Teasimed

TOWARDS AN EFFICIENT, ADEQUATE, SUSTAINABLE AND INTERCONNECTED MEDITERRANEAN POWER SYSTEM

Executing short-term demonstration project in the Maghreb Region

Benchmark Analysis

Med-TSO
MEDITERRANEAN TRANSMISSION SYSTEM OPERATORS

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TASK 3 *Identification and put into operation of some selected Interconnected Electricity Exchange Zones (IEEZ), with a view to increasing electricity exchanges in the region*

Activity 3.1 *Executing short-term demonstration project in the Maghreb Region*

Deliverable 3.1.B *Part 1 – Benchmark Analysis*

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1 Executive Summary

This report summarizes the main features of three different coupling cases in Europe and Africa. It shows the different features of the coupling, be it the stakeholders involved, the products traded, how the platforms work and the main fact sheets for each use case.

The objective is to identify the features best suited to be applied in the Maghreb region, taking into account the local constraints, regulations, practices and feasibility. The scalability and the compatibility with the European model are also studied.

The three use cases analysed are the FR-CH JAO auctions for the allocation of long-term and daily cross-border transmission rights, the Trilateral Coupling (TLC) between Belgium, France, and the Netherlands between 2006 and 2010, and the South African Power Pool (SAPP).

In the FR-CH model, the trading participant separately secures energy and the cross-border capacity. This cross-border trading model mainly focuses on a fair allocation of cross-border capacity and requires market participants to trade the energy aside from the transmission rights allocation. It allows to set up the basis for a fair treatment of third parties for the access to cross-border capacity but disregards the energy exchange per se.

The Trilateral Coupling (TLC) between Belgium, France, and the Netherlands between 2006 and 2010 was built thanks to a cooperation between three power exchanges and the three TSOs. It coupled the three spot power exchanges optimizing day-ahead energy trading and the use of cross-border transmission capacity between the three areas. The three power exchanges were existing prior to the set-up of the implicit coupling, so their coupling increased further their liquidity. The Trilateral Coupling was very successful and served as a model for the current European Day-Ahead Coupling.

The South African Power Pool (SAPP) was initiated by the Energy Ministers of the SADC region. Its goals are very broad and encompass grid planning, TSO cooperation, fund raising and market coupling. The products traded are similar to the TLC, i.e., implicit cross-border transmission capacity and energy in coupled auctions. They cover long-term and daily timeframes. The peculiarity of SAPP is that in most of the 9 interconnected countries, the only market participant is the national utility. A few Independent Power Producers (IPPs) and Independent Transmission Companies (ITC) are the exception.

The objective of the next project phase is to select the features from these models, fitting best the Maghrebin specificities.

2 Introduction

Within the TEASIMED Project, Task 3 "Identification and put into operation of the selected Interconnected Electricity Exchange Zones", includes Activity 3.1 "Executing short-term demonstration project in the Western Region (Maghreb): Zonal Platform for Power Trading", where the Benchmarking on similar cases is part of Deliverable 3.1.B.

The main objective of the benchmark analysis is to study similar cases of cross-border electricity markets and trade platform projects around the world that are related to the situation of the Maghreb countries. The study will identify key lessons and best practices from these international projects and use cases that can be applied to the development of the trade platform in the Maghreb zone. In parallel, obstacles and flaws that were encountered in the benchmarked cases can be taken into account to be avoided.

Figure 1 Project Organization.

2.1 The approach

During the execution of the benchmark, the following requirements will be looked at, as discussed during the workshop on 30th May 2022.

- Possibility of design evolution is taken into account (to be able to propose realistic and pragmatic steps)

- The benchmark will include intermediate steps that are realistic and applicable to the situation in the Maghreb region
- A pragmatic approach and not too complex to implement
- Focus of the benchmark study is on TSO activities (no market operator activities)
- Design is compatible with the situation in Maghreb (today no competition at local level in Maghreb countries. Therefore, the initial design should be without any impact on the local "market" structure)
- Compatibility in the long-term with the European model is taken into account
- Trilateral trading platform (currently only two bilateral inter-TSO agreements but no coordination among the 3 TSOs)
- Enhancement of the existing principles under the bilateral TSO cooperation
- Involvement of COMELEC, being the official SPOC for TSOs coordination in Maghreb

2.2 List of models pre-selected

During the inception phase the consultants presented five different cross-border trading models for which the products and level of cross-border integration were mapped from no multilateral trading to optimal trading solutions.

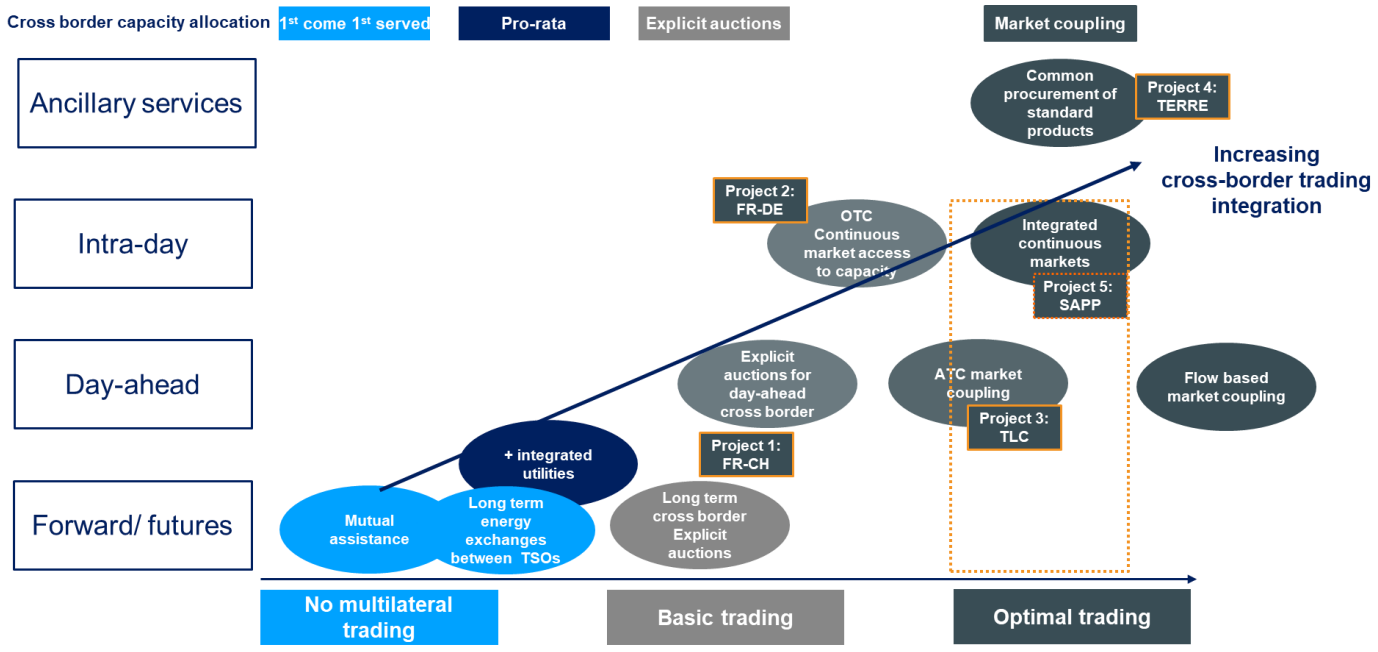

Figure 2 - Landscape of cross-border trade integration - Source: EPEX SPOT

Based on a general explanation of the different models and their respective specificities, the project selected the three following models as the most appropriate to be studied in detail. The two other projects TERRE with balancing products and FR-DE continuous trading were discarded because their product types were more complex to implement.

Projects pre-selected by the project:

- Project 1: FR-CH explicit allocation auctions

(Model: bilateral trade; explicit auctions platform; cross-border nominations)

- Project 3: Trilateral market coupling in CWE countries

(Model: Implicit allocation of capacity with local power exchanges – coupled auction)

- Project 5: SAPP Power Pool

(Model: Multilateral power pool – Trading Platform with multiple time horizon)

2.3 Principles of market integration

2.3.1 Stages of market integration

In order to build power market integration, both top-down and bottom-up approaches can be followed.

In the top-down approach, the TSOs and/or the authorities implement centrally the market coupling at once on a regulated manner. They create a platform with rules and mechanisms to allow market participants to be active in the newly created market. An apparent advantage is that the implementation will be smoother with more central coordination. However, the risk is that the rules do not fit with potential market participants' needs, market participants do not trade, and the market platform remains an empty shell. With such approach, much care should be taken to implement pragmatic tools answering concrete market participant needs. This approach was adopted in the South African Power Pool.

In the bottom-up approach, the development of a power market platform comes from the needs of market participants to exchange. Independent power producers and large industrial consumers start negotiating bilateral contracts locally. This is made possible by the emergence of an embryonic but strong legal framework with some

regulators ensuring that the access of third parties to the grid is granted by the TSOs. The scope of eligible market participants then widens progressively as per the Law. Then, when there is sufficient interest to trade bilaterally from market participants, a private power exchange can develop and organize the transactions more conveniently based on market participants' needs. In this model, a market platform is created only if the conditions are met for its success with already many trading parties seeking to improve the processes of their bilateral exchanges. Lastly, when there are power exchanges in several neighbouring areas, they decide with TSOs to implement market coupling to offer additional trading possibilities while optimizing the use of cross-border capacities. The bottom-up approach is much more gradual, each step being secured before the next one is implemented. This approach was adopted in Europe.

Regarding cross-border trades with neighbouring countries in the bottom-up approach, at the beginning TSOs allocate the capacity for free on the "first come first served" basis. As long as all requests are satisfied and the cross-border capacity is not fully used, there is no need to implement a more complex way to allocate cross-border capacity. When participants request to use more cross-border capacity than what is commercially available, the need to implement a fair capacity allocation method emerges to make sure that all participants can access the cross-border capacity on equal terms. Usually, the fair allocation process is based on a mechanism of offer and demand and leads to the creation of a price. At that stage, TSOs sell the capacity and get remunerated with a congestion rent made of cross-border capacity price multiplied by commercial volumes of energy flowing across the border.

2.3.2 Market coupling and grid management

There are several ways to envisage the links between market coupling and grid management. In the European model, the TSOs organize the grid management apart from the cross-border trading activities. Alternatively, in the SAPP model, both grid management and market platform activities are under the umbrella of the market operator who is also managed by the TSOs.

This is a governance topic since in the end, TSOs shall coordinate to organize joint balancing issues. The difference is how the roles are defined between the market platform and the technical grid management. The advantage of separating the grid management from the market platform sets the basis for the future participation of third parties with a clear distinction between the roles of TSOs as transmission operator, market operator and trading participant.

2.4 Compatibility with the Internal Energy Market principles

The objectives of the Internal European Energy Market are to harmonize and liberalize the markets to build a more competitive, customer-centered, flexible, and non-discriminatory EU electricity market with market-based supply prices.

The regulation on the Internal Electricity Market (Regulation (EU) 2019/943) and the Directive on common rules for the internal market in electricity (Directive (EU) 2019/944), define a set of market-based principles for the operation of wholesale electricity markets. The main principles include:

- The right of customers to choose their electricity supplier and be active market participants;
- The incentives for decarbonized electricity generation will be market-based;
- The barriers to cross-border electricity flows will be progressively removed;
- The producers will be directly or indirectly responsible for their electricity sales;

In order to achieve those principles, the **third-party access right** is a crucial element for opening the Internal Energy Market to competition. It requires the System Operators to treat all third parties - be they producers, consumers or any other entity - on the same level playing field and grant them access to the wholesale market. Therefore, some transparent rules shall ensure access on a just, transparent and non-discriminatory basis to any market player as a first and necessary step to achieve effective competition in the sector.

Unbundling is another important way to ensure that national utilities performing a competitive activity (production and supply of energy) are prevented from also performing a monopolistic activity (transmission and distribution) or will not use their position as grid operators to prevent the development of competition on the generation and retail segments. A firm controlling the network and involved also in the competitive segments of the supply chain has an obvious interest in limiting or denying access to the other firms active upstream or downstream. There are several degrees of unbundling, as shown in the next figure.

The different degrees of unbundling

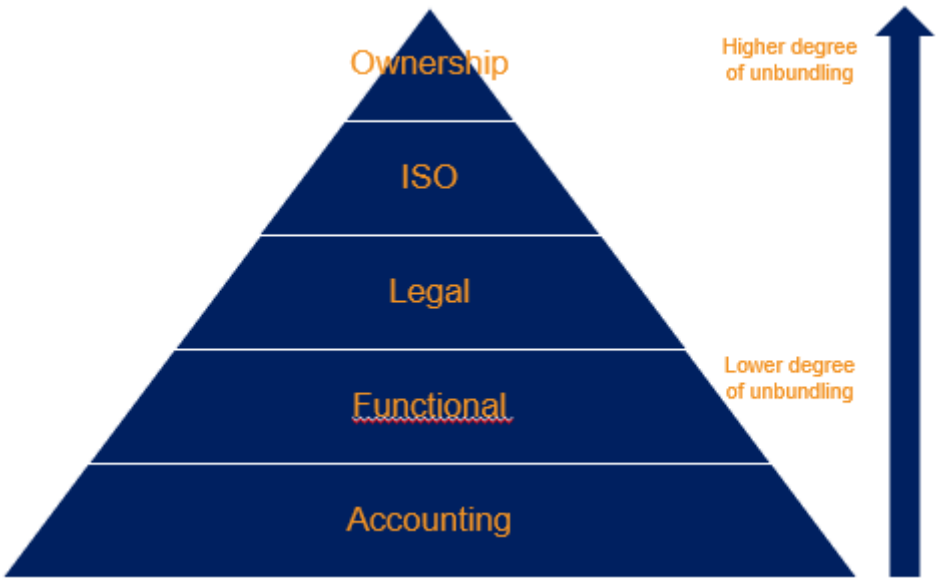

Figure 3 - The different degrees of unbundling
Source: Florence School of Regulation

2.5 IEA modes of power system integration

The International Energy Agency (IEA) has identified three main modes of cross-border integration: bilateral, multilateral and unified. Within these models, multiple categories may be defined. For example, bilateral trades may be unidirectional, may involve intermediaries or may be bidirectional in nature.

Multilateral models are generally supported by regional institutions, but individual jurisdictions may still organize their own local markets and retain full control over system operations. This model may involve differentiated (i.e. mixed) market structures, or might only include jurisdictions with harmonized market structures. Finally, unified models centralize market organisation, and possibly system operations as well, across jurisdictions in a regional institution.

The next figure shows examples of limited (bilateral, unidirectional power trades) to complete (unified market and operations) cross-border integration. The greater the degree of integration, the greater the potential benefits – but also the greater the complexity of organisation.

Examples of limited to complete cross-border integration

Bilateral, unidirectional power trade	• Thailand imports from Lao PDR
Bilateral, bidirectional power trade	• California, USA and Baja California, Mexico
Multilateral, multidirectional trade among differentiated markets	• South African Power Pool
Multilateral, multidirectional trade among harmonised markets	• EU Internal energy Market
Unified market structure, differentiated operations	• Nord Pool
Unified market and operations	• PJM

Table 1 - Examples of limited to complete cross-border integration
Source: IEA

No model is more valuable than another, the most important is to adapt to local constraints in order to build the best framework fitting the reality.

2.6 Trading venues

Electricity can be traded on “organized markets” (managed by power exchanges) or “Over The Counter” (OTC) bilaterally or through intermediaries called brokers.

Power exchanges run auctions and continuous double-sided markets and offer the facilities to trade standard products on an anonymous basis with less administrative costs and a level playing field between all exchange members. On a

power exchange, the counterparty risk is centralized by a clearing house that guarantees the fulfilment of all financial obligations of the trading participants through a daily settlement of profits and losses and a margining and collateralization system.

OTC transactions are bilateral, non-anonymous between a buyer and a seller with the counterparty risk being managed bilaterally between them, even if a broker is involved. When both types of exchanges are possible, OTC transactions can be recorded for clearing at power exchanges as a way of eliminating counterparty risk.

Bilateral vs Exchange: complementary mechanisms

Characteristics	Bilateral (OTC)	Exchange
Products	Standardized or structured	Standardized
Trading amenities	Brokers (telephone, electronic platform), Bilateral (telephone, mails)	Electronic platform
Price transparency	No	Yes
Anonymous	No	Yes
Market rules, protection	No	Market rules, market monitoring
Delivery/ nominations	Participants inform directly the TSO	Nominations are performed by the central counterparty
Payment	Bilateral with counterparty risk	Standardized and secured by the central counterparty

Table 2 –
Bilateral vs Exchange: complementary mechanisms

3 FR-CH explicit allocation auctions

3.1 General description of the model

3.1.1 History

Some long-term contracts were concluded from the 1950s between the national utilities of France and Switzerland. In some cases, running beyond 2050, they have had priority and free access to interconnection capacity. Until 2012 the long-term contracts saturated the entire interconnection for export from France to Switzerland, i.e., approximately 3,100 MW. National regulators decided that the capacity freed up by the expiry of portions of long-term contracts would be made available to market participants and offered through long-term and daily products. As from 2012 a portion of a bilateral contract relating to 610 MW from France to Switzerland expired and the corresponding capacity was thus auctioned explicitly to market participants.

3.1.2 Objective

The objective of the auction platform was to allocate fairly the available cross-border rights to trading participants. The auction system allows to treat the participants anonymously with the same market rules. Once they have acquired cross-border rights, they need to nominate it if they want to use it and flow some energy across the border. The participants buy, sell, produce or consume their energy needs locally aside from the acquisition of cross-border rights.

3.1.3 Structure between TSO, market operator and market participants

TSOs calculate the transmission capacity rights to be auctioned. They take into account the physical constraints and existing bilateral contracts retaining priority. TSOs remain in charge of managing their grid balance, taking into consideration their grid constraints, the electricity flows and the grid losses.

The Joint Allocation Office (JAO) is a service company owned by European TSOs. It hosts Europe's trading platform for cross-border transmission capacity. The JAO auction specifications include the offered capacity and are released to the participants in advance of the auctions. On behalf of the TSOs, JAO auctions the available long and short-term transmission capacity rights on all internal EU borders.

Market participants buy the transmission rights from the TSOs through the JAO platform. To be allowed to participate in JAO auctions of cross-border capacity rights, market participants shall:

- be a balance responsible party or attach their transactions to the scope of a balance responsible party,
- have the necessary authorizations within at least one Member State of the European Economic Area to trade in electrical energy,
- adhere to the Import-Export Rules in order to be able to nominate with RTE French transmission grid,
- adhere to the allocation rules of the border concerned: the JAO participation agreement

3.1.4 Type of local markets

The power market is liberalized in France and Switzerland. Power exchanges can be bilateral, through brokers, or through an organized exchange. The cross-border capacity rights are acquired apart from the energy on multilateral auctions.

FR-CH EXPLICIT ALLOCATION AUCTIONS	
Stakeholders	• TSOs and the European association for the cooperation of transmission system operators for electricity (ENTSOE) • Regulators, the European Union Agency for the Cooperation of Energy Regulators (ACER)
Unbundling of TSOs	Yes
Types of participants	Many market participants of all kinds (National utilities, IPP, industrial consumers, suppliers, aggregators, trading companies, banks, TSOs, DSOs)
Number of participants	Up to 37 per auction in 2021
Principles	Cross-border capacity rights are sold in auctions and must be nominated so that the rights can be used

Products maturity	Yearly, monthly, daily
Energy exchanged	in 2019 FR>CH 19,1 TWh CH>FR: 6,1 TWh
Cost to trade cross-border	Participants pay a fee of €77/month for each transaction (management fees per import or export transaction attached to a BRP perimeter, on a border and a deadline) This fee comes in addition to the cost of the cross-border capacity itself. For delivery November 2021 to October 2022, the congestion rent for the TSOs (i.e. Price of cross border capacity*volume of capacity allocated) of monthly and yearly products in FR-CH and CH-FR directions amounted to 19 kEuros for yearly and monthly products.

Table 3 - Fact sheet of FR-CH explicit allocation auctions
Source: JAO, EPEX SPOT

3.1.5 General cross-border arrangement

The market participants must be Balance Responsible Parties in the market area they want to trade. They also sign an agreement with the market operator JAO.

3.1.6 Summary of process

The TSOs sell the transmission rights to the participants through an auction organized by JAO. The participants shall inform digitally the TSOs if they use the transmission right. In case they use it, they must balance locally their energy balance perimeter with injections or withdrawals.

This cross-border capacity allocation allows fair competition between participants except that part of the cross-border capacity is booked as a priority for long-term bilateral contracts signed before the markets liberalization.

3.2 Fact sheet

FR-CH explicit allocation auctions	
Stakeholders	• TSOs and the European association for the cooperation of transmission system operators for electricity (ENTSOE) • Regulators, the European Union Agency for the Cooperation of Energy Regulators (ACER)
Unbundling of TSOs	Yes
Types of participants	Many market participants of all kinds (National utilities, IPP, industrial consumers, suppliers, aggregators, trading companies, banks, TSOs, DSOs)
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Cost to trade cross-border	€77/month per transaction (management fees per import or export transaction attached to a BRP perimeter, on a border and a deadline)

Source: JAO, EPEX SPOT

3.3 Respective roles and responsibilities, and the related operational agreements

EU grid codes

The Network codes were introduced as a result of the EU's third energy package. They are legally binding directives issued by the European Commission in the form of regulations and are based on the drafts of ENTSOE. This set of rules constitutes the uniform provisions concerning the operation of the market and the network. Among them the following are impacting cross-border allocation at the French-Swiss border. As Switzerland is not part of the European Union, it only follows parts of these provisions.

The Network Code on Forward Capacity Allocation (FCA) 2016/1719 deals with rules on cross-zonal capacity allocation in the forward markets, on the establishment of a common methodology to determine long-term cross-zonal capacity, on the establishment of a single allocation platform at European level offering long-term transmission rights, and on the possibility to return long-term transmission rights for subsequent forward capacity allocation or transfer long-term transmission rights between market participants. All TSOs have appointed a joint allocation office (JAO) in accordance with Article 49 of the FCA regulation, to act as the single allocation platform (SAP) for FCA as of 1 November 2018. The cost sharing methodology is in accordance with Article 59 of the FCA regulation.

Objectives of forward capacity allocation (Article 3 of FCA Network Code):

(a) promoting effective long-term cross-zonal trade with long-term cross-zonal hedging opportunities for market participants;
(b) optimizing the calculation and allocation of long-term cross-zonal capacity;
(c) providing non-discriminatory access to long-term cross-zonal capacity;
(d) ensuring fair and non-discriminatory treatment of TSOs, the Agency, regulatory authorities and market participants;
(e) respecting the need for a fair and orderly forward capacity allocation and orderly price formation;
(f) ensuring and enhancing the transparency and reliability of information on forward capacity allocation;

(g) contributing to the efficient long-term operation and development of the electricity transmission system and electricity sector in the Union.

The Network Code on Capacity Allocation and Congestion Management (CACM) 2015/1222
The Guideline on Capacity Allocation and Congestion Management sets out the methods for calculating how much space can market participants use on cross-border lines without endangering system security. It also harmonizes how cross-border markets operate in Europe to increase competitiveness but renewables' integration. CACM is the cornerstone of a European single market for electricity.

The other Network Codes are defining the system operations of the grid (SO GL), the Emergency and Restoration (NC ER), Electricity Balancing (EB GL) and Network Connection Codes. It is interesting to note that in Europe, the rules and obligations related to the organization of the market are clearly distinct from those related to the operation of the grid.

The balance responsible party system ensures the balance of electricity supply and demand. A balance group contract shall be signed between the participant and the TSO. The European regulation on balancing provides that all transmission system operators develop a proposal regarding the "terms and conditions for balance responsible parties".

- French rules relating to the balance responsible parties system are compiled in the "MA-RE Terms and Conditions"
- The Swiss Balancing Concept describes how the power market and balance group management works in Switzerland, in particular the interface between Swissgrid and the balance group managers.

The Nomination Rules organize the notification of use of physical transmission rights from the holder and their counterparty, or an authorized third party, to the respective transmission system operator.

- **The Access Rules for Imports and Exports** on the French public power transmission system define the principles governing the implementation of import and export programs on interconnections for different timeframes. The rules notably define the technical, financial and legal criteria and procedures for nominating import and/or export programs with RTE following the allocation processes

- **The Swiss Transmission Code** defines the technical and organizational principles governing the Swiss transmission system. Its provisions deal with the relationships between Swissgrid and the distribution system operators / owners, generating units, end consumers and other electricity market participants. The Transmission Code lists the tasks and functions of all parties concerned and governs the interfaces between Swissgrid and the market participants identifying the minimum requirements governing operation, use of and connection to the Swiss transmission system.

The Participation Agreement is the agreement, by which the parties undertake to comply with the terms and conditions for daily capacity allocation. The allocation platform (JAO) and the participant are the parties signing the Participation Agreement.

Allocation Rules for Forward Capacity Allocation on Swiss Borders

The Allocation Rules contain the terms and conditions for the allocation of long-term transmission rights on the Swiss borders. They set out the rights and obligations of participants as well as the requirements for participation in the auctions. They describe the auction processes, the determination of marginal price, the conditions for transfer and return of long-term transmission rights, the remuneration of holders of such returned long-term transmission rights, the processes for curtailment of long-term transmission rights and invoicing/payment.

3.4 Capacity calculation process

Available capacity for trading: multilateral power trade bidirectional since 2012

At the French-Swiss border, the bilateral long-term contracts valid until after 2050 have priority to the interconnexion. The nominations can be late which impedes the corresponding non-used capacity to be sold in subsequent long-term or daily explicit cross-border auctions or to allow a netting and an increase of the available cross-border capacity in the opposite direction. As a consequence, the total available capacity for trading for long-term products does not rely on a regular capacity calculation update.

In D-2, the short-term available capacity is deducted from the already nominated exchanges and the potential reductions due to grid safe management.

Physical transmission capacity

The determination of the transmission capacity of the network – "Net Transfer Capacity" (NTC) on the interconnected network is a task of transmission system operators; it allows market players to carry out their energy transactions without jeopardizing the interconnected network. The NTC corresponds to the maximum exchange schedule between two service areas, which complies with the security standards of the two areas.

- Direction Switzerland to France: the NTC is worth 1100 MW for the annual and monthly deadlines, once the capacities reserved for the long-term bilateral contracts have been deducted. In exceptional circumstances the NTC may be reduced.
- Direction France to Switzerland: the NTC is worth 3000 MW in summer and 3200 MW in winter for annual and monthly deadlines, once the capacities reserved for the long-term bilateral contracts have been deducted. In case of exceptional circumstances, the NTC may be reduced.

TSO coordination

In agreement with the neighbouring TSOs, Swissgrid determines the NTC values for the four Swiss borders on an annual, monthly and daily (D-2) basis. A reference situation is used for exports and another for imports. The cross-border exchanges are adapted to take into account links with other borders having an impact. Then the 2 TSOs coordinate and take the most conservative figure.

Wheeling Charges

As the cross-border exchanges between France and Switzerland are bilateral, there is no specific need to organize wheeling charges. Each TSO charges producers and consumers local network charges depending on their generation and load level. There is no interference between the commercial trading and the network technical charges.

Losses management

The electrical transmission network always suffers losses for physical reasons. These are due to resistances, such as lines and transformers, and materialize by heat losses diffused into the environment. Factors such as the network load, the outside temperature or the states of the switching stations in the network have an impact on the magnitude of the losses. As transmission system operators, Swissgrid and RTE compensate transmission system losses by purchasing the corresponding quantities of electricity on the energy market. The amount of losses depends on the amount of electricity physically injected and withdrawn from the grid. They are financed by the local network charges paid by

generators and end consumers. The trading participants are thus not impacted by the losses. The energy bought is equal to the energy sold.

Unavailability

In the event of a capacity reduction, the TSO informs the market participant that holds these capacities that it will not be able to honour them, and it pays him financial compensation, according to the terms prescribed by the FCA rules.

3.5 Trading Platform

3.5.1 Characteristics of the market operator

JAO was established in 2015 following the merger of two auction offices – Capacity Allocation Service Company (CASC.eu) and Central Allocation Office (CAO) – and is owned by 25 European TSOs. On the 1st of October 2018, JAO became the single allocation platform for all EU TSOs in accordance with EU legislation.

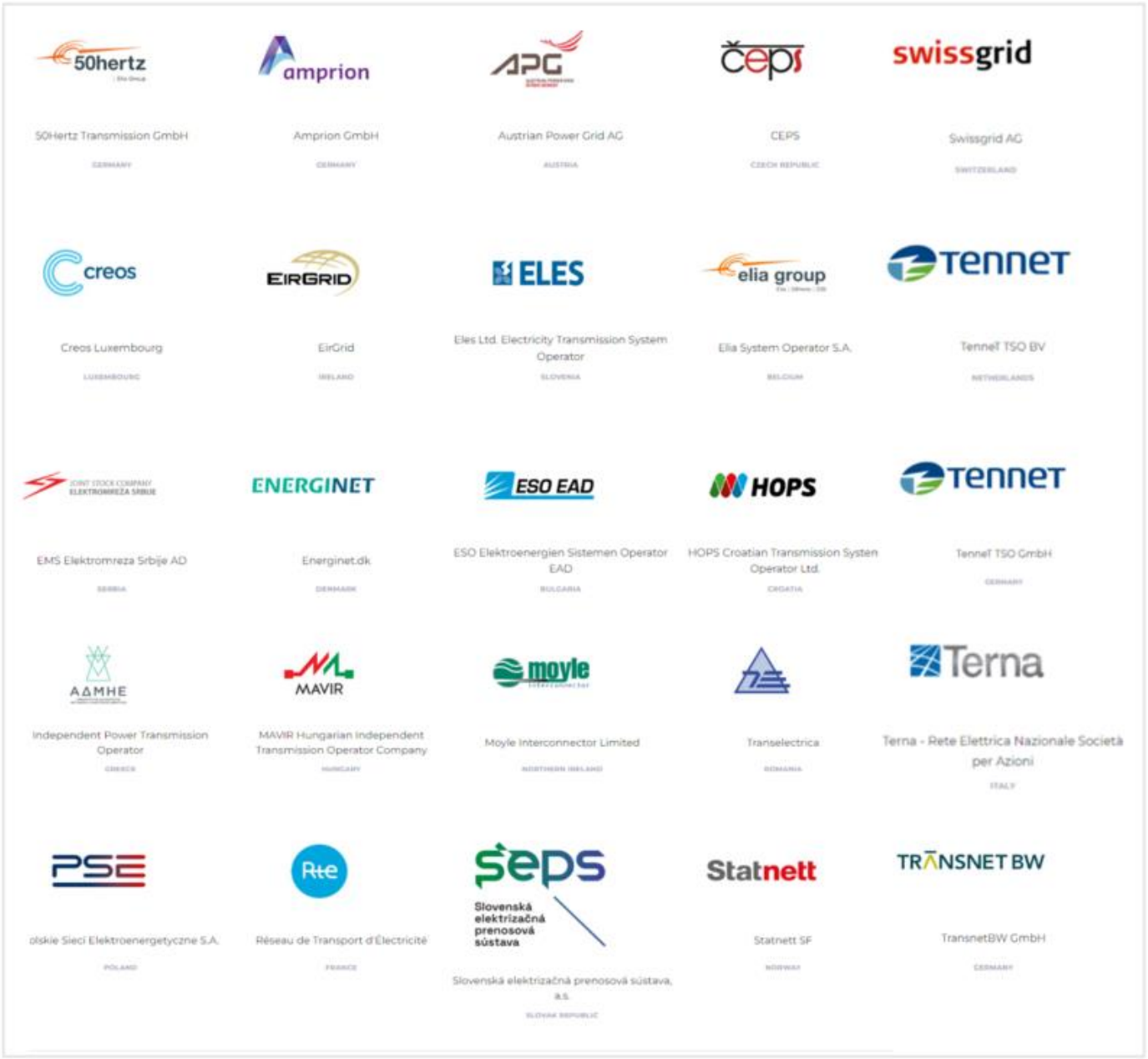

Figure 4 - JAO shareholders
Source: JAO

Governance

JAO is managed by two corporate bodies being the Management Board in charge of the day-to-day management of the company, and the Supervisory Board, which is in charge of conducting supervisory function.

Activities

On behalf of TSOs, JAO auctions long and short-term cross-border transmission capacity rights. Its activities include onboarding, operation, communication, contracts, helpdesk, financial clearing and settlement and congestion income distribution.

In the onboarding of new participants to the explicit auctions, JAO performs know-your-customer processes to verify their identity, suitability, and risks. JAO also maintains a business relationship with market participants in order to comply with anti-money laundering regulations.

For the communication, JAO presents the auction calendar and the auction results on its website. A market messages section also allows to publish market announcements such as borders capacity curtailments, platform downtimes or auction calendar updates.

While participating in many electricity market integration projects with similar services, JAO builds on its experience and fosters harmonization across the TSO community. It enables TSOs to avoid adding up different contracts and significantly reduce their transaction costs and related efforts.

3.5.2 Membership

Types of market participants

All companies are allowed to trade, provided they conclude a valid and effective Participation Agreement with the allocation platform, comply with the requirements for provision of collaterals, and with the specific provisions per TSO border and where applicable per direction. They can be any company, fulfilling those requirements, be they producers, industrials, end consumers, aggregators, national utilities, banks, trading company or any other type of company.

There is a single seller of cross-border capacity which is JAO on behalf of TSOs, and up to 37 multiple buyers on the FR-CH long and short-term auctions. The cross-border capacity auction allocation can thus be considered as multilateral trade.

Costs to access/use the Trading Platform: 77 Euros/transaction

3.5.3 Market operations

3.5.3.1 Sending order book > auction > results > nomination > settlement

Interconnection capacity is sold via auctions by the TSOs to the market participants. Then, the interconnection capacity buyers declare/nominate their power exchange schedule to the relevant transmission system operators (cross-border nomination).

Calculation of credit limits

The platform calculates and continuously updates the credit limit of each participant for each auction. The credit limit shall be equal to the amount of the collaterals in place minus any outstanding payment obligations. The platform makes this information available to each participant individually through the auction tool.

Auctions specifications

Prior to the auction, the platform publishes auction specifications on its website. For yearly auctions the platform publishes the auction specification no later than 1 week and for shorter capacity allocation timeframe no later than 2 working days before the end of the bidding period of an auction.

Sending of orders

Each participant may place bids in the auction tool until the relevant deadline expires according to the respective auction specification. Each bid includes a bid price in Euro/MW with 2 decimals and a bid quantity in full MW. The participant can modify or cancel his bid before the gate closure time. The participant has the option to send orders which will apply automatically to each subsequent relevant auction.

Verification of credit limits

Upon submission of an order, the platform checks whether the maximum payment obligations connected with the participant at the time of the bid submission exceeds the credit limit. If so, the platform issues automatically a warning to the participant to modify his credit limit.

Auction calculation

After the gate closure for placing bids in the auction, the platform checks the bids against the credit limits of the participants. Bids still exceeding the credit limits are not taken into account in the auction calculation.

The calculation of results identifies the winning bids to be fully or partially satisfied, and the marginal price per direction.

The calculation aims at maximizing the sum of the participants' surplus and the congestion income generated by the winning bids while respecting the constraints of the optimization function in form of relevant offered capacities.

Result publication

The results of the auction are notified individually to the participants via the platform. The transmission rights are deemed to have been allocated to a participant from the moment he has been informed of the results and the contestation period is closed.

The platform also publishes on its website the anonymously aggregated results:

- total requested transmission rights in MW;
- total allocated transmission rights in MW;
- marginal price in Euros/MW per hour;
- number of participants in the auction;
- number of participants with successful bid;
- list of anonymous bids;
- congestion Income per bidding zone

Use of transmission rights

The holders of transmission rights shall nominate the use of their rights before the nomination deadlines.

Auction fallback procedures

If it is technically not possible to hold an auction under normal processes, the postponement of the auction is the default fallback procedure.

Curtailment

Daily transmission rights may be curtailed in the event of force majeure or an emergency situation according to applicable legislation. In the case of force majeure or emergency situation, holders of curtailed transmission rights shall be entitled to receive a reimbursement equal to the price of the transmission rights set during the daily transmission rights allocation process.

3.5.3.2 Financial settlement

The JAO platform is the central counterparty. It collects payments from the participants and distributes the congestion rent to the TSOs.

Participants pay for the transmission rights allocated to them as follows:

Marginal Price (per MW per hour) × Transmission rights in MW allocated in individual hour of a day

The transmission rights are invoiced on a monthly basis retroactively for the preceding month. The invoice is sent by e-mail to the participant. In the cases of curtailment of transmission rights, the invoices take into account any payments to be credited to the participant.

Then, the platform collects the payment automatically from the dedicated business account of the participant on the due date of the invoice. Alternatively, the participant ensures payment through a non-automated transaction to the account of the platform specified on the invoice.

3.5.4 Products

3.5.4.1 Energy Products

This model does not take into account the settings of the local transaction for energy. It only provides for the possibility to flow energy cross-border. It is up to the participant to procure or dispose locally some power through generation, consumption or trading.

3.5.4.2 Capacity Products

Physical transmission right means a right entitling its holder to physically transfer a certain volume of electricity in a certain period of time between two bidding zones in a specific direction.

FR-CH transmission rights are yearly, monthly and daily products. The JAO platform also offers the following products for other borders: yearly, seasonal, quarterly, monthly, weekly, daily and intraday.

The physical transmission right is “Use it or Sell it” for long-term products and “Use it or lose it” for the day ahead timeframe.

Use It or Sell It (UIOSI) is a principle stating that when a participant does not nominate its long-term transmission rights, JAO will sell that respective transmission capacity on the relevant daily auction. The product of the rights resold are transferred to the participant.

Use It Or Lose It (UIOLI) is used for daily rights and where a market participant is not nominating (using) his capacity, his rights would be lost, and no compensation would be given to market participant.

3.5.5 Price formation

The auction of transmission rights is a pay-as-clear pricing model where all accepted bids are paid the marginal offer. The demand curve is the aggregation of all individual demand curves.

Determination of the pay-as-clear price

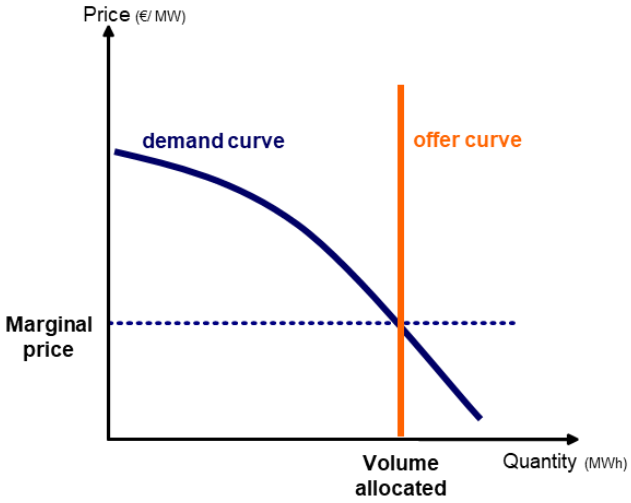

Figure 5 - Determination of the pay-as-clear price
Source: EPEX SPOT

Price when the demand is lower than the offer

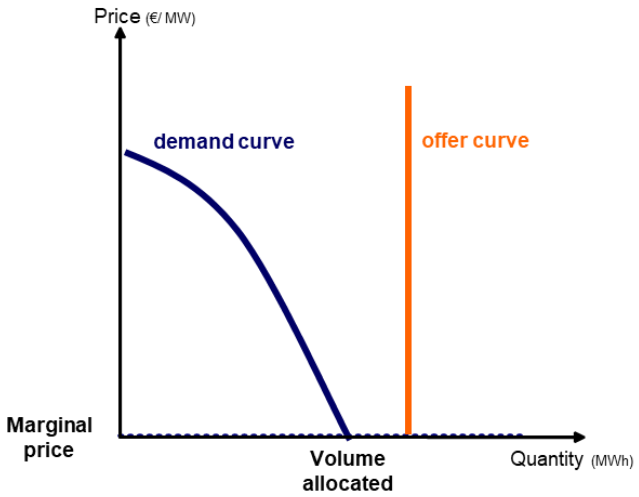

Figure 6 - Price when the demand is lower than the offer
Source: EPEX SPOT

If the demand for cross-border transmission rights is lower than the capacity offered in an auction, the price is null.

Congestion rent

The congestion rent corresponds to the volume allocated multiplied by the marginal price. If the volume allocated is lower than the volume offered, the congestion rent is null. It is to be noted that historical bilateral long-term contracts which have the priority on the FR-CH border have a free access to the cross-border capacity, be it saturated or not.

The congestion rent revenues are used to guarantee the effective availability of capacities allocated (firmness of products), to develop capacities of interconnection through investments and, finally, as a deduction the tariff for using the transmission network.

3.6 Market integration and EU compatibility

3.6.1 Regulatory context and stakeholders

The FR-CH cross-border allocation uses the JAO platform governed by the European Network Code on Forward Capacity Allocation although the France-Switzerland border has not been the subject of a decision within the framework of the implementation of the FCA regulation, since Switzerland does not fall within its scope.
National regulators CRE and ElCom decided in 2012 that the capacity freed up by the expiry of portions of bilateral long-term contracts would be made available to participants and offered for daily and long-term timeframes.

3.6.2 Local harmonization and implementation

The FR-CH model is independent from the local market settings. It allows participants to trade power cross-border on a bilateral way through the acquisition of transmission rights on a multilateral way. The cross-border trading is independent from the way the power is locally traded, bilaterally or through a power exchange.

The implementation of this cross-border trading was made possible thanks to the existence of local agreements such as balancing and nomination rules. These local rules allow the JAO platform to focus only on transmission rights allocation. The losses, grid connection charges and other balancing arrangements are local although ENTSOE the European association for the cooperation of transmission system operators (TSOs) for electricity bears a historical role in technical cooperation. Its first assignment is the development and implementation of standards, network codes, platforms and tools to ensure secure system and market operation as well as integration of renewable energy.

Level of maturity of the trades

Given the average number of participants to the FR-CH auctions for transmission rights (31 for monthly products in 2021 in the FR > CH direction), the market can be qualified as moderately mature. All the dispositions allowing the transactions with a transparency of the information, a stability of the rules, and a level playing field for all participants participate in build a positive framework to develop the cross-border trading.

Implementation steps

In Switzerland, the 2007 Law on Electricity Supply contained the necessary elements for effective market liberalization: an independent regulator, an independent transmission system operator, regulated third party grid access, and freedom to choose the supplier.

The Swiss retail electricity market has been partially liberalized since 2009: customers whose annual electricity consumption exceeds 100 kilowatt hours (kWh) can choose their supplier on the market. It means that the opening of the cross-border trading was possible despite the non-fully achieved Swiss liberalized power market.

The organization of explicit auctions on the FR-CH border was implemented in 2012. Before, on the FR-CH direction bilateral long-term contracts would monopolize almost all of the interconnexion capacity. On the CH-FR direction, there was no congestion, and the daily allocation mechanism was a pro rata.

3.6.3 EU compatibility

Long-term explicit auctions fit with the EU target model since they use the JAO platform and rules set forth by the Forward Capacity Allocation regulation. It represents a simple and fair method to allocate cross-border capacity when it is scarce, being a non-discriminatory, market-based solution that provides effective economic signals to participants and transmission system operators.

However, explicit auctions do not provide any framework for the trading of energy since energy trading is performed apart from the explicit transmission capacity auctions. This can be seen as an advantage to couple areas which have different level of market development because this model does not imply any harmonisation of local energy markets.

There are similar explicit auctions between Switzerland and Germany, Switzerland and Austria, and Switzerland and Italy on the JAO platform. Swiss participants, despite their being outside of the Europe Union can participate to the European daily coupled auctions through the acquisition of transmission rights from the JAO platform.

This model can also be seen as less developed than the implicit market coupling, if we consider that market participants need to perform several actions to trade cross-border. They need to book capacity, trade energy and perform the nominations.

3.7 Key lessons and obstacles encountered

Capacity calculation

In order to organize cross-border trading, a TSO coordination on capacity calculation is mandatory. In the FR-CH explicit auctions, the capacity calculation corresponds to annual values which are reassessed in D-2. This interesting method can always be improved; however it proved its simplicity and predictability. In case commercial capacities need to be reduced to face short-term constraints in D-2, a transparent financial mechanism allows to compensate financially the participants.

Congestion impact on third zones

Some challenges encountered in the FR-CH explicit auctions would be present for any type of coupling. For instance, an energy exchange between 2 areas can have a congestion impact on a third area. This is tackled by European TSOs in technical instances outside of the JAO platform.

Non optimum usage of cross-border capacity

Market participants first procure the transmission rights based on their forecasts of energy prices. Next their procure energy and nominate the transmission rights. The forecasts are sometimes inaccurate and the benchmark of capacity usage with price spreads show a non-optimal use of cross-border capacities. It means that the transmission capacity is not always used to its full capacity when there are positive price spreads between the countries. The flows can go sometimes opposite to the market direction from the cheapest to the most expensive country. This results to some losses in social welfare. When implementing cross-border power trading, a trade-off has to be found between simplicity of organization and optimality of the mechanism.

4 Trilateral market coupling in CWE countries

4.1 General description of the model

4.1.1 History

Upon the deregulation of the European power market, TSOs were established in the different member states. Almost simultaneously, we saw the emergence of national power exchanges:

- APX was founded in 1999 and operated the spot power exchange in the Netherlands
- Powernext was founded in 2001 and operated the spot power exchange in France
- Belpex was founded later in 2005 for the purpose of operating the day-ahead power spot market in Belgium coupled with APX and Powernext

The project was initiated in 2003 and went live 3 years later. Between 21 November 2006 and 09 November 2010, the local Belgian, Dutch and French day-ahead auctions were coupled in the Tri-Lateral Market Coupling (TLC), thus ensuring implicit allocation of cross-border capacity via Available Transmission Capacity (ATC) with energy. Setup evolved into Multilateral Market Coupling Since its inception

4.1.2 Objective

The objective of the daily auction is to determine a price and quantities for the 24 hours of the following day for each bidding zone in a decentralized and coordination manner whilst implicitly allocating capacity, i.e. capacity and energy are allocated in the same optimization process for an optimal use of the available capacity on the interconnectors.
The benefits of market coupling are manifold and can be summarised as follows:

- Removes risks of trading transmission and energy separately;
- Less prone to market power abuse: transmission capacity cannot be hoarded, reserved or scheduled adversely;
- All market participants benefit from cross-border capacity;
- Enables netting of import / export schedules, so more capacity is available for trading.

4.1.3 Structure between TSOs, market operators and market participants

TSOs calculate the available transmission capacity to be made available to the market coupling process. They take into account the physical constraints and capacity which was already allocated explicitly on a commercial basis. TSOs

remain in charge of managing their grid balance, taking into consideration their grid constraints, the electricity flows and the grid losses.

Market participants buy / sell the energy in a double-sided blind auction organised by the market operator. To be allowed to participate in the market operator's auctions with cross-border capacity allocation, market participants shall:

- be a balance responsible party or attach their transactions to the scope of a balance responsible party,
- have the necessary authorizations within at least one Member State of the European Economic Area to trade in electrical energy,
- adhere to the market rules of the market operator.

4.1.4 Type of local markets

The trading is allowed in each market area. It can be done via bilateral OTC trading (directly or through brokers), or an organized exchange. However, the participants shall trade through the power exchange if they want to benefit from the cross-border capacity.

4.1.5 General cross-border arrangement

Prior to the TLC, allocation of cross-border capacities was specific to the border under consideration.

- On the France-Belgium border
    - Legacy contracts
    - Monthly allocation by ranking order
    - Daily allocation by ranking order
- On the Belgium-Netherlands border
    - Legacy contracts
    - Yearly, monthly and daily allocation by explicit auction mechanism, simultaneous with Germany-Netherlands border

When the TLC went live, the daily allocation moved to implicit auctions whilst explicit auctions remained for annual and monthly allocations.

4.1.6 Summary of process:

Each couple of adjacent TSOs coordinate and calculate the available capacity on the respective border to be made available to the coupling process. They send the ATC values for each of the 24 hours of the following day to a coordination module.

The market operators collect the buy and sell orders from the market participants in the bidding zone where they are active (APX in NL, Belpex in BE and Powernext in FR). The bid and offer information are sent to the coordination module in a standardized format. The market operators take turns to run the coordination module and determine through iterative calculations the price and volume for each bidding zone and each time unit whilst taking into account the available transmission capacity, the bids and offers in each bidding zone. Publication of market results, clearing and settlement is performed by each market operator with its own market participants.

The general principle which governs the entire process is decentralised technical and contractual approach. There os neither a single order book nor a common clearing and settlement facility.

4.2 Fact sheet

	Trilateral market coupling in CWE countries
Stakeholders	• TSOs • Regulators and/or competent ministries
Unbundling of TSOs	Yes
Types of participants	Many market participants of all kinds (utilities, TSOs, trading houses, banks)
Number of participants	Hundreds
Principles	Implicit cross-border capacity allocation mechanism and a mechanism for matching orders. Cross-border flows and net positions must be nominated

Products maturity	Hourly
Energy exchanged	See below graph
Cost to trade cross-border	Applicable price list by each power exchange. Transaction cost in €/MWh1

Table 4 - Fact sheet of the trilateral market coupling in CWE countries
Source: EPEX SPOT

Energy exchanged – monthly power exchanged across BE, FR and NL between November 2006 and October 2010 included. Central Western Europe ATC coupling started on 09 November 2010.

[1] For illustration, the price list applied by Belpex was the following

- Entrance Fee: € 12.500
- Membership Fee: € 25.000
- Variable operational Fee: € 0,14/MWh
- Fees for additional services

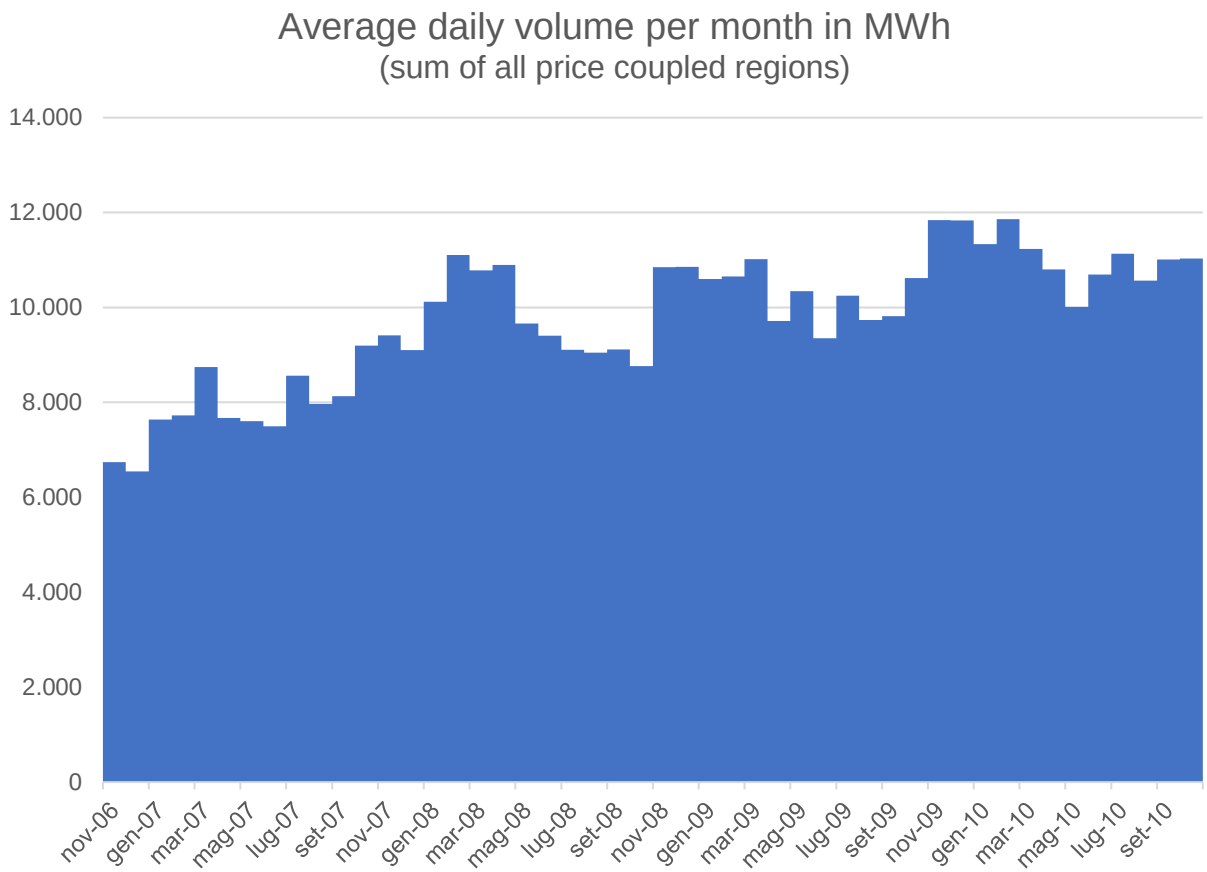

Figure 7 - Average daily volume per month in MWh (sum of all price-coupled regions)
Source: EPEX SPOT

4.3 Respective roles and responsibilities, and the related operational agreements

There are several agreements governing the TLC. The general principle which was followed is a decentralised contractual approach.

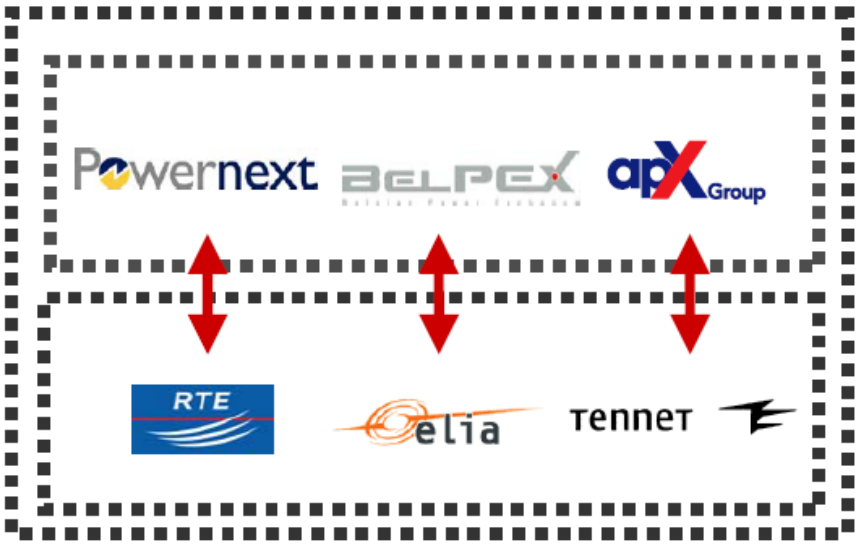

Figure 8 - TLC Agreements
Source: EPEX SPOT

- One **multilateral agreement with all TSOs and power exchanges** outlining[2]
  - Principles and objectives of market coupling
  - Roles and responsibilities of each party and description of the main flows
  - Contractual scheme and governance structure
- **Arrangements between exchanges** outlining
  - Provision of algorithms and systems
  - Operations of the market coupling
- **Arrangements between TSOs** outlining
  - Calculation and publication of capacity
  - Shipping the cross-border flow
  - Share of congestion revenues
  - Firmness
- **Local arrangements between TSO-exchange** covering

[2] It is interesting to note that the TSOs support the costs of the coupling algorithm

- "Participation" of the TSO on the exchange
- Provision of ATCs
- Reception and validation of results

- **Local arrangements binding the market participants** including
  - Market participants must qualify as Balance Responsible Parties (BRP)[3] in each market area, i.e. an agreement between the market participant and the TSO. There is no harmonisation of balancing rules across countries.
  - Market participants also hold an agreement with the market operator (Trading Agreement) active in that market area. Market rules are set by the market operator and there is no harmonization of local market rules
  - Other local agreements may exist[4]

4.4 Capacity calculation process

Available capacity for trading

The determination of the transmission capacity of the network – "Net Transfer Capacity" (NTC) on the interconnected network is a task of transmission system operators; it allows market players to carry out their energy transactions without jeopardizing the interconnected network. The NTC corresponds to the maximum exchange schedule between two service areas, which complies with the security standards of the two areas.

The calculation process must abide by certain rules:

- Physical capacity considers the capacity which was allocated in explicit auctions and their respective nominations
- Available capacity for trading is determined via the flow capacity in MW between two areas at the border in each direction for a given period (hourly granularity)

[3] In Belgium, called Access Responsible Party (ARP)

[4] For instance, a Clearing Agreement with the clearing house

TSO coordination

Each couple of TSOs makes sure that ATC values are sent daily at 10:00 CE(S)T to the market operators for integration the coordination module.

Wheeling Charges

Each TSO charges producers and consumers local network charges depending on their generation and load level. There is no interference between the commercial trading and the network technical charges.

Transmission tariffs evolution

Only TSO costs remained constant over the years of operations of the TLC as shown on the following graph.

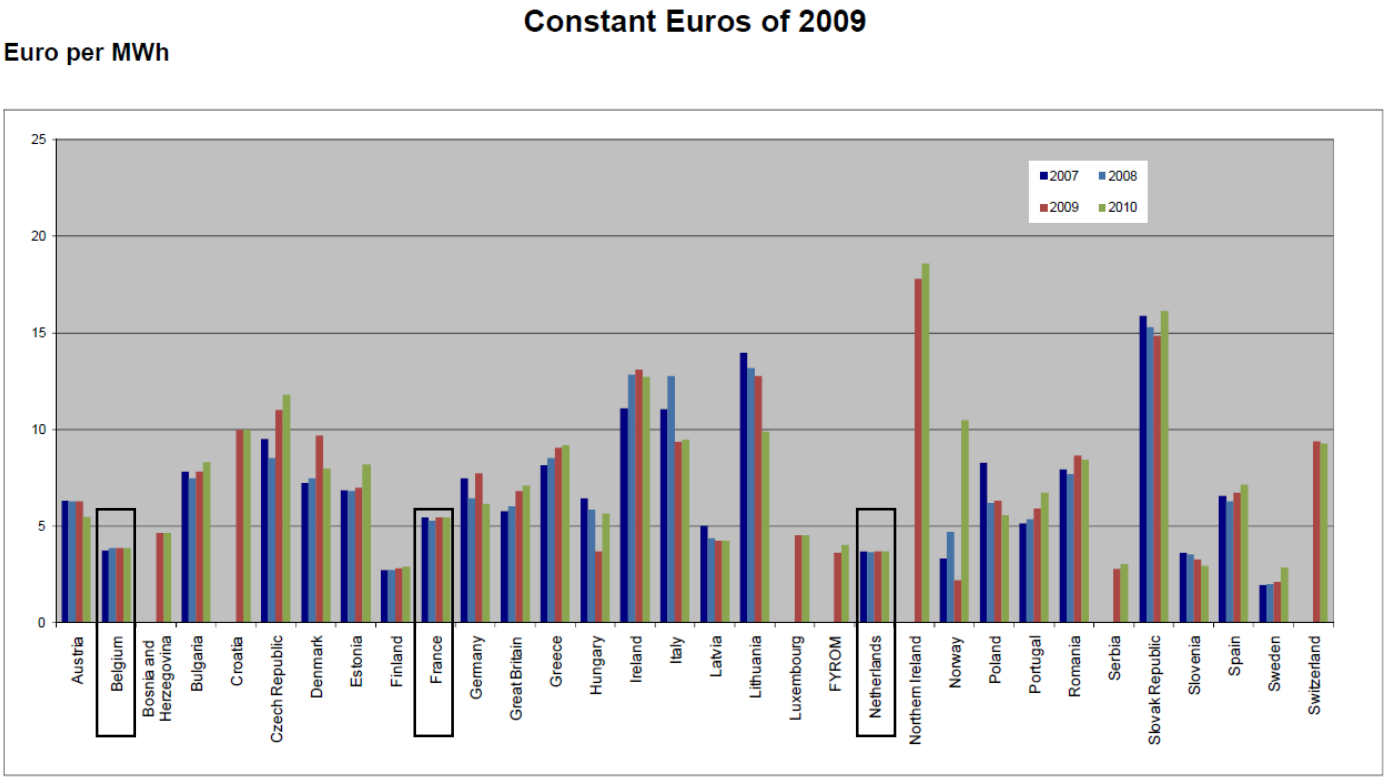

Figure 9 - TSO Costs
Source: ENTSO-E

Losses management

The electrical transmission network always suffers losses for physical reasons. These are due to resistances, such as lines and transformers, and materialize by heat losses diffused into the environment. Factors such as the network load, the outside temperature or the states of the switching stations in the network have an impact on the magnitude of the losses. As transmission system operators, Elia, RTE and Tennet compensate transmission system losses by purchasing the corresponding quantities of electricity on the energy market. The amount of losses depends on the amount of electricity physically injected and withdrawn from the grid. They are financed by the local network charges paid by generators and end consumers. The trading participants are thus not impacted by the losses. The energy bought is equal to the energy sold.

Unavailability

For any reason, a market may be unavailable for the market coupling; in this case the market is decoupled and runs in an isolated manner, using its own local matching system if possible. However, the two other markets will remain coupled. The TSO, if possible, will seek to allocate the capacity on the border in an explicit manner. The following possible fallback situations can occur:

- Decoupling of Powernext
    - Powernext runs an isolated matching
    - APX and Belpex run a coupled matching
- Decoupling of APX
    - APX runs an isolated matching
    - Powernext and Belpex runa coupled matching
- Decoupling of Belpex
    - Belpex runs an isolated matching
    - Powernext and APX run a coupled matching transiting via Belgium, using the minimum of the ATCs in each direction
- Full decoupling
    - Each exchange runs an isolated matching if they can
    - In all cases, all exchanges try to re-open their orderbooks

4.5 Trading Platform

4.5.1 Characteristics of the market operator

Shareholders at the time of the TLC. Please note the structure has evolved since then with mergers/demergers

- APX: all shares were held by Dutch TSO Tennet
- Belpex: The Belgian TSO Elia held a stake of 70%, the Dutch (APX) and the French (Powernext / EPEX SPOT) power exchanges each held a stake of 10%, as did the Dutch TSO TenneT. The French TSO RTE also subsequently participated by taking over a stake of 10% from Elia
- Powernext: the firm was founded by a consortium of power grid firms, energy companies and financial institutions including HGRT (Holding of TSOs), Euronext, EDF, Société Générale, BNP Paribas, TotalFinalElf and Electrabel

Governance

The shareholders appoint a Supervisory Board who is responsible for conducting supervisory functions, who in its turn appoints a Management Board in charge of the day-to-day management of the company.

Activities

To the exception of Belpex which was founded to play a role in the TLC project, APX and Powernext were each organising and operating local markets (power spot and derivatives, carbon, etc). Each power exchange was operating under its own market rules, onboarding and know-your-customer, products specifications, clearing setup, etc Due to the numerous power exchanges present in Europe at that time (see illustration below), any market coupling initiative and the TLC one in particular required cooperation across legal, algorithm, IT, regulation, business and procedural workstreams.

Figure 10 - Power Exchanges in Europe
Source: EPEX SPOT

4.5.2 Membership

Any market participant admitted to the exchange with a valid Balance Responsible Party with the TSO can take part in the multiple buyers – multiple sellers trading.

Costs to access/use the Trading Platform is freely defined by the market operator

4.5.3 Market operations

4.5.3.1 Sending order book > auction > results > nomination > settlement

The below operational timeline illustrates the different steps in the coupling process which runs daily from 10:00 CE(S)T to 11:30 CE(S)T under normal conditions.

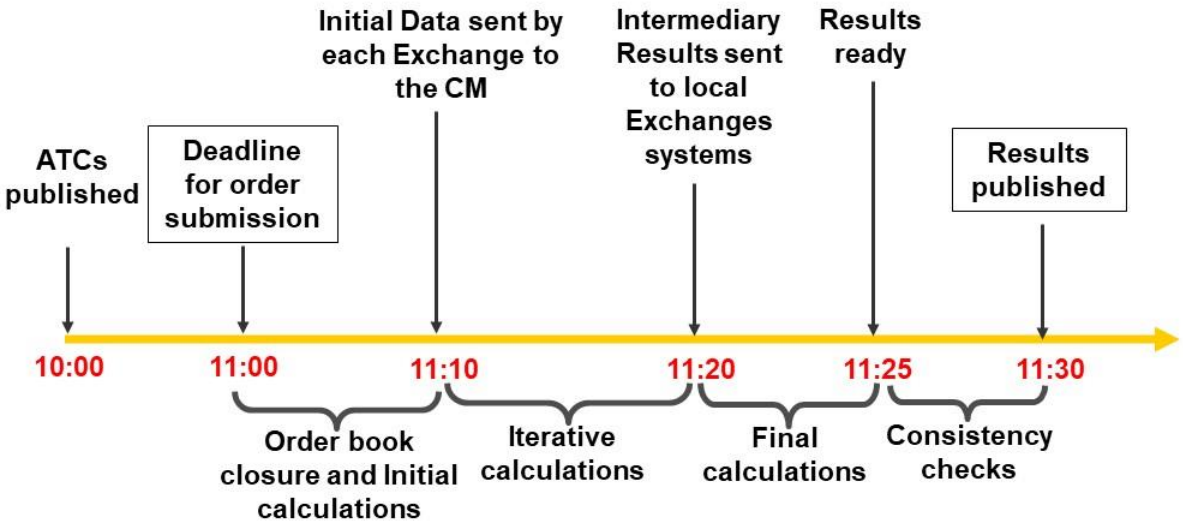

Figure 11 - Operational Timeline
Source: EPEX SPOT

Prior to the coupling process, ATCs are published by the TSOs for the use of the market participants.

Sending of orders

Each market participant places bids in via the market operator's facilities according to the specifications set by the market operator. For instance, the orderbook open 14 days before auction day. The market participants can edit/cancel bids until order book closure time. Local operation of respective day-ahead market as far as the bidding period is concerned is handled by each exchange separately. Therefore, operational contracts for participants remain at the local exchanges' discretion.

Auction calculation

Every morning Elia/RTE and Elia/Tennet are determining the ATC for the South and North borders of Belgium. Elia is acting as a so-called “representative TSO” and sends an e-mail for each border to the CMFO mailbox with the defined ATC. This file is integrated by the CMFO in the Coordination Module. If the file is compliant with the requirements, an automatic e-mail is sent to the two TSOs concerned by that border asking for confirmation of the ATC values. This e-mail is automatically handled by the TSOs that are comparing the values with the ones contained in their back-end systems. If the values are identical (which is logically the case), each TSO is sending an automatic e-mail to the Central Module Functional Operator (CMFO). The CMFO opens this e-mail and pushes the confirmation/rejection of the GUI accordingly.

There is a coordinated and harmonised deadline for orders submission by market operators which is 11:00 CE(S)T. The problem to be solved by the market coupling algorithm is a combinatorial optimisation problem i.e. an optimisation problem including integer variables (block bids). This optimisation problem includes both spatial (ATCs between the markets) and temporal (multi-hour block bids) coupling constraints. The calculation process happening at the heart of the Coordination Module can be illustrated as follows.

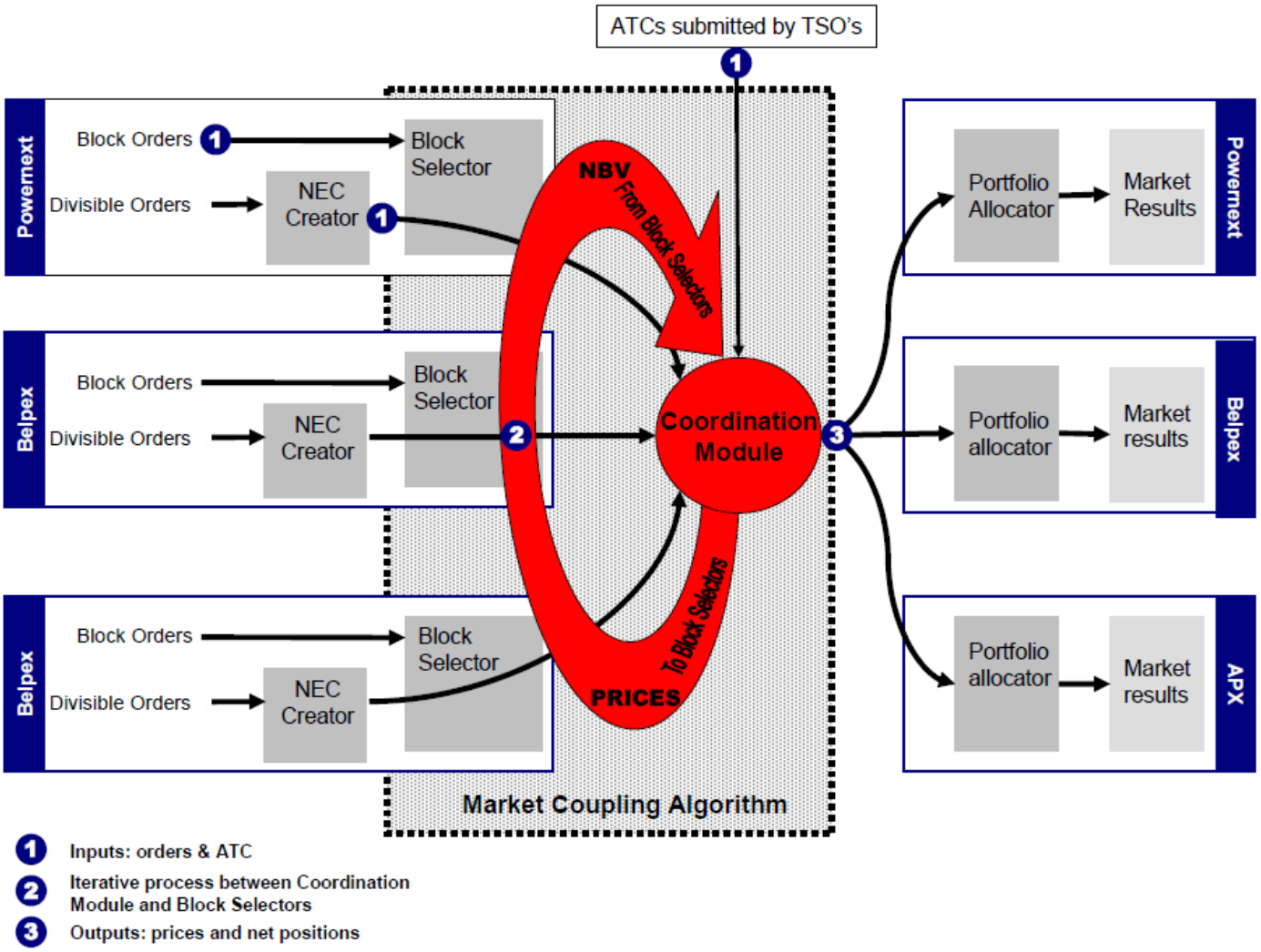

Figure 12 - Calculation Process
Source: EPEX SPOT

The Coordination Module is the masterpiece of the TLC system. It oversees the management of the communications and information flows with all the different components (except the trading systems). The Coordination Module is also in charge of preparing the numerical information for the TLC Solver. The TLC Solver is an algorithmic module that computes equilibrium prices and import/export volumes based on the Net Export Curve (NEC) of each market and their shift defined by the iterative net block volume.

The Block selectors are extensions of the trading systems and are in charge of determining the selected and rejected blocks among the blocks supplied by the market participants. The Block selector is however an independent software module that runs externally of the trading system.

The TLC relies on a decentralised principle, meaning that there is a CMFO whose responsibility is to act as the operational desk in charge of the daily TLC operations. The CMFO role is alternatively held by the three exchanges on a weekly basis.

Results publication

Once final rounded results have been determined by each trading system and sent along to the coordination module through the block selectors, these results (if they verify the high-level properties checked by the Coordination Module) are e-mailed to each TSO. The TSO are automatically applying the high-level properties on these e-mails and if the tests are positive (which is normally the case), each TSO is sending an automatic e-mail to the CMFO. The CMFO opens manually this e-mail and pushes the confirmation/rejection of the GUI accordingly.

Once the three TSOs have confirmed, the results are ready for publication.

Local operation of respective day-ahead market as far as the results publication is concerned is handled by each exchange separately. The portfolio allocation rules (and the treatment of roundings) remain at the discretion of the power exchange. Target time to publish results is 11:30 CE(S)T (latest 11:45 CE(S)T).

Settlement

Nomination rules of each TSO apply. For instance, the “double nomination” rule prevails in Belgium, meaning that the market participant and Belpex must nominate the net position to Elia whilst the “single nomination” rule prevails in France, meaning that the Powernext must nominate the net position to RTE. Other rules may apply in the Netherlands.

4.5.3.2 Financial settlement

Each power exchange had its own arrangements and rules when it comes to financial settlement.

Each power exchange had appointed its own central counter party, APX and Belpex with APX CCP and Powernext with LCH.Clearnet. The CCPs guarantee the financial security of the transactions, i.e. they collect payments from the buyers and ensure payments to the sellers. The following diagrams show the flows between the buyers and the sellers in Belgium and France respectively.

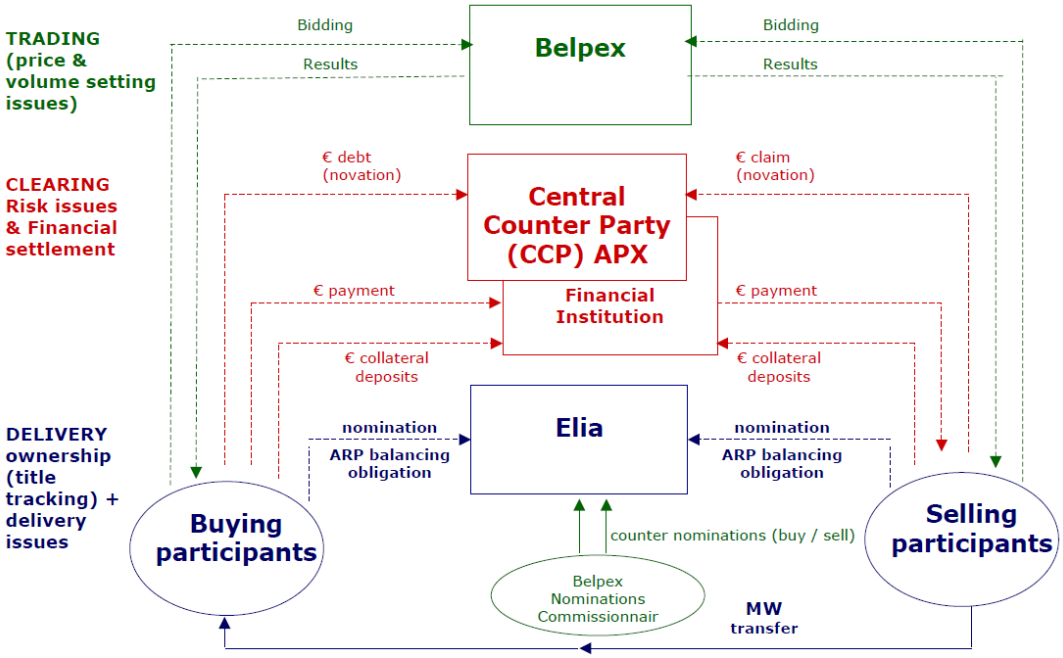

Figure 13 - Exchanged flows between the buyers and the sellers in Belgium
Source: EPEX SPOT

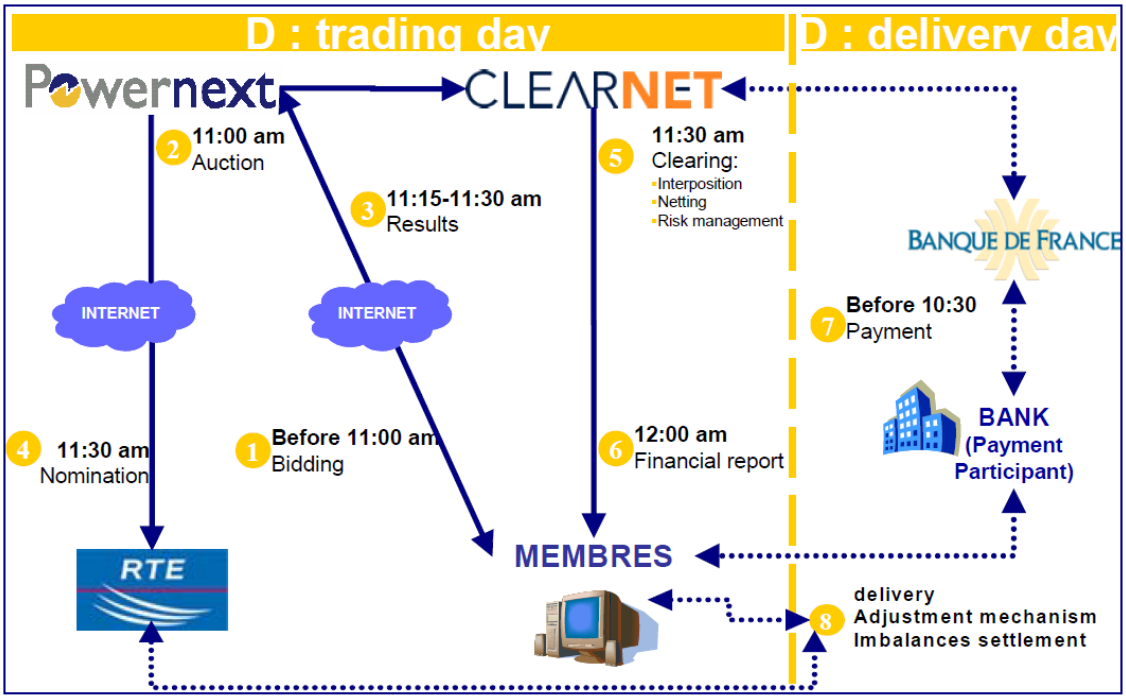

Figure 14 - Exchanged flows between the buyers and the sellers in France
Source: EPEX SPOT

4.5.4 Products

4.5.4.1 Energy Products

Each exchange has discretion to offer the products suite it deems relevant to its membership base. However, one could cite a few "common" products such as:

- 1-hour instruments
- Block orders

4.5.4.2 Capacity Products

In this model, capacity is not sold independently from the energy since there is a joint allocation of the energy along with the available cross-border capacity until this one has been fully used up. At times of constrained connection, all capacity is used, 100% Use It Or Lose It (UIOLI) for the hourly right on the interconnector – in the event the market participant fails to ship power across the border, its right would be lost and no compensation would be paid. The

netting of flows per hour yield a minimisation of price differences, thus resulting in the most efficient use of finite transmission capacity. At times of no transportation constraint, markets converge totally.

4.5.5 Price formation

The auction of the TLC is a pay-as-clear pricing mechanism where all 24 hours of the following day are cleared separately, and accepted bids are paid the marginal offer. Each exchange sends to the clearing engine its own supply and demand curves.

<table>
<tr><td>Border</td><td colspan="3">Belgian-French border</td></tr>
<tr><td rowspan="3">Belgian-Dutch border</td><td></td><td>Constrained</td><td>Unconstrained</td></tr>
<tr><td>Constrained</td><td>F ≠ B ≠ NL  </td><td>F = B ≠ NL  </td></tr>
<tr><td>Unconstrained</td><td>F ≠ B = NL  </td><td>F = B = NL  </td></tr>
</table>

Figure 15 - Price formation cases of the TLC
Source: EPEX SPOT

Diving deeper in the economics of the constrained and unconstrained cases, let us look at the supply-demand curves.

The constrained case

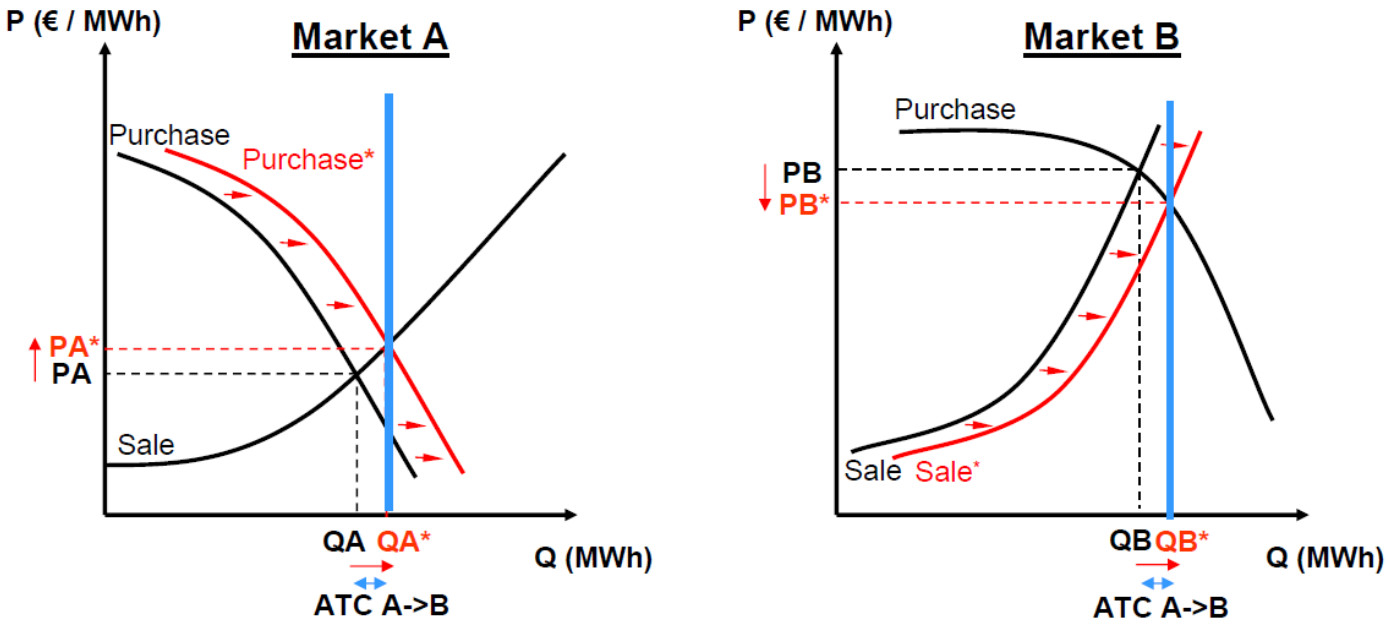

Figure 16 - Supply-demand curves in the constrained case
Source: EPEX SPOT

We observe then that

- Isolated price Market A > Isolated price Market B
- Market A can export to Market B (purchase and sale curve shift)
- The export (and therefore price convergence) is limited by the availability of the cross-border capacity

The unconstrained case

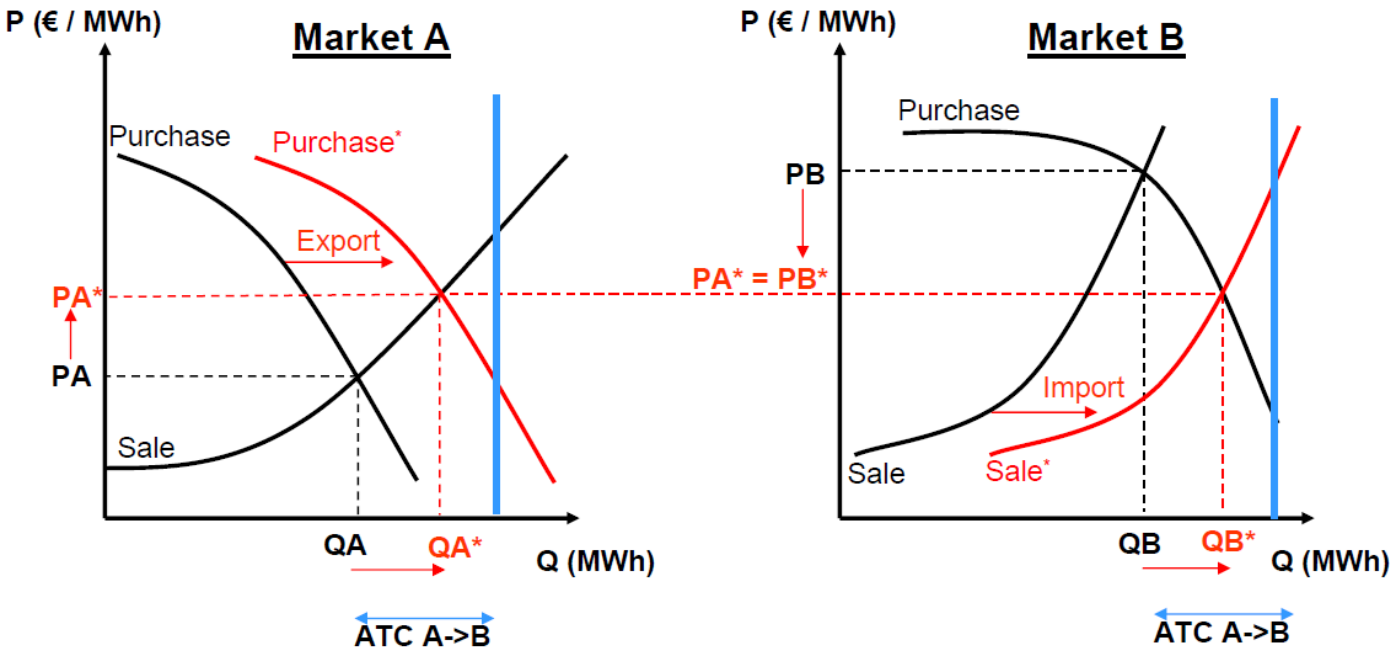

Figure 17 - Supply-demand curves in the unconstrained case
Source: EPEX SPOT

We observe then that

- Isolated price Market A > Isolated price Market B
- Market A can export to Market B (purchase and sale curve shift)
- Prices of Market A and Market B converge until price Market A = price Market B

Congestion rent

In the constrained case, price difference gives rise to congestion rent: it corresponds to the volume allocated multiplied by the delta of marginal prices between Market A and Market B.

Collection and payment of congestion revenues is the responsibility of the market operator (possibly through its clearing house) and is shared by the neighbouring TSOs.

4.6 Market integration and EU compatibility

4.6.1 Regulatory context and stakeholders

The TLC stemmed from a reasonable uniformity of approach and objectives between the parties which can be labelled 'coalition of the willing' between the TSOs and the power exchanges. The TSOs being a regulated entity, the TLC was regulated through them by the national regulators.

The three national regulators CRE in France, CREG in Belgium and DTE in the Netherland oversaw the whole project and fully supported the integration of energy and transmission markets near the real time. The national regulators converged that the instrument of trilateral Day Ahead Market Coupling (DAMC) could bring benefits compared to day-ahead explicit auction. Back then, the regulators requested 4 issues to be addressed by the market operators in the mid to long term:

- Well-functioning of the algorithm (including fallback arrangement)
- Potential of extension of the DAMC framework
- Absence of discriminatory treatment between programs nominated by DAMC or by explicit auction
- Operational cost efficiency for the implementation of DAMC

4.6.2 Local harmonization and implementation

The TLC occurred in the early days of the harmonisation of the European electricity markets. The implementation of the TLC benefitted from a configuration of a pilot project which helped in making quick progress and views and objectives were aligned between the parties. The TLC superseded the local day-ahead auction in each country participating in the project.

The implementation of this cross-border trading was made possible thanks to the existence on the one hand of power exchanges in each country (Belpex was set up for this purpose in Belgium) and on the other hand of TSO's local agreements such as balancing and nomination rules. Each power exchange maintained its specificities with some harmonisation of its market rules to accommodate the new operational process, e.g., change to common market closing times, technical price limits and new matching mechanism. The losses, grid connection charges and other balancing arrangements remain local and fully handled by the TSO and not through the co-allocation of energy and cross-border capacity.

4.6.3 EU compatibility

From the inception of the TLC, the model was ultimately leaning to an open and multilateral market coupling as foreseen by European Regulatory Forum. The below map shows the regional coupling initiatives at that time. The TLC parties committed to facilitating the addition of further areas to TLC approach and remained open to any other new partners (Italy, Iberian peninsula, UK/Ireland, Central Europe, Eastern Europe) without any exclusivity.

Figure 18 - Regional coupling initiatives
Source: EPEX SPOT

In 2010, the market coupling arrangement was extended and evolved into the pent lateral coupling with the addition of Germany and Luxembourg, thus forming the Central Western Europe (CWE) market coupling. Years later, it evolved into the Single Day Ahead Coupling with a growth in both market areas and borders as illustrated by the below map.

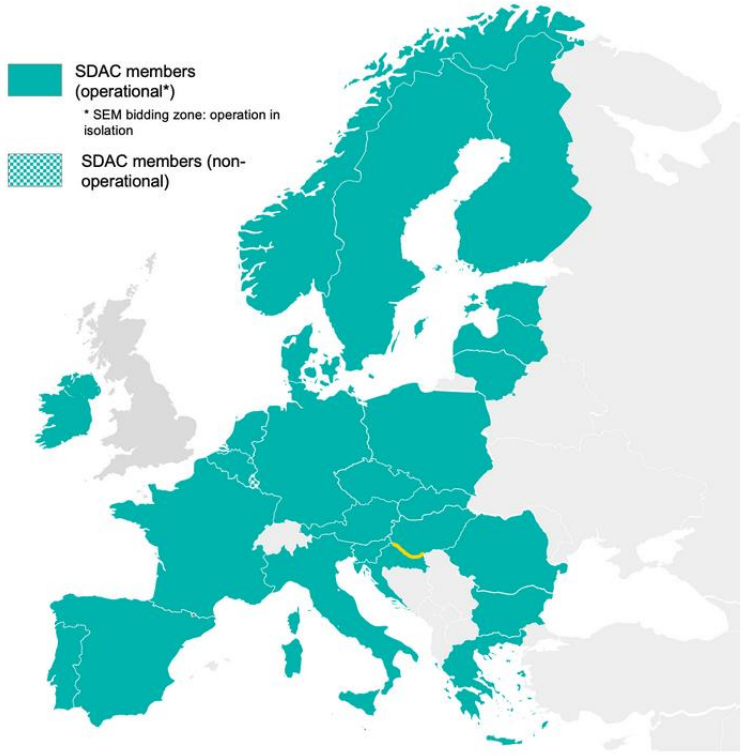

Figure 19 - Market coupling extensions
Source: ENTSO-E

In conclusion, the TLC is fully compatible with the EU target model.

4.7 Key lessons and Obstacles encountered

From the trading point of view, the TLC has stimulated very high volume of electricity exchanges between the three countries, followed by a steep rise in electricity volumes traded on Belpex while the growing trend in traded volume recorded prior to the TLC was confirmed on APX and Powernext.

From the cross-border capacity usage point of view, the TLC led to an optimal use of the transmission capacity between the three countries leading to an increase in imports and exports.

From the price point of view, the larger volume of electricity traded on Belpex had a direct impact and benefitted to a stable price setting for the Belgian market. A price convergence between the three markets in the absence of congested interconnectors led to fewer price spikes and a showed a decreasing trend. The below figure shows the immediate effect of price convergence between the three markets.

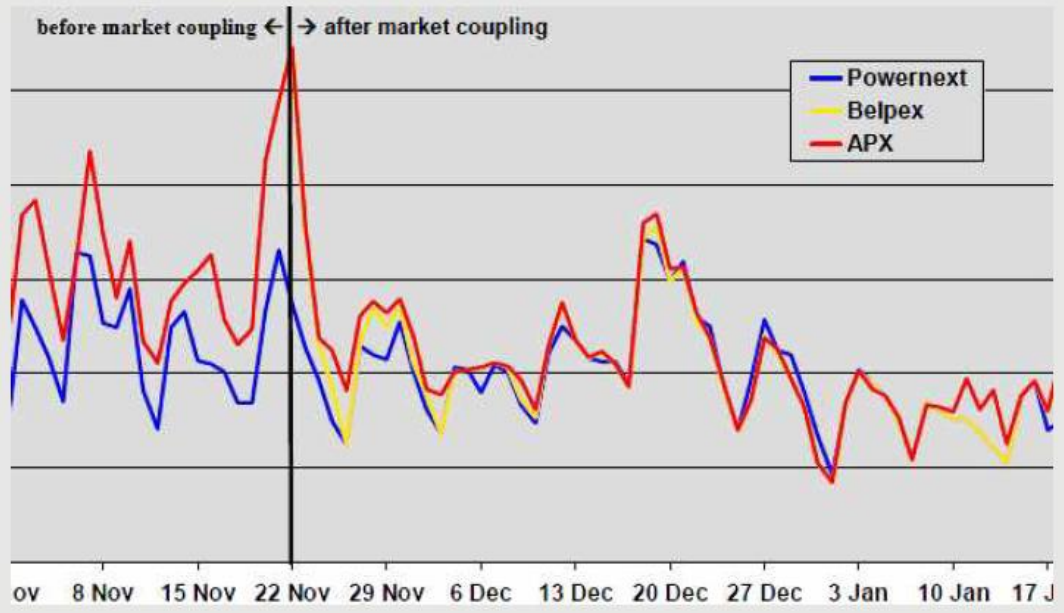

Figure 20 - Effect of price convergence between the three markets
Source: USAID

The observations of the early days after the launch of the TLC are confirmed when looking at the monthly convergence of prices between the three markets.

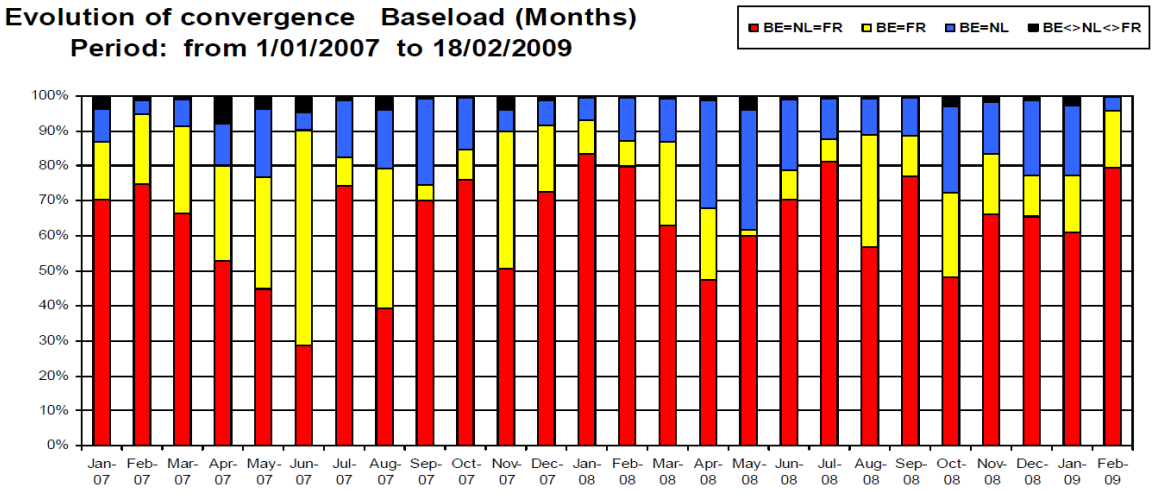

Figure 21 - Evolution of monthly convergence of prices (from 01/01/2007 to 18/02/2009) - Source: EPEX SPOT

As far as challenges are concerned, one could mention the capacity calculation process. In order to organize cross-border trading, a TSO coordination on capacity calculation is mandatory. In the TLC implicit auctions, the capacity calculation corresponds to hourly values which are calculated daily and used as input in the coupling process.

5 Southern African Power Pool SAPP

5.1 General description of the model

5.1.1 History

The Southern African Power Pool (SAPP) was created in August 1995 when governments of the Southern African Development Community[5] (SADC), excluding Mauritius, signed an Inter-Governmental Memorandum of Understanding for the formation of an electricity power pool.

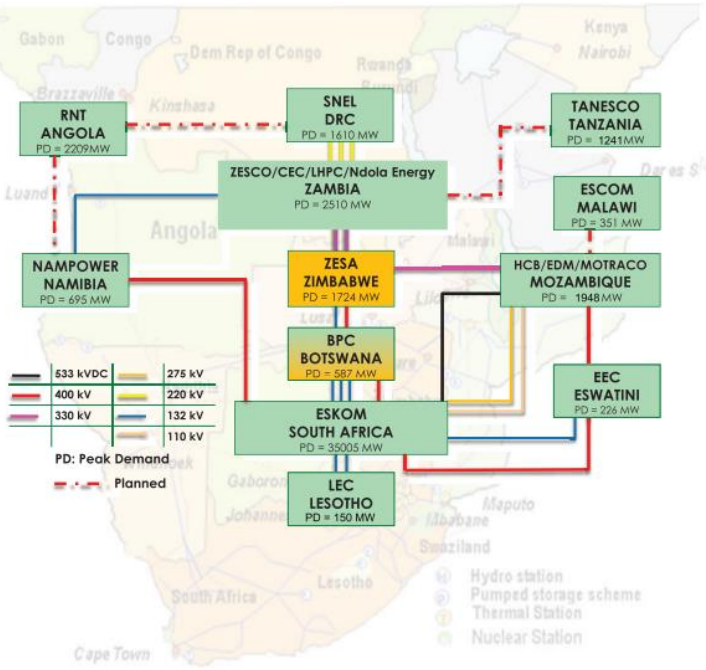

Figure 22 - SAPP interconnected grid 2021
Source: SAPP annual report 2021

The agreement between operating members includes some main obligations and benefits such as control area services, system balancing, wheeling, incremental losses, emergency support and relationships, and capacity building opportunities.

[5] Angola, Botswana, Lesotho, Malawi, Mauritius, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe

The SAPP coordinates the planning and operation of the electric power system among member utilities. 9 member states are electrically interconnected, and three member states are not yet electrically interconnected. Three of the SAPP members currently operate as Control Areas, which requires them to provide frequency control and tie line control on behalf of all the other members.

The SAPP's authority extends to managing operations and transactions on transmission interconnections between countries and the use of third-party countries for transactions between members.

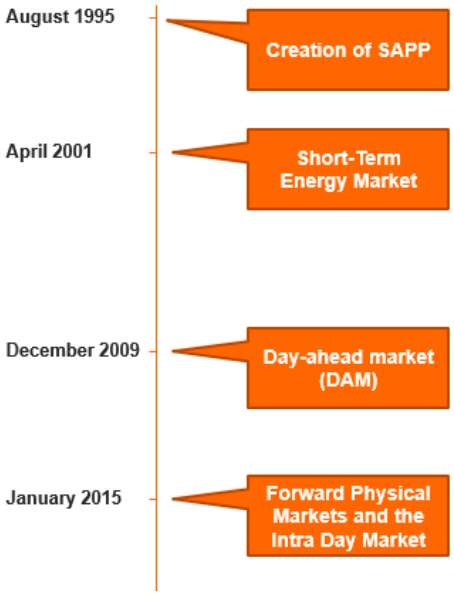

Figure 23 - Chronology of SAPP
Source: SAPP, EPEX SPOT

5.1.2 Objectives

The main objective of SAPP is to coordinate the planning and development of the electricity interconnections between members' respective networks and to expand the interconnected power system and electricity trading in the region.

In its 2021 annual report, the detailed objectives of SAPP are:

- Provide a forum for the development of a world class, robust, safe, efficient, reliable and stable interconnected electrical system in the southern African region.
- Coordinate and enforce common regional standards of quality of supply, measurement and monitoring of systems performance.
- Harmonize relationships between member utilities.
- Facilitate the development of regional expertise through training programs and research.
- Increase power accessibility in rural communities.
- Implement strategies in support of sustainable development priorities.

The specific objectives of the assignment include the establishment of a harmonized and integrated continental transmission system that will interconnect regional transmission networks, and the identification of priority power generation and transmission projects up to year 2040.

SAPP can thus be considered as a supra-TSO, whose aim is to encompass an integrated grid planning, regional grid and power generation development, coordination of operations and organization of cross-border electricity trading. SAPP is also in charge of ensuring that the region attracts investment for large energy intensive electricity users.

5.1.3 Structure between TSO, market operator and market participants

TSOs perform the capacity calculation.

SAPP performs the long and short-term auctions and operate the intraday continuous market.

Participants participate in the auctions and nominate the energy before the gate closure to the TSO National Utilities.

5.1.4 Type of local markets

SAPP is a cross-border organized market.

Bilateral exchanges are also allowed in some areas and represented 82% of energy traded in 2020-21 in the region. For cross-border bilateral transactions, the buyer and/or seller of the energy transaction contract with the wheeler outside of the SAPP rules at a mutually agreeable negotiated rate.

5.1.5 General cross-border arrangement

Applicability of domestic and SAPP rules

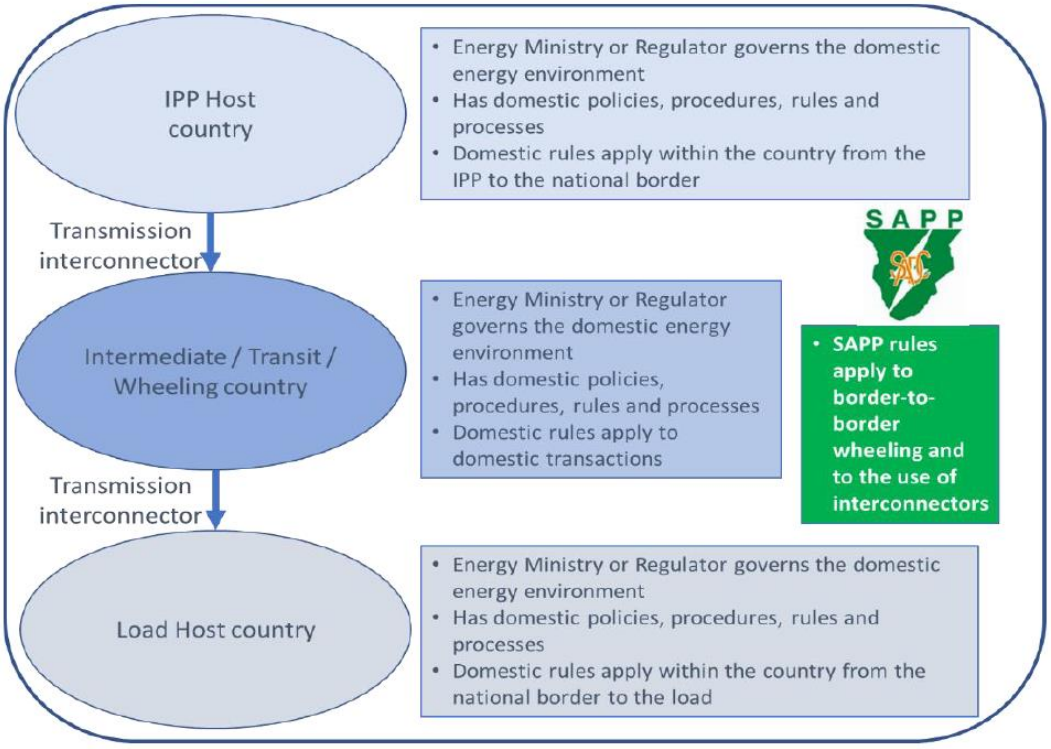

Figure 24 - SAPP areas of influence
Source: SAPP new entrant guideline 2021

An IPP operating in a country will have to abide by that country's rules from its plant to the delivery point (at the border for exports). If the exports are made to a direct neighbouring country, the importing country's rules would apply from the point of receipt (at the border). In such a transaction, the SAPP wheeling rules would not apply, but the balancing of the transaction and other requirements would.

5.1.6 Summary of process

Operating members perform energy scheduling

Control Areas provide an energy scheduling service to other members. Bilateral and SAPP market transactions may take place simultaneously in both directions through the various meters monitoring the power flow on the transmission interconnectors and tie lines. It is not possible to identify the energy flow related to each of the individual agreements. The various flows are summed and flows in opposite directions are netted off, providing a net aggregated

energy schedule. This is done for each hour of the day and the Energy Schedules are used by national control centres to control actual energy flows in real time. This is done by managing the supply/demand balance within their area of responsibility.

5.2 Fact sheet

	SAPP
Stakeholders	• Regional Council of Ministers • Energy Ministers • Regional Electricity Regulatory Association (RERA) National utilities
Unbundling of TSOs	No
Types of participants	• 9 TSOs Interconnected National Utilities • 3 IPP Independent Power Producers 2 ITC Independent Transmission Companies
Number of participants	On average, 3 members participated in the Monthly product market each month during the year of 2020/21, 5 in the weekly market, 9 in the Day-ahead
Principles	Energy and Cross-border capacity rights are sold in implicit auctions and must be nominated so that the rights can be used
Products maturity	Yearly, monthly, daily
Energy exchanged	1,498 GWh traded through SAPP in 2020/21 in the 9 interconnected countries
Cost to trade cross-border	Fees of 0.5% of the transaction value are levied on each transaction

Table 5 - Fact sheet of the SAPP
Source: SAPP, EPEX SPOT

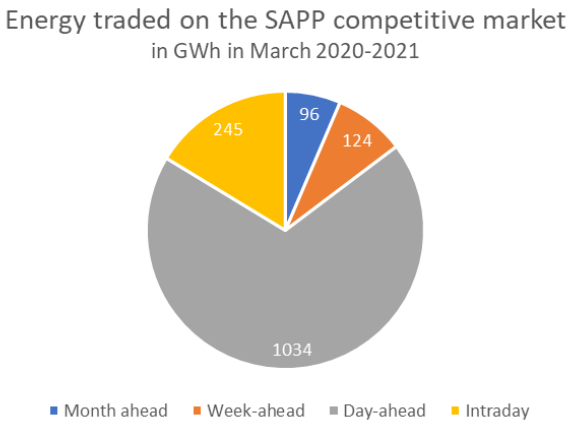

Figure 25 - Distribution of Energy Traded on the SAPP Competitive Market for the Year 2020/2021
Source: SAPP annual report 2021, EPEX SPOT

Long-term products are used to hedge the price risk of participants, based on their future consumption needs or production capabilities. The short-term day-ahead and intraday products are used to hedge the volume risk. Indeed, when the delivery comes closer, participants adjust their position to their best forecast.

This split between long-term and short-term products where the majority of exchanges are made with short-term products is characteristic of less mature markets.

5.3 Respective roles and responsibilities, and the related operational agreements

The SAPP is ultimately accountable to the SADC Integrated Council of Ministers and reports its activities to the SADC Energy Ministers.

SAPP governance rules:

- the Inter-Governmental Memorandum of Understanding signed by the ministers responsible for energy in the SADC region enabled the establishment of SAPP;

- the Inter-Utility Memorandum of Understanding, signed by the national utility members establishing SAPP's basic management and operating principles;
- the Agreement between operating members established the specific rules of operation and pricing. Specifically, it sets requirements for interconnected operations;
- the Operating Guidelines provide standards and ensure that all the operating members operate the interconnected power system safely, efficiently, effectively and in an environmentally sustainable manner.

Market rules for electricity trading:

- SAPP Market Book of Rules
- SAPP Participation Agreement

All regulations related to new members entering the SAPP must be developed and adjudicated within each member's regulatory frameworks

5.4 Capacity calculation process

Available capacity for trading: multilateral power trade bidirectional

TSO calculate the transmission capacity and the minimum is kept for each direction.

They transmit their updates of transmissions capacities every day considering the TSO's specific system constraints.

The firm bilateral contracts have priority access to the transmission capacity. Then the available transfer capacity is split between monthly, weekly and daily products. Weekly and Intraday available capacity are recalculated depending on nominated flows from bilateral and monthly contracts.

Each trading day, the SAPP market operator will communicate to the participants the available transmission capacity on the interconnections between bid areas. This information is needed before the participants can build their orders.

Wheeling Charges

SAPP transactions wheeling fees and losses are shared equally by the buyers and sellers unlike in bilateral agreements, where the buyer pays.

The transmission costs in the exporting network (from the IPP to the border) and within the importing country (from the border to the load) are subject to the domestic rules and rates, which are set by the relevant authorities in each country.

The buyer in an energy transaction is responsible for securing (and paying for) a wheeling path for SAPP transactions and requests the path on a day-ahead basis. Wheeling is therefore only confirmed on a day-ahead basis.

While SAPP wheeling only uses surplus capacity and its availability is confirmed only one day in advance, there have been some statements of intent to guarantee a wheeling path through the conclusion of bilateral agreements. In such a case, the buyer and/or seller of the energy transaction will contract with the wheeler outside of the SAPP rules at a mutually agreeable negotiated rate. This approach is likely to be preferred by funders of new power stations and transmission infrastructure to underwrite new investments in the future.

Losses

The SAPP coordination centre calculates the hourly losses from the wheeling volumes and communicates these to the members. The SAPP DAM Clearing Price per hour is applied to the losses and Wheelers raise a monthly charge for providing the service.

An alternative utilized by the SAPP is that each wheeler generates power above its own requirements to “make good” these losses – thus ensuring that the power received at its one border is delivered in full to its other border. This ensures the underlying energy contract is delivered in full regardless of the distance or number of wheelers involved in the transaction.

Imbalances

A mechanism for inter-control area imbalance settlement is in place. The SAPP coordination centre determines the imbalance on each tie line and allocates it between the three control areas. The first 25 MWh of imbalance is deemed “Inadvertent Energy” and is settled “in kind” – i.e., the same volume of energy can be scheduled and returned in a similar time period. Energy imbalances in excess of 25 MWh are settled financially where the base price is set at the SAPP DAM clearing price and this price increases as the system frequency deteriorates to a maximum of the cost of diesel generators.

The requirements to be able to schedule transactions accurately in advance and to ensure that energy imbalances are limited, favours membership by dispatchable generation rather than renewables with large potential variability (wind

and solar without storage). The domestic rules for balancing are essential to determine the ability of such variable generators to successfully participate in SAPP trading.

Unavailability

FPM-W, DAM and IDM in 2020/21 could not be traded due to transmission constraints.

5.5 Trading Platform

5.5.1 Characteristics of the market operator

Shareholders

SAPP is a public non-profit organization governed directly by Energy Ministers of the region.

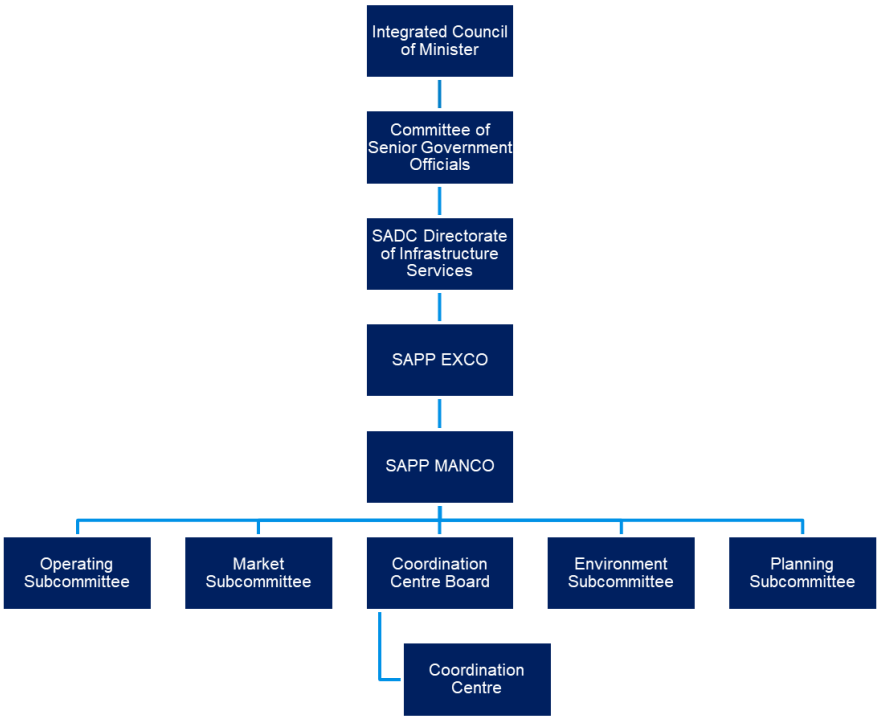

Figure 26 - SAPP Governance and SAPP Structure
Source: USAID SOUTHERN AFRICA ENERGY PROGRAM (SAEP) SAPP GUIDELINE FOR NEW ENTRANTS

The highest decision level of SAPP is the Executive Committee which is made up of the CEOs of the member utilities.

Financing

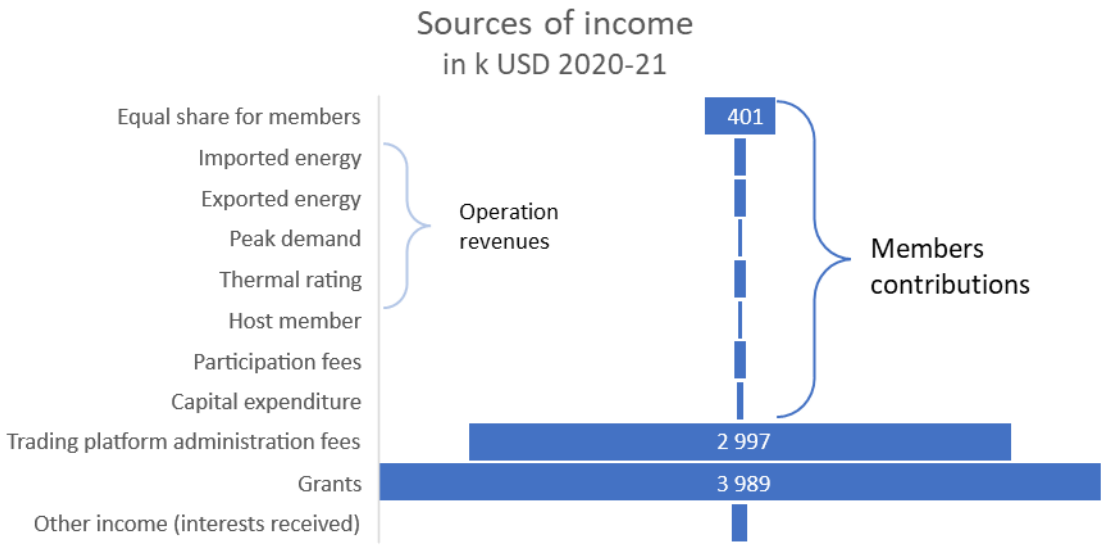

Figure 27 - Sources of income in year 2020/2021
Source: SAPP Annual report 2021, analysis EPEX SPOT

It is to be noted that grants represent 51% of yearly income. They originate mainly from the World Bank and Nora the Norwegian agency for development cooperation to coordinate the preparation and development of various generation and transmission projects.

5.5.2 Membership

In most areas, the national utility is the single participant. It is thus the single buyer and seller. As there are also 5 companies aside from national utilities, the market is multilateral.

The settlement type is an auction for monthly, weekly and daily products, and a continuous market for intraday products with 24/7 operation.

SAAP members in 2021

- 12 National Utility members, 3 of which are not interconnected; 75% of budget of member contribution i.e., 73 k USD per connected utility and 51 k USD per not connected utility in 2019

- 5 Operating Members (3 IPP and 2 ITC) 25% of budget of member contribution i.e., and 54 k USD per member in 2019
- 0 Market Participants; Annual fee: 20,000 USD

The annual fee is not fixed since it depends on the yearly budget.

Costs to access/use the Trading Platform

- Member contributions: as defined above
- Fees of 0.5% of the transaction value are levied on each transaction.

For the same volumes of energy exchanged, this set up remunerates SAPP more when prices are high. This aligns SAPP interests on those of the sellers.

- The SAPP Coordination Center provides an annual list of all possible transactions and the associated wheeling charges for each leg of the transaction.

The SAPP wheeling rates are relatively low and do not reflect the full cost of providing a transmission service as only surplus capacity is used. The average rate is approximately USD 0.352 c/kWh but the actual charge varies dependent on which and how many networks are traversed. This will also increase as new infrastructure is commissioned to increase the capacity, redundancy and reliability of the interconnected SAPP transmission grid.

Requirements for new entrants

New SAPP entrants will have a duty to minimize any negative impact on the system and will be required to conclude arrangements with their host TSO to provide balancing support. At present none of the countries have balancing rules in place and this has caused a delay in processing new applications. Regulators and other authorities will have to develop rules specifically to allow new entrant participation.

5.5.3 Market operations

5.5.3.1 Sending order book > auction > results > nomination > settlement

As a first step, each TSO transmit its updates of transmissions capacities every day for maximum monthly, weekly and daily transfer capabilities considering the TSO's specific system constraints.

Then the seller of a bilateral agreement and for traded contracts in SAPP are responsible to nominate it for each delivery day in the SAPP Trading system.

Each trading day, the SAPP market operator will communicate to the participants the available transmission capacity on the interconnections between bid areas. This information is needed before the participants can build their orders.

Activity	FPM-M	FPM-W	DAM	IDM
Trading day	Last Wednesday and at least 5 days before delivery month start	Every Thursday in the week before delivery month start	A day before delivery day	Continuous for the following delivery day
TTC nomination on trading day	10:30	10:30	09:30	Ad Hoc
BC nominations/reservations on trading day	10:30	10:30	09:30	Ad Hoc
Future market reservation (MR)	10:30	10:30	09:30	Ad Hoc
Order submission gate closure	14:30	14:30	12:00	One hour before the delivery hour starts
Price calculation/matching	14:30	14:30	12:00	Continuous
Trade results publication	14:45	14:45	12:15	Continuous

Confirmation of trades	16:00	16:00	14:30	On the hourly shift after the trade happened
Settlement Data	Delivery day + 1 day			
Payment of invoices by participants (buyers)	Delivery Month + 10 days			
Credit notes to participants (sellers)	End of Month + 18 days			
Final Bilateral nominations	Delivery day + 1 day at 15:00			
Metered values	Delivery day + 1 day at 15:00			
Frequency data submission	Delivery day + 1 day at 15:00			

Source: SAPP

Table 6 - SAPP trading timelines

Unavailability

If the IPP or Service Provider is exporting, it would be required to declare an emergency in the event of the unplanned loss of capacity and it would be required to inform the buyers, TSO and Control Area. Should their buyers not conclude other arrangements and continue to consume power, they will be liable for emergency energy charges in line with SAPP conditions. The IPP or Service Provider is advised to provide for this eventuality and to identify accountability in their agreements.

5.5.3.2 Financial settlement

SAPP is the central counterparty.

Members are required to deposit and retain sufficient funds in a SAPP security account before being allowed to trade – hence eliminating credit risk.

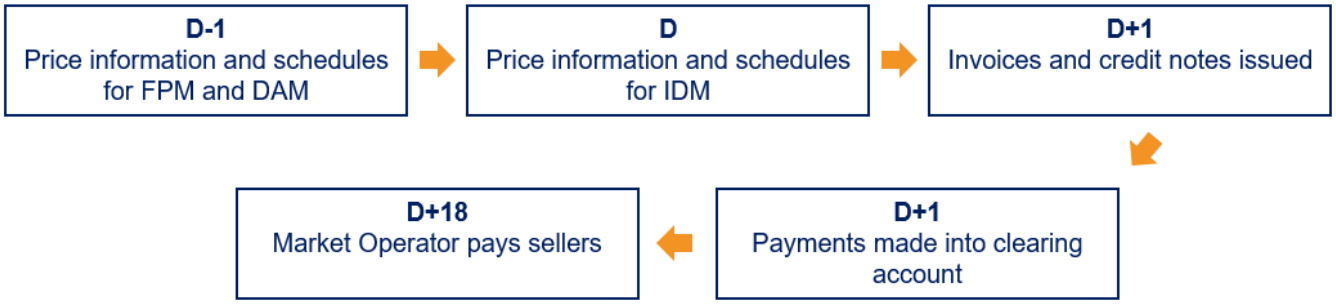

Figure 28 - SAPP settlement timelines
Source: SAPP

5.5.4 Products

- Forward Physical Market – Monthly (FPM-M): Hourly energy baseload, peak, off-peak contracts for each of the days in the following month
- Forward Physical Market – Weekly (FPM-W): Hourly energy baseload, peak, off-peak contracts for each of the days in the following week
- Day-Ahead Market (DAM): Hourly energy contracts for each of the 24 hours of the following day, or a future day
- Intra-Day Market (IDM): Hourly energy contracts for one or more hours – A continuous market where trades are concluded up to one hour before delivery. Prices are based on a first come, first served basis.

5.5.4.1 Capacity management

The Total Transmission Capacity (TTC) is based on the minimum value per interconnector in both directions. It falls under the responsibility of the respective TSO for each interconnector.

The allocation of transmission capacity follows a set of rules where the bilateral contracts have precedence. The Bilateral Contract Transmission Capacity Reservation (BTCR) is based on the maximum value required for individual firm bilateral contracts for the path that will be used by the bilateral contract flows.

Then the market operator books some capacity for each monthly, weekly and daily market timeframe. The weekly, daily and intraday capacity are then recalculated to add unused capacity from preceding timeframes.

For example, the transmission capacity available for the trading of weekly products on SAPP is:

ATC for weekly products =

TTC

–

Bilateral Contract Transmission Capacity Reservation (BTCR)

–

Market Transmission Capacity Reservation (MTCR) ie. capacity booked for day-ahead and intraday timeframes

–

Monthly Market Flow (MMF) ie. Capacity booked for monthly traded products

To sum up, the wheeling/transmission capacity is allocated in the following order:

1. Firm Power Bilateral agreements (in order of age)
2. SAPP Forward Physical Market (Monthly)
3. SAPP Forward Physical Market (Weekly)
4. SAPP DAM
5. Non-firm Power Bilateral agreements (in order of age)
6. SAPP Intra-Day Market

Emergency Energy takes precedence in real-time over all non-firm agreements which can be curtailed or interrupted based on technical and economic considerations without any penalty.

To maintain its priority, the Bilateral Contract's use of interconnectors shall be nominated. The transmission capacity for SAPP traded FPM-Monthly, FPM-Weekly and DAM shall also be nominated before 09.30.

In the event of prolonged outages that are outside the Emergency Situation period of 6 hours, the transmission asset owners shall have the right to recall transmission capacity that would have been allocated to third parties through bilateral or competitive market trades.

5.5.5 Price formation

Pay-as-clear monthly, weekly and day-ahead auctions

Based on orders received, the market operator calculates first an unconstrained market clearing price (MCP). All orders are aggregated in one purchase and one sales curve without taking potential capacity constraints between the relevant areas into account. The point of intersection between the two curves establishes the MCP. If the power flow between two or more areas exceeds the available transmission capacity, market splitting will take place and two or more area prices will be calculated.

Continuous intraday market (IDM)

The IDM facilitates trading close to delivery hour allowing participants to adjust their positions close (until 60 minutes) ahead of the delivery hour. To facilitate this type of trading the IDM provides a Shared Order Book which is continuously updated based on participants orders and available transmission capacities (ATC).

The market operator publishes the contract prices and volumes without any inclusion of wheeling and transmission charges. Wheeling and transmission costs will be calculated according to rules decided by the SAPP.

Congestion rent

USD 0.16 million was collected as congestion income.

5.6 Market integration and EU compatibility

5.6.1 Regulatory context and stakeholders

The SAPP was established by a decision from the Energy Ministers from the Southern African Development Community (SADC) region (see chapter 5.3 on the Respective roles and responsibilities, and the related operational agreements).

5.6.2 Local harmonization and implementation

Trading in the SAPP is done either through bilateral agreements or on the SAPP competitive multilateral markets. Bilateral agreements can be long-term or short-term and may be for firm power or non-firm energy. The SAPP competitive market is thus an organized venue competing with a bilateral market.

Level of maturity of the trades

Given the average number of participants in the SAPP competitive multilateral markets (3 for monthly products in 2021), the market can be qualified as not mature at all. All the dispositions allowing the transactions with a transparency of the information, a stability of the rules, and a level playing field for all participants are available for the market participants to trade on the market. However, according to the SAPP New entrant guideline, the lack of standard local balancing rules impedes potential new entrants to access the market.

Level of local harmonization required

Three of the SAPP members currently operate the control areas, which requires them to provide frequency control and tie line control on behalf of all the other members.

Implementation steps

The SAPP market was implemented in a big bang manner from top to bottom by the Energy Ministers of the SADC region in 1995. The political will to develop an ambitious market scope encompassing grid planning, TSO coordination and markets made that it took 6 years to launch the short-term energy market and 10 years to launch the forward physical and intraday markets.

5.6.3 EU compatibility

EU compatibility of the SAPP platform is ensured by the presence of market rules which provide a fair treatment of participants. However, if we consider that the third-party access right is not applied locally, it explains why there are only three IPPs apart from the national utilities and two Independent Transmission Companies (ITC). The SAPP new entrant guideline explains that "the SAPP has defined processes, procedures and the necessary rules to accommodate new entrants. It is, however, a relatively new focus and is likely to evolve over time. Perhaps the single largest risk to new entrants is the host country approvals and their need to set up enabling frameworks to support applicants. Few, if any, of the countries have rules in place for an IPP to contract for system balancing or criteria for licensing for exports."

5.7 Key lessons and obstacles encountered

Limited number of market participants

SAPP's first MOU was signed in 1995. In 2021 there are 9 member states electrically interconnected and three member states are not yet electrically inter-connected. 9 National Utilities and 5 other companies (IPP or ITC) are members from interconnected countries.

After 25 years of existence, the market counts a very limited number of market participants. In most areas the TSO is the only participant. This limited number of participants is due to the complexity to sign local non-standard balancing agreements with TSOs, and also to the high level of yearly fees which ranges from 20,000 to 54,000 USD per year without the trading costs.

No local rules for balancing

The requirements to be able to schedule transactions accurately in advance and to ensure that energy imbalances are limited, favours membership by dispatchable generation rather than renewables with large potential variability (wind and solar without storage). The domestic rules for balancing are essential to determine the ability of such variable generators to successfully participate in SAPP trading. With no local rules for balancing, renewable producers cannot participate in the market.

The recent delays in processing new membership applications are related to the need for all domestic approvals being received, which in turn is due to the absence of rules. This can be seen as an obstacle to third party access.

Length of implementation

Although it was developed in a top-down manner, the implementation of SAPP took 10 years to reach the go-live of the long-term market. Meanwhile, SAPP was also in charge of studies related to grid planning and development. Limiting the scope of the objectives to the organization of a cross-border market might be a solution to reduce the implementation duration.

6 Conclusion

This report describes three electricity market coupling cases with different features.

With regards to capacity management, the same main principles apply in all examples. TSOs calculate their own constraints, share it and the minimum value is taken to calculate the commercial transmission capacity.

The capacity calculation might be more elaborated in the Trilateral Coupling case. This reflects the fact that the commercial transmission capacity is used optimally, and any increase of the capacity will be used fully as long as there is no price equilibrium between the areas.

The transmission capacity management is very similar in the FR-CH and SAPP models for future products. Indeed, the bilateral contracts have precedence over other contracts, and the remaining available transmission capacity is divided ex ante between the different timeframes yearly, monthly and daily for FR-CH, and monthly, weekly, daily and intraday for SAPP. In both models, the contract's use of interconnectors shall be nominated. After the gate closure for nominations take place for a timeframe, the unused transmission capacity for that timeframe is added to the subsequent timeframe.

The FR-CH JAO explicit auctions are particularly fit to couple two market areas which have different local markets which cannot be coupled implicitly. In the case of Switzerland, its day-ahead auction cannot be coupled implicitly with the Single Day Ahad Auction due to the lack of an electricity agreement between EU and Switzerland.

The Trilateral coupling and SAPP offer very similar kind of implicit coupling where the transmission capacity is traded together with the energy. The main differences between both cases are that the SAPP offers long-term products in addition to daily products to be traded in auctions, and the Trilateral Coupling liquidity and number of participants is far much developed than in SAPP.

The below table summarize the main features of each trading model.

	FR-CH JAO auctions	Trilateral Coupling	SAPP
Transmission rights allocated to bilateral and exchanged traded contracts	Yes	No	Yes
Product	Transmission rights	Transmission rights and energy	Transmission rights and energy
Product maturity	yearly, monthly and daily	hourly	monthly, weekly, daily and intraday
Nominations	Manual by the participants	Automatic in the process	Manual by the participants
Financial settlement	Only for transmission rights	For transmission rights and energy	For transmission rights and energy
European compatibility	Fair access to transmission capacity, third party access granted	Fair access to transmission capacity, optimal use of capacity, third party access granted	Fair access to transmission capacity, optimal use of capacity, third party access not granted

Table 7 - Summary of the Trading Model features

To conclude, the next work phase of the project will detail which features are more fit to the Maghrebin case. A pragmatic approach will take into account local constraints and expected costs and benefits to propose a model to foster cross-border exchanges between Algeria, Morocco and Tunisia.

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