T20 Policy Brief

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Task Force 02

SUSTAINABLE CLIMATE ACTION AND INCLUSIVE JUST ENERGY TRANSITIONS

Transforming Green Knowledge Governance to Enable a Just Energy Transition

Kirsty M. L. Mackinlay, Research Associate, University of Cambridge and the Centre for Global Equality (UK)

Kabwe Mubanga, Senior Lecturer, University of Zambia (Zambia)

Clement Sichimwa, Lecturer and Researcher, University of Zambia (Zambia)

Martin Mutembei, Project Coordinator, Energy Research Centre, Strathmore University (Kenya)

Anne Nganga, Project Assistant, Energy Research Centre, Strathmore University (Kenya)

Sounthisack Phommachanh, Senior Lecturer, National University of Laos (Laos) Orlavanh Sonesouphap, Senior Lecturer, National University of Laos (Laos)

Nguyen Hoang Nam, Senior Lecturer and Policy Advisor, National Economics University (Vietnam)

Le Huy Huan, Senior Lecturer, National Economics University (Vietnam)

Joseph Akowuah, Associate Professor, Kwame Nkrumah University of Science and Technology (Ghana)

Divya Subash Kumar, Project Scientist, Centre for Climate Change and Disaster Management, Anna University (India)

Ligia Zagato, Research Associate, University of Cambridge and the Centre for Global Equality (UK)

Elizabeth M. Tennyson, Senior Research Associate, University of Cambridge and the Centre for Global Equality (UK)

Dinh Duc Truong, Dean of Faculty of Environment, Climate Change and Urban Studies, National Economics University (Vietnam)

Kurian Joseph, Professor and Director, Centre for Climate Change and Disaster Management, Anna University (India)

Francis Kemausuor, Dean of the Faculty of Mechnical and Chemical Engineering, Kwame Nkrumah University of Science and Technology (Ghana)

Khamphone Nanthavong, Professor, National University of Laos (Laos)

Lara Allen, Senior Research Associate, University of Cambridge and the Centre for Global Equality (UK)

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Abstract

If net-zero emission targets are to be reached in an inclusive manner, a structural transformation of green policy governance is needed, along with a re-imagining of how countries cultivate national innovation systems. To decarbonise, G20 countries will need to promote innovation within both public and private sectors, avoiding previous innovation practices that have led to social and economic exclusion. By drawing upon inclusive frameworks for participatory democratic governance and knowledge democracies, we propose a series of recommendations on how conventional national innovation systems can be reconfigured into "Inclusive Green Innovation Systems" to deliver on the G20 presidency's commitment to ensure that no one is left behind during the green energy transition. We advocate for a shift away from top-down, siloed policy making structures, to a knowledge governance framework that positions national governments as multi-level institutions that are responsive to academia, private sector, civil society organisations, and other knowledge-based actors. We draw upon case studies of low-emission innovation systems deployed across Asia, Africa and Europe that are promoting horizontal and reciprocal knowledge exchange between national and international actors, and are embedding knowledge into domestic institutions to ensure sustainable, low-emission, and inclusive economic growth.

Keywords: Inclusion, Innovation, Just Energy Transitions

Diagnosis of the Issue

Brazil's G20 presidential priorities foreground the need to transform energy systems rapidly by accelerating low-emission, just, affordable, and inclusive energy transitions. These commitments are aligned with the United Nations Sustainable Development Goals (SDGs), particularly SDG-7, which aims to ensure access to affordable, reliable, sustainable, and modern energy for all.

The deployment of new energy technologies has been the driving force of the energy transition globally in recent decades. In 2022 alone, electric car vehicle sales grew by 55%, heat pumps saw an 11% growth in sales, electrolyser manufacturing capacity grew by 20% and solar photovoltaic generation grew by 26% (IEA, 2023). Such progress is the manifestation of a broader, growing system of "green innovation", a framework of innovation seeking to leverage "green knowledge" to promote economic growth that is harmonious with environmental protection. However, historically, conventional approaches to innovation have exacerbated social inequality (Schot & Steinmueller, 2018) and the energy sector is at risk of repeating past mistakes. Indeed, cases of renewable energy technologies and projects displacing local livelihoods, endangering indigenous communities, disrupting food production supply chains, and peripheralising rural communities are being reported in both developed and developing economies (Karp & Richter, 2011; Liu et al., 2024; Zárate-Toledo et al., 2019). Accordingly, this brief provides recommendations on how Inclusive Green Innovation Systems (IGISs) can be developed both at the national and international level across G20 members, and beyond, and how, in turn, IGISs can deliver G20's Energy Transitions Working Group's commitment to consider the "social dimension of the energy transition".

Resource dependency theory dictates that effective innovation systems must consist of multiple agents that collaborate to engage at different, but complementary, stages of complex technological innovation (Carlsson et al., 2002). This leads to fewer capacity concerns within the system's agents, reduces the technological and market uncertainties within green innovation activities, and leads to more heterogeneous knowledge creation. However, conventional innovation systems have been configured to generate economic growth, and have failed to prioritise sustainability, leading to the exclusion of marginalised voices and indigenous forms of knowledge (Morales et al., 2023) (Figure 1a). This leads to a cycle in which prevailing innovation policy does not consider the needs of excluded populations, thereby reinforcing their status. Consequently, G20 countries should support the development of innovation systems that are configured towards inclusion, with social good and environmental protection acting as equal drivers of innovation alongside economic growth (Figure 1b).

Innovation systems are categorised into knowledge generators, knowledge utilisers, and intermediaries that diffuse knowledge across all agents in the system. Conventional National Innovation Systems literature foregrounds universities as prominent knowledge generators, and private firms as major knowledge utilisers (Carlsson et al., 2002). A contributing factor to social exclusion within such innovation systems is the inability of conventional agents and excluded agents to establish dialogues with each other (Morales et al., 2023). Universities and civil society organisations are well positioned to act as intermediaries for presenting and evidencing marginalised voices and knowledge to governments and firms. However, government engagement with evidenced-based policymaking varies between countries, with the transfer of research outputs into policy design in itself considered a transformative approach in some country contexts (Lundvall, 2022).

Importantly, innovation systems should extend beyond national borders. Income inequality between nations, rather than inequality within a nation, is the main driver of global levels of inequality currently (Lundvall, 2022). However, current intellectual property rights can make it difficult for developing countries to capitalise on green energy innovation. Equally, knowledge should flow out of developing economies, as there is a shortage of country-specific research that considers their socio-economic, cultural, and environmental context. Thus, if low- and middle-income countries are to reap the benefits of green energy innovations, that are predominantly being innovated by developed nations, IGISs must enable rapid dispersal of knowledge and technological capabilities at the regional and international level.

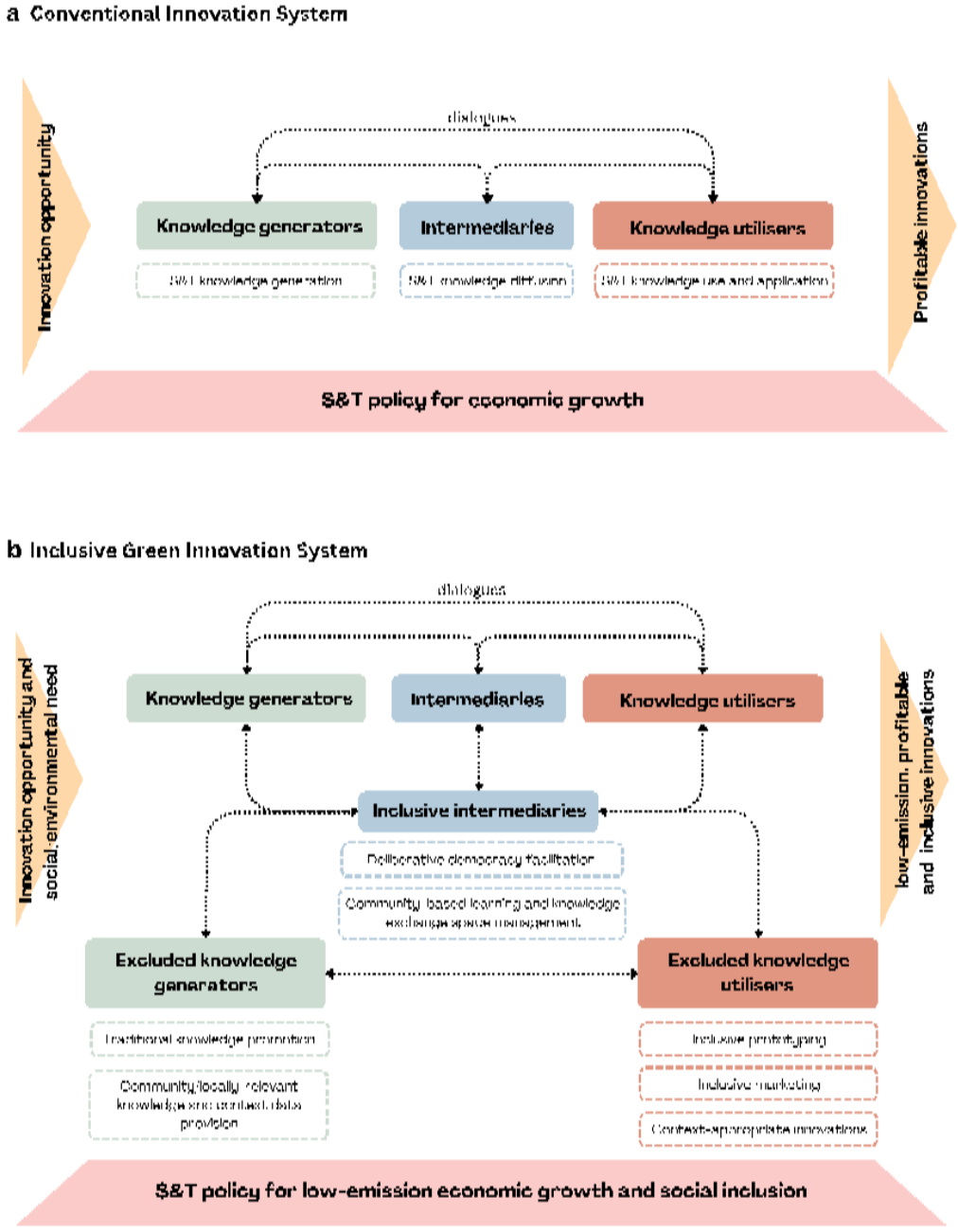

FIGURE 1. Comparison between Conventional Innovation Systems and Inclusive Green Innovation Systems (a) Within a Conventional Innovation System, profitability drives the directionality of the system. Dialogues exist between conventional knowledge generators, intermediaries, and knowledge utilizers. Science and technology (S&T) policy is designed to deliver economic growth across the system. (b) Within an Inclusive Green Innovation System, profitability, emission reductions and social inclusion equally drive system directionality. Inclusive intermediaries mediate inclusion of agents that are

conventionally excluded from the innovation system. S&T policy is designed to concurrently reduce emissions, deliver economic growth and enhance social inclusion across the system.

Recommendations

1. **Involve historically excluded agents within Inclusive Green Innovation Systems**

An imperative characteristic of an IGIS is the inclusion of groups normally excluded from conventional innovation systems. Excluded populations should be viewed not only as beneficiaries of green innovation, but as active agents that contribute as knowledge generators, intermediaries and utilisers.

The G20 should set representative quotas for women and marginalised peoples within decision-making processes within the energy sector at the level of national decision making and within firm boards, as has been done in Ghana (National Energy Policy of Ghana 2021), and Zambia (Gender Equality Strategy and Action Plan for the Energy Sector 2023), thereby guaranteeing a platform for marginalised voices. Decentralisation of energy planning processes can also grant agency to rural and marginalised actors, as has been seen in Kenya's Integrated National Energy Planning Framework. As such, G20 members should promote decentralised energy planning processes that encourage sub-national decision-making bodies to develop their own energy plans using participatory community consultation and engagement best practices.

"Local energy communities" (LECs) offer a bottom-up structure by which renewable energy planning and innovation can be driven from the municipal, or even village, level in Africa (Ambole et al., 2021) and Europe (Otamendi-Irizar et al., 2022) (Figure 2).

Accordingly, G20 members should establish a "National Community Energy Contact Group" with representatives of communities, local authorities and local enterprise partnerships working with government to identify barriers and solutions for community-led socioeconomic development within the energy sector, while also enabling knowledge sharing between the LEC groups, as has been done under the UK's "Empowering Community Energy" scheme. G20 members should also revise electricity market regulation to facilitate consumer participation in electricity trade, facilitated by special trading structures for small producers, consumers, communities.

In line with deliberative democracy theory, IGISs should contain spaces within which excluded and conventional agents can convene in an equitable manner to discuss the issues they face and, based on those discussions, deliberate on policies and innovation that will affect their lives (Bächtiger et al., 2018). Inclusion of excluded agents into conventional innovation systems can also be mediated, by "inclusive intermediaries" (Figure 1b). These agents are able to "understand the language and motivations" of other agents and form connections between them based on adherence to system directionality (Morales et al., 2023). Therefore, G20 members should establish statutory cross-stakeholder consultatory groups and/or "citizen's juries" that are mandated to convene at defined intervals to discuss national green energy planning and innovation policy.

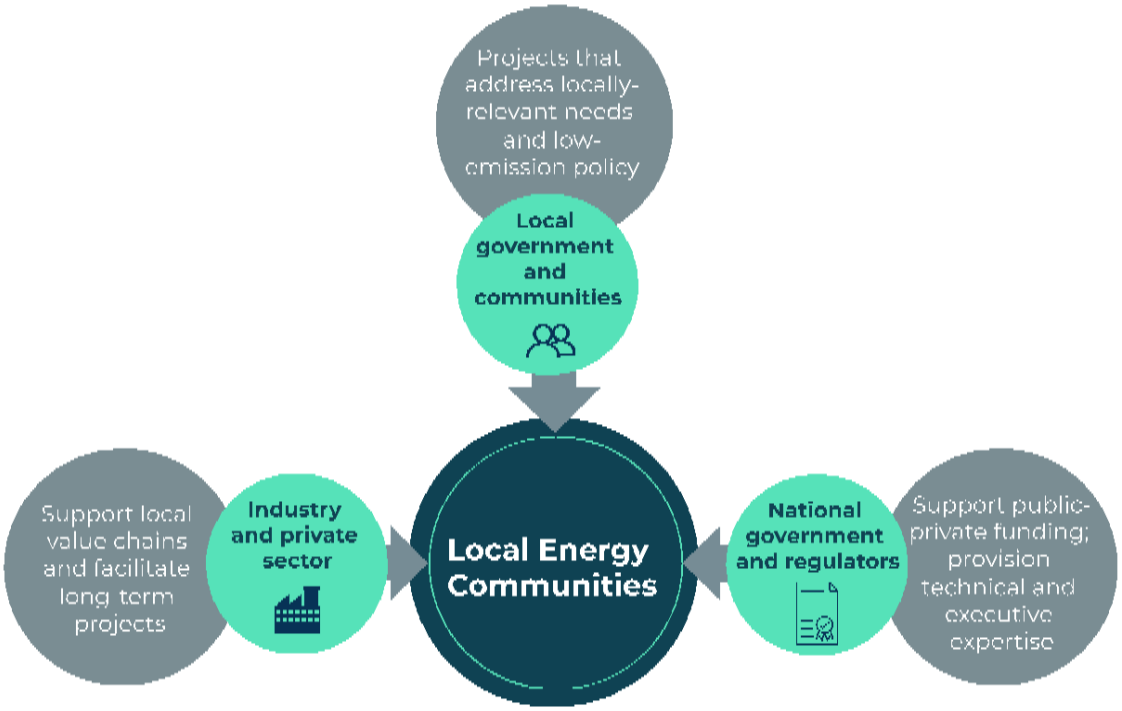

FIGURE 1: Collaboration dynamics within Local Energy Communities

Membership of Local Energy Communities can include representatives from the private sector, local government and communities, and the national government and regulators. Each stakeholder group contributes a unique set of skills and resources to the community.

2. Prioritise green knowledge education and training

Given that science and technology (S&T) knowledge circulates within innovation systems, equitable access to comprehensive energy systems education is a crucial prerequisite for an IGIS. Equipping marginalised groups with basic energy systems knowledge will enhance their ability to contribute equitably to dialogues surrounding renewable energy projects, run community-led energy projects effectively, and innovate context-appropriate technologies. G20 members should establish “green skills and educations centres” for, and led by, local communities, that will act as centres for green

knowledge training and discussions, and eventually can act as consultative bodies for energy projects that come to the community, as trialled in Indonesia (Novitasari et al., 2019).

Green knowledge education should also target the delivery of a skilled workforce for private sector innovation. G20 members should establish green jobs training programmes that partner universities and educational organisations with green private sector firms to address green skills gaps. Such programmes being executed by G20 members that could be replicated include India's "Skill Council for Green Jobs" programme and Canada's "Energy Advisor Recruitment, Training and Mentorship" programme. The latter foregrounds inclusion within the selection of training institutions and those being trained by allocating at least 10% of its funding to indigenous governments or organisations to develop their own training programmes.

Secondary school and university curricula should also address the requirements of both public sector green policy development and green innovation activities in the private sector, thereby ensuring a constant flow of skilled experts into innovation systems. Accordingly, G20 members should mandate a National Green Curriculum Development Committee, populated with inclusive representation from firms, universities, secondary schools, community leaders and civil society organisations to inform national curricula setting processes. Zambia's Committee on Education, Science and Technology may act as a guiding example.

3. Adopt Open Science principles across the energy sector

Open approaches to innovation foster transparency and collaboration among system agents, facilitating the widespread dissemination of S&T knowledge and technological innovation nationally and internationally. Thus, the G20 should advocate for the use of

"Open Science" approaches to data, research, and teaching and, as such advocate for adoption of the FAIR data principles (Wilkinson et al., 2016) within the energy sector.

Open modelling and data foster multi-disciplinary approaches to addressing the co-evolution of energy technologies. Adoption of open models enables soft-linking of numerous models with greater ease and scope, enabling holistic analyses of entire resource systems, including energy, water, land, and beyond. As such, the use of open-source energy models and tools by G20 governments should be prioritised over closed-source equivalents.

Where Open Science approaches are more difficult to cultivate, such as in the private sector, firm-firm collaboration should be facilitated to reduce the uncertainty in green research and development (R&D) activities and to enable enterprises to absorb knowledge innovation spill over. As such, G20 members should establish cooperative energy R&D consortiums across firms and universities, as has been successful in Japan (Yang, 2022), and incentivise joint patent applications.

4. Incorporate inclusive green finance practices into IGISs

As foregrounded by Brazil's G20 Presidency prioritisation of "Accelerating financing for the energy transition", there cannot be significant transformation in climate action without sufficient, timely, and equitable access to financial resources. Conventional innovation systems have overlooked the crucial role that financial institutions play in facilitating green innovation. Green innovation activities are often percieved as high risk, which can hinder access to finance. Therefore, empowering knowledge utilisers to access commercial credit can alleviate cash pressures, and act as a buffer for high upfront investments, output uncertainty, and externalities associated with green R&D (Cui et al., 2023). The adoption of an Inclusive Green Finance approach (IGF) can allow

governments and financial institutions to merge green finance and social inclusion policies. Accordingly, G20 members should advocate for financial regulatory bodies and central banks to mainstream IGF through the adoption of environmental, social and governance-related risk frameworks. G20 members should also work with financial institutions to develop classifications of IGF-compliant products and services that can be incorporated into a voluntary (or binding) standards system. Finally, to minimise transition costs, financial incentives for IGF practices should be offered, through means such as credit guarantees, and capital relief for the low-emission energy sector.

Scenario of Outcomes

Public policy defines the institutional environment that all innovation system agents must align to. Indeed, studies have demonstrated the decisive role that environmental policy plays in private firm cooperation, industry-academia cooperation, financial institution activity and government subsidies in the context of green innovation (Cui et al., 2023). Hence, initially the onus will fall on national governments to drive a reconfiguration of national innovation systems and to advocate for inclusive intermediaries. They, consequently, should be prepared to commit resources upfront to this cause, with a long-sighted view on returns. Governments should, however, call upon knowledge generating agents, both conventional and historically excluded, within the system to provide evidence-based policy recommendations, while also outsourcing training and educational responsibilities to these agents wherever relevant to relieve the resource burden of initial IGIS implementation.

Strong upskilling of marginalised communities and subnational authorities will enable equitable dialogues between system actors and will support bottom-up planning efforts. Without sufficient human capacity, planning processes will stall, and community energy projects may be ill-managed and potentially unprofitable. Universities and educational organisations should also be leveraged to deliver training and upskilling programmes and to deliver vocational training programmes to reskill the workforce towards green jobs.

Bottom-up energy planning also requires well structured energy data flows between national and subnational actors. Where open energy databases are deployed, data sharing is significantly easier, although data formats and disaggregation templates must still be systematised through comprehensive compliance to national data collection and storage frameworks.

Within developing economies, where resources tend to be more limited, Open Science practices also offer a pathway to overcome knowledge gaps by enabling knowledge exchange between different countries' innovation systems. Open energy data is a key component of the Open Science approach and is the foundation of ensuring transparency, peer-review, reproducibility, and traceability. Further, Open Science approaches support burden sharing across academic and government actors: in many innovation systems, energy modelling capacity is strongest in national research institutions, whereas national statistics are generally managed by government bodies.

However, adoption of Open Science, and specifically open data, approaches may receive push back from system agents. For example, commercially sensitive data pertaining to energy consumer behaviour, contents of power purchase agreements, or on grid infrastructure may be deemed unsuitable for public databases. Therefore, agents should not take an "all or nothing" approach to Open Science practices, instead upfront dialogues should be maintained between collaborating system agents, with parts of model codebase or datasets being published depending on the context's goals and requirements.

Overall, the adoption of IGIS frameworks for innovation systems within G20 members presents opportunities to promote an energy transition that leaves no one behind, a major priority for the Brazil G20 presidency. Importantly, the IGIS framework can be applied across any sector, including agriculture and industry, to promote innovation that can address other G20 presidential priorities, such as alleviating hunger and poverty. Indeed, the more inclusive and interdisciplinary innovation systems are, the greater the possibility for knowledge and benefit sharing, and thus the greater the potential for transformative social change.

References

Ambole, A., Koranteng, K., Njoroge, P., & Luhangala, D. (2021). A review of energy communities in sub-saharan Africa as a transition pathway to energy democracy. Sustainability, 13(4), 2128.

Bächtiger, A., Dryzek, J., Mansbridge, J., & Warren, M. (2018). The Oxford handbook of deliberative democracy. Oxford University Press.

Carlsson, B., Jacobsson, S., Holmén, M., & Rickne, A. (2002). Innovation systems: analytical and methodological issues. Research Policy, 31(2), 233–245.

Cui, R., Wang, J., & Zhou, C. (2023). Exploring the linkages of green transformational leadership, organizational green learning, and radical green innovation. Business Strategy and the Environment, 32(1), 185–199.

Fressoli, M., Dias, R., & Thomas, H. (2014). Innovation and Inclusive development in the south: a critical perspective. Beyond Imported Magic. Essays on Science, Technology, and Society in Latin America, 45–63.

Karp, A., & Richter, G. (2011). Meeting the challenge of food and energy security. Journal of Experimental Botany, 62(10), 3263–3271.

Liu, Y., Chen, Aj., & Liu, Z. (2024). Social Exclusion in the Development of Photovoltaics: The Perspective of Fishers in the HU Township. Social Inclusion, 12.

Lundvall, B. (2022). Transformative policies for sustainable innovation systems.

Morales, M., Castañeda, W., & Velásquez, J.(2023). Configuration of inclusive innovation systems: Function, agents and capabilities. Research Policy, 52(7), 104796.

Novitasari, D., Hidayat, S., Puruhito, D., Arruzi, R., Aliyah, F., & Mahfud, A. (2019). An Efforts to Maintain the Sustainability of Renewable Energy System in Rural Area through Green School Education Model. IOP Conference Series: Earth and Environmental Science, 353(1), 012051.

Otamendi-Irizar, I., Grijalba, O., Arias, A., Pennese, C., & Hernández, R. (2022). How can local energy communities promote sustainable development in European cities? Energy Research & Social Science, 84, 102363.

Schot, J., & Steinmueller, W. (2018). Three frames for innovation policy: R&D, systems of innovation and transformative change. Research Policy, 47(9), 1554–1567.

Wilkinson, M. D., Dumontier, M., Aalbersberg, Ij., Appleton, G., Axton, M., Baak, A., Blomberg, N., Boiten, J.-W., da Silva Santos, L., & Bourne, P. (2016). The FAIR Guiding Principles for scientific data management and stewardship. Scientific Data, 3(1), 1–9.

Yang, X. (2022). Coopetition for innovation in R&D consortia: Moderating roles of size disparity and formal interaction. Asia Pacific Journal of Management, 39(1), 79–102.

Zárate-Toledo, E., Patiño, R., & Fraga, J. (2019). Justice, social exclusion and indigenous opposition: A case study of wind energy development on the Isthmus of Tehuantepec, Mexico. Energy Research & Social Science, 54, 1–11.

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