

Item 4: Role of gas in attaining Sustainable Development Goals

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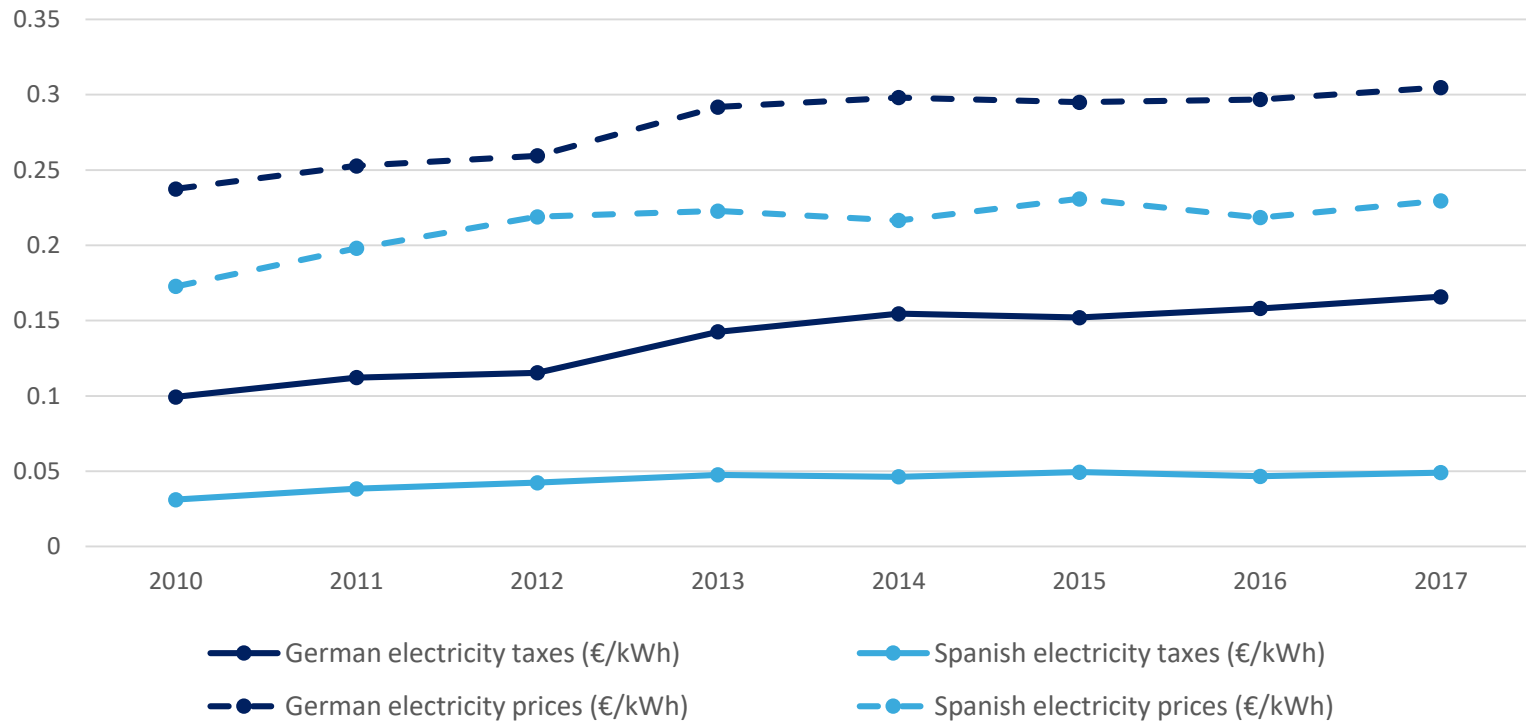
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Gas Exporting Countries Forum (GECF)

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- How can gas and LNG help access to affordable, reliable, sustainable and modern energy for all?
- Can gas improve energy efficiency of the electricity system?
- How about climate objectives?
- How can gas improve social and economic conditions (poverty, hunger, health) and promote decent work and economic growth?
- What are interlinkages between gas and Goal 6 (clean water and sanitation), Goal 9 (industry, innovation and infrastructure), Goal 11 (inclusive, safe, resilient and sustainable cities), Goal 12 (sustainable consumption and production patterns)?

How can gas and LNG help access to affordable, reliable, sustainable and modern energy for all?

Electricity prices (€/kWh) and electricity taxes (€/kWh) in Germany and Spain (2010 – 2017)



- The cost of producing electricity from natural gas remains competitive
- In many countries with a high penetration of renewable energies, the price of electricity has increased significantly to support the cost of subsidies

Can gas improve energy efficiency of the electricity system?

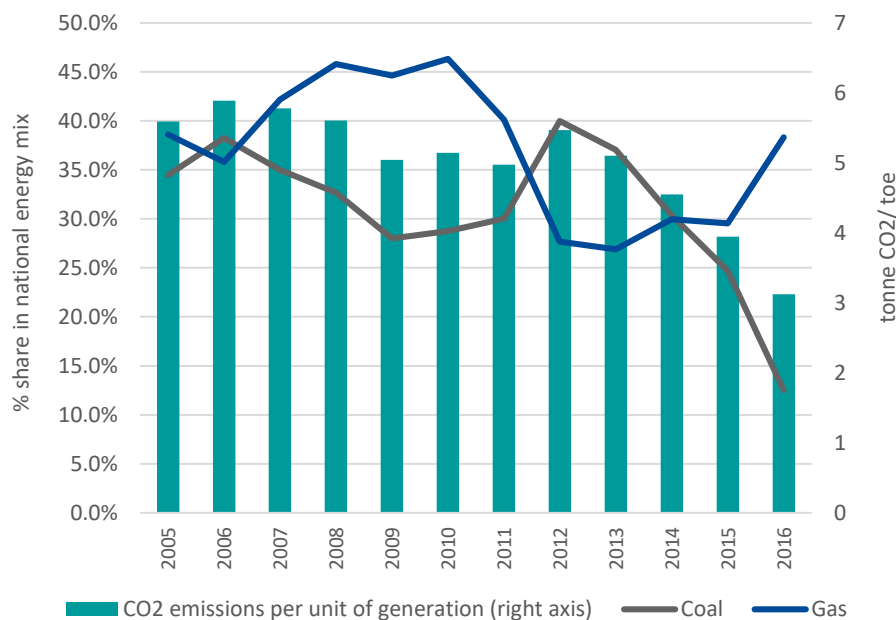
- On the average, gas-fired power plants are much more efficient than coal-fired power plants (47% vs 36%)
- Combined-cycle power generation using natural gas can reach more than 60% energy efficiency
- We estimate average thermal power plant efficiency at around 40% (including coal, gas and oil fired power plants)
- Efficiency can be further improved by:
 - Supporting innovation to improve gas power plants efficiency; optimizing the cost of gas technologies
 - Improving the efficiency of co-generation; investing in steam/heat networks
 - Developing hybrid solutions for natural gas and renewables (e.g. pilot-scale gas and solar hybrid units); this also provides an interesting opportunity to enhance implementation capacity and position gas for the scale-up of future renewable energy use

- National climate policies and mitigation measures outlined in countries' NDCs/INDCs largely overlook the potential contribution of natural gas in meeting climate objectives
- More than 50 countries have increased the share of natural gas and decreased the share of coal in their energy mixes between 2012 and 2016

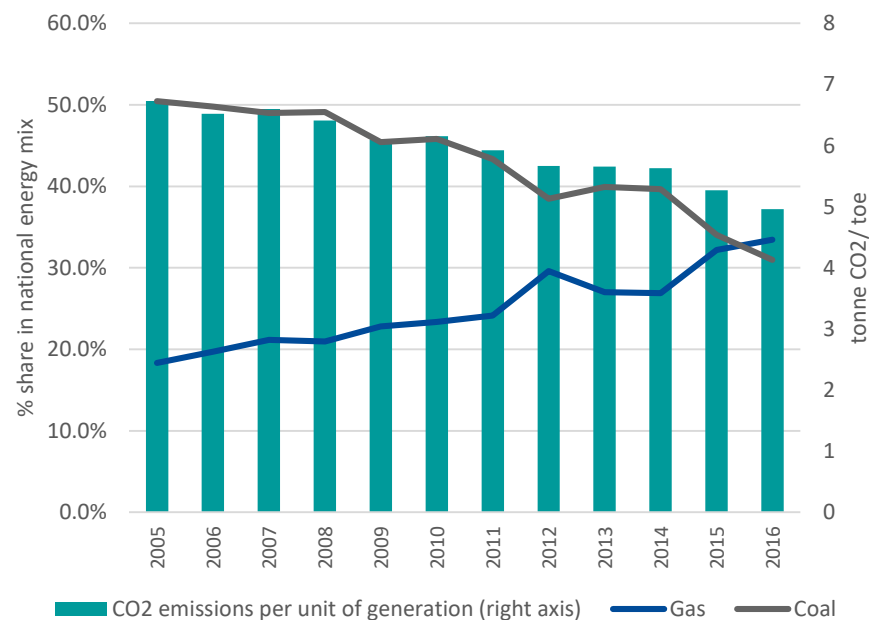
Role of natural gas in meeting climate objectives

- Coal to gas switching has resulted in CO₂ emissions reductions in the United States and the United Kingdom

United Kingdom: Percentage of natural gas and coal in the energy mix, plus emissions intensity (2005 - 2016)



United States: Percentage of natural gas and coal in the energy mix, plus emissions intensity (2005 - 2016)



How can gas improve social and economic conditions (poverty, hunger, health) and promote decent work and economic growth?

- Gas based industries (e.g. petrochemicals and steel) stimulate economic activity
 - Integration of economic value chains; for example: the gas-based fertilizer industry can support agricultural productivity
 - Agricultural productivity is of paramount importance for economic development in developing countries
 - In India and sub-Saharan Africa agriculture accounts for around 18% of GDP
- Access to clean and modern energy services
 - Natural gas is an excellent alternative to traditional biomass fuels for cooking
 - There are important synergies between clean energy for cooking and other SDGs
 - SDGs 5 and 8 (gender equality and economic growth): women are primarily responsible for cooking and preparing fuel
 - SDG 3 (health): through improved indoor air quality and reduced physical impacts from collecting fuel
 - SDG 4 (education): particularly for women and girls, time saved through access to modern energy can be redirected towards education

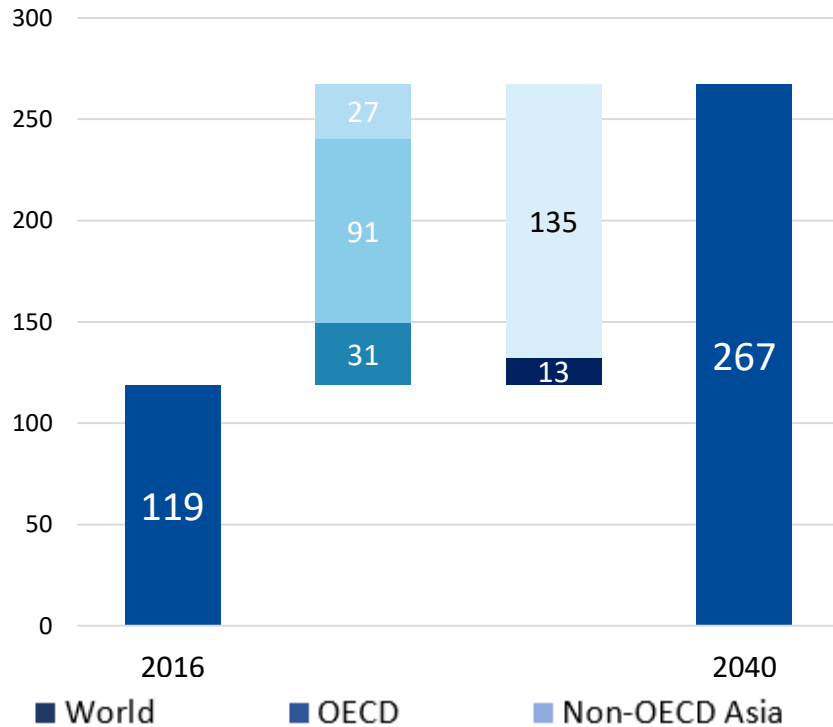
What are interlinkages between gas and Goal 6 (clean water and sanitation), Goal 9 (industry, innovation and infrastructure), Goal 11 (inclusive, safe, resilient and sustainable cities), Goal 12 (sustainable consumption and production patterns)?

- Natural gas can be used in desalination with fewer CO₂ than oil- and coal-based technologies.
 - Reliability and flexibility of natural gas important in reducing water stress
 - Algeria and other Middle Eastern countries have achieved successful results
- Water utilities in urban centers are dependent on energy to provide clean drinking water and sanitation services
- Potential for innovation in gas-based industries:
 - Chemicals and transportation
 - The GECF Gas Research Institute aims to support R&D and innovation in the natural gas industry and gas supply chains, including optimization and dissemination of best practices
- Safe and resilient cities through reliable and flexible power generation
 - Access to electricity is correlated with improved safety, especially for women and girls
 - Supporting the development of cleaner transportation systems

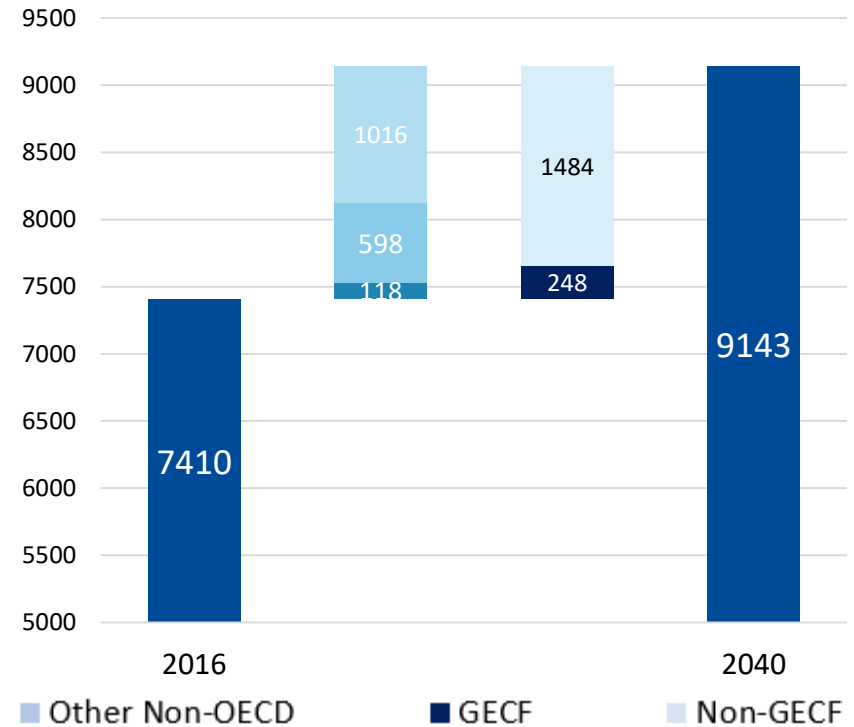
Population growth and household wealth will be the main drivers of global energy demand

growth

GDP (2016\$ PPP trillion)



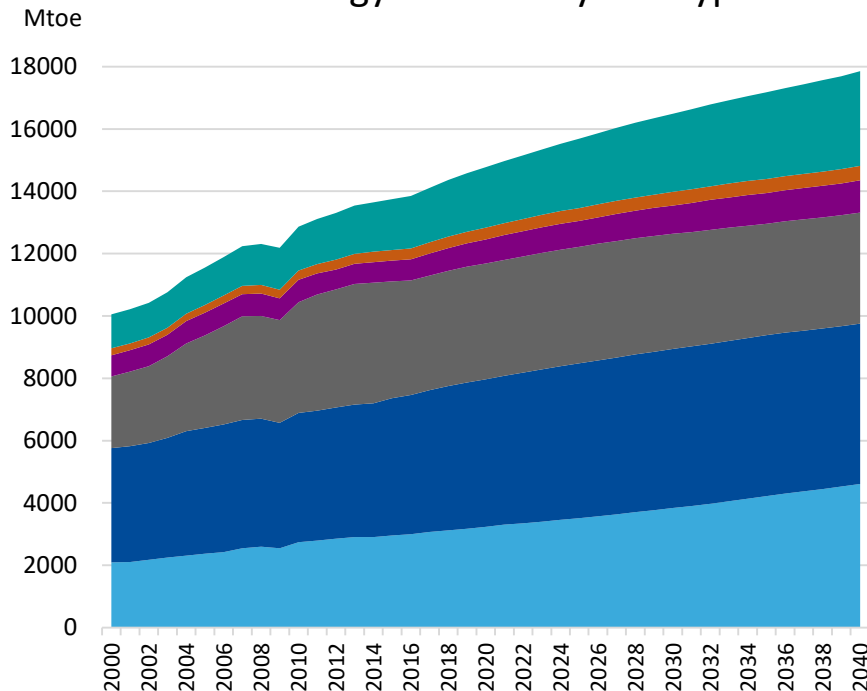
Population (mn)



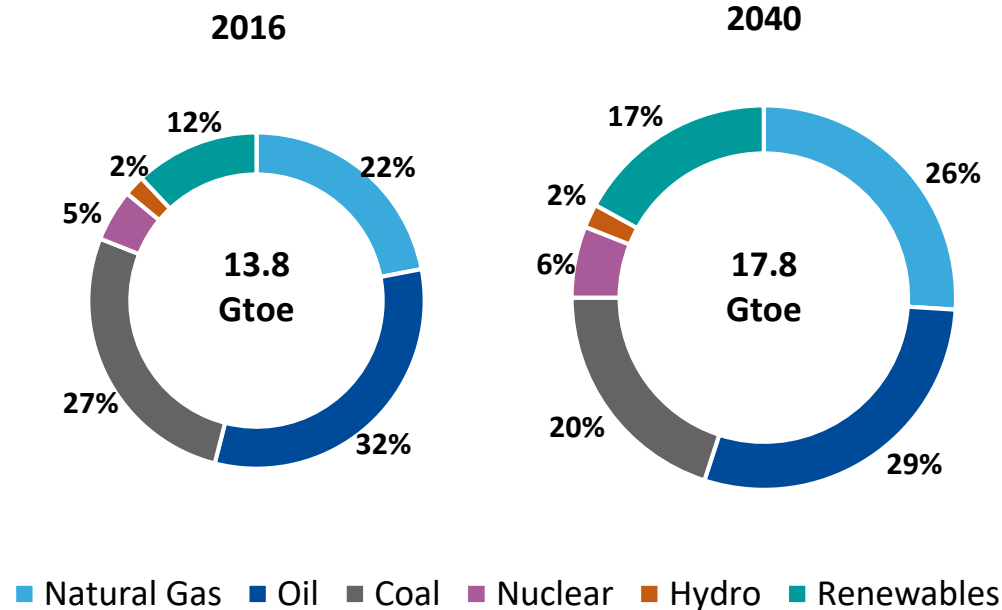
- Global GDP is expected to grow by 3.7% over the next five years, a slight upswing from the 3.4% seen over the previous five years.
- The global population will reach 9.2 bn by 2040— a 1.7 bn person increase from today
- This substantial population increase is paired with an 80% forecasted increase in average GDP per capita relative to current levels

Global energy demand to rise by 29% between 2017 and 2040

Global energy demand by fuel type



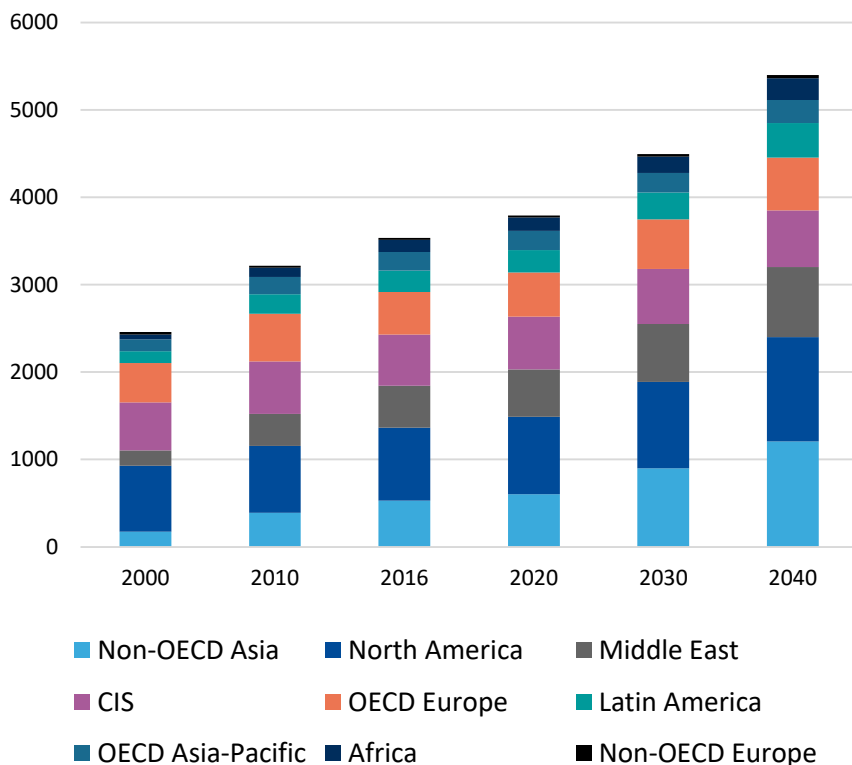
Global energy mix in 2016 and 2040



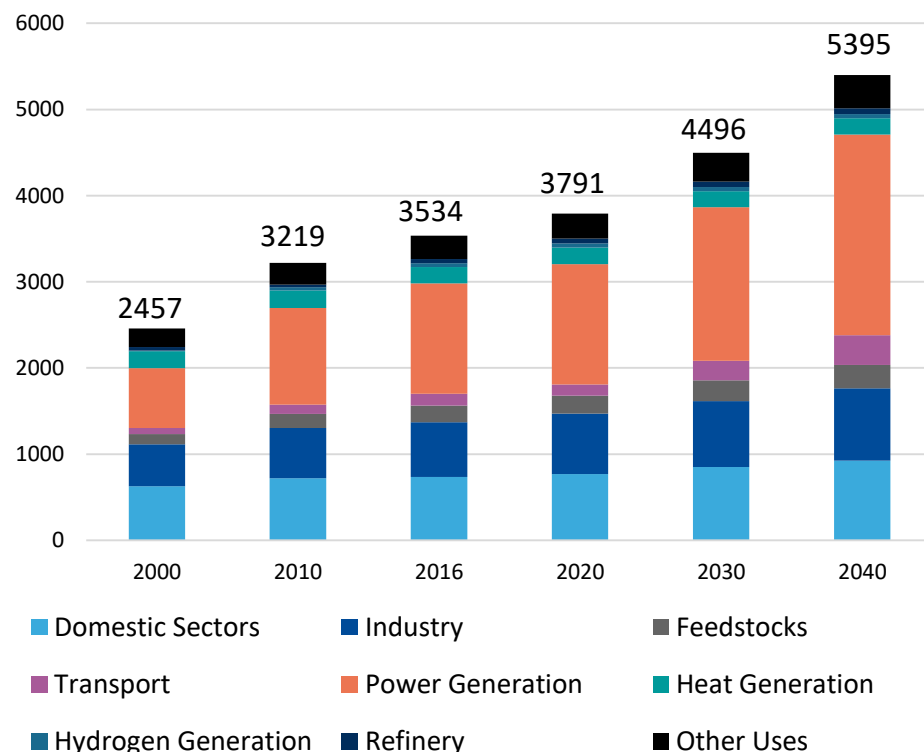
- Global energy demand is projected to grow by 1.1% per annum, amid population and economic growth, as well as expanding middle class in developing countries
- The share of gas in the overall energy mix will increase strongly in 2040. Moreover, natural gas will occupy the second place in the global energy mix, overtaking coal

Global natural gas demand increases to 5395 bcm in 2040

Natural gas demand by region (bcm)



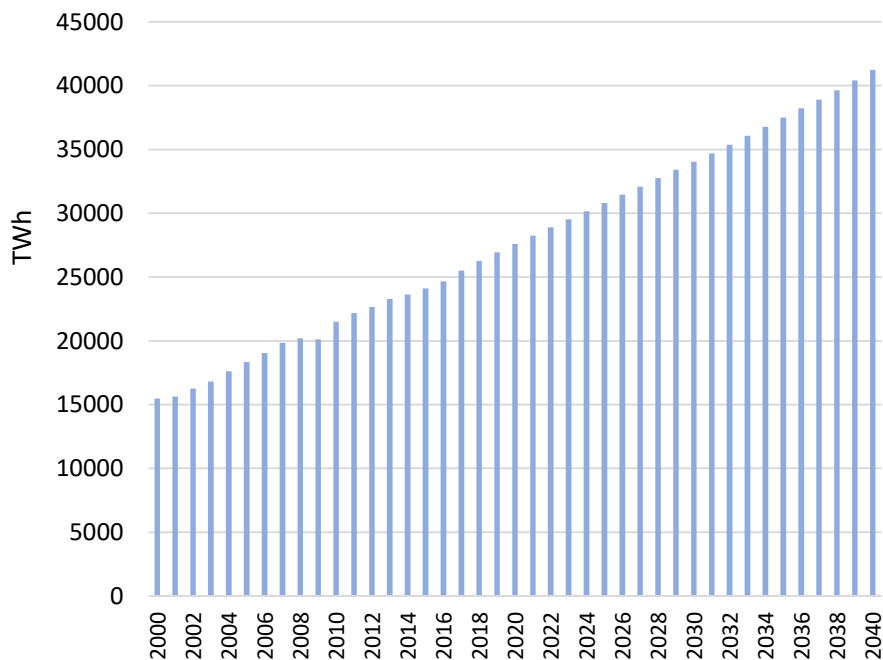
Natural gas demand by sector (bcm)



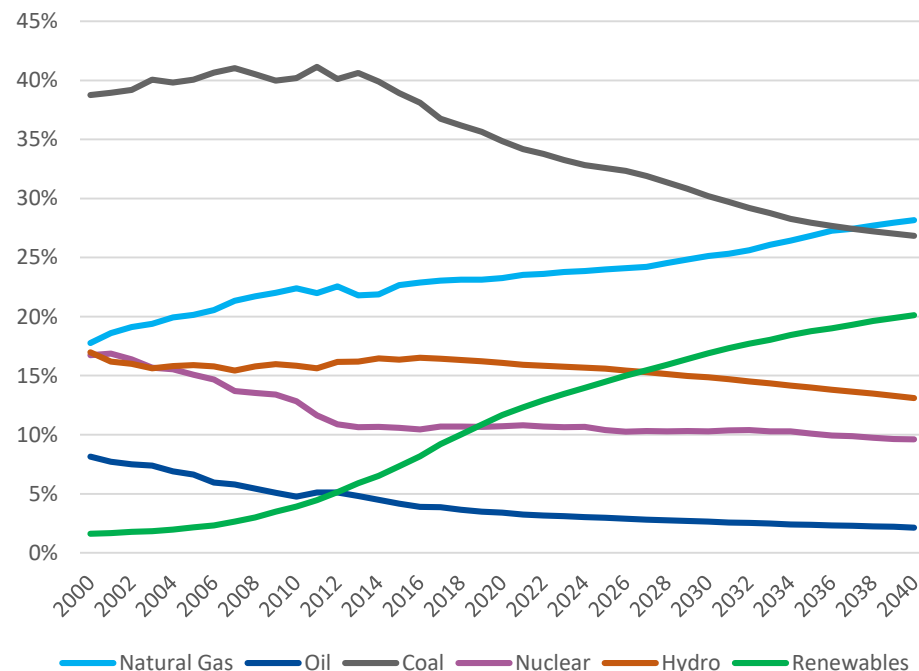
- Developing and emerging economies, including non-OECD Asia (3.5%), Africa (2.5%), and the Middle East (2.2%), will lead gas demand growth by 2040
- Power generation will remain the largest natural gas consuming sector. It will consume 2329 bcm, or 43% of global gas demand in 2040

Natural gas and renewables provide 48% of global electricity generation

Global electricity demand



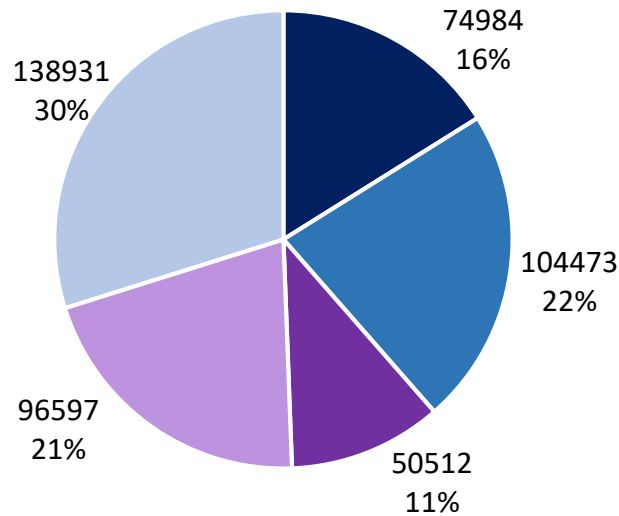
Global power generation mix



- Global electricity demand is expected to grow at an annual average growth rate of 2.2%, amid GDP growth in developing and emerging economies, and the fight against energy poverty
- The share of gas in the power generation sector will increase from 23% in 2016 to 28% in 2040, which will represent the largest market share of any fuel

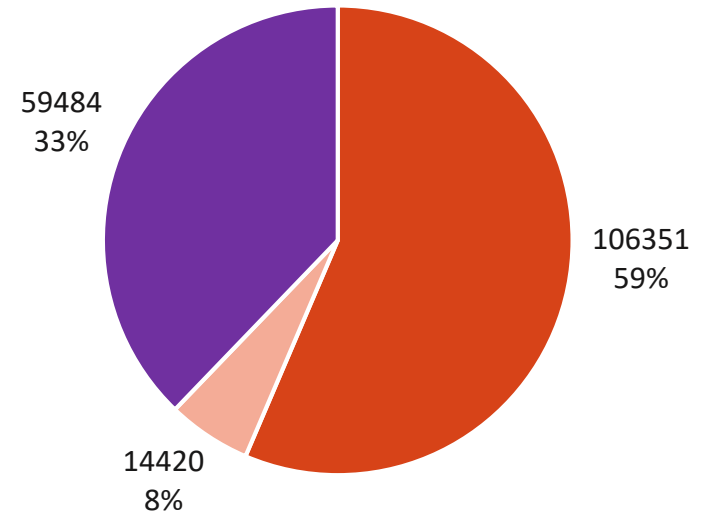
Global abundance of natural gas resources

Total natural gas resources by type (bcm)



- Conventional-Existing Projects
- Conventional-New Projects
- Unconventional - Existing
- Unconventional - YTF
- Conventional - YTF

Total natural gas reserves (bcm)

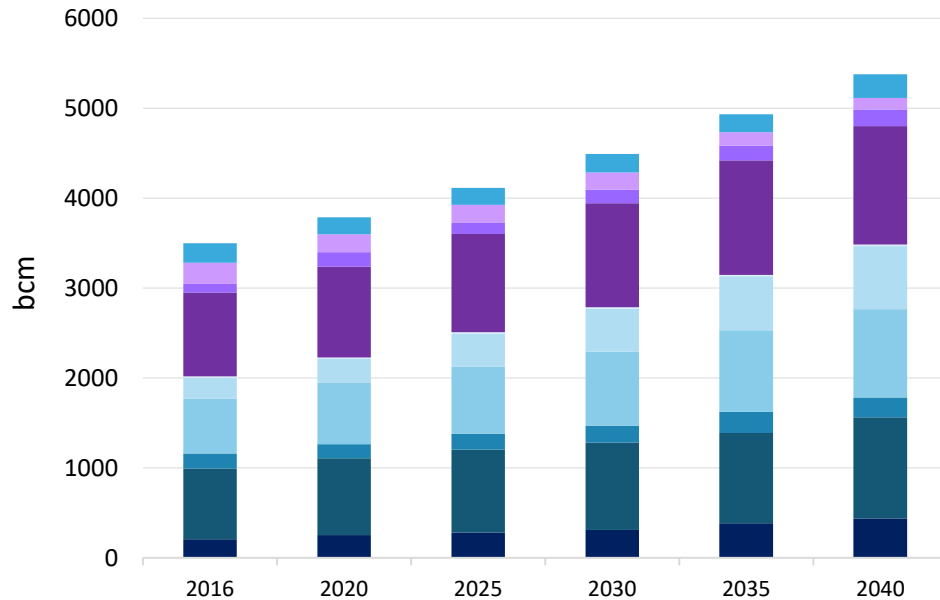


- GECF Members
- GECF Observers
- Non-GECF

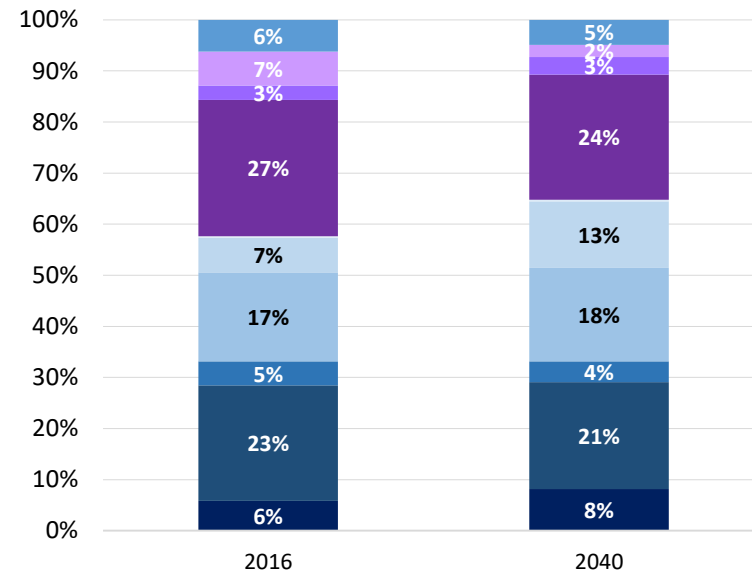
- The world possesses an ample amount of natural gas, totalling 465 tcm. Almost 180 tcm are identified as proven conventional reserves
- The current resource to production ratio is about 60 years for proven reserves (include existing projects, new projects, and unconventional reserves). This figure represents 130 years for the total resource base (including YTFs)

Marketed gas production increases to 5395 bcm in 2040

Natural gas production outlook by region



Natural gas production share by region

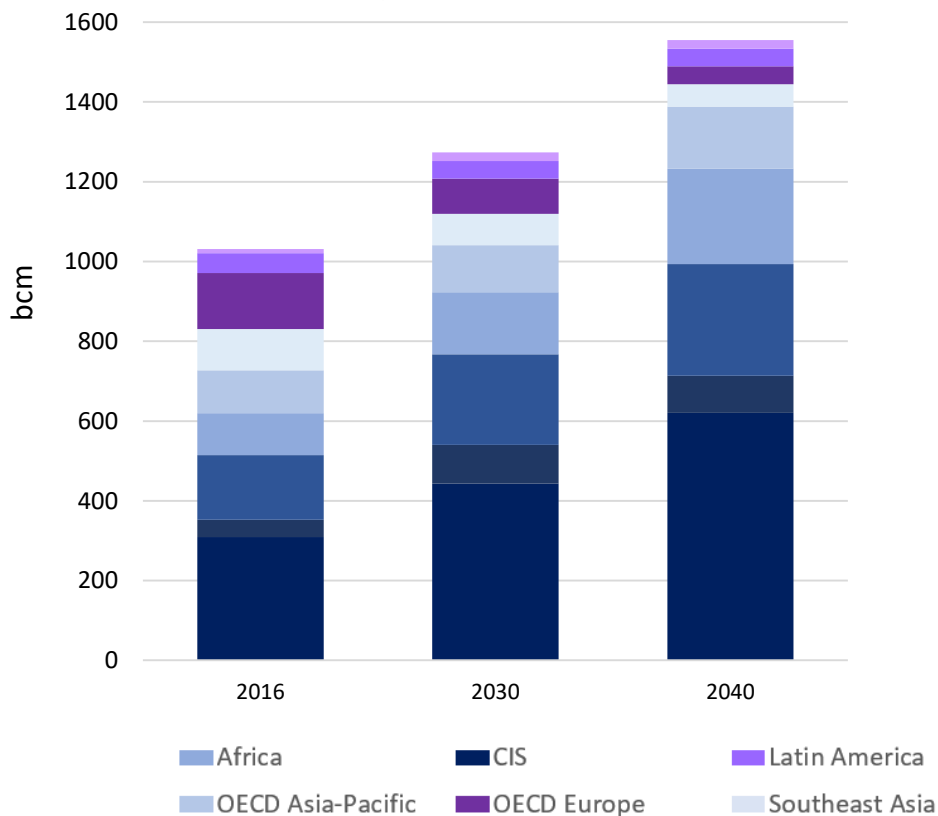


- Africa
- CIS
- Latin America
- Middle East
- Non-OECD Asia
- Non-OECD Europe
- North America
- OECD Asia-Pacific
- OECD Europe
- Southeast Asia

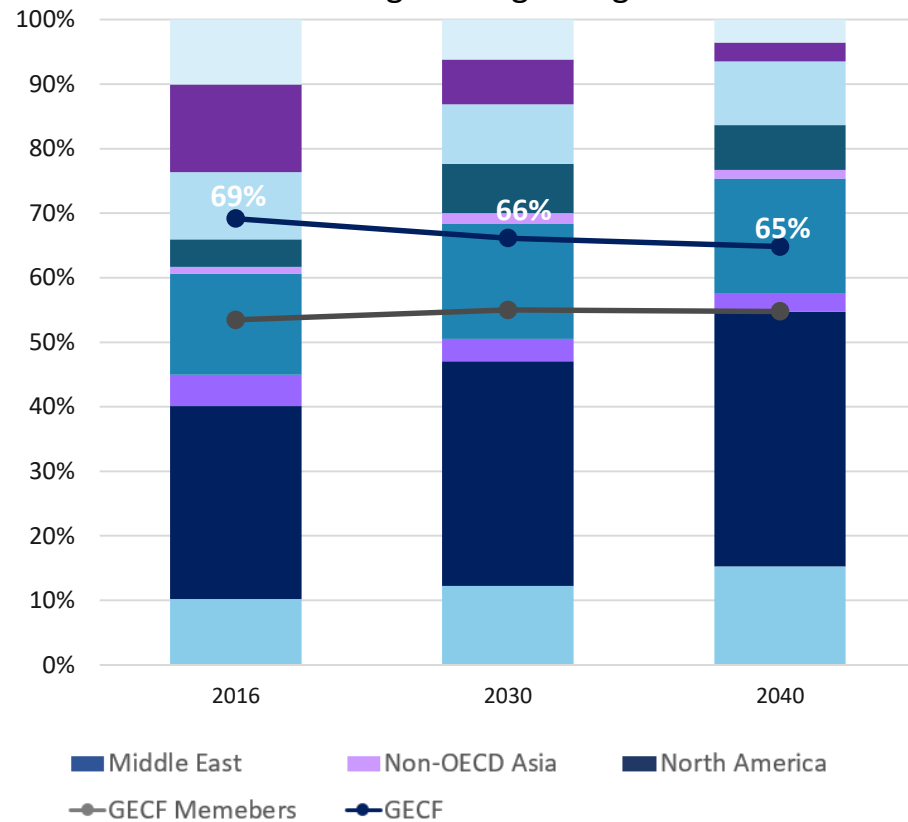
- Production in non-OECD Asia almost triples, Africa doubles and OECD-Europe halves
- North America, CIS and the Middle East dominate gas production over the outlook period
- Natural gas production will be more widespread in all world regions by 2040

Natural gas trade will increase by 50%

Natural gas trade outlook

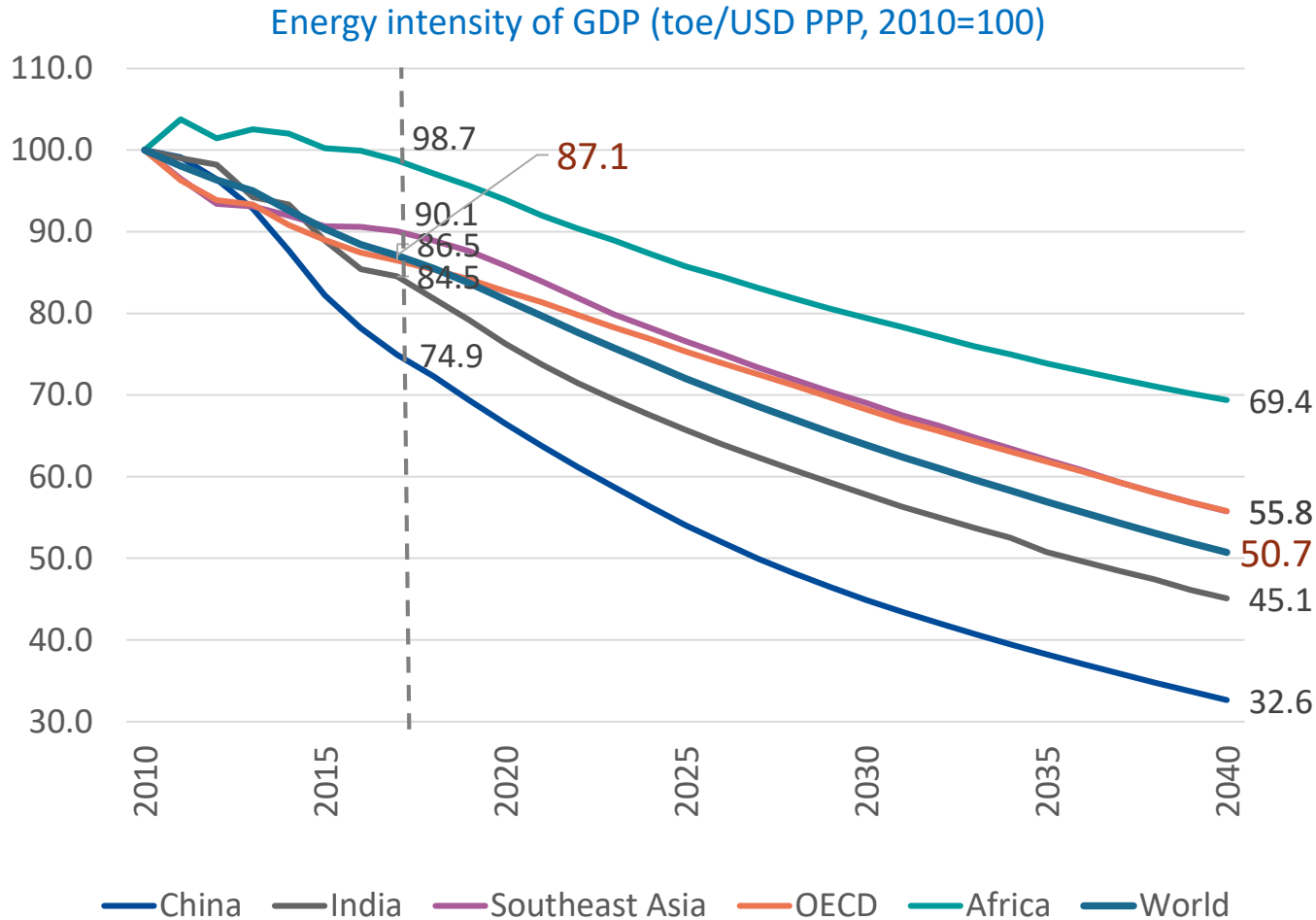


Share of regions in global gas trade



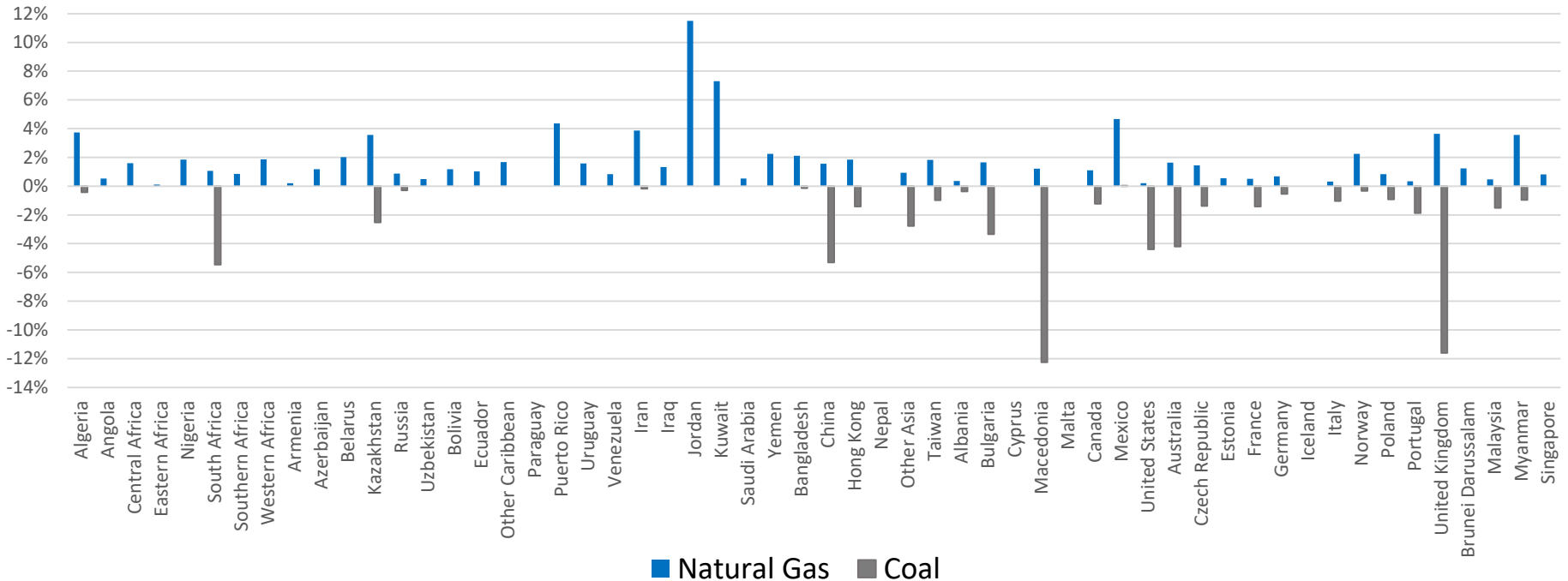
- Natural gas trade (LNG and pipeline) increases from about 1 tcm to more than 1.5 tcm
- GECF countries contribute to 65% of total exports
- Southeast Asia and Europe lose shares, while the CIS, Africa and the Middle East gain

Energy demand decouples from economic growth as services and manufacturing add more to GDP



- During 2010-2017, energy intensity decreased 13% globally, China led the way with over 30% decrease
- By 2040, additional 40% decrease in the intensity is expected

Between 2012 and 2016, in 56 countries and area the share of gas increased and the share of coal was stable or declined



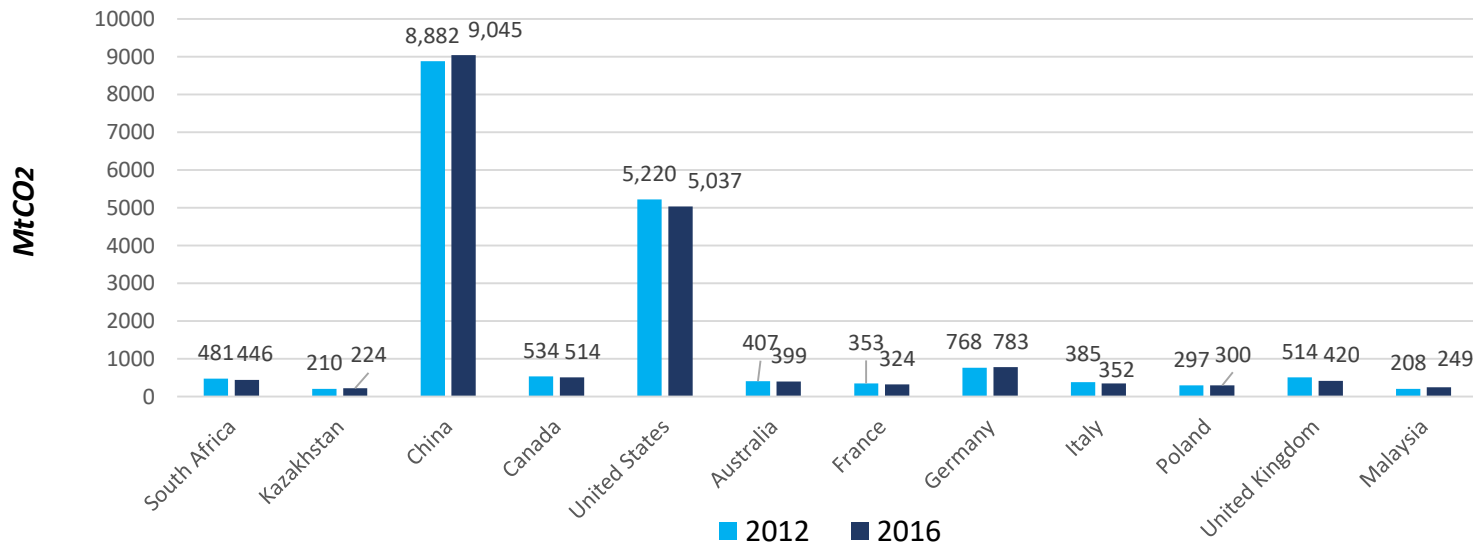
Between 2012 and 2016:

Global energy consumption: 68.1 Gtoe

Energy consumption of above 56 countries: 50.2 Gtoe, or 74% of the global consumption

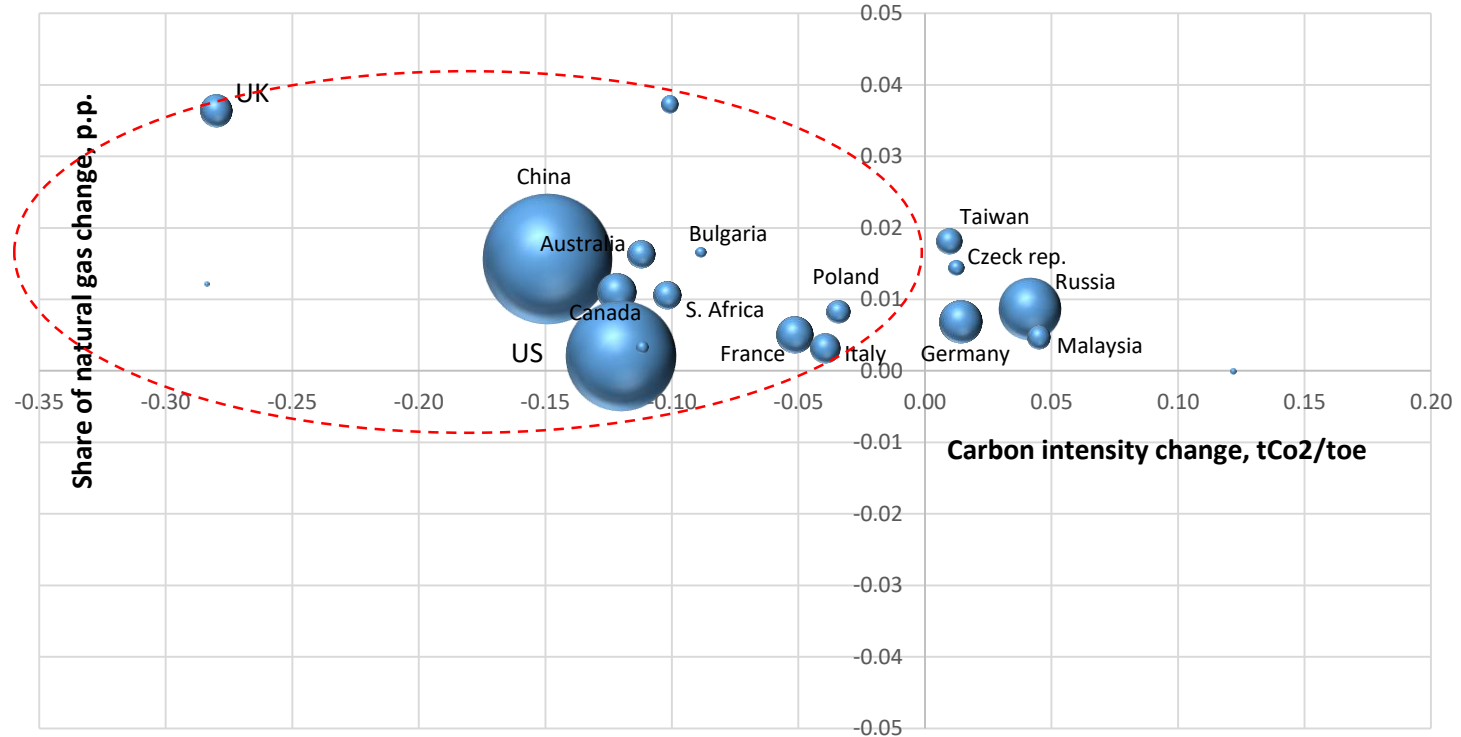
- Natural gas is far from zero-carbon, but reduces CO2 emissions because it mostly displaces high-carbon coal.
- Asian gas demand grew due to its flexibility and government policies, such as climate change.
- EU's gas demand recovered, as the retirements of coal and nuclear power plant.

CO2 emissions have been slowing down, or even declining in many selected countries



- Between 2012 and 2016, many countries with increasing natural gas share, have seen their emissions declined (Ex: United States (-4%), Italy (-9%), France (-8), UK (-18%), or stabilized (ex. South Korea, and Mexico).
- China has increased their CO2 emissions, but the average growth rate of its emissions decreased significantly compared to previous period, marking an important slowdown (For China emissions, Average Annual Growth Rate 2008-2012: 7.6% Vs. AAGR 2012-2016: 0.5%).
- Natural gas penetration against carbon intensive fuels is a main contributor to the recent CO2 emissions slowdown and reduction of carbon intensity.
- In 2016, coal-to-gas switching in the US power sectors, accounting for 33% of the emissions reduction, while wind generation was responsible for only 19% of the emissions reduction.

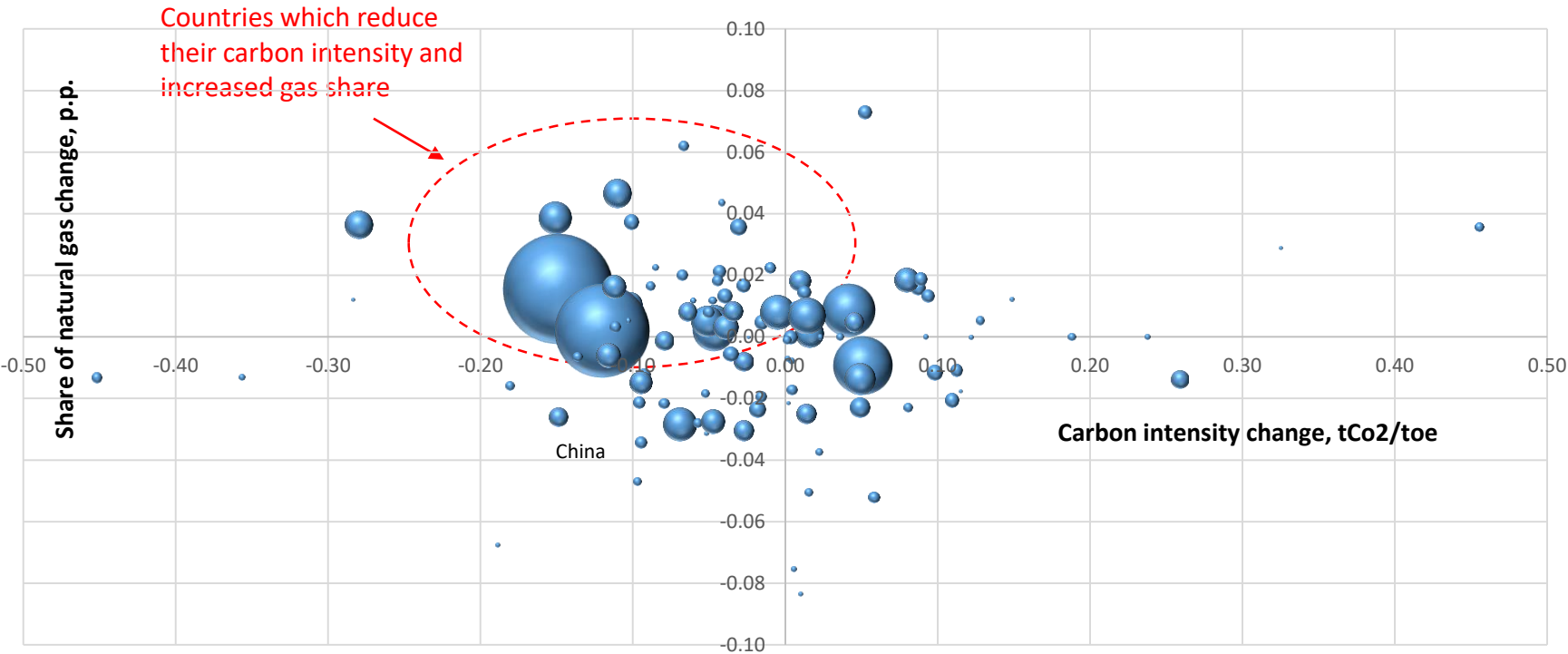
Many of the countries increasing natural gas and decreasing coal shares have achieved decrease in their carbon intensity



Bubble size: Share in global energy consumption

- Our analysis of the selected countries showed that large part of these countries including big consumers of Energy have reduced their carbon intensity, mainly by increasing the role of natural gas against coal between 2012 and 2016.

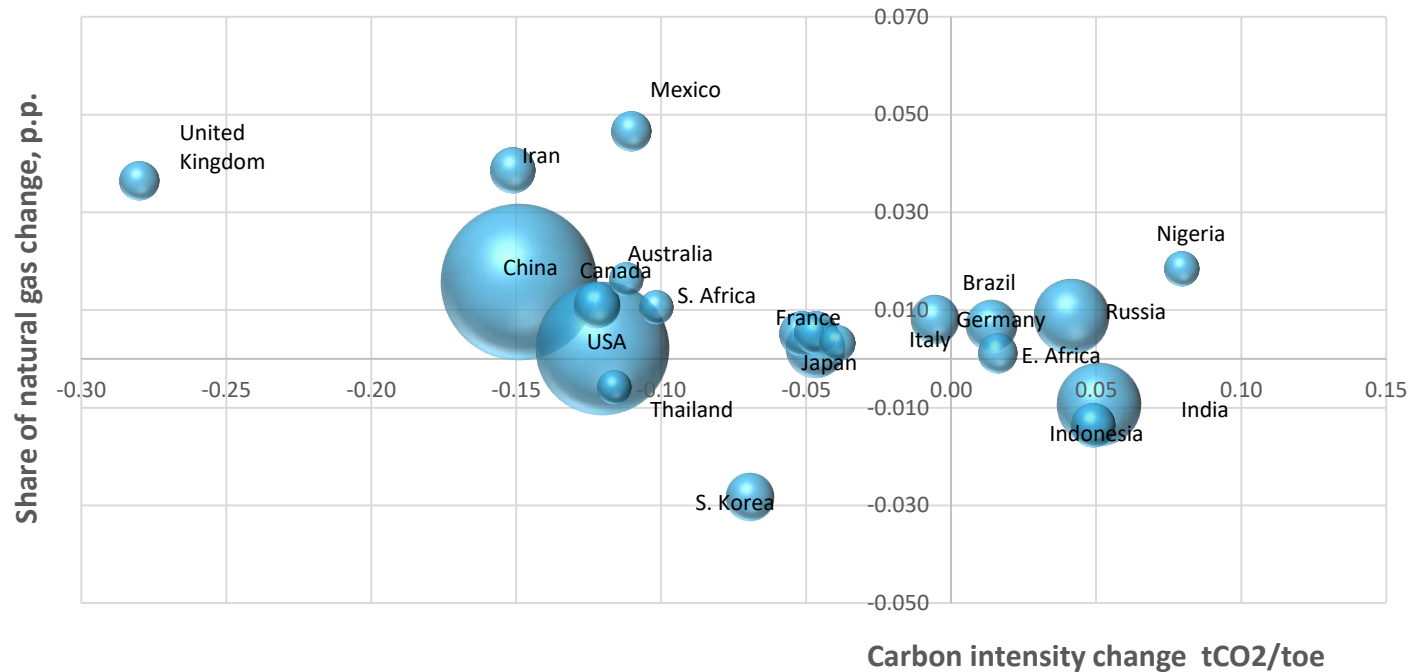
Global picture: Observed changes of carbon intensity and of natural gas shares (for more than 100 countries)



Bubble size: Share in global energy consumption

- Our analysis of more than 100 countries (representing more than 96% of primary energy consumption in 2016), showed that more than 1/3 (representing more than 60% of global primary energy consumption in 2016), have reduced their carbon intensity, mainly by increasing the share natural gas between 2012 and 2016.

This relationship between carbon intensity and penetration of gas could be appreciated for the big energy consuming countries



Bubble size: Share in global energy consumption

- United States and China, the biggest energy consumers, have achieved large reduction of their carbon intensity by increasing gas consumption.
- The reduction of natural gas shares in India and also in Germany (between 2012 and 2016), as well as the increasing use of coal have contributed in increasing carbon intensity of these countries.

- Demand for energy is rising and will position natural gas as the fastest growing fossil fuel
- Natural gas supply will remain strong
- The role of natural gas in achieving GHG emissions reductions and SDGs has much untapped potential
- The GECF Countries have the largest share of gas reserves and production capacity in the world, and will maintain their role as reliable suppliers that are capable of satisfying global energy needs
- GECF Countries will continue their position as major gas suppliers

Thank you!

