POLITECNICO DI MILANO
Facoltà di Ingegneria dei Processi Industrali
Corso di Laurea Specialistica in Ingegneria Energetica

DEVELOPMENT OF A VISUALIZATION AND ANALYSIS TOOL FOR PUBLIC DOMAIN DATA OF THE ITALIAN ELECTRIC POWER MARKET

Tesi di

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Sessione Laurea 28 Aprile 2014

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Abstract

The European energy sector is in a major transition as the member states have agreed on an ambitious plan of building a European single market. Italy is fully committed to promoting national initiatives with the objective of the best price and infrastructure convergences. There are a number of Italian institutions working towards the stabilization of a well-functioning and competitive market. Every effort is made to ensure that the maturing of the internal market is on the right track. This calls for many analyses of the price and volume evolutions on the electricity market and transparency with publishing raw data and results. This master thesis comes in addition to the information already available. It aims at providing an analysis tool and further information about the Day-Ahead and Intra-Day markets of Italian power system for a better understanding of how they work. The thesis is using an innovative and refined business intelligence software to facilitate access and intelligibility of complex official data for all the future potential users. The ultimate goal is to have tools capable of processing huge amounts of complex data in order to extract their strategy-relevant contents. The multiple findings are synthesized into easily readable and compact result briefs.

Mieux vaut un instant en Avril que tout un long mois en Automne.
Adam Mickiewicz

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Introduction

For the past twenty years the EU has, step by step, opened up the gas and electricity market in Europe. The European electricity market is in the middle of a transformation from monopolistic state-owned production and distribution to privatized markets. Each country started policies of liberalization of the electric sector. This is the case of Italy.

A first important step is the approval of the Legislative Decree n. 79/99 in 1999. With this decree, also called "Bersani Decree" the liberalization of electricity production was well advanced, introducing a competitive regime in segments where competition was possible. It set standards and regulatory measures intended to achieve the transition to a totally supply and demand market. The social ambitions whose aims were to ensure coverage and direct access to electricity for all the territory of Italy were over with the end of the former best monopolistic solution. The whole organization had to be rethought and upgraded.

The year 2004, in particular the first of April, has established a great change in the process of liberalization; for the first time the rights of injections (generation) or withdrawals (load) of electrical energy from/to the national electric system were delivered observing the principles of market orientation. The wholesale market prices were determined according to new supply/demand dynamic. On 1st April 2004, five years after the Bersani Decree came into effect, the Italian Power Exchange (IPEX) was launched and the Italian Market of Electricity was born. It enables producers, consumers and wholesale customers to enter into hourly electricity purchase and sale contracts. It's all based on market auction procedures and non-discriminatory competition. IPEX is an electronic marketplace (all transactions take place through the Internet) where demand and supply meet, defining the quantities and prices of the electricity to be traded. The existence of power exchange facilitates the liberalization process and makes it more fluid, to the extent that it makes prices and how they are formed more transparent.

The process is still in progress and continues to modify the Italian electric market landscape. A domestic liberalization has been launched. From July 1st 2007, all the customers can be part of the market. Furthermore, they can freely choose the sellers and thanks to competition between distributors, have access to a lot of commercial offers. At the end with an important structural reform, the Italian electricity sector can now partly respond to the followings needs:

- Promoting competition in the activities of electricity generation and wholesale through the creation of a "marketplace".

- Maximizing transparency and efficiency in the naturally monopolistic activity of dispatching.

In order to control and make sure of the well-functioning of the power system, some entities have been defined by legislation. Their roles are specific. One of them, GME, "Gestore dei Mercati Energetici S.p.A." is the company in charge of organizing and managing the Electricity Market, the Natural Gas Market and the Environmental Markets in Italy under principles of neutrality, transparency and competition among the producers. In particular, on the website of the organization (www.mercatoelettrico.org) can be found all the data about the Italian electric market.

For transparency reasons, all the information relative to demand bids and supply offers are available from the seventh day after the closing day of the market. In accordance with the Decree of the minister of Economic Development issued on 29 April 2009 and on 31 July 2009 (Called Decree Transparency) GME must allow access to information with a limit of seven days (confidentiality). In this way, XML files containing all the transactions for each day, hour and market can be downloaded on the GME's website. In a file, each transaction will be described indicating the operator, the unit of production, the quantity offered , the price demanded, the date, the interval, the quantity and the price accepted and other information.

The work of the thesis focuses on the study of these data. The aim is to retrieve information and results from the analysis of the data. Thanks to a development of analysis tools based on the software Qlikview®, a general framework of the electricity production could be formulated. The thesis will take interest in the position of the different traders on the market, in their strategic behavior, in the global generation situation. The idea is also to set up an interactive and simple tool which will be used in the future for further analysis after data collection and updating.

In the first chapter, the story and the organization of the Italian Electricity Market will be exposed. It is useful to understand how the country and its institution have succeeded in establishing a liberalized market and to have an overview of the internal coordination mechanisms of the latter. Secondly, it may be good to know the situation of the actual market providing specific features and available results. The review of the situation will be based on the latest report of GME available (Annual report 2012) and will try to evaluate the different trades of the considered markets. Then it is important to clearly explain on what data is based the thesis. The third chapter contains the principle methods used for the acquisition of raw data and the introduction to the software, the working tool necessary to the processing of the data. Finally, it will be exposed all the results obtained by the use of the analysis tools developed. It will be shown how the user can learn about the execution of the market from the different visualizations and calculations available on the application.

Chapter 1

The Italian Electricity Market

In the literature [18], electricity is defined as having three main characteristics that lead and explain specific aspects of its market. See below in Fig.1.1 the characteristics of electricity:

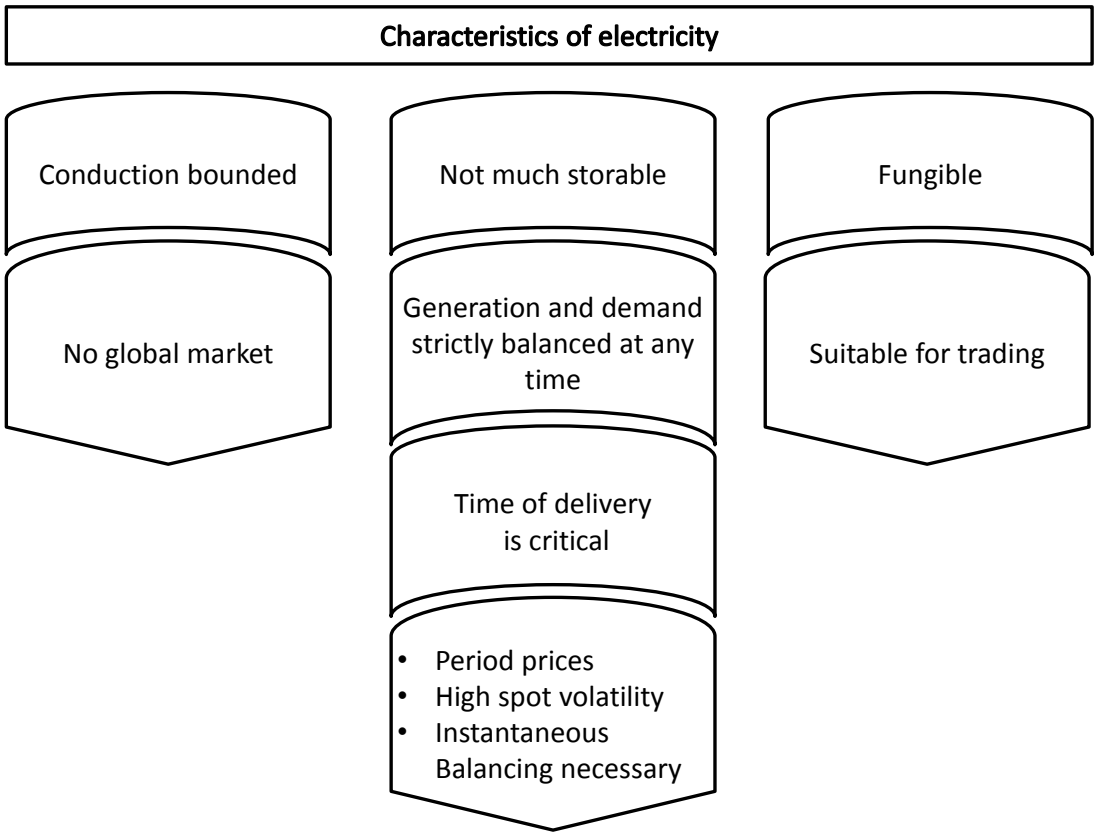

Figure 1.1: Characteristics of electricity as a commodity

That gives an implication for trading of this service. The exact match of demand and supply at any time, the issues of a grid shared and limited, the capacity constraints in transmission imply the creation of a coordinator. In fact with the process of liberalization, the single operator structure carried out by Enel was removed. The whole organization has been rethought in order to form a reliable electricity market. It was imperative that adequate rules and institutions be established. Thus, such a system needs a whole institution dedicated to its management and the control to ensure that technical, physical constraints or standards are respected.

In order to better understand the real implication of the national coordinator, it is appropriate to explain the different and typical activities the system is divided into:

- Up the activities, there is the generation and import of electricity. Primary energy sources are converted into electricity by power plants or electricity is directly imported from others countries, as France for example [1].
- Then there is the activity of transmission. The energy is transmitted to consuming zones through the grid system. On this grid will be conducted operations of balancing. The grid operates as a system of communicating vessels, all the injected electricity is withdrawn, without the possibility of determining the plant or installation from which the electricity consumed originates.
- To this grid the distribution local networks are connected. This is the last activity: the distribution. The electricity is regulated and delivered to the final consumers.

The Italian power system must be a really well organized grid system.

1.1 Story of the liberalization of Electricity Market in Italy

The so called “Electric Reform”, which launched the complex process of liberalization in the electricity sector in Italy, began in the first 90’s. First, the Law No 9 of 1991 had enabled a partial liberalization of the Electricity sector. The provisions of the law enhanced the possibility of access for new operators, establishing in particular the ability of undertakings other than ENEL, historic operator, to produce energy, upon the authorization of the dedicated Minister. Those are the first signs of opening up towards liberalization, by reducing the constraints fixed by the nationalization law (1962) [4].

In 1992, the main tenets of the Enel’s privatization were formulated and the company became actually a private corporation in 1999.

1. France is the largest electricity import partner of Italy. The latest agreement between the two countries was the construction of a new power line called "Piedmont-Savoy" [16]. This is a completely underground 320 kV DC line which represents the longest underground power line in the world, result of the successful cooperation between Terna and RTE tranmission system operators of Italy and France.

In 1995, the law No 481 established the "Autorità per l'energia elettrica e il gas" (Autorità per l'energia elettrica ed il gas (AEEG), agency for regulation of electricity and gas) which has the mission of regulating and monitoring the electricity and gas sector.

What is common to call the cornerstone of the liberalization of the Electricity Market is the legislative decree N° 79/1999. In fact, the also called Bersani Decree (Legislative Decree N° 79 of 16 March 1999) totally liberalized electricity production and eliminated the previous obligations. It was a transposition of the Community Directive 96/92EC concerning common rules for the international market in electricity (See Table 1.1 and Table 1.2 in Legislative framework). The decree proposed a gradual liberalization of the electricity sector, introducing competition in the market, a scale resizing of the importance of ENEL and the creation of entities to manage the market. The competitive Italian Electricity Market was born. Among the main new proposals established by the decree, the following issues must be noted:

- The liberalization of the activity of generation, sale and trade with abroad.
- The regulation of the access to the transmission grid through tariff governed by AEEG
- The separation between ownership and management of the grid with the allocation of the management of the dispatching and the interconnections with European system to the entity called GRTN (Gestore della Rete di Trasmissione Nazionale) and the allocation of ownership, development and maintenance operations to the operator TERNA (part of the group ENEL)
- The institution of Gestore dei Mercati Energetici (GME) (then Gestore dei Mercati Energetici in 2009), company in charge of organizing and managing the Electricity Market, the natural Gas Market and the Environmental Markets by the mean of the auction system.
- The creation of the company AU (Acquirente Unico) which guaranties electricity supply.
- The allocation of the distribution by a unique territorial concession for each local authority.
- The introduction of the notions of "eligible" and "captive" customers for a further liberalization of the final sale.

Other wide ranging measures were taken to limit the market power of the incumbent (i.e. ENEL). They are policies aimed at enhancing competition and improving the functioning market.

- Maximum set point for the generation and importation for one single operator (50% of market share). Specifically, ENEL had to retain a maximum market share of 50% after 2003.

- Obligation to dispose of a maximum production capacity (15 000 MW in total) for ENEL.
- Regulatory simplification for authorization process of new generation plant construction.

As a consequence, three generation companies were established and sold on the market. Under the name GENCO, the different thermoelectric and hydroelectric plants for a power total of 15 GW were distributed following the repartition:

- 5400 MW for Elettrogen S.p.A., renamed Endesa Italia;
- 7000 MW for Eurogen S.p.A. awarded to Edipower;
- 2600 MW for Interpower S.p.A renamed Tirreno Power.

Obviously, at beginning Enel might have benefit from such an historic position; having an idea of the production expected, of the extra-costs. The company possessed a lot of information about the whole generation system. They knew better how the transmission and the balancing operations worked. That's why the decree tried from the start to reduce the former monopolistic position of Enel.
The Bersani Decree focused also on environmental improvement by providing incentives complying with the production of electricity from renewable energy sources. Specifically, it introduced the system of "Green Certificates" (Certificati Verdi) based on a legislation which requires producers and importers of non-renewable electricity to inject a minimum quota of renewable electricity into the power system every day.

If on one hand, the activity of selling electricity was totally liberalized; on the other hand the activity of buying adopted a pragmatic and step-by-step approach to full competition. As explained before, in 1999, the above-mentioned decree defined two types of customers: eligible and captive (or non-eligible) customers. The eligible customers are customers who are free to purchase electricity from the supplier of their choice. They are able to stipulate electricity supply contracts directly with producers, distributors or wholesalers. The non-eligible customers are customers who can only purchase electricity from the local distributor. This is consistent with the definition in the EU directives which declares that where functioning competitive electricity market is in place, customers must be able to freely negotiate the prices with their suppliers. That's the final step of the process of liberalization: the access for all the customers to the Electricity market and that's the topic of the Directive 03/54/CE of June 2003 implemented in Italy with the so called "Marzano law" which allows every customer to purchase electricity on the market.

Since 1st July 2007, every customer has been defined as an eligible customer and can choose his own supplier, making the full opening -up of the electricity market.
The Law-Decree N° 73/07 indicated the role of the entity AU (Acquirente Unico - Single Buyer) and the approaches to support the transition from the former to the new system (See Table 1.2). AU purchases electricity on the wholesale market and sells it to local

distributorsa and protects former captive consumers that were applied the national singe tariff set up by AEEG. In this way, it covers the requirements of the "enhanced protection" (maggior tutela) market (that overlaps the previous captive market, including household and small business consumers with less than 50 employees and a yearly turnover not exceeding 10 M€) who did not choose a new supplier in the open market. This is called also Standard-offer service.

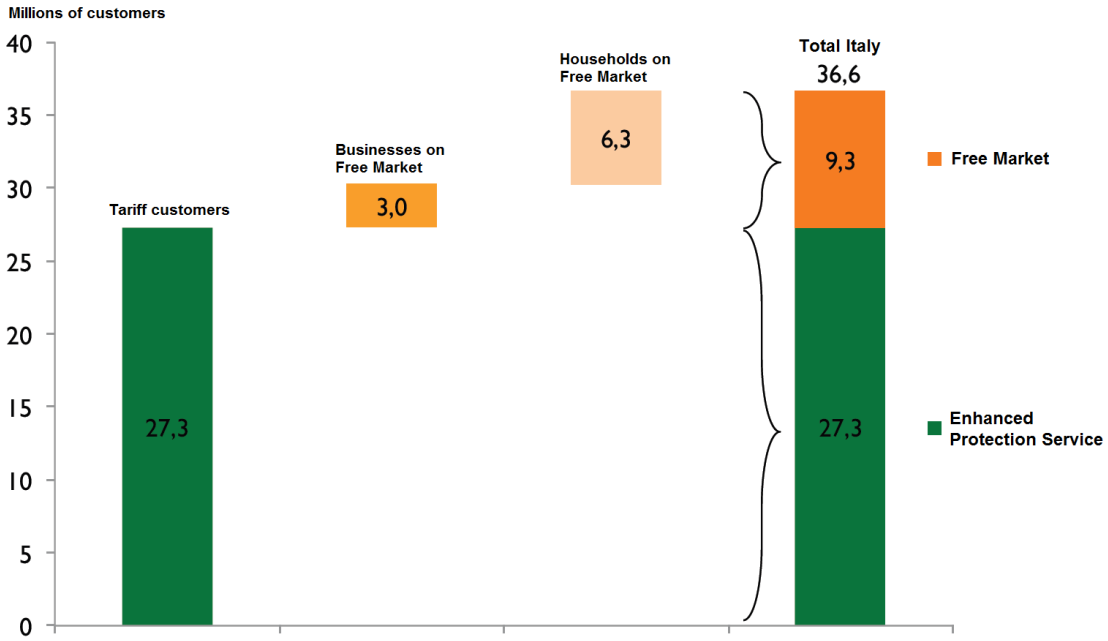

Figure 1.2: Enhanced protection service distribution for the year 2012 [2]

Furthermore, a last resort service has been introduced. It foresees a provider of last resort for all those clients who for any reason are abandoned by their existing supplier. This service is awarded based on competitive market mechanisms applied by geographical area. To avoid discontinuities, the safeguard service can assure even for short periods the distribution of electricity.

Thus, at the end of the year 2007 demand liberalization and supply liberalization were accomplished.

The objective to bring competition into the market was partly fulfilled. Since the 1st of April 2004, companies can trade in IPEX the Italian Power Exchange. On 1st January 2005, the market was opened to full demand-side partiation: all interested parties may purchase the electricity that they need directly on IPEX, subject to the obligation of scheduling their withdrawal profile on an hourly basis.

2. Source: Data processing and estimates NE Nomisma Energia [17] from AEEG data

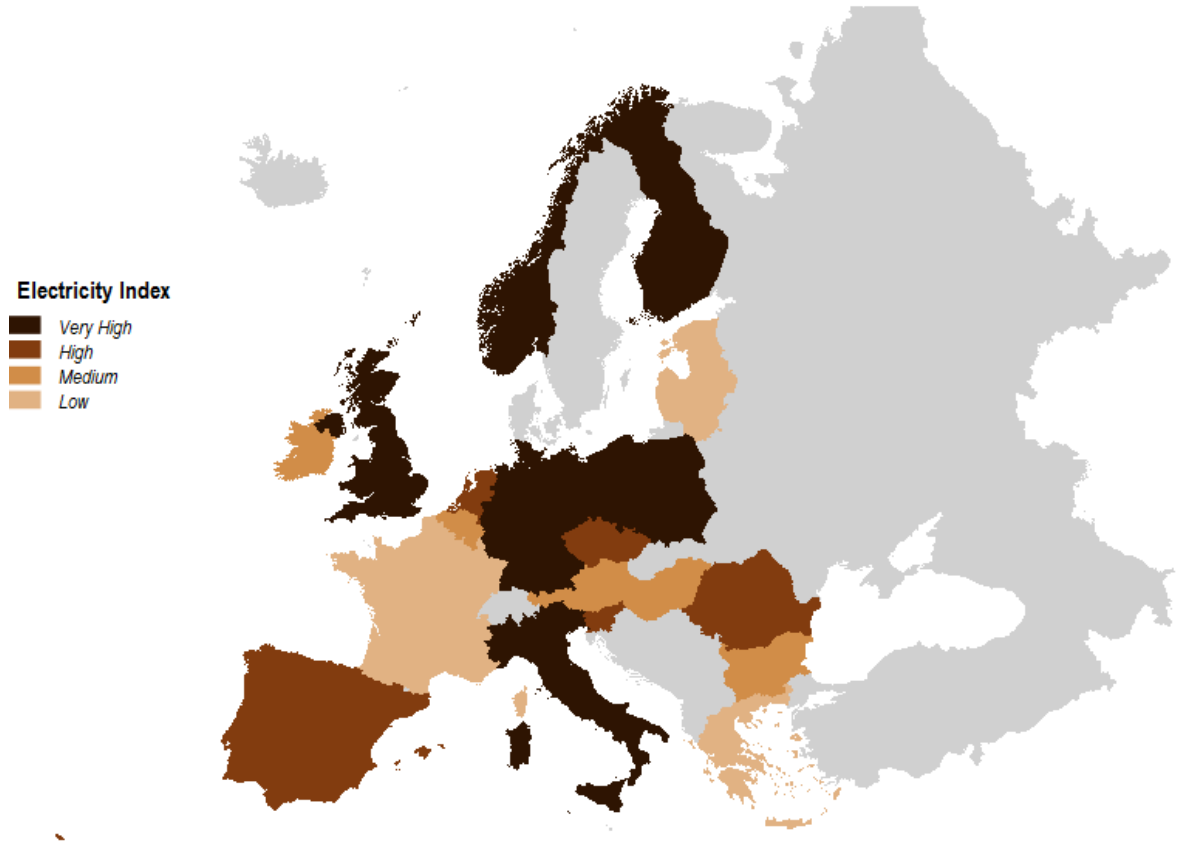

Figure 1.3: European Map of Electricity Index

The map (see above Fig.1.3) shows the level of liberalization for the different markets of Europe [3]. To calculate the index which is used to compare one country from another, the followings aspects have been taken into consideration: the presence or not of a coordinator of the power system, the market shares of the first three companies of the market in term of generation and in term of distribution. Italy is in a good way for a opened and competitive electricity market.

3. Source: Estimates NE Nomisma Energia [17] from European Commission data

Legislative framework

Phase	Date	Typology	Content
Origins	1951-1957-1988	Treaties establishing the European Community	Basis of the institution. Analysis of a possible energy internal market
	December 1995	White Paper: An Energy Policy for the European Union	Definition of the strategic objectives for the Energy Policy
Phase I	January 1997	Directive 96/92/CE Of the European Parliament and the Council	Common standards for the internal market of electricity.
Phase II	June 2003	Directives 2003/54/CE	Common rules for generation, transmission, distribution and supply of electricity. Members states shall ensure that eligible customers are -From 1 July 2004 all nonhousehold customers – From 1 July 2007 all customers
Phase III	July 2009	Directives 2009/28/CE and 2009/72/CE	New directions for European electricity markets. Redefinitions of national entities.

Table 1.1: Main Milestones of European energetic policy.

Date	Typology	Content
14 November 1995	Law No 481/95 Norms governing competition and regulation of public utilities	Constitution of Regulatory Authorithies for Public utilities. Creation of the Entity AEEG.
16 March 1999	Legislative Decree No 79/99, Implementing Directive 96/92/CE	Common rules for the internal market of electricity.
24 August 2004	Law No 239/004	Reorganization of the energy sector, providing security, flexibility and continuity of energy supplies.
June 2007	Law-Decree No 73 and No 125	Urgent measures for implementing Community legislation on liberalization of energy markets. Standard-offer service and Last-resort service.
2011	Law-Decree No 28 and No 93 Implementing Directives 2009/28/CE, 2009/72/CE, 2009/73/CE	Adaptation of European Directives, and new indications about the management of the power system.

Table 1.2: Main Milestones of Italians Electric Reform.

1.2 Entities of the Market

The Bersani Decree brought the creation and the organizationof several companies which have each specific role defined by the applicable legislation in order to manage and control the Electricity Market. The institution of those companies is entirely combinable with the entities at that date already created (Ministry or AEEG see before). In addition to Parliament and Government, the total number of main entities which contribute to theoperation of the power system is 6 and it is important to describe them:

"Ministero dello Sviluppo Economico" - Ministry of Economic Development – MiSE
It is a government ministry responsible for a variety of policies concerning among others the economic development of the power system. It defines strategic and operational guidelines for the production and the economic activities around the energy and the mineral resources.

"Gestore dei Mercati Energetici" – GME
This is the company in charge of organizing and managing the Electricity Market. It maintains obligations and principles which guarantee the functioning of the Electricity Market such as neutrality, transparency, efficient clearing prices or cost-effectiveness. In 2004, with the take-off of the Italian Power Exchange, since market participants connect to the electronic platform through the Internet and enter on-line contracts and information under secure-access procedures based on digital certificates, GME is responsible of the proper functioning of the system. In particular, the entity is providing all data concerning the different markets to ensure the principle of transparency, data whose the thesis is based on.

"Autorità per l'energia elettrica ed il gas" – Electricity and Gas Regulator – AEEG
It was established in 1995, by the law No 481 seen before in order to protect the interests of users and consumers of the power system. It guarantees the promotion of competition and efficiency in the sector and has regulating and monitoring tasks. In practice, the institution is continually monitoring the Electricity Market to ensure an efficient formation of prices and a satisfying degree of competition. For example, it will agree or not for the assessment of anomalies or malfunctioning in prices by deciding if the behavior of one producer to impose a price is desired and not competitive (this is the case in tacit collusion when two or more companies agree upon a certain strategy to become impacting operators)

"Acquirente Unico" – Single Buyer - AU

The mission of this entity is to procure continuous, secure, efficient and reasonably-priced electricity supply for households and small businesses. AU buys electricity in the market on favorable terms and resells it to distributors of the standard offer market for supplying who did not switch to the open market. It establishes its mission in accordance with the directions given by AEEG. As seen before, since the 1st July 2007, every consumer is eligible for the open market, therefore AU deals with consumers who did not choose a new provider, who did not exercise his switch power. AU also manages the energy consumers' help desk; that's mean ensuring the protection of the consumers.

TERNA – "Gestore della Rete Elettrica Nazionale"

Terna S.p.A. manages the national transmission grid under security conditions, as well as the power flows thereon through its dispatching activity (i.e. by balancing supply and demand of electricity for 365 days a year and 24 hours a day). Terna's commitment is to guarantee the greatest efficiency of its infrastructures and their maintenance, monitoring their operation and activity through remote control centers. This company was born from the unification between the former Terna and a part of GRTN ("Gestore della Rete di Trasmissione Nazionale", Management of the National Transmission Grid) on November 1, 2005. Today, Terna controls 63500 km kilometers of high-voltage power lines and this is the first electricity transmission grid operator of Europe.

"Gestore dei Servizi Energetici" – GSE

This is the public holding company responsible of the development of renewable energy sources by managing support schemes and granting the related incentives. GSE S.p.A was previously part of GRTN ("Gestore della Rete di Trasmissione Nazionale") and was called "Gestore dei Servizi Elettrici SpA". The company changed its name after the transfer of part of its assets to Terna S.p.A. Since, GSE ensures the promotion of renewables and a sustainable development by providing actions to build awareness of environmentally-efficient energy uses.

"Autorità Garante della Concorrenza e del Mercato" - Antitrust Authority - AGCM

It is an independent body, all its decisions are based on the law and the Government cannot interfere with its action. The authority enforces the rules which prohibit anticompetitive agreements. It takes steps to combat abuse of dominant positions and is in charge of the protection of the consumers.

GME is owned by the GSE which is in turn wholly owned by the Ministry of Economic and Finance which exercises its rights in consultation with the Ministry of Economic Development. GSE holds also 100% of the companies "Acquirente Unico "and "Ricerca sul

Sistema Energetico" (RSE). GSE is as a consequence parent of three subsidiaries: GME, AU and RSE.

1.3 Management of the Power System

In the power grid system, the activities quoted before of transmission and dispatching are subject to strict physical and technical constraints; for example quantities of electricity injected into the grid or withdrawn from it need to be continuously balanced, frequency and voltage on the grid should be kept into a certain range or the existence of a power maximum admissible on the grid. To avoid critical conditions all those parameters need always to be controlled.

Furthermore, given the very nature of electricity and its characteristics, satisfying these constraints is ever more complicated. In fact, electricity can't be stored or only indirectly with hydro power plants; and it a solution with capacity limits and minimum switching times. The demand of electricity is very inelastic and variable (high variability in the short and medium term). All the physical laws which govern the exchange and the propagation of the electricity on the grid are very complex. The externalities, the losses, the anomalies are difficult to minimize. It's important to coordinate all the side effects because even there are very specific or localized, imbalance can propagate to the overall grid.

That's why the role of the dispatching or control centers is essential. There are the entities which coordinate the high complexity of the power system. At any time these centers guarantee the continuity and the quality of the services on the grid. They ensure that all the difficulties met can be solved. The main tasks provided are: the real time balancing, the control of generating units for equilibrium production (primary and secondary reserve) and the action on any node of the grid to control local imbalance. It is important to note that even if a main part of the work done by the centers is automatic with automatic controlling systems, for security reasons, the control centers can directly step into the production units.

1.4 The Structure of the Market

The Legislative Decree has detailed the composition of the Electricity Market and the role of GME, responsible for organizing and managing it; for the purposes of better planning of generating and consumption units electricity trading can be conducted through forward or spot contracts. It takes place on organized market with optional access or on a decentralized platform with bilateral transactions [6].

Concerning the electricity supply, the methods or procedures used by the operator are not related to the choice of the market. It's left to the operator's goodwill.

So, the GME's market consists of:

- The Spot Electricity Market (MPE – Mercato a Pronti);
- The Forward Electricity Market (MTE- Mercato a Termine);
- The Forward Market Accounting Platform (PCE).

The Spot Market is composed of:

- The Day-Ahead Market (MGP – Mercato del Giorno Prima) where electricity is traded for the following day and the Infra-Day Market (MI) in which operators can adjust their sales and purchases bids/offers and commercial positions with respect to trading on the Day-Ahead Market (MGP);

- Ancillary Services Market or Dispatching Services Market (MSD – Mercato per il Servizio di Dispacciamento) in which Terna procures the resources needed to manage and control the system in order resolve intra-zone congestions, create the energy reserve and balance the system in real-time.

The MI had replaced the Adjustment Market (MA). It was set up through the law of January 2009. First it was divided into two sessions; then two others were added (in January 2011) with different successive closing times (the last two sessions are covered with sub-stages of MSD, see Outlines).

The law of January 2009 also changed the process of MSD. The Market was still divided into two stages, a planning and a balancing stage (ex-ante MSD and MB). During the ex-ante session, services for congestion relief and reserve capacity are bought and during the MB, infra-day session, the same offers are accepted for balancing purposes. The law included other innovations: the possibility during each session to specify the nature of the service offered (congestion resolution, reserve etc.) and the division of the two stages into scheduling sub-stages; 3 for the planning MSD and 5 for the MB.

The Forward Electricity Market (MTE) is the place for negotiating forward contracts envisaging an obligation to deliver/withdraw electricity. Negotiating take place continuously, from the hours 9 AM to 2 PM in the days of market. GME is acting as central counterparty. The same operators as the others markets are accepted on this market. Two types of contracts are concerned, the baseload contract and the peakload contract, which can be negotiated on monthly, quarterly or annual delivery periods.

Another tool has been set up in November 2008 to regulate the derivatives on the Italian Power system. It's called the Italian Derivatives Electricity Exchange (IDEX). Launched by the Italian Stock Exchange (borsa italiana) it's dedicated to the trading of instruments based on the average purchase price and establishes financial contracts surrounding the

Electricity market. GME and Borsa Italiana made a collaboration agreement to enable operators to participate in both markets and to control that financial measures don't impinge upon physical delivery. The physical delivery option can be exercised on the third open Exchange day prior to the month of delivery with the reference to the position gained by the operator on the IDEX for the following month. The request for market participants is subject to GME's approval.

More recently, operators can buy and sell electricity not just through the market organized by the GME but also by entering into sales contracts out with the bidding system. In May 2007, The Forward Market Accounting Platform (PCE), for the recording of bilateral contracts was opened .

In the part 1.6 of the thesis, a schema of the overall organization of the markets is drawn up.

1.4.1 The Spot Electricity Market

1.4.1.1 Bids/Offers System

The keystone of the functioning of the markets managed by the GME is the confrontation by auctioning of demands bids and supply offers. Participants of the market trade by submitting bids or offers. In this way, they express their willingness to sell or to buy a volume of electricity at a giving price. For a demand bid, the participant wants to buy a certain quantity (MWh) of electricity not higher than the one specified in the bid at a price (€/MWh) not higher than the one specified. And for a supply offer, the participant wants to sell a certain quantity of electricity not higher than the one specified in the offer at a price not lower than the one specified in the same offer. So bids/offers consist of pairs of values, i.e. volume and unit price of electricity.

Volume of Electricity	MWh
Price of Electricity	€/MWh

Prices and Volumes cannot be negative. Actually the real keystone is the information left on the market by the participant is the quantity of electricity offered or looked for, knowing that demand bids may not specify any price (except in the MSD). In this case, the participant is ready to buy electricity at any price.

Bids/offers refer to "offer points". They are physical and consuming units. In the case of injection, the infection offer points ususally match the individual generating units (which convert the energy supplied by any primary source into electricity). In the case of withdrawal, the withdrawal offer points correspond to individual consuming units (and/or sets of withdrawal points). The mixed points are the points configured to switch from injection to withdrawal and vice versa in case of need. The pumped-storage hydropower

plants are potentially mixed points. The offer points refer also to individual hours. That mean; for each day and each offer point, a maximum of 24 bids /offers can be entered, each bid/offer is independent of the other ones. For one bid/offer, several participants of the market can be involved; it's easier to call them traders according to their real role. On one single production unit, a supply offer may be entered by different operators depending on their agreements on the unit.

Bids/offers may be:

- simple: pair of a values indicating the volume of electricity offered in the market by a market participant and the related price for a given interval;
- multiple: it's one overall volume of electricity divided into several offers, consisting a number of pair volume/price for the same applicable period, the same generating unit and the same withdrawal point;
- pre-defined: Simple or multiple bids/offers which are daily submitted to GME.

Bids/offers in the Spot Electricity market should contain the following data (See in Fig1.4 an example of an offer):

- the identification code of the market participant submitting the offer/bid;
- the identification of the market ;
- the identification code of the offer point to which the offer/bid refers (the code of the physical group or unit);
- the applicable period to which the bid/offer refers;
- the type of bid/offer. If it's a bid, a purchase type and if it's an offer a sale type;
- Yes or No the bid/offer is pre-defined (from bilateral contract);
- the pair: offered volume/unit price for the offered volume.

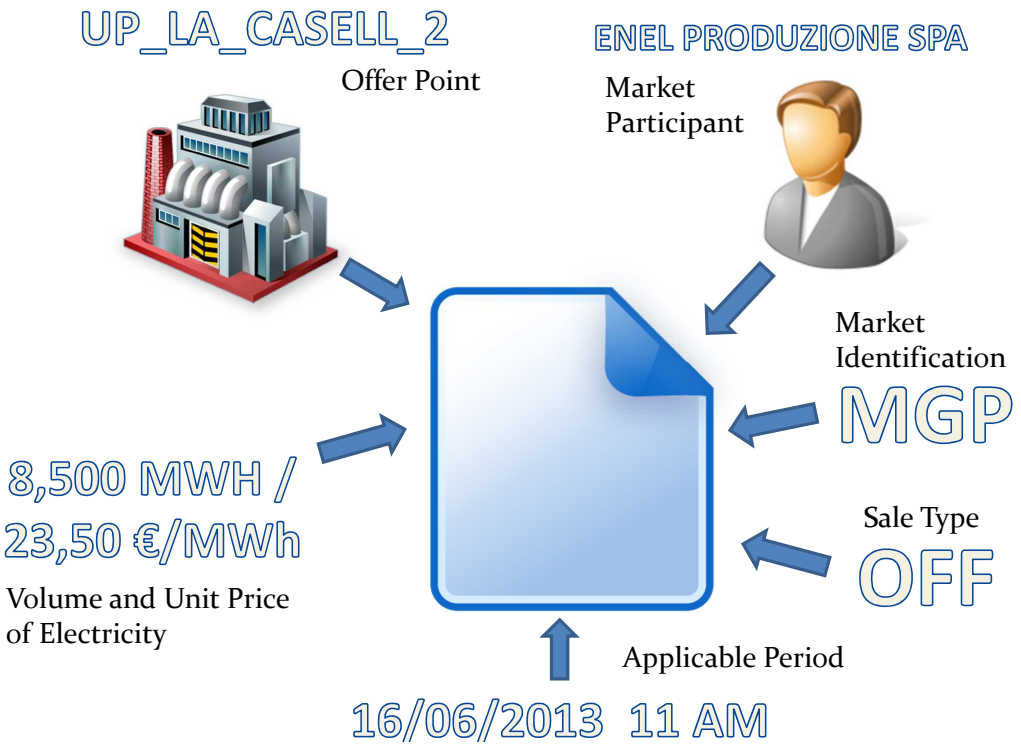

Figure 1.4: Example of a supply offer

Then after the closure of the considered session, other data will be associated to the bid/offer such as the outcome of the market (if the bid/offer has been accepted or not) an identification of transaction, the volume and the price accepted by the market.

1.4.1.2 Day-Ahead Market

The Day-Ahead Market (MGP) is a wholesale electricity market carried out by producers, wholesalers, AU and eligible consumers. Hourly blocks of electricity are negotiated for the next day and at the closure of the market prices, volumes and injections and withdrawal schedules are defined. The session of the market opens at 8 AM of the ninth day before the day of delivery and closes at 09:15 AM of the day before the day of delivery. The participants are all the market participants accepted and related to an offer point. They have acquired the status of "Electricity Market Participant".

GME publishes preliminary information about the MGP on its website for the operators, information partly given by Terna. GME also publishes the provisional market results and the cumulated schedules to dispatching users and to Terna. All this information concerns: the overall energy consumption for each applicable period, injections and withdrawal schedules under the GSE's control (CIP/6), maximum admissible transmission limits between zones etc.

When the session of the MGP opens, participants can submit bids/offers where they specify the volume and price (maximum or minimum) at which they are willing to purchase or sell. Bids/Offers can't overcome some constraints; they must be consistent with the injection or withdrawal capabilities of the offer points to which they refer and show the real commitment of the participants to produce or accept the volume of electricity detailed. The Bids/Offers express the willingness of the sell or purchase electricity. For supply offers, only injection or mixed points are referred. And for demand bid, withdrawal or mixed points are concerned. Bids/Offers may be multiple, simple or pre-defined. Multiple ones may include both supply offers and demand bids.

The energy concerned in the bilateral contracts is included into the market as they participate and affect the transmission capacity. So, Terna communicates the programs related to bilateral contracts to GME as virtual offers with the price zero and as virtual bids without price detailed. The same reasoning can be applied to the units concerned by CIP 6 and those that are considered as essential (the so called MUST RUN units for security and reliability reasons).

At the end of the bid/offer submission sitting, GME activates the market resolution process. For each hour of the following day, an algorithm will accept bids/offers in such a way to maximize the value of transactions while satisfying maximum transmission limits between zones. Let's summarize the acceptance process:

+ GME ranks all the valid and adequate supply offers in increasing price order. It creates an aggregate supply curve. If there are offers with the same unit price of electricity, the following order of priority is applied: offers from essential units for the purpose of security – offers from CIP 6 units – offers related to international trades for the purpose of compensation – all other offers.

+ GME ranks all the valid and adequate demand bids in decreasing price order. It creates an aggregate demand curve. If there are several offers with the same unit price of electricity or without price indication, the following priority order is applied: bids from the Singe Buyer (AU) – bids related to international trades for the purpose of compensation – all the other bids.

+ The intersection of the two curves identifies the equilibrium of the market. It gives the overall traded volume, the clearing price, the accepted bids/offers and the injection and withdrawal schedules obtained as the sum of the accepted bids/offers pertaining to the same hour and the to same offer point.

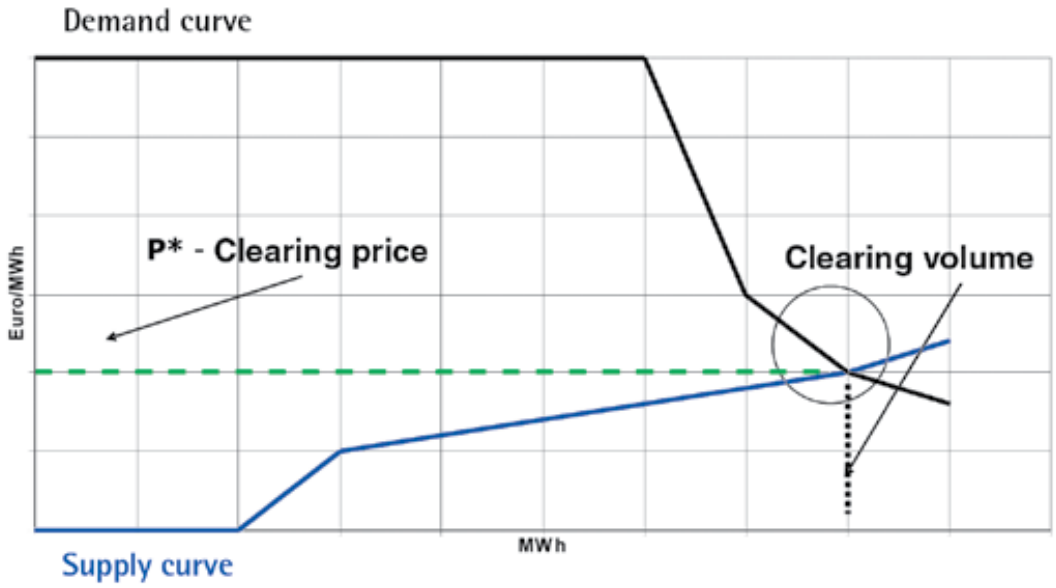

Figure 1.5: Determination of Clearing Price

+ If the flows on the grid are not violating the transmission limits between the zones, the clearing price is a single one in all the zones. The equilibrium price is unique and a single acceptance process has been done. Accepted bids/offers are those having a selling price not higher than the equilibrium price and a purchasing price not lower than the equilibrium price.

+ If at least one limit is violated, the algorithm splits the market into different zone, exporting ones and importing ones. The acceptance process is repeated in each zone and a new intersection of the curves is found. Actually for each market zone, it builds a supply curve (including all the supply offers submitted in the same zone, as well as the maximum imported volume) and a demand curve (including all the demand bids submitted in the same zone, as well as a volume equal to the maximum exported volume). The result is a zonal clearing price. It is a zonal equilibrium price different from one zone to another (in particular the zonal price is higher in the importing market zone and lower in the lower in the exporting one).

Demand bids in respect of consuming units belonging to geographical zones are always valued at the National Single Price (PUN).The PUN is the average of zonal prices in the Day-Ahead market, weighted for total purchases and net of purchases for pumped-storage units and of purchases by neighbouring countries' zones. It is calculated as follows:

$$PUN = \frac{\sum_{i=1}^{n^{\circ}\, zones} Consumption.ZonalPrice}{\sum_{i=1}^{n^{\circ}\, zones} Consumption} \tag{1.1}$$

$$\text{where } Consumption = \sum_{j=1}^{n^{\circ}\, bid\ transactions} Purchases\ (MWh),$$

$$ZonalPrice = \text{Clearing price of the zone } (€/MWh)$$

The outcomes of the mechanism above-described are: identification of the selling prices (prices that remunerate operators that provide energy), identification of the purchase price (PUN, price paid by demand side operators), the overall trade volume and all the injections and withdrawal schedules. This represents a non-discriminatory implicit auction for the assignment of transmission rights.

1.4.1.3 Intra-Day Market

The Intra-Day Market (MI) is the continuation of the adjustment market. It was introduced by the law 2/09 [6] and allows the market participants to submit appropriated demand or supply offers in order to accommodate their own schedules in the Day-Ahead Market; in other words as the name the previous indicates it, to adjust their purchase or sale schedules. So the participants accepted into the MGP may present new bids/offers during the trading sessions of the MI. The central counterpart is the GME which manages the mechanism of trading and communicates (as done for the MGP) with Terna for the purpose of sustainability of the grid. It notifies Terna of the results that are relevant for dispatching. These results are required by Terna to determine preliminary information about residual transmission capacities between zones.

This market allows participants to change the schedules defined in the MGP through additional demand bids or supply offers. Like in the MGP, demand bids or supply offers may be multiple, simple or pre-defined. Multiple ones may include both supply offers and demand bids. Four sessions have been defined to model a continuous trading mechanism. MI1, MI2, MI3 and MI4 are organized in the form of implicit auctions of electricity with different sitting and closing times. Through those auctions, operators may better manage the distribution schedules of consuming units or the generation of their power plants. The sessions of the MI are bases on price-setting rules that are consistent with those of the MGP. However, the equilibrium price PUN is not anymore calculated and all the purchases and sales are valued at the zonal price.

The session of the MI1 takes place after the closing of the MGP (See Table1.4 in section 1.6); it opens at 10:45 AM of the day before the day of delivery and closes at 12:30 PM of the same day. The results of the MI1 are notified to participants and published by 1 PM of the day before the day of delivery.
The session of the MI2 opens at 10:45 AM of the day before the day of delivery and closes at 02:40 PM of the same day. The results of the MI2 are notified to participants and published by 03:10 PM of the day before the day of delivery.
The session of the MI3 opens at 04 PM of the day before the day of delivery and closes at 07:30 AM of the day of delivery. The results of the MI3 are notified to participants and published by 8:00 AM of the day of closing of the session.
The session of the MI4 opens at 04 PM of the day before the day of delivery and closes at 11:45 AM of the day of delivery. The results of the MI4 are notified to participants and published by 12:15 PM of the day of closing of the session.

The acceptance process of the bids/offers is similar to the MGP process. This analogue structure requires constraints to avoid arbitrage policies; in fact all the consumers in the zones where the zonal price is lower than the national single price could make the decision of purchasing energy on the MI instead of the MGP. It would be a benefit for the consumers but would represent a vicious outcome of the market. The final result would be a high concentration of demand in particular zones to benefit from the difference of price. To replicate the effect of the application of the PUN to withdrawal points, GME applies a non-arbitrage tariff to all accepted bids/offers pertaining to such points. The provisions introduced are:

- The purchase transactions concluded in the MI on withdrawal points are valuated in this way: if the PUN in the previous MGP has been higher (lower) than the related zonal price, the market participant will pay (receive) a non-arbitrage fee. This fee is equal to the difference between the PUN and the zonal price, applied to each MWh covered by the purchase transaction.
- The sale transactions concluded in the MI on withdrawal points are valuated in this way: if the PUN in the previous MGP has been lower (higher) than the related zonal price, the market participant will receive (pay) a non-arbitrage fee. This fee is equal to the difference between the zonal price and the PUN, applied to each MWh covered by the sale transaction.

Concrete example:

For a given applicable period, GME activated the market resolution process, and two zonal prices for two different market zones came out, $Pz_1 = 38€/\text{MWh}$ and $Pz_2 = 43€/\text{MWh}$. GME also calculated the National Single Price (PUN) and found out the following value applicable on all accepted demand bids pertaining to withdrawal points belonging to geographical zones, $PUN = 40€/\text{MWh}$. The operator POLI made a demand bid for this period: [50 MWh x 37 €/MWh] on a withdrawal point UC_BOVISA in a geographical zone which belongs to the market zone Z1 defined before.

Period	Offer point	Operator	Market	Sale Type	Quantity	Price
28/04/2014 int.n° 10	UC_BOVISA	POLI	MGP	BID	50	37

As the price of the bid is lower than the respective zonal price ($37 < Pz_1$), the bid won't be accepted. The operator POLI has the possibility to make again a demand bid on the first session of the Intra-Day market MI1, with the following information:

Period	Offer point	Operator	Market	Sale Type	Quantity	Price
28/04/2014 int.n° 10	UC_BOVISA	POLI	MI1	BID	50	37

This time a new zonal price is calculated which can be assumed as related to the same market macro-zone as before (Z1), $P^*z_1 = 35€/\text{MWh}$. The PUN is not calculated anymore and all purchases and sales are valued at the zonal price. The new bid will be accepted and POLI will purchase its volume of electricity at a unit price lower than the one specified therein. The operator might focus on the Intra-Day market if the trend is repeated. So to avoid an arbitrage GME applies the following process:

- $37 > P^*z_1$: POLI purchases his 50 MWh of electricity at the unit price P^*z_1 , that is to say he is paying $50 * 35 = 1750€$
- $P^*z_1 < PUN$: GME calculates the difference between the previous PUN and the new zonal price : $40 - 35 = 5€/\text{MWh}$. And POLI will have to pay $50 * 5 = 250€$ to GME.
- At the end, POLI has purchased 50 MWh of electricity for the total price of 1500€.

1.4.1.4 Ancillary Services Market

The Ancillary Services Market (MSD) is the market where Terna procure the resources needed to manage, operate, monitor and control the power system (relief of intra-zonal congestions, creation of energy reserve, real time balancing). Therefore, according to the nature of its function, this is the only market which operates in a time period close to the real-time (Spot).

In the MSD, Terna acts as central counterparty. The entity monitors the purchase and sale contracts to obtain the resources required for its dispatching service. The market still deals with bids/offers from market participants but the bids/offers must refer to

offer points authorized to provide ancillary services in the MSD and be submitted by the respective dispatching users directly. So, they are only one type: pre-defined.

The determining-price process is different from the other markets. For each demand bid accepted in the MSD and pertaining to withdrawal points, GME determines the non-arbitrage tariff that the participant is held to pay or receive. All accepted bids/offers are remunerated at the offered price (pay-as-bid).

MSD has two distinct stages. One refers to the ex-ante MSD, scheduling stage, in which Terna accepts scheduled bids/offers in order to resolve congestions appearing after MGP and form an adequate reserve margin. The other refers to the balancing Market (MB), in which Terna accepts offers/bids in real-time, the aim being to balance injections and withdrawal. The ex-ante MSD consists of three scheduling substages: MSD1, MSD2 and MSD3 and the MB consists of 5 sessions. The last sessions of the MI, the sessions of the ex-ante MSD and the sessions of the MB come into superposition (see section 1.6) for a better functioning of the markets and application of the dispatching rules.

The bids/offers available on the MSD express the capacity of a unit to modify the injections or withdrawals defined in the previous markets. Such bids/offers are considered "increasing" or "decreasing" offer:

- "increasing" offer when the operator is ready to increase his production if he is related to an injection point or decrease his purchase if he is related to a withdrawal point;
- "decreasing" offer when the operator is ready to decrease his production if he is related to an injection point or increase his purchase if he is related to a withdrawal point.

The MSD market might be seen as the final phase for the physical equilibrium of the Electricity Market.

1.4.2 The Forward Market Accounting Platform

The Forward Electricity Market (MTE- Mercato a Termine) was launched in November 2008. The market is operated by GME with the purpose of allowing operators to manage their energy portfolios more flexibly with forward electricity contracts. The platform where all the transactions are concluded is also called OTC Registration Platform (or Electricity Account Registration Platform) known by the acronym PCE [11].

Two types of contract may be traded in the MTE. The underlying electricity volume is set by GME equal to 1 MW and multiplied by the applicable periods covered by the contract. The types of contract are baseload and peakload contracts with delivery periods of a month, a quarter or a year.

All Electricity Market participants are admitted to this market. They enter bids/offers where they specify the type and delivery period of contracts, the number of contracts and

the price at they are willing to purchase/sell. GME organizes an order book for each type of contract and each delivery period (the order priority is the price). Then GME organizes the continuous trading during which contracts are concluded via automatic matching of bids/offers of opposite sign entered into the order book and ranked under priority criteria.

It is important to know that a cascading mechanism is applied to the forward contracts with a maturity of more than one month at the end of the trading period. Then delivery contracts are recorded in corresponding transactions on the PCE.

For each trading session and each contract, GME publishes the following data:

- minimum and maximum prices;
- reference price of the session;
- check price;
- volume traded in the session;
- open interest.

1.5 The Market Zones

The effectiveness of the production and the distribution of the electricity is guaranteed by centralized mechanism of the electricity markets MGP and MI. All the operators participate at the trading sessions and the overall generation and transmission are outcomes of the centralized process. It is to Terna to monitor the security and the reliability of the national transmission grid and solve the complex problem of limits of transition on it. That's why the power system is divided into areas of transmissions grids ("Zones") where for purposes of power system security, there are physical limits to transmission of electricity to/from the corresponding neighboring zone.
The zones or areas have been determined according to these simplifying assumptions:

- The interfaces between areas consist of all the lines which have the highest probability to be congested when injections and withdrawals programs are executed;
- Inside the area, no congestions are assumed when injections and withdrawals programs are executed;
- The location of the injections and withdrawals inside one area doesn't impact the transport capacity between the zones.

Therefore, the solution of the Electricity Market is determined taking into account transmission existing limits that characterize the different zones. The identification of these limits has been done through a computational model that is based on the balance between electricity generation and consumption. The analysis is carried out by Terna in accordance with the (N-1) security criterion and considering serious circumstances. The

Italian transmission electricity network has a particular structure [15]: the continental network is a highly meshed network in northern areas and the lines are in the South concentrated on the Tyrrhenian and Adriatic coasts interconnected ones with the others through cross connections. The largest islands, Sicily and Sardinia, are connected through submarine power cable to the Italian mainland with the following configuration: an 380 kV alternate current (AC) cable from Sicily, two direct current cables (one of 200 kV called SACOI and one of 500 kV called SAPEI) from Sardinia. Both connections from Sardinia use the French territory Corsica as an intermediary.

All technical and geographical hypotheses led to the identification of market zones, group of geographical and/or virtual zones that form the Italian power system. The national transmission grid is interconnected with neighboring countries via 22 lines: 4 with France, 12 with Switzerland, 1 with Austria, 2 with Slovenia, 1 direct-current submarine cable with Greece. Please see Fig.1.6 for a better understanding of the organization between the zones.

They may be summarized as follows:

- 6 geographical zones: Central-Northern Italy, Northern Italy, Central-Southern Italy, Southern Italy, Sicily and Sardinia.

Name	Italian Name	Type of Zone	Details
Central-Northern Italy	Centro-Nord	Geographical	Toscana, Umbria, Marche
Central-Southern Italy	Centro-Sud	Geographical	Lazio, Abruzzo, Campania
Northern Italy	Nord	Geographical	Val D'Aosta, Piemonte, Liguria, Lombardia, Trentino, Veneto, Friuli Venezia Giulia, Emilia Romagna
Sardinia	Sardegna	Geographical	Island of Sardinia
Sicily	Sicilia	Geographical	Island of Sicily
Southern Italy	Sud	Geographical	Molise, Puglia, Basilicata, Calabria

Table 1.3: Detail of GME's Geographical Market Zones.

- 8 Neighbouring countries' virtual zones: France, Switzerland, Austria, Slovenia, BSP (Zone used only for market coupling with Slovenia), Corsica, Corsica AC and Greece.

- 5 National virtual zones representing constrained zones: Brindisi, Foggia, Monfalcone, Priolo G., Rossano. They are zones consisting only of generating units whose interconnection capacity with the grid is lower than their installed capacity.

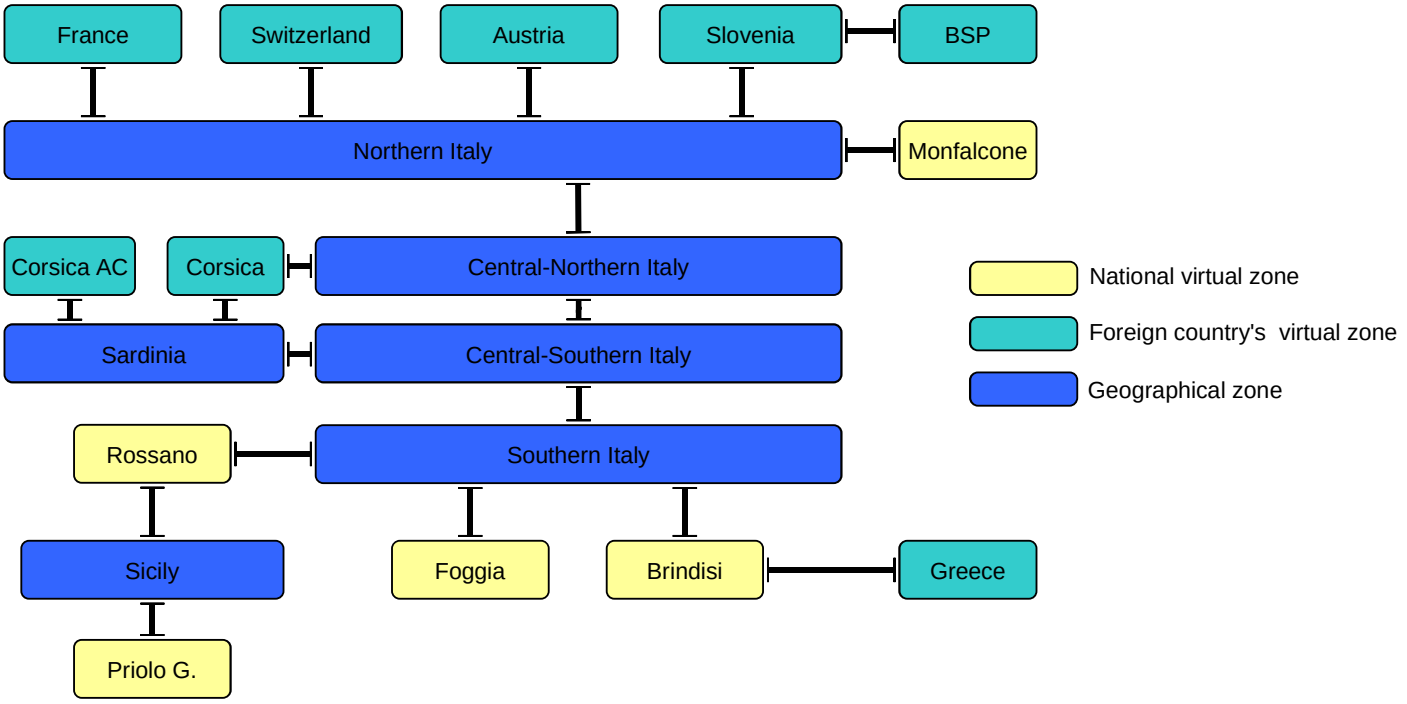

Figure 1.6: Virtual and geographical zones of the national transmission grid

1.6 Outlines of the Spot Market

All the intervals of session can be summarized into the following table:

	MGP	MI1	MI2	MSD1	MB1	MB2	MI3	MSD2	MB3	MI4	MSD3	MB4	MB5
Reference Day			D-1						D				
Preliminary information	08:45	12:30	14:40	n.d.	n.d.	n.d.	07:30	n.d.	n.d.	11:45	n.d.	n.d.	n.d.
Opening of sitting	*08:00*	10:45	10:45	15:10	*	22:30	16:00	*	22:30	16:00	*	22:30	22:30
Closing of sitting	09:15	12:30	14:40	16:40	*	05:00	07:30	*	11:00	11:45	*	15:00	21:00
General Results	10:30	12:55	15:05	20:30	#	#	07:55	09:50	#	12:10	14:05	#	#
Individual Results	10:45	13:00	15:10	20:40	#	#	08:00	10:00	#	12:15	14:15	#	#

Table 1.4: Time Table of the Market Sessions

08:00 the hour refers to day D-9
22:30 the hour refers to day D-1
depends of the applicable period
* use is made of bids/offers submitted in the first substage of the MSD

The Spot Market can be express by the following summary diagram:

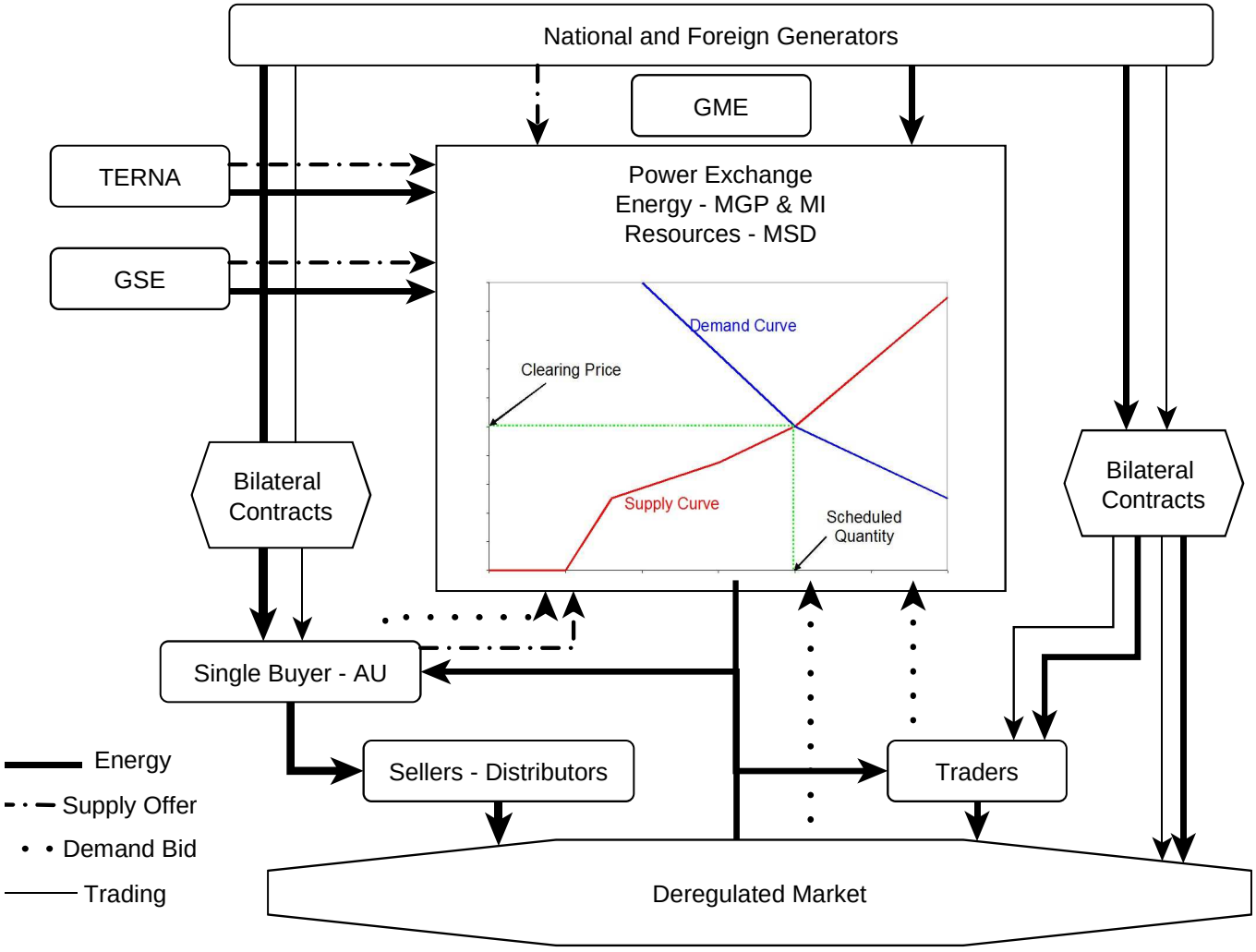

Figure 1.7: Structure of the Spot Electricity Market

Chapter 2

Evaluation of the Italian Electricity Market

The AEEG, as competent authority, gives the GME the responsibility of monitoring the Italian Electricity Market. Since the beginning of the transactions in electricity market in April 2004, GME has been carrying out several monitoring activities within the general objective of framing the electricity power system. These activities are supposed to support the different tasks exercised by the institutional parties such as the AGCM, the MiSE or European energetic institutions. The process of liberalization is still more and more complex and aimed at establishing the European single energy market through the creation of new infrastructures and rules. The amount of work for GME is significant since it is about putting together a large amount of data, identifying and clarifying them in order to present an understandable and accurate reading of the electricity markets.

The AEEG decided through several Resolutions (ARG/elt 115/08 is one of the most important [1]) to have GME do some specific works. For example, GME must implement and run a data warehouse which is then available to AEEG through an appropriate business intelligence tool (this is exactly the approach of the thesis). Besides, GME has to create specific monitoring indicators and develop simulations aimed at evaluating the impact of alternative behaviors from operators. Finally, one of the ordered works is to draw up an in-depth monthly and annual report which states the technical and economic situation of the Electricity Market. All these reports are published on the GME's official website and help to understand if the actions and the rules which controlled the Market are effective and sufficient to create a complete national deregulated electricity market. The publication of these data is a highly valuable source of information for professionals, institutions and students too. This is the focus of this chapter which is aimed at describing the recent situation of the market from a short state of the art of electricity generation and the study of GME's reports and understanding the necessity of further analysis through a new developed tool.

1. Resolution ARG/elt 115/08 - 5th August 2008 - Integrated Text on Market Monitoring lays the groundwork of the collaboration between AEEG and GME

2.1 Overview of Italian Energy Consumption

In 2011, Italy's total primary energy supply (TPES) was 167,4 million tonnes of oil equivalent (Mtoe) [2]. Between 1990 and 2008, TPES increased by 19 % (174,5 Mtoe in 2008) then declined slightly due to the impact of the crisis on the energy consumption.

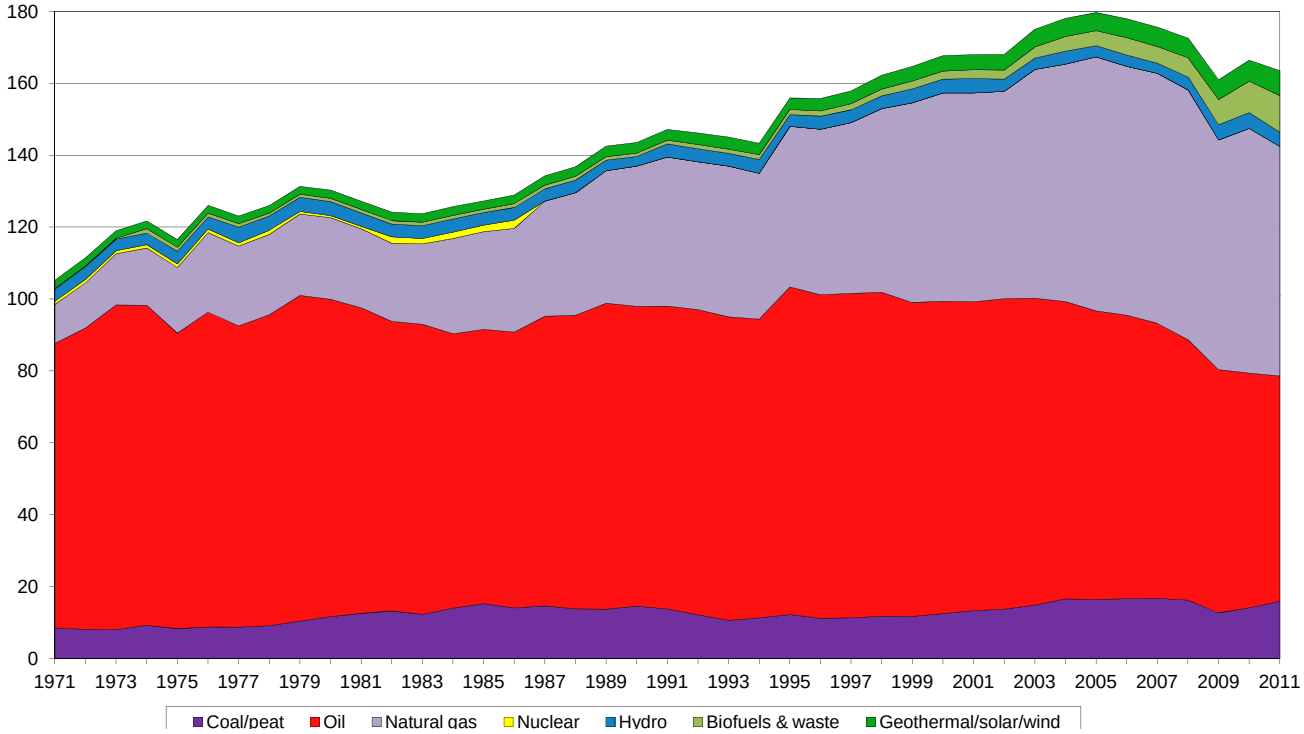

Figure 2.1: Total Primary Energy Supply, 1971 to 2011

In 2011, the total final consumption of energy (TFC) was 126,7 Mtoe, again a bit lower than the previous years. But from 1990 to 2008, TFC grew at a slightly higher rate than TPES; that implies some relevant movements and policies in energy efficiency. Between 2008 and 2011, TFC started decreasing with a peak in 2008 (-1,5%) and especially due to the economy collapse in 2009 (-5,8%).The transport sector is the largest consumer of energy (using around 30% in 2009). The industry sector is the next largest consumer of energy.
In 1987, Italy decided to abandon domestic production of nuclear electricity. Following a referendum, the Italian government decided to terminate the nuclear program. The country has therefore relied predominantly on oil and increasingly, on gas (including imports) for its energy needs. Oil represented the largest share of TPES (50,3% in 2000), although it has gradually declined from 2000(See fig.) Meanwhile, TPES of gas has grown from 25,8% in 1990 to 33,9 % in 2000, and also declined after. All those figures are expected to increase again after the small breakdown of the crisis.

2. the tonne of oil equivalent (toe) is a unit of energy: the amount of energy released by burning one tonne of crude oil, approximately 42 GJ

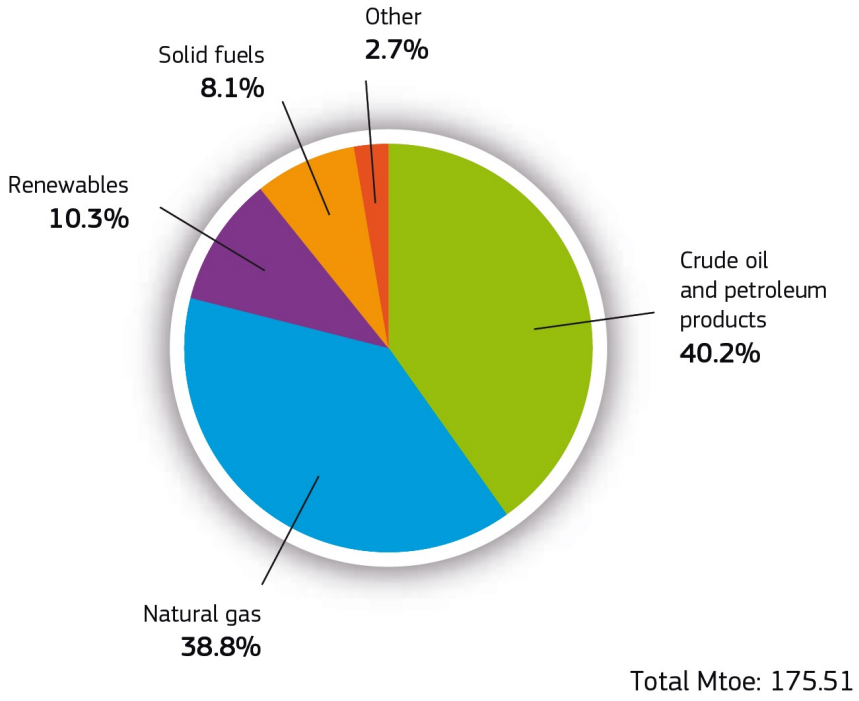

Figure 2.2: Primary energy consumption - 2010

Italy produces really small volumes of natural gas and oil; actually most of fossil fuels are imported and come in addition to the increasing production of energy from renewable sources. The import dependence is still high, in particular for electricity (the strong collaboration with the France was mentioned before).
To cope with the emergencies of a too strong dependence and a future growth of energy consumption, the country started incentivizing local production of energy from renewable sources and first adopted in 2009 a new nuclear program aimed at reintroducing nuclear power production. But the program was partly abandoned with the negative result of a new referendum in 2011.

So, grouping the sources, crude oil and petroleum products dominate the consumption of primary energy (also called energy mix or energy balance). As regards the electricity balance and it would be detailed further (See section) natural gas is the most important fuel, providing more than the half of electricity produced. Renewables are second, almost two thirds of which originate from hydropower. The pie charts (Fig 2.2 and Fig 2.3) of the section summarize a situation which has changed little since (2010).

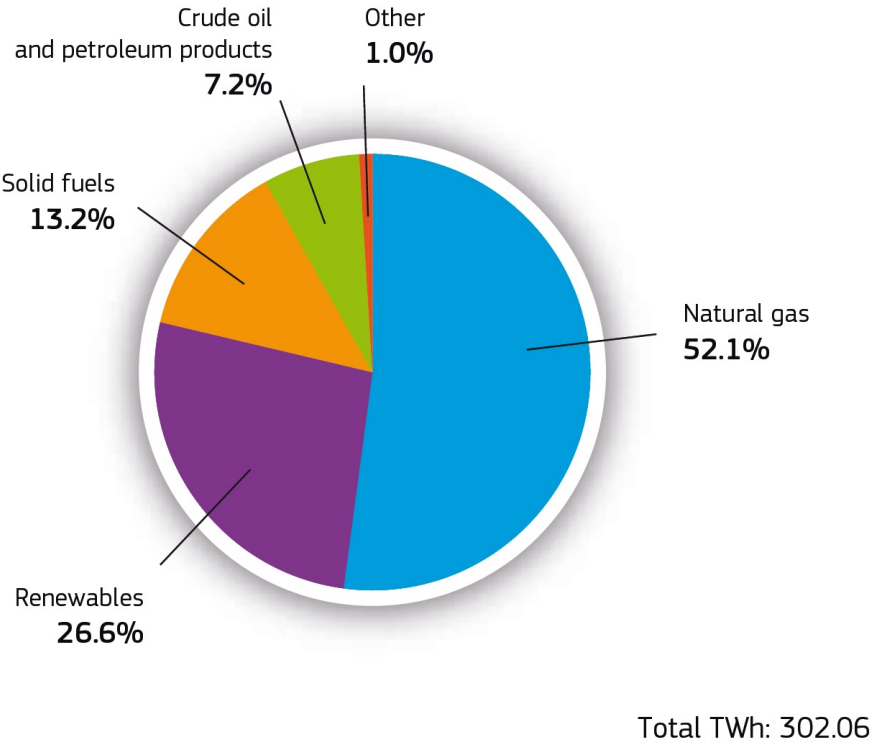

Figure 2.3: Gross electricity generation - 2010

2.2 Market Trends from annual report 2012

As stated before, the annual reports published by GME contain a large amount of information. The latest available is the report of the year 2012. The idea of the section is to let emerge the recent trends of the Electricity market through the study of factors and accurate figures and to outline the possibilities of a better and further knowledge.

2.2.1 State of the Italian electricity sector

The year 2012 was a difficult and challenging year for all the economic markets as the Italian economy moved from a state of stagnation to recession. The electricity consumption significantly declined, falling down to the lowest levels in the past three years. The effects of the weak economic situation are clearly visible in the consumption by sector; the industrial sector for example the more elastic to the aggregate demand fell by 6%.Even the peak demand tended to decline, with a maximum demand level of 54,1 GW(-2,4GW).

In spite of the electricity demand decline, some features on the supply side are rather positive. The installed capacity has increased. According to Terna's estimates and GME's report, on March 2013 the total installed capacity reached the level of 130 GW, with a

good contribution from the non-schedulable renewable generation and the photovoltaic generation. Whereas the installed capacity keeps growing the actual generating capacity is stagnating, especially from combined cycle plant, but it seems logical with the current trend of the demand. It should be noted the existing collapse of the thermal power generation, which can be explained according the GME's results by still the demand drop and by the growth of renewables. It seems to mostly affect the natural gas-fired power plants (-15,5 TWh in 2011).Concerning the import, it should be mentioned the decrease of the net importation of electricity, partly due to the abundance of renewable supply and to the prices peaks observed in the rest of Europe (for further information see Table 2.1).

GW	As of 31 Dec.2008	As of 31 Dec.2009	As of 31 Dec.2010	As of 31 Dec.2011	As of 29 Feb.2013
GROSS MAXIMUM CAPACITY	102.3	105.2	110.3	122.3	129.8
HYDRO	21.6	21.7	21.9	22.1	22.3
THERMAL	76.0	76.7	78.3	79.7	81.1
GEOTHERMAL	0.7	0.7	0.8	0.8	0.8
WIND & PHOTOVOLTAIC	4.0	6.0	9.3	19.7	25.7
Wind	-	-	-	*6.9*	*8.4*
Photovoltaic	-	-	-	*12.8*	*17.2*
PEAK DEMAND	55.3	51.9	56.4	56.5	54.1
DAY	*26 June*	*17 July*	*16 July*	*13 July*	*10 July*
HOUR	*12*	*12*	*12*	*12*	*12*

Table 2.1: Maximum generating capacity and peak demand - 2012

Finally, focusing on the grid situation, the larger growth of renewable generation in the Southern Italy has led to more congestions over the sections connecting this zone to the others and can explain the price gap observed this year in the MGP between zones.

2.2.2 Market participation and concentration

In 2012, the number of market participants continues to grow, reaching a new all-time high. A very interesting aspect is the growth of the active participant, especially in the markets the thesis is focused on, as the number of active participants (excluding PCE) reached 114 for the MI and 149 for the MGP (+23/+12 compared to 2011). It is noteworthy that both bidding and selling participants rose in number. Therefore the GME's markets get a good level of participation.

Speaking about the concentration, the use of the aggregate market index HHI which stands for Herfindahl-Hirschmann Index is highly recommended. It measures the degree of concentration and is an indicator of the amount of competition among the participants of a market. For the Electricity market, the HHI is calculated by aggregating the volumes offered and/or sold by the individual market participants, including those sold through bilateral contracts. The value of the HHI ranges from 0 (perfect competition) to 10.000 points. It the value is below 1.200 the market is competitive, if it is above 1.800 it is poorly competitive. As it is described in the Tables 2.2 and 2.3, the indexes are still

decreasing for the volumes offered and are even below the historical low levels of 2005. The diversification of operators extends to all the market and for the Northern Italy the index of concentration is close to a situation sufficiently competitive (2.003). Since 2005, the Southern Italy has made active efforts to diversify the supply offers. Central Northern and Central Southern Italy are the zones the less competitive, partly because of the historical positions of the incumbent operator and his partners in these areas and also because of the difficult extension of the generating capacity especially from renewable energy sources.

Zona	2005	2006	2007	2008	2009	2010	2011	2012
Nord	2.042	2.039	2.104	2.241	2.311	2.197	2.134	2.003
Centro Nord	4.693	4.588	4.535	4.664	4.787	4.387	4.626	4.112
Centro Sud	5.425	4.755	5.061	4.979	5.172	5.519	5.888	5.480
Sud	5.439	3.881	3.052	2.627	2.764	2.384	2.388	2.502
Sicilia	3.544	3.570	2.718	2.701	2.946	2.809	3.475	3.383
Sardegna	3.243	3.193	3.164	3.166	3.290	3.212	3.295	3.327

Table 2.2: HHI of the supply offers

Concerning the volumes sold, in 2012, the indexes slightly increased breaking the trend of the previous years but the numbers are still relatively low and therefore the execution of the market tends to make it more competitive. It should be noted that the index varies slightly from one table to the other (Volumes offered/sold) in Sicily and Sardinia; it would appear that the numbers of setting-price operators is limited.

Zona	2005	2006	2007	2008	2009	2010	2011	2012
Nord	1.474	1.345	1.369	1.460	1.325	1.345	1.205	1.234
Centro Nord	4.219	4.051	3.742	3.765	3.495	3.216	3.034	3.209
Centro Sud	3.526	3.666	3.524	3.272	2.616	2.929	3.379	3.343
Sud	4.421	2.641	2.020	1.786	2.105	1.868	1.830	2.054
Sicilia	3.991	4.267	3.668	3.696	3.836	3.596	3.278	3.297
Sardegna	3.378	3.241	3.207	3.384	3.585	3.647	3.627	3.674

Table 2.3: HHI of the sales

According the GME's data, the market shares do not change significantly except for the continuous decline of the share of the incumbent operator. In 2012, it reached the historical minimum of 25%. It should be noted the more important position of the GSE who trades offers from renewable energy source. The real change lays in the distribution of the Price-setting Operator Index (IOM) and Price-setting Technology Index (ITM). The IOM is an index which refers to individual participants who have set the sale price at least once. The index ITM is similar to IOM but considers the production technology in lieu of the market participant. Since 2005, the index IOM of the incumbent operator has registered a genuine collapse (from 89,3% in 2005 to 25,1% in 2012) His historical partner Edison first knew a significant increase of its IOM but since 2009 is in decline too. The trend about the ITM is this: a larger proportion for the Ccgt technology to the detriment

of the other thermal technology, a significant decrease of the hydropower with modulation and a favorable position for the foreign units.

For all these features, it would be interesting to, on the one hand, select different periods of time and on the other hand focus on a single zone. This can be some of the functions implemented in the analysis tool.

2.2.3 Electricity balance

An overview of the electric mix was already given in the section 2.1. The data from Terna and from GME's report bring more detail especially in the sales proportion.

TWh	2008	2009	2010	2011	2012	% Change
TOTAL DEMAND	**339.5**	**320.3**	**330.5**	**334.6**	**325.3**	*-3.1%*
DOMESTIC CONSUMPTION	319.0	299.9	309.9	313.8	305.0	*-3.1%*
GRID LOSSES	20.4	20.4	20.6	20.8	20.3	*-3.1%*
PURCHASES BY PUMPED-STORAGE PLANTS	7.6	5.8	4.5	2.5	2.6	*3.2%*
NET GENERATION	**307.1**	**281.1**	**290.7**	**291.4**	**284.8**	*-2.5%*
HYDRO	46.7	52.8	53.8	47.2	43.3	*-8.5%*
THERMAL	250.1	216.1	221.0	218.5	204.8	*-6.5%*
GEOTHERMAL	5.2	5.0	5.0	5.3	5.2	*-1.7%*
WIND	4.9	6.5	9.0	9.8	13.1	*33.9%*
PHOTOVOLTAIC	0.2	0.7	1.9	10.7	18.3	*71.3%*
NET IMPORTS/EXPORTS	**40.0**	**45.0**	**44.2**	**45.7**	**43.1**	*-6.0%*
IMPORTS	43.4	47.1	46.0	47.5	45.4	*-4.8%*
EXPORTS	3.4	2.1	1.8	1.8	2.3	*27.3%*

Table 2.4: Electricity Balance - Source: Terna's data

In 2012, the power generation came at 63% from fossil energy sources, at 23% from renewable energy sources and at 14% from imports. The proportion of imports compared with the previous years is rather stable whereas the proportion of the windpower and photovoltaic is always more and more important. Speaking about the electricity sales, the traditional sources (Natural gas, coal, etc.) are declining even if the sales of electricity from coal energy are increasing (around 32 TWh in 2012) The sales from windpower, photovoltaic and sunthermal plants are as mentioned before constantly progressing up to 10,3 TWh in 2012 for the wind and 23,3 TWh for the sunpower. It should be noted the constant number of the geothermal source (around 5,3 TWh).

MWh	2007	2008	2009	2010	2011	2012
Fonti tradizionali	236.701.694	226.686.302	199.989.813	204.591.717	197.945.188	175.083.417
Gas	141.764.694	145.987.224	128.268.701	149.528.151	138.638.673	114.175.649
Carbone	24.066.453	22.698.171	23.009.110	24.445.791	29.304.433	32.250.068
Altre	70.870.548	58.000.906	48.712.002	30.617.776	30.002.082	28.657.700
Fonti rinnovabili	34.731.424	48.416.442	57.708.629	59.465.662	59.539.377	74.090.694
Idraulica	26.102.797	33.169.370	40.576.088	42.150.854	37.861.680	35.204.629
Geotermica	5.263.553	5.197.930	5.059.575	5.086.129	5.351.817	5.296.694
Eolica	2.195.082	5.057.575	6.107.261	5.639.151	7.218.629	10.312.231
Solare e altre	1.169.991	4.991.567	5.965.705	6.589.528	9.107.251	23.277.141
Pompaggio	4.789.294	6.434.493	5.403.171	5.750.143	4.139.600	2.956.039
TOTALE	**276.222.412**	**281.537.237**	**263.101.613**	**269.807.522**	**261.624.164**	**252.130.151**
Offerte Integrative / VENF	3.157.605	7.622.206	-	-	-	54
TOTALE VENDITE	**279.380.017**	**289.159.443**	**263.101.613**	**269.807.522**	**261.624.164**	**252.130.204**

Table 2.5: Sales by source

Another relevant information concerning the sales by source is the percentage of success of the source in the market (i.e. the percentage of acceptance of the offers on the MGP for example). In the Table 2.6 which concern the MGP, it may be pointed out the competitiveness of the geothermal, photovoltaic and wind sources. In fact, in 2012 and before, the success of these sources reached the 100%. The success of the traditional sources is decreasing as well as the hydropower's one.

	2007	2008	2009	2010	2011	2012
Fonti tradizionali	68,9%	67,7%	60,1%	60,6%	55,3%	48,7%
Gas	79,1%	78,3%	69,9%	72,4%	63,1%	50,7%
Carbone	92,2%	88,2%	81,1%	71,8%	74,8%	83,5%
Altre	51,3%	47,2%	40,3%	31,5%	30,2%	30,0%
Fonti rinnovabili	72,0%	75,9%	79,5%	76,3%	72,0%	76,0%
Idraulica	65,9%	68,4%	73,1%	69,6%	62,1%	60,1%
Geotermica	100,0%	99,9%	100,0%	100,0%	100,0%	100,0%
Eolica	100,0%	100,0%	100,0%	100,0%	100,0%	99,9%
Solare e altre	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%
Pompaggio	16,2%	17,7%	14,0%	14,4%	9,2%	6,1%
TOTALE	**65,6%**	**64,7%**	**59,2%**	**59,2%**	**53,8%**	**49,9%**
Offerte Integrative / VENF	100,9%	100,0%	-	-	-	100,0%
TOTALE VENDITE	**65,8%**	**65,3%**	**59,2%**	**59,2%**	**53,8%**	**49,9%**

Table 2.6: Sales by source (% of success)

It would be worth investigating the actual electricity balance based on these trends while focusing on the real hours of production and on specific operators for a better understanding of the situation.

2.2.4 Volumes - Supply and Demand

At the first glance, it is particularly noteworthy the fall of the exchange volumes in the MGP. This fall partly explains the overall drop of the spot traded electricity. The MGP exchange volumes equal to 179 TWh in 2012 (-1% compared to 2011) and to a large extent, bilateral execution schedules are declining down to 120 TWh (-9%). One exception is the Intra-day Market (MI), although the overall volumes still account for less than 10% of MGP volumes (including bilaterals), MI markets reach a historical record thanks to a simultaneous growth across the four MI sessions (25 TWh in total). The significant progression of the MI's volumes is important to note. The consequence of the decrease in bilateral volumes, proportionally larger than the Exchange decline, is a growth of MGP liquidity [3], up to 60%. (See Fig. 2.4)

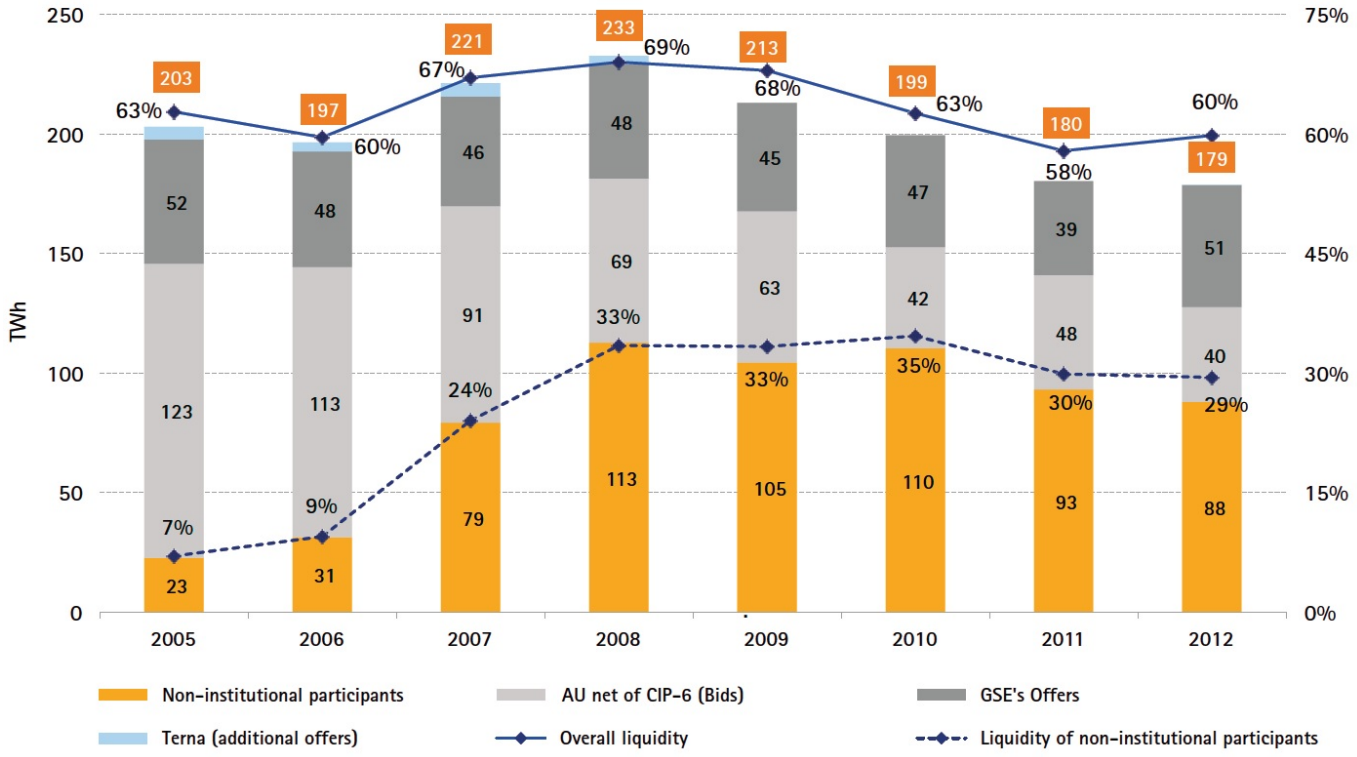

Figure 2.4: Liquidity of the MGP

By examining in greater detail the volumes in MGP (See Table 2.7), it should be pointed out the historical value of the MGP purchases (298,7 TWh). As stated before, this is mostly because of the economic situation but also because of the increase of out-of-market self-consumption with renewable power [4]. The non-schedulable renewable plants had a phenomenal growth in sales on the MGP, rising up to 33,6 TWh and with a market

3. ratio of volumes traded on the Exchange (MGP) to total volumes (including bilateral contracts) traded in the Italian System

4. the situation is now changing and recently the new government has discussed wether the self-consumption context should be redefined [3]

share of 11,2%. The gap between the amount total of supply and sales continues to rise; the sales are decreasing driven by the demand drop and the supply is increasing driven by all the effects mentioned before (growth of the national power capacity, good participation and better concentration in the markets, etc.).The gap might be considered as representative of the difficulties encountered by a part of the market participants which do not achieve success and might spell a lack of competitiveness.

TWh	2005	2006	2007	2008	2009	2010	2011	2012	Change
Terna's requirements	330.4	337.5	339.9	339.5	320.3	330.5	334.6	325.3	-3.1%
Demand	324.0	337.1	335.4	354.3	339.2	345.1	338.2	330.5	-2.5%
with specified price	3.5	8.5	7.3	20.9	27.9	28.3	28.2	34.8	23.4%
rejected	0.8	7.1	5.4	17.2	25.7	26.4	26.6	31.8	19.1%
Purchases	323.2	329.8	329.9	337.0	313.4	318.6	311.5	298.7	-4.4%
% of Terna's requirements	97.8%	97.7%	97.1%	99.3%	97.9%	96.4%	93.1%	91.8%	-1.6%
Supply	445.2	455.8	480.2	495.4	499.2	509.5	538.1	555.4	2.9%
% from wind and PV sources	3.4	4.0	3.4	10.0	12.1	12.2	16.3	33.6	105.6%
Sales	323.2	329.8	329.9	337.0	313.4	318.6	311.5	298.7	-4.4%
from wind and PV sources	3.1	4.0	3.4	10.0	12.1	12.2	16.3	33.6	105.5%
zero price	233.6	247.4	221.0	226.5	225.8	218.4	210.0	201.8	-4.2%
IPEX	*100.6*	*100.6*	*103.8*	*116.5*	*126.0*	*123.0*	*111.5*	*119.8*	*7.1%*
PCE	*133.0*	*146.8*	*117.2*	*110.0*	*99.8*	*95.4*	*98.5*	*82.1*	*-16.9%*

Table 2.7: Volumes in the MGP

In terms of structural composition, Northern Italy is confirmed as the zone where the energy demand is the highest, absorbing almost half of the overall demand (159,6 TWh, i.e. 49 %) much higher than the demands of Southern Italy (25,1 TWh, 7,5%) and of the islands (3,8 % for Sardinia and 6 % for Sicily). Northern Italy is also the major contributor of power generation with highest value of supply and sales but not at the same degree. In 2012, the zone made around 40 % of the overall sales and a significant part of the sales concern Southern Italy (16 %) and the foreign countries (15,5%). Speaking about the rejected bids/offers, the results of the change from 2011/2012 are consistent the decrease of the demand (-2,5%) and the increase of the supply (2,9%).

Zone	Purchases	2012/2011 change	Sales	2012/2011 change	Supply	2012/2011 change	Demand	2012/2011 change	Rejected bids/offers	2012/2011 change
Northern IT	158.4	-4.6%	120.5	-7.5%	254.0	4.0%	159.6	-3.9%	133.5	17.1%
Central-northern IT	31.6	-7.2%	20.8	3.1%	39.7	-2.2%	31.9	-6.5%	18.8	-7.6%
Central-southern IT	47.7	-4.1%	31.5	0.8%	77.7	8.5%	47.8	-3.8%	46.1	14.5%
Southern IT	25.0	-2.3%	47.4	-4.7%	83.6	1.7%	25.1	-1.9%	36.3	11.5%
Sicilia	20.0	0.5%	19.0	-1.0%	32.0	6.2%	20.0	0.7%	13.0	19.0%
Sardegna	12.7	-6.3%	12.8	10.2%	18.6	1.0%	12.7	-6.0%	5.8	-14.6%
Foreign countries	3.3	-7.6%	46.5	-6.9%	49.8	-4.9%	33.3	10.3%	3.3	36.9%
Italy	298.7	-4.4%	298.7	-4.4%	555.4	2.9%	330.5	-2.5%	256.8	13.0%

Table 2.8: Zonal volumes in the MGP - 2012

2.2.5 Wholesale tariffs

In 2012, the wholesale price of electricity (average) had a slight increase at 75,48 €/MWh (+4,5%), while the other wholesale prices in Europe were generally declining. The case of Italy seems to take an opposite direction, maybe because of a less affordable electricity mix and of a higher cost of the main source and raw material, the gas, compared to the rest of Europe.

2.2.5.1 National Single Price (PUN)

The average Pun of 2012 was 75,48 €/MWh showing an increase of 2,25 €/MWh compared to 2011 (-4,3%), 11,76 €/MWh compared to 2009 (-15,6%) but below the peak of 2008 (86,99 €/MWh). In particular the increase of Pun was mainly due to the reduction in the ratio of peak-load to off-peak prices (86.28 €/MWh vs. 69.82 €/MWh). The most probably is that the market participants have tried to recover their margins taking advantage of the lower contribution of new renewable capacity.

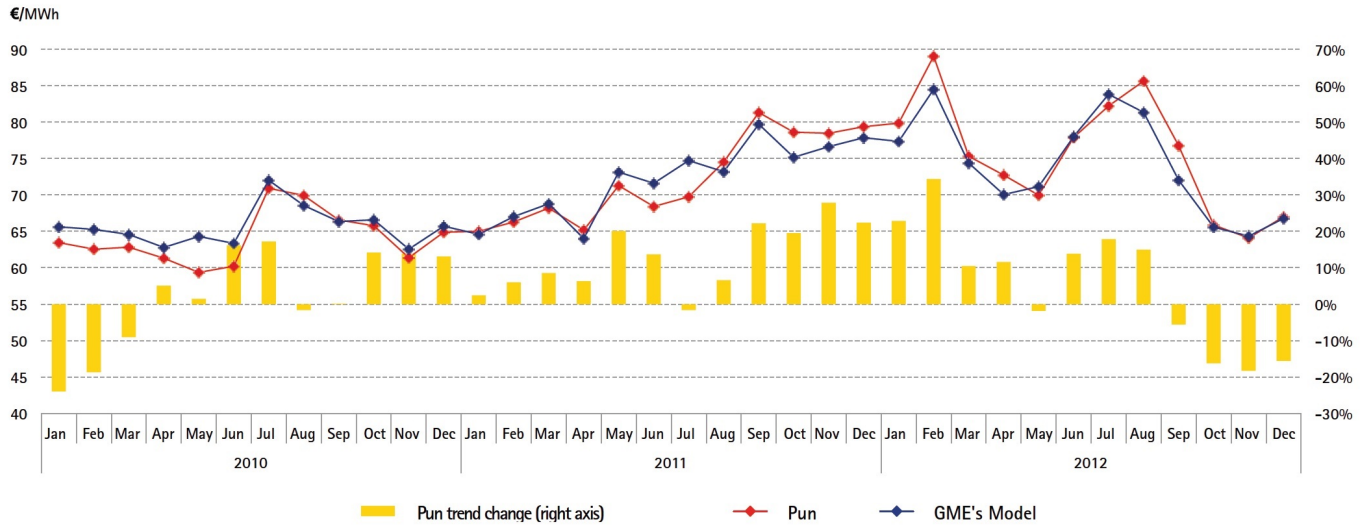

Figure 2.5: Monthly trend of Pun

Usually, the Pun follows a monthly trend, even a typical seasonal trend, influenced by the high demands during the summer and winter months. The trend of the year 2011 and 2012 has deviated. In particular, the last quarter of 2012, prices reached an average value of 65,66 €/MWh versus 78,78 €/MWh in the previous nine months with first a series of increases and then of major reductions (16-19%)throughout the first half of 2013. After some searching the main upward determinant having a significant impact on the Pun and explaining the current trend is the growth of the gas cost.

2.2.5.2 Zonal Prices

In 2012, the zonal prices increased similarly to the Pun. Zonal prices rose to 70-74€/MWh in the mainland and as much as up to 82 €/MWh and 95 €/MWh in Sardinia

and Sicily. The reasons of the increase should obviously been seen in the light of what happened with the Pun. However, it should be important to note the significant size of the price increases, quite different from the last five years. The rate of change different from one zone to another, has modified the price situation in place since 2008 in mainland zones. For the first time, Northern Italy is the most costly zone in the continent (74,05 €/MWh, +5.5%), with a difference of about 4 €/MWh with the cheaper Southern Italy (70,34 €/MWh, +1.9%).

€/MWh	2005	2006	2007	2008	2009	2010	2011	2012
Zone fisiche								
Nord	57,71	73,63	68,47	82,92	60,82	61,98	70,18	74,05
Centro Nord	58,62	74,98	72,80	84,99	62,26	62,47	71,17	73,87
Centro Sud	59,03	74,99	73,05	87,63	62,40	62,60	70,86	73,16
Sud	59,03	74,98	73,04	87,39	59,49	59,00	69,04	70,34
Calabria	59,83	75,67	73,22	87,99				
Sicilia	62,77	78,96	79,51	119,63	88,09	89,71	93,11	95,28
Sardegna	60,38	80,55	75,00	91,84	82,01	73,51	79,93	81,67
Poli di produzione limitata								
Monfalcone	57,71	73,49	68,37	82,90	60,82	61,98	70,18	
Turbigo R.	57,70	73,57	68,47					
Piombino	58,97	77,62						
Brindisi	58,94	74,28	72,98	86,93	57,04	57,66	68,20	68,49
Foggia		71,55	69,96	86,79	59,31	58,99	67,16	67,81
Rossano	58,99	74,61	73,00	86,99	58,75	58,47	69,01	70,00
Priolo G.	62,18	76,68	78,44	118,46	87,95	89,58	93,11	95,28
Zone estere								
Francia	52,32	64,34	-	-	60,82	61,98	70,18	74,05
Svizzera	55,66	64,66	50,47	-	60,78	61,98	70,18	74,05
Austria	53,20	58,32	-	-	60,82	61,98	70,18	74,05
Slovenia	55,90	70,94	41,08	-	60,82	61,98	70,18	74,05
BSP							57,20	53,02
Grecia	55,68	67,96	-	-	57,04	57,66	68,20	68,49
Corsica	57,38	73,33	71,07	87,25	61,33	91,58	74,60	81,60
Corsica AC		81,53	75,00	91,84	82,01	73,36	80,94	81,67
Estero Corsica		81,53	75,00	91,84				
Estero Nord-Est	57,21	73,63	68,22	82,92				
Estero Nord-Ovest	57,68	73,63	68,45	82,92				
Estero Sud	61,16	68,48	64,62	80,35				

Table 2.9: MGP selling zonal prices

The overcapacity of the electricity market (too much supply for the actual demand) seems to affect Northern Italy relatively more (rejected +17% vs. +12% in the South).Due to both a higher increase of offered volumes and to a declining demand, the diverging zonal prices are probably accounted for by a faster growth of renewable generating power in Southern Italy. According to GME's latest data, the figures in 2013 seem to endorse such trend. The situation is different with regard to the islands Sicily and Sardinia. Their limited size represents a serious obstacle for the intern development of the supply offers contributing to maintain the productive structure highly concentrated and to make the prices trend really dependent on mainland situation and on the capacity of the intercon-

nection with this latter.

Concerning the structure of zonal markets, the various zones play an important role in setting prices; the different configurations between zones, the market characteristics can make the clearing prices of a specific zone determinant for the other zones. On the one hand, Northern Italy seems to play a leading role setting-price. According to the Table 2.10, this influence proportion is around 50 %, over the years has fluctuated around this value. Therefore the zone remains the leader in setting-price but on the other hand, a few zones have gotten a more powerful position regarding the North. This is the case of Southern Italy and the foreign countries. The South has increased by 2 points since 5,7 points for 7 years and rose up to 17,3% in 2012 making it the second leading zone. The zones from abroad, have increased by 12,7 points, this is the biggest increase, and reached the third position with 13,1%. All these data suggest a progressive and continuous integration of pro-competitive conditions and rules between North and South but also between National Italian power system and neighboring markets.

Zona price maker	2005	2006	2007	2008	2009	2010	2011	2012
Nord	47,9%	47,4%	47,7%	46,3%	51,0%	48,0%	56,3%	49,3%
Centro Nord	6,5%	5,9%	8,2%	7,1%	2,1%	3,6%	3,1%	2,8%
Centro Sud	24,0%	18,4%	13,6%	11,0%	7,8%	7,1%	6,3%	8,8%
Sud	11,9%	16,3%	15,7%	13,0%	11,8%	15,9%	15,4%	17,3%
Sicilia	7,0%	6,7%	7,7%	6,0%	6,7%	5,6%	6,6%	6,8%
Sardegna	2,3%	3,0%	2,7%	3,8%	4,3%	2,3%	2,3%	1,8%
Estero	0,4%	2,3%	4,4%	12,9%	16,3%	17,4%	10,0%	13,1%
TOTALE	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%

Table 2.10: Percentage of volumes sold on the price maker zone - MGP

2.2.5.3 Prices on the Intra-Day Market

In 2012, in every market session, prices rose between 5 and 10 %, less than the increase observed in 2011 on the previous year (MI1 and MI2 as the sessions MI3 and MI4 were inaugurated in 2010). They all hit an all-tie high level since their creation. The average price (see Table reftab13) of the four sessions varied in 2012 between 71,90 euro/MWh for MI2 and 85,38 euro/MWh for MI4. Looking more closely at the trend of the prices, the prices of the MIs market seem to follow the trend of the MGP market and hence related to the Pun, at it happened with the MA in the 2005-2009 period (of course MI3 and MI4 can only be compared in the hours of the day in which such markets generate a price). Prices of MI1 and MI2 sessions are less volatile than MI3 and MI4, nearer in time to the first and closer to the physical delivery of traded electricity. The price volatility of the two first sessions of MI has been decreasing since 2009, getting close to the PUN's.

	MI1				MI2				MI3		MI4	
€/MWh	2009 nov-dic	2010	2011	2012	2009 nov-dic	2010	2011	2012	2011	2012	2011	2012
Medio	55,25	62,22	69,03	72,60	56,78	62,06	68,76	71,90	74,64	79,16	77,76	85,38
Minimo	8,53	10,00	10,00	10,00	9,00	2,00	0,00	6,49	28,94	10,00	15,00	10,00
Massimo	184,90	304,00	349,64	248,30	2.944,10	243,86	1.746,62	492,67	3.000,00	424,63	873,70	347,59
Volatilità	15,4%	14,1%	8,0%	7,7%	15,9%	16,4%	11,4%	10,9%	16,8%	15,5%	19,9%	18,9%

Table 2.11: MI selling prices

Speaking about the zonal prices, GME provisionally concluded in 2012 that the four MI sessions' zonal prices are correlating with the zonal selling prices in the MGP (in terms of both trend and level). For example, during the period 2010-2012, the prices of MI sessions in both islands were considerably higher than those in the continental zones; these latter were quite convergent (fluctuations within a rather narrow range). The two followings figures (2.6 and 2.7) present the zonal prices in the sessions MGP and MI1 with the classification: Sicily, Sardinia and mainland.

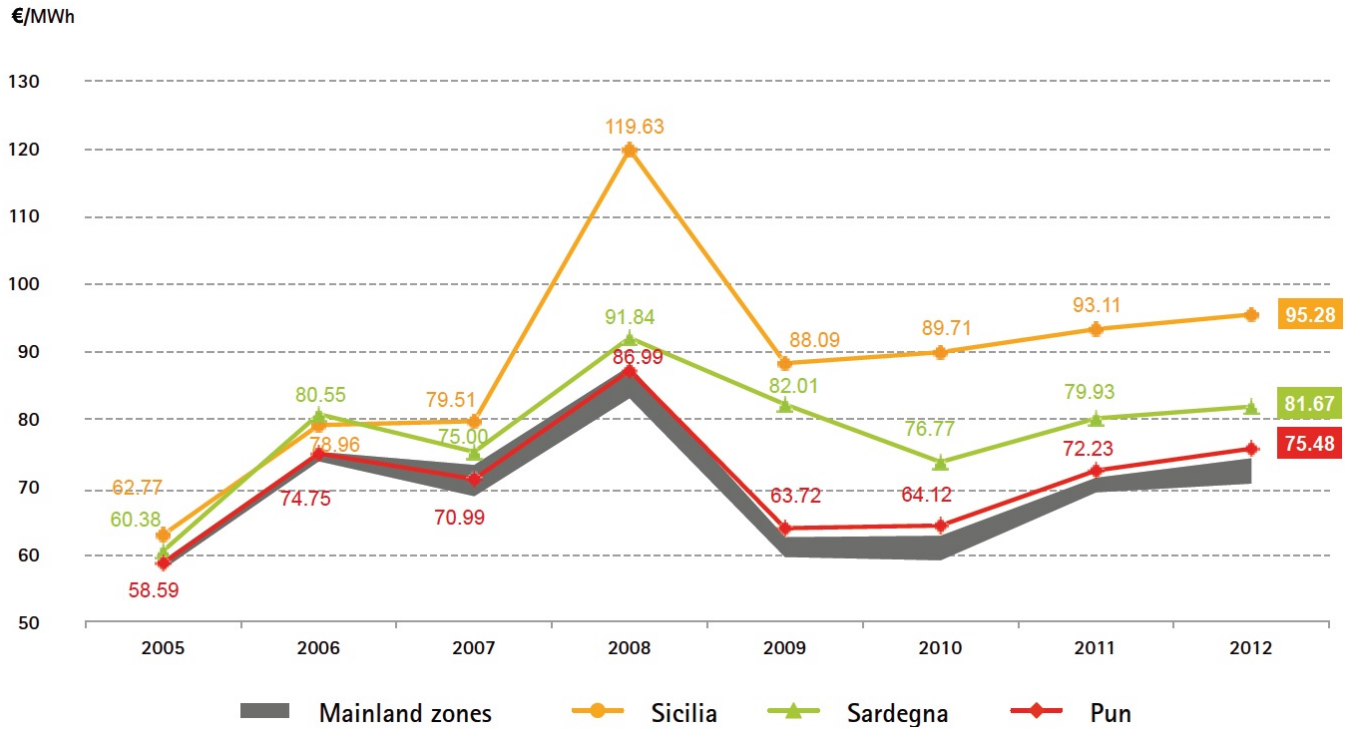

Figure 2.6: Yearly average zonal prices in the MGP

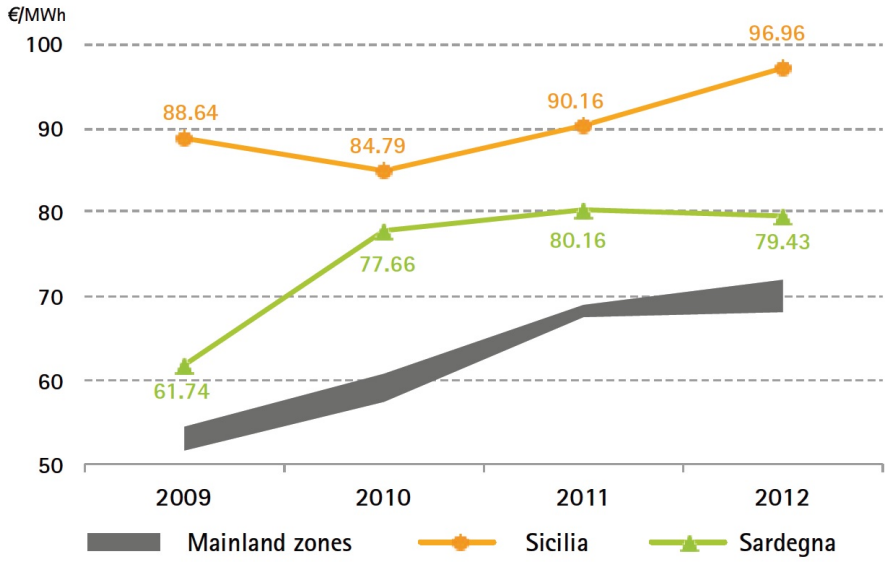

Figure 2.7: Yearly average zonal prices in the session MI1

2.3 Reflections

All that have been described in this section lead to a better understanding of the Italian Electricity market situation in 2012. The huge amount of work accomplished by GME is an inexhaustible source of information and of course all the tables and figures of the section are taken directly from the monthly and annual GME's reports [5].

But on the matter of statistical data, it is true that the analysis should be completed by a tool which gives a more detailed account of the power system and remove ambiguities from the GME's results. It would be interesting to be able to zoom on participants of interests, to understand a specific situation over a determined period of time.

The different conclusions from the GME's and AEEG's reports are somewhat frozen and the idea of the thesis is to make available an analysis tool which is not rigid and allows dynamic comparison and study based on the user's interest and goodwill. This section has drawn up the framework of the Italian Electricity market (regarding the features which concern the thesis) until the year 2012. The user of the application tool would be able to continue the overview by adding new data and rapid updating in order to be continually aware of the results that interest him.

Chapter 3

Data acquisition and Analysis tools development

After providing an overview of the composition and the different processes of the Italian Eletricity Market, it's essential to clarify the basis and the technical content of the thesis.

To start, all the aggregate market data and results shall be of public domain and published on the GME's website. Public domain means that they are freely usable and that everyone has access to the data and can analyze them. By making obvious comparisons, by developing a set of functions, a lot of information and conclusions can be drawn from them, in particular a better understanding of the strategies of the operators. The data are available on the official GME's website (www.mercatoelettrico.org) on the downloads' tab. The free access to the data implies a certain waiting period of seven days for reasons of confidentiality (Decree Transparency 2009) and that the Internet user may complete a contract of terms and conditions noting that the data are the property of "Gestore dei Mercati Energetici S.P.A".

The objective of the thesis is to develop a tool which allows searches and analysis of these data. The idea is to take an amount of raw data and to examine them by implementing some relevant functions. It looks like a complex statistic study and many parameters cannot be taken into consideration. Moreover with approximations and restrictions justified, positive and interesting results can be expected. For sure, the data are affected by market unforeseeable conditions and by events such as black-outs, weather events or handling procedures. They won't be registered into the database. Another important dimension that should be emphasized is the interactivity of the tool developed. The user of the program will able to easily add new raw data for new periods of time and especially add new functions for further analysis.

First, the study time window should be delimited. On the GME's website all the public bids/offers of the Spot Market since the 1st April 2004 are available. The decision was to focus on four years of data. Thus the raw used data are from January 2010 to December 2013. With such a long time period, geopolitical, financial situations and new construc-

tions in the energy park are relevant information but won't be considered.

Furthermore the full data set concerning all the different markets represent too much information. The study will include only the information from the Day-Ahead Market and the Infra-Day Market (MGP&MI). It's interesting in particular to see how the operators' acts in the MI depend on the MGP.

3.1 Data description

The data published on the GME's website are downloaded on the tab "public domain bids/offers" a day at a time by specifying the date concerned. They are available in Extensible Markup Language (XML) form. This is a format which seems to be really complicated but it has a recursive and schematic structure which allows the expression of the data in a simple table. With the XML format GME can store the bids/offers data of all the markets of the Spot Market (MGP, MI, MSD). For one day, and for one specific market, there is a table with all the bids/offers from the market participants of this day. In the table, each row corresponds to a single bid or offer to which a unique transaction number is assigned. So, in one specific row, there is the demand bid or the supply offer of one operator through one offer point for a certain date and hour of a given market.

As a mean to study in more depth the raw data and to know how to use them, serve a description of the fields used in the GME's files. In the following table, the caption necessary to understand the fields of the database is detailed :

Field	Description	Comments	Markets Concerned
PURPOSE_CD	The type of the offer	2 possible values: BID for demand bid (purchase) and OFF for supply offer (sale)	MGP/MI/MSD/MB
TYPE_CD	Its indicates whether the bid/offer is predefined or current	-REG for Current -STND for Predefined	MGP/MI/MSD/MB
STATUS_CD	Status of bid/offer after the market execution	6 possible values: -ACC: accepted -REJ: rejected -INC: inadequate -REP: replaced -REV: revoked -SUB:submitted	MGP/MI/MSD/MB
MARKET_CD	Market code to which refers to bid/offer	-MGP for the Day-Ahead Market	MGP/MI/MSD/MB

		-MI% for the Infra-Day Market with % number of the session -MSD for the ex-ante session of the Ancillary Services Market -MB the balancing session of the Ancillary Services Market	
UNIT_REFERENCE_NO	Identification Code of the generation or consumption unit	Information present into the Terna's register: &RUC	MGP/MI/MSD/MB
MARKET_PARTECIPANT_XREF_NO	Code assigned by the Participant	No longer used	
INTERVAL_NO	Relevant Period to which the bid/offer refers	Whole Number 1,24 (the number 25 is also present but due a likely error)	MGP/MI/MSD/MB
BID_OFFER_DATE_DT	Date to which the bid/offer refers in the YYYYMMDD format	Example for the 08/11/2013: "20131108"	MGP/MI/MSD/MB
TRANSACTION_REFERENCE_NO	Number of the transaction	GME's identifier of the bid/offer	MGP/MI/MSD/MB
QUANTITY_NO	Volume submitted by the participant	Unit: MWh	MGP/MI/MSD/MB
AWARDED_QUANTITY_NO	Volume awarded by the market (after the execution of the market)	Unit: MWh	MGP/MI/MSD/MB
ENERGY_PRICE_NO	Price submitted by the Participant	Unit: €/MWh	MGP/MI/MSD/MB
AWARDED_PRICE_NO	Price awarded by the market	Unit: €/MWh	MGP/MI/MSD/MB
MERIT_ORDER_NO	Merit order of the bid/offer as calculated by the market solution algorithm	Order in the auctions increasing for the supply offers and decreasing for the demand bids	MGP/MI/MSD/MB
BALANCED_REFERENCE_NO	Code for balanced bids/offers	Only for the MI1&MI2	MI1/MI2
PARTIAL_QTY_ACCEPTED_IN	Indicator of partially accepted bid/offer	"Y" for Yes "N" for No	MGP/MI/MSD/MB
ADJ_QUANTITY_NO	Submitted volume, possibly adjusted by the system		MGP/MI/MSD/MB
ADJ_ENERGY_PRICE_NO	Price possibly adjusted by the system	Significant for the MSD and the MB	MSD/MB
GRID_SUPPLY_POINT_NO	Grid supply point with which the unit is associated		MGP/MI/MSD/MB
ZONE_CD	Zone to which the unit belongs	See Part 1...	MGP/MI/MSD/MB
OPERATORE	Registered name of the Participant		MGP/MI/MSD/MB

SUBMITTED_DT	Time of submission in the format "yyyymmddhhmmssmmm"	Example for 08/11/2013 a possibility is :"20131107083554576"	MGP/MI/MSD/MB
BILATERAL_IN	It indicates whether the bid/offer comes from the PCE platform	True" or "false " For True the operator is "Bilateral-ista" Significant only for the MGP	MGP/MI/MSD/MB
SCOPE	Purpose if the bid/offer	{GR1 GR2 GR3 GR4} Incremental and successive prices AC maximum price or Starting-up AS minimum price or shut-down RS minor reservation	MSD/MB
QUARTER_NO	Quarter of the hour in the hour of the flow	"1 2 3 4"	MB
BAType	It details more specifically the status of the bids/offers	"Rev" for a revocation of bids/offers accepted in the MSD , "Norev" for actually accepted in the MB, "Netting" netting bids/offers	MB

Table 3.1: Caption of GME's data

As a first step, it is necessary to collect all the files from the GME's website concerning the MGP and MI markets. It should be pointed out that some fields aren't relevant or even not existing for the study of those markets. This is the case of ADJ_QUANTITY_NO, ADJ_ENERGY_PRICE, SCOPE, QUARTER_NO and BAType. In the creation of the database they won't be taken into consideration.

3.2 Database setting up

3.2.1 List of Production Units

The data published by the GME are the outcomes of the execution of the Italian Electricity Market. They are the results of the algorithm implemented around the economic transactions. But behind the market, there are concrete and physical assets. On the one hand, the knowledge about units of consumption is difficult to disseminate and information about them is almost inaccessible [1]. Moreover with a holistic perspective, the consumption part is not a major concern. On the other hand, the units of production are really interesting and it's important to know how the National Italian Electricity Parki is made. So the idea is to collect the maximum of information about the power stations plants in Italy with the aim of improving the quality of the information on the overall market operation.

1. All the consumption units are registered in a register maintained by Terna called Registro delle Unità di Consumo (RUC). Only the users concerned can have access to it.

From the GME's data, the production unit specific information available is:

- The zone: Geographical framework (ZONE_CD)
- The operator: it would rather be the "trader" because this is the one who sells the electricity not the owner and because there might be more than one operator per unit. (OPERATOR)
- The identification code of the unit: it may look like the real name of the unit. (UNIT_REFERENCE_NO)

So as to enhance the data, some searches and requests to the main electricity producers have been done [10] [14]. On the Enel's website for example, data are available about all their power stations in Italy. At the end an Excel File has been created and completed. It includes the following information which can be used at the same time with the GME's data for a better survey:

- Company who owns the station
- Geographical indications: Town, Province, Region.
- Date of construction
- Capacity of the station and of the whole plant (in MW)
- Type of the energy source
- Type of plant depending of the energy source

The type of the energy source was the main objective of this database setting up and deserves a further explanation. Knowing which kind of primary energy source is used allows a deep analysis at the national level. Six different types of source have been carefully selected and summarize in the following Table 3.2:

Symbol	Name	Detail
TE	Thermal - Termico	Category of power plants which produce electricity from heat sources. This gives different types of thermal power plants: -solar thermal plant -fossil fuel (Coal, Gas or others) plant -nuclear power plant Geothermal and Biomass have been treated separately.
ID	Hydraulic - Idraulico	Production of electricity through the use of the gravitational force of falling or flowing water. (Hydropower)
EO	Wind - Eolico	Category of power plants which convert the wind energy to electricity.
GEO	Geothermal - Geotermico	The electricity is generated from geothermal energy (thermal energy stored in the Earth).
BIO	Biomass - Biomassa	Category of power plants which convert the biological material derived from living or living organisms (biomass) to electricity.
FV	Photovoltaic - Fotovoltaico	Power conversion source is via photovoltaic modules that convert light directly to electricity.

Table 3.2: Caption of the types of energy source

Besides, GME makes available to the public in the section 'Historical data', Excel Files which among all the other information, contain a table giving the technology of the marginal plant for each period applicable divided into zones. GME defines its own sub-categories of technology which are clarified and summarised in Table 3.3.

Therefore, the different types of technology have been extracted from the GME's file and the list of the production units has been completed with the type of technology.

Plant Type	**Tipologia Impianto**	**Description**
Renewable	Fer	Renewable Energy
Coal	Carbone	Coal power plant
Ccgt	Ccgt	Combine Cycle power plant
Abroad	Estero	From abroad
Hydro. Run-of-river	I.Fluente	Run-of-river hydropower plant
Hydro. Pumped-Storage	I.Modulazione	Pumped-Storage hydropower plant
Hydro. Pumped	I.Pompaggio	Pumped hydropower plant
Methane	Metano	Natural Gas power plant
Fuel Oil	Olio Fue	Oil power plant
Fuel Oil. Coal	Oliocarbone	Both Fuel oil and Coal power plant
Fuel Oil. Methane	Oliometano	Both Fuel oil and Methane power plant
GT	Tg	Gas turbine plant
Other	Altro	Other than the above- mentioned categories

Table 3.3: Caption of the types of technology

It may be noted that when a type of energy source or plant was unknown, a blank in the database was left.

3.2.2 GME's data

The large amount of information and data which need to be collected and elaborated exclude a priori the possibility to use programs such as Microsoft Excel® or similar. Two different approaches were chosen to create the database which will be used for the analysis which will be developed on the software Qlikview®.

Qlikview® is a software in the Business Intelligence sector [1]. The Business Intelligence was born with the idea of converting amount of data into useful information in order to conduct survey in a simple and intuitive way. Business intelligence systems combine operational data with analytic tools to present complex and competitive information to planners and decision makers. It's widely used in industry as a strategic tool for management; the objective is to improve the timeliness and quality of inputs to the decision process, hence facilitating managerial work. Qlikview® is one of those softwares really intuitive and powerful in loading and examining large amount of data. It uses a patented technology called

Associative Query Logic (AQL) to build a non-relational, associative and highly space efficient database that resides in RAM. The result is powerful analytical capabilities provided through a highly intuitive user interface that encourages exploration and creativity.

Two different methods of elaboration of the data have been selected and they need to be compared on the same sample of data: Data from the MGP market for the first three months of 2012.

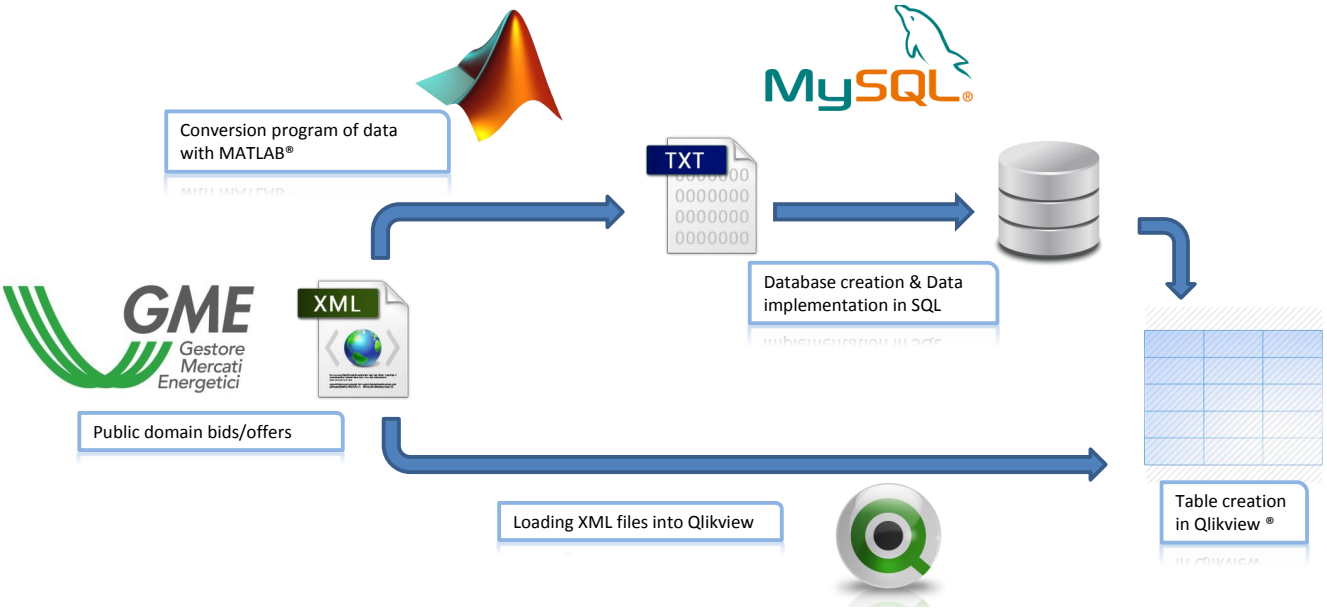

Figure 3.1: The two methods of Data processing

The first idea was to store the data on SQL database in order to have access to a secured source both for the loading and for the exchange between users of the analysis tool (clever use of the Backups SQL). The loading of data from XML format into a SQL file through the database management system MySQL is now possible [13] directly with a simple query (new versions of MySQL): LOAD XML INFILE 'file_name.xml' INTO TABLE tbl_name. [2]

Data acquisition with the method "hand-made"

But the procedure is way too long. It's better to use another indirect method, a little program created on MATLAB® which extract the rows from the XML file and creates in output a file *.txt. Then with the fast query LOAD DATA LOCAL INFILE 'file_name.txt' INTO TABLE tble_name, it's much easier and faster to enter all the rows in the database (See Fig 3.1). Once the database created, it must be linked to the software Qlikview® through a server MySQL. The only requirement is the availability of a so called Driver

2. The latest stable release of MySQL is the version 5.6 and the query is available since the version 5.5.

ODBC for the given database which creates an interface between the ODBC system and the database[3]. It allows applications such as Qlikview® to access data in database management system using SQL.

Then in Qlikview®, the table is automatically created as it was stored in the *.txt file. The software will recognize the fields and the each record (row) will be a new instance of object type and each field a specific attribute or propriety of the object.

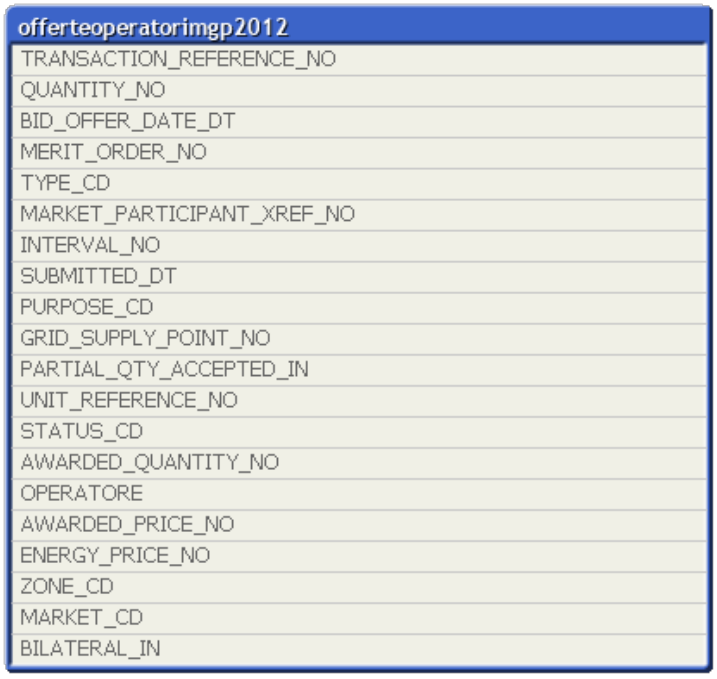

Figure 3.2: Example of a table created in Qlikview®

Data acquisition with the option "Table Files ..." of Qlikview®

Among the powerful proprieties of the software used to develop the tool which will be detailed in the next section, there is the Database Wizard which allows simple creation of tables from different recognized files. The types of file recognized are delimited text file, fixed record file, Excel® file, HTML file and XML file. They are Table Files. The wizard helps in the creation of the table.

3. One of the side tasks of the thesis was to prepare tutorials to avoid future common difficulties with the use of the software. One is about the connection between SQL and Qlikview®.

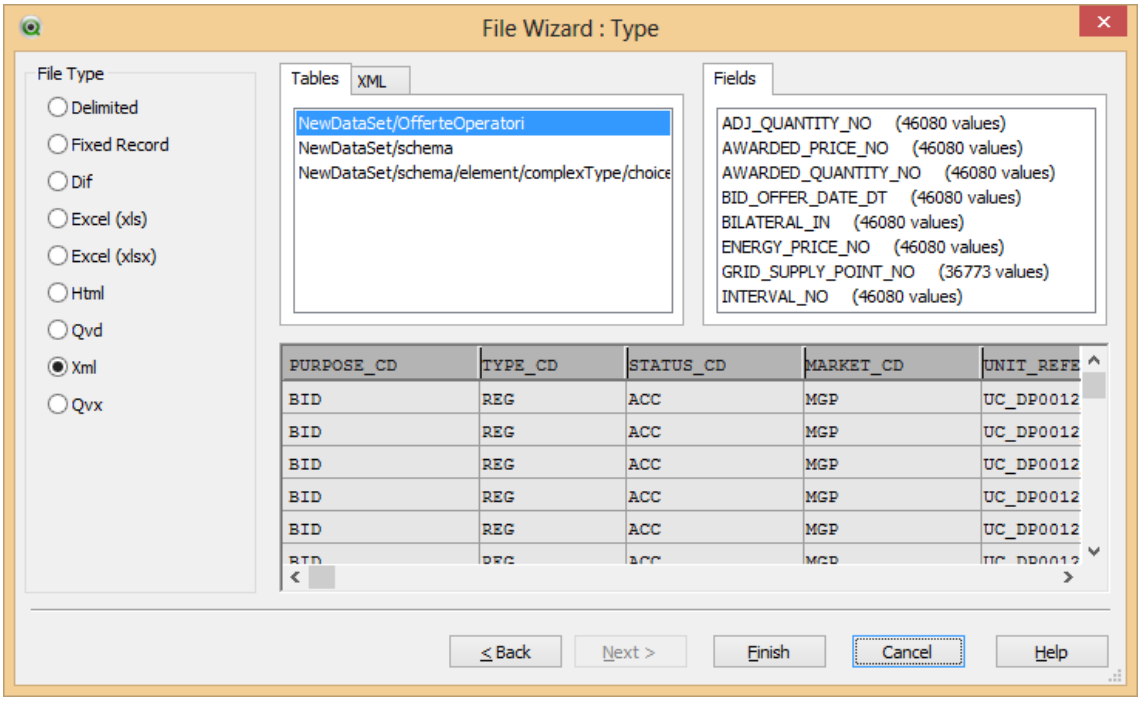

Figure 3.3: Database wizard window

To enter several XML files at a time, there is no better ingenious symbol than * in the query in the script to indicate from which file it's loading the data:
FROM D:\test*MGPOffertePubbliche.xml
(XmlSimple, Table is[NewDataSet/OfferteOperatori]);

Comparison of the acquisition speed.

The sample used is composed of 60 XML files for a 2.70 Gigaoctets total weight. Until it's possible to work on the data on a table in Qlikview®, five steps are necessary with the first method and only one with the second. In the following table the times of the procedure for each method are reported.

	"Hand-made" method	Direct method
Conversion with MATLAB®	3 H 10 mn	–
Creation db with MySQL®	12 mn	–
Data Loading with Qlikview®	10 mn	25 mn
Total	3 H 32 mn	25 mn

Table 3.4: Time table of the Data acquisition procedures

Obviously, the second method is more efficient for simplicity and speed reasons. However, the creation of the database represents a security element with the possibility of

Backup and the solidity of the structure of data. For the MGP and MI markets several databases from MySql have been created and the respective backups for the period of time concerned.

Backup

As it was said before, the backup with the SQL instruction: mysqldump -u root -p –opt nome_db>"D:/path/backup.sql" from the Console window allows a secured saving. But the idea of the thesis is to take advantage of the functions (detailed in the next section) of Qlikview®, one of them is the potential of the QVD files.

The mere existence if the Qvd files (Qlikview Data File) justifies the use of this software. Qvd is a native Qlikview format and can only be written to and read by Qlikview. The file format is optimized for speed when reading data from a Qlikview script but it is still very compact. Reading data from a Qvd file is typically 10-100 times faster than reading from other data sources (Excel, Access, Oracle SQL etc.)

Therefore the first extraction and reading from the GME's data is done with the method as described above, and then the usual backup, the next reading and updating are realized through the specific qvd file of Qlikview (See Fig 3.4).

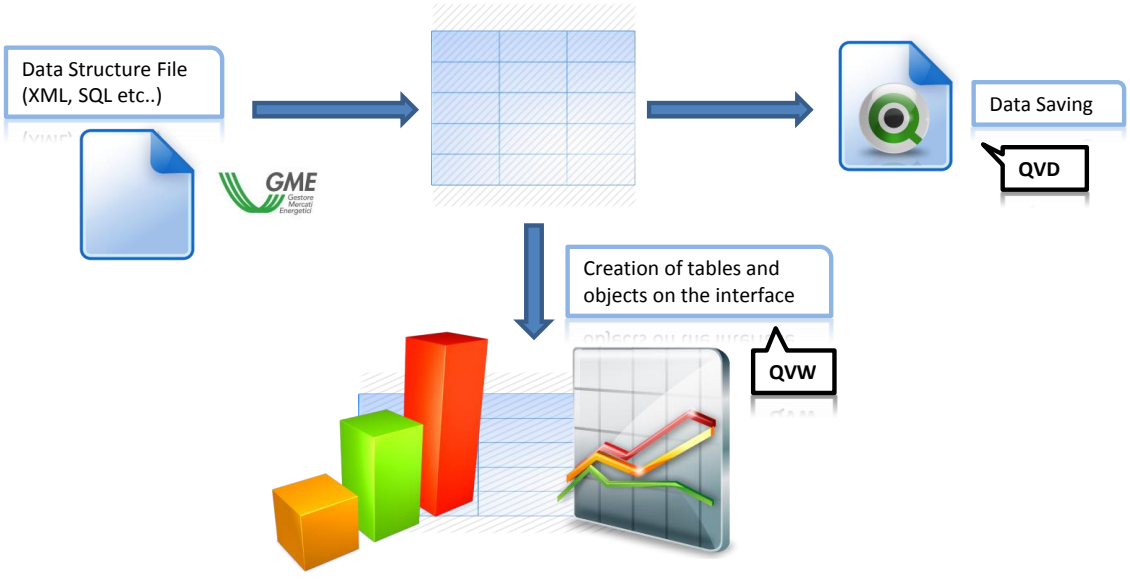

Figure 3.4: Data aquisition with Qlikview®

3.3 Introduction to Qlikview®

A powerful software able to collect and classify all the data and make them accessible in a clear form must have been found. Thinking about the study of database, this goes back to the product of Microsoft Access®. It allows creation of simple and intuitive enquiry template through graphic means. But the possibilities for interaction with the database are limited and with the increasing number of data, it's still more complicated working on this software. There are a lot of different data visualization tools and the ones of the Business Intelligence should be taken into consideration. Business Intelligence is a set of theories, methodologies, architectures, and technologies that transform raw data into meaningful and useful information for business purposes. Qlikview® is one of the most flexible Business Intelligence platforms for turning data into knowledge. More than 31.000 organizations worldwide are using the platform and enable their users to visually analyze all their data. The software has been therefore chosen to support the development of the analysis tools of the thesis.

3.3.1 Product Description

This business intelligence software has been provided by QlikTech, a company based in Pennsylvania. It was found in 1993 in Sweden with the aim of solving critical problems for organizations of all sizes, including the largest global enterprises. Its PC-based desktop tool was called QuikView and was sold only in Sweden. The company has grown exponentially over the last few years. In 2005, the single-user desktop tool was replaced with a server-based web tool. In 2010, QlikTech debuted on Wall Street and remains a success story with its software now called Qlikview. Forbes placed them in the top three of 2012 list of America's 25 fastest-growing tech companies, alongside Apple and LinkedIn[1].

Qliktech proposes different edition of its software including one edition absolutely free. This is the Personal Edition. It's the full Qlikview Desktop product that is run on a machine without or partner license assigned on it. With this version, everyone is free to create documents for a personal use. In others words it's totally appropriate for someone who doesn't share his work with others and is doing his own analysis with his own data. If at any point, it's necessary to acquire a full license in order to make the tool connected to a server and therefore to people and to share the results with other users, the process is automatic. Besides, Qliktech supports the students and the universities by providing an academic edition which offers Qlikview Licenses to promote the learning experience. It enables to develop strong analytic skills and tools and to share them with a limited number of counterparties. So, this version seems particularly appropriate the smooth development of the thesis.

Qlikview offers a new perspective for database applications. Contrary to the traditional database tools, it has a unique interface not only focused on the reports and tables. Instead, the platform gives the user various presentation interfaces to suit the needs of particular circumstances. The user works with a very intuitive interface, able to create

simple functions instead of working with inflexibles tables or restrictive forms. Most of traditional databases are built upon a relational model whereas Qlikview creates an associative database as it loads data from a data source. The associative database is specially designed to allow users to get maximum benefit from all the information stored in their databases.

In order to retrieve data from a data source, Qlikview executes a load script. To help to create the load script, Qlikview includes a wizard that will generate the script. On the script wizard, the user specifies the source databases and the tables that should be loaded. In addition, he can create and calculated new fields or variables from the sources using a lot of functions available in the script. This is from this menu that the loading of XML files into Qlikview has been done. Then, applications and functions are created on the general interface. One exciting feature of the software is that each user can personalize an application to meet his specific needs. A lot of sheet objects are available and ready to be used and personalized. The list box is the most basic object. Combining various objects together on a sheet creates a powerful application for working with and analyzing any type of data.
The most interesting objects available are:

- List Box
- Table Box
- Charts
- Input Box
- Pivot Table
- Calendar Object
- Current Selection Object
- Button
- Text Object

Finally, the platform allows complex expressions, combining multiple functions, operators and constants. They can be used anywhere in the application and allows dynamic visualization of the data while the user makes his selection in the database [12].

3.3.2 Potentials of the software

The first advantage of Qlikview is its speed of execution. In fact a new generation in-memory architecture is used which distinguishes him from the other Data Visualization tools and enables the data to be processed in real-time. With Qlikview, all the data are loaded in memory and available for instant associative search and real-time analysis with

a few clicks. The speed advantage is even evident if the QVD files are used (see previous section). Qvd files are stored in a format that mirrors the compression used in memory (small space on the disk) and during an optimized load data is sent directly from disk to memory in the same compressed format. When a non-optimized load is performed this is not the case[8].

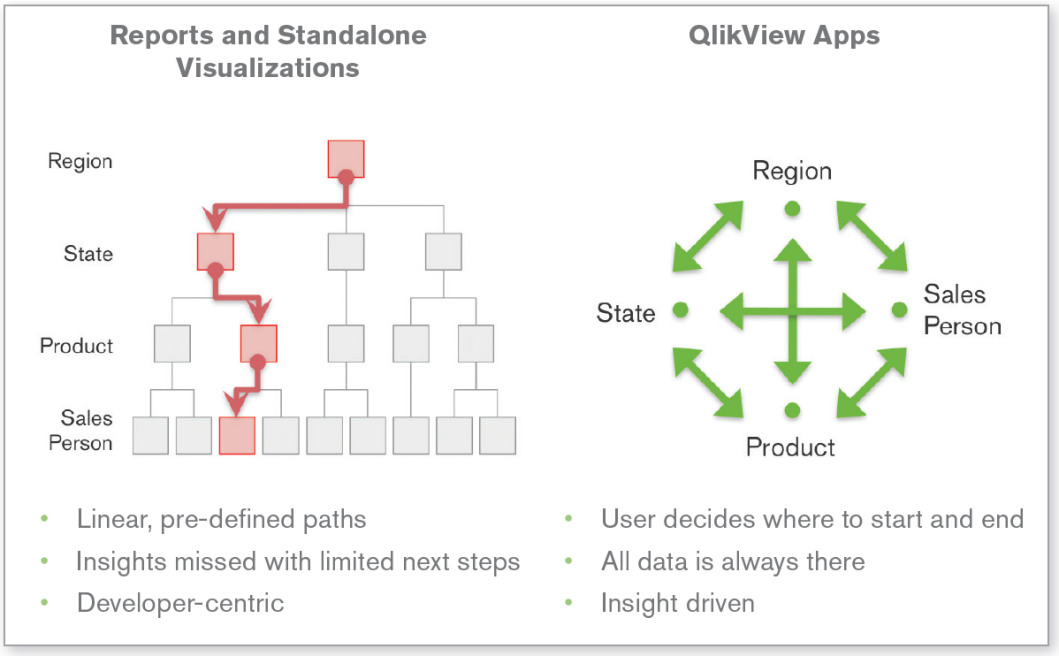

Figure 3.5: Associative experience with Qlikview®

The other main advantages of Qlikview are:

- Ease of use: the platform is simple and intuitive
- Transparent reporting: direct access and exploration to/of the data.
- Scalability: a large amount of data can be loaded with no restrictions. Near instant response time on very huge data volumes
- Data integration: the software can load data from various data source into a single application. For example, on the same sheet, can be loaded data from SQL database, XML file and Excel file and they can be associated into the same table.
- Full-Filtering data: search across all data
- Fast and powerful visualization capabilities
- Mobility: access to data from mobile devices
- Low cost: accessible at low cost (personal or academic edition) and quick return on investment.

3.4 Creation of Analysis tools

It is now considered necessary to create applications on the platform which allow easy operations in the information. It have been created three Qlikview files .qvw which are the worksheets where are stored all the functions and visualization tables.

The first file (See Fig 3.6) takes into account the four years of data and offers an analysis and a comparison of some characteristics such as the equivalent hours or the total year production of the units of production through the years.

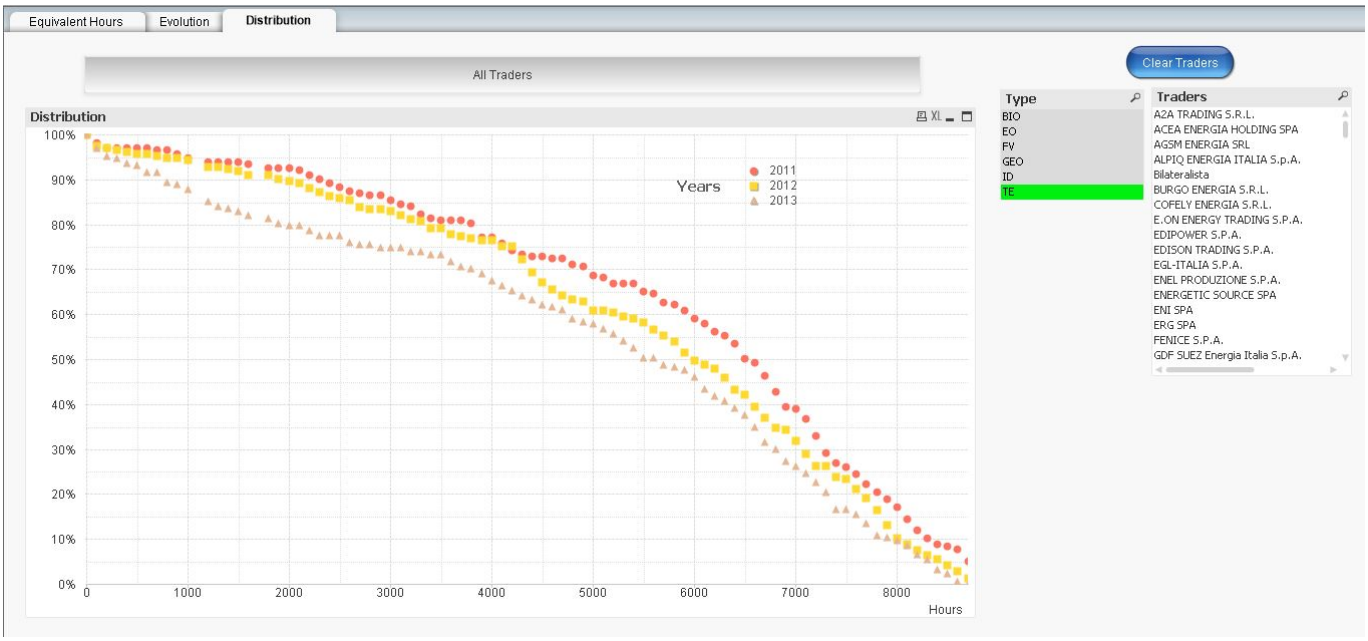

Figure 3.6: Interface of the Dashboard n^o 1

The second file (See Fig 3.7) is more a general framework of the generation. It helps to analyze the market shares and to know the time schedule production of each production unit. The inputs data are only concerning one single year at a time. To switch from one year to another, it is sufficient to apply the file to another set of data (another year).

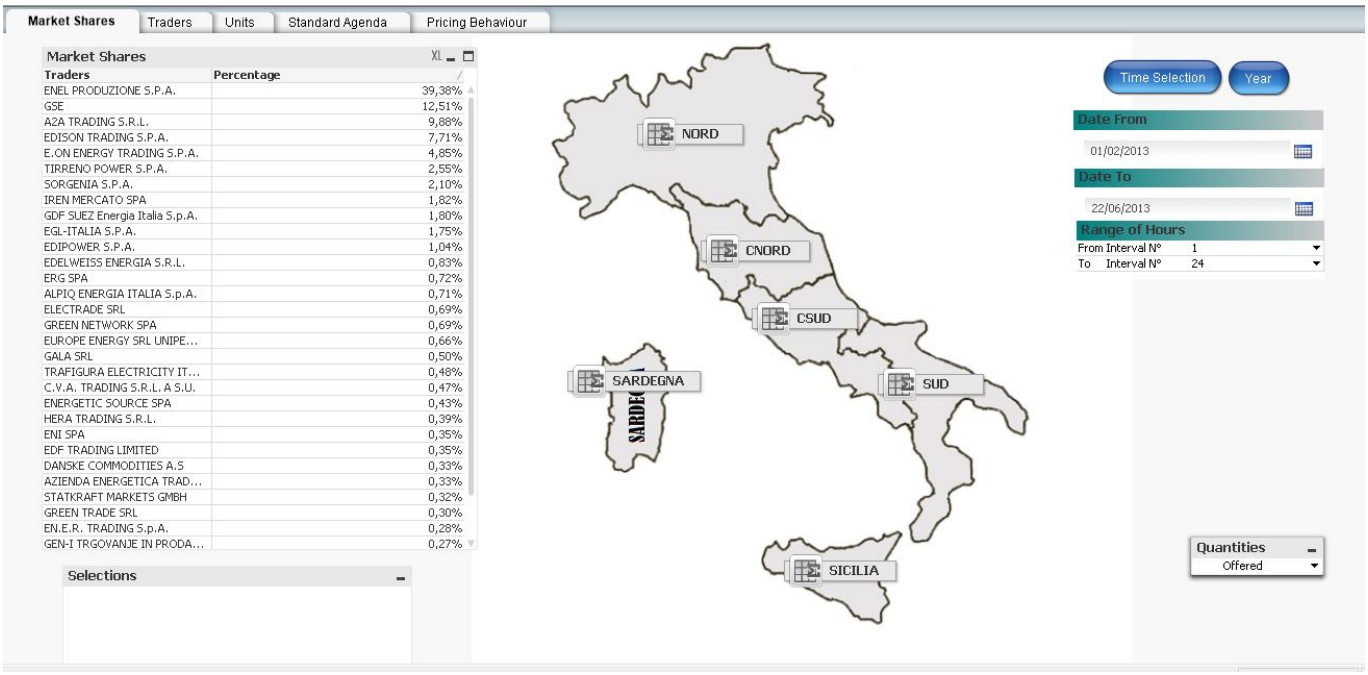

Figure 3.7: Interface of the Dashboard n° 2

Finally the third file is the only one which studies both the consumption and the production. It's as the second file a one year analysis and it's providing several functions and visualizations around the equilibrium price from the consumption and the generation point of view.

Chapter 4

Results of analysis

The databases are ready. On the one hand, the list of the production units is available with the maximum of information about the source of energy and the technology of the plant. On the other hand, the GME's data have been prepared and can be analyzed by the applications created on Qlikview®. Now, it's a question of clarifying the functions implemented in the applications, giving their relevance and the reasons of some approximations and of looking at the results. It's necessary to discuss all the outcomes of the analysis and to show how the thesis provides further insights into the issue of the Electricity Market operation.

First, the general framework of the production of electricity will be examined. Among others things, an investigated issue will be how the hours of production can be approximate. After focusing on the aggregate curves of demand and supply and the prices curves, it will be interesting to analyze the difference between market zones. Then the results of the market shares will be commented. The purpose is to understand who leads the Electricity markets and to compare the evolution by zones and by the years of the leading positions. Finally, the application about the scheduled power generation will be explained in more detail; at this point it's important to highline the benefits of such an interactive tool.

4.1 General Framework of Power Generation

4.1.1 Estimates of maximum power and capacity factor

The first function implemented helps to analyze the data in order to determine estimates of the maximum power delivered by each unit production and its capacity factor.

4.1.1.1 Calculation of the maximum power

It should be noted that such an input is already available in a register maintained by Terna. It used to be present in a record called Registro delle Unità di Produzione (RUP) which monitored the identifying data for all the production units accepted on the market and subject to registration for dispatching system. The Resolution of the authority AEEG

n° 124/10 of August 2010 has established the new system of registration for all the production units called GAUDI which stands for in Italian "Gestione delle Anagrifiche Uniche Degli Impianti di produzione e delle relative unità". After being validated as a production unit (UP), the unit is classified according to its power. If the maximum power is higher than 10 MVA, the unit is certified "relevant" (UPR for "rilevanti"), otherwise it's called "non relevant". The register codifies in a univocal way the production units and assigns them a unique reference code, the UNIT_REFERENCE_NO of the GME's data. Each producer, in order to be registered, must provide operational and technical data. Among other things, he must precise a minimum and maximum power between whom the generation unit is supposed to work. These are the values which need to be estimated.

Obviously, from the database it's rather difficult to extract the accurate information concerning the maximum power that a unit can possibly produce. Actually a single unit is able to offer the maximum power only if there is no technical constraints at all (which is quiet rare and unusual) or no environmental constraints or if the unit is not subject to energy reserve obligations from Terna's decisions. In fact the latter for purpose of controlling the power system needs to create energy margins and can force some units to produce below their maximum capacity. Moreover, it's possible to get really close to the real value by examining the data on a long time period. The idea is to extract the maximum hourly energy offer for each single production unit. For one UNIT_REFERENCE_NO, all the supply offers from the possible traders have been added concerning the same hour and the same day. Then the sums have been compared and only the maximum has been selected. The result is in practice a good approximation of the maximum power that a unit can produce.

The function takes in input the data from each year separately. Thus for each year an approximation of the maximum power is available which has been stored in four news fields into the production unit database (see section 3.2.1). As a result, a list of production units and their power is obtained and can be compared to the data available on internet as well as reused for further calculations. A better approximation is found if then the value is given taking the maximum through the four years of study. The first thirty unit powers (in decreasing order) and as possible the official respective values are given below (See Fig 4.1).

Unit Code	Type	Technology	Off. Power (MW)	Max Power (MW)
UP_DI1902_CNOR_B	-	-	-	19643
UP_DI1902_NORD_B	TE	Ccgt	-	19643
UPV_TERNA_CNOR	-	-	-	10000
UPV_TERNA_CSUD	-	-	-	10000
UPV_TERNA_NORD	-	-	-	10000
UPV_TERNA_SARD	-	-	-	10000
UPV_TERNA_SICI	-	-	-	10000
UPV_TERNA_SUD	-	-	-	10000
UP_DI8888_NORD_Y	-	-	-	5437,867
UP_DI8888_NORD_N	-	-	-	3607,693
UP_DI8888_SUD_Y	-	-	-	2620,717
UP_DI8888_SUD_N	-	-	-	2221,86
UPV_SWGDOENRDSTO	-	Abroad	-	1700
UP_DI8888_CSUD_Y	-	-	-	1685,635
UPV_SWGD105742O	-	-	-	1650
UP_DI8888_CNOR_Y	-	-	-	1532,779
UP_DI8888_NORD_H	-	-	-	1358,545
UPV_RTED105741O	-	-	-	1350
UPV_SWGDOEBEAKWO	-	Abroad	-	1314
UP_ETQCHIOTAS_1	ID	Pumped	1065	1249,108
UPV_SWGDOEDTSCHO	-	Abroad	-	1238
UPV_SWGD105852O	-	-	-	1200
UPV_SWGDOEAETRTO	-	Abroad	-	1200
UP_DI8888_CSUD_N	-	-	-	1182,067
UP_DI8888_CNOR_N	-	-	-	1180,031
UP_PRESENZAN_1	ID	Pumped	1000	1150
UPV_RTEDOEGRNNTO	-	-	-	1145
UPV_SWGDOEESLCDO	-	Abroad	-	1139
UPV_SWGD109783O	-	Abroad	-	1102
UP_RONCOVALG_1	ID	Pumped	1000	1100

Table 4.1: Largest power units

See Appendix A for the rest of the results. Please note that as mentioned above, when the information about the official power or the technology of the plant is unknown the field is left blank.

The first eight powers draw the attention; in fact they all exceed 10 000 MW. 6 of them are virtual units managed by Terna. They are exactly equal to 10 000 MW and correspond to each geographical zone. They aren't physical production units and have been introduced into the market platform in case of emergency. According to a Resolution of the AEEG, for each hour and each zone of the MGP market, Terna must present a virtual offer with the couple of values (Quantity x Price) equal to (10000MWh,3000€/MWh)to ensure a safety margin for the power system. The two first values of power are abnormal. In accordance with the GME's data about the technology, it suggests that they correspond to thermal power plants (Ccgt). After verification of all the offers made by these two units, it appears that the 21th December 2013 they both offered on every period of the day volumes of electricity higher than 18000 MWh and all the daily offers went partly accepted at the maximum capacity of the units (69,395 MWh for UP_DI1902_NORD_B and 8,397 MWh

for UP_DI1902_CNOR_B). For the rest of the year, both units had an operation perfectly normal. Such a high maximum power on the MGP is most likely an error in data oversight.

Let's take an example of the consistence of the results. Among the results given above, three can allow the comparison of the theoretical and the calculated power. These three production units are UP_ETQCHIOTAS_1, UP_PRESENZAN_1 and UP_RONCOVALG, three hydraulic power plants. The results found are close to the information available on the internet. Another example with the case of a specific well-known plant: the power plant of Ferrara controlled by the company Enipower Ferra s.r.l. owned at 51% by Enipower s.p.a. and at 49% by Axpo Italia s.p.a. It's a combined cycle power plant, fuelled by natural gas and divided into three generation groups for a total installed capacity of 841 MW; two combined cycles of 390 MW and one backup steam power plant of 61 MW. In the Appendix A, the two production units of 390 MW can be found with both a maximum power of 381 MW under the unit codes: UP_SCTNPWPFRR_2 and UP_SCTNPWPFRR_3. Therefore, even if the data on which is based the study of the thesis present an inherent and inevitable risk of error, the method of calculation ensure reliable results.

4.1.1.2 Calculation of the capacity factor

The capacity factor is a measure of the efficiency, which is defined as the ratio of the actual output of a power plant over a period of time to its energy output if it had operated at full capacity. This is calculated by totaling the energy plant actually produced and dividing it by the energy it would have produce if running the entire time at full capacity. As the time period of the study is the year, the factor is associated to the equivalent hours which constitute the equivalent relationship between the operational time of the machine and its nominal capacity. To switch from a concept to the other, it's only necessary to divide by one year expressed in hour (365.25*3600).

$$\begin{cases} F = \dfrac{Q_{el}}{P_{nom}.\Delta t} \quad (\%) \\ H_{eq} = \dfrac{Q_{el}}{P_{nom}} \end{cases}$$

where Q_{el} = Actual quantity of electricity produced within the period Δt (MWh),
P_{nom} = Nominal Power of the Plant (MW_{el})
Δt = Period of time of the study = 1 year = 1314000 hours

For the power used in the equations, the definitions differ in substance. Sometimes, the power refers to the nominal power as mentioned above and sometimes it is relative to the plant functioning at full capacity and hence to the maximum operating power. The calculation of the maximum power from the GME's data seems to agree with the concept

of both definitions.
To approximate the quantity of energy actually produced by a production unit, all the supply offers and their respective quantities accepted or not on the MGP and MI market which concern this unit are available.The user of the application can choose the way he wants to approach the value of the total quantity of electricity. The user can define the quantity as:

- the energy proposed over one year on the Day-Ahead Market (MGP). This value may be considered as the total amount of energy the production unit is ready to produce in one year. The equivalent hours calculated with this selection criterion could be compared to the theoretical operating hours of the unit and common knowledge. For example capacity factors close to 25% can be expected for the wind turbines.

- the energy accepted over one year on the MGP. This is the quantity that the unit is supposed to produce after the execution of the market. It is obviously lower than the former value and may reflect certain price behaviors or constraints.

- the energy modified over one year after the first session of the Intra-Day Market (MI). The operator of the unit could adjust its production schedules defined in the MGP.

- the energy modified over one year after the second session of MI (MI2). The operator of the unit could adjust its production schedules defined in the MGP and already modified in the first session of the MI market. For one market participant this value may represent the market decision on his own will of producing or not. In fact after these two sessions, the ancillary services market begins.

In addition to the quantity choice, the user can display only the units of one energy source or of one market participant and he can choose the year of study. All the results for year 2013 and the fourth definition of the total quantity produced (i.e. adjusted after the two first sessions of MI) are annexed (See Appendix A same table as the maximum power).

Obviously, all the production units cannot operate with a capacity factor of 100%. First of all, some technologies do not permit it. This is the case of a few renewable power units which operate with unpredictable and inconsistent source. The wind power even if remain competitive with the government subsidies and the price zero of the energy source is still very unsteady and the wind power plant won't operate over 3500 equivalent hours. Furthermore, the price-competitive market forces are enforced, and a lot of supply offers are refused because of a price submitted by the market participant too high. It's difficult to foresee the behavior and the consequences for a virtual production unit (UPV) but as regards the real production units (UP) this means cutting the production and operating far below the maximum capacity. In other words, low equivalent hours are expected for a few units. However, it's surprising to find so many power plants functioning below 30% of capacity, especially for the thermal power plants. For example, the Gas Natural plants UP_CASSANO_2 owned by A2A, UP_CHIVASSO_1 owned by Edipower and UP_TRAPANI_C_1 owned by E.ON with equivalent hours which don't exceed 1000 deserve more attention.

Let's try to explain the reasons of such low values of hours:

- UP_CASSANO_2 : the unit is part of the thermal plant of Cassano d'Adda, property of A2A. The plant is composed of two Ccgt generation units; one has a total capacity of 230 MW and the second 760 MW. It's about the second one and the calculation of the maximum power gives a result of 752 MW which is a consistent result. The table in Appendix A indicates also a number of equivalent hours around 918 and a capacity factor of 10% which represent just a little over a month of production. On closer examination about the situation of A2A in Italy during the year 2013, it seems that because of the decrease of the energy consumptions and sales, the company has decided to close for short period some of its power plants (including Cassano). At it is generally the case in industries, when the output is compromised, the number of employees needs to be reduced and that's what A2A planned to do in the course of the year 2013 and 2014. This highlights the difficulties for the fuel fossil power companies to remain competitive and in full-production.

- UP_CHIVASSO_1: the unit is part of a thermal plant having a total power of 1179 MW composed by two Ccgt generation units (the first section with 790 MW and the second with 390 MW). This is evident in the table in Appendix A that the plant doesn't produce at full capacity; 630 equivalent hours with a maximum power of 775 MW for the given section. This is another example of the difficulties that is facing A2A (Edipower is largely owned by A2A). In fact, in December 2013, the companies A2A and Edipower Spa announced that the production could not continue anymore because of the lack of competitiveness of the plant. Thus the generating station of Chivasso will be closed throughout 2014.

- UP_TRAPANI_C : The power station of Trapani owned by E.ON is located in Sicily and is composed of two open-cycle gas turbines fuelled by natural gas for a total power of 214 MW (107 MW + 107 MW). On the table in Appendix A the two units UP_TRAPANI_C_1 and UP_TRAPANI_C_2 have similar results: respectively 105 and 106 MW of maximum power, 403 and 397 of equivalent hours and 5 % of capacity factor for both of them. These results are very bad for a thermal power station. Actually, since March 2011 a rehabilitation project of the two turbines has been launched with the modernization and the replacement of the main components. Therefore the results of the table may be due to a voluntary stop of production. This is another explanation for the capacity factor very low for a lot of thermal power plants: the production shut-down for maintenance or organizational plan reasons.

As mentioned before, the user of the application can also focus on one type of energy source or one type of technology and draw a specific chart according to his choice. For example, by choosing the energy source type TE, he focuses on all the thermal power stations and provides more arguments for the debate made above. The first twenty thermal production units in term of factor capacity for 2013 are detailed below, the first table with the selection of total quantity proposed on the MGP (Table 4.2) and the other table with the selection of total quantity accepted on the MGP and MI (first and second sessions) (Table 4.3).

Unit Reference	Prov.	Zone	Type	Technology	Total Quantity (MWh)	Power Max (MW)	Equivalent Hours (heq)	Capacity Factor
UP_CNTRLDTSTI_7	FI	CNOR	TE	Ccgt	540 910	62,8	8 613	0,98
UP_CNTRLLTTRG_1	GO	NORD	TE	Ccgt	491 459	57,3	8 577	0,98
UP_ASSEMINI_2	CA	SARD	TE	GT	641 125	75	8 548	0,98
UP_SPEZIA_CE_1	SP	NORD	TE	Ccgt	2 821 780	331	8 525	0,97
UP_ASSEMINI_1	CA	SARD	TE	GT	635 725	75	8 476	0,97
UP_SANQUIRICO_1	PR	NORD	TE	Ccgt	1 124 079	132,669	8 473	0,97
UP_SPEZIA_CE_2	SP	NORD	TE	Ccgt	2 768 840	330	8 390	0,96
UP_MONTALTO_4	VT	CSUD	TE	Methane	6 498 640	780	8 332	0,95
UP_BRNDSSUDCE_1	BR	BRNN	TE	OilCoal	5 034 755	605	8 322	0,95
UP_GIUGLIANO_1	NA	CSUD	TE	Methane	581 280	70	8 304	0,95
UP_FUSINA_T_2	VE	NORD	TE	Coal	1 275 125	155	8 227	0,94
UP_LA_CASELL_4	PC	NORD	TE	Ccgt	2 629 036	320	8 216	0,94
UP_BRNDSSUDCE_4	BR	BRNN	TE	OilCoal	4 945 937	605	8 175	0,93
UP_BASTARDO_1	PG	CNOR	TE	Coal	530 037	65	8 154	0,93
UP_MONTALTO_2	VT	CSUD	TE	Methane	6 593 405	810	8 140	0,93
UP_TORREVALN_4	RM	CSUD	TE	Coal	4 871 275	600	8 119	0,93
UP_PIETRAFIT_5	PG	CNOR	TE	Ccgt	2 954 919	365	8 096	0,92
UP_MONTALTO_1	VT	CSUD	TE	Methane	6 141 350	760	8 081	0,92
UP_SBARBARA_3	AR	CNOR	TE	Ccgt	3 138 831	395	7 946	0,91
UP_FUSINA_T_3	VE	NORD	TE	Coal	2 284 292	290	7 877	0,90

Table 4.2: First twenty thermal power plants - Based on the total quantity offered on MGP

The values of the capacity factor are very high. That represents a theoretical functioning and it reveals the role of the base load power plants which operate at maximum output. They could even never shut down if any maintenance process weren't necessary. These plants are most economically used at maximum capacity for positive return on investment reason. They usually include coal, fuel oil, geothermal, nuclear, and hydroelectric and combined cycle plants (Nuclear can't be taken into consideration for Italy). That's why, by choosing the total quantity proposed as reference quantity value, such results are expected.

Unit Reference	Prov.	Zone	Type	Technology	Total Quantity (MWh)	Power Max (MW)	Equivalent Hours (heq)	Capacity Factor
UP_TORREVALN_4	RM	CSUD	TE	Coal	4 412 221	600	7 354	0,84
UP_FUSINA_T_3	VE	NORD	TE	Coal	1 907 448	290	6 577	0,75
UP_BRNDSSUDCE_4	BR	BRNN	TE	OilCoal	3 553 830	605	5 874	0,67
UP_BRNDSSUDCE_1	BR	BRNN	TE	OilCoal	3 177 556	605	5 252	0,60
UP_FUSINA_T_2	VE	NORD	TE	Coal	702 296	155	4 531	0,52
UP_BASTARDO_1	PG	CNOR	TE	Coal	167 423	65	2 576	0,29
UP_CNTRLDTSTI_7	FI	CNOR	TE	Ccgt	80 558	62,8	1 283	0,15
UP_CNTRLLTTRG_1	GO	NORD	TE	Ccgt	65 980	57,3	1 151	0,13
UP_PIETRAFIT_5	PG	CNOR	TE	Ccgt	62 988	365	173	0,02
UP_SPEZIA_CE_2	SP	NORD	TE	Ccgt	15 461	330	47	0,01
UP_LA_CASELL_4	PC	NORD	TE	Ccgt	13 185	320	41	0,00
UP_SPEZIA_CE_1	SP	NORD	TE	Ccgt	7 353	331	22	0,00
UP_SBARBARA_3	AR	CNOR	TE	Ccgt	7 968	395	20	0,00
UP_ASSEMINI_2	CA	SARD	TE	GT	1 435	75	19	0,00
UP_ASSEMINI_1	CA	SARD	TE	GT	1 033	75	14	0,00
UP_SANQUIRICO_1	PR	NORD	TE	Ccgt	0	132,669	0	0,00
UP_GIUGLIANO_1	NA	CSUD	TE	Methane	0	70	0	0,00
UP_MONTALTO_1	VT	CSUD	TE	Methane	0	760	0	0,00
UP_MONTALTO_2	VT	CSUD	TE	Methane	0	810	0	0,00
UP_MONTALTO_4	VT	CSUD	TE	Methane	0	780	0	0,00

Table 4.3: Same thermal power plants - Based on the total quantity accepted on MGP, MI1 and MI2

The same units have been left selected and it has been chosen the total quantity accepted on the Day-Ahead and Intra-day markets as reference quantity. It's important to notice the difference of capacity factors from one table to the other. Some plants have an effective capacity factor around zero which means no production at all. This is the case of the gas turbines UP_ASSEMINI and UP_MONTALTO. This table shows the importance of the energy source to be competitive with the regress among the twenty units of all the plants fuelled by gas. Remain at the top of the list only the coal power stations with expected base load plant results.

4.1.2 Analysis by energy source

4.1.2.1 Evolution over time

Now it is interesting to see how the factors calculated before change during the years and with the type of energy source. The focus is entirely placed on the equivalent hours with always the ability for the user to choose the reference quantity. Another function has been added and allows the user to access to the average or the median (which may be a better indicator than the average when the data are distorted by extremely high or low values). The following bar charts (Fig 4.1 and 4.2) indicate the average of equivalent hours depending on the year (2011, 2012 and 2013 data are displayed – 2010 is excluded for good visualization reason) and depending on the type of energy source. The values and the detail for each energy source are available separately on the application and appear in the following pages (only the thermal sector is detailed. See Tables 4.3 and 4.4).

It may be recalled that the information about the type of energy source is limited and depends on the researches and general data available on the Internet. In this case, doing the average for the biomass or the photovoltaic sectors is not relevant in the very few data available.

At first sight, the results are consistent. Concerning the calculation theoretical (based on the quantity offered), the equivalent hours for the geothermal sector are around 6500 as expected, the ones for hydropower and thermal sector are similar and between 4000 and 5500 and the windpower sector is much lower with values around 2000.

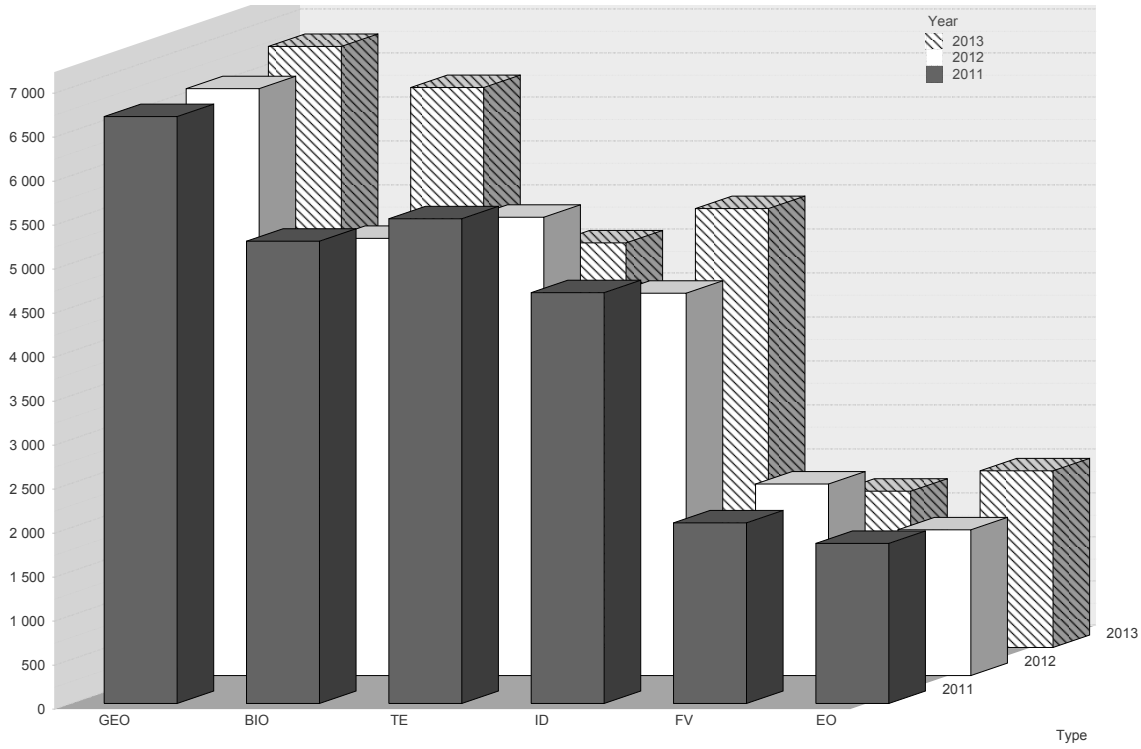

Figure 4.1: Evolution of the equivalent hours - Based on the total quantity offered on MGP

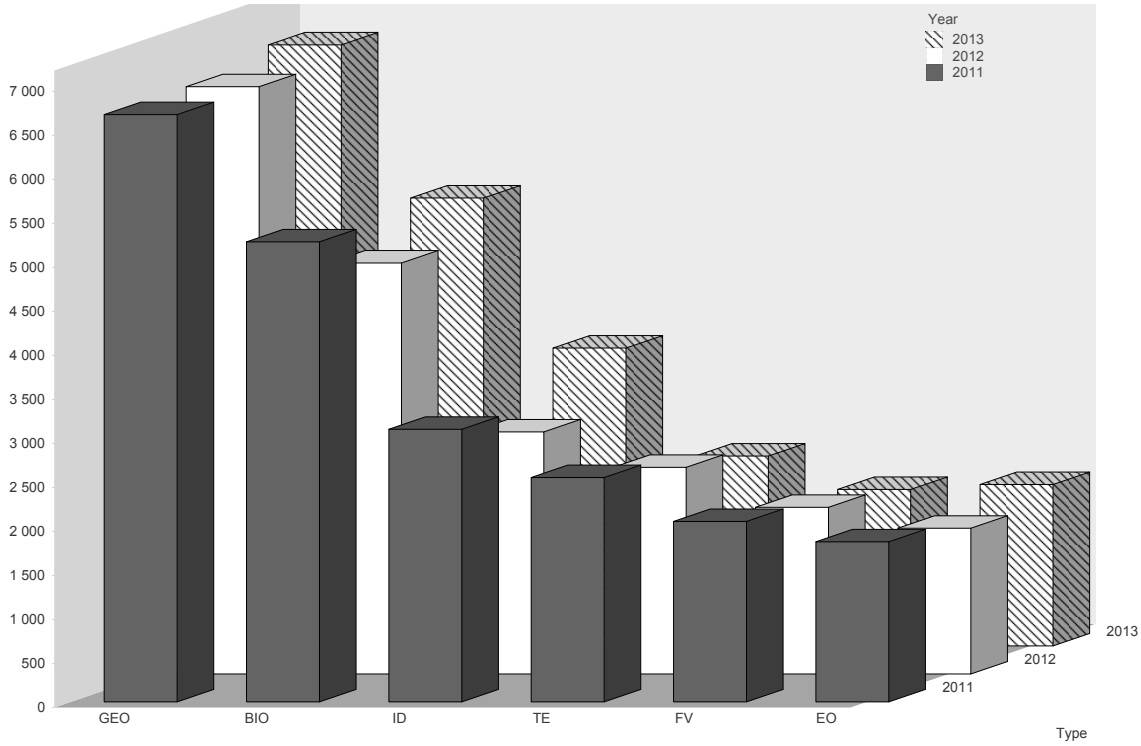

Figure 4.2: Evolution of the equivalent hours - Based on the total quantiy accepted on MGP, MI1 and MI2

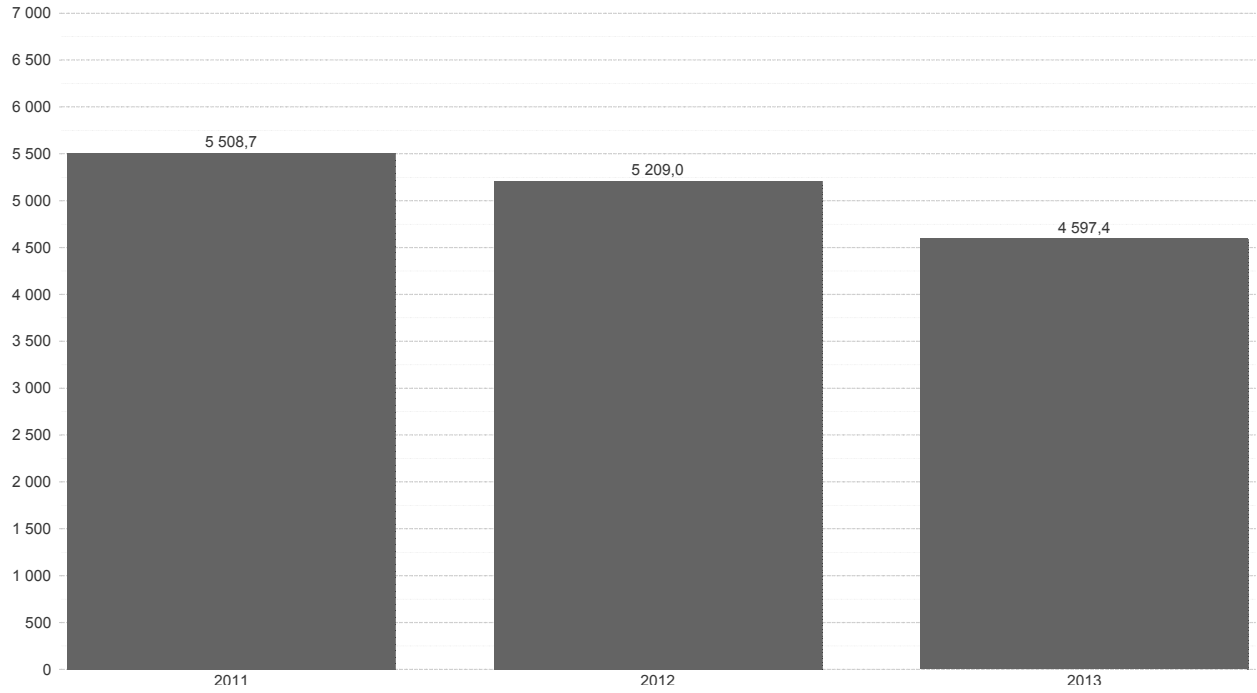

Figure 4.3: Average of the equivalent hours for Thermal plants- Quantity Offered on MGP

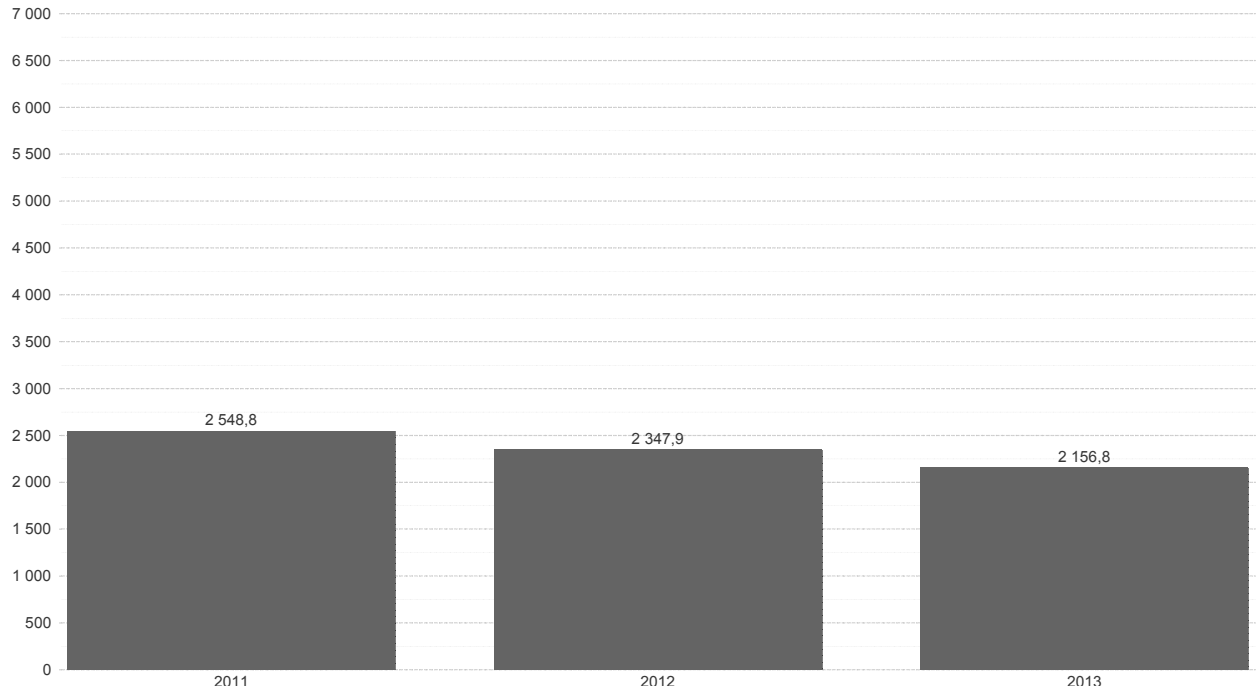

Figure 4.4: Average of the equivalent hours for Thermal plants- Quantity Accepted on MGP, MI1 and MI2

Type	Year	2011	2012	2013
BIO		5 255	4 970	6 365
EO		1 819	1 657	2 008
FV		2 053	2 176	1 777
GEO		6 671	6 670	6 830
ID		4 670	4 345	4 989
TE		5 509	5 209	4 597

Table 4.4: Average of the equivalent hours- Quantity Offered on MGP

Type	Year	2011	2012	2013
BIO		5 226	4 669	5 089
EO		1 819	1 655	1 833
FV		2 049	1 894	1 777
GEO		6 671	6 672	6 827
ID		3 097	2 751	3 383
TE		2 549	2 348	2 157

Table 4.5: Average of the equivalent hours- Quantity Accepted on MGP, MI1 and MI2

The results correspond with the typical equivalent hours. According to the International Energy Agency (IEA), in 2010 on average in the world the equivalents functioning hours are: around 5000 for the thermal power stations (3700 natural gas plants - 5600 coal plants), around 2100 for the wind farms, around 2000 for the photovoltaic units and around 3500 for the hydroelectric plants (source : IEA 2010 [9]). For the hydropower systems, the value depends of the scale and the design of the plants. It's normal in Italy to find the present values (around 4600 hours). However, the calculation of the equivalent hours based on quantity offered presents lower statistical significance and can at least give an idea of the production capacity. The second method is more valuable and corresponds to on-the-ground reality. It is an indicator of the actual situation of the Italian electricity balance as outlined in the part 2.2.3 . Indeed the average of the equivalent hours for the thermal power plants is much lower than the international average given by the IEA and has decreased from year to year. This indicates that, on average, the thermal power plants produce less and less whereas except for the photovoltaic sector, the other production units produce more in 2013. The year 2012 seems to be a difficult year for the productivity of the whole electricity park. Actually, the decrease of the equivalent hours of the thermal sector appears to benefit to almost all the other sectors. This highlights a general trend which is manifested by a slowdown of the activity of the combined cycle power and coal plant in favor of other sectors more encouraged such as the renewable energies (See section 2.2).

The "theoretical" production (before the execution of the market) and the "effective" production (after decision of the MGP and MI markets) of the wind power sector, the geothermal sector and the photovoltaic sector remain almost unchanged. The thermal power sector is experiencing the market laws with an average divided by two from 4597 hours in 2013 with the first reference quantity to 2157 hours in 2013 with the second. In

terms of global competition, the hydropower is facing difficulties too with a between 30 and 40 % decrease of the equivalent hours.

4.1.2.2 Distribution of the equivalent hours

Another function implemented in the application is the distribution of the equivalent hours. The frequency distribution is a statistical tool which helps to understand how an expression is distributed over classes of data. The tool is useful for a large amount of data; the sample can't be reduced to a few elements. That's why the function won't be applied to the biomass and photovoltaic sector. The analysis has been conducted only based on the quantity offered on the MGP in order to compare the results with the typical curves [7]. On the chart, the median is easily retrievable by looking at the value of equivalent hours for 50%.

- Hydropower:

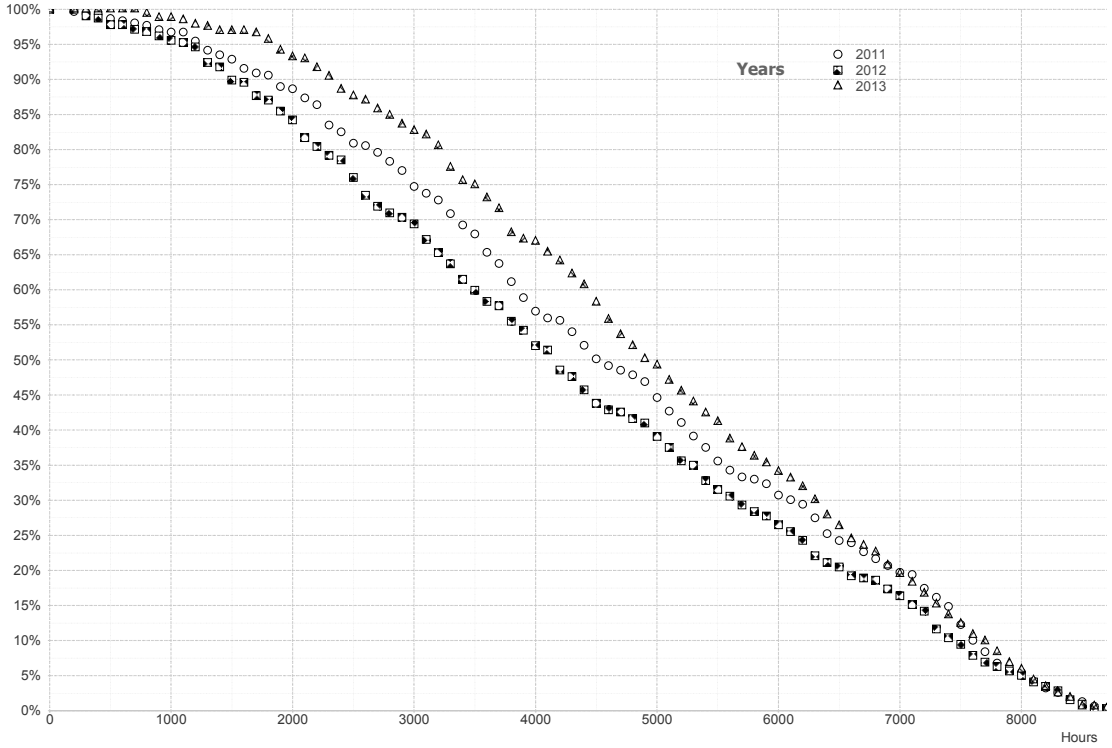

Figure 4.5: Distribution % of the equivalent hours of the hydroelectric power plants

It may be noted the slight decline of the 2012 curve, probably caused by climatic conditions less favorable. In fact, the total annual rainfall for the year 2012 was lower than the average of the previous years. The distribution seems to be linear which can be explained by the great variety of plants in the hydropower sector. From the micro

hydro power stations to the big pumped-storage hydropower plants, the operating criteria are really different and cover all the possible functioning hours. The median is between 4000 and 5000 hours which corresponds a normal hydroelectric plant.

- Thermopower:

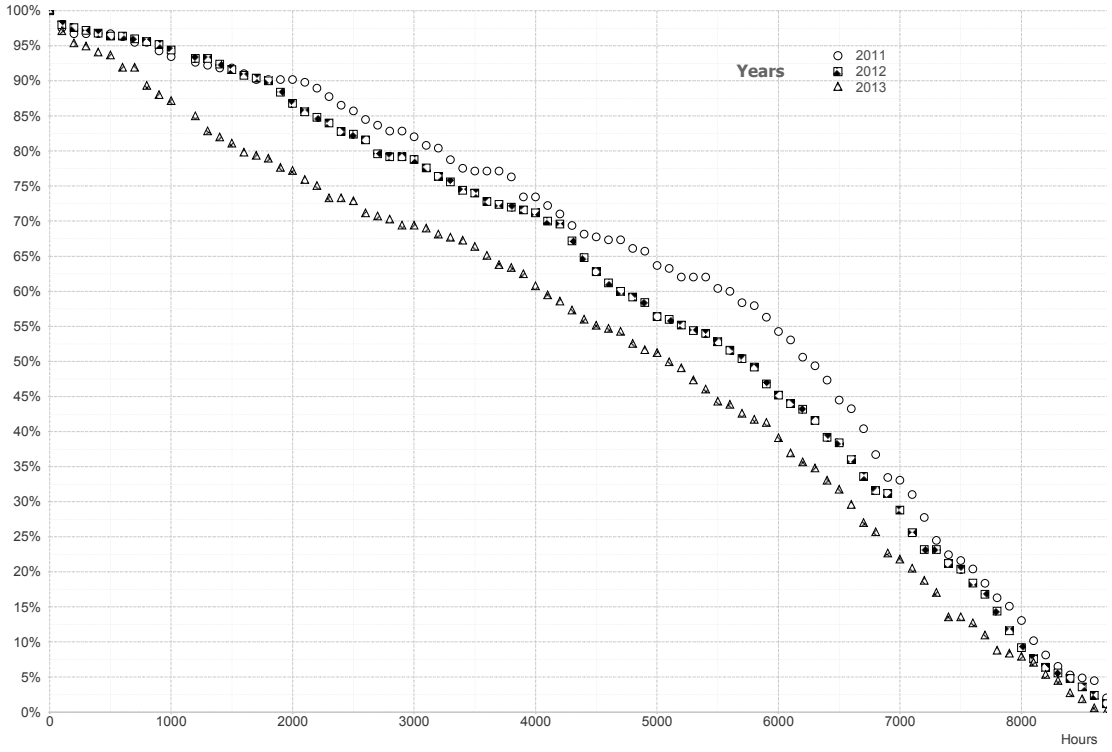

Figure 4.6: Distribution % of the equivalent hours of the thermoelectric power plants

On this graph, it seems clear the activity of the thermoelectricity park is in decline. The median of equivalent hours is between 5000 and 6500 which is a rather high value compared to the other sectors. The distribution seems to be linear which can be explained by the difference of the fuel used and the function of the plant. Some power stations will be devoted to the production of baseload supply (base load plants) and their equivalent hours will be significant (above 6000). This is the case of some plants fuelled by coal and combined cycle power plants. Other plants will be considered as load following plants. They adjust their power outcome and have construction cost, fuel cost which don't force them to produce the more possible. Typically, those are gas turbine power plants. All the types of technology of the thermal power plant are sufficient to explain the linear coverage of the equivalent hours.

- Windpower

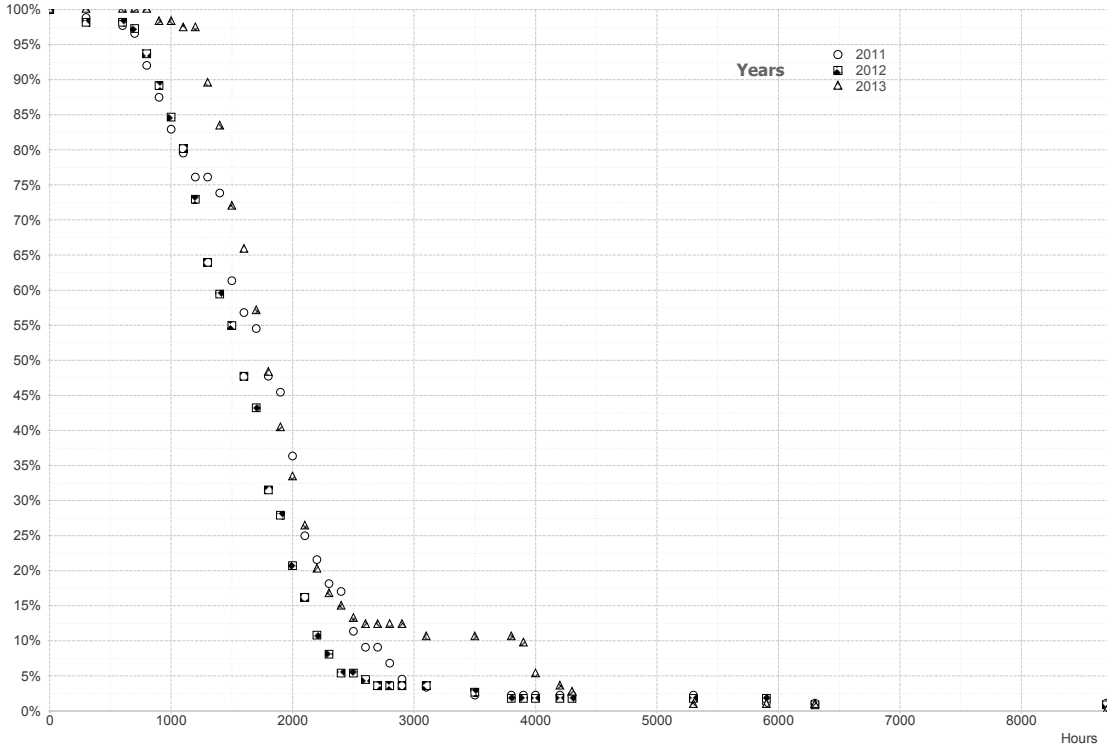

Figure 4.7: Distribution % of the equivalent hours of the wind power plants

This time, the curve is not linear anymore and has a particular trend; from 1000 to 2000 hours the curve is almost vertical because of the characteristics of the wind power. In fact, the constructions of the windpower plants are studied and the incentives from the government are created in order to ensure a certain production for these plants. There are very few stations below 1000 hours. Besides, the very nature of the wind doesn't help to go beyond the limit of 3000 hours. The median is between 1500 and 1750. And the curves are very similar.

- Geothermopower

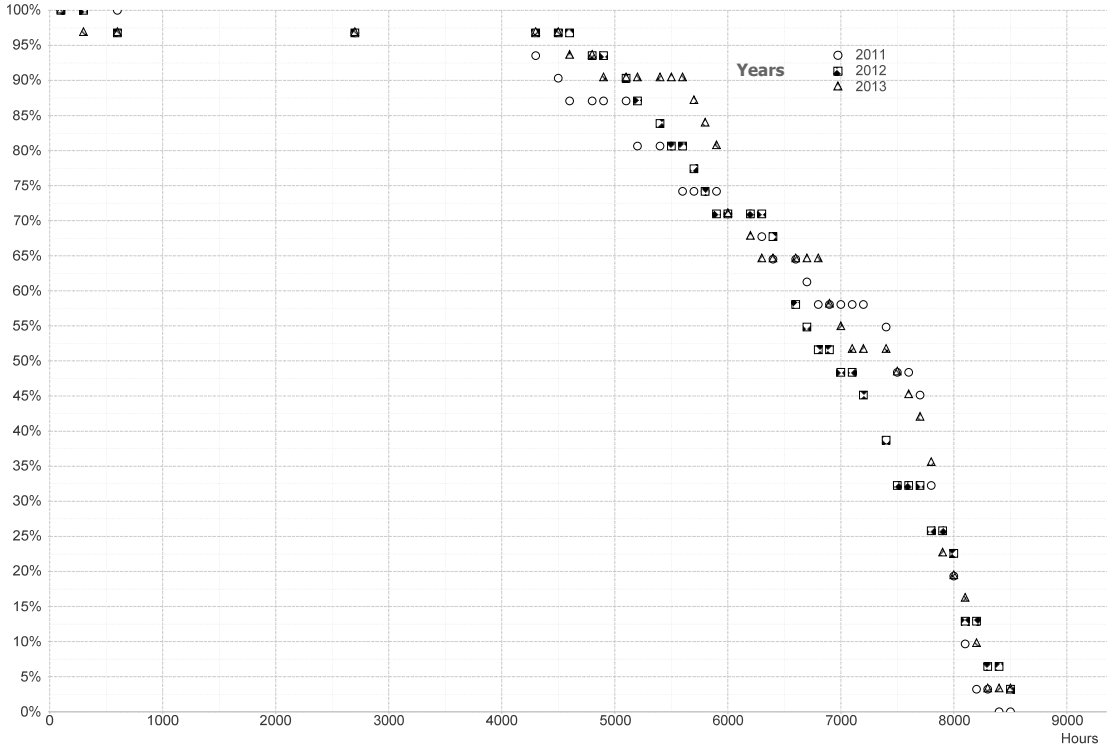

Figure 4.8: Distribution % of the equivalent hours of the geothermal power plants

The trend of the curves of the distribution is representative of the status of baseload plants and the competitiveness of the geothermal power plants. 95% of the production units are above 4000 hours. The median is between 7000 and 7500. And almost 20% is above 8000 equivalent hours which a huge figure.

Summary table of data processed

The following table summarizes a few figures which illustrate the potential of the work carried out in this part and help to realize the huge amount of data analyzed.

		N° of units	N° of Transactions	Volume accepted	Save file size
Year	2010	1066	11 931 552	267 TWh	996 Mo
	2011	1034	12 397 502	257 TWh	970 Mo
	2012	1143	12 445 081	263 TWh	983 Mo
	2013	1215	14 010 813	248 TWh	1050 Mo
	Total	895*	50 784 948	1 035 TWh	3.88 Go

* number of adequate units for the comparison between years (units which produced for the four years)

4.2 Demand and Supply Curves

One of the main foundation concepts of the execution of the Day-Ahead Market is the acceptance process. Based on energy auctions, the market resolution process is activated by the GME after the end of the bid/offer submission sitting, and hence for each of a day. All the valid and adequate bids/offers are selected ("ACC" and "REJ" for the field STATUS_CD in the GME's database). Then all purchase and sell orders are aggregated into two curves, an aggregate demand curve where bids are ranked into decreasing price order and an aggregate supply curve where offers are ranked into increasing price order. The system price for each hour of a day is determined by the intersection of the curves (only if the schedules do not violate any transmission limit - see Part 1.4.1.2). One work of the thesis is to in an appropriate file provide several functions and visualizations which approach the matching electricity market supply and demand.

In input, the application concerns one single year at a time. The user can choose the year of study before the upload of the data. All the bids/offers inadequate (INC), replaced (REP), revoked (REV) or submitted (SUB) have been put aside. Then all the bids/offers have been treated separately depending on whether they concern sales (OFF) or purchase (BID). In the script, functions have been created in order to calculate the right aggregate curves. It has been chosen to create four different aggregate indexes to get a more general framework of the resolution process. The indexes correspond to four analysis situations that the user can choose on the application:

- Single Zone: Visualization of the aggregate curves for each single zone. The reference lines of the selling price and the purchasing price can be displayed. The user has also access to the total amount of purchases and sales of the zone and he can know which is the marginal unit (i.e. the production unit whose the offer correspond to the equilibrium price).

- Zonal Distribution: When one limit transmission is violated in the resolution process, the algorithm splits the market into macro-zones. In each macro-zone, the algorithm is repeated. The function is used to define the different macro-zones of the execution of the market and highlight the price-making process with the intersection of the aggregate curves. The user, choosing this option, will have to select the set of zones he wants to visualize. Actually, in a macro-zone all the zone share the same unit price. The user may also visualize the identity of the marginal unit.

- Italy: Visualization of the aggregate curves of the Italian territory. For the calculation of the aggregates quantities, only the data about the zones Central ern Italy (CNOR), Central Southern Italy (CSUD), Northern Italy (NORD), Southern Italy (SUD), Sicily (SICI), Sardinia (SARD), Brindisi (BRNN), Foggia (FOGN), Priolo (PRGP) and Rossano (ROSN) have been taken into account.

- Total: Visualization of the aggregate curves for all the adequate bids/offers.

As stated above for the single zone, the application whatever the option selected provides the total amount of sales and purchases of the zones concerned and for the period of time selected.

A clarification about the calculation of the aggregate demand curve should be added. As demand bids express the willingness to purchase a volume of electricity not higher than the one specified therein and at a unit price not higher than the one specified therein, if a market participant is ready to purchase at any price, in theory he should only specify a volume of electricity. However, in practice, GME sets the price to zero. Consequently, in order to respect the price decreasing order of the resolution process, all the bid prices (ENERGY_PRICE_NO) equal to zero have been set to 3000 €/MWh as arbitrary quantitative value. They are hypothetical infinity prices.

The screen-shot below shows the visualization window of the application.

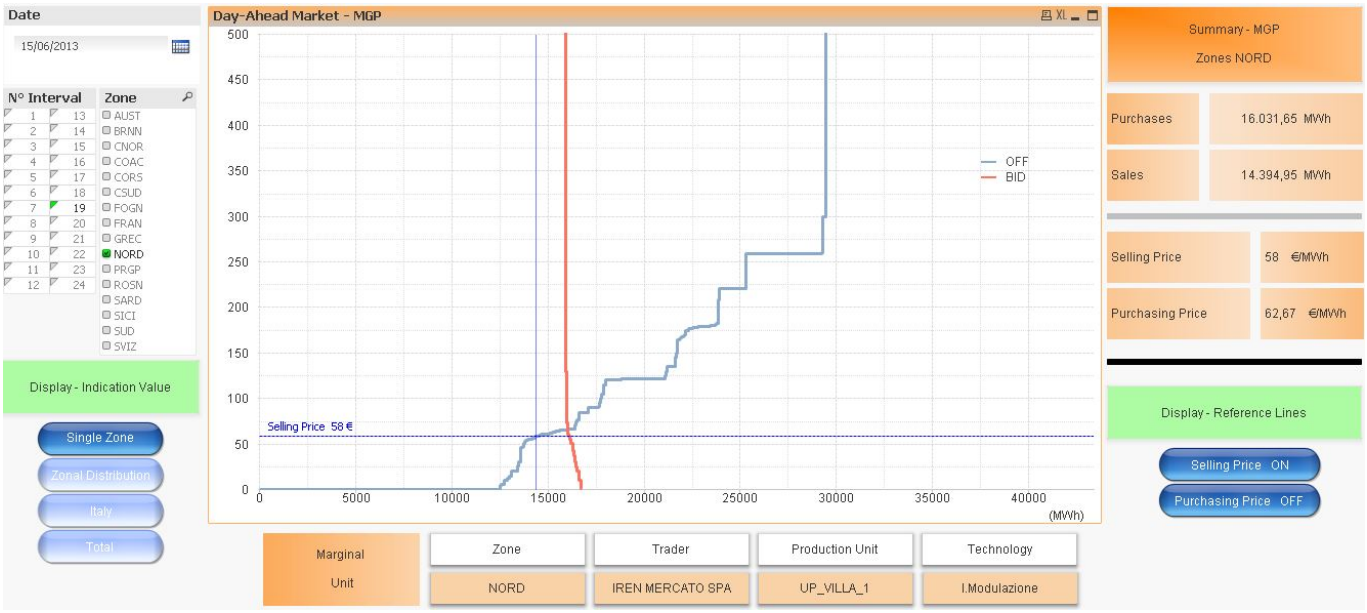

Figure 4.9: Interface of the Dashboard n° 3

The application is conceived as an interactive tool. The user updates the data after choosing the year of study and then can browse and manage data so that he makes his own analysis on the days and the periods selected. The goal of this part of the thesis is to focus on a representative sample of data in order to underline the relevance and the consistence of the tool. Two periods have been chosen: the 15th of June 2013 Interval n° 19 (i.e. the hour from 6 PM to 7 PM) and the 24th of October 2013, Interval n° 19.

◇ Saturday, 15th of June 2013

On the following page, the graphs of the aggregate curves for the zone Northern Italy and Sicily are depicted. For the applicable period, they are the zones in which the marginal units are present. For the North this is the unit UP_VILLA_1, a pumped-storage hydroelectric power plant, with the offer made by the trader IREN S.p.a. For Sicily, this is the unit UP_TERMINI_I_6, a combined cycle power plant with an offer from a bilateral contract.

In both charts, the stepped supply and demand curves are identifiable, and especially the final step which corresponds to the virtual units managed by Terna. For each hour and each geographical zone of the MGP market, Terna must present a virtual offer with a unit price equal to 3000 €/MWh. Therefore the vertical growth of the supply curve and the vertical decline of the demand curve are prompted by the existence of bid fixed demand participants (i.e. they will buy at any price) and the monitoring of Terna.

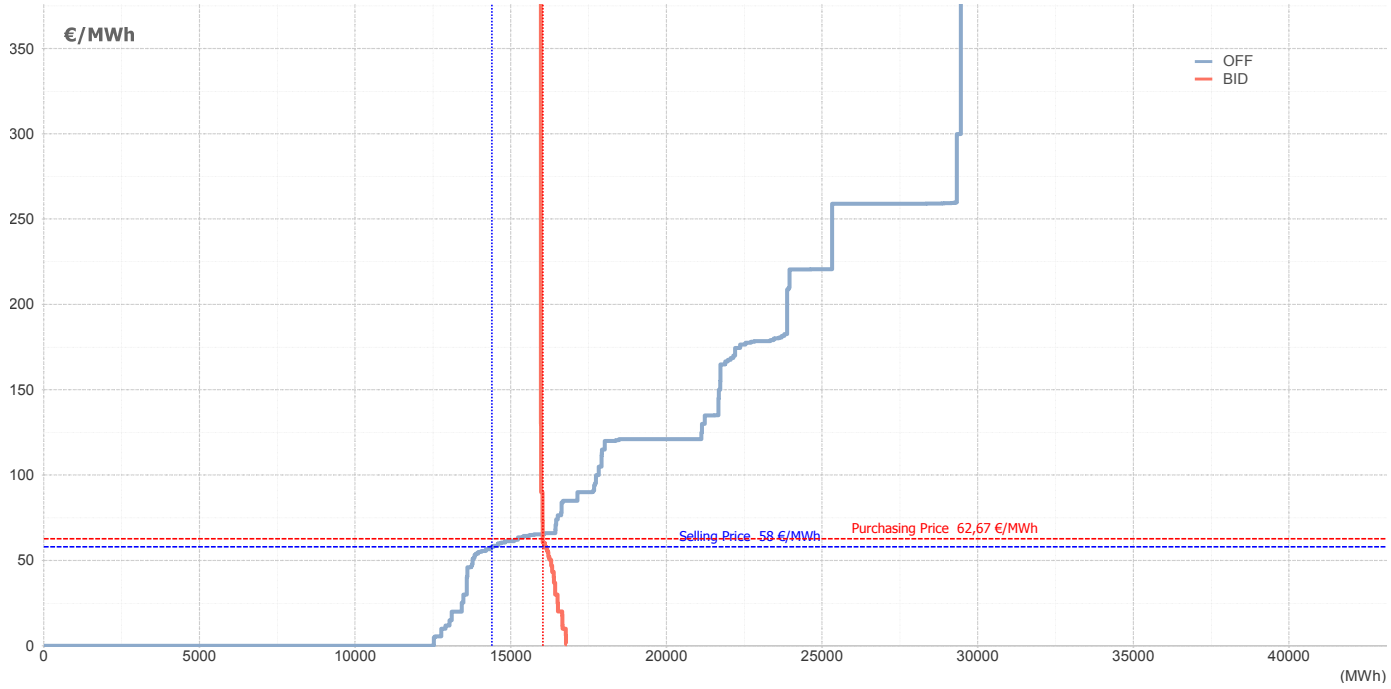

Figure 4.10: Demand and Supply Curves for Northern Italy - June 15th, 2013 - Interval nº 19

The diversity of supply is also particularly noteworthy; in fact the supply curves have a lot of steps over the selling price. For the zone Northern Italy, the selling price is set at 58 €/MWh. Many offers have been made over this price. Almost 4000 MWh have been offered at a price around 260 €/MWh, 4.5 times higher than the clearing price. This price gives the accepted offers and the withdrawal schedules of

the zone. The overall traded volume for Northern Italy for the applicable period is 14 394,95 MWh. All accepted supply offers are valued at this clearing price whereas the accepted demand bids are valued at the national single price (PUN) which is equal to 62,67 €/MWh because the zone is a geographical zone. The PUN set the total amount of purchases to 16 031,65 MWh.

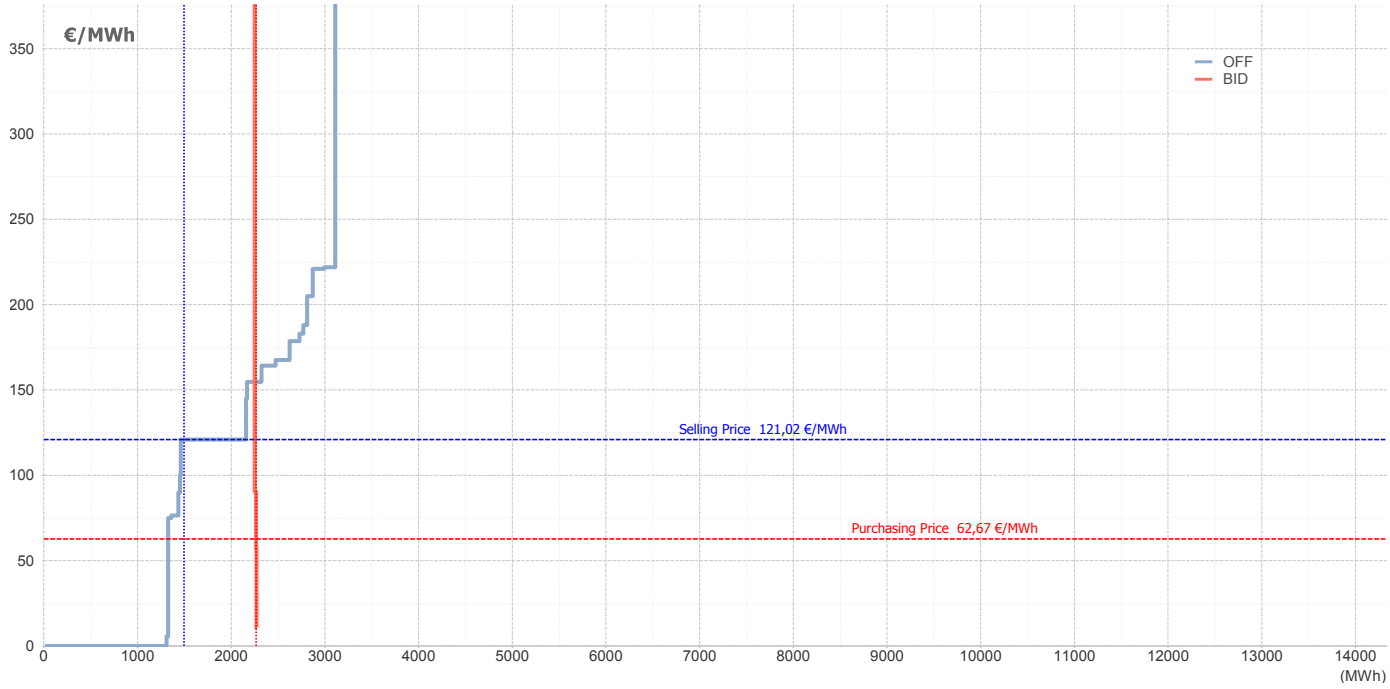

Figure 4.11: Demand and Supply Curves for Sicily - June 15th, 2013 - Interval n^o 19

For the zone Sicily, the selling price is set to 121,02 €/MWh. It gives all the accepted offers and the overall traded volume: 1 496,56 MWh. The demand bid are valued at the national single price too and the amount of purchases is 2 265,88 MWh. All those data are consistent with the information found on the GME's report.

The Clearing Price

For a better understanding of the price-making algorithm, the different zones have been divided into groups with the same selling prices. The idea is to approach the step-wise mechanism which repeats resolution process on the groups of zones separately. For each hour of a day, the user has access to selection from among the groups in the option "Zonal Distribution". On the chart below are displayed the aggregate demand and supply curves for the first group of zones which includes Central Northern Italy (CNOR), Central Southern Italy (CSUD), Nord Italy (NORD), South Italy (SUD, Sardinia (SARD), Brindisi (BRNN), Foggia (FOGN), Rossano (ROSN), Austria (AUST), France(FRAN), Greece

(GRE) and Switzerland (SVIZ). One can clearly recognize the intersection of demand and supply curves which sets the unconstrainted clearing price: 58 €/MWh.

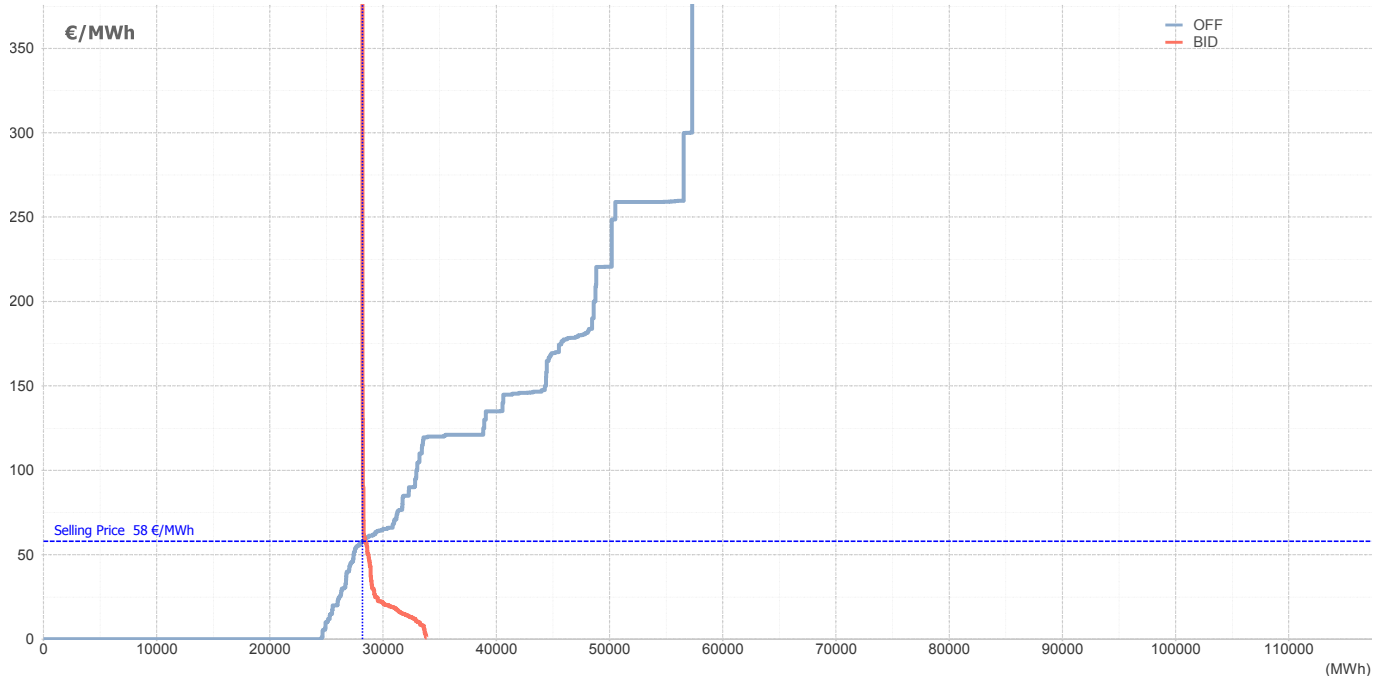

Figure 4.12: Demand and Supply Curves for zones AUST,BRNN,CNOR,CSUD,FOGN,FRAN,GREC,NORD, ROSN,SARD,SUD and SVIZ - June 15th, 2013 - Interval n^{o} 19

◇ Thursday, 24th of October 2013

For Northern Italy, the selling price is set to 70,52 €/MWh and the total amount of sales is 17 742,75 MWh. As regards demand bids, the national single price is set to 75,89 €/MWh and the total amount of purchases is 21 588,46 MWh. A first observation about these results compared to the results of June 15th is that the prices are higher. 24th of October is a day of mid-autumn. A large consumption of electricity can be expected, moving the demand curve on the right. Therefore the intersection of the supply and demand curve will be higher on the supply curve, increasing the clearing price. The PUN is also higher because of the increase of all the zonal prices. Overall the configuration of the steps is different even if a slight similarity can be found with the curve of the 15th of June: the big supply step at 260 €/MWh. After using the data export function and after analysis of the group of offers, it was found that all these offers have been made by the operator ENEL and are in most of cases hydroelectric power plant. Thus it should be identified as a strategic behavior which aims to increase the supply offer curve and eventually move the intersection of the two curves on the right and in this case the equilibrium price would be higher.

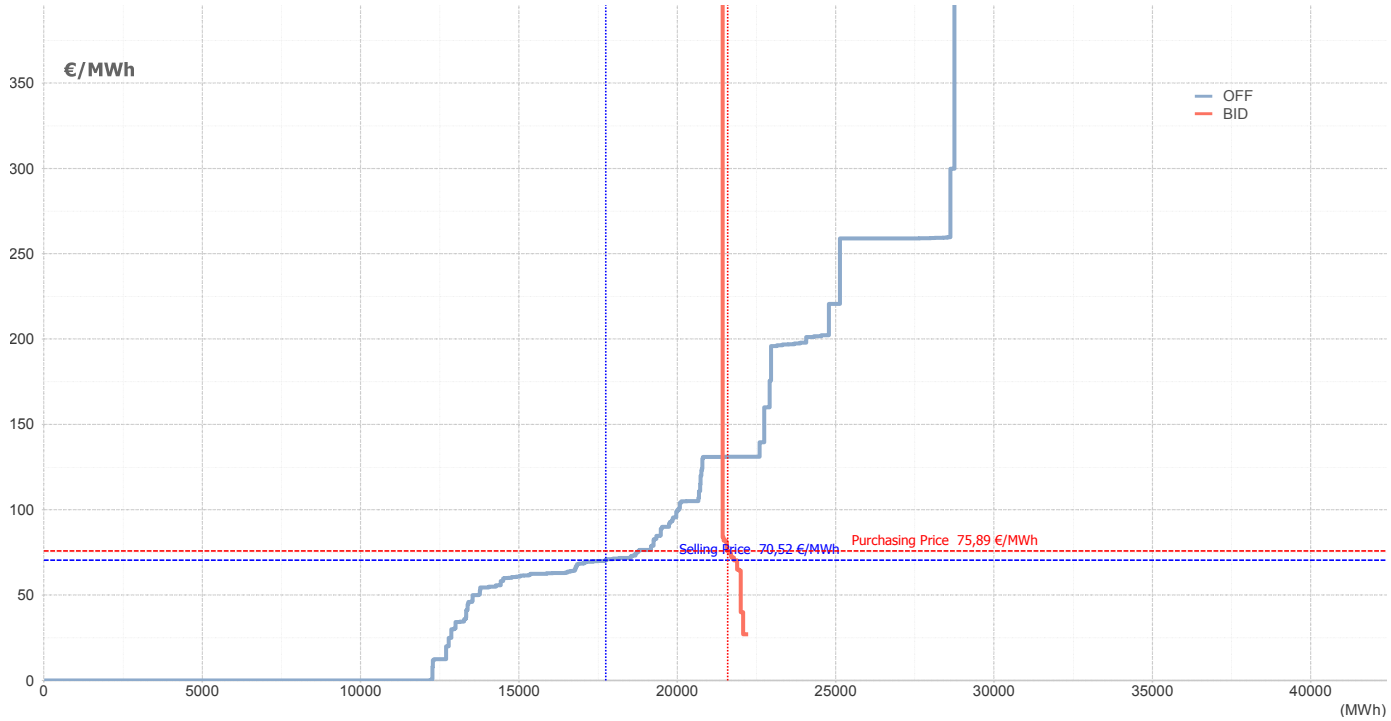

Figure 4.13: Demand and Supply Curves for Northern Italy - October 24th, 2013 - Interval n^o 19

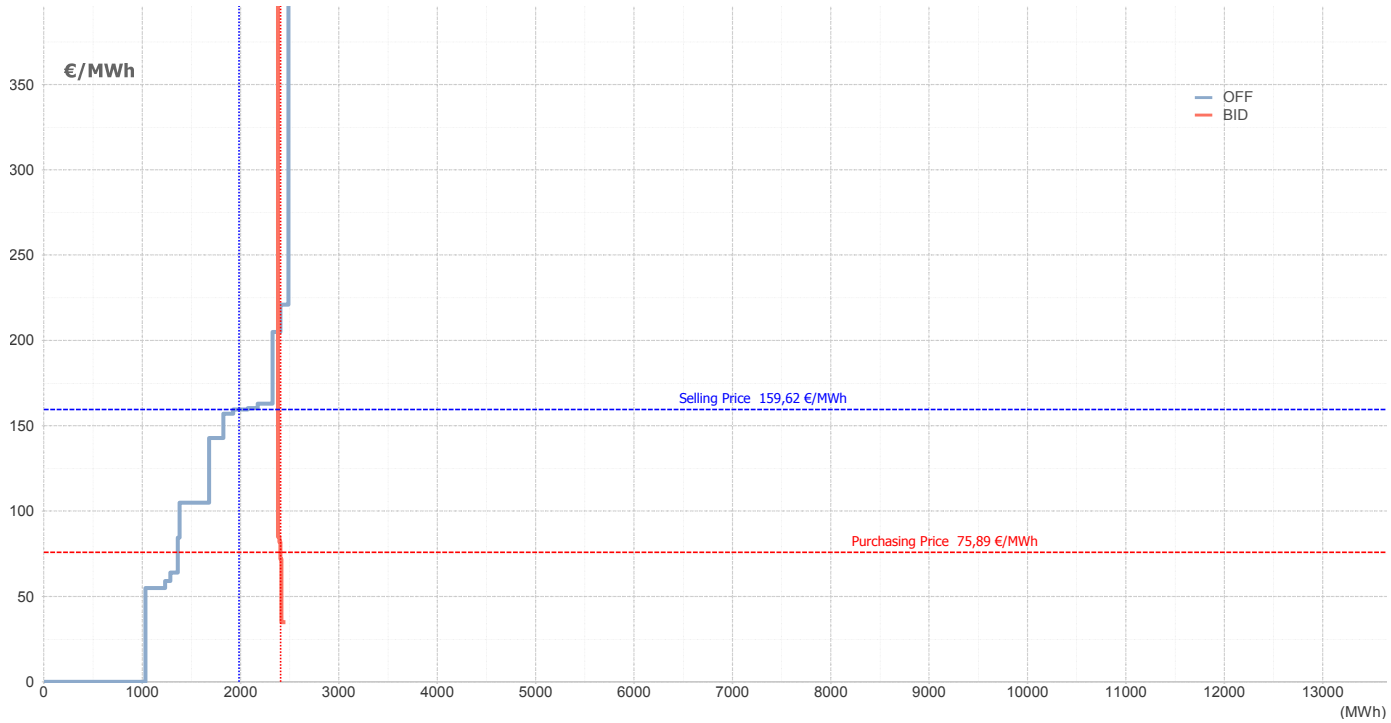

Figure 4.14: Demand and Supply Curves for Sicily - October 24th, 2013 - Interval n^o 19

For Sicily, the selling price is set to 159,62 €/MWh. The total of accepted supply offers represent 1984,01 MWh and the total of accepted demand bids: 2 406,01 MWh. The overall traded volumes and the clearing price had also increased from the 15th of June for certainly the same reasons.

4.3 Market Shares

On the Dashboard n^{o} 2, the attention is drawn to the generation of electricity. The objective of this part of the application is to provide a complete view of the production by analyzing the market shares and knowing the entire and precise time schedule production. The first function implemented is the calculation of the market shares. In an economic situation, this is important to understand if there ar,e in the Electricity Market, traders who have significant market power. The concept of market share is closely monitored by the authorities such as AEEG. Their role and responsibilities are crucial in safeguarding the proper functioning of the Market, in maintaining the competitiveness and avoiding creating distortions significant difficulties or obstacles for market actors, especially for the new entrants.

In Italy as stated before, the so-called Bersani decree (16 March 1999) acknowledged the European Parliament and Council's directive 96/92/CE and marked the real beginning of deregulation in the Italian power sector. The dual objective of the decree was to encourage installation of new production operators and to limit energy prices charged to final consumers. The effect it produced on monopolistic Enel was unprecedented. This forced the incumbent company to break up its structure and create new entities to carry out generation, transmission and distribution. New national directives established some limits for power generation and operators (see Chapter 1) to encourage new operators to enter into the market. In conclusion, the pressure for deregulation, the important decisions and the willingness of a fast liberalization had a very strong and incisive impact on the company. The effects of this drastic approach are still real and effective; in particular in comparison with the French neighbors which has still a highly concentrated generation market (the market share of the three leaders is per almost 95 per cent). However the process of liberalization is rather recent, so an important market share of Enel can be expected but in decline.

The market share analysis is based on the study of four years of data (from 2010 to 2013). It has been considered that the market share should be calculated on the basis of volume of electricity offered and accepted. Two pieces of information are barriers to access of relevant results: the presence of powers abnormally high (already seen before) and the substantial presence of the operator "Bilateralista", evidence of the entry of the bilateral contracts into the MGP market. The first constraint is easily overcome not taking account in the calcultations of the quantity of electricity which exceed 9000 MW.

The electricity traded through bilateral transactions that are registered onto the PCE participates in the resolution process. That's why supply offers are presented on the MGP

market platform under the "Bilateralista" operator name. It was decided not to consider offers from such an operator in that he does not really participate in the electricity exchange. These transactions are inserted into the MGP market because they physically take capacity on the grid and participate in the transmission resolution process but they are predefined and their operator is not a real market participant. It is a question of knowing who is most involved in the active participation of the market without any regard to the contracts already concluded onto the PCE.

Therefore, the user of the application after choosing the year of study and uploading the data will have access to the overall market shares and the ones for each geographical zone by clicking on the map. In this way, he can easily understand which market participants are leaders and where they show their relative superiority. He can also restrict the time period of study by selecting the time interval and choose on which type of quantity the calculations of the market shares are based (offered or accepted). The general market share dashboard is provided below.

Figure 4.15: Interface of the Dashboard n° 2 - Market Shares

The analysis will focus on the market shares calculated with the quantity accepted on the market because it's more representative of the leadership of the companies in the actual power production. Compared to the previous years and as expected[2], the market shares of the company Enel continue to reduce. At global level, the share decreased from 24% in 2010 and 20% in 2011 to 13,4% in 2012 with a slight burst of growth in 2013 (24%). Furthermore, Edison has reduced constantly his market shares (7,9% in 2010, 6,8% in 2011, 7,2% in 2012 and 6,5 % in 2013). The role of the GSE is becoming more important (29,1% in 2012) because this trader mainly deals with the renewable energies and benefits from

the larger proportion given to this type of energy source is the electricity generation. The activity of Eni on the platform MGP is in decline, from 3,2% in 2010 to below 0,4%. The market shares of E.On and A2A seem to be reasonably stable (around 3% for E.On and around 5% for A2A). As regards the concentration of market share, the diversification of operators is effective but there are few changes at top of the rankings,with still 15 traders above 1% .

It is noteworthy that the main competitors (Eni or E.On) of the incumbent operator don't benefit particularly from their slight decline unlike smaller size operators which took advantage of it.

The tables of the market shares above 0,4% for the year 2013 are reported below(the rest of the tables is reported in the Annex B). One table is based on the quantity offered and the other on the quantity accepted. The values are calculated without taking into account the share of the operator "Bilateralista". This calculation on both tables reduces the real share of each operator and therefore it's difficult to compare the results with the official data. Anyway, from both tables it's possible to draw significant conclusions.

The first table (a)) provides information about the position of strength in terms of production capacity. Enel is way ahead in the ranking market shares because the company still benefits from its incumbent position and its large production capacity which brings it to flood the marketplace with many supply offers. The second table (b)) indicates how the market participation is distributed. The results quoted before are difficult to compare with values found on national reports. However one thing is certain, the number of market participants is constantly rising, the trend is even more interesting concerning the active participants. The level of 200 participants has been reached since 2012.

Three interesting points must be raised:

– in the ranking list of traders and their market shares, some traders seem to disappear and others to appear from one year to another. On the one hand, this is certainly the mark of a sudden decrease or an increase of activity on the market. On the other hand, it can be explained by some beginnings or ends of Joint Venture between traders. This is the case with Acea and GDF Suez. The Joint venture agreement signed between the two companies in 2002 was terminated on March 2011. They agreed for a new agreement on the restructuring of the partnership. ACEA would gain full control of the sales activities (AceaElectrabel Elettricità), as well as two power plants and GDF SUEZ would retain most of the generation capacity and the trading activities currently in joint venture (GDF SUEZ would retain 100% of Acea-Electrabel Produzione and of AceaElectrabel Trading.) Therefore, year 2011 can be seen as a transition year. And it's now easy to understand in tables why Acea has collapsed in the ranking and why GDF Suez has appeared since 2011 as a leading market participant.

Traders	Percentage
ENEL PRODUZIONE S.P.A.	39,38%
GSE	12,51%
A2A TRADING S.R.L.	9,88%
EDISON TRADING S.P.A.	7,71%
E.ON ENERGY TRADING S.P.A.	4,85%
TIRRENO POWER S.P.A.	2,55%
SORGENIA S.P.A.	2,10%
IREN MERCATO SPA	1,82%
GDF SUEZ Energia Italia S.p.A.	1,80%
EGL-ITALIA S.P.A.	1,75%
EDIPOWER S.P.A.	1,04%
EDELWEISS ENERGIA S.R.L.	0,83%
ERG SPA	0,72%
ALPIQ ENERGIA ITALIA S.p.A.	0,71%
ELECTRADE SRL	0,69%
GREEN NETWORK SPA	0,69%
EUROPE ENERGY SRL UNIPE...	0,66%
GALA SRL	0,50%
TRAFIGURA ELECTRICITY IT...	0,48%
C.V.A. TRADING S.R.L. A S.U.	0,47%
ENERGETIC SOURCE SPA	0,43%
Others	**8,44%**

Traders	Percentage
GSE	24,70%
ENEL PRODUZIONE S.P.A.	24,09%
EDISON TRADING S.P.A.	6,54%
A2A TRADING S.R.L.	5,46%
E.ON ENERGY TRADING S.P.A.	3,13%
IREN MERCATO SPA	3,04%
EGL-ITALIA S.P.A.	3,03%
SORGENIA S.P.A.	2,85%
GDF SUEZ Energia Italia S.p.A.	2,58%
TIRRENO POWER S.P.A.	1,42%
EDELWEISS ENERGIA S.R.L.	1,39%
GREEN NETWORK SPA	1,36%
EUROPE ENERGY SRL UNIPE...	1,29%
ERG SPA	1,26%
GALA SRL	0,98%
ALPIQ ENERGIA ITALIA S.p.A.	0,87%
HERA TRADING S.R.L.	0,75%
ENERGETIC SOURCE SPA	0,74%
ELECTRADE SRL	0,63%
GREEN TRADE SRL	0,57%
TRAFIGURA ELECTRICITY IT...	0,57%
EN.E.R. TRADING S.p.A.	0,54%
EDF TRADING LIMITED	0,54%
C.V.A. TRADING S.R.L. A S.U.	0,53%
GEN-I TRGOVANJE IN PRODA...	0,52%
DANSKE COMMODITIES A.S	0,44%
AZIENDA ENERGETICA TRAD...	0,44%
STATKRAFT MARKETS GMBH	0,43%
E-NOI S.P.A.	0,42%
Others	**8,89%**

Figure 4.16: Market Shares for the year 2013 based on quantities a) offered b) accepted

– It's interesting also to focus the analysis on a few zones: one continental zone, Central Southern Italy and one island Sicily. The tables of the year 2013 concerning those two zones are reported below. For Central Southern Italy (CSUD), the first two traders of the ranking list are Enel and GSE. Enel remains a leader in power production in this macro-region because of the high number of hydropower plants in Abruzzo and Lazio. GSE is still a strong trader in the zones where renewable energies are massively present; this is the case in Campania with so many wind power farms. That's why the company EGL which is part now of the Swiss energy supplier AXPO is also mainly active in the area. The presence of the company Sorgenia must be noted because almost only one power plant (the 800 MW combined cycle power plant of Aprilia) has a significant market share. For Sicily, the reasoning is the same concerning GSE. A large capacity of renewable energy is available; the large numbers of wind turbines, solar stations justify the good position of GSE. The situations of Enel and Edipower must be clarified. In fact the two companies still benefit from their strategic positions. Enel has a gas-fired Ccgt, oil and turbogas plants and also hydropower plants. And Edipower has one oil plant only. But because of the particular connection and situation of Sicily compared to the rest of the grid, the plants of these two companies remain essential (for backup capacity for example) and their market shares are rather high in a zone dominated by renewable-energy

traders. (GSE , ERG, EGL etc.) The rest of the results of both zones for the years 2010,2011 and 2012 are available in the Appendix B.

Traders	Percentage
ENEL PRODUZIONE S.P.A.	41,47%
GSE	23,60%
EGL-ITALIA S.P.A.	7,59%
SORGENIA S.P.A.	4,80%
TIRRENO POWER S.P.A.	4,15%
EDISON TRADING S.P.A.	3,50%
ACEA ENERGIA HOLDING SPA	2,64%
GDF SUEZ Energia Italia S.p.A.	1,99%
REZIA ENERGIA ITALIA S.P.A.	1,32%
TERMICA CELANO S.P.A.	1,13%
BURGO ENERGIA S.R.L.	1,12%
EDELWEISS ENERGIA S.R.L.	1,10%
A2A TRADING S.R.L.	1,02%
ERG SPA	0,91%
HERA TRADING S.R.L.	0,87%
GREEN TRADE SRL	0,54%
EN.E.R. TRADING S.p.A.	0,42%
Others	**1,81%**

Figure 4.17: Market Shares -Year 2013 - CSUD

Traders	Percentage
GSE	56,57%
ERG SPA	11,92%
ENEL PRODUZIONE S.P.A.	9,49%
EDISON TRADING S.P.A.	8,28%
EDIPOWER S.P.A.	4,95%
EGL-ITALIA S.P.A.	2,71%
ALPIQ ENERGIA ITALIA S.p.A.	2,24%
E.ON ENERGY TRADING S.P.A.	1,44%
GDF SUEZ Energia Italia S.p.A.	1,39%
EDELWEISS ENERGIA S.R.L.	0,86%
Others	**0,16%**

Figure 4.18: Market Shares -Year 2013 - SICI

– Finally, the application includes another function related to the market shares. A procedure which tried to approach the figures available about the market participants and the share of the market has been implemented by redistributing the offers made by the operator “Bilateralista” to the right participants. If on one production unit, are acting two operators, a real one and the one called “Bilateralista", all the offers made by the “Bilateralista” are allocated to the given real operator. If more than one real operator is acting on a production unit, the offers are then sharing and sharing alike to the operators concerned by this unit. The results of this function are slightly different from the other method. Actually, as the market share is a relative concept and this method is applicable on every unit, the effects are not really observed. Therefore the analysis has been limited to the first method.

4.4 Generation detail

The considerations at the end of the chapter 2 led to the need of an interactive tool more targeted towards the specific analysis of the schedule productions for example. Choosing one operator or one production unit, it would be pertinent to know why it doesn't produce, if it tries to extend its offers on the MI sessions or not and its typical production schedule. In some way, the idea is to follow the production and the relevant strategies of the chosen unit. This part of the application has been developed to this goal.

4.4.1 Distribution of electricity supply by operator

First, the user chooses the trader he wishes to examine. Then several functions have been implemented on the main dashboard in order to give him an overview of the distribution of the electricity production by this trader. As for the study of the market shares (See section 4.3), the bilateral contracts are not taken into account and the operator 'Bilateralista' is an operator in his own. Once again unable to reach the real operator behind the 'Bilateralista', the focus is on the active market participants. A button for selecting the desired time period is always available and the user can target the interval of time he desires.

One function implemented prepares the list of all the units to which the operator participates; with for each unit, the classic information extracted from the production units' database (See section 3.2.1), the maximum volume of electricity in MWh offered on a single period on the MGP and the maximum power estimated of the unit (See section 4.1.1.1). Obviously, the last two features may match. Indeed, if the offer concerned by the maximum volume is a single offer (not divided into several pairs of values 'Quantity x Price') and if the same offer is proposed by the operator selected, the method used for the calculation of the maximum power will match the maximum volume offered on this unit (See Fig 4.19).

The overall quantities offered and accepted on the market by the trader are also available. It may be worth calculating the amount of money involved in the market by the volume accepted of electricity. For a given operator, the simple sum of the volume accepted multiplied by the corresponding price of each transaction is carried out:

$$M = \sum_{i=1}^{n^{\text{o}}\, transactions} Volume.ZonalPrice \tag{4.1}$$

where $Volume\ in\ MWh$,
$ZonalPrice\ in\ €/MWh$

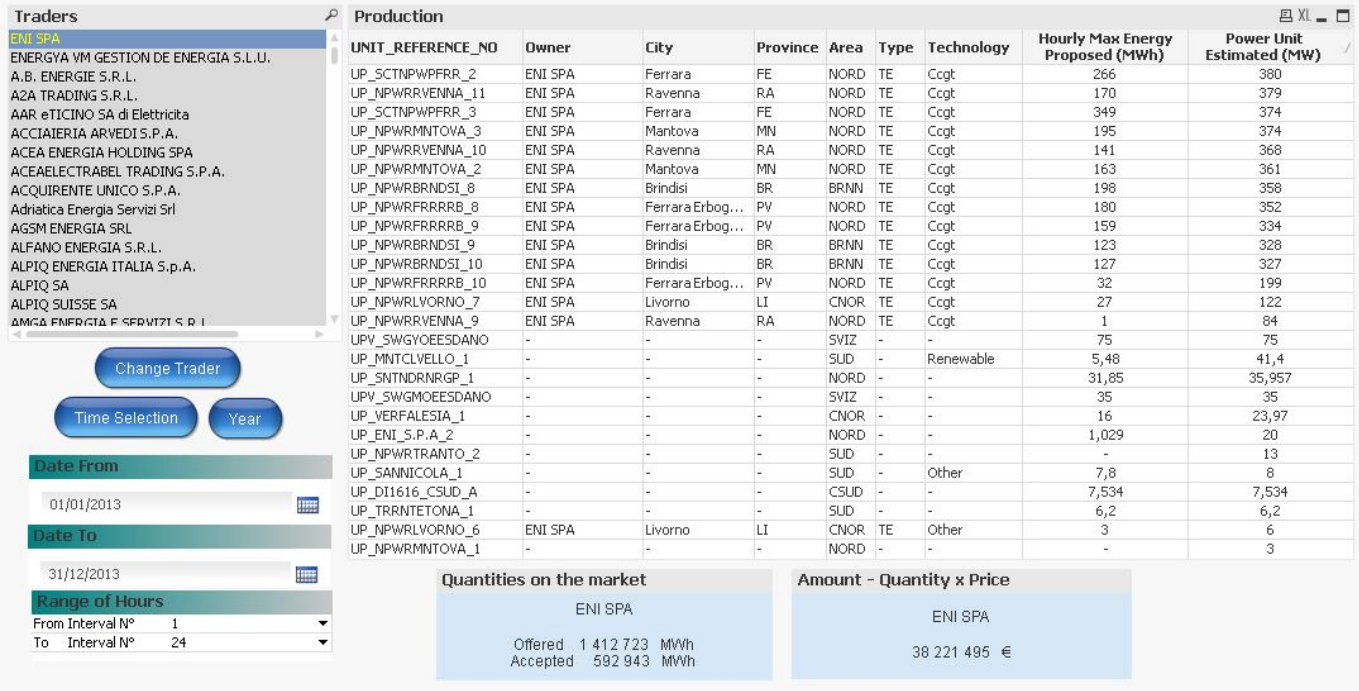

Figure 4.19: Interface - Distribution of electricity supply by operator

This gives an idea of the economic and financial commitment of the operator into the market. For instance, the incumbent operator Enel during the year 2013 on the MGP put on sale for 3 117 million euros (M€) of electricity. On the 158 TWh offered during the year only 49 TWh were accepted ,but as stated before, it remains leader in market share and hence in amount incurred. It is noteworthy that dividing the year into some periods, the total amount has strongly decreased, so much so that the last two months represent only 40% of the first two. This is a mark of the decelerating situation of Enel. Mention should also be made of A2A with 11 TWh of volumes accepted and 38 M€on sale and of E.ON with 6,4 TWh for 445 M€. Indeed, these two operators have an important role in the Italian Electricity market but seem to be in difficulty in recent times.

In practical terms, the user chooses first the trader. Let's select E.ON Energy Trading S.p.a., operator already mentioned before. Then the table (See Table 4.6) of the distribution of the electricity supply is displayed. The information unknown about the production units is left blank (Owner, Province, Type, Technology etc.). The user can check on which production unit, the operator is trading electricity, with the maximum hourly volume offered. E.ON. has ownership of most of its units. It should be noted the participation of the company in the thermal plant of Scandale (KR). Indeed the two units UP_CNTRLDSCND_1 and UP_CNTRLDSCND_2 belong to Ergosud S.p.a. Ergosud S.p.A is the company, a 50% joint venture between E.ON Italia and A2A S.p.a, which built and managed the plant of Scandale.

UNIT_REFERENCE_NO	Owner	Province	Area	Type	Technology	Hourly Max Energy Proposed (MWh)	Power Unit Estimated (MW)
UP_NCTLVRNFRR_1	E.ON Energy ...	VC	NORD	TE	Ccgt	785	786
UP_TAVAZZANO_5	E.ON Energy ...	LO	NORD	TE	Ccgt	771	772
UPV_SWGD104384O	-	-	SVIZ	-	Abroad	550	550
UPV_RTED104384O	-	-	FRAN	-	Abroad	500	500
UP_CNTRLDSCND_1	ERGOSUD S.P.A	KR	ROSN	TE	Ccgt	410	416
UP_CNTRLDSCND_2	ERGOSUD S.P.A	KR	ROSN	TE	Ccgt	409	414
UP_FIUMESANT_4	E.ON Energy ...	SS	SARD	TE	Coal	204	408
UP_OSTIGLIA_2	E.ON Energy ...	MN	NORD	TE	Ccgt	395	395
UP_OSTIGLIA_1	E.ON Energy ...	MN	NORD	TE	Ccgt	394	395
UP_OSTIGLIA_3	E.ON Energy ...	MN	NORD	TE	Ccgt	391	395
UP_TAVAZZANO_C_6	E.ON Energy ...	LO	NORD	TE	Ccgt	385	385
UP_TAVAZZANO_8	E.ON Energy ...	LO	NORD	TE	OilMethane	300	300
UP_FIUMESANT_3	E.ON Energy ...	SS	SARD	TE	Coal	266,099	267
UP_GALLETO_1	E.ON Energy ...	TR	CNOR	ID	-	155	155
UP_GALLETO_2	E.ON Energy ...	TR	CNOR	ID	-	140	140
UP_CNTRNRGFRR_1	-	-	NORD	TE	Ccgt	138	138
UP_FIUMESANT_1	E.ON Energy ...	SS	SARD	TE	Oil	131	131
UP_FIUMESANT_2	E.ON Energy ...	SS	SARD	TE	Oil	131	131
UP_TRAPANI_C_2	E.ON Energy ...	TP	SICI	TE	GT	106	106
UP_TRAPANI_C_1	E.ON Energy ...	TP	SICI	TE	GT	105	105
UP_TEVERE_1	E.ON Energy ...	TR	CNOR	ID	Run-of-river	90	90
UP_MONTE_ARG_1	E.ON Energy ...	TR	CNOR	ID	-	58	58
UPV_APGD104384E	-	-	AUST	-	Abroad	54	54
UP_PRCLCSRRPL_1	E.ON Energy ...	CZ	SUD	EO	Renewable	53,946	53,946
UPV_RTEP104384O	-	-	FRAN	-	-	50	50
UP_PRCLCMNTCT_2	E.ON Energy ...	PZ	SUD	EO	Renewable	44	44
UP_PRCLCMRCRL_1	E.ON Energy ...	CS	SUD	EO	Renewable	43,768	43,768
UP_PRCLCPNDCR_1	E.ON Energy ...	CZ	SUD	EO	Renewable	43,421	43,421
UP_COTILIA_1	E.ON Energy ...	RI	CNOR	ID	Pumped-S...	40	40
UP_DI2017_NORD_C	E.ON Energy ...	-	NORD	FV	Renewable	36,647	36,647
UP_SANTANINFA_1	E.ON Energy ...	TP	SICI	EO	Renewable	32,28	32,28
UP_NARNI_1	E.ON Energy ...	TR	CNOR	ID	-	32	32
UP_NERA_MONT_1	E.ON Energy ...	TR	CNOR	ID	-	28,2	28,2
UP_VIZZINI_2	E.ON Energy ...	CT	SICI	EO	Renewable	23,8	23,8
UP_PRCLCPGGLT_1	E.ON Energy ...	GR	CNOR	EO	Renewable	20	20
UP_FLORINAS_1	E.ON Energy ...	SS	SARD	EO	Renewable	20	20
UP_PRCLCRDINO_1	E.ON Energy ...	BV	CSUD	EO	Renewable	14	14
UP_PRECI_1	E.ON Energy ...	PG	CNOR	ID	-	7,4	7,4
UP_DI2017_SARD_C	-	-	SARD	-	-	1,827	1,827
UP_DI2017_NORD_B	E.ON Energy ...	-	NORD	FV	Renewable	0,479	0,479
UP_DI2017_CNOR_B	E.ON Energy ...	-	CNOR	FV	Renewable	0,473	0,473
UP_DI2017_SUD_B	E.ON Energy ...	-	SUD	FV	Renewable	0,377	0,377

Table 4.6: Distribution of electricity supply - trader E.ON - 2013

The company E.ON has an electricity balance well distributed. Many offers are made from thermal power plants through different technologies (Ccgt, Oil or Coal). Besides, the company has integrated renewable energies in its production facilities. The wind power holds a significant place especially thanks to the wind farms located in the southern zone with hourly maximum energy offered always higher than 40 MWh. Finally, E.ON, as an international operating company, trades energy from abroad, in particular from France, Switzerland and Austria. The total energy quantity offered in 2013 was 19,4 TWh and 33 % of the total was accepted (6,4 TWh). If the user is taking interest in whether the company in producing more in a specific period, he can select the time interval he wants. For the first quarter of 2013, 2,0 TWh in the MGP were accepted on 4,5 TWh offered. For the second quarter, 1,3 TWh were accepted on 5,3 TWh offered. For the third quarter,

1,7 TWh were accepted on 4,4 TWh offered and finally for the last quarter 1,4 TWh were accepted on 5,2 TWh offered. The second quarter seem to be a period more difficult for the company and it should be interesting to understand how and why so many offers were refused and the reaction of the operator in the sessions of MI.

The user can now click on the unit he is interested in to open a window which reports the detail of the generation schedule.

4.4.2 Generation schedule by unit

The user chooses the unit, subject of the study. Various options and functions are available (the given user interface is represented in Fig 4.20):

- General information about the unit: Part of a Production units' database is displayed (i.e. geographical information, owner, type and technology);
- Year production: Calculation of the total energy offered on the MGP, accepted after execution of the markets and the equivalent hours based on the quantity accepted;
- Distribution of the traders on the plant: list of the different traders which are selling energy from the selected unit with the respective share of volumes proposed en accepted;
- Overview of production schedule;
- Detail of production schedule on MGP;
- Detail of production schedule on each session of MI. The first two sessions are obviously of a particular interest in the understanding of an operator's behavior. The visualization of the last two sessions is provided for information purpose only as in the meantime two sessions of the balancing market (MB1 and MB2) would have been executed (See outline n^o 1 in section 1.6).

Figure 4.20: Interface - Generation schedule

The emphasis of this part is on a few units representative of the electricity production facilities of E.ON:

- UP_TAVAZZANO_5: a 800 MW Ccgt module located in Lodi.
- UP_TEVERE_1: a 75 MW hydroelectric complex located in Terni.
- UP_PRCLCMNTCT_2: a 44 MW windfarm located in province of Potenza.

By selecting the second quarter of 2013 and the production unit UP_TAVAZZANO_5, the user can realize that for many periods of time there is no production at all. This is the case for example from the end of April to the beginning of May and for all the month of June. If one zooms on a more precise period, he will have access to an overview of the production schedules and will be able to choose whenever visualize it: after the execution of MGP (total quantity accepted), after the execution of MGP and with the modifications accepted on MI1 and after the execution of MGP with the modifications accepted on both MI1 and MI2. The results for the period from 16th April 2013 interval n^o 1 to 18th April 2013 interval n^o 18 are reported in the following page (Fig 4.21). For this period, it is clear that the unit doesn't produce at full capacity and the operator tries on the first session of MI and then on the second to improve its production schedule by avoiding sudden fall of generation. The operator has two options: he can try another supply offer to fulfill the lack of production or he can make a demand bid to prevent the part-load production and/or extend a no-production period. On the 15th, from midnight to 13 PM he decided not to produce at all. For further information the user can click on Detail MGP or Detail MI.

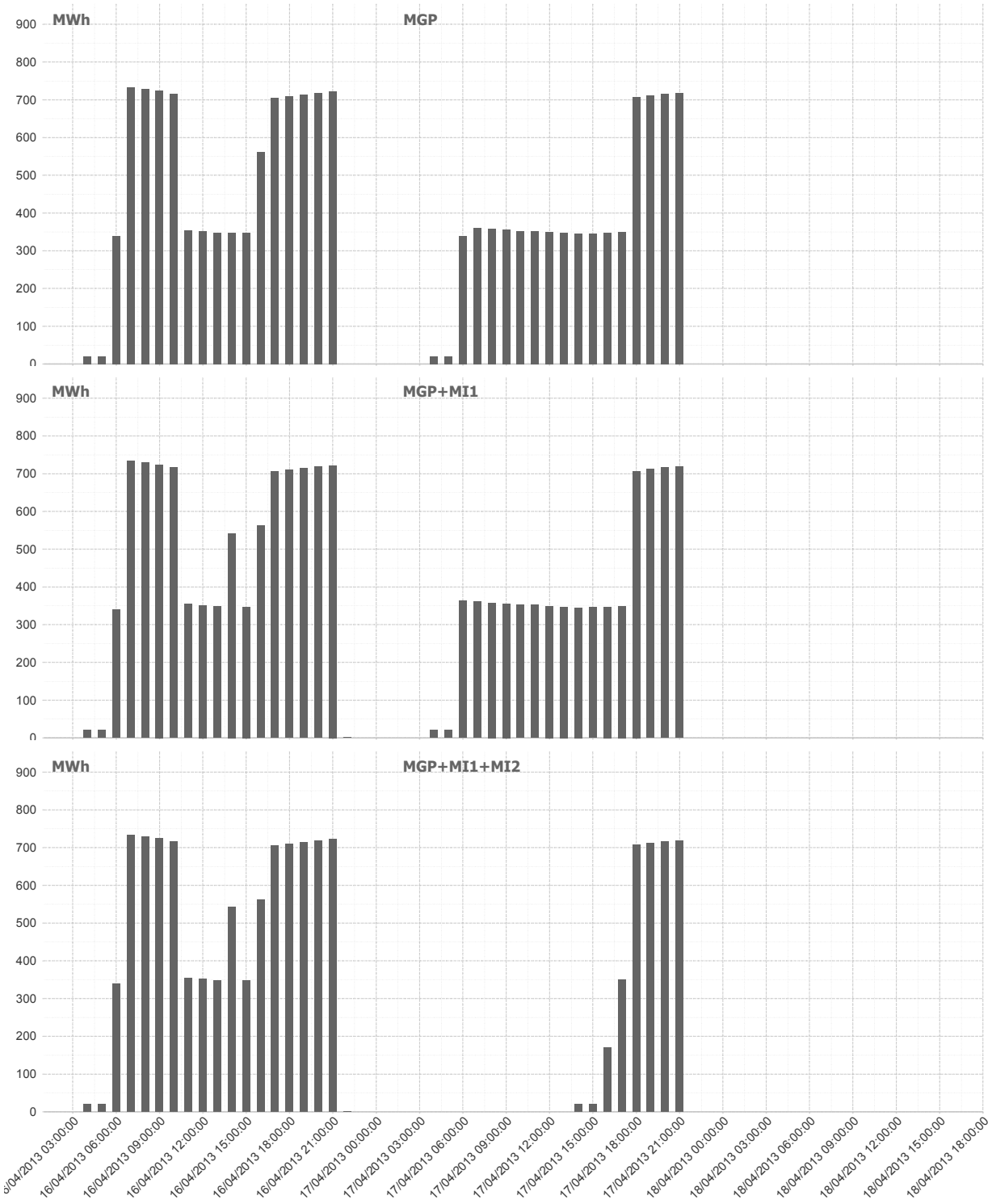

Figure 4.21: Overview of Production schedule - UP_TAVAZZANO_5 - From 16/04/2013 nº 1 to 18/04/2013 nº 18

Clicking on Detail MGP, the user has three options for the detailed visualization of the production schedule:

- Visualization of Stack bar chart by number of offer;
- Visualization of Stack bar chart by distinguishing Quantity accepted/offered
- Visualization of Stack bar chart by trader.

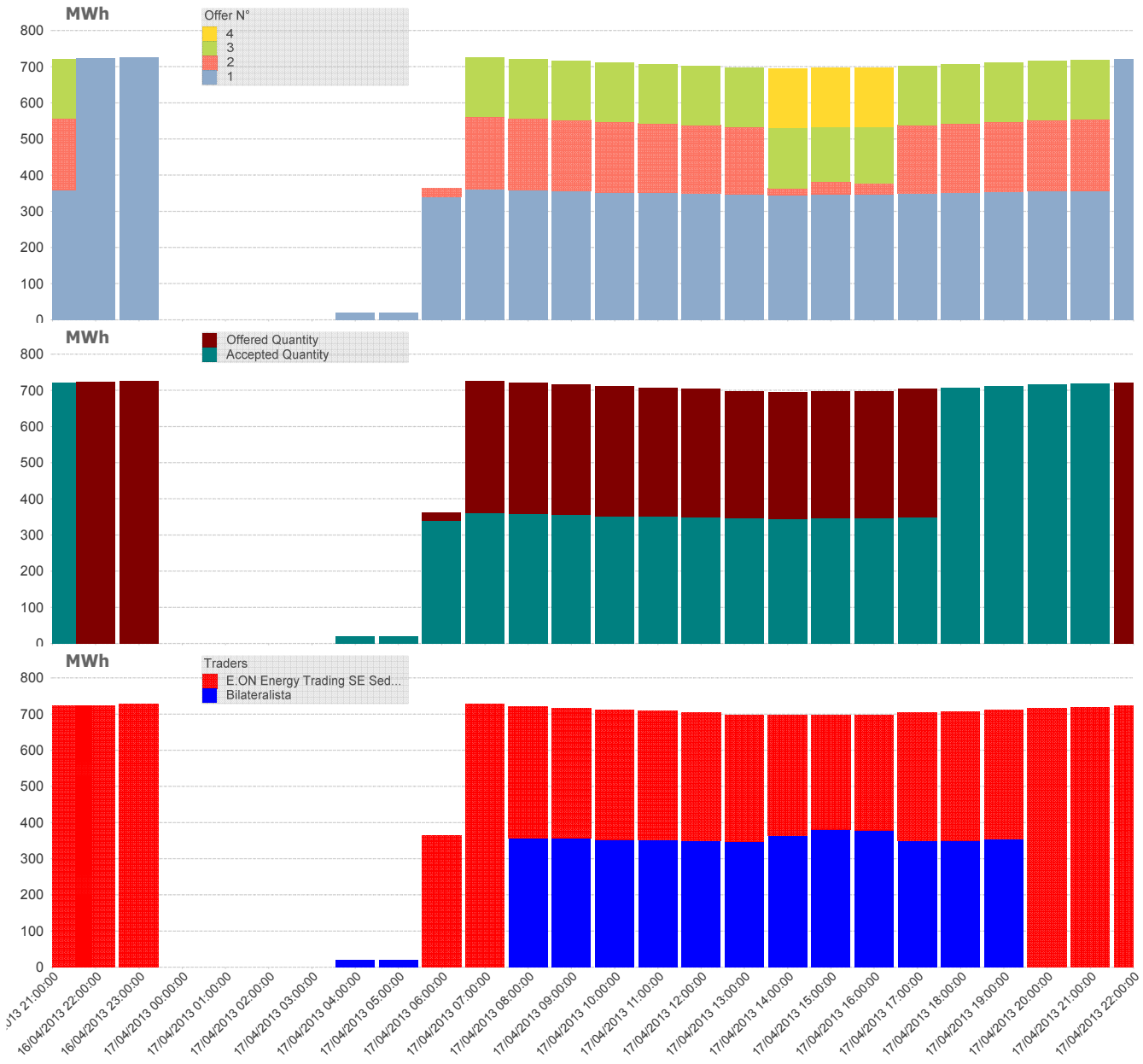

Figure 4.22: Detail Production on MGP - UP_TAVAZZANO_5 - From 16/04/2013 n° 21 to 17/04/2013 n° 22

He has also access to step curve of each single hour, by selecting a relevant period.Once again with regard to the April period, the time interval has been reduced to: from 16th April 2013 interval n^{o} 21 to 17th April 2013 interval n^{o} 22 and the three possible charts are reported in the Fig 4.22 above.

In the first chart, the different offers are reported and it is helpful to understand the strategy of the operator on the use of simple or multiple offers and the partition of the maximum quantity available of the unit into several offers.
In the second chart, the distinction between the overall quantity offered and accepted for each period is made. It gives an adequate picture of the production schedule while knowing whether the non-generation is intended or not.
Finally, the third chart gives the distributed production schedule by operator. In most cases, there are only two operators on one production unit: the owner and the one called 'Bilateralista'. The offers of 'Bilateralista' will always be considered as first offers in the order of the stacked areas because of their zero prices and the sorting order based on the unit price. It is possible that more than two operators are trading on the same unit. That's the case for example of UP_BRINDISI_3 and UP_BRINDISI_4, a coal thermal plant owned by Edipower Spa. Until 2012, Edipower had four different shareholders: A2A, Edison, Iride (IREN group) and the Swiss company Alpiq. Therefore, in the studied data, six simultaneous traders can be found: EDISON, IREN MERCATO Spa, ALPIQ ENERGIA ITALIA Spa, A2A TRADING, Bilateralista and Edison Spa itself.

Returning to the UP_TAVAZZANO_5 case, at first glance, the unit has decided not to produce at all the night between midnight and 3 AM of the 17th April. In the three charts there is no offer for the given intervals. Then it started with small offers for the start-up of the power plant (interval no 4 and 5 25 MWh accepted) and afterwards proposed when the station is supposed to operate at full capacity a first offer often made through bilateral contract (the operator is 'Bilateralista') of aroud 350 MWh. The simultaneous reading of the second and the third chart highlights this strategy. Above the capacity of 350 MWh a series of offers (2 or 3) up to larger capacity close to the maximum one (around 700 MWh) are made. The first offer is accepted and the following series is not, despite the effort from E.ON to divide the overall quantity in more offers as it happened for the interval no 14, 15 and 16 of the 17th April (See the first chart of Fig 4.22). In order to appreciate the market process on the offers, the user can select a relevant period and display the step curve.

Concerning, the time period selected before, the interval no 13, 15 and 18 of the 17th April are interesting cases.

As shown in Fig 4.23, for the interval nº 13 of this day, three offers have been made on the production unit. The first one is obviously accepted because of the zero price comes from a bilateral contract and that explains the price (rule for the offer from the PCE). The trader, E.ON made two offers at really close prices (62,05 €/MWh and 62,55 €/MWh) higher than the zonal selling price 36,1 €/MWh. Therefore, the offers are not accepted.

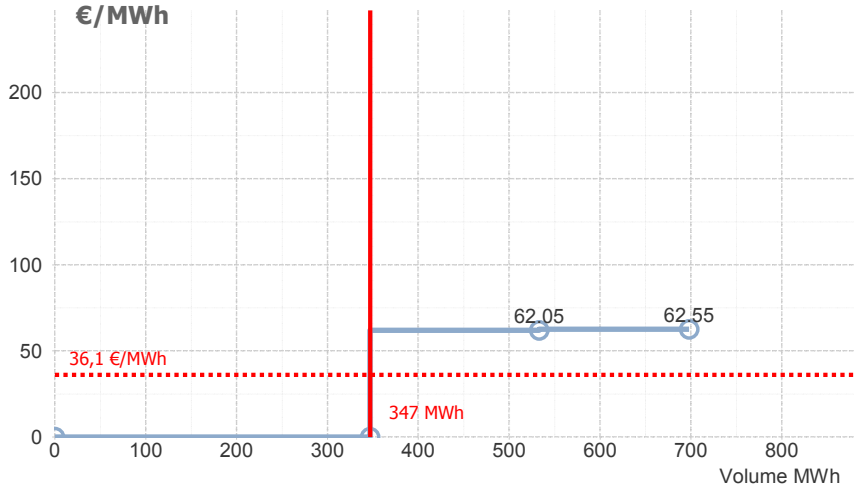

Figure 4.23: Step curve QuantityxPrice - UP_TAVAZZANO_5 - 17/04/2013 nº 13

In Fig 4.24, the scenario is different. It is an interval which follows the precedent one and the operator changed his strategy. The same offer as the interval no 13 has been divided in two offers at the same price (62,05 €/MWh). The selling price increased a little but not enough to accept the series of three offers.

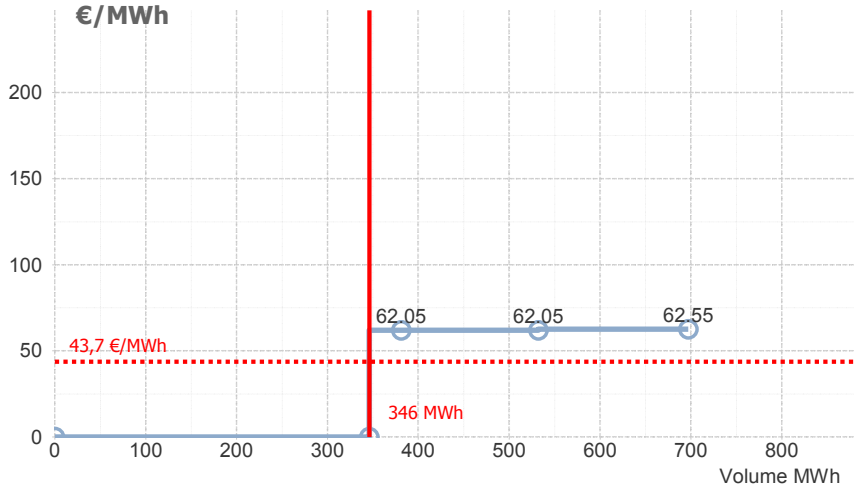

Figure 4.24: Step curve QuantityxPrice - UP_TAVAZZANO_5 - 17/04/2013 nº 15

The last analyzed interval, in Fig 4.25, is the case in which all the offers were accepted. The operator raised the price of its offers to 62,78 €/MWh and 63,11 €/MWh, always close one from the other (it might be considered as a strategy to become price-setting unit). This time the selling price reached the value of 63,79 €/MWh, higher than the prices proposed by the operator. The offers are accepted and the tolal volume of energy the unit has to produce equals now 707 MWh.

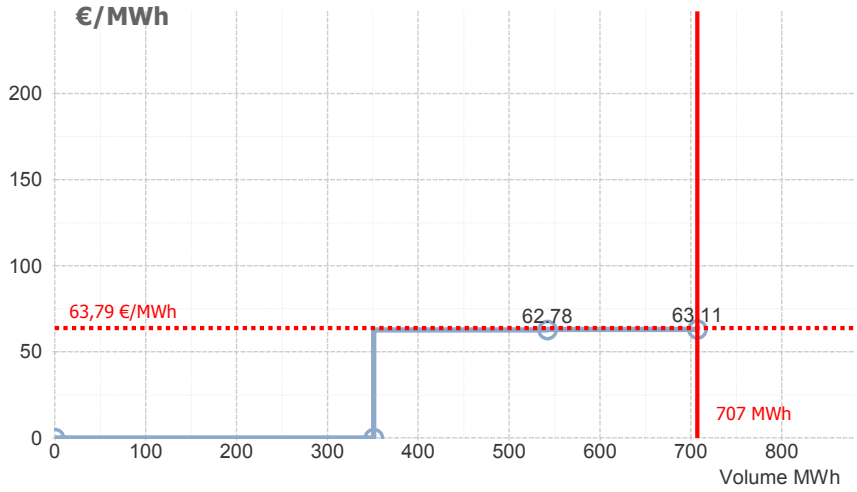

Figure 4.25: Step curve QuantityxPrice - UP_TAVAZZANO_5 - 17/04/2013 nº 18

Clicking on Detail MI, the user has access to the same functions mentioned before but now related to the sessions of MI. Concerning the time interval studied and the unit UP_TAVAZZANO_5, it is worth noticing several demand bids made by the operator on the first two sessions MI1 and MI2 in order to cancel the production (See Fig 4.21). In the first session MI1, for the interval from nº 6 to nº 17, E.ON made purchasing bids at a price over 42 €/MWh and they were refused. Then in the second session MI2, the operator is forced to make new bids at a zero-price and of course accepted. Still in the Fig 4.21, it is clearly that the first stage of the MI1 execution slightly modified the production schedule whereas the seconde stage of the MI2 execution removed the production for the interval from nº 6 to nº 17 of the 17th April. As a more specific example, let's examine what happened on the interval nº 13 of the 17th April. . The following table 4.7 summarizes the situation of the different bids/offers made on the markets MGP , MI1 and MI2 by E.ON for the considered period.

As seen before in Fig 4.23, only one in three offers has been accepted on the MGP. Therefore, as for the previous and the following periods, the unit would have to produce at half of its capacity. It would have sold 349 MWh for a total of 14 958 €. In terms of efficiency and profitability, it would not be worth it. A thermal power plant prefers not to produce at all than at reduced capacity.

So, E.ON made then a first demand bid on the MI1 at the same price as the MGP selling price (42 €/MWh) in order to cancel the production already scheduled on the MGP without price difference. Because the zonal price (47 €/MWh) is higher than the unit price proposed by E.ON, the transaction wasn't accepted.

Market session	Type of transaction	Volume (MWh)	Price (€/MWh)	Accepted or Refused	Market price (€/MWh)
MGP	OFF	349	0	ACC	42
MGP	OFF	189	62,05	REF	42
MGP	OFF	165	62,55	REF	42
MI1	BID	349	42	REF	47
MI2	BID	349	0	ACC	47

Table 4.7: List of bids/offers made on MGP, MI1 and MI2 - UP_TAVAZZANO_5 - 17/04/2013 n° 13

Finally, the trader decided to purchase the given volume of 349 MWh at any price by making a transaction on the MI2 with the unit price equal to 0. For the MI sessions, the PUN is not calculated anymore and all purchases and sales are valuated at the zonal price. As a result, E.ON had purchased 349 MWh of electricity at 47 €/MWh (i.e. for 16 403 €) and in practice didn't produce at all. As it was mentioned before (see section1.4.1.3), GME applies a non-arbitrage tariff to replicate the effect of the application of the PUN. It calculates the difference between the previous PUN (40,02 €/MWh) and the new zonal price (47 €/MWh): 6,98 €/MWh. E.ON hence received 2 437,02 €(349MWh x 6,98 €/WMh) from GME.

For the interval n° 13 of the 17th April, the unit UP_TAVAZZANO_5 didn't produce and succeeded in making an extra few 691,02 €. (14 658 €-16 403 €+2 437,02 €).

This highlights the way operators must adapt their strategy to the market mechanisms.

Looking now at the second production unit considered, UP_TEVERE_1, it turns out that the operator is content with pursuing the process market than taking action. Indeed, all the offers are made in a simple mode at a price equal to zero and they are all accepted. In 2013, the total amount of energy accepted for this plant was 384 816 MWh and it represents 3820 equivalent operating hours (See section 4.1.1.2). The unit of Tevere is a Run-of-river technology hydropower plant. Therefore there is no purchasing bid on the MGP. Besides the plant depends from the hydrological context and cannot produce at full capacity all year long. As seen in Fig 4.26 (Time period selected: April 2013), its production schedule is independent from the market and the operator can plan the production according to its willing and the current situation of the plant. However, that means E.ON is ready to sale electricity from this unit at any price even very low.

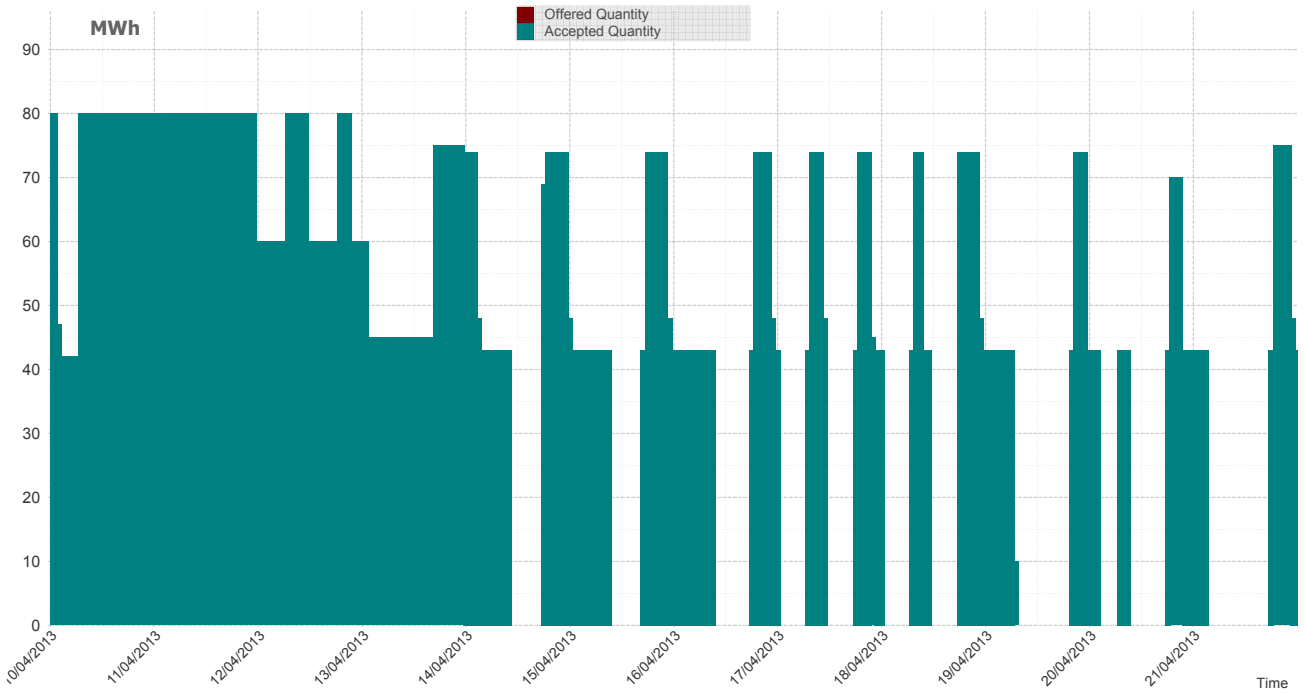

Figure 4.26: Detail Production on MGP - UP_TEVERE_1 - April 2013

Same attitude for the third production unit considered: UP_PRCLCMNTCT_2. It is a wind farm of 44 MW located in Basilicata. The trader E.ON is making only simple offers at a zero price. Actually this is electricity generation based on incentives and its validation is not subject to the MGP market. The production schedule doesn't depend on the market. But, in contrast to the hydropower plant mentioned before, this production unit acts much more on the MI sessions. In the chart Fig 4.27, (see below) the overview of the production schedule after the MGP, the detail of the production schedule relating to MI1 with supply offer in green and demand bid in orange and finally the overview of the production schedule after the execution of MGP and MI1 are displayed. The three charts highlight some specific wind power characteristics: the difficulty to produce at full capacity

according to the wind speed distribution not constant, the periodicity of the production (diurnal and seasonal depending on the wind properties) and also the need to adapt its production in real time. For the latter, there is significant interest in the first sessions of MI. Given that the wind forecasting is continuously changing, these sessions are perfectly adapted to real time modification of the wind farm production. Therefore, the MI sessions are playing an important role in integrating wind power to the generating power system.

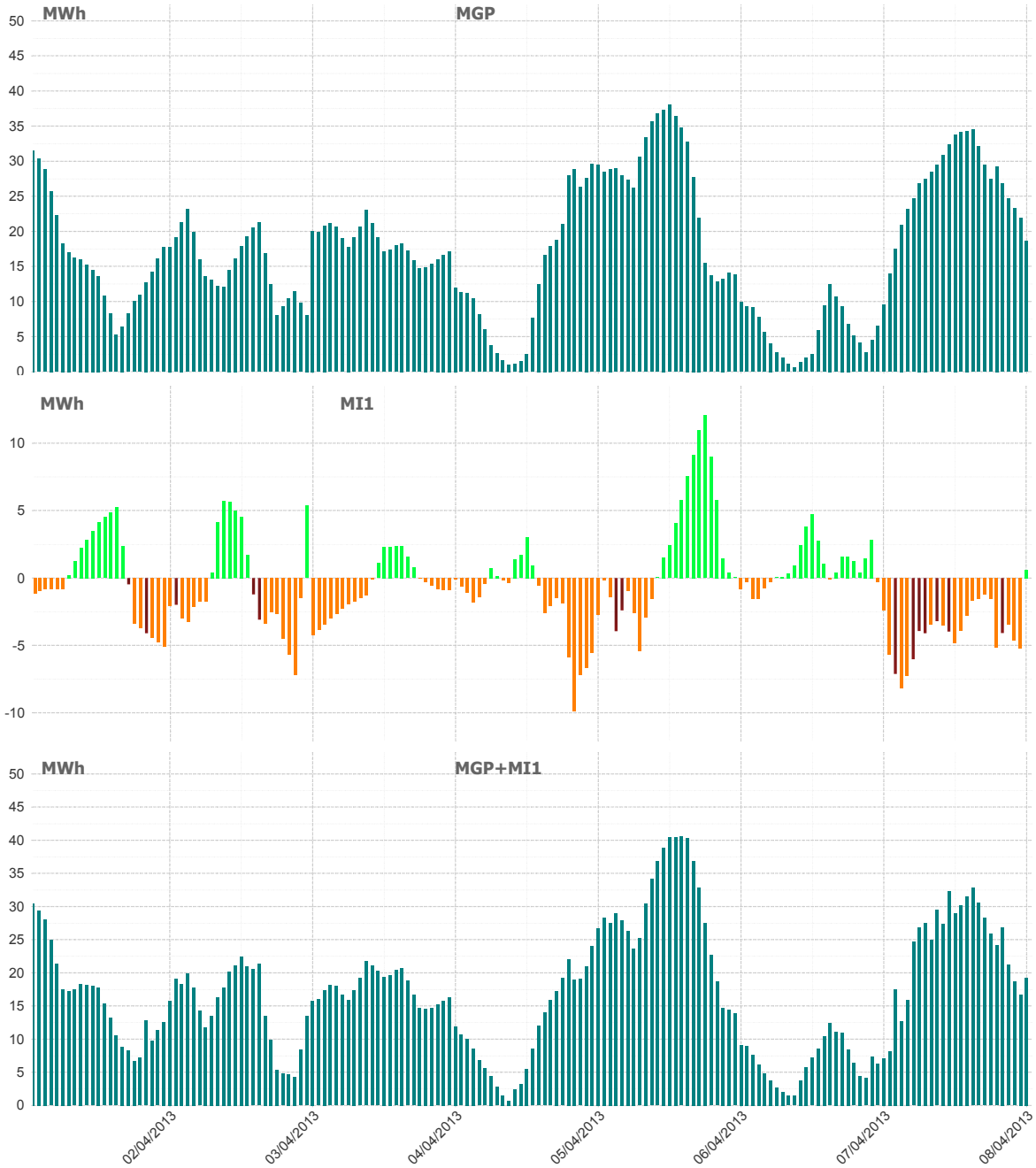

Figure 4.27: Overview Production Schedul - Detail Production on MI1 - UP_PRCLCMNTCT_2 - April 2013

Conclusion

This master thesis provides the tools to understand the mechanisms and procedures of the Italian wholesale electricity market with special attention paid to the Day-Ahead and Intra-Day markets. It aims at providing further clarifications and, in order to ensure this, the work of the thesis has been to explain the consecutive steps leading to the development of an application capable of acquiring, updating, visualizing and analyzing the raw market data made available by the institution in charge of the management and the control of the Electricity market, GME.

First, the focus is on an overall description of the Italian Electricity market with its story of liberalization and its structure to evaluate the current situation and to think about the further improvements that the thesis should provide.

Then, on the basis of the work carried out previously, in particular the past analyses made on tools such as Access or MySQL by former students, we decided to work on a new approach more intuitive and interactive. Business intelligence softwares have been considered, developed for industrial and commercial companies that allow anyone to easily connect to data, then visualize and create interactive, sharable dashboards for further analyses. The software Qlikview® was selected for its international recognition and for academic reasons. A large part but hardly noticeable of the thesis was therefore the setting up and handling of the software. The advantages of the latter, its computing and association powers made the acquisition and the processing of the database much simpler. The visualization and the search times have been reduced. Therefore, an enormous amount of data have been collected and analyzed. The big study sample includes the public domain offers/bids available on the website of GME from 2010 to 2013 for the Day-Ahead and Intra-Day markets.

Afterwards, the actual analysis of the data starts; it has been realized by the means of the development of different visualization tools. The central part of the work is to implement functions that may lead to a better understanding of the Electricity market. From the different dashboards, the user can choose the information he wants to display and the features he wants to calculate with always the possibility to reduce the time period of the study. The many functions implemented may include, for example, the estimate of the maximum power of a production unit, the calculation of the equivalent operating hours or the plot of the aggregate demand and supply curves.

The achievement of such an application has required the definition of a set of assumptions necessary for the purpose of comparing the results with the ones available in the official surveys and reports.

Therefore the use of these tools allows an analysis which couldn't be carried out by other means and makes the situation of electricity production more transparent. The actual difficult period of the thermal power plants became more apparent with the study of the equivalent hours. A high renewable generation and ongoing poor demand are forcing fossile-fuelled plants to reduce their production. The specific cases of some operators and units in thermal production have been highlighted: because of a high reliance to the fuel price, of a more renewable development and the decline in energy demand over time, they became uncompetitive.

Finally, the thesis has enabled the creation of a rapid and effective visualization tool for a greater detail of the electricity generation. It has been conceived as an interactive application which allows the user to ensure a more comprehensive analysis of the production of a specific unit. The work done represents an ideal starting point for a further exploration of the Italian Electricity market, especially in this transition period towards a full perfect unregulated and European market.

List of Acronyms

AU Single Buyer

AEEG Autorità per l'energia elettrica ed il gas

AGCM Antitrust Authority

GME Gestore dei Mercati Energetici

GSE Gestore dei Servizi Energetici

MGP Day-Ahead Market

IOM Price-setting Operator Index

ITM Price-setting Technology Index

MA Adjustment Market

MI Intra-Day Market

MSD Ancillary Services Market

MiSE Ministry of Economic Development

MB Balancing Market

MTE Forward Electricity Market

PCE Forward Market Accounting Platform

PUN National Single Price

XML Extensible Markup Language

IEA International Energy Agency

RUP Registro delle Unità di Produzione

GAUDI Gestione delle Anagrifiche Uniche Degli Impianti di produzione e delle relative unità

RUC Registro delle Unità di Consumo

IOM Price-setting Operator Index

ITM Price-setting Technology Index

Bibliography

[1] Jason Atkinson, Lucai Fracassi, and Anamica Ramkhelawan. *Hello QlikView! A Beginner's Guide to QlikView*. Kindle Edition, 2013.

[2] Massimo Bergami, Pier Luigi Celli, and Guiseppe Soda. *National Monopoly to Successful Multinational: the case of Enel*. Palgrave Macmillanl, 2012.

[3] Ministero dello Sviluppo Economico. *Audizione del Viceministro De Vincenti presso la commissione attività produttive della camera dei deputati*, 2014.

[4] Fabiana Di Porto. *Energy Law in Italy*. Kluwer Law International, 2011.

[5] Gestore Mercati Energetici GME. *Relazione Annuale*. 2012.

[6] Gestore Mercati Energetici GME. *Vademecum della borsa elettrica*. 2012.

[7] Gestore Servizi Energetici GSE. *Rapporto Statistico 2012, Impianti a fonti rinnovabili*. 2012.

[8] Barry Harmsen and Miguel Garcia. *QlikView 11 for Developers*. Packt Publishing, 2012.

[9] International Energy Agency I.A.E. "statistics by country". `http://www.iea.org/statistics/`, 2013.

[10] Enel Information. Enel impianti. `http://www.enel.it/it-IT/impianti/`, 2013.

[11] Autorità per l'energia elettrica and il gas AEEG. *Annual Report to the European Commission on regulatory activities and the state of services in the electricity and gas sectors*. 2011.

[12] Qliktech. *Qlikview Reference Manual*, 2011.

[13] Christian Soutou. *Programmer avec MySQL*. Eyrolles, 2011.

[14] Axpo Italia Spa. *Impianti Axpo in Italia - I cicli combinati*. AXPO, 2012.

[15] Terna S.p.a. "individuazione zone della rete rilevante". `http://http://www.terna.it/`, 2013.

[16] Terna S.p.a. "italy - france, the invisible line that transmits energy". [Motion Picture], 2013.

[17] Davide Tabarelli, Eugeniai Famiglietti, Francesco Baldini, Carlo Vittorio, Bevilacqua Ariosti, Giovanni Ceccaroni, Matteo Monti, Elvira Oliva, and Davide Scapinelli. *I vantaggi del Mercato libero dell'elettricità e del gas*. NE Nomisma Energia Srl, 2013.

[18] Serge Voronin. *Price spike forecasting in a competitive Day-Ahead energy market*. PhD thesis, Lappeenranta University of Technology, 2013.

Appendix A

Complete table of maximum power and equivalent hours for 2013

The table below indicates the results obtained from the calculations of the maximum power and the equivalent hours. For each production unit of the market are mentioned when they are known, the owner of the unit, the province of the localization, the market zone, the type of energy source, the technology of the unit and then the calculated values which are the total quantity accepted on the MGP, MI1 and MI2 markets, the maximum power, the equivalent hours and the capacity factor. Please note that all the data refer to the year 2013.

Table A.1: Maximum power and Equivalent hours of Production Units - 2013

Unit Reference	Owner	Prov.	Zone	Type	Technology	Total Quantity (MWh)	Power Max (MW)	Equivalent Hours (heq)	Capacity Factor
UP_BAGNORE_3_1	ENEL PRODUZIONE S.P.A.	GR	CNOR	GEO	Other	163 499	19,034	8 590	0,98
UP_PFLOR_1	GDF SUEZ Energia Italia...	-	SUD	-	-	300 118	35,3	8 502	0,97
UP_RANCIA_1_1	ENEL PRODUZIONE S.P.A.	SI	CNOR	GEO	Other	154 076	18,6	8 284	0,95
UP_CNTRLBMSSB_1	AXPO ITALIA S.P.A.	-	NORD	-	-	95 609	11,6	8 242	0,94
UP_MONTEVERD_1	ENEL PRODUZIONE S.P.A.	PI	CNOR	GEO	Other	143 321	17,4	8 237	0,94
UP_RNDCOSESTO_1	-	-	SUD	-	-	109 286	13,312	8 210	0,94
UP_CNTRLBMSSB_2	AXPO ITALIA S.P.A.	-	NORD	-	-	93 419	11,4	8 195	0,94
UP_N_SMARTIN_1	ENEL PRODUZIONE S.P.A.	GR	CNOR	GEO	Other	297 246	36,6	8 121	0,93
UP_LE_PRATA_1	ENEL PRODUZIONE S.P.A.	PI	CNOR	GEO	Other	141 523	17,5	8 087	0,92
UP_TRAVALE_4_2	ENEL PRODUZIONE S.P.A.	GR	CNOR	GEO	Other	311 019	38,6	8 057	0,92
UP_DI0114_CNOR_C	-	-	CNOR	-	-	16 104	2	8 052	0,92
UP_IGES_3	GDF SUEZ Energia Italia...	-	SUD	-	Other	85 910	10,8	7 955	0,91
UP_NUOVA_RAD_1	ENEL PRODUZIONE S.P.A.	SI	CNOR	GEO	Other	419 351	53	7 912	0,90
UP_SALISANO_2	-	-	CSUD	ID	Run-of-river	181 859	23	7 907	0,90
UP_CHIUSDINO1_1	ENEL PRODUZIONE S.P.A.	SI	CNOR	ID	-	142 808	18,1	7 890	0,90
UP_TURBIGO_S_1	ENEL PRODUZIONE S.P.A.	MI	NORD	ID	-	77 963	9,892	7 881	0,90
UP_TORNAVENT_1	ENEL PRODUZIONE S.P.A.	VA	NORD	ID	-	53 816	6,829	7 880	0,90
UP_RANCIA_2_1	ENEL PRODUZIONE S.P.A.	SI	CNOR	GEO	Other	147 145	18,7	7 869	0,90
UP_NUOVA_GAB_1	ENEL PRODUZIONE S.P.A.	PI	CNOR	GEO	Other	143 825	18,3	7 859	0,90
UP_NUOVA_LAG_1	ENEL PRODUZIONE S.P.A.	GR	CNOR	GEO	Other	82 499	10,5	7 857	0,90
UP_VALLE_SEC_1	ENEL PRODUZIONE S.P.A.	PI	CNOR	GEO	Other	828 732	106	7 818	0,89
UP_VIZZOLA_T_1	ENEL PRODUZIONE S.P.A.	VA	NORD	ID	-	247 975	31,8	7 798	0,89
UP_ISAB_ENER_1	ISAB ENERGY	SR	SICI	TE	Ccgt	4 142 486	531,5	7 794	0,89
UP_NUOVA_CAS_1	ENEL PRODUZIONE S.P.A.	PI	CNOR	GEO	Other	114 433	14,7	7 785	0,89
UP_N_LARDERE_1	ENEL PRODUZIONE S.P.A.	PI	CNOR	GEO	Other	124 455	16	7 778	0,89
UP_FARINELLO_1	ENEL PRODUZIONE S.P.A.	PI	CNOR	GEO	Other	394 752	51,8	7 621	0,87
UP_TRRNTETONA_1	-	-	SUD	-	-	46 946	6,2	7 572	0,86
UP_DI0526_NORD_A	-	-	NORD	-	-	67 025	8,89	7 539	0,86
UP_NUOVA_SER_1	ENEL PRODUZIONE S.P.A.	PI	CNOR	GEO	Other	339 697	45,2	7 515	0,86
UP_ACERRA_1	FRI-EL	NA	CSUD	BIO	Other	540 282	72	7 504	0,86
UP_DI0230_NORD_C	-	-	NORD	-	-	46 407	6,2	7 485	0,85
UP_ENNA_1	AXPO ITALIA S.P.A.	-	SICI	-	Other	120 596	16,2	7 444	0,85
UP_MONTEVERD_2	ENEL PRODUZIONE S.P.A.	PI	CNOR	GEO	Other	74 204	10	7 420	0,85
UP_BUSSOL._M_1	ENEL PRODUZIONE S.P.A.	VR	NORD	ID	-	331 262	44,68	7 414	0,85
UP_MPNTDTRMVL_1	-	-	NORD	-	-	135 802	18,4	7 381	0,84
UP_TORREVALN_4	ENEL PRODUZIONE S.P.A.	RM	CSUD	TE	Coal	4 412 221	600	7 354	0,84
UP_CHIEVO_1	ENEL PRODUZIONE S.P.A.	VR	NORD	ID	-	199 659	27,2	7 340	0,84
UP_ALA_1	ENEL PRODUZIONE S.P.A.	TN	NORD	ID	-	278 037	38	7 317	0,84
UP_SARLUX_1	SARLUX	CA	SARD	TE	Ccgt	4 232 346	582	7 272	0,83
UP_LLSVTTRDLL_2	-	-	CSUD	-	-	84 166	11,6	7 256	0,83
UP_SICET_1	-	-	NORD	-	Other	132 761	18,3	7 255	0,83
UP_MONFALCO_1	A2A TRADING S.R.L.	GO	MFTV	TE	Coal	1 069 532	148,5	7 202	0,82
UP_PORCARI_1	EDISON	LU	CNOR	TE	Ccgt	646 481	90	7 183	0,82
UP_BOFFETTO_1	ENEL PRODUZIONE S.P.A.	SO	NORD	ID	-	74 135	10,4	7 128	0,81
UP_MONFALCO_2	A2A TRADING S.R.L.	GO	MFTV	TE	Coal	1 111 128	156	7 123	0,81
UP_SANNICOLA_1	-	-	SUD	-	Other	56 871	8	7 109	0,81
UP_TRMVLRZZTR_3	-	-	CSUD	-	-	581 306	82	7 089	0,81
UP_NUOVA_MON_1	ENEL PRODUZIONE S.P.A.	GR	CNOR	GEO	Other	49 561	7	7 080	0,81
UP_PRUSCA_1	-	-	NORD	-	-	56 520	8	7 065	0,81
UP_MPNTDPRSLZ_1	-	-	NORD	-	-	337 892	48	7 039	0,80
UP_PMGLNDARCO_1	-	-	CSUD	-	-	708 762	101	7 017	0,80
UP_DI2055_CSUD_A	-	-	CSUD	ID	Pumped-St...	71 739	10,23	7 013	0,80
UP_STRONGOLI_1	BIOMASSE ITALIA	KR	SUD	BIO	Other	336 361	48	7 008	0,80
UP_TECNOBORGO_1	-	-	NORD	-	-	66 798	9,6	6 958	0,79
UP_NUOVA_MOL_1	ENEL PRODUZIONE S.P.A.	PI	CNOR	GEO	Other	93 100	13,5	6 896	0,79
UP_SESTA_1_1	ENEL PRODUZIONE S.P.A.	SI	CNOR	GEO	Other	66 838	9,7	6 891	0,79
UP_PIANCASTA_8	ENEL PRODUZIONE S.P.A.	SI	CNOR	GEO	Other	134 860	19,6	6 881	0,79
UP_SORIO_NUO_2	ENEL PRODUZIONE S.P.A.	VR	NORD	ID	-	101 094	14,7	6 877	0,79
UP_DI0370_CSUD_B	-	-	CSUD	-	-	1 715	0,25	6 859	0,78
UP_CLHRFRLIBG_1	-	-	NORD	-	-	64 879	9,49	6 837	0,78
UP_FEATV2_2	-	-	NORD	-	-	135 237	20	6 762	0,77
UP_MILAZZO_1	EDISON	ME	SICI	TE	Ccgt	986 646	147	6 712	0,77
UP_VADO_TERM_3	TIRRENO POWER S.P.A.	SV	NORD	TE	Coal	1 979 206	296	6 687	0,76
UP_ADDA2_1	EDISON	-	NORD	ID	-	279 362	42	6 651	0,76
UP_SAGITTA_2	ENEL PRODUZIONE S.P.A.	AQ	CSUD	ID	-	65 958	9,988	6 604	0,75
UP_IGES_4	GDF SUEZ Energia Italia...	-	SUD	TE	Ccgt	422 514	64	6 602	0,75
UP_CLHRMDNCVZ_1	-	-	NORD	-	-	103 099	15,657	6 585	0,75
UP_FUSINA_T_3	ENEL PRODUZIONE S.P.A.	VE	NORD	TE	Coal	1 907 448	290	6 577	0,75
UP_TORREVALN_2	ENEL PRODUZIONE S.P.A.	RM	CSUD	TE	Coal	4 039 087	615	6 568	0,75
UP_PREMESA_M_1	EDISON	BZ	NORD	ID	-	52 498	8,038	6 531	0,75
UP_TERMOUTIL_1	-	-	NORD	-	-	553 893	85	6 516	0,74

Unit Reference	Owner	Prov.	Zone	Type	Technology	Total Quantity (MWh)	Power Max (MW)	Equivalent Hours (heq)	Capacity Factor
UP_DI8888_NORD_V	-	-	NORD	-	-	164 835	25,31	6 513	0,74
UP_LLSVTTRDLL_3	-	-	CSUD	-	-	84 240	13	6 480	0,74
UP_MOLINE_1	DOLOMITI ENERGIA	BL	NORD	ID	-	119 410	18,5	6 455	0,74
UP_PESCARA_1_1	ENEL PRODUZIONE S.P.A.	PE	CSUD	ID	-	66 584	10,4	6 402	0,73
UP_PONTE_FEL_1	ENEL PRODUZIONE S.P.A.	VT	CSUD	ID	-	115 140	18	6 397	0,73
UP_NAZZANO_1	ENEL PRODUZIONE S.P.A.	RM	CSUD	ID	-	102 101	16	6 381	0,73
UP_ROSEN_1	GDF SUEZ Energia Italia...	LI	CNOR	TE	-	2 381 115	373,5	6 375	0,73
UP_ISOLA_SER_1	ENEL PRODUZIONE S.P.A.	PC	NORD	ID	-	483 202	76	6 358	0,73
UP_CARDANO_1	ENEL PRODUZIONE S.P.A.	BZ	NORD	ID	-	768 643	120,919	6 357	0,73
UP_FNZCNVRTTE_1	-	-	NORD	-	-	69 664	11	6 333	0,72
UP_SNMCHLCRSO_1	-	-	NORD	-	-	59 876	9,459	6 330	0,72
UP_CNTRLLTTRC_11	-	-	SARD	-	-	73 397	11,6	6 327	0,72
UP_CRSBRZNSCA_1	-	-	NORD	-	-	59 789	9,459	6 321	0,72
UP_DI0107_NORD_C	-	-	NORD	-	-	55 223	8,74	6 318	0,72
UP_BLVNBMASSA_1	-	-	NORD	-	-	126 110	20	6 306	0,72
UP_CANDELA_1	EDISON	FG	FOGN	TE	Ccgt	2 447 455	388,518	6 299	0,72
UP_CARBOLI_2_1	ENEL PRODUZIONE S.P.A.	GR	CNOR	GEO	Other	108 781	17,3	6 288	0,72
UP_DI0339_NORD_C	-	-	NORD	-	-	34 345	5,468	6 281	0,72
UP_COSCILE_1_1	ENEL PRODUZIONE S.P.A.	CS	SUD	ID	-	58 624	9,343	6 275	0,72
UP_NRGNTSRLBM_1	GDF SUEZ Energia Italia...	-	SUD	-	-	84 778	13,62	6 225	0,71
UP_CASTEL_GI_1	ENEL PRODUZIONE S.P.A.	RM	CSUD	ID	-	74 545	12	6 212	0,71
UP_BRESSANON_1	ENEL PRODUZIONE S.P.A.	BZ	NORD	ID	Pumped-St...	568 620	91,8	6 194	0,71
UP_QUERO_1	ENEL PRODUZIONE S.P.A.	BL	NORD	ID	-	184 302	30	6 143	0,70
UP_NGRCNSLICE_1	-	-	NORD	-	-	331 219	54	6 134	0,70
UP_CEPRANO_1	ENEL PRODUZIONE S.P.A.	FR	CSUD	ID	-	68 747	11,298	6 085	0,69
UP_CREVOLA_T_1	ENEL PRODUZIONE S.P.A.	VB	NORD	ID	-	193 045	32,05	6 023	0,69
UP_PIANCASTA_6	ENEL PRODUZIONE S.P.A.	SI	CNOR	GEO	Other	120 252	20	6 013	0,69
UP_SELVA_1_1	ENEL PRODUZIONE S.P.A.	PI	CNOR	GEO	Other	114 077	19	6 004	0,69
UP_LAGONI_RO_1	ENEL PRODUZIONE S.P.A.	PI	CNOR	GEO	Other	71 668	12	5 972	0,68
UP_CORNIA_2_1	ENEL PRODUZIONE S.P.A.	PI	CNOR	GEO	Other	92 248	15,5	5 951	0,68
UP_BOLOGNANO_1	ENEL PRODUZIONE S.P.A.	PE	CSUD	ID	-	181 872	30,6	5 944	0,68
UP_NPWRBRNDSI_10	ENI SPA	BR	BRNN	TE	Ccgt	1 933 096	327	5 912	0,67
UP_NOVEL_1	ALPIQ ENERGIA ITALIA...	NO	NORD	TE	Ccgt	542 079	92,256	5 876	0,67
UP_BRNDSSUDCE_4	ENEL PRODUZIONE S.P.A.	BR	BRNN	TE	OilCoal	3 553 830	605	5 874	0,67
UP_NPWRRVENNA_10	ENI SPA	RA	NORD	TE	Ccgt	2 151 190	368	5 846	0,67
UP_NPWRLVORNO_7	ENI SPA	LI	CNOR	TE	Ccgt	713 115	122	5 845	0,67
UP_PIANCASTA_7	ENEL PRODUZIONE S.P.A.	SI	CNOR	GEO	Other	99 463	17,1	5 817	0,66
UP_CTNUCENORD_1	ERG SPA	SR	SICI	TE	Ccgt	2 231 442	384	5 811	0,66
UP_SASSO2_1	ENEL PRODUZIONE S.P.A.	PI	CNOR	GEO	Other	115 955	20	5 798	0,66
UP_MBLSERVICE_1	-	-	CSUD	-	Other	68 342	11,8	5 792	0,66
UP_SUIO_1	ENEL PRODUZIONE S.P.A.	CE	CSUD	ID	-	37 645	6,5	5 792	0,66
UP_MONCALIERI_3	IREN MERCATO SPA	TO	NORD	TE	Ccgt	2 037 062	352	5 787	0,66
UP_NPWRRVENNA_11	ENI SPA	RA	NORD	TE	Ccgt	2 182 859	379	5 760	0,66
UP_SPEZIA_CE_3	ENEL PRODUZIONE S.P.A.	SP	NORD	TE	OilCoal	2 984 788	520	5 740	0,66
UP_DI0005_NORD_A	-	-	NORD	-	-	47 041	8,2	5 737	0,65
UP_EPSISTEMI_1	-	-	CSUD	-	-	51 465	9	5 718	0,65
UP_MARLENG.M_1	EDISON	BZ	NORD	ID	-	217 164	38	5 715	0,65
UP_GOLTARA_1	-	-	NORD	-	-	48 378	8,5	5 692	0,65
UP_REA_DALMI_1	-	-	NORD	-	-	84 399	14,83	5 691	0,65
UP_DARFO_1	-	-	NORD	-	-	54 057	9,5	5 690	0,65
UP_CASTELMAS_1	EDISON	RO	NORD	TE	Ccgt	242 274	42,58	5 690	0,65
UP_NUOVA_SAS_1	ENEL PRODUZIONE S.P.A.	GR	CNOR	GEO	Other	68 190	12	5 683	0,65
UP_TORREVALN_3	ENEL PRODUZIONE S.P.A.	RM	CSUD	TE	Coal	3 463 853	610	5 678	0,65
UP_PRIOLO_C_1	ENEL PRODUZIONE S.P.A.	SR	PRGP	TE	Ccgt	2 104 306	371	5 672	0,65
UP_NPWRBRNDSI_9	ENI SPA	BR	BRNN	TE	Ccgt	1 840 929	328	5 613	0,64
UP_MONCALRPW_2	IREN MERCATO SPA	TO	NORD	TE	Ccgt	2 153 880	384	5 609	0,64
UP_BALSORANO_1	ENEL PRODUZIONE S.P.A.	AQ	CSUD	ID	-	85 781	15,326	5 597	0,64
UP_DI8888_NORD_X	-	-	NORD	-	-	974 810	174,354	5 591	0,64
UP_PORTOTORR_1	ENEL PRODUZIONE S.P.A.	VA	NORD	ID	-	64 367	11,517	5 589	0,64
UP_SERVOLA_2	-	-	NORD	TE	Ccgt	814 321	146	5 578	0,64
UP_CHAMPAGNE_4	C.V.A S.P.A.	AO	NORD	ID	-	150 305	27	5 567	0,64
UP_DI1918_NORD_A	-	-	NORD	-	-	25 221	4,533	5 564	0,64
UP_AIROLE_1	-	-	NORD	-	-	44 473	8	5 559	0,63
UP_DI1990_NORD_C	-	-	NORD	-	-	92 780	16,779	5 530	0,63
UP_PRECI_1	E.ON Energy Trading SE	PG	CNOR	ID	-	40 819	7,4	5 516	0,63
UP_PPNERGYSRL_1	AXPO ITALIA S.P.A.	-	SUD	-	-	55 121	10	5 512	0,63
UP_HONE_1_1	C.V.A S.P.A.	AO	NORD	ID	-	101 951	18,5	5 511	0,63
UP_PONT_1	IREN MERCATO SPA	TO	NORD	ID	-	75 404	13,7	5 504	0,63
UP_AGRI_1	ENEL PRODUZIONE S.P.A.	PZ	SUD	ID	Pumped-St...	214 346	38,97	5 500	0,63
UP_TUSCIANO_1	EDIPOWER S.P.A	SA	CSUD	ID	-	54 035	9,83	5 497	0,63
UP_DI0196_NORD_C	C.V.A S.P.A.	-	NORD	-	-	189 573	34,558	5 486	0,63

Unit Reference	Owner	Prov.	Zone	Type	Technology	Total Quantity (MWh)	Power Max (MW)	Equivalent Hours (heq)	Capacity Factor
UP_TANAGRO_1	EDIPOWER	SA	CSUD	ID	-	105 448	19,272	5 472	0,62
UP_PONTE_MAL_1	ENEL PRODUZIONE S.P.A.	AP	NORD	ID	-	44 236	8,1	5 461	0,62
UP_DI1608_NORD_A	-	-	NORD	-	-	17 394	3,194	5 446	0,62
UP_ACEA_ORTE_1	ACEA ENERGIA	-	CSUD	-	-	97 855	18	5 436	0,62
UP_CBTRVNNCT1_1	AXPO ITALIA S.P.A.	-	NORD	-	-	60 503	11,147	5 428	0,62
UP_NPWRFRRRRB_10	ENI SPA	PV	NORD	TE	Ccgt	1 079 376	199	5 424	0,62
UP_ZEVIO_1	ENEL PRODUZIONE S.P.A.	VR	NORD	ID	-	131 266	24,252	5 413	0,62
UP_ST._CLAIR_1	C.V.A S.P.A.	AO	NORD	ID	-	164 681	30,5	5 399	0,62
UP_DI0462_NORD_A	-	-	NORD	-	-	12 956	2,4	5 398	0,62
UP_FUSINA_T_4	ENEL PRODUZIONE S.P.A.	VE	NORD	TE	Coal	1 511 286	280	5 397	0,62
UP_BARDONETT_1	IREN MERCATO SPA	TO	NORD	ID	-	78 180	14,5	5 392	0,62
UP_MEDUNO_2	EDISON	PN	NORD	ID	-	53 606	9,963	5 381	0,61
UP_TORINONORD_1	IREN MERCATO SPA	TO	NORD	TE	Ccgt	2 058 370	383	5 374	0,61
UP_PARONA_1	-	PV	NORD	BIO	Other	183 448	34,2	5 364	0,61
UP_NPWRMNTOVA_3	ENI SPA	MN	NORD	TE	Ccgt	2 005 391	374	5 362	0,61
UP_CNTRALETEL_11	-	-	NORD	-	-	149 530	27,91	5 358	0,61
UP_POGGIBONSI_1	AXPO ITALIA S.P.A.	-	CSUD	-	-	35 995	6,729	5 349	0,61
UP_CIMENA_1	ENEL PRODUZIONE S.P.A.	TO	NORD	ID	-	112 138	21	5 340	0,61
UP_IGES_2	-	-	SUD	-	Other	398 105	74,6	5 337	0,61
UP_RIO_PUSTE_1	-	-	NORD	-	-	111 481	21	5 309	0,61
UP_S.LEONARD_1	-	-	NORD	-	-	97 644	18,4	5 307	0,61
UP_STANGA_1	ENEL PRODUZIONE S.P.A.	BL	NORD	ID	Run-of-river	155 900	29,48	5 288	0,60
UP_MONASTERO_1	ENEL PRODUZIONE S.P.A.	SO	NORD	ID	-	256 093	48,709	5 258	0,60
UP_CLFRRRCSSN_1	-	-	NORD	-	-	56 253	10,7	5 257	0,60
UP_LBPOWERSPA_1	-	-	NORD	-	-	243 704	46,387	5 254	0,60
UP_BRNDSSUDCE_1	ENEL PRODUZIONE S.P.A.	BR	BRNN	TE	OilCoal	3 177 556	605	5 252	0,60
UP_AEM-STAZZ_1	A2A TRADING S.R.L.	SO	NORD	ID	Run-of-river	153 530	29,25	5 249	0,60
UP_VOBARNO_1	ENEL PRODUZIONE S.P.A.	BS	NORD	ID	-	143 482	27,389	5 239	0,60
UP_VADO_TERM_4	TIRRENO POWER S.P.A.	SV	NORD	TE	Coal	1 508 631	288	5 238	0,60
UP_DI0182_NORD_C	ENEL PRODUZIONE S.P.A.	-	NORD	ID	Run-of-river	1 501 774	287,238	5 228	0,60
UP_DI1999_NORD_A	-	-	NORD	-	-	95 927	18,398	5 214	0,60
UP_DI2245_NORD_C	-	-	NORD	TE	Ccgt	13 123	2,52	5 208	0,59
UP_QUINCINET_1	C.V.A S.P.A.	AO	NORD	ID	-	105 076	20,208	5 200	0,59
UP_IMPSUD_2	ERG SPA	SR	SICI	TE	Other	259 939	50	5 199	0,59
UP_DI1676_CSUD_C	-	-	CSUD	-	-	35 318	6,8	5 194	0,59
UP_NPWRMNTOVA_2	ENI SPA	MN	NORD	TE	Ccgt	1 874 934	361	5 194	0,59
UP_VINCHIANA_1	ENEL PRODUZIONE S.P.A.	LU	CNOR	ID	-	106 382	20,616	5 160	0,59
UP_PONTEFIUM_1	ENEL PRODUZIONE S.P.A.	FR	CSUD	ID	-	34 020	6,595	5 158	0,59
UP_S.FOCA_1	-	-	NORD	-	-	58 655	11,4	5 145	0,59
UP_PRIOLO_C_2	ENEL PRODUZIONE S.P.A.	SR	PRGP	TE	Ccgt	1 908 732	371	5 145	0,59
UP_S.DAMIANO_1	ENEL PRODUZIONE S.P.A.	CN	NORD	ID	-	72 676	14,139	5 140	0,59
UP_CHAMPAGNE_3	C.V.A S.P.A.	AO	NORD	ID	-	57 694	11,25	5 128	0,59
UP_MANDELA_1	-	-	CSUD	-	-	25 636	5	5 127	0,59
UP_CAIRO_1	-	-	NORD	-	-	110 385	21,6	5 110	0,58
UP_LEVANTE_3	EDISON	VE	NORD	TE	Ccgt	1 833 569	359,705	5 097	0,58
UP_TRMCCLLFRR_1	TERMICA COLLEFERRO...	RM	CSUD	TE	Ccgt	181 892	36	5 053	0,58
UP_ARSIE_1	ENEL PRODUZIONE S.P.A.	BL	NORD	ID	Pumped-St...	162 047	32,105	5 047	0,58
UP_CNTRLBMSSC_1	-	-	SUD	-	Other	55 330	10,99	5 035	0,57
UP_CASTELB.E_1	EDISON	BZ	NORD	ID	Run-of-river	435 099	86,652	5 021	0,57
UP_DI1676_SARD_A	-	-	SARD	-	-	23 551	4,691	5 020	0,57
UP_TRIANO_1	ENEL PRODUZIONE S.P.A.	CH	CSUD	ID	-	119 849	24	4 994	0,57
UP_BRNDSSUDCE_2	ENEL PRODUZIONE S.P.A.	BR	BRNN	TE	OilCoal	3 016 217	605	4 985	0,57
UP_ALANNO_1	ENEL PRODUZIONE S.P.A.	PE	CSUD	ID	-	109 675	22	4 985	0,57
UP_DI8888_SUD_X	-	-	SUD	-	-	118 796	23,868	4 977	0,57
UP_VILLA_RIN_1	-	-	NORD	-	-	50 807	10,224	4 969	0,57
UP_SULCIS_CEN_2	ENEL PRODUZIONE S.P.A.	CA	SARD	TE	Coal	1 361 217	275	4 950	0,57
UP_CMPLCCIOLI_2	ENEL PRODUZIONE S.P.A.	VB	NORD	ID	-	42 008	8,51	4 936	0,56
UP_MSSRVNCLLI_1	-	-	SUD	-	-	7 545	1,536	4 912	0,56
UP_DI0462_NORD_B	-	-	NORD	-	-	18 315	3,736	4 902	0,56
UP_MAZZUNNO_1	-	-	NORD	-	-	52 387	10,7	4 896	0,56
UP_GOGLIO_3	ENEL PRODUZIONE S.P.A.	VB	NORD	ID	-	97 502	19,937	4 891	0,56
UP_TRAVALE_3_1	ENEL PRODUZIONE S.P.A.	GR	CNOR	GEO	Other	85 717	17,6	4 870	0,56
UP_MONTELUNG_1	ENEL PRODUZIONE S.P.A.	CE	CSUD	ID	-	172 055	35,337	4 869	0,56
UP_ACQUORIA_1	ENEL PRODUZIONE S.P.A.	RM	CSUD	ID	-	237 108	48,8	4 859	0,55
UP_VERAMPIO_1	ENEL PRODUZIONE S.P.A.	VB	NORD	ID	-	232 152	47,864	4 850	0,55
UP_GARDONA_1	ENEL PRODUZIONE S.P.A.	BL	NORD	ID	-	56 607	11,7	4 838	0,55
UP_SOVERZENE_2	ENEL PRODUZIONE S.P.A.	BL	NORD	ID	Pumped-St...	225 582	46,994	4 800	0,55
UP_CALICE_1	ENEL PRODUZIONE S.P.A.	VB	NORD	ID	-	107 094	22,35	4 792	0,55
UP_PONTECORV_1	ENEL PRODUZIONE S.P.A.	FR	CSUD	ID	-	72 966	15,273	4 777	0,55
UP_ACEA_CAST_1	ACEA ENERGIA	-	CSUD	-	-	38 161	8	4 770	0,54
UP_VILLA_S.M_1	ENEL PRODUZIONE S.P.A.	CH	CSUD	ID	-	286 008	60	4 767	0,54

Unit Reference	Owner	Prov.	Zone	Type	Technology	Total Quantity (MWh)	Power Max (MW)	Equivalent Hours (heq)	Capacity Factor
UP_AVENTINO1_1	ENEL PRODUZIONE S.P.A.	CH	CSUD	ID	-	38 997	8,2	4 756	0,54
UP_ETASRL_1	AXPO ITALIA S.P.A.	KR	SUD	TE	-	66 222	14	4 730	0,54
UP_IGES_1	-	-	SUD	-	-	37 822	8	4 728	0,54
UP_PALLANZENO_2	ENEL PRODUZIONE S.P.A.	VB	NORD	ID	-	168 099	35,637	4 717	0,54
UP_VOLTUR1S_1	ENEL PRODUZIONE S.P.A.	-	SUD	ID	Pumped-St...	108 320	23,034	4 703	0,54
UP_CAVILLA_1	ENEL PRODUZIONE S.P.A.	VI	NORD	ID	-	118 676	25,256	4 699	0,54
UP_DI8888_CNOR_X	-	-	CNOR	-	-	204 063	43,532	4 688	0,54
UP_BRNDSSUDCE_3	ENEL PRODUZIONE S.P.A.	BR	BRNN	TE	OilCoal	2 835 963	605	4 688	0,54
UP_P.GARD.ME_1	EDISON	BZ	NORD	ID	-	213 128	45,586	4 675	0,53
UP_CROTONE2_1	AXPO ITALIA S.P.A.	KR	SUD	-	-	214 970	46	4 673	0,53
UP_GOGLIO_2	ENEL PRODUZIONE S.P.A.	VB	NORD	ID	-	89 209	19,094	4 672	0,53
UP_SCTNPWPFRR_3	ENI SPA	FE	NORD	TE	Ccgt	1 746 634	374	4 670	0,53
UP_NERA_MONT_1	E.ON Energy Trading SE	TR	CNOR	ID	-	131 685	28,2	4 670	0,53
UP_DI1902_NORD_C	-	-	NORD	-	-	33 620	7,211	4 662	0,53
UP_CHAVONNE_1	C.V.A S.P.A.	AO	NORD	ID	-	125 768	27	4 658	0,53
UP_MORINO_1	ENEL PRODUZIONE S.P.A.	AQ	CSUD	ID	-	51 940	11,155	4 656	0,53
UP_TRNIENASPA_1	-	-	CNOR	-	-	53 493	11,5	4 652	0,53
UP_PELOS_1	ENEL PRODUZIONE S.P.A.	BL	NORD	ID	-	141 728	30,502	4 647	0,53
UP_M.DI_TURE_1	ENEL PRODUZIONE S.P.A.	BZ	NORD	ID	-	70 199	15,113	4 645	0,53
UP_LTGRDPWRSR_1	AXPO ITALIA S.P.A.	-	NORD	-	-	194 762	42	4 637	0,53
UP_UPBRNSFIR1_2	-	-	SUD	-	-	150 141	32,5	4 620	0,53
UP_DI0060_NORD_C	EDISON	-	NORD	-	-	175 184	37,957	4 615	0,53
UP_PARAVISO_1	-	-	NORD	-	-	114 626	25	4 585	0,52
UP_DI1621_NORD_C	-	-	NORD	-	-	253 648	55,455	4 574	0,52
UP_CARBOLI_1_1	ENEL PRODUZIONE S.P.A.	GR	CNOR	GEO	Other	78 648	17,2	4 573	0,52
UP_CARZANO_1	ENEL PRODUZIONE S.P.A.	TN	NORD	ID	-	47 967	10,5	4 568	0,52
UP_NPWRFRRRRB_9	ENI SPA	PV	NORD	TE	Ccgt	1 523 313	334	4 561	0,52
UP_DI0361_NORD_G	-	-	NORD	-	-	14 222	3,123	4 554	0,52
UP_GUARCINO_1	-	-	CSUD	-	Other	94 171	20,7	4 549	0,52
UP_SALSOMINO_1	ENEL PRODUZIONE S.P.A.	PC	NORD	ID	Pumped-St...	63 113	13,877	4 548	0,52
UP_CANEVA_2	ENEL PRODUZIONE S.P.A.	PN	NORD	ID	-	152 133	33,5	4 541	0,52
UP_BRUNICO_M_1	EDISON	BZ	NORD	ID	-	175 833	38,769	4 535	0,52
UP_MALLERO_1	ENEL PRODUZIONE S.P.A.	SO	NORD	ID	-	65 306	14,4	4 535	0,52
UP_SANMAURO_1	IREN MERCATO SPA	TO	NORD	ID	-	33 990	7,5	4 532	0,52
UP_FUSINA_T_2	ENEL PRODUZIONE S.P.A.	VE	NORD	TE	Coal	702 296	155	4 531	0,52
UP_DI0012_NORD_B	-	-	NORD	-	-	36 246	8	4 531	0,52
UP_BGNCHVASSO_1	-	-	NORD	-	-	81 752	18,05	4 529	0,52
UP_SOSPIROLO_1	ENEL PRODUZIONE S.P.A.	BL	NORD	ID	-	117 460	26,063	4 507	0,51
UP_EDIS_CIVI_1	EDISON	-	NORD	ID	Run-of-river	171 223	38	4 506	0,51
UP_NPWRFRRRRB_8	ENI SPA	PV	NORD	TE	Ccgt	1 582 197	352	4 495	0,51
UP_DI2017_NORD_C	E.ON Energy Trading SE	-	NORD	FV	Renewable	164 065	36,647	4 477	0,51
UP_DI2182_CNOR_B	-	-	CNOR	TE	Ccgt	110 989	24,85	4 466	0,51
UP_DI0114_NORD_B	-	-	NORD	TE	Ccgt	64 836	14,52	4 465	0,51
UP_NARNI_1	E.ON Energy Trading SE	TR	CNOR	ID	-	142 880	32	4 465	0,51
UP_SIGNAYES_1	C.V.A S.P.A.	AO	NORD	ID	Run-of-river	209 028	47	4 447	0,51
UP_HONE2_1	C.V.A S.P.A.	AO	NORD	ID	-	48 679	11	4 425	0,51
UP_POSCHIAVI_1	ENEL PRODUZIONE S.P.A.	So	NORD	ID	-	45 562	10,3	4 423	0,50
UP_AGORDO_1	ENEL PRODUZIONE S.P.A.	BL	NORD	ID	-	112 143	25,5	4 398	0,50
UP_CNTRLDRLTT_49	IREN MERCATO SPA	-	NORD	-	-	39 441	9	4 382	0,50
UP_CORDENONS_1	-	-	NORD	-	-	47 899	10,991	4 358	0,50
UP_QUARTNUS_1	C.V.A S.P.A.	AO	NORD	ID	-	195 525	45	4 345	0,50
UP_ROSONE_1	IREN MERCATO SPA	TO	NORD	ID	Pumped-St...	573 127	132	4 342	0,50
UP_VERRES_1	C.V.A S.P.A.	AO	NORD	ID	-	53 277	12,288	4 336	0,49
UP_DI1886_SUD_C	-	-	SUD	ID	Run-of-river	73 515	17,075	4 305	0,49
UP_DI0060_CNOR_C	EDISON	-	CNOR	-	-	38 680	9,003	4 296	0,49
UP_DI0360_NORD_C	DOLOMITI ENERGIA	-	NORD	-	-	110 534	25,739	4 294	0,49
UP_LEINI_1	GDF SUEZ Energia Italia...	TO	NORD	TE	Ccgt	1 707 854	397,7	4 294	0,49
UP_DI0062_NORD_C	AXPO ITALIA S.P.A.	-	NORD	-	-	215 667	50,248	4 292	0,49
UP_CASTELLET_1	ENEL PRODUZIONE S.P.A.	TV	NORD	ID	-	71 996	16,81	4 283	0,49
UP_NOVE_1	ENEL PRODUZIONE S.P.A.	TV	NORD	ID	Pumped-St...	248 324	58,077	4 276	0,49
UP_BORGO_TRE_1	AGSM ENERGIA SRL	VR	NORD	TE	Ccgt	117 206	27,5	4 262	0,49
UP_CADARESE_1	ENEL PRODUZIONE S.P.A.	VB	NORD	ID	-	272 490	64,036	4 255	0,49
UP_CENCENIGH_1	ENEL PRODUZIONE S.P.A.	BL	NORD	ID	-	117 696	27,66	4 255	0,49
UP_PNTSTMRTIN_1	C.V.A S.P.A.	AO	NORD	ID	-	185 862	44	4 224	0,48
UP_GALLICANO_1	ENEL PRODUZIONE S.P.A.	LU	CNOR	ID	-	102 509	24,28	4 222	0,48
UP_DI2182_NORD_A	-	-	NORD	-	-	90 917	21,72	4 186	0,48
UP_SOVERZENE_1	ENEL PRODUZIONE S.P.A.	BL	NORD	ID	Pumped-St...	515 277	123,657	4 167	0,48
UP_DI1973_NORD_C	-	-	NORD	-	-	145 643	35	4 161	0,48
UP_DI0005_NORD_C	A2A TRADING S.R.L.	-	NORD	-	-	105 489	25,37	4 158	0,47
UP_COGHINAS_1	ENEL PRODUZIONE S.P.A.	SS	SARD	ID	Pumped-St...	90 434	21,905	4 128	0,47
UP_S._ANGELO_1	ACEA ENERGIA	CH	CSUD	ID	Pumped-St...	181 110	44	4 116	0,47

Unit Reference	Owner	Prov.	Zone	Type	Technology	Total Quantity (MWh)	Power Max (MW)	Equivalent Hours (heq)	Capacity Factor
UP_DI1170_CNOR_A	-	-	CNOR	ID	Pumped-St...	26 334	6,4	4 115	0,47
UP_ISOLA_PAL_1	ENEL PRODUZIONE S.P.A.	PR	NORD	ID	-	39 076	9,501	4 113	0,47
UP_DI0156_NORD_C	ALPIQ ENERGIA ITALIA...	VC	NORD	ID	-	17 277	4,201	4 113	0,47
UP_DI2055_NORD_C	-	-	NORD	ID	Run-of-river	440 610	107,457	4 100	0,47
UP_MONTJOVET_1	C.V.A S.P.A.	AO	NORD	ID	-	202 903	49,5	4 099	0,47
UP_CGCNTRCTTA_1	-	-	NORD	-	Other	43 625	10,7	4 077	0,47
UP_C.T.E.C_1	-	-	NORD	-	-	55 206	13,56	4 071	0,46
UP_PRATI_ME_1	EDISON	BZ	NORD	ID	-	96 423	23,712	4 066	0,46
UP_DOSSI_1	ENEL PRODUZIONE S.P.A.	BG	NORD	ID	Pumped-St...	170 964	42,109	4 060	0,46
UP_DI1174_CNOR_B	-	-	CNOR	TE	Ccgt	129 785	32	4 056	0,46
UP_MONTE_ARG_1	E.ON Energy Trading SE	TR	CNOR	ID	-	234 765	58	4 048	0,46
UP_DI0182_CNOR_C	ENEL PRODUZIONE S.P.A.	-	CNOR	-	-	145 778	36,034	4 046	0,46
UP_DI1170_CSUD_B	-	-	CSUD	TE	Ccgt	33 289	8,239	4 040	0,46
UP_NOCE_1	EDISON	TN	NORD	ID	Run-of-river	606 527	151	4 017	0,46
UP_CAORIA_1	DOLOMITI ENERGIA	TN	NORD	ID	-	163 442	40,7	4 016	0,46
UP_PREDAZZO_1	ENEL PRODUZIONE S.P.A.	TN	NORD	ID	-	60 923	15,395	3 957	0,45
UP_CNTRLDCGNR_47	-	-	NORD	TE	Ccgt	48 258	12,2	3 956	0,45
UP_DI8888_CSUD_X	-	-	CSUD	-	-	127 088	32,18	3 949	0,45
UP_DI8888_CNOR_V	-	-	CNOR	-	-	20 043	5,08	3 945	0,45
UP_DI0114_NORD_C	-	-	NORD	-	-	74 789	18,962	3 944	0,45
UP_DI1895_SUD_B	-	-	SUD	-	-	33 011	8,4	3 930	0,45
UP_LUDRIGNO_S_1	ENEL PRODUZIONE S.P.A.	BG	NORD	ID	-	51 204	13,06	3 921	0,45
UP_CNTRLBMSSS_1	-	-	NORD	-	-	35 611	9,1	3 913	0,45
UP_PONTE_GAR_1	ENEL PRODUZIONE S.P.A.	BZ	NORD	ID	-	56 930	14,6	3 899	0,45
UP_MPNTDRLTTR_33	-	-	NORD	-	-	101 315	26	3 897	0,44
UP_SNTNDRNRGP_1	-	-	NORD	-	-	140 102	35,957	3 896	0,44
UP_FUSINA_T_1	ENEL PRODUZIONE S.P.A.	VE	NORD	TE	Coal	563 987	145	3 890	0,44
UP_DI1676_SUD_C	-	-	SUD	-	-	12 438	3,2	3 887	0,44
UP_DI2005_NORD_B	-	-	NORD	-	-	33 691	8,7	3 873	0,44
UP_PONTE_GIU_1	-	-	NORD	-	-	42 517	11	3 865	0,44
UP_PONTE_MAR_1	ENEL PRODUZIONE S.P.A.	CN	NORD	ID	-	62 034	16,059	3 863	0,44
UP_DI0360_NORD_A	DOLOMITI ENERGIA	-	NORD	-	-	16 199	4,198	3 859	0,44
UP_MASINO_1	ENEL PRODUZIONE S.P.A.	SO	NORD	ID	-	26 231	6,8	3 857	0,44
UP_DI0526_NORD_C	-	-	NORD	-	-	40 628	10,566	3 845	0,44
UP_COVALOU_1	C.V.A S.P.A.	AO	NORD	ID	-	149 395	39	3 831	0,44
UP_DI0526_NORD_B	-	-	NORD	-	-	98 078	25,652	3 823	0,44
UP_LINATE1_1	-	-	NORD	TE	Ccgt	66 332	17,408	3 810	0,43
UP_DI1886_SICI_C	-	-	SICI	ID	Run-of-river	3 892	1,022	3 808	0,43
UP_DI1973_NORD_B	-	-	NORD	-	-	69 494	18,253	3 807	0,43
UP_BATTIGGIO_1	EDISON	VB	NORD	ID	-	75 617	19,931	3 794	0,43
UP_MAEN_4	C.V.A S.P.A.	AO	NORD	ID	-	79 067	21	3 765	0,43
UP_S.PANCRAZ_1	ENEL PRODUZIONE S.P.A.	BZ	NORD	ID	Pumped-St...	127 605	33,97	3 756	0,43
UP_PIOMBINO_5	ENEL PRODUZIONE S.P.A.	LI	CNOR	TE	-	217 789	58	3 755	0,43
UP_GRIGNO_1	ENEL PRODUZIONE S.P.A.	TN	NORD	ID	-	54 032	14,402	3 752	0,43
UP_CAFFARO_2_1	EDISON	BS	NORD	ID	Run-of-river	169 394	45,16	3 751	0,43
UP_TEVERE_1	E.ON Energy Trading SE	TR	CNOR	ID	Run-of-river	337 416	90	3 749	0,43
UP_DI0060_NORD_A	EDISON	-	NORD	-	-	140 738	37,607	3 742	0,43
UP_GENOVA_T_6	ENEL PRODUZIONE S.P.A.	GE	NORD	TE	Coal	538 397	144	3 739	0,43
UP_SCTNPWPFRR_2	ENI SPA	FE	NORD	TE	Ccgt	1 417 590	380	3 731	0,43
UP_DI1625_NORD_C	-	-	NORD	-	-	45 336	12,176	3 723	0,43
UP_S.FLORI.A_1	ENEL PRODUZIONE S.P.A.	BZ	NORD	ID	Pumped-St...	224 258	60,255	3 722	0,42
UP_RIORIVA_1	-	-	NORD	-	-	67 870	18,253	3 718	0,42
UP_SCALELLE_1	ENEL PRODUZIONE S.P.A.	RM	CSUD	ID	-	20 385	5,502	3 705	0,42
UP_PIEDIMULE_1	ENEL PRODUZIONE S.P.A.	VB	NORD	ID	-	27 410	7,401	3 704	0,42
UP_VENAMARTE_1	ENEL PRODUZIONE S.P.A.	AP	CSUD	ID	-	73 943	20,01	3 695	0,42
UP_ISOLLAZ_1	C.V.A S.P.A.	AO	NORD	ID	-	118 225	32	3 695	0,42
UP_OZIERI_1	ENEL PRODUZIONE S.P.A.	SS	SARD	ID	Pumped-St...	14 651	3,969	3 691	0,42
UP_VARZO_2_1	ENEL PRODUZIONE S.P.A.	VB	NORD	ID	-	117 657	32	3 677	0,42
UP_ISOLA_E_M_1	-	-	NORD	-	-	73 511	20	3 676	0,42
UP_PATERNOCLE_1	ENEL PRODUZIONE S.P.A.	CT	SICI	ID	-	23 444	6,4	3 663	0,42
UP_PORTA_ROM_1	ENEL PRODUZIONE S.P.A.	AP	CNOR	ID	-	55 703	15,239	3 655	0,42
UP_IIISALTO_1	-	-	NORD	-	-	35 035	9,6	3 649	0,42
UP_FIUMESANT_3	E.ON Energy Trading SE	SS	SARD	TE	Coal	972 089	267	3 641	0,42
UP_S.ANTONIO_1	ENEL PRODUZIONE S.P.A.	BZ	NORD	ID	Pumped-St...	263 009	72,291	3 638	0,42
UP_DI1170_NORD_C	-	-	NORD	ID	Run-of-river	352 615	98,331	3 586	0,41
UP_DI2182_CSUD_B	-	-	CSUD	TE	Ccgt	77 137	21,546	3 580	0,41
UP_LASA_ME_1	EDISON	BZ	NORD	ID	Pumped-St...	227 441	63,8	3 565	0,41
UP_CPODIPONTE_3	ENEL PRODUZIONE S.P.A.	AP	CSUD	ID	-	37 342	10,486	3 561	0,41
UP_DI2055_SUD_C	-	-	SUD	-	-	9 137	2,57	3 555	0,41
UP_DI0182_CSUD_C	ENEL PRODUZIONE S.P.A.	-	CSUD	-	-	227 974	64,29	3 546	0,40
UP_MELISSA_1	EDISON	KR	SUD	EO	Renewable	176 933	50	3 539	0,40

Unit Reference	Owner	Prov.	Zone	Type	Technology	Total Quantity (MWh)	Power Max (MW)	Equivalent Hours (heq)	Capacity Factor
UP_S.SILVEST_1	DOLOMITI ENERGIA	BZ	NORD	ID	-	116 001	32,86	3 530	0,40
UP_SNGRGLMLRA_1	EDISON	-	CSUD	-	Renewable	190 532	54	3 528	0,40
UP_DI2052_NORD_C	-	-	NORD	-	-	33 812	9,59	3 526	0,40
UP_FNMPLMENTO_1	EDISON	-	CSUD	-	Renewable	59 920	17	3 525	0,40
UP_DI1825_NORD_C	-	-	NORD	-	-	11 522	3,278	3 515	0,40
UP_ORSARA_5	EDISON	FG	SUD	EO	Renewable	63 114	18	3 506	0,40
UP_CALCINERE_1	GDF SUEZ Energia Italia...	CU	NORD	ID	-	87 577	25	3 503	0,40
UP_BRLTTA10MW_1	-	-	SUD	-	Renewable	35 013	10	3 501	0,40
UP_ZUINO_1	C.V.A S.P.A.	AO	NORD	ID	-	80 430	23	3 497	0,40
UP_NPWRBRNDSI_8	ENI SPA	BR	BRNN	TE	Ccgt	1 243 595	358	3 474	0,40
UP_ROVESCA_1	ENEL PRODUZIONE S.P.A.	VB	NORD	ID	Pumped-St...	155 625	44,906	3 466	0,40
UP_TORRENT_1	C.V.A S.P.A.	-	NORD	TE	Ccgt	54 372	15,7	3 463	0,40
UP_STORO_1	ENEL PRODUZIONE S.P.A.	TN	NORD	ID	-	65 020	18,788	3 461	0,40
UP_TALAMONA_2	ENEL PRODUZIONE S.P.A.	SO	NORD	ID	-	62 495	18,075	3 458	0,39
UP_DI0228_NORD_C	-	-	NORD	-	-	18 303	5,3	3 453	0,39
UP_VOGHERA_1	GDF SUEZ Energia Italia...	PV	NORD	TE	Ccgt	1 401 294	407	3 443	0,39
UP_GRAVEDONA_1	A2A TRADING S.R.L.	CO	NORD	ID	-	49 252	14,31	3 442	0,39
UP_PSNFRNCSCO_1	EDISON	KR	SUD	EO	Renewable	89 422	26	3 439	0,39
UP_DI0068_NORD_C	-	-	NORD	-	-	2 992	0,87	3 439	0,39
UP_CHIAVENNA_1	EDIPOWER S.p.A.	SO	NORD	ID	-	205 931	60	3 432	0,39
UP_GROSOTTO_1	A2A TRADING S.R.L.	SO	NORD	ID	-	36 604	10,683	3 426	0,39
UP_SARENTINO_1	ENEL PRODUZIONE S.P.A.	BZ	NORD	ID	-	75 970	22,206	3 421	0,39
UP_DI2182_SUD_G	-	-	SUD	-	Other	31 422	9,216	3 410	0,39
UP_CLHRCSLGNO_1	-	-	NORD	TE	Ccgt	283 103	83,147	3 405	0,39
UP_RATINO_1	ALPIQ ENERGIA ITALIA...	FG	FOGN	TE	Ccgt	1 369 102	402,623	3 400	0,39
UP_CREGO_1	ENEL PRODUZIONE S.P.A.	VB	NORD	ID	-	134 487	39,603	3 396	0,39
UP_DI0361_NORD_B	-	-	NORD	-	-	48 401	14,255	3 395	0,39
UP_FUCINE_1	ENEL PRODUZIONE S.P.A.	TO	NORD	ID	-	37 315	11	3 392	0,39
UP_DI1170_NORD_A	-	-	NORD	ID	Pumped-St...	321 173	94,708	3 391	0,39
UP_CREVOLA_D_1	ENEL PRODUZIONE S.P.A.	VB	NORD	ID	-	153 384	45,304	3 386	0,39
UP_MNTFRRANTEN_5	EDISON	CH	CSUD	EO	Renewable	108 361	32,04	3 382	0,39
UP_VALPELLIN_1	C.V.A S.P.A.	AO	NORD	ID	Pumped-St...	432 226	128	3 377	0,39
UP_MERCURE_1	-	-	SUD	-	-	118 013	35	3 372	0,38
UP_ORSARA_4	EDISON	FG	SUD	EO	Renewable	88 953	26,4	3 369	0,38
UP_ACCEGLIO_1	ENEL PRODUZIONE S.P.A.	CN	NORD	ID	-	60 627	18,099	3 350	0,38
UP_MNTFALCONE_1	EDENS	BN	CSUD	EO	Renewable	54 162	16,2	3 343	0,38
UP_DI2228_NORD_B	-	-	NORD	-	-	10 183	3,05	3 339	0,38
UP_CANAVESE_1	A2A TRADING S.R.L.	MI	NORD	TE	-	42 696	12,8	3 336	0,38
UP_DI0012_NORD_C	-	-	NORD	-	-	232 006	70	3 314	0,38
UP_BROSSASCO_1	ENEL PRODUZIONE S.P.A.	CN	NORD	ID	-	117 552	35,495	3 312	0,38
UP_DI0013_NORD_C	IREN MERCATO SPA	-	NORD	-	-	20 856	6,3	3 310	0,38
UP_FLUMENDOS_4	ENEL PRODUZIONE S.P.A.	OG	SARD	ID	Pumped-St...	25 494	7,711	3 306	0,38
UP_GORDONA_1	-	-	NORD	-	-	44 418	13,44	3 305	0,38
UP_DI0360_NORD_B	DOLOMITI ENERGIA	-	NORD	-	-	45 355	13,739	3 301	0,38
UP_COTILIA_1	E.ON Energy Trading SE	RI	CNOR	ID	Pumped-St...	132 026	40	3 301	0,38
UP_NEMBIA_1	ENEL PRODUZIONE S.P.A.	TN	NORD	ID	Run-of-river	28 004	8,5	3 295	0,38
UP_VALCAMONICA_1	EDISON	BS	NORD	ID	-	368 749	112	3 292	0,38
UP_TORBOLE_1	ENEL PRODUZIONE S.P.A.	TN	NORD	ID	-	360 149	109,466	3 290	0,38
UP_SANFRONT_1	ENEL PRODUZIONE S.P.A.	CN	NORD	ID	-	46 657	14,211	3 283	0,37
UP_LUCITO_1	EDISON	CB	SUD	EO	Renewable	111 580	34	3 282	0,37
UP_CNTRLLTTRC_7	AXPO ITALIA S.P.A.	-	SUD	-	-	52 401	16	3 275	0,37
UP_MNTFRRANTE_4	EDISON	CH	CSUD	EO	Renewable	47 091	14,4	3 270	0,37
UP_SLLDICONZA_1	EDISON	SA	CSUD	EO	Renewable	32 703	10,02	3 264	0,37
UP_TAVAZZANO_5	E.ON Energy Trading SE	LO	NORD	TE	Ccgt	2 515 275	772	3 258	0,37
UP_PIETRAPOR_1	ENEL PRODUZIONE S.P.A.	CN	NORD	ID	-	42 330	13	3 256	0,37
UP_CHATILLON_1	C.V.A S.P.A.	AO	NORD	ID	-	87 845	27	3 254	0,37
UP_COGOLO_2	ENEL PRODUZIONE S.P.A.	TN	NORD	ID	Run-of-river	187 133	57,595	3 249	0,37
UP_DI1608_NORD_B	-	-	NORD	-	-	3 342	1,03	3 245	0,37
UP_RPABOTTONI_1	EDISON	CB	SUD	EO	Renewable	51 303	15,84	3 239	0,37
UP_CURON_ME_1	EDISON	BZ	NORD	ID	-	40 105	12,388	3 237	0,37
UP_ANDONNO_C_1	ENEL PRODUZIONE S.P.A.	CN	NORD	ID	Pumped-St...	183 337	56,724	3 232	0,37
UP_DRONERO_C_1	ENEL PRODUZIONE S.P.A.	CN	NORD	ID	-	30 486	9,448	3 227	0,37
UP_BARCIS_1	-	-	NORD	-	-	84 064	26,1	3 221	0,37
UP_PEDESINA_1	ENEL PRODUZIONE S.P.A.	SO	NORD	ID	-	36 916	11,466	3 220	0,37
UP_DUINO_1	-	-	NORD	-	Other	196 383	61	3 219	0,37
UP_TIRSO1S_1	ENEL PRODUZIONE S.P.A.	OR	SARD	ID	-	44 978	14,005	3 212	0,37
UP_CALORE_1	-	-	CSUD	-	-	30 212	9,409	3 211	0,37
UP_GALLETO_2	E.ON Energy Trading SE	TR	CNOR	ID	-	449 509	140	3 211	0,37
UP_CHIOMONTE_1	IREN MERCATO SPA	TO	NORD	ID	-	44 932	14	3 209	0,37
UP_MESE_1	EDIPOWER S.P.A	SO	NORD	ID	Run-of-river	512 820	160	3 205	0,37
UP_FLUMENDOS_5	ENEL PRODUZIONE S.P.A.	OG	SARD	ID	Pumped-St...	31 041	9,695	3 202	0,37

Unit Reference	Owner	Prov.	Zone	Type	Technology	Total Quantity (MWh)	Power Max (MW)	Equivalent Hours (heq)	Capacity Factor
UP_FLUMENDOS_6	ENEL PRODUZIONE S.P.A.	OG	SARD	ID	Pumped-St...	75 475	23,618	3 196	0,36
UP_FADALTO_1	ENEL PRODUZIONE S.P.A.	TV	NORD	ID	Pumped	303 728	95,083	3 194	0,36
UP_PBRLLPARMA_1	-	-	NORD	-	-	111 642	35	3 190	0,36
UP_GUARNIERI_1	-	-	SUD	-	Renewable	80 508	25,246	3 189	0,36
UP_DI0182_SUD_C	ENEL PRODUZIONE S.P.A.	-	SUD	-	-	158 008	49,556	3 188	0,36
UP_BSCCIA48MW_1	EDISON	-	CSUD	-	Renewable	152 718	48	3 182	0,36
UP_SMRICRICHI_1	EDISON	CZ	ROSN	TE	Ccgt	2 775 969	872,961	3 180	0,36
UP_LAPPAGO_1	ENEL PRODUZIONE S.P.A.	BZ	NORD	ID	Pumped-St...	89 133	28,079	3 174	0,36
UP_NDRTTA22MW_1	EDISON	-	CSUD	-	Renewable	69 725	22	3 169	0,36
UP_SLDGLRENZA_1	EDISON	BZ	NORD	ID	Pumped-St...	150 183	47,5	3 162	0,36
UP_DI2055_CNOR_C	-	-	CNOR	-	-	96 824	30,778	3 146	0,36
UP_DI1918_NORD_B	-	-	NORD	-	-	36 110	11,5	3 140	0,36
UP_CEDEGOLO_1	ENEL PRODUZIONE S.P.A.	BS	NORD	ID	-	45 728	14,583	3 136	0,36
UP_SPRTIVENTO_1	-	-	SUD	-	Renewable	62 778	20,081	3 126	0,36
UP_AEM-LOVER_1	A2A TRADING S.R.L.	SO	NORD	ID	Run-of-river	149 218	47,776	3 123	0,36
UP_VOLTURINO_1	EDISON	FG	SUD	EO	Renewable	40 773	13,08	3 117	0,36
UP_DI2044_NORD_C	GDF SUEZ Energia Italia...	-	NORD	-	-	284 937	91,562	3 112	0,36
UP_ARDENNO_1	ENEL PRODUZIONE S.P.A.	SO	NORD	ID	Pumped-St...	175 614	56,454	3 111	0,36
UP_DI0012_NORD_A	-	-	NORD	-	-	8 071	2,6	3 104	0,35
UP_FURLO_1	ENEL PRODUZIONE S.P.A.	PU	CNOR	ID	-	37 224	11,999	3 102	0,35
UP_SENDREN_1	C.V.A S.P.A.	AO	NORD	ID	-	29 202	9,5	3 074	0,35
UP_DI1928_NORD_C	-	-	NORD	-	-	12 107	3,963	3 055	0,35
UP_DI2182_CNOR_C	-	-	CNOR	-	-	2 119	0,696	3 044	0,35
UP_DI1999_NORD_B	-	-	NORD	-	-	72 511	23,901	3 034	0,35
UP_CNTRLTRMLT_8	-	-	SUD	-	Other	139 521	46	3 033	0,35
UP_BORDOGNA_1	ENEL PRODUZIONE S.P.A.	BG	NORD	ID	Pumped-St...	142 936	47,428	3 014	0,34
UP_GALLETO_1	E.ON Energy Trading SE	TR	CNOR	ID	-	463 162	155	2 988	0,34
UP_PIEVE_VER_1	ENEL PRODUZIONE S.P.A.	VB	NORD	ID	-	149 058	50	2 981	0,34
UP_DI1170_CNOR_C	-	-	CNOR	-	-	40 968	13,768	2 976	0,34
UP_SLDGLRENZA_2	EDISON	BZ	NORD	ID	Pumped-St...	148 041	50	2 961	0,34
UP_ENI_S.P.A_2	-	-	NORD	-	-	59 208	20	2 960	0,34
UP_DI1079_CSUD_B	-	-	CSUD	-	-	42 502	14,41	2 949	0,34
UP_DI0182_SARD_C	ENEL PRODUZIONE S.P.A.	-	SARD	EO	Renewable	30 932	10,55	2 932	0,33
UP_FEDIO_1	ENEL PRODUZIONE S.P.A.	CN	NORD	ID	-	31 720	10,836	2 927	0,33
UP_RETE_2_1	-	-	NORD	-	Other	185 776	63,5	2 926	0,33
UP_VINADIO_1	ENEL PRODUZIONE S.P.A.	CN	NORD	ID	Pumped-St...	175 453	59,999	2 924	0,33
UP_CASSINO_1	ENEL PRODUZIONE S.P.A.	FR	CSUD	ID	-	132 527	45,486	2 914	0,33
UP_DI0344_NORD_C	-	-	NORD	-	-	40 499	13,909	2 912	0,33
UP_SSTSNGVNN2_1	EDISON	MI	NORD	TE	Ccgt	147 972	50,823	2 912	0,33
UP_RESIO_1	-	-	NORD	-	-	35 651	12,3	2 898	0,33
UP_PAISCO_1	ENEL PRODUZIONE S.P.A.	BS	NORD	ID	-	22 732	7,85	2 896	0,33
UP_PORTO_EMP_2	ENEL PRODUZIONE S.P.A.	AG	SICI	TE	Oil	115 549	40	2 889	0,33
UP_MUCONE_1S_1	ENEL PRODUZIONE S.P.A.	CS	SUD	ID	Pumped-St...	261 214	90,738	2 879	0,33
UP_SND_CAMPO_1	EDISON	SO	NORD	ID	-	108 454	37,707	2 876	0,33
UP_AVEZZANO_1	BURGO	AQ	CSUD	TE	Other	185 262	65	2 850	0,33
UP_MUCONE_2S_1	ENEL PRODUZIONE S.P.A.	CS	SUD	ID	Pumped-St...	150 996	53	2 849	0,33
UP_PONTE_1	ENEL PRODUZIONE S.P.A.	VB	NORD	ID	Pumped-St...	252 818	89,161	2 836	0,32
UP_DI1835_NORD_C	-	-	NORD	-	-	33 574	11,878	2 827	0,32
UP_BIOVENTO_1	-	-	NORD	-	Renewable	56 446	20	2 822	0,32
UP_FT20DIFESA_1	-	-	SUD	-	-	46 191	16,4	2 817	0,32
UP_FAUBOURG_1	C.V.A S.P.A.	AO	NORD	ID	-	30 925	11	2 811	0,32
UP_BADUOZZAN_1	ENEL PRODUZIONE S.P.A.	NU	SARD	ID	Pumped-St...	62 304	22,266	2 798	0,32
UP_CASTROCUC_1	ENEL PRODUZIONE S.P.A.	PZ	SUD	ID	Pumped-St...	244 506	87,554	2 793	0,32
UP_SPTROORZIO_1	ENEL PRODUZIONE S.P.A.	BG	NORD	ID	-	25 391	9,26	2 742	0,31
UP_FONDOVALL_1	ENEL PRODUZIONE S.P.A.	VB	NORD	ID	-	26 073	9,512	2 741	0,31
UP_TAVAZZANO_C_6	E.ON Energy Trading SE	LO	NORD	TE	Ccgt	1 052 440	385	2 734	0,31
UP_LEMIE_1	ENEL PRODUZIONE S.P.A.	TO	NORD	ID	-	62 313	22,81	2 732	0,31
UP_CGNRZNLYPR_6	GDF SUEZ Energia Italia...	-	NORD	TE	Ccgt	138 996	51	2 725	0,31
UP_CORENNO_1	ENEL PRODUZIONE S.P.A.	LC	NORD	ID	Pumped-St...	40 742	15,001	2 716	0,31
UP_TORRITE_1	ENEL PRODUZIONE S.P.A.	LU	CNOR	ID	Pumped-St...	162 809	60,036	2 712	0,31
UP_DI0062_NORD_A	AXPO ITALIA S.P.A.	-	NORD	-	-	44 091	16,315	2 702	0,31
UP_CIMEGO_2	ENEL PRODUZIONE S.P.A.	TN	NORD	ID	-	24 449	9,066	2 697	0,31
UP_MNTGNFAETO_1	-	-	SUD	-	-	37 217	14	2 658	0,30
UP_BASTARDO_2	ENEL PRODUZIONE S.P.A.	PG	CNOR	TE	Coal	172 588	65	2 655	0,30
UP_SOMPLAGO_2	A2A TRADING S.R.L.	UD	NORD	ID	Pumped-St...	424 521	160	2 653	0,30
UP_COMUNANZA_1	ENEL PRODUZIONE S.P.A.	AP	CNOR	ID	-	14 471	5,5	2 631	0,30
UP_CASTELDEL_1	ENEL PRODUZIONE S.P.A.	CN	NORD	ID	-	75 160	28,754	2 614	0,30
UP_CRLUVA16MW_1	-	-	SUD	-	Renewable	41 728	16	2 608	0,30
UP_DI8888_SICI_X	-	-	SICI	-	-	31 276	12	2 606	0,30
UP_FARNETA_1	ENEL PRODUZIONE S.P.A.	MO	NORD	ID	-	78 207	30,156	2 593	0,30
UP_DI1902_SUD_C	-	-	SUD	-	-	21 957	8,5	2 583	0,29

Unit Reference	Owner	Prov.	Zone	Type	Technology	Total Quantity (MWh)	Power Max (MW)	Equivalent Hours (heq)	Capacity Factor
UP_DI2017_SUD_B	E.ON Energy Trading SE	-	SUD	FV	Renewable	974	0,377	2 583	0,29
UP_PRCLCCMSDM_1	-	-	SUD	-	-	87 809	34	2 583	0,29
UP_BASTARDO_1	ENEL PRODUZIONE S.P.A.	PG	CNOR	TE	Coal	167 423	65	2 576	0,29
UP_SFLORIANO_2	ENEL PRODUZIONE S.P.A.	TV	NORD	ID	Pumped-St...	297 075	116,064	2 560	0,29
UP_CPODIPONTE_2	ENEL PRODUZIONE S.P.A.	AP	CSUD	ID	Pumped-St...	59 341	23,184	2 560	0,29
UP_SAMPEYRE_1	ENEL PRODUZIONE S.P.A.	CN	NORD	ID	-	92 032	36,05	2 553	0,29
UP_MURGE_1	-	-	SUD	-	-	40 520	15,9	2 548	0,29
UP_DI2182_CSUD_C	-	-	CSUD	-	-	7 626	3	2 542	0,29
UP_NCTLVRNFRR_1	E.ON Energy Trading SE	VC	NORD	TE	Ccgt	1 997 446	786	2 541	0,29
UP_DI0012_CNOR_C	-	-	CNOR	-	-	42 067	16,561	2 540	0,29
UP_CPONTE14MW_1	-	-	SUD	-	Renewable	35 534	14	2 538	0,29
UP_DI0360_NORD_G	DOLOMITI ENERGIA	-	NORD	-	-	14 036	5,53	2 538	0,29
UP_ACTV_1	ALPIQ ENERGIA ITALIA...	VC	NORD	TE	Ccgt	131 068	51,7	2 535	0,29
UP_DI0062_NORD_B	AXPO ITALIA S.P.A.	-	NORD	-	-	309 065	121,919	2 535	0,29
UP_AVIGLAINO_1	ERG SPA	PZ	SUD	EO	Renewable	33 458	13,2	2 535	0,29
UP_PRCLCCSTLN_1	-	-	SUD	-	-	30 710	12,15	2 528	0,29
UP_DI0060_NORD_B	EDISON	-	NORD	-	-	69 317	27,5	2 521	0,29
UP_AVISE_1	C.V.A S.P.A.	AO	NORD	ID	-	315 361	126	2 503	0,29
UP_PORTO_EMP_1	ENEL PRODUZIONE S.P.A.	AG	SICI	TE	Oil	99 851	40	2 496	0,28
UP_MPNTLCSMBC_1	-	-	ROSN	-	Renewable	52 165	20,968	2 488	0,28
UP_CIMEGO_1	ENEL PRODUZIONE S.P.A.	TN	NORD	ID	Pumped-St...	472 723	190,617	2 480	0,28
UP_ROCCHETTA3_3	-	-	SUD	-	-	98 903	39,931	2 477	0,28
UP_DI2044_SUD_C	GDF SUEZ Energia Italia...	-	SUD	TE	Ccgt	64 289	25,97	2 476	0,28
UP_ROTELLO_1	ERG SPA	CB	SUD	EO	Renewable	103 694	42	2 469	0,28
UP_SONDEL_TE_1	EDISON	MS	CNOR	ID	Pumped-St...	70 096	28,422	2 466	0,28
UP_VILLA_1	IREN MERCATO SPA	TO	NORD	ID	Pumped-St...	97 406	39,5	2 466	0,28
UP_DI0198_SUD_C	-	-	SUD	-	-	8 810	3,574	2 465	0,28
UP_DI1999_CSUD_C	-	-	CSUD	-	-	22 898	9,298	2 463	0,28
UP_S.VALBURG_1	ENEL PRODUZIONE S.P.A.	BZ	NORD	ID	Pumped-St...	108 189	44,15	2 450	0,28
UP_PREM-GROSIO_1	A2A TRADING S.R.L.	SO	NORD	ID	Run-of-river	1 571 053	644	2 440	0,28
UP_DI2044_CNOR_B	GDF SUEZ Energia Italia...	-	CNOR	TE	Ccgt	38 689	15,905	2 433	0,28
UP_MATESE_2S_1	ENEL PRODUZIONE S.P.A.	CE	CSUD	ID	-	43 678	18	2 427	0,28
UP_SANGIACOMO_1	A2A TRADING S.R.L.	SO	NORD	ID	Pumped-St...	24 202	10	2 420	0,28
UP_PNTVENTOUX_2	IREN MERCATO SPA	TO	NORD	ID	-	174 159	72	2 419	0,28
UP_DI1902_NORD_A	-	-	NORD	-	-	48 362	20	2 418	0,28
UP_REGOLEDO_1	ENEL PRODUZIONE S.P.A.	SO	NORD	ID	-	92 174	38,3	2 407	0,27
UP_DI0526_NORD_G	-	-	NORD	-	-	25 576	10,635	2 405	0,27
UP_FORNO_DI_1	ENEL PRODUZIONE S.P.A.	BL	NORD	ID	-	25 181	10,499	2 398	0,27
UP_BARDONECC_1	ENEL PRODUZIONE S.P.A.	TO	NORD	ID	-	47 955	19,998	2 398	0,27
UP_CROT_1	ENEL PRODUZIONE S.P.A.	TO	NORD	ID	-	42 240	17,626	2 396	0,27
UP_SND_ALBAN_1	EDISON	CO	NORD	ID	-	33 483	14	2 392	0,27
UP_DI8888_NORD_Y	-	-	NORD	-	-	12 933 657	5437,867	2 378	0,27
UP_SPARANISE_2	AXPO ITALIA S.P.A.	CE	CSUD	TE	Ccgt	893 903	375,9	2 378	0,27
UP_FOIANO2_1	ERG SPA	BN	CSUD	EO	Renewable	166 876	70,2	2 377	0,27
UP_SAVINER_1	ENEL PRODUZIONE S.P.A.	BL	NORD	ID	-	33 234	13,999	2 374	0,27
UP_CAIRO_MON_1	-	-	NORD	-	-	14 225	6	2 371	0,27
UP_PEPIZZA_1	-	-	ROSN	-	Renewable	141 884	60	2 365	0,27
UP_DI1716_NORD_B	-	-	NORD	TE	Ccgt	47 179	20	2 359	0,27
UP_SSTSNGVNNI_1	EDISON	MI	NORD	TE	-	119 969	50,858	2 359	0,27
UP_ROSELECTRA_1	GDF SUEZ Energia Italia...	LI	CNOR	TE	Ccgt	1 061 882	451	2 355	0,27
UP_SCLDLICETO_1	-	-	SUD	-	-	56 493	24	2 354	0,27
UP_AMBIENTE_1	-	-	CNOR	-	-	23 401	10	2 340	0,27
UP_MATESE_1S_1	ENEL PRODUZIONE S.P.A.	CE	CSUD	ID	-	56 245	24,057	2 338	0,27
UP_SCLSTRIANO_1	ERG SPA	FG	SUD	EO	Renewable	143 659	61,8	2 325	0,27
UP_CHIEVOLIS_2	EDISON	PN	NORD	ID	-	43 784	18,924	2 314	0,26
UP_SNGVNNNGLD_2	-	-	SUD	-	-	31 200	13,5	2 311	0,26
UP_CREVA_1	ENEL PRODUZIONE S.P.A.	VA	NORD	ID	-	25 400	11,016	2 306	0,26
UP_MALPENSA__1	MALPENSA ENERGIA	VA	NORD	TE	Other	117 543	51	2 305	0,26
UP_TRSANCIREO_1	ERG SPA	FG	SUD	EO	Renewable	69 080	30	2 303	0,26
UP_OSTIGLIA_2	E.ON Energy Trading SE	MN	NORD	TE	Ccgt	908 677	395	2 300	0,26
UP_SPIGNO_CE_1	-	-	NORD	-	-	27 504	12	2 292	0,26
UP_PREDARE_1	ENEL PRODUZIONE S.P.A.	RE	CNOR	ID	-	27 059	11,839	2 286	0,26
UP_DI1716_CSUD_C	-	-	CSUD	ID	Run-of-river	4 802	2,109	2 277	0,26
UP_FSSDELLUPO_1	ERG SPA	-	SUD	-	-	221 357	97,5	2 270	0,26
UP_NPWRLVORNO_6	ENI SPA	LI	CNOR	TE	Other	13 562	6	2 260	0,26
UP_MNTZIMMARA_1	ENEL PRODUZIONE S.P.A.	PA	SICI	EO	Renewable	61 378	27,2	2 257	0,26
UP_DI1174_NORD_B	-	-	NORD	TE	Ccgt	182 767	81	2 256	0,26
UP_SPARANISE_1	AXPO ITALIA S.P.A.	CE	CSUD	TE	Ccgt	861 199	382,8	2 250	0,26
UP_DI2044_CNOR_C	GDF SUEZ Energia Italia...	-	CNOR	-	-	15 224	6,777	2 246	0,26
UP_AMARONI_1	ERG SPA	CZ	ROSN	EO	Renewable	50 436	22,5	2 242	0,26
UP_MONTORSI_1	-	-	SUD	-	-	53 674	24	2 236	0,26

Unit Reference	Owner	Prov.	Zone	Type	Technology	Total Quantity (MWh)	Power Max (MW)	Equivalent Hours (heq)	Capacity Factor
UP_SNGRGRMGNO_1	SORGENIA S.P.A.	SA	CSUD	EO	Renewable	83 073	37,167	2 235	0,26
UP_DI2044_CSUD_C	GDF SUEZ Energia Italia...	-	CSUD	-	-	71 463	31,995	2 234	0,25
UP_DI1886_CNOR_B	-	-	CNOR	TE	Ccgt	44 515	20	2 226	0,25
UP_SATRIANO_2	A2A TRADING S.R.L.	CZ	SUD	ID	-	74 114	33,32	2 224	0,25
UP_SAN_LAZZA_1	ENEL PRODUZIONE S.P.A.	PU	CNOR	ID	-	26 691	12	2 224	0,25
UP_SUSA_1	IREN MERCATO SPA	TO	NORD	ID	-	25 570	11,5	2 223	0,25
UP_CARONA_1	ENEL PRODUZIONE S.P.A.	BG	NORD	ID	-	103 206	46,516	2 219	0,25
UP_BOAZZO_1	ENEL PRODUZIONE S.P.A.	TN	NORD	ID	Pumped-St...	196 000	88,352	2 218	0,25
UP_DI1999_CSUD_A	-	-	CSUD	-	-	14 680	6,625	2 216	0,25
UP_LBRNMZZNLL_1	-	-	SUD	-	-	55 133	24,999	2 205	0,25
UP_MALGA_MAR_1	ENEL PRODUZIONE S.P.A.	TN	NORD	ID	-	26 560	12,052	2 204	0,25
UP_LECCE3_1	-	-	SUD	-	-	79 032	36	2 195	0,25
UP_GEROLA_1	ENEL PRODUZIONE S.P.A.	SO	NORD	ID	-	35 032	16,001	2 189	0,25
UP_SRRDLVNTNR_1	-	-	SUD	-	-	26 053	11,9	2 189	0,25
UP_MDACORTALE_1	ENEL PRODUZIONE S.P.A.	CZ	ROSN	EO	Renewable	122 566	56	2 189	0,25
UP_DI1170_NORD_B	-	-	NORD	TE	Ccgt	201 973	92,686	2 179	0,25
UP_PTRGLLLICO_1	-	-	SUD	-	-	39 124	18	2 174	0,25
UP_VOLTURARA_2	ERG SPA	FG	SUD	EO	Renewable	32 543	15	2 170	0,25
UP_SONDRIO_1	ENEL PRODUZIONE S.P.A.	So	NORD	ID	Pumped-St...	309 413	142,912	2 165	0,25
UP_SRRCPRIOLA_1	-	-	SUD	-	-	90 569	42	2 156	0,25
UP_PSTICCIOLA_1	-	-	SUD	-	-	25 860	12	2 155	0,25
UP_VERFALESIA_1	-	-	CNOR	-	-	51 548	23,97	2 151	0,25
UP_DI2189_NORD_B	-	-	NORD	-	-	25 769	12	2 147	0,25
UP_TORVISCOSA_1	EDISON	UD	MFTV	TE	Ccgt	1 712 630	798,177	2 146	0,24
UP_LEVANE_1	ENEL PRODUZIONE S.P.A.	AR	CNOR	ID	-	39 382	18,37	2 144	0,24
UP_IVPC4_ROS_1	ERG SPA	FG	SUD	EO	Renewable	38 471	18	2 137	0,24
UP_DI0005_SUD_C	A2A TRADING S.R.L.	-	SUD	-	-	12 819	6	2 137	0,24
UP_GRESSONEY_1	C.V.A S.P.A.	AO	NORD	ID	Pumped-St...	25 631	12	2 136	0,24
UP_DI1928_NORD_Z	-	-	NORD	-	-	2 560	1,2	2 134	0,24
UP_VALCIMARR_2	ENEL PRODUZIONE S.P.A.	MC	CNOR	ID	-	87 442	40,991	2 133	0,24
UP_CNTRLSCLMB_5	DOLOMITI ENERGIA	-	NORD	-	-	43 909	20,6	2 131	0,24
UP_GRECI2_1	-	-	CSUD	-	-	23 528	11,05	2 129	0,24
UP_SANNA012_1	-	-	SUD	-	-	135 920	64	2 124	0,24
UP_VARZO_1	ENEL PRODUZIONE S.P.A.	VB	NORD	ID	-	33 901	15,976	2 122	0,24
UP_SANCHIRICO_1	-	-	SUD	-	-	36 812	17,38	2 118	0,24
UP_PANNI_1	ERG SPA	CB	SUD	EO	Renewable	41 921	19,8	2 117	0,24
UP_SANTANINFA_1	E.ON Energy Trading SE	TP	SICI	EO	Renewable	68 287	32,28	2 115	0,24
UP_PRCLCRDONA_1	-	-	SUD	-	-	54 995	26	2 115	0,24
UP_DI1716_CNOR_B	-	-	CNOR	TE	Ccgt	15 571	7,37	2 113	0,24
UP_DI2055_CNOR_A	-	-	CNOR	-	-	543	0,257	2 113	0,24
UP_IVPC_ANZA_1	IVPC	FG	SUD	EO	Renewable	103 879	49,2	2 111	0,24
UP_DI1174_CSUD_C	-	-	CSUD	ID	Run-of-river	33 743	16	2 109	0,24
UP_PRCVCCHVLL_1	-	-	SUD	-	-	53 126	25,2	2 108	0,24
UP_IVPC_FOIA_1	IVPC	BN	CSUD	EO	Renewable	113 118	54	2 095	0,24
UP_OSTIGLIA_3	E.ON Energy Trading SE	MN	NORD	TE	Ccgt	824 833	395	2 088	0,24
UP_MONTORIO_1	ENEL PRODUZIONE S.P.A.	TE	CSUD	ID	Pumped-St...	210 906	101	2 088	0,24
UP_TRPNCNTRDC_3	ENEL PRODUZIONE S.P.A.	TP	SICI	EO	Renewable	38 609	18,5	2 087	0,24
UP_EOS4FAETO_1	ERG SPA	FG	SUD	EO	Renewable	49 982	24	2 083	0,24
UP_SUVIANA_N_1	ENEL PRODUZIONE S.P.A.	BO	NORD	ID	-	49 772	24,004	2 073	0,24
UP_S.MASS.CL_1	ENEL PRODUZIONE S.P.A.	TN	NORD	ID	Pumped	759 671	367,101	2 069	0,24
UP_ALTOADDA_1	EDISON	MI	NORD	ID	Pumped	618 962	299,5	2 067	0,24
UP_SRRDLVNTSD_1	-	-	SUD	-	-	29 793	14,45	2 062	0,24
UP_AEM-BRAUL_1	A2A TRADING S.R.L.	SO	NORD	ID	-	38 423	18,67	2 058	0,23
UP_PGGMPRIALE_1	ERG SPA	FG	SUD	EO	Renewable	61 615	30	2 054	0,23
UP_DI8888_NORD_Z	-	-	NORD	-	-	567 289	276,641	2 051	0,23
UP_DI2051_NORD_A	-	-	NORD	-	-	20 289	9,912	2 047	0,23
UP_CNTRLDTRNL_1	SORGENIA S.P.A.	LO	NORD	TE	Ccgt	1 643 812	804,99	2 042	0,23
UP_MPNTFTVLTC_1	-	-	ROSN	-	-	36 742	18,028	2 038	0,23
UP_BDDSLDSRDI_1	-	-	SARD	-	-	281 076	138	2 037	0,23
UP_DI2044_NORD_Z	GDF SUEZ Energia Italia...	-	NORD	-	-	8 042	3,963	2 029	0,23
UP_LCLCRBRGSN_1	-	-	FOGN	-	-	52 754	26	2 029	0,23
UP_CARPINONE_1	-	-	SUD	-	-	48 554	24	2 023	0,23
UP_RCCFICUZZA_1	-	-	SICI	-	-	44 702	22,1	2 023	0,23
UP_MNRVNMURGE_1	SORGENIA S.P.A.	BA	SUD	EO	Renewable	36 101	17,867	2 021	0,23
UP_LGNCHOZOLA_2	ENEL PRODUZIONE S.P.A.	RE	NORD	ID	-	17 122	8,499	2 015	0,23
UP_TIMPAGRAN_1	A2A TRADING S.R.L.	KR	SUD	ID	Pumped-St...	364 364	181,3	2 010	0,23
UP_CSTLLANETA_1	-	TA	BRNN	EO	Renewable	112 401	56	2 007	0,23
UP_LA_PENNA_1	ENEL PRODUZIONE S.P.A.	AR	CNOR	ID	-	54 389	27,124	2 005	0,23
UP_MACCHIAVF_1	ERG SPA	CB	SUD	EO	Renewable	20 438	10,2	2 004	0,23
UP_SRRMRROCCO_1	ENEL PRODUZIONE S.P.A.	EN	SICI	EO	Renewable	91 514	45,74	2 001	0,23
UP_CZZVLLFND1_1	ENEL PRODUZIONE S.P.A.	PA	SICI	EO	Renewable	20 302	10,2	1 990	0,23

Unit Reference	Owner	Prov.	Zone	Type	Technology	Total Quantity (MWh)	Power Max (MW)	Equivalent Hours (heq)	Capacity Factor
UP_PRCLCLCAMO_1	-	-	SICI	-	-	63 393	32	1 981	0,23
UP_SPERANDO_2	ENEL PRODUZIONE S.P.A.	PT	CNOR	ID	-	15 830	8	1 979	0,23
UP_DI0182_SICI_C	ENEL PRODUZIONE S.P.A.	-	SICI	-	-	102 748	52,042	1 974	0,23
UP_LIRO_1	A2A TRADING S.R.L.	SO	NORD	ID	Run-of-river	222 720	112,87	1 973	0,23
UP_IVPC_MONT_1	IPVC	BN	CSUD	EO	Renewable	58 373	29,61	1 971	0,23
UP_SNMRTNNPNS_1	SORGENIA S.P.A.	CB	SUD	EO	Renewable	23 620	11,982	1 971	0,23
UP_SANMARCO_1	-	-	CSUD	-	-	29 139	14,8	1 969	0,22
UP_VNTODIVINO_1	-	-	SICI	-	-	46 399	23,59	1 967	0,22
UP_RDNVLLSCDL_1	-	-	SUD	-	-	66 841	34	1 966	0,22
UP_SPINA_2	-	-	SUD	-	-	28 522	14,525	1 964	0,22
UP_SANSOSTENE_1	FALCK RENEWABLES	CZ	SUD	EO	Renewable	155 957	79,5	1 962	0,22
UP_CLVCCHCLVE_1	-	-	SUD	-	-	27 415	13,986	1 960	0,22
UP_SNMRTNNPNS_2	-	-	SUD	-	-	113 110	58	1 950	0,22
UP_DI8888_CNOR_Y	-	-	CNOR	-	-	2 987 227	1532,779	1 949	0,22
UP_CNTRDCORVO_1	ENEL PRODUZIONE S.P.A.	PA	SICI	EO	Renewable	74 274	38,25	1 942	0,22
UP_FONTANA_B_1	ENEL PRODUZIONE S.P.A.	BZ	NORD	ID	Pumped-St...	19 789	10,193	1 941	0,22
UP_VAGLIO_3	-	-	SUD	-	-	23 800	12,3	1 935	0,22
UP_DI2182_CSUD_A	-	-	CSUD	ID	Pumped-St...	7 468	3,87	1 930	0,22
UP_DI1900_NORD_B	-	-	NORD	-	-	11 071	5,749	1 926	0,22
UP_PRCLCSRRPL_1	E.ON Energy Trading SE	CZ	SUD	EO	Renewable	103 766	53,946	1 924	0,22
UP_DI2055_CSUD_B	-	-	CSUD	TE	Ccgt	22 676	11,811	1 920	0,22
UP_MONTAGUTO_1	GDF SUEZ Energia Italia...	AV	CSUD	EO	Renewable	66 094	34,449	1 919	0,22
UP_ALTOMONTE_1	EDISON	CS	ROSN	TE	Ccgt	1 456 159	760,439	1 915	0,22
UP_LANA_1	ENEL PRODUZIONE S.P.A.	BZ	NORD	ID	Pumped-St...	229 211	120,363	1 904	0,22
UP_DI0062_CNOR_G	AXPO ITALIA S.P.A.	-	CNOR	-	-	27 261	14,341	1 901	0,22
UP_BICCARI_1	-	-	SUD	-	-	20 893	11	1 899	0,22
UP_LMCARVOTTA_1	-	-	BRNN	-	-	18 966	9,998	1 897	0,22
UP_BISACCIA2_1	ERG SPA	AV	CSUD	EO	Renewable	44 769	23,6	1 897	0,22
UP_PRCLCMNTCR_1	-	-	CNOR	-	-	24 564	12,96	1 895	0,22
UP_PWHIRLPOOL_1	-	-	NORD	-	-	24 333	12,85	1 894	0,22
UP_NVCQSPRZZA_1	ENEL PRODUZIONE S.P.A.	IS	SUD	EO	Renewable	72 357	38,25	1 892	0,22
UP_DI2182_NORD_G	-	-	NORD	-	-	6 383	3,384	1 886	0,22
UP_RWNDORDONA_1	-	-	SUD	-	Renewable	70 729	37,5	1 886	0,22
UP_PRCLCDLSSI_1	-	-	SARD	-	-	172 088	91,431	1 882	0,21
UP_MRCLLINARA_1	-	-	SUD	-	-	22 793	12,116	1 881	0,21
UP_MALALBERGO_1	-	-	CNOR	-	Renewable	19 746	10,5	1 881	0,21
UP_TVRNLSTRTN_1	-	-	SUD	-	-	33 839	18	1 880	0,21
UP_AEMTECNO_1	A2A TRADING S.R.L.	MI	NORD	TE	-	25 010	13,312	1 879	0,21
UP_MIMIANI_1	GDF SUEZ Energia Italia...	CL	SICI	EO	Renewable	41 274	22	1 876	0,21
UP_NRGAMOLISE_1	SORGENIA S.P.A.	CB	FOGN	TE	Ccgt	1 498 384	800	1 873	0,21
UP_DI2055_NORD_B	-	-	NORD	TE	Ccgt	141 011	75,314	1 872	0,21
UP_OSTIGLIA_1	E.ON Energy Trading SE	MN	NORD	TE	Ccgt	739 315	395	1 872	0,21
UP_DI8888_SARD_X	-	-	SARD	-	-	11 800	6,318	1 868	0,21
UP_DI2051_NORD_C	-	-	NORD	-	-	15 628	8,375	1 866	0,21
UP_TRSNVNCNZO_1	ERG SPA	-	SUD	-	-	78 219	42	1 862	0,21
UP_DI2182_NORD_C	-	-	NORD	ID	Run-of-river	37 397	20,096	1 861	0,21
UP_RTNVLCSNTS_1	-	-	SUD	-	-	52 104	28	1 861	0,21
UP_CNTRLLCVCR_1	ERG SPA	-	SICI	-	-	69 652	37,5	1 857	0,21
UP_HYDRLCTRQC_1	C.V.A S.P.A.	-	NORD	-	-	34 155	18,398	1 856	0,21
UP_PRCLCDMZRD_1	-	-	SICI	-	-	88 999	48	1 854	0,21
UP_LAMARMORA_1	A2A TRADING S.R.L.	BS	NORD	ID	-	174 328	94,208	1 850	0,21
UP_SORA_2	-	-	CSUD	TE	Ccgt	76 503	41,5	1 843	0,21
UP_SCLSTRNLCL_1	-	-	SUD	-	-	69 995	38	1 842	0,21
UP_AMPEZZO_1	A2A TRADING S.R.L.	UD	NORD	ID	Pumped-St...	106 754	58	1 841	0,21
UP_PRCLCPNDCR_1	E.ON Energy Trading SE	CZ	SUD	EO	Renewable	79 919	43,421	1 841	0,21
UP_VADOTERM_5	TIRRENO POWER S.P.A.	SV	NORD	TE	Ccgt	1 389 340	755,669	1 839	0,21
UP_PNTVENTOUX_3	IREN MERCATO SPA	TO	NORD	ID	-	132 335	72	1 838	0,21
UP_FARFA_II_1	ENEL PRODUZIONE S.P.A.	RM	CSUD	ID	-	5 503	3	1 834	0,21
UP_LACEDONIA2_1	Alerion	AV	CSUD	EO	Renewable	33 008	18	1 834	0,21
UP_SNPTRVLLNA_1	ENEL PRODUZIONE S.P.A.	IS	SUD	EO	Renewable	18 687	10,2	1 832	0,21
UP_VNTPANSANO_1	-	-	CSUD	-	-	76 798	42	1 829	0,21
UP_NVPGNONEMS_1	-	-	CNOR	TE	GT	69 478	38	1 828	0,21
UP_SRGNPGLCNT_1	SORGENIA S.P.A.	BA	BRNN	TE	Ccgt	1 380 770	758	1 822	0,21
UP_IVPC_ALBE_1	IVPC	FG	SUD	EO	Renewable	65 471	36	1 819	0,21
UP_DI8888_CSUD_Y	-	-	CSUD	-	-	3 058 255	1685,635	1 814	0,21
UP_TVRNLSTRTS_1	-	-	SUD	-	-	39 864	22	1 812	0,21
UP_GRECI_1	ERG SPA	AV	CSUD	EO	Renewable	26 292	14,52	1 811	0,21
UP_GIARRATANA_1	ERG SPA	RG	SICI	EO	Renewable	81 881	45,32	1 807	0,21
UP_PRCLCDCMPG_1	-	-	CSUD	-	-	36 117	20	1 806	0,21
UP_ORICHELLA_1	A2A TRADING S.R.L.	CS	SUD	ID	Pumped-St...	239 799	133,28	1 799	0,21
UP_SAVIGNANO_1	GDF SUEZ Energia Italia...	AV	CSUD	EO	Renewable	136 380	75,99	1 795	0,20

Unit Reference	Owner	Prov.	Zone	Type	Technology	Total Quantity (MWh)	Power Max (MW)	Equivalent Hours (heq)	Capacity Factor
UP_LCDNCRRLLO_1	-	-	CSUD	-	-	26 900	15	1 793	0,20
UP_STRRNMANNA_1	ENEL PRODUZIONE S.P.A.	SS	SARD	EO	Renewable	57 049	31,866	1 790	0,20
UP_DI8888_SUD_Y	-	-	SUD	-	-	4 686 675	2620,717	1 788	0,20
UP_MNTFRRANTE_7	EDISON	CH	CSUD	EO	Renewable	31 988	17,9	1 787	0,20
UP_LECCE3_2	-	-	SUD	-	-	21 431	12	1 786	0,20
UP_IVPC4_LAC_1	ERG SPA	AV	CSUD	EO	Renewable	70 598	39,6	1 783	0,20
UP_SNFLRCRFF2_1	-	-	SUD	-	-	32 777	18,4	1 781	0,20
UP_MNRVNMRGCN_3	-	-	SUD	-	-	28 409	16	1 776	0,20
UP_DI0323_CNOR_B	-	-	CNOR	-	-	3 248	1,83	1 775	0,20
UP_MNRVNMRGCN_1	-	-	SUD	-	-	31 874	18	1 771	0,20
UP_MNTFRRANTE_8	EDISON	CH	CSUD	EO	Renewable	25 492	14,4	1 770	0,20
UP_DI8888_SICI_Y	-	-	SICI	-	Renewable	1 464 135	829,787	1 764	0,20
UP_ITAVSERIO_2	-	-	NORD	-	-	52 904	30	1 763	0,20
UP_LANZADA_1	ENEL PRODUZIONE S.P.A.	SO	NORD	ID	Pumped-St...	219 328	124,416	1 763	0,20
UP_DI2182_NORD_B	-	-	NORD	TE	Ccgt	187 683	106,672	1 759	0,20
UP_GARGANO1_1	-	-	SUD	-	-	66 855	38	1 759	0,20
UP_MNRVNMRGCN_2	-	-	SUD	-	-	31 616	18	1 756	0,20
UP_MONTALTO24_1	-	-	CSUD	-	-	41 184	23,5	1 753	0,20
UP_PONTE_ANN_1	ENEL PRODUZIONE S.P.A.	CE	CSUD	ID	-	7 006	4	1 751	0,20
UP_DI1156_NORD_C	-	-	NORD	-	-	11 565	6,605	1 751	0,20
UP_TROIA2_2	EOS1 TROIA	FG	SUD	EO	Renewable	17 026	9,727	1 750	0,20
UP_TULA2_1	ENEL PRODUZIONE S.P.A.	SS	SARD	EO	Renewable	87 086	49,833	1 748	0,20
UP_CNTRLNTRNO_11	AZIENDA ENERGETICA ...	BZ	NORD	ID	Pumped-St...	343 805	198	1 736	0,20
UP_PRCLCPGGLT_1	E.ON Energy Trading SE	GR	CNOR	EO	Renewable	34 714	20	1 736	0,20
UP_DI1170_CSUD_C	-	-	CSUD	ID	Run-of-river	15 939	9,223	1 728	0,20
UP_MPNTLCDCTR_1	ENEL PRODUZIONE S.P.A.	-	SUD	-	-	79 385	46	1 726	0,20
UP_CORFINO_1	ENEL PRODUZIONE S.P.A.	LU	CNOR	ID	-	26 176	15,206	1 721	0,20
UP_DI1999_NORD_G	-	-	NORD	-	-	5 825	3,394	1 716	0,20
UP_SALEMI_1	ERG SPA	-	SICI	-	-	43 704	25,5	1 714	0,20
UP_CMPMGGIORE_1	BAYWA R.E.	PZ	SUD	EO	Renewable	20 554	12	1 713	0,20
UP_SSNPLOAGHE_1	ERG SPA	SS	SARD	EO	Renewable	71 404	41,747	1 710	0,20
UP_GSANDONACI_1	GDF SUEZ Energia Italia...	BR	SUD	EO	Renewable	25 672	15,013	1 710	0,20
UP_MPNTLCCSNI_1	-	-	NORD	-	-	21 746	12,8	1 699	0,19
UP_DI1990_CSUD_C	-	-	CSUD	-	-	24 359	14,377	1 694	0,19
UP_MATOS_1	-	-	SICI	-	Renewable	32 776	19,37	1 692	0,19
UP_NDRMDA45MW_1	-	-	CSUD	-	-	76 092	45	1 691	0,19
UP_PIAN_DELL_1	ENEL PRODUZIONE S.P.A.	LU	CNOR	ID	-	38 282	22,649	1 690	0,19
UP_GREENPATTI_1	-	-	SICI	-	-	80 937	48	1 686	0,19
UP_IVPC4_VID_1	ERG SPA	SS	SARD	EO	Renewable	50 036	29,7	1 685	0,19
UP_CALUSIA_1	A2A TRADING S.R.L.	KR	SUD	ID	Pumped-St...	75 810	45	1 685	0,19
UP_FNESTRELLE_1	-	-	NORD	-	-	52 703	31,32	1 683	0,19
UP_CALLARI_1	ALERION	CT	SICI	EO	Renewable	60 490	36	1 680	0,19
UP_DI0005_NORD_B	A2A TRADING S.R.L.	-	NORD	-	-	22 416	13,352	1 679	0,19
UP_IVPC4_BIS_1	ERG SPA	AV	CSUD	EO	Renewable	44 346	26,45	1 677	0,19
UP_PRCLCMNTCT_2	E.ON Energy Trading SE	PZ	SUD	EO	Renewable	73 766	44	1 676	0,19
UP_FIUMESANT_4	E.ON Energy Trading SE	SS	SARD	TE	Coal	683 405	408	1 675	0,19
UP_FRANCIOSA1_1	-	-	SUD	-	-	30 721	18,4	1 670	0,19
UP_ILPRIMO_1	-	-	SUD	-	-	57 436	34,435	1 668	0,19
UP_DI1170_SUD_C	-	-	SUD	ID	Run-of-river	60 275	36,185	1 666	0,19
UP_GNSTRDGLSC_2	ERG SPA	-	CSUD	-	-	53 197	32	1 662	0,19
UP_CSTLNVDCNZ_1	SORGENIA S.P.A.	SA	CSUD	EO	Coal	16 665	10,029	1 662	0,19
UP_PRCLCMRCRL_1	E.ON Energy Trading SE	CS	SUD	EO	Renewable	72 515	43,768	1 657	0,19
UP_DI2298_NORD_G	-	-	NORD	-	-	1 322	0,8	1 652	0,19
UP_DI2055_NORD_G	-	-	NORD	-	-	18 568	11,254	1 650	0,19
UP_MATISSE_1	-	-	SUD	-	-	64 218	39	1 647	0,19
UP_DI1621_SARD_C	-	-	SARD	-	-	2 810	1,707	1 646	0,19
UP_RNRPNOLICO_1	-	-	CSUD	-	Renewable	16 440	10	1 644	0,19
UP_SNNRGYPRTN_1	-	-	SUD	-	-	33 866	20,618	1 643	0,19
UP_PIZZONE_1	ENEL PRODUZIONE S.P.A.	IS	SUD	ID	-	30 614	18,648	1 642	0,19
UP_SUGARELLA_1	-	-	CSUD	-	-	39 355	24	1 640	0,19
UP_VOLTURARA_1	EDF EN	FG	SUD	EO	Renewable	18 691	11,4	1 640	0,19
UP_SNMRCNLMIS_1	-	-	SUD	-	-	71 920	44,2	1 627	0,19
UP_DI2163_SICI_C	-	-	SICI	-	-	862	0,531	1 624	0,19
UP_FORENZA_1	ERG SPA	PZ	SUD	EO	Renewable	64 257	39,6	1 623	0,19
UP_PRCLCSNTMN_1	-	-	CSUD	-	-	32 426	20	1 621	0,19
UP_PTRCATELLA_1	ERG SPA	CB	SUD	EO	Renewable	43 750	27,06	1 617	0,18
UP_CASALBORE_1	GDF SUEZ Energia Italia...	AV	CSUD	EO	Renewable	30 179	18,798	1 605	0,18
UP_GNSTRDGLSC_1	GDF SUEZ Energia Italia...	-	CSUD	-	-	28 805	17,967	1 603	0,18
UP_FTTRLCDSNT_1	-	-	CNOR	-	-	37 421	23,4	1 599	0,18
UP_MNTDLLDFSA_1	GDF SUEZ Energia Italia...	-	CSUD	-	Renewable	57 409	35,96	1 596	0,18
UP_CENTRALE__1	-	-	NORD	-	-	18 208	11,414	1 595	0,18

Unit Reference	Owner	Prov.	Zone	Type	Technology	Total Quantity (MWh)	Power Max (MW)	Equivalent Hours (heq)	Capacity Factor
UP_MPNTLCSCLS_1	-	-	SUD	-	-	82 766	52	1 592	0,18
UP_LANUVIO_1	-	-	CSUD	-	-	36 308	22,871	1 588	0,18
UP_PRCLCPGGML_1	-	-	CNOR	-	-	28 491	17,966	1 586	0,18
UP_DI0360_CSUD_C	-	-	CSUD	-	-	3 088	1,948	1 585	0,18
UP_DI0062_CNOR_B	AXPO ITALIA S.P.A.	-	CNOR	-	-	44 930	28,391	1 583	0,18
UP_BAGALADI_1	ENEL PRODUZIONE S.P.A.	RC	SUD	EO	Renewable	44 320	28,05	1 580	0,18
UP_CCGTPRILIA_1	SORGENIA S.P.A.	LT	CSUD	TE	Ccgt	1 228 939	780	1 576	0,18
UP_DI2044_SICI_C	GDF SUEZ Energia Italia...	-	SICI	-	-	3 676	2,337	1 573	0,18
UP_PILANI_2	GDF SUEZ Energia Italia...	-	CSUD	-	-	18 684	11,881	1 573	0,18
UP_PNDLCRNALE_1	GDF SUEZ Energia Italia...	-	CSUD	-	-	28 843	18,346	1 572	0,18
UP_LTMPPSANIA_1	ALPIQ ENERGIA ITALIA...	CT	SICI	EO	Renewable	104 197	66,56	1 565	0,18
UP_CRLENTINI2_1	ENEL PRODUZIONE S.P.A.	SR	SICI	EO	Renewable	22 606	14,45	1 564	0,18
UP_DI1079_SUD_B	-	-	SUD	-	-	34 744	22,209	1 564	0,18
UP_COMUNACQU_1	-	-	CSUD	-	-	4 227	2,704	1 563	0,18
UP_LGOARANCIO_1	-	-	SICI	-	-	68 745	43,998	1 562	0,18
UP_TOMBETTA_1	-	-	NORD	-	-	14 973	9,589	1 561	0,18
UP_DENITTIS2_1	-	FG	SUD	FV	Renewable	16 039	10,281	1 560	0,18
UP_DENITTIS1_1	-	FG	SUD	FV	Renewable	17 173	11,043	1 555	0,18
UP_DI1170_NORD_G	-	-	NORD	-	Other	23 772	15,312	1 553	0,18
UP_MNTCLVELLO_1	-	-	SUD	-	Renewable	64 270	41,4	1 552	0,18
UP_SERROLUNGO_1	-	-	SUD	-	-	35 681	23	1 551	0,18
UP_FLORINAS_1	E.ON Energy Trading SE	SS	SARD	EO	Renewable	30 887	20	1 544	0,18
UP_MPNTLCDMRN_1	-	-	SICI	-	-	34 125	22,1	1 544	0,18
UP_DENITTIS3_1	-	FG	SUD	FV	Renewable	19 301	12,559	1 537	0,18
UP_MNMLITELLO_1	ERG SPA	CT	SICI	EO	Renewable	37 752	24,649	1 532	0,17
UP_GUGLIANOFV_5	-	-	CSUD	-	-	29 064	19	1 530	0,17
UP_CLLCPTRMNT_1	-	-	SUD	-	-	26 003	17	1 530	0,17
UP_VAL_NOANA_1	ENEL PRODUZIONE S.P.A.	TN	NORD	ID	-	82 559	54	1 529	0,17
UP_VIZZINI_1	MAESTRALE Green Energy	CT	SICI	EO	Renewable	38 932	25,48	1 528	0,17
UP_CANDELA_2	EDISON	FG	SUD	TE	-	59 408	39,1	1 519	0,17
UP_RSMAGGIORE_1	-	-	CSUD	-	-	22 717	15	1 514	0,17
UP_DI2004_CSUD_C	-	-	CSUD	-	-	9 454	6,244	1 514	0,17
UP_PTRLSTTANA_1	-	-	SICI	-	-	33 458	22,1	1 514	0,17
UP_PRCLCDPRZZ_1	-	-	SICI	-	-	90 800	60	1 513	0,17
UP_PRCLCDPLRM_1	-	-	SICI	-	-	44 927	29,75	1 510	0,17
UP_BRGSBOTINO_1	-	-	CSUD	-	-	16 561	11	1 506	0,17
UP_S.F._DEL_1	EDIPOWER S.P.A	ME	SICI	TE	Oil	217 867	145	1 503	0,17
UP_PSCUSOEOLO_1	ENEL PRODUZIONE S.P.A.	-	SARD	EO	Renewable	134 761	89,7	1 502	0,17
UP_LCNTARASUD_1	-	-	SICI	-	-	35 595	23,8	1 496	0,17
UP_TERMINI_I_6	ENEL PRODUZIONE S.P.A.	PA	SICI	TE	Ccgt	1 120 373	750	1 494	0,17
UP_DLCTTRRTTA_1	-	-	SUD	-	-	17 413	11,661	1 493	0,17
UP_DI1170_SICI_C	-	-	SICI	ID	Run-of-river	56 143	37,605	1 493	0,17
UP_DI2055_CNOR_B	-	-	CNOR	-	-	103	0,069	1 492	0,17
UP_VIZZINI_2	E.ON Energy Trading SE	CT	SICI	EO	Renewable	35 417	23,8	1 488	0,17
UP_DI1079_NORD_B	-	-	NORD	-	-	44 073	29,648	1 487	0,17
UP_GGSVDDLBA2_1	ERG SPA	SS	SARD	EO	Renewable	42 948	28,9	1 486	0,17
UP_BUGLIA_1	-	-	SUD	-	-	30 459	20,5	1 486	0,17
UP_CSTLDLUCIO_1	ALERION	ME	SICI	EO	Renewable	33 976	22,95	1 480	0,17
UP_BOVINO1_1	-	-	SUD	-	-	14 698	9,93	1 480	0,17
UP_NEBRODIEST_1	-	-	SICI	-	-	30 150	20,4	1 478	0,17
UP_TNRSDLMNSP_1	-	-	NORD	-	-	144 773	98,186	1 474	0,17
UP_CRLENTINIA_1	ERG SPA	SR	SICI	EO	Renewable	36 225	24,615	1 472	0,17
UP_TRCANCARRO_1	-	-	FOGN	-	-	19 738	13,413	1 472	0,17
UP_DI2095_CSUD_C	-	-	CSUD	-	-	4 978	3,385	1 470	0,17
UP_ROCCAROSSA_1	ALPIQ ENERGIA ITALIA...	PA	SICI	EO	Renewable	119 999	81,65	1 470	0,17
UP_MNTECAVUTI_1	-	-	SUD	-	-	15 750	10,72	1 469	0,17
UP_DI8888_SARD_Y	-	-	SARD	-	-	561 118	382,456	1 467	0,17
UP_LOREO_1	-	-	NORD	-	Renewable	18 386	12,557	1 464	0,17
UP_DI2044_NORD_A	GDF SUEZ Energia Italia...	-	NORD	-	-	74 291	50,814	1 462	0,17
UP_LASCLAFANI_1	-	-	SICI	-	Renewable	37 103	25,5	1 455	0,17
UP_PARTINICO_1	ERG SPA	PA	SICI	EO	Renewable	23 482	16,15	1 454	0,17
UP_MEGASOL13_1	-	-	CSUD	-	-	19 205	13,24	1 451	0,17
UP_PITAGORA_1	-	-	SUD	-	-	66 562	45,9	1 450	0,17
UP_PALAZZO_2_1	ENEL PRODUZIONE S.P.A.	CS	SUD	ID	Pumped-St...	65 073	45,158	1 441	0,16
UP_TRPNSALEMI_1	GDF SUEZ Energia Italia...	TP	SICI	EO	Renewable	125 053	86,902	1 439	0,16
UP_DI0114_SUD_C	-	-	SUD	-	-	2 210	1,537	1 438	0,16
UP_CNTRLDTVRL_1	REPOWER	CE	CSUD	TE	Ccgt	569 106	395,921	1 437	0,16
UP_SRRCPROLA2_1	-	-	SUD	-	-	14 368	10	1 437	0,16
UP_CNTRLDCGNR_46	IREN MERCATO SPA	-	NORD	TE	Ccgt	35 127	24,5	1 434	0,16
UP_LICODIA_1	ALERION	CT	SICI	EO	Renewable	31 669	22,099	1 433	0,16
UP_FRANCIOSA2_1	-	-	SUD	-	-	16 441	11,5	1 430	0,16

Unit Reference	Owner	Prov.	Zone	Type	Technology	Total Quantity (MWh)	Power Max (MW)	Equivalent Hours (heq)	Capacity Factor
UP_NBRODINORD_1	-	-	SICI	-	-	33 953	23,8	1 427	0,16
UP_DI0156_SICI_C	ALPIQ ENERGIA ITALIA...	AG	SICI	ID	Run-of-river	57 686	40,513	1 424	0,16
UP_TENERGY_1	-	-	NORD	-	-	71 156	50	1 423	0,16
UP_CADAU1_1	-	-	SARD	-	-	27 601	19,437	1 420	0,16
UP_CNTRDCOLLA_1	ENEL PRODUZIONE S.P.A.	PA	SICI	EO	Renewable	28 957	20,4	1 419	0,16
UP_DI2044_NORD_B	GDF SUEZ Energia Italia...	-	NORD	TE	Ccgt	139 116	98,267	1 416	0,16
UP_TROIA3E4_1	EOS1 TROIA	FG	SUD	EO	Renewable	29 710	21	1 415	0,16
UP_DI2182_SUD_B	-	-	SUD	TE	Ccgt	8 373	5,919	1 415	0,16
UP_CRLENTINIB_1	ERG SPA	SR	SICI	EO	Renewable	33 506	23,724	1 412	0,16
UP_FUMESANTO2_1	-	-	SARD	-	-	29 337	20,824	1 409	0,16
UP_DI2055_NORD_Z	-	-	NORD	-	-	29 578	21	1 408	0,16
UP_DI2126_CSUD_C	-	-	CSUD	-	-	2 658	1,9	1 399	0,16
UP_CNTRNRGFRR_1	-	-	NORD	TE	Ccgt	192 873	138	1 398	0,16
UP_ALFONSINE_1	-	RA	NORD	FV	Renewable	42 145	30,163	1 397	0,16
UP_DI0060_SUD_C	EDISON	-	SUD	ID	Run-of-river	49 324	35,307	1 397	0,16
UP_COLOGNO_M_1	EDISON	MI	NORD	FV	Renewable	62 857	45	1 397	0,16
UP_SRRDCRISTO_1	-	-	FOGN	-	-	44 631	32	1 395	0,16
UP_DI1676_CNOR_C	-	-	CNOR	-	-	1 531	1,098	1 394	0,16
UP_DI0060_CSUD_C	EDISON	-	CSUD	ID	Run-of-river	46 549	33,392	1 394	0,16
UP_CSTAGRANDE_1	GDF SUEZ Energia Italia...	-	CSUD	-	-	26 604	19,092	1 393	0,16
UP_DI0196_SUD_C	-	-	SUD	-	-	3 690	2,659	1 388	0,16
UP_SNTLBERTO2_1	-	-	NORD	-	-	33 269	24,033	1 384	0,16
UP_DI2182_NORD_Z	-	-	NORD	-	-	4 274	3,092	1 382	0,16
UP_SUSCIOFFU_1	-	-	SARD	-	-	23 848	17,299	1 379	0,16
UP_SCLFNBGNI2_1	ENEL PRODUZIONE S.P.A.	PA	SICI	EO	Renewable	17 276	12,61	1 370	0,16
UP_DI0342_CNOR_G	-	-	CNOR	-	-	6 976	5,1	1 368	0,16
UP_PALINO20MW_1	AXPO ITALIA S.P.A.	-	SUD	-	Renewable	40 583	29,694	1 367	0,16
UP_TRMVLRZZTR_2	-	-	SUD	-	-	14 341	10,5	1 366	0,16
UP_MONTEDURRA_1	MONCADA ENERGY GR...	AG	SICI	EO	Ccgt	45 435	33,456	1 358	0,16
UP_SRRCHPPONI_1	ENEL PRODUZIONE S.P.A.	IS	SUD	EO	Renewable	13 829	10,2	1 356	0,15
UP_TRETORRI_1	-	-	BRNN	-	-	40 605	30	1 353	0,15
UP_DI2055_SUD_A	-	-	SUD	-	-	14 836	11	1 349	0,15
UP_DI8888_CSUD_Z	-	-	CSUD	-	-	113 958	85,009	1 341	0,15
UP_PERRERES_1	C.V.A S.P.A.	AO	NORD	ID	Pumped-St...	21 441	16	1 340	0,15
UP_MPNTLCPTRM_1	-	-	SUD	-	Renewable	89 659	67	1 338	0,15
UP_DI2126_SICI_C	-	-	SICI	-	-	3 872	2,9	1 335	0,15
UP_MONTARONE_1	ENEL PRODUZIONE S.P.A.	IS	SUD	EO	Renewable	14 753	11,05	1 335	0,15
UP_PRCDSTALLA_1	-	-	SUD	-	-	15 171	11,379	1 333	0,15
UP_NBRDIOVEST_1	-	-	SICI	-	-	27 166	20,4	1 332	0,15
UP_MPNTFVSNTL_1	-	-	NORD	-	-	44 754	33,666	1 329	0,15
UP_DI8888_SUD_Z	-	-	SUD	-	-	87 113	65,572	1 329	0,15
UP_MASOCORON_1	AGSM ENERGIA SRL	TN	NORD	ID	Pumped-St...	52 975	40	1 324	0,15
UP_FRRRFCMRT2_1	-	-	NORD	-	-	13 728	10,401	1 320	0,15
UP_CNTRLDCGNR_48	AXPO ITALIA S.P.A.	-	CSUD	-	-	17 773	13,48	1 318	0,15
UP_BONORVA_1	EDF	SS	SARD	EO	Renewable	97 279	74	1 315	0,15
UP_SATRIANO_1	A2A TRADING S.R.L.	CZ	SUD	ID	-	30 875	23,53	1 312	0,15
UP_MMZTSLRPRK_1	-	-	NORD	-	-	81 994	62,985	1 302	0,15
UP_DI2017_CNOR_B	E.ON Energy Trading SE	-	CNOR	FV	Renewable	616	0,473	1 302	0,15
UP_ALFONSINE2_2	-	RA	NORD	FV	Renewable	31 597	24,323	1 299	0,15
UP_DI1608_NORD_C	-	-	NORD	-	-	8 497	6,543	1 299	0,15
UP_FNVLFRTORE_1	GDF SUEZ Energia Italia...	BN	CSUD	EO	Renewable	19 230	14,893	1 291	0,15
UP_LCNTRANORD_1	-	-	SICI	-	-	30 691	23,799	1 290	0,15
UP_MAEN_5	C.V.A S.P.A.	AO	NORD	ID	Pumped-St...	25 744	20	1 287	0,15
UP_DI2044_NORD_G	GDF SUEZ Energia Italia...	-	NORD	-	-	4 005	3,113	1 286	0,15
UP_OMIRAFIORI_3	FIAT	TO	NORD	TE	-	71 981	56	1 285	0,15
UP_FRNCOFONTE_1	WKN AG	SR	SICI	EO	Renewable	92 503	72	1 285	0,15
UP_PRCOEOLICO_1	AXPO ITALIA S.P.A.	-	SUD	-	Renewable	246 970	192,31	1 284	0,15
UP_CNTRLDTSTI_7	TRAFIGURA ELECTRICI...	FI	CNOR	TE	Ccgt	80 558	62,8	1 283	0,15
UP_DI1973_SICI_C	-	-	SICI	TE	Ccgt	3 500	2,73	1 282	0,15
UP_CNTRLDCGNR_45	-	-	NORD	-	Other	63 237	49,5	1 278	0,15
UP_DI0068_CSUD_C	-	-	CSUD	TE	Ccgt	14 199	11,116	1 277	0,15
UP_DSTRCGNRZN_1	-	-	NORD	-	-	63 836	50	1 277	0,15
UP_MNTNARBONE_1	MONCADA ENERGY GR...	AG	SICI	EO	Renewable	38 564	30,213	1 276	0,15
UP_MNTMLVIZZO_1	MONCADA ENERGY GR...	AG	SICI	EO	Renewable	25 219	19,8	1 274	0,15
UP_MNTFRRANTE_9	EDISON	CH	CSUD	EO	Renewable	33 617	26,4	1 273	0,15
UP_RPACANDIDA_1	-	-	SUD	-	-	52 469	41,4	1 267	0,14
UP_DI2044_SUD_B	GDF SUEZ Energia Italia...	-	SUD	-	-	5 575	4,416	1 262	0,14
UP_CACCAMO_1	ACCIONA ENERGIA	AQ	SICI	EO	Renewable	18 133	14,45	1 255	0,14
UP_FTVLTCNRSL_1	-	-	NORD	-	-	58 290	46,512	1 253	0,14
UP_DI8888_CNOR_Z	-	-	CNOR	-	-	70 396	56,185	1 253	0,14
UP_DI2055_CNOR_E	-	-	CNOR	-	-	19 425	15,53	1 251	0,14

Unit Reference	Owner	Prov.	Zone	Type	Technology	Total Quantity (MWh)	Power Max (MW)	Equivalent Hours (heq)	Capacity Factor
UP_PNSNBIAGIO_1	-	-	SUD	-	-	37 518	30	1 251	0,14
UP_LVTRNTCET3_1	-	-	BRNN	-	-	124 120	100	1 241	0,14
UP_CAMPOREALE_1	ERG SPA	PA	SICI	EO	Renewable	25 282	20,4	1 239	0,14
UP_PRCLCMINEO_1	AXPO ITALIA S.P.A.	-	SICI	-	-	52 352	42,5	1 232	0,14
UP_LTTIGHEDDU_1	ENEL PRODUZIONE S.P.A.	SS	SARD	EO	Renewable	75 243	61,454	1 224	0,14
UP_DI1990_CNOR_B	-	-	CNOR	-	-	2 621	2,147	1 221	0,14
UP_DI1901_NORD_B	-	-	NORD	-	-	21 197	17,367	1 221	0,14
UP_FERRANTI_1	-	-	SUD	-	-	66 428	54,6	1 217	0,14
UP_MUSCHIOSO_1	ENEL PRODUZIONE S.P.A.	MO	NORD	ID	-	9 728	8	1 216	0,14
UP_MNTPETRASI_1	MONCADA ENERGY GR...	AG	SICI	EO	Ccgt	57 337	47,28	1 213	0,14
UP_CONTRASTO_1	ENEL PRODUZIONE S.P.A.	CT	SICI	ID	-	42 437	35	1 212	0,14
UP_RIZZICONI_1	AXPO ITALIA S.P.A.	RC	ROSN	TE	Ccgt	501 813	414	1 212	0,14
UP_PRCLCRDINO_1	E.ON Energy Trading SE	BV	CSUD	EO	Renewable	16 811	14	1 201	0,14
UP_UPWTE2_1	-	-	CSUD	-	-	14 386	12	1 199	0,14
UP_ELCE_3	-	-	SUD	-	-	28 394	24	1 183	0,14
UP_DI1716_NORD_C	-	-	NORD	-	-	1 951	1,651	1 182	0,13
UP_DI1963_CSUD_A	-	-	CSUD	-	-	4 573	3,871	1 181	0,13
UP_VLLCSTLLWF_1	AXPO ITALIA S.P.A.	-	SUD	TE	Ccgt	66 923	56,751	1 179	0,13
UP_DI0312_NORD_C	-	-	NORD	-	-	3 344	2,854	1 172	0,13
UP_DI2055_NORD_A	-	-	NORD	ID	Pumped-St...	39 563	33,845	1 169	0,13
UP_BARCA_CLE_1	ENEL PRODUZIONE S.P.A.	CT	SICI	ID	-	10 561	9,057	1 166	0,13
UP_SANSEVERI_1	-	-	CSUD	-	-	33 222	28,5	1 166	0,13
UP_DI2044_CSUD_B	GDF SUEZ Energia Italia...	-	CSUD	-	-	14 149	12,158	1 164	0,13
UP_DI1928_CSUD_C	-	-	CSUD	-	-	4 293	3,705	1 159	0,13
UP_CNTRLLTTRG_1	TRAFIGURA ELECTRICI...	GO	NORD	TE	Ccgt	65 980	57,3	1 151	0,13
UP_DI1174_NORD_A	-	-	NORD	ID	Pumped-St...	20 660	18	1 148	0,13
UP_DLLLVNQLEA_1	AXPO ITALIA S.P.A.	-	SICI	-	Renewable	51 182	44,656	1 146	0,13
UP_PNDLLCPR20_1	AXPO ITALIA S.P.A.	-	SUD	-	Renewable	40 654	35,52	1 145	0,13
UP_PRLGRGALLO_1	-	-	PRGP	-	Renewable	15 364	13,5	1 138	0,13
UP_SULCIS_CE_3	ENEL PRODUZIONE S.P.A.	CA	SARD	TE	Coal	206 368	182	1 134	0,13
UP_GRTTLE18MW_1	AXPO ITALIA S.P.A.	-	SUD	-	-	41 914	37,203	1 127	0,13
UP_SIMERI_1	A2A TRADING S.R.L.	CZ	SUD	ID	Run-of-river	79 865	71	1 125	0,13
UP_BUSSENTO_1	A2A TRADING S.R.L.	SA	CSUD	ID	Pumped-St...	132 343	118	1 122	0,13
UP_MARSICAII_1	-	-	CSUD	-	-	29 989	26,976	1 112	0,13
UP_RICIGLIANO_1	AXPO ITALIA S.P.A.	-	CSUD	-	-	62 931	56,924	1 106	0,13
UP_PRCLCRGLBT_1	-	-	SICI	-	-	54 995	50	1 100	0,13
UP_CASUZZE_1	ENEL PRODUZIONE S.P.A.	PA	SICI	ID	-	9 897	9	1 100	0,13
UP_URURI_1	FRI-EL	CB	SUD	EO	Renewable	56 992	51,89	1 098	0,13
UP_VALLATA_1	-	un	CSUD	-	-	52 529	48	1 094	0,12
UP_PRCLCCCLLO_1	-	-	CSUD	-	-	34 372	31,45	1 093	0,12
UP_DI1895_CSUD_C	-	-	CSUD	-	-	7 257	6,715	1 081	0,12
UP_DI0060_CNOR_A	EDISON	-	CNOR	-	-	11 453	10,6	1 080	0,12
UP_DI2004_NORD_C	-	-	NORD	-	-	220	0,204	1 076	0,12
UP_FRANZI_1	AXPO ITALIA S.P.A.	-	SUD	-	Renewable	33 724	31,554	1 069	0,12
UP_MORASCO_1	ENEL PRODUZIONE S.P.A.	VB	NORD	ID	Pumped-St...	43 842	41,158	1 065	0,12
UP_DI1928_CNOR_A	-	-	CNOR	-	-	8 634	8,119	1 063	0,12
UP_DI2301_NORD_B	-	-	NORD	-	-	4 350	4,096	1 062	0,12
UP_DI1928_NORD_B	-	-	NORD	-	-	16 903	15,985	1 057	0,12
UP_DI1999_SICI_C	-	-	SICI	-	-	5 058	4,8	1 054	0,12
UP_DI1999_NORD_C	-	-	NORD	-	-	10 604	10,064	1 054	0,12
UP_DI0062_CSUD_B	AXPO ITALIA S.P.A.	-	CSUD	-	-	17 720	16,896	1 049	0,12
UP_DI0060_SICI_C	EDISON	-	SICI	ID	Run-of-river	17 835	17,117	1 042	0,12
UP_GARGNANO_1	ENEL PRODUZIONE S.P.A.	BS	NORD	ID	Pumped	84 906	81,85	1 037	0,12
UP_DI0230_SUD_C	-	-	SUD	-	-	14 005	13,555	1 033	0,12
UP_DI2300_SUD_C	-	-	SUD	-	-	2 322	2,247	1 033	0,12
UP_DLCTEOLICO_1	-	-	SUD	-	-	18 559	18	1 031	0,12
UP_TROINAGRTT_1	ENEL PRODUZIONE S.P.A.	EN	SICI	ID	Run-of-river	30 613	29,801	1 027	0,12
UP_RIZZICONI_2	AXPO ITALIA S.P.A.	RC	ROSN	TE	Ccgt	395 918	388,4	1 019	0,12
UP_NULVITERGU_1	FRI-EL	SS	SARD	EO	Renewable	30 147	29,75	1 013	0,12
UP_MNTMURRO12_1	AXPO ITALIA S.P.A.	-	SUD	-	Renewable	52 133	51,512	1 012	0,12
UP_NVLTANURRA_1	ENEL PRODUZIONE S.P.A.	SS	SARD	EO	Renewable	12 004	11,927	1 006	0,11
UP_DI1170_NORD_Z	-	-	NORD	-	-	8 722	8,668	1 006	0,11
UP_GRTTLE36MW_1	AXPO ITALIA S.P.A.	-	SUD	-	Renewable	75 166	75,282	998	0,11
UP_DI1928_CSUD_B	-	-	CSUD	-	-	1 299	1,308	993	0,11
UP_TURBIGO_4	EDIPOWER S.P.A	MI	NORD	TE	Ccgt	780 520	786	993	0,11
UP_GNNSFNDIGA_1	AXPO ITALIA S.P.A.	-	SARD	-	Renewable	21 829	22	992	0,11
UP_DI2126_SARD_C	-	-	SARD	-	-	2 473	2,5	989	0,11
UP_STTNNRGSRL_1	OTTANA ENERGIA S.R.L.	NU	SARD	TE	Other	40 150	41	979	0,11
UP_DI1174_NORD_Z	-	-	NORD	-	-	5 853	6	975	0,11
UP_RIVADEL_3	ENEL PRODUZIONE S.P.A.	TN	NORD	ID	Pumped	105 468	108,416	973	0,11
UP_GUSPINI_1	FRI-EL	VS	SARD	EO	Renewable	23 139	24	964	0,11

Unit Reference	Owner	Prov.	Zone	Type	Technology	Total Quantity (MWh)	Power Max (MW)	Equivalent Hours (heq)	Capacity Factor
UP_CNTRLDSCND_2	ERGOSUD S.P.A	KR	ROSN	TE	Ccgt	398 620	414	963	0,11
UP_NAPOLIL_4	TIRRENO POWER S.P.A.	NA	CSUD	TE	Ccgt	359 894	375,601	958	0,11
UP_VENAUS_1	ENEL PRODUZIONE S.P.A.	TO	NORD	ID	Pumped-St...	234 848	245,4	957	0,11
UP_GRFALCOPEG_1	-	-	SUD	-	-	25 348	26,636	952	0,11
UP_SANBASILIO_1	FRI-EL	CA	SARD	EO	Renewable	23 422	24,649	950	0,11
UP_DI2189_CNOR_C	-	-	CNOR	-	-	1 897	2	949	0,11
UP_PZZDLTSR16_1	AXPO ITALIA S.P.A.	-	SUD	-	Renewable	25 439	26,964	943	0,11
UP_CNTRLADRIA_2	-	-	NORD	TE	GT	13 903	14,755	942	0,11
UP_SNGVNPBLLN_1	AXPO ITALIA S.P.A.	-	SARD	-	Renewable	22 557	24	940	0,11
UP_TRRVLDLIGA_5	TIRRENO POWER S.P.A.	RO	CSUD	TE	Ccgt	715 422	761,59	939	0,11
UP_DI1990_NORD_B	-	-	NORD	-	-	649	0,692	938	0,11
UP_DI1621_CSUD_C	-	-	CSUD	-	-	3 659	3,907	937	0,11
UP_TOPPA_2	AXPO ITALIA S.P.A.	-	CSUD	-	-	20 629	22,198	929	0,11
UP_DI8888_SARD_Z	-	-	SARD	-	-	42 600	45,912	928	0,11
UP_MPNTDTRMVL_2	-	-	NORD	-	-	27 780	30	926	0,11
UP_DI2004_SUD_C	-	-	SUD	-	-	941	1,019	923	0,11
UP_MISTRETTA_1	EDISON	ME	SICI	EO	Renewable	27 612	30	920	0,11
UP_CASSANO_2	A2A TRADING S.R.L.	MI	NORD	TE	Ccgt	690 282	752	918	0,10
UP_DI1174_NORD_C	-	-	NORD	ID	Run-of-river	37 544	41	916	0,10
UP_DI0062_CSUD_C	AXPO ITALIA S.P.A.	-	CSUD	-	-	16 455	18,074	910	0,10
UP_PIACENZA_4	EDIPOWER S.P.A	PC	NORD	TE	Ccgt	722 526	798	905	0,10
UP_TERNI_1	EDISON	TR	CNOR	TE	Ccgt	84 939	94,401	900	0,10
UP_BUSSI_1	EDISON	PE	CSUD	TE	Ccgt	104 970	117,193	896	0,10
UP_PRCLCDRCGL_1	-	-	CSUD	-	-	10 154	11,389	892	0,10
UP_CNTRLMNTCR_7	AXPO ITALIA S.P.A.	-	SUD	-	-	40 729	45,729	891	0,10
UP_LE_PIANE_1	ENEL PRODUZIONE S.P.A.	BO	NORD	ID	-	8 926	10,134	881	0,10
UP_LIVOLA16MW_1	AXPO ITALIA S.P.A.	-	SUD	-	Renewable	24 350	27,876	874	0,10
UP_PANTANO_D_1	ENEL PRODUZIONE S.P.A.	BS	NORD	ID	-	11 166	12,791	873	0,10
UP_GUARDIA_2	FRI-EL	MT	SUD	EO	Renewable	20 758	24	865	0,10
UP_GEROSA_1	ENEL PRODUZIONE S.P.A.	AP	CNOR	ID	-	3 777	4,375	863	0,10
UP_CAMPO_MOR_1	ENEL PRODUZIONE S.P.A.	SO	NORD	ID	Pumped	29 640	34,56	858	0,10
UP_GIUNCHETTO_1	REPOWER	EN	SICI	EO	Renewable	25 384	29,732	854	0,10
UP_SERMIDE_4	EDIPOWER S.P.A	MN	NORD	TE	Ccgt	656 172	770	852	0,10
UP_DI1170_CNOR_B	-	-	CNOR	TE	Ccgt	1 720	2,019	852	0,10
UP_DTTCORLANO_1	-	-	CSUD	-	-	16 983	20	849	0,10
UP_DI1616_CSUD_A	-	-	CSUD	-	-	6 393	7,534	849	0,10
UP_DI8888_SICI_Z	-	-	SICI	-	Other	42 509	50,57	841	0,10
UP_TRRVLDLIGA_6	TIRRENO POWER S.P.A.	RO	CSUD	TE	Ccgt	311 015	374,823	830	0,09
UP_CTE_DEL_M_2	A2A TRADING S.R.L.	MN	NORD	TE	Ccgt	378 000	458	825	0,09
UP_DI2052_NORD_B	-	-	NORD	-	-	761	0,922	825	0,09
UP_MPNTLCSCMP_1	-	-	CSUD	TE	Ccgt	54 660	67	816	0,09
UP_DI1621_NORD_B	-	-	NORD	-	-	1 142	1,4	816	0,09
UP_TOPPA_1	AXPO ITALIA S.P.A.	-	CSUD	-	-	62 016	77,15	804	0,09
UP_CAPRIATI_1	ENEL PRODUZIONE S.P.A.	CS	CSUD	ID	Pumped	79 083	100,44	787	0,09
UP_DI0198_NORD_C	-	-	NORD	-	-	3 483	4,444	784	0,09
UP_PPLMBNTLNT_1	-	-	NORD	-	-	6 421	8,2	783	0,09
UP_SGIACOMO_3	ENEL PRODUZIONE S.P.A.	TE	CSUD	ID	Pumped	346 353	443,232	781	0,09
UP_DI1902_NORD_G	-	-	NORD	-	-	3 633	4,701	773	0,09
UP_PSCINAWIND_1	-	-	CSUD	-	-	12 359	16	772	0,09
UP_ROTONDELLA_1	BAYWA R.E.	MT	SUD	EO	Renewable	16 857	22	766	0,09
UP_DI1621_SUD_C	-	-	SUD	TE	Ccgt	1 230	1,607	765	0,09
UP_NURRI_1	FRI-EL	CA	SARD	EO	Renewable	16 817	22,1	761	0,09
UP_DI1174_NORD_G	-	-	NORD	-	Other	14 339	19	755	0,09
UP_FARFA_I_1	ENEL PRODUZIONE S.P.A.	RM	CSUD	ID	-	3 885	5,162	753	0,09
UP_DI0370_NORD_B	-	-	NORD	TE	Ccgt	40 540	54	751	0,09
UP_S.F._DEL_2	EDIPOWER S.P.A	ME	SICI	TE	Oil	108 211	145	746	0,09
UP_CNTRLDRLTT_51	-	-	NORD	ID	Run-of-river	11 901	16,2	735	0,08
UP_S.F._DEL_4	EDIPOWER S.P.A	ME	SICI	TE	Oil	104 924	150	699	0,08
UP_CNTRLGRGHN_1	-	-	SARD	-	Renewable	68 767	98,9	695	0,08
UP_DI1886_CSUD_C	-	-	CSUD	-	-	13 672	20	684	0,08
UP_DI0062_CNOR_C	AXPO ITALIA S.P.A.	-	CNOR	ID	Run-of-river	10 990	16,098	683	0,08
UP_PROVVIDEN_1	ENEL PRODUZIONE S.P.A.	AQ	CSUD	ID	Pumped	89 723	134	670	0,08
UP_DI2017_NORD_B	E.ON Energy Trading SE	-	NORD	FV	Renewable	317	0,479	662	0,08
UP_CNTRLSCCO1_7	-	-	NORD	-	-	7 116	11	647	0,07
UP_NRGLTRNTVA_1	-	-	SARD	-	-	15 177	24	632	0,07
UP_CHIVASSO_1	EDIPOWER S.P.A	TO	NORD	TE	Ccgt	488 372	775	630	0,07
UP_DI1886_NORD_C	-	-	NORD	-	-	12 440	20	622	0,07
UP_DI2011_NORD_B	-	-	NORD	-	-	899	1,46	616	0,07
UP_DI1902_CSUD_C	-	-	CSUD	-	-	2 445	4	611	0,07
UP_GTG1GTG501_1	GDF SUEZ Energia Italia...	-	SICI	TE	GT	1 776	3	592	0,07
UP_DI2252_NORD_C	-	-	NORD	-	-	886	1,5	591	0,07

Unit Reference	Owner	Prov.	Zone	Type	Technology	Total Quantity (MWh)	Power Max (MW)	Equivalent Hours (heq)	Capacity Factor
UP_DI2300_CNOR_C	-	-	CNOR	-	-	3 503	5,948	589	0,07
UP_DI1902_CSUD_B	-	-	CSUD	-	-	4 550	8	569	0,06
UP_S.FIORANO_1	ENEL PRODUZIONE S.P.A.	BS	NORD	ID	Pumped	299 893	544,242	551	0,06
UP_CUCCHINAD_1	ENEL PRODUZIONE S.P.A.	NU	SARD	ID	Pumped-St...	19 933	36,308	549	0,06
UP_DLCTOLICO2_1	-	-	SUD	-	-	22 881	41,716	548	0,06
UP_MONTICELLI_1	-	-	SUD	-	-	17 490	31,91	548	0,06
UP_VLLSCCRDA1_1	-	-	CSUD	-	-	35 695	67	533	0,06
UP_DI1170_SARD_C	-	-	SARD	-	-	3 080	5,833	528	0,06
UP_NPWRRVENNA_9	ENI SPA	RA	NORD	TE	Ccgt	42 623	84	507	0,06
UP_LA_CASELL_1	ENEL PRODUZIONE S.P.A.	PC	NORD	TE	Ccgt	197 441	390	506	0,06
UP_LEVANTE_4	EDISON	VE	NORD	TE	Ccgt	176 939	360,082	491	0,06
UP_CELANO_1	TERMICA CELANO S.P.A.	AQ	CSUD	TE	Ccgt	90 245	184	490	0,06
UP_DI2126_SUD_C	-	-	SUD	-	-	1 305	2,7	483	0,06
UP_CTTAMARETE_1	-	-	CSUD	TE	Ccgt	52 941	110	481	0,05
UP_DI2182_CSUD_G	-	-	CSUD	-	-	2 885	5,996	481	0,05
UP_BPWRSRDGNA_1	OTTANA ENERGIA S.R.L.	NU	SARD	BIO	Other	9 615	20	481	0,05
UP_DI2044_CNOR_Z	GDF SUEZ Energia Italia...	-	CNOR	-	-	71	0,159	449	0,05
UP_CANTERNO_1	-	-	CSUD	-	-	5 268	12	439	0,05
UP_AZOTATI_5	EDISON	VE	NORD	TE	Ccgt	99 420	230,3	432	0,05
UP_PNTRECOGEN_1	-	-	CNOR	-	-	12 921	30,08	430	0,05
UP_NIC_1	-	-	NORD	-	Other	4 287	10	429	0,05
UP_TOR_DI_VA_2	ACEA ENERGIA	RM	CSUD	TE	GT	9 308	22	423	0,05
UP_DI0182_CNOR_Z	-	-	CNOR	-	-	211	0,5	422	0,05
UP_M._CIAPEL_1	ENEL PRODUZIONE S.P.A.	BL	NORD	ID	-	8 090	19,502	415	0,05
UP_TRAPANI_C_1	E.ON Energy Trading SE	TP	SICI	TE	GT	42 328	105	403	0,05
UP_DI2055_CSUD_G	-	-	CSUD	-	Other	16 725	42	398	0,05
UP_TRAPANI_C_2	E.ON Energy Trading SE	TP	SICI	TE	GT	42 128	106	397	0,05
UP_DI1170_SUD_Z	-	-	SUD	-	-	2 298	6,138	374	0,04
UP_DI0068_NORD_A	-	-	NORD	-	-	368	1	368	0,04
UP_DI2044_CNOR_A	GDF SUEZ Energia Italia...	-	CNOR	-	-	256	0,717	357	0,04
UP_DI1886_CSUD_B	-	-	CSUD	TE	Ccgt	7 092	20	355	0,04
UP_DI1895_NORD_B	-	-	NORD	-	-	346	0,98	353	0,04
UP_S.F._DEL_5	EDIPOWER S.P.A	ME	SICI	TE	Oil	101 398	288	352	0,04
UP_DI1886_NORD_B	-	-	NORD	TE	Ccgt	42 434	123,03	345	0,04
UP_DI2189_CSUD_Z	-	-	CSUD	-	-	296	0,924	320	0,04
UP_GISSI_2	A2A TRADING S.R.L.	CH	FOGN	TE	Ccgt	130 014	419	310	0,04
UP_CNTRLDSCND_1	ERGOSUD S.P.A	KR	ROSN	TE	Ccgt	116 445	416	280	0,03
UP_VERZUOLO_2	BURGO	CN	NORD	TE	-	11 980	43,01	279	0,03
UP_DI1621_CNOR_C	-	-	CNOR	-	-	347	1,253	277	0,03
UP_DI2004_NORD_B	-	-	NORD	TE	Ccgt	5 932	21,537	275	0,03
UP_DI1970_CNOR_C	-	-	CNOR	-	-	218	0,81	269	0,03
UP_BARI_TE_2	ENEL PRODUZIONE S.P.A.	BA	SUD	TE	OilMethane	16 343	64	255	0,03
UP_MPNTDGNRZN_1	-	-	NORD	-	Other	3 532	14	252	0,03
UP_DI1156_SUD_C	-	-	SUD	-	-	3 170	13,022	243	0,03
UP_DI0526_CSUD_B	-	-	CSUD	-	-	252	1,055	239	0,03
UP_CHP_1	-	-	NORD	-	-	7 667	32,747	234	0,03
UP_DI2382_SUD_C	-	-	SUD	-	-	686	2,995	229	0,03
UP_EDOLO_1	ENEL PRODUZIONE S.P.A.	BS	NORD	ID	Pumped	221 759	988,479	224	0,03
UP_TELESSIO_1	IREN MERCATO SPA	TO	NORD	ID	Pumped	7 698	34,4	224	0,03
UP_TOR_DI_VA_1	ACEA ENERGIA	RM	CSUD	TE	Ccgt	13 099	60	218	0,02
UP_LA_CASELL_3	ENEL PRODUZIONE S.P.A.	PC	NORD	TE	Ccgt	79 119	368	215	0,02
UP_S.F._DEL_3	EDIPOWER S.P.A	ME	SICI	TE	Oil	31 420	150	209	0,02
UP_CHIVASSO_2	EDIPOWER S.P.A	TO	NORD	TE	Ccgt	76 784	370	208	0,02
UP_S.F._DEL_6	EDIPOWER S.P.A	ME	SICI	TE	Oil	59 762	288	208	0,02
UP_NRAMONTORO_3	EDISON	TR	CNOR	TE	-	9 971	50	199	0,02
UP_FAMAGOSTA_3	A2A TRADING S.R.L.	MI	NORD	TE	-	1 017	5,12	199	0,02
UP_DI2067_SARD_A	-	-	SARD	-	-	46	0,259	178	0,02
UP_AUGUSTA_C_1	ENEL PRODUZIONE S.P.A.	SR	SICI	TE	Oil	7 923	45	176	0,02
UP_DI2017_SARD_C	-	-	SARD	-	-	321	1,827	176	0,02
UP_DI2055_SARD_B	-	-	SARD	-	-	2 340	13,536	173	0,02
UP_PIETRAFIT_5	ENEL PRODUZIONE S.P.A.	PG	CNOR	TE	Ccgt	62 988	365	173	0,02
UP_DI0062_SUD_B	AXPO ITALIA S.P.A.	-	SUD	-	-	1 703	10,01	170	0,02
UP_DI1973_CNOR_C	-	-	CNOR	-	-	1 008	6,088	166	0,02
UP_TALORO1_1	ENEL PRODUZIONE S.P.A.	NU	SARD	ID	Pumped	33 978	217,593	156	0,02
UP_DI0062_SUD_C	AXPO ITALIA S.P.A.	-	SUD	-	-	1 570	10,117	155	0,02
UPV_SWGYOEAETRTO	-	-	SVIZ	-	-	771	5	154	0,02
UP_SERMIDE_3	EDIPOWER S.P.A	MN	NORD	TE	Ccgt	55 326	380	146	0,02
UP_PORTO_COR_4	ENEL PRODUZIONE S.P.A.	RA	NORD	TE	Ccgt	54 045	380	142	0,02
UP_PORTO_COR_3	ENEL PRODUZIONE S.P.A.	RA	NORD	TE	Ccgt	51 902	366	142	0,02
UP_GRAVINANE_1	AXPO ITALIA S.P.A.	-	SUD	-	-	9 524	68,912	138	0,02
UP_LA_CASELL_2	ENEL PRODUZIONE S.P.A.	PC	NORD	TE	Ccgt	45 577	368	124	0,01

Unit Reference	Owner	Prov.	Zone	Type	Technology	Total Quantity (MWh)	Power Max (MW)	Equivalent Hours (heq)	Capacity Factor
UP_SARMATO_1	EDISON	PC	NORD	TE	Ccgt	21 399	176,518	121	0,01
UP_PIANACCE_1	ENEL PRODUZIONE S.P.A.	SI	CNOR	GEO	Other	2 086	17,7	118	0,01
UP_DI2355_NORD_B	-	-	NORD	-	-	350	3	117	0,01
UP_DI1825_CSUD_C	-	-	CSUD	-	-	260	2,282	114	0,01
UP_ETQCHIOTAS_1	ENEL PRODUZIONE S.P.A.	CN	NORD	ID	Pumped	123 020	1130,329	109	0,01
UP_DI1156_SUD_Z	-	-	SUD	-	-	50	0,461	108	0,01
UP_GISSI_1	A2A TRADING S.R.L.	CH	FOGN	TE	Ccgt	43 020	419	103	0,01
UP_DI2373_SUD_C	-	-	SUD	-	-	410	4	103	0,01
UP_BARI_TE_1	ENEL PRODUZIONE S.P.A.	BA	SUD	TE	OilMethane	6 431	64	100	0,01
UP_CTE-RAGE_1	-	-	SICI	-	-	2 070	21,56	96	0,01
UP_DI2227_NORD_G	-	-	NORD	-	-	932	10,2	91	0,01
UP_DI2355_CSUD_B	-	-	CSUD	-	-	91	1	91	0,01
UP_DI2373_CNOR_C	-	-	CNOR	-	-	721	10	72	0,01
UPV_APGM105128E	-	-	AUST	-	-	720	10	72	0,01
UP_NPWRTRANTO_2	-	-	SUD	-	-	921	13	71	0,01
UPV_SWGDOEENSPAO	-	-	SVIZ	-	Abroad	16 977	250	68	0,01
UPV_SWGD107162O	-	-	SVIZ	-	Abroad	19 724	292	68	0,01
UPV_SWGDOEAETRTO	-	-	SVIZ	-	Abroad	40 379	625	65	0,01
UP_DI2055_SICI_C	-	-	SICI	TE	Ccgt	1 562	25,398	62	0,01
UP_RONCOVALG_1	ENEL PRODUZIONE S.P.A.	VA	NORD	ID	Pumped	56 958	956,254	60	0,01
UP_TERMINI_I_42	ENEL PRODUZIONE S.P.A.	PA	SICI	TE	GT	6 517	120	54	0,01
UP_LMDCLMENTE_1	-	-	BRNN	-	-	550	10,61	52	0,01
UPV_RTEDOEENSPAO	-	-	FRAN	-	Abroad	12 720	250	51	0,01
UPV_RTEPOEENSPAO	-	-	FRAN	-	-	480	10	48	0,01
UP_TERMINI_I_5	ENEL PRODUZIONE S.P.A.	PA	SICI	TE	GT	5 629	118	48	0,01
UP_SPEZIA_CE_2	ENEL PRODUZIONE S.P.A.	SP	NORD	TE	Ccgt	15 461	330	47	0,01
UPV_APGM104460E	-	-	AUST	-	-	3 096	70	44	0,01
UPV_HELYOEGTIPER	-	-	GREC	-	-	1 890	45	42	0,00
UPV_SWGMOEENSPAO	-	-	SVIZ	-	-	2 100	50	42	0,00
UPV_HELDOEEFTGNR	-	-	GREC	-	Abroad	3 327	80	42	0,00
UP_LA_CASELL_4	ENEL PRODUZIONE S.P.A.	PC	NORD	TE	Ccgt	13 185	320	41	0,00
UPV_APGMOEGNBDPE	-	-	AUST	-	-	2 712	70	39	0,00
UPV_RTEDOEESNRXO	-	-	FRAN	-	-	3 179	85	37	0,00
UPV_SWGD108582O	-	-	SVIZ	-	-	2 380	66	36	0,00
UP_DI2055_NORD_E	-	-	NORD	-	-	46	1,284	36	0,00
UPV_SWGDOECETSVO	-	-	SVIZ	-	Abroad	8 958	250	36	0,00
UPV_RTEPOEESLCDO	-	-	FRAN	-	Abroad	7 776	220	35	0,00
UPV_SWGD108623O	-	-	SVIZ	-	Abroad	8 700	250	35	0,00
UPV_SWGDOESRGNTO	-	-	SVIZ	-	-	5 406	180	30	0,00
UP_WRTSLTLSPA_1	GDF SUEZ Energia Italia...	-	NORD	-	-	299	10	30	0,00
UPV_RTED107162O	-	-	FRAN	-	Abroad	6 257	210	30	0,00
UPV_RTEPOEAAETTO	-	-	FRAN	-	-	852	30	28	0,00
UPV_SWGMOEESLCDO	-	-	SVIZ	-	Abroad	18 073	637	28	0,00
UPV_RTED108623O	-	-	FRAN	-	Abroad	5 445	200	27	0,00
UPV_SWGD107841O	-	-	SVIZ	-	Abroad	8 913	340	26	0,00
UP_DI1156_SUD_Y	-	-	SUD	-	-	27	1,1	24	0,00
UPV_APGM106135E	-	-	AUST	-	-	600	25	24	0,00
UPV_APGY106163E	-	-	AUST	-	-	840	35	24	0,00
UPV_APGYOEEWSNRE	-	-	AUST	-	-	240	10	24	0,00
UPV_HELM109770R	-	-	GREC	-	-	120	5	24	0,00
UPV_HELY106765R	-	-	GREC	-	-	1 080	45	24	0,00
UPV_HELYOEGNMLNR	-	-	GREC	-	-	1 080	45	24	0,00
UPV_SWGYOEESSPRO	-	-	SVIZ	-	-	432	18	24	0,00
UPV_SWGYOEJMSSRO	-	-	SVIZ	-	-	3 240	135	24	0,00
UPV_RTED108582O	-	-	FRAN	-	-	1 022	45	23	0,00
UP_SPEZIA_CE_1	ENEL PRODUZIONE S.P.A.	SP	NORD	TE	Ccgt	7 353	331	22	0,00
UP_PORTOFERR_1	ENEL PRODUZIONE S.P.A.	LI	CNOR	-	-	333	15	22	0,00
UPV_SWGD109644O	-	-	SVIZ	-	-	2 864	130	22	0,00
UPV_RTEDOETEISRO	TRAFIGURA ELECTRICI...	-	FRAN	-	Abroad	2 612	120	22	0,00
UPV_APGM107165E	-	-	AUST	-	-	65	3	22	0,00
UPV_RTEPOEAETRTO	-	-	FRAN	-	-	1 080	50	22	0,00
UPV_APGM106054E	-	-	AUST	-	-	210	10	21	0,00
UPV_RTEDOECETSVO	-	-	FRAN	-	Abroad	4 097	200	20	0,00
UP_SBARBARA_3	ENEL PRODUZIONE S.P.A.	AR	CNOR	TE	Ccgt	7 968	395	20	0,00
UPV_SWGYOEECDCSO	-	-	SVIZ	-	-	200	10	20	0,00
UP_ASSEMINI_2	ENEL PRODUZIONE S.P.A.	CA	SARD	TE	GT	1 435	75	19	0,00
UPV_HELYOEDCANSR	-	-	GREC	-	-	570	30	19	0,00
UPV_APGYOEAAETTE	-	-	AUST	-	-	274	15	18	0,00
UPV_SWGDOEAAETTO	-	-	SVIZ	-	Abroad	5 461	303	18	0,00
UPV_SWGM109770O	-	-	SVIZ	-	-	1 500	85	18	0,00
UP_MONTEMART_1	ACEA ENERGIA	RM	CSUD	TE	GT	1 288	75	17	0,00

Unit Reference	Owner	Prov.	Zone	Type	Technology	Total Quantity (MWh)	Power Max (MW)	Equivalent Hours (heq)	Capacity Factor
UP_ETQ_ROVINA_1	ENEL PRODUZIONE S.P.A.	CN	NORD	ID	Pumped	2 279	133,491	17	0,00
UP_DI1901_NORD_A	-	-	NORD	-	-	67	3,989	17	0,00
UPV_SWGD107294O	-	-	SVIZ	-	-	2 703	160	17	0,00
UP_NPWRMNTOVA_1	-	-	NORD	-	-	48	3	16	0,00
UPV_SWGM107298O	-	-	SVIZ	-	-	720	45	16	0,00
UPV_RTEDOESRGNTO	-	-	FRAN	-	-	2 765	180	15	0,00
UPV_HELDOEESLCDR	-	-	GREC	-	Abroad	767	50	15	0,00
UP_ROSSANO_T_1	ENEL PRODUZIONE S.P.A.	CS	ROSN	TE	Methane	5 964	393	15	0,00
UPV_APGMOEEWSNRE	-	-	AUST	-	-	600	40	15	0,00
UPV_SWGD106280O	TRAFIGURA ELECTRICI...	-	SVIZ	-	Abroad	3 610	245	15	0,00
UPV_RTEPOELGSNRO	-	-	FRAN	-	-	360	25	14	0,00
UPV_APGDOEAAETTE	-	-	AUST	-	Abroad	1 411	100	14	0,00
UPV_SWGM107778O	-	-	SVIZ	-	-	2 267	161	14	0,00
UPV_SWGY105994O	-	-	SVIZ	-	-	1 540	110	14	0,00
UP_ASSEMINI_1	ENEL PRODUZIONE S.P.A.	CA	SARD	TE	GT	1 033	75	14	0,00
UP_TURBIGO_3	EDIPOWER S.P.A	MI	NORD	TE	OilMethane	3 801	277	14	0,00
UPV_SWGROETSRNTO	-	-	SVIZ	-	-	144	11	13	0,00
UPV_RTEDOEREISZO	-	-	FRAN	-	-	830	65	13	0,00
UPV_SWGDOETSLLRO	TRAFIGURA ELECTRICI...	-	SVIZ	-	Abroad	1 390	110	13	0,00
UPV_RTEPOEIGSBRO	-	-	FRAN	-	-	1 236	100	12	0,00
UPV_HELM104507R	-	-	GREC	-	Abroad	244	20	12	0,00
UPV_SWGDOEENRGKO	-	-	SVIZ	-	Abroad	2 693	250	11	0,00
UP_FIUMESANT_1	E.ON Energy Trading SE	SS	SARD	TE	Oil	1 393	131	11	0,00
UPV_RTED107841O	-	-	FRAN	-	Abroad	2 218	210	11	0,00
UPV_RTEP105956O	-	-	FRAN	-	-	1 504	145	10	0,00
UPV_SWGM109788O	-	-	SVIZ	-	-	600	58	10	0,00
UPV_RTEDOECNDRMO	-	-	FRAN	-	Abroad	2 568	250	10	0,00
UPV_SWGDOENRDJYO	-	-	SVIZ	-	Abroad	6 779	700	10	0,00
UPV_HELMOEELPDSR	-	-	GREC	-	-	144	15	10	0,00
UPV_HELDOEGNTHNR	-	-	GREC	-	Abroad	95	10	10	0,00
UPV_RTEDOEETSDNO	-	-	FRAN	-	Abroad	2 248	239	9	0,00
UP_DI0312_CSUD_C	-	-	CSUD	-	-	1	0,1	9	0,00
UPV_RTEP104347O	-	-	FRAN	-	-	500	60	8	0,00
UPV_SWGD105312O	-	-	SVIZ	-	-	230	28	8	0,00
UPV_RTEP104946O	-	-	FRAN	-	-	1 432	184	8	0,00
UP_ISE_PIOMB_1	EDISON	LI	CNOR	TE	-	1 103	150	7	0,00
UPV_SWGD107231O	-	-	SVIZ	-	-	1 466	215	7	0,00
UPV_SWGDOEECDCSO	-	-	SVIZ	-	-	882	130	7	0,00
UP_FIUMESANT_2	E.ON Energy Trading SE	SS	SARD	TE	Oil	882	131	7	0,00
UPV_SWGM106508O	-	-	SVIZ	-	-	600	90	7	0,00
UPV_RTEDOEEDLLCO	-	-	FRAN	-	Abroad	2 998	475	6	0,00
UPV_RTEDGE00447O	-	-	FRAN	-	-	1 234	200	6	0,00
UPV_SWGD110004O	-	-	SVIZ	-	Abroad	1 466	250	6	0,00
UPV_RTEDOEIGSBRO	-	-	FRAN	-	Abroad	674	115	6	0,00
UPV_RTEP107298O	-	-	FRAN	-	-	240	45	5	0,00
UPV_APGD107165E	-	-	AUST	-	-	42	8	5	0,00
UPV_RTED105312O	-	-	FRAN	-	-	105	20	5	0,00
UPV_RTEPOEHSEDLO	-	-	FRAN	-	-	489	95	5	0,00
UPV_SWGDOEEDLLCO	-	-	SVIZ	-	Abroad	3 083	600	5	0,00
UPV_SWGROEETSDNO	-	-	SVIZ	-	-	584	115	5	0,00
UPV_SWGD104992O	-	-	SVIZ	-	-	784	155	5	0,00
UP_PORTO_VIR_1	EDISON	RO	NORD	TE	Ccgt	667	132,469	5	0,00
UPV_APGM106884E	-	-	AUST	-	-	350	70	5	0,00
UPV_RTEPOEEISPGO	-	-	FRAN	-	-	175	35	5	0,00
UPV_APGDOENRDJYE	-	-	AUST	-	-	633	127	5	0,00
UPV_SWGD111383O	TRAFIGURA ELECTRICI...	-	SVIZ	-	Abroad	1 129	227	5	0,00
UPV_RTEPOEATTLSO	-	-	FRAN	-	-	265	55	5	0,00
UPV_RTEDOEAAETTO	-	-	FRAN	-	Abroad	1 243	275	5	0,00
UPV_SWGD106561O	-	-	SVIZ	-	Abroad	1 530	340	5	0,00
UPV_RTEP105538O	-	-	FRAN	-	-	120	27	4	0,00
UPV_SWGDOETEISRO	TRAFIGURA ELECTRICI...	-	SVIZ	-	Abroad	857	200	4	0,00
UPV_RTEDOEENRGKO	-	-	SVIZ	-	Abroad	707	175	4	0,00
UPV_RTED106135O	-	-	FRAN	-	Abroad	1 500	375	4	0,00
UPV_HELY105991R	-	-	GREC	-	-	180	45	4	0,00
UPV_SWGDOEETSDNO	-	-	SVIZ	-	Abroad	2 784	726	4	0,00
UPV_RTED106719O	-	-	FRAN	-	Abroad	1 650	436	4	0,00
UPV_HELDOEDCANSR	-	-	GREC	-	Abroad	788	223	4	0,00
UPV_RTED108373O	-	-	FRAN	-	-	120	35	3	0,00
UPV_APGDOEEDLLCE	-	-	AUST	-	Abroad	419	125	3	0,00
UPV_RTEPOEVTLSIO	-	-	FRAN	-	-	330	100	3	0,00
UPV_RTEDOEEISPGO	-	-	FRAN	-	-	1 444	450	3	0,00

Unit Reference	Owner	Prov.	Zone	Type	Technology	Total Quantity (MWh)	Power Max (MW)	Equivalent Hours (heq)	Capacity Factor
UPV_SWGD108106O	-	-	SVIZ	-	-	598	190	3	0,00
UPV_SWGD105198O	TRAFIGURA ELECTRICI...	-	SVIZ	-	Abroad	1 044	337	3	0,00
UPV_RTEDOESTTKRO	-	-	FRAN	-	Abroad	671	230	3	0,00
UPV_RTED107698O	-	-	FRAN	-	-	795	300	3	0,00
UP_DI0388_SARD_C	OTTANA ENERGIA S.R.L.	NU	SARD	TE	-	63	24	3	0,00
UP_DI1902_NORD_B	-	-	NORD	TE	Ccgt	51 448	19643	3	0,00
UPV_RTEDOEDESFRO	-	-	FRAN	-	-	500	200	3	0,00
UP_LARINO_TG_1	ENEL PRODUZIONE S.P.A.	CB	SUD	TE	Methane	265	110	2	0,00
UPV_SWGM104946O	-	-	SVIZ	-	-	600	250	2	0,00
UPV_RTEDOENRDJYO	-	-	FRAN	-	Abroad	1 802	758	2	0,00
UPV_RTEPOEAAETSO	-	-	FRAN	-	-	40	17	2	0,00
UPV_APGDOEGTIPEE	-	-	AUST	-	-	104	49	2	0,00
UP_LARINO_TG_2	ENEL PRODUZIONE S.P.A.	CB	SUD	TE	Methane	220	110	2	0,00
UPV_SWGMOEAETRTO	-	-	SVIZ	-	-	90	45	2	0,00
UPV_SWGD107888O	-	-	SVIZ	-	Abroad	860	435	2	0,00
UPV_RTEDOEEPSPIO	-	-	FRAN	-	-	297	162	2	0,00
UPV_HELYOEETSDNR	-	-	GREC	-	-	36	20	2	0,00
UPV_RTEPOEETLDFO	-	-	FRAN	-	-	648	360	2	0,00
UPV_APGD104367E	-	-	AUST	-	Abroad	164	95	2	0,00
UPV_RTEDOEAETRTO	-	-	FRAN	-	Abroad	330	192	2	0,00
UPV_RTEDOEMSLTTO	-	-	FRAN	-	-	100	60	2	0,00
UPV_RTED106644O	-	-	FRAN	-	-	165	100	2	0,00
UPV_RTEPOEAECBZO	-	-	FRAN	-	-	18	11	2	0,00
UPV_SWGDOEBEA...	-	-	SVIZ	-	Abroad	2 143	1314	2	0,00
UPV_APGDOETEISRE	TRAFIGURA ELECTRICI...	-	AUST	-	-	38	25	2	0,00
UPV_HELDOEETSDNR	-	-	GREC	-	Abroad	75	50	2	0,00
UPV_SWGD106562O	-	-	SVIZ	-	Abroad	423	291	1	0,00
UPV_RTEP109770O	-	-	FRAN	-	-	204	145	1	0,00
UPV_SWGDOESTTKRO	-	-	SVIZ	-	Abroad	425	307	1	0,00
UPV_APGD106135E	-	-	AUST	-	-	205	150	1	0,00
UPV_RTED105401O	-	-	FRAN	-	-	771	609	1	0,00
UPV_APGY104367E	-	-	AUST	-	-	6	5	1	0,00
UPV_RTEDOEGNVRTO	-	-	FRAN	-	-	276	230	1	0,00
UPV_RTEDOEAAETSO	-	-	FRAN	-	-	62	53	1	0,00
UPV_HELDOEGNMLNR	-	-	GREC	-	-	53	47	1	0,00
UPV_SWGDOEAECBZO	-	-	SVIZ	-	-	152	140	1	0,00
UPV_SWGD105630O	-	-	SVIZ	-	Abroad	556	528	1	0,00
UPV_RTED106507O	-	-	FRAN	-	-	225	215	1	0,00
UPV_APGMOEAAETTE	-	-	AUST	-	-	15	15	1	0,00
UPV_SWGY106840O	-	-	SVIZ	-	-	10	10	1	0,00
UPV_SWGDOEAESMPO	-	-	SVIZ	-	-	125	130	1	0,00
UPV_APGD104384E	-	-	AUST	-	Abroad	49	54	1	0,00
UPV_RTED106718O	-	-	FRAN	-	Abroad	395	540	1	0,00
UPV_SWGDOEESPASO	-	-	SVIZ	-	-	175	240	1	0,00
UPV_SWGD105989O	-	-	SVIZ	-	-	121	170	1	0,00
UPV_APGDOEOEWASE	-	-	AUST	-	-	43	61	1	0,00
UPV_SWGM111324O	-	-	SVIZ	-	-	20	30	1	0,00
UPV_RTED110022O	-	-	FRAN	-	Abroad	340	537	1	0,00
UPV_SWGD107258O	-	-	SVIZ	-	Abroad	331	529	1	0,00
UPV_SWGD106719O	-	-	SVIZ	-	Abroad	387	635	1	0,00
UPV_RTED105630O	-	-	FRAN	-	Abroad	225	395	1	0,00
UPV_SWGYOEAECBZO	-	-	SVIZ	-	-	6	11	1	0,00
UPV_SWGDOEHTSRRO	-	-	SVIZ	-	-	160	300	1	0,00
UPV_SWGYOEHSEDLO	-	-	SVIZ	-	-	17	35	0	0,00
UPV_SWGMOEAECBZO	-	-	SVIZ	-	-	6	15	0	0,00
UPV_RTEDOEESPASO	-	-	FRAN	-	-	115	300	0	0,00
UPV_RTED111284O	-	-	FRAN	-	-	40	105	0	0,00
UPV_RTEPOEERGSPO	-	-	FRAN	-	-	20	55	0	0,00
UPV_SWGM108623O	-	-	SVIZ	-	-	45	125	0	0,00
UPV_APGDOEDCANSE	-	-	AUST	-	Abroad	37	104	0	0,00
UPV_EXTYOEISSGST	-	-	NORD	-	-	7	19,182	0	0,00
UPV_SWGDOEHBTRDO	-	-	SVIZ	-	-	15	51	0	0,00
UPV_RTEDOEHTSRRO	-	-	FRAN	-	-	50	175	0	0,00
UPV_SWGD109783O	-	-	SVIZ	-	Abroad	302	1102	0	0,00
UPV_SWGDOEDCANSO	-	-	SVIZ	-	Abroad	150	700	0	0,00
UPV_SWGDOECND...	-	-	SVIZ	-	Abroad	42	200	0	0,00
UPV_SWGD106718O	-	-	SVIZ	-	Abroad	117	635	0	0,00
UPV_SWGD106440O	-	-	SVIZ	-	Abroad	35	277	0	0,00
UPV_RTEPOEBEAKWO	-	-	FRAN	-	-	24	200	0	0,00
UPV_HELDOEENDSHR	-	-	GREC	-	Abroad	21	175	0	0,00
UPV_RTED107258O	-	-	FRAN	-	-	39	350	0	0,00

Appendix B

Additional tables for market share analysis

In this appendix are present all the tables mentioned in the market share section.

Traders	Percentage
ENEL PRODUZIONE S.P.A.	23,90%
GSE	23,09%
EDISON TRADING S.P.A.	7,91%
A2A TRADING S.R.L.	6,67%
EGL-ITALIA S.P.A.	5,16%
ENI SPA	3,20%
E.ON ENERGY TRADING S.P.A.	2,94%
SORGENIA S.P.A.	2,20%
TIRRENO POWER S.P.A.	1,79%
ACEAELECTRABEL TRADING S...	1,56%
IRIDE MERCATO SPA	1,52%
ALPIQ ENERGIA ITALIA S.p.A.	1,36%
ALPIQ SA	1,36%
IREN MERCATO SPA	1,12%
EDF TRADING LIMITED	0,98%
T.P.E. Trading per l energia e...	0,85%
HERA TRADING S.R.L.	0,79%
ICD - INTER COMMERCIAL D...	0,68%
ELETTROGREEN POWER SRL	0,66%
GALA SRL	0,65%
DEUTSCHE BANK AG LONDON...	0,61%
AZIENDA ELETTRICA TICINESE	0,57%
BURGO ENERGIA S.R.L.	0,53%
DANSKE COMMODITIES A.S	0,47%
C.V.A. TRADING S.R.L. A S.U.	0,44%
EZPADA S.R.O.	0,41%
IBERDROLA GENERACION S.A...	0,40%
Others	**8,20%**

Traders	Percentage
GSE	21,87%
ENEL PRODUZIONE S.P.A.	19,79%
EDISON TRADING S.P.A.	6,81%
A2A TRADING S.R.L.	6,57%
EGL-ITALIA S.P.A.	4,22%
SORGENIA S.P.A.	3,30%
ENI SPA	3,08%
IREN MERCATO SPA	2,31%
TIRRENO POWER S.P.A.	2,10%
ALPIQ ENERGIA ITALIA S.p.A.	2,10%
E.ON ENERGY TRADING S.P.A.	2,10%
EDF TRADING LIMITED	1,46%
ALPIQ SA	1,46%
GDF SUEZ Energia Italia S.p.A.	1,27%
GALA SRL	1,11%
HERA TRADING S.R.L.	0,97%
T.P.E. Trading per l energia e...	0,93%
ICD - INTER COMMERCIAL D...	0,93%
DEUTSCHE BANK AG LONDON...	0,90%
EDELWEISS ENERGIA S.R.L.	0,82%
AZIENDA ELETTRICA TICINESE	0,76%
GDF SUEZ ENERGY MANAGE...	0,72%
ERG SPA	0,66%
ELECTRADE SRL	0,66%
REPOWER ITALIA SPA	0,65%
BURGO ENERGIA S.R.L.	0,63%
EDIPOWER S.P.A.	0,60%
ENERGETIC SOURCE SPA	0,51%
ACEAELECTRABEL TRADING S...	0,51%
ELETTROGREEN POWER SRL	0,51%
EZPADA S.R.O.	0,51%
TEI ENERGY S.p.A.	0,49%
AZIENDA ENERGETICA TRAD...	0,43%
ENECO TRADE SRL	0,42%
STATKRAFT MARKETS GMBH	0,41%
Others	**7,44%**

Traders	Percentage
GSE	29,05%
ENEL PRODUZIONE S.P.A.	13,35%
EDISON TRADING S.P.A.	7,22%
A2A TRADING S.R.L.	6,13%
EGL-ITALIA S.P.A.	4,32%
E.ON ENERGY TRADING S.P.A.	4,31%
SORGENIA S.P.A.	3,17%
EUROPE ENERGY SRL UNIPE...	2,46%
GDF SUEZ Energia Italia S.p.A.	2,33%
IREN MERCATO SPA	2,32%
TIRRENO POWER S.P.A.	2,02%
ALPIQ ENERGIA ITALIA S.p.A.	1,55%
EDELWEISS ENERGIA S.R.L.	1,41%
ENI SPA	1,03%
HERA TRADING S.R.L.	0,93%
ERG SPA	0,85%
GEN-I TRGOVANJE IN PRODA...	0,83%
DEUTSCHE BANK AG LONDON...	0,75%
TRAFIGURA ELECTRICITY IT...	0,72%
ENERGETIC SOURCE SPA	0,71%
GREEN NETWORK SPA	0,66%
EDF TRADING LIMITED	0,66%
REZIA ENERGIA ITALIA S.P.A.	0,65%
ALPIQ SA	0,64%
AZIENDA ENERGETICA TRAD...	0,64%
GALA SRL	0,59%
STATKRAFT MARKETS GMBH	0,57%
EN.E.R. TRADING S.p.A.	0,57%
ELECTRADE SRL	0,52%
AZIENDA ELETTRICA TICINESE	0,49%
BURGO ENERGIA S.R.L.	0,48%
DANSKE COMMODITIES A.S	0,44%
EDIPOWER S.P.A.	0,44%
PUBLIC POWER CORPORATI...	0,41%
Others	**6,80%**

Table B.1: Market Shares based on quantities accepted a) 2010 b) 2011 c) 2012

Traders	Percentage
ENEL PRODUZIONE S.P.A.	47,19%
GSE	11,91%
EDISON TRADING S.P.A.	6,77%
A2A TRADING S.R.L.	5,20%
E.ON ENERGY TRADING S.P.A.	5,02%
EGL-ITALIA S.P.A.	2,94%
SORGENIA S.P.A.	2,16%
ENI SPA	2,07%
TIRRENO POWER S.P.A.	1,60%
ALPIQ ENERGIA ITALIA S.p.A.	1,17%
ACEAELECTRABEL TRADING S...	1,09%
IRIDE MERCATO SPA	0,95%
ALPIQ SA	0,89%
IREN MERCATO SPA	0,77%
EDF TRADING LIMITED	0,56%
DANSKE COMMODITIES A.S	0,47%
T.P.E. Trading per l energia e...	0,44%
C.V.A. TRADING S.R.L. A S.U.	0,43%
HERA TRADING S.R.L.	0,42%
Others	**7,94%**

Traders	Percentage
ENEL PRODUZIONE S.P.A.	47,47%
GSE	9,74%
EDISON TRADING S.P.A.	6,88%
A2A TRADING S.R.L.	6,13%
E.ON ENERGY TRADING S.P.A.	4,62%
SORGENIA S.P.A.	2,53%
ENI SPA	2,51%
EGL-ITALIA S.P.A.	2,05%
TIRRENO POWER S.P.A.	1,49%
IREN MERCATO SPA	1,24%
ALPIQ ENERGIA ITALIA S.p.A.	1,09%
EDIPOWER S.P.A.	1,05%
GDF SUEZ Energia Italia S.p.A.	0,76%
ALPIQ SA	0,73%
EDF TRADING LIMITED	0,68%
GALA SRL	0,53%
ELECTRADE SRL	0,47%
HERA TRADING S.R.L.	0,44%
GDF SUEZ ENERGY MANAGE...	0,44%
DEUTSCHE BANK AG LONDON...	0,43%
T.P.E. Trading per l energia e...	0,41%
ICD - INTER COMMERCIAL D...	0,41%
Others	**7,89%**

Traders	Percentage
ENEL PRODUZIONE S.P.A.	42,61%
GSE	12,07%
A2A TRADING S.R.L.	8,70%
EDISON TRADING S.P.A.	7,31%
E.ON ENERGY TRADING S.P.A.	6,25%
TIRRENO POWER S.P.A.	2,02%
EGL-ITALIA S.P.A.	2,00%
ENI SPA	1,88%
SORGENIA S.P.A.	1,71%
IREN MERCATO SPA	1,27%
GDF SUEZ Energia Italia S.p.A.	1,17%
EUROPE ENERGY SRL UNIPE...	1,02%
ALPIQ ENERGIA ITALIA S.p.A.	0,94%
EDIPOWER S.P.A.	0,76%
EDELWEISS ENERGIA S.R.L.	0,67%
ERG SPA	0,43%
DEUTSCHE BANK AG LONDON...	0,41%
Others	**8,77%**

Table B.2: Market Shares based on quantities offered a) 2010 b) 2011 c) 2012

Traders	Percentage
ENEL PRODUZIONE S.P.A.	28,32%
GSE	27,95%
EGL-ITALIA S.P.A.	17,25%
TIRRENO POWER S.P.A.	10,98%
EDISON TRADING S.P.A.	2,72%
REPOWER ITALIA SPA	2,59%
BURGO ENERGIA S.R.L.	2,10%
HERA TRADING S.R.L.	2,02%
ENECO TRADE SRL	1,85%
ACEAELECTRABEL TRADING S...	1,78%
TERMICA CELANO S.P.A.	0,78%
REZIA ENERGIA ITALIA S.P.A.	0,49%
A2A TRADING S.R.L.	0,30%
Others	**0,87%**

Table B.3: Market Shares -Year 2010 - CSUD

Traders	Percentage
GSE	52,85%
ENEL PRODUZIONE S.P.A.	22,34%
EDISON TRADING S.P.A.	7,08%
ERG SPA	6,86%
ALPIQ ENERGIA ITALIA S.p.A.	2,64%
A2A TRADING S.R.L.	2,55%
EGL-ITALIA S.P.A.	1,94%
E.ON ENERGY TRADING S.P.A.	1,30%
IRIDE MERCATO SPA	0,94%
ENI SPA	0,75%
IREN MERCATO SPA	0,45%
Others	**0,30%**

Table B.4: Market Shares -Year 2010 - SICI

Traders	Percentage
GSE	24,17%
ENEL PRODUZIONE S.P.A.	21,08%
EGL-ITALIA S.P.A.	16,84%
TIRRENO POWER S.P.A.	12,36%
REPOWER ITALIA SPA	5,21%
TERMICA CELANO S.P.A.	3,91%
HERA TRADING S.R.L.	3,66%
EDISON TRADING S.P.A.	3,16%
BURGO ENERGIA S.R.L.	2,76%
ENECO TRADE SRL	2,65%
GDF SUEZ Energia Italia S.p.A.	0,81%
ELETTROGREEN POWER SRL	0,71%
ACEAELECTRABEL TRADING S...	0,52%
SORGENIA S.P.A.	0,49%
GDF SUEZ ENERGY MANAGE...	0,34%
Others	**1,32%**

Table B.5: Market Shares -Year 2011 - CSUD

Traders	Percentage
GSE	48,94%
ENEL PRODUZIONE S.P.A.	17,08%
ERG SPA	10,32%
EDIPOWER S.P.A.	10,07%
EDISON TRADING S.P.A.	8,68%
EGL-ITALIA S.P.A.	2,61%
E.ON ENERGY TRADING S.P.A.	1,30%
ALPIQ ENERGIA ITALIA S.p.A.	0,96%
Others	**0,03%**

Table B.6: Market Shares -Year 2011 - SICI

Traders	Percentage
GSE	37,56%
EGL-ITALIA S.P.A.	18,34%
ENEL PRODUZIONE S.P.A.	9,79%
SORGENIA S.P.A.	8,27%
TIRRENO POWER S.P.A.	6,21%
REZIA ENERGIA ITALIA S.P.A.	4,08%
HERA TRADING S.R.L.	2,67%
TERMICA CELANO S.P.A.	2,36%
BURGO ENERGIA S.R.L.	2,17%
ENECO TRADE SRL	1,98%
EDISON TRADING S.P.A.	1,26%
GDF SUEZ Energia Italia S.p.A.	1,12%
ACEA ENERGIA HOLDING SPA	1,03%
EDELWEISS ENERGIA S.R.L.	0,71%
A2A TRADING S.R.L.	0,57%
GREEN TRADE SRL	0,48%
Others	**1,40%**

Table B.7: Market Shares -Year 2012 - CSUD

Traders	Percentage
GSE	53,68%
ENEL PRODUZIONE S.P.A.	17,50%
ERG SPA	10,91%
EDISON TRADING S.P.A.	7,18%
EDIPOWER S.P.A.	4,65%
EGL-ITALIA S.P.A.	1,81%
ALPIQ ENERGIA ITALIA S.p.A.	1,75%
E.ON ENERGY TRADING S.P.A.	1,25%
GDF SUEZ Energia Italia S.p.A.	1,00%
Others	**0,27%**

Table B.8: Market Shares -Year 2012 - SICI

Remerciements

Tout d'abord je tiens à remercier mes parents et ma famille qui m'ont soutenu durant toutes mes études jusqu'à l'aboutissement final de ce double diplôme. J'ai mis mon temps mais m'y voilà dans le grand monde et j'espère que vous serez fiers de moi dans le futur.

Ensuite je remercie tout particulièrement les professeurs Ing. Cristian Bovo et Ing. Alberto Berizzi qui m'ont fourni une précieuse aide dans le bon déroulement de ma thèse de master.

Je n'oublierai pas de citer également toutes les belles rencontres faîtes durant mes études à Milan : mes colocataires, mes amis et mes camarades de classes. Un remerciement spécial au chef Djemaa sans qui ces derniers mois de travail auraient été difficiles.

Enfin j'adresse les dernières paroles de cette thèse à celle qui a su me faire sourire toute une année durant et à laquelle je tiens tant.

Rémi