

Technology Based Modelling of Economy Decarbonization

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External Modeling Factors Evaluation Using Statistical Forecasting Methods: Electricity Price Case

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External Modeling Factors



- Modelling concentrates on one particular energy system;
- External connected systems still exist and does affect the modeled one;
- Lack of information about neighboring systems prevent from building another model;
- How to reliably evaluate energy and reserve prices in neighboring systems without building another model?



A need for reliable external factors evaluation model for surrounding systems



Electricity Price

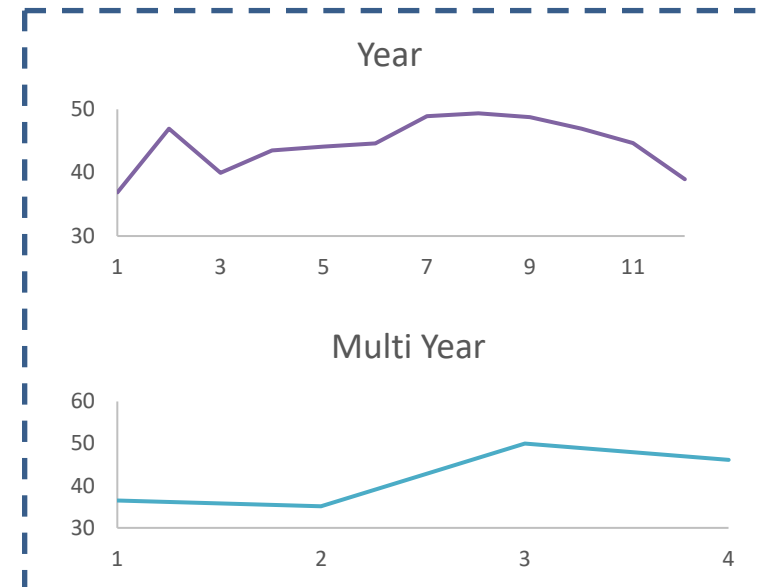
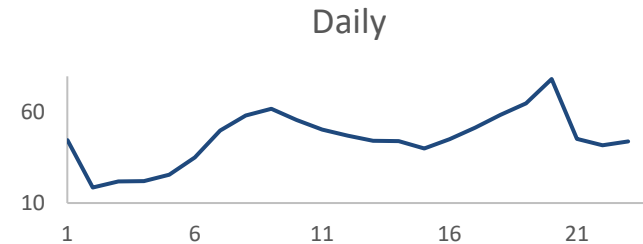


Dynamics

Influencing Factors

- Energy generation mix;
- Weather conditions;
 - Temperature;
 - Precipitation;
 - Wind speed;
 - Solar radiation.
- Fuel prices;
- Demand dynamics;
- ...

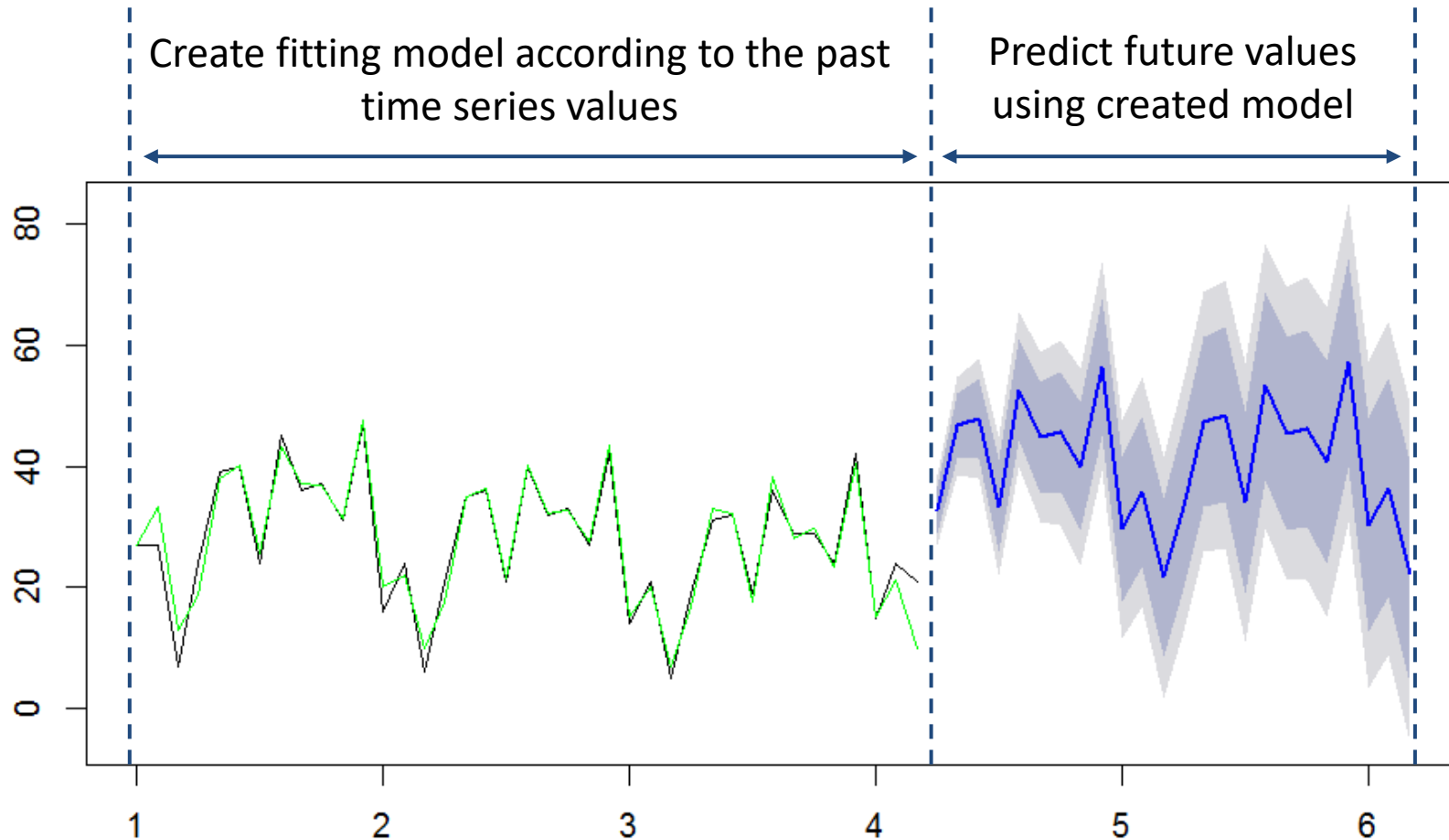
Current Focus



Electricity price often have seasonality and can highly depend on external factors



Statistical Forecasting



Statistical forecasting provides tools for future values prediction based on the past



Forecasting Methods



Univariate Models

- Extrapolation;
- Moving average;
- Linear regression;
- Exponential smoothing;
- AR;
- ARMA;
- ARIMA;
- SARIMA;
- ...

Prediction is based only on the dynamics of past values

Multivariate Models

- Multivariable regression;
- ARIMAX;
- SARIMAX
- VAR;
- VARMA;
- ...

Prediction is based on the dynamics of past values and additional external variables

Methods predict future values based on the past values and relation with other factors



Conceptual Model



Evaluation

Level 1: Multivariate model

Forecasted value = past values + variable 1 + variable 2 + ...

Level 2: Multivariate model

variable 1 = past values + variable 1.1 variable 2 = past values + variable 2.1

Current Focus

Level 3: Univariate model

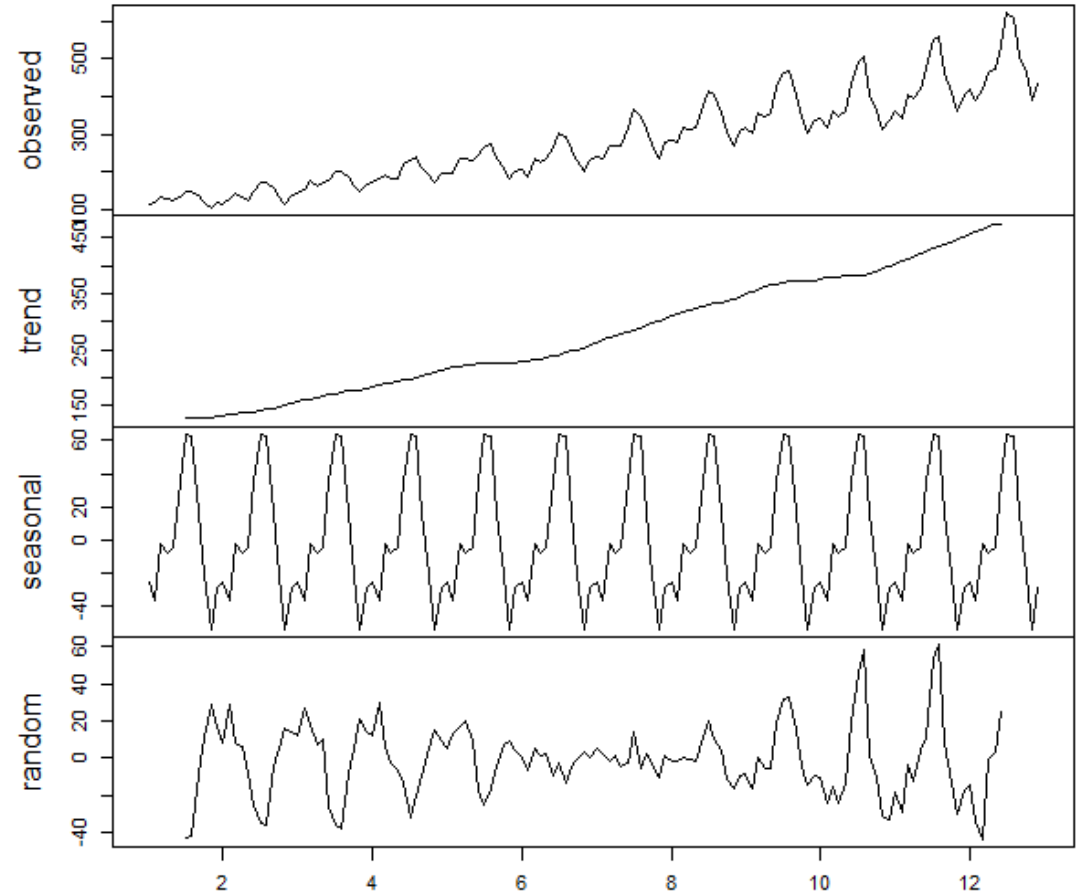
variable 1.1 = past values

variable 2.1 = past values

Forecasting

Multivariate model is divided until univariate forecasting is the most suitable

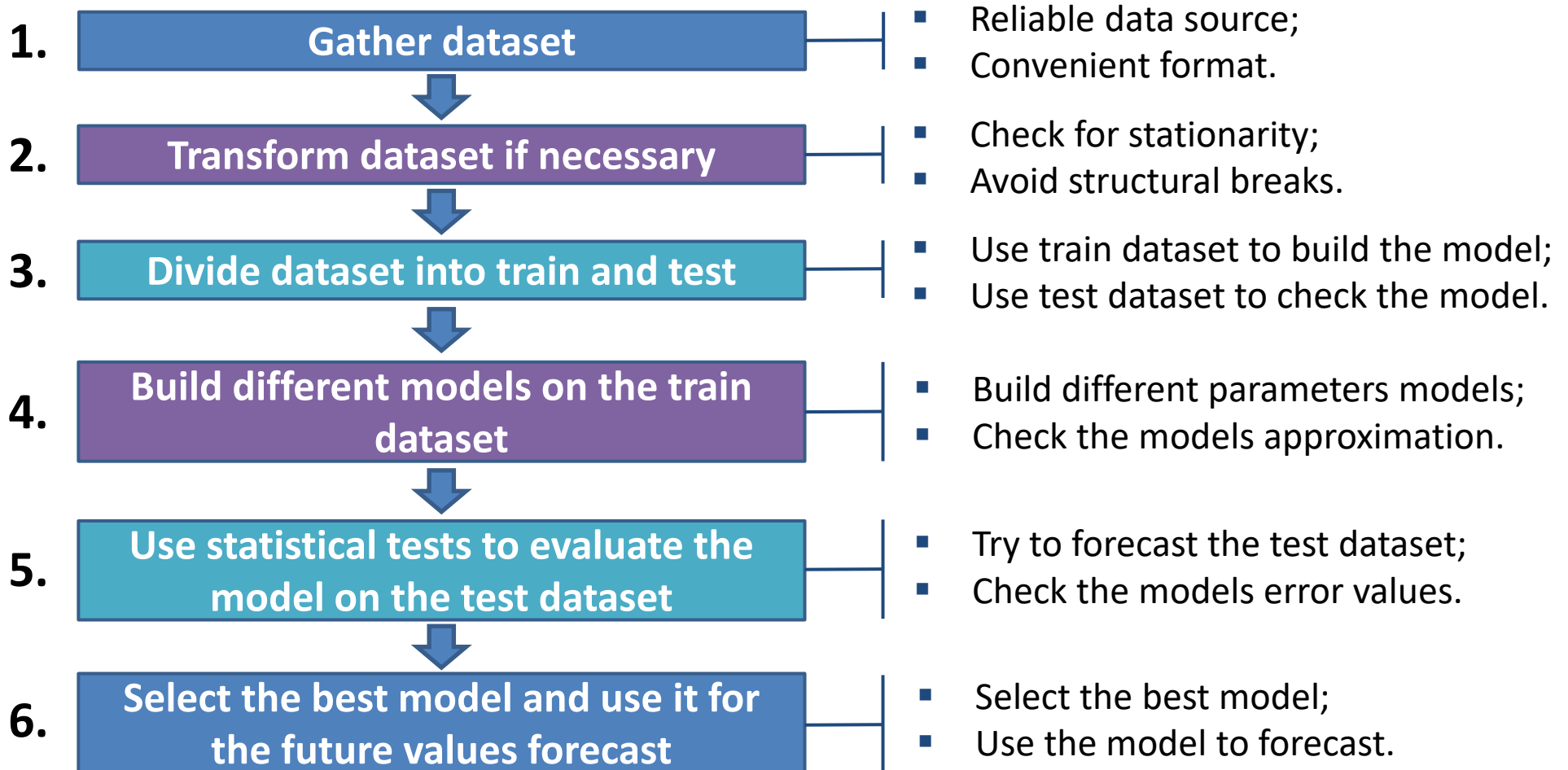
- Every time series can be divided into: trend, seasonal and random components;
- Trend component shows long-term direction of the time series;
- Seasonal components shows pattern which is time series repeat over same periods of time;
- Random component represents unpredicted time series movement;
- SARIMA model breaks down time series into components and forecasts them separately.



SARIMA model evaluates time series trend, seasonal and random components



Forecasting Methodology



Various statistical tests and criteria helps to ensure created model reliability

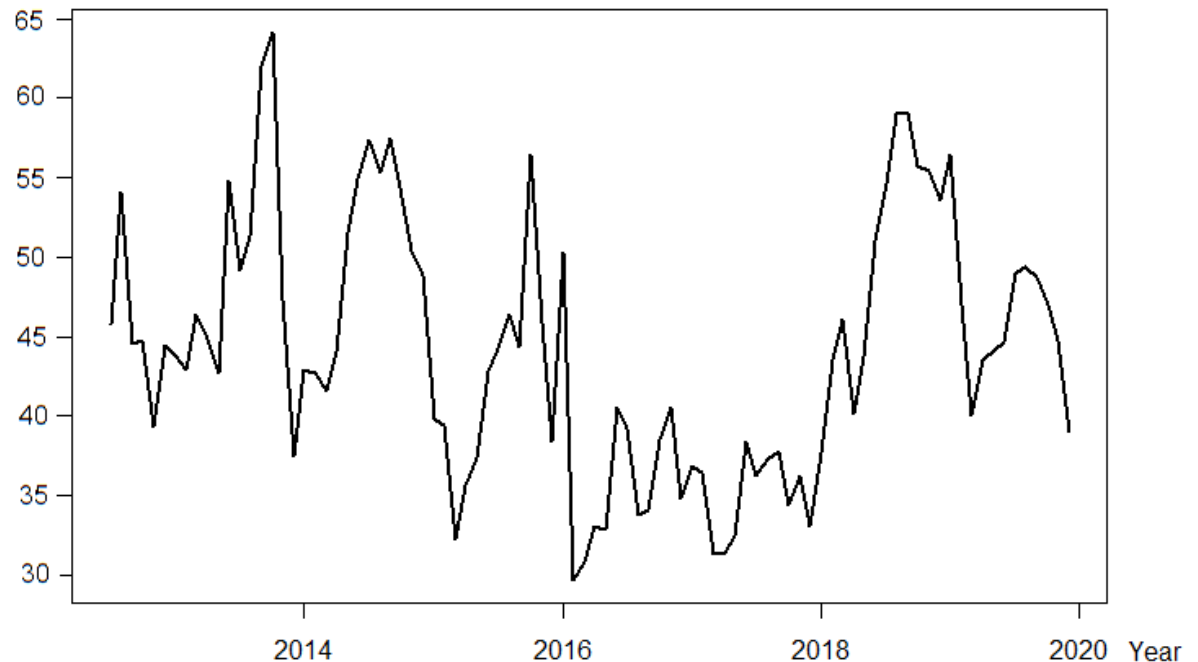


Univariate Forecasting Example



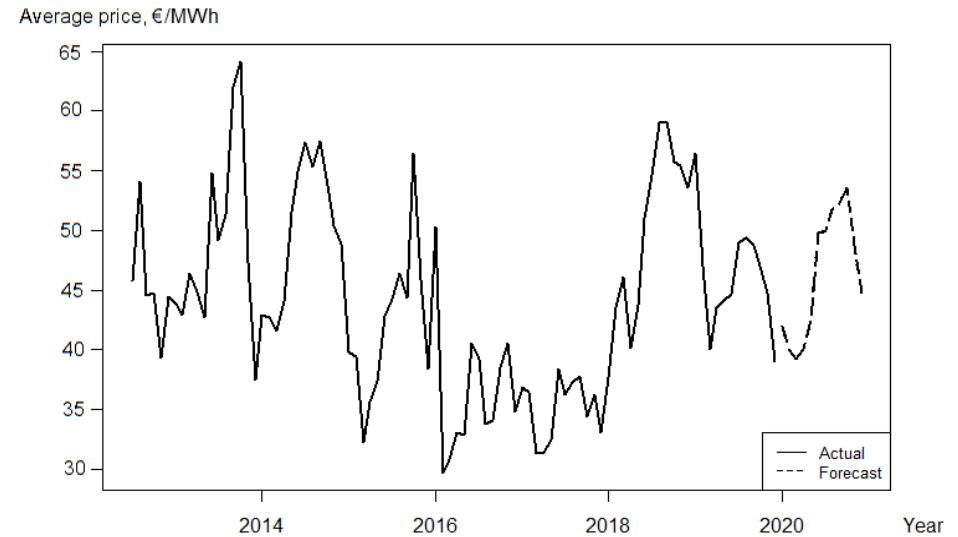
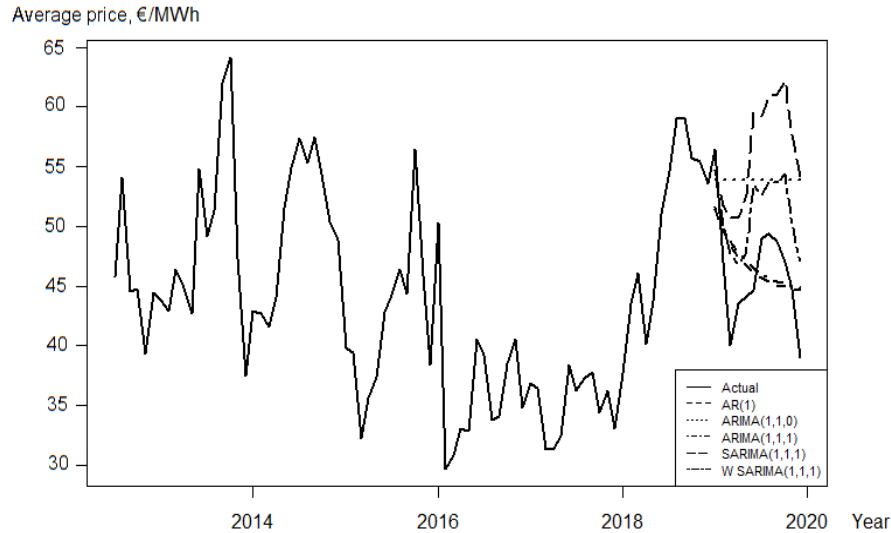
- Data are gathered from Nordic electricity market operator NordPool;
- Dataset contains 90 points;
- Price points are collected from 2012 July to 2019 December;
- Electricity price varies from 29 €/MWh to 64 €/MWh;
- Goal to forecast electricity price for 2020.

Average price, €/MWh



Lithuania electricity price time series data are selected for example

Univariate Forecasting Result



	Models				
	AR (1)	ARIMA (1,1,0)	ARIMA (1,1,1)	SARIMA (1,1,1)	Weighted SARIMA (1,1,1)
Approximation Criteria					
AIC	492.64	491.27	488.91	429.75	-
BIC	499.71	495.95	495.94	440.62	-
Accuracy Criteria					
RMSE	4.13	8.95	4.22	11.21	5.64
MAE	3.58	8.20	3.65	10.44	5.19
MPE	-1.97	-17.91	-2.67	-22.74	-11.13
MAPE	7.94	18.68	8.16	23.27	11.65

Final model have ~12% electricity price forecasting error

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