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ELEKTRİK PİYASALARINDA RİSK YÖNETİMİ BÖLÜM 2

Lignite Power Plants and Subsidies
Risk Management in Electricity Markets
Part 2

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LIST OF ABBREVIATIONS

DAM	: Day-ahead Market
DAMP	: Day-ahead Market Price
EIA	: Environmental Impact Assessment
EPDK	: Energy Market Regulatory Authority
EÜAŞ	: Electricity Generation Company
kWh	: kilowatt/hour
LPP	: Lignite Power Plant
MW	: Megawatt
TEİAŞ	: Turkish Electricity Transmission Company
TETAŞ	: Turkish Electricity Trading and Contracting Co.
TKİ	: Directorate General of Turkish Coal Enterprises
TTK	: Directorate General of Turkish Hard Coal
RESUM	: Renewable Energy Support Mechanism

EXECUTIVE SUMMARY

It is not, in general, true that investing in lignite power plants is economically non-viable. In fact, most of the currently operating lignite power plants' operating costs are lower than similarly sized hard coal and natural gas power plants in Turkey. It is also not technically feasible to replace the base-load production capabilities of coal-powered plants with renewable technologies. Nevertheless, large initial capital requirements and long investment planning horizons bring in significant risks for lignite power plants, which reduce the investment appetite for these projects in the market.

It is well-known that subsidies distort liberal markets. Investments in electricity markets require large capital outflows, and it usually takes multiple years before these investment projects start generating cash inflows. Hence, also considering the strategic nature of these markets for the rest of the economy, it is too naïve and socially costly to wait for these markets to adjust itself, and reach an efficient equilibrium by itself. On the other hand, it also does not make economic sense to provide subsidies for all of the lignite mines regardless of their operating costs. Overall, a well-designed subsidy mechanism (similar to the one used to incentive the renewables) is needed for lignite power plants in order to effectively capitalize on lignite sites in Turkey, while minimizing the impact of such subsidies on the liberal electricity markets.

In this report, we investigate the possible subsidy mechanisms for lignite power plants and evaluate the possible effects of such mechanisms on the electricity market. As a result, we suggest fixed price purchase guarantees for these power plants and calculate the value of this fixed price. In addition, we suggest that the tender process should start with the most efficient lignite sites, and the investor who asks for the lowest fixed price should receive the right to invest. We argue that this approach will minimize the impact of subsidies on the electricity market. The details of the suggested subsidy mechanism and its impact of the economy and electricity market is provided in the report.

On the other hand, subsidizing new investments in lignite power plants may also reduce electricity prices and negatively affect the economic value of the existing lignite power plants. Hence, policy makers should be careful about minimizing the negative affect of subsidies on the existing power plants. In this regards, as a short-term solution, we suggest gradually phasing out TETAŞ-contracted power plants to increase the electricity prices in the market. As a mid- and long-term solution, we suggest establishing capacity markets to encourage capacity investments.

Keywords: Coal Power Plants, Risk Management, Incentive Mechanisms

NATIONAL LIGNITE POWER PLANTS AND SUBSIDIES

1. LIGNITE POWER PLANTS IN TURKEY

This chapter takes up the role of lignite power plants in electricity generation in Turkey as well as in the world and Turkey's potential in terms of lignite power plants.

1.1 Introduction to Lignite Power Plants

Lignite Power Plants (LPPs) are some sort of thermal power plants and their operating systems match up with those of other thermal power plants that consume fossil fuels. Basically, electricity is generated when stream heated with energy output of coal-firing turns the stream turbine (See Figure 1.1). Key electromechanical components of a LPP are the turbine, the boiler, and the generator. Whereas the stream turbines and generators in LPPs are rather standardized, technological features of a boiler and its design vary.

LLPs are constructed with either the pulverized boiler technology or the fluid bed boiler technology. The former is the conventional and the widely-used one while the latter is the newer technology. Currently, 90% of electricity generated from lignite is produced in LLPs which have pulverized boilers[5]. Fluidized bed boilers are preferred for two basic reasons: They have the capacity of firing coals with wider calorific values and also they don't need stack gas cleanup facilities. Hard coal power plants have standardized boiler designs simply due to the fact that hard coals have similar calorific values and qualities. But the same is not valid for lignite power plants. Lignite samples from each and every mine have different calorific values and varying percentages of humidity, sulphur, and ash which requires customized and on-the-field boiler designs specific to individual lignite mines. With the advancement of boiler design technology, net efficiency rates in subcritical power plants are around 38%, in supercritical power plants 42% and in ultra supercritical power plants around 45%.

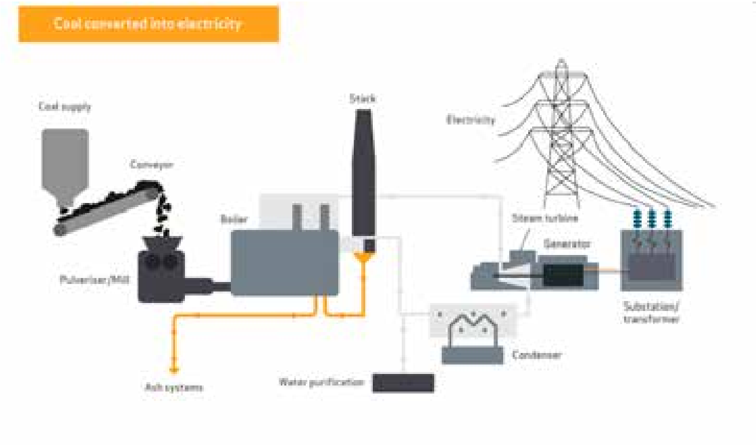

Figure 1.1 : Operating System of a Pulverized Coal Power Plant[6]

5 IEA, www.iea-coal.org.uk/content/default.asp? PageId=976, 2008.
6 http://www.worldcoal.org/coal/uses-coal/coal-electricity

1.2 Electricity Generation in Lignite Power Plants

The worldwide proportion of electricity generated from coal is 41% to the overall production. Coal holds its role in electricity generation for many years7. See below the chart (Figure 1.2) showing the percentage of electricity generated from coal in given countries. Please notice that the figures in Turkey are well below the world average.

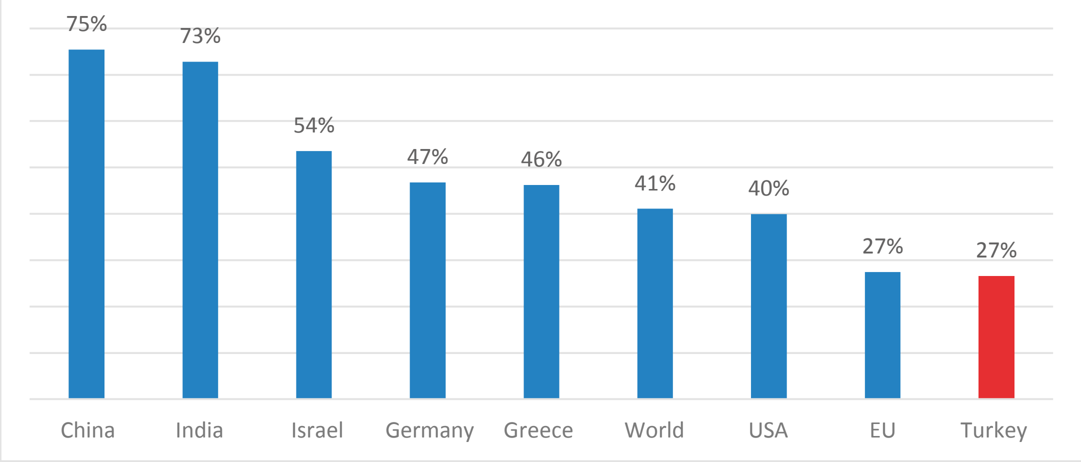

Figure 1.2: Percentage of electricity generated from coal in given countries.[7]

As of May 2016, Turkey's installed capacity has reached 74,627 MWs. 15,913 MWs, i.e. 21.3% of the total sum, are generated in lignite power plants. Details of Turkey's installed capacity are shown in Figure 1.3 and Figure 1.4.

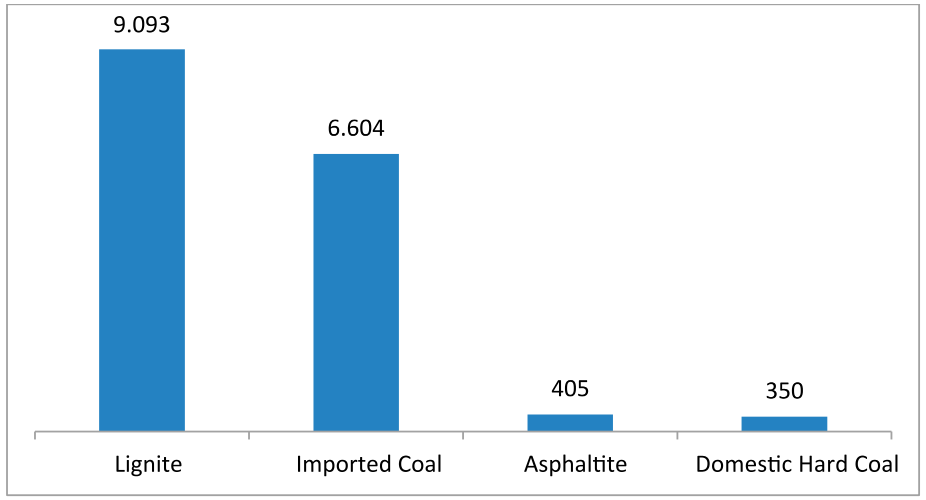

Figure 1.3: Installed capacity for different types of coal processed.[8]

7 Source: World Bank, http://wdi.worldbank.org/table/3.7 (2013 data)
8 Source: TEİAŞ

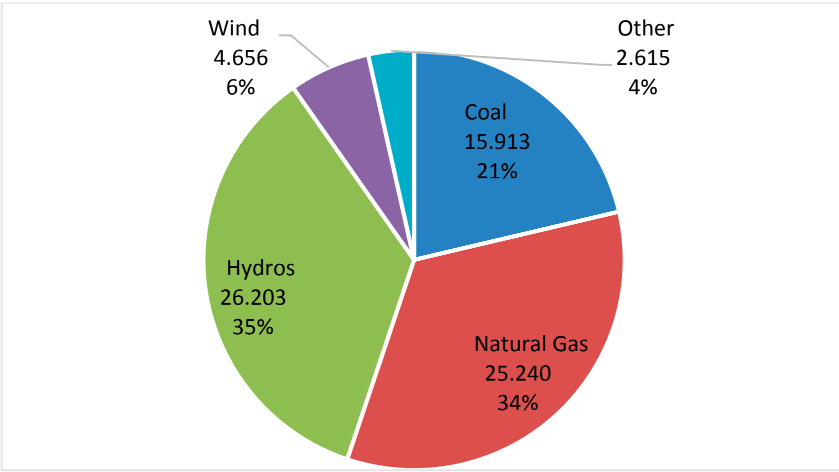

Figure 1.4: Breakdown of installed capacity according to sources (01.05.2016).

In 2015, power plants in Turkey generated 259.7 billion kWh of electricity. 74 billion kWh of electricity corresponding to 28.4% of the whole production was generated in LPPs. Around 40 billion kWh and 34 billion kWh of electricity was generated from imported lignite and domestic lignite respectively. Although installed capacities of the imported lignite power plants are lower, their higher productivity rates indicate that their availabilities and capacity factors are higher than those of the domestic lignite power plants. This fact makes sense when we take into account that imported lignite power plants are newer ones and the quality of coal fired therein is more stable, which consequently lowers technical troubles and load declines. Below are detailed charts and tables regarding;

(i) advancement of installed capacities in lignite power plants

(ii) qualitative and quantitative change in electricity generation from lignite

(iii) “EPDK License” status of lignite power plants.

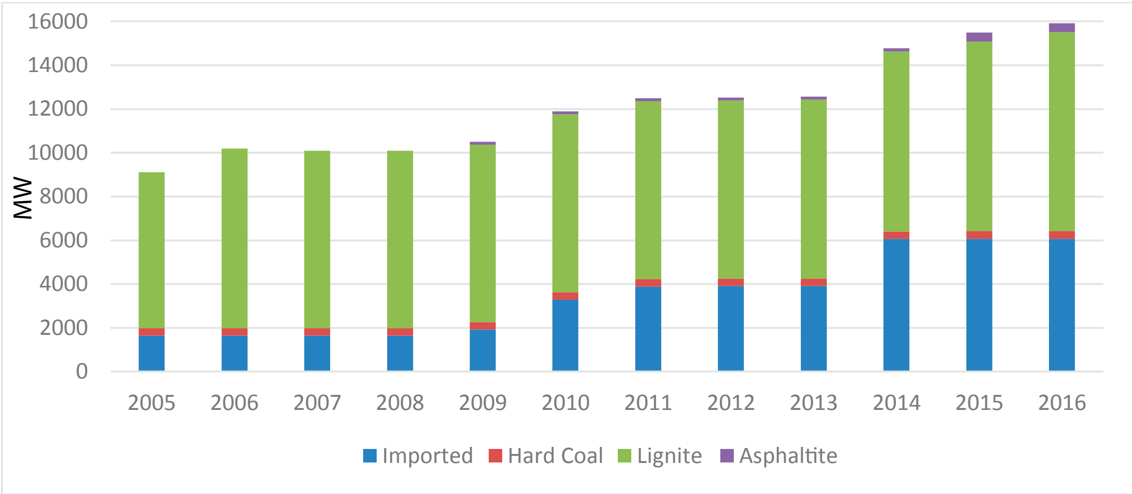

Figure 1.5: Advancement of installed capacities in lignite power plants (Source: TEİAŞ)

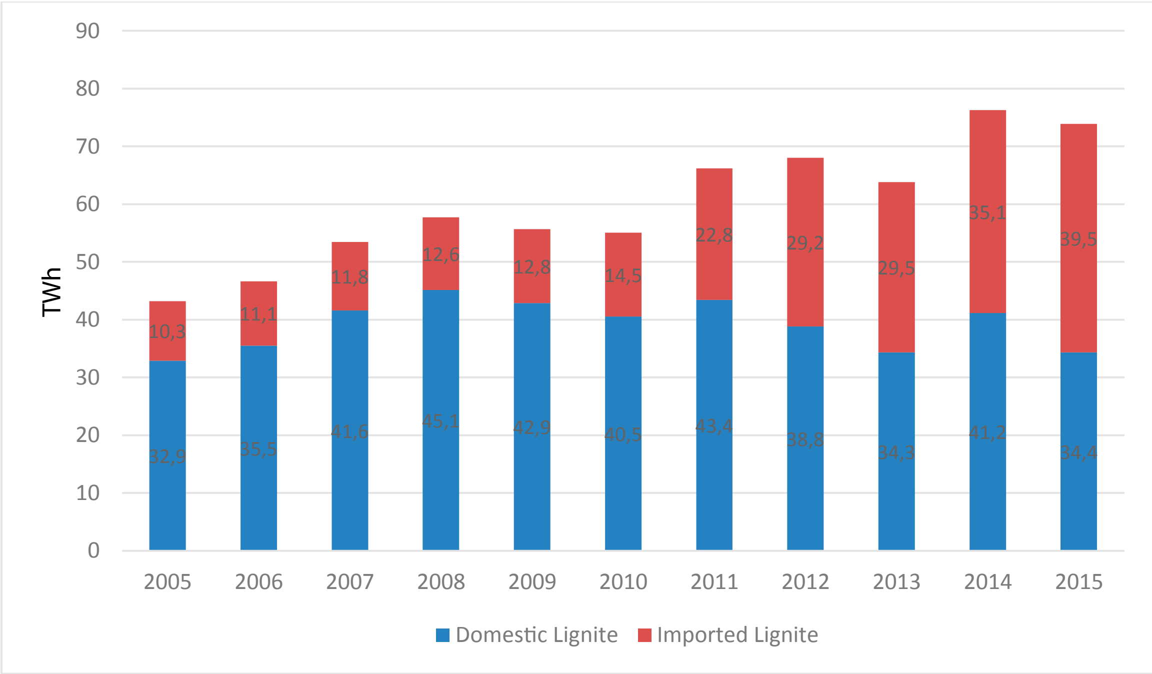

Figure 1.6: Changes in electricity generation from lignite.[9]

9 Source: TEİAŞ

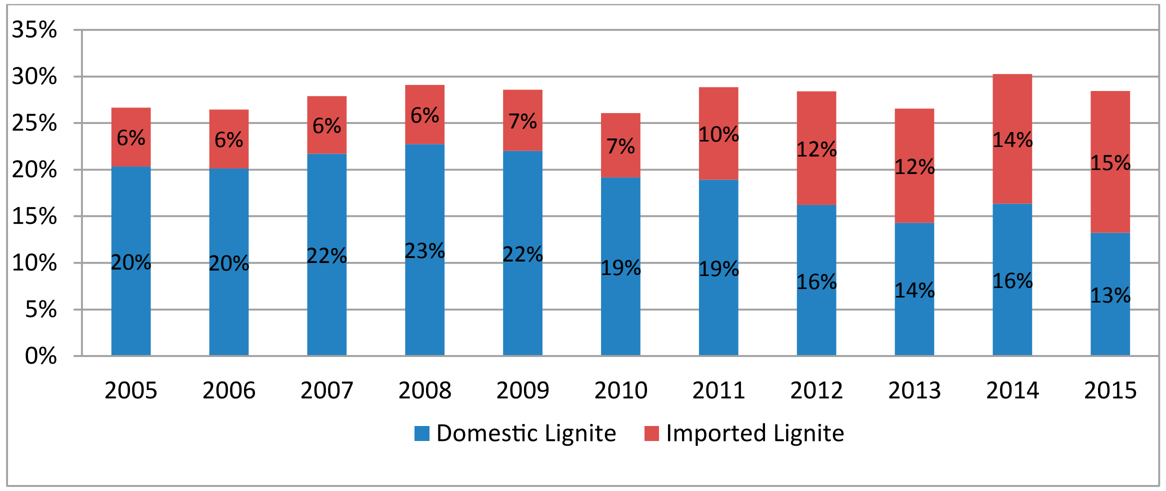

Figure 1.7: Share of coal in electricity generation.

Table 1.1: "EPDK License" status of lignite power plants as of 20.05.2016

	Pre-license Assessment		Pre-license in effect		Production License			
Fuel	Count	Installed Capacity Application	Count	Installed Capacity Application	Count	Installed Capacity Application	Operational Capacity	Capacity Under Construction
Domestic Lignite			8	2.370 MW	57	12.921 MW	9.745 MW	8.160 MW
Imported Lignite	13	12.647 MW	4	4.306 MW	16	14.503 MW	6.076 MW	3.004 MW

According to EPDK Progress Reports, 1,400 MW of all imported lignite power plants which are currently under construction recorded progress by more than 50% and the remaining ones by no more than 50%. On the other hand, only 135 MW of domestic lignite power plants has the progress level of 15% while the figure is even below 3% for the rest[10].

1.3 Outlook of Turkey's Lignite Power Plants and their Capacities

Compared by installed capacity and productivity, average capacity factors of power plants in Turkey are shown in Figure 1.8. Average capacity factors of lignite power plants and imported coal power plants are 51% and 82% respectively. The gap between figures is mainly due to the facts that lignite power plants have lower availabilities since they are mostly older than 30 years, that they have been only recently privatized, revision investments are underway, and that quality of coal is no stable than that of imported coal[11].

10 Source: EPDK Progress Reports.
11 Capacity factors of privatized power plants are expected to reach 80% after necessary revisions.

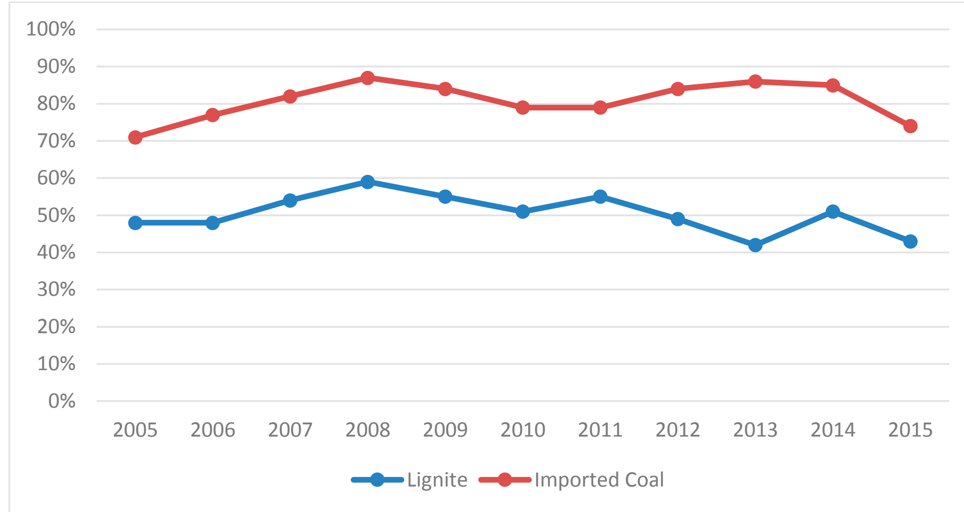

Figure 1.8: Capacity factors in power plants[12.]

Please find in the following tables the names of some LPPs, their installed capacities, technological categories and efficiencies.

Table 1.2: List of lignite power plants established before 2000[13]

Power Plant	Installed Capacity (MW)	Coal Type	Became Operational In	Technology	Efficiency (%)
Soma A	2*22	Lignite	1957; 1958	PC-Subcritical	AR-GE
Seyitömer	4*150	Lignite	1973; 1973; 1977; 1989	PC-Subcritical	32,0
Tunçbilek (B 4-5)	2*150	Lignite	1977; 1978	PC-Subcritical	33,2
Yatağan	3*210	Lignite	1983; 1983; 1984	PC-Subcritical	35,1
Afşin Elbistan-A	3*340 1*335	Lignite	1984; 1985; 1986; 1988	PC-Subcritical	28
Soma B	6*165	Lignite	1981; 1982; 1985; 1985; 1991; 1992	PC-Subcritical	33,1
Yeniköy	2*210	Lignite	1986; 1987	PC-Subcritical	34,1
Çayırhan	2*150 2*160	Lignite	1987; 1987; 1998; 1999	PC-Subcritical	35
Kangal	2*150 1*157	Lignite	1989; 1990; 2000	PC-Subcritical	35,2
Çatalağzı	2*150	Hard Coal	1989; 1991	PC-Subcritical	34,4
Orhaneli	210	Lignite	1992	PC-Subcritical	27
Kemerköy	3*210	Lignite	1994; 1994; 1995	PC-Subcritical	34,5

12 Source: TEİAŞ
13 Source: http://www.unece.org/fileadmin/DAM/energy/se/pp/clep/ge11_ws_oct.2015/8_M.Ersoy_TURKEY.pdf

Table 1.3: List of lignite power plants established after 2000

Santral	Kurulu Güç (MW)	Kömür	Hizmete Giriş	Teknoloji	Verimlilik (%)
Sugözü-İskenderun	1320	İthal	2004	PC	39
Afşin Elbistan-B	4*360	Linyit	2009	PC	39
Çolakoğlu Metalurji	190	İthal	2012	PC	34
18 Mart-Çan	2*160	Linyit	2003	CFB	41
Silopi	1*135	Asfaltit	2009	CFB	38
Biga-Değirmencilik	3*135	İthal	2005	CFB	37
ZETES-1	160	İthal	2014	CFB	36
ZETES-2	2*615	İthal		Süper-kritik	41
Bekirli-Çanakkale	2*600	İthal	2011; 2013	Süper-kritik	42
Atlas Energy	2*600	İthal	2014	Süper-kritik	44
İzdemir-Aliağa	350	İthal	2014	Süper-kritik	44

Tables 1.2 and 1.3 indicate that the most recently established lignite power plants have more than 40% gross efficiency rates. In order to see detailed information on potential mine sites whereon new lignite power plants can be constructed, please check Table 1.4.

Table 1.4: Potential mine sites and their estimated lignite reserves

Site	Parties	Reserve	Calorific Value	Capacity	Other Info
Manisa-Soma	TKİ – Bidding Company	153 million tons	1.900 kcal/kg	510 MW	Company: Hidro-Gen Construction started
Bursa-Keles	TKİ – Bidding Company	61 million tons	2.012 kcal/kg	270 MW	Company: Çelikler EIA continues
Adana-Tufanbeyli	TKİ – Bidding Company	323 million tons	1.173 kcal/kg	700 MW	Company: Teyo EIA continues
Bingöl-Karlıova	TKİ – Bidding Company	80 million tons	1.460 kcal/kg	150 MW	Company: Flamingo Process stopped for security and Hydroelectric Power Plant overlapping
Şırnak-Silopi	TKİ – Bidding Company	28 million tons	5.400 kcal/kg	270 MW	Company: Global Enerji Process stopped for security
Şınark-Silopi	TKİ – Bidding Company	22 million tons	5.400 kcal/kg	135 MW	Process stopped for security
Kütahya-Domaniç	TKİ – Bidding Company	117 million tons	2.200 kcal/kg	300 MW	Company: Çelikler EIA continues
Kırklareli-Vize	TKİ – Bidding Company	105 million tons	1.700 kcal/kg	300 MW	Underground mine. Projection continues.
Konya-Ilgın	TKİ – Bidding Company	28 million tons	2.100 kcal/kg	135 MW	Open-pit mine. Projection continues.
Eskişehir- Alpu (A)	TKİ – Bidding Company	240 million tons	2.404 kcal/kg	1.260 MW	Underground mine. Projection continues.
Eskişehir- Alpu (B)	TKİ – Bidding Company	477 million tons	2.424 kcal/kg	300 MW	Coal gasification project
Eskişehir- Alpu (C)	TKİ – Bidding Company	202 million tons	2.355 kcal/kg	1.050 MW	Underground mine. Projection continues.
Eskişehir-Alpu (D)	TKİ – Bidding Company	68 million tons	2.295 kcal/kg	300 MW	Underground mine. Projection continues.
Eskişehir-Alpu (E)	TKİ – Bidding Company	64 million tons	2.133 kcal/kg	300 MW	Underground mine. Projection continues.
Eskişehir-Alpu (F)	TKİ – Bidding Company	28 million tons	2.073 kcal/kg	135 MW	Underground mine. Projection continues.
Manisa-Soma	TKİ – Bidding Company	260 million tons	2.351 kcal/kg	200 MW	Coal gasification project
Konya-Karapınar	EÜAŞ – Projection Continues	1.8 billion tons	1.374 kcal/kg	4.000 MW	Projection continues.
Afşin-Elbistan	EÜAŞ – Projection Continues	4.8 billion tons	1.136 kcal/kg	6.000 MW	Projection continues.
Tekirdağ	EÜAŞ – Projection Continues	214 million tons	2.140 kcal/kg	350 MW	Projection continues.
Çatalca	EÜAŞ – Projection Continues	280 million tons	2.018 kcal/kg	450 MW	Projection continues.
Afyon-Dinar	EÜAŞ – Projection Continues	941 million tons	1.855 kcal/kg	3.000 MW	Projection continues.
Ankara-Çayırhan	EÜAŞ – Projection Continues	422 million tons	2.319 kcal/kg	750 MW	Projection continues.

For the time being, TKİ opened several biddings for domestic coal reserves with a total capacity of 2,335 MWs and environmental impact assessments are underway. Also, coal reserves that amount to 10,7 billion tons with a total capacity of 20,865 MWs are currently under projection. That being the case, economic feasibility of this total amount is unknown to us. However, we can roughly estimate that no more than 25% of the planned capacity (around 5,000 MW) can be realized, providing that relevant projects are subsidized. Among the reasons for low rates of project realization are operational difficulties of lignite mines, high costs of nationalization, failures in obtaining EIA clearances, difficulty to design custom-made boilers for different mines, and the impact of new capacity investments on prices.

2. RISKS AND OPPORTUNITIES IN LIGNITE POWER PLANTS AND RISK MANAGEMENT

LPPs face numerous risks during the phases of both establishment and operation. Accurate diagnosis of risks and correct formulation of solutions pave the way for taking maximum advantage of opportunities created by LPP investments. Possible risks are taken up in following subchapters.

2.1 Long Durations of Projects

It routinely takes 6 or 7 years from the date of tender for a mine site to begin electricity generation (See Figure 2.1). Analysis and improvement of the mine site and getting administrative permits generally take 3 years while the construction of the power plant needs another 3 years. Varying structures of lignite mines in Turkey necessitates the phases of a project at hand to be realized consecutively, although these phases can normally be handled with separately but simultaneously. To paraphrase, it is not feasible to design a boiler and start constructing a power plant until fully improving the mine site and determining the characteristics of the coal to be extracted. Each and every coal sample from different lignite sites in Turkey has a sui generis structure. Additionally, tailor-made boilers and plants may not function properly in the first years of operation and they might need tuning to ensure optimum functioning. So, at least one more year may be required for efficient operation of the power plant. Therefore, newly-established power plants can generate cash inflows after 7-year-long investment processes. Besides, depending on the market conditions, reimbursement of the total investment costs would take at least 7 more years. All in all, the duration of a given project may reach up to 15 years thus creating an environment with several potential risks for the entrepreneur, which is surely a discouraging factor for the LPP investments.

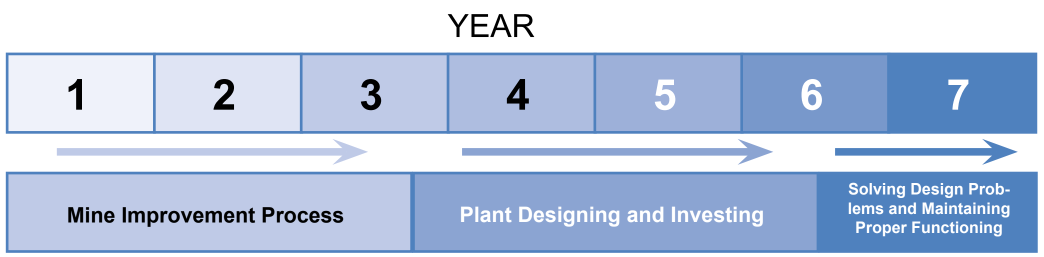

Figure 2.1: Phases of a lignite power plant

2.2 Risks of Costs

A sizeable amount of risks of costs depend on fluctuations in the costs of raw material procurement. Thorough analysis of the mine site and proper planning of optimum management are required before a decision to invest is made. However, costs of raw material-based mining activities are fairly hard to be foreseen, especially in enclosed mine sites. Such costs can be determined only after the commencement of full functioning.

For example, the structure of a lignite vein, characteristics of the fault lines, clay in the mine, humidity, sulphur, and ash values of the lignite are among variables that we can determine following the full functioning of a lignite mine. Unforeseen and undesired deviations in these variables can affect the costs of operation and the costs of raw material in a very negative way. Unexpected clay and fault line problems in enclosed mine sites can increase the costs of employment and bring in additional investment costs such as washing-up of lignite. Also, throughout the long investment process, changes in fares, forest fees, nationalization costs etc. can cause substantial increase in total investment costs. Changes in such costs may, in some cases, render the whole project economically unfeasible. For this reason, an accurate analysis of risks before a possible investment is essential.

The aforementioned risks are unsystematic risks peculiar to lignite power plants and cannot be hedged against by using financial instruments. For those entrepreneurs who haven't got diversified investment portfolios, these risks stand as a fairly discouraging factor. Notwithstanding, hedging these risks operationally is possible to some extent. For instance, fluidized bed power plant designs enable firing of lignite in a wider calorie range thus relatively limiting the operational costs. Though, it should be borne in mind that costs of maintenance in fluidized bed power plants are higher.

2.3 Risk of Electricity Prices

To reiterate, an LPP investment needs 7 years to generate cash inflows. In the meanwhile, well beyond expectations, electricity prices may fluctuate dramatically. Various economic factors can potentially change the price of electricity unexpectedly and alter the economic value of the power plant. Among these economic factors are subsidies for renewable energy, change of costs in technology, price of natural gas, increase in the efficiency of natural gas power plants, proliferation of distributed generation systems, changes in electricity demand, investments for nuclear energy, to name a few.

It is impossible to hedge the risk of electricity prices in a liberal market 7 years beforehand without the guarantee of purchase. So, power plants face the risks of both prices and costs. In addition to that, since risks of costs are unsystematic ones and they are peculiar to entrepreneurs involved, prices and costs may not always be in correlation. In conclusion, in order to encourage investors to step in, i) either the state should guarantee purchase, ii) or gross profit margins of the companies should be large enough to tolerate these risks. The first option is valid for some investment projects and the second is the case for some others, especially enclosed ones.

2.4 Operational Risks

Domestic lignite power plants differentiate from other generation technologies since their marginal production costs are lower and fixed costs are higher. Domestic lignite power plants get the necessary raw material from the very mine site they are installed on thus leading a light burden of variable costs. Monthly costs of raw material depend on the costs of fares and management costs. This very fact keeps the marginal production costs low. Although that seems to be an advantage when compared to other power plants, it should be kept in mind that their gross profits need to meet relatively much higher fixed costs, which incorporates, in the final analysis, a higher investment risk. During the periods when prices plummet, natural gas power plants can pause production to contain losses. However, that cannot be said for lignite power plants. As said, lignite power plants have marginal production costs. So, even if the prices nosedive, lignite power plants have to continue their operation and meet their fixed costs. Corollary to this, domestic lignite power plants keep functioning when they even lose. But that is a rare case for natural power plants. We can, thus, conclude that domestic lignite power plants are more prone to price risks.

The main reason for the aforementioned phenomenon is the fact that LPPs have much higher start/stop costs. It takes 8 hours for an ordinary lignite power plant to resume production. For these types of power plants are designed to function on base-load and not on a start/stop basis, frequent start/stopes may severely damage the power plant itself. Because of this very fact, power plants prefer functioning when the prices are even lower, instead of start/stopes.

2.5 Risk of Exchange Rates and Credits

Since LPP investments require large sums of wherewithal, such projects need financing by banks. This causes a credit risk. Also, as banks finance large projects by foreign exchange, risks of exchange rates and credits usually coexist. Incomes of the investors are in Turkish liras whereas they indebt in foreign currencies. So, unfavorable changes in exchange rates put them in a very dire situation. Expectations of exchange rates should incorporate even the worst scenarios. Taking advantage of various hedging opportunities in financial markets will also help reduce the risk of exchange rates.

2.6 Bureaucratic, Regulative and Environmental Risks

In general, bureaucratic risks involve functioning pace of bureaucracy and long-term uncertainties of subsidies and regulations. Delays caused by red-tape increase the risk of non-conformity with realities on the ground, and, as a result, projects may not meet the expectations. Ambiguity of subsidies and regulations and their instability create similar problems as well. Bureaucratic risks can be reduced with effective use of appropriate communication channels between public and private sectors.

Among the bureaucratic and regulatory factors which affect LPPs are subsidies for renewable energy, subsidies and support for distributed generation, fees of permits in forests/fields, unexpected rise in transmission prices, and changes in imbalance cost liabilities. Besides, nuclear energy investments put downward pressure on electricity prices and decrease the capacity factors of LPPs and the dark spread.

In terms of environment, LPPs trigger fierce reaction of local people without regard to whether they have stack gas cleanup systems and they cause pollution or not. For this very reason, in a given investment project EIA process takes a long while, and in some circumstances this process even hinders the realization of the project. Also, environmental sensitivity may lead to levying taxes on carbon emission of the plant, and this can be counted as one of the regulatory risks.

2.7 Risks of Workplace Accidents

Turkey ranks high in terms of mine accidents. Catastrophic accidents of recent years rendered Turkey's already bad record in mine safety even worse. Mine accidents precipitate the Turkish people into questioning, quite understandably, whether workplace safety rules are duly observed in the mine sites, and questioning the mining and LPP system as a whole. Modernization of mine sites in conformity with workplace safety rules and increase in machinery-using would reduce the number of mine accidents substantially.

2.8 Dark Spread

The dark spread is one of the most essential factors to be taken account before planning an LPP investment. The dark spread is the theoretical gross margin of a coal-fired power plant from selling a unit of electricity. Start/stop costs of power plants aside, LPPs shall normally operate only when the dark spread is positive. In a given time, the dark spread for imported lignite power plants is calculated as follows:

Changes may occur in electricity and lignite prices that determine the dark spread and cause fluctuations. Power plants are expected to halt operation when the dark spread is very low. In the long haul, the level of the dark spread serves as a basis for the economic valuation of an investment. Declining of the dark spread in the long run is one of the most significant risks for power plants. Very low figures of the dark spread may, in the end, render the power plant uneconomical.

Figure 9 shows changes in average monthly dark spread of imported lignite power plants in 2010-2015 in Turkey. Day-ahead market (DAM) prices are taken for electricity. As for the lignite prices, the following scenario is applied. Table 2.1 and Figure 2.2 contain data for imported lignite used for this analysis.

Table 2.1: A Scenario for an imported lignite power plant

Source	South Africa
Calorie values	6.000 kcal/kg
Delivery at	Port of Iskenderun
Transportation to	South Africa
Transportation costs	$26 per ton
Efficiency factor (net)	%40

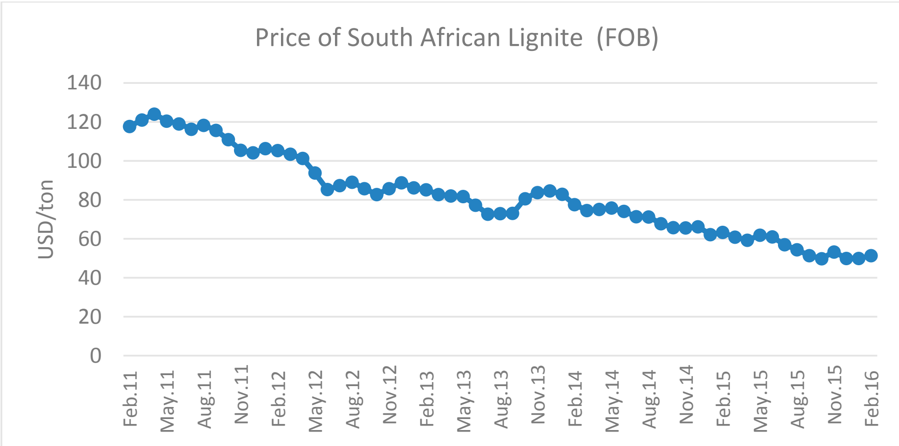

Figure 2.2: Price of imported South African lignite

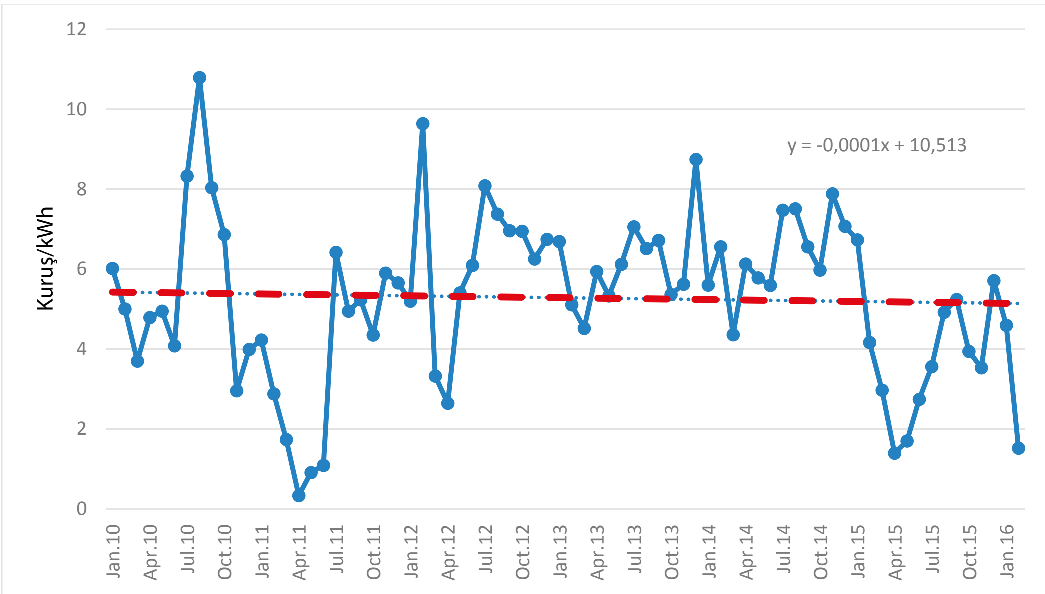

Figure 2.3: Average monthly dark spread of imported lignite power plants in 2010-2015 in Turkey

As seen in Figure 2.3, in the period 2010-2014 the dark spread was around 6 kuruş/kWh (1 Turkish Lira = 100 kuruş) and no steep decline was observed in that period. In 2015, however, the dark spread fell below 4 kuruş/kWh. Taking into account the start/stop costs of power plants, one can say that, in 2015, gross profits of LPPs were no more than 4 kuruş/kWh. This analysis goes for a power plant operating on 40% efficiency factor. The less the efficiency factor is, the lower the dark spread would naturally be. Please find below a similar analysis for domestic lignite power plants.

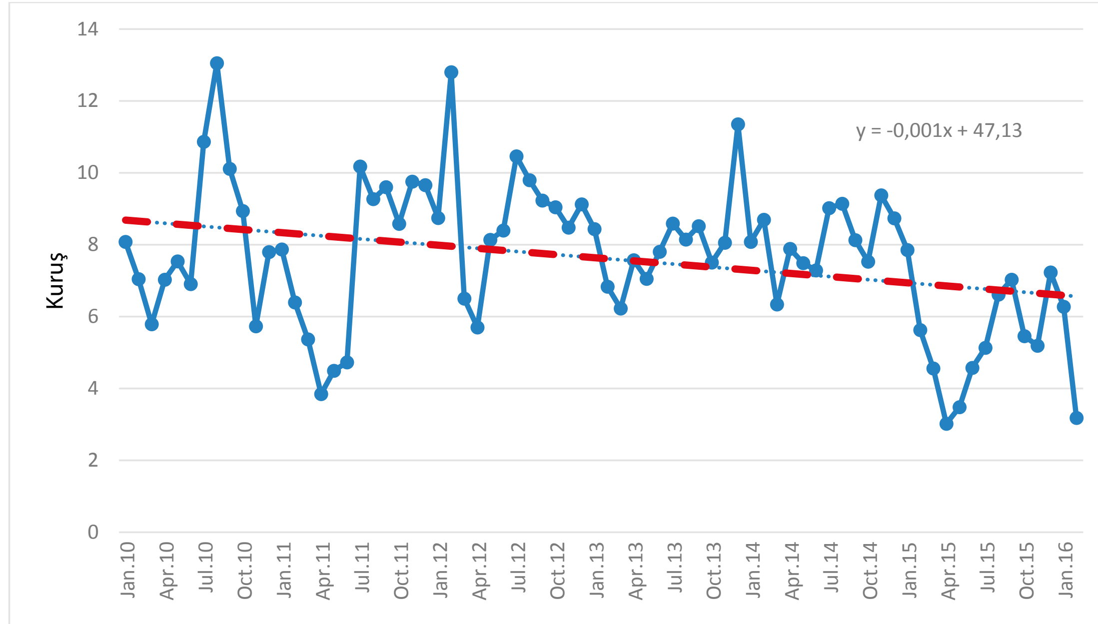

Figure 2.4: Average monthly dark spread of imported lignite power plants in 2010-2015 in Turkey (assuming that domestic lignite production cost is 40 TL/ton)

In a domestic lignite power plant where the lignite production cost is 40 TL/ton (1,500 kcal/kg), in the period 2010-2014, the dark spread was above 8 kuruş/kWh. This figure can be seen as a high gross profit. Nevertheless, high margins of profit should meet high amounts of investment and operational costs. In 2015 the dark spread, in line with the decline of prices, went below 5 kuruş/kWh thus creating a problematic situation for some power plants regarding profitability.

2.9 Overall Assessment of Risks in Lignite Power Plants

On a comparison between types of power plants, we can conclude that domestic lignite power plants stand out with longer durations of investment and higher fixed operational costs. The risk of fuel price is moderate whereas the reliability of production is high.

Table 2.2: A comparison between types of power plants

Type of Power Plant	Duration of Investment	Investment Costs	Variable Operational Costs	Fixed Operational Costs	Fuel Price Risk	Reliability
Domestic lignite	Long	Medium	Medium	High	Medium	High
Imported lignite	Medium	Medium	Medium	High	High	High
Natural Gas	Short	Low	High	Low	High	High
Renewable	Short	High	Low	Low	Low	Low
Nuclear	Long	High	Low	Low	Low	High

3. NATIONWIDE SUBSIDIES FOR LIGNITE POWER PLANTS

It is a well-known fact that the rationale behind subsidies is to encourage investments in sectors in which investments are needed for the good of nation but entrepreneurs are reluctant to step in for economic reasons. Several methods can apply for subsidizing. That being the case, subsidies involve interference, one way or the other, in competitive liberal markets which should normally be regulated by an "invisible hand". So, subsidizing has a distorting effect on liberal markets. On the other hand, markets are imperfect and a pure liberal point of view may be misleading especially in developing countries like Turkey. Contrary to developed countries, markets in developing countries have difficulties in rebalancing in an easy and costless manner. For instance, in case of a supply gap in the electricity market, a couple of years are needed for recovery and severe economic and social costs may occur until re-balancing. Therefore, subsidy mechanisms bolster the resistance of the markets against shocks.

3.1 Rationale behind Subsidizing National Lignite Power Plants

Subsidizing domestic lignite power plants bears importance for the following reasons:

1. Securing supply
2. Creating employment
3. Ensuring reliable production
4. Reducing importation

Upon a thorough analysis of these four reasons, we come to the conclusion that domestic lignite power plants are;

-well ahead of natural gas, but similar with other sources in terms of supply security,

-fairly ahead of imported lignite, natural gas and renewables in terms of employment,

-ahead of renewables, similar with imported lignite and natural gas in terms of reliable production.

Table 3.1: Impact assessments of different power plant types

Type of Power Plant	Securing supply	Creating Employment	Production Reliability	Reducing Importation
Domestic lignite	High	High	High	High
Imported lignite	Medium	Medium	High	Medium
Natural Gas	Low	Low	High	Low
Renewable	High	Low	Low	High

For detailed information, please see following subchapters.

3.1.1 Securing Supply

The most expensive energy is "unavailable energy". Thus, strategic goods like "energy" cannot be assessed merely through an economic standpoint and preferment of domestic sources in order to meet energy demand goes beyond being simply an economic choice.

With regard to Turkey's electricity supply security, the most risky factor is the natural gas imported via pipelines. On the other hand, importation of lignite and LNG does not create dependency on a couple of countries and carry risks regarding supply security since source countries and import routes are pretty diversified. Importation of natural gas through pipelines, however, bears the risks of source country and transit countries alike. Should a supply crisis arises in one of the countries involved, the share of domestic sources or diversified sources overseas should be increased in order to eliminate the risk of a possible energy gap at home. The strategic target for supply security ought to be the reduction of imported sources and diversifying sources at the same time.

Table 3.2: Transit countries in importation of natural gas via pipelines

Name of pipeline	Risk of Routes	Annual Capacity (bcm)	Termination of Contract
Russian gas/West	Russia – Ukraine – Moldova – Romania – Bulgaria - Turkey	14	Special – 10 bcm 2021 – 4 bcm
Blue Stream	Russia - Turkey	16	2025
BTE	Azerbaijan – Georgia - Turkey	12.75	2021 – 6.6 bcm 2032 – 6 bcm 2046 – 0.15 bcm
Iran	Iran - Turkey	9.6	2026

In 2015, 40.8 billion m3 of natural gas was imported through pipelines. This makes up 84% of the whole natural gas importation. LNG importation holds the remaining 16% with a total of 7.6 billion m3 in the same period. 38% of the natural gas available (i.e. 18.3 billion m3) was consumed for electricity generation. An increase in domestic lignite consumption would mean a decrease in the consumption of natural gas for generating electricity. To illustrate, in case a domestic lignite power plant with a capacity of 5,000 MW becomes operational, 5 billion m3 of imported natural gas would be substituted.

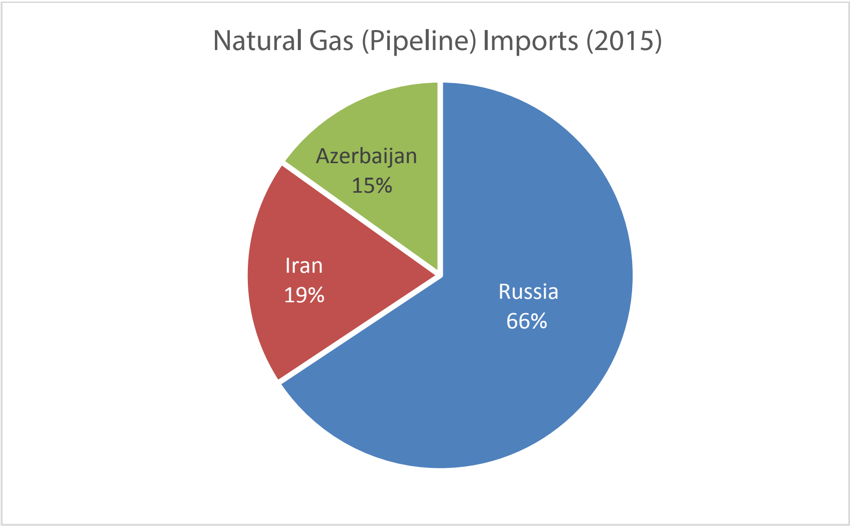

Figure 3.1: Breakdown of imported natural gas by source countries (2015)

The rise in number of renewable energy power plants prompted a proportional scale-down in the concerns of electricity supply security. Even currently, natural gas power plants tend to face possible shut-downs let alone increase in number. Capacity projections foresee that the share of natural gas in electricity generation is going to fall below 30%. Furthermore, when, in the near future, Iraqi gas is imported with a maximum annual capacity of 10 billion m3, the TANAP project is put into effect with a start-up capacity of 16 billion m3, and LNG and storing capacities are advanced, natural gas supply will be further diversified.

On the other hand, even if natural gas flow is not interrupted during transit, high domestic demand may cause electricity cuts since the capacity of pipelines cannot meet the demand in such cases. For example, on biting winter days, in-house use of natural gas rockets and the pipeline capacities prove insufficient. Those days are dubbed as "difficult day" and gas supply to natural gas power plants come to a halt. On those days when electricity consumption is high as well, natural gas power plants become non-operational. Lignite power plants are not vulnerable to that sort of capacity restrictions and, in this sense; they play a significant role in securing supply.

Due to aforementioned reasons, domestic lignite power plants, along with other renewable power plants, should be supported with a view to maintaining supply security since they are not affected by political developments in other countries.

3.1.2 Creating Employment Opportunities

In imported lignite or natural gas power plants, the fuel needed is outsourced. So, the costs of workforce employed in the phases of mine exploring and operation are a component of fuel price paid to the source country.

Thus, employment in these phases rests in exporting countries. For example, usage of lignite in imported lignite power plants means contributing employment in the mining sectors of Colombia, South Africa, and Russia. Similarly, gas firing in natural gas power plants helps create employment opportunities in gas exploring and distribution fields in Russia, Iran and Azerbaijan.

Therefore, natural gas and imported lignite power plants are in need of workforce only for the operation and maintenance of the power plant, whereas domestic power plants create employment not only for the operation and maintenance but also for the pits. To paraphrase, numbers of employees recruited by different types of power plants with a capacity of 600 MW are as follows:

- Natural gas power plant: 60 employees
- Imported lignite power plant: 370 employees
- Domestic lignite power plant: 1,100 employees
    - Electricity plant: 600 employees
    - Pits: 500 employees

In other words, domestic lignite power plants recruit 1.83 employees per MW, while the figures are 0.6 and 0.1 for imported lignite power plants and natural gas power plants respectively.

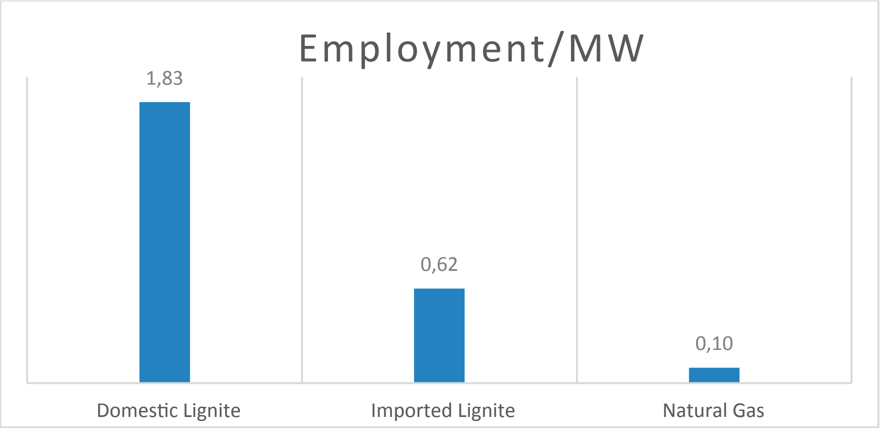

Figure 3.2: Direct employment figures in power plants

From this standpoint, if a mine site overseas is bought and Turkish nationalities are employed therein, then the "imported lignite" is partly nationalized. Nevertheless, the procurement of supplies and needed services requires outsourcing and ends up in paying taxes to relevant countries.

On the other hand, since underground mining is more labor-intensive and necessitates working in tougher conditions and under death risks, it is highly controversial whether increasing or decreasing employment in underground mines is preferable for social welfare.

Judging from this point of view, one may argue that it is more rational to augment the use machinery in underground mines, lessen the number of workers underground, and import lignite in order to get rid of the risks of all mining activities. As a long-standing practice, the developed countries outsource labor-intensive goods incorporating unfavorable work conditions and fatal risks from countries that have to bear these burdens for economic reasons. In this context, raising lignite production per worker by using mechanized systems ought to be the ultimate target in underground mines. In open-pit mines, however, impact of employment is definitely positive since mining in these sites does not involve risks of an underground mine.

3.1.3 Ensuring Reliable Production

Thermal power plants are indispensable for the whole system in the sense that they help ensure reliable operation of the electricity network and secure technical supply. The same is true for domestic lignite power plants and they basically have the following benefits.

Short-term Balancing (Frequency Control)

Thermal power plants, in cases of instantaneous fluctuations in supply and demand, render primary and secondary frequency services thus helping system frequency remain in reliable ranges. For instance, solar and wind energy productions may change at any moment. So, a thermal power plant needs to align its productivity with solar and wind energy output.

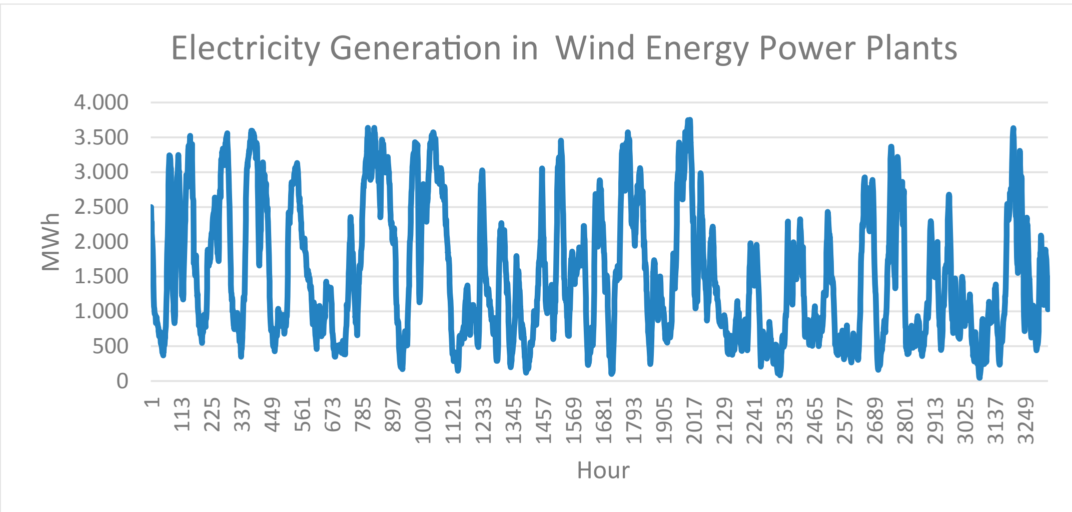

Figure 3.3: Production fluctuations in wind energy power plants in the first 4 months of 2016

In the first 4 months of 2016, wind energy power plants with a total capacity of 4,648 MW peaked at 3,750 MW in some hours and hit the bottom at 44 MW in some others (See Figure 3.3).

Adept management of fluctuations by the system requires the fact that a thermal power plant has to position itself according to wind energy production. With this feature, thermal power plants contain the relevant spare capacity to incorporate new renewable energy power plants into the system.

When compared to domestic lignite power plants, hydro power plants with reservoirs and natural gas power plants are more flexible in terms of recovery from instantaneous fluctuations. But domestic lignite power plants function on the basis of base-load and can load/unload up to 20-50% of their whole capacity with the aim of balancing.

Long-term balancing

Thermal power plants, besides helping recover sudden unbalances in renewable power plants, are needed for long-term balancing. For instance, with its hydraulic capacity of 26,000 MW, Turkey's annual electricity generation may vary from 57 billion kWh to 80 billion kWh. In this sense, big installed capacity in renewable power plants doesn't necessarily entail high rates of reliability. Since generation in renewable power plants change in months and years, keeping spare capacities is essential. Thermal power plants duly function to this end and are fundamental for the system.

3.1.4 Reducing Importation

Turkey's total energy imports in 2014 were worth 54.9 billion USD. The decline of oil prices cut this figure down to 37.8 billion USD. Medium Term Program foresees 33 billion USD-worth of energy imports in 2016. The share of energy in Turkey's total imports is shown in Figure 3.4.

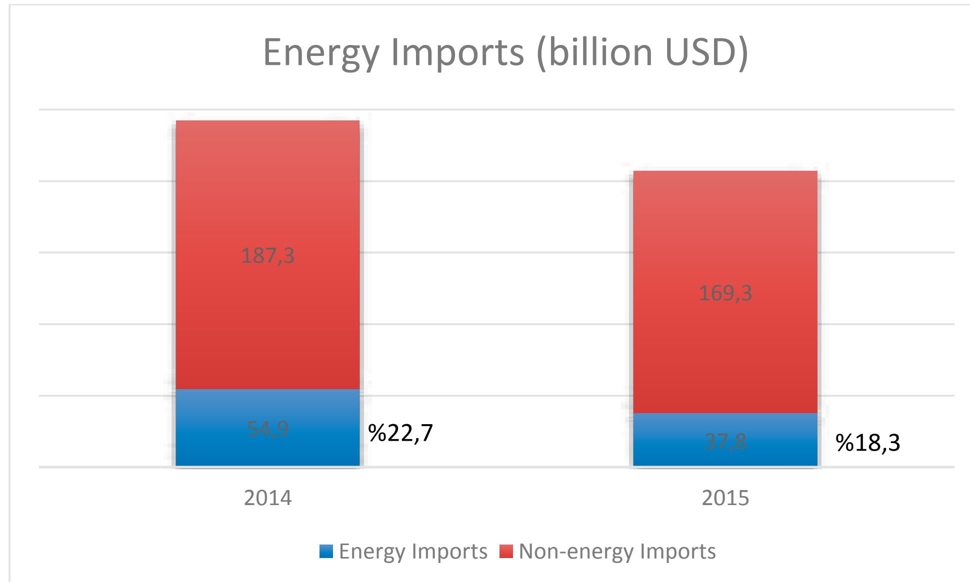

Figure 3.4: Share of energy in total imports

According to the current situation, as natural gas power plants are the marginal producers, a possible increase in electricity generation from domestic lignite will act as a substitution for natural gas power plants thus dropping Turkey's need for natural gas in the long term.

In 2014, 23.4 billion m3 of natural gas were consumed in electricity-generating power plants[14] and 120,576 GWh of electricity was produced. In the year 2015, 18.3 billion m3 of natural gas were fired to generate 98,326 GWh of electricity. Average efficiency of natural gas power plants scored 50.5%. This percentage is not the intended efficiency rate and includes efficiency losses emanating from start/stopes and loading/unloading.

Under normal circumstances, in a natural gas power plant with a 59% efficiency rate, the average gas consumption for generating 1 MWh of electricity is 159 m3. Natural gas power plants in Turkey, however, have an average of 186.1 m3/MWh. Therefore, this national average figure will be taken for comparisons.

Table 3.3: A comparison between 1000 MW domestic lignite power plant* and other power plants

	Domestic Lignite	Imported Lignite	Natural Gas	Natural Gas (Turkey average)
Net Efficiency	34%	%40	%59	%50,5
Electricity Production (net)	6.132 GWh	6.132 GWh	6.132 GWh	6.132 GWh
Calorific Value	1.000 – 5.500 kcal/kg	6.000 kcal/kg	9.155 kcal/m3	9.155 kcal/m3
Fuel Consumption	...	2,2 million tons	977 million m3	1,14 billion m3
Fuel Price	...	~55 $/ton	~180 $/1000m3	~180 $/1000m3
Fuel Imports	-	$121 million	$176 million	$205 million

*80% capacity factor, 12.5% domestic consumption.

As seen in Table 3.3, a domestic lignite power plant with an installed capacity of 1000 MW cuts natural gas importation down by 1 billion m3 with a value of 176 million USD. An accurate analysis cannot be carried out as to whether this reducing effect helps make up the foreign trade deficit simply because one cannot calculate precisely to what extent an increase in electricity prices due to subsidies would affect competitiveness and export revenues.

3.2 Subsidy Mechanisms

3.2.1 Subsidizing Investments

Subsidizing certain sectors and providing exemptions are among practiced methods as far as supporting investments is concerned. Decree No: 2012/3305 of the Council of Ministers includes domestic lignite power plants in the list of prioritized fields of investments. In line with the said Decree, domestic lignite power plants enjoy 5th Region subsidies. These subsidies are:

- Exemption from added value tax,
- Exemption from customs tax,

14 EPDK, Sectorial Report on Natural Gas, 2014.

- 70% discount in corporate tax,
  - up to 30% of the investment cost if it does not exceed 1 billion TL,
  - up to 40% of the investment cost if it exceeds 1 billion TL,
- Interest support (TL 5%, foreign currency 2%)
  - up to 700,000 TL,
- Support for employer's share in insurance premiums,
  - 6 years for investments after 01.01.2016,
  - up to 35% of fixed investment.

Also, advantages offered by Electricity Market Law and relevant other legislation are as follows:

- Pre-license application fee for domestic lignite power plants is 1% of the company's minimum capital whereas the same fee is 5% for other power plants.
- License application fee for domestic lignite power plants is 5% of the company's minimum capital whereas the same fee is 20% for other power plants.
- Domestic power plants have priority in case of numerous applications.
- 85% discount applies in forest permits of the power plant and its facilities concerned during the first 10 years of investment and operation. "Tax for Supporting Forest Villagers" and "Tax for Forestry and Erosion Control" are waived. (only for power plants to be operational until 31.12.2020).

To sum up, domestic lignite power plants are prioritized in terms of investments and enjoy all support and subsidy mechanisms.

3.2.2 Guaranteeing Purchase and Price

The first method that springs to mind about subsidizing domestic lignite power plants is fixed price guarantee (feed-in tariff) as we know it from Renewable Energy Resources Support Mechanism (RESUM). Notwithstanding its advantages for a forward-looking investor, it should be the last resort as it harms a liberal market mechanism.

The projects that have purchase guarantees with a fixed price for a certain while are the ones that are most easily financed by financial institutions. The logic is simple. Future cash inflows are not based on price estimations which may cause deviations but are under government guarantee. As a corollary, investors don't have to run the risk of being affected by future cash inflows and they feel comfortable in their decisions to invest.

However, this method is the chief obstacle to the development of a liberal and competitive electricity market in Turkey. Long-term contracts of the Turkish Electricity Trading and Contracting Co. (TETAŞ) and long-term feed-in tariffs as foreseen in RESUM reduce the trade volume in the free markets. Likewise, feed-in tariff for domestic lignite power plants decreases the liberal market's volume. This very fact bears the risk of transition from a liberal electricity market into a structure where electricity is sold and bought on tariffs.

Even currently, an overwhelming majority of matching amounts in DAM (~9,400 MW) consists of zero-price offers, i.e. offers independent of the price, just because of TETAŞ power plants, renewable power plants and lignite power plants that have to carry on producing. As you see in Figure 3.5, in the first 5 months of 2016, the proportion went up to 74%.

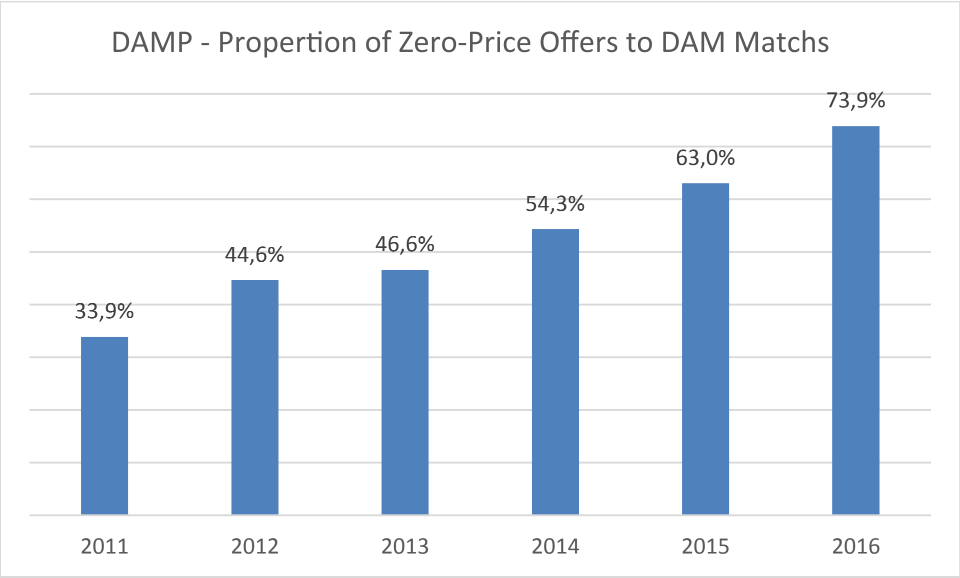

Figure 3.5: Proportion of zero-price offers to DAM matches

In the first 4 months of 2016, 22% of total electricity production is under TETAŞ contracts and 17% is by EÜAŞ, thus leaving 61% on the shoulders of the free market. This being the case, 20.6% of total production in the said period was within the context of RESUM (see Figure 3.6). So, the share of liberal market in the field is around 40%. TETAŞ contracts damage the liberal setup of markets. Hence, by the time these contracts end, it is essential not to draft new ones in order to extend the term or grant purchase guarantees at the risk of hindering progress toward the liberalization of the market.

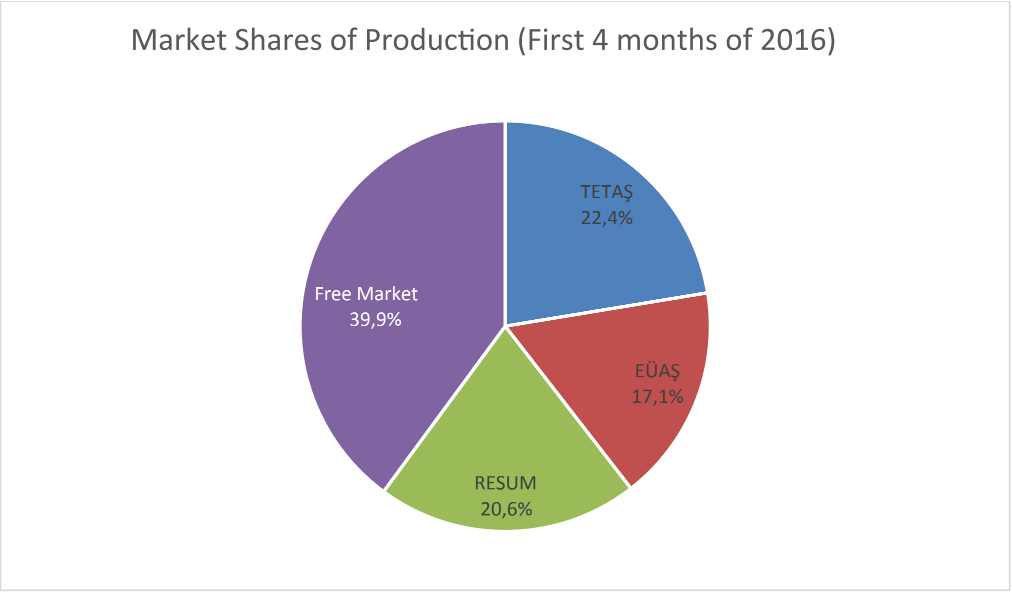

Figure 3.6: Shares of trade volume in electricity market, 2016 (%)

3.2.2.1 Determining Subsidy Prices

Disadvantages of fixing purchase price notwithstanding, if it is decided to do so, the question of determining a calculation formula will arise. It can be formulated according to the criteria below:

I. Consideration of the Reimbursement of Investments

The decision of making an investment relies upon the profitability of the project and the duration of reimbursement. As far as domestic lignite power plants are concerned, the phases of obtainment of administrative permits, improvement of the mine site, commencement of lignite production and the construction of the power plant take at least 6 years, a pretty long while for an investment. During this period, investors constantly tie their money up in the investment but can't bring a penny in until the start-up of electricity generation. This situation increases the costs of investment and the costs of financing at the same time.

Please see below a rough calculation of a purchase guarantee that enables an investment to reimburse in the 10th year after becoming operational. Note that this calculation assumes 3 years of mine site improvement and another 3 years of power plant investment.

The initial phases are research, administrative permits, and mine site investment. Normally, money-pouring starts with power plant investment. So the duration of the investment project is 6 years but the average duration of money inflow is 2 years. Therefore, reimbursement of the power plant in the 10th year after beginning operations would mean the reimbursement of the whole investment in 12 years.

Table 3.4: Model assumptions

Financial Parameters	Unit	Amount
Costs of Mine Investment	$	300 million
Coasts of Power Plant Investment	$	1.100 million
Equity	%	30%
Credit Interest Rate	%	4,0%
Alternative Revenue	%	4,0%
Duration With No Reimbursement	year	6
Reimbursement	year	10
Purchase Guarantee Price (first 10 year)	$/MWh	?
USD Exchange Rate	$/TL	3,0

Teknik Parametreler		
Installed Capacity	MW	1.000
Net Capacity	MW	880
Operation Hours (yearly)	hour	7.500
Net Efficiency	%	34%
Coal Production Costs (0,027 TL/kcal)	$/kcal	0,009
Non-Coal Operating Costs	$/MWh	12,6
TEİAŞ, Incwance, Forrest Fees	$/MW/year	14.322

Based on assumptions shown in Table 3.4, a possible reimbursement in 10 years after becoming operational necessitates the electricity price to be 6.6 cent/kWh during the first 10 years. For 8 years, the price needs to be 7.2 cent/kWh.

Since the main factor determining the production cost of a lignite power plant is the lignite price, guaranteed purchase price relies chiefly upon the costs of lignite production. The following chart indicates various guaranteed purchase prices which correspond to changes in the costs of lignite production. As the major factor in deciding lignite price is its calorific value, the costs are shown as TL/kcal.

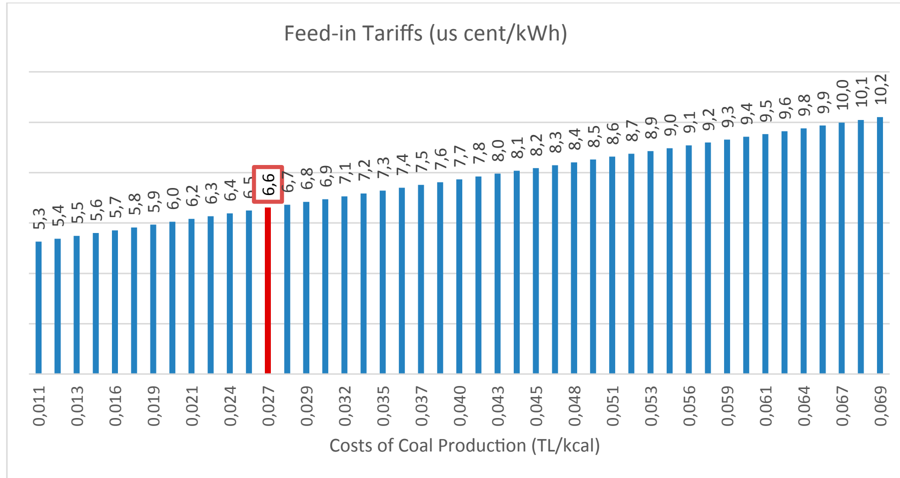

Figure 3.7: Feed-in tariffs based on cost of lignite production (USD cent/kWh)

Figure 3.7 demonstrates that in a mine site where the cost of lignite production is 0,027 TL/kcal (40 TL/ton @ 1.500 kcal/kg), the guaranteed purchase price is 6.6 cent/kWh. In another mine site where the cost of production is 0,040 TL/kcal (60 TL/ton @ 1.500 kcal/kg) the figure needs to be 7.7 cent/kWh. An approximate calculation makes us conclude that every 0.001 TL/kcal change in the cost of lignite production affects the guaranteed purchase price by 0.084 cent/kWh.

Besides having various costs of lignite production, domestic lignite power plants have varying costs of mine site investments. Guaranteed purchase price is supposed to meet these costs as well. In the base scenario, $300 million USD is taken as the costs of mine site investment. Changes in these amounts and corresponding changes in guaranteed prices are shown in Figure 3.8.

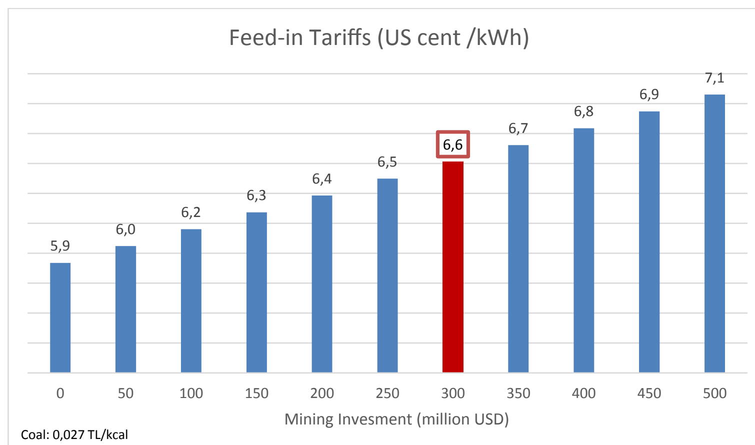

Figure 3.8: Feed-in tariffs based on costs of mine site investments

Additional $50 million USD-worth slices of investments in mine sites, together with financing costs, entail an increase of 0.1 cent/kWh in guaranteed prices.

II. Future Price Expectations

The guaranteed purchase price of a given product should not vastly exceed the market price. Otherwise, the additional cost created by subsidies will be above the level that the consumers can normally carry. Currently, the less the electricity price is, the more the burdensome costs to support RESUM power plants for the citizens is.

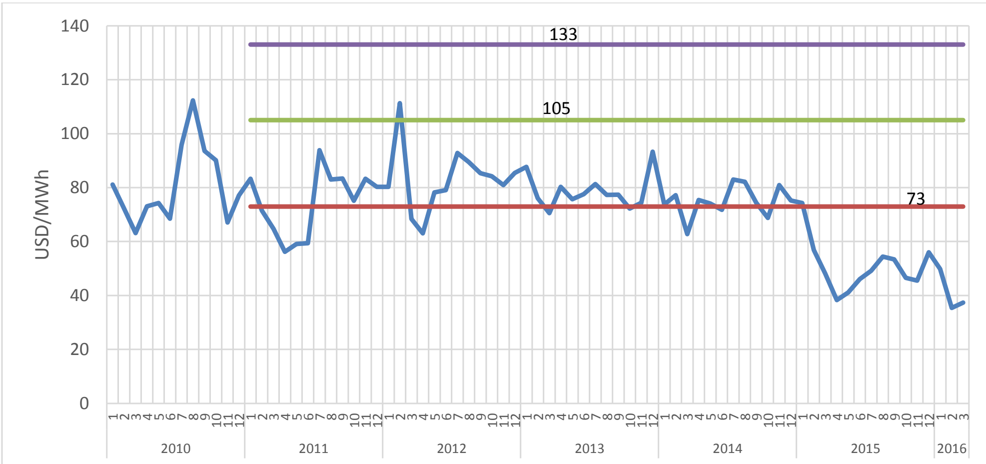

Figure 3.9: A comparison between monthly subsidized prices of Renewable Energy Sources and electricity prices

As shown in Figure 3.9, subsidized prices within the context of RESUM helped remove uncertainties in the proliferation process of renewable energy technologies. Electricity price push-downs, however, quite contrarily, cause push-ups in social costs. Average market prices of electricity in 2015 and in the first trimester of 2016 were 5.1 cent/kWh and 4.1 cent/kWh respectively. See Figure 3.10 which shows electricity price drops in years caused by lower demand due to new renewable energy power plants and attainment a certain level of development. This phenomenon can apply to Turkey, a country where usage of renewable energy sources is making headway.

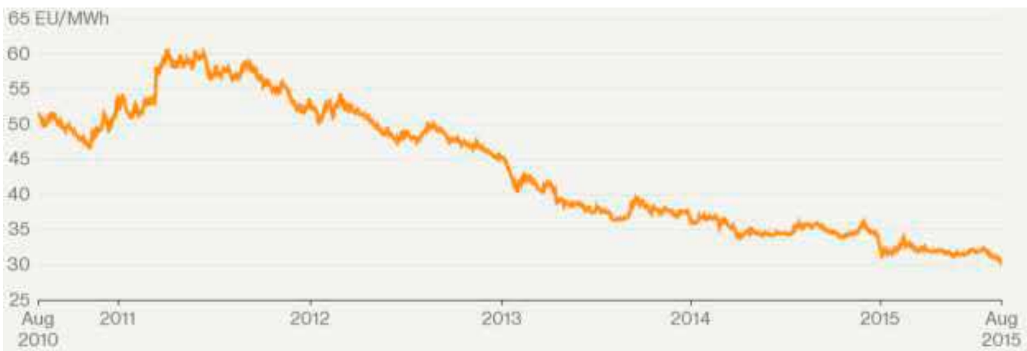

Figure 3.10: One-year term electricity prices in Germany[15].

15 http://www.bloomberg.com/news/articles/2015-08-25/why-do-germany-s-electricity-prices-keep-falling-, 25.03.2016

III. Total Cost of Subsidies

The total cost of price subsidy is the difference between the free market price and the subsidized price. In other words, if the market price is 4 cent/kWh and the guaranteed purchase price is 7 cent/kWh, then the additional 3 cent/kWh will need to be imposed upon other market participants in order to pay the subsidies.

Let’s take a likely scenario. If the guaranteed purchase price in the first 4 months of 2016 for operational domestic lignite power plants had been 7 cent/kWh (~20.5 kuruş/kWh), then the additional cost borne would have been 8.2 kuruş/Kwh and 1.132.344.944 TL in total according to DAM prices. Since the total electricity supply in the same period was 88.682.156.167 kWh, the cost of subsidy carried by market participants would have been 1.28 kuruş/kWh. Currently, as market prices are low, domestic lignite power plants reduce their loading activities at nights and delay resuming operation after technical hitches. When the prices are subsidized, however, they aim maximum production thus increasing the costs of subsidies. In the aforementioned period, although the installed capacity of domestic lignite power plants is 9,848 MW in total, average production per hour was 4,766 MWh.

In 2015, the average electricity price was 13.8 kuruş/kWh (5.05 cent/kWh). That year, if all of the electricity generated in domestic lignite power plants (i.e. 34.4 billion kWh) had been purchased at 7 cent/kWh, then an additional payment worth 671 million USD would have been made to lignite power plants and the additional burden for market participants would have been 0.69 kuruş/kWh (0.25 cent/kWh). In the same period, average production per hour in domestic lignite power plants was 3.922 MWh. If per-hour generation in these plants had been 7,000 MWh, then the additional burden would have been 1.23 kuruş/kWh (0.45 cent/kWh) totaling 1.2 billion USD.

As RESUM practices show clearly, any rise in number of subsidized power plant capacity will entail bigger additional costs. To give an example, in the first trimester of 2016, 13 billion kWh of RESUM generation with a total market price of 1.5 billion TL was subsidized by paying 2.98 billion TL and the additional cost was 1.45 billion TL. In this very period, average price transferred to RESUM power plants was 22.9 kuruş/kWh while the average DAM price was only 12.1 kuruş/kWh. The total electricity supply in this period was 67.2 billion kWh and the additional RESUM cost per consumer was 2.15 kuruş/kWh.

IV. Preserving Free Market Capacity

As far as fixed price guarantees are concerned, for the sake of keeping free markets undamaged, the guaranteed purchase prices should be below market prices and subsidized power plants should not harm the merit order. Although guaranteed purchase prices for RESUM power plants are above market prices, this practice of subsidizing does not alter the merit order due to the lack of fuel costs. Nevertheless, natural gas power plants that have TETAŞ contracts disturb the merit order and adversely affect the liberal market.

On the other hand, taking into account the fact that current market prices fall short of stimulating investments, keeping total subsidized capacity below a certain level would be an alternative solution. The shares of TETAŞ, EÜAŞ and RESUM are 22%, 18.3% and 19.7% respectively which leaves the remaining 40% in the hands of competitive market. Free market’s share will go up to 75% following the termination of TETAŞ contracts and the privatization of EÜAŞ.

Keeping these figures is essential for the liberalization of the market and the determination of prices under competitive market conditions. Otherwise, we will have to face the risk of creating an environment where power plants sell electricity on fixed tariffs and not at prices agreed in a competitive market.

V. Conclusion

In conclusion, guaranteeing fixed price prolongs the liberalization process of the electricity sector. So, it should be the last resort. Please see below in Table 3.5 a scenario in which the effects of guaranteeing price in a 5,000 MW domestic lignite power plant are shown.

Table 3.5: Effects of guaranteeing price in a 5,000 MW domestic lignite power plant

Assumption	Reduction of Fuel Importation	Additional Cost on Markets	Effect on Free Market Volume	Effect on DAM Prices	Effect on Consumer Prices
In case the merit order is violated	-	-	Additional TETAŞ/EÜAŞ contracts for 30.7 billion kWh, decreasing of market volume by 11.6%**	-	-
In case the merit order is NOT violated	Decrease in natural gas importation by ~5 billion m3 and $879 million.	$613 million annually, 0,23 cent/kWh**		Low DAM prices	High tariffs 0,23 cent/kWh* and taxes

* In case the purchase guarantee is above the average market price by +2 cent/kWh.
** According to market volume of 2015.

3.2.3 Additional Price

This method involves supporting domestic lignite power plants by applying the formula of "Market Price + X". In this method, power plants are not granted price or purchase guarantees but they are provided with additional income as long as they continue producing.

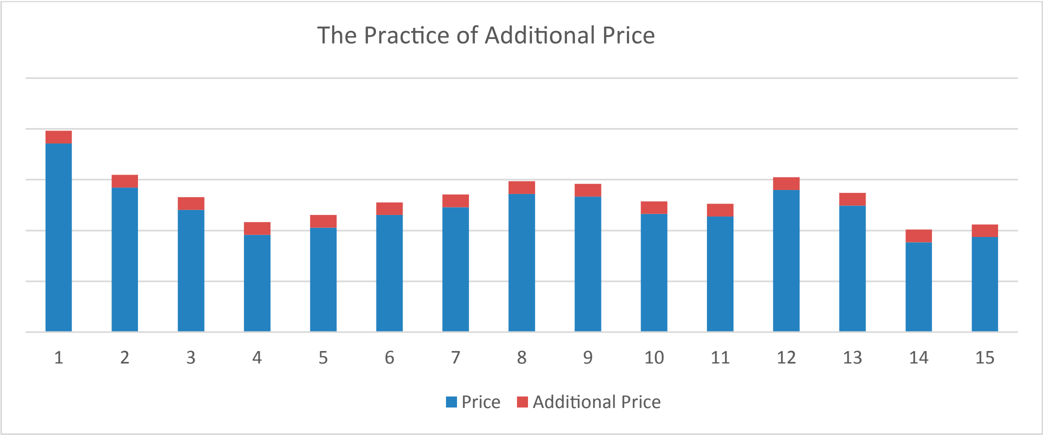

Figure 3.11: Additional price method

Owing to the lack of purchase guarantee, the power plants need to sell their products under bilateral contracts or in the wholesale market. For that reason, this method distorts the free market less than guaranteeing prices do.

As subsidizing by this method is per kWh generated, generation in larger amounts will result in more subsidies. This encourages the availability of power plants and their operation.

Additional price can be determined either as a fixed amount or as a percentage of the market price. For instance, if it is decided as +3% of the market price, then it would mean more subsidizing when the prices are high, and vice versa. By doing so, production in high hours is encouraged and supported.

This method renders unnecessary support for power plants when the market prices are already high but duly supports them when the market prices are down. Taking this into account, a couple of restrictions may be applied to ensure due practice of the method. Among possible restrictions to this end are setting a market price threshold like "7 cent/kWh and under" and determining a fixed total amount that will be granted to each power plant.

Notwithstanding its advantages, this method does not provide fixed cash inflow as the method of purchase guarantee does, and leaves the power plants prone to the risk of market price. So, the costs of financing are higher than those of the former method. To give an example, purchase guarantee price at 6.6 cent/kWh and the price with additional price subsidy at 7.4 cent/kWh[16] are two equivalent scenarios. The difference, i.e. 0.8 cent/kWh, stems from higher credit interests on the grounds of uncertainty and from the rise in alternative income rates due to the risk borne.

In conclusion, the subsidy in the form of additional price is determinable by adding "X cent/kWh" to the difference between the guaranteed purchase price and the approximate market price. On the other hand, if we pursue the aim of reducing the duration of investment to 8 or 10 years, total costs will be higher than the purchase guarantee method. However, if the overriding aim is to keep the existing power plants in the game then this method stands applicable.

Table 3.6: Assessment of the impacts of additional price (for 5.000 MW)

Assumption	Reduction of Fuel Importation	Additional Cost on Markets	Effect on Free Market Volume	Effect on DAM Prices	Effect on Consumer Prices
In case the merit order is violated	-	-	Declining of bilateral contracts. Increase in DAM volumes.	-	-
In case the merit order is NOT violated	Decrease in natural gas importation by ~5 billion m3 and $879 million.	$613 million annually, 0,23 cent/kWh**		Low DAM prices	High tariffs 0,23 cent/kWh* and taxes

* In the case the additional price is +2 cent/kWh higher than the average market price
** According to the market volume in 2015

16 On the assumption that the credit interest is 7% and the alternative income is 9%.

3.2.4 Procurement Quotas (Capacity Liability)

Procurement quotas involve imposing an obligation on the shoulders of the supplier to procure a certain amount of the electricity they sell in the market by prior purchase of capacity. For example, the liability of suppliers to buy 10% of the total electricity they sell to end users from domestic lignite power plants is among the practices of procurement quotas. RESUM prioritizes this method to the methods of purchase guarantee and price guarantee.

This method needs to be complemented by certificate market. Suppliers can honor their quota obligations by purchasing either electricity or certificates. Let's take the scenario in which the suppliers are under the obligation of buying 10% of the total electricity they sell to end users from domestic lignite power plants. In that case, certificate fees approach "0" if the supply is sufficient in the market. If the supply is insufficient, however, they approach the fines. For example, assuming that the fine levied by the relevant certification authority for not honoring procurement quotas is 7 cent/kWh, the suppliers in such a scenario will try to ink deals with lignite power plants at a price lower than 7 cent/kWh. When the supply is sufficient, the trade is conducted at a price close to the market prices.

With the imposition of procurement quotas or liability of bilateral contracts, domestic lignite power plants compete only with each other and can fix their selling prices under annual bilateral contracts to be signed until the quotas are fully met.

Although this method stimulates conclusion of bilateral contracts in line with the quotas, subsidizing investment by this method is not as efficient as the purchase guarantee method owing to uncertainties in both the market prices and the certificate fees.

Table 3.7: Impact assessment of a 10% quota of procurement from domestic lignite power plants

Impact on the Market	Impact on the Free Market Volume	Impact on DAM Prices	Impact on Consumer Prices
Certificate fees to be paid. Lignite Power plants have the upper hand in contracts.	Increase of bilateral contracts. Declining of DAM volume.	Low DAM	High tariffs (Certificate fees added).

3.2.5 Establishing a Capacity Market

An electricity generation power plant carries high investment costs and goes through a time-consuming establishment process. For this very reason, in times of supply shortage and high electricity prices, putting a new supplier in the game is no possible. So, in systems which the electricity prices fail to encourage new investments, capacity markets need to be established to cover a couple of years ahead.

In this method, upon a rough estimation of peak load for, say, the third year from now, capacity price quotes are obtained from all power plants that are supposed to be functioning in that year. In the case that 45,000 MWs of peak load is needed, then the quotes are received from power plants that are already operational or will start operating in 3 years and these power plants are paid additional capacity fees.

By doing so, capacity planning for the following 3 years is also done on an annual basis thus reducing the risk of supply shortfall. Also, corrective tenders in these 3-year periods enable failing power plants to transfer their liabilities unto other willing ones.

By virtue of capacity markets, electricity generation power plants receive grants not only for the electricity they generate but also for the capacity they create in the market. In times of supply surplus they are subsidized more, and vice versa. This method is not entitled to support domestic lignite power plants directly but provides a certain income for all power plants.

Along with long-term capacity markets, there exists a need for stand-by power plants destined to operate for a short while in times of huge demand for electricity. These substitute power plants have lower fixed costs but higher fuel costs and operate only dozens of hours throughout the year. Their fixed costs should be met as well. Within the context of this practice, as we know from fuel-oil power plants in the past, the power plants that step in when the demand for electricity peaks receive additional subsidies to meet their annual fixed costs. Bearing the rationale behind supporting stand-by power plants in mind, we can safely conclude that this method is not economically feasible for domestic lignite power plants with high fixed costs and low variable costs but aims to support liquid-fuelled or natural gas power plants that can easily conduct operation for a short span of time.

On the other hand, in a market where the share of renewable power plants is constantly growing, there is an increasing need for reliable capacity against a fall in electricity prices. For that, on the grounds of supply security, a new mechanism may be activated by which additional reliability grants are awarded to the power plants supplying constant and reliable capacity to the market. For instance, granting additional X TL/MW to the power plants operating in peaks hours when the total demand exceeds 36,000 MW will both enhance supply security and guarantee a certain amount of fixed costs of these power plants.

In conformity with relevant legislation in effect, it is possible either to establish a separate capacity market or go out to capacity tenders within the context of ancillary services.

Table 3.8: Impact assessment of capacity markets

Impact on Producers	Impact on the Market	Impact on DAM Prices	Impact on Consumer Prices
Income guarantee. Meeting some of the fixed prices from outside the market.	Securing supply and planning. Payment of Capacity/ Reliability grants within the context of Capacity Market / Ancillary Services. Reducing the risk of electricity price in peak hours.	Low DAM price. Preventing very high prices in peak hours.	Payment of capacity fees balances very high prices in peak hours.

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3.2.6 Subsidizing Existing Power Plants and Private Mining Sites

On account of long durations of investment, subsidizing new domestic lignite power plants means winning markets new supply sources only after 7 years. In the meanwhile, synchronous steps should be taken to incorporate new mine sites and assure uninterrupted functioning of existing domestic lignite power plants.

The difficulties that domestic lignite power plants come up against can be summarized as follows:

- Feasibility analyses done in the privatization process estimate electricity prices at 8-9 cent/kWh (based on projections of international consulting firms, etc.) and valuation of the power plant is done accordingly. But current electricity prices, i.e. 4 cent/kWh, render financing costs unaffordable.
- The fact that privatized domestic lignite power plants are older than 30 years old brings on the following:
  - o Opt-repeated technical problems cause low rates of availability and capacity factors
  - o Low rates of efficiency.
  - o Investment process (cash inflow) continues on grounds of revision which results in lengthy pauses and losses in production.
- In power plants privatized under royalty fees per kWh;
  - o Royalty rates increase by official annual Producer Price Index although electricity prices keep going down both in TL and USD.
  - o Proportion of royalty fees rises contrary to declining electricity prices.
- Lignite production costs may soar after the tender owing to additional costs levied upon the mining sector (base fares, reduction of working hours, etc.).
- Unpredicted management conditions and unexpected reserve structure may lead to higher production costs than planned.

In order to get through these difficulties and continue production, the domestic lignite power plants that suffer hardships regarding management and financing need to be supported by;

- ✓ reducing production in TETAŞ power plants, in the short term, and keeping electricity prices close to the free market price
- ✓ paying annual capacity (or reliability) grants, in the medium and long term, to domestic lignite power plants offering reliable generation within the context of capacity markets and ancillary services.

Apart from opening tenders for new power plants and privatizing existing ones, a third segment is fully private-sector domestic lignite power plants. These sorts of power plants become operational with a view to using products of lignite power plants in the electricity sector and they are not public-owned power plants. Corollary to this, subsidies and tenders for them are out of the question. However, in order to nurture these plants and ensure their swift incorporation into the market, results of tenders for new lignite mine sites can be taken as a basis. For instance, let's assume that the winning price is 6.5 cent/kWh in a tender made for mine site where lignite extraction cost per calorie is 0.027 TL/kcal. In that case, purchase guarantee may be offered to private-sector domestic lignite power plants in line with the proportion of lignite extraction cost per calorie to 0.027 TL/kcal and under the same conditions and for the same periods.

4. PRIVATIZATION MODELS

Hard coal is consumable both in electricity generation power plants and in the fields of heating and industry. Lignite, however, can be fired only for the purpose of generating electricity. For this very reason, lignite mine sites are economically valuable only for the aim of erecting electricity generation power plants. Hence, the main purpose in the privatization model of these sites is to determine the type of payment that investors will have to make in order to be entitled to operate in these sites and construct power plants thereon. Privatization models may be as follows:

1. One-off payment
2. Paying per kWh
3. Reducing the purchase guarantee price.

One-off payment encourages the investor to spring into action whereas paying per kWh doesn't lead up to that. On the other hand, paying in bits following production is financially preferable for investors. Bearing this in mind, another method ought to be applied so that swift action is encouraged and the investors don't face financial hardships.

One-off payment method has primacy for the sake of predictability and feasibility of investments. In this scenario, the investors endeavor to re-gain the money they paid for privatization by putting the investment into action.

Pre-qualifications should be set and short lists need to be drawn up to enable a successful tender process and ensure swift fulfillment of investments. Besides, estimated costs should be shown in pre-reports of feasibility in order to avoid unrealistic bids that render the investment impracticable. By doing so, bids deviating from the estimated cost to a certain extent may be disregarded.

Table 4.1: Assessment of privatization models

	One-off Payment	Royalty fees per kWh	Reducing the purchase guarantee price
Discarding irrational investors	High	Low	Low
Probability of Non-viability	Low	High	Medium
Risk of electricity prices for the investor	High	Very high	None
Impact on DAM Price	-	High DAM Price	Low DAM Price
Impact on consumer prices	-	High	High

Conclusion of Tenders Pursuant to the Administrative Permits

In several interviews, investors in the sector of lignite power plants opine that the chief obstacle for the realization of investment projects is the prolongation of administrative permit-getting process. Limiting this process will lead up to nimble action in terms of investments.

On the other hand, removing all hurdles in front of investors will surely be a more reasonable attitude rather than granting them permits issued by an administrative body through another public institution. As far as the permits are concerned, whether the applicant is a private-owned or a public-owned entrepreneur should not make any difference. Affirmative or negative replies to applications do not depend on whether the applicants are state-owned or not.

Administrative permits take shape according to the qualifications of investment projects. A sizeable number of permits are not issued without submission of proper plans and projects. EIA Reports for mine sites are obtained only after submitting operation plans, detailed information about storing excavations, etc. In a similar vein, EIA Reports for power plants are filed on the basis of information about electro-mechanic components (pulverized/fluid bed), auxiliary fuel (fuel-oil, natural gas, etc.), power plant settlement plan, storage field, amount of storage, type of the stack gas cleanup system, etc. It is unthinkable to make decisions, on behalf of the investors and incognizant of their projections, on the technology, operation plan, and power plant settlement and expect them to construct power plants accordingly. Otherwise, the government will have to shoulder the burden of planning and projection in addition to the issuance of permits, which is definitely a game-changer.

When compared to state-owned applicants for permits, private-sector applicants prove more active. As they own the projects involved, they act nimbly to solve the problems and make necessary corrections in their plans and projects. Even if the applicant is a public body, it has to hire services of public sector through various consultation firms to obtain IEA reports, development plan, and construction permits etc. Giving the mandate of permit-issuance to the public sector and forming a Coordination Committee that would intervene in times of gridlocks may be an alternative solution.

The obtainment of administrative permits is not the end of the game since they may be annulled by the courts following legal procedures. In the case that an IEA Report or a construction permit is annulled after due issuance and the kick-off of the investment, the government then should compensate the losses. On the other hand, if investing companies take on the legal responsibility after they receive the permits, then the companies carry the risk of these permits altogether. For that reason, it will be more appropriate to leave the mandate of offering permits to the private sector simply for the sake of integrity.

5. CONCLUSION AND RECOMMENDATIONS

That all types of subsidies disrupt the free market is a well-known fact. Therefore, this report recommends minimization of the negative impacts of subsidies on a liberal market and efficient incorporation of domestic lignite power plants into the economy. In a nutshell, the report's recommendations are as follows:

1. Operation plans with international standards should be drafted for each and every lignite basin in order to ascertain economically feasible lignite reserves. Uncertainties regarding the details of reserves need to be eliminated to the extent possible prior to the tenders.
2. Hard coal reserves ought to be prioritized over lignite reserves as every 1 ton of hard coal is equivalent to 4-5 tons of lignite.
3. In the first instance, the sites with lowest lignite production costs should go out to tender. This would bring subsidy prices down to market prices thus limiting the negative effects of subsidies on free market.
4. Purchase at fixed prices should be guaranteed. The recommended price to this end is 6.6 cent/kWh for 10 years.
5. Tenders, carried out with Dutch auction method, need to be made starting with 6.6 cent/kWh. Subsidy prices for efficient lignite sites may fall below this price considerably in the tender process.
6. Diversified conditions should be set for days and nights as well as weekdays and weekends. Hours of supply surplus doesn't need to be subsidized.
7. In issuance of administrative permits, the government should help the process along, instead of granting permits. The Coordination Committee ought to give primacy to the problems of domestic lignite power plants.
8. Necessary steps should be taken to ensure that subsidizing new power plants does not lead up to the phasing-out of existing power plants.
    a. Debts of existing economically viable lignite power plants should be restructured but not written off and unsound bankruptcies should be cut out.
    b. The solution in the short run is to raise electricity prices. Reduction of electricity generation in TETAŞ power plants may help out to this end.
    c. As a long-term solution, additional revenues may be offered to capacity markets and existing domestic lignite power plants.

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