KW 22

Flexible Software-Umgebung für Strommarkt- und Netzmodelle

VAMOS (VARIED MARKET-**M**ODEL **O**PERATING **S**YSTEM)

Graz, 13.02.2020

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Österreich braucht Strom.

Need to develop a Power Market Model?

Understand fundamental changes in the European power market

- Complexity of power systems makes it impossible to manually asses simple input/output relations.
- Hence, power market models are needed for **detailed assessments** and estimations (market design, bidding zone configurations, grid extensions, network development plans).
- **In house development** of a simulation and optimization tool **started in 2013.**
- First prototype (Matlab/GAMS) of a model to assess changes of BZ-configurations ready in 2015.

In house development project 2016-2019

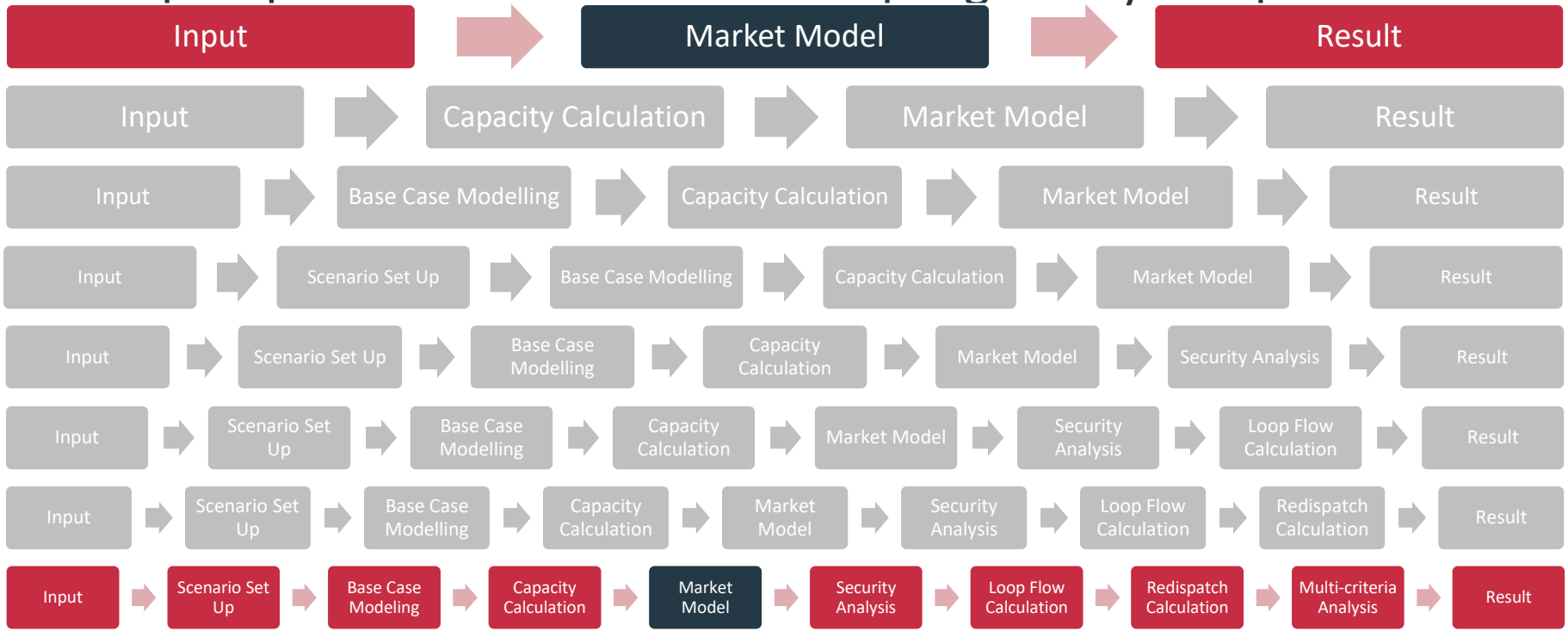
- The first Bidding Zone Review (CACM Art. 31) triggered a further **software development.**
- The market model **prototype** was **transferred** to a software product.
- To make the tool **user friendly** for a **broad range of experts** from different departments, many process steps have been automated and complex interactions have been simplified.

Development of an own power market modelling simulation facility – VAMOS

VAMOS – Varied Market Model Operating System.

Power market assessments I

A complex process chain – Market Coupling is only one part



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Operating system?

In difference to a „plain“ market model, VAMOS is an operating system

Challenges	Solutions
• **Infeasible or implausible outcomes** of modules often lead to manual feedback loops between different modules (e.g. negative RAMs in FB capacity calculation).	• Automation of process chain & consistency checks over process chain.
• A lot of **data** to process, preparations and transformations of data for dedicated tools.	• Tools for big data transformation, formatting, visualization.
• **Distributed** in-house expert **knowledge** (market, grid operation and asset management).	• Experts are brought together at one and easy accessible platform.
• **Dependent on** (single) **experts** for performing simulations.	• Multiple experts can access and work with VAMOS on different tasks.
• Each **scenario** to be **prepared separately** and **laboriously**.	• Easy and quick tools for scenario set up & reusable editing-tasks.
• Only **one simulation per time**.	• Parallel simulations & queueing.

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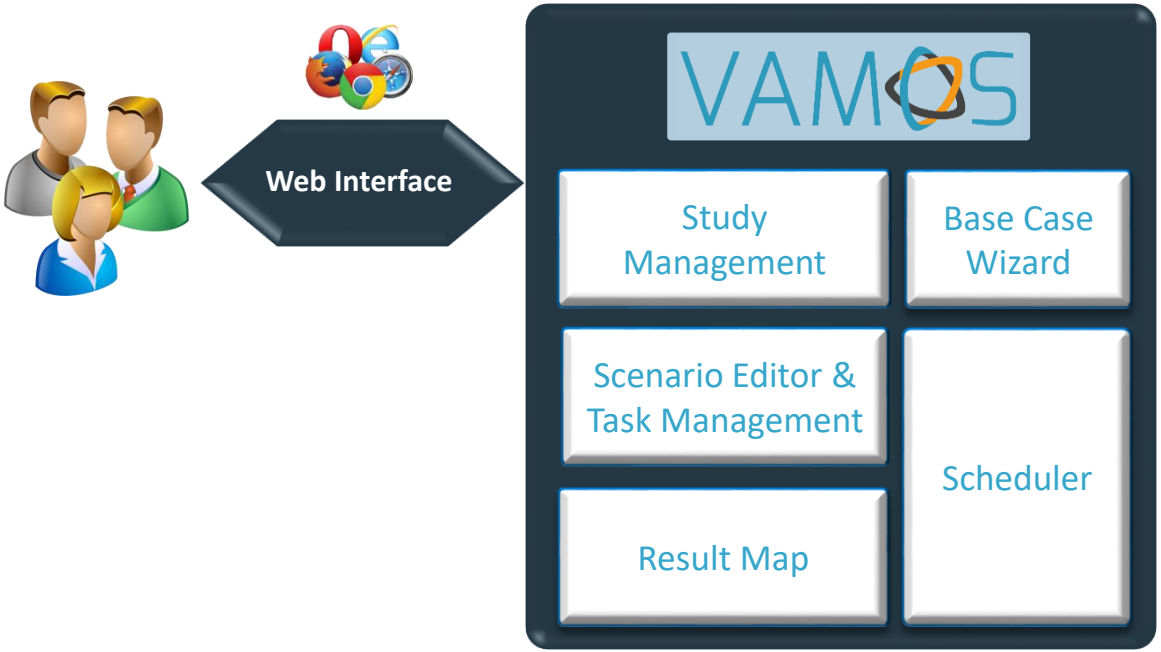
Architecture

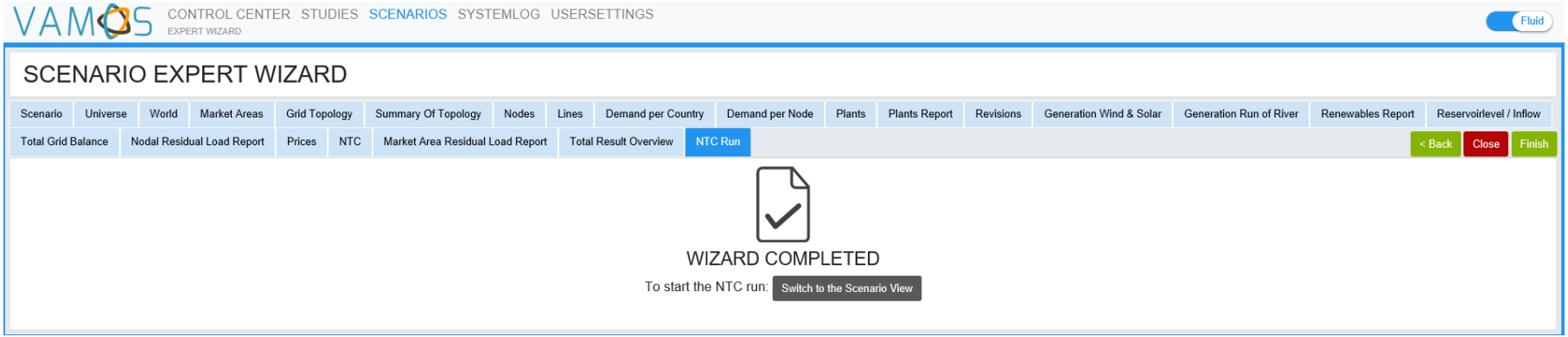
Web based access



Base Case Wizard

Step by step wizard for setting up a scenario base-case record

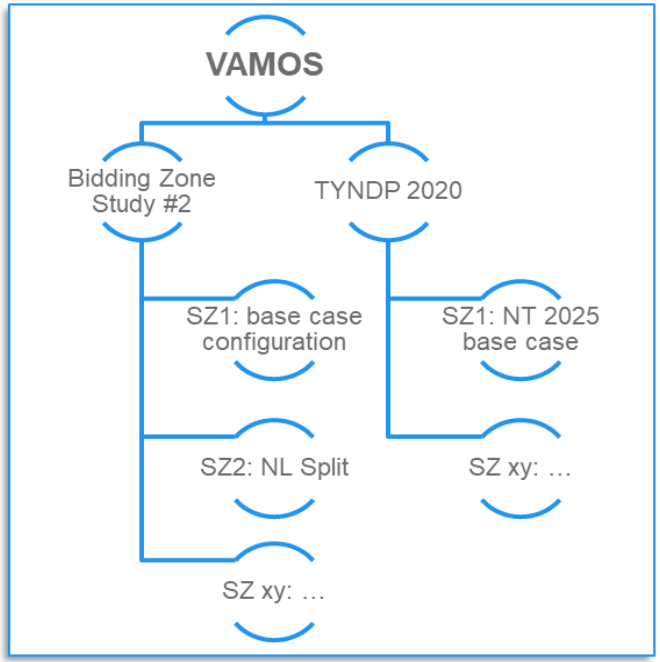
- Once a **base-case record** is set up, it **can be re-used** as a starting point for new scenarios
- Fundamental input data can be uploaded in csv or xlsx format
- Basic checks are immediately performed to ensure feasibility at the best
  - Plausibility checks of all uploaded data
  - Balance checks over the whole simulation area, each market area, and each grid element
  - **Big advantage:** infeasibilities and implausibilites can be caught or at least monitored at a very early stage



Study & Scenario Management

Tree oriented file management

- For calculations a new study can be set up.
- A study may consists of several scenarios.
- Different studies and scenarios can be viewed, copied, partly edited and executed by different users.
- Studies and scenarios can be archived, searched and the results could be compared using different criteria.



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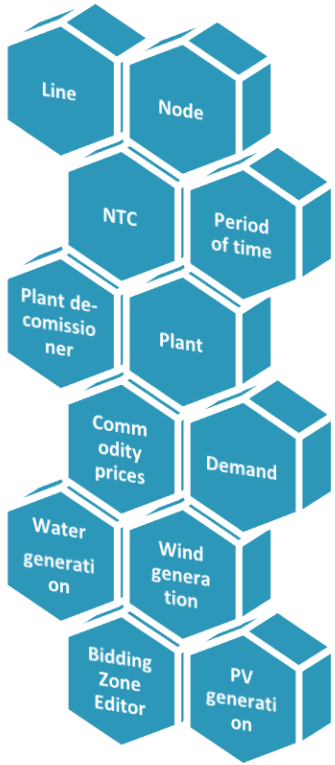
Scenario Editors & Task Management

Setting up new scenarios can be time consuming → supporting tools

VAMOS Provides tools for supporting changes of base case scenarios

- Many assessments are **starting from base cases → sensitivities to be assessed**
- For example common TSO tasks: e.g. define a **new bidding zone**, building a **new line**, **grid node** or change a **NTC.**
- But also **other important parameters** can be changed easily: e.g. commodity prices, power plant phase outs, RES generation.
- Each setting from an editor can be saved as **task** and re-used for future set ups.
- These single tasks can be packed to a **bunch of tasks → called project** and also re-used for upcoming set ups.



Scheduler

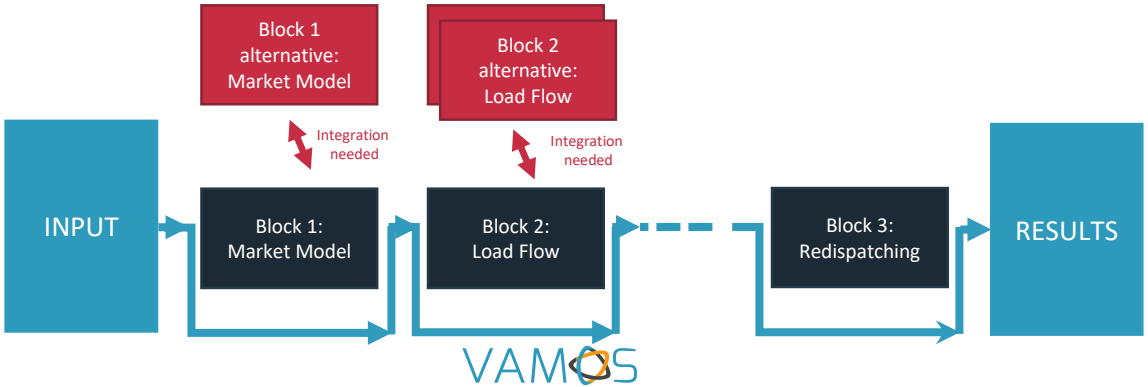
Customization, flexibility, scalability, parallel execution

The scheduler handles the calculation flow

- An assessment chain can be build up; called calculation rule
- Modules are batched and linked.
- Each module can be exchanged, adapted or extended → customized.
- Even different calculation rules can be used at a time

Parallel execution of scenarios

- Model chain is executed as defined in the configuration file and dependent on CPU load.
- VAMOS is able to keep processes in a queue and start them as soon as resources are available.
- Many scenarios can be started and processed in parallel.
- With current APG hardware ~10 scenarios (8760h) can be calculated in parallel.



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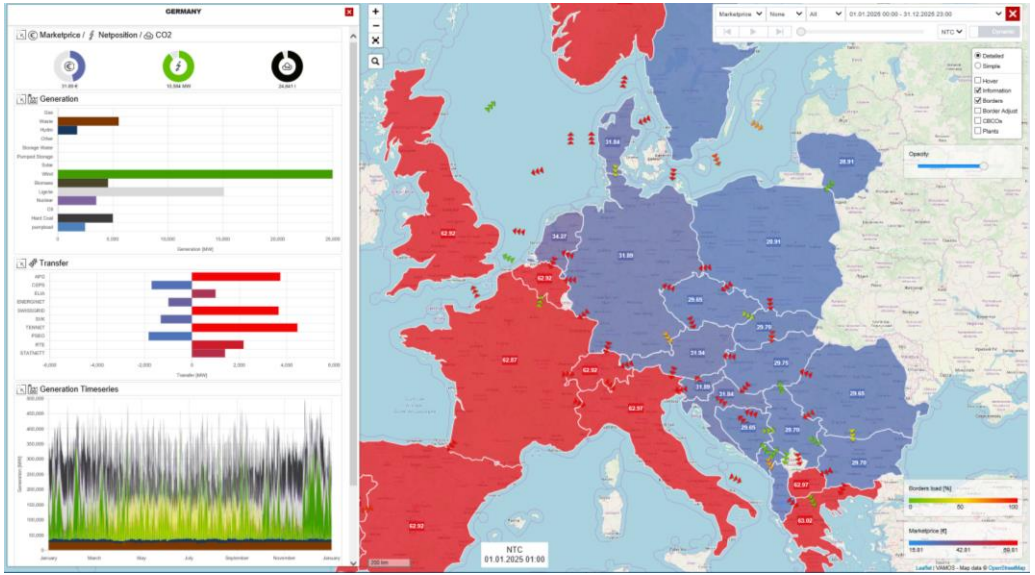
Result Map

Detailed georeferenced result depiction

Quick and user friendly data exploration

- Results can be viewed on a georeferenced-map immediately after a calculation step has finished.
- Detailed information can be shown and selected for all timestamps.
- Raw data can be exported in csv format.



VAMOS

LIVE DEMO

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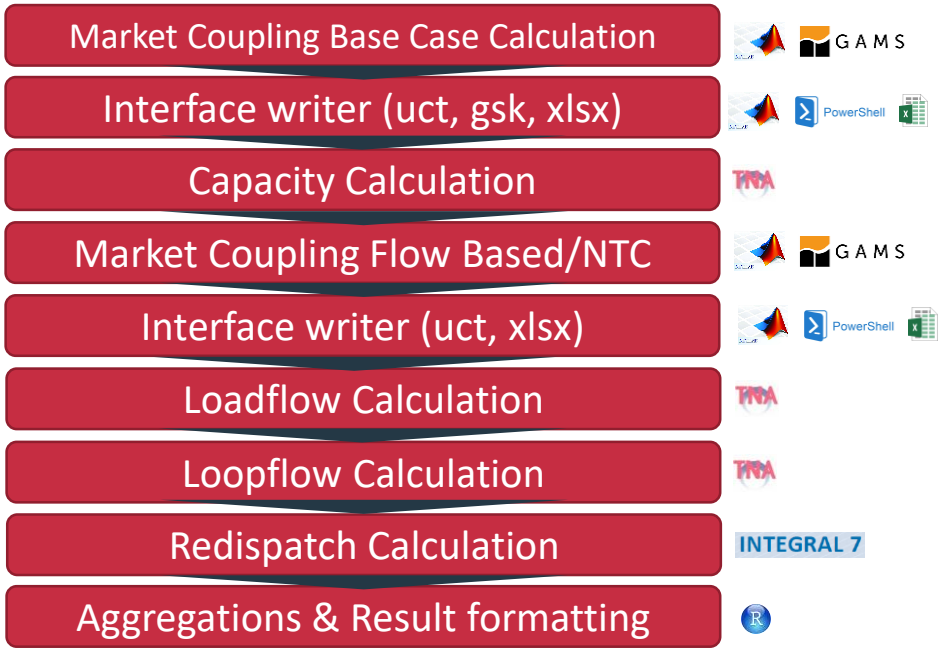
Current APG tools and defined chain



Advantages of VAMOS

Transparent

- Sharing of expert knowledge
- Full transparency in data handling, transformation and formatting

Customizable

Sequence of model chain and core tools can be customized

Base Case Wizard

- Guided base case building
- PEMMDB data can mostly be used as an input

Scenario Editors

- Easy and fast change of up-and-running base scenarios
- For supporting quick sensitivity calculations

Role Management

- Different authorizations for users configurable
- Multi-client capability (planned)

High Scalability

VAMOS software architecture is set up with a high scalability

Easy User Access

Web based

Tailor Made

TSO assessment needs are directly addressed

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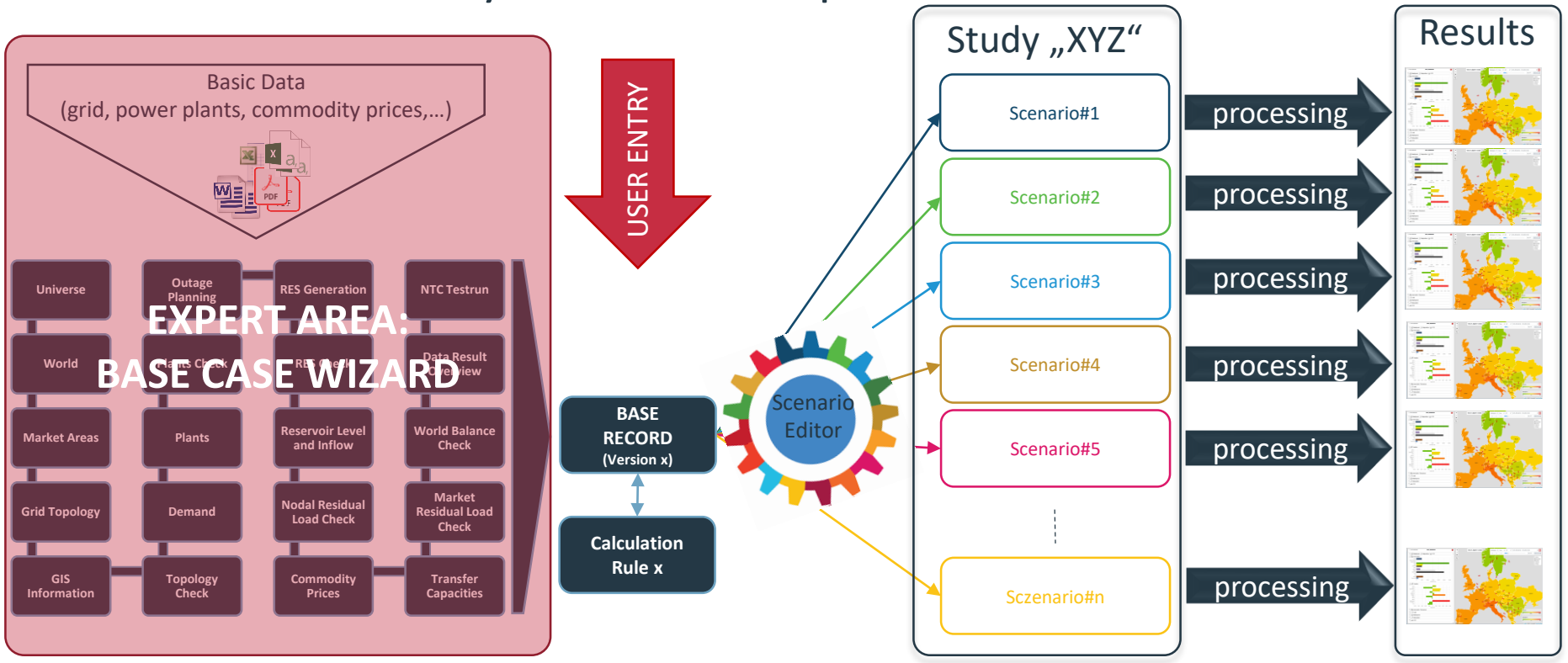
Workflow

Fast and user friendly scenario set up



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Next Steps

- Share expertise and know how.
- Change/integrate other tools & modules.
- Build up a community for multi-disciplinary simulations and calculations.
- Perform simulations and analysis of different current TSO questions coming from new regulations

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