***Carbon mitigation pathway for renewables and gas in the power sector under strengthened climate policy actions***

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## Overview

Power sector is gaining a large importance in the transition process towards low carbon energy systems. This role is underpinned by the increasing electrification of final energy-consuming sectors and the development of large range of power generation options, which provide lower carbon emissions. Among these, intermittent renewables, including solar and wind, and natural gas emerge as key options. Renewables and gas have several complementarities that allow to improve cost-effeciently the flexibility and reliability of power systems, reduce the curtailement of intermittent renewables while mitigating the carbon footprint of electricity generation.

This communication aims to investigate possible long-term pathways for electricity and emissions based on an increasing role of renewables and natural gas capacities in the power generation sector. The paper analyses the competitiveness of these sources in producing electricity and assesses the potential effect of strenghened climate policy actions implemented by several countries, on the progress of renewables and natural gas in the power generation mix.

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## Methods

This communication uses a forward-looking scenario approach that enables to define a Carbon Mitigation Scenario for power sector (CMS\_P). This scenario considers the potential of larger deployment of gas and renewables capacities comparing to a Reference Case and evaluates their contribution to emissions abatement.

The paper is structured in three parts: the first part highlights the main determinants and assumptions that feed into the scenario analysis, including mainly the countries’ policy assumptions that might drive future development of renewables and natural gas in power generation. These drivers and assumptions are factored in the power module of the GECF Global Gas Model, in order to evaluate electricity and emissions patterns in the Reference Case and the CMS\_P. The costs of generating power are also analysed in this part to show the competitiveness of different sources of power generation.

The second part will analyse the global and regional prospects of power sector in the Carbon Mitigation Scenario. It highlights the change, compared to the reference case, in terms power capacity developments, electricity generated and contribution of different sources to the power generation mix. In the third part, we will highlight prospects of CO2 emissions and the potential abatement of emissions on global and regional basis.

## Results

* CMS\_P scenario highlights that carbon emissions from the power sector are significantly reduced at global level with larger penetration of gas and renewables compared to the Reference Case. There are, however, disparities between regions depending on the level of climate policy ambitions and choices, the potential of coal to gas switching and of scaling up the uptake of renewables.
* Non OECD Asia, the Middle East and North America are expected to drive the rise of gas-fired capacities. They will be responsible of more than 75% of the additional gas capacities in CMS\_P compared to reference case. Non OECD Asia and North America will achieve significant emissions abatement through coal to gas substitution. The two regions will also observe a large incremental increase of renewables due to market size, cost decrease and policy ambitions to scale up renewables, particularly solar.
* In Europe and OECD Asia, there is less potential to increase gas-fired capacities compared to the reference case. This is driven by the existence of large under-used gas-fired capacities and larger deployment of renewables, underpinned by renewables supportive policy. However, despite less capacity development, coal to gas switching still plays a non-negligible role in these regions and contributes to significant emissions reduction compared to the reference case.
* Total incremental electricity generated is forecasted to be higher in CMS\_P scenario compared to reference case; due to increased electrification that outweighs the efficiency improvements of electrical equipment, considered in various sectors. On the other side, total power capacity is larger in the CMS\_P, which not only driven by increased electricity demand, but also by the large uptake of renewables having low capacity factors.
* The deployment of CCS enables a significant reduction of power-related emissions, specifically from the gas-fired power plants in the US, and the coal-fired power plants in China. It is estimated that CCS will achieve around 2 GtCO2 emissions savings by 2050.
* The large penetration of renewables affects the utilization rates of gas-fired capacities, due particularly to the expected increasing role of these gas capacities in backing up renewables.
* Coal is expected to decline substantially, with a share in total electricity generation dropping from 37% in 2019, to less than 6% in the CMS-P. The utilisation of CCS allows to mitigate the emissions from coal power plants in non OECD Asia.

## Conclusions

Power generation sector has a large potential of carbon emissions mitigation, which can be tapped through switching to less carbon-intensive fuels and development of renewables. The analysis of carbon mitigation pathway in the power sector under the CMS\_P scenario, enables to appreciate the impact of gas and renewables in abating emissions over the long term.

This scenario analysis highlights that gas for power can play a key mitigating role in several regions, not only because it allows to reduce emissions through substitution to coal, but gas is also a complement and an enabler for renewables development. It provides the required flexibility for power systems to balance and accommodate an increasing share of variable renewables.

One of the key feature of the CMS\_P scenario is that it shows the need to secure more total power capacity than in the Reference Case. This is due, on one side, to larger penetration of intermittent renewables that have low capacity factors, and on the other side, to larger electricity demand underpinned by the increased electrification.

The decrease of the utilization rate of the gas-fired capacities, which are increasingly involved in backing up renewables intermittency, brings a serious risk on the profitability of the gas fired power plants. Capacity remuneration and reinforced integration between gas and renewables in the planning process need to be considered in order to allow gas playing its role in reducing emissions in a cost-efficient way.

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