



## Coal Developments and Prospects

Presented by:

**Moufid Benmerabet**

Downstream Oil Industry Analyst

**Energy Studies Department**

# Disclaimer



This Report is intended solely for the use of OPEC Member Country officials and may be legally privileged and/or confidential. Any unauthorized use, disclosure or copying of this Report or any parts of it or its attachment(s) by any unintended recipient is strictly prohibited. If you have received this Report in error, please immediately return or destroy it. The OPEC Secretariat does not warrant or assume any liability or responsibility for the accuracy, completeness, or usefulness of any information contained in this Report. Nothing in this Report shall be construed as interpreting or modifying any legal obligations under any agreement, treaty, law or other texts; or expressing any legal opinions or having probative legal value in any proceedings.



- Selected OPEC 2016 Outlook results :
  - World primary energy demand
  - Change in fuel shares in the total energy mix
  - Regional coal demand
- Coal investment and challenges
- Technology developments in coal-related industries
- Coal technologies and environment
- Prospects for coal industry in a low carbon pathway
- Conclusions

# World primary energy demand



- Total global primary energy demand is forecast to increase by 108.2 mboe/d (or 40%) from 273.9 mboe/d in 2014 to 382.1 mboe/d by 2040
- Although overall coal consumption is forecast to increase in the long-term, its share in the total global energy mix is expected to decline by 4.4 percentage points

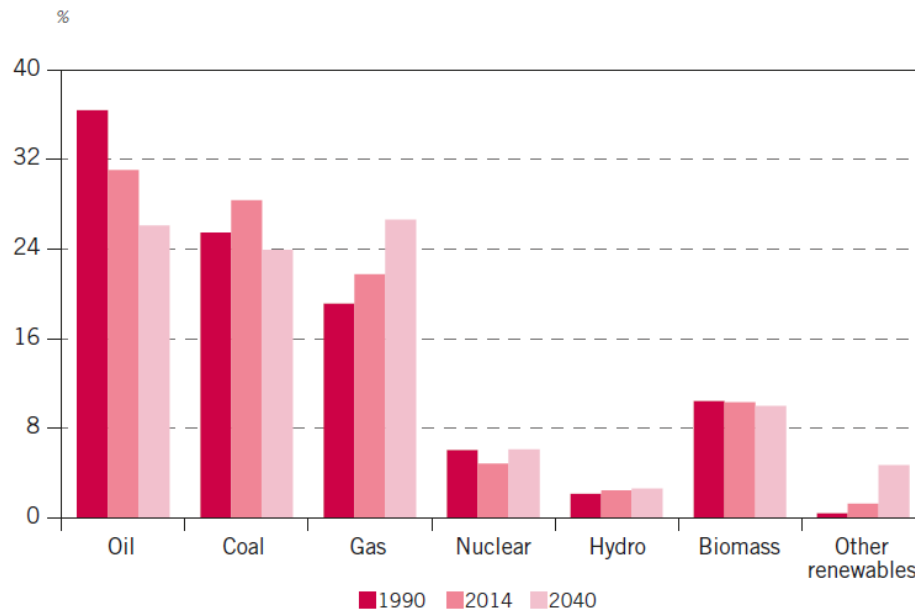
	Levels <i>mboe/d</i>				Growth <i>% p.a.</i>
	2014	2020	2030	2040	2014–2040
Coal	77.7	82.7	88.9	91.5	0.6
Coal	77.7	82.7	88.9	91.5	0.6
Gas	59.6	66.9	84.0	101.7	2.1
Nuclear	13.2	15.5	19.5	23.4	2.2
Hydro	6.6	7.6	8.9	9.9	1.5
Biomass	28.2	30.7	34.6	38.1	1.2
Other renewables	3.4	5.7	11.0	17.9	6.6
<b>Total world</b>	<b>273.9</b>	<b>299.9</b>	<b>343.6</b>	<b>382.1</b>	<b>1.3</b>

Source : OPEC World Oil Outlook 2016

# Change in fuel shares in the total energy mix



- The share of coal is forecast to decline by 4.4 percentage points
- During the past 25 years, a notable difference is that the share of coal is projected to decrease over the forecast period whereas this share has increased between 1990 and 2014

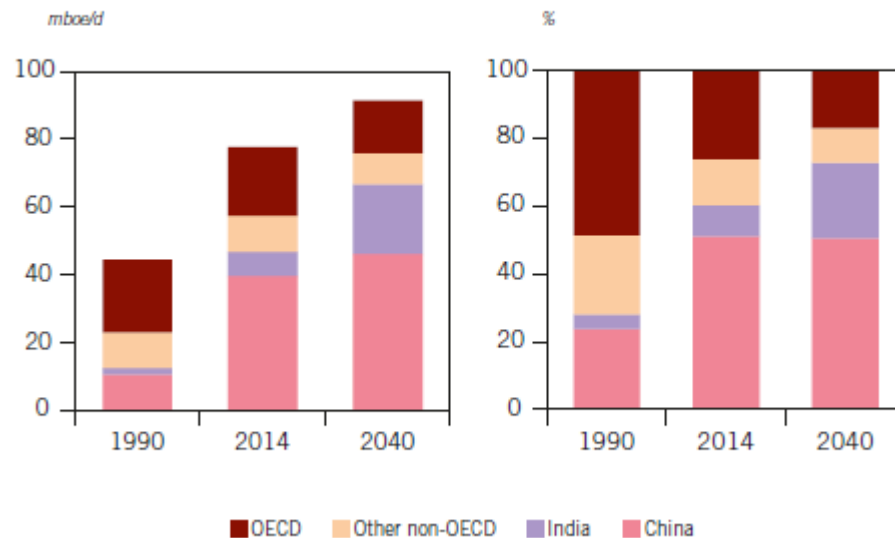


# Regional coal demand



- Five countries and regions (China, US, India, EU, and Japan) hold 82% of the world coal consumption
- Coal use in non-OECD countries is expected to rise, driven by economic and population growth
- Coal demand in the OECD region is estimated to show a strong decline as the fuel is phased out due to regulatory pressures and is substituted by cleaner alternatives, such as natural gas and renewables, in the electricity sector
- China and India are showing the highest coal expansion, as aggregate global coal demand that made up only around 28% of in 1990, climbed to 60% in 2014 and is forecast to rise to levels just below 75% in 2040

Global coal demand and shares by region



Source : OPEC World Oil Outlook 2016

# Coal investment and challenges



- The Paris Agreement has added stress to the coal industry which may hamper progress in developing the resource:
  - Post-COP21, funds may become more scarce for coal developments
  - Uncertainties around coal prospects will make decision-making more difficult
- The dimmed US Clean Power Plan is a good example of how controversial coal regulations are and may be confronted with, in order to initiate new sustainable investment paradigms
- Chinese and Indian companies are expected to pursue investment in coal projects worldwide, especially in Australia which has more potential to increase coal production and export
- Major exporting regions, namely Australia, Indonesia, Russia, Colombia, South Africa and Mozambique, also have plans to expand production and exports

# Technological developments in coal-related industries

- High efficiency and low emissions (HELE) technologies are conditioning new developments in coal-related industries
- S. Africa and China have unique experiences, and developed expertise in coal conversion technologies, and have been leading the world in converting coal to synthetic fuels and chemicals
- Majority of power plants are high-temp or high-efficiency cycles namely moving toward Super (BAT) and ultra S Critical
- Efficiency improvements focus on Combining Heat and Power and waste-heat recovery with IGCC
- Stationary fuel cells are still lagging behind for full development of IGFC
- However, HELE technologies alone cannot achieve global 2050 targeted CO<sub>2</sub> emissions reduction

Operation mode	Mean	Power Driver	Power Block
Sub Critical (Sub-C)	Boiler (combustion)	steam	steam turbine
Super Critical (SC)	Boiler (combustion)	steam	steam turbine
Ultra Super critical (USC)	Boiler (combustion)	steam	steam turbine
Advanced Ultra Super Critical (A-USC)	Boiler (combustion)	steam	steam turbine
I.G.C.C	Gasifier & Combined cycle	syngas	Gas turbine
U.C.G	Underground Gasification	syngas	Gas turbine
I.G.F.C	Gasifier & Stationary Fuel Cell	H <sub>2</sub>	Gas turbine





- The power sector dominates coal utilization, however clean coal technology (namely CCS) development faces a major dilemma (efficiency penalty) and requires economical incentives (e.g. global carbon pricing mechanism)
- Large-scale reduction in CO<sub>2</sub> emissions from coal power plants has had successful stories in the US and Canada when coupled with EOR
- The Paris Agreement has set a dynamic for low carbon development pathways and an opportunity for economically coal dependent Parties to set their national differentiated contribution without penalizing their social and economic development and where CCS should play a crucial role



Prominent clean coal pathways :

1. Combining EOR to CO<sub>2</sub> capture: the only current option that alleviates the CCS energy penalty
  - i. EOR practice is moving toward CO<sub>2</sub>-EOR+ and advanced novel technology
  - ii. EOR offers potential for storing economically
  - iii. There is opportunity to move within a carbon negative option
  
2. Integrated CCUS:
  - i. Unless CO<sub>2</sub> is permanently stored, use of CO<sub>2</sub> may not be sustainable
  - ii. Carbon pricing and sinks and sources allocation are required
  
3. Carbon Removal through DAC: Removing and capturing CO<sub>2</sub> from the atmosphere through Direct Air Capture in equivalent volumes of CO<sub>2</sub> emitted



- The share of fossil fuels in the global energy mix in the 2016 OPEC outlook is set to decrease from 81% to 77% in relative terms
- Coal is losing ground to natural gas and renewables
- India and, to a lesser extent, China will continue expanding in coal developments domestically and abroad
- Post-COP21 challenging times are expected ahead of coal investment
- Lowering CO<sub>2</sub> emissions and improving efficiency are being pursued by the coal industry but insufficient to reduce the industry carbon footprint
- Cleaning coal with EOR is the most attractive option today



Thank you

