CLEANER ELECTRICITY PRODUCTION FROM COAL in TURKEY: Issues and Prospects

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TURKISH COAL ENTERPRISES

Electricity Forum on Fostering Investment in Cleaner Electricity Production
In the UNECE Region, 27 November 2007, Geneva
CLEANER ELECTRICITY PRODUCTION FROM COAL in TURKEY

- CONTENT

• Policy
• Role of Coal in Power Generation in Turkey
• Restructuring of Coal & Power Sector in Turkey
  – Regulatory & Administrative developments
  – Privatization developments
  – Investment developments
• Future Prospects for Power Generation
• R&D Projects for Cleaner Power Generation from Coal
Cleaner Electricity Production from Coal in Turkey

- Policy

- Developing existing indigenous energy resources especially in the coal sector,
- Restructuring of coal mining & electricity sectors
- Privatization of
  - some inefficient and inactive coal mines
  - distribution grids
  - Generation plants
- Promoting the adoption of clean coal technologies in the utilization of coal in thermal power plants
- Since Turkey has a candidate country status for European Union (EU) membership, harmonization of Turkish legislation on coal, electricity and environment with EU legislation is underway.
Role of Coal in Turkey

- Shares of coal in primary energy consumption

ALL 1972 2006
Domestic: 68% 29%
Imported: 32% 71%

COAL:
Domestic: 1972 25% 2006 14%
Imported: 0% 12%
Total: 25% 26%

N.GAS
Domestic: 0% 1972 0.8% 2006
Imported: 0% 27%
Total: 0% 27.8%

Source: ETBK

Ersoy & Anac, Electricity Forum, 27 Nov 2007, Geneva
Role of Coal in Turkey - Coal Reserves

Total Coal Reserves:
- 1.3 billion tonnes hardcoal (all state)
- 9.3 billion tonnes lignite (77% state)

68% of lignite reserves has low calorific value
Role of Coal for Power Generation in Turkey
- Coal Production & Consumption

- ~90% of Lignite production state owned (TKİ+EÜAŞ)
- (Shares of private sector within state production by leasing or contract mining 20-25 %)
- Whole hardcoal production state owned (TTK),
  - 16 Mt hard coal imported in 2006.

Distribution of Lignite Consumption (60.9 Mt, 2006)
- Household: 10%
- Industry: 7%
- Power: 83%

Distribution of Hard Coal consumption (19.5 Mt, 2006)
- Household: 5%
- Coke Oven: 23%
- Power: 27%

Ersoy & Anac, Electricity Forum,
27 Nov 2007, Geneva
Role of Coal in Power Generation
- Shares of coal in power generation

**WORLD** (Source: IEA)

- 1973: 6116 TWh
- 2005: 18235 TWh

**TURKEY** (Source: TEIAŞ)

- 1973: 12424 GWh
- 2006: 176300 GWh

**TURKEY**

- 1973: 26.1%
- 1986: 49%
- 2006: 26.4%

- 1973: 0%
- 1986: 6%
- 2006: 45%
1970-1984: Turkish Electricity Enterprises (TEK)
(State owned Monopoly- Generation+Transmission+Distribution)

Law: 3096
3996-BOT law
4283-BO law
4628-El.Market law / EPDK


Insufficient
Competitive liberalized electricity market

Road map for privatization
Of 20 distribution grids & Generation plants

TEK
TEDAS Distribution
TEAS Generation Transmission
EUAS Generation
TEIAS Transmission
TETAS Trade

ERSOY & ANAC, Electricity Forum,
27 Nov 2007, Geneva
Regulatory Developments (continue)

• United Nations Framework Convention on Climate Change in Turkey (16 Oct 2003 4990 numbered law)
  – First National Declaration has been prepared.

• Harmonisation of Turkish regulation with EU coal, electricity and environment related regulation is underway.
  – Harmonisation with EU Electricity Liberalisation Directive (2001)
  – Amendment in Mining Law (2004)
    • to promote foreign investment & privatization
  – Amendment in Environment Law (2006)
RESTRUCTURING OF COAL SECTOR in TURKEY
- Privatization of coal deposits
TKI
Lignite+ Hardcoal Prod.

TTK
Harcoal Prod.

TKI
Lignite Prod. (15 active mines, 2006)

1957

1983

TTK
Privatized Hardcoal Mines

2005- Amasra-B*
2005- Alacaagzi-Kandilli*
2005- Gelik Dik Kanat*
22 small deposit

1989- Sivas-Kangal Mine+
1995- Afsin-Elbistan Mine+
2000- Ankara-Cayirhan Mine

TKI
Privatization

2002- 2007 :: in 9 mines prod. Activities have been stopped and privatized by leasing, contract mining and sale methods

in total: 15 mines leased
2 contract mining
1 mine sold

EUAŞ
Electricity & Lignite

Sivas-Kangal Mine

Ankara-Cayirhan Mine & Cayirhan Pow. Station


Private Sector
Lignite Prod.

Private Sector
Lignite & Electricity Generation

EUAŞ
Lignite & Elect. Gen.

EUAŞ-Private Sector
- 2006 - Elbistan B Power Station
- March 2007 – Lignite Prod. B (Çöllalar *)

* Leasing
## Current Capacity for Lignite-Based Electricity Generation

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Consumption Capacity (x1000 t/y)</th>
<th>Installed Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afsin-Elbistan A</td>
<td>18.000</td>
<td>1356</td>
</tr>
<tr>
<td>Afsin Elbistan B</td>
<td>(17.000)*</td>
<td>1376</td>
</tr>
<tr>
<td>Ankara-Cayirhan</td>
<td>4.300</td>
<td>620</td>
</tr>
<tr>
<td>Bursa-Orhaneli</td>
<td>1.500</td>
<td>210</td>
</tr>
<tr>
<td>Canakkale-Can</td>
<td>1.800</td>
<td>320</td>
</tr>
<tr>
<td>Kütahya-Seyitomer</td>
<td>5.500</td>
<td>600</td>
</tr>
<tr>
<td>Kutahya- Tuncbilek</td>
<td>2.300</td>
<td>366</td>
</tr>
<tr>
<td>Manisa-Soma B</td>
<td>8.200</td>
<td>1032</td>
</tr>
<tr>
<td>Mugla-Husamlar (Kemerkoy)</td>
<td>5.000</td>
<td>630</td>
</tr>
<tr>
<td>Mugla-Milas-Sekkoy (Yenikoy)</td>
<td>3.750</td>
<td>420</td>
</tr>
<tr>
<td>Mugla-Yatagan</td>
<td>5.350</td>
<td>630</td>
</tr>
<tr>
<td>Sivas-Kangal</td>
<td>5.400</td>
<td>456</td>
</tr>
<tr>
<td><strong>TOTAL (Lignite)</strong></td>
<td><strong>61.100</strong></td>
<td><strong>8.016</strong></td>
</tr>
</tbody>
</table>

* Mine to feed Elbistan B power plant was leased to private sector in March 2007.
** Except autoproducers
What are the future prospects for coal in electricity production in Turkey?

**High Growth of Demand Expected**

2007-2016:
- Scenario 1: 8.1%
- Scenario 2: 6.3%

Source: TEIAS, 2007
### Available Additional Capacity for Electricity

**Generation - Expected Reliazed by PRIVATE SECTOR**

#### LIGNITE/ ASPHALTITE PROJECTS:

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Reserve (1000 ton)</th>
<th>Prod. Capacity (1000 t/y)</th>
<th>Installed Capacity (MW)</th>
<th>Planned Power Pl. Technology</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TKİ-Leasing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silopi (Asphaltite)</td>
<td>50000</td>
<td>300</td>
<td>135</td>
<td>Fluidized Bed</td>
<td>investment period for pow.pl.construction</td>
</tr>
<tr>
<td>Bolu- Göynük</td>
<td>39000</td>
<td>1200</td>
<td>150</td>
<td>Fluidized Bed</td>
<td>leased by TKI, applied for el.prod.licence</td>
</tr>
<tr>
<td>Bursa-Davutlar</td>
<td>39000</td>
<td>1200</td>
<td>160</td>
<td>Fluidized Bed</td>
<td>leased to private sector by TKI</td>
</tr>
<tr>
<td>Tekirdağ-Saray</td>
<td>129000</td>
<td>2500</td>
<td>300</td>
<td>Fluidized Bed</td>
<td>leased to private sector by TKI</td>
</tr>
<tr>
<td><strong>Total I</strong></td>
<td>257000</td>
<td>5200</td>
<td>745</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TKİ-Others</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bingöl-Karlıova</td>
<td>26000</td>
<td>1115</td>
<td>100</td>
<td>Evaluation phase</td>
<td></td>
</tr>
<tr>
<td>Adana-Tufanbeyli</td>
<td>214000</td>
<td>7200</td>
<td>600</td>
<td>Negotiation phase</td>
<td></td>
</tr>
<tr>
<td>Manisa-Eynez</td>
<td>100000</td>
<td>3400</td>
<td>600</td>
<td>Evaluation phase</td>
<td></td>
</tr>
<tr>
<td>Kütahya-Derin Sahalar</td>
<td>100000</td>
<td>3000</td>
<td>300</td>
<td>Evaluation phase</td>
<td></td>
</tr>
<tr>
<td><strong>Total II</strong></td>
<td>440000</td>
<td>14715</td>
<td>1600</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TKİ TOTAL</strong></td>
<td>697000</td>
<td>19915</td>
<td>2345</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Name</td>
<td>Reserve (1000 ton)</td>
<td>Prod. Capacity (1000 t/y)</td>
<td>Installed Capacity (MW)</td>
<td>Planned Power Plant Technology</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>--------------------</td>
<td>---------------------------</td>
<td>--------------------------</td>
<td>--------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td><strong>EÜAŞ</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elbistan A(5,6),B,C,D,E,F</td>
<td>2818000</td>
<td>86400</td>
<td>6650</td>
<td>Pulverized</td>
<td>Increase in reserve + high tech.: 8600 MW (100 million t/y)</td>
</tr>
<tr>
<td>(Elbistan B)</td>
<td></td>
<td>(17000)</td>
<td>(1440)</td>
<td></td>
<td>Power St.in operation, Çöllolar Deposit leased to Ciner Group</td>
</tr>
<tr>
<td>(Elbistan C,D)</td>
<td></td>
<td>(29000)</td>
<td>(2400)</td>
<td>Pulverized</td>
<td>New tender specs. will be prepared</td>
</tr>
<tr>
<td>Cayirhan B</td>
<td>n.a.</td>
<td>n.a.</td>
<td>450</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Private Sector</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adana-Tufanbeyli</td>
<td>236000</td>
<td>6200</td>
<td>450</td>
<td></td>
<td>Ciner Group sold mining licence to EnerjiSa, el.prod. licence was received</td>
</tr>
<tr>
<td>Çankırı-Orta</td>
<td>51000</td>
<td>1500</td>
<td>165</td>
<td>Fluidized Bed</td>
<td>TKI sold mining licence to Calık NTF. Elect. prod. licence was received.</td>
</tr>
<tr>
<td>Konya-Ilgın</td>
<td>152000</td>
<td>3100</td>
<td>500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adıyaman-Gölbaşı</td>
<td>49000</td>
<td>1400</td>
<td>150</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>488000</td>
<td>12200</td>
<td>1265</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>GENERAL TOTAL</strong></td>
<td>4003000</td>
<td>118515</td>
<td>10710</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Total Capacity for Electricity Generation

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Power St. Cap. (1000 t/y)</th>
<th>Installed Cap (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lignite (current)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TKİ</td>
<td>33400</td>
<td>4208</td>
</tr>
<tr>
<td>EÜAŞ + Private</td>
<td>27700</td>
<td>3808</td>
</tr>
<tr>
<td>Total (current)</td>
<td>61.100</td>
<td>8016</td>
</tr>
<tr>
<td>Lignite (additional)</td>
<td>118515</td>
<td>10710</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>179.615</strong></td>
<td><strong>18726</strong></td>
</tr>
</tbody>
</table>
2007-2016 Government Electricity Demand Prospects

**Additional capacity:**
- 17570 MW low scenario, 6.3%
- 29921 MW high scenario, 8.1%
  (TEIAS, 2007)

**Share of Coal in Total Additional Capacity**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lignite</td>
<td>5880</td>
<td>4480</td>
<td>10360</td>
</tr>
<tr>
<td>Hard Coal</td>
<td>0</td>
<td>1200</td>
<td>1200</td>
</tr>
<tr>
<td>Imported Coal</td>
<td>0</td>
<td>4500</td>
<td>4500</td>
</tr>
</tbody>
</table>

**Received Electricity prod. Licences**
*(November 2007)*
- Lignite: 920 MW
- Hard Coal: 960 MW

**Applied for Elec.Prod.Licences**
*(November 2007)*
- Lignite: 570 MW
- Impoted Hardcoal: 7055 MW
Investments done to install coal washing plants

Hard Coal Washing Plants
- Capacity (50-750 t/h) 12 plants to wash all produced hardcoal.

Lignite Washing Plants:
- Capacity (50-800 t/h) 15 plants to wash 30% of produced lignite.

Source: G.Özbayoğlu, 2007
Investments done to reduce CO2, SO2, and other emissions from existing power plants

SOX Control Tekn.

Particulate Matter

CO2

FGD Plants (Çayırhan I-II, Kemerköy, Orhaneli, Yatağan Yeniköy)
After 1986 FGD plant is compulsory (Kangal III, Çayırhan III-IV, Elbistan B)

ESP – all existing power plants

High efficiency technology

- Atmospheric Fluidized Bed Combustion
- Çan 18 Mart Power Plant (42%)
R&D Projects for Cleaner Electricity Production from Coal

- Pilot-scaled CTL project in cooperation with Universities, 2007

- CBM projects, for both hardcoal & lignite
  (Electricity licences were received by EPDK for installing 2 Power Plants based on hardcoal + Methane having capacity 650 MW and 50 MW)

- Project on desulphurization of lignite by washing lignite within a special solvent, 2007

- Benefication of Turkish Lignite Coals to produce clean fuel by shaking table, Multi Gravire Separator and Flotation Methods
CONCLUSION

• Increasing of energy demand and dependency to foreign energy resources(71%) are the main issues of Turkey.

• Coal is the the most important energy resource.

• To increase in usage of domestic coal for electricity generation is government policy

• Selection of clean coal technologies for new coal-based power plants to reduce harmful emissions

• restructuring of coal and electricity sectors and modernisation activities to be survived,

• More importance to be given to R&D Projects in cooperation with Research Institions and Universities
CLEANER ELECTRICITY PRODUCTION FROM COAL in TURKEY: Issues and Prospects

Thank You for Your Attention