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CAETS Energy report 2022

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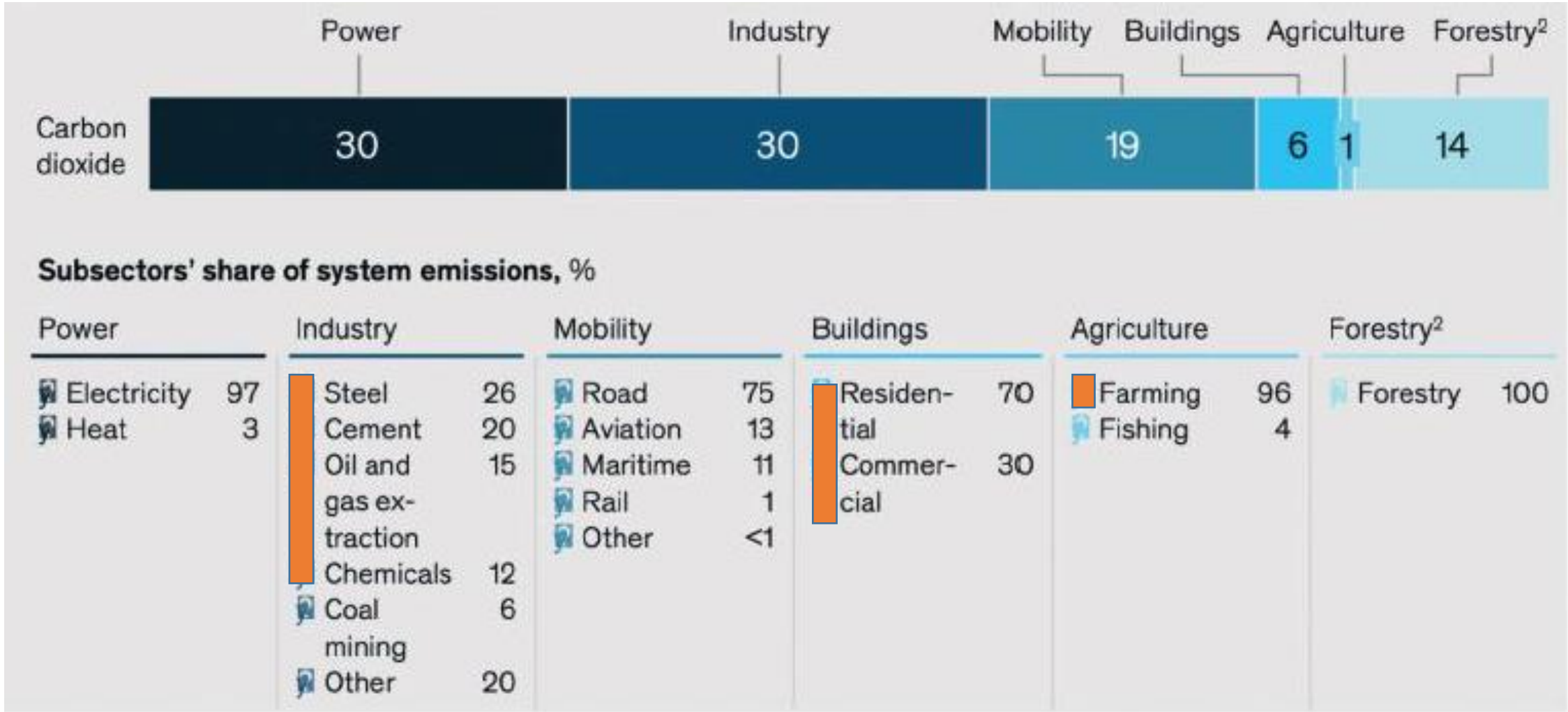
CAETS Council 27/09/2022

« TOWARDS LOW-GHG EMISSIONS FROM ENERGY USE IN SELECTED SECTORS »

The FOCUS:

- **ALREADY AVAILABLE and AFFORDABLE TECHNOLOGIES for DEPLOYMENT**
- **COMMENTS, MESSAGES and RECOMMENDATIONS to advise policymakers, industry and academic leaders**


Power
Industry
Mobility
Buildings
Agriculture
Forestry²
Carbon dioxide
30
30
19
6
1
14
Subsectors' share of system emissions, %
Power
Electricity 97
Heat 3
Industry
Steel 26
Cement 20
Oil and gas extraction 15
Chemicals 12
Coal mining 6
Other 20
Mobility
Road 75
Aviation 13
Maritime 11
Rail 1
Other <1
Buildings
Residential 70
Commercial 30
Agriculture
Farming 96
Fishing 4
Forestry²
Forestry 100
Methane
33
38
5
23
Power
Industry
Mobility
Agriculture
Forestry
Waste

TOWARDS LOW-GHG EMISSIONS FROM ENERGY USE IN SELECTED SECTORS

- **Executive summary** *Yves Bamberger (France)*
- **Chapter 0. To set the scene** *Yves Bamberger (France)*
- **Chapter 1. Food and agriculture** *Norman Roy Scott (USA) Patrick Caron (France)*
- **Chapter 2. Buildings and Smart cities** *Pradeep Chaturvedi (India) Ulrich Wagner (Germany)*
- **Chapter 3. Oil and gas industry** *Amos Avidan (USA) Godwin Igwe (Nigeria)*
- **Chapter 4. Chemical industry** *Michaël Matlosz (France) Oscar Vignart (Argentina)*
- **Chapter 5. Cement industry** *Rui Cai (China) Neven Duic (Croatia)*
- **Chapter 6. Iron and Steel industry** *Woong-Seong Chang (Corea) Alvarez Pelegry Eloy (Spain)*
- **Chapter 7. ICT** *Erol Gelenbe (France) Brunilde Sanso (Canada)*
- **Chapter 8**. **Conclusions** *Yves Bamberger*
- List of the 69 authors; list of other contributors, reviewers (internal – external)
- Annexes: data and information by countries and sectors

The content of the 7 chapters on the sectors

- Executive summary
- Current situation of the sector
- Available solutions to reduce the GHG emissions
- Some perpectives
- Case studies
- Key messages and recommendations

Thanks to the 69 authors and to the other contributors!

Chap.0 To set the scene

The central role of low-carbon electrification (renewables, nuclear)

[Principal low-carbon sources: 1. Direct use of solar energy 2. Low-carbon electricity 3. Low-carbon hydrogen 4. CCS…]

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- **Low-carbon technologies are available, and have often co-benefits**
- **Energy efficiency and rebound effect**
- **Synergies between uses and resiliency**
- **Importance of metrics**
- **Heat Pumps**
- **Life Cycle Analysis**

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- ***Importance of holistic approaches***
- ***Stability and predictability of regulatory changes***
- ***Benchmarking***
- ***Skills and competencies (old ⬆⬇↺, new)***
- ***Effective leadership and arbitration capacity***

Chap.1 Food and Agriculture

- Around 26 -33 % of the total GHG emissions (principally methane)
- The Food and Agriculture System is a complex adaptive context-specific system interacting with water, energy, population, land-use, etc.

Key message

Decarbonisation and methane reduction imply trade-offs among diverging sustainability objectives and across time and space – scales: it needs to reinforce our capacity to adress such issues.

Recommendations

- Possibilities for methane reduction from livestock (new feed additives,…) and rice cultivation (improvement in irrigation and use of fertilisers,…) already exist and have to be improved.
- Electrification « from farm to fork », including agrivoltaic, tractors, food processing and storage, is more and more possible.
- The benefits of alternative plant-based protein foods, 3D-printed food, advanced greenhouses and vertical farms have to be assessed through LCA and their societal consequences.

Chap.2 Buildings and smart cities

- Around 37 % of the total GHG emissions (directly and through electricity and heat consumption)
- Very different situations (poor/favoured people, emerging/industrialised countries): case study on carbon emissions reduction of a poor neighbourhood in Buenos-Aires for example.

Key message

Existing buildings (cities) and new buildings (cities) require different policies.

Recommendations

- Keys to new sustainable buildings (including materials)
- Well-balanced retrofits solutions to reduce emissions and energy-use at the lowest cost
- Electrification for decarbonisation and improved integration of renewables and flexibility (cooking, lighting,water heating, heating, cooling).
- Consider buildings as energy systems
- Smart cities to bring together smart buildings (for example: digitalisation)

Chap.3 Oil and Gas

Around 8 % of the total GHG emissions (CO_2 and CH_4) ***before the end-use***:

24 % of the total emissions from oil and gas.

Key messages

- Big facilities have a life spans of decades and are highly optimised from feedstocks to products for their markets.
- The ratio between energy and non-energy products will decrease.

Recommendations

- Strong emphasis on reducing methane flaring and fugitive methane emissions in all phases.
- Electrification as a substitute for the direct heating process streams.
- Use and improve LCA models to obtain realistic views of the choices.
- Continue to evaluate and develop the CCuS for oil and gas operations.

Chap.4 Chemical industry

- The chemical sector is responsible for 15% of the total GHG emissions.
- Seven « primary chemicals » derived from petroleum products ***as a feedstock***, for more than 70 000 products.

Key message

Major high-tonnage chemical production will not disappear in the next 20 years.

Recommendations

- Accelerate the reuse, reduction and recycling of carbon-based materials and reduce the use of nitrogeneous fertilisers
- Replace when possible chemicals process by less emitting ones
- Electrify the process heating
- Develop large scale low-carbon hydrogen production for ammonia synthesis

Chap.5 Cement Industry

- The cement industry is responsible for about 7% of the total GHG emissions
- The chemical reaction (calcination using limestone) to produce standard cement is emitting by itself (50 % of the emissions) and needs some 1 450°C.

Key message

Cement is a cheap versatile and durable material used worldwide for construction and will continue doing so.

Recommendations

- Use the already available technologies for carbon reduction: energy efficiency, alternative fuels, low-carbon electricity
- Use and explore alternative raw materials.
- Develop and update benchmarks and standards for new cements.
- Promote close cooperation between cement and other industries.

Chap.6 Iron and steel industry

The steel industry is responsible for 7 to 9% of the total GHG emissions

Key message

- Steel is a versatile and durable material, with a wide range of applications and will continue doing so, produced by a capital-intensive industry.
- Blast Furnace/Basic Oxygen Furnace using coal represents still 73% of the production vs. 27% to Electric Arc Furnace using scrap.

Recommendations

- Expanding scrap use and improve new scrap processing technologies.
- Implement every possible and economically affordable CO_2 emissions reduction on existing facilities (partial electrification, use of low-carbon hydrogen, residual energies,…).
- Incentivise and promote demonstration plants to be able to deploy low-carbon industrial facilities in the 2030s or earlier.
- Support cooperation and partbership in the development of new technologies and sharing experience and costs in order to accelerate practical implementatons.

Chap.7 Information and Communication technologies

In exponential growth, the ICT sector uses principally electricity (around 8 – 10 % of the worlwide consumption, eg. 2-2.5% of the total GHG emissions).

Key message

The expansion of ICT will continue, reducing emissions in some other sectors (?).

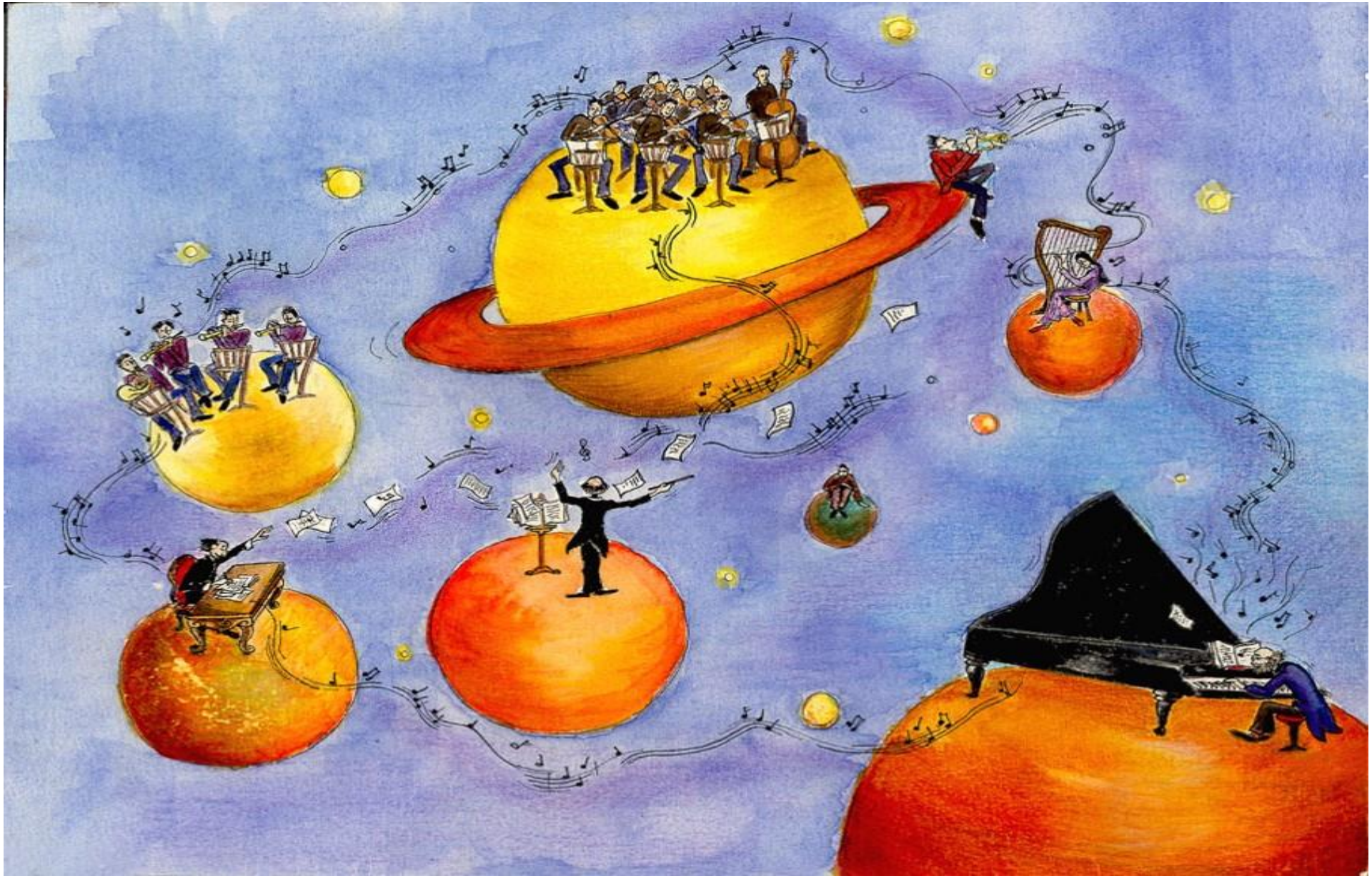
Recommendations

- Different solutions are already existing to minimize the increase of consumption coming from 5G technology.
- Keep improving the Data centre energy efficiency and consumption is possible.
- Improve the optimal replacement of ICT equipment to reduce ICT impact.
- Set public requirements and standards for the compilation and publication ICT energy consumption and emissions data.

Chap.8 CONCLUSIONS

Through the 2022 CAETS Energy Report:

- **We wish to emphasise that many technologies designed to reduce – and in some cases almost eliminate – GHG emissions are already available for immediate action in the key sectors and will require the availability of enough low-carbon electricity.**
- **We are aware of the many difficulties and conflicting interests involved in moving the world faster towards fewer GHG emissions.**
- **We insist on the importance of education and training, even more on the essential character of the involvement with citizens and public opinion.**
- **We are convinced that more interaction between our Academies and the CAETS with the policy makers, the industrial and academic leaders could be useful to facilitate the path toward lower GHG emissions.**



Communication on CAETS 2022 Energy report to contribute to our strategy

KEY MESSAGES
(Chapter 0)

MESSAGES and
RECOMMENDATIONS
(Chapters on sector)

- **From CAETS, from the Academies**

- **POLICY MAKERS/ADMINISTRATIONS**
- **INTERNATIONAL ORGANISATIONS (International Energy Agency,…)**
- **INDUSTRIAL SECTORS (International and National Professional organisations and leaders from Industry)**
- **ACADEMICS: Engineering schools and University Professors**