MULTIACTOR COLLABORATIVE STRATEGY TO ADDRESS SOCIAL AND ECONOMIC BARRIERS IN GREEN ENERGY IMPLEMENTATION IN NORTH KONAWE

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ABSTRACT

This study examines Multi-Stakeholder Collaborative Strategies to Overcome Social and Economic Barriers in Green Energy Implementation in North Konawe with a case-study-based qualitative approach, combining in-depth interviews, participatory observation, document review, stakeholder mapping, and process tracing to analyze synergies between the government, private sector, academia, NGOs, and local communities. The results show that cross-actor collaboration, through adaptive regulation, inclusive investment, technology transfer, and local economic empowerment, creates a green energy ecosystem that is sustainable, inclusive, and responsive to local needs. This research provides theoretical contributions in the form of integrative models of multi-stakeholder collaboration in the clean energy transition, as well as practical contributions with recommendations for participatory dialogue mechanisms, innovative financing strategies, and empowerment programs that strengthen local capacity and ensure equitable access to the socio-economic benefits of green energy.

Keywords: Collaborative Strategy, Economic Barriers, Green Energy Implementation, Multiactor, Social Barriers,

INTRODUCTION

The implementation of green energy is essential to reduce dependence on fossil fuels that contribute greatly to greenhouse gas emissions and climate change that threatens the sustainability of the global environment. Green energy through PV systems with a dual tracking scheme is able to increase the potential of solar radiation and electricity production, thereby reducing dependence on fossil fuels and reducing greenhouse gas emissions to support climate change mitigation (Ahmed et al., 2021). Green growth emphasizes environmental policies that support a sustainable economy, and the green energy transition reduces dependence on fossil fuels, improves efficiency, improves balance of payments, and boosts emerging economies growth of up to 2.5 percent without increasing external debt (Oberholzer, 2023). To achieve the long-term temperature targets of the 2015 Paris Agreement and prevent the climate crisis, a realignment of the role of international law is needed to regulate the production of fossil fuels that have been proven to contribute significantly to the acceleration of global climate change (van Asselt, 2021). In the decade of SDGs, especially SDG 13, the ten largest banks of the fossil fuel industry have shown an increase in post-Paris climate action statements, but clear commitments to reduce fossil fuel financing that exacerbate climate change are still minimal (Elliott & Löfgren, 2022).

The use of green energy, such as solar and wind power, can help maintain air quality, reduce pollution, and improve public health through a cleaner environment free of harmful emissions. Studies show that ICT development drives the efficiency of total carbon emissions through green innovation and energy optimization, so that increased use of green energy not

only reduces emissions but also provides public health benefits in China (Linghu et al., 2023), The design of low-rise residential buildings in Odessa with green roofs shows that the application of this concept, through the use of green energy and environmentally friendly public spaces, can improve public health while improving the ecology and tourist attraction of the city (Vilinskaya et al., 2022). The introduction of intermittent renewable energies such as solar and wind, which helps maintain air quality, demands coal-fired power plants to operate flexibly through adaptive technologies and procedures to maintain system stability, efficiency, as well as equipment lifespan (Minchener, 2022). The intermittent integration of solar and wind power challenges the stability of electrical frequencies, so variable HVAC technology is needed to help with power regulation without sacrificing comfort, efficiency, and at the same time contribute to maintaining air quality in a sustainable manner (Cai & Braun, 2019).

Investment in green energy supports national energy independence, reduces dependence on energy imports, and strengthens energy security in the face of fluctuations in fossil fuel prices in the global market. Green energy investment plays an important role in supporting national energy independence, through CGE model-based planning that projects an increase in the renewable energy mix on the island of Java by 23% by 2025 according to the National Energy Policy target (Daryono et al., 2019), Not only does it support national energy independence, but it also plays an important role in maintaining and improving the quality of global ecology through the use of alternative energy sources that are environmentally friendly and sustainable according to modern development trends (Kulinich & Leshanych, 2023). The idea of a blue economy encourages the sustainable use of coastal and marine resources, where SIDS faces energy security challenges due to dependence on fossil fuel imports that are prone to price fluctuations, so that the renewable energy transition becomes a strategic priority (Birchenough, 2023), that the integration of motor transport in the Arctic/Subarktic communities creates energy dependence, so that food-energy security is influenced by local culture, important for the transition to renewable energy in the face of fluctuations in fossil fuel prices (Schwoerer et al., 2020).

The implementation of green energy is a key strategy in achieving sustainable development targets, ensuring a balance between energy needs, environmental conservation, and improving the quality of life of current and future generations. Green energy is a key strategy for sustainable development by utilizing renewable technologies, smart integration, and storage solutions to replace fossil energy, reduce emissions, and ensure a clean, reliable, and environmentally friendly energy supply for the future (Trinh & Chung, 2023). The results of the study used the fuzzy AHP and fuzzy WASPAS methods to prioritize ESG factors, place the environment as a top priority and establish green bonds, ESG integration, and renewable energy funds as key strategies for sustainable development of green energy (Meng & Shaikh, 2023). The study uncovered two consumer profiles in Colombia, showing that sustainable consumption behaviors related to quality of life and future resources are quite acceptable, but low environmental concern due to economic factors, affecting sustainable development and the quality of life of generations (Guzmán Rincón et al., 2021), that EJMSTE contributes to sustainable development by publishing research that supports improving the quality of life of current and future generations through education, technology, energy efficiency, and environmental literacy based on a sustainability-oriented curriculum (Husamah et al., 2022).

Reality shows that the implementation of green energy is often hampered by low public awareness of the long-term benefits, resulting in less than optimal public support for renewable energy investment on a national scale. Low public awareness of green energy is hampering decarbonization efforts, whereas research in Malaysia shows that green technology and population growth are suppressing environmental degradation, while exports and economic growth are exacerbating it, requiring sustainable investment, incentives, and public education (Majekodunmi et al., 2023), This is reflected in the lack of application of green roofs in the

midst of urbanization that triggers environmental problems, even though this technology is able to reduce emissions, save energy, manage rainwater, and support sustainable urban development (Tang et al., 2023). The results of the study analyzed the electricity supply chain with three market force models and found that renewable energy investment was less than optimal, except for the vertical Nash model which resulted in the highest quality of electricity service and investment compared to the Stackelberg model (Chen et al., 2023). The energy community (EC) has the potential to strengthen the resilience of the green energy system in Europe, but renewable energy investment is less than optimal due to constraints on energy consumption and production data acquisition, especially related to smart meter installations, low data quality, and complex collection procedures (Heuninckx et al., 2023).

The community's dependence on fossil energy, which is relatively cheap and abundantly available, makes the transition to green energy considered risky to disrupt household economic stability. Studies show that green remodeling (GR) for low-income elderly households is not economically feasible, so policy support is needed so that the benefits of green energy are achieved without causing risks to household economic stability (Kim et al., 2022), Marx-Keynes-Schumpeter model for analyzing the social dimensions of climate change, shows that carbon tax policies based on environmental sentiment risk disrupting household economic stability through declining capital accumulation and growth fluctuations (Sordi & Dávila-Fernández, 2023). In the 21st century, the debate on de-growth highlights the risks of a green energy transition that, while aimed at reducing emissions, has the potential to widen economic disparities between countries and disrupt household economic stability through a decline in social welfare (Schlör & Schubert, 2022).

Limited access to financing for renewable energy projects, especially in rural and remote areas, hinders the development of green infrastructure that requires considerable start-up capital. The results of the study show that the relationship between government policies, availability and access to financing, and stakeholder involvement in renewable energy project investment in China, with results showing that financing constraints play an important role in influencing the effectiveness of renewable energy development (Zhu, 2023). The role of Polish local governments in accelerating energy transformation through renewable energy investments, shows that financing constraints are a major obstacle so that projects are easier to realize if grants and accompanying loan support are available (Kata & Pitera, 2023). The development of green energy requires large capital, so the Asia-Pacific conference emphasized the important role of Islamic finance, especially green sukuk, as a sustainable financing instrument to support climate change mitigation and green projects in various sectors (Pathan et al., 2022). Global geopolitical, economic, environmental, and social instability demands effective sustainable development policies, where an analysis of international indices reveals Ukraine's slow progress, indicating the need for large capital to encourage the development of green energy as a key pillar of the SDGs (Musina et al., 2022).

The unequal distribution of green energy technology causes a gap between urban and rural areas, so that the benefits cannot be felt fairly by all levels of society. As global efforts to save energy and reduce emissions increase, the uneven distribution of green energy in China is influenced by energy intensity gaps between regions due to differences in technology, regulations, trade between regions, and provincial administrative authority (Shao et al., 2020). Efforts to decarbonize the steel industry in Europe face infrastructure and demand barriers, requiring production subsidies and market-creation policies, but the uneven distribution of green energy leaves some regions lagging behind in adopting low-emission steel technology effectively (Vogl et al., 2021). The gap in green energy utilization between cities and villages reflects the need for a new economic system that is in harmony with ecosystems, makes sustainable use of natural potential, and manages resources, including forests, for the sake of common prosperity without harming the environment (Fukuoka, 1995). This collaborative

KKN-55 activity aims to increase the awareness of the people of RT 13 Sriwijaya Village about the use of yards for greening, support P2KH, while reducing the gap in green energy utilization between urban and rural areas (Lensari et al., 2021).

The shift towards green energy has also triggered fears of job losses in the fossil energy sector, which has an impact on social resistance to energy transition policies. The global climate crisis is driving the U.S. energy shift from fossil to green, accelerated by the Inflation Reduction Act, but leaving uncertainty over the scale of fossil divestment and potential job losses in the traditional energy sector (Cowan et al., 2023). The shift towards green energy due to the climate and energy crises requires cross-sectoral collaboration, equitable green skills development, and attention to gender gaps and job losses in the fossil energy sector for a just transition (Mininni & Hiteva, 2023). Social resilience to energy transition policies, such as the results of a study that examined social resistance to low-carbon energy transition policies in Austria through an analysis of discourses based on distributive and procedural justice issues, which uncovered five categories of important rejection narratives to consider for a just transition (Trimmel et al., 2024). Social Sciences and Humanities play an important role in examining factors, interventions, and public support for energy transition policies, in order to understand and overcome social resistance through empowerment of actors, adoption of sustainable technologies, and effective changes in energy systems (Steg et al., 2021).

The solution is to implement a multi-stakeholder collaborative strategy emphasizing synergy between government, the private sector, civil society, and academia to formulate inclusive policies that address socio-economic barriers to the sustainable application of green energy technologies. The capabilities of multi-UAV collaborative missions are gaining increasing attention as research develops, where multi-agent reinforcement learning-based collaborative strategies with attention mechanisms and historical memory have been proven to improve decision-making effectiveness in complex airborne combat scenarios (Li et al., 2022), In contemporary conservation, effective communication is needed to manage institutional tensions, agendas, cultures, and perceptions, so as to strengthen social equality, accommodate local priorities, and support the achievement of positive post-2020 eco-social outcomes (Rice, 2022). In addition to synergizing the government, the private sector, civil society and academia, the results of the study show that the empowerment of MSMEs in Batu City through the synergy of the government, the private sector, civil society, and academics based on the quadruple helix model, includes access to capital, human resource development, partnerships, and market strengthening in a sustainable manner (Mindarti & Muzaqi, 2020). State-people relations in China show a shift from state dominance to a pattern that emphasizes the synergy of government, the private sector, civil society, and academia, which is realized through collaboration between NGOs, think tanks, and the government despite institutional constraints (Guosheng & Menegazzi, 2018).

This approach integrates innovative financing, technology transfer, and community empowerment programs to strengthen local capacity and ensure equitable access to the economic benefits of the clean energy transition. Innovative financing integration strengthens local capacity, such as the integration of solar energy in rural health services that improve access, quality, and sustainability, where innovative financing strengthens local capacity to address technical, environmental, and financial challenges in a sustainable manner for the well-being of remote communities (Uchenna Izuka et al., 2023), Rights-based long-term care strategy with an integrated and participatory approach, emphasizing the integration of innovative financing to strengthen local capacity through cross-sector collaboration, service quality improvement, and community empowerment (Hendry et al., 2023). Implementing Equal Access to the Economic Benefits of the Green Energy Transition, for example, the COP27 Delegation emphasized the need to accelerate inclusive fossil-free development, but gender inequality in the green sector is still large, so equal access for women to the economic

benefits of the green energy transition is a challenge as well as an important opportunity that must be realized (Deininge & Gren, 2022).

Through participatory dialogue and transparent partnership mechanisms, multi-stakeholder collaboration is able to build trust, reduce social resistance, and create a supportive ecosystem for equitable and equitable green energy adoption. The MAPS study developed and validated instruments for measuring the success of long-term CBPR partnerships, examining the relationship of key variables, and developing feedback mechanisms to strengthen collaboration towards health equity (Israel et al., 2020). Conceptual model of CBPR empirically shows that participatory dialogue and trusted partnership mechanisms play an important role in building synergies, increasing community engagement, and driving social change and health outcomes that support equity (Oetzel et al., 2018). Equitable and equitable adoption of green energy, such as the EU Green agreement since 2019, promotes a sustainable economic transition in a just manner through the adoption of Digital Twin and IoT-based assessment systems in buildings, supporting real-time monitoring for equitable and equitable green energy optimization throughout the building life cycle (Tagliabue et al., 2021), and the importance of green strategies in marketing product policies to ensure equitable and equitable adoption of green energy, while maintaining business competitiveness, environmental sustainability, and social welfare in an integrated and sustainable manner (Kirnosova, 2023).

Literature review

The multi-stakeholder collaborative strategy in the application of green energy technology emphasizes the importance of synergy between parties as a transformative approach in driving a sustainable energy transition. Jacob Torfing emphasized that cross-actor collaboration between government, the private sector, and non-profits through collaborative innovation can break policy impasses, optimize resources across sectors, and drive public reform and innovation to address complex problems and social needs (Torfing, 2016). *The Governing Cross-Sector Collaboration* addresses the strategies and challenges of collaboration across public, private, and nonprofit actors in the provision of public services, and provides a framework and method for public managers to select, manage, and evaluate partnerships in the interest of the Community (Boyer et al., 2014). This approach is in line with the concept *of quadruple helix innovation* in the face of resource scarcity and global competition, the Quadruple Helix innovation model emphasizes the synergy of government, academia, industry, and civil society to connect research with markets, encourage sustainable innovation, and create socially accountable policies and practices (Carayannis & Campbell, 2012). The integration of innovative financing, such as *green bonds* or community-based financing schemes, shows a negative premium green bond of 8–14 basis points, with an increase of one point in the average ESG score lowering the spread by 6–13 basis points, mainly influenced by corporate governance aspects, not just environmental sustainability (Immel et al., 2022). Technology transfer from the industrial sector The University plays a role in developing high-skilled human resources, researching issues in their fields, and contributing to local communities through technology transfer, joint research, and industry-government partnerships for the improvement of welfare and the formation of a prosperous society ("Contrib. to Local Community Through Univ.," 2022). On the other hand, community empowerment programs play an important role in ensuring active participation and equitable distribution of benefits, reducing the gap in access to green technology, such as the Malaysian Government needs to prioritize education and community empowerment to reduce the gap in access to green technology, through the development of 5G infrastructure, sustainable development practices, and encouraging the growth of innovative and environmentally friendly economies in the western and eastern regions (Lau et al., 2023). Participatory dialogue and

transparent partnership mechanisms are important instruments in building trust such as the High-Level Political Forum discussing the progress of the 2030 Agenda through participatory dialogue and partnership mechanisms, emphasizing inclusion, poverty alleviation, environmental sustainability, multi-stakeholder collaboration, data strengthening, technology, capacity, and national-global policy synergy to ensure that no party is left behind in development Sustainable (*High-Level Political Forum on Sustainable Development, Convened under the Auspices of the Economic and Social Council*, 2017). With a structured and equitable collaborative ecosystem, climate change is now the world's most pressing issue, requiring strong government policies and corporate strategies to drive the clean energy transition, reduce emissions, and implement green innovations to achieve global commitments and successful climate change mitigation (Wang, 2019). Thus, a multi-stakeholder collaborative strategy is a strategic approach that is able to overcome socio-economic barriers and create a strong foundation for the equitable and sustainable adoption of green energy technology.

METHOD

The research method used in the study entitled *Multiactor Collaborative Strategies to Overcome Social and Economic Barriers in Green Energy Implementation in North Konawe* applies a qualitative approach with a case study strategy to gain an in-depth understanding of the synergies between the government, private sector, civil society, and academia in driving the clean energy transition. Data collection was carried out through in-depth interviews with representatives of each actor, including local government officials, management of energy companies and related industries, community leaders, non-governmental organizations, and academics involved in green energy research. In addition, participatory observations were made at public dialogue forums, technology transfer workshops, and cross-sector coordination meetings that were part of the collaboration process. Secondary data were obtained through the review of policy documents, empowerment program reports, and academic publications related to innovative financing and renewable energy partnership models. Data analysis was carried out using *thematic analysis techniques* to identify patterns, opportunities, and challenges of multi-stakeholder collaboration in overcoming socio-economic barriers, especially related to financing, technical capacity, and public acceptance. The validity of the data is maintained through *a triangulation technique* that combines the results of interviews, observations, and document analysis. This research also utilizes *stakeholder mapping* to map the roles, interests, and level of influence of each actor, as well as *process tracing* to trace the dynamics of interaction and partnership mechanisms formed. This approach is expected to be able to explore collaborative strategies that are not only technically effective, but also inclusive, equitable, and sustainable in strengthening local capacity and ensuring equitable access to the economic benefits of green energy implementation in North Konawe.

RESULTS AND DISCUSSION

Multiactor Synergy as the Key to Success

Multi-stakeholder synergy is the key to the successful implementation of green energy in North Konawe because it is able to integrate the roles, resources, and expertise of various parties. Collaboration between government, the private sector, academia, NGOs, and local communities creates effective coordination, adaptive policies, and inclusive participation. Through this synergy, socio-economic barriers can be minimized, equal access to green technologies is guaranteed, and public trust is increased, thereby fostering sustainable development that is responsive to local needs and oriented towards ecological justice.

Table 1. Multi-Stakeholder Synergy to Overcome Social and Economic Barriers in Green Energy Implementation in North Konawe

Main Actors	Synergy with Other Actors	Forms of Synergy & Implementation	Strategic Impact on Socio-Economic Barriers
Government	Private, Academic, NGO, Local Community	- Establish a cross-sectoral forum as a forum for policy coordination.- Provide adaptive regulations that facilitate green investments.- Ensure community involvement in energy project planning.	- Reduce policy overlap.- Increase public trust.- Guarantee equal access to green energy resources.
Private	Government, Academics, NGOs, Local Communities	- Allocating investment in inclusive green energy projects.- Adopting clean technologies with social-environmental values in mind.- Forging partnerships based on mutual benefits.- Establishing partnerships based on mutual benefits.	- Accelerating the provision of green infrastructure.- Increasing local employment.- Reducing inequality in access to technology.
Academy	Government, Private, NGO, Local Community	- Providing research results as a basis for policy.- Organizing local HR training.- Mapping the potential and risks of green energy in the region.	- Increase the capacity of communities and governments.- Reduce socio-environmental risks.- Encourage evidence-based decision-making.

Main Actors	Synergy with Other Actors	Forms of Synergy & Implementation	Strategic Impact on Socio-Economic Barriers
LSM / NGO	Government, Private, Academic, Local Community	- Advocacy for data disclosure and ecological justice.- Become a bridge of communication between the community and policymakers.- Facilitate community participation in formal forums.	- Increase transparency and accountability.- Reduce social conflicts due to energy projects.- Strengthen the social legitimacy of projects.
Local Community	Government, Private, Academic, NGO	- Share local knowledge in project design.- Become a social supervisor of program implementation.- Provide socio-cultural support for program sustainability.	- Reduce social resistance.- Ensure programs are tailored to local needs.- Increase a sense of belonging to green energy projects.

Source : Primary Data Processing Results, 2025

Based on Table 1, it can be seen that multi-stakeholder synergy in the implementation of green energy in North Konawe plays an important role in overcoming social and economic barriers. The government serves as a policy steer with adaptive regulation and coordination forums, while the private sector accelerates green infrastructure through inclusive investment and partnerships. Academics support evidence-based decision-making through HR research and training, while NGOs ensure transparency, advocacy, and community participation. Local communities contribute with local knowledge and socio-cultural support. The degradation of local socio-cultural centres, such as the closure of community pubs in the UK, weakens community identity and interaction, increases social isolation, and encourages support for UKIP, especially in areas experiencing economic and social hardship (Bolet, 2021), factors supporting and inhibiting the development of urban community parks in New Zealand and Germany, emphasizing the role of local communities as well as socio-cultural support in the transformation of spaces into places through biophysical, socio-economic, and regulatory

dimensions (Wesener et al., 2020). This synergy results in a reduction in policy overlap, community capacity building, project social legitimacy, equitable access to technology, and a strengthening sense of belonging, thereby minimizing social resistance and economic inequality in the region. Social entrepreneurs embark on efforts to address social problems, and their perception of social legitimacy increases when the synergy between the market and the country is strong, so that efficiency is achieved and social inequality can be minimized in various welfare countries (Kibler et al., 2018).

Innovative Financing Overcomes Initial Capital Barriers

Innovative financing is the key to overcoming initial capital barriers to green energy collaboration in North Konawe. Through the role of the government, the private sector, academics, NGOs, and local communities, various schemes such as green bonds, blended finance, and microfinance can be optimized. Challenges such as budget constraints, investment risks, and low financial literacy require cross-actor collaboration. This approach not only strengthens access to funding, but also ensures the sustainability of green energy projects based on local needs and capacity.

Table 2. Innovative Financing as a Solution to Initial Capital Barriers in Green Energy Collaboration in North Konawe

Actor	The Leading Role in Innovative Financing	Innovative Financing Contribution	Specific Challenges related to Initial Capital	Collaborative Needs for Financing Scheme Success
Government	Green financing incentive policy director	- Providing *green financing schemes* (e.g., *green bonds*, revolving funds) - Renewable energy loan interest subsidies - *Public-private partnership* (PPP) schemes	- Limited regional budget for initial projects - Not optimal use of national green financing instruments	- Establish *a multi-stakeholder financing task force - Central-regional policy synchronization - Regulations that support access to innovative financing*
Private	Provider of start-up capital and business model innovation	- *Impact investment* - *Corporate social responsibility* (CSR) thematic green energy - *Blended finance* (combined private and public capital)	- High investment risk in new territories - Lack of market certainty and investment security	- Profit-sharing schemes or government guarantees - Project transparency platforms to reduce information risk
Academy	Designer of data- and	- Economic feasibility study of green	- Lack of accurate local	- Cross-actor collaborative

Actor	The Leading Role in Innovative Financing	Innovative Financing Contribution	Specific Challenges related to Initial Capital	Collaborative Needs for Financing Scheme Success
	risk-driven financing models	energy projects - *Community-based renewable energy business model* - Incentive policy recommendations	financial data - Limited capacity for innovative funding research	research - Open green financing database
NGO/LSM	Community financing access facilitator	- Grant proposal assistance - Liaisons with international donors - Microfinance schemes for clean energy	- Limited operational funds for financing advocacy - Difficulty reaching large donor agencies	- Strategic partnerships with government and the private sector - Technical support and community financial management training
Local Community	Beneficiaries and community-based fund managers	- *In-kind* contribution (manpower, land) - Local *revolving fund* management - Participation in *community-based* crowdfunding	- Limited access to formal financial institutions - Lack of financial literacy	- Fund management assistance - Flexible financing schemes according to local capacity

Source : primary data processing results, 2025

Based on Table 2, innovative financing is a strategic solution to overcome initial capital barriers in green energy collaboration in North Konawe, with different roles for each actor. The government facilitates through green financing, interest subsidies, and PPP schemes, although the regional budget is limited; the private sector provides start-up capital and innovative business models, facing high investment risks; academics support with data-driven models and feasibility studies; NGOs/NGOs facilitate community access through grants and microfinance; Local communities contribute in-kind and manage funds. The success of this scheme requires intensive collaboration, policy synchronization, transparency, joint research, financial literacy training, and flexibility according to local capacity, so that innovative financing can drive the implementation of sustainable green energy. Intensive collaboration at the regional level and comprehensive green fiscal policies encourage the adoption of sustainable green energy in Kazakhstan, address dependence on fossil fuels, strengthen the economy, reform institutions, and support industrialization and green leadership until 2050 (Shakeyev et al., 2023), intensive collaboration between public and private institutions in China through green bonds, development banks, investors, and carbon trading mechanisms encourages risk management and large funding allocations, thereby strengthening the development of sustainable green energy post-COVID-19 (Fu & Ng, 2021).

Technology Transfer Increases Local Self-Reliance

Technology transfer is key in increasing local self-sufficiency, especially in the multi-stakeholder collaborative strategy of green energy in North Konawe. Through the synergy of government, the private sector, academia, NGOs, and communities, technology is not only adopted, but also adapted according to the local context. This process includes training, mentoring, and strengthening the capacity of the community to be able to manage and develop technology independently. Thus, technology transfer plays a strategic role in creating green energy sustainability based on local wisdom.

Table 3. Technology Transfer Enhances Local Self-Reliance in Green Energy Multiactor Collaborative Strategy in North Konawe

Actor	Specific Roles in Technology Transfer	Forms of Contribution to Local Independence	Challenges in Implementation	Collaborative Strategies Required
Government	Establish regulations and incentives for the adoption of green energy technologies at the local level	- Providing technical training budgets- Facilitating the incubation of renewable technologies in villages- Building regional green energy innovation centers	- Regulations are not specific to regulate technology transfer- Weak coordination between levels of government	- Establish fiscal incentive policies for technology transfer- Provide a *cross-sector training* hub
Private	Efficient technology, investment, and operational system provider	- Transfer of solar panel, microhydro turbine, or bioenergy technology- Technical operational and maintenance training- Local business partnership schemes	- Project focus is limited to a specific region- Local involvement is often symbolic	- Establish MoUs with government & community - Ensure knowledge transfer accompanied by *hands-on training*
Academy	Provider of research, adaptive technology design, and human resource capacity strengthening	- Research on the application of technology according to the local context- Local problem-solving-based training module - Monitoring the	- Lack of collaborative research forums - Limited applied research funding	- Integrating university research with private & government projects- Conducting green energy

Actor	Specific Roles in Technology Transfer	Forms of Contribution to Local Independence	Challenges in Implementation	Collaborative Strategies Required
		effectiveness of technology in the field		*living labs* in villages
NGO / LSM	Technology transfer mediators and community empowerment facilitators	- Providing ongoing technical assistance- Translating technology to suit local wisdom- Encouraging community participation in management	- Limited access to technical information- Lack of formal involvement in project planning	- Become a liaison between the community, technicians, and donors- Strengthen technology literacy in the community
Local Community	Key users and managers of green energy technologies	- Adapting technology to local needs- Caring for and developing technology independently- Transferring skills to the younger generation	- Lack of initial technical skills- Reliance on outside parties for repairs	- Full involvement from the planning stage- Training *of trainers* program for local cadres

Source : primary data processing results, 2025

Based on Table 3, technology transfer in the multiactor collaborative strategy of green energy in North Konawe shows that each actor has a specific role that complements each other to enhance local self-sufficiency. The government focuses on regulations, incentives, and training facilities, while the private sector supplies technology and operational training. Academics support adaptive research and monitoring, while NGOs facilitate technical assistance and community empowerment. Local communities are the main recipients and managers of technology, playing a role in the adaptation, maintenance, and transfer of skills to the younger generation. Local governments are increasingly leveraging administrative data to improve performance, while local communities of technology managers are developing an OpenComm framework that harmonizes secondary and administrative data, generating spatial-temporal insights and protecting people's privacy (Ho et al., 2022). Local communities that manage technology, such as the Bali Buja Community, utilize online and offline-based digital media to develop community innovations, while preserving the values of local wisdom through creative expression and modern hyperlocal media management (Prasetyo Jati, 2022). Key challenges include weak coordination, limited funding, access to information, and lack of initial technical skills. Effective collaborative strategies demand policy integration, cross-sector MoU, living labs, and full community involvement from the planning stage.

Economic Empowerment Strengthens Social Support

Economic empowerment plays an important role in strengthening social support for green energy collaboration in North Konawe. Through incentives, training, partnerships, and business mentoring, various actors, government, the private sector, academics, NGOs, and communities can increase local capacity, public trust, and community solidarity. Targeted economic support encourages active participation, reduces potential conflicts, and strengthens social networks. With a cross-sectoral collaborative mechanism, this empowerment creates sustainable synergies for the success of green energy programs.

Table 4. Economic Empowerment to Strengthen Social Support in Green Energy Collaboration in North Konawe

Actor	Forms of Economic Empowerment	Impact on Social Support	Collaboration Mechanism
Government	- Economic incentive schemes for green energy projects- Renewable energy entrepreneurship training programs- Microfinance support for green MSMEs	- Increase public trust in public policy - Encourage active citizen participation in green energy programs	- Establish a cross-sectoral collaborative forum with an agenda of green energy-based economic empowerment
Private	- Direct investment in community-based renewable energy infrastructure and businesses- Business partnership schemes with local residents-	- Strengthen trust relationships between companies and communities- Reduce the potential for social conflicts due to projects	- Actively involved in multi-stakeholder consortiums with a commitment to long-term and transparent engagement

Actor	Forms of Economic Empowerment	Impact on Social Support	Collaboration Mechanism
	CSR programs based on improving the green economy		
Academy	- Technical and managerial training for green energy business actors- Research for local business model innovation- Village-based clean energy business incubation program	- Foster local capacity and a sense of ownership of the program- Expand the network of collaboration between communities	- Integrate research results into cross-actor planning and open data sharing
NGO / LSM	- Assistance for micro businesses based on renewable energy- Access to alternative capital through donor networks- Economic advocacy training for business sustainability	- Building community solidarity and mutual support between affected groups- Strengthening the bargaining position of the community in dialogue with the government & the private sector	- Ensuring community involvement from the planning stage to monitoring
Local Com	- Development of clean energy cooperatives-	- Increase a sense of belonging and responsibility for	- Playing an active role as an equal partner in multi-

Actor	Forms of Economic Empowerment	Impact on Social Support	Collaboration Mechanism
mu nit y	Utilization of local wisdom for green energy-based products and services- Business diversification based on energy project results	the success of the program- Strengthen internal and cross-village social networks	stakeholder consortiums and policy forums

Source : primary data processing results, 2025

The results of the study show that economic empowerment plays a strategic role in strengthening social support for green energy collaboration in North Konawe. The government encourages participation through green MSME incentives, training, and financing, while the private sector strengthens community trust through investments, partnerships, and CSR programs. Academics contribute to local capacity building through training, innovation, and incubation of clean energy businesses. NGOs/NGOs build solidarity and strengthen the bargaining position of the community through mentoring, access to capital, and advocacy. Meanwhile, local communities are developing energy cooperatives, utilizing local wisdom, and diversifying businesses. This synergy creates a transparent, inclusive, and locally-based cross-actor collaborative mechanism, thereby strengthening social networks and the sustainability of green energy programs. Corporate Social Responsibility (CSR) in Peruvian companies has been proven to improve reputation and performance through product innovation, environmental protection, financial inclusion, and collaborations that strengthen social networks and partnerships with various Community stakeholders (Guadalupe Zevallos et al., 2023). Based on the theory of knowledge flow between organizations and social networks, this study shows that collaboration strengthens social networks through structural and relational embeddedness, encouraging open innovation practices of inbound and outbound companies, with the influence of which is influenced by network inertia (Shi et al., 2020). And Based on the perspective of green communication, this study shows that green thinking, marketing through social media, and the acceptance of green communication emotionally significantly influence green consumption intentions, shaping effective social networking strategies towards the green energy transition (Wu & Long, 2024).

Participatory Dialogue Builds Trust and Reduces Conflict

Participatory dialogue plays an important role in building trust and reducing potential conflicts between green energy development actors. Through open communication, policy

transparency, and the involvement of all parties from the early stages, this dialogue creates a sense of shared ownership, accountability, and recognition of the role of each actor. The mechanism not only prevents misunderstandings and resistance, but also strengthens the social legitimacy of the project, reduces polarization, and encourages evidence-based consensus for sustainable development.

Table 5. Participatory Dialogue to Build Trust & Reduce Conflict

Actor	Identified Barriers	The Role of Participatory Dialogue	Built Trust Mechanism	Impact on Conflict Reduction
Government	Weak cross-level coordination, no green energy focus, no cross-actor consortium	Facilitate regular face-to-face forums between sectors and open development plan data	Policy transparency, a sense of shared ownership over the direction of development	Prevent suspicion and misunderstanding between actors; Lowering resistance to new policies
Private	Limited to specific projects, not yet integrated in a local collaborative system	Establish two-way communication with communities and NGOs before the project starts	Investment accountability and project impact disclosure	Reduce the potential for protests due to citizen involvement; avoiding land conflicts or compensation
Academy	The role has not been maximized, there is a lack of synergy forums with the government/donors	Integrating research results in multi-stakeholder forums, inviting other parties in data validation	Scientific credibility recognized by all parties	Avoiding assumption-based debates; Facilitate evidence-based consensus
NGO / LSM	Public information is covered, access is limited in formal forums	Become a mediator of dialogue between citizens, the government, and the private sector;	Public trust in the decision-making process	Reduce the polarization of the "pros" and "cons" of the project; Minimizing the chance of escalation of disputes

Actor	Identified Barriers	The Role of Participatory Dialogue	Built Trust Mechanism	Impact on Conflict Reduction
		Facilitating public hearings		
Local Community	Masih diposisikan sebagai objek, minim pelibatan di semua tahap	Voice aspirations directly in dialogue forums, sharing local wisdom	Sense of being valued and recognized as a partner of development	Prevent horizontal conflicts between citizens; Increasing the social legitimacy of green energy projects

Sumber : hasil pengolahan data primer, 2025

Based on Table 5, participatory dialogue has proven to be a strategic instrument in building trust and reducing conflicts between actors in the green energy transition. Governments, the private sector, academia, NGOs, and local communities have specific barriers, but through open dialogue mechanisms, they can be overcome. Governments build policy transparency, the private sector fosters investment accountability, academia strengthens scientific legitimacy, NGOs facilitate information disclosure, and local communities gain recognition of their roles. The trust mechanisms formed such as a sense of common belonging, openness, and respect for aspirations are able to prevent suspicion, avoid land conflicts, minimize polarization, and increase the social legitimacy of the project. These results show that active participation across actors is an important foundation for the success of sustainable green energy development. The report emphasises that achieving good water status in Europe requires identification of key pressures, policy harmonisation, the implementation of ecosystem-based solutions, and active participation across sectors as a foundation for sustainable green energy development and healthy and resilient management of water resources (Denmark, 2021). The 1997 National Forestry Policy (PLP) needs to be updated to keep pace with changes in European forest policy, emphasizing cross-sectoral active participation as a foundation for sustainable forest management and supporting the development of green energy that is inclusive, adaptive and aligned with climate change mitigation (Kaliszewski & Gil, 2017).

Supporting Ecosystems Driving Sustainability

Green energy sustainability in North Konawe requires a strong supporting ecosystem through multi-stakeholder synergies. The government, the private sector, academia, NGOs, and local communities have complementary roles in creating adaptive regulations, providing technology, strengthening human resource capacity, advocating for the interests of the community, and maintaining social legitimacy. Structured collaboration ensures the integration of scientific knowledge, sustainable investment, and public participation, so that the transition

to green energy is not only technically effective, but also socially just and ecologically sustainable.

Table 6. Supporting Ecosystems for Green Energy Sustainability in North Konawe

Actor	Strategic Role in the Ecosystem	Contribution to Sustainability	Required Collaboration Mechanisms
Government	Policy steer and formation of cross-sectoral collaborative legal frameworks	Ensuring sustainability through adaptive regulation, legal certainty, and integration of green energy issues in development plans	Forming a regional green energy consortium; hold regular cross-sector forums; Ensure data and budget transparency
Private	Provider of capital, innovative technology and operational efficiency	Driving accelerated implementation through green infrastructure investments, technology transfer, and sustainable business models	Public-private partnership (PPP) schemes based on shared benefits; Accountability and open reporting mechanisms
Academy	Scientific knowledge base generator and local human resource capacity booster	Provide mapping of energy potential and socio-environmental risks; Providing research and innovation for policy improvement	Collaborative research forums; integration of research results into policy formulation; Technical training for local communities
NGO / LSM	Connecting the interests of the community with decision-makers; Independent Supervisor	Maintaining ecological and social justice; advocating for information disclosure; Strengthening the capacity of affected communities	Involved from the initial planning; mechanisms for public participation in project evaluations; Strengthening Data-Based Advocacy
Local Community	Owner of local knowledge and a source of social legitimacy	Provide adaptive wisdom and ensure the sustainability of the program through active participation	Full involvement in the entire project cycle; ongoing assistance for empowerment; Fair benefit-sharing scheme

Sumber : hasil pengolahan data primer, 2025

The results of the study show that green energy sustainability in North Konawe requires a supporting ecosystem that involves close collaboration between actors. The government plays a strategic role as a policy director and guarantor of legal certainty through adaptive regulation. The private sector contributes to accelerating implementation through investment, technology, and sustainable business models. Academics strengthen the knowledge base and capacity of human resources, while NGOs/NGOs function as a liaison for the interests of the community as well as independent supervisors. The local community, as the owner of adaptive knowledge, ensures the social legitimacy and sustainability of the program.

This collaboration requires cross-sectoral forums, public-private partnerships, integrated research, and public participation mechanisms, so as to create synergies that maintain a balance between development, environmental, and community interests. The concept of Blue Economy (BE) in Africa often emphasizes economic benefits to the exclusion of environmental sustainability and social inclusion; the success of BE is achieved through a balance of environmental, economic, and community development with the participation of local communities and ecosystem protection in a post-COVID-19 collaborative framework (Okafor-Yarwood et al., 2020). In an effort to balance economic and environmental development, China established five national parks in 2021, with the strategy of harmonizing the needs of local communities, ecological conservation, environmental education, and sustainable tourism development (Rule et al., 2022).

CONCLUSION

Based on the results and discussion of the research, it can be concluded that the successful implementation of green energy in North Konawe is highly dependent on an integrated multi-stakeholder collaborative strategy to overcome social and economic barriers. The government plays a policy role as a policy guide through adaptive regulations, incentives, and coordination forums, ensuring legal certainty and encouraging public participation. The private sector is accelerating the development of green infrastructure through inclusive investments, technology, innovative business models, and CSR programs that increase community trust. Academics support evidence-based decision-making through adaptive research, feasibility studies, and human resource training, while NGOs/NGOs facilitate transparency, advocacy, technical assistance, and access to capital for communities. Local communities play a key role in the application and maintenance of technology, skills transfer, in-kind fund management, development of energy cooperatives, and business diversification based on local wisdom. This collaboration is strengthened through participatory dialogue mechanisms that build trust, openness, and social legitimacy, thereby reducing conflict, polarization, and socio-economic risks. Innovative financing strategies, adaptive technology transfer, and local economic empowerment are important pillars that complement each other, enabling policy integration, program synchronization, financial literacy training, and joint monitoring. Overall, the cross-actor synergy creates a green energy ecosystem that is sustainable, inclusive, and responsive to local needs, with a balance between development, environment, and community welfare, demonstrating that multi-stakeholder collaborative strategies are an effective instrument to overcome social and economic barriers in the green energy transition in North Konawe.

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