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Content

Master the Renewable Energy Data Challenge – Summary

1. Business background → Business need

In accordance with the European CO2 reduction targets, the capacity of intermittent renewable energy sources (RES) connected to the power grid is increasing. This is impacting the power markets, which continue to evolve towards real-time trading, and thus, staying up to date with the market situation is very critical for power traders.

In the big picture, improving the usage of available data is expected to enhance the market efficiency and therefore, facilitate the integration of large amounts of RES. Traders act on the information they have at hand – by giving them more and better processed information and predictions, they will be able to react faster and make better decisions. The solution you develop shall alert traders to specific changes of data, recognize situations and create alerts, when the market movements, weather alerts or other relevant information suggest that a significant price change has happened or is imminent.

Once the viability of the software has been proven and tested by Alpiq, it might be offered to other utilities and trading floors on a Notifications-as-a-Service basis.

2. Deliverable

Design a novel notification concept for traders and implement self-learning algorithms that automatically create alerts when a significant event in the continuous intraday power market has occurred or is imminent. Achieve this by analyzing a set of signals from timeseries data from different sources to determine the significance of the events, detect significant events, and alert the customers (traders).

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3. Introduction short-term power markets

In 2020, Germany had the highest wind and solar installed capacity in Europe (>115 GW) resulting in 45% of the total annual power to be generated by RES. And until 2030, the share of RES production in the total electricity generation mix is expected to reach up to 65%. Thus, due to the stochastic nature of their production, the turnover of the day-ahead German market has increased significantly and the intraday power market is one of the most challenging and liquid intraday markets. That's why we need you!

Information about the day-ahead and intraday power market in Germany:

- Day ahead market: Power is traded for a specific hour or blocks of hours to be delivered the following day. It closes at 12:00 (midday) of the day before delivery.
- Continuous intraday market: Power is traded in hourly products from 15:00 the day before until 5 minutes before delivery (before the delivery hour begins). There are also quarter and half-hourly products, but they are out of scope for this challenge and would present an interesting opportunity for further development.
  Since the market we are looking at is a continuous (not a static) market, there are some indices for each hourly product, which depict the average market movement for the respective product throughout a certain period of the trading life cycle.
    - ID WAP: volume weighted average price throughout the whole trading life cycle
    - ID3: volume weighted average price within the last 3 hours before delivery
    - ID1: volume weighted average price within the last 1 hour before delivery

Never heard about day ahead and intraday power markets? No problem, a good high level introduction can be found in the knowledge bases:

- https://www.next-kraftwerke.com/knowledge/intraday-trading
- https://www.epexspot.com/en/basicspowermarket.

But which are the main drivers of these two power markets? As in every market, the markets are driven by demand and supply:

- The power demand is related to the schedules of the industry and the private household consumption, which can both fluctuate throughout the day and differ between weekdays to weekends.
- The power supply depends mainly on the thermal power plant availability (nuclear, lignite, coal, gas, etc.) and generation from RES (wind parks and solar/PV production).
- Since the German power grid is interconnected with the neighboring countries, the demand and supply in the neighboring countries play an important role in the German market. Always taking into consideration the available transfer energy capacitiy at the respective border.
- The forecast error in any of these aspects should be depicted in the intraday power market and finally in the grid imbalance. Any imbalance gets penalized with the imbalance price.

To get a feeling for past prices and how they roughly correlate with electricity demand, renewable production, and other factors for the German market, check out the historical data here.

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4. Further business information related to the challenge

To solve the case, we recommend using at least the following data for Germany (more information on how to access data is provided below and in separate documents):

- Power prices: Day-ahead, Intraday, Imbalance prices
- Weather: Wind, Solar, Temperature (different runs and models)
- Demand (electricity consumption)
- Grid imbalance
- Power plant availability
- Transmission grid data (ENTSO-E)
- Unplanned outages (power plants) (EEX transparency)
- Similarly for the surrounding countries: AT / CH / FR / DK / PL / CZ / BE / NL

Recommended timeframe of available data: 2018-2021.

Alerts could be created when the following is recognized by the intelligent algorithms:

- Situation has changed based on most recent update of actuals
- Forecast for future has changed significantly and might require attention
- Event that had an impact in the past has been detected again (unplanned outage, high grid imbalance,…)

Significant situations/events could be identified based on:

- Anything that has a major impact on the intraday prices (i.e., 10%, 20% or x% change compared to day-ahead prices). Consider that your customer (the user) has to keep track of all the alerts, so the frequency of alerts could be something to consider.
  As intraday prices you can use the indices ID VWAP, ID1, ID3.
  - You could enable the users to adjust the sensitivity preferences
- Deltas (changes) between runs: e.g. forecast changed significantly compared to the previous forecast
- Forecast errors: actuals vs. forecast, changes in power plant availability

The content of the notification / alert is up to you. However, here are some suggestions: Reason/Trigger (cluster by categories, i.e. forecast update, outage, price movement,..), impacted time horizon, expected impact, event likelihood (probability) in case of forecast and similar other information.

Users could be asked for feedback on notification relevance to improve the system performance over time.

5. Technical details / Data access and other resources

Data Sources

a. **Wattsight/Volue** accounts: According to separate user guide, account (login) information will be provided to each team separately. Please reach out to us on Discord!

   Time series IDs Wattsight API: Provided in a separate document

   - For DE
     - Prices: DA auction, Intraday Prices (ID VWAP, ID3, ID1, imbalance price)
     - Wind, Solar, Temperature, Demand (Forecast x 8 + Backcast + Normal)
     - Power plant availability + Estimated Production
     - Grid imbalance
   - Please decide on which data from further countries you want to use, we recommend that you use a similar data set for those countries

b. **ENTSO-E:** The API access tokens will be provided to each team separately. Please reach out to us on Discord!

   - API endpoint: https://transparency.entsoe.eu/api
   - API user guide https://transparency.entsoe.eu/content/static_content/Static%20content/web%20api/Guide.html
   - Recommended data:
     - Scheduled commercial exchanges
     - Forecasted Transfer Capacities - Day Ahead
     - Cross-border physical flows
     - Outage data

c. **EEX Transparency:**
   Webpage is the source of all truth - Extract the information from https://www.eex-transparency.com/power

d. **DE grid stabilization measures:** https://www.netztransparenz.de/EnWG/Redispatch
   (→ csv can be easily configured and exported)

Further resources

e. **Unit8 forecasting library** https://github.com/unit8co/darts

f. **Plotly libraries** https://plotly.com/graphing-libraries/

6. Possible approaches and examples:

Some ideas and examples are provided below, however we encourage you to come up with **your own alternative solutions**!

- Webapp which periodically pulls latest data from subscribed timeseries from various sources and based on the expected probability of event occurrence writes detected events on its web page and notifies users, potentially with a link to a plotly chart of the timeseries with a marked detected event and the base timeseries where a change is anticipated.
- Mobile app that allows the trader to access a visualization of:
    - the latest available actual data for the relevant markets
    - the most likely forecast(s)
    - Events and respective additional information (e.g. probability of occurrence if in the future, importance of the event, explanation of the trigger of the event - potentially visualizing the related time series, …)

  This could be done using different screens, e.g.:
    - Diagram displaying clearly distinguishable actuals and forecasts, where time periods are highlighted in case an event has taken place or is expected
    - Event list sorted by time, showing also event properties such as probability and importance

  Possibilities for user settings and configuration:
    - Manage notifications, e.g.
        - Sensitivities - threshold for "importance" of events to be notified about
        - Markets to be notified about
        - Information included in alerts
        - Time window for notifications
        - Type of notification
    - "Feedback" to alerts - collect feedback if an alert is relevant

7. Expectations for pitch:

- Demo of solution
- Explanation of solution approach
- (additional voluntary Q&A session with Alpiq team on Sunday morning)