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Statement of the International Council of Academies of Engineering and Technological Sciences (CAETS) on the Report *Towards low-GHG emissions from energy use in selected sectors*

The 2022 report of the Energy Committee of the International Council of Academies of Engineering and Technological Sciences (CAETS), ***Towards low-GHG emissions from energy use in selected sectors*** reviews existing technologies that can be used immediately to reduce greenhouse gas (GHG) emissions. The report also makes reference to technologies that are already in the pipeline. ***Report Annexes*** contain country-specific information provided by CAETS member academies.

The seven selected sectors, Food and Agriculture, Buildings and Smart Cities, Oil and Gas, Chemicals, Cement, Iron and Steel, and Information and Communication Technologies, accounted in 2019 for approximately 70% of industry's CO_2 emissions and 60% of methane emissions worldwide.

The quick deployment of already existing technologies would, by itself, generate deep emission reductions before 2040, which is the primary time frame of the report. However, even if deployed rapidly, these technologies are not sufficient to meet the net-zero targets by mid-century. GHG emissions are still growing in many countries and worldwide. Therefore, the report also highlights research and development needs for new and/or improved technologies and industrial demonstrations for the near-ready technologies.

Key findings

The key findings to boost faster and cost-cutting innovation are summarised in the following five points.

1) Nowadays, 'systemic' or 'holistic' approaches must be considered, including Life Cycle Analysis. They break away from the traditional vertical 'silo' mentality and practices. Political and industrial leaders should encourage national and local administrations, as well as company affiliates, to work together to reduce GHG emissions and ensure consistency among their actions.

2) In order to reduce GHG emissions, the various economic sectors covered in the report will need to use more low-carbon electricity, such as hydropower, wind, solar and nuclear energy. In cases where the direct use of low-carbon electricity is not possible, the use of low-carbon energy vectors, like hydrogen produced using low-carbon electricity may be feasible.

3) Education and training, in particular in technology and engineering, is crucial: develop the skills of those who already work in these sectors and accompany them as needed in the transition. Furthermore, adapt the world of education and training to facilitate the transformation into a low-GHG society – Schools of Engineering and Technologies should rethink and develop their role.

4) Connecting with citizens and public opinion, which is essential for the sustainable acceptance of the changes allowing for lower GHG solutions, is crucial.

5) The professional experience of the Energy Committee members suggests that scientific and technological interactions are important, as is the sharing of good practices, and cooperation between governments, industry, and academia, both nationally and internationally.

This report makes a strong case that beyond the Research and Industrial development, which are essential for tackling climate change, existing and future technology deployments should be based on enlightened stable policies, appropriate funding, and robust public and private support, as well as accurate information and sound logic, to protect our common planet Earth and its ecological heritage.

Main Recommendations

The implementation of these recommendations could start immediately.

Food and Agriculture: The report recommends avenues for reducing the emissions of two important GHGs produced by the Food & Agricultural Systems (FAS): methane from ruminant livestock and rice cultivation, and CO_2 along the supply chain from farm to fork, especially through energy efficiency and electrification. The report highlights the importance of assessing the potential contribution of each specific technology considering the local, ecological, economic, and social contexts and the way technology may be applied in practice.

Buildings and Smart Cities: To design low-carbon, low-energy buildings, the report recommends an energy hierarchy principle: first, choose materials with a low-carbon footprint and low-carbon energy sources, and second, apply the most efficient equipment (considering their affordability). Applying this principle to retrofitting to reduce emissions in the most affordable way requires evaluating the right level of insulation and the implementation of a low-carbon heating system, especially heat pumps.

Oil and Gas: The authors observed that 24% of the GHG emissions due to Oil and Gas use are produced by the related extraction and refining/processing industry itself. The report strongly recommends reducing the flaring and fugitive emissions of methane in all phases of oil and gas production, transport, and refining/processing. Technologies to abate methane emissions/leaks are available and many are already cost-effective. To reduce CO_2 emissions, electrification, where possible, should be promoted.

Chemicals: It is recommended to recycle plastics and other carbon-based materials, as well as to reduce the application of nitrogenous fertilisers by increasing their efficiency. Furthermore, it is recommended to electrify process heating using low-carbon electricity, e.g., in steam cracking, to replace coal and natural gas. Moreover, it is recommended to modify the chemical processes by increasing, for example, the use of ethane in the production of ethylene, or replacing coal with natural gas in the production of methanol. For ammonia synthesis using hydrogen, large-scale low-carbon hydrogen production should be developed; alternatively, the production of hydrogen from fossil fuels should be followed by CCUS of resulting CO_2.

Cement: The report urges close cooperation between the cement and other industries to benefit from the use of different wastes, non-recycled elements, granulated slag from steel blast furnaces, etc., either as fuel substitutes or alternative raw materials. The importance of R&D efforts to further reduce the GHG footprint of cement making is highlighted, and the development and industrial demonstration of related technologies as well as the exploration around CCUS and CO_2 mineralisation (carbonates) in some rock formations, as affordable ways to reach deep decarbonisation, is encouraged.

Iron and steel: There is a substantial longer-term decarbonization opportunity using new technologies such as low-carbon hydrogen. Considering the urgency of reducing CO_2 emissions and taking account of the lifetime of many existing facilities, the report also recommends implementing every possible and economically affordable, even marginal, reduction of CO_2 emissions for existing steel plants by increasing energy efficiency, using residual energies, and partial electrification for heating. Furthermore, the use of biomass, better process control, etc., should be promoted.

Information and Communications Technology (ICT): The report recommends continuing to improve the efficiency of Data Centres through relevant measures and effective management practices. It recommends certain initiatives to reduce the 5G related energy consumption. A further recommendation touches on the increasing number of small data centres, which will constitute the so-called 'edge' system. The final recommendation of the chapter tackles the lack of reliable data on the ICT sector by proposing the development of metrics and systematic studies on its energy consumption and emissions.

***This statement was endorsed by the following CAETS member academies*:**

Argentina: Academia Nacional de Ingenieria of Argentina
Australia: Australian Academy of Technological Sciences and Engineering
Belgium: Royal Belgian Academy Council of Applied Sciences
Canada: Canadian Academy of Engineering
China: Chinese Academy of Engineering
Croatia: Croatian Academy of Engineering
Czech Republic: Engineering Academy of the Czech Republic
Denmark: Danish Academy of Technical Sciences
Finland: Council of Finnish Academies
France: National Academy of Technologies of France
Germany: National Academy of Science and Engineering of Germany
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