COAL IN THE WORLD AND IN TURKEY
Outlook, geopolitics, policies and future prospects

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REFERENCES
I.
INTRODUCTION
TO
COAL
WHAT IS COAL?

- Coal is a combustible, sedimentary, organic rock, which is composed mainly of carbon, hydrogen and oxygen.

- Coal is a fossil fuel and is the altered remains of prehistoric vegetation that originally accumulated in swamps and peat bogs.

- A form of rock rich in organic carbon.

- Able to be burned as a source of energy.

- Contains; organic carbon, inorganic elements (Fe, Al, CaCO3, trace metals), form ash, water.
COAL FORMATION

How Coal Was Formed

Millions of years ago, dead plant matter fell into swamplike water and over time, a thick layer of dead plants lay decaying at the bottom of the swamps. Over time, the surface and climate of the Earth changed, and more water and dirt washed in, halting the decay process, forming peat. The weight of the top layers of water and dirt packed down the lower layers of plant matter. Under heat and pressure, this plant matter underwent chemical and physical changes, pushing out oxygen and leaving rich hydrocarbon deposits. What once had been plants gradually turned into coal.

Coal can be found deep underground (as shown in this graphic), or it can be found near the surface.
COALIFICATION - RANK OF COAL

CHANGES IN RANK OF COAL

INCREASE IN HEAT AND PRESSURE

INCREASE IN HEAT AND PRESSURE

INCREASE IN HEAT AND PRESSURE

INCREASE IN COAL RANK

PEAT

LIGNITE

SUBBITUMINOUS

BITUMINOUS

ANTHRACITE
CARBON AND HEAT CONTENT OF COAL

Source: Stanley P. Schweinfurth
TYPES OF COAL?

- **Low Rank Coals**: 47%
  - Lignite: 17%
  - Sub-Bituminous: 30%
- **Hard Coal**: 53%
  - Bituminous: 52%
  - Anthracite: 1%

**USES**
- Largely power generation
- Power generation, cement manufacture, industrial uses
- Power generation, cement manufacture, industrial uses
- Manufacture of iron and steel
- Domestic/industrial including smokeless fuel

% OF WORLD RESERVES

Source: World Coal Institute
FINDING COAL

Coal reserves are discovered through exploration activities. The process usually involves creating a geological map of the area, then carrying out geochemical and geophysical surveys, followed by exploration drilling. This allows an accurate picture of the area to be developed.

The area will only ever become a mine if it is large enough and of sufficient quality that the coal can be economically recovered. Once this has been confirmed, mining operations begin.
Coal in the World and in Turkey – Outlook, geopolitics, policies and future prospects, Dr. Nejat Tamzok
Energy Economics, Policy and Security (Master of Arts Program) - Faculty of Economics, Administrative and Social Sciences – Bilkent University

COAL MINING

Underground Mining Methods

Surface Mining Methods

Original land surface

Rock spoil valley fill

Mountaintop mine
Dragline

Contour mine
Dozer

Highwall or Auger mine
Auger or thin-seam miner

Area mine
Dragline

Rock spoil

Coal beds

Drift mine

Slope mine

Shaft mine

Coal elevator
Miner's elevator

Stephen Greb, KGS
USES OF COAL

ELECTRICITY GENERATION

IRON & STEEL PRODUCTION

INDUSTRIAL PLANTS
(e.g. CEMENT FACTORIES)

CHEMICALS
II.

THE PAST, TODAY, AND FUTURE OF COAL

%
SHORT HISTORY OF COAL - I

➢ >2600 years ago in ancient cultures for heating.

➢ 1000 BC: the first known commercial use in China for smelting copper and for casting coins.

➢ Not much use of coal between 400-1200 A.D.

➢ 18th and 19th Century Industrial Revolution: Jump in coal demand. Steam generators, locomotives, and eventually electric generators.

➢ 1910-1920: coal’s share at climax (60%).

➢ 1920-1970: rise of oil, fall of coal.

➢ Mid-60’s: king coal left his throne to oil.

➢ Early 70’s: A new rival for coal, natural gas. Coal’s share drops to 25%.

➢ 1970’s – oil crises: end of the retreat period for coal despite rising environmentalist movements and growing natural gas demand.

World energy consumption by source, 1850- 2014
Data: J. Laherrere 2005, IEA Data Services, IEA Key World Energy Statistics 2005-2013
SHORT HISTORY OF COAL - II

- **Expectation of the past:** When viewed from 80’s or 90’s, it was not easy to predict that the share of coal in the global energy equation will increase in the future. The estimates made were pointing a continuous decline in the global coal consumption.

- **Reality of today:** However, subsequent developments were totally opposite of the expectations. All the predictions pointing out that the global coal consumption entered a period of decline crashed with the twenty-first century. There was an explosion in coal production and consumption. New age would almost be exactly a "Coal Age" from the beginning until today.

- While global energy consumption increased by only 36 percent in the first 13 years of the new century, the increase in coal consumption took place at a much higher level with 63 percent.

- In the same period, the growth rate in the global oil consumption was only 17 percent and the increase in global natural gas consumption was 39 percent.

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*World fossil fuel consumptions, 1999-2014,*

Data: IEA Data Services, IEA Key World Energy Statistics 2005-2014
WORLD TOTAL PRIMARY ENERGY SUPPLY
BY SOURCE (2012)

- Coal 29.0%
- Oil 31.4%
- Natural gas 21.3%
- Nuclear 4.8%
- Hydro 2.4%
- Biofuels and waste 10.0%
- Other 1.1%

WORLD TOTAL: 13.371 Mtoe
COAL’S SHARE: 3.878 Mtoe

Data: IEA
WORLD ELECTRICITY GENERATION BY SOURCE (2012)

- Coal: 40.4%
- Natural gas: 22.5%
- Nuclear: 10.9%
- Hydro: 16.2%
- Oil: 5.0%
- Other: 5.0%

WORLD TOTAL: 22.668 TWh
COAL’S SHARE: 9.158 TWh

Source: IEA
### FUTURE OF COAL

<table>
<thead>
<tr>
<th>Source</th>
<th>Primary Energy</th>
<th>Electricity Generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>24,6</td>
<td>29,0</td>
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<tr>
<td>Oil</td>
<td>46,1</td>
<td>31,4</td>
</tr>
<tr>
<td>Natural gas</td>
<td>16,0</td>
<td>21,3</td>
</tr>
<tr>
<td>Nuclear</td>
<td>0,9</td>
<td>4,8</td>
</tr>
<tr>
<td>Biofuels/waste</td>
<td>10,5</td>
<td>10,0</td>
</tr>
<tr>
<td>Hydro</td>
<td>1,8</td>
<td>2,4</td>
</tr>
<tr>
<td>Other</td>
<td>0,1</td>
<td>1,1</td>
</tr>
</tbody>
</table>

- Weight of fossil fuels in the global energy consumption: 1973: %97,2 and 2012: %91,7
- Fierce competition between the three fossil fuels today and probably for some more decades.
- In the race between fossil fuels in the last century, coal's performance was much higher against its arch rivals, oil and natural gas. Coal has caught a serious chance to recapture the podium.
- The number of analyses pointing out that the coal consumption will pass the oil consumption within a few years has increased each year.

**Primary energy and electricity generation by source, 1973-2012,**
Source: IEA Key World Energy Statistics 2005-2014
## FUTURE OF COAL

### PROJECTIONS ON WORLD TPES BY SOURCE (%)

<table>
<thead>
<tr>
<th>Year</th>
<th>Coal</th>
<th>Oil</th>
<th>Gas</th>
<th>Nuclear</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>29,0</td>
<td>31,4</td>
<td>21,3</td>
<td>4,8</td>
<td>13,5</td>
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<tr>
<td>2040 (IEA New Policy Scenario)</td>
<td>24,3</td>
<td>26,0</td>
<td>24,2</td>
<td>6,6</td>
<td>18,9</td>
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<tr>
<td>2040 (IEA Current Policies Scenario)</td>
<td>29,2</td>
<td>26,6</td>
<td>23,7</td>
<td>5,0</td>
<td>15,4</td>
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<tr>
<td>2040 (IEA 450 Scenario)</td>
<td>16,6</td>
<td>20,7</td>
<td>22,2</td>
<td>10,7</td>
<td>29,8</td>
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<tr>
<td>2040 (DOE/EIA Reference Scenario)</td>
<td>26,8</td>
<td>28,4</td>
<td>23,3</td>
<td>7,0</td>
<td>14,5</td>
</tr>
<tr>
<td>2040 (DOE/EIA High Economic Growth)</td>
<td>31,4</td>
<td>27,3</td>
<td>21,6</td>
<td>6,3</td>
<td>13,5</td>
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<tr>
<td>2040 (DOE/EIA Low Economic Growth)</td>
<td>24,8</td>
<td>28,2</td>
<td>24,2</td>
<td>7,7</td>
<td>15,0</td>
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<tr>
<td>2040 (DOE/EIA High Oil Price Case)</td>
<td>30,2</td>
<td>27,0</td>
<td>22,1</td>
<td>6,5</td>
<td>14,1</td>
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<tr>
<td>2040 (DOE/EIA Low Oil Price Case)</td>
<td>26,8</td>
<td>29,6</td>
<td>22,8</td>
<td>6,8</td>
<td>14,0</td>
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</table>

### PROJECTIONS ON WORLD ELECTRICITY GENERATION BY SOURCE (%)

<table>
<thead>
<tr>
<th>Year</th>
<th>Coal</th>
<th>Oil</th>
<th>Gas</th>
<th>Nuclear</th>
<th>Other</th>
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<tbody>
<tr>
<td>2012</td>
<td>40,5</td>
<td>5,0</td>
<td>22,5</td>
<td>10,8</td>
<td>21,2</td>
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<tr>
<td>2040 (IEA New Policy Scenario)</td>
<td>30,5</td>
<td>1,2</td>
<td>23,7</td>
<td>11,6</td>
<td>33,0</td>
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<tr>
<td>2040 (IEA Current Policies Scenario)</td>
<td>40,3</td>
<td>1,3</td>
<td>24,6</td>
<td>8,8</td>
<td>25,1</td>
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<tr>
<td>2040 (IEA 450 Scenario)</td>
<td>13,1</td>
<td>0,7</td>
<td>16,5</td>
<td>18,4</td>
<td>51,3</td>
</tr>
<tr>
<td>2040 (DOE/EIA Reference Scenario)</td>
<td>35,6</td>
<td>1,7</td>
<td>24,0</td>
<td>14,1</td>
<td>24,6</td>
</tr>
</tbody>
</table>
FUTURE OF COAL

- When we look at its first 13 years, the twenty-first century showed a "Coal Age" feature. During this period, compared with total energy consumption or competitor energy resources, global coal consumption grew much faster. Now the matter of curiosity is how the global energy equation to be shaped in the rest of the century. Will rise of the coal continue at the same rate? Which will be the winner in the competition between fossil fuels? And most importantly, at what level will be the chance to compete with alternative or clean energy sources, for fossil fuels.

- And a final question: Where will coal go?
III.

WORLD COAL INDUSTRY OUTLOOK
WORLD COAL RESERVES

WORLD TOTAL: 892 billion tonnes

Major Coal Deposits of the World

- Anthracite and Bituminous Coal
- Lignite

Source: Encyclopædia Britannica

Anthracite and bituminous 403 BT
Lignite 201 BT
Subbituminous 287 BT
WORLD COAL RESERVES

Data: WEC
WORLD COAL PRODUCTION, 2014

Data: BP 2015, Turkey’s 2014 coal production figure is 70.6 Mtons in BP but 64.1 Mtons in IEA and MENR
WORLD COAL CONSUMPTION BY YEARS

Data: BP
WORLD COAL CONSUMPTIONS, 2014

China: 3.909 million tons
India: 907 million tons
US: 835 million tons
Germany: 236 million tons
Russia: 201 million tons
Japan: 188 million tons
S.Africa: 174 million tons
S.Korea: 133 million tons
Australia: 116 million tons
Turkey: 94 million tons

China: 1.962 mtoe
US: 453 mtoe
India: 360 mtoe
Other: 408 mtoe
Russia: 85 mtoe
S.Korea: 85 mtoe
S.Africa: 89 mtoe
Japan: 127 mtoe

Data: BP
COAL AND ELECTRICITY GENERATION

Coal’s share in global electricity generation by years (IEA current policies scenario)

Coal’s share in electricity generation by countries, 2012

Data: IEA
Main Trade Flows in Seaborne Hard Coal Trade, 2011 (in Mt)

Seaborne trade: 978 Mt
Incl. 739 Mt steam coal
239 Mt coking coal

Global hard coal production: 6.9 Bnt

Source: VDKI, Hamburg 2012 (via David Victor)
WORLD COAL TRADE, 2013

Data: IEA
IV.
GLOBAL GEOPOLITICS OF COAL
1 - Question marks on adequacy and reliability of global coal reserves - Sufficiency problem

Remaining lifespan of fossil fuels (years)
Data: WEC, BP

Lifespan of coal with a consumption rate of 4.5%/y

Coal, Oil, and Gas lifespans over the years.
I - Question marks on adequacy and reliability of global coal reserves - Sufficiency problem

- World coal reserve figures and remaining lifespan of reserves are seriously controversial.

- That the sources used to collect the world coal reserve figures generally not reliable, old dated and that the numbers exaggerated are frequently put forwarded.
II – Control of a small number of country on the large portion of reserves

- Only one country has 26.6% of global coal reserves while this figure is 15.7% for oil reserves and 18.2% for natural gas reserves.

- Ten countries have 91.1% of global coal reserves while this figure is 85% for oil reserves and 79.1% for natural gas reserves.

Data: WEC
WORLD COAL PRODUCTION AND CONSUMPTION

III – Axis shift in production and consumption geographies

Shift in the production geography

- While US and EU-27 aggregate share in the global coal production was 44% and Asia-Pacific share was 31% in 1985, this table has reversed today and the shares of parties have been 17% and 69% respectively.
- While US and EU-27 aggregate share in the global coal consumption was approximately 45% and Asia-Pacific share was 32% in 1985, the shares of parties have been 19% and 72% today.

Data: BP
IV – Weak competition in global coal markets

- Increasingly greater portion of global coal production is collected in the hands of a smaller number of countries.

- While approximately 86% of total coal exports made by only 8 countries in 1991, over 90% is made by only 8 countries today.

- The effectiveness of a small number of multi-national companies in the global coal markets is much greater extent than many other commodity markets. Most of the world coal trade is under the control of few large firms.

- World coal trade seem to be stuck in a monopoly of only 10 countries and an economic union. Five of the ten countries are the exporters and the other five and EU-27 are the importers.

**Shares of top eight countries in global coal market**

<table>
<thead>
<tr>
<th>Country</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kazakhstan</td>
<td>100</td>
</tr>
<tr>
<td>Canada</td>
<td>90</td>
</tr>
<tr>
<td>S. Africa</td>
<td>80</td>
</tr>
<tr>
<td>Colombia</td>
<td>70</td>
</tr>
<tr>
<td>US</td>
<td>60</td>
</tr>
<tr>
<td>Russia</td>
<td>50</td>
</tr>
<tr>
<td>Australia</td>
<td>40</td>
</tr>
<tr>
<td>Indonesia</td>
<td>30</td>
</tr>
</tbody>
</table>

Data: BP
Coal prices have fluctuated in a very narrow range until 2004. As of that year both steam and coking coal prices entered into a rapid rising period.

While coal prices were almost constant in a 16-year period between 1988 and 2003, since 2004 coal has seen unusual price increases in its 200-year history.
V.

COAL, ENVIRONMENT AND TECHNOLOGY
The relationship between the use of coal and CO2 emissions, Data: BP

Mankind cannot give up to use coal.

However, coal mining and coal utilization are the set of activities that also have an impact on the environment in all stages and that cause pollution at certain levels.

CO2 emissions that emerge as a result of burning coal and that cause global warming is the most important problem arising from coal today.

In what way the effects of coal causing global warming can be eliminated, is one of the most important world issues today.
CLIMATE CHANGE DEBATE, TECHNOLOGY ISSUES, AND THE FUTURE OF COAL

I – CO2 emissions

65% of world CO2 emissions are emitted by five countries and EU-27.

44% of world CO2 emissions arise from the use of coal.

71% of coal-sourced CO2 emissions is from electricity and heat production.

Data: IEA, BP
II – Reducing CO2 emissions through improved efficiency and CO2 capture at coal-fired pp

Average worldwide
30%
1,116 g CO2/kWh
480 g coal/kWh
EU
38%
881 g CO2/kWh
379 g coal/kWh
State-of-the-art
45%
743 g CO2/kWh
320 g coal/kWh
Steam power plant
700°C technology
about 50%
669 g CO2/kWh
288 g coal/kWh
CCS technology
But: Efficiency loss of 7 to 12 points

-13%
-27%
-34%
-90%

Coal in the World and in Turkey – Outlook, geopolitics, policies and future prospects, Dr. Nejat Tamzok
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The future direction of coal, in large part, will depend on the developments that took place on its competing energy sources. However, when viewed from today, the main factors that will determine the future of coal are likely to arise from its own internal dynamics of the coal industry.

In this context, it is only possible to make an analysis related with the future of coal that played a decisive role on the world economies for almost two hundred years by examining a number of parameters that are separated from each other, but constantly interacting with one another by the cause-and-effect relationships and that can be collected under the topics of geopolitics, environment and technology.
VI.
TURKEY’S COAL INDUSTRY OUTLOOK

Soma Coal Mine, Turkey
VI.I.
TURKEY’S ENERGY DEMAND AND COAL

Muğla Milas Mine, Turkey
### TOTAL PRIMARY ENERGY CONSUMPTION BY SOURCES

#### Mtoe

<table>
<thead>
<tr>
<th>Year</th>
<th>Natural gas</th>
<th>Oil</th>
<th>Domestic coal</th>
<th>Imported coal</th>
<th>Hydro</th>
<th>Wood-waste</th>
<th>Other</th>
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<tbody>
<tr>
<td>1973</td>
<td>0.0</td>
<td>12.6</td>
<td>5.2</td>
<td>0.0</td>
<td>0.2</td>
<td>6.4</td>
<td>0.0</td>
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<tr>
<td>1983</td>
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<td>17.5</td>
<td>7.9</td>
<td>1.0</td>
<td>1.0</td>
<td>8.1</td>
<td>0.3</td>
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<td>1993</td>
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<td>2003</td>
<td>19.5</td>
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<td>10.4</td>
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<td>3.0</td>
<td>5.7</td>
<td>0.6</td>
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<tr>
<td>2013</td>
<td>37.6</td>
<td>33.9</td>
<td>14.3</td>
<td>20.3</td>
<td>5.1</td>
<td>4.3</td>
<td>1.3</td>
</tr>
</tbody>
</table>

#### Consumption growth rate

- Consumption growth rate is 43% in the last ten years and 100% in the last twenty years.
TOTAL PRIMARY ENERGY PRODUCTION BY SOURCES

Data: MENR

Production growth rate is 34% in the last ten years and 21% in the last twenty years.
ENERGY PRODUCTION, CONSUMPTION AND COAL’S SHARE IN TURKEY

- Turkey’s energy production could be increased by 21% in the last twenty years while country's energy consumption rose by 100%. The increase in coal production is 34% in the last two decades.

- Therefore, growth rate increase in energy production is significantly behind that of energy consumption. The ratio of domestic production to consumption has fallen under 27% in 2013 while it was 44% twenty years ago.

- Likewise, the ratio of domestic coal production to energy consumption has also declined. This rate has been 12,8% while it was 19,2% in 1993 and 12,9% in 2003.
VI.II. TURKEY’S COAL RESOURCES
Resource: The amount of coal that may be present in a deposit or coalfield. This does not take into account the feasibility of mining the coal economically. Not all resources are recoverable using current technology.

Reserves: Reserves can be defined in terms of proved (or measured) reserves and probable (or indicated) reserves. Probable reserves have been estimated with a lower degree of confidence than proved reserves.

Proved Reserves: Reserves that are not only considered to be recoverable but can also be recovered economically. This means they take into account what current mining technology can achieve and the economics of recovery. Proved reserves will therefore change according to the price of coal; if the price of coal is low, proved reserves will decrease.
Turkey has hardcoal resources of 1.3 billion tons and lignite resources of 15.3 billion tons.
TURKEY’S COAL RESOURCES

- Turkey’s hard coal resources in the Zonguldak basin are estimated at some 1.3 billion tons of which 512 million tons are in the proven category. The calorific value of hard coal resources varies between 6,200 and 7,200 kcal/kg.

- Lignite deposits are spread across the country, with proven reserves of approximately 15.3 billion tons. The quality of Turkish lignites is generally very poor and only around 6% of the reserves have a heat content of more than 3,000 kcal/kg.
VI.III. COAL PRODUCTION AND CONSUMPTION IN TURKEY
COAL SUPPLY IN TURKEY

In 2014 >> Saleable lignite production: 62.6 Mtons
Saleable hardcoal production: 1.8 Mtons
Coal import: 30 Mtons

Data: MENR
Number of coal production licenses: 470 (public: 70, private: 400)
Number of coal mines in production in 2013: 260

Data: MENR
Total saleable production: 60.4 Mtones in 2013
57.5 Mtons lignite (45.5 Mtons public and 12 Mtons private) 2 Mtons hardcoal (public)

Data: MENR
PRODUCERS

HARDCOAL PRODUCTION, 2014

- TTK**: 29%
- TTK: 71%

LIGNITE PRODUCTION, 2014

- Private Sector: 39%
- EÜAŞ: 22%
- EÜAŞ(*): 9%
- TKİ(*): 14%
- TKİ: 16%

TTK: Turkish Hardcoal Enterprises (state owned)
TKİ: Turkish Coal Enterprises (state owned)
EÜAŞ: Electricity Generation Company (state owned)
(*) Redevance, procurement or transfer of operating rights

Data: TTK, TKİ, EÜAŞ, MENR
CONSUMPTIONS

**DOMESTIC HARDCOAL CONSUMPTION, 2013**
- Heating and other industry: 10%
- Iron-steel: 33%
- Electricity generation: 57%

**LIGNITE CONSUMPTION, 2012**
- Social aid program: 3%
- Heating: 7%
- Industry: 8%
- Electricity generation: 82%

**IMPORTED COAL CONSUMPTION, 2012**
- Heating: 34%
- Other industry: 14%
- Iron and steel industry: 16%
- Electricity generation: 36%

Data: TTK, TKİ, EÜAŞ, MENR
VI.IV.
COAL IMPORTS
ENERGY IMPORT OF TURKEY

Coal, coke, petrocoke 20.1 Mtoe
Gas 37.6 Mtoe
Oil 38.2 Mtoe

Data: MENR
Coal imports carried out in Turkey since 1973. Imports remained below 10 million tons until 2000. It increased rapidly to over 20 million tons in 2000s. In 2012 it saw 30 million tons.

Data: MENR
COAL IMPORTS BY COUNTRIES

Data: Turkish Statistical Institute
IMPORTED COAL CONSUMPTION BY SECTORS

- **Heating**: 34%
- **Other industry**: 14%
- **Iron and steel industry**: 16%
- **Electricity generation**: 36%

Data: MENR
VI.V.
COAL
AND ELECTRICITY GENERATION
IN TURKEY
Domestic coal’s share in installed electricity capacity dropped to 12.2% from 30.2% between the years 1994 and 2014. The share of imported coal increased to 6.5% from zero in the same period.
Domestic coal’s share in electricity generation was 13.6% and imported coal’s share was 13% in 2014.

Data: Turkish Electricity Transmission Company
DOMESTIC COAL-FIRED POWER PLANTS

- Establishment of TKİ (1957)
- Oil crises
- Law on state-run mines, 2172 (1978)
- Establishment of TTK (1982)
- Entry of EÜAŞ (1989)

Annual capacity increment
Total domestic coal-fired plant capacity

MW


0 200 400 600 800 1000 1200 1400 1600 1800 2000 2200 2400 2600 2800 3000 3200 3400 3600 3800 4000 4200 4400 4600 4800 5000 5200 5400 5600 5800 6000 6200 6400 6600 6800 7000 7200 7400 7600 7800 8000 8200 8400 8600 8800 9000 9200 9400 9600 9800 10000
## COAL FIRED POWER PLANTS IN TURKEY

<table>
<thead>
<tr>
<th>Total installed capacity (October, 2015)</th>
<th>72.156 MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic hardcoal-fired capacity</td>
<td>335 MW (%0.5)</td>
</tr>
<tr>
<td>Domestic lignite-fired capacity</td>
<td>8.529 MW (%11.8)</td>
</tr>
<tr>
<td>Imported coal-fired capacity</td>
<td>6.064 MW (%8.4)</td>
</tr>
<tr>
<td>Total electricity generation (2014)</td>
<td>251.963 GWh</td>
</tr>
<tr>
<td>Generation from domestic coal-fired</td>
<td>40.223 GWh (%16.0)</td>
</tr>
<tr>
<td>power plants</td>
<td></td>
</tr>
<tr>
<td>Generation from imported coal-fired</td>
<td>35.086 GWh (%13.9)</td>
</tr>
<tr>
<td>power plants</td>
<td></td>
</tr>
</tbody>
</table>

### New plant capacity installed in 2000-2014

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic coal</td>
<td>2.354 MW (%4.6)</td>
</tr>
<tr>
<td>Imported coal</td>
<td>6.064 MW (%11.8)</td>
</tr>
<tr>
<td>Natural gas</td>
<td>22.319 MW (%43.6)</td>
</tr>
<tr>
<td>Renewables</td>
<td>5.193 MW (%10.1)</td>
</tr>
<tr>
<td>Hydro</td>
<td>15.495 MW (%30.3)</td>
</tr>
<tr>
<td>Liquid fuels</td>
<td>-224 MW</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>51.201 MW</strong></td>
</tr>
</tbody>
</table>

### Domestic coal-fired large-scale power plants

<table>
<thead>
<tr>
<th>Power plant</th>
<th>MW</th>
<th>Power plant</th>
<th>MW</th>
<th>Power plant</th>
<th>MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afşin-Elbistan A</td>
<td>1.355</td>
<td>Kangal</td>
<td>457</td>
<td>Soma B</td>
<td>990</td>
</tr>
<tr>
<td>Afşin-Elbistan B</td>
<td>1.440</td>
<td>Kemerköy</td>
<td>630</td>
<td>Tunçbilek A</td>
<td>65</td>
</tr>
<tr>
<td>Çan</td>
<td>320</td>
<td>Orhaneli</td>
<td>210</td>
<td>Tunçbilek B</td>
<td>300</td>
</tr>
<tr>
<td>Çatalağzı</td>
<td>300</td>
<td>Seyitömer</td>
<td>600</td>
<td>Yatağan</td>
<td>630</td>
</tr>
<tr>
<td>Çayırhan</td>
<td>620</td>
<td>Soma A</td>
<td>44</td>
<td>Yeniköy</td>
<td>420</td>
</tr>
</tbody>
</table>

**Weighted average age of total 43 power plant units:** 24
IMPORTED COAL-FIRED POWER PLANTS IN OPERATION OR CONSTRUCTION, 2015

In operation: 5,463 MW
Share in total installed capacity: 8%

In construction: 6,345 MW
Share in total installed capacity: 9%

Data: Energy Market Regulatory Authority
IMPORTED COAL-FIRED POWER PLANTS IN EXAMINATION FOR PRODUCTION LICENSE, 2015

In examination: 30,800 MW
Share in total installed capacity: 45%

Data: Energy Market Regulatory Authority
COAL-FIRED POWER PLANTS IN OPERATION, CONSTRUCTION OR PRE-EXAMINATION, 2015

Data: Energy Market Regulatory Authority
VI.VI.
TURKISH COAL INDUSTRY AND PUBLIC POLICIES: ON THE BRINK OF CHANGE

Tunçbilek Coal Mine, Turkey
SOME RELATED LEGISLATION

EMPLOYMENT

There is no any comprehensive study to determine the employment in the sector.

However, direct employment in the coal industry is estimated to be around 55,500 people; 18,500 in hardcoal sector and 37,000 in lignite sector.
TRANSFORMATION IN TURKISH COAL INDUSTRY

Turkey’s coal industry is in the process of a significant structural transformation.

Given the gaining momentum of the recent work in this direction, public enterprises are highly likely to leave their places to the private sector in a short time.

Looking at the developments, it seems that Turkey’s coal industry is on the verge of a major transformation.
Public institutions increasingly prefer service procurement from private companies for production and overburden removal activities instead of using their own machinery park.
# TRANSFORMATION IN TURKISH COAL INDUSTRY

## II – PRIVATIZATION OF THERMAL POWER PLANTS AND COAL FIELDS

Model: Private placement for power plant and transfer of operating rights for coal fields

<table>
<thead>
<tr>
<th>Power plant</th>
<th>Fuel</th>
<th>Plant capacity (MW)</th>
<th>Coal reserve (Mton)</th>
<th>Ownership</th>
<th>Mine license</th>
<th>Date of privatization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seyitömer</td>
<td>Lignite</td>
<td>600</td>
<td>170</td>
<td>EÜAŞ=&gt;Private</td>
<td>TKİ=&gt;Private</td>
<td>June 2013</td>
</tr>
<tr>
<td>Yatağan</td>
<td>Lignite</td>
<td>630</td>
<td>150</td>
<td>EÜAŞ=&gt;Private</td>
<td>TKİ=&gt;Private</td>
<td>May 2014</td>
</tr>
<tr>
<td>Yeniköy</td>
<td>Lignite</td>
<td>420</td>
<td>250</td>
<td>EÜAŞ=&gt;Private</td>
<td>TKİ=&gt;Private</td>
<td>April 2014</td>
</tr>
<tr>
<td>Kemerköy</td>
<td>Lignite</td>
<td>630</td>
<td></td>
<td>EÜAŞ=&gt;Private</td>
<td>TKİ=&gt;Private</td>
<td></td>
</tr>
<tr>
<td>Kangal</td>
<td>Lignite</td>
<td>457</td>
<td>90</td>
<td>EÜAŞ=&gt;Private</td>
<td>EÜAŞ=&gt;Private</td>
<td>August 2013</td>
</tr>
<tr>
<td>Çatalağzı</td>
<td>Hardcoal</td>
<td>300</td>
<td></td>
<td>EÜAŞ=&gt;Private</td>
<td>TTK</td>
<td>May 2014</td>
</tr>
<tr>
<td>Soma</td>
<td>Lignite</td>
<td>990</td>
<td>720</td>
<td>EÜAŞ=&gt;Private</td>
<td>TKİ</td>
<td>December 2014</td>
</tr>
<tr>
<td>Çanakkale Çan</td>
<td>Lignite</td>
<td>320</td>
<td>75</td>
<td>EÜAŞ</td>
<td>TKİ</td>
<td></td>
</tr>
<tr>
<td>Orhaneli</td>
<td>Lignite</td>
<td>210</td>
<td>35</td>
<td>EÜAŞ=&gt;Private</td>
<td>TKİ=&gt;Private</td>
<td>December 2014</td>
</tr>
<tr>
<td>Tunçbilek B</td>
<td>Lignite</td>
<td>300</td>
<td>250</td>
<td>EÜAŞ=&gt;Private</td>
<td>TKİ</td>
<td>December 2014</td>
</tr>
</tbody>
</table>
TRANSFORMATION IN TURKISH COAL INDUSTRY

II – PRIVATIZATION OF COAL FIELDS
Planned model: Public-private partnership + international agreement

<table>
<thead>
<tr>
<th>Power plant</th>
<th>Fuel</th>
<th>Plant capacity (MW)</th>
<th>Coal reserve (Mton)</th>
<th>Ownership</th>
<th>Mine license</th>
<th>Date of privatization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afşin-Elbistan A</td>
<td>Lignite</td>
<td>1355</td>
<td>5000</td>
<td>EÜAŞ</td>
<td>EÜAŞ</td>
<td>?</td>
</tr>
<tr>
<td>Afşin-Elbistan B</td>
<td>Lignite</td>
<td>1440</td>
<td></td>
<td>EÜAŞ</td>
<td>EÜAŞ</td>
<td>?</td>
</tr>
<tr>
<td>Konya Karapınar</td>
<td>Lignite</td>
<td>2000</td>
<td></td>
<td>EÜAŞ</td>
<td>EÜAŞ</td>
<td>?</td>
</tr>
<tr>
<td>Afyon-Dinar</td>
<td>Lignite</td>
<td>1000</td>
<td></td>
<td>EÜAŞ</td>
<td>EÜAŞ</td>
<td>?</td>
</tr>
<tr>
<td>Eskişehir-Alpu</td>
<td>Lignite</td>
<td>1000</td>
<td></td>
<td>EÜAŞ</td>
<td>EÜAŞ</td>
<td>?</td>
</tr>
</tbody>
</table>
## TRANSFORMATION IN TURKISH COAL INDUSTRY

### II – PRIVATIZATION OF COAL FIELDS

Model: Transfer of coal-fields to the private sector provided that they will build power plants

<table>
<thead>
<tr>
<th>Power plant</th>
<th>Fuel</th>
<th>Plant capacity (MW)</th>
<th>Coal reserve (Mton)</th>
<th>Date of commencement of electricity generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adana Tufanbeyli</td>
<td>Lignite</td>
<td>700</td>
<td>323</td>
<td>2018</td>
</tr>
<tr>
<td>Bingöl Karlıova</td>
<td>Lignite</td>
<td>150</td>
<td>104</td>
<td>2019</td>
</tr>
<tr>
<td>Bolu Göynük</td>
<td>Lignite</td>
<td>270</td>
<td>38</td>
<td>2015</td>
</tr>
<tr>
<td>Bursa Orhaneli, Keles, Davutlar</td>
<td>Lignite</td>
<td>270</td>
<td>106</td>
<td>2018</td>
</tr>
<tr>
<td>Manisa Soma</td>
<td>Lignite</td>
<td>450</td>
<td>720</td>
<td>2018</td>
</tr>
<tr>
<td>Kütahya Tunçbilek</td>
<td>Lignite</td>
<td>300</td>
<td>262</td>
<td>2019</td>
</tr>
<tr>
<td>Eskişehir-Mihaliççik</td>
<td>Lignite</td>
<td>290</td>
<td>130</td>
<td>2016</td>
</tr>
</tbody>
</table>
Coal in the World and in Turkey – Outlook, geopolitics, policies and future prospects, Dr. Nejat Tamzok
Energy Economics, Policy and Security (Master of Arts Program) - Faculty of Economics, Administrative and Social Sciences – Bilkent University

TRANSFORMATION IN TURKISH COAL INDUSTRY
COAL PRODUCTION BY YEARS

Mtons

- Private sector
- EÜAŞ
- TKİ


10 20 30 40 50 60 70 80
TRANSFORMATION IN TURKISH COAL INDUSTRY

EXPECTATIONS AFTER TRANSFORMATION

- Increase in productivity
- Decrease in cost and price
- Rise in occupational safety and health standards
- Ecofriendly operations
- Growth in domestic coal-fired electricity generation capacity

BUT,

GENERAL CHARACTERISTICS OF NEWCOMERS

- Weak institutionalization
- Low levels of institutional culture
- Weak capital structures
- Minimal investments to human resources, coal explorations, R&D, occupational safety-health and environment. These are seen as only cost-increasing factors.
- Limited engineering quality
VI.VII.
FUTURE OF DOMESTIC COAL IN TURKEY

Tunçbilek Coal Mine, Turkey
ENERGY DEMAND PROJECTION

Primary energy demand
Final energy demand
Power plant's demand
Household heating demand

Installed capacity, MW
Electricity generation (GWh)

Installed Capacity (MW)
Electricity generation (GWh)
PRIMARY ENERGY DEMAND AND DOMESTIC COAL SUPPLY

- Assuming that no change in the existing lignite production, the ratio of domestic coal production to primary energy demand will drop to 9.8% in 2020 and to 6.4% in 2030.

- Domestic coal production should be raised to 108 million tons in 2020 and to 165 million tons in 2030 to maintain its current share in total primary energy demand.
The ratio of total installed capacity of domestic coal-fired power plants to the installed capacity of the electricity system will fall to the level of 8.8% in 2020 and 4.7% in 2030 in case of no new domestic coal-fired plants will put into service.
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THANK YOU…

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