UNIVERSITY OF PIRAEUS
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**MASTER'S THESIS**

# The European Target Model in energy markets

# Objectives, challenges and prospects

**ILEKTRA CHALKIADAKI (men17056)**

**Supervisor Professor Dr. Nikolaos Farantouris**

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Ilektra Chalkiadaki

# **Abstract**:

The aim of the present master's thesis is to represent the evolution of energy markets in the European Union from a fragmented monopolistic structure to a unified competitive form and the way in which a single energy market in the Union is gradually being established, through the adoption of common rules and the development of interconnections. This internal energy market which is named Target Model and constitutes one of the major intentions of the European Union, is being examined from a legal perspective in the following chapters. Specifically, the first chapter of the thesis attempts to represent an overview of the legislative framework that has been adopted in succession by European Commission towards the liberalization and unification of the energy market, namely the four energy legislative packages that have determined the structure and the operation of the European electricity market. In the second chapter we examine the basic forms of power markets depending on their degree of competition, as well as we examine the transformation of the energy markets to mandatory pool systems or power exchange models. The third chapter of the thesis consists of an analytical overview of the Target model operation, which is mainly based on the power exchange model, as well as the coupling of national markets. Chapter four refers to the establishment of the network codes, which have been enacted in order to facilitate and secure the well-functioning of the single market through common rules on market integration, operation and interconnection procedures. In chapter five, a more specific reference to the electricity system of Greece is made, while chapter six consists of a general conclusion over the progress that has been made so far in the energy field regarding the unification of the market, as well as over the obstacles that have to be overcome by European Union in order to finally realize the goal of a fully integrated electricity market.

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# 1. The Liberalization Progress of the Energy Markets in Europe

## 1.1 Introduction

The aim of the present master's thesis is to represent the evolution of energy markets in the European Union from a fragmented monopolistic structure to a unified competitive form and the way in which a single energy market in the Union is gradually being established, through the adoption of common rules and the development of interconnections. This internal energy market which is named Target Model and constitutes one of the major intentions of the European Union, is being examined from a legal perspective in the following chapters. The present chapter presents the evolution and reform of the regulatory framework of European energy markets towards their liberalization and the creation of a single European energy market, moving from a purely monopolistic nature to a pattern of open and competitive operation, for the benefit of consumers, as well as of energy stability and security.

The very first steps were already taken after the World War II, when all the countries that have been involved in it had to deal with the incalculable damage left by the war in all sectors of their economies. So, in 1951 **European Coal and Steel Community** (**ECSC**) was established by the renowned Treaty of Paris, which was finally signed by Germany, the Netherlands, Luxemburg, Italy, France and Belgium[1]. We are now in the position to mention that ECSC was the forerunner of what we call European Union. The Treaty of Paris aimed to the creation of a coal and steel united market for its participants, in order to accelerate economic growth, safe trade conditions, security of production, fair and equal access to natural resources and thus a better living standard for their citizens contrary to the war's devastation that had been caused by the former uncontrollable and unfair competition among the European States[2].

Some years later, in 1957, in Rome two Treaties established respectively the European Economic Community (EEC) and the European Atomic Energy Community (EAEC). The latter was an organization aiming to build up a specialized European common market over nuclear power, in order to secure the productive exploitation of this form of power and its fair distribution to the Community Members.

For a long period after the very first attempts for the creation of a common market related to energy,

[1] Treaty establishing the European Coal and Steal Community, 1951, Paris, available at: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:11951K:EN:PDF

[2] Europa, Activities of the European Union, Summaries of legislation, available at: https://web.archive.org/web/20071213202339/http://europa.eu/scadplus/treaties/ecsc_en.htm

no initiative had been taken by European countries in the direction of a further liberalization in the energy sector. In 1987, the above mentioned Treaties were reformed by the Single European Act (SEA), which intended to promote and deepen the European integration, as well as hasten the completion of an internal market within the European Community by 1992. The intended single market would allow and ensure free movement of goods, people, services and capital inside the borders of European Community[3].

In 1992, Maastricht Treaty, turned into the main authoritative text to mention energy as a European Community field of activity, setting the premise of the change of the energy industry, which by then, was mainly organized at a national level as vertical monopoly.

From that point forward, in 1996 for the first time the European Union took significant measures in order to transform its energy markets (electricity and natural gas) from natural monopolies to competitive activities. Community Directive 96/92/EC for electricity and Community Directive 98/30/EC for natural gas consisted the renowned First Energy Package, which aimed to accelerate the transition of the energy market to a liberalized environment. A few years later European Union adopted the Second Energy Package, namely Community Directive 2003/54/EC for electricity and Community Directive 2003/55/EC for natural gas, which pointed towards liberating the energy market and presenting free rivalry in the supply of energy.

However, due to specific obstacles that prevented the full implementation of the planned transformation of the energy markets, the European Commission conducted in 2005 an in-depth sector enquiry, in order to identify and overcome the difficulties that had arisen.

The research completed and published in 2007, clearly showed the obstacles that had to be effectively faced towards the formation of a unified energy market. Specifically, European Commission conducted that the main impediments were related to enormous market concentration, lack of separation between network and supply activities, as well as lack of fair access to market information[4].

In 2008 Treaty of Lisbon reformed the afore-mentioned a. Maastricht Treaty (1992) also known as Treaty on European Union (TEU) and b. Treaty of Rome (1957) also known as Treaty on Functioning of European Union (TFEU), constituting a clear legislative platform for energy matters.

[3] Single European Act, 1987, available at: http://data.europa.eu/eli/treaty/sea/sign

[4] European Commission, Energy and Environment, Sector Inquiry, 2012, available at: https://ec.europa.eu/competition/sectors/energy/2005_inquiry/index_en.html

Pursuant to Article 194 as added in the text of TFEU by Treaty of Lisbon[5]:

*"1. In the context of the establishment and functioning of the internal market and with regard for the need to preserve and improve the environment, Union policy on energy shall aim, in a spirit of solidarity between Member States, to:*

*(a) ensure the functioning of the energy market;*

*(b) ensure security of energy supply in the Union;*

*(c) promote energy efficiency and energy saving and the development of new and renewable forms of energy; and*

*(d) promote the interconnection of energy networks.*

*2. Without prejudice to the application of other provisions of the Treaties, the European Parliament and the Council, acting in accordance with the ordinary legislative procedure, shall establish the measures necessary to achieve the objectives in paragraph 1. Such measures shall be adopted after consultation of the Economic and Social Committee and the Committee of the Regions.*

*Such measures shall not affect a Member State's right to determine the conditions for exploiting its energy resources, its choice between different energy sources and the general structure of its energy supply, without prejudice to Article 192(2)(c).*

*3. By way of derogation from paragraph 2, the Council, acting in accordance with a special legislative procedure, shall unanimously and after consulting the European Parliament, establish the measures referred to therein when they are primarily of a fiscal nature."*

Under Lisbon Treaty, for the first time in European Union's history energy sector becomes a field of share competence between EU and its Member States[6]. The establishment of a legal base that gives the EU the right to partly regulate its members' energy policy serving the "spirit of solidarity", is the most significant pace towards the creation of an internal energy market.

It is more than obvious that without a common energy policy, every attempt for the establishment of a single market would be fruitless and disappointing.

[5] Treaty of Lisbon, 2008, available at: https://eur-lex.europa.eu/eli/treaty/lis/sign

[6] Wolfsgruber, D. and Gunnar, B. O., 2010, The Lisbon Treaty and sustainable energy, Inforse – Europe, International Network for sustainable energy, available at: https://www.inforse.org/europe/eu_table_lisbon.htm

In the context of Lisbon Treaty provisions, European Union enacted the Third Energy Package, namely Community Directive 2009/72/EC about electricity and Community Directive 2009/73/EC about natural gas, Regulation 713/2009 about the creation of the Authority for the Cooperation of Energy Regulators (ACER), Regulation 714/2009 about access to the network for cross-border exchanges in electricity and Regulation 715/2009 about access to the natural gas transmission networks. The Third Energy Package repealed the former legislative package and created a solid and detailed legal framework for the establishment of the single market model in all Member States, the EU Target Model.

Third energy package was in 2019 followed and recasted by a fourth one, the Clean Energy for all Europeans Package (CEP), which in fact aims to further ensure the effectiveness and stability of market unification.

In the following paragraphs, we will set out the main provisions of each legislative package related to electricity, reflecting the evolution of energy market needs and priorities during its liberalization procedure.

## 1.2 The Community Directive 96/92/EC

### 1.2.1 Legal Framework

Community Directive 96/92/EC being included in the first energy package, was adopted by the European Parliament and the European Council on 19 December 1996 and had to be imposed on national legislations of each Member State within two (2) years. All Member States incorporated the Directive 96/92/EC on schedule, aside from Belgium and Ireland, which required an extra year, as well as Greece which required 2 extra years due to peculiarities concerning its power system[7].

The main provisions of Community Directive 96/92/EC towards market liberalization were the following[8]:

[7] International Energy Agency, “Competition in Electricity Markets”, OECD, 2001, p. 37, available at: https://regulationbodyofknowledge.org/wp-content/uploads/2013/03/OECDIEA_Competition_in_Electricity.pdf

[8] European Commission, 1996, Directive 96/92/EC of the European Parliament and of the Council of 19 December 1996 concerning common rules for the internal market in electricity, available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31996L0092&from=EL

- For the manufacturing of new power generating units, the option between licensing or tendering procedure was granted in favor of Member States
- Appointment of an independent Transmission System Operator (TSO) in each Member State. TSO ought to be responsible for national network operation, maintenance, development and interconnection with other networks, ensuring security, reliability and efficiency of the network.
- Regulation of third party access to the networks ensuring non-discriminative and transparent procedures.
- Appointment of an independent Distribution System Operator (DSO) in each Member State. DSO ought to be responsible for the operation, maintenance, development and interconnection with other distribution systems.
- Accounting and functional separation of production, transmission and supply activities in vertically integrated energy companies
- Setting up of a timetable for the gradual opening of the markets

The starting point for the estimation of the intended market opening percentage for each Member State would be the total energy consumption of eligible consumers, who totally consumed more than 40 GWh per year. Three (3) years after the entry into force of the Directive the threshold should drop to 20 GWh starting from 40 GWh per year or even more, while 3 years later it should fall to 9 GWh resulting in the minimum. The opening of the energy market of each Member State would increase from 26% corresponding to 40 GWh to 35% corresponding to 9 GWh[9].

### 1.2.2 Evaluation of Directive 96/92/EC

Although Directive 96/92/EC provided for significant steps in the creation of the single market, it did not ultimately have the expected positive results, given that its legal framework was far less strict than what was necessary for an effective and secure transition of the energy market from a monopolistic and fragmented type to a competitive and unified structure. Despite that Member States finally incorporated the Directive in their national legislation, many of them in fact avoided absolute compliance with it. In this context, the degree of market opening of each Member State was not uniform within European Union, which was something that led to different speeds in the whole

9 International Energy Agency, "Competition in Electricity Markets", OECD, 2001, p. 37, available at: https://regulationbodyofknowledge.org/wp-content/uploads/2013/03/OECDIEA_Competition_in_Electricity.pdf

liberalization process. Apart from the above mentioned, another reason that the Directive did not manage to become as successful as it could be is because there was not any legal demand for the creation and operation of a wholesale market, which is something that resulted in lack of liquidity and obstacles for new participants. In parallel, the opening of the market did not follow the timetable, as it was defined in the Directive 96/92/EC[10].

Furthermore, accounting and functional unbundling was finally not adequate for ensuring non discriminative third party access to networks, while lack of an independent regulatory authority controlling the implementation of the Directive and generally the operation of energy sector amplified its monopolistic attributes[11]. Finally, the opening up of energy markets was very limited, with few consumers in Europe being able to choose a supplier and third-party access being achieved to a very small extent[12].

However, although there have been significant failures during the implementation procedure of the Directive as mentioned above, many Member States transposed it into their national laws at a higher rate than expected.

It was therefore obvious that European Union needed to take effective measures that would lead to problem-solving and liberalization facilities, mainly ensuring a level playing field and addressing the potential risk of monopolies.

## 1.3 The Community Directive 2003/54/ EC

### 1.3.1 Legal Framework

Under the prism of the above mentioned, on 26 June 2003 the European Council and the European Parliament implemented another mandate called "Community Directive 2003/54/EC" setting down issues related to the opening of the energy industry, the transmission and distribution activity, as well as the procedures of licensing regarding electricity.

The Directive 2003/54/EC, being included in the second energy package, repealed the previous

[10] ΑΔΜΗΕ, "Ευρωπαϊκή αγορά ενέργειας. Η μετάλλαξη των μονοπωλίων?" (IPTO, "European energy market. Monopolies' mutation?"), p. 9, available at: http://www2.econ.aueb.gr/GraduatePrograms/Hmerida-Koutzoukos.pdf

[11] Ibid.

[12] Hancher, L., & Salerno, F. M., 2017, "EU energy and competition: analysis of current trends and a first assessment of the new package", Research Handbook on EU Energy Law and Policy, Edward Elgar Publishing

Directive and regulated the following important issues[13]:

- Construction of new power generating units would take place exclusively via licensing.
- Not only accounting and functional separation of production, transmission and supply activities in vertically integrated energy companies, but also legal unbundling between monopolistic activities of transmission/distribution and competitive activities of production/supply.
- Right of switching providers gradually granted for all consumers by July 2007, enjoying reasonable and easily comparable prices.
- Ensuring of third party access to networks.
- Obligation for the establishment of an independent National Regulatory Authority (NRA) which would be responsible for the energy market supervision.
- Provision for the setting up of a European Regulators Group, which will act as an advisory mechanism to European Commission towards the improvement of coordination among NRAs and the promotion for the internal single market.

The motivation behind Member States is to guarantee that families and private companies approach energy at sensible and effectively equivalent costs. They should likewise take all essential means to guarantee the assurance of socially weak groups. Obviously, these actions may fluctuate from one state to another. Also, different measures are expected to protect domestic clients from those expected to ensure small independent companies[14].

### 1.3.2 Evaluation of Community Directive 2003/54/ EC

By 1st July 2003 which was the threshold for the incorporation of the Directive into national legislations, only the Netherlands and Slovenia had on time transposed it on their laws, while the rest Member States had shown significant delays. Nevertheless, ultimately all countries, including Germany which had vigorously insisted on the monopoly market, complied with the new legal framework.

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[13] ΑΔΜΗΕ, "Ευρωπαϊκή αγορά ενέργειας. Η μετάλλαξη των μονοπωλίων?" (IPTO, "European energy market. Monopolies' mutation?"), p. 13, available at: http://www2.econ.aueb.gr/GraduatePrograms/Hmerida-Koutzoukos.pdf

[14] Llamas, J., Bullejos, D., Barranco, V., & de Adana, M. R., 2017, "Regulation issues for renewable energy integration into electrical markets", 2017 IEEE International Conference on Environment and Electrical Engineering and 2017 IEEE Industrial and Commercial Power Systems Europe (EEEIC/I&CPS Europe), pp. 1-6, IEEE.

The Community Directive 2003/54/EC, although attempted to overcome the weaknesses of the former Directive 96/92/EC, finally did not manage to ensure the transition to an internal energy market operating under real competitive conditions, as well as to protect security of supply and transparency in all procedures.

The main reasons that the improvements on energy market were slow and minor are related basically to the fact that an obligation for the creation of a wholesale market had not still been enforced, which led to lack of liquidity and transparency. In addition Member States did not follow the same degree of compliance concerning the implementation of the Directive and in many states the energy sector was still dominated by monopolies. Furthermore, unbundling between production/supply and transmission/distribution activities remained at an immature stage, whereas National Regulatory Authorities had to strengthen their independency and widen their decisive competency[15].

Some years after the adoption of the Directive 2003/54/EC it was clearly proved that the absence of particular measures resulted in the increase of concentration in the energy market to the detriment of supply security, reasonable pricing and market unification.

For all these reasons, in 2005 European Commission elaborated an inquiry over the impediments and shortcomings that had arisen during the liberalization process, pursuant to Article 17 of Regulation 1/2003 EC.

According to European Commission[16] "*The final report, published in January 2007, identified serious shortcomings in the electricity and gas markets:*

- *too much market concentration in most national markets;*
- *a lack of liquidity, preventing successful new entry;*
- *too little integration between Member States' markets;*
- *an absence of transparently available market information, leading to distrust in the pricing mechanisms*
- *an inadequate current level of unbundling between network and supply interests which has*

[15] ΑΔΜΗΕ, "Ευρωπαϊκή αγορά ενέργειας. Η μετάλλαξη των μονοπωλίων?" (IPTO, "European energy market. Monopolies' mutation?"), p. 14, available at: http://www2.econ.aueb.gr/GraduatePrograms/Hmerida-Koutzoukos.pdf

[16] European Commission, Energy and Environment, Sector Inquiry, 2012, available at: https://ec.europa.eu/competition/sectors/energy/2005_inquiry/index_en.html

*negative repercussions on market functioning and investment incentives;*

- *customers being tied to suppliers through long-term downstream contracts;*
- *current balancing markets and small balancing zones which favour incumbents.*"

The need for the establishment of a new legislative package had already been born and European Union had to take into account all inhibitory parameters that hinder the full opening of the market and tackle with them in a more effective way.

## 1.4 The Community Directive 2009/72/EC

### 1.4.1 Legal Framework

Following the above sector inquiry that was published in 2007, European Union in September 2009 adopted the third Energy Package, that inter alia included the Community Directive 2009/72/EC regarding electricity, the Regulation (EC) 714/2009 regarding the access to networks and cross-line trade of energy, as well as the Regulation (EC) 713/2009 building up the Agency for the Cooperation of Energy Regulators (ACER). This package repealed the previous one and aimed to solve the identified structural problems of energy markets and at last establish the intended single market, namely the EU Target Model. The package had to be incorporated in national legal systems by March 2011.

Especially, the Community Directive 2009/72/EC about electricity, the Regulation (EC) 714/2009 and the Regulation (EC) 713/2009 attempted to cover the following energy matters of electricity market: 1. Unbundling, 2. Independent regulators, 3. Agency for the Cooperation of Energy Regulators (ACER), 4. Cross-border cooperation and 5. Open and fair retail markets, as it is reported by European Commission[17].

The provisions of the above legal texts related to each subject will be reported analytically bellow:

**a. <u>Unbundling</u>**

The Directive 2009/72/EC provides for the absolute separation of the supply and generation branches of vertically integrated companies from their transmission activities, by imposing ownership unbundling on Member States' transmission systems.

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[17] European Commission, 2019, Energy, Third energy package, available at: https://ec.europa.eu/energy/topics/markets-and-consumers/market-legislation/third-energy-package_en

Thus, according to Art. 9 par. 1 of Directive 2009/72/EC[18]:

*"1. Member States shall ensure that from 3 March 2012:*

*(a) each undertaking which owns a transmission system acts as a transmission system operator;*

*(b) the same person or persons are entitled neither:*

*(i) directly or indirectly to exercise control over an undertaking performing any of the functions of generation or supply, and directly or indirectly to exercise control or exercise any right over a transmission system operator or over a transmission system; nor*

*(ii) directly or indirectly to exercise control over a transmission system operator or over a transmission system, and directly or indirectly to exercise control or exercise any right over an undertaking performing any of the functions of generation or supply;*

*(c) the same person or persons are not entitled to appoint members of the supervisory board, the administrative board or bodies legally representing the undertaking, of a transmission system operator or a transmission system, and directly or indirectly to exercise control or exercise any right over an undertaking performing any of the functions of generation or supply; and*

*(d) the same person is not entitled to be a member of the supervisory board, the administrative board or bodies legally representing the undertaking, of both an undertaking performing any of the functions of generation or supply and a transmission system operator or a transmission system."*

However, the Directive 2009/72/EC provides also for the option of some kind of derogation of the provision of article 9.

So, under the third energy package there are three options of transmission system unbundling[19]:

**i.** Full Ownership Unbundling (OU)

In this case, as mentioned above, the company operating as the system operator is the one that owns the transmission system. However, the owner and operator of the system shall not control or be controlled either directly or indirectly by production and/or supply undertakings.

[18] European Commission, 2009, Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC, available at: http://data.europa.eu/eli/dir/2009/72/oj

[19] Ibid.

**ii.** Independent System Operator (ISO)

This option can only be implemented in case of vertically integrated undertakings and allows this undertaking to retain ownership of the system but not at the same time control its management. An independent company (ISO) legally certified and under constant and strict regulatory surveillance should undertake system operation, maintenance and development through autonomous commercial and investment decisions. ISO must ensure that it owns the necessary financial, technical, physical and human means to execute its competences. System owner has to be legally and functionally unbundled. ISO is responsible for its investment schedule, whereas the owner has the obligation to finance investments decided by ISO and approved by the NRA[20].

**iii.** Independent Transmission Operator (ITO)

In this case, also met in vertically integrated undertakings, power supply firms can keep ownership and operation rights on networks but they are obliged to do so through a subsidiary company (ITO), which must be legally independent in its financial and corporate operations and personnel, as well as must own all needed assets and resources. ITO is also independent to manage its day to day business, but is under strict regulation and supervision by NRA[21].

As far as distribution system unbundling is concerned, the Directive 2009/72/EC Article 26 provides for the obligation of legal unbundling of distribution activities from production/supply sector, as in the previous Directive 2003/54/EC had been regulated[22]. Ownership unbundling is not obligatory in the distribution systems pursuant to the provisions of the Directive under consideration.

**b. <u>Establishment of independent regulators</u>**

The Directive 2009/72/EC in Article 35 provided also for the establishment of national regulatory authorities that would be soundly independent both from energy market and the state. In order to

[20] Richter, M.T., 2016, Transmission unbundling, Energy Community, p.p. 10-12, available at: https://energy-community.org/dam/jcr:3b37c06e-0581-42be-98e2-c50efaf27eec/WSE042016_ECS.pdf

[21] Ibid.

[22] European Commission, 2009, Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC, available at: http://data.europa.eu/eli/dir/2009/72/oj

operate in a proper and fair way, authorities' personnel should be independent from any other interest[23]. Regulatory authorities are supposed to have their own legal identity and to manage their own accounts, although each state is obliged to finance the regulatory authority in order to ensure its proper operation. Their main competences include the issuance of decisions regarding regulatory matters, market monitoring, as well as the imposition of penalties in case of violation of their decisions. In this context, producers, network operators and suppliers have the obligation to give exact and true information to regulatory authorities[24].

According to the Directive and in view of the creation of the single market, national regulators of member states are required to coordinate in a community level in order to strengthen rivalry of energy market and ensure sufficient and safe network function[25].

### c. <u>Agency for the cooperation of energy regulators</u>

The Regulation (EC) 713/2009[26] provided for the establishment of the Agency for the Cooperation of Energy Regulators (ACER) as an instrument that would accelerate the unification of the European energy market (electricity and gas) through the improvement of the coordination of the national regulatory authority of each Member State[27]. ACER would keep no dependence from EU institutions or governments or any other participant of the energy market in order to secure that the single market would operate properly and according to the provisions of the third energy package.

Indicatively, ACER's responsibilities include inter alia [28]:

- The development of common rules for the functioning of cross border networks (electricity and gas)

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[23] Ibid.

[24]European Commission, 2019, Energy, Third energy package, available at: https://ec.europa.eu/energy/topics/markets-and-consumers/market-legislation/third-energy-package_en

[25] Ibid.

[26] European Commission, 2009, Regulation (EC) No 713/2009 of the European Parliament and of the Council of 13 July 2009 establishing an Agency for the Cooperation of Energy Regulators, available at: http://data.europa.eu/eli/reg/2009/713/oj

[27] European Commission, 2019, Energy, Third energy package, available at: https://ec.europa.eu/energy/topics/markets-and-consumers/market-legislation/third-energy-package_en

[28] Ibid.

- Decisive competence over matters related to networks between states in case their national regulators cannot reach an agreement
- Examination of the realization of network infrastructure projects across EU
- Supervising the operation of the unified market as far as costs, access to the network for RES and consumer protection is concerned.

It is obvious that the role of ACER in the establishment of the internal energy market is determinant, given that supporting the national regulatory authorities and enhancing their cooperation is an absolutely necessary step towards the unification of individual states' markets.

**d. <u>Cooperation of transmission system operators</u>**

The Regulation (EC) 714/2009[29] provided for the establishment of the European Network for Transmission System Operators for Electricity (ENTSO-E) in order to promote the effective cooperation of national system operators in the way of facilitating the cross-border energy flows. As it had been proven, Member States had to cooperate with each other and secure the safe and sufficient transportation of energy across European Union via safe, functional and adequate grids[30].

According to European Commission "*These organisations develop standards and draft network codes to adjust the flow of electricity and gas across different transmission systems. They also coordinate the planning of network investments and monitor the development of new transmission capabilities. This includes publishing Europe-wide 10-year investment plans for electricity and gas to help identify investment gaps*."[31][32]

**e. <u>Protection of consumers</u>**

[29] European Commission, 2009, Regulation (EC) No 714/2009 of the European Parliament and of the Council of 13 July 2009 on conditions for access to the network for cross-border exchanges in electricity and repealing Regulation (EC) No 1228/2003, available at: http://data.europa.eu/eli/reg/2009/714/oj

[30] European Commission, 2019, Energy, Third energy package, available at: https://ec.europa.eu/energy/topics/markets-and-consumers/market-legislation/third-energy-package_en

[31] Ibid.

[32] Regarding gas, European Commission has enacted Regulation (EC) 715/2009 about access to the natural gas transmission networks, but the overview of gas European market is not included in the subject of the present thesis.

The third energy package aims inter alia to ensure that the operation of the retail market would be protected from abusive practices. Fair competition in an open retail market secured by specific and effective measures would protect customers' interests. In the context of the third package legislation, customers are permitted to change a provider without cost, have access to all required contractual information, have access to an independent mechanism for submitting their complaints and have access to costs and tariffs data[33].

As far as compliance with the third package provisions is concerned, European Commission was relatively inelastic towards Member States. So, it had been consequently monitoring the incorporation of the above European legal framework in the national legislation system of each Member State and in case of indiscipline of a state, particular infringement procedures had been activated by the Commission in order to ensure that the provisions of the third package would be correctly applied[34].

### 1.4.2 Evaluation of Community Directive 2009/72/EC

According to the conclusions of Commission's ex post evaluation report conducted in 2016[35] over the efficiency of Directive 2009/72/EC, the goal of enhancing rivalry and overcoming impediments of electricity trade across the Community has been satisfied through the effective compliance of Member States[36]. Major steps had been made towards market concentration reduction and

[33] European Commission, 2009, Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC, available at: http://data.europa.eu/eli/dir/2009/72/oj

[34] Burkhalter, D.C., 2020, Legal and Regulatory Framework of European Energy Markets: Competition Law and Sector-Specific Regulations, p. 61, Tectum Wissenschaftsverlag, available at: https://www.tectum-elibrary.de/10.5771/9783828874404/legal-and-regulatory-framework-of-european-energy-markets

[35] European Commission, 2016, COMMISSION STAFF WORKING DOCUMENT Evaluation Report covering the Evaluation of the EU's regulatory framework for electricity market design and consumer protection in the fields of electricity and gas Evaluation of the EU rules on measures to safeguard security of electricity supply and infrastructure investment , available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52016SC0412

[36] Burkhalter, D.C., 2020, Legal and Regulatory Framework of European Energy Markets: Competition Law and Sector-Specific Regulations, p.p. 77-79, Tectum Wissenschaftsverlag, available at: https://www.tectum-elibrary.de/10.5771/9783828874404/legal-and-regulatory-framework-of-european-energy-markets

consumers' rights protection due to strict separation of competitive energy activities from transmission and distribution sector as well as due to coordination between national transmission operators that accelerated energy trade across the Community making wholesale markets more flexible and competitive[37].

Nevertheless, Commission concluded that despite the progress that had been made through the application of Community Directive 2009/72/EC, there was space for market developments in view of its unification, given that retail market competition could achieve a higher standard of operation. In addition prices fluctuations from country to country could be avoided, if costs of transmission were decreased and energy congestion was effectively faced. Furthermore consumers had not yet benefited from low power prices due to grid costs, increments of RES, several tax charges and gas price raises[38].

After Commission ascertained the shortages of Directive 2009/72/EC, it issued in November 2016 its proposals for a new energy package (then called Winter Package) that would recast the latter legislative package through rules aiming to an ideally competitive, consumer protective, impartial and elastic single power market which would ensure fair and realistic pricing, as well as security of supply and greater RES penetration in the energy mix towards a decarbonized energy economy.

## 1.5 Clean Energy Package

### 1.5.1 Legal Framework

It has to be mentioned that on 25 February 2015 European Commission issued its Energy Union Strategy, which was based mainly on the Paris Agreement and essentially determined five (5) pillars of setting up the European Energy Union. According to the Commission the Energy Union Strategy draws the following lines-principles[39] towards the creation of the intended market unification:

- ✓ ***Security, solidarity and trust***
- ✓ ***A fully integrated internal energy market***

[37] Ibid.

[38] Ibid.

[39] European Commission, 2017, Energy, Energy Union, available at: https://ec.europa.eu/energy/topics/energy-strategy/energy-union_en

- ✓ ***Energy efficiency***
- ✓ ***Climate action, decarbonising the economy***
- ✓ ***Research, innovation and competitiveness***

Following to the publication of Energy Union Strategy and committed to these five principles, Commission launched in November 2016 the above mentioned Winter Package, which was going to become the forerunner of the fourth legislative package, known today as Clean Energy for all Europeans Package (CEP) that was finalized in June 2019 and is consisted of eight (8) legislative texts. This fourth legal bundle aimed to recast the previous energy framework in European power market, as well as to set up rules for the decarbonization of the energy economy[40].

Clean Energy for all Europeans Package includes[41]:

- Directive (EU) 2018/844 about Energy Performance in Buildings, regarding energy efficiency of buildings;
- Directive (EU) 2018/2001 about Renewable Energy, providing for larger penetration of RES in the energy mix and aiming to a rate of 32% by 2030;
- Directive (EU) 2018/2002 about Energy Efficiency, which sets a goal of 32.5% of energy efficiency by 2030;
- Regulation (EU) 2018/1999 about Governance of the Energy Union, related to the governing of the Energy Union. According to the Regulation countries should public a 10year National Energy and Climate Plan (NECP) for 2021-2030 and the ways in which they will materialize their plans;
- Electricity Regulation (EU) 2019/943 about EU Electricity market basically related to provisions for the wholesale market and the function of networks;
- Electricity Directive (EU) 2019/944 concerning the retail energy market, as well as contains rules for the energy industry (from production to supply) and power storage;
- Risk Preparedness Regulation (EU) 2019/941 about tackling with possible power crises; and

[40] Florence School of Regulation (FSR), 2020, The Clean Energy for all Europeans Package, European University Institute (EUI), available at: https://fsr.eui.eu/the-clean-energy-for-all-europeans-package/

[41] Ibid.

- ACER Regulation (EU) 2019/ 942 about the operation and responsibilities of the Agency for the Cooperation of Energy Regulators (ACER).

In this chapter we will examine the parts of CEP that refer directly to the upgrade of the existed regulation of the internal energy market operation towards the renowned "*New market design*":

❖ **<u>The Electricity Directive (EU) 2019/944 and Electricity Regulation (EU) 2019/943</u>**

In January 2020 the Electricity Directive (EU) 2019/944 on common rules for the internal market for electricity took the place of the previous Electricity Directive (2009/72/EC) and the Regulation (EU) 2019/943 on the internal market for electricity took the place of the previous Electricity Regulation (EC/714/2009).

Pursuant to Electricity Directive (EU) 2019/944 on common rules for the internal market for electricity [42]:

- Electricity prices can be freely set by providers.
- Providers' rivalry will be based on the real market
- Weak consumers will be protected
- The member state of the supplier will play no role for the consumer's right for electricity, which will be determined by their contract
- Smart metering placement will not be charged
- Home consumers and small companies will be able to use price comparison mechanisms at free
- The right of switching provider in 3 weeks at no cost will be established
- Consumers that have smart meters will be able to sell the power they have produced in a fair way ensured by their contract clauses.

Pursuant to Regulation (EU) 2019/943 on the internal market for electricity [43]:

- Legislation over internal energy market is reformed so that its operation becomes free from impediments and rivalry is secured. Some of the main rules that are imposed by the

[42] Giucci, M. and Keravec, A., 2021, Internal Energy Market, European Parliament, Factsheets on the European Union, 2021, available at: https://www.europarl.europa.eu/factsheets/en/sheet/45/internal-energy-market

[43] Ibid.

Regulation refer to market-determined pricing, consumers' participation in the market and generators' selling responsibilities.

- Enhancing the attempt to less carbon emissions in energy industry becomes a main target.
- Power commerce among European Union will get free from several obstacles
- Ensure the creation of a legal framework in the way to clean energy in accordance with Paris Agreement.

❖ **Risk Preparedness Regulation (EU) 2019/941**

The Regulation on risk preparedness in the electricity sector (EU) 2019/941 regulates the context in which Transmission System Operators (TSOs) will upgrade their cooperation with other TSOs across European Union or with TSOs of other close states, as well as the ACER. By establishment of particular common rules, this Regulation is attempting to protect security of energy supply under risk conditions[44].

❖ **ACER Regulation (EU) 2019/942**

Regulation (EU) 2019/942 about a European Union Agency for the cooperation of energy regulators amends the previous Regulation (EC) 713/2009. The new Regulation serves the European goal of upgrading energy trade across European Union and abroad. Given that cross-border energy commerce is one of the most basic pillars of the single market, ensuring security of supply as well as competitiveness, European Union should enhance ACER's role in order to be compatible with the new market requirements. Thus, pursuant to the new Regulation ACER's competences (apart from the already existed) exceed to matters related to the wholesale market, interstate energy grid, network codes, as well as any other matter that could cause discrepancies in the internal market due to conflicting national actions or decisions[45].

### 1.5.2 Expectations of Clean Energy Package implementation

Member States are obliged to incorporate the Clean Energy Package on their national Law in 1-2

[44] Ibid.

[45] Ibid.

years since each included law act was respectively published. The new rules which amended the previous legislative package in the context which had been set by Energy Union Strategy in 2015, are expected to upgrade the single energy market taking into account all innovative technologies that can contribute to a clean environmental future. Larger RES share in the energy mix, exploitation of new low-carbon developments, healthy rivalry conditions and market based pricing, secure, regulated and unobstructed cross-border energy flows, up to date infrastructures and informed as well as active consumers can guarantee the reinforcement of the above Energy Union Strategy's dimensions and thus a clean and competitive energy economy.

However, the correct implementation of the new legal framework by each Member State respectively is going to ensure that what has been intended will also be realized. If countries timely comply with the provisions of the CEP, then European Union will have made one significant step to achieve its energy intentions. From that point on, provided that the rules of the CEP are fully followed during market operation, it will be proven in fact whether this new legislation attempt will show up unpredicted shortages or will lead to positive prospects.

# 2. Basic structures of electricity markets

## 2.1 Introduction

In the present chapter, we will make a short reference to the basic market structures that energy markets have been formed in over time. The energy industry includes four (4) business sectors, namely production, transmission, distribution and finally supply. Each sector's openness to competition defines the economic model of each market structure.

In the past, the most usual form of energy market was the model of vertically integrated state owned undertakings, which were activated in all energy sectors and dominated the relevant market. The separation of the four energy sectors is the prerequisite for any market transformation from monopolistic to more competitive forms. Although electricity industry can be organized in many structures which can be combined with each other, we will focus on four (4) of them that are the most typical and represent the main characteristics of each type.

## 2.2 Vertical Monopoly

Vertical monopoly is the most typical energy market option, where one and only company operates in all sectors, namely it produces power and controls its delivery from the generating unit to the final consumer through the network[46].

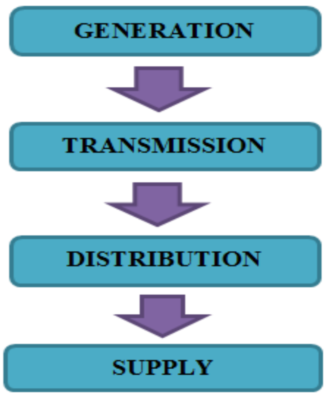


*Figure 1: Diagram of vertical monopoly (Own Figure)*

[46] Kessides, N.I., 2004, Reforming Infrastructure: Privatization, Regulation and Competition, A World Bank Policy Research Report, p. 144, available at: https://documents1.worldbank.org/curated/en/709301468779183565/310436360_20050007115940/additional/289850PAPER0reforming0infrastructure.pdf

The market model of a vertically integrated company, mostly state owned, could theoretically ensure cost reduction in relation to the demand thanks to the fact that one entity owns the power stations as well as the grids, while at the same time it is responsible for the rendering of power services. Nevertheless, these advantages are rather minor compared to the ones that competition can provide, such as lower expenditures for infrastructure building and operation, ceasing of inadequate generating units as well as competitive prices[47]. As it is shown above the main characteristic of monopoly is the absolute lack of competition in all industry sectors and at all levels. The vertically integrated undertaking is exclusively responsible for pricing of electricity, as well as for every energy issue arising in the market.

The monopolistic type of energy market was prominent in European Union until 1990s when market conditions turned to more competitive forms through the separation of the energy sectors.

## 2.3 The Single Buyer Model

Under the single buyer model different producers sell the power they have generated to a single market agent, who fully dominates the transmission network and is the only supplier for distributors and final consumers. This market model can be met in many different types that are mostly defined by the dominance degree of the buyer entity in the market and the risk that it assumes[48].

This form of market allows production sector to function in a fully competitive mode and keeps the rest sectors in a monopolistic environment. The system is based on long term power purchase agreements signed between producers and the single buyer, so there is no risk for producers. However any market risk is inevitably transferred to the final consumer who has to absorb any potential burden, whereas competition advantages remain limited due to the lack of interaction of producers with the rest market.

[47] Ibid.

[48] Ibid, p.p. 144, 148-149.

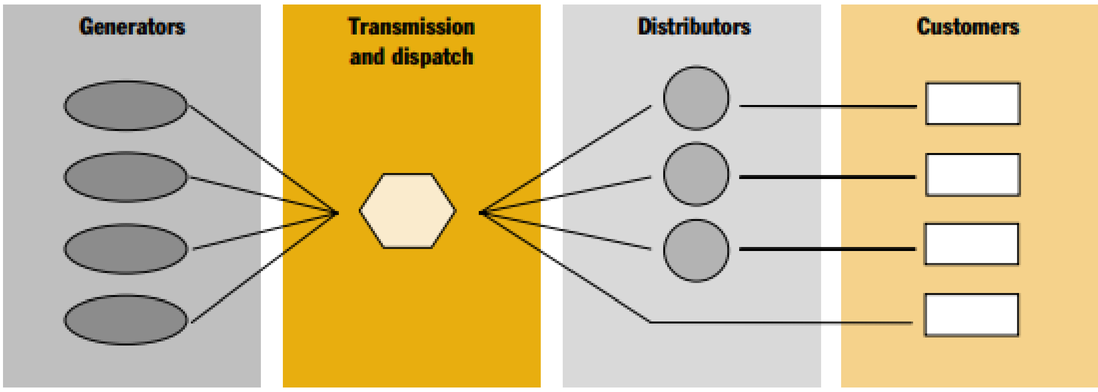


*Figure 2*: *The single buyer model*

*Source: Lovei (2000)*[49]

## 2.4 The wholesale market competition model

In this kind of market structure different distributors can purchase power from different producers and further sell it to the final consumers by using the grid and keeping a dominant position as sellers in their district[50]. In other words wholesale market functions under competitive conditions. Monopolistic regime though remains for retail sector.

Consumers are not allowed to select their power providers, although large entities that use major amounts of electricity are able to sign direct agreements with producers. The degree of competition here is greater than that of the previous model, given than more stakeholders have the option to choose their supplier at a lower price[51].

[49] Lovei, L., 2000, "The Single Buyer Model: A Dangerous Path toward Competitive Electricity Markets", Public Policy for the Private Sector Note 225, World Bank, Washington D.C.

[50] Kessides, N.I., 2004, Reforming Infrastructure: Privatization, Regulation and Competition, A World Bank Policy Research Report, p.p. 144, 148-150 available at: https://documents1.worldbank.org/curated/en/709301468779183565/310436360_20050007115940/additional/289850PAPER0reforming0infrastructure.pdf

[51] Ibid.

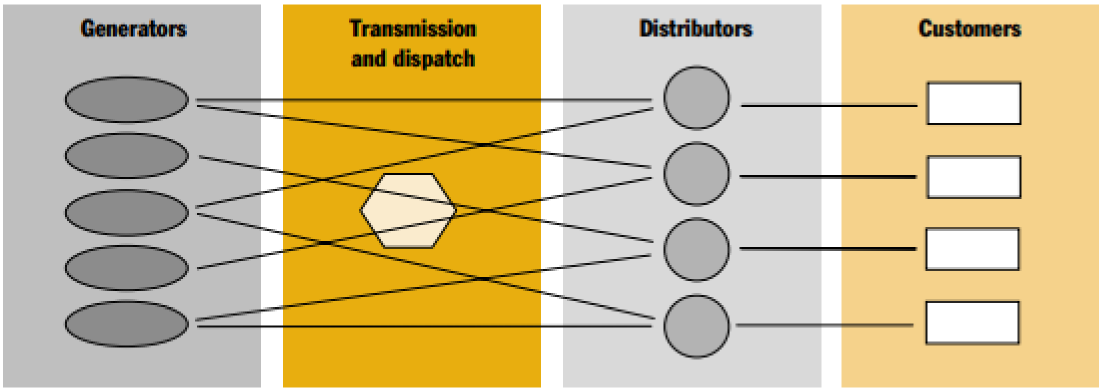


*Figure 3: The wholesale market competition model*

*Source: Lovei (2000)*[52]

For this model to function it is necessary that there is a pool system which operates under a market regulator and a system operator that are responsible for the proper functioning, adequacy and security of the market[53]. This pool is mandatory and is based on the fact that power trade takes place through auctions, where producers on the one hand and distributors on the other bid in the power pool regarding the quantity they want to sell or to buy respectively. The market should be divided into spot market/exchange and forward market for future oriented agreements[54]. There is no other way of power trading for producers and buyers apart from the mandatory pool, where all energy production is being traded.

This type of market is characterized by competition in production sector, while distribution sector is dominated by regional monopolies. Wholesale market is open to rivalry, while final customers cannot choose their provider. A competitive wholesale market, as described above, is a stage before full liberalization.

[52] Lovei, L., 2000, "The Single Buyer Model: A Dangerous Path toward Competitive Electricity Markets", Public Policy for the Private Sector Note 225, World Bank, Washington D.C.

[53] Tómasson, E., Hesamzadeh, M. R., Söder, L., & Biggar, D. R., 2020, An incentive mechanism for generation capacity investment in a price-capped wholesale power market, *Electric Power Systems Research*, *189*, 106708.

[54] Kessides, N.I., 2004, Reforming Infrastructure: Privatization, Regulation and Competition, A World Bank Policy Research Report, p. 150 available at: https://documents1.worldbank.org/curated/en/709301468779183565/310436360_20050007115940/additional/289850PAPER0reforming0infrastructure.pdf

## 2.5 The retail market competition model

In an open retail market, consumers have the free option to be supplied with energy by producers or suppliers, while open access to transmission and distribution grids is allowed through contracts[55]. The opening of retail/supply sector is the last step in liberalization line.

The main difference with the previous market model is the fact that there is no regional monopoly for distribution entities, given that here consumers are free to select their supplier. It is remarkable though that this type of market functioning results to increased transaction costs because of the complexity of trading contracts. Furthermore, application of regulatory and management principles is absolutely necessary for the operation of the market[56].

Due to big costs of power transmission, usually only large entities buy energy directly from generators, whereas the majority of consumers buy energy through supply companies. Transmission and distribution sectors remain under monopolistic conditions, so it is very important that impartiality and transparency is ensured as far as the use of networks is concerned.

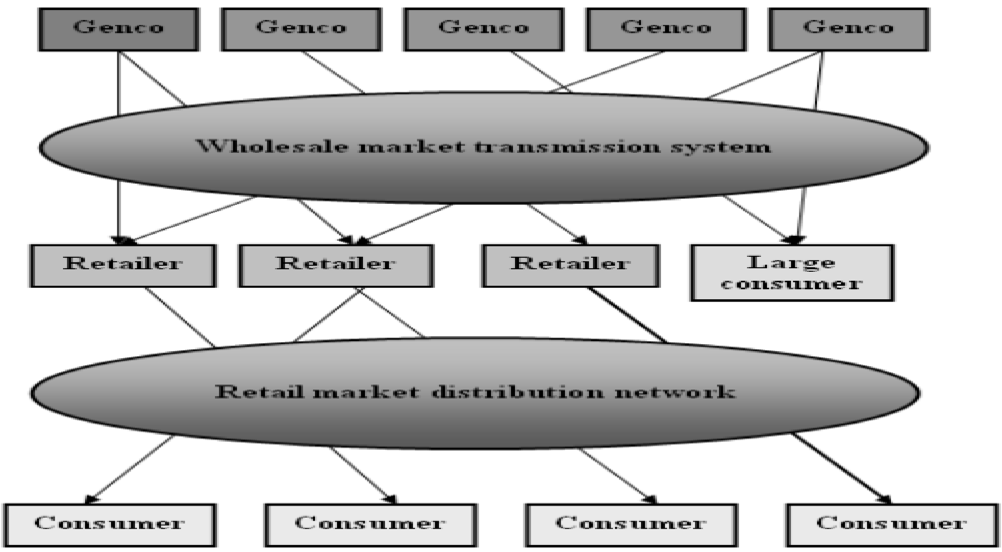


*Figure 4: The retail market competition model*

*Source: Hassan Y.M. et al (2008)*[57]

[55] Ibid p. 144.

[56] Pepermans, G., 2019, European energy market liberalization: experiences and challenges, *International Journal of Economic Policy Studies*, *13*(1), 3-26.

[57] Hassan, Y.M., Abdullah, P., Arifin, A.S., Hussin, F. & Majid, M., 2008, Electricity Market Models in Restructured Electricity Supply Industry, IEEE Xplore, Researchgate, DOI:10.1109/PECON.2008.4762618

The above mentioned four (4) typical models of market functioning are defined by the competition degree that each one applies. The following table gathers the basic differences between these models depending on the competitiveness of each distinct energy sector.

| Characteristic | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| **Definition** | Monopoly at all levels | Competition in generation | Competition in generation and choice for Distcos | Competition in generation and choice for final consumers |
| **Competition Generators** | NO | YES | YES | YES |
| **Choice for retailers** | NO | NO | YES | YES |
| **Choice for final consumers** | NO | NO | NO | YES |

*Table 1: Types of market structuring depending on competition degree*

*Source: Mohammad Y.H.et al (2008)*[58]

## 2.6 Energy markets transformation

The European Union aimed for the full liberalization of the energy market through the formation of a stable, supportive and forward-looking legal base, that would allow its gradual opening to competition tackling any arising discrepancies or impediments.

By adopting the above mentioned legislative packages, each Member State had to ensure that the four energy sectors would be effectively separated, production and supply would be fully opened to rivalry and third party access to network would be protected from discriminatory and non-transparent practices. Under the supervision of independent regulatory authorities and operators of transmission and distribution grids, the energy market in every state of European Union would operate as an absolutely liberalized market and become an integrated part of the internal EU energy market.

As market liberalization procedure was evolving, two different kind of wholesale markets finally started to be formed during the years: **a.** mandatory pools and **b.** power exchanges, which are based on different functional principles regarding the formation of the energy price, as well as the participation of sellers and buyers in each kind of market.

[58] Ibid.

Below some basic attributes of each model of organized market are referred:

### 2.6.1 Mandatory Pools

In case of a power pool model, energy is being traded via mandatory auctions that take place between producers and suppliers. In other words this type of market is characterized by obligatoriness and does not allow any other way of trading, apart from participation in the pool. The predefined procedure requires that every producer has to offer a particular quantity of energy at a specific price and for a specific time and be capable to dispose the offered quantity in the power pool, whereas in parallel suppliers state the quantity that they can buy from the pool for a specific time. The price of energy for the day-ahead is called "system marginal price" and is formed by taking into account the price and capacity of the offered energy in the previous day and the demand per hour as it is declared by suppliers[59].

The mandatory character of power pool model excludes any other type of transaction of electricity and compels sellers and buyers to participate in the pool, not allowing the conclusion of bilateral contracts outside the pool system.

This kind of market manages to satisfactorily protect fair competition for the benefit of electricity generators, encouraging new participants to enter the market offering their production without being dominated by companies that had been operating as monopolies in the past[60].

### 2.6.2 Power Exchanges

The liberalization of the electricity market has been crucial for the industry operation and energy trade, as well as played a catalytic role for the abolition of monopoly markets, leading to the creation of the institution of Electricity Exchange. With the creation of the Electricity Exchanges, the negotiations are organized into organized competitive markets, which have been developed and continue to grow very rapidly creating conditions for the operation of related derivative markets eg. electricity futures, options etc[61].

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[59] Kyriakides Georgopoulos Law Firm, The Hellenic Power Exchange, Institute of Energy for South East Europe, available at: https://www.iene.eu/the-hellenic-power-exchange-p4548.html

[60] Ibid.

[61] Ringler, P., Keles, D., & Fichtner, W., 2017, "How to benefit from a common European electricity market design", *Energy Policy*, *101*, 629-643.

As the liberalization process was evolving, power transactions were gradually being increased and new challenges appeared regarding energy as a commodity, which could now be considered not only as immediately deliverable, but also as investment means through the formation of financial derivatives based on it[62]. The Power Exchange market model serves both kinds of energy trading that were established, the one based on the physical delivery of energy and the other that has to do with financial energy products incorporating future rights[63].

In case of the Power Exchange model the market is organized into distinct sub-markets operating with a different timescale through standardized transactions. The key point for the optimal operation of such energy model is supply and demand matching under the prism of secured energy capacity and fair price formation, which is something that requires sufficient participations in the exchange mechanism. Electricity price is formed by supply and demand on an hourly base.

This market type does not prohibit the conclusion of bilateral agreements between producers and suppliers in forms that are not standardized. According to Kyriakides Georgopoulos law firm's article published at the official site of Institute of Energy for South East Europe, *"Standardization means the definition of specific packages and unities of electricity power based on the criteria of time delivery or way of delivery. Power Exchange markets cannot always cover through the standardized energy products they offer for negotiation, the special transactional needs of the producers and suppliers. Special reasons do justify, and not rarely, the formation of bilateral contracts between producers and suppliers outside a generally organized power exchange platform (known as, transactions concluded Over the Counter – OTC).*"[64]

It is concluded that participation of sellers and buyers in the power exchange market, contrary to the previous model of power pool, is absolutely optional and in no case compulsory. Consequently, the organized energy exchange mechanism operates in parallel to OTC contracts, which have a complementary character, as they cannot cover adequately the totality of energy transactions due to the peculiar risks that energy as a commodity involves.

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[62] Νάντση, Ε., 2019, "Η ελληνική αγορά ηλεκτρικής ενέργειας : το ευρωπαϊκό μοντέλο στόχος και το χρηματιστήριο ενέργειας", Master's Thesis, Aristotle University of Thessaloniki, p.p. 8-9, available at: https://dspace.lib.uom.gr/bitstream/2159/23504/4/NantsiEudoxiaMsc2019.pdf

[63] Ibid.

[64] Kyriakides Georgopoulos Law Firm, The Hellenic Power Exchange, Institute of Energy for South East Europe, available at: https://www.iene.eu/the-hellenic-power-exchange-p4548.html

It should be mentioned that many European countries had been applying the power exchange model in their energy sector already since 1990s, such as Nordic Peninsula countries, or since 2000 such as Germany and since 2004 such as Italy.

# 3. The EU Target Model

## 3.1 Introduction

In the first chapter we studied the legal framework on which European Union attempts to base the creation and growth of a unified energy market, which is going to operate under common rules for all Member States ensuring solidarity among them. The formation of such a market was from the beginning a project full of challenges and impediments mainly due to the special characteristics of energy as a marketable commodity and the fragmented market structure of Member States which was dominated by vertical monopolies.

The previously mentioned legislative packages along with the Energy Union Strategy and many other significant European initiatives gradually paved the way towards the unification of the European energy markets and the establishment of a common operation model for the new single market. This is what we call Target Model.

Target Model's guidelines were prepared and set by the Agency for the Cooperation of Energy Regulators (ACER) and European Network of Transmission System Operators for Electricity (ENTSO-E) in association with European Commission. According to the basic axes of Target Model, the internal energy market would be organized in four (4) separated sub-markets, namely i. the Forward market, ii. The Day-ahead market, iii. The Intraday market and iv. the Balancing market, as each kind of them will be extensively described below.

As of now, market integration has satisfactorily progressed and most of the Member States have already adopted their national market operation to the imposed common rules, although different degrees of competition maturity are met in each State causing delays and shortages as far as the full implementation of Target Model is concerned.

## 3.2 Target Model's fundamentals

Through the adoption of the first three energy packages the European Union aimed for the creation of an internal energy market, the renowned Target Model, the realization of which was assigned to ACER and ENTSO according to the Directive 2009/72/EC.

According to Keay, M., *"Target model is based on two broad principles:*

- *Energy only regional markets, preferably organized on a zonal basis, in which generators' revenues depend primarily on the price for each marginal unit of energy supplied.*

- *Market coupling which is a way of linking zonal day-ahead spot markets into a virtual market, so that the lowest priced bids are accepted up to the point where congestion constraints limit further trade (using flow-based transmission allocation, based on optimization models).”*[65]

ACER in coordination with ENTSO published - inter alia - three guidelines providing for the formation of four (4) separated markets which operate in different timeframes. More specifically, the energy market is divided in 1. the futures market (Forward market), 2. the pre-daily market (Day-ahead market), 3. the endo-daily market (Intraday market) and 4. the balancing market. Electricity is going to be exchanged inside the Union through market coupling procedures and will be transferred via cross border networks. The capacity of networks (Available Transfer Capacity - ATC) is going to define the electricity quantities that could be exchanged among coupled regional markets.

The reason for this division is based on the fact that electricity, although can be considered as a commodity, it has significant differences from usual commodities due to its special features.

According to Schittekatte, T. et al, the most basic features of electricity are the following:

*“<u>Time</u>: large volumes of electricity cannot be stored economically (yet). Therefore, electricity has a different cost and value over time.*

*<u>Location</u>: electricity flows cannot be controlled easily and efficiently, and transmission components must be operated under safe flow limits. If not, there is a risk of cascading failures and blackouts. Therefore, electricity has a different cost and value over space.*

*<u>Flexibility</u>: demand can vary sharply over time, while some power stations can only change output slowly and can take many hours to start up. Also, power stations can fail suddenly. Demand and generation must match each other continuously; otherwise there is a risk of black-out. Therefore, the ability to change the generation/consumption of electricity at short notice has a value. These three unique physical characteristics can explain why there is not just one electricity market. Electricity is not only energy in MWh. Transmission capacity and flexibility are scarce resources and should be priced accordingly. Therefore, electricity (energy, transmission capacity, flexibility) is exchanged in*

[65] Keay, M., 2013, The EU “Target Model” for electricity markets: Fit for purpose?, The Oxford Institute for Energy Studies, p. 2, available at: https://www.oxfordenergy.org/wpcms/wp-content/uploads/2013/05/The-EU-Target-Model-for-electricity-markets-fit-for-purpose.pdf

*several markets until the delivery in real-time.”*[66]

Taking into account the above mentioned special attributes of energy as a commercial product, ACER and ENTSO assumed the issuance of the following guidelines in relation to the operation of the energy market regarding the frametime of trading:

- The forward capacity allocation guideline (FCA GL)
- The capacity allocation and congestion management guideline (CACM GL)
- The electricity balancing guideline (EB GL)

Under the prism of the above guidelines the European internal energy market should include, according to European Commission:

*“**For longer timeframes** (i.e., longer than day-ahead), a single European platform for the explicit allocation of cross-border transmission capacities. Physical transmission rights ('PTRs') and/or financial transmission rights ('FTRs') on cross-border interconnections are to be auctioned by TSOs in case a relevant liquid forward derivatives market does not exist;*

***For the day-ahead timeframe**, the implicit allocation of cross-border transmission capacities through a single European price coupling process, replacing explicit auctions. Implicit market coupling implies that all order books from power exchanges (all bids and offers) are to be aggregated and optimized in one algorithm that calculates prices and flows, subject to the available transmission capacity between market areas. Price differences can still occur due to bottlenecks between different market areas (congestion on interconnections);*

***For the intraday timeframe**, a single platform where electricity and the corresponding cross-border capacities are traded in one (i.e., implicit capacity allocation) on a continued basis;*

***For the balancing timeframe**, European-wide balancing platforms where all TSOs would have access to different types of balancing products while taking into account the available transmission capacity between market areas.”*[67]

Pursuant to the relevant guidelines, each Member State has to configure and organize its national

[66] Schittekatte, T., Reif, V. & Meeus, L., 2020, The EU Electricity Network codes (2020Ed.), European University Institute, Florence School of Regulation, Energy, p. 5, available at: https://fsr.eui.eu/publications/?handle=1814/67610

[67] European Commission, Directorate General for Energy, 2017, COMMISSION STAFF WORKING DOCUMENT IMPACT ASSESSMENT Accompanying the document Commission Regulation (EU) No .../... establishing a Guideline on Electricity Balancing. SWD/2017/0383 final, Document 52017SC0383, EUR-Lex, available at: https://eur-lex.europa.eu/legal-content/PT/ALL/?uri=CELEX:52017SC0383

energy wholesale market in such a way that serves the operation of the above mentioned platforms and facilitates market coupling. Although there is no compulsory provision for the market type that should be followed by each Member States, Regulation (EU) 2015/1222 establishing the guideline on capacity allocation and congestion management, directly points out that the intended market coupling should be accomplished through the formation and operation of power exchanges.

More specifically, according to the preamble of Regulation (EU) 2015/1222, point 4, *"To implement single day-ahead and intraday coupling, the available cross-border capacity needs to be calculated in a coordinated manner by the Transmission System Operators (hereinafter 'TSOs'). For this purpose, they should establish a common grid model including estimates on generation, load and network status for each hour. The available capacity should normally be calculated according to the so-called flow-based calculation method, a method that takes into account that electricity can flow via different paths and optimises the available capacity in highly interdependent grids. The available cross-border capacity should be one of the key inputs into the further calculation process, in which all Union bids and offers, collected by* ***power exchanges****, are matched, taking into account available cross-border capacity in an economically optimal manner. Single day-ahead and intraday coupling ensures that power usually flows from low- price to high- price areas.*"[68]

Furthermore, according to the preamble of Regulation (EU) 2015/1222, point 5, *"The market coupling operator (hereinafter 'MCO') uses a specific algorithm to match bids and offers in an optimal manner. The results of the calculation should be made available to all* ***power exchanges*** *on a non-discriminatory basis. Based on the results of the calculation by the MCO, the power exchanges should inform their clients of the successful bids and offers. The energy should then be transferred across the network according to the results of the MCO's calculation. The process for single day-ahead and intraday coupling is similar, with the exception that the intraday coupling should use a continuous process throughout the day and not one single calculation as in day-ahead coupling."*[69]

Given the above mentioned, it is obvious that power exchanges are considered by European Union to be the most appropriate means for the integration of the internal energy market, operating under common rules that will ensure effective market coupling and therefore successful cross border trade

[68]European Commission, 2015, COMMISSION REGULATION (EU) 2015/1222 of 24 July 2015 establishing a guideline on capacity allocation and congestion management, available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32015R1222&from=EL

[69] Ibid.

of electricity inside European Union. In fact, the European single market is intended to function as a "sole European power exchange", following the structure of the power exchanges that already operate in some Member States since 1990s, namely the structure of the above four (4) sub-markets.

That is why market coupling is of major importance for the function of the internal energy market and its accomplishment is one of the basic principles of Target Model.

In this context, according to European Commission, *"the EU Target Model requires a 'flow-based' method to be used for capacity calculation and allocation. Flow-based means that capacity is calculated and allocated taking into account the meshed nature of the transmission network and all possible paths through which electricity is flowing in it. The flow-based calculation algorithms will thus optimize directly the commercial power flows taking into account the limitations of the network. In other words, the values on available transmission capacity will be calculated as part of the market algorithm itself, i.e. simultaneously (and not ex-ante based on expected flows). The EU Target Model is based on zonal pricing and requires efficient price-zones reflecting actual system constraints."*[70]

The following figure shows the operation of an energy stock market in line with the objective set by the European Union about Target Model.

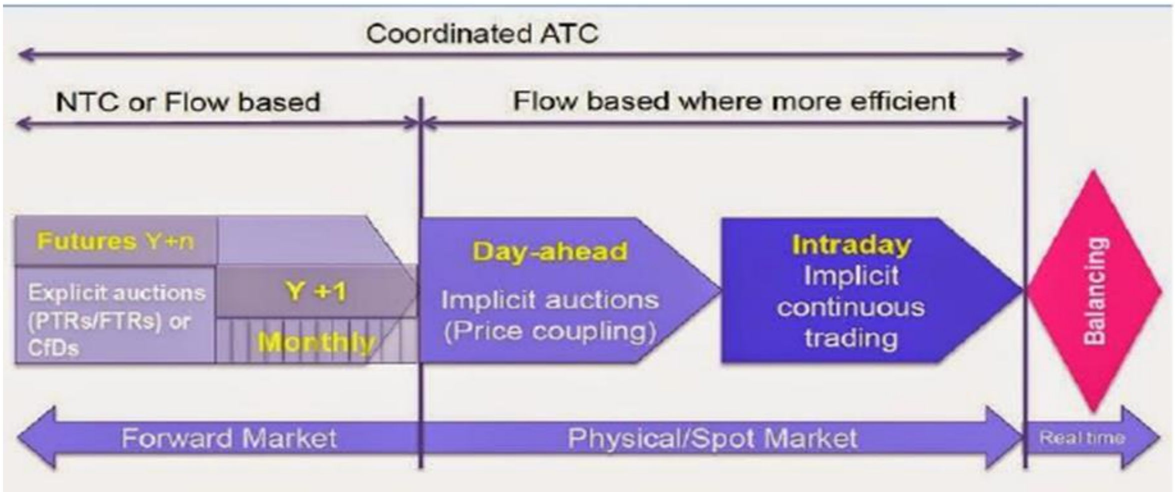


*Figure 5: The EU Target Model in electricity*
*Source: European Commission*[71]

[70] European Commission, Directorate General for Energy, 2017, COMMISSION STAFF WORKING DOCUMENT IMPACT ASSESSMENT Accompanying the document Commission Regulation (EU) No .../... establishing a Guideline on Electricity Balancing. SWD/2017/0383 final, Document 52017SC0383, EUR-Lex, available at: https://eur-lex.europa.eu/legal-content/PT/ALL/?uri=CELEX:52017SC0383

[71] Ibid.

## 3.3 The sub-markets of Power Exchange

In this chapter we will attempt to make an analytical reference to the sub-markets, which Power Exchange consists of in line with the guidelines that have been issued by ACER in the context of Target Model establishment.

The guideline on Forward Capacity Allocation (FCA) sets out the conditions of operation of long-terms energy transactions in the context of a future market. The guideline on Capacity Allocation and Congestion Management (CACM) concerns the day-ahead and intraday timeframe, thus it provides for a flow-based procedure towards functioning of market coupling on the basis of day-ahead and intraday market. CACM Regulation (Articles 4, 5 and 6) also provides for the establishment of Nominated Electricity Market Operators (NEMOs) in each Member State, which should be responsible for the coupling in day-ahead and intraday markets.

The electricity balancing guideline (EB) sets out the terms for an effective balancing process between supply and demand of traded electricity. In the fourth chapter with the title “The network codes” the above guidelines will be analytically examined under the prism of market integration in European Union.

### 3.3.1 Forward Market

Forward markets are related to long-term contracts through which energy is agreed to be delivered in the future under a predefined price. In this way, parties (seller and buyer) manage to mitigate the market risk arising from the price volatility of electricity due to its special characteristics.

In forward markets energy can be traded not only in its physical form (physical transmission rights - PTR), but also as a financial product (financial transmission rights - FTR).

According to Battle et al[72]: “*A PTR entitles the buyer to the right to transmit a specific amount of power between two electricity network nodes during a given period of time. In Europe, PTR holders must declare whether they intend to exercise their physical right (‘nomination’) before a pre-established deadline, often the day ahead. Where they fail to do so, the system operator automatically re-sells the right on the short-term market on behalf of the holder, who receives the resale price. This is known as the use-it-or-sell-it (UIOSI) condition”.*

[72] Batlle, C., Mastropietro, P. & Gómez-Elvira, R., 2014, “Toward a Fuller Integration of the EU Electricity Market: Physical or Financial Transmission Rights?”, The Electricity Journal v. 27, 8–17, doi:10.1016/j.tej.2013.12.001

In addition, according to Battle et al [73] *"An FTR hedges the buyer against the market price difference between two or more bidding zones. These contracts do not have an impact on the economic dispatch or on the actual use of the line. Financial transmission rights can be obligations or options. Obligations imply that the rights holder receives the value of the entitlement when it is positive but must pay the counterparty to the contract if it is less. With options, the holder is not obligated to pay the counterparty if the value of the entitlement is negative."*

Trading of electricity in such markets may commence many years before its physical delivery and may last until one day before it. A financial exchange organizes trade using standardized products, or market parties can make bilateral over the counter (OTC) deals. The negotiated energy prices are denominated per bidding zone, which in most cases overlap with national borders[74].

The Clean Energy Package sets out a detailed common legislative basis of the operation of forward markets. Specifically, according to article 9 of the Regulation (EU) 2019/943, *"In accordance with Regulation (EU) 2016/1719, transmission system operators shall issue long-term transmission rights or have equivalent measures in place to allow for market participants, including owners of power-generating facilities using renewable energy sources, to hedge price risks across bidding zone borders, unless an assessment of the forward market on the bidding zone borders performed by the competent regulatory authorities shows that there are sufficient hedging opportunities in the concerned bidding zones."*

*2. Long-term transmission rights shall be allocated in a transparent, market based and non-discriminatory manner through a single allocation platform.*

*3. Subject to compliance with Union competition law, market operators shall be free to develop forward hedging products, including long-term forward hedging products, to provide market participants, including owners of power-generating facilities using renewable energy sources, with appropriate possibilities for hedging financial risks against price fluctuations. Member States shall not require that such hedging activity be limited to trades within a Member State or bidding zone"*[75]

[73] Ibid.

[74] Florence School of Regulation, 2020, Electricity Markets in the EU, available at: https://fsr.eui.eu/electricity-markets-in-the-eu/

[75] European Commission, 2019, Regulation (EU) 2019/943 of the European Parliament and of the Council of 5 June 2019 on the internal market for electricity, available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32019R0943

The function of forward markets in the context of the internal European market is significant, given that it allows participants to gain profit via transactions of non-traditional energy products (such as derivatives) and overcomes difficulties related to the physical delivery of electricity, which in short term markets may result to risky fluctuations. Therefore hedging activity through long-term contracts is allowed to take place beyond each bidding zone via a special allocation platform which is responsible for the transparent allocation of the contracted transmission rights. The trading of cross – zonal transmission rights through auctions is the factor that makes forward markets absolutely necessary for Target Model establishment, thanks to broad risk hedging capacity that they provide.

In the figure below the European bidding zones as they were in September 2020, are presented.

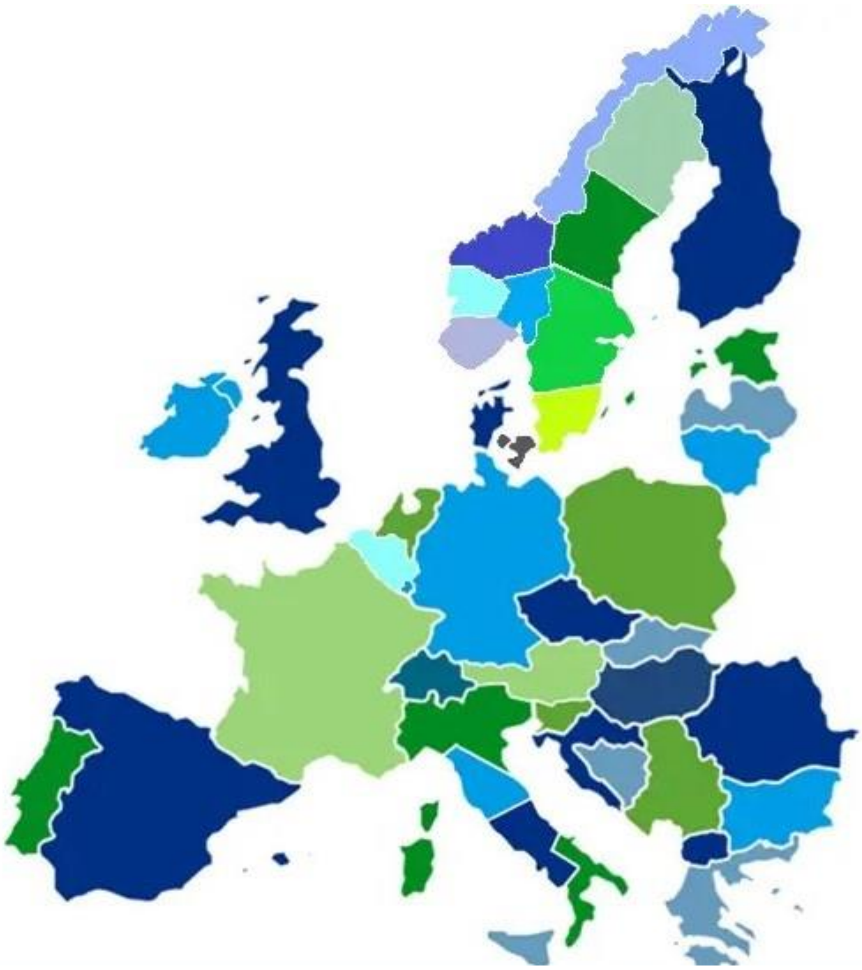

*Figure 6: The bidding zones in Europe – September 2020*
*Source: Florence School of Regulation*[76]

[76] Florence School of Regulation, 2020, Electricity Markets in the EU, available at: https://fsr.eui.eu/electricity-markets-in-the-eu/

### 3.3.2 Day-ahead Market (DAM)

Day-ahead or Spot Market accommodates the conclusion of energy contracts through which power is going to be transacted on an hourly basis for the next 24 hours. The nature of Target Model requires that the day ahead trading must take place implicitly through auctions in the environment of a power exchange that will be responsible for the allocation of transmission capacity among bidding zones[77].

According to Shah D. and Chatterjee S., *"Hourly contracts are submitted by supplier and buyers in terms of multiple volume-price pairs which basically represent the willingness of supplier/buyer to sell/buy a certain volume of power at a price equal to or higher/lower than their respective specified price. Both electric power sellers and buyers were allowed to submit volume-price offers and bids for each hour in Power Exchange."*[78]

This market is based on an implicit auctions mechanism, which collects offers for selling or buying electricity coming from producers or suppliers respectively by 12:00 in the noon of each day for every hour of the next day. Price and quantity of energy that is going to be physically delivered hourly in the next day, are estimated via a particular algorithm in the noon of the previous day according to the point where supply and demand curves meet balance. Therefore, the day of delivery the electricity load, that had been contracted the previous day, must be delivered from the seller to the buyer on the agreed price.

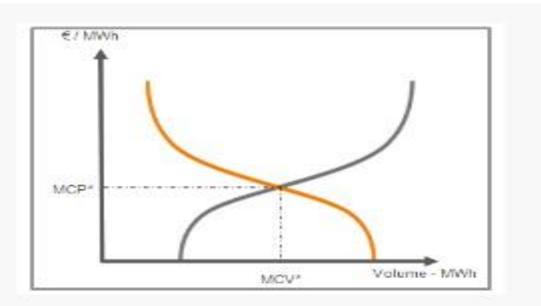


*Figure 7: MCP: Market Clearing Price, MCV: Market Clearing Volumes*
*Source: Epexspot*[79]

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[77] Neuhoff, K., Wolter, S. & Schwenen, S., 2016c, "Power markets with renewables: New perspectives for the European Target Model", The Energy Journal v. 37, p.p. 23–38, doi:10.5547/01956574.37.2.kneu

[78] Shah, D. & Chatterjee, S., 2020, A comprehensive review on day-ahead electricity market and important features of world's major electric power exchanges, Wiley Online Library, p. 5, https://doi.org/10.1002/2050-7038.12360, available at: https://onlinelibrary.wiley.com/doi/epdf/10.1002/2050-7038.12360

[79] https://www.epexspot.com/en/basicspowermarket

The estimation of the clearing price defines which offers are going to be executed in a specific time.

All sellers that had offered electricity in lower price than the Market Clearing Price will be paid this price and all buyers that had bidded for electricity in higher price than the Market Clearing Price will pay the demanded volume at this price[80].

As Florence School of Regulation reports, *"There is no obligation for market parties to buy and sell their energy on the spot market. Spot markets are often used to adjust long-term positions closer to delivery. Importantly, although volumes traded in the wholesale markets are, in some cases, only a fraction of the final volume of generated electricity, the wholesale prices serve as the price reference in long-term contracts."*[81]

### 3.3.3 Intraday Market (IM)

In the Intraday market, sellers and buyers keep trading continuously for twenty four hours within the delivery day. At the exact time that buyer's offer meets seller's one the transaction is completed. This kind of market allows trading to take place through agreements on a base of 1 hour, half an hour or even a quarter of hour basis and until five minutes before delivery[82].

Target Model environment requires that national intraday markets will operate beyond their borders as a single one in a cross zonal level (XBID[83]).

The intraday market follows the clearance of the day-ahead market and participants mainly aim to adjust their offers closer to real time delivery of energy.

Furthermore as Shah, D. and Chatterjee, S. state, *"Intraday trading is particularly useful for adjusting unforeseen changes in power production and consumption to its market participants. On contrary to uniform price market clearing in DAM where last accepted bid sets price for all*

[80] Schittekatte, T., Reif, V. & Meeus, L., 2020. The EU Electricity Network codes (2020Ed.). European University Institute, Florence School of Regulation, Energy, p. 30. Available at: https://fsr.eui.eu/publications/?handle=1814/67610

[81] Florence School of Regulation, 2020, Electricity Markets in the EU, available at: https://fsr.eui.eu/electricity-markets-in-the-eu/

[82] Epex Spot, Basics of the Power Market, Day-Ahead and Intraday – the backbone of the European spot market, available at: https://www.epexspot.com/en/basicspowermarket

[83] XBID is the Cross Border Intraday Market project and will be further detailed below.

*transactions, the prices in intraday trading were set in a "pay-as-bid" process*[84].

The way of function of intraday markets is not yet fully uniform in all Member States, given that some of them operate through continuous trading procedures, whereas some other operate through auctions. Nevertheless, Target Model legislative framework provides for a continuous trading procedure in intraday markets, allowing regional auctions to take place on a supplementary base.

### 3.3.4 Balancing Market

The Balancing Market is the last stage of the energy exchange process and follows Day-ahead and Intraday Market's closure. The aim of Balancing Market operation is to ensure that any imbalances of demand and supply having appeared during the previous stages of trading (DAM & IM) will be solved in such a way that energy supply remains stable and secure. In fact, it is about a corrective market mechanism, which is absolutely necessary for the security of the total energy system, given that it is a system extremely prone to fluctuations due to the nature of power as a commodity.

The Balancing Market functioning is one of the major competences of national TSOs (Transmission System Operators), which are responsible for taking into account the final output of the rest markets of the system (DAM & IM) and activating the balancing mechanisms in order to keep demand and supply aligned in real time.

Apart from TSOs, there are two kinds of participants in Balancing Markets, Balancing Service Providers (BSPs) and Balance Responsible Parties (BRPs).

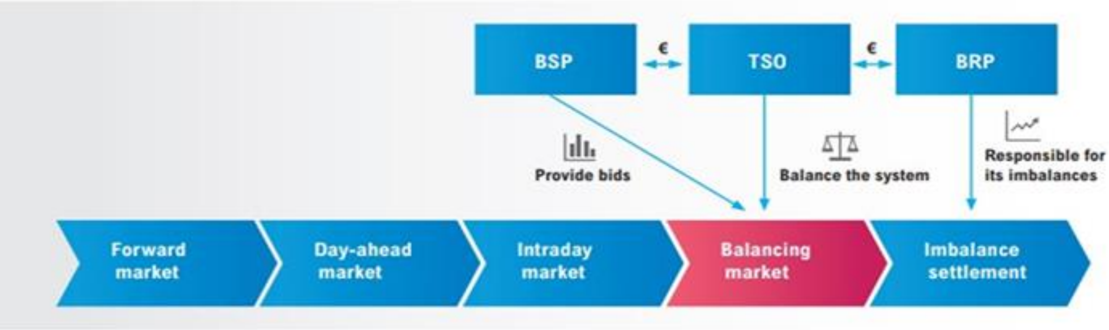


*Figure 8*: *Balancing Markets sequence in electricity markets and its participants*
*Source: ENTSO-E, Electricity Balancing in Europe, 2018*[85]

[84] Shah, D. & Chatterjee, S., 2020, "A comprehensive review on day-ahead electricity market and important features of world's major electric power exchanges", Wiley Online Library, p. 5, https://doi.org/10.1002/2050-7038.12360, available at: https://onlinelibrary.wiley.com/doi/epdf/10.1002/2050-7038.12360

BSPs represent entities that provide TSOs with balancing services regarding energy or capacity and TSOs ensure system balance by using these services. On the other hand BRPs, namely buyers and sellers of energy are obliged to pay the defined financial burden for any discrepancies that arise out of their offering, therefore they should try to facilitate the system balance by maintaining the stability of their commitments[86].

The balancing market is based on the legal formation of three major axes, which are the liability of BRPs in balance maintenance, the balancing service procurement and the final stage of imbalance settlement[87].

Pursuant to the above mentioned, the pillar of the balancing procedure refers to the liability of BRPs to provide their power plans to TSOs one day before load's injection to the system reporting the expected volumes of production and purchase for every time section of the day of load's injection[88].

The next stage, that of balancing services, provides that BSPs offer their services regarding system balance to the TSOs, which accept and activate these services.

According to Van der Veen, R.A.C. and Hakvoort, A.R. "*Balancing services consist of two main types: balancing energy (the real-time adjustment of balancing resources to maintain the system balance) and balancing capacity (the contracted option to dispatch balancing energy during the contract period). Selected bids in the balancing capacity market are transferred to the balancing energy market. Furthermore, one can also differentiate between upward regulation and downward regulation, and between Frequency Containment Reserve (FCR), Frequency Regulation Reserve (FRR), and Replacement Reserve (RR), which vary in function and activation method.*"[89]

We also have to mention that there are two more balancing services, which play an ancillary role in

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[85] ENTSO-E, November 2018, Electricity Balancing in Europe, An overview of European balancing market and electricity balancing guideline, p. 4, available at: https://eepublicdownloads.entsoe.eu/clean-documents/Network%20codes%20documents/NC%20EB/entso-e_balancing_in%20_europe_report_Nov2018_web.pdf

[86] Ibid.

[87]Glowacki Law Firm, 2020, Balancing Market, Emissions-EUETS.com, available at : https://www.emissions-euets.com/internal-electricity-market-glossary/607-balancing-market

[88] Van der Veen & R.A.C., Hakvoort, A.R., 2016, The electricity balancing market: Exploring the design challenge, Utilities Policy 43 (2016), 186-194, Elsevier, p. 187, https://doi.org/10.1016/j.jup.2016.10.008, available at: https://www.sciencedirect.com/science/article/pii/S0957178716303125

[89] Ibid, p. 188.

the balancing procedure maintaining the frequency of the network. The first one is the automatic Frequency Restoration Reserve (aFRR), the secondary reserve, that is provided to TSOs by BSPs in order to replace FCR after thirty seconds. The other one is the manual Frequency Restoration Reserve (mFRR), acting as a tertiary reserve which replaces aFRR after twelve and a half minutes.

In the final stage of balance settlement, the discrepancies that have arisen from BRPs plans and BSPs offers are solved. This means that if a BRP shows a divergence due to energy deficiency, it must make a relevant payment for every energy unit of divergence, whereas in case of an excess the BRP gains the respective price. In the same way, BSPs pay or receive the respective price depending on whether they had offered downward or upward regulation. It shall be mentioned that the prices that are estimated in this phase correspond to the cost of real-time balancing.

Therefore, it should be said that the Balancing Market consists of two submarkets, namely the balancing capacity market and the balancing energy market, both of which are followed by the final balancing mechanism of imbalance settlement.

At the following figure the balancing market mechanism is displayed taking into account all the three steps of the balancing procedure, as well as all participants of this market.

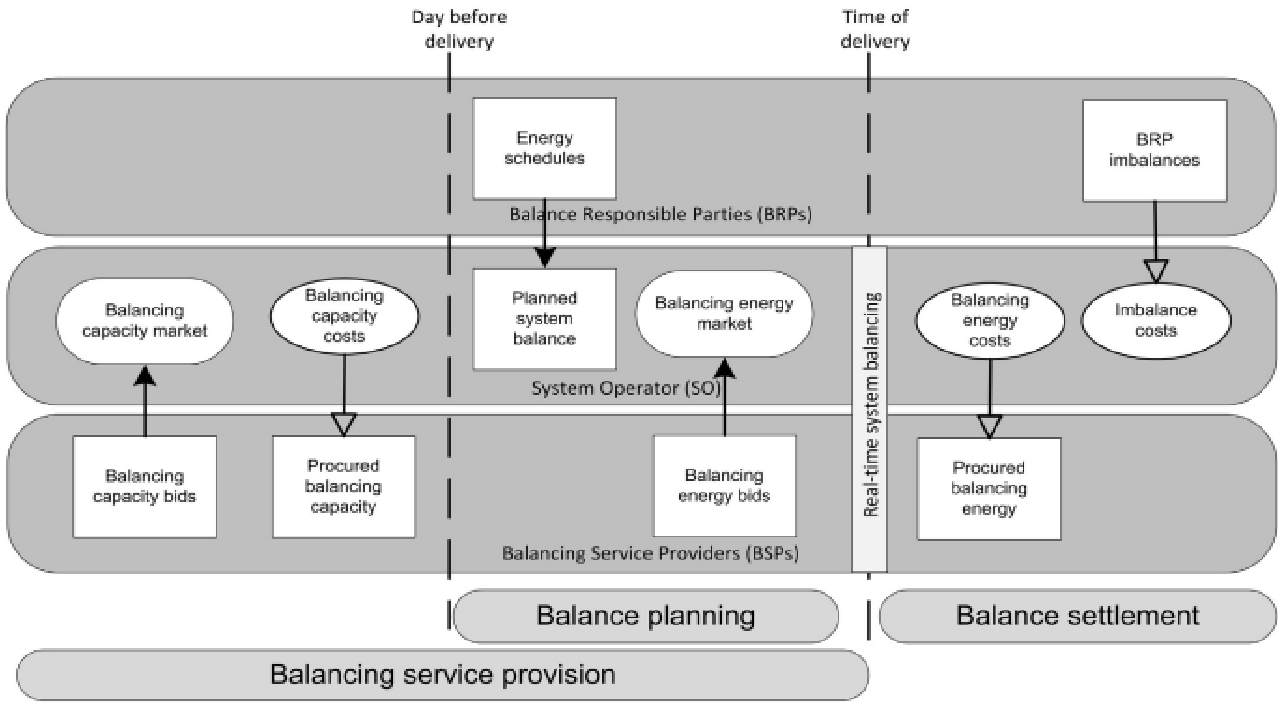


*Figure 9: Basic structure of the balancing market*

*Source: Van der Veen, R.A.C. & Hakvoort, A.R. (2016)*[90]

[90] Ibid.

Nevertheless, the structure of Balancing Markets varies across European Union, because not all Member States follow the same way of system balancing operation given the special characteristics of each country related to power production, network infrastructure or other important energy issues. It is obvious that there should be a kind of uniformity among national balancing markets structure and operation, in order their effective integration and unification in the context of Target Model to be facilitated and accelerated.

## 3.4 Market Coupling

After the creation of a common energy market structure in all Member States of European Union, the next crucial step towards the establishment of a single energy market is the integration of the fragmented national markets through coupling mechanisms, which by allowing cross border trading will ensure power price convergence, as well as a stable balance between supply and demand of energy for the benefit of final consumers. As a result, energy security will be enhanced, reduction of prices will be met and new great chances for investments will be born, leading national economies to development and success. Nevertheless, the path towards market integration is full of challenges due to numerous barriers, which mainly are related to different conditions of market functioning in each Member State, different degrees of network capacity or market maturity.

However, until today European Union has obtained significant achievements in the field of market integration, while the future is meant to be very hopeful for achieving even larger integrated areas across the Union.

As we can observe in the figure below, there has been a remarkable improvement on day-ahead market coupling in European Union over the years 2012 – 2019.

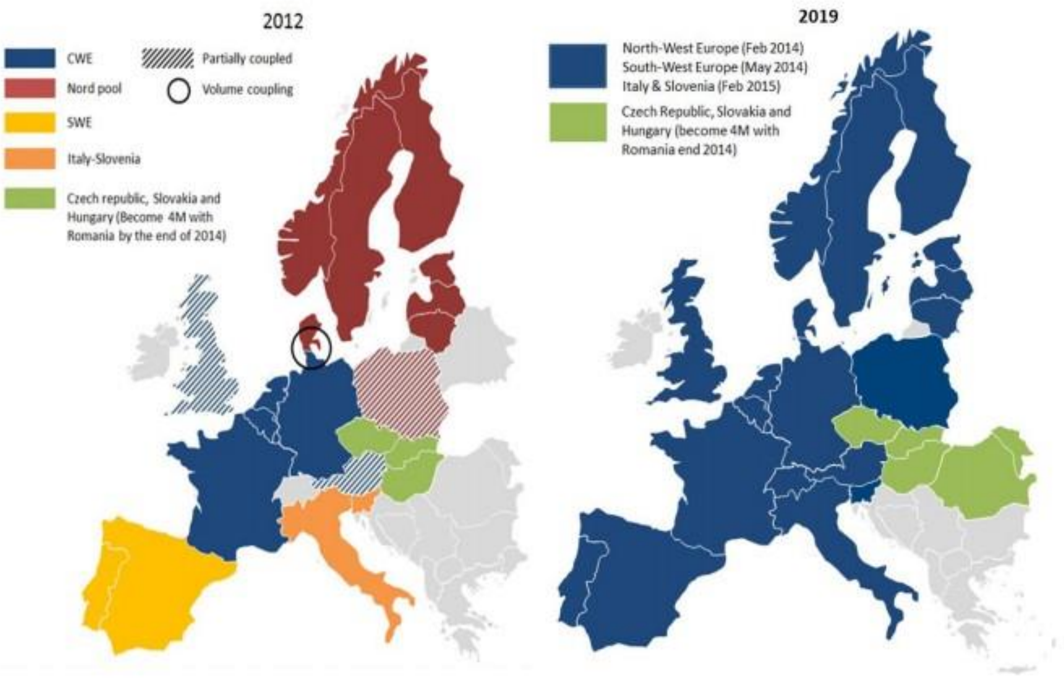


*Figure 10: Progress with market coupling in Europe (2012 and 2019)*
*Source: Roques F., 2020*[91]

In the following units we will examine the integration process at a European level for each of the above four (4) distinct submarkets separately.

### 3.4.1 Forward market integration

It is indisputable that the forward markets unification is of major importance for their operational improvement and the enhancing of trading convenience in general. Buyers and sellers can participate in forward markets of different bidding zones through obtaining future transmission rights on a cross-zonal basis. In this way, traders are able to hedge the price volatility danger arising from the different conditions of each bidding zone, which otherwise would have deterred them from taking part in cross-zonal transactions. Additionally, in the same way the fluctuation danger that may arise during several trading periods of a particular bidding zone, can also be avoided by allowing the trader to participate in another bidding zone.

[91] Roques, F., 2020, "The European Model for Electricity Markets – Achievements to date and key enablers for the emergence of a new model", Chaire European Electricity Markets/Working Paper #45, Dauphine, PLS, p. 11, available at: http://www.ceem-dauphine.org/assets/dropbox/CEEM_Working_Paper_45_Fabien_Roques.pdf

The basic instrument of forward markets integration is the issue of long-term cross-zonal transmission rights. In case, any TSO doesn't establish such rights in a given bidding zone[92], they are obliged to cover the lack of such rights with other offsetting tools. This indicates the importance of protection mechanisms that will ensure the risk mitigation and motivate stakeholders to participate in cross-border energy trade.

TSOs shall secure that future capacity on a cross-zonal level will be available to market parties *"for at least annual and monthly time frames"* according to Forward Capacity Allocation Guideline (FCA GL), Article 31(2)[93]. One of the basic goals of the FCA GL is the alignment of the different fragmented dispensation rules at a national level across the Union. Apart from that, the available capacity has to be allocated via explicit auctions through a single platform, the called Joint Allocation Office (JAO). As far as the estimation of capacity is concerned, FCA GL provides for the establishment of a Common Grid Model (CGM) which selects all information that must be taken into consideration by TSOs, which have to cooperate regionally on the capacity calculating procedure. TSOs measuring shall result to trustworthy conclusions about the available capacity that may be auctioned. It is mentioned that according to FCA GL there are two options for calculation of capacity, the flow-based option and the coordinated net capacity option[94].

### 3.4.2 Day-ahead market integration

The market coupling process for day-ahead energy markets in European Union has already began in 2006, when Belgium, France and the Netherlands managed to interconnect their national day-ahead markets in order to improve cross-border power trading.

After that, major steps have been made, such as the achievement of Central West Europe (CWE) market coupling in 2010 and North Western Europe (NWE) market coupling in 2014. A little later all regions covered by CWE and NWE were coupled and all this coupled region is named Multi-

[92] FCA GL provides for a particular and rigorous procedure, through which TSOs are allowed not to establish long-term cross-zonal transmission rights on a particular bidding zone.

[93] European Commission, 2016, Commission Regulation (EU) 2016/1719 of 26 September 2016 establishing a guideline on forward capacity allocation, article 31 (2), available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?toc=OJ:L:2016:259:TOC&uri=uriserv:OJ.L_.2016.259.01.0042.01.ENG

[94] Schittekatte, T., Reif, V. & Meeus, L., 2020, The EU Electricity Network codes (2020Ed.), European University Institute, Florence School of Regulation, Energy, p. 20, available at: https://fsr.eui.eu/publications/?handle=1814/67610

Regional Coupling (**MRC**), which is gradually expanded.

In 2015, European Commission through capacity allocation and congestion management guideline (CACM GL) introduced the single day-ahead coupling (SDAC) across Europe, aiming to a Pan-European energy market, across which electricity could be traded efficiently and uninterruptedly ensuring supply security and rivalry.

Nowadays, according to the website of all Nominated Electricity Market Operators (NEMOs), *"The parties involved in SDAC are:*

- *Transmission System Operators (TSOs): 50Hertz Transmission, ADMIE, Amprion, APG, AST, CEPS, Creos, EirGrid, Elering, ELES, ELIA, Energinet, ESO, Fingrid, HOPS, Litgrid, MAVIR, PSE, REE, REN, RTE, SEPS, SONI, Statnett, Svenska Kraftnät, TenneT DE, TenneT NL, Terna, Transelectrica, and TransnetBW.*
- *Nominated Electricity Market Operators (NEMOs): BSP, CROPEX, SEMOpx (EirGrid and SONI), EPEX, EXAA, GME, HEnEx, HUPX, IBEX, Nasdaq, Nord Pool, OMIE, OKTE, OPCOM, OTE, and TGE.*[95]*"*

Furthermore, as Schittekatte et al. describe about market coupling in day-ahead markets, *"In the SDAC, two coupling projects are in parallel operation, namely the Multi-Regional Coupling (MRC) and 4M Market Coupling (4MMC) project. […]The 4MMC covers Czech Republic, Slovakia, Hungary, and Romania.*[96]*"*

In 2010 seven power exchanges developed the system of Price Coupling of Regions (PCR), in order to form a unified method of price coupling, which would estimate energy price all over Europe, taking into account the limits and the attributes of each respective grid. This is how a single algorithm for price coupling was created and took the name EUPHEMIA (Pan-European Hybrid Electricity Market Integration Algorithm). For the time being, PCR is implemented by nine energy exchanges, namely Nord Pool, GME, HEnEx, EPEX SPOT, OMIE, TGE, OTE, NASDAQ and OPCOM.

[95] ALL NEMO COMMITTEE, http://www.nemo-committee.eu/sdac

[96]Schittekatte, T., Reif, V. & Meeus, L., 2020, The EU Electricity Network codes (2020Ed.), European University Institute, Florence School of Regulation, Energy, p. 45, available at: https://fsr.eui.eu/publications/?handle=1814/67610

PCR operation has 3 central pillars[97]:

1. The formation of a single algorithm which provides price calculation transparency;
2. Decentralization of information managing, which ensures an effective function;
3. Liability of each power exchange separately.

According to the system of PCR, energy and capacity are implicitly allocated among bidding zones, which means that the allocation of electricity and the allocation of capacity take place at the same time.

We have to mention that the establishment of PCR and consequently of the simultaneous trading of capacity and energy is of major significance, given that before PCR energy couldn't be traded if capacity hadn't been ensured firstly. This previous system deterred parties from trading, put in danger security of supply and undermined competition, facts that didn't allow the creation of a single market.

The Single Day-ahead Coupling (SDAC) intends to contribute to the unification of DAMs in a pan-European level, allowing countries with different resources conditions to be coupled with each other ensuring their energy sufficiency and to take advantage of a transparent price system. Through SDAC the idea of an internal competitive market that increases financial surplus for the benefit of the economies comes even closer to fulfillment.

### 3.4.3 Intraday market integration

The European Commission through capacity allocation and congestion management guideline (CACM GL) provides also for the integration of intraday markets in a pan-European level. These markets are very important for energy commerce, given that through continuous trading on the delivery day, they allow market participants to overcome system imbalances between Day-ahead time and real time.

According to Schittekatte et al., *"by integrating intraday markets, the opportunities for market parties to trade close to real-time can be significantly increased as they also can benefit from the available liquidity in other zones next to their bidding zone, which increases matching*

[97]Epex Spot, European Market Coupling, Price Coupling of Regions, available at: https://www.epexspot.com/en/marketcoupling#price-coupling-of-regions-pcr

*probabilities.'*[98]

The Single Intraday Coupling (SIDC) is the way towards the unification of the relevant markets in a cross-zonal level. Such a unification makes market even more competitive, secures supply all over EU, amplifies the share of renewable resources in the market and contributes to the maintenance of system balance in general.

For the time being, SIDC covers 22 countries already and is expected to expand to more countries gradually (in "go-live waves" as it is known).

The figure below shows the phases, in which member countries joined SIDC and how SIDC expansion is going to take place in the future.

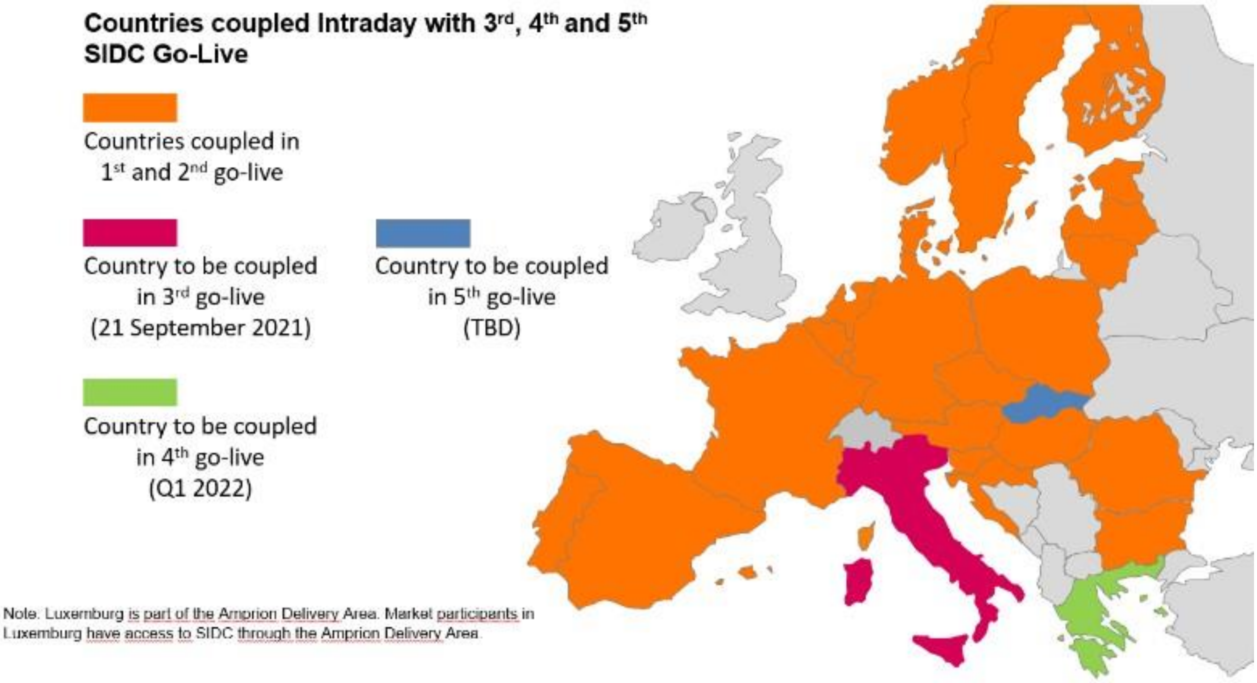


*Figure 11: Countries of SDIC*

*Source: All NEMO Committee website* [99]

[98] Schittekatte, T., Reif, V. & Meeus, L., 2020. The EU Electricity Network codes (2020Ed.). European University Institute, Florence School of Regulation, Energy, p. 58, available at: https://fsr.eui.eu/publications/?handle=1814/676

[99] ALL NEMO COMMITTEE, http://www.nemo-committee.eu/sidc

Nowadays, according to the website of all Nominated Electricity Market Operators (NEMOs), *"The organisations involved in SIDC are:*

*-Transmission System Operators (TSOs):50HERTZ, ADMIE, AMPRION, APG, AST, ČEPS, CREOS, EirGrid, ELERING, ELES, ELIA, ELSO, ESO, FINGRID, HOPS, Litgrid, MAVIR, PSE, REE, REN, RTE, SEPS, SONI, STATNETT, SVENSKA KRAFTNÄT, TenneT DE, TenneT NL, TERNA, TRANSELECTRICA and TransnetBW.*

*- Nominated Electricity Market Operators (NEMOs):BSP, CROPEX, EirGrid, EPEX SPOT, GME, HEnEx, HUPX, IBEX, Nord Pool, OKTE, OMIE, OPCOM, OTE, SONI and TGE."*[100]

For the realization of the single intraday market, a coupling project called Cross-Border Intraday Market Project (XBID) was introduced by NEMOs and TSOs from twelve countries. XBID functions as a mechanism which aligns regional Power Exchanges operation with cross-zonal network capacity as it is determined by TSOs. In this way, there is the ability of matching orders between different countries, when a given capacity is declared. It has to be mentioned that XBID serves not only implicit trading on a continuous base but also explicit (by NRA's decision).

XBID can serve orders for 15, 30 and 60 minutes, as well as user-defined blocks (always hourly).[101]

According to Schittekatte et al., *"a major difference between the DAM integration and IDM integration is the fact that the former is based on 'coupling' auctions of bidding zones (single merit order if no transmission constraints are present), while the latter is based on 'merging' order books for continuous trading."*[102]

### 3.4.4 Balancing markets integration

One more significant step for the realization of an internal energy market in Europe is the integration of balancing markets, which is expected to ensure uninterrupted system stability and security in general. However, due to the nature of balancing markets, which operate differently from country to

[100] Ibid.

[101] https://www.entsoe.eu/network_codes/cacm/implementation/sidc/

[102] Schittekatte, T., Reif, V. & Meeus, L., 2020, The EU Electricity Network codes (2020Ed.), European University Institute, Florence School of Regulation, Energy, p. 59, available at: https://fsr.eui.eu/publications/?handle=1814/676

country, the coupling procedure is even more challenging than that of DAM or IM.

European Commission issued the guideline on electricity balancing (EB GL) and the System Operation Guideline (SO GL), in order to build up the base on which fragmented balancing markets will become unified. Towards this goal, there are 4 factors that shall be aligned, according to Schittekatte et al., specifically *"balancing products, the balancing energy gate closure time, the imbalance settlement period and the pricing rule in balancing energy markets."*[103]

Apart from these four factors that shall be aligned effectively, it was realized that common algorithms and "TSO-TSO settlement rules" had also to be issued towards the unification of balancing markets.

For the time being, there are 4 projects that concern the integration of balancing markets, namely PICASSO, MARI, IGCC and TERRE[104].

Specifically:

- PICASSO (Platform for the International Coordination of Automated Frequency Restoration and Stable System Operation) was launched in 2017 in the context of the provisions of article 21 of Electricity Balancing Guideline. The project concerns the operation of the aFRR platforms and its harmonization.

- MARI (Manually Activated Reserves Initiative) was also launched for the first time in 2017 and was completed in 2018 in the context of the provisions of article 21 of Electricity Balancing Guideline. The project concerns the operation of the mFRR platforms and its harmonization.

- IGCC (International Grid Control Cooperation) was launched for first time in 2010 at a local level, however it was expanded to a great number of countries and finally in 2016 it was selected to become the basic platform regarding imbalance netting alignment. The implementation of such a project is provided in article 22 of Electricity Balancing Guideline.

- TERRE (Trans European Replacement Reserves Exchange) was initiated in 2020 in the

[103] Ibid, p. 88.

[104] https://www.entsoe.eu/network_codes/eb/

context of article 19 of Electricity Balancing Guideline. The project aims to contribute to the implementation of a common platform for Replacement Reserves (RR).

In the next figure, the countries that participate in each of the above projects during their balancing markets' integration, are presented in a schematic illustration.

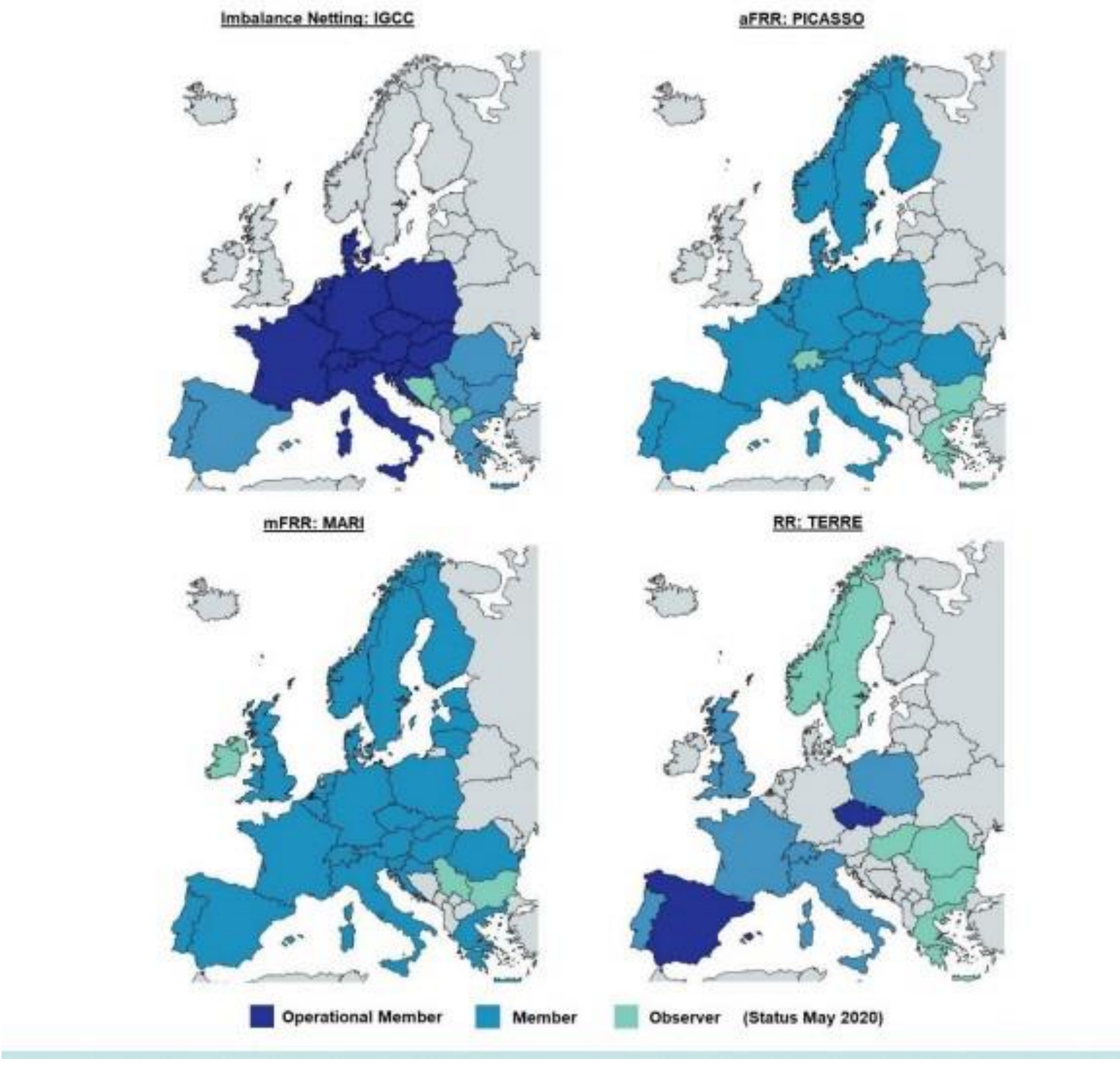


*Figure 12: Overview of European balancing implementation projects and their TSO members (May 2020)*
*Source: ENTSO-E*[105]

[105] ENTSO-E, November 2018, Electricity Balancing in Europe, An overview of European balancing market and electricity balancing guideline, p. 14, available at: https://eepublicdownloads.entsoe.eu/clean-documents/Network%20codes%20documents/NC%20EB/entso-e_balancing_in%20_europe_report_Nov2018_web.pdf

# 4. Network codes

## 4.1 Introduction

For the purpose of accomplishment of the internal energy market as it is designed in the Third Energy Package, the advancement of specific codes and rules is recognized as a significant component. All the more explicitly, Regulation (EC) 714/2009 designates the environment in which codes will be created and harmonizes the procedure of their creation. It should be underlined that these rules are an arrangement regulation opting for the alignment of power markets that formerly used to have intense national characteristics. Aiming to the Target Model market ENTSO-E, ACER and the European Commission formed 8 Network codes which were established by 2017. Following the completion of these codes, the execution stage began. However, European Commission through the Clean Energy Package, which was firstly introduced in 2016 and implemented in 2018, proceeded to the reform of the aforementioned Regulation (EC) 714/2009. Consequently, these changes pointed out the need to also importantly reform the content of the Network codes respectively.

So, the Network codes firstly launched in 2009 with the Regulation on conditions for access to the network for cross-border exchanges in electricity [Regulation (EC) 714/2009] were reformed with the Regulation on the internal market for electricity [Regulation (EU) 943/2019] a decade later in 2019.

Network codes constitute obligatory principles ruling the grid linking conditions adequately, fairly and impartially for each stakeholder. Their significance lays on the fact that they are meant to secure the function of the whole integrating mechanism, as well as the adequacy of the network across the Union.

There are 8 Network codes, all of which can be found in the Official Journal of the European Union, such as regulations. Commission Regulations become applicable 20 days after the date of publishing, except if unequivocally expressed something else. It has to be mentioned that although named as Codes, only four of them are Codes in reality, the rest four are Guidelines.

The Network codes are sorted into 3 sets :

**1.** The market codes include:

i. The capacity allocation and congestion management guideline (CACM GL), the publishment day of which is 25.07.2015

ii. The forward capacity allocation guideline (FCA GL), the publishment day of which is 27.09. 2016

iii. The electricity balancing guideline (EB GL), the publishment day of which is 23.11.2017

**2.** The connection codes include:

i. The network code on requirements for grid connection of generators (RfG NC), the publishment day of which is 14.04.2016

ii. The demand connection network code (DC NC), the publishment day of which is 18.08.2016

iii. The requirements for grid connection of high voltage direct current systems and direct current-connected power park modules network code (HVDC NC), the publishment day of which is 08.09.2016

**3.** The operation codes include:

i. The electricity transmission system operation guideline (SO GL), the publishment day of which is 25.08.2017

ii. The electricity emergency and restoration network code (ER NC), the publishment day of which is 24.11.2017

In the following units, we will examine the content of each code or guideline separately and point out their most important elements towards energy market unification.

## 4.2 Market Codes

Market Codes are obligatory principles ruling the linking of the power markets of Member States and their merger into a European single power market, assisted by a sufficient power transmission framework which will satisfactorily ensure delivery safety and promote infrastructure well-functioning and continuous improvement of the grids across the European Union. Market codes' goal is the development of market effectiveness by enhancing the market merger, through the usage of the maximum network capacity, as well as through the exploitation of all energy resources across the

Union. Furthermore, under the prism of integration the market codes regulate the process for market offsetting and support the creation of commercial chances. Apart from the above, these codes aim to ensure a fair environment for market participants regarding their accessibility to the network in a cross-zonal level and the RES share in the market, so that an equal field of action for each party is created and discriminatory barriers are demolished. Hence, the principles of translucency and data trustworthiness are also of major importance in the context of the market codes.

Serving the principles that are presented above, rivalry is going to increase and the market mechanisms are going to secure fairness for the participants and minimize any possible deterioration, making significant steps toward the single market.

The legislative context in which this market is about to function is determined by the Regulation on the internal market for electricity [REGULATION (EU) 2019/943] in conjunction to the abovementioned market codes (guidelines) that regulate the unified power market at all time levels, covering the day-ahead and intraday period (CACM GL), the forward period (FCA GL) and the period of balance (EB GL). Pursuant to the market codes provisions TSOs and NEMOs have to publish further and more specialized legal instruments for the implementation of single market's principles in each individual market.

### 4.2.1 The capacity allocation and congestion management guideline (CACM GL)

The capacity allocation and congestion management guideline (CACM GL) is designated in Regulation (EU) 2015/1222 and regulates the linking of individual markets across the Union for the day-ahead and intraday periods. The competent authorities for the implementation of the relative provisions are TSOs, NEMOs, NRAs and ACER.

Given that market coupling is the base of market integration, CACM GL includes an ideal description of the so-called "bidding zones" and defines the way of capacity estimation between them. According to the guideline, bidding zones are regions within which power exchanges have no restrictions, in contrary to regions outside a bidding zone where power exchanges have to obtain capacity at a cross-zonal level. However, even inside a bidding zone excessive power concentration must be avoided through structural corrective solutions implemented by TSOs. As far as capacity estimation is concerned, CACM GL provides that this should be a result of coordination between TSOs so that parties enjoy the maximum efficiency of the network. Furthermore, the guideline provides for the capacity distribution at a cross-zonal level through the linking of markets, namely the market coupling. Through this procedure the whole quantity of offers is gathered and energy is traded via an implicit auction in the day-ahead period, or as continual implicit auctions in case of intraday period.

Finally, CACM GL also provides for the facing of excessive concentration of energy in case that estimation and distribution mechanisms fail, by introducing corrective acting on behalf of TSOs that should act in coordination.

### 4.2.2 The forward capacity allocation guideline (FCA GL)

The forward capacity allocation guideline (FCA GL) is designated in Regulation (EU) 2016/1719 and regulates the estimation and distribution of grid capacity at a cross-zonal level in the future, in order to cover the function of the unified market in the forward period.

As with the day-ahead and intraday periods, this Guideline aims to regulate the estimation of capacity among bidding zones on a yearly or a monthly level. In this way, TSOs are able to foresee the future capacity and secure allocation of the long-term transmission rights, giving to the buyers and sellers the opportunity to offset their positions. The Guideline intends to organize and align the legal context of future allocation in the Union, contributing to the building of the single market. Towards this objective a Single Allocation Platform (SAP) is provided, in order for common legislation to be applied to all participating units. The Platform in a fair and transparent way, estimates the future capacity and allocates the long-term transmission rights to the parties across the Union.

### 4.2.3 The electricity balancing guideline (EB GL)

The electricity balancing guideline (EB GL) is designated in Regulation (EU) 2017/2195 and refers to the time period after the closure of the forward, day-ahead and intraday markets, when power adjustment has to be made due to arising imbalances. The Guideline refers to the creation of a united legislation on market balancing issues, namely the obtainment, usage and trading of adjustment services, in order to settle and regulate the integration process of balancing markets and the appropriate function of them as a united organization. In this procedure TSOs, NRAs and ACER are involved and they are obliged to ensure to correct implementation of the common rules.

The Guideline provides for two categories of market players at that time stage of trading, the

Balancing Service Providers (BSP) and the Balancing Responsible Parties (BRP), which shall be treated equally and fairly without discrimination of any kind in order to consolidate their participation to the system enhancing proper rivalry and finally securing energy flows.

According to the Guideline, the unification process of balancing markets passes through the formulation of united platforms on a European level. These common platforms maintain common records of requests in order to guarantee the most profitable matching with energy balancing offers across the Union.

Furthermore, the Guideline provides for common legislation on issues that refer to balancing capacity trading and distribution on a cross-zonal level. These issues are very important in order for TSOs to coordinate and properly exploit the available capacity, taking advantage of financial deposit procuring energy out of their regions.

One more provision of the Guideline is the alignment of imbalance settlement systems of Member States, which is an achievement that will augment even more the effectiveness of balancing market operation.

## 4.3 Connection Codes

This set of Regulations applies to the totality of issues arising out of the usage and maintenance of network joining across the Union. Their goal is to formulate a united legal environment over grid joining, securing the maximum efficiency of its use and enhancing RES penetration in the European energy industry. Through these regulations proper competition conditions are consolidated and energy trading appeals all the more participants ensuring supply adequacy.

There are three (3) network codes and more specifically: 1. The network code on requirements for grid connection of generators (RfG Regulation) regarding the relationship of producers with the network, 2. The network code on demand connection (DCC Regulation) regarding the relationship of demand units with the network and 3. The network code on requirements for grid connection of high voltage direct current systems (HVDC Regulation) regarding direct current (DC) grid joining.

### 4.3.1 The network code on requirements for grid connection of generators (RfG NC)

The network code on requirements for grid connection of generators (RfG NC) is designated in Regulation (EU) 2016/631 and regulates the prerequisites of joining to the grid for power producers

(onshore and/or offshore)

Specifically, the RfG NC defines the categories of power units that are legally covered by its provisions and records the exceptions of its scope of application. New energy producing units or groups of such units or energy storage units (under specific circumstances) are included in the scope of the regulation. The units that require to join the grid must satisfy the connection criteria pursuant to the regulation. Furthermore, according to the Regulation the connecting units should function in common frequency conditions with the whole system. Producers that do not retain a continual connection and only conditionally inject their production to the net are out of the scope of the Regulation.

It also has to be mentioned that the Regulation prerequisites do not cover the power-producing units that already existed at the time of its issue or that units of developing technology.

### 4.3.2 The network code on demand connection (DCC NC)

The network code on demand connection (DCC NC) is designated in Regulation (EU) 2016/1388 and regulates the prerequisites for the joining of sizeable RES generating units and demand facilities.

The Regulation' scope, according to its article 3 covers: *"a. new transmission-connected demand facilities, b. new transmission-connected distribution facilities, c. new distribution systems, including new closed distribution systems and d. new demand units used by a demand facility or a closed distribution system to provide demand response services to relevant system operators and relevant TSOs."*[106]

The units that require to join the grid must satisfy the connection criteria pursuant to the Regulation. Furthermore, as it is also regulated in the case of generating units of the RfG NC, the connecting demand units should function in common frequency conditions with the whole system. It also has to be mentioned that the Regulation prerequisites do not cover the demand of distribution units that already existed at the time of its issue.

[106] European Commission, 2016, Commission Regulation (EU) 2016/1388 of 17 August 2016 establishing a Network Code on Demand Connection, available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2016.223.01.0010.01.ENG

### 4.3.3 The network code on requirements for grid connection of high voltage direct current systems (HVDC NC)

The High Voltage Direct Current Connections Network Code (HVDC Regulation) is designated in Regulation (EU) 2016/1447 and regulates the conditions and prerequisites under which HVDC mechanisms and energy farms that are connected to direct current can be joined to the grid.

According to the Regulation's article 3, the common rules to be established cover: *"a. HVDC systems connecting synchronous areas or control areas, including back-to-back schemes, b. HVDC systems connecting power park modules to a transmission network or a distribution network, c. embedded HVDC systems within one control area and connected to the transmission network and d. embedded HVDC systems within one control area and connected to the distribution network when a cross-border impact is demonstrated by the relevant transmission system operator (TSO)."*[107]

The units that are interested to join the net must meet the defined preconditions for connection, otherwise they will not be allowed by the TSO to get connected.

One of the basic exceptions of the Regulation's scope regards units, the joining spot of which does not reach 110 kV, except if they affect the system significantly on a cross-border level. Furthermore, particular requirements of the Regulation do not cover the case of HVDC converter stations that are possessed by the TSO or HVDC mechanisms that are possessed by bodies on which TSO administratively depends.

Additionally, the Regulation does not concern units that already exist, as in all Network Codes is provided for.

## 4.4 Operation Codes

Operation codes regulate the procedure of the network management by TSOs, as well as the actions that shall be taken in case of an emergent accident. Through these Regulations common provisions are established for the coordination of regional TSOs across the Union.

As mentioned before, there are 2 Operation Codes and more specifically, 1. the Guideline on Electricity Transmission System Operation (SO GL) regarding the common provisions on functional

[107]European Commission, 2016, Commission Regulation (EU) 2016/1447 of 26 August 2016 establishing a network code on requirements for grid connection of high voltage direct current systems and direct current-connected power park modules, available at: https://eur-lex.europa.eu/eli/reg/2016/1447/oj

safety, stability and adequacy of interconnections and 2. the Network Code on Electricity Emergency and Restoration (ER NC) regarding the common standards for impeding a system crisis (e.g. blackout) from spreading, as well as for the quick recovery of the network in case of a damage or malfunction.

### 4.4.1 The Guideline on Electricity Transmission System Operation (SO GL)

The Guideline on Electricity Transmission System Operation (SO GL) is designated in Regulation (EU) 2017/1485 and it concerns the establishment of common legislation regarding the well-functioning and sufficiency of the network, as well as the proper utilization of resources.

According to article 2 of the Regulation its provisions apply to: *"a. existing and new power generating modules that are, or would be, classified as type B, C and D, b. existing and new transmission-connected demand facilities, c. existing and new transmission-connected closed distribution systems, d. existing and new demand facilities, closed distribution systems and third parties if they provide demand response directly to the TSO, e. providers of redispatching of power generating modules or demand facilities by means of aggregation and providers of active power reserve and f. existing and new high voltage direct current ('HVDC') systems."*[108]

It has to be mentioned that the Regulation does not provide for an exhaustive legislative context, but it only sets up the basic common lines for the establishment of the relevant terms, while allowing the more specific regulation to the regional competent authorities.

### 4.4.2 The Network Code on Electricity Emergency and Restoration (ER NC)

The Network Code on Electricity Emergency and Restoration (ER NC) is designated in Regulation (EU) 2017/2196 and concerns the common standards that have to be established for guaranteeing the secure function of the system across the Union. Particularly the main subject of the Guideline is the prevention of the expanding of a network crisis, which can lead to a blackout with serious consequences on the energy supply.

Another important subject that the Guideline requires to regulate is the process of the grid recovery

[108] European Commission, 2017, Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation, available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32017R1485

after such a crisis.

Towards an internal market, interconnections safety and adequacy is of major importance, therefore European Commission requires to safeguard the network well-functioning by implementing an adequate legal frame ensuring that in any case supply of energy will not be affected by unpredictable factors.

# 5. Greece's electricity market

## 5.1 Introduction

This last chapter examines the structure of the electricity market in Greece, which is moving towards the harmonization of its electricity system with the European Target Model and the unification of energy markets by establishing the Greek Energy Exchange (HEnEx). In the following paragraphs we will record the transition from the former Greek electricity system to the Target Model system, namely from the system of Daily Energy Scheduling (DES) and long-term power availability market to the operation of the Energy Exchange.

## 5.2 History of electricity in Greece

The very first Greece's power unit was fabricated in 1889 by the General Contracting Company, while ten years later the Greek Electricity Company was founded by an American undertaking named "Thomson-Houston" in cooperation with the National Bank of Greece. After that by the middle of twentieth century across the country there were four hundred energy generating units that had been exploiting imported coal and petroleum as crude material. Due to the discontinuity of production arising from the fragmented power generation system, as well as due to the import costs, the energy prices had been skyrocketed[109].

At that years, electricity was a very expensive good, which could be afforded only by a very small minority of rich people, although not constantly due to often power failures.

For power to spread equally all through the country and be utilized both in industry and on a domestic level, large investments on exploitation of domestic resources were absolutely necessary along with a national interconnected grid and a single administrative body that could effectively balance the costs.

In 1950 the Public Electricity Company (PPC) managed to meet the above mentioned prerequisites aiming to offer energy to every individual at the most affordable cost. PPC promptly turned to the exploitation of domestic energy sources as lignite mining and also built hydroelectric units. In addition, gradual integration of the transmission networks started.

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[109] ΔΕΗ, https://www.dei.gr/en/i-dei/i-etairia/omilos-dei-ae/dei-ae

Gradually, all private power units were bought by PPC and merged in a single power undertaking constituting the Greek energy industry, which finally ensured electricity supply to every area of Greece, making the country independent in the field of energy.

Nowadays, Greece follows the legislative context of European Union, as this is described above and has already established its national energy exchange, which functions in accordance with the Target Model system. In the next chapters, we will refer to the former Greek electricity system as it had been working until very recently, as well as the transition of Greece to the new era of energy pursuant to the goals of the Energy Union.

## 5.3 The structure of Greek former electricity market

The Greek electricity market until recently consisted of two distinct markets:

- on the one hand a long-term market, called capacity market, in which the power availability was the determining factor and
- on the other hand a short-term (wholesale) market and ancillary services market, called energy and ancillary services market, which operated according to the daily Day Ahead Schedule (DAS) that was solved.

### 5.3.1 Purchase Long Term Power Availability (Capacity Market)

Long-term power availability market (capacity market) aimed to reduce the risk of producers and suppliers, by ensuring constant and sufficient quantity of electricity at long range. To achieve this objective, the market was initially based on the issuance by each producer of the Certificate of Availability, which indicated the actual power availability of each generator unit as specified by the system operator. Each supplier then concluded contracts with the producers, called Power Availability Contracts, in which financial terms were agreed by the producers' guarantees of a minimum availability of their units. The existence of the long-term power availability market was essential because it effectively enabled participants to plan and secure long-term energy sufficiency given that electricity is economically a set of products that entails many different costs for both producers and consumers and there must be a market where each producer will be paid an amount for partially covering the investment costs and the supplier will be guaranteed by high prices in the wholesale market[110].

### 5.3.2 Energy and ancillary services market (Wholesale Market)

The Day-ahead schedule (DAS) is the daily market resolution on the day before the delivery day, which is separated into 24 hour periods. The purpose of Day Ahead Schedule (DAS) was the minimization of the total cost of meeting the power load on an everyday base ensuring at the same time fair and safe system operation and adequate reserves.

DAS was connected with the wholesale market and focused at ideally planning both the activity of all plants (warm, hydro, RES) and energy imported from neighboring countries in order to fulfill the daily power needs of consumers, the demand for energy exports and the supplementary activities. Each producing unit was needed to offer its full accessibility, both in energy and in auxiliary administrations in the wholesale market. This is the market model of "Compulsory Consortium» (Mandatory Power Pool).

Settling DAS determined how every unit works for each hour of the following day in order to boost the social advantage of meeting the energy balance and the next day's requirements by considering the limitations of the Transmission System.

DAS included the following 3 markets[111]:

- Energy Market: Consumers' electricity needs were met for the time that energy was needed on each day of distribution. More specifically, in this market domestic producers and importers supplied electricity and were paid for their services, as well as suppliers, customers and exporters purchased electricity.
- Market of auxiliary services: This market covered the needs of consumers to ensure the quality and reliability of their supply e.g. to maintain frequency and voltage.
- Purchasing mechanism for the location of production units close to consumption areas. This would make it possible for new power plants to be as close as possible to the power stations. In

[110] ΑΔΜΗΕ, Εγχειρίδιο Αγοράς 3.1, p. 3, available at:
https://www.admie.gr/sites/default/files/users/dda/KAE/Egcheiridio_Agoras_version_3.1%20(1).pdf

[111] Ibid, p.5

this way, there was an increased participation in the annual charge for the use of a system of northern producers as well as an increased producer fee in the south, during the few hours of overcrowding in the transmission of electricity from the north to the south.

The incorporation into the DAS of the necessary auxiliary services and technical constraints of the System, which limited the amount of energy that could be diverted from North to South, revealed the true total value of electricity consumed, taking into account both quantities (volume and consumption time) as well as its quality characteristics (frequency, voltage, reliability required for each consumer).

Through DAS and according to specific procedures the System Marginal Price (SMP) was calculated. For the sake of consumers protection and the creation of healthy competition conditions, an administrative upper limit on the price offered was set. Generators were ranked according to their bids in ascending order, starting with the lowest bid for a certain amount of energy and ending up with the highest bid. At the point where the offered quantities of energy served the requested load, SMP was set. SMP coincided with the supply of the last unit that had to function to meet demand.

## 5.4 The Hellenic Energy Exchange (HEnEx)

In November 2020 Greece's energy system passed into the new era through the beginning of its Energy Exchange operation.

The Energy Exchange is an intervention-cut for the trading regime in the wholesale electricity market. Thus, the position of a wholesale market, which operated within the mandatory pool, will be taken by four new markets. In detail, according to law 4425/2016, as amended by law 4512/2018 four markets of electricity are defined:

- Energy Financial Market (Derivatives Market)
- Day-Ahead Market
- Intraday Market
- Balancing Market

The harmonization of the Greek market and specifically of its regulatory framework with the electricity markets of the European countries refers mainly to the European legislation and specifically to the European Single Electricity Market. This is provisioned by the European Target Model, which is based on European integration and the extension of the idea of a single energy market, in which all European should participate. The Price Coupling of Regions (PCR) which is mentioned previously, is the project that has been chosen by EU in order to enact market unification.

According to HEnEx, *"the project is currently being carried out by nine Power Exchanges: EPEX SPOT, GME, HEnEx, Nasdaq, Nord Pool, OMIE, OPCOM, OTE and TGE. PCR is used to couple the following countries: Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Italy, Latvia, Lithuania, Luxembourg, the Netherlands, Norway, Poland, Portugal, Republic of Ireland, Romania, Slovakia, Slovenia, Spain, Sweden and UK. The initiative started in 2009 and the PCR parties signed the PCR Cooperation Agreement and PCR Co-ownership Agreement in June 2012. One of the key elements of the PCR project is the development of a single price coupling algorithm, which was given the name EUPHEMIA (acronym of Pan-European Hybrid Electricity Market Integration Algorithm)."*[112] It is used to calculate energy at the installation level, its net location, and power prices across Europe. The process of price improvement and the general use of electricity by citizens across Europe will be maximized[113]. The current market in which Greece participates aims to enhance competitiveness and market dynamics, for the benefit of consumers.

In order for Greece to be able to adapt to the new reality of Target Model, Law 4425/2016 was issued, according to the provisions of which, in summary, the afore-mentioned four separate wholesale Electricity Markets were established, and more specifically, the Energy Financial Market, the Day-ahead Market, the Intraday Market and the Balancing Market. With Law 4425/2016 as amended and in force, a provision was made on the one hand for the abolition of the Daily Energy Scheduling Transaction System and the Mandatory Consortium model and on the other hand the operation of the four distinct electricity markets[114].

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[112] HEnEx, 2021, available at: https://www.enexgroup.gr/web/guest/eu-market-integration.

[113] Ibid.

[114] Regulatory Authority of Energy (RAE), 2021, available at: https://www.rae.gr/%cf%87%ce%bf%ce%bd%ce%b4%cf%81%ce%b5%ce%bc%cf%80%ce%bf%cf%81%ce%b9%ce%ba%ce%ae-%ce%b1%ce%b3%ce%bf%cf%81%ce%ac-%ce%b4%ce%b9%ce%b1%cf%83%cf%85%ce%bd%ce%b4-%cf%83%cf%85%cf%83%cf%84%ce%ae%ce%bc%ce%b1/

Specifically, based on article 7 entitled "Electricity Markets" of Law 4425/2016, *"Electricity transactions in the Interconnected Electricity System are carried out in the following Markets: Day-Ahead Market, Intraday Market, Balancing Market or Electricity Financial Market"*[115].

It is essential to mention that in the Day-Ahead Market and in the Intraday Market entities submit their electricity trading orders and are obliged to make a delivery within one day. The operation of these Markets is carried out by the Hellenic Energy Exchange S.A., in collaboration with the Hellenic Electricity Transmission System (HETS) Administrator and the competent bodies, in accordance with the regulations of the Energy Exchange Regulations for the Day-Ahead Market and the Intraday Market[116].

The Balancing Market includes the Balancing Energy Market, the Balancing Capacity Market as well as the Deviation Clearing Process (Law 4425/2016, art. 7). The participants of this market have the obligation to submit bids which they have to cover by physical delivery, both in the Balancing Energy Market and in the Balancing Capacity Market. The management of this Market is the responsibility of the Administrator of Hellenic Electricity Transmission System - HETS (IPTO S.A.), as responsible for the balancing of HETS and is carried out in accordance with the regulations of the Balancing Market Regulation[117]. In this regard, and in relation to the settlement of transactions carried out in the above Markets, Article 117C of Law 4001/2011, as in force, provides that *" […] the Hellenic Energy Exchange S.A. establishes a new company and submits to RAE the Business Plan of the new company which shall implement the clearing of the Day-Ahead Market and Intraday Market as the Clearing Entity, according to the provisions of Articles 12 and 13 of law 4425/2016 [… ] "*[118], While article 13 of Law 4425/2016, as in force, provides that *"[…] the Clearing Entity issues a Regulation that […] includes transparent and non-discriminatory rules, which are based on objective criteria, regarding the access of the Clearing Members in clearing proceedings. […]*[119]*"*.

[115] Ibid.

[116] Ibid.

[117] Ibid.

[118] Law 4001/2011, Government Gazette, 2011, (179/A/2011), available at: https://www.e-nomothesia.gr/energeia/n-4001-2011.html

[119] Law 4425/2016, Government Gazette, 2016, (185/A/2016), available at: https://www.e-nomothesia.gr/energeia/nomos-4425-2016.html

In order to implement the above legal framework, RAE has proceeded to particular decisions, following the suggestions of HEnEx S.A., IPTO S.A. and Energy Exchange Clearing Company S.A., on the basis of which the regulatory framework for the operation of the above markets has been established. Finally, RAE with the no. 1298/2020 Decision set November 1, 2020, as the Commencement Date of the Day-ahead Market, Intraday Market and Balancing Market[120].

In the Following table a current list of energy market members of HEnEx is presented.

| A/A | COMPANY NAME | COUNTRY |
|---|---|---|
| **1** | ALPIQ ENERGY SE | CZECH REPUBLIC |
| **2** | AYEN ENERGIJA d.o.o | SLOVENIA |
| **3** | AXPO ENERGY ROMANIA SA | ROMANIA |
| **4** | AXPO SOLUTIONS AG | SWITZERLAND |
| **5** | CEZ A.S. | CZECH REPUBLIC |
| **6** | DANSKE COMMODITIES A/S | DENMARK |
| **7** | Duferco Energia S.pA. | ITALIA |
| **8** | DUFERCO HELLAS A.E. | GREECE |
| **9** | ELECTRADE S.P.A. | ITALY |
| **10** | ELEKTRICNI FINANCNI TIM d.o.o | SLOVENIA |
| **11** | ELPEDISON A.E. | GREECE |
| **12** | ENSCO Energy Services Company AG | SWITZERLAND |
| **13** | EUNICE AGGREGATION MAE | GREECE |
| **14** | EUNICE TRADING AE | GREECE |
| **15** | EVN TRADING SOUTH EAST EUROPE | BULGARIA |
| **16** | FORENA ENERGY A.E | GREECE |
| **17** | GEN - I ATHENS M.E.Π.E.(SMLLC) | GREECE |
| **18** | GREEK ENVIRONMENTAL & ENERGY NETWORK A.E. | GREECE |
| **19** | HSE d.o.o. | GREECE |
| **20** | INTERENERGO d.o.o. | SLOVENIA |
| **21** | INACCESS NETWORKS S.A. | GREECE |
| **22** | LE Trading a.s | SLOVENIA |
| **23** | NRG SUPPLY AND TRADING S.A. | GREECE |
| **24** | OPTIMUS ENERGY SOCIETE ANONYME | GREECE |
| **25** | PROTERGIA ENERGY S.A. | GREECE |
| **26** | PROTERGIA ΘΕΡΜΟΗΛΕΚΤΡΙΚΗ ΑΝΩΝΥΜΗ ΕΤΑΙΡΕΙΑ | GREECE |
| **27** | RENOPTIPOWER S.A. | GREECE |

[120] Regulatory Authority of Energy (RAE), 2021, available at: https://www.rae.gr/%cf%87%ce%bf%ce%bd%ce%b4%cf%81%ce%b5%ce%bc%cf%80%ce%bf%cf%81%ce%b9%ce%ba%ce%ae-%ce%b1%ce%b3%ce%bf%cf%81%ce%ac-%ce%b4%ce%b9%ce%b1%cf%83%cf%85%ce%bd%ce%b4-%cf%83%cf%85%cf%83%cf%84%ce%ae%ce%bc%ce%b1/

| | | |
|---|---|---|
| **28** | SOLAR ENERGY | GREECE |
| **29** | STATKRAFT MARKETS GMBH | GERMANY |
| **30** | STRATEGIC ENERGY TRADING ΕΝΕΡΓΕΙΑΚΗ ΑΝΩΝΥΜΗ ΕΤΑΙΡΕΙΑ | GREECE |
| **31** | Vitol Gas and Power B.V. | NETHERLANDS |
| **32** | VOLTERRA S.A. | GREECE |
| **33** | VOLTON ΕΛΛΗΝΙΚΗ ΕΝΕΡΓΕΙΑΚΗ ΑΝΩΝΥΜΗ ΕΤΑΙΡΕΙΑ | GREECE |
| **34** | WATT AND VOLT A.E. | GREECE |
| **35** | ZENIΘ GAS & LIGHT | GREECE |
| **36** | ΑΝΕΞΑΡΤΗΤΟΣ ΔΙΑΧΕΙΡΙΣΤΗΣ ΜΕΤΑΦΟΡΑΣ ΗΛΕΚΤΡΙΚΗΣ ΕΝΕΡΓΕΙΑΣ (ΑΔΜΗΕ) ΑΝΩΝΥΜΗ ΕΤΑΙΡΕΙΑ | GREECE |
| **37** | ΒΙ.ΕΝΕΡ Α.Ε. ΕΝΕΡΓΕΙΑΚΕΣ ΕΠΙΧΕΙΡΗΣΕΙΣ ΑΝΩΝΥΜΗ ΕΤΑΙΡΙΑ | GREECE |
| **38** | ΒΙΟΛΑΡ Α.Ε | GREECE |
| **39** | ΒΟΩΤΗΣ Α.Ε. | GREECE |
| **40** | ΔΗΜΟΣΙΑ ΕΠΙΧΕΙΡΗΣΗ ΗΛΕΚΤΡΙΣΜΟΥ Α.Ε. | GREECE |
| **41** | ΔΙΑΧΕΙΡΙΣΤΗΣ ΑΠΕ & ΕΓΓΥΗΣΕΩΝ ΠΡΟΕΛΕΥΣΗΣ Α.Ε. | GREECE |
| **42** | ΕΛΙΝ ΒΕΡΝΤ ΑΝΩΝΥΜΗ ΕΤΑΙΡΙΑ | GREECE |
| **43** | ΕΛΙΝΟΙΛ ΕΛΛΗΝΙΚΗ ΕΤΑΙΡΕΙΑ ΠΕΤΡΕΛΑΙΩΝ ΑΝΩΝΥΜΗ ΕΤΑΙΡΕΙΑ | GREECE |
| **44** | ΕΛΛΗΝΙΚΑ ΤΑΧΥΔΡΟΜΕΙΑ Α.Ε. | GREECE |
| **45** | ΕΤΑΙΡΕΙΑ ΠΑΡΟΧΗΣ ΑΕΡΙΟΥ ΑΤΤΙΚΗΣ –ΕΛΛΗΝΙΚΗ ΜΟΝΟΠΡΟΣΩΠΗ ΑΝΩΝΥΜΗ ΕΤΑΙΡΕΙΑ ΕΝΕΡΓΕΙΑΣ | GREECE |
| **46** | ΗΛΕΚΤΡΟΠΑΡΑΓΩΓΗ ΣΟΥΣΑΚΙΟΥ ΜΟΝΟΠΡΟΣΩΠΗ ΑΝΩΝΥΜΗ ΕΤΑΙΡΕΙΑ ΠΑΡΑΓΩΓΗΣ ΚΑΙ ΕΜΠΟΡΙΑΣ ΗΛΕΚΤΡΙΚΗΣ ΕΝΕΡΓΕΙΑΣ | GREECE |
| **47** | ΗΡΩΝ ΙΙ ΒΟΙΩΤΙΑΣ Α.Ε | GREECE |
| **48** | ΗΡΩΝ ΘΕΡΜΟΗΛΕΚΤΡΙΚΗ Α.Ε. | GREECE |
| **49** | ΚΕΝ ΠΑΡΑΓΩΓΗ ΚΑΙ ΕΜΠΟΡΙΑ ΕΝΕΡΓΕΙΑΚΩΝ ΠΡΟΪΟΝΤΩΝ Α.Ε. | GREECE |
| **50** | ΚΟΡΙΝΘΟΣ POWER Α.Ε. | GREECE |
| **51** | ΚΩΝΣΤΑΝΤΙΝΟΣ Β. ΜΑΡΚΟΥ Α.Β.Ε.Ε. | GREECE |
| **52** | ΛΙΓΝΙΤΙΚΗ ΜΕΓΑΛΟΠΟΛΗΣ Α.Ε. | GREECE |
| **53** | ΛΙΓΝΙΤΙΚΗ ΜΕΛΙΤΗΣ ΜΟΝΟΠΡΟΣΩΠΗ Α.Ε. | GREECE |
| **54** | ΜΟΤΟΡ ΟΙΛ (ΕΛΛΑΣ) ΔΙΥΛΙΣΤΗΡΙΑ ΚΟΡΙΝΘΟΥ Α.Ε | GREECE |
| **55** | ΜΥΤΙΛΗΝΑΙΟΣ ΑΝΩΝΥΜΟΣ ΕΤΑΙΡΕΙΑ - ΟΜΙΛΟΣ ΕΠΙΧΕΙΡΗΣΕΩΝ | GREECE |
| **56** | ΟΤΕ ΑΚΙΝΗΤΑ ΑΝΩΝΥΜΗ ΕΤΑΙΡΕΙΑ | GREECE |
| **57** | ΤΕΡΝΑ ΕΝΕΡΓΕΙΑΚΗ ΑΝΩΝΥΜΗ ΒΙΟΜΗΧΑΝΙΚΗ ΕΜΠΟΡΙΚΗ ΤΕΧΝΙΚΗ ΕΤΑΙΡΕΙΑ | GREECE |

*Table 2 : List of Energy Markets Members*

*Source: HEnEx (2021)*[121]

[121] HEnEx, 2021, available at: https://www.enexgroup.gr/web/guest/commodities-members-list

Below a summarized report of each market's operation can be found:

**a.** With regards to the **Energy Financial Market**, participants trade in derivatives that are related to various energy products. All transactions have the option of physical delivery (injection or absorption of energy) otherwise they are subject to cash settlement. The products that are currently provided by the market regulation are either Futures - Contracts or Rights Options. Both types of contracts can be distinguished depending on the Load profile. Load profile can be: **1.** Baseload contracts i.e. action which is injected or absorbed all hours of the day for the whole week and **2.** Peakload contracts which refer to injection or energy absorption from 08:00 to 20:00 of each day, Monday to Friday. The duration of the contracts can be monthly, quarterly or yearly[122].
It is mentioned that this kind of energy trading is also allowed to take place bilaterally out of the operation of the Power Exchange.

**b.** Concerning the **Day-ahead Market**, participants trade energy that is to be produced or consumed the next day. This market is essentially an auction that ends the day before the day the bids are quoted. In most countries at noon the auction has been completed in order for the managers to calculate the market price as well as to draw up a production plan for the producers. In Greece, this auction closes at 13:00 at noon, i.e. until that time offers are accepted. It is noted that for all participants participation in this market is optional with the exception of Producers (thermal producers), who must submit bids for all their remaining energy (energy that has not been sold in the derivatives market which we will see below). In this market we always refer to hourly intervals. In other words, this market consists of 24 products one for each hour of the day (Market Time Unit). Of course, for each hour a different purchase price is calculated. This is calculated according to the principle of maximizing social surplus. In more detail, all sale (or energy injection) and purchase (or energy consumption) offers are collected and sorted in ascending and descending order respectively. Where the two curves intersect show the market equilibrium price (for each hour). It is worth noting that all transactions carried out on the Day-ahead Market have the obligation of physical delivery, i.e. the actual injection or consumption of electricity based on the offers that were accepted. It is obvious that for an injection offer to be accepted, its value must be lower than the equilibrium value. Accordingly, an offer of energy consumption must have a higher price than the equilibrium value in order to be accepted. We emphasize that regardless the price that the participants have included in their offer, they whose offers will be accepted receive the same price.

[122] HEnEX, 2021, available at: https://www.enexgroup.gr/web/guest/derivatives-markets

Finally, in case there are separate offer zones such as Central Greece - Crete, then the offers refer to a specific zone. All adjacent zones will have the same equilibrium values for each hour unless there is a technical restriction that is violated. This may be a congestion on a line or a technical minimum of an internal combustion plant. In this case the administrator intervenes and there is a difference in prices between the zones.

**c.** The **Intraday Market** consists of three sub-markets: **1.** Local Intraday Auctions (LIDAs), **2.** Complementary Regional Intraday Auctions (CRIDAs) and **3.** Continuous trading (XBID). The local intraday auctions behave in exactly the same way as the pre-day market, i.e. all the infusion and absorption bids are collected together and at a certain time the market closes. The equilibrium value is then calculated again by its method optimizing the social surplus.
More specifically, the local intraday auctions are three (LIDA 1, LIDA 2, LIDA 3) with the first being a few hours after the closing of the Day-ahead market. As soon as the first one closes, a little later the second one opens and the third one respectively. During the first and second local intraday auctions, bidders may submit bids for any of the 24 market time units of the following day while on the third the participants submit only for the last 12 market time units. As mentioned before, the Day-ahead market closes at 13:00 of the previous day from the day of physical delivery and so the first and second local intra-day auctions are completed the previous day as well. The additional regional intra-day auctions work exactly the same like local intraday auctions. The trading hours, the market time units as well as their types commands are the same. The only difference is that regional intraday auctions are conducted in a mating region consisting of 2 or more bidding zones.

**d.** Lastly, the **Balancing Market** consists of three sub-markets. These are: **1.**The Balancing Capacity Market, **2.** The Balancing Energy Market and **3.** The Imbalances Settlement.
The role of these three markets is solely to protect the system from any instability. As we know, the electricity system must always be in balance, i.e. all the energy consumed so much to be produced. It is logical that, at least with today's data, it is not possible to know exactly how much energy is consumed every second across the country. Thus, the administrator counts at various points in the system frequency (through which it detects any disparities between production and consumption) and intervenes in case of instability.

According to IPTO (ADMIE), "*Participation in the Balancing Capacity Market takes place prior to real time. The market design has prescribed the three key balancing capacity products. Upward and downward Frequency Containment Reserve (FCR), Upward and downward manual (non-automatic) Frequency Restoration Reserve (mFRR), and Upward and downward automatic Frequency*

*Restoration Reserve (aFRR). Participants are compensated for the balancing capacity quantity that corresponds to them from the market clearing on a pay-as-bid basis every 30 minutes and participants are required to commit the respective capacity in order to maintain a safe margin for System balancing in real time."*[123]

Furthermore, according to IPTO (ADMIE) about Balancing Energy Market and Imbalance Settlement, *"Market design has provided for products of Upward and downward manual Frequency Restoration Reserve (mFRR) and Upward and downward automatic Frequency Restoration Reserve (aFRR). Close to real time, the operator estimates, based on the System condition, where activation of Upward or downward manual Frequency Restoration Reserve (mFRR) is necessary and then issues the corresponding orders based on the lowest priced bids. In real time, the entities that can provide aFRR, receive automatic orders for activation of the lowest priced bids in order to ensure the balance of the System, under the limitation of protecting the safe operation of the System[...]Imbalances Settlement takes place post real time and aims at the compensation or charge of the energy arising from any imbalances of the participants in the Balancing market from the last schedule of the market and/or the dispatch orders."*[124]

Finally, the operation of the Forward, Day-ahead and Intraday market has been assigned to the Hellenic Energy Exchange, while the Balancing Market is the exclusive responsibility of IPTO. The Hellenic Energy Exchange is the Appointed Electricity Market Operator (NEMO), for the coupling of the day-ahead market and the coupling of the single intraday electricity market[125]. What is sought today is the balancing of the system. With this term in an electricity system all those procedures are included for the continuous adaptation of the production to the total load in order to maintain a constant frequency in the system. The present procedure is the most critical service to ensure safe operation.

## 5.5 Energy System Agencies

After studying the Greek electricity market it would be advisable to make a reference to the Greek Regulatory Authority, the Transmission and Distribution Operators as well as the Renewable Energy

[123] IPTO, 2021, available at: https://www.admie.gr/en/market/general/capacity-calculation

[124] Ibid.

[125] IPTO, 2021, available at: https://www.admie.gr/en/market/general/description

Sources Operator, given that they are fully involved in the energy market and their contribution is crucial according to the relative European directives.

### 5.5.1 The Energy Regulatory Authority (RAE)

The Energy Regulatory Authority (RAE) is the independent administrative authority set up by Law 2773/1999, as amended and in force, on the base of Directives 2003/54/EC and 2003/55/EC on electricity and gas, the basic role of which is overseeing the domestic energy market.

Pursuant to Article 3 of Law 4001/2011, the Energy Activities fall under the authority of the State, which is practiced by the Minister of Environment, Energy and Climate Change and the Energy Regulatory Authority (RAE) inside the extent of its duties and the country's long-term energy planning.

RAE's role as a public energy regulator has been upgraded since 2011, by venturing up and reinforcing its conclusive decisive powers over the regulation of electricity and gas markets, according to Community Directive 2009/72/EC, which turned national energy regulators to guarantors of the proper functioning of energy markets.

RAE's main responsibilities under Law 4001/2011, as amended and in force are[126]:

- Monitoring and supervision of the energy market.
- Consumer protection.
- Infrastructure development
- Monitoring of distribution networks
- Cooperation with ACER (Agency for the Cooperation of Energy Regulators)
- Monitoring the security of the country's energy supply.
- Issuance / revocation of electricity licenses (production, supply, marketing, direct lines)
- Supervision of the Independent Transmission Operator.
- Approval of charges for non-competitive activities.
- Monitoring of access to energy interconnections.

[126] Law 4001/2011, Government Gazette, 2011, (179/A/2011), available at: https://www.e-nomothesia.gr/energeia/n-4001-2011.html

➢ Imposing regulatory measures to ensure the proper functioning of energy markets.

From the above, we can easily conclude the wide range of responsibilities that RAE has assumed, as well as the enormous amount of work that this entails.

### 5.5.2 The Independent Power Transmission Operator (IPTO)

The Independent Power Transmission Operator (IPTO) is the operator of the Hellenic Electricity Transmission System (HETS) according to the provisions of Community Directive 2009/72/EU and performs all the tasks specified in Law 4001/2011, the Grid Code and HETS Operation License.

According to IPTO, *"The mission of IPTO is the operation, control, maintenance and development of the Hellenic Electricity Transmission System, to ensure the country's supply with electricity in an adequate, safe, efficient and reliable manner, as well as the operation of the electricity market for transactions outside the Day Ahead Scheduling, pursuant to the principles of transparency, equality and free competition."* [127]

In the case of IPTO, ownership unbundling has been implemented since June 2017 in line with Community Directive 2009/72/EU, so its absolute independence is a guarantor for transparency and confidentiality in its general operation and impartiality as far as third-party access to the network is concerned.

Apart from IPTO's duties that are related to the function of the transmission system and ensure a consistent and adequate flow of power pursuant to the needs of consumers, IPTO is also responsible for the effective exploitation of recourses and advancement of new technologies or researches, which will improve the energy future of the country.

Furthermore, according to the Balancing Market RuleBook, as amended and in force, IPTO is also responsible for the operation of the Balancing Market of Energy Exchange.

The function of the Balancing Market is determined by the Balancing Market Rulebook according to Articles 17 and 18 of Law 4425/2016, as amended and in force and Regulation (EU) 2017/2195. According to IPTO, the Balancing Market Rulebook, inter alia has to:

- *"designate the Participants in the Balancing Market and describe the relevant registration procedure*

[127] IPTO, 2021, available at : admie.gr/en/company/about-us

- *set out detailed rules and conditions under which Participants may participate in the Balancing Market*
- *define the rights and obligations of the HETS Operator vis-à-vis the Participants in connection to their participation in the Balancing Market*
- *describe the interface between the Balancing Market, the Day-Ahead Market and the Intra-Day Market, including the exchange of information between the Power Exchange and the HETS Operator*
- *set out detailed rules for the validation of Balancing Energy Offers and Balancing Capacity Offers by the HETS Operator*
- *describe the input data, the operation, and the results of the Integrated Scheduling Process and the Energy Balancing Market*
- *describe the interface between the Integrated Scheduling Process and the Energy Balancing Market*
- *determine the penalties for the Participants in the event of non-compliance with the provisions of this Rulebook*
- *define the Balancing Market Settlement procedure*
- *define the procedure for exchanging information with other stakeholders*
- *specify the reporting and monitoring obligations of the HETS Operator in relation to the Balancing Market*
- *define the procedures for the protection of commercially sensitive information"*[128]

### 5.5.3 The Hellenic Electricity Distribution Network Operator (HEDNO)

The Operator of the Hellenic Electricity Distribution Network (HEDNO S.A.) was established with the secession of the electricity distribution company of PPC SA. in accordance with Law 4001/2011 and in accordance with Directive 2009/72/EC of the European Union on the organization of electricity markets, in order to assume the duties of Operator of the Greek Distribution Network. It is a wholly-owned subsidiary of PPC S.A., however it is independently operational and

[128] IPTO, 2021, available at: admie.gr/en/market/regulatory-framework/balancing-market-rule-book

administratively and legally compliant with all the independence requirements that are incorporated in the above legal framework.

The company's mission is to operate, maintain and develop the electricity distribution network in Greece and to ensure transparent and impartial access to consumers and to all users of the network in general. Furthermore HEDNO is also responsible for the power system of the Non-interconnected Islands of the country.

The objectives of the company are inter alia:

- The improvement of service quality, aiming at upgrading the services provided to customers, by satisfying their requests on time through high-tech solutions that ensure on-line services.
- Ensuring the energy quality by optimizing the reliability of distribution facilities and further developing the existing network in order to secure power efficiency
- Minimizing operating costs and avoiding extra charges.
- Adapting to the environmental requirements of the new environment and contributing to the sufficient operation of the power market[129].

### 5.5.4 Renewable Energy Sources Operator & Guarantees of Origin (DAPEEP)

The Renewable Energy Sources Operator & Guarantees of Origin (DAPEEP S.A.) is the Operator of Renewable Energy market in Greece and it is essentially an evolution of the former Electricity Market Operator (LAGIE S.A.), which was incorporated in 2011 by the Law 4001/2011 in the context of the establishment of the single internal market as Community Directive 2009/72/EC provided for.

After the amendment of the Law 4001/2011 by Law 4425/2016 (as amended by Law 4512/2018) which practically imposed the annulment of the Day-ahead schedule (DAS) system and the market model of the Mandatory Pool, enacting the creation and operation of the Energy Exchange with the above mentioned four distinct energy markets, LAGIE proceeded to the secession of its branch that was related to activities concerning the formation of Day-ahead Schedule (DAS). This branch was simultaneously absorbed by HEnEx S.A. and the company “LAGIE S.A.” was renamed to “DAPEEP S.A.” keeping the rest of its existing duties, namely the management of renewable energy

[129]HEDNO, 2021, available at: https://www.deddie.gr/en/deddie/i-etaireia/stratigikos-sxediasmos/

sources (RES).

Furthermore, DAPEEP is nowadays responsible for the issuance of the Guarantees of Origin of Electricity from RES and Combined Heat and Power Units (CHP), as well as for the auctions of the Co2 emissions allowances.

As far as the function of the electricity market is concerned, DAPEEP participates in the Greek Energy Exchange market representing RES producers as the Aggregator of Last Resort (FOSETEK).

The role of DAPEEP in the transition of electricity market to a new era is proved to be very crucial, given that the penetration of RES in the energy mix not only in Greece but also in a European level is constantly increasing at a fast pace. Under this prism, electricity coming from RES is going to increase even more in the next years and its expected contribution to the markets of Energy exchange should be regulated and protected by DAPEEP in such a way that ensures sustainability and efficiency, taking into account the special characteristics of RES exploitation.

## 5.6 Evaluation of the Target Model system operation in Greece's power market

Although late, Greece finally managed to transform its electricity market from a mandatory pool model based on the Day-ahead scheduling system to the Target Model System comprised of four distinct markets, in line with the provisions of EU Third Legislative Package as it has been imposed on the national energy legal framework.

The foundation of Hellenic Energy Exchange is of extremely high importance towards a single European energy market, the unification of which necessarily passes through the formation of the energy market of each Member State separately. Coupling of different markets along with the interconnection development are going to lead to the completion of what European Commission has named as Target Model.

So far, Greek Energy Exchange has already managed to ensure coupling with Italy and Bulgaria, which is a crucial step for its operation capacity, as well as its sustainability and the attraction of new participants. In this way, competition is significantly strengthened in favor of final consumers who enjoy lower prices of electricity.

However, the commissioning of HEnEx in November 2020 did not take place smoothly. In the first few months of its function, the energy prices in the wholesale market almost quadrupled, which in some cases led to significant increases in the retail market to the detriment of consumers. What was observed in the very first period of HEnEx's operation was that despite the fact that one of the main goals of Target Model is prices reduction, the participation of Greek energy market in the Target Model led to the exactly opposite result. The Regulatory Energy Authority intervened examining the reasons that resulted to that prices raise and finally imposed price ceiling on the participants offers, in order to restrict possible speculation phenomena.

In any case, other Member States' examples have proven that the operation of the energy exchange market needs a reasonable time period in order to face possible discrepancies and imbalances that could arise due to different reasons related mainly to supply deficits or demand surplus that have a direct impact on balancing markets. Greek energy market needs time in order to adapt to the transition from the former system to the new Target Model system and the results of this transition are going to appear in a long term.

# 6. General Conclusion

Concluding this project, the Target Model is practically a set of uniform rules that determine the creation of an internal European electricity market which produces positive economic result for consumers by strengthening cross-border trade while secures smooth energy flows across the Union by developing power interconnections. By establishing the Target Model market electricity moves freely within the European Union in order to meet demand at the lowest cost. The means for achieving the internal energy market are the unification of national electricity markets aiming at a better production-demand ratio, the common calculation process and the controlling of grid congestion. Target Model's rules have the form of European regulations in order to allow Member States to follow the process they want in terms of design and implementation, so that there is space for adaptation to domestic requirements, needs and procedures.

At the same time, as the markets mature, regional initiatives such as the Pentalateral Forum (Austria, Germany, Belgium, the Netherlands, Luxembourg, France, Switzerland), which also participate in the formation of European Union's internal electricity market, are becoming more and more powerful, taking into account regional differences in market integration.

This model was designed to draw on real markets in order to meet the objectives set by the European Union. Today the European Energy Exchanges (EPEX SPOT, GME, HEnEx, Nord Pool, OMIE, OPCOM, OTE and TGE,) apply through the PCR (Price Coupling of Regions) project a common algorithm for resolving their daily markets, resulting in the Austrian markets, Belgium, Croatia, Denmark, Estonia, Finland, France, Germany, Italy, Ireland, Latvia, Lithuania, Luxembourg, the Netherlands, Norway, Poland, Portugal Slovenia, Sweden, Spain, the United Kingdom and the 4MMC countries (Czech Republic, Slovakia, Hungary, Romania).

The main benefits from the application of the Target Model are noted in cross-border trade and therefore in the better use of interconnections and in the general unified operation of energy markets resulting to positive financial signals.

The implementation of the Target Model facilitates the management of production, reduces wholesale prices, improves supply, more efficient investments in wind and photovoltaic parks. This situation will help the Union to ensure its production of alternative forms of clean energy, will promote the environmental sustainability and will give the Member States many options in the energy field. However there are still space for improvements in the operation of the single energy market, mainly on issues concerning the active participation of all Member States that must effectively transform their national electricity system and harmonize it with the existing European energy market, as well as on issues relating to the clean energy transition that is of high importance taking into account the destructive results of the climate change.

As everything shows, energy markets become even more mature as the time goes by and finally seem to achieve the necessary operational balance. The completion of the EU's energy market unification is now a matter of time, as most of the Member States are getting involved in its formation procedure mainly through market coupling expansion.

Furthermore, RES penetration in energy markets is expected to be impressively raised in the next years ensuring energy efficiency. RES aggregators are going to play a crucial role in RES participation in energy market. Nevertheless, discrepancies will not be easily avoided due to the stochastic attributes of RES production that may cause fluctuations between foreseen and real production and consequently result to turmoil in the balancing market.

Under this prism, it is obvious that although numerous operational obstacles should be overcome and market challenges should be faced, the achievement of a unified internal energy market that will ensure energy efficiency, security of supply and lower prices for the final consumers is closer than ever before.

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