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Policy Brief

Task Force 3: Environment, Energy and Sustainable Development

SDG 7 and Renewable Energy Innovations: The Road Ahead for Green Growth and Sustainable Trade, and Energy Security

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Key Points

- Renewable energy is essential for tackling climate change, economic growth, and energy security.
- Global renewable capacity must triple by 2030 to meet climate targets (IRENA 2022).
- Key challenges: financing gaps, technology transfer barriers, and energy poverty.
- G7 nations must lead through R&D investments, green financing, and trade frameworks.
- Tech advancements have lowered costs, but regulatory and supply chain issues persist.
- AI-driven energy management, public-private partnerships, and knowledge-sharing are vital.
- The next decade is crucial—urgent action is needed to achieve SDG7 and build a sustainable energy system for all.

Introduction: The Global Renewable Energy Imperative

Energy Security and renewable energy stands as the most critical solution to global climate challenges, economic development. The urgent imperative for transforming global energy systems has never been more apparent. According to the UAE Consensus, the world must triple renewable energy capacity and double energy efficiency by 2030 (IRENA 2024). This addition is important because energy efficiency represents the "first fuel" in the clean energy transition - often providing the most cost-effective way to reduce emissions while delivering multiple benefits across the economy.

The current global energy landscape reveals a complex intersection of environmental, economic, and social challenges. Developed economies, particularly G7 nations, bear a disproportionate responsibility for driving this transformative energy transition. The economic potential is substantial – clean energy investments could generate 30 million jobs globally by 2030, representing a profound opportunity for sustainable economic restructuring.

Critical challenges demand immediate and coordinated international action. Financing limitations remain the most significant barrier to rapid renewable energy deployment, particularly in developing economies (Fasesin et al. 2024). Technology transfer mechanisms are fragmented, and global investment remains uneven (McDonald and Vaughan 2023).

This policy brief proposes a comprehensive strategy for addressing these challenges through:

- Innovative financing mechanisms for renewable energy projects
- Creation of supportive international trade frameworks
- Strategic investments in breakthrough renewable technologies

- Robust capacity-building programs in emerging economies

The global energy landscape is experiencing a fundamental transformation driven by urgent climate imperatives, technological innovations, and shifting economic paradigms. Sustainable Development Goal 7 (SDG7) represents a holistic vision of energy access that extends far beyond traditional environmental considerations. This goal interconnects with broader development objectives, touching critical aspects of economic growth, social equity, and global security.

Renewable energy offers a multifaceted solution to these complex challenges. Beyond carbon reduction, it presents unprecedented opportunities for economic diversification, technological innovation, and social development. Developing nations can leverage renewable technologies to address energy poverty while simultaneously pursuing sustainable economic growth. The World Bank consistently emphasizes that reliable, affordable energy is a fundamental driver of economic development and poverty reduction (World Bank 2022).

Technological innovations in renewable energy are accelerating progress toward critical tipping points that can drive systemic change. Breakthroughs in solar photovoltaics, wind energy, energy storage, and smart grids have not only reduced costs and enhanced efficiency but are also rapidly reshaping economic ecosystems. As these technologies scale, they trigger self-reinforcing adoption cycles that challenge traditional energy paradigms. Countries that strategically invest in and support this transition are more likely to gain a competitive edge in the emerging green economy.

International collaboration emerges as a critical mechanism for achieving equitable and effective energy transitions. This requires a comprehensive approach that addresses technological, financial, and regulatory barriers. The complexity of global energy transformation demands a holistic strategy that considers technological innovation, economic feasibility, and social implications.

The role of G7 nations is particularly crucial. These economies possess the technological capabilities, financial resources, and global influence to drive meaningful change. By creating supportive policy frameworks, investing in research and development, and establishing innovative financing mechanisms, G7 nations can catalyze a global renewable energy revolution. The G7 should act as a platform for collaboration with the Global South to promote shared global prosperity. This transformation should be inclusive, ensuring active participation from developing countries, rather than being led solely by G7 nations. The renewable energy landscape presents a complex geopolitical and economic dynamics that directly affect global energy security. While G7 nations have significant potential to lead the global renewable energy transition, the production of key components such as solar panels and wind turbines remains concentrated in China, creating supply chain dependencies and vulnerabilities (Tagotra 2022). Geopolitical tensions or trade disputes could further disrupt access to these critical technologies.

Notably, China's innovation and economies of scale have played a pivotal role in advancing renewable energy globally, alongside Germany. To maximize their impact, G7 nations should leverage their financial resources and influence by directing IGOs like the IMF and World

Bank to support renewable energy deployment through initiatives such as the Climate Economic Transition Program (CETP) (Tabrizi et al. 2025). The WTO can also facilitate trade rules that encourage renewable energy development.

While current U.S. climate policy positions present challenges to multilateral cooperation, G7 nations should emphasize how renewable energy advances energy security and economic competitiveness—areas of bipartisan interest in the United States (Shah 2025). Building broad support through these shared priorities will strengthen G7 influence in global energy transition efforts.

Current Progress and Barriers in Renewable Energy Development

Despite a significant rise in global electricity access from 75% in 2000 to 90% in 2020, energy poverty remains a major issue, affecting 1.18 billion people who lack reliable, affordable, or functional electricity. This number is 60% higher than the 685 million officially reported as without electricity (IEA 2024). Sub-Saharan Africa faces the most severe challenges, with many households unable to afford reliable energy services despite the region's abundant resources (Wang et al. 2023).

Case Study: Solar Home Systems in Rwanda: Rwanda has demonstrated significant success with its decentralized solar home system program, which provided affordable electricity to over 370,000 households in remote areas within five years (Rwanda Energy Group 2024). This program combined microfinance options with public-private partnerships, creating local jobs while significantly reducing energy poverty. The initiative also stimulated local entrepreneurship through phone-charging micro-businesses that generated sustainable income for rural communities.

Many electrified areas still experience power outages, equipment failures, and unaffordable costs, preventing meaningful usage. Using satellite imagery, researchers analyzed nighttime light data to identify energy-poor settlements, revealing stark disparities, especially in Sub-Saharan Africa. Their findings suggest that local solutions, rather than large-scale infrastructure, could significantly reduce energy poverty. The data, available through the High Resolution Electricity Access (HREA) project, aims to guide policies for achieving Sustainable Development Goal 7—ensuring affordable, reliable, and sustainable energy for all by 2030 (Min et al. 2024).

Global renewable energy capacity has witnessed significant growth, yet substantial challenges remain. In 2022, renewable energy sources contributed approximately 29% of global electricity generation (Selin and Eckley 2025), representing a promising but insufficient progression towards comprehensive decarbonization. The trajectory of renewable energy deployment reveals a complex landscape of achievements and persistent obstacles.

Technological advancements have dramatically transformed the renewable energy sector. Solar and wind energy costs have decreased by 82% and 39% respectively since 2010

(International Renewable Energy Agency 2022), making these technologies increasingly competitive with fossil fuel alternatives. According to the latest reports, global clean energy investment reached a record $2.1 trillion in 2024, driven by electrified transport, renewable energy, and power grids (Catsaros 2025). The International Energy Agency (IEA) also highlights that investment in clean energy has accelerated, with spending on renewable power, grids, and storage now higher than total spending on oil, gas, and coal (IEA 2024).

Financing remains a critical challenge, particularly for developing economies. Traditional financial mechanisms are inadequately structured to support large-scale renewable energy infrastructure. Developing countries face multiple barriers, including:

- Limited access to long-term, low-cost capital
- Higher perceived investment risks
- Insufficient financial and technical expertise
- Weak regulatory frameworks
- Inefficient grid infrastructure

Technological constraints continue to challenge comprehensive renewable energy deployment. Energy intermittency and storage limitations represent significant technical barriers. While battery storage technologies are advancing rapidly and its costs have declined by 90% in less than 15 years (International Energy Agency 2024), they have not yet reached the level of reliability and cost-effectiveness required for complete grid transformation.

Supply chain complexities further complicate global renewable energy expansion. Geopolitical tensions, pandemic-related disruptions, and economic uncertainties have created significant challenges in technology procurement, manufacturing, and deployment. The concentration of critical renewable energy supply chains in limited geographic regions presents potential strategic vulnerabilities.

Regulatory environments for renewable energy remain fragmented and often inconsistent. Different jurisdictions adopt varying **policy mechanisms** such as feed-in tariffs, tax incentives, or renewable portfolio standards, creating uncertainty for investors and technology developers. The absence of **harmonized international frameworks** for industry support — including standards for grid integration, certification processes, and financial incentives — significantly impedes global renewable energy deployment. Aligning these approaches could enhance investor confidence and accelerate renewable energy growth.

G7's Role in Driving Green Energy Innovations and Trade

Building on the G7's historic commitment to tripling global renewable capacity by 2030 (as established at the Hiroshima Summit), this brief proposes enhancing and expanding existing G7 frameworks rather than creating entirely new structures. The 3X commitment provides a solid foundation, but requires implementation mechanisms that address financial, technical, and regulatory barriers.

The G7 historically served as a platform for coordinating environmental policies among leading economies, though with varying commitment levels and limited binding agreements. Performance has been mixed—while the G7 has helped advance dialogues on green technologies and sustainable trade frameworks, implementation has often fallen short of announced ambitions, with progress undermined by competing national economic priorities and inconsistent follow-through on funding pledges.

While political shifts in some countries have created policy uncertainties, renewable energy presents multiple points of bipartisan alignment including energy security, economic competitiveness, and technological leadership. By framing renewable energy policies around these shared priorities, G7 initiatives can maintain momentum despite changing political landscapes. G7 nations can be transformative catalysts in global renewable energy transitions through strategic investments, policy innovations, and international collaboration.

Renewable energy development serves G7 nations' direct self-interests through:

1. Enhanced energy security and reduced dependency on imported fossil fuels.
2. Competitive advantages in emerging green technology markets.
3. Protection against volatile fossil fuel price fluctuations.
4. Reduced climate-related economic damages and adaptation costs.
5. New high-skill job creation in domestic manufacturing and services.

Technology leadership emerges as a critical domain for G7 intervention. Investments in next-generation technologies like green hydrogen, advanced solar technologies, and grid-scale energy storage can accelerate global renewable energy transformation. The potential for breakthrough innovations is substantial, with emerging technologies promising higher efficiency, lower costs, and improved energy storage capabilities.

Financial mechanisms represent another crucial area of intervention. G7 nations can develop innovative financing instruments that support energy transitions in developing economies. This includes:

- Creating green credit lines with preferential terms
- Developing risk-sharing mechanisms
- Establishing multilateral investment frameworks
- Supporting capacity-building programs

Trade policy reform offers another significant avenue for intervention. Even amid trade tensions, renewable energy presents an opportunity for cooperative frameworks that benefit all parties. For instance, Canada-U.S. trade in renewable components could be designated as a strategic priority exempt from broader tariff disputes, creating a model for sustainable trade relationships.

Public-private partnerships emerge as a powerful mechanism for driving green energy investments. By creating collaborative platforms that bring together governments, private sector entities, research institutions, and international organizations, G7 nations can create comprehensive ecosystems of innovation and deployment.

Policy Recommendations

Each policy recommendation below enhances existing G7 frameworks while addressing both global needs and G7 nations' self-interests. These recommendations could be advanced through the existing G7 Climate and Energy Ministers' Meeting or incubated at the G7 before broader introduction at the G20 level.

1. Scaling investment in renewable energy research & development

Establishing a coordinated G7 renewable energy research fund represents a critical strategy for accelerating global energy transformation. The proposed fund would prioritize breakthrough technologies that have transformative potential for addressing complex energy challenges. This investment will drive economic growth through creating high-skilled jobs in renewable tech sectors while establishing new sustainable trade ecosystems.

Implementation step: G7 nations should commit 0.1% of GDP to clean energy R&D by 2026, with research priorities determined through annual coordination meetings and funding disbursed through a dedicated secretariat.

Energy storage technologies emerge as a particularly crucial area of focus, given the intermittent nature of renewable energy sources. Advanced battery technologies, including solid-state batteries and novel chemical compositions, could dramatically improve energy storage capacity and reliability.

Smart grid management systems represent another pivotal research domain. These sophisticated technological platforms would leverage artificial intelligence and advanced computational models to optimize energy distribution, predict demand fluctuations, and integrate renewable energy sources more effectively into existing electrical infrastructure. Smart grid advancements will facilitate cross-border power trading, creating new market opportunities that align with SDG7's vision of sustainable energy access while promoting regional economic integration.

Next-generation renewable technologies require sustained, strategic investment to overcome current technological limitations. These investments create new industrial sectors and export opportunities, particularly benefiting countries that develop early technology leadership, thereby driving green economic growth through innovation-based competitive

advantage. Emerging technologies like advanced photovoltaic materials, offshore wind innovations, and green hydrogen production methods represent frontier areas with significant potential. Research should focus on increasing energy conversion efficiency, reducing manufacturing costs, and improving overall system performance.

Artificial Intelligence for energy optimization presents a revolutionary approach to renewable energy management. AI integration into energy systems creates new service export opportunities and promotes sustainable trade in digital solutions that optimize resource use—a perfect embodiment of SDG7's goal to increase renewable energy efficiency while stimulating economic growth. Machine learning algorithms can enhance predictive maintenance, optimize energy generation and distribution, and create more responsive and adaptive energy ecosystems. By integrating AI technologies, renewable energy systems can become more intelligent, efficient, and responsive to dynamic energy demands. Smarter grid management will reduce the need for energy storage systems by enabling optimal integration of variable renewables with flexible generation.

Case Study: Denmark's AI-Powered Wind Energy Management: Denmark has successfully implemented AI algorithms that predict wind patterns and optimize turbine operations, increasing energy output while reducing maintenance costs (Marcher Hansen, 2023). This system combines weather data, turbine performance metrics, and grid demand patterns to create a responsive energy system that maximizes renewable energy utilization.

The discourse on renewable energy development often focuses on the electricity sector, overlooking the combustion sector from transportation and industry. Creating sustainable biofuel supply chains offers significant trade opportunities between agricultural economies and industrial nations, fostering green growth through circular economic principles. While electrification is a key energy efficiency strategy, its adoption in developing economies may face slower progress due to infrastructure and economic constraints. To address this gap, research into 100% bio-hydrocarbon fuels, such as bioethanol derived from agricultural waste or biodiesel produced through hydrotreating vegetable oils, should be accelerated. These biofuels offer a viable pathway to decarbonize sectors and regions where widespread electrification faces significant hurdles, ensuring a more comprehensive transition to sustainable energy systems.

2. Facilitating equitable energy financing mechanisms

Developing comprehensive financial strategies is essential for supporting renewable energy transitions in developing economies. Green financing directly addresses SDG7's affordability and accessibility goals while creating new financial service export opportunities for G7 economies. Green credit lines with preferential terms can provide critical financial support, offering lower interest rates and more flexible repayment structures specifically designed for renewable energy infrastructure projects. These financial instruments would help overcome traditional investment barriers faced by emerging economies.

Implementation step: Create a G7-backed guarantee mechanism that reduces investment risk premiums by 50% for renewable projects in developing nations, mobilizing an estimated $300 billion in private capital by 2030.

Risk-sharing instruments represent an innovative approach to mitigating investment uncertainties. These mechanisms help operationalize SDG7 by mobilizing private capital into renewable energy markets, particularly in developing economies, stimulating both domestic green growth and international investment flows. By creating multilateral guarantee mechanisms, international financial institutions can provide confidence to private investors considering renewable energy projects in developing regions. These instruments would distribute potential financial risks among multiple stakeholders, making renewable energy investments more attractive and feasible.

Additionally, equitable carbon trading is essential to channel financial flows from wealthier economies to developing ones, supporting their renewable energy transitions. Carbon markets create tradable commodities from emissions reductions, establishing new financial instruments that directly connect SDG7 implementation with economic growth opportunities. International or regional carbon markets should be established with mutually recognized standards, aligned with the Paris Agreement's Article 6. Integrating wealthier countries into these markets will drive demand and price, scaling up global climate action and accelerating emissions reductions.

3. Creating a global renewable energy trade framework

Eliminating tariffs on renewable energy technologies represents a critical first step in creating a supportive international trade environment. This directly implements SDG7's access and affordability goals through trade policy while stimulating global economic growth in sustainable technology sectors. By removing financial barriers to technology transfer, G7 nations can accelerate global renewable energy adoption. Standardized tariff reductions would create a more accessible and competitive global market for renewable energy technologies.

Implementation step: Establish a G7 agreement to eliminate tariffs on an agreed list of climate-critical technologies by 2027, with designated critical supply chains receiving expedited customs processing regardless of broader trade tensions.

Standardizing technical regulations is essential for facilitating smoother international technology transfers. Harmonized standards accelerate technology diffusion required for SDG7 implementation while reducing trade barriers that restrict green economic growth opportunities. Developing harmonized technical standards would reduce compliance complexities, lower certification costs, and create a more predictable regulatory environment for renewable energy technology manufacturers and investors. These standardized frameworks would promote technological innovation and international collaboration.

Case Study: EU-Africa Renewable Energy Cooperation Platform: By 2030, the Africa-EU Green Energy Initiative (EU 2023) aims to provide electricity access to at least 100 million people (European Commission n.d.). Through Team Europe, €3.4 billion in EU grants will support renewable energy, energy efficiency, a just transition, and the greening of local value chains. As part of this initiative, €400 million has been mobilized for clean cooking

activities, combining contributions from EU countries, implementing agencies, and public development banks, along with €150 million from EU funds (EC n.d.).

Regional energy cooperation platforms can create strategic mechanisms for technology sharing and collaborative infrastructure development. These platforms enable cross-border renewable energy trading and shared infrastructure investments that directly address SDG7's clean energy access goals while creating new regional economic opportunities. These platforms would facilitate knowledge exchange, joint research initiatives, and coordinated infrastructure planning. By promoting regional integration, countries can develop more robust and interconnected renewable energy ecosystems.

4. Capacity-Building and knowledge transfer initiatives

International training programs are essential for building technical expertise in renewable energy technologies. Creating skilled renewable energy workforces globally expands markets for sustainable technologies while enabling SDG7's implementation through human capital development. These comprehensive programs would provide specialized education, hands-on training, and professional development opportunities for energy professionals from developing economies. By investing in human capital, G7 nations can support long-term sustainable energy transitions.

Implementation step: Establish a G7-funded scholarship program providing advanced technical training for 10,000 renewable energy professionals from developing nations annually, with graduates forming a global knowledge network.

Technology-sharing platforms can create dynamic ecosystems for collaborative innovation. These platforms foster SDG7 implementation through democratized knowledge access while creating new service-based trade opportunities in the digital green economy. These digital and physical platforms would facilitate knowledge exchange, collaborative research, and technology demonstrations. By creating accessible and interactive spaces for global energy professionals, these platforms can accelerate technological learning and innovation.

5. AI-driven energy transition & digitalization

AI integration in renewable energy systems represents a transformative opportunity that combines technological innovation with practical implementation strategies. The following framework outlines how G7 nations can systematically implement AI solutions in renewable energy:

Artificial Intelligence (AI) is revolutionizing energy storage, a critical yet often overlooked factor in the transition to renewable energy. While global renewable capacity surged by 50% in 2023, effective energy storage is essential to ensuring reliability, affordability, and accessibility. AI-driven solutions can optimize existing energy grids, improve grid stability, and enhance energy efficiency by dynamically managing supply and demand. AI-powered microgrids also provide decentralized energy access in remote areas, benefiting communities and essential services like healthcare.

Implementation steps for AI integration in renewable energy:

1. Data infrastructure development: Establish standardized protocols for energy data collection, storage, and sharing across G7 nations by 2026.
2. AI workforce development: Train 100,000 AI-energy specialists through dedicated academic programs and industry partnerships.
3. Regulatory frameworks: Create common G7 standards for AI application in critical energy infrastructure with emphasis on security and reliability.
4. Testing and demonstration: Fund 20 large-scale demonstration projects of AI-optimized renewable energy systems across diverse geographic regions.
5. Knowledge dissemination: Create an open-source repository of AI applications for renewable energy with documentation and implementation guides.

Additionally, AI-integrated storage systems can boost resilience against extreme weather events. However, innovation in this field requires supportive policies, data security measures, and cross-sector collaboration. Governments and industries must create frameworks that foster AI-driven advancements while addressing socio-economic barriers to equitable energy access (Meddeb 2024).

Conclusion: Advancing SDG7 and Green Economic Growth

The strategic importance of renewable energy extends beyond environmental considerations to encompass critical geopolitical and economic dimensions. By advancing the policy recommendations in this brief, G7 nations can simultaneously:

1. Enhance their own energy security and reduce dependencies on volatile energy imports.
2. Stimulate sustainable economic growth through high-value technology sectors.
3. Reduce competition for Critical Raw Materials through coordinated investment strategies.
4. Create resilient trade relationships cantered on mutually beneficial clean energy exchanges.
5. Generate widespread socioeconomic benefits in developing regions through increased energy access.

The path to a sustainable energy future requires an integrated, collaborative approach that transcends traditional economic models. Technological innovation, progressive policy frameworks, and genuine international cooperation can reshape the global energy landscape. While geopolitical tensions with some countries present challenges, they also emphasize the strategic importance of G7 nations developing diversified renewable energy supply chains and technology leadership positions. Rather than competing directly with China's established manufacturing scale advantages, G7 nations can focus on next-generation innovations in areas like advanced materials, AI integration, and systems optimization where they maintain competitive advantages.

The next decade is critical. Coordinated action, substantial investments, and unwavering commitment can accelerate the global transition to sustainable energy systems. G7 nations must lead by example, demonstrating that economic prosperity and environmental sustainability are complementary objectives.

Author Biographies

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Syed Munir Khasru is a global thought leader with more than a decade of involvement in G7 and G20 communities. He has led around 25 policy briefs and co-chaired task forces for both the G7 and the G20. An M.B.A. from the Wharton School of Business, University of Pennsylvania, Syed founded and successfully built two world-class institutes in the global knowledge industry: the international knowledge outfit the Institute for Policy, Advocacy, and Governance (IPAG) and the international management consulting firm e.Gen Consultants Ltd.

Under his leadership, IPAG has become a well-respected international knowledge outfit from the developing Global South, addressing global challenges in key policy and strategy in areas such as geopolitics and multilateral affairs, sustainable development and green growth, climate change and energy transition, digital transformation and cybersecurity. His innovative approach has seen leveraging a policy-focused knowledge outfit (IPAG) with a project implementation wing (e.Gen), creating a unique synergy in the global knowledge industry. Syed's active engagement with international forums such as the G7 and the G20 and multidisciplinary expertise have enabled him to lead from the front in translating policies into practices and strategies into impactful solutions on a global scale.

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