

Coal Policy of Turkey & Some Efforts on CCS/CCUS

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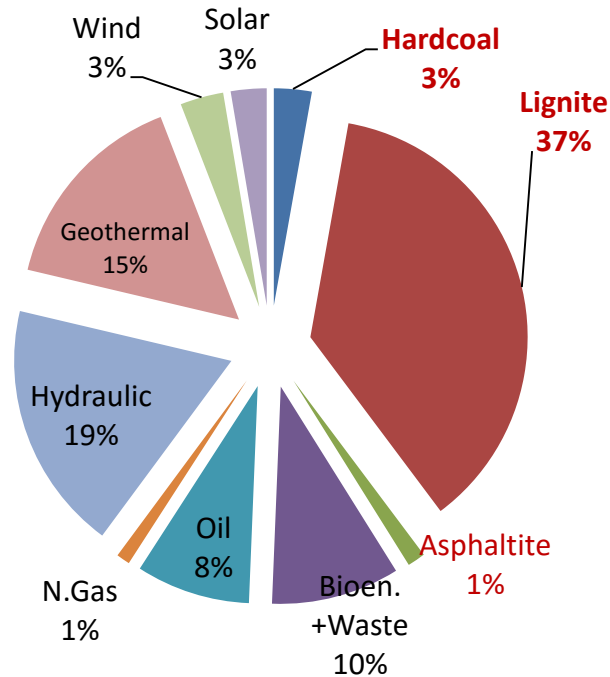
**Part IV: Development and deployment of carbon capture,
use and storage (CCUS) technologies**

**Workshop on sustainable management of fossil fuels in
electricity generation**

13th session of the Group of Experts on Cleaner Electricity Production from Fossil
Fuels, 26-27 Oct 2017, Geneva

KEY DRIVERS for COAL POLICY in TURKEY

Domestic Energy Production (2015) : 31.1 Mtoe



Total Coal Share: 41%

Raw Data: 2015 Energy Balance Table of MENR

- 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
- acceralating 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)

(Turkey is 6th Biggest lignite producer & consumer country . Also 8th biggest coal importer country in the World

-ref. IEA-Coal Information 2016)

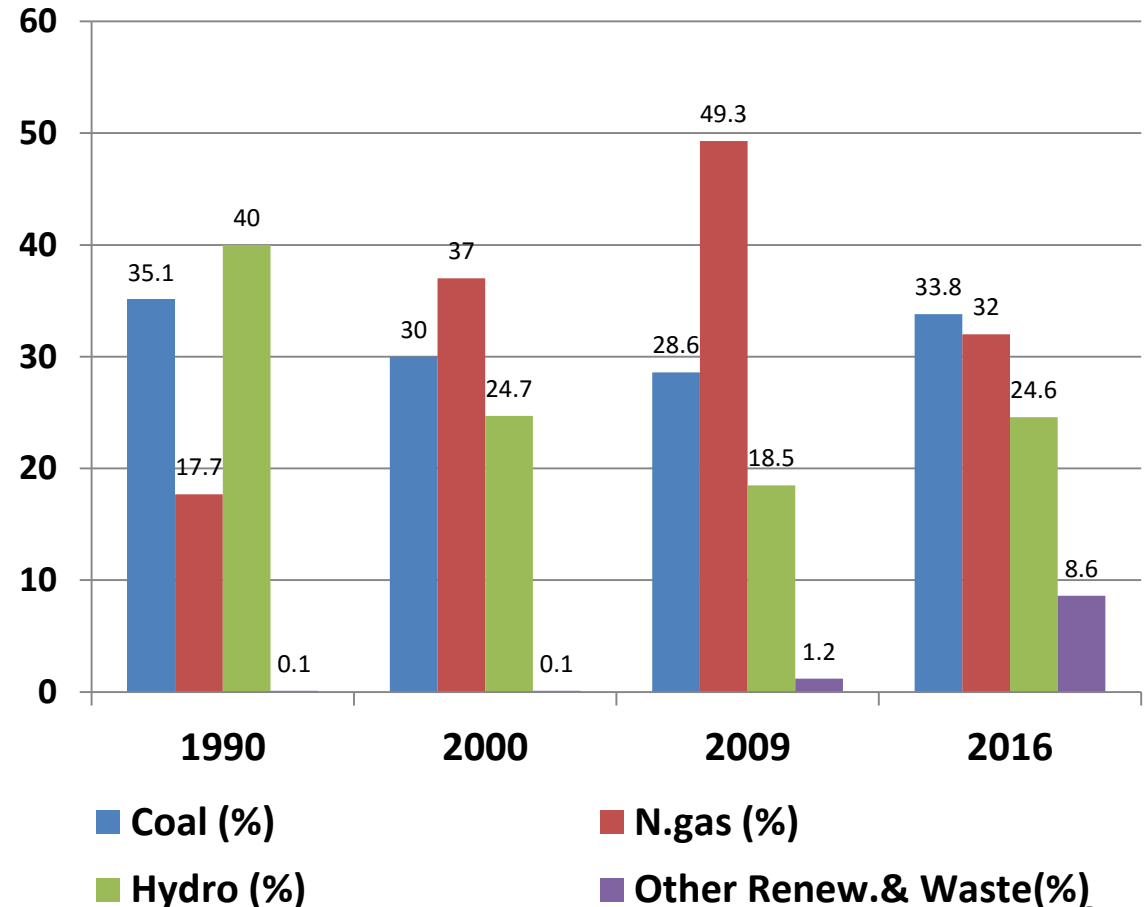
HIGH LEVEL STRATEGY PAPERS - Energy Security

- Changes in fuel shares in electricity generation

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%



	2009	2016
Fossil fuels share (%)	80,3	76,8
Renewables energy share(%)	19,7	33,2

Mücella Ersoy, UNECE CEP- Workshop,
26 Oct 2017

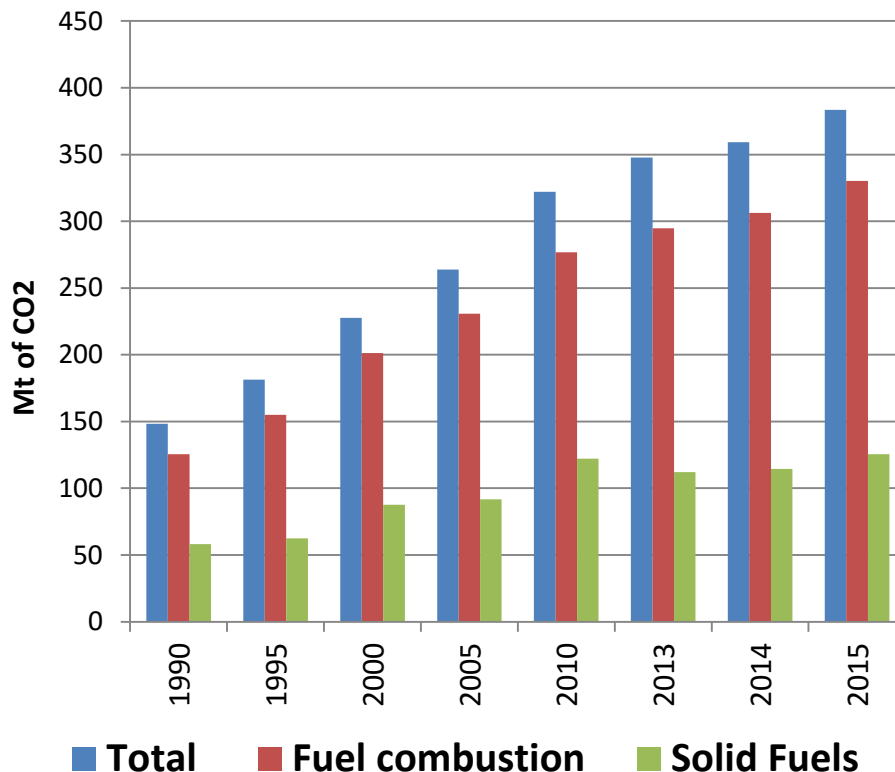
MEASURES

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

- 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, NO_x 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 builds & to **retrofit** existing coal-fired power plants

CO2 EMISSIONS in TURKEY

CO2 Emissions of Turkey (1990-2015)



Source: National Inventory Report of Turkey (2017)

Comparison with 2014 data of IEA- CO2 Highlights2016tables

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: IEA- CO2 Highlights2016tables

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

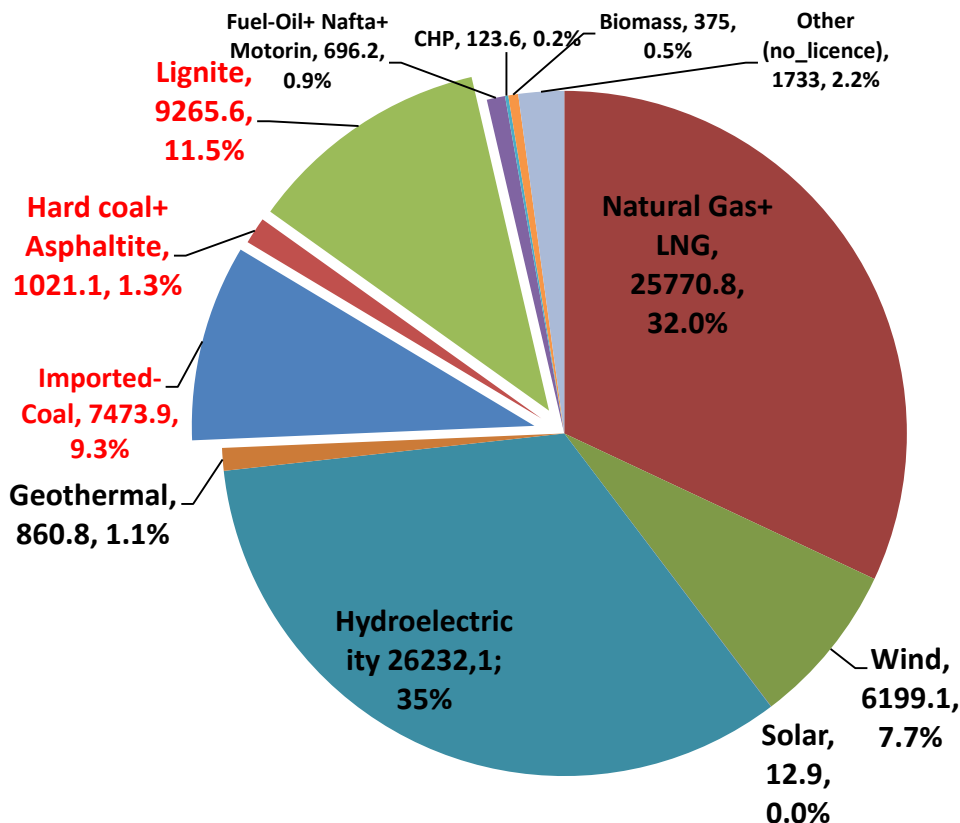
- Lignite combustion projects
 - Lignite Gasification Projects
 - Coal-derived products (humic acid, kozmetic,..)
- CCS/CCUS technologies

KEY DRIVERS for Coal Policy in TURKEY

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

CLEAN COAL TECHNOLOGIES- Efficiency Improvement

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



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 MW_t**) (Financed by TUBITAK-under evaluation)
- Feasibility study on gasification of Turkish lignites
- Laboratory scaled plasma aided gasification plant.



1-MW_{th} Pressurized CFB pilot plant, 15/11/2015 THERMAX, Pune

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

- 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



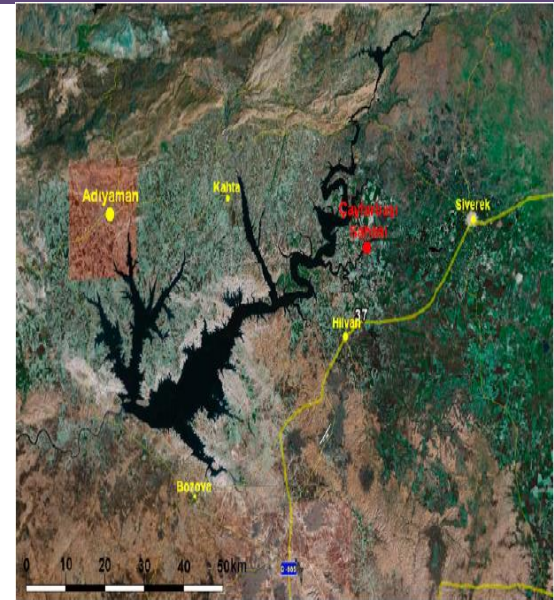
1,1 MWt CBTL Plant in TKI Soma Area

Mücella Ersoy, UNECE CEP- Workshop,
28 Oct 2017
Target: Demonstration scale commercial IGCC + chemical plant in Soma Region

Assessment of **CO₂ Storage Potential in Turkey**, Modeling and a Prefeasibility Study for Injection into an Oil Field

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

Source: Okandan, E. et al, 2011, Energy Procedia

Current status EOR- TPAO Research & Exploration Activities

- 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.



Source: TPAO & Okandan, 2008

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.



Thank you for your Attention

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