Prediction of electricity off-take evaluation of portfolio deviation

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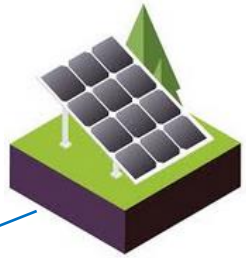
How the electricity flow works

Energy traders

Production/photovoltaic



Purchased/sold energy

Balancing of energy/financial settlement

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Súčasť vášho domova

Energy nomination

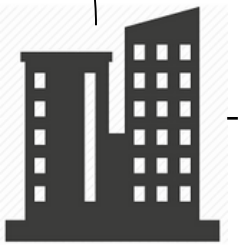
OKTE

Deviation costs

Portfolio management

Households

Industry



Companies

Measured data through Distribution company

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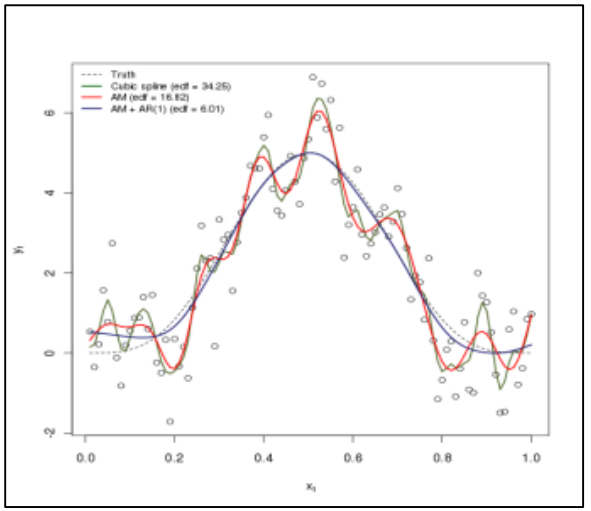
What is the objective of prediction in energy business?

Save (deviation) costs!



What does it mean to model electricity?

- **Robust data** (15 minutes granularity/ >6ths. Profiles)
- **Structure of data** (big vs. small customers**)**
- **Quality of data** (problems with measurement)
- **Production of renewables** (mainly photovoltaic significantly fluctuate in portfolio)

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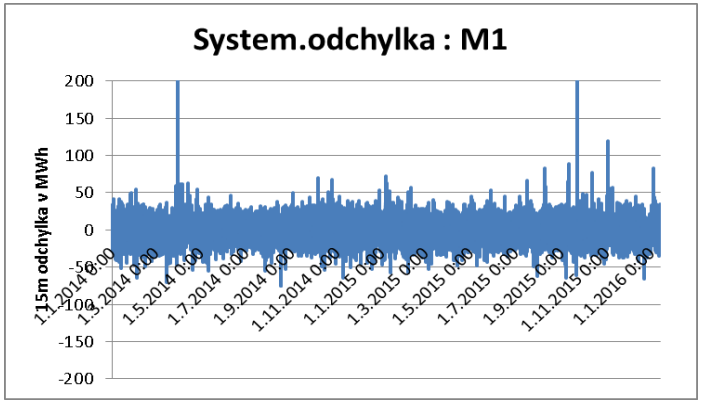
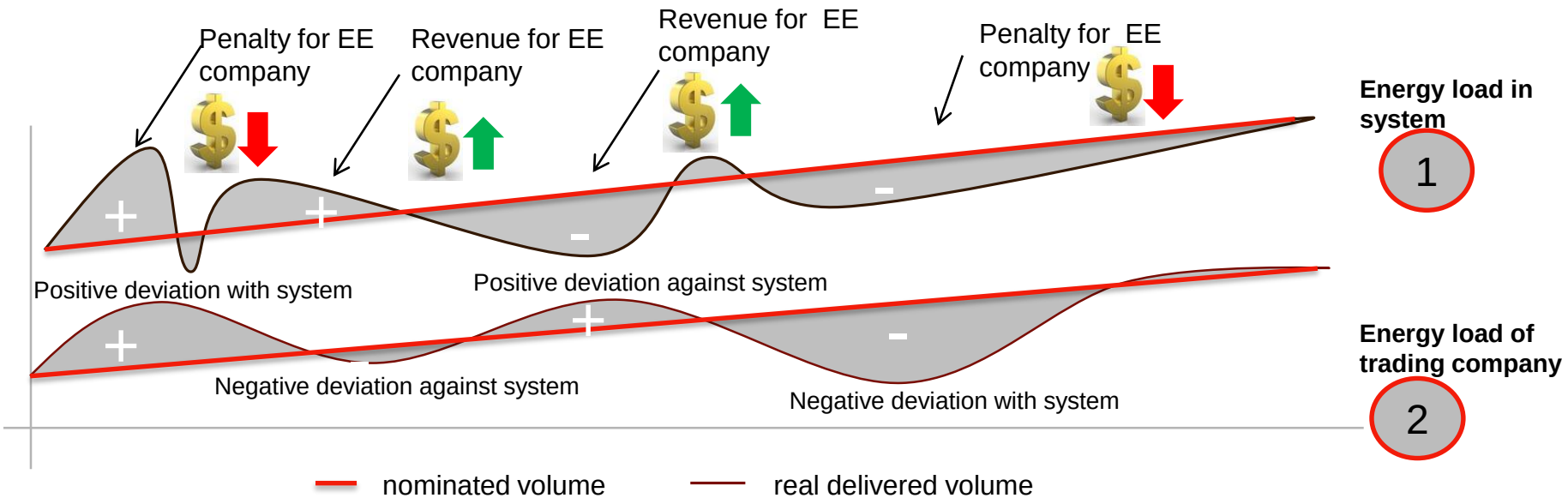
What is deviation (costs) in electricity

Deviation (in volume units/MWh) represent the difference between nominated (plan/purchased) energy and the real energy offtake of customers.



The MWh delta of inaccuracy of nomination (deviation) is financially reflected to energy company in positive or negative way based on following logic:



What is important to understand while modeling prediction

1. **Portfolio data**
   - Off-take/load of customers (6 ths. measured profiles)
   - Development of production if is present in portfolio
   - Significant impact of **photovoltaic** on portfolio data

2. **Prediction Model**
   - Linear/nonlinear model
   - Auto regression model
   - Neural networks
   - Other

MATLAB

$$\hat{\boldsymbol{\beta}} = (\mathbf{X}^{\mathrm{T}}\mathbf{X})^{-1}\mathbf{X}^{\mathrm{T}}\mathbf{y} = \left(\sum \mathbf{x}_i \mathbf{x}_i^{\mathrm{T}}\right)^{-1}\left(\sum \mathbf{x}_i y_i\right).$$

$$X_t = c + \sum_{i=1}^{p} \varphi_i X_{t-i} + \varepsilon_t$$

3. **Relevance of predictors**
   - Weather forecast
   - Working days / weekdays / holidays

Sometimes simple auto regression model can surprise

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How to understanding the correctness of prediction

In order to understand the **best model** is important to test several models and several predictors.....on various scenarios...

How to catch the direction?

Evaluation of errors/determinants transfer it into **money**

Evaluation of errors

$$\mathrm{MAE} = \frac{1}{n}\sum_{i=1}^{n}|f_i - y_i| = \frac{1}{n}\sum_{i=1}^{n}|e_i|\,.$$

$$\mathrm{MAPE} = \frac{1}{n}\sum_{t=1}^{n}\left|\frac{A_t - F_t}{A_t}\right|,$$

$$\mathrm{MSE} = \frac{1}{n}\sum_{i=1}^{n}(\hat{Y}_i - Y_i)^2$$

Simplified:

Deviation costs = MW prediction error x Penalty

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What can I get from prediction modeling

CAN WE PERFORM BETTER?

- Does our company has right model or system set up to perform best predictions?
- Which **component in portfolio cause** me biggest errors = costs what should I do with it in terms of pricing it (customer/production) ?
- Should I do „bottom up“ or „top down“ prediction?
- How should I separate portfolio components to minimize error?

1. Calculate it

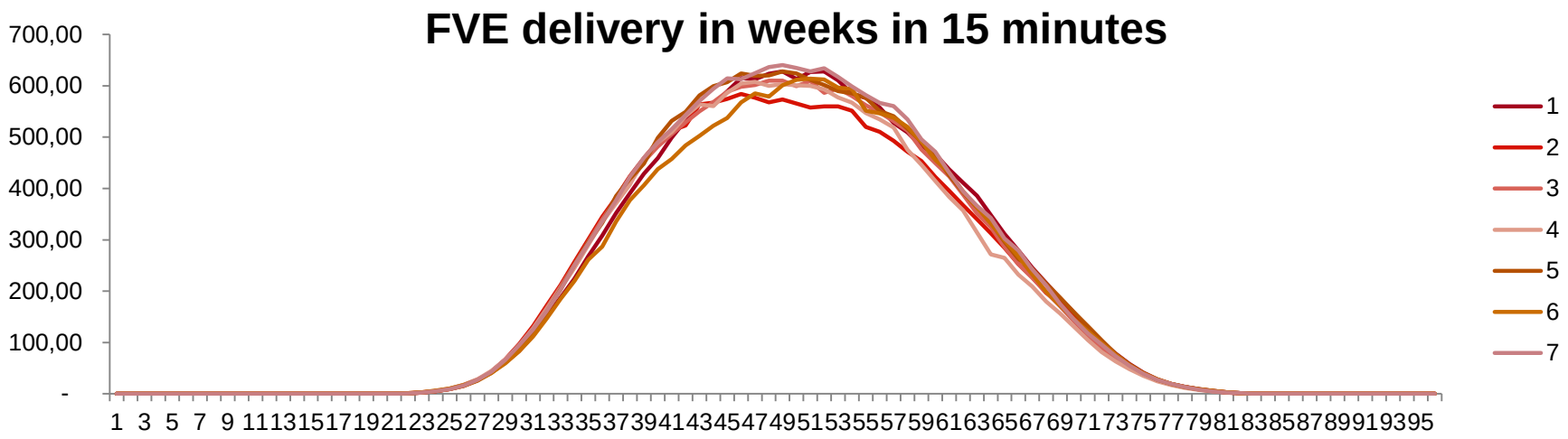
2. Transfer results into money

3. Have arguments what make sense

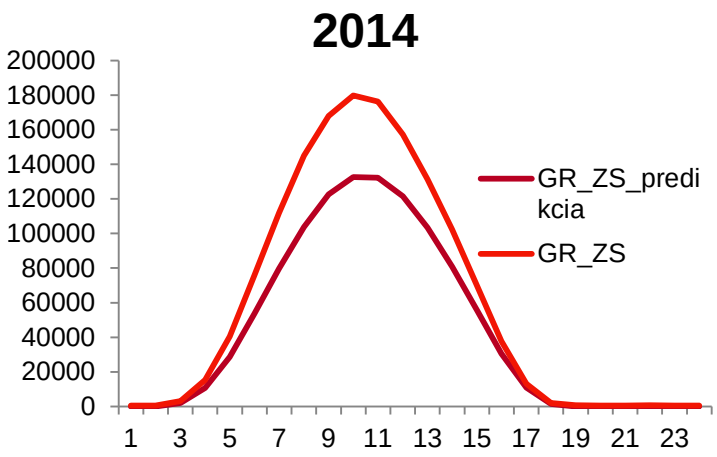
Matlab is environment that can help you to do it!

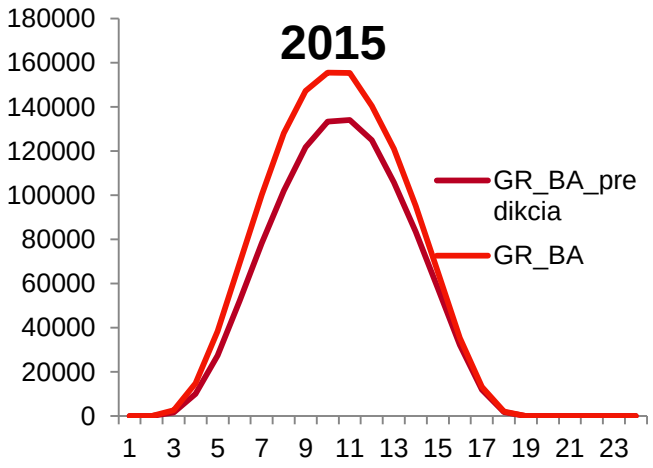
MATLAB

FVE prediction



Predictors – quality/ SHMU data



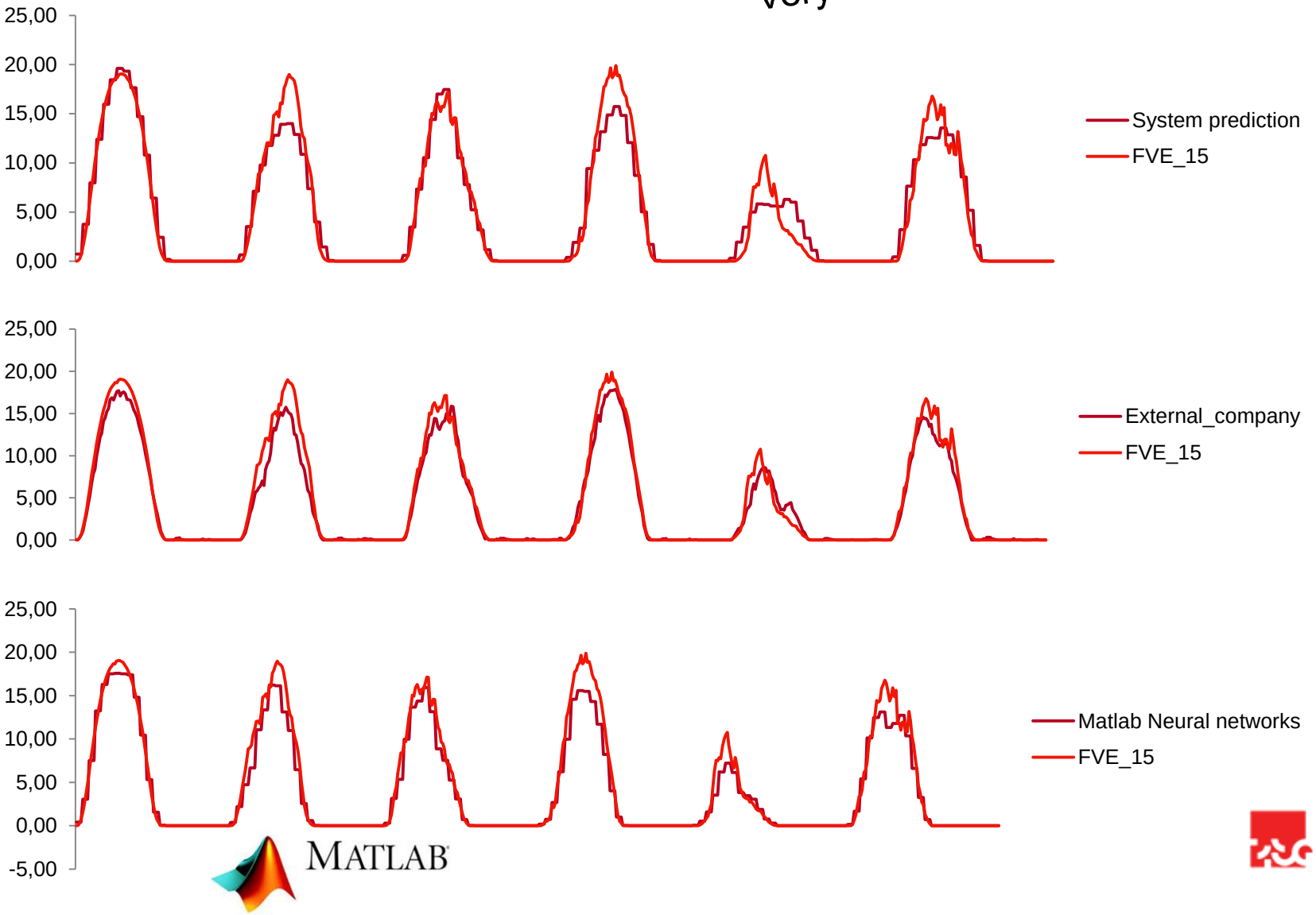


Osvit	Západne slovensko	
roky	2014	2015
mae	56,3	50,65
mape adj	0,34	0,31
mse	110,93	101,51

Osvit	Bratislava	
roky	2014	2015
mae	45,76	43,05
mape adj	0,31	0,28
mse	92,06	84,83

FVE modeling prediction

Very comparable results of all exercises



ZSE