

2016 ELECTRICITY MARKET REPORT



MA(13) 4,898,306

Highlights of 2016;

Average MCP was calculated as 140,60 TL/MWh, increased by 1.8% compared to 2015,

Installed capacity increased by 4.910 MW and reached to 77.789 MW,

Annual electricity generation increased by 3,9% and reached to 272,5 TWh, annual electricity consumption increased by %4,25 and reached to 277,5 TWh,

Due to natural gas curtailment in December, natural gas power stations electricity generation decreased and MCP was calculated as 589 TL/MWh on Friday, December 23, and at 14:00 in same day MCP was calculated as 1.899,99 TL/MWh,

Cleared volume in Day-Ahead Market was 114 TWh and 0,89 TWh energy was traded in Intraday Market,

66% of annual market volume consists of bilateral contracts, 27% consists of Day Ahead Market, 7% consists of Balancing Power Market and 0,2% consists of Intraday Market transactions,

Regarding the shares of electricity generation by energy source, generation from natural gas-LNG power stations declined by 6% to 32%, generation from hydropower stations declined by 1% to 25%, generation from import coal-fired power stations increased by 2% to 17%, generation from lignite power stations increased by 2% to 14% and generation from wind power stations increased by 2% to 6%,

The highest hourly peak demand was 44.341 MWh at 15:00 on Thursday, August 11 and the lowest demand was 17.448 MW at 07:00 on Tuesday, September 13,

According to the final list published by EMRA in 2015, the installed capacity of the power stations utilizing from Feed-in Tariff Mechanism (YEKDEM) increased from 5.423 MWh to 15.083 MWh by 9.660 MW change,

Regarding the amendment of YEKDEM regulation in May, YEKDEM participants were responsible for their own energy imbalances and they were obliged to same rules like other market participants,

As for June 1, Market Clearing Prices was calculated by In-house developed Day Ahead Market Software,

The Intra-Day Market contract closure time downed from 2 hours to 90 mins prior to physical delivery,

Eligible Consumer Portal, which eligible consumers can access to their consumption information, put into service on December 30,

The summary of 2016 on the Turkish electricity market has been brought to the public attention via this report. You are more than welcome to present your opinion and suggestions herein <a href="space-spac

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List of Abbreviations

EMRA	Energy Market Regulatory Authority
EPİAŞ	Energy Exchange Istanbul
TEİAŞ	Turkish Electricity Transmission Company
EÜAŞ	Electricity Generation Company
TETAŞ	Turkish Electricity Trading and Contracting Company Inc.
ΒΟΤΑŞ	Petroleum Pipeline Corporation
DAM	Day- Ahead Market
IM	Intraday Market
BPM	Balancing Power Market
YEKDEM	Renewable Energy Sources Support Mechanism
SBDT	Zero Balance Adjustment Amount
іѕкк	Transmission System Loss Coefficient
KGÜP	Daily Final Generation Program
UEVM	Generation Volume Basis to Financial Settlement
UEÇM	Consumption Volume Basis to Financial Settlement
МСР	Market Clearing Price
SMP	System Marginal Price
Ы	Price Independent Order
вс	Bilateral Contract
FS	Financial Settlement
во	Build-Operate
вот	Build-Operate-Transfer
TOR	Transfer of Operational Rights
NGPS	Natural Gas Power Station

1. Day Ahead Market

Within the scope of Market Operation activities, Day Ahead and Intraday Markets are operated by EPIAS. In line with orders submitted by market participants to Day Ahead Market, supply and demand volumes are announced alongside the Market Clearing Prices while there are matches with continuous trading method in the Intraday Market. Objections to transactions for both markets are evaluated and resulted.

As of 1th of June, Market Clearing Price is being calculated with the software and optimization infrastructure which is using the technology and information required by time and developed with EPIAS's own resources.

It is provided convenience to foreign users who make transactions at the market, by adding an English language option to the Day Ahead and Intraday Market software. Both market software user guides were prepared in Turkish and in English, and became available for users. In addition, call center services are provided to market participants in order to provide 7/24 efficient and fast service about operated markets.

Providing Continuous Operation of Spot Markets

As of 1th June 2016, only one day time extension was given due to some technical problems and on other days the market clearing prices were announced on time in the day ahead market.

In the 7/24 operated Intraday Market no problem occurred in 2016.

Data Publishing Activities Related to the Market

Within data releasing activities; statistics are being published on price formation and transactions for the purpose of ensuring independence, transparency and non-discriminatory approach among the parties. Besides, information and data are being published for market participants as daily, weekly, monthly and annual reports. These reports can be accessed from the "Bulletins" section of the EPİAŞ website.

In-House Developed Day-Ahead Market Project

In line with the targets of EPİAŞ, "In-House Developed Day Ahead Market Project" was started to meet increasing number of participant and sector expectations and to create a Day Ahead Market software system at the level of developed market operators.

The previous Day Ahead Market web application had been used since December 1, 2011. However, it was unable to fulfil sector's needs and wants because of having an old software technology and algorithm. Since previous web application had external dependence and thus its source code was not open to access, its program development and problem solution cannot be possible. All these problems has revealed the need of a new software development. Experiences acquired while Day Ahead Market Operation created the fundamentals of In-House Developed DAM Project.

The Day-ahead Market software and optimization model was opened to the use of market participants in the test environment on March 18, 2016 and the test process was completed on June 1, 2016 and put into use in real environment. In-House Developed Day Ahead Market software with a user-friendly interface is designed and developed with our own resources, so it is flexible and open for developments.

Project; as the analysis, design, development and testing phases lasted six months in total, and the new software was successfully deployed on June 1, 2016, replacing the old software. With the application developed, EPIAS has got the source codes and knowledge of Day Ahead Market software. With the aforementioned know-how, all the markets that EPİAŞ is running and supporting is able to develop originally by itself and provide efficient support independently.

1.1. Developments in Day-Ahead Market Web Application

Day-Ahead market web application user guide is prepared in both Turkish and English. By adding English language option to the web application, it provided convenience to the foreign participants trading actively in the market.

EPİAŞ has taken measures to prevent serious financial risks that market participants may encounter as a result of material errors make in their orders. The "Limit Determination Section" has been developed in order to prevent users' (fat finger) in orders in Day Ahead Market software. It is aimed to prevent the possible material errors in the submitted bids by determining the maximum purchase and sell limits for the transactions that the market participants will perform during the Day Ahead Market on the hourly basis. The Limit Determination Screen and its functions have been activated on Tuesday, August 9, 2016 at 17:00.

To alert market participant who haven't submitted their orders and to inform them about the volume of change (order deviation) that occurred in Day Ahead Market bids, e-mail sending service have been brought into use.

- Bilateral Contracts section in the Day Ahead Market Web Application have been changed; Innovations have been brought in the bilateral contract processes. While the bilateral contracts are being created, new types of contracts can be categorized as "One-Sided" and "Two-Sided". One-sided contract is a contract type that it can be cancelled by one of the parties. Two-sided contract is a contract type that it can only be cancelled by the approval of both parties.
- In the Official Gazette dated 08.09.2016 and numbered 29825, "in order utilize of daylight; It was decided that daylight saving time started by taking one hour from 03:00 on Sunday, 27.03.2016 in the whole country will be carried out every year, all the year round. " decision has been published by the Cabinet of Ministers. Referring to this decision, Regulation on the Amendment of the Electricity Market Balancing and Settlement Regulation published in the Official Gazette dated 30.10.2016 and numbered 29873 and the provisional article added to the Balancing and Settlement Regulation stated that "If the summer time application continues all the year, the periods stated by 52 nd, 57 th, 58 th, 63 rd, 68 th, 69 th, 71 st, 88 th and 89 th items may be delayed up to one hour by the Market Operator. In this case, the Market Operator announces new determined deadlines to the market participants before they are implemented." Based on this decision the Day-ahead Market and bilateral notification procedures were re-determined in order to ensure that the Interim Market Clearing Prices were published in the Transparency Platform at 13:00. No changes were made in the margin call, collateral calls and Balancing Power Market processes. By re-determining the Day ahead Market processes, unjust treatments of market participants in energy import / export activities with neighboring countries have been prevented. Detailed processes are listed below.

Previous market processes before change:

Processes	Opening Time	Closure Time
Order Submission	00:01	11:30
Order Verification	11:30	12:00
Market Clearing	12:00	13:00
Objection	13:00	13:30
Final Results	13:30	14:00
Bilateral Contract	00:01	16:00

Table 1: Previous market processes before change

Market processes after change:

Processes	Opening	Closure
	Time	Time
Order Submission	00:01	12:30
Order Verification	12:30	13:00
Market Clearing	13:00	13:30
Objection	13:30	13:50
Final Results	13:50	14:00
Bilateral Contract	00:01	17:00

Table 2: Market processes after change

In-House Developed Day Ahead Market Software Second Phase

The development of new order types as the second phase of the Day Ahead Market started in December, 2016. With these developments, it is aimed to include new order types to Day Ahead Market for meeting the technical needs of production facilities in our country and market participants on the demand side better. Within the scope of the related studies, order types in EUPHEMIA Day-ahead algorithm, which is commonly used in major European electricity markets, are examined.

The needs assessment activities have been completed with the meetings and the feedbacks of the market participants and it is aimed to complete the related design, software, legislation and algorithm works in 2017.

Mobile Application

Works on Mobile Application Project has been started in order to increase the accessibility of the "Transparency Platform", "Day Ahead Market", "Intra-Day Market", "Reporting" and "Announcement and

Informing" services related to the markets, which are presented to market participants and other users on the official web site of EPİAŞ. With putting the mobile application into use, users will be able to take advantage of the services mentioned above using phone and tablet devices via both IOS and Android operating system.



1.2. Monthly Average Market Clearing Price, 2015-2016



As average MCPs are analyzed on a monthly basis for 2016, it is observed that the lowest price was in February with 104,08 TL/MWh and the highest price was in December with 219,04 TL/ MWh. Due to the natural gas curtailment in December, the MCP average increased by 48% compared to the previous month and was 219,04 TL/MWh. The average MCP for the first 11 months of 2015 was 135,61 TL/MWh, and the average MCP for the first 11 months of 2016 was 133,21 TL/ MWh. While the average MCP was 138,01 TL / MWh in 2015, the average MCP was 140,60 TL / MWh in 2016.

1.3. Daily Average Market Clearing Price



Figure 2: Daily Average Market Clearing Price

Over the past year the daily MCP average was below 200 TL / MWh. In 2016, the average daily MCP was less than 50 TL / MWh for forty occurrences, between 100-150 TL / MWh for two-hundred

occurrences, between 150-200TL / MWh for hundred-four occurrences and over 200 TL / MWh for twenty-two occurrences and above.

On the 21st of February, daily MCP averaged 22.93 TL / MWh, which was the lowest value of the year due to the fall in demand especially at night hours. On the 23rd of December, due to the natural gas curtailment, the daily average MCP was calculated as 586.56 TL / MWh and that was the highest level of the year.



1.4. Hourly Market Clearing Price

Figure 3: Hourly Market Clearing Price

Hourly MCP in 2016,

- 237 hours 0-1 TL / MWh,
- 1.557 hours, 1-100 TL / MWh,
- 3.256 hours 100-150 TL / MWh,
- 2,169 hours 150-200 TL / MWh,
- 1,518 hours 200-300 TL / MWh,
- 46 hours is calculated between 300-2000TL / MWh.

The highest MCP value of 2016 was 1.899.99 TL / MWh on Friday, December 23 at 14:00.

Besides, MCP exceeded the 1000 TL / MWh level by 3 times with 1.169,55 TL / MWh on Thursday, December 22 at 17:00 , 1.159,18 TL / MWh on Friday, December 23 at 11:00 and 1.500,05 TL / MWh on Friday, December 23 at 15:00.



1.5. Average Market Clearing Prices on Hourly Basis

As average MCPs are examined on hourly basis, the lowest MCP average is 72,43 TL/MWh at 06:00 and the highest MCP average is 193,03 TL / MWh at 11:00.

While average MCP was above the annual MCP average between the hours of 00:00 and 09:00 to 22:00, average MCP was below the annual MCP average between the hours of 01:00, 08:00, and 23:00.

1.6. Distribution of Market Clearing Price during Weekdays-Weekend

Distribution of market clearing prices during the year on weekdays and weekends in the year 2016 is shown via boxplots. Hourly weekdays and weekend MCP values* distribution average, deviation values, distribution skewness and distribution plow were shown via prepared boxplots. Two different colored boxes are shown in Figures respectively indicate lower and upper quartile of distribution and the areas encompassed by colored sections represent most dense 50% of the distribution, and the error bars added respectively to the beginning and end of the boxes, represent the minimum and maximum values reached by the MCP distribution at the related hour. Related distribution values are also indicated under the charts of the boxplots.



1.6.1. Distribution of Market Clearing Price during Weekdays

Figure 5: Distribution of Market Clearing Price during Weekdays in 2016

*On Sunday, March 3, 2016, the price was not calculated at 03:00 for the related day because of the daylight saving time and related day was arranged over 23 hours.

HOURS	00	01	02	03	04	05	06	07	08	09	10	11
MINIMUM	1,04	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,10	6,26	65,00
MEDIAN	144,99	127,99	115,10	87,26	80,03	79,98	90,07	130,98	161,77	190,00	200,15	205,93
MAXIMUM	232,74	230,67	230,10	228,97	228,95	230,06	230,42	231,06	236,08	699,18	999,99	1.159,18
LOWER QUARTILE	120,00	105,04	84,77	52,98	39,89	45,89	30,00	109,99	134,98	171,16	170,25	175,99
UPPER QUARTILE	175,00	152,25	135,25	118,91	117,95	105,02	120,00	149,99	198,89	209,87	214,99	220,01

Table 3: Weekdays MCP Distribution for the hours of 0-11

HOURS	12	13	14	15	16	17	18	19	20	21	22	23
MINIMUM	0,94	5,10	1,08	1,07	1,02	5,07	0,82	10,39	60,89	53,06	4,46	0,00
MEDIAN	170,00	175,00	195,55	184,99	180,00	172,15	158,38	155,99	157,61	149,99	140,00	120,00
MAXIMUM	999,98	799,99	1.899,99	1.500,05	800,00	1.169,55	777,00	500,00	460,06	297,00	236,05	236,02
LOWER QUARTILE	121,96	134,72	155,78	143,44	145,01	134,99	125,00	123,95	134,67	128,99	114,99	93,99
UPPER QUARTILE	209,67	211,14	215,47	213,33	211,59	205,58	194,84	189,97	180,01	170,10	169,48	148,99

Table 4: Weekdays MCP Distribution for the hours of 12-23





Figure 6: Hourly Weekend MCP Boxplot Distribution in 2016

HOURS	00	01	02	03	04	05	06	07	08	09	10	11
MINIMUM	0,83	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,95
MEDIAN	160,99	139,99	121,96	90,22	90,04	81,53	66,56	82,87	101,81	142,57	162,17	177,14
MAXIMUM	231,09	220,82	216,02	214,21	213,71	211,97	215,10	219,55	230,87	238,00	238,01	238,01
LOWER QUARTILE	135,74	119,99	99,98	66,92	44,19	29,99	1,04	21,15	44,25	115,41	136,26	148,74
UPPER QUARTILE	191,07	162,32	148,17	124,97	121,12	109,81	101,83	119,00	142,93	179,93	190,39	202,19

Table 5: Weekends MCP Distribution for the hours of 0-11

HOURS	12	13	14	15	16	17	18	19	20	21	22	23
MINIMUM	5,03	5,10	1,57	5,05	10,96	5,04	51,10	65,00	65,00	64,88	5,08	30,04
MEDIAN	150,00	164,13	159,98	147,09	139,43	125,96	139,88	149,97	160,03	149,99	146,56	124,45
MAXIMUM	238,00	238,00	238,00	238,00	238,00	238,00	238,01	238,01	238,01	238,00	238,00	238,00
LOWER QUARTILE	127,66	133,69	128,20	123,97	119,32	112,84	118,17	121,81	135,84	134,93	117,10	135,74
UPPER QUARTILE	180,06	185,01	184,90	171,34	160,89	154,61	173,68	178,20	176,13	170,94	171,37	191,07

Table 6: Weekends MCP Distribution for the hours of 12 - 23

1.7. Standard Deviation Analysis

According to statistical tests, the daily standard deviations of the average market clearing prices in 2016 have increased between 8 and 13 TL/MWh with a 95% confidence rate according to the values of the year 2015.

1.8. Volatility Analysis

The arithmetic average and volatility of the MCP in 2016 is calculated by taking a 14-day moving window and is shown in the Figure below. Weekdays and workdays are used as base in average volatility calculations. The following formula has been used by adopting the daily volatility calculation method.

$$Vol_{t,n} = \sqrt{\frac{1}{n} \times \sum_{i=1}^{n} (R_{t-i+1} - \bar{R}_{t,n})^2}$$
$$R_t = \log_{10} GAOPTF_t - \log_{10} GAOPTF_{t-1}$$
$$\bar{R}_{t,n} = \frac{1}{n} \times \sum_{i=1}^{n} GAOPTF_{t-i+1}$$

Vol_{t,n} = The realized volatility of daily arithmetic average market clearing price at market day t for past n market days

GAOPTF_t = Daily Arithmetic Average of Market Clearing Price for market day t

n= Number of days that the volatility value is calculated



Figure 7: MCP Average and Volatility in 2016

1.9. Optimization Time

Between June 1, 2016 and December 31, 2016, the percentage of days for which the optimal outcome occurred within the time allocated for the DAM pricing process was calculated as 96%.

1.10. Monthly Cleared Volume, 2015-2016



Figure 8: Cleared Volume on a monthly basis, 2015-2016

When the monthly distribution of the total number of cleared volumes in Day-Ahead Market is examined, it is seen that the highest cleared volume was 11,49 TWh in December and the lowest cleared volume was 8,38 TWh in September. In all other months except for September, the number of cleared orders increased compared to the previous year.



1.11. Daily Cleared Volume

Figure 9: Cleared Volume on daily basis in 2016

While Daily average cleared volume was 311.611 MWh in Day Ahead Market, the highest Daily cleared volume was 417.127 MWh on Wednesday, December 28 and the lowest Daily cleared volume was 229.906 MWh on Sunday, September 18.

Daily cleared volume in 2016:

• Between 0-300.000 MWh for 140 days (38%),

- Between 300.000 and 350.000 MWh for 176 days (48%),
- Between 350.000 and 400.000 MWh for 46 days (13%),
- 400.000 MWh or more for 4 days (all in December) (1%).



1.12. Hourly Cleared Volume

Figure 10: Cleared Volume on hourly basis in 2016

In Day Ahead Market, the hourly average cleared volume was 12.985 MWh in 2016, and thus when the hourly cleared volume are examined specifically it can be seen below;

- Between 0-10.000 MWh for 799 hours (9%),
- Between 10.000-12.000 MWh for 2.778 hours (32%),
- Between 12.000-15.000 MWh for 3.318 hours (38%),
- Between 15.000 and 20.000 MWh for 1872 hours (21%),
- 20.000 MWh and over for 16 hours (0.2%).

The lowest cleared volume in 2016 was 7,628 MWh at 03:00 on Sunday, September 18, and the highest cleared volume was 20.686 at 14:00 on Tuesday, June 14.

In 2016, for 374 hours Day Ahead Market cleared volume accounted for 50% and more of the hourly consumption volume in Turkey. At 07:00 and 08:00 in July, the cleared volume of Day Ahead Market was accounted for 66% of hourly consumption.

1.13. Cleared Hourly - Block Order Statistics

72% of the cleared volume in the sales side in 2016 were hourly orders and 28% were block orders. 98% of the cleared volume in the purchase side in 2016 were hourly orders and 2% were block orders.

March was the month in which cleared block volume is highest in sales side with 11% and lowest with 13% in purchase side. November is the with highest cleared block volume in sales side which was accounted for 39% of total cleared volume in this month.

When the cleared block order volume is examined on daily basis, it is observed that in sales side highest cleared block order volume accounted for 52% of total cleared volume on August 23, whereas in purchase side the highest cleared block order volume accounted for 25% of total cleared volume on July 6, 2016.

While all cleared orders in sales side were composed of hourly orders on February 14, 2016; for 119 days of year 2016, only hourly orders were cleared in purchase side.



1.13.1. Shares of Cleared Hourly - Block Orders in Sales Side

Figure 11: Shares of Hourly-Block Orders in Sales Side in 2016



1.13.2. Shares of Cleared Hourly - Block Orders in Purchase Side

Figure 12: Shares of Hourly-Block Orders in Purchase Side in 2016



1.13.3. Cleared Hourly-Block Orders Sales Volume on Monthly Basis

Figure 13: Cleared Hourly-Block Order Sales Volume in 2016

1.13.4. Cleared Hourly-Block Orders Purchase Volume on Monthly Basis



Figure 14: Hourly-Block Order Purchase Volume in 2016



1.13.5. Submitted-Cleared Block Orders Sales Volume on Monthly Basis

Figure 15: Submitted-Cleared Block Orders Sales Volume in 2016

1.13.6. Submitted-Cleared Block Orders Purchase Volume on Monthly Basis



Figure 16: Submitted-Cleared Block Orders Purchase Volume in 2016



1.14. Price Independent Sales-Purchase and Cleared Volume on Monthly Basis



In 2016, average hourly price independent purchase volume was 11.393 MWh, average hourly price independent sales volume was 7.884 MWh, and average hourly cleared volume was 12.985 MWh. The average hourly price independent purchase volume was 88% of the total cleared volume and the price independent sale volume was 61% of total the cleared volume.

In August, the price independent purchase volume reached year's maximum value of 12.925 MWh (93% of the cleared volume), in March price independent sale volume reached its maximum value with 10.416 MWh (81% of the cleared volume).

The highest value of hourly average cleared volume was in December with 15,437 MWh. In December average hourly cleared volume was 2.461 MWh (19%), which was more than yearly average. December is the month in which the price independent purchase and sales volume accounted for the lowest in cleared volume ratio. In December, 81% of the total cleared volume consisted of the independent purchase volume and 39% of the total cleared volume was independent sales volume.



1.15. Day Ahead Market Annual Transaction Volume

Figure 18: Day Ahead Market Annual Transaction Volume

In 2016, the realized annual transaction volume was 33, 90 billion TL by increasing 18, 29% in contrast with the previous year in Day Ahead Market.

1.16. Average Number of Submitted Orders

Yearly average number of submitted orders and uplift payment amount made, between deployment date of in-house developed DAM Web Application and end of year are given below;

Average Number of Hourly Orders	Average Number of Block Orders in Sales Side	Average Number of Block Orders in Purchase Side	Average Number of Flexible Orders	Average Number of Cleared Orders with Uplift Payment Made	Average Uplift Payment Amount (TL)
15.028,5	128,0	20,1	2,7	4,2	35.261,6

Table 7: Average Number of Submitted Orders

1.17. Number of Day Ahead Market Participant Active in Trade

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
291	296	296	303	646	661	641	621	614	632	642	645

Table 8: Number of Day Ahead Market Participant Active in Trade

In the first 4 months of 2016, the average number of participants who bid for the Day Ahead Market was 297, while the number of the average number of participants who submitted bids to the Day Ahead Market since May was 638, due to changed YEKDEM Regulation in May.

1.18. EU Energy Exchanges and EXIST DAM Prices

1.18.1. Central and Western Europe and EXIST Day Ahead Market Prices



*Source: Montel-Foreks

* Exchange rate data: Central Bank of the Republic of Turkey.

Figure 19: Central and Western Europe and EXIST Day Ahead Market Prices



1.18.2. Eastern Europe and EXIST Day Ahead Market Prices

*Source: Montel-Foreks * Exchange rate data: Central Bank of the Republic of Turkey.

Figure 20: Eastern Europe and EXIST Day Ahead Market Prices



2. Intraday Market

2.1. Developments of Intraday Market in 2016

It was aimed to improve Intraday Market Web Application in 2016 in accordance with feedbacks received from participants for more efficient utilization of Intraday Market.

Intraday Market Web Application, put into service on July 1, 2015 and funded by in-house sources, updates in 2016 are listed below:

 As it was known, participants have been able to trade on Intraday Market contracts prior to two hours of physical delivery in accordance with Electricity Market Balancing and Settlement Regulation upon the (f) clause of article 66/A. However, as of August 16, 2016, participants were able to trade on Intraday Market contract prior to 1,5 hours of physical delivery in accordance with the joint decision of Regulatory Authority (EMRA) and System Operator (TEİAŞ)

Consequently, participants will be able to proceed physical delivery of their transactions more closely to real time and thus minimize the likelihood imbalances. For example, those participants having renewable energy sources based generation facilities in their portfolios benefit from this development as they can minimize imbalances and update their generation plan closer to physical delivery time.

- The other updates in Intraday Market Web Application are listed below;
 - Stating Market Clearing Price correspond to relevant contract in Intraday Market Order Book,
 - o Informing participant via SMS and e-mail in case of matching in contracts,
 - Informing participant via SMS or e-mail regarding the contract summary after the final trading time of relevant contract,
 - Adding choice of automatic log-off deactivation

Furthermore, new developments were taken place regarding collateral status section, contract transaction history section, and Intraday Market Ticker.



2.2. Monthly Traded Volume of Intraday Market

Figure 21: Intraday Market Monthly Traded Volume, 2015 - 2016

Total traded volume of Intraday Market was 0,83 TWh in 2016. The maximum traded volume was 114.976 MWh in December due to natural gas curtailment for power plants.

The maximum daily traded volume was 8.712 MWh on June 17, 2016, and maximum hourly traded volume was 990 MWh at 22:00 on same day of 2016.



2.3. Average Hourly Traded Volume of Intraday Market in Total

Figure 22: Total Average Intraday Market Traded Volume on hourly basis in 2016

The maximum average traded volume on hourly basis was 61.231 MWh at 18:00 of each trading day in 2016 and minimum average traded volume on hourly basis was 11.345 MWh at 05:00 of each trading day in 2016.

2.4. Number of Intraday Market Participants Active in Trade

In 2016, 148 participants in average were active in Intraday Market trade.



Figure 23: Intraday Market Total Purchase Volume per Participant in 2016

There were 40 market participants whose transactions in purchase side were minimum 5.000 MWh and thus maximum purchase volume was 111.434 MWh by a single participant.



2.6. Intraday Market Total Sales Volume per Participant



There were 38 market participants whose transactions in sales side were minimum 5.000 MWh and thus maximum sales volume was 71.342 MWh by a single participant.



2.7. Monthly Intraday Market Weighted Average Price, MCP and SMP



Monthly weighted average price of intraday market was higher than average MCP and SMP for almost every month of 2016 except for March. The biggest difference between weighted average price of intraday market and MCP took place in December.



2.8. Annual Traded Volume of Intraday Market

Figure 26: Intraday Market Transaction Volume on a yearly basis in 2016

Total traded volume of intraday market was 279 million TL in 2016.



3. Market Volume

Months	Total BC	BCs between Private Entities	EÜAŞ Sales BCs	TETAŞ Sales BCs	Other Public BCs	DAM Cleared Volume	IM Traded Volume	BPM Volume	Total Market Volume
Jan	24.934.973	10.528.178	4.592.655	9.814.140	0	9.613.833	43.813	2.065.101	36.657.721
Feb	23.251.797	9.913.177	4.230.767	9.107.853	0	8.405.241	38.684	1.877.880	33.573.602
Mar	23.504.950	10.018.660	4.232.306	9.253.985	0	9.530.015	58.750	1.923.084	35.016.800
Apr	18.924.885	9.115.571	2.525.565	7.283.749	0	9.439.597	45.002	2.386.990	30.796.473
May	18.927.667	10.119.273	2.157.893	6.650.502	0	9.468.807	73.104	3.300.723	31.770.301
Jun	18.740.962	10.210.390	1.881.535	6.649.037	0	9.601.900	87.953	3.558.053	31.988.867
Jul	24.845.907	11.725.223	4.107.238	9.013.446	0	9.795.862	65.716	2.702.324	37.409.808
Aug	26.902.476	13.809.997	3.645.014	8.962.648	484.817	10.388.979	79.568	1.992.786	39.363.809
Sep	23.320.096	11.611.390	2.195.620	8.243.274	1.269.812	8.377.373	73.763	1.783.000	33.554.232
Oct	23.463.875	11.547.763	2.300.348	8.065.709	1.550.056	8.759.758	77.177	1.671.535	33.972.344
Nov	23.819.018	11.814.565	2.169.062	8.414.004	1.421.387	9.184.190	80.875	1.692.251	34.776.334
Dec	25.744.609	12.387.642	2.474.382	9.282.474	1.600.111	11.485.162	114.976	2.946.180	40.290.927
Total	276.381.213	132.801.827	36.512.384	100.740.154	6.326.182	114.050.715	839.382	27.899.907	419.171.217

3.1. Monthly Volume of Electricity Market

Table 10: Electricity Market Volume on a monthly basis in 2016

The highest market volume of bilateral contracts took place as 26.902.476 MWh in August and the highest bilateral sales contract volume of EÜAŞ was 4.592.655 MWh in January.





Figure 27: Market Volume on annual basis

- Total BC: Sum of bilateral contract volume in purchase or sales side,
- Private BC: Sum of bilateral contract volume between private entities,
- Public (Other): Difference between TETAŞ BC purchase volume and EÜAŞ BC sales volume,
- DAM Cleared Volume: Cleared sales volume of DAM,
- IM Traded Volume: Traded sales volume of IM,
- BPM Volume: Sum of executed up and down regulation volume.



4. Balancing and Power Market Data

4.1.



Figure 29: Average MCP-SMP on a monthly basis

Average System Marginal Price was lower than Average Market Clearing Price on a monthly basis in 2016.

The highest System Marginal Price was 225,88 TL/MWh and the highest Market Clearing Price was 219,04 TL/MWh in December, 2016. The lowest System Marginal Price was 86,69 TL/MWh in May, 2016.



Hourly System Marginal Prices 4.2.

Figure 30: System Marginal Price on hourly basis

Daily average of SMP was 132,20 TL/MWh in 2016. The highest SMP was 1.899,99 TL/MWh at 14:00 on Friday, December 23, 2016.



4.3. Hourly Difference between MCP and SMP

Figure 31: Difference between MCP and SMP on hourly basis

The highest difference between MCP and SMP was 222,82 TL/MWh in Thursday at 07:00 on December 22, 2016. The highest difference between SMP and MCP was 320,01 TL/MWh at 21:00 on Thursday, December 22, 2016.

4.4. Monthly Volumes of 0 - 1 - 2 Coded Regulations

System Direction		Up			Down	
Months/Reg.Code	0	1	2	0	1	2
January	189.944	606.808	165.800	565.703	102.657	460.487
February	28.943	337.943	300.511	872.995	114.296	221.297
March	276.008	285.232	250.687	612.745	240.231	276.517
April	511.669	359.025	157.251	351.791	614.145	413.253
May	778.632	434.577	226.180	162.518	1.327.633	399.897
June	1.246.802	423.621	153.293	76.901	1.258.320	421.726
July	920.800	291.812	195.426	283.718	627.351	408.830
August	668.613	458.396	37.168	101.612	166.881	573.539
September	274.377	326.579	226.809	507.703	77.237	387.769
October	343.638	442.586	67.738	207.504	65.962	565.312
November	533.006	325.462	55.411	103.173	120.487	573.249
December	1.347.956	425.743	28.063	100.543	471.587	613.925

Table 11: 0 - 1 - 2 Coded Regulation Volume on a monthly basis

The highest total number of up-down regulation took place in June, 2016. The highest number of up regulation occurred in June and the highest number of down regulation occurred in May whereas, the lowest number of up regulation occurred in February and the lowest number of down regulation took place in November.

5. Settlement and Registration

EPİAŞ operates the settlement of Day Ahead Market, Intraday Market, Balancing Power Market, Energy Imbalances and YEKDEM without the purpose of profit/loss. These operations are performed in a fast, secure, transparent manner in line with settlement regulation.

The settlement of Day Ahead Market and Intraday Market are performed considering purchase and sales amount on a daily basis. Here, the participants' calculation of uplift, debt and receivable advances are proceeded on a daily basis.

In addition to settlement, minimum collateral amount, imbalance collateral, collateral amount required for Day Ahead Market transactions, collateral amount required for Intraday Market transactions and risk collateral are calculated and announced.

At the end of each month, final up-down regulation volumes which are in scope of Balancing and Power Market, are calculated. Moreover, final up-down regulation volumes for each participant in BPM was determined on a monthly basis and receivable and payable for each participant are calculated based on up-down regulation offer prices are being calculated. In case commitment of regulation were not realized, associated extra cost is being calculated and participant is being informed.



5.1. SBDT (Zero Balance Adjustment Amount)

Figure 32: Zero Balance Adjustment Amount on a monthly basis

Beginning form 2016, TEİAŞ is liable for SBDT resulted from transactions of BPM, Energy Imbalances and Retroactive Adjustment and monthly proportion of net consumption. Changes in SBDT are shown in Figure 32 on a monthly basis.



5.2. ISKK (Transmission System Loss Coefficient)

Figure 33: Transmission System Loss Coefficient on a monthly basis

Transmission System Loss Coefficient for 2016 is given in Figure 33 on a monthly basis.



5.3.1. Total YEKDEM Payment

YEKDEM

5.3.

Figure 34: Total Payment to YEKDEM Participants in 2016

The changes in total payment made YEKDEM participant are shown in Figure 34 on a monthly basis.



5.3.2. Unit Costs of YEKDEM

Figure 35: Unit Cost of YEKDEM

After YEKDEM settlement, monthly average unit costs per MWh that are liable for participants, are shown in Figure 35 above. The highest unit cost of YEKDEM per MWh took place in March, whereas the lowest unit cost of YEKDEM per MWh occurred in December.

5.4. Total BPM Amount



Figure 36: Total BPM Amount in 2016

Total calculated amount of Balancing and Power Market for 2016 is shown in Figure 36.



5.5. Imbalance



The highest imbalance volume was in December, whereas the lowest imbalance volume was in October for 2016.



5.5.2. Total Amount of Energy Imbalances

Figure 38: Total Energy Imbalances Amount in 2016

Monthly fluctuation of financial amount resulted from imbalances is shown in Figure 38. Monthly settlement of YEKDEM mechanism is announced under YEKDEM payable and receivable bullets.

5.6. Generation Volume (UEVM) – Consumption Volume (UEÇM) Basis to Financial Settlement



Figure 39: Generation-Consumption Volumes Basis to Financial Settlement

Monthly changes in generation and consumption volumes after settlement process for 2016 are shown in Figure 39 above.



5.7. Number of Eligible Customers



The number of eligible customers are given in Figure 40.

5.8. Number of Participants

Registration process consists of approval of power plants, participation agreement, registration of participants' legal entities and eligible customers. As such, the number of active participants in market is listed below in terms of licenses granted by EMRA.

TERM	RETAIL	DISTRIBUTION	TRANSMISSION	WHOLESALE	GENERATION	TOTAL
January	42	21	1	154	667	885
February	42	21	1	157	675	896
March	42	21	1	157	684	905
April	42	21	1	155	690	909
May	42	21	1	153	697	914
June	42	21	1	153	699	916
July	42	21	1	150	703	917
August	42	21	1	149	713	926
September	42	21	1	149	722	935
October	42	21	1	149	736	949
November	42	21	1	149	738	951
December	42	21	1	150	745	959

Table 12: Number of Participants on a monthly basis



6. TEİAŞ Data

*This part of market report comprises of data compiled from TEİAŞ 2015 Annual Report and National Dispatch Center Database.



6.1. Generation and Consumption, 2015 - 2016



Figure 41: Consumption (TWh), 2015-2016

As it is clearly seen in Figure 41 and Figure 42, in 2016 generation volume increased by 3,9% and consumption volume increased by 4,25% compared to 2015.



6.2. Monthly Generation, 2015 - 2016



Compared to values 2015 vs. 2016;

- In 2016, the biggest percentage increase in generation volume took place in June by 8,3%
- In 2016, generation volume decreased in September compared to 2015. In 2016, the biggest power generation was in August, whereas the lowest power generation was in February. As for power generation by energy source in 2016, natural gas power stations had the greatest portion of generation by 37%, while hydroelectric power stations came second by 21%. More specifically,

natural gas power stations had the greatest portion of generation by 33% and hydroelectric power stations came second by 24% in February, 2016.

The highest peak demand was 44.341 MWh on August 11, 2016 at 15:00. The highest spike in demand was 44.734 MW on August 11, 2016 at 14:30 and lowest spike in demand was 17.448 MW on September 13, 2016 at 07:00.



6.3. Number of Power Stations by Electric Utilities

Utilities	Number of Stations
Private Power Stations	1065
EÜAŞ Power Stations	72
Transfer of Operational Rights	66
вот	16
во	5
Affiliated Partnership of EÜAŞ	1

Figure 44: % of Power Stations by Electric Utilities in 2016

6.4.

Table 13: Number of Power Stations by Electric Utilities in 2016



Number of Power Stations by Energy Source

Energy Source	Number of
	Stations
Run-of-the-	478
river	
Natural Gas	283
Wind	148
Conventional	115
(Dam)	
Biomass	82
Lignite	47
Geothermal	31
Fuel Oil	20
Import Coal-	11
Fired	
Other	10

Figure 45: % of Power Stations by Energy Source in 2016

Table 14: Number of Power Stations by Energy Source in 2016



6.5. Installed Capacity by Energy Source

Figure 46: Installed Capacity (MW) by Energy Source in 2016

Turkey's total installed capacity is 77.789 MW as of Jan 1, 2017. The installed capacity of power stations benefited from renewable support mechanism is 15.083 MW comprising 19,4% of total installed capacity.

The proportion of power stations by renewable energy sources in total installed capacity is 42,6%.

Stations generate power with imported coal and natural gas had the highest increase in installed capacity respectively from 2015 to 2016.

6.6. Installed Capacity by Electric Utilities



Utilities	Installed Capacity (MW)
Private Power Stations	48.158
EÜAŞ Power Stations	20.414
BO Power Stations	6.102
BOT Power Stations	1.637
Transfer of Operational Rights	1.478
Total	77.789

Table 15: Installed Capacity by Electric Utilities in 2016

Private power stations cover 74% of installed capacity while public power stations cover 26% of installed capacity.

Figure 47: % of Installed Capacity by Electric Utilities in 2016



6.7. Electricity Generation Figures, 2015 - 2016

6.7.1. Electricity Generation Figures by Energy Source, 2015 - 2016

Figure 49: Generation (MWh) by Energy Source in 2015

Figure 48: Generation (MWh) by Energy Source in 2016

While generation of Natural Gas-LNG power stations decreased by 6% compared to 2015, generation of power stations by import coal-fired, lignite and wind source increased by 2% compared to 2015



6.7.2. Generation Figures by Energy Source, 2015 - 2016

Figure 50: Generation Figures by Energy Sources, 2015-2016

In an analysis of generation figures by energy sources in December, 2016, change in natural gas power stations was striking. Electricity generation of natural gas power stations in December declined in comparison to November 2016 and November 2015. Natural gas curtailment particularly brought about such huge generation volume decrease in natural gas power stations in December, 2016.

Supply deficit being rooted in decreasing electricity generation volume of natural gas power stations in December were covered by the generation of hydroelectric power stations and imported coal-fired power stations.



6.7.3. Electricity Generation by Electric Utilities in 2016

Figure 51: Electricity Generation by Electric Utilities in 2016

Shares of public utilities in power generation is 17% and share of private utilities in power generation is 83% in 2016.



6.8. Yearly Electricity Generation by Cities

Figure 52: Yearly Electricity Generation by Cities in 2016

As for yearly generation figures by cities in Turkey, Izmir, Sakarya, Adana, Canakkale and Hatay were top five cities in electricity generation respectively.



6.9. Monthly Volumes of Electricity Import-Export



During 2016, the largest volume of electricity import was 711.997 MWh in December, whereas the largest volume of electricity export was 190.271 MWh in October.

7. Important Developments Affected Market Clearing Price in 2016

7.1. Capacity Addition of YEKDEM

According to data released by EMRA, the total installed capacity of power stations benefiting from YEKDEM mechanism was 5.423 MW in 2015 while it increased from 9.660 MW to 15.083 MW with a 278% change.

Observing the development of the installed capacity of YEKDEM power stations by energy source in 2016 compared to 2015, pumped-storage hydroelectric power stations increased from 4.378 MW to 4.402 MW, tidal power stations from 2.940 MW to 4.433 MW, wind power stations from 1.588 MW to 4.320 MW respectively.



Figure 54: Fluctuation of YEKDEM and non-YEKDEM Price Independent Orders

The volume of price independent sales orders of non-YEKDEM participants did not increase in January, 2016. Because sales of YEKDEM participants doubled, volume of price independent sales orders increased accordingly.

7.2. Natural Gas Curtailment in January

Upon the decision of BOTAŞ on January 24, 2016, natural gas quantity provided for natural gas power stations curtailed by 50% to ensure natural gas supply security to households as top priority. This curtailment affecting natural gas power stations conduced to decline in volume supply of these power stations as well as increase in MCP during the period of January 25 – 30. This increase encompassed only six days with the average 228,05TL/MWh MCP.



Figure 55: MCP during the Period of Natural Gas Curtailment



7.3. Public Bilateral Contracts (Period of April – July)

Figure 56: Bilateral Contract Sales Volume of EÜAŞ

In April, 2016, bilateral contract sales volume of EÜAŞ declined by 40%, 2.181 MWh per hour and 1.706.741 MWh in total in comparison to previous month.





Figure 57: Bilateral Contract Sales Volume of TETAŞ

Bilateral contract sales volume provided for distribution and retail companies by TETAŞ decreased by 16%, 1.1916 MWh per hour, 1.379.569 in total in April, 2016 compared to March, 2016



7.5. Bilateral Contract Purchase Volume of TETAŞ

Figure 58: Bilateral Contract Purchase Volume of TETAŞ

Total bilateral contracts purchase volume of TETAŞ did not change despite of government's subsidy to local lignite coal-fired power stations on August 22, 2016. The reason why this unchanged volume is that TETAŞ diversified its portfolio by means of covering power needs from subsidized coal power stations. As a result of this strategy, bilateral contract volume between TETAŞ and EÜAŞ declined by 37% as hourly average of 2.010 MWh.



7.6. Natural Gas Curtailment on November 24, 2016



Due to natural gas curtailment started on November 24, natural gas quantity provided to Build-Operate power stations of TETAŞ was decreased. Thus, electricity generation of power stations in nationwide decreased by 50%. This decrease in electricity generation led to 3.595 MW capacity unavailability in natural gas power stations belong to TETAŞ.

Accordingly, average of MCP was 173,76 TL/MWh during the period of November 24 – December 14, whereas average MCP was 267,02 TL/MWh during the period of December 15 – 29.



7.6.1. Generation Figures of Natural Gas Power Stations in period of November-December

Figure 60: Generation Figures of Natural Gas Power Stations, November-December 2016

While daily average electricity generation of natural gas stations was 283.449 MWh during the period of November 1-December 13, daily average electricity generation was 183.688 MWh by 35,2% decrease during the period of December 14-28.

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