



Net-Zero Social Governance and the Promotion of Community Resilience via Sandbox Experimentation



Introduction

Climate change has been scientifically recognized as a systemic and cross-scale environmental risk, significantly impacting environmental health, socio-economic systems, and public welfare (Richardson, K. et al., 2023; IPCC, 2023). International experience indicates that past mitigation strategies have predominantly relied on top-down supply-side measures. However, the net-zero transition involves cross-sectoral and highly complex challenges. Technological innovation alone is insufficient to slow the pace of climate change effectively; it must be accompanied by the simultaneous mobilization of social, political, and economic resources to overcome institutional and behavioral inertia. Simultaneously, beyond climate and net-zero challenges, energy resource scarcity, geopolitical and natural disaster risks, and demographic shifts represent shared pressures for nations. Addressing these demands requires urgent integration of private-sector technological capabilities and social forces. Based on this, countries such as the UK, Australia, and the US have adopted multiple bottom-up policy instruments that emphasize enhancing social inclusion and equitable benefit distribution during and after the transition period, while targeting marginalized regions, communities, and vulnerable groups to facilitate local economic development and promote systemic innovation in community-level governance mechanisms (Smith et al., 2023).

Taiwan's Response Experience: Bottom-Up Innovation and Net-Zero Transition Trends

In Taiwan, the National Science and Technology Council (NSTC) launched the Net-Zero Civic Experimentation and Sandbox Innovation Projects (hereafter referred to as the Sandbox Projects) in 2023. The program centers on three core objectives: mobilizing grassroots communities to participate in net-zero actions, redistributing net-zero benefits, and fostering innovative socio-economic and governance models. By encouraging civic groups to conduct evidence-based, locally grounded, and inclusive citizen science experiments, and by leveraging the capacity of intermediary organizations to support

local industries in transformation and capacity building, the program aims to develop replicable and scalable pathways for civic participation. The Executive Yuan has recognized its successful implementation as a reference for policy development. To realize a bottom-up, “socially driven, citizen-innovated” pathway for the net-zero transition, it is necessary to mobilize more grassroots communities across Taiwan to engage in diverse and innovative climate actions, thereby contributing to achieving the 2050 net-zero target.

Strategic Recommendations for Implementation

In advancing bottom-up net-zero actions, the Sandbox Projects promoted by the National Science and Technology Council (NSTC) have already demonstrated exemplary outcomes in expanding network influence and advancing technological R&D. To achieve the 2035 Low-Carbon Taiwan Vision, leveraging the bottom-up momentum of civil society will help drive innovation from the micro to the macro level and from individual actions to collective transformation. The following five strategies will serve as the key pillars supporting this transformation:

- (1) Energy autonomy and system resilience,
- (2) Local carbon reduction and the benefits of carbon sink enhancement,
- (3) Sustainable production, consumption, and livelihood support,
- (4) Circular economy and regional revitalization, and
- (5) Talent transformation and community networks.

These five strategies aim to achieve the overarching goals of a safer energy transition, a more competitive industrial transformation, a more sustainable lifestyle transition, and a more resilient societal transformation.

Strategy 1: Energy Autonomy and System Resilience

(1) Background

In his 2024 inaugural address, President Lai Ching-te announced the promotion of a Second Energy Transition, aimed at advancing diversified renewable energy development while achieving the green growth objectives of the National Hope Project and implementing the smart and shared green energy strategy under Taiwan's 2050 Net-Zero Transition Strategy. To enable communities to become key drivers of the energy transition and to strengthen their energy supply capacity during natural disasters and emergencies, policies should prioritize enhancing local energy self-sufficiency and regional power system resilience.

(2) Second Energy Transition: Pilot Experience from the Sandbox Projects

The Sandbox Projects have provided valuable practical experience. For example, in Neicheng Community in Yilan, community residents have led efforts to collaborate with local startups that use micro-hydropower technology to meet local electricity demand with renewable energy.

This includes providing electricity for charging electric vehicles (iron bull carts) and supplying power for community schools.

(3) Strategic Approach: Community Energy Self-Sufficiency for Strengthening Regional Power System Resilience

Based on this experience, it is recommended that the Ministry of Economic Affairs collaborate with other government agencies to conduct an inventory of potential sites for diversified renewable energy development across Taiwan, establish demonstration projects in selected locations, and connect with local startups possessing strong technological capabilities to serve as third-party intermediary organizations and regional resources, thereby driving community net-zero transition through technological innovation. Once viable operational models are established, solar panels can be widely installed on residential rooftops in communities and rural areas. At the same time, dam-type or run-of-river micro-hydropower generators can be deployed in rivers and irrigation canals.

Secondly, the renewable electricity generated can be integrated into community microgrids, combined with energy storage systems. This electricity can primarily serve as the power source for community smart streetlights and further support community care centers, community kitchens, libraries, and educational centers, which are important local social infrastructure.

Furthermore, to promote green agricultural production in rural areas, stored renewable electricity can also support agricultural electricity demand or be used to charge transport vehicles and agricultural machinery, thereby enhancing community energy self-sufficiency and enabling diversified applications of renewable energy.

Strategy 2: Local Carbon Reduction and Carbon Sink Enhancement

(1) Background

To achieve Taiwan's 2035 carbon reduction targets, the Ministry of Agriculture plans to reduce emissions by 2.824 million metric tons and increase carbon sinks by 1.369 million metric tons by 2030, including 265,000 metric tons from soil carbon sinks, 759,000 metric tons from forest carbon sinks, and 340,000 metric tons from marine carbon sinks. To achieve more ambitious local carbon reduction and carbon sink enhancement, experiences from Sandbox experimentation projects show that traditional forestry practices can be linked with the carbon sink economy, thereby creating innovative economic development models for communities and enterprises.

(2) Promoting Local Forestry Net-Zero Transition: Pilot Experience from the Sandbox Projects

In Pingtung, a forestry company has adopted an approach that differs from traditional forestry management. By introducing new forestry technologies and management practices, the company collaborated with a non-profit organization (NPO) possessing expertise in forest carbon sinks and ESG practices. Through this collaboration, corporate resources were mobilized to pursue voluntary carbon-reduction projects focused on forest carbon sinks, which not only support forest carbon sequestration initiatives but also contribute to the revitalization and development of the forestry sector. Moreover, corporate participation has created forestry employment opportunities for residents and Indigenous communities living around forest areas, fostering a new local forest-carbon-sink economy.

(3) Strategic Approach: Carbon Sink Certification Mechanisms to Foster a Positive Cycle

Following this approach, it is recommended to establish a certification and verification system for carbon sink methodologies to support the implementation of incentive and subsidy mechanisms for locally driven carbon reduction and carbon sink enhancement initiatives. These mechanisms can encourage improvements in agricultural practices, including the adoption of organic farming, ecological conservation, and other mitigation measures. In addition, further actions such as enhanced afforestation, algae cultivation, and the promotion of regenerative agriculture can directly enhance natural carbon sinks. Such efforts would help build a more comprehensive supply of carbon sinks and an ecological stewardship system, enabling the generated carbon sinks to be incorporated into national carbon reduction inventories and recognized as part of corporate carbon reduction performance. Ultimately, this will help establish a positive cycle of “carbon sink generation – ecological conservation and stewardship – a new local net-zero economy,” while promoting broad public participation in locally driven carbon reduction actions.

Strategy 3: Sustainable Production and Distribution with Livelihood Support

(1) Background

According to data released by the Ministry of Health and Welfare in August 2023, there are currently 308 food bank locations nationwide. Statistics from 2022 show that food banks provided services more than 2.71 million times, averaging approximately 9,000 service cases per location. Similar livelihood support mechanisms can continue to be expanded to provide broader assistance. As Taiwan faces an aging society, it is necessary to expand social

investment further to realize the vision of a sustainable livelihood support system.

(2) Building Sustainable Production–Consumption Models: Pilot Experience from the Sandbox Projects

Within the Sandbox Projects, a practical case of sustainable production, consumption, and livelihood support emerged in Qigu, Tainan. The Coastal Land Resource Protection Association connected residents, schools, and various partners, successfully mobilizing National Cheng Kung University, local aquaculture producers, and youth engaged in fishery education. Through this collaboration, the carbon footprint of mullet roe was calculated, and the water levels of aquaculture ponds were adjusted to attract black-faced spoonbills for foraging, thereby contributing to biodiversity conservation while integrating sustainable aquaculture practices with local economic activities.

(3) Strategic Approach: Establishing Market Mechanisms while Integrating Social Welfare

Building on the above experience, it is recommended to encourage farmers to adopt organic agricultural practices and to utilize food banks as distribution channels for organic agricultural products. At the same time, establishing a carbon footprint certification mechanism can help ensure sustainable production practices, while a community-based low-carbon resource collection and distribution system can support the goal of fair distribution through local production and consumption.

Under this approach, organic agricultural products can serve multiple purposes—including green consumption, green meals, and green care services—through the combined operation of market mechanisms and social welfare systems. This will contribute to the development of a comprehensive livelihood support system and further expand social investment initiatives. In the long term, these efforts are expected to increase the coverage of carbon footprint certification for major agricultural products, expand the area of organic and environmentally friendly farming, and increase the number of beneficiaries of food assistance, ultimately moving closer to the goal of ending hunger.

Strategy 4: Circular Economy and Regional Revitalization

(1) Background

Taiwan faces limited natural resources, while its economic development has also generated significant waste. Therefore, it is necessary to promote resource recycling and reuse, transforming waste into recyclable materials and energy resources that can re-enter production cycles. Such practices can reduce dependence on natural

resource extraction while simultaneously lowering waste generation.

(2) Revitalizing Urban Spaces: Pioneering Sandbox Initiatives

Within the Sandbox Projects, the circular economy has become one of the most widely adopted approaches among civic groups seeking to build net-zero communities and promote local sustainability. Among them, the circular economy and regional revitalization initiatives can be further divided into rural- and urban-based models. Taking urban areas as an example, metropolitan districts often contain numerous small and underutilized spaces within streets and alleys. In Nanjichang in Wanhua, Taipei, a previously dilapidated 400-ping (approximately 1,322 m²) vacant space that the city had long neglected was gradually revitalized through a series of innovative social actions and community engagement efforts initiated since 2016. Alongside the establishment of Nanji Rice (now Ngóo-kak), local actors repeatedly carried out community actions and dialogue. Ultimately, in 2020, they established a community-based NPO called “Imma.” In Imma, most facilities are built from repurposed second-hand materials. The space follows an open, flexible design, allowing movable partitions and furniture to adapt to different uses while encouraging interaction and collaboration among the various organizations operating within it. Subsequently, different forms of local net-zero community hubs were developed, focusing on space renewal, community networking, and resource circulation. These initiatives also actively engaged with external partners, including repair cafés and farms in other regions, fostering diverse circular-economy practices and networks.

(3) Strategic Approach: Innovative Social Action, Sustainable Urban-Rural

Based on these experiences, urban communities are encouraged to promote zero-waste and environmentally friendly practices. Idle urban spaces can be repurposed as community repair hubs, where communities collectively gather repair tools and repair expertise through community participation or crowdfunding. Residents can bring small household appliances, second-hand clothing, and other repairable items to these repair hubs. This approach not only promotes the concept of repair rather than replacement, but also allows refurbished goods to be sold through various types of community shops.

For rural communities, governments can provide subsidies for circular industry equipment, establish centralized collection and management systems for recyclable agricultural materials, and develop appropriate utilization pathways to transform waste into resources, such as compost and biomass fuel briquettes. In collaboration

with regional revitalization teams, these efforts can help establish low-carbon, circular systems, increase the reuse of agricultural residues, and support the development of community repair hubs. Through resource circulation and local collaboration, rural communities can further advance the transition toward low-carbon and sustainable living environments.

Strategy 5: Talent Transformation and Community Networks

(1) Background

Amid the global momentum toward a net-zero transition and corporate ESG sustainability, countries around the world are implementing not only top-down policy strategies but also locally tailored approaches to achieve net-zero emissions. By placing local community residents at the center and fostering collaboration among governments and intermediary organizations, these initiatives support local net-zero transition through joint industrial cooperation. Such collaborative efforts enable the development of net-zero solutions driven by civil society, while green talent development becomes a key enabler of this transformation.

(2) Agricultural Technology and Organizational Innovation: Pioneering Sandbox Initiatives

A Taichung-based agricultural marketing cooperative has worked with farmers in the coastal region of Taichung to promote contract soybean farming and introduce low-carbon agricultural practices. Step by step, the initiative has expanded the influence of locally produced soybeans. By shifting from imported soybeans to domestically produced soybeans, each kilogram of local soybeans reduces approximately 0.56 kilograms of carbon emissions in Taiwan. This success stems from the development of a locally distinctive production–marketing model. Through integrating low-carbon farming practices and brand development, the cooperative has transformed multiple stages of the supply chain—from procurement, air winnowing, drying, and sorting to storage and transportation—that previously made domestic soybeans less competitive with imported products. Furthermore, the cooperative has expanded into diversified soy-based products, including soy milk, rice noodles, and soy sauce, thereby creating new value for local agricultural industries.

(3) Strategic Approach: Empowering All as Green-Collar Workers Through Matchmaking Mechanisms

By integrating local industries, spaces, technologies, human resources, organizations, and regulatory frameworks, and by leveraging support from third-party intermediary organizations—such as legal persons,

universities, startups, and non-profit organizations—this strategy aims to cultivate opportunities for all citizens to participate in green talent development. Through these efforts, locally distinctive net-zero ecosystems or community models can be jointly established. At the same time, support systems aligned with regional lifestyles can be developed to strengthen local ecosystems and stimulate local economic vitality.

To activate the role of intermediary organizations and enable every citizen to become part of the green talent ecosystem, several strategic approaches can be adopted. Third-party intermediary organizations can facilitate resource matchmaking, integrate local capacities, and utilize regional resources to support capacity building for core local actors, while also redefining the diverse roles

of green talent, strengthening professional knowledge, and promoting green talent certification and evaluation mechanisms. In addition, the strengths and capabilities of intermediary organizations can be leveraged to align local initiatives with net-zero policies, driving the transformation of communities and local industries while fostering new spatial and economic models that enhance community autonomy. Finally, the establishment of cross-policy and cross-scale intermediary platforms can support both intermediary organizations and local actors in collaboratively developing systemic solutions to local challenges, thereby nurturing democratically driven models of public governance.

Expected Benefits

Resilient Communities, Circular Economy Sites, Beneficiary Populations, Participating Community Groups, Intermediary Organizations

Through civic mutual support, community networking, corporate participation, and cross-ministerial collaboration, communities will pursue the vision of community energy self-sufficiency and diversified renewable energy development, thereby strengthening community energy resilience. Through coordinated efforts among the Ministry of Economic Affairs, the Ministry of Agriculture, the Ministry of the Interior, the Council of Indigenous Peoples, and the Hakka Affairs Council, community-based renewable energy systems can be further promoted. In terms of circular economy and regional revitalization, efforts will focus on promoting the high-value recycling of local materials. By integrating the resources and support of the Ministry of Agriculture, the Ministry of the Environment, the National Development Council, and the Hakka Affairs Council, the technical capacity and application of residual material reuse will be strengthened. At the same time, counties and cities will be encouraged to establish community repair hubs to expand the value and scale of the circular economy. For sustainable production and distribution with livelihood support, the principles of local production for local consumption and equitable distribution will be implemented. Relevant ministries include the Ministry of Economic Affairs, the Ministry of Agriculture, the Ministry of Health and Welfare, the Ministry of Education, and the Hakka Affairs Council, with particular attention to supporting elderly populations and children. Regarding local carbon reduction and carbon sink enhancement, the vision is to promote locally driven efforts and diversified approaches. Through the collaborative efforts of the Ministry of Agriculture, the Ministry of the Environment, the Ministry of Economic Affairs, the Ocean Affairs Council, and the Hakka Affairs Council, the initiative aims to mobilize 1,000 civil society organizations to participate in carbon reduction actions. Finally, under Talent Transformation and Community Networks, efforts will focus on advancing social co-creation and resource integration through cross-ministerial collaboration among the National Development Council, the Ministry of Education, the Ministry of Culture, the Ministry of the Interior, and the Hakka Affairs Council. By promoting public-private partnerships, establishing enterprise matchmaking mechanisms, and building third-party intermediary platforms, these initiatives will connect net-zero civic networks, cultivate citizens' net-zero knowledge and technical capabilities, and foster new forms of local spatial and economic models. This approach will strengthen community autonomy and ultimately nurture a new model of democratically driven public governance.

[1] .IPCC, 2023. In: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)], 35-115, Available: 10.59327/IPCC/AR6-9789291691647.

[2] Richardson, K., Steffen, W., Lucht, W., Bendtsen, J., Cornell, S.E., Donges, J.F., Drüke, M., Fetzner, I., Bala, G., von Bloh, W., Feulner, G., Fiedler, S., Gerten, D., Gleeson, T., Hofmann, M., Huiskamp, W., Kummu, M., Mohan, C., Nogués-Bravo, D., Petri, S., Porkka, M., Rahmstorf, S., Schaphoff, S., Thonicke, K., Tobian, A., Virkki, V., Wang-Erlandsson, L., Weber, L., Rockstrom, J., 2023. Earth beyond six of nine planetary boundaries. Sci. Adv. 9, 1–17, Available: 10.1126/sciadv.adh2458.

[3] Smith Adrian, Torres Contreras Gerardo A, Brisbois Marie-Claire, Lacey Barnacle Max, Sovacool Benjamin K., 2023. Inclusive innovation in just transitions: the case of smart local energy systems in the UK. Environ. Innov. Soc. Transit. 47, Available: <https://doi.org/10.1016/j.eist.2023.100719>.

[4] Ministry of Health and Welfare (August 15, 2023). Implementation Status of In-kind Benefits (Food Bank). (https://ncsd.ndc.gov.tw/_ofu/meet/8fb14b04-ef63-4f20-b949-ef3ec542cf7c/files/%E5%A0%B1%E5%91%BA%E6%A1%88%E4%B8%89_%E9%A3%9F%E7%89%A9%E9%8A%80%E8%A1%8C%E6%8E%A8%E5%8B%95%E6%83%85%E5%BD%A2.pdf?ccfad289-3453-4669-b546-ab144e171004)