



## OPEN ACCESS

## EDITED BY

Murray A. Rudd,  
Satoshi Action Education (SAE), United States

## REVIEWED BY

Adam Peter Hejnowicz,  
University of Edinburgh, United Kingdom

## \*CORRESPONDENCE

Usman Sattar,  
✉ usman@zjnu.edu.cn

RECEIVED 05 December 2023

ACCEPTED 29 January 2024

PUBLISHED 08 February 2024

## CITATION

Yang F and Sattar U (2024), COP29: Technology development and transfer framework. *Front. Environ. Sci.* 12:1349843. doi: 10.3389/fenvs.2024.1349843

## COPYRIGHT

© 2024 Yang and Sattar. This is an open-access article distributed under the terms of the [Creative Commons Attribution License \(CC BY\)](https://creativecommons.org/licenses/by/4.0/). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

# COP29: Technology development and transfer framework

Fuxue Yang and Usman Sattar\*

Law School, Zhejiang Normal University, Jinhua, China

## KEYWORDS

environmental governance, Paris agreement, climate policy, technology transfer framework, technological needs assessment, technology mechanism, NDCs, COP29

## 1 Introduction

One of the key climate governance concerns for the upcoming Conference of the Parties (COP29) should be strengthening the existing technology development and transfer framework with more specifications. The current “technology development and transfer” framework provided under Article 10, paragraph 4 of the Paris Agreement (PA) broadly states that, “A technology framework is hereby established to provide overarching guidance to the work of the Technology Mechanism in promoting and facilitating enhanced action on technology development and transfer in order to support the implementation of this Agreement, in pursuit of the long-term vision referred to in paragraph 1 of this Article” (United Nations, 2015). The said paragraph 1 of the same Article only mentions that “Parties share a long-term vision on the importance of fully realizing technology development and transfer in order to improve resilience to climate change and to reduce greenhouse gas emissions.” These paragraphs do set some preliminary direction for the future working on technology development and transfer between party countries but the overall working pace for achieving the PA goal—1.5-degree Celsius pre-industrial levels—is not consistent (Kirchherr and Urban, 2018; Tanaka and O’Neill, 2018; Fu et al., 2022; Dafnomilis et al., 2023; Sattar, 2023). Thus innovating climate technologies require further rules of procedures both from the policy and practice side (Matos et al., 2022; Sharman, 2022). Therefore, to strengthen the technology development and transfer framework under Article 10, the 21st session of COP under decision number 67 requested its Subsidiary Bodies (SBs) for policy—Technology Executive Committee (TEC)—and for practice—the Climate Technology Centre and Network (CTCN)—to undertake technology needs assessments (TNAs) for the successful implementation of the PA. The joint report published by the SBs in 2021 (FCCC/SB/2021/5) (United Nations, 2021) recommends that to stimulate the uptake of climate technologies and the implementation of nationally determined contributions (NDCs) of party countries, “Sharing further information on technology needs and support to foster a clearer understanding of policy targets by domestic technology stakeholders, facilitate international cooperation and enable a more targeted provision of support by the TEC and the CTCN, according to their respective functions, and other support providers, as appropriate” (p. 26). The sharing of further information on technology needs and support here refers to, and depends on, the information communicated through NDCs under Article 4, paragraph 2: “Each Party shall prepare, communicate and maintain successive nationally determined contributions that it intends to achieve;” and Article 13 directing the developing and developed country parties to provide information regarding their technological needs, the support provided, and support received. However, the gap here exists at the end of both the developing and developed country parties. They have either

submitted their NDCs with no relevant information on climate technologies needed/supported or some fuzzy data with no quantifiable information for policy and research. This is also confirmed by the latest report on Technology and Nationally Determined Contributions, by the TEC and the CTCN, jointly published in 2023 (UNFCCC, 2023e) with these words: “In their latest NDCs, as at September 2022, the majority of Parties included information on technology. However, the level of detail of the information provided on technology aspects varies significantly. Most Parties included qualitative information, while some also included quantitative information on climate technologies in their NDCs” (p. 7). Hence, COP28, recalling Article 10 of the PA, notes the insufficient transfer and deployment of technology in developing countries, and invites the TEC and the CTCN to provide technical assistance to support the implementation of the PA (see Decision -/CP.28 and Decision -/CMA.5, paras. 3 and 9) (UNFCCC, 2023d; UNFCCC, 2023c). It has blurred the scope of achieving climate change mitigation and adaptation targets under the PA. The national designated entities (NDEs) have their due role to play with the Technology Mechanism (TM) of the United Nations Framework Convention on Climate Change (UNFCCC) here. To justify this gap, the next section provides some references from the NDC documents of developing country parties submitted to the UNFCCC. It then proposes a specified and unified reporting framework for bridging the communication gap between party countries and the TM. It has the potential for enhancing technology development and transfer under Article 10 of the PA.

## 2 Technology, NDCs, and policy framework

### 2.1 Technology and NDCs

The NDC submissions of developing party countries show three types of information communicated for technology development and transfer under Article 10 of the PA: 1) no quantifiable information or a very general reference of technological needs; 2) specifying sectors of technological needs; or 3) specifying the specific type of climate technologies needed for climate action. To justify the referred three types, some NDC references are cited here for validation. The first type of NDC submissions includes (among many others) Belize, Botswana, Brazil, Dominica, Georgia, Grenada, Jamaica, Maldives, Montenegro, South Africa, Suriname, Tonga, and Turkey. They provided no quantifiable information on technology development and transfer. The second type of NDC submissions includes Albania which broadly mentions that the country requires “new technologies” (NDC., p. 79) in the health sector. Armenia and Saint VG just refer to technologies required related to “renewable energy” (NDC., p. 8) and “energy efficiency” (NDC., p. 14) respectively. The third type of information is provided from some countries like Thailand (NDC., p. 7) requires carbon capture and storage (CCS) technology, carbon capture, utilization, and storage (CCUS) technology, bioenergy with CCSs, direct air capture (DAC), etc. Palau (NDC., p. 4) needs 5 MW of solar, rooftop solar, and 10 MW to power the water sector. A random review of NDC submissions shows that most of the parties from developing countries fall under the first category. Another study on NDCs of

71 developing countries reports that “further developing the TNAs could play a vital role in filling gaps in the existing NDCs, specifically those relating to identifying appropriate technologies, their required enabling framework conditions and preparing implementation plans for their transfer and diffusion” (p. 189) (Charlery and Trærup, 2019). The NDC submissions of the developed party countries also lack such data on technological support provided to the developing party countries under Article 13 of the PA. It confirms a fundamental gap in the NDC submissions from both sides. COP28 in its Decision -/CP.28, para 4, invites the TEC and CTCN to report on the progress of the support provided to the developing country parties (UNFCCC, 2023c). The NDCs are the bases for technological development and transfer and NDC submissions without providing such a piece of important information decelerate the pace of work by the TM. Hence, the academic researchers are unable to provide policy inputs. Thus, to further strengthen the reporting mechanism for technology development and transfer, an improved policy framework is inevitable.

### 2.2 Technology and policy framework

A basic gap in the technology development and transfer framework provided under Article 10, paragraphs 4 and 1 of the PA, as referred to in the introductory part of this article, is an open-ended scheme without any specific methodology for the interactive working between the developed and developing countries concerning the TNAs and communicating assessment information through NDC submissions in a quantifiable manner. It only directs towards the TM for future guidance on “innovation” as provided in Article 10, paragraph 5: “Accelerating, encouraging and enabling innovation is critical for an effective, long-term global response to climate change and promoting economic growth and sustainable development. Such effort shall be, as appropriate, supported, including by the Technology Mechanism and, through financial means, by the Financial Mechanism of the Convention, for collaborative approaches to research and development, and facilitating access to technology, in particular for early stages of the technology cycle, to developing country Parties” (United Nations, 2015). The TM here refers to the interactive working of the COP, the TEC, and the CTCN. The joint work program of the UNFCCC’s TM for 2023–2027 mentions that “Developing countries have lagged in benefitting from technological opportunities. Technological change is inhibited if technological innovation system functions are not adequately fulfilled, this inhibition occurs more often in developing countries” [point 15 (f), p. 3] (United Nations, 2022). It further validates the gap in the NDC submissions by developing country parties. Moreover, another point to be noted here is that when the PA spaces the developing country parties to report their assessments under Article 4 (NDCs) and plans for working under Article 10, it presumes them having the prerequisite financial, technical, and scientific knowledge to proceed accordingly. Whereas the starting point is grounded at deeper levels. The NDC submissions reveal that it is simply beyond the working capacity of most developing party countries independently. The NDC targets of developing party countries

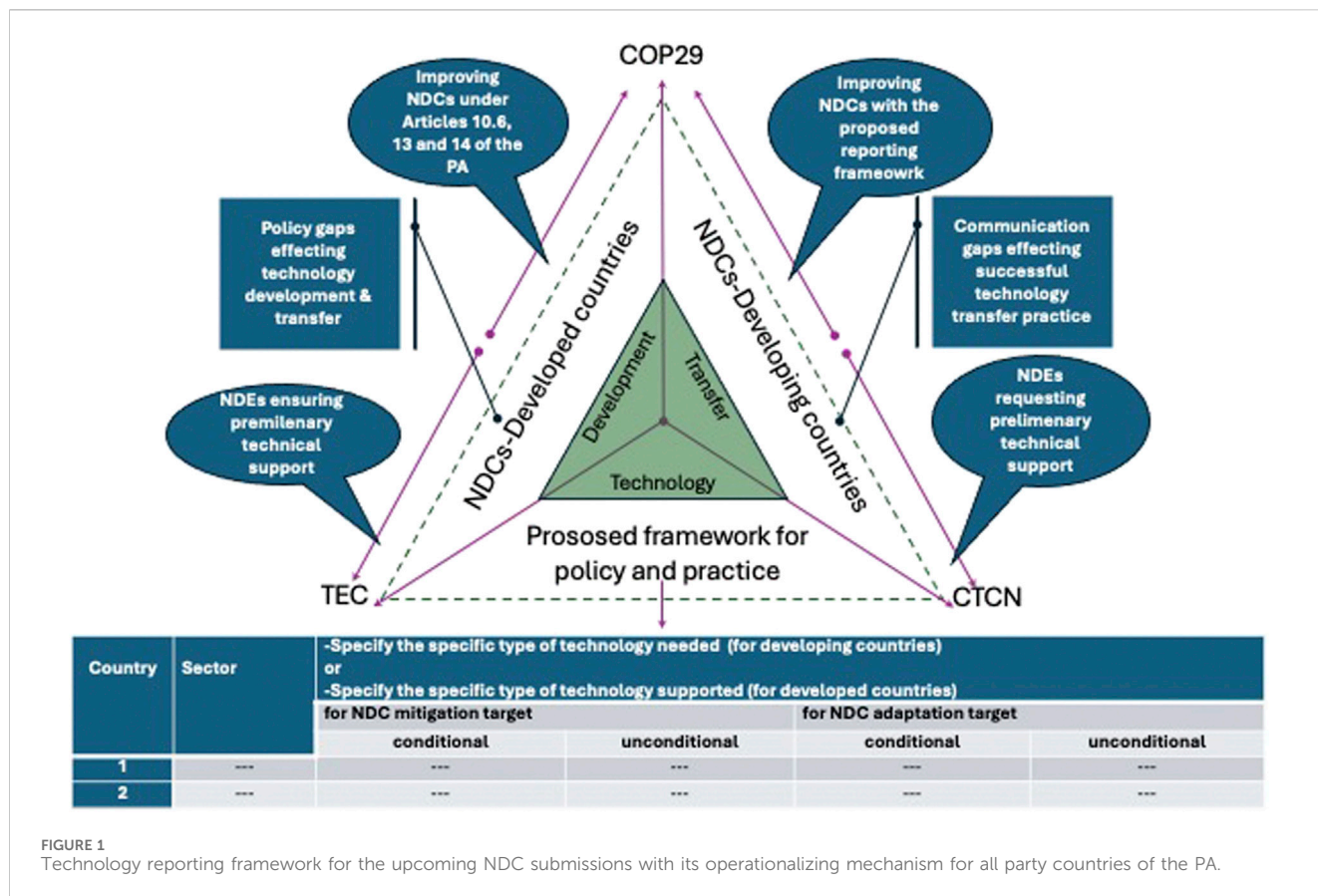


FIGURE 1 Technology reporting framework for the upcoming NDC submissions with its operationalizing mechanism for all party countries of the PA.

are highly conditional on external export (Sattar, 2022). Therefore, it starts from the TM itself. It requires a specified and unified technology assessment and reporting framework for all party countries. The updated NDCs which are due for submission by 2025, as decided in COP28 (UNFCCC, 2023b), should come with key information required under Articles 10.6, 13, and 14 of the PA. The upcoming COP29 can fulfill this gap with the help of NDEs. The NDEs of developed party countries should be engaged with the TEC to ensure preliminary technical support as requested by the NDEs of developing party countries. The NDEs of developing party countries should be engaged with the CTCN with specifications of the prerequisite technical support for the TNAs. Figure 1 proposes a specified and unified reporting framework for technology development and transfer process between the developed and developing countries with the help of TM linkages across the COP, the TEC, and the CTCN. It points out the communication gaps and specifies the NDEs' functions to move on with a specified reporting framework for technological needs of developing party countries and support provided by the developed party countries in a quantifiable manner. The PA parties can use it to update their NDCs by providing a sector-wise information on technology development and transfer. It would help specifying that what specific technologies are needed by the developing party countries and supported by the developed party countries. It would further stipulate what technologies are required for the NDC mitigation targets, both for conditional and unconditional targets, and what technologies

are needed for the NDC adaptation targets, both for conditional and unconditional.

### 3 Discussion

The successful technology development and transfer under Article 10 of the PA starts from filling the NDC communication gaps with a specified and unified technology reporting framework along with preliminary technical and financial support. Innovative and interactive mechanisms are needed for the diffusion of climate technologies in the developing world (Ogink et al., 2023). The COP28 'looking ahead' with innovative reporting tools with these words: "The negotiations on the 'enhanced transparency framework' at COP 28 laid the ground for a new era of implementing the Paris Agreement. UN Climate Change is developing the transparency reporting and review tools for use by Parties, which were showcased and tested at COP 28. The final versions of the reporting tools should be made available to Parties by June 2024" (UNFCCC, 2023a). The most effective way to communicate technological needs from the developing country parties, and the support provided by the developed parties, is by writing through the NDC submissions. The PA (United Nations, 2015) under Article 13.10 states that "Developing country Parties should provide information on financial, technology transfer and capacity-building support needed and received under Articles 9, 10 and 11." A similar direction is given to the developed party countries under Article

13.11 that “Developed country Parties shall, and other Parties that provide support should, provide information on financial, technology transfer and capacity-building support provided to developing country Parties under Articles 9, 10 and 11.” However, the current state of the NDC submissions without fulfilling the reporting criteria from both sides might have the following justifications: 1) the developing parties are unable to communicate their technological needs as they need technical and financial assistance as a prerequisite for technological needs assessments; 2) the developed parties might not be able to support and communicate the same as the developing party countries do not provide sufficient prerequisite information on the specific type of technologies needed. The first justification is validated by some developing countries. Albania (NDC., p. 79) and Indonesia (NDC., p. 20) state that they require support for “Technology needs assessment.” Similarly, Kazakhstan (NDC., p. 20) and Thailand (NDC., p. 7) anticipate “research” assistance for estimating technological needs. It poses not only a gap in communication but also a strategic matter to investigate. The technological innovation process under Article 10 of the PA will not start from the TNAs from the developing countries but from the preliminary capacity-building of developing countries for such assessments. The COP29 requires building on both policy (TEC) and practice (CTCN) sides, engaging NDEs of all party countries. The NDEs have a key role to bridge this gap. And the engagement of NDEs largely depends on the national level political institutions. A recent study of an ‘elite sample’ consisted of diplomats, scientific experts, and COP members have concluded that political institutions are the largest explainer of the credibility and implementation of the pledges made in NDCs (Victor et al., 2022). The TM should propose all parties to agree on a unified and specified reporting framework to improve the NDC submissions of both the developed and developing party countries. It should include sector-wise technology information specifying the specific type of technologies needed (developing parties) or/and provided (developed parties) for conditional/unconditional mitigation/adaptation targets categorically. The proposed reporting framework provided in Figure 1 can potentially improve the governance mechanism of the TM and make the technology development and transfer process more efficient and effective.

## References

- Charlery, L., and Trærup, S. L. M. (2019). The nexus between nationally determined contributions and technology needs assessments: a global analysis. *Clim. Policy* 19, 189–205. doi:10.1080/14693062.2018.1479957
- Dafnomilis, I., den Elzen, M., and van Vuuren, D. P. (2023). Achieving net-zero emissions targets: an analysis of long-term scenarios using an integrated assessment model. *Ann. N. Y. Acad. Sci.* 1522, 98–108. doi:10.1111/nyas.14970
- Fu, B., Li, J., Gasser, T., Ciais, P., Piao, S., Tao, S., et al. (2022). Climate warming mitigation from nationally determined contributions. *Adv. Atmos. Sci.* 39, 1217–1228. doi:10.1007/s00376-022-1396-8
- Kirchherr, J., and Urban, F. (2018). Technology transfer and cooperation for low carbon energy technology: analysing 30 years of scholarship and proposing a research agenda. *Energy Policy* 119, 600–609. doi:10.1016/j.enpol.2018.05.001
- Matos, S., Viardot, E., Sovacool, B. K., Geels, F. W., and Xiong, Y. (2022). Innovation and climate change: a review and introduction to the special issue. *Technovation* 117, 102612. doi:10.1016/j.technovation.2022.102612
- Ogink, R. H. A. J., Goossen, M. C., Romme, A. G. L., and Akkermans, H. (2023). Mechanisms in open innovation: a review and synthesis of the literature. *Technovation* 119, 102621. doi:10.1016/j.technovation.2022.102621
- Sattar, U. (2022). A conceptual framework of climate action needs of the least developed party countries of the Paris agreement. *Int. J. Environ. Res. Public Health* 19, 9941. doi:10.3390/ijerph19169941
- Sattar, U. (2023). Achieving net zero with internationally determined contributions. *Front. Environ. Sci.* 11. doi:10.3389/fenvs.2023.1249193
- Sharman, N. (2022). Inter-State climate technology transfer under the UNFCCC: a benefit-sharing approach. *Rev. Eur. Comp. Int. Environ. Law* 31, 435–446. doi:10.1111/reel.12454
- Tanaka, K., and O'Neill, B. C. (2018). The Paris Agreement zero-emissions goal is not always consistent with the 1.5°C and 2°C temperature targets. *Nat. Clim. Chang.* 8, 319–324. doi:10.1038/s41558-018-0097-x
- UNFCCC (2023a). COP 28: what was achieved and what happens next? Available at: <https://unfccc.int/cop28/5-key-takeaways#looking-ahead>.

## Author contributions

FY: Conceptualization, Investigation, Validation, Writing–original draft, Writing–review and editing. US: Conceptualization, Investigation, Validation, Writing–original draft, Writing–review and editing.

## Funding

The author(s) declare that no financial support was received for the research, authorship, and/or publication of this article.

## Acknowledgments

The authors are thankful to the reviewer who significantly improved the quality of this article.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher’s note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

## Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fenvs.2024.1349843/full#supplementary-material>

UNFCCC (2023b). COP28 agreement signals “beginning of the end” of the fossil fuel era. Available at: <https://unfccc.int/news/cop28-agreement-signals-beginning-of-the-end-of-the-fossil-fuel-era>.

UNFCCC (2023c). Enhancing climate technology development and transfer through the Technology Mechanism. Available at: <https://unfccc.int/documents/636517>.

UNFCCC (2023d). Enhancing climate technology development and transfer to support implementation of the Paris Agreement. Available at: <https://unfccc.int/documents/636619>.

UNFCCC (2023e). Technology and nationally determined contributions. Available at: [https://unfccc.int/ttclear/misc\\_/StaticFiles/gnwoerk\\_static/techandndc/4801dcaef1a74c5ca27f33360a6bd9d1/0aa460d277b54863a9fdbd51bf36aca5.pdf](https://unfccc.int/ttclear/misc_/StaticFiles/gnwoerk_static/techandndc/4801dcaef1a74c5ca27f33360a6bd9d1/0aa460d277b54863a9fdbd51bf36aca5.pdf).

United Nations (2015). Paris agreement - UNFCCC. United Nations Clim. Chang. Available at: [https://unfccc.int/sites/default/files/english\\_paris\\_agreement.pdf](https://unfccc.int/sites/default/files/english_paris_agreement.pdf).

United Nations (2021). *Joint annual report of the technology executive committee and the climate technology Centre and Network for 2021*. Available at: <https://unfccc.int/documents/306935>.

United Nations (2022). *Joint work programme of the UNFCCC technology mechanism for 2023–2027*. Available at: [https://unfccc.int/ttclear/misc\\_/StaticFiles/gnwoerk\\_static/TEC\\_key\\_doc/525876375aa8467eb6379f868b925e49/51b7785f86b54889837fecb7aecb6b.pdf](https://unfccc.int/ttclear/misc_/StaticFiles/gnwoerk_static/TEC_key_doc/525876375aa8467eb6379f868b925e49/51b7785f86b54889837fecb7aecb6b.pdf).

Victor, D. G., Lumkowsky, M., and Dannenberg, A. (2022). Determining the credibility of commitments in international climate policy. *Nat. Clim. Chang.* 12, 793–800. doi:10.1038/s41558-022-01454-x