



Technology Executive Committee

06 April 2021

Twenty-second meeting

Virtual meeting, 20-23 April and 26 April 2021 (TEC-CTCN Joint session)

Future work of the Technology Executive Committee on emerging climate technologies in the energy supply sector

Concept note

I. Background

1. At TEC21, the task force on innovation presented a background note that included information on elements and features that characterize key emerging climate technologies, a mapping of key emerging climate technologies, examples of mappings of emerging climate technologies produced by other organizations and guiding questions for consideration by the TEC on possible further work on this matter.¹
2. TEC21 welcomed the background note and provided guidance on further work of the TEC on this matter, including on the social acceptability of emerging technologies and possible overlapping with the work of the Katowice Committee of Experts on the Impacts of the Implementation of Response Measures (KCI).
3. TEC21 also requested the task force on innovation to elaborate a proposal for future work of the TEC on this matter for consideration at its first meeting in 2021, taking into account the comments and guidance provided by the TEC at its 21st meeting.
4. The secretariat consulted with colleagues supporting the work of KCI about possible overlapping of the work of the TEC on emerging climate technologies with the work of the KCI. The consultation revealed that the KCI work aims to analyse tools and methodologies for modelling and assessing the social, environmental and economic impacts of mitigation policies and actions and their links with just transition and economic diversification. The KCI work looks broadly at impacts of the implementation of response measures without focussing either on specific economic sectors or specific climate technologies. The possibility of a duplication of the work of the TEC on emerging climate technologies, if any, is minimal.
5. Taking into account different sectors mentioned in TEC21 mapping document, the Innovation taskforce agreed to start working on emerging technologies in energy supply sector. The taskforce noted that other sectors may be considered for future work on emerging technologies, having learned from the experience of undertaking this work, or may be embedded in other part of Innovation work; for example, activity 3 in the same thematic area of Innovation under its current rolling workplan has a specific focus on adaptation technologies.

II. Purpose

6. This concept note aims to provide a description of future work of the TEC on emerging climate technologies in energy supply sector, including generation and enabling technologies. It elaborates on the objective, scope, activities and timeline of future work of the TEC on this matter.

¹ See TEC meeting document TEC/2020/21/5 available at <https://bit.ly/3qV1zQa>.

III. Possible action by the Technology Executive Committee

7. The TEC will be invited to consider the concept note and agree on future work of the TEC on emerging climate technologies in the energy supply sector.

IV. Emerging climate technologies in energy supply sector

A. Objectives

8. The work intends to analyse key emerging climate technologies in a selected priority sector and elaborate on elements that may affect their successful deployment, commercialization and long-term sustainability.

9. The overall objective is to provide policymakers and other relevant stakeholders with a set of information that may help their decision making when defining national and/or regional strategies for accelerating the scale-up and diffusion of these technologies.

B. Scope

1. Technology development stage

10. The work will focus on emerging climate technologies that, in line with the definition of emerging technologies by the World Economic Forum and by Rotolo, Hicks and Martin,^{2,3} are intended as technologies which arise from new knowledge or the innovative application of existing knowledge and have the potential to exert a considerable and long-lasting impact on climate change.

11. Climate technologies that are at early stages of development, i.e. still in a conceptualization phase or undertaking preliminary laboratory analytical measurements, will not be considered in this work. The focus will be on technologies with tested climate change mitigation and adaptation potential and not yet operating in a commercial environment. Taking the Technology Readiness Levels (TRL) scale as reference, these would be technologies from TRL 4 (early prototype, proven in test conditions) to TRL 8 (first of a kind commercial, commercial demonstration).⁴

12. This approach avoids overlapping with and duplication of work conducted by the TEC in the thematic area of Implementation of its rolling workplan for 2019-2022, where the focus is on commercially available technologies that are awaiting diffusion or uptake.

2. Technology sector

13. The analysis under this work will address selected key emerging technologies in the energy supply sector, including generation and enabling technologies. The power sector is the largest contributor to global greenhouse gas emissions. In 2010, the energy supply sector was responsible for approximately 35% of total anthropogenic GHG emissions.⁵ To achieve the goals of the Paris Agreement, countries are required to peak greenhouse gas emissions as soon as possible and achieve climate neutrality by mid-century. It is of paramount importance making efforts to transform and decarbonize energy systems that align with the Paris goals. As shown in the mapping of emerging climate technologies considered by the TEC at its 21st meeting,⁶ the energy supply sector offers a wide range of emerging decarbonization technologies with high potential for climate change mitigation.

² <https://arxiv.org/pdf/1503.00673.pdf>

³ <http://reports.weforum.org/global-agenda-council-2012/councils/emerging-technologies/>

⁴ Technology readiness levels (TRL) scale, as originally developed by NASA and eventually modified by the International Energy Agency (IEA), is a common framework applied to assess maturity of technologies. It is a scale ranging from 1 (initial idea, basic principles defined) to 11 (mature technology, proof of stability reach). See Energy technology perspective 2020 by the IEA available at <https://bit.ly/38MGeSR>

⁵ See https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_chapter7.pdf.

⁶ See <https://bit.ly/3qGz1dc>

14. Emerging decarbonization technologies for energy supply also come with potential environmental impact, for instance, in terms of land occupation and water use. Although the topic around energy supply may put emphasize on climate change mitigation, its relevance to multiple social and environmental co-benefits of such technologies would allow consideration on climate change adaptation as well.

3. Specific focus

15. It is crucial for the TEC not to duplicate analysis of emerging climate technologies produced by other organizations and to make its efforts different from what already produced and attractive to different audiences. The TEC at its 21st meeting and the Innovation task force afterwards provided guidance in this regard and identified the following elements related to the development, diffusion and impacts of emerging decarbonization technologies that should be subject of focus analysis under this work:

(a) **Access to new markets:** markets adopt new technologies at various paces, depending on the broader ecosystem (e.g. services, standards, regulations) that supports them. Penetration rates of new technologies—the percentage of workers in a country using them and their diffusion across the population—remain low among developing and transition countries. The penetration and diffusion of climate technologies in developing countries is often too low to sustain new markets that depend on them. Factors that account for the low penetration levels span from country-specific characteristics (for example political risk) to general bottlenecks (business models, access to finance, infrastructure, among other factors), that are common in developing economies.

(b) **Social, institutional, economic and business preconditions:** when looking for the key ingredients to effectively deploy climate technologies, it is very important to consider the interplay between technological, institutional, economic, business and social factors. Successful deployment is an interplay of several heavily context-specific factors. Innovative emerging technologies without connections to the context may be hopelessly ineffective. Traditional technology transfer models and sustainable development efforts — whether for developing or developed countries — pay insufficient attention to first creating enabling socio-political, economic and business conditions.

(c) **Social acceptability:** social acceptance is a major driver of the success of climate technologies. Technologies that are economically and technically feasible may not be implemented due to social resistance, lack of awareness of technology. Social or public ‘acceptance’ is defined as a positive attitude towards a technology or measure, which leads to supporting behaviour if needed or requested, and the counteracting of resistance by others. People's perception and awareness help to determine if the technologies are acceptable and in what forms. This is a complex issue depending upon the variety of factors ranging from understanding, people's conviction about risk, security, landscape, economic and political power.

C. Deliverables

16. The work plans to produce the following deliverables:

1. Technical paper

17. The overall purpose of the technical paper is to identify policy options for further enhancing the development and transfer of emerging decarbonization technologies in the energy supply sector, including generation and enabling technologies.

18. The paper will look at selected emerging decarbonization technologies and:

(a) Provide an overview of the technologies, their state of play, and potential climate change mitigation and adaptation impacts;

(b) Analyse social, institutional, economic and business challenges and solutions related to their development and effective deployment, including access to new markets and social acceptability;

(c) Identify innovative options for policymakers to effectively support the deployment of emerging climate technologies, based on the abovementioned analysis.

19. The paper will consider the following emerging decarbonization technologies in the energy supply sector:

- (a) Airborne wind energy;
- (b) Floating wind systems;
- (c) Floating photovoltaic systems;
- (d) Wave power systems;
- (e) Tidal power systems;
- (f) Ocean thermal energy conversion systems;
- (g) Bioenergy associated with carbon capture and storage;
- (h) Green hydrogen;
- (i) Next generation batteries;
- (j) Thermal energy storage;
- (k) Others as deemed appropriate.

20. A draft outline of the technical paper is provided in the Annex for TEC consideration and comments.

2. Thematic dialogue(s)

21. The overall purpose of the thematic dialogue(s) is to gather global and regional experts to discuss and exchange views on policy options for further enhancing the development and transfer of emerging decarbonization technologies in the energy supply sector, including generation and enabling technologies.

22. Specifically, the objectives of the thematic dialogue are to:

- (a) Enhance the understanding on social, institutional, economic and business factors that affect the effective deployment of emerging climate technologies in the energy supply sector;
- (b) Identify policy options and actions that key stakeholders can take to facilitate effective deployment of emerging climate technologies in the energy supply sector.

23. The outcomes of the thematic dialogues are intended to complement the analysis conducted in the context of technical paper. Inputs received during the thematic dialogue(s) will be reflected as appropriate in the technical paper.

24. The thematic dialogue(s) will be held in conjunction with the regional climate weeks in 2021 to maximise resource efficiency and to ensure high visibility. The number of thematic dialogues organized will depend on slot availability in the programme of the regional climate weeks. The secretariat will endeavour to secure a slot for at least one thematic dialogue.

3. Key messages and recommendations for the Conference of the Parties and the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement

25. Key messages recommendation on emerging climate technologies for the COP and CMA will be produced, based on the findings of the technical paper and outcomes of the thematic dialogue(s).

D. Timeline

26. The table below shows a tentative timeline of the work:

#	Deliverables	Timeline
1	Technical paper <i>Outline for consideration by TEC 22 (April)</i> <i>Intersessional work of Innovation task force (May-August) 2021</i> <i>Final draft for consideration by TEC 23 in September</i> <i>Finalization immediately after TEC 23</i>	April – September 2021
2	Thematic dialogue(s) <i>Organized in conjunction with a regional climate week(s)</i>	May-July 2021
3	Policy recommendations <i>Draft for consideration by TEC 24</i>	March 2022

Annex

Draft Outline for the technical paper on emerging climate technologies in the energy supply sector

1. Executive summary
2. Introduction
 - (a) Background
 - *Relevant TEC mandates, technology framework*
 - *TEC rolling workplan for 2019-2022*
 - (b) Theoretical background
 - *Problem statement*
 - *What material impact could emerging technologies have? How ready are they for early commercialization, and what enabling conditions would enable or speed this? What barriers and enabling conditions are relevant given: market access; social, institutional and economic preconditions; and social acceptability?*
 - (c) Objective
 - *Provide an overview of the technologies, their state of play, and potential climate change mitigation and adaptation impacts;*
 - *Analyse social, institutional, economic and business challenges and solutions related to their development and effective deployment, including access to new markets and social acceptability;*
 - *Identify ways for policymakers to effectively support the deployment of emerging climate technologies, based on the abovementioned analysis.*
 - (d) Scope and methodological approach
 - *Technology development stage (TRL 4-8)*
 - *Technology sector*
 - *Specific focus*
 - *Literature review to assess all the above*
3. Emerging technologies for energy supply
 - *Role of emerging technologies in energy supply systems*
 - *Potential for replacement or complementarity with existing technologies/systems*
 - *Do the new technologies blend seamlessly with existing infrastructure and fuelling transmission networks and end-uses (“ Are they plug and play?”), or does both supply infrastructure and end-use market share need to be built from scratch?*
 - (a) Airborne wind energy;
 - *Brief description (techs and characteristic)*
 - *State of play*
 - *Enabling conditions (regulatory environment, local skill development, stakeholder involvement, access to markets, social acceptability).*
 - (b) Floating wind systems;
 - *(as above)*
 - (c) Floating photovoltaic systems;
 - *(as above)*
 - (d) Wave power systems;
 - *(as above)*

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- (e) Tidal power systems;
 - *(as above)*
 - (f) Ocean thermal energy conversion systems;
 - *(as above)*
 - (g) Bioenergy associated with carbon capture and storage;
 - *(as above)*
 - (h) Green hydrogen;
 - *(as above)*
 - (i) Next generation batteries for behind-the-meter and utility-scale storage;
 - *(as above)*
 - (j) Thermal energy storage
 - *(as above)*
 - (k) Other potential technologies
 - *(as above)*
4. Policy options for effective deployment of emerging technologies.
- *Policy options across emerging technologies*
 - *How policy options for commercially available decarbonization technologies help effective deployment of emerging technologies*
 - *How can we "draw out" as yet unknown positive technologies, i.e. white swans?*
5. Recommendations
- *Policy recommendations for policymakers to stimulate effective deployment of emerging technologies*
6. Acknowledgments.
7. References.
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