THE TECHNOLOGY MECHANISM UNDER THE UNFCCC AS A TRANSFORMATIONAL POLICY TO HELP ACHIEVING LOW CARBON SOCIETIES

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Abstract

The goal of this report is to analyse the Technology Mechanism (TM) established under UNFCCC in 2010 at COP16 in Cancun, to highlight the process behind its conception, its current status of implementation, its efficacy to fostering Low Carbon Transition and the way forward according to the Paris Agreement of COP21. TM is organized in two branches: the Technology Executive Committee – TEC, responsible for setting the strategies and the Climate Technology Centre and Network – CTCN for the implementation of specific mitigation and adaptation projects in Developing Countries. The Technology Mechanism represents a discontinuity in the traditional way of conceiving cooperation towards Developing Countries as it acts as "a 'dynamic' arrangement geared towards fostering public-private partnerships; promoting innovation; catalysing the use of technology road maps or action plans; mobilizing national, regional and international technology centres and network; and facilitating joint R&D activities" on a "Country-driven basis". Moreover, after analysing the main characteristics of CTCN projects implemented so far, we will propose an evaluation approach of such projects based on the social network analysis in order to capture also the "local self-empowerment" aspects for the achievement of the Sustainable Development Goals (SDGs).

1. Introduction

The 2015 Paris Agreement calls for a common goal of capping the planet average temperature increase since pre-industrial level to well below 2 degrees Celsius; this would imply, for developed countries, a near zero emission target for 2050 and a substantial deviation from business as usual scenario for developing countries[17].

This process towards the achievement of low carbon societies would imply a radical change in the way energy is produced and consumed and can be described in its dynamics as a transitional process.

The role of technology transfer in helping the transition towards Low Carbon Societies (LCS) is described in this article highlighting the importance of achieving greenhouse gas emissions reduction together with the entire set of the Sustainable Development Goals (SDGs) decided in New York in 2015.

2. The UNFCCC Technology Mechanism

The Conference of the Parties (COP) at its 16th meeting held in Cancun (Mexico) in 2010 agreed, through its decision 1/CP.16, to establish a Technology Mechanism to facilitate the implementation of actions on technology development and transfer for achieving the full implementation of the Convention on Climate Change. The Paris

[16] ENEA

[17] See G8 Aquila Summit final declaration on climate change (2009) and the resulting Deep Decarbonization strategies in Industrialized countries (http://deepdecarbonization.org/)

Agreement confirmed the importance of technology development and diffusion to achieve the 1,5-2°C target.

The Technology Mechanism consists of the following components:

a) the Technology Executive Committee (TEC)
b) The Climate Technology Centre and Network (CTCN)

The TEC is the Technology Mechanism's policy body. It analyses issues and provides policy recommendations that support country efforts to enhance climate technology development and transfer. The TEC consists of 20 technology experts representing both developed and developing countries. It meets several times a year and holds climate technology events that support efforts to address key technology policy issues.

The implementation body of the Technology Mechanism is the CTCN. It facilitates the transfer of technologies through the following three services:

- Providing technical assistance at the request of developing countries to accelerate the transfer of climate technologies
- Creating access to information and knowledge on climate technologies, particularly through its knowledge management system
- Fostering collaboration among climate technology stakeholders via its network of regional and sectorial experts

The CTCN is hosted by the United Nations Environment Programme in collaboration with the United Nations Industrial Development Organization, and is supported by 11 partner institutions. The Centre facilitates a network of national, regional, sectorial and international technology centres, networks, organizations and private sector entities. The CTCN is accountable to and under the guidance of the Conference of the Parties through the CTCN Advisory Board.

TEC and the CTCN work together and support developing country efforts to address both policy and implementation aspects of climate technology development and transfer. They work to enrich coherence and synergy in the delivery of climate technology support and respond effectively to the needs of countries.

3. The CTCN mandate

The CTCN mandate has been defined, in 2010, in COP decision 1/CP.16 in which it is stated that CTCN shall facilitate a network of national, regional, sectorial and international technology networks, organization and initiatives with a view to engaging the participants of the network effectively in the following functions:

a) At the request of a developing country Party:
   i. Providing advice and support related to the identification of technology needs and the implementation of environmentally sound technologies, practices and processes;
   ii. Facilitating the provision of information, training and support for programmes to build or strengthen capacity of developing countries to identify technology options, make technology choices and operate, maintain and adapt technology;
   iii. Facilitating prompt action on the deployment of existing technology in developing country Parties based on identified needs;

b) Stimulating and encouraging, through collaboration with the private sector, public institutions, academia and research institutions, the development and transfer of existing and emerging environmentally sound technologies, as well as opportunities for North–South, South–South and triangular technology cooperation;

c) Facilitating a network of national, regional, sectorial and international technology centres, networks, organization and initiatives with a view to:

i. Enhancing cooperation with national, regional and international technology centres and relevant national institutions;

ii. Facilitating international partnerships among public and private stakeholders to accelerate the innovation and diffusion of environmentally sound technologies to developing country Parties;

4. Arrangements to make CTCN fully operational

The CTCN is built around the Climate Technology Centre (CTC), which consists of the CTC Core Centre and the Technical Resource Pool (TRP). The TRP includes the so-called Consortium Partners[18], which support the CTCN and its activities as the main strategic partners besides the Advisory Board (AB) that ensures the efficiency of the action of CTCN in respect of the COP mandate.

The Technical Resource Pool will mainly be engaged in the initial appraisal, refinement, and technical support for requests received through the National Designated Entities - NDEs from developing countries, and contribute to the Knowledge Management System. The CTC Core Centre can ask for their support (e.g. in form of a respond to a project request by a developing country) if the network cannot yet, or in general deliver the needed services.

The National Designated Entity (NDE) acts as the focal point to the CTCN and is an intermediary between the national actors and the CTCN. NDEs are to be determined by the national governments. They can be located in varying (existing) offices with relevance to the targets of CTCN. In this case the political mandate by the UNFCCC asks all Parties to determine an NDE, even though the CTCN services are intended for developing countries. However, each member state is supposed to have a public focal point to the CTCN.

The CTC network provides the pool of expertise, knowledge and resources that are supposed to respond to the requests of the developing countries. This network needs to encompass a broad range of skills and expertise to support the mission of the CTCN. "Considering the wide range of adaptation and mitigation expertise required across sectors, regions and sub-regions and technologies, a wide and diverse Network of regional and national institutions is required as a delivery mechanism that can respond effectively and efficiently" (CTCN, 2013, p. 16). Therefore, the members ideally include varying

[18] In particular, the Consortium Partners are: 1) Asian Institute of Technology (AIT – Thailand); 2) Bariloche Foundation (Argentina); 3) Council for Scientific and Industrial Research (South Africa); 4) Deutsche Gesellschaft fur Internationale Zusammenarbeit (GIZ – Germany); 5) Energy Research Centre of the Netherlands (ECN); 6) Environment and Development Action in the Third World (ENDA – Senegal); 7) National Renewable Energy Laboratory (NREL – United States); 8) The Energy and Resources Institute (TERI – India); 9) Tropical Agricultural Research and Higher Education Centre (CATIE – Costarica); 10) UNEP DTU; 11) UNEP-DHI – Centre on Water and Environment (DK); 12) United Nations Environment Programme (UNEP); 13) United Nations Industrial Development Organization (UNIDO); 14) World Agroforestry Centre (ICRAF - Kenia).

stakeholders such as regional climate technology centres, international and regional organizations, (private) technology and other service providers, project developer, research/academic institutions as well as financial institutions and nongovernmental organizations. The selection of network members follows certain criteria and the CTC Core Centre screens each potential member before the membership is approved.

5. An overview of the CTCN technical assistance projects

So far, up to January 2018, the CTCN has received almost 194 requests for technical assistance. Of these about 30 are completed and 53 are in the implementation phase[19].

CTCN received most of its request for technical assistance from low and lower-middle income countries[20] and Africa is the main geographic destination followed by Asia and Latin America.

The technical assistance projects financed by the CTCN cover a wide range of activities by sector of application, in the mitigation and adaptation area, and by stage of the technology cycle. There are also numerous requests asking support for strengthening enabling framework for technology deployment and scale up (institutional straightening, legal and financial framework, etc.).

Energy related projects are the most requested projects, moreover most of the time the "cross sectoral" requests include an action on renewable energy within the activities.

The characteristics of the provided assistance in terms of its scope and the size of the financial commitment for single action (from 50.000 to 250.000 $), suggest that it is important to consider the wide contribution to the future sustainable development and the local community involvement when evaluating the effectiveness of the CTCN technology assistance activities besides measuring the direct effect of the specific action implemented in terms of its mere contribution to the global reduction of CO2 emission. The promotion of technical innovation in low developed areas is delayed by the scarcity of human capital (i.e. the lack of high technological skills and capabilities), and limited access to financial capital.

In such a context, the CTCN technical assistance is unavoidable to assist promotion of innovative sector.

These elements, i.e. the characteristics of the CTCN projects and its mandate together with the local obstacle towards systemic innovation, suggest the Transition Theory (as articulated in the multilevel approach and technology niche) as a proper instrument to analyze and evaluate the achievement of the CTCN.

[19] A detailed description of specific projects financed by CTCN is available at https://www.ctc-n.org/technical-assistance/data

[20] According to the World Bank classification of the world's economies are currently divided into four income groupings: low, lower-middle, upper-middle, and high. Income is measured using gross national income (GNI) per capita, in U.S. dollars. As of 1 July 2016, low-income economies are those with a GNI per capita of $1,025 or less in 2015; lower middle-income economies are those with a GNI per capita between $1,026 and $4,035; upper middle-income economies are those with a GNI per capita between $4,036 and $12,475; high-income economies are those with a GNI per capita of $12,476 or more. https://datahelpdesk.worldbank.org/knowledgebase/articles/378834-how-does-the-world-bank-classify-countries

6. The theoretical framework of the socio economic transition of technological system in a nutshell and its relation to the CTCN

In order to be able to cope with a transition it is crucial to understand, in anticipation, evolutionary pathways and key drivers of change. In this framework the socio-technical change, i.e. innovation, is of particular interest.

The processes that lead to innovation has been investigated from different point of view, one of the most interesting one is the approach of evolutionary school of innovation (Nelson and Winter, 1982, Dosi, 1982). Here innovation is analysed as a "solution of problems", not as an exogenous process. The difference between incremental and radical innovation is also introduced. Incremental innovation is the one that rests on a knowledge base and infrastructure accumulated over time, and allows improvements within a defined technological system, which reduces the scope of problems, the knowledge base needed to solve them, the range of possible solutions, the research methodologies, the actors involved in the innovation process.

The incremental innovation path produces innovation quickly and cheaply, but this is why it sometimes locks in innovation by preventing the activation of new paths. The "radical" innovation places the foundations of a new technological system, as it identifies several problems to answer, adopt new knowledge bases, revolutionize research methodologies, identify new solutions, involving new actors.

Starting from the concepts of the evolutionary school, the school of technological transition extends the concept of innovation to all socio-economic spectra that can influence the emergence of new ways of production, such as consumption, research, institutions, (Rip and Kemp, 1998; Bijker et al., 1987; Geels, 2004). Similarly to the evolutionist approach, there is radical innovation when it creates a new socio-technical regime. Therefore an innovation policy is a policy that leads to new socio-economical regimes.

The transition school analyses the social and economic organization by distinguishing three levels of complexity interacting among them. The first level, the "micro", is the level where the niches are formed, starting with novelty (i.e. breaks in the routines of the regime), consolidating through a progressive definition of their internal components (rules, networks, structures) that brings the novelty to merge into a stabilized system; in the second level, that "meso", the stabilized niches interact with the regime and work in it, starting building new regimes; Different regimes can thus coexist to a "macro" level called "landscape" characterized by global factors, which can cause pressure to create conditions conducive to the initiation of change processes and thus the emergence of new regimes.

Applied to climate change and decarbonisation, this approach builds responses to the growing problem of transition to sustainable production and consumption systems. Niches, in other words, are the areas for experimenting with new rules of consumption, production, research, and social organization that may prove to be winning as soon as the context conditions change or that can help change the context through size growth.

The figure below provides an illustrative picture of this dynamic process. In the predevelopment phase different niches emerge (e.g. First Photovoltaic field; biomass energy production etc) and, in order to survive, they need to gain critical mass also cooperating with each other. In this phase the incumbent stakeholders (e.g. the fossil fuel resources technologies, which represent the regime level) are defending their position either by preventing the development of the niche solution or by locking their

technologies in by the so called the "end of pipe" solutions which improve the environmental impact of fossil technology, allow new technology as ancillary solution the incumbent fossil technology. If the niches technology are supported by additional forces (e.g. public opinion and/or international cooperation and support, i.e. the Landscape level) they will be able to overcome the incumbent position and start a reconfiguration process of the overall system that will lead to a stable new "low carbon" regime.

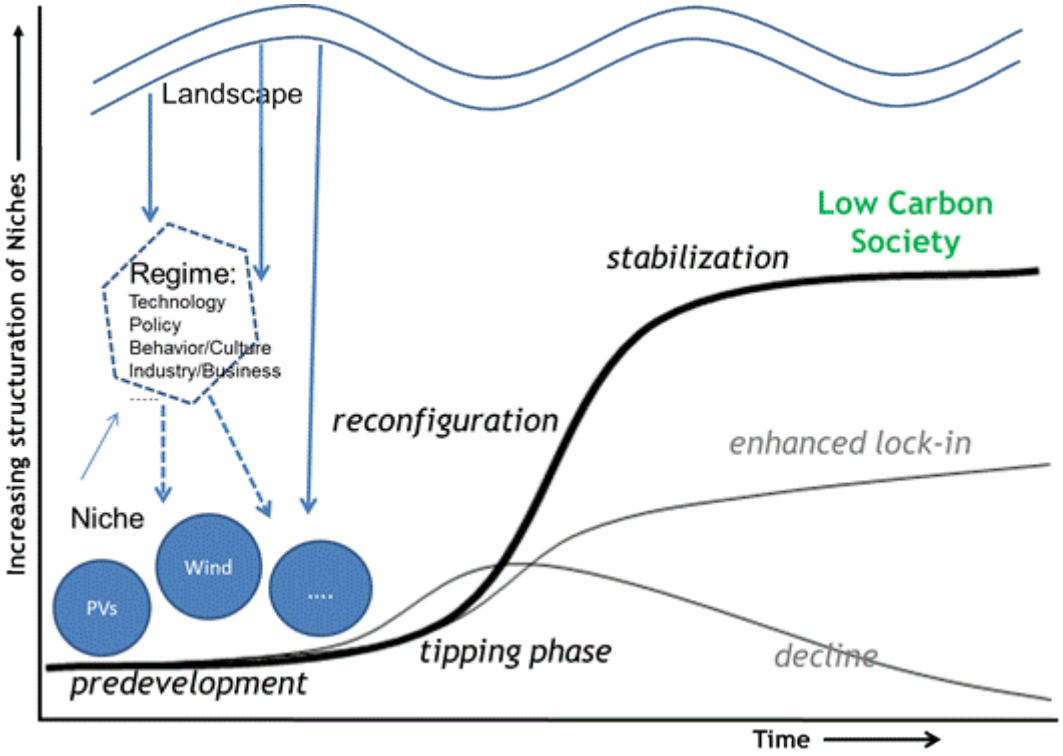

Figure 1: based on Loorback, Rotmans et al. 2001 and Schot and Geels 2008

As mentioned before, transition happens when the combined forces at Landscape and Niche level are able to force a change at Regime level. The transition is a co-evolution of the three levels. Radical innovations emerge from the niches when processes in progress at the meso and macro level create "windows of opportunities" (Glees and Schot, 2007).

The alignment of the CTCN mandate and structure with the Transition Theory can be summarized in relation to the three level of analysis and to the success factors of a technology niche (TN):

Landscape: International cooperation and aid against climate change. Today technology for mitigation and adaptation are almost standard product. CTCN provides Technical assistance in response at the requests of Developing countries to accelerate the transfer of climate technologies[21]

- Regime: It is the local area where the CTCN support is focused. The region is characterized by limited technology, knowledge and finance availability. CTCN provides outreach, networking and private sector engagement

[21] Developing countries agreed on a shared vision and commitments with the Paris Agreement which contains a collaboration on climate technology transfer (art. 10 of the Paris Agreement).

- Niche: The specific technology project developed under the CTCN that provides knowledge management, peer learning, capacity building

The CTCN can support developing countries in the instructional transition directly via its technical assistance projects on "Policy and regulatory reform design" and indirectly via the virtuous self-regulating conducts arising from the involvement in an international network.

7. CTCN Technical Assistance and its impact on transition towards Low Carbon Societies, resilient to climate change in respect of SDGs attainment

CTCN activities have a high potential to help developing countries to implement their roadmaps towards low carbon resilient societies transition. To unleash this potential, CTCN activities should strive for implementing only those projects that can have both a large potential for scaling up and can gather sufficient financing resources coming from different financing institution such as the Green Climate Fund, Global Environmental Facility and the Developing Banks. Those projects should also be coherent with the general developing goals of the recipient Developing Country and should be consistent with the most important national documents already agreed at Country level such as the Technology Need Assessment Report – TNA and its implementation document i.e. the Technology Action Plan – TAP.

An extract of projects completed by CTCN up to December 2017 is provided in the following table. All these projects are in line with the TNAs and TAPs of the recipient countries.

Recipient Country	Project Title	Impact on SDGs[22]
Afghanistan	Identification of technology needs	6, 7, 13
Algeria	Design and Construction of a ground based photovoltaic plant	7, 9, 13
Antigua and Barbuda	Workforce development strategy for priority energy sectors	7, 9, 13

[22] Goal 1. End poverty in all its forms everywhere; Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture; Goal 3. Ensure healthy lives and promote well-being for all at all ages; Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all; Goal 5. Achieve gender equality and empower all women and girls; Goal 6. Ensure availability and sustainable management of water and sanitation for all; Goal 7 Ensure access to affordable, reliable, sustainable and modern energy for all; Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all; Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation; Goal 10. Reduce inequality within and among countries; Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable; Goal 12. Ensure sustainable consumption and production patterns: Goal 13. Take urgent action to combat climate change and its impacts; Goal 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development; Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss; Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels; Goal 17. Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development.

Bosnia and Herzegovina	Modernization of Banjia Luka's district heating system	7, 9, 11, 13
Chile	Design of a national network for monitoring ecosystem resilience	13, 14, 15
Colombia	National system to monitor impact of adaptation efforts	11, 13, 15
Colombia	Policies for energy efficiency and renewable energy in industrial and transport sectors	7, 9, 13
Ivory Coast	Development of an environmental information system	6, 13, 15
Guinea	Optimizing Guinea's access to climate change adaptation funding	10, 13, 17
Iran	Technical assistance for Photovoltaic Solar Cell Design and Manufacturing	7, 9, 13
Jordan	Strengthening capacity to access international financing	1, 2, 13
Mali	Identification of climate adaptation solutions in rural communities	2, 7, 13
Mali	Technology design and private sector investment in climate resilient crop productivity	2, 8, 13
Mozambique	Feasibility study to use waste as fuel for cement factories	7, 13
Swaziland	Building capacity for climate change science	4, 13, 17
Uganda	Developing a policy, legal and regulatory framework for geothermal energy	7, 9, 13

Table 1: a list of projects already implemented by CTCN.

From the list of implemented projects, it can be seen that CTCN interventions cover almost the entire technology cycle, spanning from the initial identification of climate solution, as in the case of Mali, to the developing of a policy, legal and regulatory framework for the development and diffusion of specific technologies as in the case of Uganda. All these projects come from specific requests by Developing Countries and are in line with their transformational objectives. Furthermore, it can be stressed that CTCN action is not limited to the specific technical project but it strives for a long-term assistance to help the niche markets to emerge and building climate resilient societies (CTCN Progress Report 2017, introduction by the Director J. Uosukainen) in line with the transitional theory framework. Moreover it is highlighted how the CTCN considers the impact of its operation not limited to mere technology transfer but against all the targets and indicators of SDGs. The figure below highlights the capability of CTCN to implement projects to attain the overall set of SDGs. In the figure, the percentage of implemented CTCN projects that have impact on specific sustainable development goal is indicated.

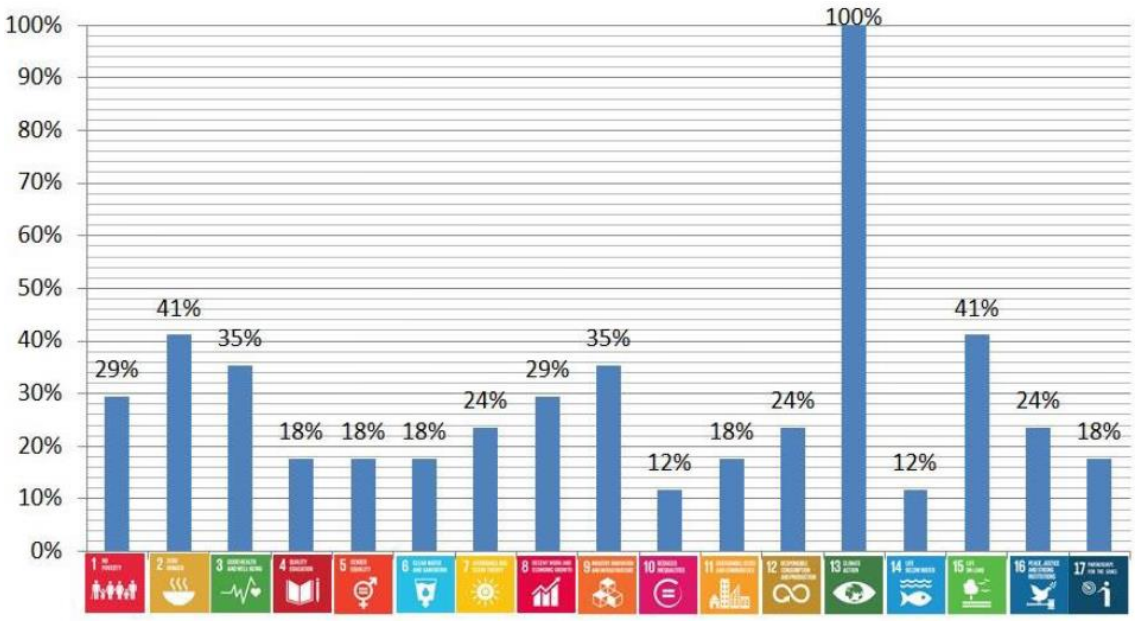

***Figure 2**: percentage of CTCN implemented projects that have impact on specific SDGs (Source: CTCN, 8° Advisory Board Meeting)*

The Algerian case can be seen as a typical case study in which the CTCN action matches the transition dynamics and the aspirational national objectives. Algeria is the leading natural gas producer and one of the top three oil producers in Africa (OPEC member since 1969). The oil and gas revenues are the backbone of the Algerian economy and its hydrocarbon-based growth model. Algeria represents one of the top three gas suppliers for the European Union (EU). Today, the energy demand of Algeria is completely covered by its own production, which is almost fully based on fossil fuels. Natural gas is the primary source of power generation contributing to over 93% of installed power capacity. The share of RE in the energy mix is only around 3.4% and until recently was largely dominated by hydropower. Algeria introduced a Law on Renewable Energy Promotion in the Framework of Sustainable Development already in 2004. Then it emphasized its commitment to expand the use of RE in February 2011, when the Renewable Energy and Energy Efficiency Development Plan 2011-2030 was published. In 2015, the Plan was revised resulting in some adjustment of the RE targets. According to the revised strategy, Algeria aims to add 22 GW of power generation capacity from RE by 2030, with more than 4.5 GW to be realized before 2020. The share of RE in electricity generation should thereby reach 27% (previously 20%) by 2030. These targets have been included in the National Determined Contribution, which Algeria has sent to the UNFCCC secretariat as a contribution to attain the Paris Agreement. In this case, the CTCN intervention goes in the direction of helping the photovoltaic market in Algeria with a specific project on the design and construction of a ground bases 1 MW photovoltaic plant and with a project still in its implementation phase focused on the establishment of a laboratory for accreditation and quality control of photovoltaic modules. It is clear that a successful implementation of CTCN technical assistance will help Algeria to attaining the goals of its renewable energy national program, also by reinforcing the national RE niche by increase national knowhow and competence in the specific sector.

8. Conclusion and final remark

Low Carbon Society transition needs radical innovation in order to change the overall system framework and avoid technical lock-in, the bitter fruit of incremental innovation.

A radical innovation it is not only a technological issue, but it has a larger scope, including the change of the socio-economic framework and the interaction of different actors (production, consumption, civil society, institutions).

The CTCN is not only a new way of cooperation, including south-south technology transfer, but, through the capacity building activities, it is also a clear example of a policy tool that fosters radical innovation in the framework of socio-technical transition. This characteristic of the CTCN will be enhanced in the Paris Agreement implementation effort as specifically stated in article 10 of the Paris Agreement itself.

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