Key Takeaways from an International Workshop held on July 5-6, 2017 at EPFL

TECHNOLOGY TRANSFER FOR CLEAN-ENERGY ACCESS: OPPORTUNITIES AND CHALLENGES

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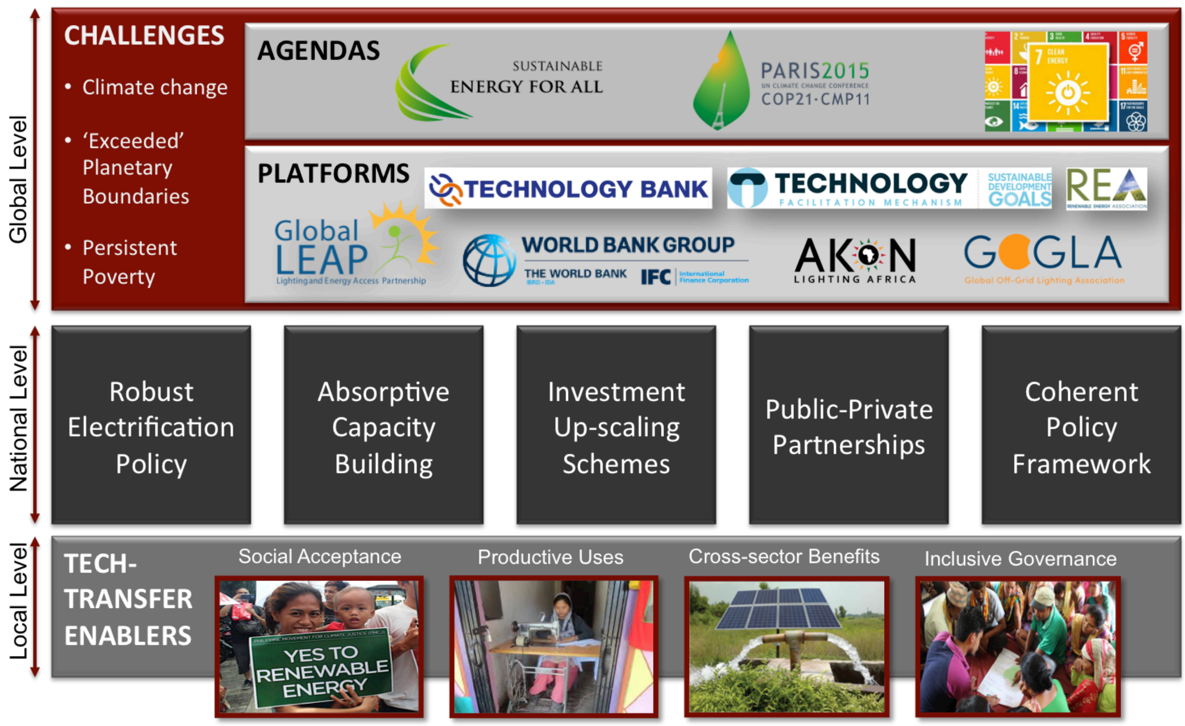
Summary. ***Energy access is the linchpin among the 17 Sustainable Development Goals (SDGs). In particular access to clean energy remains a key challenge, especially in the Global South. Technology transfer, an important feature of the United Nations Framework Convention on Climate Change (UNFCCC), emerges as a crucial element to accelerate development and deliver on the 2030 Agenda for Sustainable Development as well as the Paris Agreement on climate change. Accordingly, investment in technology transfer is expected to rise significantly in the coming years. Against a backdrop of underperforming technology transfer in many sectors, it is therefore important to better understand best practices and levers for stimulating the development of robust investment and tech-transfer strategies. Cooperation among international development agencies, financial and research institutions, and governing bodies will be critical to harness synergies among international development projects so as to maximize their respective impacts.***

The Technology Transfer Monitor (TTM) was launched as a bottom-up initiative at the EPFL Energy Center[1] in the context of the EPFL Cooperation for Development (CODEV) Center's seed money program.[2] The first milestone was a workshop where researchers and practitioners shared lessons from different projects and discussed knowledge gaps in view of informing further efforts in scaling up technology transfer for universal access to clean energy as well as other SDGs. In the context of the TTM, technology transfer encompasses (i) technology, (ii) people, (iii) know-how, (iv) financing, and (v) policy. Intervention happens at three different levels: international, national and local. Successful strategies for tech transfer, whether North-South, South-South, or triangular North-South-South, need to include actions at all three levels.

CLEAN ENERGY TECH-TRANSFER LANDSCAPE: A BIRD'S EYE VIEW



Source: Workshop Discussion. The figure maps *some* of the main drivers and enablers of clean-energy technology transfer.

WORKSHOP TAKEAWAYS

I FOCUS ON LOCAL IMPACT

Electrification, even in its most basic form—by means of standalone technologies and systems such as solar lanterns, solar home systems and clean cook stoves—has *immediate and direct benefits*, particularly reduced indoor pollution. However, local economic development does not unfold by itself with clean-energy access. Setting in motion the *multiplier effect* of clean-energy access requires moving up the energy ladder and enabling *productive uses of energy* (PUE).[3] It is therefore imperative to design accompanying policies and development programs to promote micro, small and medium enterprises (MSME) as well as to upgrade infrastructure (e.g., rollout of electric appliances) and improve market access. Enabling PUE should be an integral part of energy-related technology transfer programs. Besides stimulating the local economy, PUE can create a virtuous circle, allowing the up-scaling of energy infrastructure, particularly mini-grids, attracting larger enterprises to the electrified area, while higher loads improve the economic viability of mini-grid projects.

I.1 *Spatial Effects*

Productivity increases follow the transition from traditional labor-intensive activities or diesel-run machinery to electricity-based machinery. The combined effect of productivity increase and competition implies lower prices for consumers, and reduced profit margins for producers.[4] The overall *distributional effect* could be either positive or negative (e.g., when some individuals have to shut down their businesses). This *competition effect* may extend to other communities through trade networks, adversely affecting the economy of those neighborhoods. While the spatial effects are poorly understood, it seems reasonable that energy-related tech transfer should ensure equitable spatial economic development, and at the very least safeguard those economic activities that contribute to local communities' resilience.

I.2 *Inclusive Governance*

Going forward, the traditional top-down policy approach must be complemented by more engagement with local communities and authorities. Specifically, support should be earmarked towards capacity building for local governance throughout the project lifetime. Local inclusive governance reaps the benefits of both the local know-how to project developers at the design phase and the involvement of the local population and authorities in the management of the project, fostering sustainable impacts (driven by social acceptance, proper operations and maintenance, and appropriate monitoring). Local governance, such as Nobel Laureate Ostrom's *polycentric governance*, though well known within academic circles for its effectiveness, is not sufficiently promoted in tech-transfer projects, where they can be particularly relevant since cross-sectoral linkages are often involved, e.g., the water-energy-food nexus.

I.3 *Evidential Support*

A prerequisite to scaling up tech-transfer in underserved communities is to understand how structural, institutional and cultural factors play out at the local level. Data, especially *longitudinal data* are not available today, opening up new research opportunities. *Citizen science* can be promoted to assemble micro-level data that capture valuable *heterogeneous effects* and feed in new behavioral and structural model assumptions. *Data-driven analytical framework* can be developed to detect breaks in trends and emergence of new ones to inform policymaking as well as project development. PUE initiatives, for instance, push local enterprises into risky ventures. An understanding of *businesses' success drivers* (such as risk appetite, innovative capability and access to finance) and causal effects between electrification and successful business is needed to inform sound policy decisions and to help *create winners rather than picking them.*

II ROBUST NATIONAL POLICY MAKING

II.1 *Limited Scope for Policy Transfer*

Strong contextual factors—in terms of resource availability, institutions, culture, and singular historical events—determine the success or failure of tech transfer. Policies that worked for one country/state or for one technology or in the past need not be effective in a new setting. Renewables tech transfer to South Africa in the context of the REI4P[5] (since 2011) is a good example of a rare confluence of enabling national and global circumstances and national policy framework, namely blackouts due electrification rollout in impoverished areas, slowdown of OECD markets, an appropriate government package (incorporating lessons from an earlier unsuccessful feed-in-tariff program[6]), and a sophisticated capital market. In 2015, about 35% of FDI flows into South Africa were due to renewable energy only.

II.2 *Policy Tradeoffs*

Despite its unprecedented success, the REI4P fell short of high-value-added job creation, boosting only local manufacturing jobs in line with REI4P's minimum local content requirement (LCR, aka. domestic content requirement (DCR)). And, while LCR for PV modules in India did create jobs, particularly in the rural areas, the sustainability of job creation in such asset-focused environment is not clear. Cheaper modules are available on the international market, which may preempt up scaling of solar in India (akin to Brazil, where LCR—although successful for wind—stalled solar development). Taken together, the *precise terms of LCR have to be clarified in order to avoid unintended consequences*. The need to proper assessment of tradeoffs extends to other features of renewable energy policies such as subsidy disbursals, tendering mechanisms and power purchase agreements (PPAs).

II.3 *Barriers to Foreign Investment*

Private sector investors tend to prioritize bankable renewable energy projects. Such projects have traditionally been rare to identify due to small project sizes. With technological cost reductions, the economic viability of projects are increasing, but absence of scale economies potential in remote underserved areas remain a deterrent. Tender and concession design could foster economies of scope and spatial diversification. Although individual projects may not be bankable, on aggregate all projects are. Policy should encourage business model innovation to leverage any local technical knowhow. Additional ways for de-risking investment, in particular large-scale renewable energy projects, include: the combined use of public financing schemes and auction based schemes, where public financing focuses on risky part of the investment (e.g., infrastructure development), integrated planning of off-grid and on-grid solutions, and promoting competition in the electricity sector.

II.4 *Policy Coherence*

The discussion is ongoing as to whether to prioritize on-grid or off-grid, renewables or carbon-intensive solutions. Policy decisions should be made on careful environmental, economic and social impact analysis in light of technological innovations and cross-sector linkages as well as the possibilities for leapfrogging traditional centralized grid paradigm. Technology-neutral market-based incentives should be used to promote investment in electrification projects. Incentives should be smart as in outcome-based or need-based subsidy disbursal. And, the so-called 'resource curse' can be avoided by adopting sequential adaptive policies, with clear terms (e.g., maximum penetration levels, local development requirements) under which domestic fossil fuels can be exploited for electrifying underserved areas, considering also developments in micro-grids. Synergies between energy, innovation, competition and capital market policies must be actively sought.

III GLOBAL PARTNERSHIPS

III.1 *International Donor Engagement*

A first step is to describe actors who is financing energy infrastructure and/or renewable energy projects, how, why and where. A tree of demand-driven (government-led) or top-down (donor-led) flows, with respect to success rates can further inform tech-transfer policies. At present, there is no open access database systematically mapping multilateral financial flows. This mapping helps to identify funding gaps—which may cause project delays, streamline flows across projects for multi-project programs, and improve coordination across multilateral donor platforms. It may also highlight new financing vehicles, e.g., electricity subsidies, traditionally issued by national governments.

III.2 *Needs-Based Technology Cooperation*

Just as donor platforms are emerging to coordinate financial flows, technology platforms aimed at facilitating transfer of appropriate and affordable technologies have been instituted. Examples include the technology facilitation mechanisms in the context of the 2030 Agenda, and the UN Technology Bank for Least Developed Countries.[7] Both aim at making Science, Technology, Innovation (STI) fit for local contexts. In so doing it is important to identify obstacles to improving access to clean energy. It may well be that the challenge is not a lack of technological knowhow, but a lack of business acumen (e.g., alternative ways to monetize grid connection than the upfront fee). Technology transfer in this case, requires new ways—such as innovative profit sharing schemes—for foreign investors to partner with local project developers.

III.3 *Green-Trade Facilitation*

Sustainable trade is perhaps the key to achieving the numerous 2030 visions. Taking stock, the benefits of current trade flows do not trickle down to the underserved communities: South-North trade flows underpin the disguised decoupling between growth and emissions in developed nations while south-south trade flows is dominated by Chinese PV exports. And, under prevailing carbon accounting and WTO rules, local green growth, WTO obligations and climate change mitigation are in competition with one another. New measures (e.g., green trade finance) and accounting frameworks are needed to ensure that renewable-energy trade transactions result in net positive value creation, measured across multiple dimensions such as emissions, water savings, resource efficiency, green job creation.

CONCLUSION: ALIGNMENT WITH 2030 GOALS

Looking ahead to 2030 and the multiple parallel energy agendas—Sustainable Energy for All (SE4ALL) initiative, the SDGs and, implicitly, the Paris Agreement—a nuanced understanding of the extent to which clean-energy access can facilitate SDGs is needed. Central to successful tech-transfer is the implementation of an appropriate monitoring and assessment framework, including new metrics: electrification rate does not capture the intricacies of energy access even less so that of economic wellbeing. To close knowledge gaps, further research collaborations ought to shape and leverage the science-industry-policy interface in tech-transfer governance.

WORKSHOP PARTICIPANTS

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[1] http://energycenter.epfl.ch
[2] http://cooperation.epfl.ch/SeedMoneyEn
[3] https://energypedia.info/wiki/Productive_Use_of_Electricity
[4] Forthcoming GIZ publication
[5] REI4P stands for Renewable Energy Independent Power Producer Procurement
[6] The South African REFIT program failed because of uncertainty regarding the FITs
[7] http://unohrlls.org/technologybank/