

# CLIMATE CHANGE AND NATURAL GAS IN THE CASPIAN REGION

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Ray Leonard: Anglo Eurasia LLC

Caspian Week: DAVOS

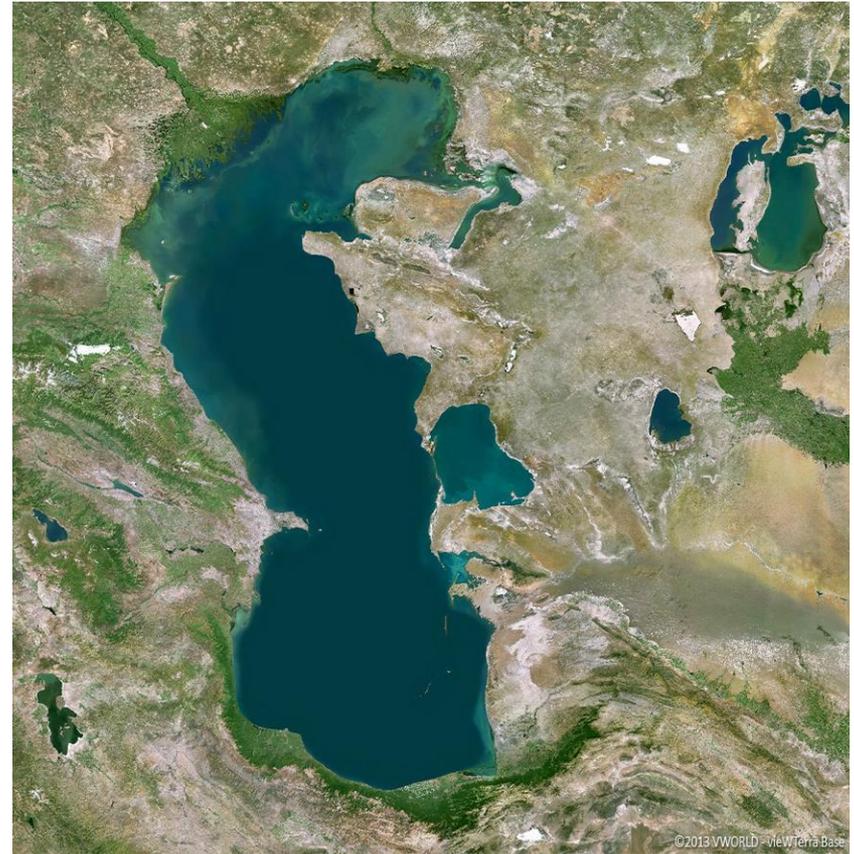
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[WWW.RAYLEONARD.CONSULTING](http://WWW.RAYLEONARD.CONSULTING)

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# Climate Change and Natural Gas in the Caspian Region

- Climate Change is an accelerating problem; the greatest challenge of our time
- The Caspian region is one of the most environmentally sensitive regions on the planet and is already feeling the affects of climate change
- The most realistic path for the world in combating climate change is to shift to the use of natural gas as a bridge fuel while increasing capacity of nuclear+renewable energy sources
- The countries of the Caspian region (Azerbaijan, Turkmenistan, Uzbekistan and Kazakhstan) have capacity to supply a significant portion of the needed supply of natural gas needed to replace coal in Eurasia's three largest gas markets; Europe, South Asia (India) and China

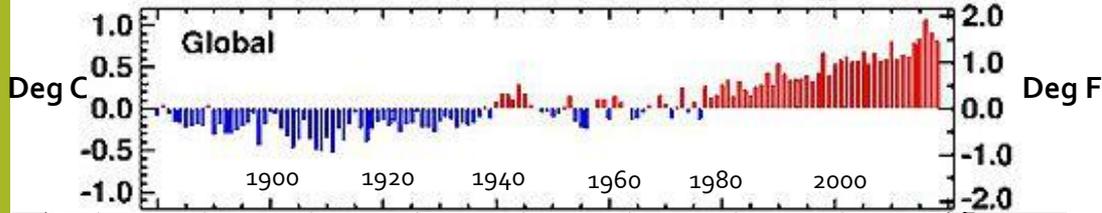


# GLOBAL WARMING

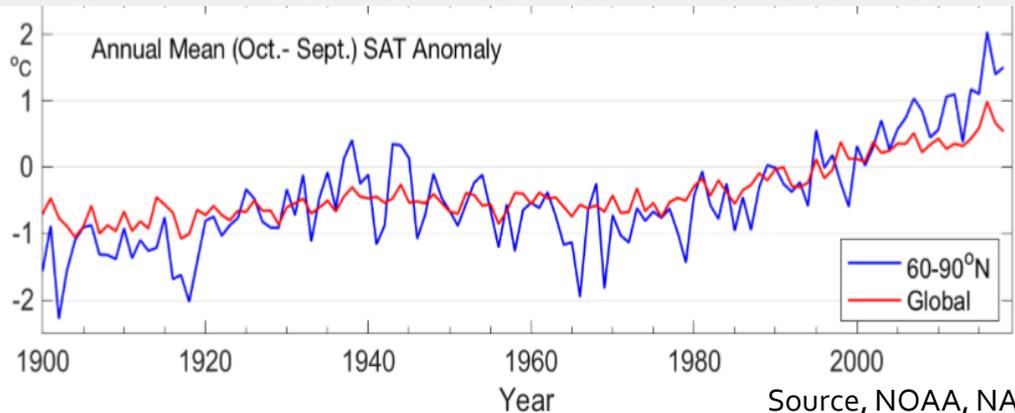
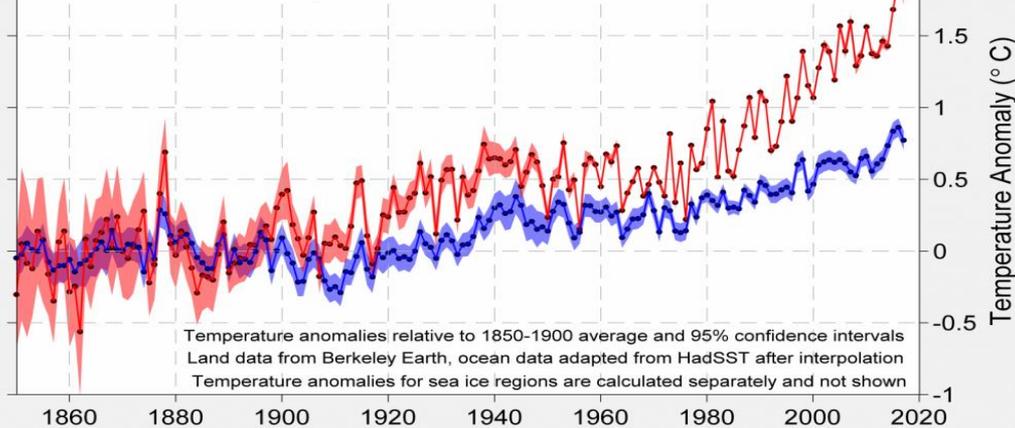
## Mar-May Land & Ocean Surface Mean Temp Anomalies

NCEI/NESDIS/NOAA

Analysis is based upon Smith et al. (2008) methodology. 1880-2018

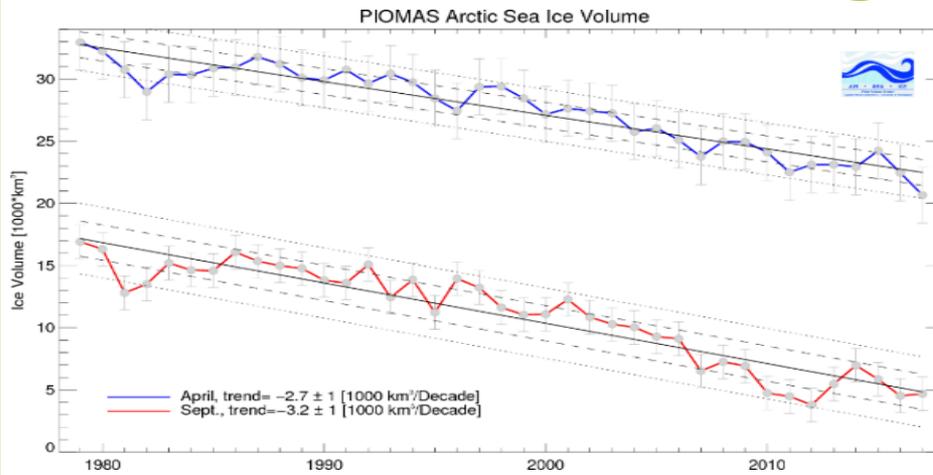


## Land and Ocean Temperatures 1850 - 2017



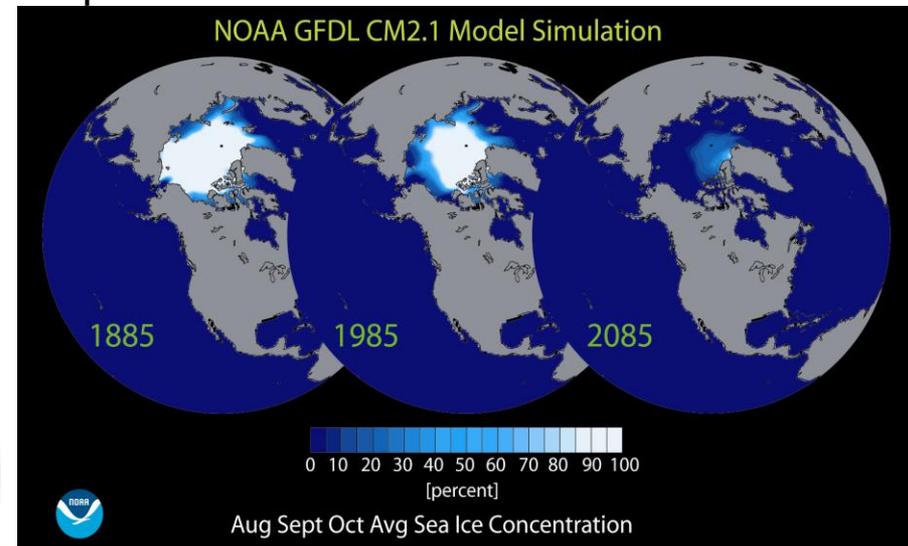
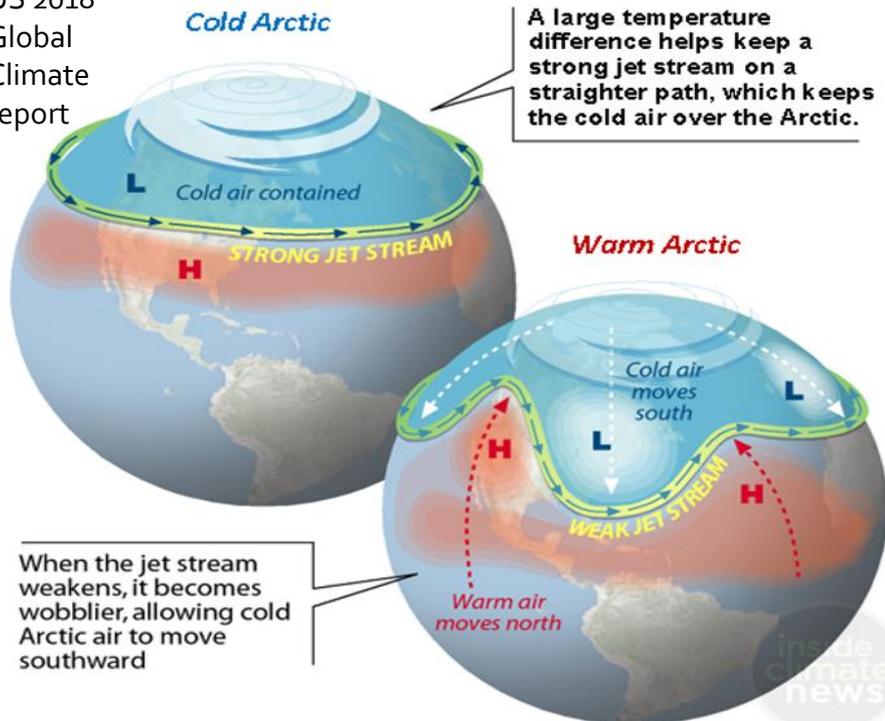
- Global temperatures on average have increased by approximately 1 degree C since 1900 and are increasing at a rate of 0.25 degrees per decade.
- Temperatures have increased at **double** the global rate on land as compared to over the ocean since 1980
- Temperatures have increased at **double** the global rate in the polar latitudes (60-90 degrees) since 2000

# Effect of Warming on Polar regions



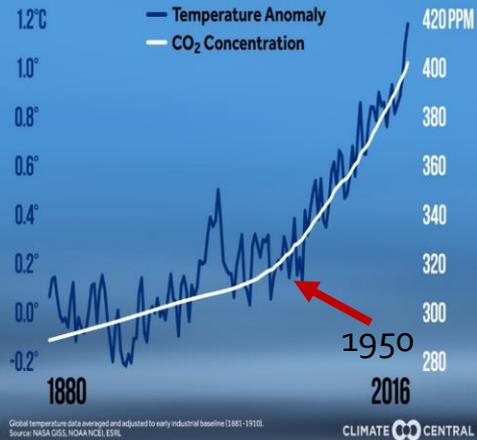
- By 2016, 70% of ice volume in north polar cap was gone in September minimum compared to 1980. By mid-century, Arctic Ocean will be mostly ice free in summer.
- Northern hemisphere weather patterns driven by jet stream which is already weakening due to reduced temperature differential. Loss of polar ice will greatly increase this phenomenon

US 2018  
Global  
Climate  
report



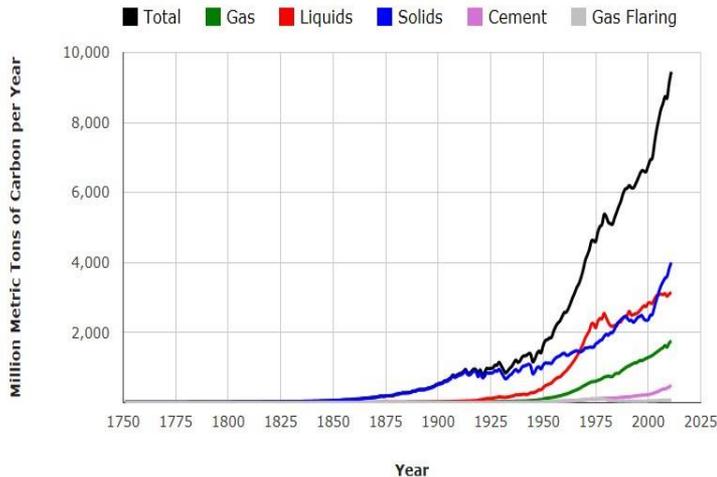
# Relationship of CO<sub>2</sub> to Temperature Increase

Global Temperature and Carbon Dioxide



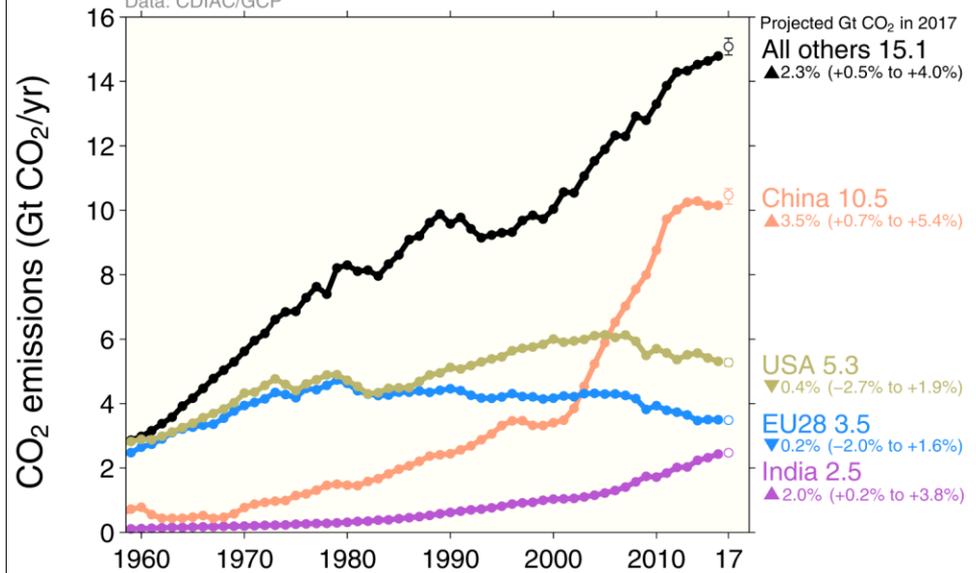
- ❖ Correlation between temperature rise and CO<sub>2</sub> emission increase is obvious
- ❖ First major increase in CO<sub>2</sub> emissions came after 1950 with industrial expansion in Europe, USA and Soviet Union, second pulse in 2000-2015 with industrialization of China
- ❖ Coal causes 42% of CO<sub>2</sub> emissions, oil 34%, natural gas 19%
- ❖ China produces 28% of all emissions, more than USA and EU combined

Total and Individual Contributors



Source: Boden, T.A., G. Marland, and R. J. Andres. 2015. Global, Regional, and National Fossil-Fuel CO<sub>2</sub> Emissions. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., U.S.A. doi: 10.3334/CDIAC/00001\_V2015

Data: CDIAC/GCP

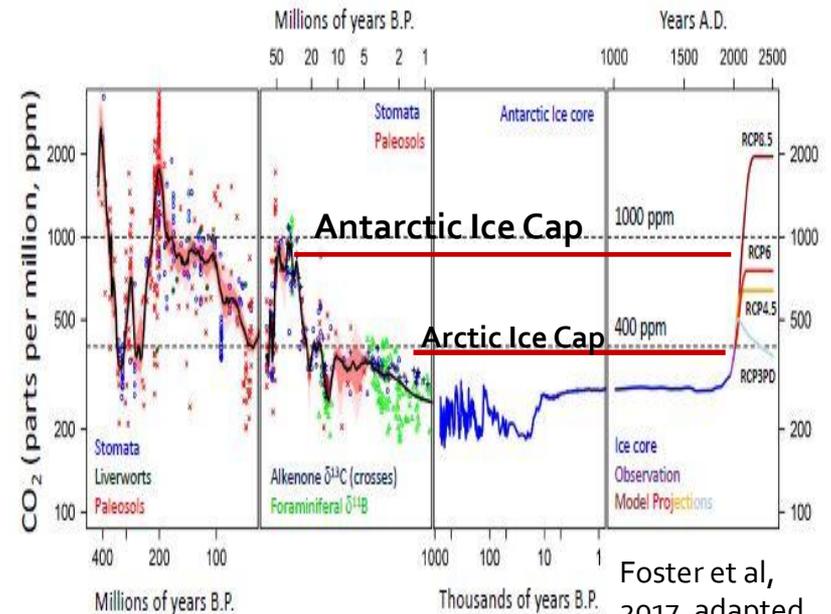
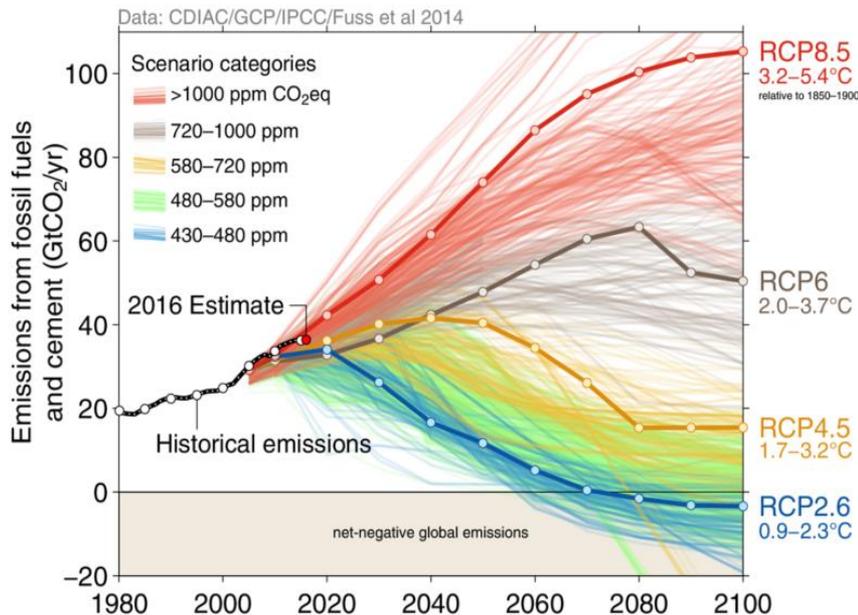


Global Carbon Project

# What will be the results of the rise in CO<sub>2</sub> in the atmosphere?

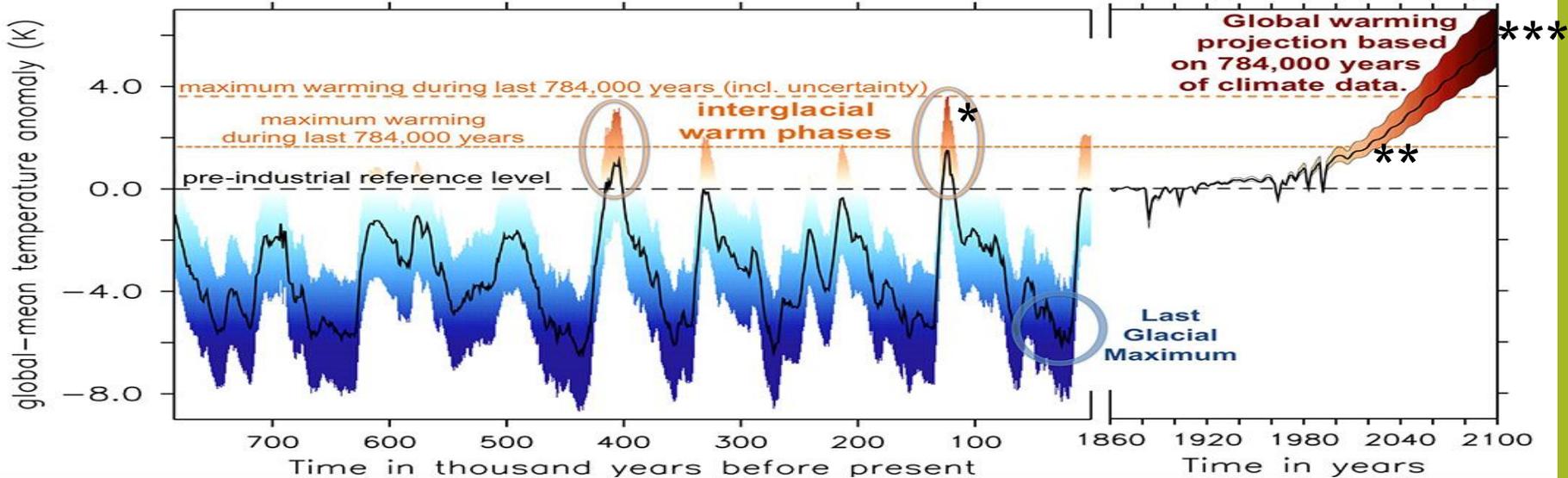
- Current CO<sub>2</sub> level (4/18) is 411 ppm, increasing 2.7-3 ppm per annum at 40 GtCO<sub>2</sub> emissions/annum
- +2.3 deg C (RCP2.6) only possible if immediate major reduction in HC use which is unrealistic
- +3.2 deg C (RCP4.5) would require significant new policies to take effect by 2040
- +3.7 deg C (RCP6) most likely case under current policies
- +5.4 deg C (RCP8.5) is case with no restrictions

- With CO<sub>2</sub> level above 400 ppm, we have already reached point at which north polar cap will mostly disappear in summer around 2050, causing major climate shift
- Difference between taking action in the near future and “business as usual” is saving the Antarctic ice sheet which holds 90% of the world ice and would be the cause of major sea level rise



Foster et al, 2017, adapted, Montenez, 2018

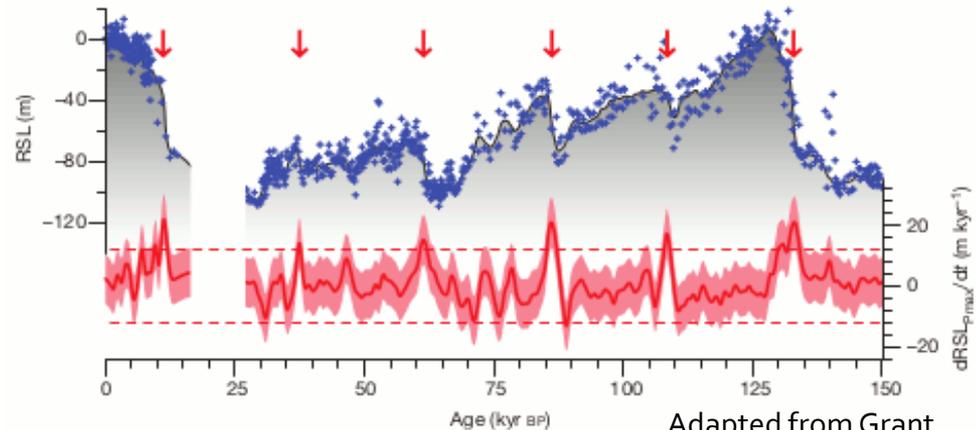
# Additional (Geological) Historical Perspective



\*Oldest age of ice cores in Greenland are about 120,000 BC. Temperature at that time est. 3 degrees above 1900 level. Sea level est. 7-10 meters above current level.

\*\*By 2050, temperature increase will be 2.5-3 degrees C above 1900 level and CO<sub>2</sub> level in atmosphere will be 475-500 ppm

\*\*\*By 2100, unless major change in world policies, temperature will be >4 degrees above current level and CO<sub>2</sub> >600 ppm



Adapted from Grant (2012)

Within last 150,000 years, sea level rise during periods of rapid warming estimated at 1.2 meter per century, or 3X current rate

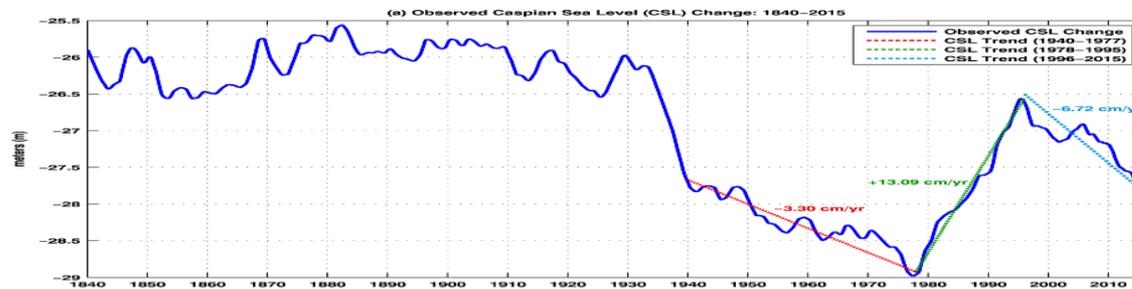
# Climate Change will have a negative effect on the Caspian Region

- The temperature has risen 1.4 degrees C since the 1950's in the Caspian region, likely >2 deg. C by 2050
- Changes in global circulation will likely cause reduction in precipitation

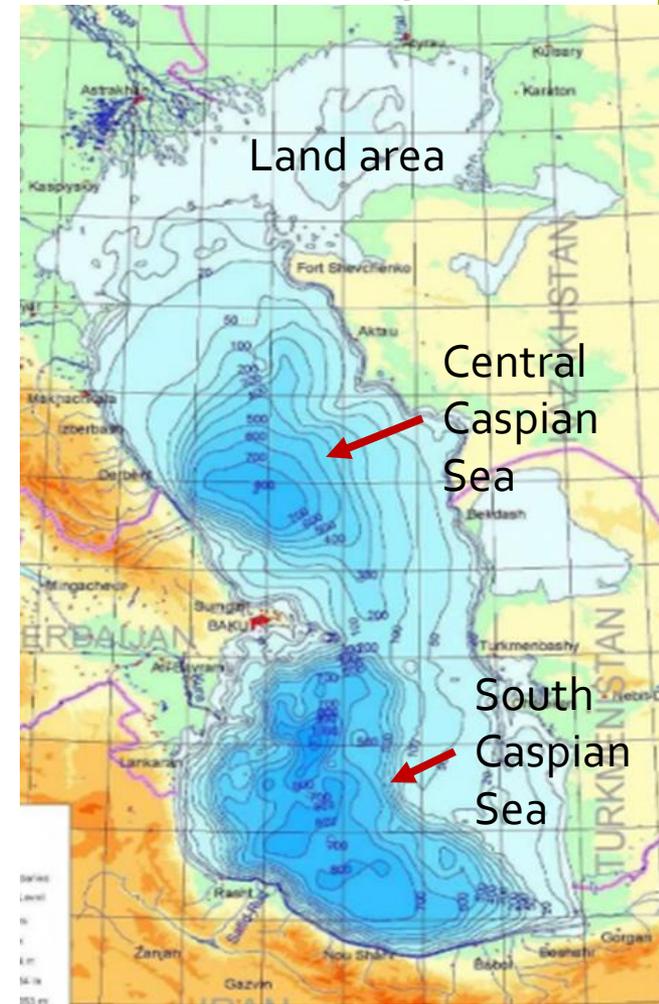
These factors could put the very existence of the Caspian Sea as we know it at risk by the next century. The water balance is dominated by evaporation and river runoff as well as outflow to Kara-Bolgaz-Gol.

- Higher temperature is increasing evaporation
- Reduced precipitation will reduce water runoff

**CASPIAN SEA LEVEL HAS BEEN DROPPING AT 6.7 CM/YR IN THIS CENTURY.** While there has been variation through time, recent changes, tied to climate change, if continued, will lead to Caspian reducing to two smaller bodies in the next century. (Aral Sea is the example)

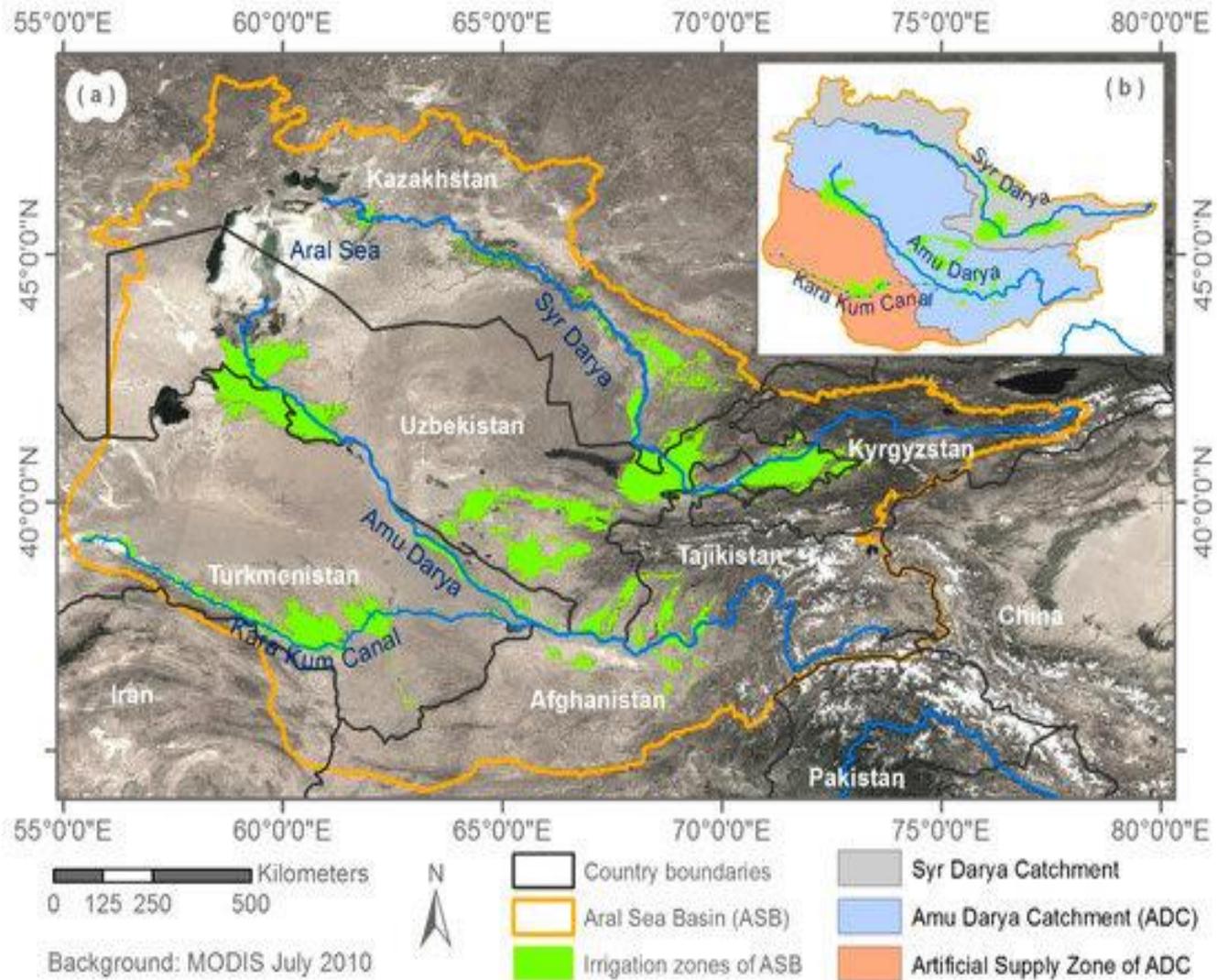


## Caspian Sea in the next Century



# Glaciers that provide most of the water for the East Caspian region are melting

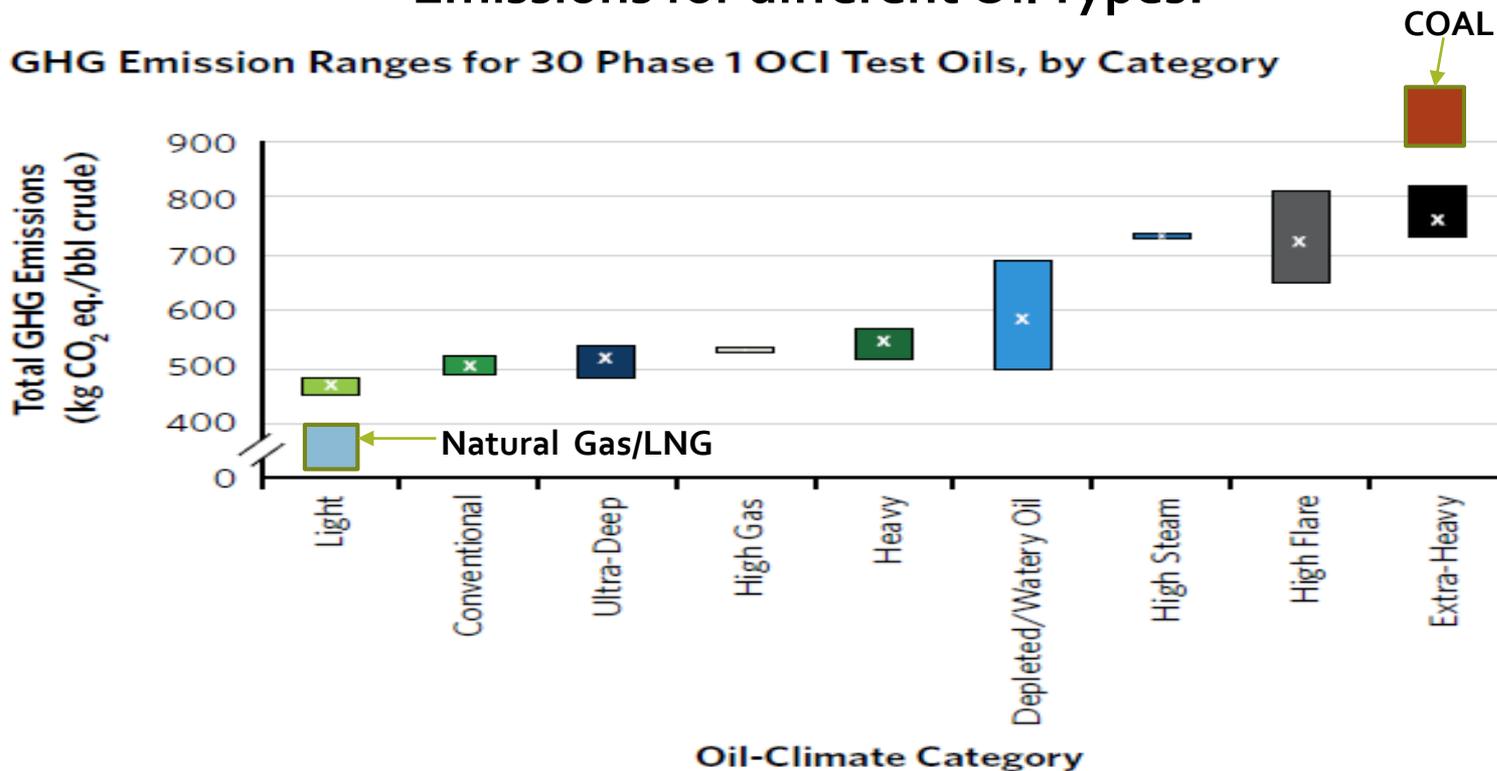
Most of water resources on East flank of Caspian supplied by Amu Daria and Syr Daria rivers which are supplied by glacial melt from mountains to East. **Since 1950's, 30% of ice has melted and by 2050, another 30% will be gone.** While initially this increases waterflow, in long term this will be disaster for region



# Comparison of GHG Emissions for different types of oil production

Greenhouse Gas Emissions for oil are less than coal and greater than natural gas. However, there is a wide difference in Greenhouse Gas Emissions for different Oil Types!

GHG Emission Ranges for 30 Phase 1 OCI Test Oils, by Category



Adapted from Carnegie Endowment Oil Climate Index

# What is a REALISTIC scenario to address global warming taking into account technology, resources, economics and politics?

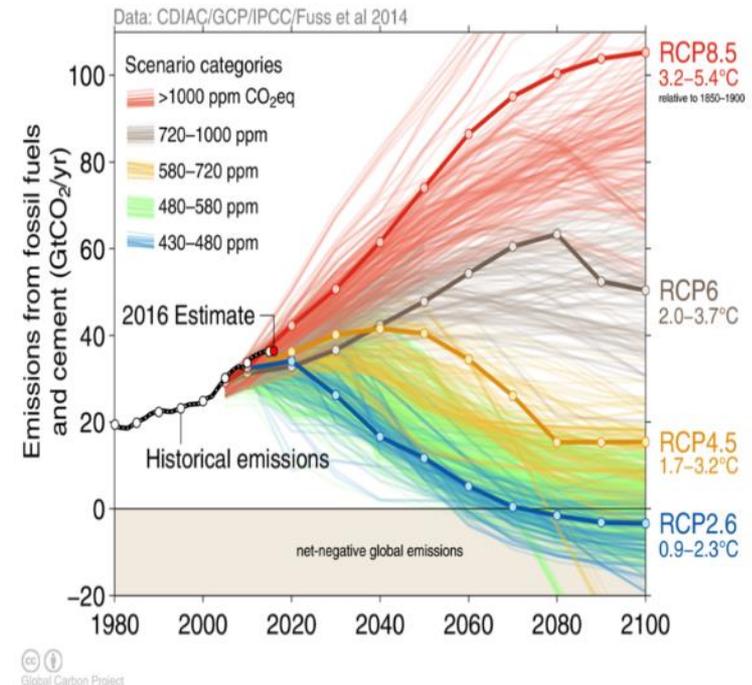
The following must be assumed:

- The world will continue GDP growth of 3% with increased energy efficiency, energy use increasing at 1% per year
- Shifting to lower GHG energy generation and technologies will only happen if the transition can be made with some compensation for economic pain and without putting countries that do not have the resources of low GHG fossil fuels at major disadvantage

**The RCP4.5 Scenario, which keeps CO<sub>2</sub> emissions at about 40 GHG GtCO<sub>2</sub>/yr. emissions is now “best case scenario”**

In order for this to happen, the following would need to occur:

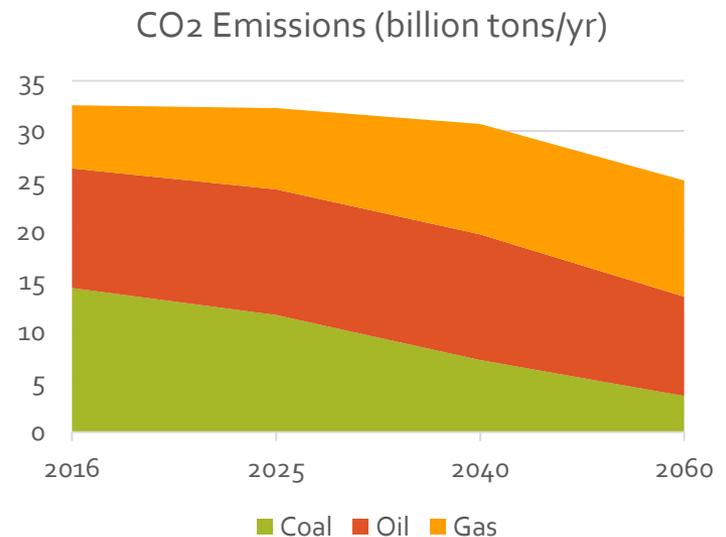
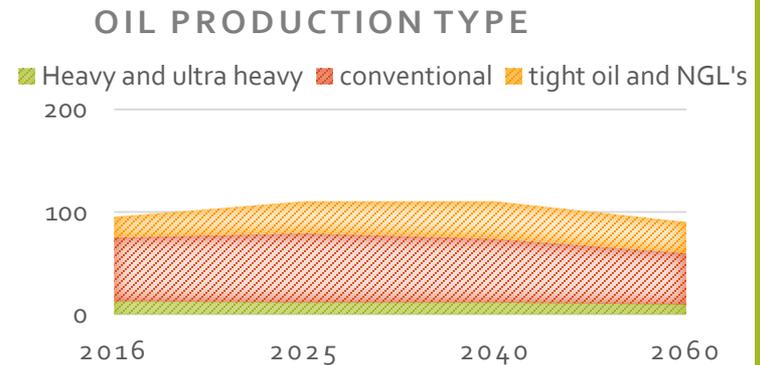
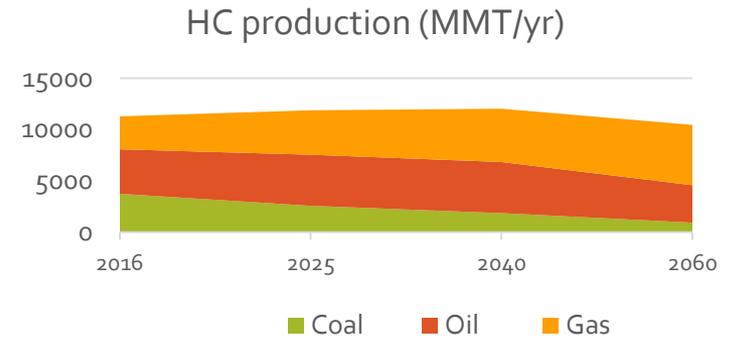
- Coal production reduced by 50% in 2040 from 2016 level, reduced again by 50% by 2060
- Oil production peaks at 110 MMBO/D in 2025, plateau at that level though 2040 and drops 1%/year thereafter
- Natural gas production increases from 2016 level by 60% to 2040 (2%/yr.) and an additional 15% by 2060
- Renewable+nuclear increases from 15% of energy production in 2016 to 30% in 2040 to 50% in 2060



# HC Emission plan to achieve Climate change Goals

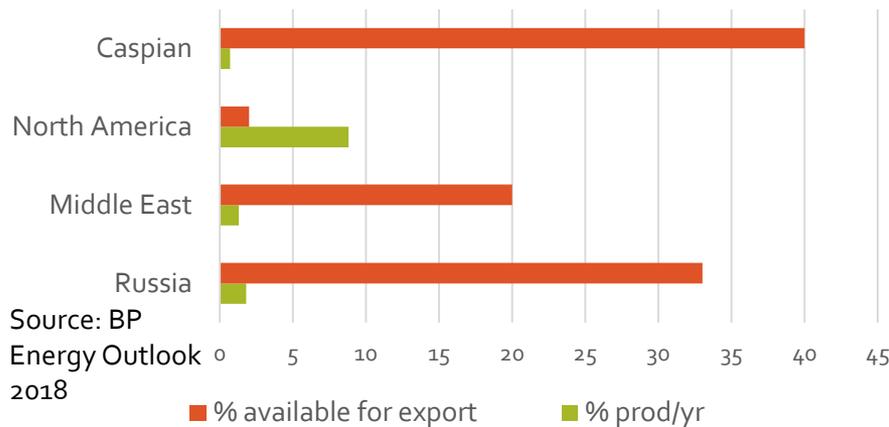
The plan to reduce coal production, have oil production “plateau” and **utilize natural gas as “transition fuel”** while building up renewable+nuclear share of energy generation will result in CO<sub>2</sub> emissions from fossil fuels gradually reducing CO<sub>2</sub> emissions from present level of 33 billion tons/year to 31 billion tons in 2040 with further reduction to 25 billion tons in 2060. To incentivize nations to move in this direction, the following steps will be necessary:

1. **A TARGETED carbon tax, starting with the highest GHG emitting fossil fuels**
2. **Halt construction of new coal-fired power stations as soon as practical**
3. **Reduction and then elimination of gas flaring**
4. **Utilization of the proceeds from the carbon tax to subsidize low GHG energy generation and Carbon Capture and Sequestration (CCS) technologies**



# 75% of World's Natural Gas Reserves are found in four Regions: Russia, Middle East, North America and Caspian

Reserves and Export capacity



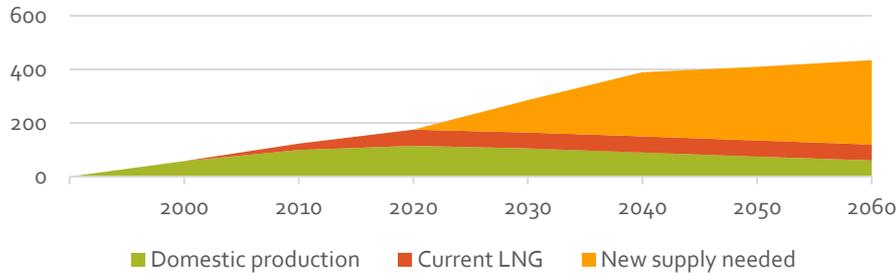
Of the four regions, the Caspian currently produces a smaller portion of its reserves per year (2%) and has a larger share available for export (40%) than any of the other regions. 80% of Caspian gas reserves are in Turkmenistan, the world's 4<sup>th</sup> largest holder of gas reserves.

The Caspian is the only region that can service by pipeline the three largest gas markets in Eurasia: Europe, South Asia and China



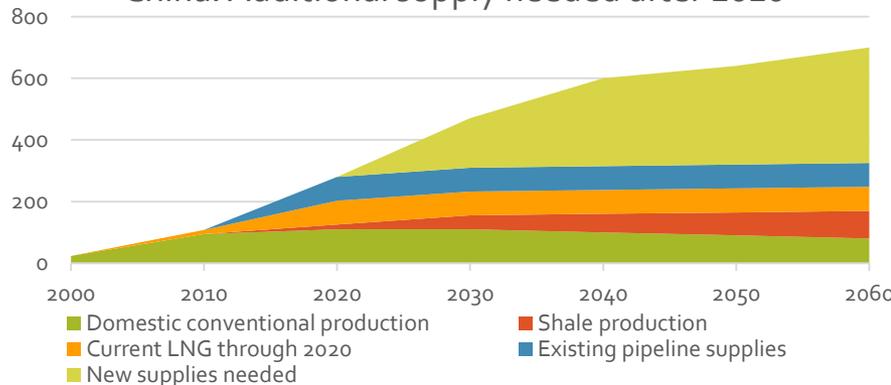
# Three Major markets require gas to replace coal\*

South Asia New Demand after 2020



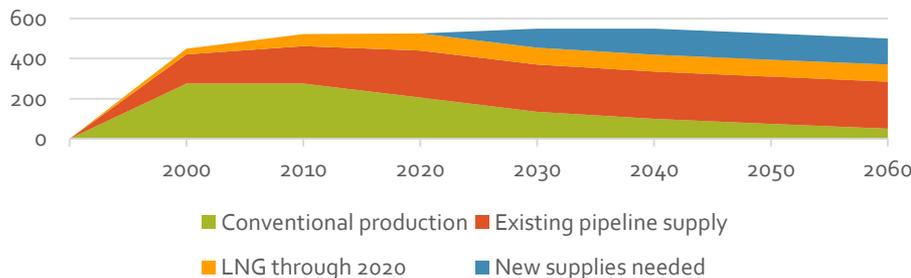
India currently generates 76% of electricity from coal. Replacing that with gas and renewables, plus economic growth in South Asia will require 120 BCM of new annual gas supplies by 2030, 240 BCM by 2040 and 300 BCM by 2060

China: Additional supply needed after 2020



China consumes more coal than the rest of the world combined. Domestic gas production will provide only fraction of gas needs as coal use declines. Additional supplies of 150 BCM by 2030 and 300 BCM by 2050 will be needed

Europe: new supplies needed after 2020

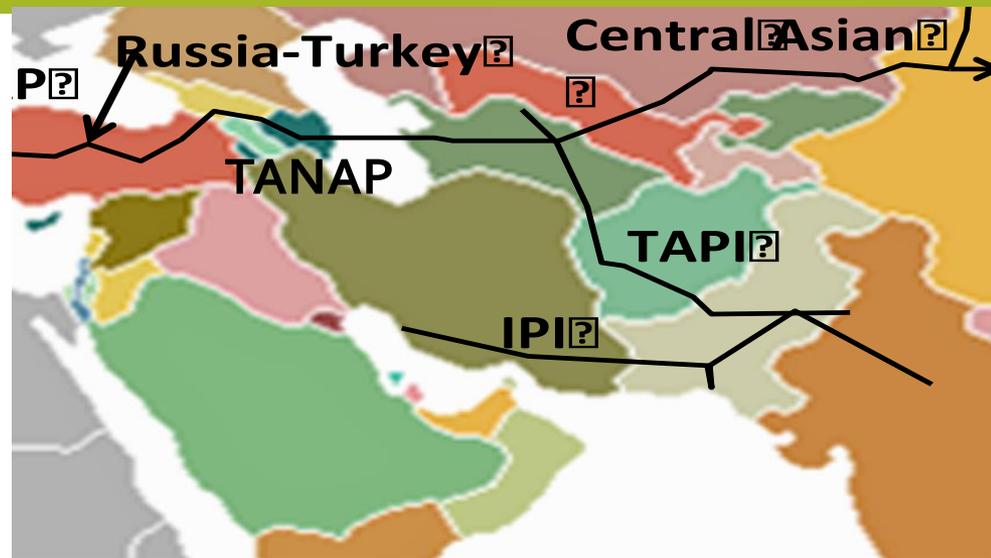


While Europe gas demand is projected to be constant, declining domestic production will have to be replaced by about 100 BCM of new supplies

\*assumes 50% reduction in coal use 2020-2040, 50% further reduction by 2060 with 50% of energy replaced by gas, the rest by nuclear + renewables

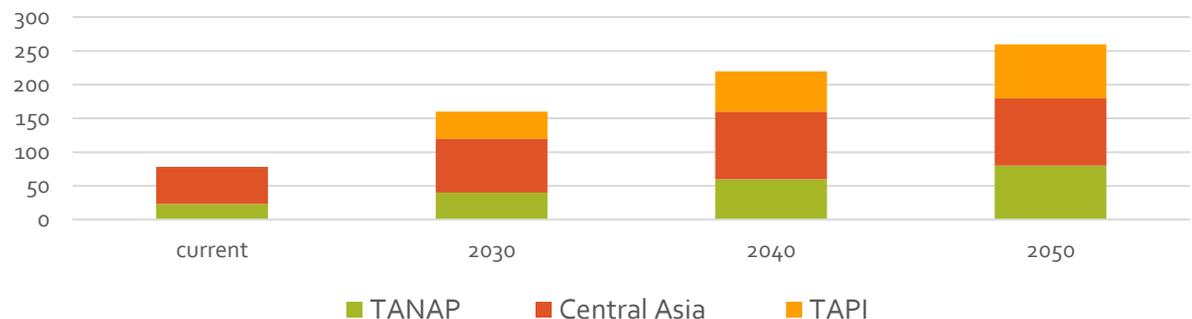
## The Caspian region needs to maximize its role in supplying each of these three markets

- **TAPI:** This could provide support for a 40 BCM pipeline by 2030, expanding to 60 BCM by 2040 and 80 BCM by 2050. This could provide about 20% of South Asia's requirements.
- **Central Asian:** Current thruptut of 55 BCM will be expanded to 80 BCM by 2030 and could be expanded to 100 BCM by 2040. This could supply about 15% of the supplies needed by China.
- **TANAP:** Current thruptut of 23 BCM should be expanded to 31 BCM by 2026 and 40 BCM by 2030, 60 BCM by 2040 and 80 by 2050. If 2/3 of this supply goes to Europe (the rest to Turkey) it would supply about 15% of Europe's needed gas.



Participation in these three pipelines could triple current Caspian gas exports by 2050

Potential Caspian pipeline exports (BCM/year)



# Importance of Natural Gas for Caspian Nations and the World

- Climate Change is probably the most serious issue facing the world; the longer we wait to seriously address it, the more difficult the challenge will be
- For the Caspian nations, the effects of Climate Change threaten their way of life and possibly their very existence
- A rapid transition to natural gas as a “bridge fuel” while renewable+nuclear energy generation continues development is the only realistic way forward
- The abundant gas resources of the Caspian nations, combined with their central geographic location make them a possible positive factor in assisting in this solution

*The next step could be the development of a comprehensive plan, including the producing and consuming nations, energy and infrastructure companies and finance institutions, to fully utilize the gas resources of the Caspian nations*