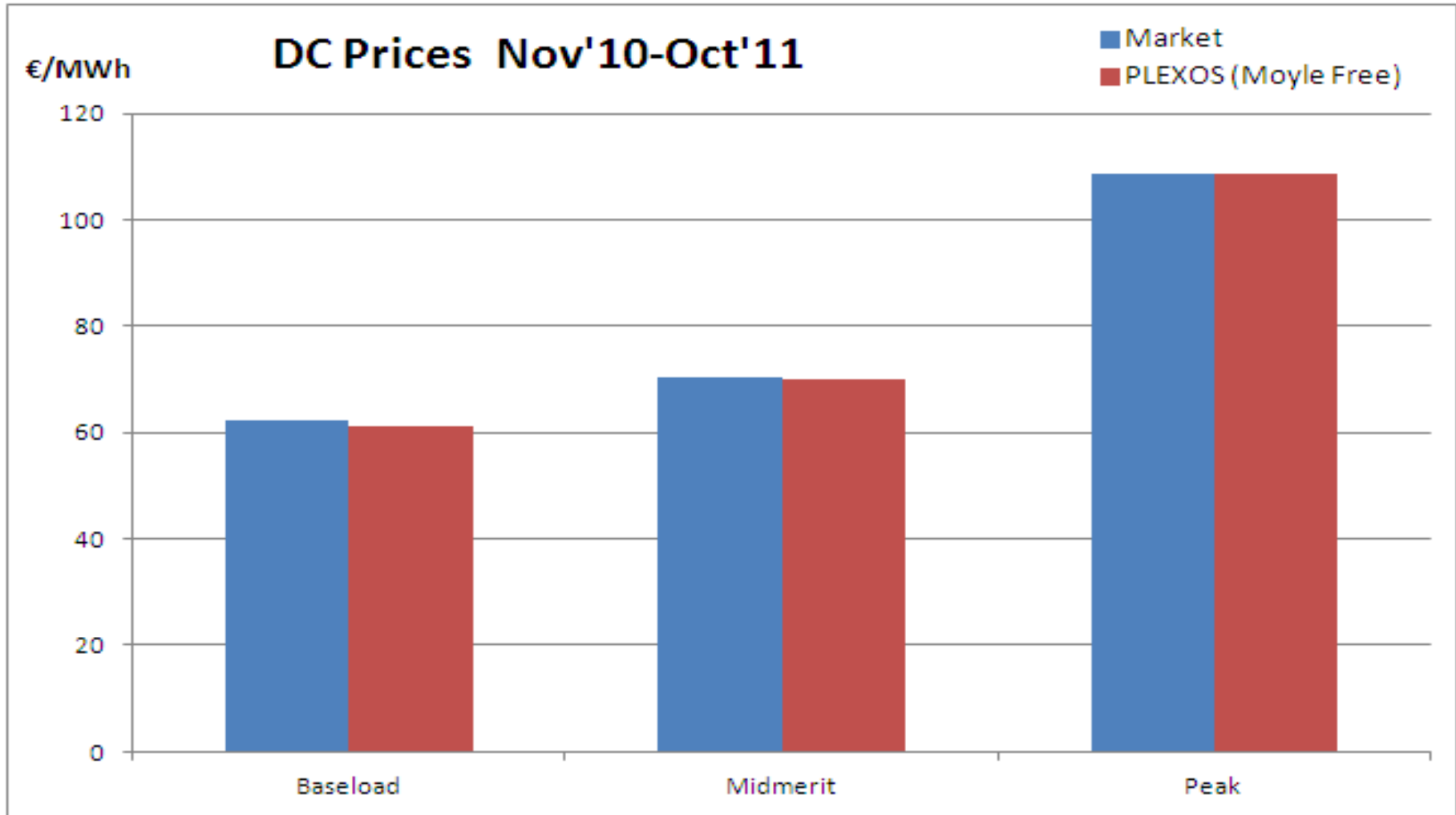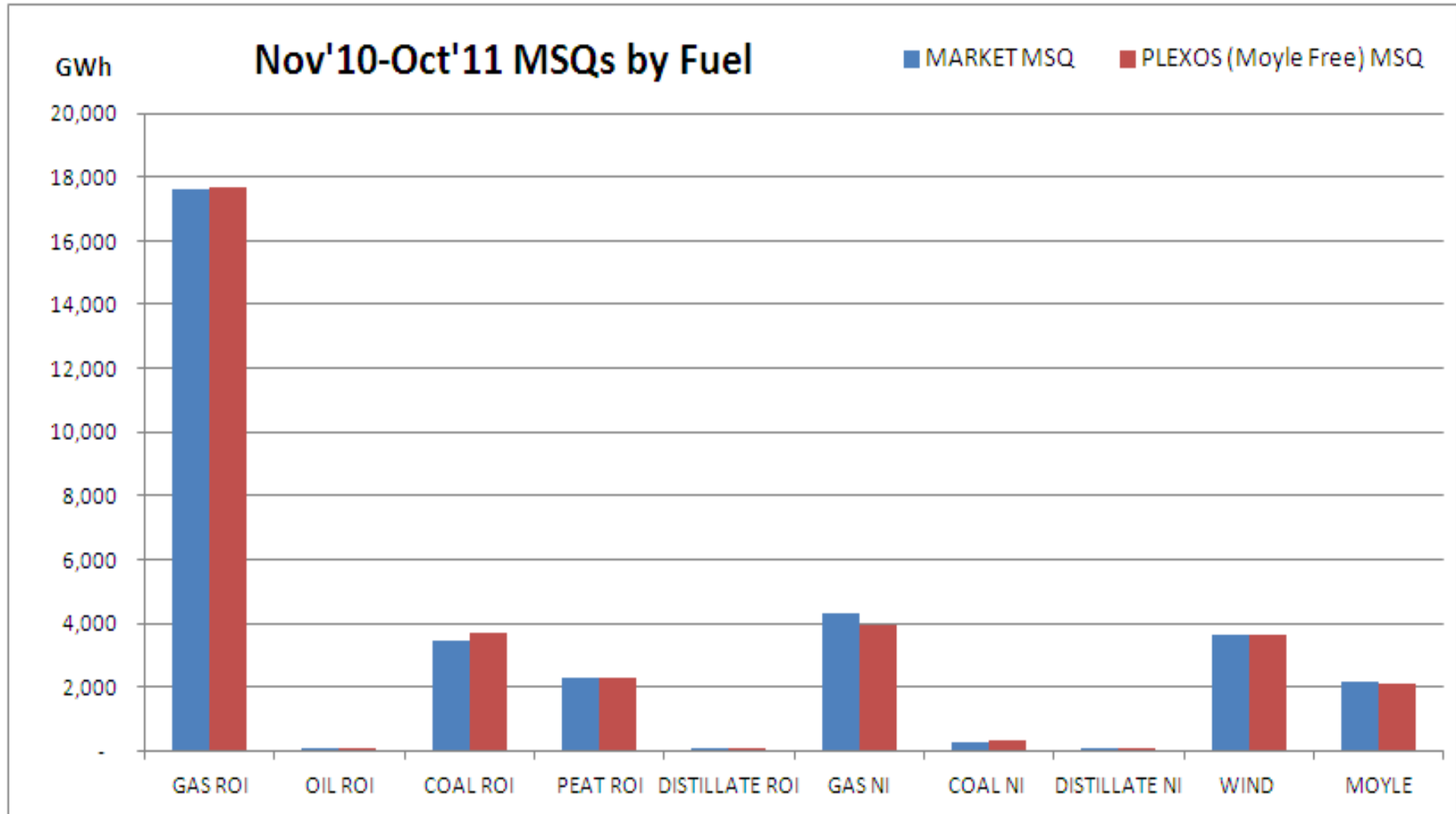
# Moyle (2)

# Moyle Free

# Moyle Free



Nov'10-Oct'11 Uplift profile

# Moyle Free



Nov'10-Oct'11 Shadow profile

# Moyle Free

# Moyle Free

Moyle Free

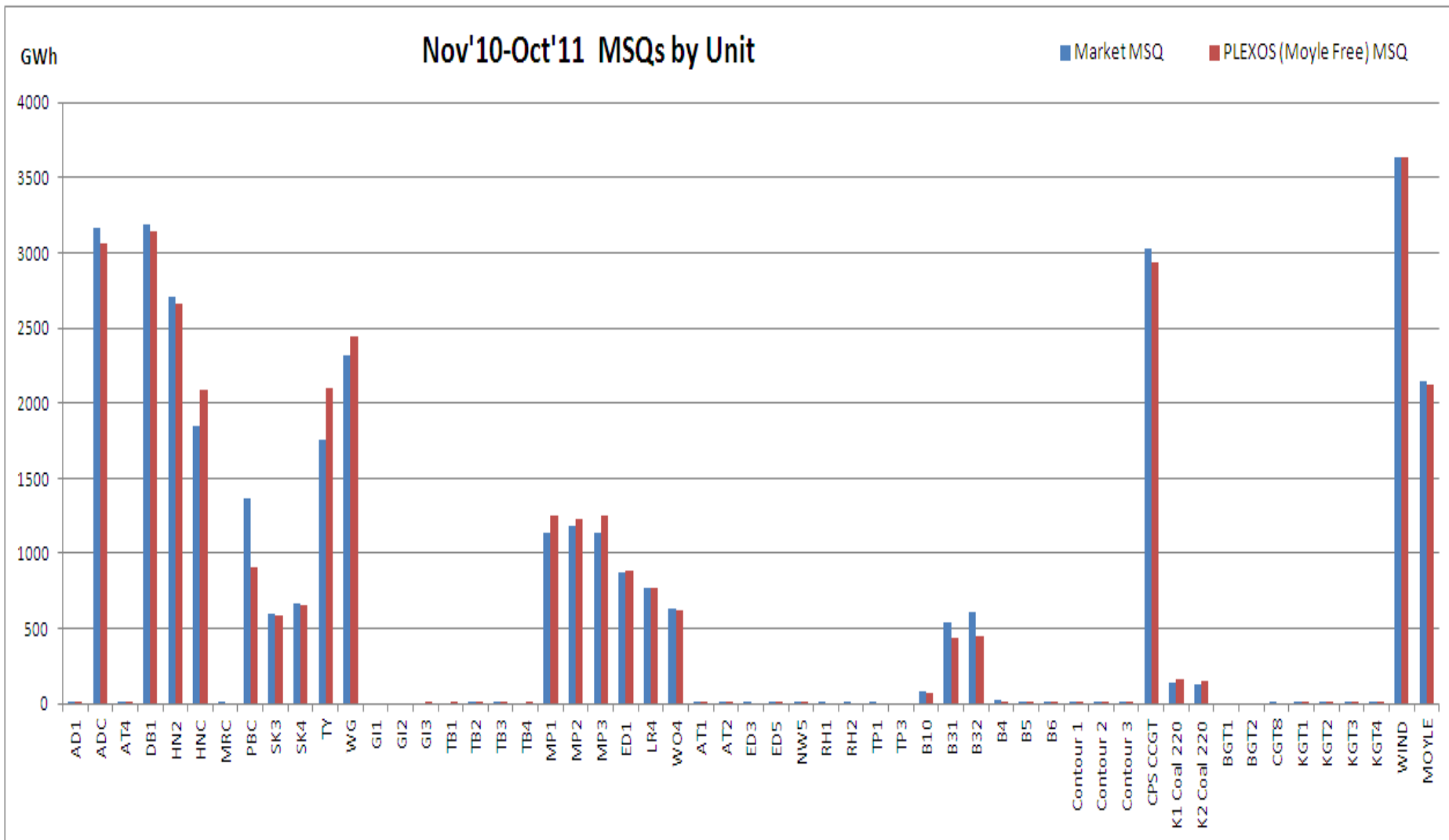# Moyle Free



Nov'10-Oct'11  Hydro profile
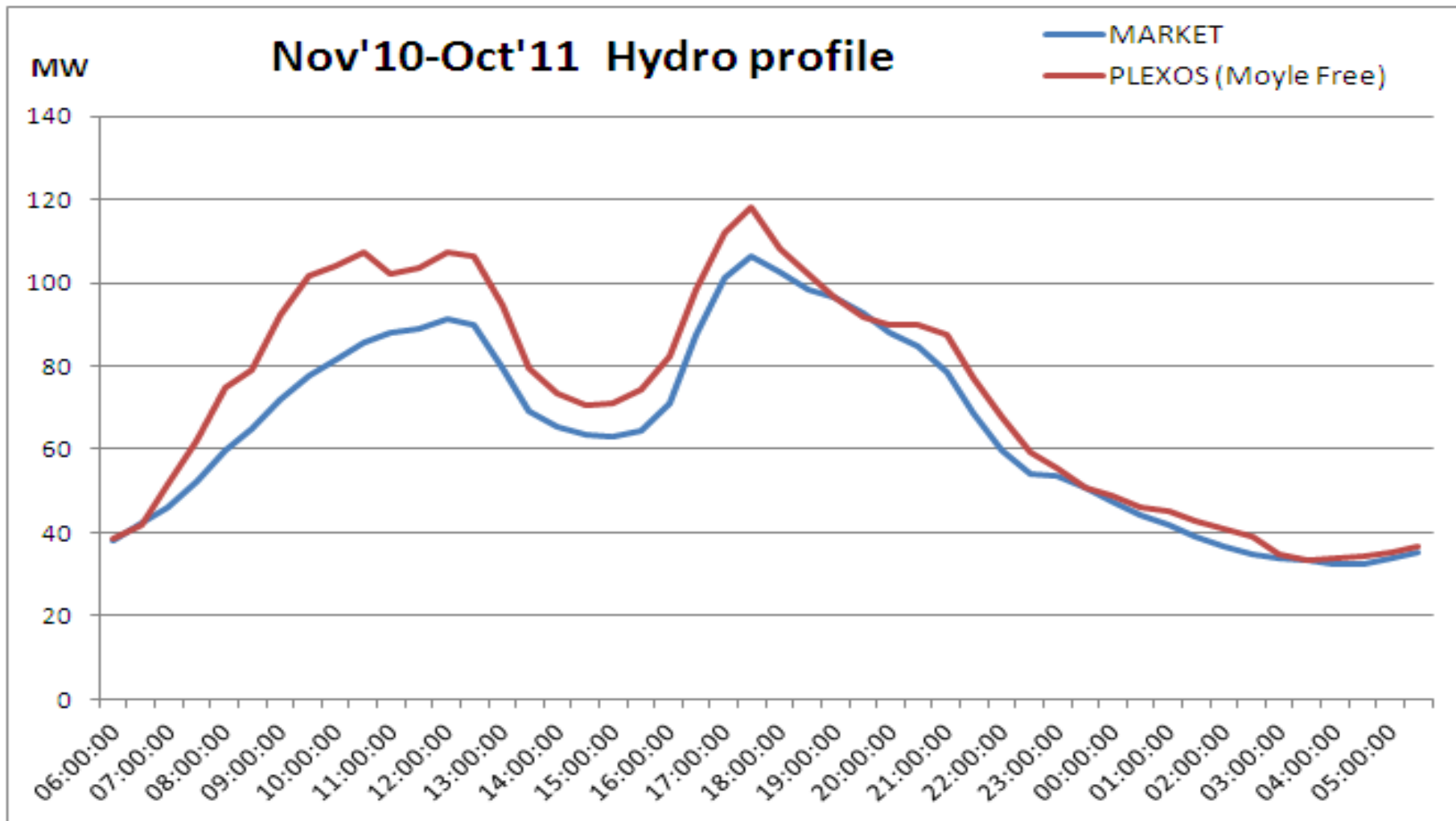
# SMP Results Summary

| Moyle Fixed | Outturn |
|---|---|
| Baseload | 2.1% below Market |
| Midmerit | 0.2% below Market |
| Peak | 1.0% above Market |

| Moyle Free | Outturn |
|---|---|
| Baseload | 2.0% below Market |
| Midmerit | 0.9% below Market |
| Peak | 0.1% below Market |

# Recommended Settings

- Xpress-Mp Solver

- Rounded Relaxation

- RR Self Tune (0.05, 0.95, 0.05)

- "3 State" Start Costs

- PLEXOS Version 6.205R07

# Forecast Model - Data Requirements

| Data Requirement | Source |
|---|---|
| Generator COD and TOD data | Generators |
| Fuel transportation charges (Variable) | Generators |
| Generator New entry & Retirements | System Operators |
| Half hourly SEM demand assumptions out to the end of 2013 | System Operators |
| Embedded generation<br>  - NI embedded gen included | System Operators |
| Wind profiles | System Operators |
| Transmission Loss Adjustment Factors | System Operators |
| Daily hydro availability limits | System Operators |
| Outage schedules | System Operators |

# Forecast Model - Generator Data

| **Commercial Offer Data** | **Technical Offer Data** |
|---|---|
| ❖ Heat Rates & No Load | ❖ Outages (Forecast & Forced) |
| ❖ Variable Operational & Maintenance Costs | ❖ Ramp Rates |
| ❖ Start Costs & Energy | ❖ Min Up & Down Times |
| ❖ Delivered Fuel Prices | ❖ Start Boundary Times |
| ❖ TLAFs (incorporated to all the above) | ❖ Max Capacity |
| | ❖ Min Stable level |

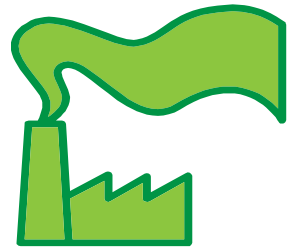# Forecast Model
## - Changes to Last Year

**Fuel Sheet**

- Variable fuel transportation adders - updated based on generator submissions and publicly available data.
- NI carbon price support of £4.94 from 1$^{st}$ April 2013
- ROI Carbon Levy added for Q4 2012
    - Now set to zero

**Generator Data**

Compared to last year's data and to market submissions

- Great Island 1,2 &3 retired from 1$^{st}$ October 2013
- Great Island CCGT added from 1$^{st}$ October 2013
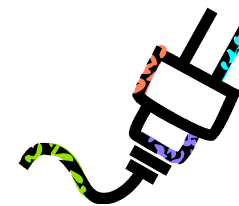- Various COD and TOD characteristics of existing generators.

# Forecast Model - Changes to Last Year

## SEM System Data

**SEM Demand growth**:

No growth in 2012

Moderate increase in 2013 of 0.6%

**Wind**:

Capacity: SO data on target connection dates by quarter.
Profile based on 2009.

**Embedded Generation**:

Updated profiles for 2012 and 2013.
NI embedded generation included for first time.

**Hydro**:
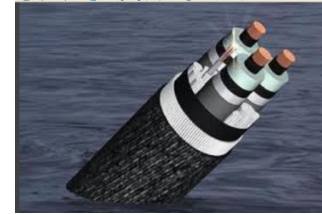
Daily limits and FOP provided by EirGrid.

**TLAFs**:

2011/12

# Forecast Model
# - Changes to Last Year

**Interconnection**

- For 2011/12 model East-West Interconnector was added from 24th September 2012.
- EWIC included for all of 2012/13
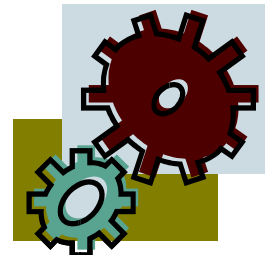- Moyle wheeling charges incorporated directly into GB price.

**Great Britain**

- Single generator – same approach to previous years.
- Capacity & Demand updated for East-West entry.
- Heat Rate coefficients & VOM values based on Regression Analysis used in Backcast.

**Model Settings**

- PLEXOS version 6205R07
- Solver used Xpress MP – Rounded Relaxation.
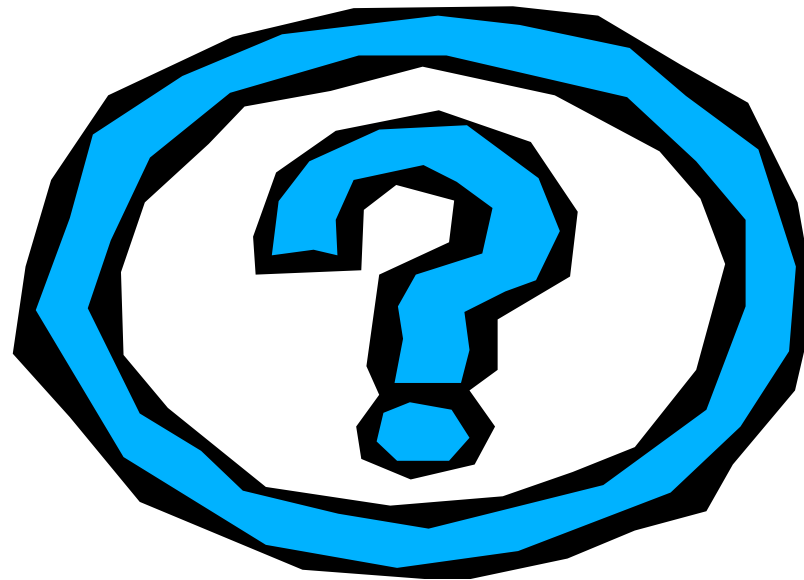- RR "Self Tune"

# Next Steps

- RAs to publish validated model by Fri 15$^{th}$ June including:
  - Input database of gen technical characteristics
  - SEM system data, e.g. demand, wind profiles
  - Model of GB prices to determine Moyle flows
  - Fuel spreadsheet to convert index prices into delivered SEM costs
- Excludes confidential data: gen VOM and outages, and fuel prices
- Model will be followed up with a report

# Next Steps

- New rolling quarterly approach to DCs decided in SEM-12-026 following consultation
- DC quantities and pricing for Q4 '12 to Q3 '13 initial "front-loaded" auction to be published next week
- "Front-loaded" DC auction:
  - Primary Subscription Window from Mon 25th June to Fri 6th July
  - Supplemental Subscription Window from Mon 9th July to Wed 11th July
- Quarterly DC auctions thereafter with shorter auction windows
- Updated prices/quantities published quarterly thereafter

*Questions and Answers*