



EUROPEAN WORKSHOP ON ELECTRICITY PRICE FORECASTING
Paris, April 28, 2014

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- MOTIVATION
- A MODEL FOR SHORT TERM POWER PRICES
 - DETERMINISTIC PART
 - RESIDUALS TIME SERIES
- SCALING OF HOURLY PROFILES

- *EX ANTE*: ALERT EPEX SPOT MARKET OPERATORS WHEN THE MARKETS ARE NERVOUS.
- *EX POST*: MAKE SURE OUR PRICES REFLECT THE FAIR VALUE OF THE GOOD.

- DELIVER THREE WARNING VALUES (A PRICE FORECAST AND A CONFIDENCE BAND) INSTEAD OF A LARGE SET OF FUNDAMENTALS' VALUES TO THE MARKET OPERATIONS TO WARN OF A POSSIBLE SECOND AUCTION PROCESS – IF HIGH OR LOW PRICE THRESHOLDS ARE DETECTED AFTER THE FIRST AUCTION IS CONDUCTED, EPEX TRIGGERS A SECOND AUCTION:

- THE PREDIFINED THRESHOLDS TO TRIGGER A SECOND AUCTION FOR THE GERMAN/AUSTRIAN AUCTION ARE: €/MWh -150 AND €/MWh 500.
- EPEX ORDER BOOKS REOPENS FOR 10 MINUTES AT A TIME INDICATED IN A MARKET MESSAGE.
- A SECOND CALCULATION TAKES PLACE AND THE RESULTS PUBLICATION IS CONSIDERABLY DELAYED.
- IF PRICES STILL REACH THE PREDEFINED THRESHOLDS AFTER THE SECOND AUCTION CALCULATION, NO ADDITIONAL AUCTION IS TRIGGERED.

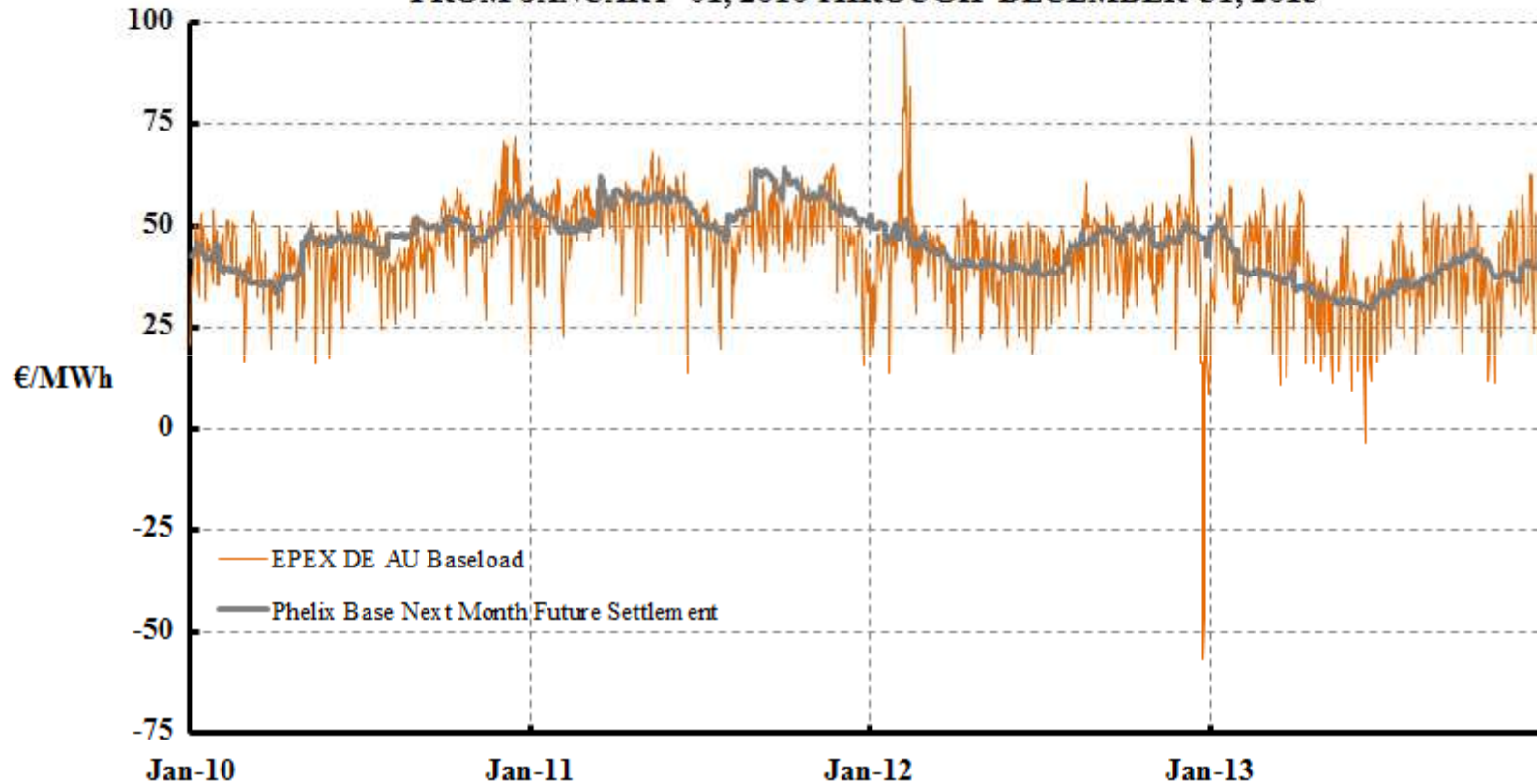
- MAKE SURE OUR PRICES REFLECT THE FAIR VALUE OF THE GOOD (A DAILY COMPARISON OF THE MARKET PRICE, THE OTC, AND THE FORECAST.)

EXAMPLE: DELIVERY DAY APRIL 16, 2014

Delivery Day	EPEX Spot	OTC MID	Fcast	Fcast Min	Fcast Max
APR 16, 2014	34.97	38.50	39.75	32.10	47.39

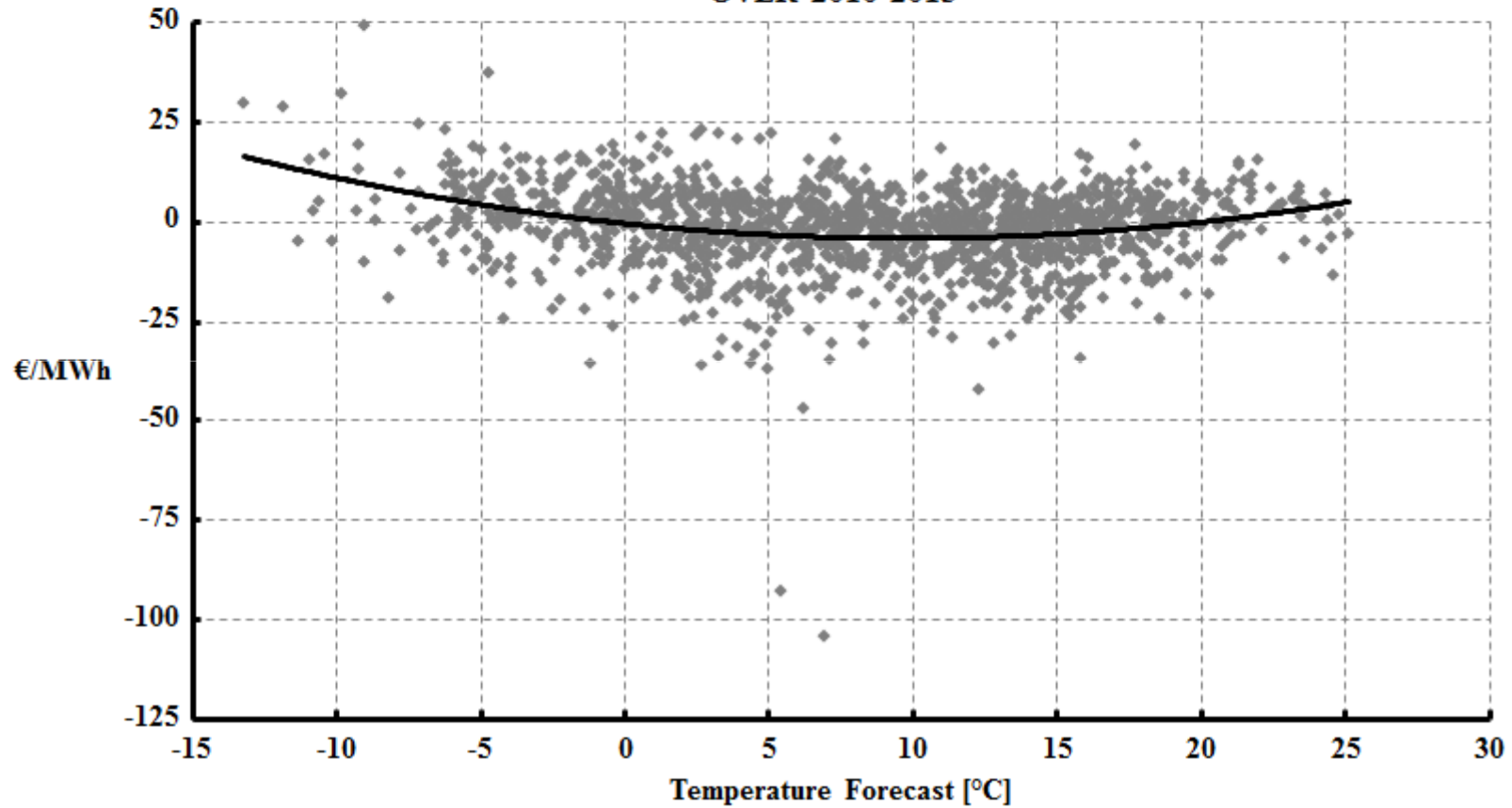
- *“DUE TO AN IT ERROR, A FAULTY SALES POSITION WAS IMPORTED INTO THE POSITION-LEADING SYSTEM,”* SAID A UTILITY IN A NOTE POSTED ON ITS TRANSPARENCY WEBSITE, ACCORDING TO REMIT RULES.

**EPEX DE AU BASELOAD VS. PHELIX BASE MONTH FUTURE SETTLEMENT
FROM JANUARY 01, 2010 THROUGH DECEMBER 31, 2013**



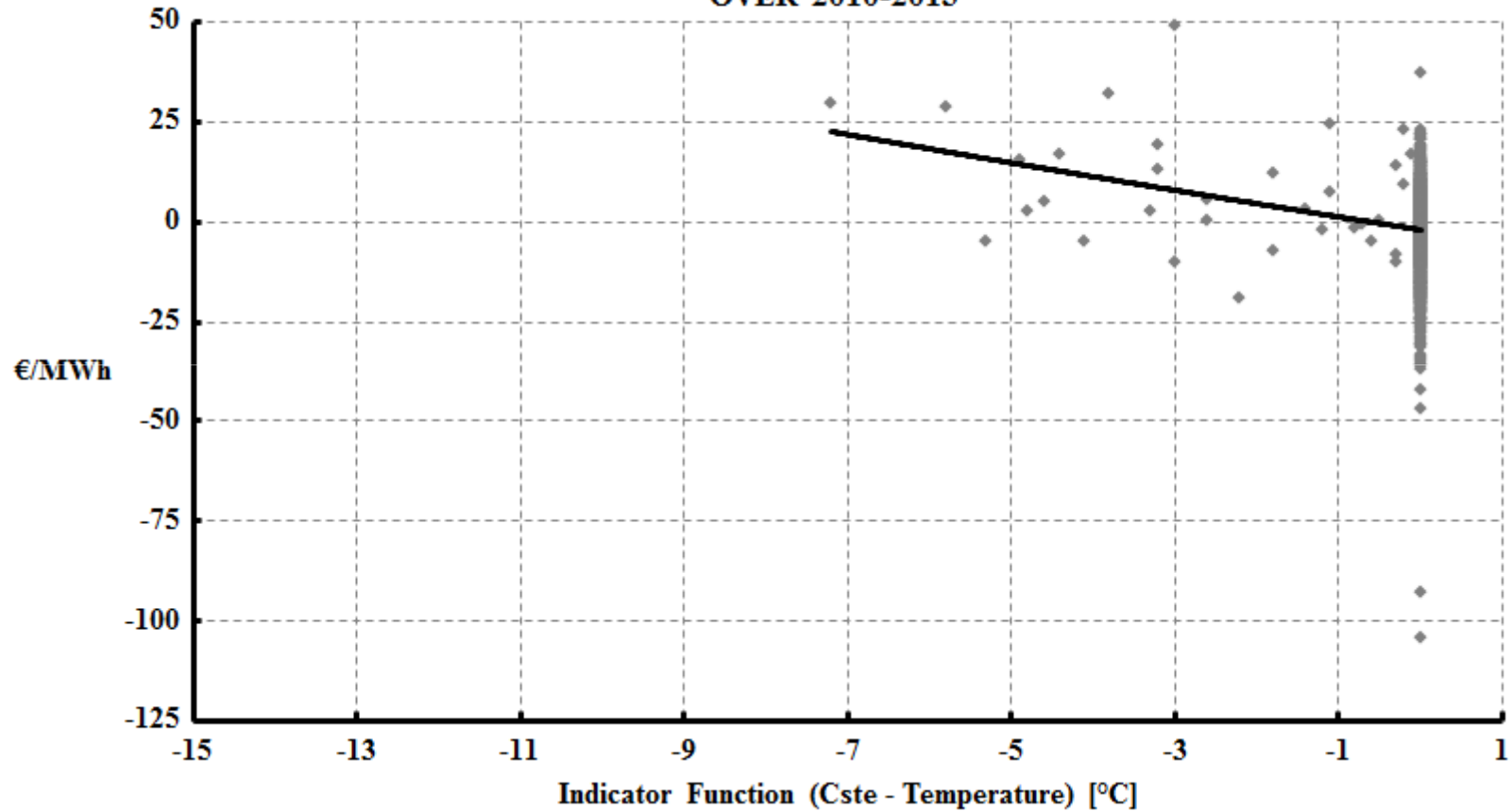
INDEPENDENT VARIABLES TEMPERATURES

THE DEPENDENT VARIABLE VERSUS TEMPERATURES FORECASTS
OVER 2010-2013



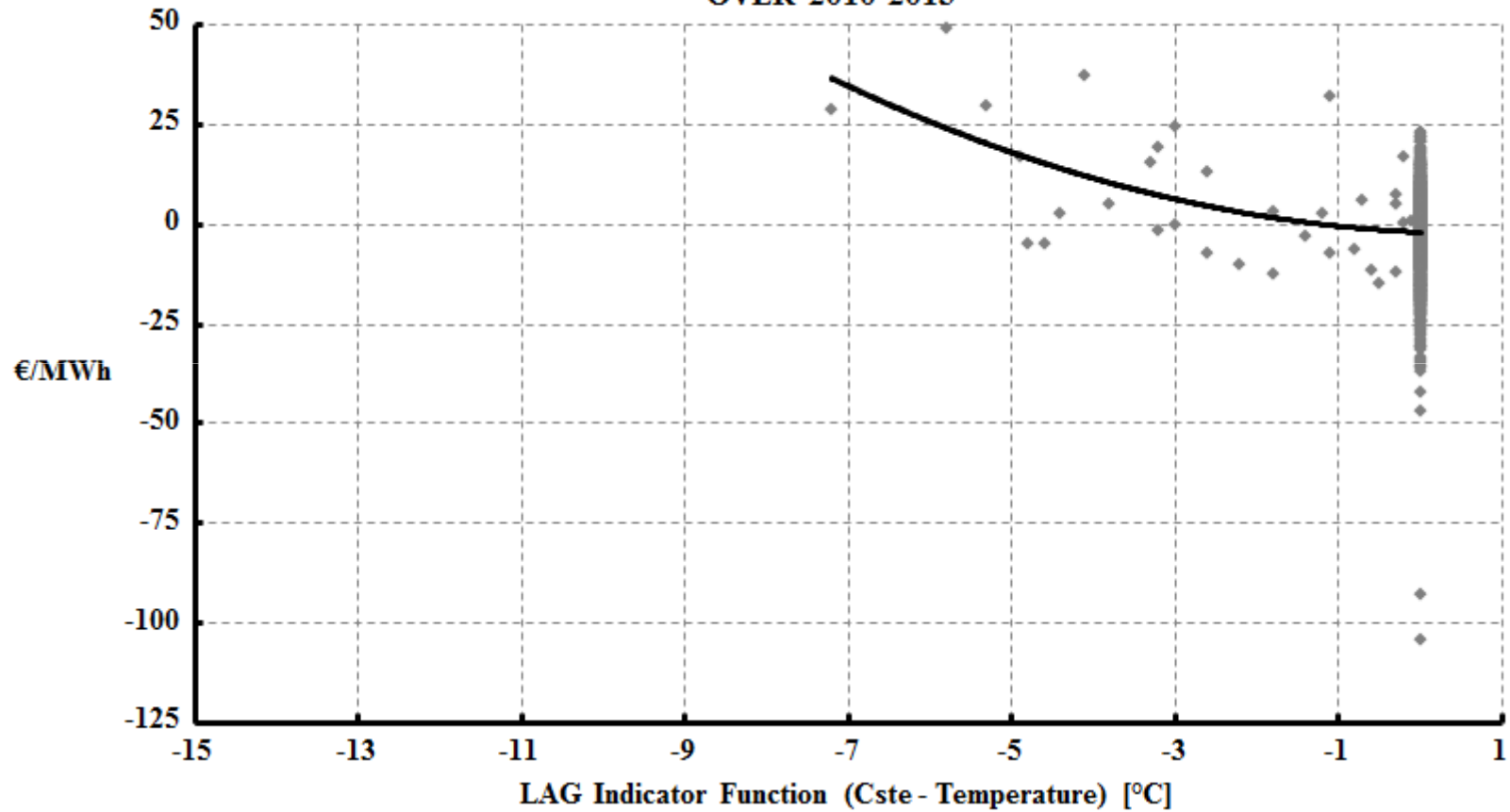
INDEPENDENT VARIABLES TEMPERATURES

THE DEPENDENT VARIABLE VERSUS EXTREME LOW TEMPERATURES
OVER 2010-2013



INDEPENDENT VARIABLES TEMPERATURES

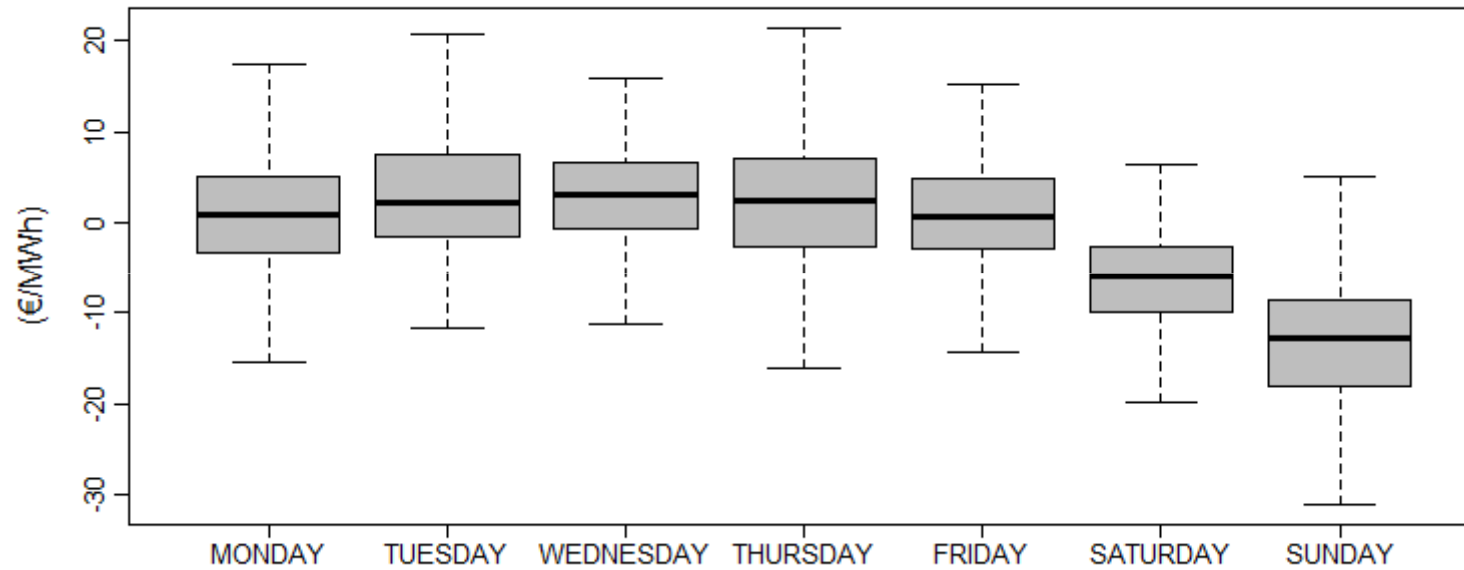
THE DEPENDENT VARIABLE VERSUS LAG EXTREME LOW TEMPERATURES
OVER 2010-2013



INDEPENDENT VARIABLES

DAY OF WEEK

THE DEPENDENT VARIABLE OVER 2010-2013



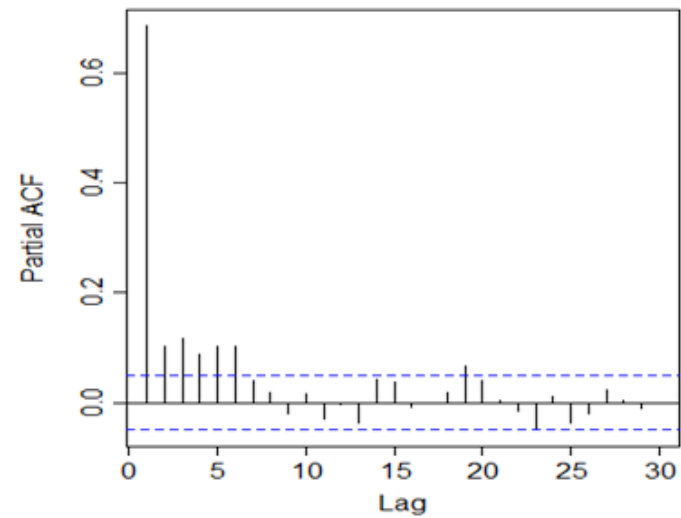
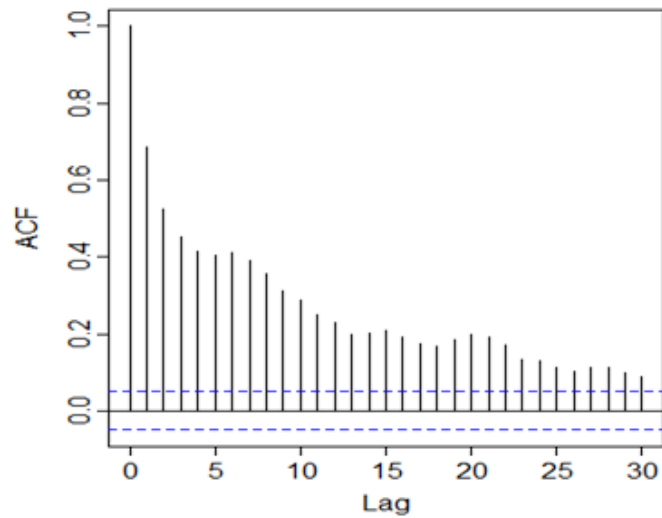
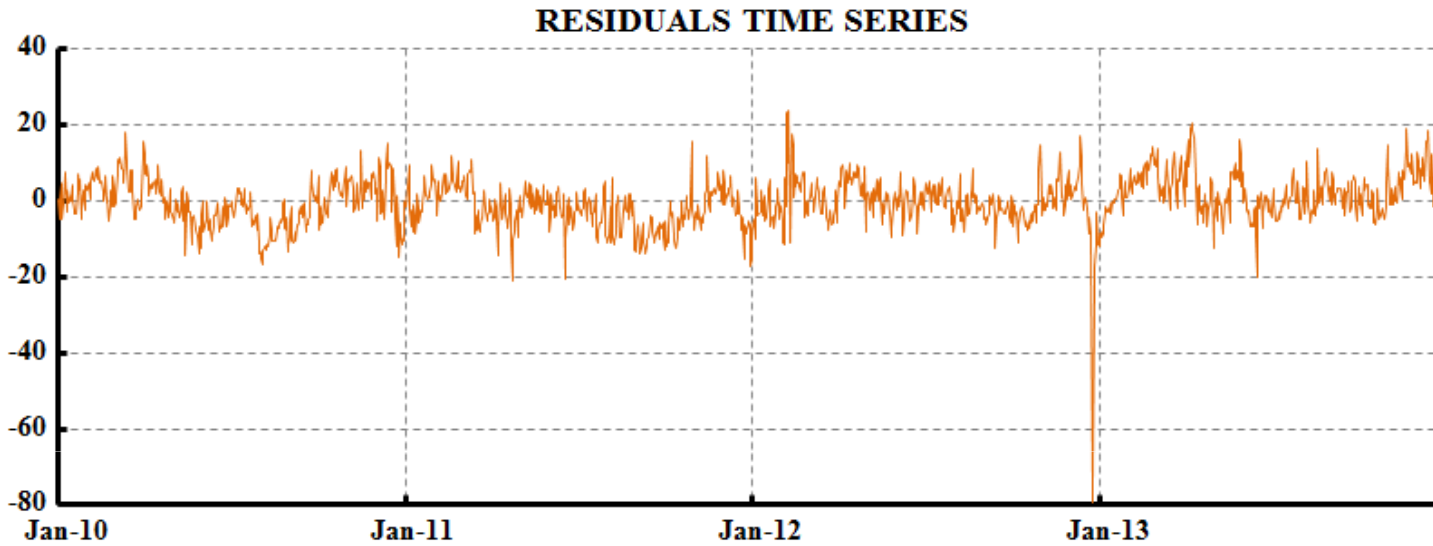
INDEPENDENT VARIABLES WIND FORECAST

	Average Resiliency To 0.5 GW Price Inelastic Sell Order	Average Resiliency To 1 GW Price Inelastic Sell Order	Average Resiliency To 1.5 GW Price Inelastic Sell Order
OFF-PEAK 1	- 1.05	- 2.27	- 3.86
PEAK	- 0.83	- 1.72	- 2.59
OFF-PEAK 2	- 0.97	- 1.93	- 3.33

- OFF-PEAK SUPPLY CURVES ARE GENERICALLY LESS RESILIENT THAN PEAK SUPPLY CURVES.
- IT IS THE OTHER WAY ROUND UNDER UPWARDS SPIKES REGIMES.
- WE CONSIDER TWO WIND VARIABLES:
 - WIND PEAK FORECAST
 - DELTA BASE TO PEAK

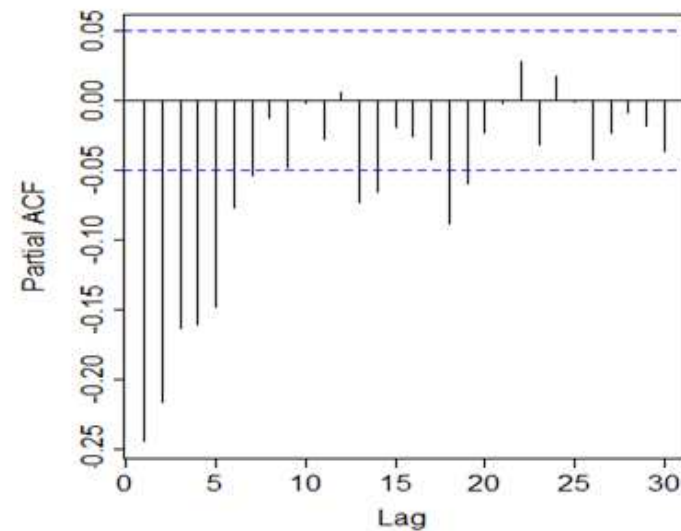
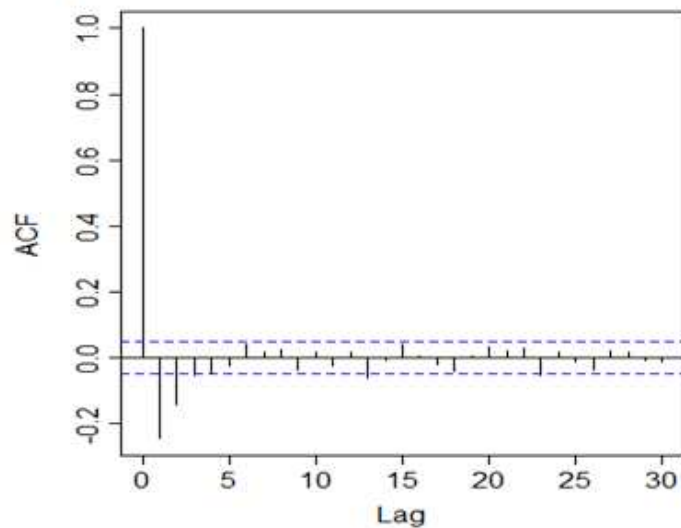
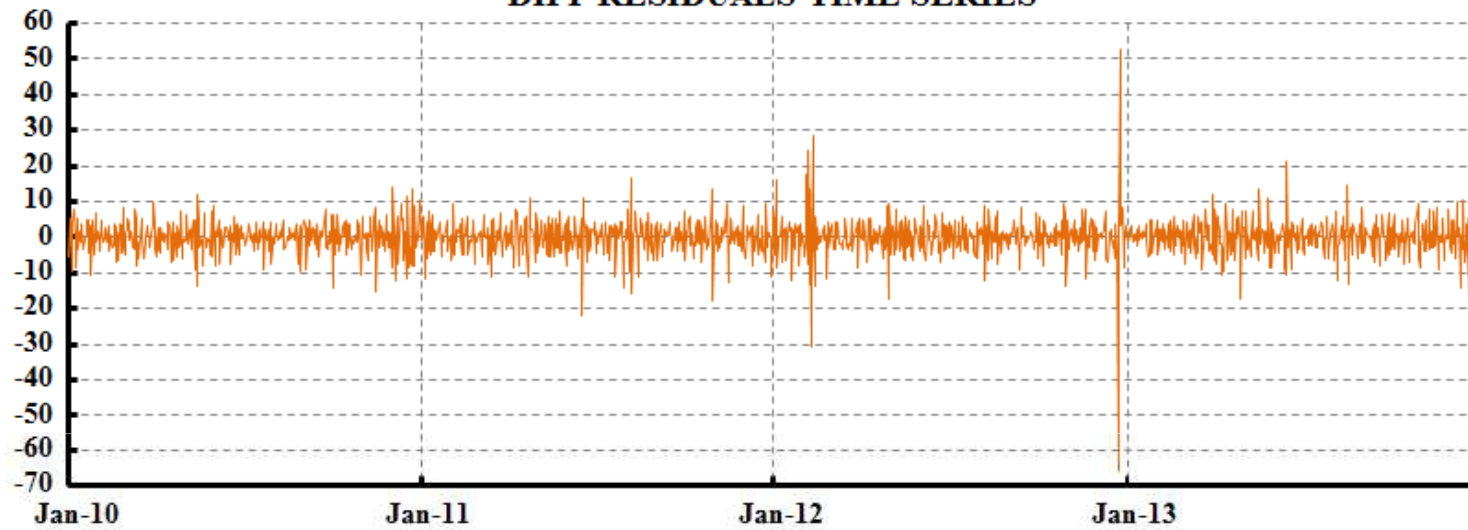
	Estimate	Std. Error	t value	Pr(> t)	Signif.
Intercept	(-) 07.93	00.49	(-) 16.04	< 2e-16	***
Bank Holiday Non Sunday	(-) 12.76	00.91	(-) 14.10	< 2e-16	***
Monday Before Bank Holiday	(-) 10.30	03.34	(-) 03.09	0.00207	**
1 Day Before BH Non Sun & Mon	(-) 04.46	01.10	(-) 04.05	5.31e-05	***
2 Days Before BH Sat/Sun/Mon	(-) 03.42	01.20	(-) 02.84	0.00450	**
Monday	15.06	00.63	23.92	< 2e-16	***
Tuesday	15.84	00.63	25.29	< 2e-16	***
Wednesday	16.74	00.63	26.62	< 2e-16	***
Thursday	16.79	00.63	26.81	< 2e-16	***
Friday	15.14	00.62	24.28	< 2e-16	***
Saturday	07.48	00.63	11.95	< 2e-16	***
Lag Extreme Low Temperature	03.65	00.37	09.74	< 2e-16	***
Wind Peak Forecast	(-) 1.092 e-03	0.04 e-03	(-) 26.40	< 2e-16	***
Delta Base to Peak Wind Forecast	(-) 1.463 e-03	0.17 e-03	(-) 08.57	< 2e-16	***


- **Multiple R-squared: 0.5938, Adjusted R-squared: 0.5904**
- **F-statistic: 174.6 on 13 and 1553 DF, p-value: <2.2 e-16**



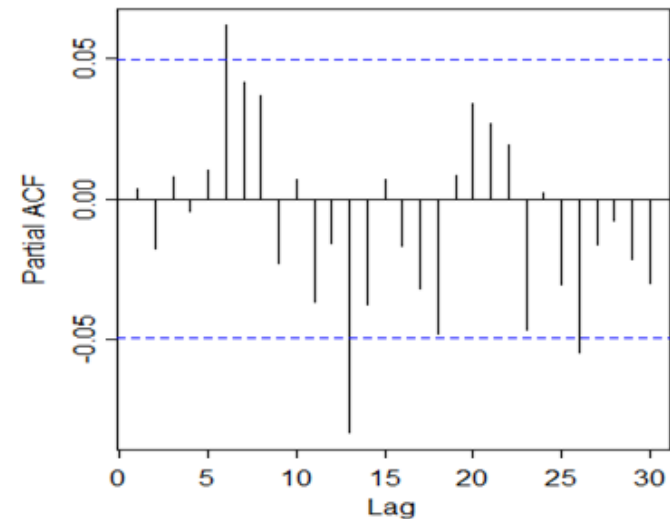
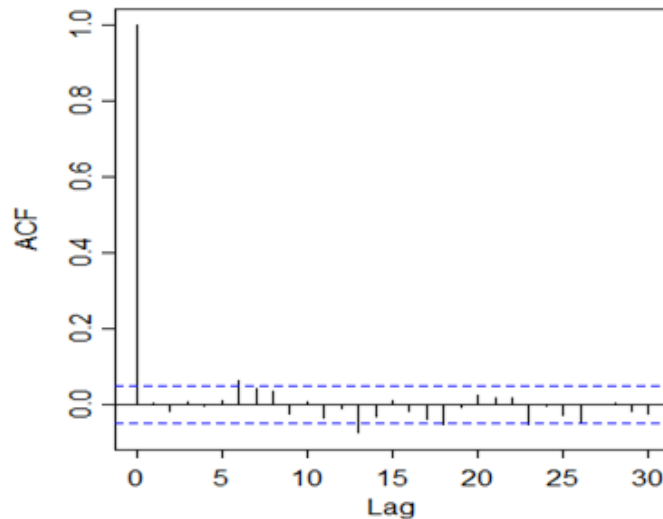
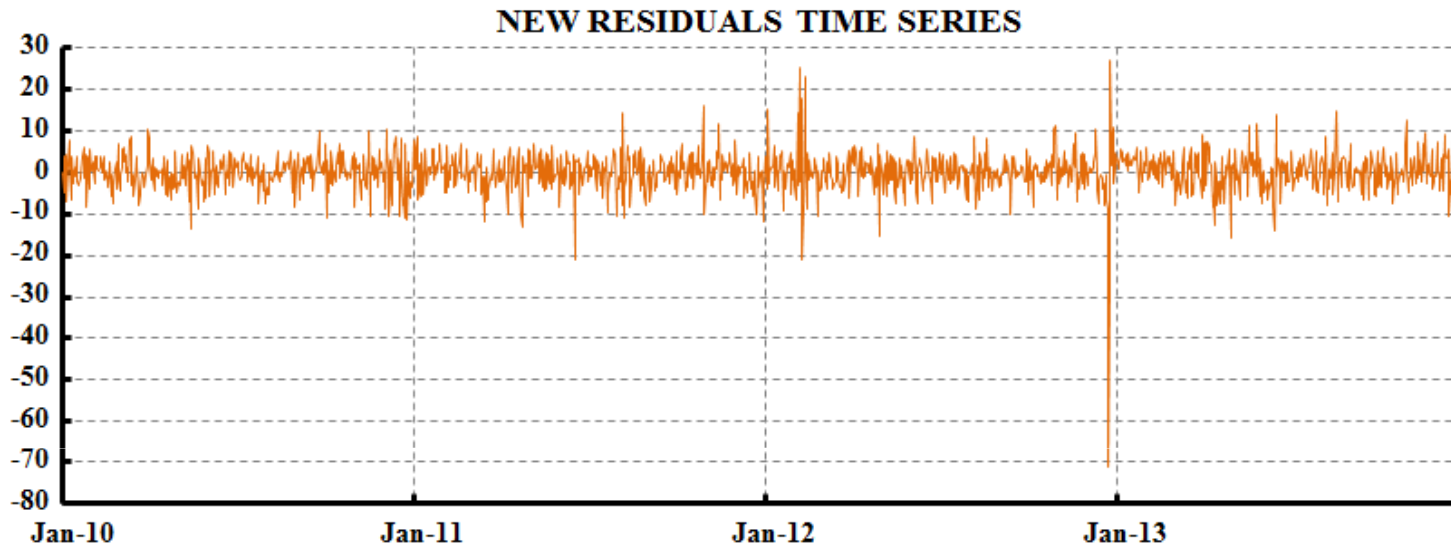
FIRST DIFFERENCES OF THE RESIDUALS TIME SERIES

DIFF RESIDUALS TIME SERIES

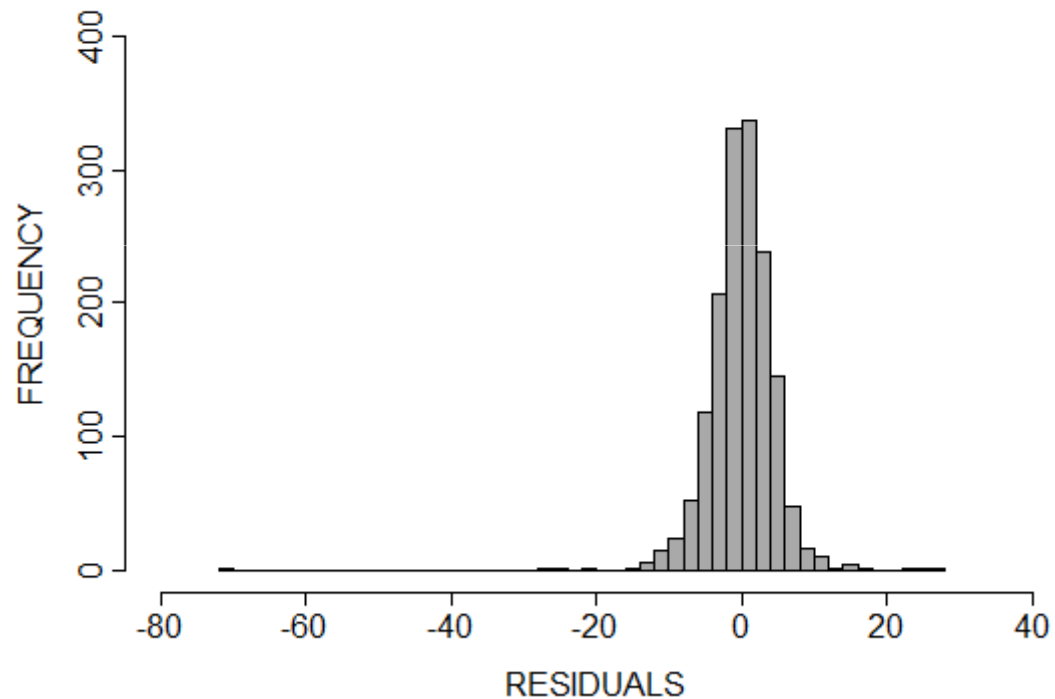




	AR1	MA1
Coefficient	0.48	(-) 0.89
s.e.	0.04	0.02
Pr(> t)	0	0



HISTOGRAM OF THE NEW RESIDUALS TIME SERIES



Statistics	
Min.	(-) 71.38
1st Qu.	(-) 2.26
Median	0.11
Mean	0.009
3rd Qu.	2.64
Max.	26.77
STDV	4.70
VAR	22.10
Kurtosis	36.59
Skewness	(-) 2.28

Coefficient	Estimate	Std. Error	T value	Pr(> t)	Signif.
α_0	10.36	0.479	21.58	<2e-16	***
α_1	0.41	0.017	23.90	<2e-16	***
α_2	0.18	0.020	8.80	<2e-16	***

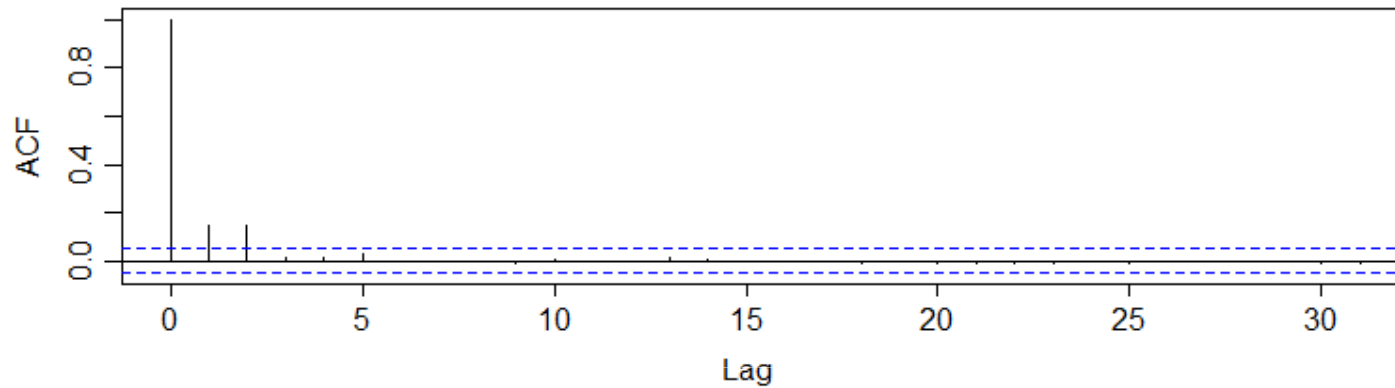
$ARCH_p$

- $X_t = \varepsilon_t$
- $\varepsilon_t | X_{t-1}, X_{t-2}, \dots \sim N(0, \sigma_t^2)$
- $\sigma_t^2 = \alpha_0 + \alpha_1 X_{t-1}^2 + \alpha_2 X_{t-2}^2 + \dots + \alpha_p X_{t-p}^2$

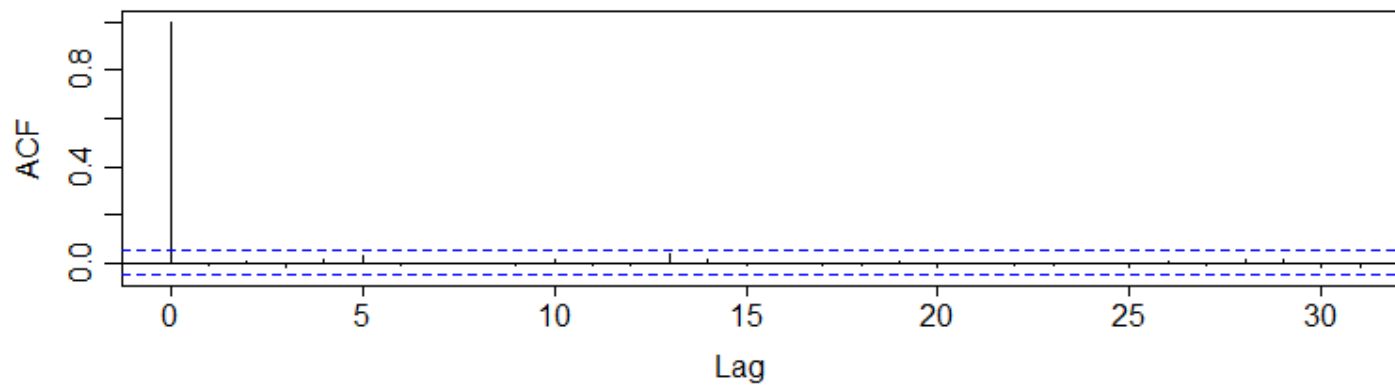
Properties

- $E[X_t] = 0$
- $E[X_t | I_{t-1}] = 0$, where $I_{t-1} = X_{t-1} + X_{t-2} + \dots$
- $V[X_t] = \frac{\alpha_0}{1 - \sum_{i=1}^p \alpha_i}$, if $\sum_{i=1}^p \alpha_i < 1$
- $V[X_t | I_{t-1}] = \alpha_0 + \alpha_1 X_{t-1}^2 + \dots + \alpha_p X_{t-p}^2$
- $Cov(X_t, X_{t+h}) = \gamma_h = 0 \quad \forall h > 0$
- $Cov(X_t, X_{t+h} | I_{t-1}) = 0$

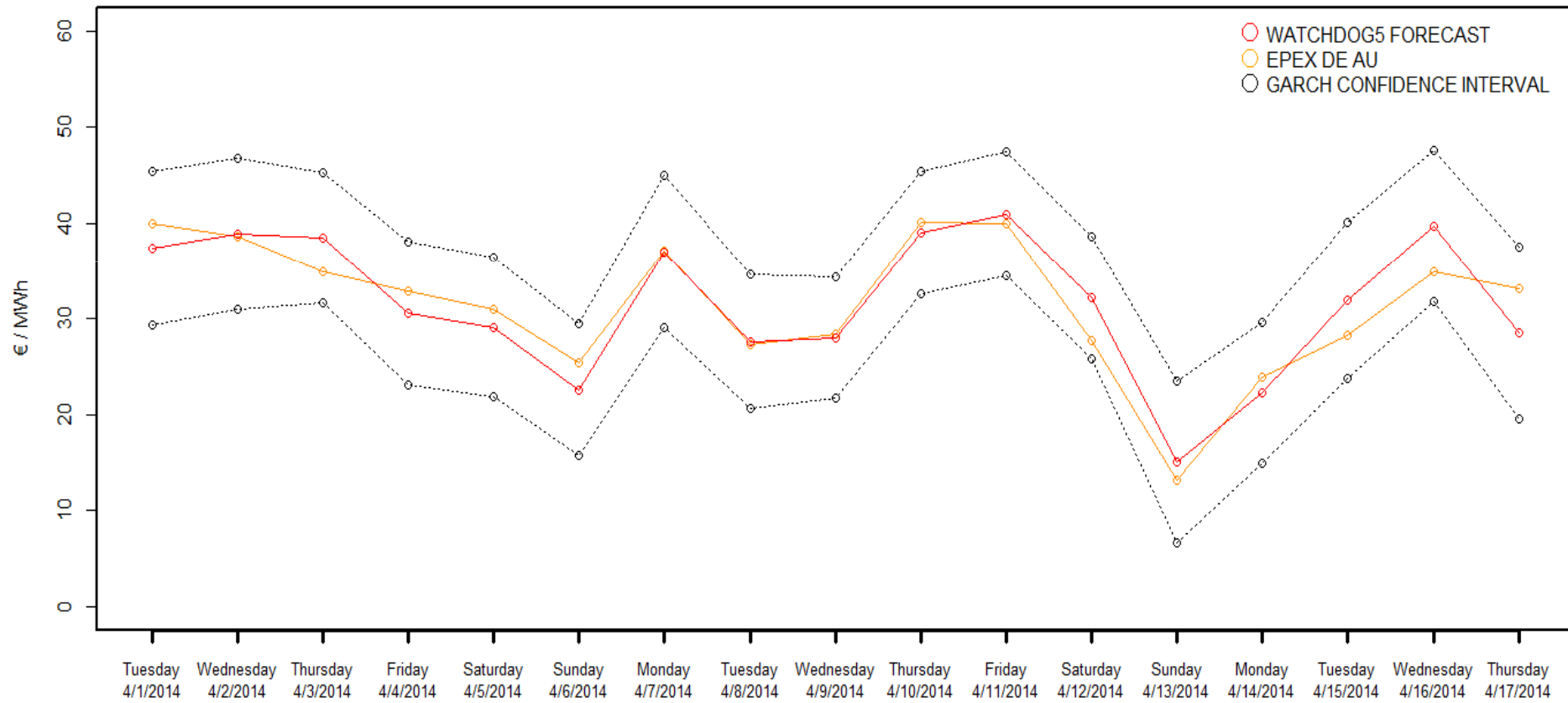
ACF of Squared residuals(arima)



ACF of Squared Residuals

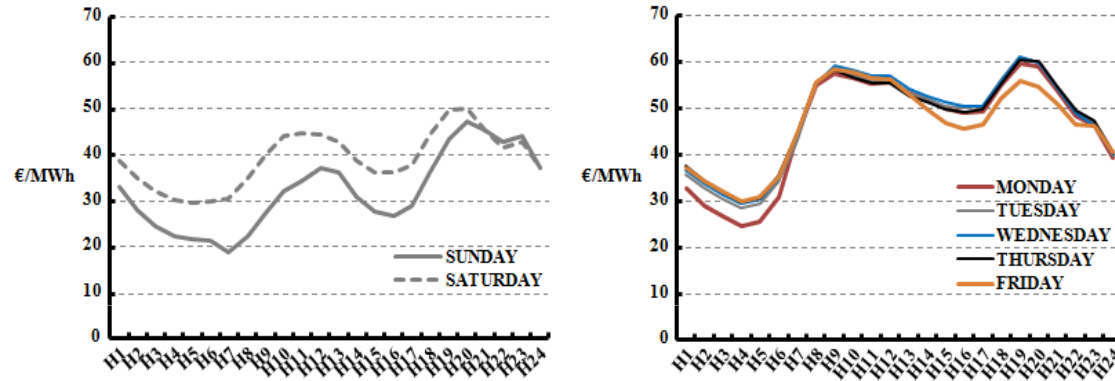


EPEX DE/AU FORECAST FROM TUESDAY APRIL 01, 2014 THROUGH THURSDAY APRIL 17, 2014



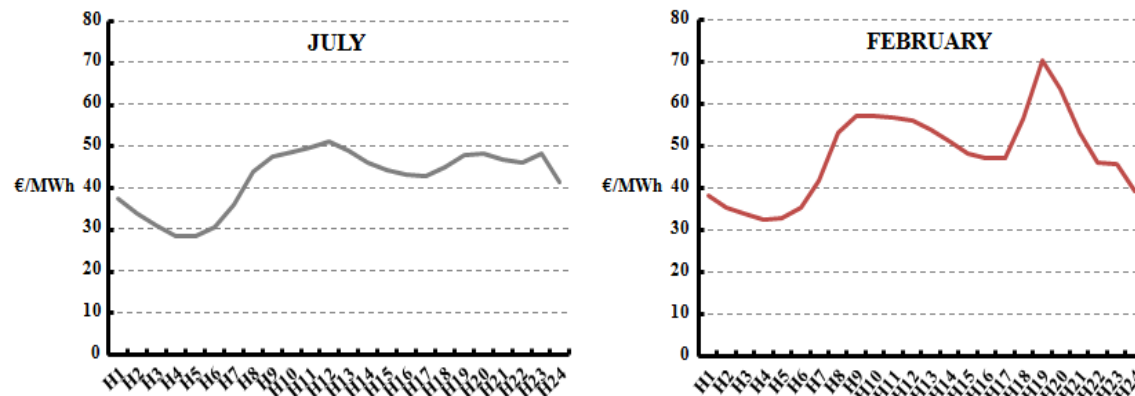
A DAY IS NOT A DAY

AVERAGE HOURLY PRICES ON EPEX DE/AU OVER 2010-2013



A MONTH IS NOT A MONTH

AVERAGE HOURLY PRICES ON EPEX DE/AU OVER 2010-2013





THANK YOU FOR YOUR ATTENTION