Coal Policy of Turkey & Some Efforts on CCS/CCUS

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Part IV: Development and deployment of carbon capture, use and storage (CCUS) technologies

Workshop on sustainable management of fossil fuels in electricity generation

KEY DRIVERS for COAL POLICY in TURKEY

High demand growth in energy and electricity
- High dependency on foreign energy: 76% (2015) = high cost fuel imports
- High dependency on technology

Foces to increase use of domestic resources by:
- increasing coal exploration studies
- accelerating to install domestic lignite based power plants and clean coal technologies,
- improvement of investment incentives for coal based power plants
- maintaing the momentum at R&D studies on CCT (particularly on coal gasification & liquid fuel production technologies)


- Hardcoal 3%
- Lignite 37%
- Geothermal 15%
- Hydraulic 19%
- Oil 8%
- Bioen. + Waste 10%
- Asphaltite 1%
- N.Gas 1%
- Solar 3%
- Wind 3%

Total Coal Share: 41%

Raw Data: 2015 Energy Balance Table of MENR

(Turkey is 6th Biggest lignite producer & consumer country. Also 8th biggest coal importer country in the World - ref. IEA-Coal Information 2016)
ELECTRICITY MARKET and SECURITY of SUPPLY STRATEGY PAPER (2009)

Targets for Electricity:
- Priority to usage domestic energy resources
- To use all existing the domestic coal reserves by 2023.
- To increase renewables share to 30% by 2023
- To decrease n.gas share to 30%
- To add nuclear power with min. 5%

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Turkey became a party to UNFCCC-United Nations Framework Convention on Climate Change (24 May 2004)

Kyoto Protokol was signed in May 2009

National Climate Change Strategy Document for the years 2010-2020 approved by the Higher Planning Council in 2010

Paris Agreement was signed in April 2016
(INDC- 21% emission reduction (2021-2030) Solar: 10 GW; Wind: 16 GW; full Hidroelectric potential; commissioning a nuclear power plant; rehabilitation public electricity systems; reducing electricity transmission and distribution losses to 15 percent; establishment of micro-generation, co-generation systems and production on site at electricity production)

Harmonisation of Turkish regulation with EU coal, electricity and environment related regulation to limit PM, SO2, NOx emissions etc. (LCP Directive (2010))

To improve energy efficiency (Energy Efficiency law put into effect)

To increase share of Renewables (renewables law)

To deploy cleaner coal-based technologies for new builts & to retrofit existing coal-fired power plants
CO2 EMISSIONS in TURKEY

CO2 Emissions of Turkey (1990-2015)

- **Tonnes CO2 per capita (2014):**
  - World: 4.47
  - OECD: 9.36
  - Turkey: 4.01

- **CO2 Emission from fuel combustion:**
  - Turkey (2014): 307.1 Mt CO2 (Share in World: %0.95)

- **CO2 from fuel combustion-Coal (2014):**
  - World: 14871 Mt
  - OECD: 3950 Mt
  - Turkey: 132 Mt (Increase rate: %122, Share in World: %0.87)

Source: National Inventory Report of Turkey (2017)

Source: IEA- CO2 Highlights2016tables

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KEY DRIVERS for Coal Policy in TURKEY
- Efficient use of coal to protect Environment & Combat Climate Change – CLEAN COAL TECHNOLOGIES

- Coal preparation & upgrading technologies - Increase in capacity of coal washing, conduct projects, (pilot scaling lignite drying project)

- Efficiency improvements at new coal-based power plants & Emission Control Technologies - FGD, de-Nox, ESP

- Involvement of R&D studies on CCT by TKI budget and also by the support of national (TUBITAK) and EU (Framework Programmes) funding

Coal Combustion, Coal Conversion Technologies and Alternative Products from Coal
  - Lignite combustion projects
  - Lignite Gasification Projects
  - Coal-derived products (humic acid, kozmetic,..)

- CCS/CCUS technologies
**KEY DRIVERS for Coal Policy in TURKEY**

- Efficient use of coal to protect Environment & Combat Climate Change –

**CLEAN COAL TECHNOLOGIES- Efficiency Impovement**

August 2017 Tot. Installed Cap. by Fuel = 80,580 MW

- **Lignite,** 9265.6, 11.5%
- **Hard coal+ Asphaltite,** 1021.1, 1.3%
- **Imported Coal,** 7473.9, 9.3%
- **Geothermal,** 860.8, 1.1%
- **Hydroelectricity** 26232.1, 35%
- **Natural Gas+ LNG,** 25770.8, 32.0%
- **Wind,** 6199.1, 7.7%
- **Solar,** 12.9, 0.0%
- **Fuel-Oil+ Nafta+ Motorin,** 696.2, 0.9%
- **CHP,** 123.6, 0.2%
- **Biomass,** 375, 0.5%
- **Other (no licence),** 1733, 2.2%

**Total Coal Cap.:** 17,760.6 MW, 22%

**Domestic Coal Cap.:** 10,286.7 MW

**New Builts:**

- More efficient low emission tech. + Emission control tech. (ESP, FGD, DeNOx) -to comply with emission limits of LCP Directive-2010)

  - **CFB Preference for lignite & Asphaltite –fired PP**
  - **Supercritical preference for imported-hard coal-fired PP**
  - **(2 imported-coal based PP with USC tech. Underconstruction)**

Cleaner Technology to reduce CO2 Emissions (1% efficiency increase 2.5% CO2 reduction)
KEY DRIVERS for Coal Policy in TURKEY

- Efficient use of coal to protect Environment & Combat Climate Change

**CLEAN COAL TECHNOLOGIES- Lignite Gasification Projects**

- Coal gasification (pilot plants in Tunçbilek area having cap. 250 kg/h and 20 kg/h): target to produce methanol

- EU 7. FP Project- Optimisation of high ash coal gasification and installing pilot scaled IGCC Plant- OPTIMASH Project

- Pilot scaled Coal + biomass–to –Liquid Project –TRIGEN Project (financed by Turkish Scientific and Technical Research Institute-TUBITAK)

- Technology development for Turkish lignites on electricity generation by Gasification (10 MWt ) (Financed by TUBITAK-under evaluation)

- Feasibility study on gasification of Turkish lignites

- Laboratory scaled plasma aided gasification plant.

**Target: Demonstration scale commercial IGCC + chemical plant in Soma Region**

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- Efficient use of coal to protect Environment & Combat Climate Change – COAL GASIFICATION R&D PROJECTS (including CO2 Capture)

TKI- Coal gasification (pilot plants in Tunçbilek area) **including CO2 capture**

(250 kg/h –Entrained & 20 kg/h- CFB gasifier) **Target: Methanol Production**

Liquid Fuel Production from Biomass and Coal Blends – TRIGEN Project, **including CO2 Capture**

Lab Scale 150 kWth CFB Gasifier

1,1 MWt CBTL Plant in TKI Soma Area

**Target: Demonstration scale commercial IGCC + chemical plant in Soma Region**
Project components:

- Collecting annual fuel amount and fuel type data for selected thermal power plants and industries,
- Calculation of CO₂ emission,
- Investigation of potential storage site,
- Modeling of injection and storage of CO₂ at selected site,
- Conducting economic feasibility about storage of CO₂ at the selected site,
- Carrying out technical trips and organising workshops.

Selected site: (Çaylarbaşı oil field and cement factory locating away 130 km from the selected zone)

• TPAO, Turkey has experience on EOR since 1986.

• CO2 produced from Dodan field is injected to West Raman Field and oil recovery enhanced.

• Similar applications are done at the West Kozluca and Çamurlu Oil Fields.
CONCLUSION

• Increasing of energy demand and dependency to foreign energy resources and technologies are the main issues of Turkey.

• Coal, particularly lignite & renewables are the the most important energy resource in Turkey to decrease energy dependence of Turkey.

• Continue of usage of domestic coal, particularly for electricity generation requires promotion of more efficient, clean coal Technologies to comply with environmental legislation and climate change commitments.

• There is good progress on installing more efficient coal based power plants & improving environmental legislation & also renewables deployment in Turkey.

• CCS on coal is initial stage.

• More importance are given to R&D Projects on Clean Coal Technologies particularly on lignite gasification in cooperation with national and international Research Institutions and Universities.

• There is a potential increase in CCS on coal in parallel with commercial scale lignite gasification plants including IGCC.

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Thank you for your Attention

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