Market Design of an Energy Exchange: The case of Greece

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• **Objective:** to investigate previous studies on the field of PXs, their market design and integration

• Secondly, the study presents the latest developments in the Greek energy sector, accompanied by the formation of the three new markets that are going to be formed, during the next period (Day-ahead, Intraday and Forward)

• Since, the concept of market design fundamentals in Hellenic Energy Exchange is poorly investigated by prior research...

• This paper discuss concepts such as market design and market structure, bidding system modelling, auction and order types of the imminent Power Exchange.
Driven by the **liberalization** of the energy market launched in the 1990s, the EU through the **Third Energy Package** seeks to unify the internal market and achieve **price convergence** with all European economies.

Most EU countries have successfully instituted PXs, through which cross-border transactions are conducted in a **transparent** and **reliable** manner, ensuring **greater liquidity** in the energy market, and at the same time providing a **competitive** environment for the benefit of the final consumers.

Given the ongoing **coupling** among separate regions in Europe, in the next years we are likely to witness a **significant integration** among energy markets.
Currently, electronic auctions are conducted daily, where energy products such as electricity, natural gas, CO₂ emissions and green certificates are traded in PXs all over Europe.

The major PXs in Europe, are the following: Nordpool in Scandinavia, EPEX SPOT in Central Europe, EEX in Germany and OMIE in Spain and Portugal.
In Greece the framework in energy market shaped radically in February of 2017, when the Market Operator (LAGIE) and Athens Stock Exchange (ATHEX), signed a memorandum of cooperation, aiming to establish the Hellenic Energy Exchange (HEE).
**Literature Review (1/4) Power Exchanges**


Literature Review (2/4) Market Design


Literature Review (3/4) Integration


The case of Greece(1/2)

• Over the previous period, Greece has introduced numerous stages towards the **liberalization** and **deregulation** of wholesale electricity market

• The transition to the **Target Market** imposes the establishment of a **PX**, accompanied with Day-Ahead, Intraday, Balancing and Forward markets

• Based on the latest available data provided by the International Energy Agency (2017), total electricity consumption in Greece is estimated to be **52.4 TWh**, while total electricity generation is about **48.9 TWh**
The case of Greece (2/2)

- The electricity sector value chain is dominated by the vertically integrated state-owned electricity company **Public Power Corporation** (PPC)

- Consequently, PPC accounts for **75% of thermal electricity** generation and for about **79% of the installed thermal generation capacity**

- PPC’s share in the Day-Ahead market, which includes imports, hydro, and RES, was **53%** in 2016

- PPC’s share in the retail market is currently **78%** (88% 2017), although 17 suppliers are active in the market, with the second-largest alternative supplier, reaching the level **5.1%** (2.9% 2017) of total market’s share

- However, as part of the economic adjustment program, the share of PPC is about to decrease to **50%** by the end of 2019, meaning that, radical changes are about to occur on the electricity sector
HEE permits participants to submit different orders for the supply and demand of electricity for different production levels and time intervals, and at the same time keeps a record of all OTC contracts.

In that context, HEE is assigned with various liabilities such as

- the daily operation of the markets
- the smooth function and maintenance of the transaction system
- support the settlement of physical delivery
- retain statistics and comparative data
- supervise the wholesale market and finally
- cooperate with the national TSO and Clearing House

Regarding the basic characteristics of the introduced PX, standardization, transparency, low transaction cost and elimination of counterparty risk are some of the features accompanied with its function.

In contrast to the existing mandatory pool, the new PX is anticipated to provide a fair, secure and regular transaction process.
• PX’s operation and OTC contracts function in a complementary way, numerous of differences exist between them.

• Namely, the dynamic two-sided OTC contracts are available only to a limited number of participants, and since their supervision and regulation is problematic, both participants encounter high levels of counterparty risk.

• On the other side, the existence of a Clearing House in the function of HEE, eliminates any chances of counterparty risk.

• Yet, the interaction of prices on the two markets is highly correlated, since the prices formed in any PX function as a benchmark or reference price for the prices shaped in the corresponding OTC market.
Introduced Markets Structure (3/5)

- **Definition**: A PX is competitive wholesale trading facility, designed for energy commodities. It is a central electronic auction platform, that stands amongst buyers and sellers.

- **Market place** where different forms of energy and energy-based financial products are traded based on standardized characteristics, quality and transaction terms.

- **The foremost role**: to match the supply and demand (to determine a public market-clearing price).

- **Electricity** is considered as the core market, since the rest of energy products enter the platform, after the market reaches a certain level of development.
Introduced Markets Structure (4/5)

![Diagram showing the structure of introduced markets]

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• The **Clearing House** is a legal entity that is planned to be established followed by the formation of HEE, and undertakes the responsibilities of clearing, settlement and transaction coverage

• Given that participants are required to maintain margin accounts, Clearing House is interposed *among counterparties* to guarantee financial reliability

• It adopts the role of buyer vis-à-vis each seller and seller vis-à-vis each buyer. The foremost responsibility of a Clearing House is to keep a **record and archive all transactions**

• According to EMIR, the Clearing House manages the **settlement fund**, which covers the likelihood of default of any market participant

• From this perspective, HEE is expected to act as a central risk-taking and risk-management platform for all market participants, enabling them to **diversify their variable costs and pricing policy**
Registered participants are **obliged to pay fees** for the trading services provided by the HEE. The overall fees comprise the following components:

a) **Annual fee**, separately for each market (Day-Ahead, Intraday and Forward). This component represents the cost of trading services for the participation in the markets, and it is a fixed amount per year.

b) **Membership fee** which is separate for all markets.

c) **Transactions fee**, for each MWh traded, both bought and sold, by each registered participant.
Forward Market (1/3)

- The Forward market refers to agreements between two participants for buying or selling a specific quantity of electricity at a **specific price**, on a specified **future date**.

- The elements included in such a contract are standardized and comprise of:
  - The underlying title
  - The delivery date
  - The contract size

- The settlement price of the Forward contracts is **not** recorded in the transaction system.

- The products available in the Forward market are timely separated into:
  - Base (24 hours),
  - Peak (8:00-20:00)
  - Off-peak (20:00-8:00)

**Monthly contract Peak**: [31 days*12 hours=372 MWh]

**Quarterly Base contract**: [31 days*3 months*24 hours=1584 MWh]
Forward Market (2/3)

A supplier participating in the Forward market may pre-determine "today" the price and the agreed quantity that it is required to deliver according to the **agreed contract**, which in terms of the HEE function, are designed to be:

- Monthly standardized contracts
- Quarterly standardized contracts
- Yearly standardized contracts

Forward electricity contracts, will be traded in a **Continuous Transaction**, while the trading hours will last from 10:30 EET to 15:30 EET on each trading day.

**Execution and time requirements:**

- Good for Day
- Good till Canceled
- Good till date
- Immediate or Cancel
- Fill or Kill, All or None
- Stop Order

**The types of orders**

- Market Order
- Limit Order
- Linked Order
- Iceberg Order
Forward Market (3/3)

- The Forward market structure involves the registration of bilateral OTC contracts with physical delivery obligation, at HEE’s platform.

- In case of bilateral trading, all Forward contract specifications included in a bilateral OTC contract are at the sole discretion of the two participants involved, apart from those affected by power mitigation rules, as decided by RAE.

- Standard year contracts and standard quarter contracts are designed to be further fragmented through the cascading mechanism.

- Standard year contracts cascade into corresponding standard quarter contracts, spanning the same delivery period as the standard year contract, on the expiry day.

- Standard quarter contracts cascade into corresponding standard month contracts.

- However, standard month contracts are not subject to any further splitting.

- The price of the cascaded contracts equals the final settlement price of the original contract on its expiry day.
Day-Ahead Market

- Day-Ahead market refers to wholesale transactions in each D-1 calendar day, where electricity supply contracts are auctioned for each market time unit (1 hour) of physical delivery in day D.

- The delivery day (D) consists of **twenty-four purchased time units**, starting at 01:00 Easter Europe Time (EET) on calendar day D and ending at 01:00 EET on the next calendar day D+1.

**Gate opening** is at 10:30 (D-1) and last for 150 minutes, since **Gate closure** time is at 13:00 (D-1).
Intraday Market(1/3)

Intraday market concerns wholesale trading on each calendar day D, where contracts are traded in:

- **Local Intraday Auctions** (1-hour, 24 market time units)
- **Complementary Intraday Auctions** (1-hour, 24 market time units)
- **Continuous Intraday Trading** (30 minutes, 48 market time units)

Each market time unit of the physical delivery in day D starts at 01:00 EET on calendar D and ends at 01:00 EET on the next calendar day D+1.

- According to RAE’s Decision 67/2017, the implementation of the Intraday market in HEE will take place in two phases
- During the first phase, three Local Intraday Auctions will be implemented within Greece, according to the number and timing of the corresponding Local and Complementary Regional Intraday Auctions of the second phase
- The design of the Greek Intraday market will be adapted to implement pan-European Continuous Intraday Trading through the already agreed Intraday solution, in combination with one Local Intraday Auction and two Supplementary Regional Intraday Auctions
Intraday Market (2/3)

Type of Orders
- Hourly Orders
- Half-hourly Orders
- Predefined Block Orders
- User Defined Block Orders
- Limit Orders
- Linked Orders
- Iceberg Orders

Order Execution Restrictions
- None
- Fill or Kill
- Immediate or Cancel
- All or Nothing:

Validity restrictions:
- Good for session
- Good till date
Continuous Intraday Trading, is the procedure allowing transactions in which orders may be executed as soon as they are placed in the frame of the Intraday market.

The single intraday coupling is based on a continuous matching process of sell orders and buy orders.

The orders with the highest buying price and the lowest selling price get served first, given also that the Cross Zonal Capacity constraints are respected in case the orders are submitted in separate Bidding Zones.

The price limit of the sell order must be equal to or below that of the buy order, namely the intersection of the two order execution ranges may not be empty.
Conclusions(1/2)

This study outlined the theoretical perspective of a Power Exchange, which was separated into three discrete subjects.

(i) the broad concept of PXs
(ii) their market design
(iii) their imminent integration towards a single European energy market.

Next, driven by the formation of HEE, the second objective of this paper was to outline its market design and structure.

We examined concepts such as:

• bidding system modelling
• auction mechanisms
• order types

Additionally, we provide a comprehensive overview of the recent developments in the Greek wholesale market structure, accompanied by a careful investigation in terms of Day-Ahead, Intraday and Forward markets function
Conclusions (2/2)

• The HEE is anticipated to act as a **central risk-taking and risk-management platform** for all market participants (encourage **competition**, guarantee **transparency** and enhance **liquidity**)

• This study will be of interest to **policy makers and regulators**, as understanding the mechanism of PXs is essential for the development of appropriate policies and could assist the **further integration** of the internal European energy market (South-Eastern European electricity markets)

• **Future research** on this topic should be directed towards the incorporation of other energy commodities, such as the **natural gas**, into the Hellenic Energy Exchange, and towards the empirical investigation of the potential advantages that are expected to emerge from **regional market coupling**
Thank you for your attention!!!