

**WHERE THE DIGITAL TRANSFORMATION
OF THE EUROPEAN ELECTRICITY
SYSTEM STARTS:**

ENTSO-E'S COMMON GRID MODEL

European Network of
Transmission System Operators
for Electricity





To guarantee the efficient operation of the end-to-end electrical systems, transmission system operators (TSOs) need complex operational planning approaches across time horizons from several years to the day ahead of delivery; at hourly intervals on the day of delivery as well as in real time.

These complex operational planning processes, require TSOs to build mathematical models of their grid through consistent data structures. These models allow them to run situational awareness simulations of their grids integrating market schedules with representations of the different elements of infrastructure in service. This simulation process is continuous and iterative across the various time horizons. It ensures constant optimisation of the grid usage while maintaining the security of the system, and thus of electricity security of supply.

The ultimate objective is to have the highest quality forecasts of electricity flows across the pan-European electrical system.

MARKET INTEGRATION AND ENERGY TRANSITION CALL FOR OPERATIONAL PLANNING 4.0

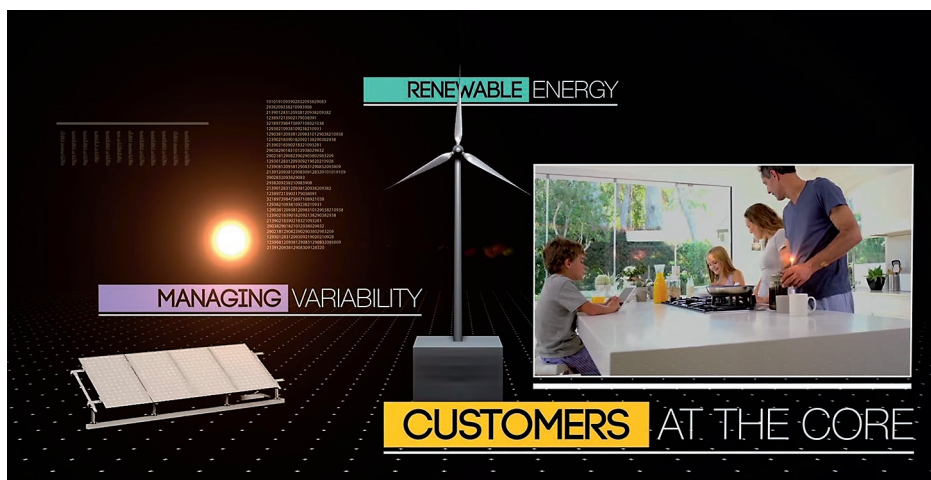
Europe's electricity markets are getting more and more interconnected. This increases the number of cross border flows requiring TSOs to be aware of the situation in neighbouring parts of the European system. Decentralisation of generation, development of demand response, of e-mobility and local storage will lead TSOs to extend situational awareness across distribution systems' boundaries.

In parallel, renewable generation from wind and solar is fast growing with twice as much electricity produced from renewables in Europe today compared to ten years ago. This type of generation is of course dependent of weather conditions and is thus more variable; adding to the difficulty of operational planning. Fur-

thermore, a large share of renewable generation is today physically connected to lower voltage within the electrical system which is not directly observable by TSOs.

HOW ARE TSOs ADAPTING?

TSOs need to adapt their operation through increased coordination – today, horizontally, TSO-TSO, and tomorrow, vertically, TSO-DSO. At the same time they need to leverage new digital platforms for a 'system of systems'. These digital platforms facilitate data exchanges and coordination increasing the observability and forecasting of electricity flows for greater efficiency and security. **One of the first illustrations of this crucial adaption is the Common Grid Model.**



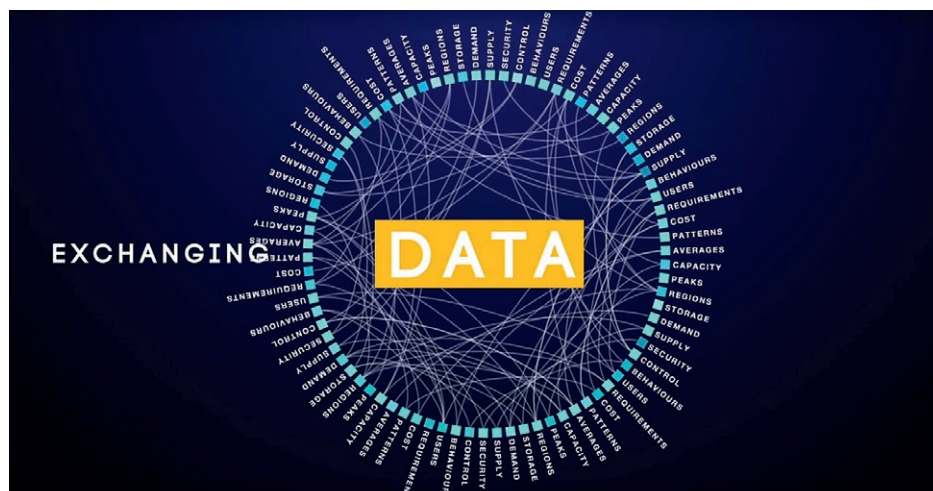
THE COMMON GRID MODEL: CORNERSTONE OF A MORE COORDINATED & DATA-DRIVEN SYSTEM

What is the common grid model? The common grid model will be a pan-European mathematical model of the grid.

How will the common grid model be produced? TSOs need to share their individual grid models with the other TSOs and the regional security coordinators¹ (RSC). RSCs are responsible for merging the different grid models of the TSOs and issue common grid models. These are then shared with the TSOs in order for them to adapt their operational planning with this new regional information. The same process can be used in the future for next TSO-DSO coordination.

What IT infrastructure is needed? The common grid model is considering a vast pool of shared and updated operational data. Therefore, the business process needed to produce common grid models requires a tailor made IT environment. For the management in all security of a continuous exchange of sensitive data, this new operational planning IT environment needs to run on a dedicated communication network. Additionally, central calculation units or apps need to be integrated in the environment to run a series of sub processes at pan-European level.

¹ Regional security coordinators are subsidiary structures of their shareholder TSOs. They were started in 2008 and, following the 2015 multilateral agreement signed by ENTSO-E members, are being rolled out throughout Europe. www.entsoe.eu/regions



ENTSO-E: DELIVERING CUTTING-EDGE IT FOR THE POWER SYSTEM TRANSITION

In 2015, members of ENTSO-E signed a multi-lateral agreement on the coordination of operational planning and derived services. They voluntarily agreed to outsource to regional security coordinators five services that were so far performed on a national or control area basis. The first and core coordinated service is the common grid model. Additionally, three of the eight European network codes² are re-

ferring to coordinated services including the common grid model. The European network codes are turned into or about to being turned into binding EU regulations.

ENTSO-E is tasked by legislation with the delivery of the IT environment, communication network and app store to enable the coordination of services.

THE OPERATIONAL PLANNING DATA ENVIRONMENT

FOR THE SECURE AND OPTIMAL EXCHANGE OF OPERATIONAL PLANNING DATA BETWEEN TSOS AND RSCs, ENTSO-E HAS BEEN DEVELOPING THE OPERATIONAL PLANNING DATA ENVIRONMENT OR OPDE.

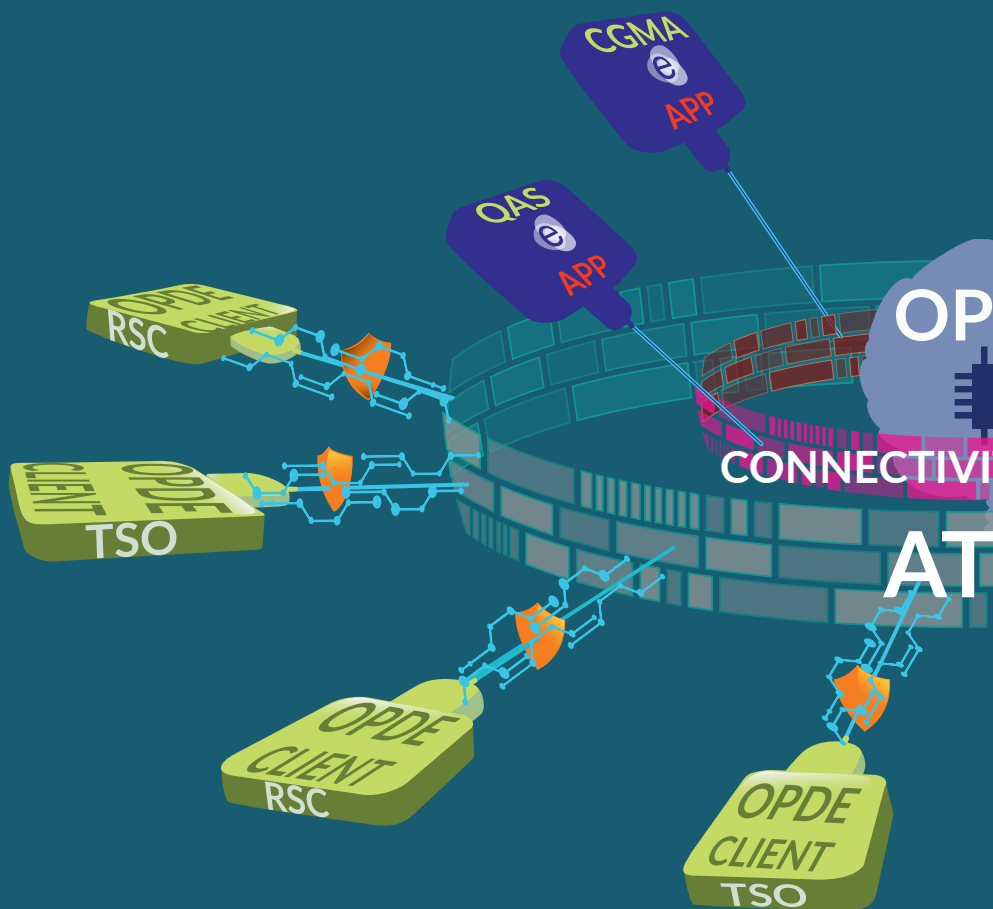
The **OPDE** is a brand new, state of the art, 'system of systems' digital platform that connects the different TSOs to central elements and vice versa. It is designed on the basis of a layered architecture consistent with the SmartGrid Architecture Model. The OPDE will see the development of central business apps for usage across TSOs as a first step but which could be

open at a later stage to other stakeholders of the digital energy value chain.

The OPDE is the central layer: a standard middleware integration layer. The bottom layer is composed of a dedicated communication network called **ATOM** on which the OPDE is running for high security and service levels.

The data exchange standard used in the OPDE is based on the Common Information Model (**CIM**), the international standard of reference for data exchanges within the energy sector managed by the International Electrotechnical Commission (IEC).

² Two of the three codes referring to coordinated services have entered into force as European regulations (the guideline on capacity allocation and congestion management and the guideline on forward capacity allocations). The system operation guideline, which should enter into force in 2017, defines the regional security coordinators and their five services.

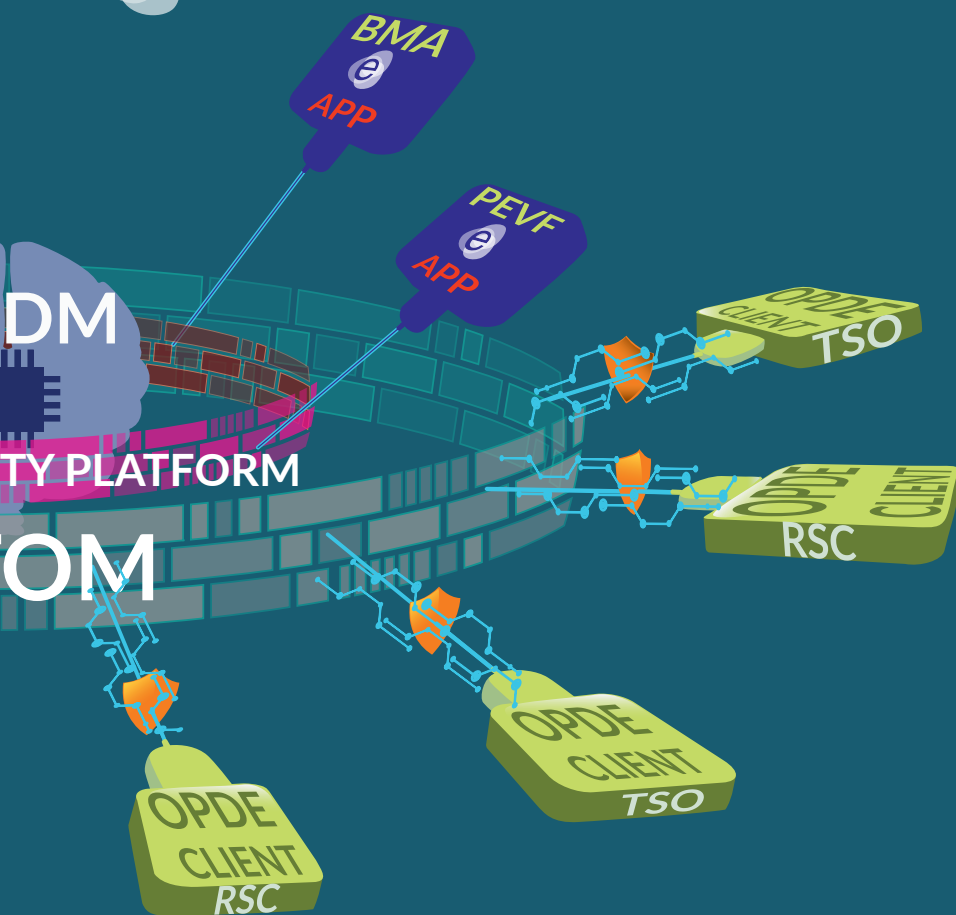


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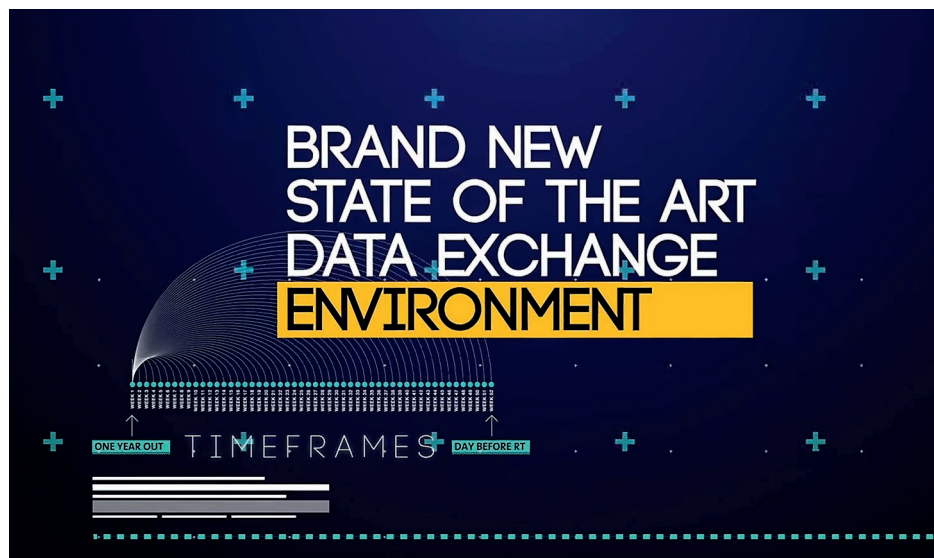
THE APP STORE: GENERIC CALCULATION ENGINES FOR ADVANCED SITUATIONAL AWARENESS AND DECISION SUPPORT IN THE NEXT DIGITAL GRIDS

EXCHANGES AND AGGREGATION OF INDIVIDUAL GRID MODELS IS NOT SUFFICIENT IN CREATING THE COMMON GRID MODEL. A SERIES OF SUB PROCESSES ARE REQUIRED.

A set of apps has thus been developed by ENTSO-E to support the elaboration of common grid models. For example, the **Quality Assessment Service App** checks if the data sent to the OPDE meets the ENTSO-E defined quality standards. The **Pan-European Verification Function App** verifies the consistency of the market

data used in the different models. The **Common Grid Model Alignment App** checks if there is a coherence at European level between the number of imports and exports included in the models.

While more coordinated services get developed as a result of the deployment of European network codes, new apps will be created to support consistent situational awareness and decision-making by the TSOs across the various time horizons.



OPDE: THE DIGITAL ENABLER OF REGIONAL COORDINATION IN OPERATIONAL PLANNING

ENTSO-E AIMS AT STARTING THE OPERATIONAL PHASE OF THE COMMON GRID MODEL PROGRAMME IN THE FIRST SIX MONTHS OF 2018.

But the common grid model is just a starting point. The multilateral agreement and the system operation guideline foresee indeed four other services to be regionally coordinated.

1. Coordinated capacity calculation is about maximising capacity for trading on the network while maintaining system security.

2. Coordinated operational security analysis is a coordinated check of whether the security standards (the N-1 standards) are respected.

3. The outage planning coordination is about regionally coordinating the plans to disconnect grid elements for maintenance.

4. Short and medium term coordinated adequacy forecasts is about coordinated analysis of whether TSOs will have enough generation to cover demand in their control area.





IS THERE POTENTIAL FOR A WIDER USE OF THE OPDE BEYOND THE REGIONAL COORDINATED SERVICES?

POWER SYSTEM OPERATION IS A HIGHLY SKILLED & DATA INTENSIVE BUSINESS REQUIRING REAL-TIME SITUATIONAL AWARENESS AND DECISION SUPPORT.

Market integration, increase of inter-connections, further growth of wind and solar generation but also decentralisation of generation, storage, demand response within lower system voltage, further sector coupling across gas, heating and transport, all this requires more data collection and processing at pan-European scale and between transmission and distribution.

Today most of ENTSO-E's missions end up in data analytics and reporting. Be it the 10-year network development plans, adequacy forecasts, seasonal outlooks, energy market transparency platform, bidding zone reviews, just to name a few.

THERE IS THUS GREAT POTENTIAL FOR THE OPDE TO BE USED MORE WIDELY IN THE TSO COMMUNITY.

There are increasingly interlinked IT needs across TSOs, the RSCs, the capacity calculation regions, the Joint Allocation Office (JAO) and ENTSO-E but also with

power exchanges and distribution system operators (DSOs). The TSO/DSO, wholesale/retail data, linkage is indeed key for implementing the provisions proposed in the package “Clean Energy for All Europeans” of the European Commission.

THE OPDE ENVIRONMENT IS THE FOUNDATIONAL BUILDING BLOCK TO ENABLE THE MULTIPLE AND INTERCONNECTED DIGITAL LINKS NEEDED HORIZONTALLY ACROSS REGIONS AS WELL AS VERTICALLY ACROSS DSOS, ENERGY COMMUNITIES AND PROSUMERS.

WANT TO LEARN MORE ABOUT THE COMMON GRID MODEL? WATCH OUR VIDEO ON YOUTUBE.

<https://www.youtube.com/user/ENTSOE>

DO YOU SPEAK COMMON GRID MODEL?

Here is a list of acronyms often used in relations to the common grid model

IGM	Individual Grid Model	NOC	Network Operation Centre
CGM	Common Grid Model	NSC	Network Security Centre
CGMES	Common Grid Model Exchange Standard	QAS	Quality Assessment Service
EMF	European Merging Function	CGMA	Common Grid Model Alignment
OPDE	Operational Planning Data Environment	PEVF	Pan-European Verification Function
OPDM	Operational Planning Data Management	CGMM	Common Grid Model Methodology
ATOM	All TSO Network for non-real time Operational and Market related data	RSC	Regional Security Coordinator
		MVS	Minimum Viable Solution

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