

ENERGY TRANSITION PROCESS: RENEWABLE ENERGIES, SOCIAL AND ECONOMIC CONSIDERATIONS
Task Force 3 - S20 Brasil 2024

This is a Chair's summary of S20 Brasil 2024 discussions; the positions are not necessarily shared by all S20 members.

Preamble

In September 2015, at the United Nations Headquarters, representatives of 193 countries approved a global agenda to be achieved by 2030. The signatory countries recognized that to make our planet suitable for sustainable living, we urgently need to take action on the 17 Sustainable Development Goals (SDGs). Among the most important identified was eradicating poverty in all its forms and dimensions, including extreme poverty, which is the greatest global challenge and an indispensable requirement for sustainable development. Bold and transformative measures were outlined, with our governments committing to embrace them to steer the world towards a sustainable and resilient path. These actions are integrated and indivisible and must balance the three dimensions of sustainable development: social, economic, and environmental. Science and international scientific collaboration serve as key mechanisms to reach these goals. With this standpoint, under the motto “Science for Global Transformation”, the S20 Academies of Sciences met in Rio de Janeiro in 2024, and focused the discussions on five themes related to the UN 2030 Agenda: (1) Artificial Intelligence; (2) Bioeconomy; (3) Energy Transition Process; (4) Health Challenges; and (5) Social Justice.

We present to the G20 governments and society the S20 Brasil 2024 recommendations with the expectation that these will be considered by our governments and help guide the final document of the G20. We also draw attention to the fact that G20 countries should consider their demographic trends, proactively anticipating and adapting to changes in their workforce size and age distribution, as these factors will significantly impact social security, pension systems, health and welfare programs, thereby affecting economic growth and competitiveness. It is essential for the educational system to address the diverse needs of both aging and youthful populations. Grasping social and demographic trends is essential for anticipating technological requirements and driving innovation.

Introduction

Goal 7 of the Sustainable Development Goals (SDGs) points to the need to ensure access to affordable, reliable, sustainable and modern energy for all. An energy transition is essential for achieving this goal, representing a crucial shift in how we generate and consume energy without carbon emission, driven by the global imperative to combat climate change, address resource depletion, enhance energy security and market stability. At its core, the energy transition involves moving away from fossil fuels to solutions minimizing the CO₂ emissions in integrating a significant proportion of sustainable and renewable energy into the energy mix and moving to less energy-intensive processes and products. This different transition pathways not only promises to reduce our environmental impact, but also carries significant social and economic implications. The overall efforts to decarbonize energy production currently rely on the increasing use of low-carbon energy sources including both nuclear and renewable energies, in a mix that varies from one country to another. Here the main focus is on enhancing the contribution of renewable energies, for its rapid deployment and long-term possibilities.

As a result of COP28, many countries made a strong commitment to triple sustainable and renewable energy capacity and double energy efficiency by 2030, moving away from fossil fuels. Renewable energy, encompassing sources like solar, wind, and hydropower, is key in our pursuit of a sustainable energy future. Unlike finite fossil fuels that contribute substantially to greenhouse gas emissions, renewable sources are characterized by their abundance and reduced environmental impact. Additionally, the integration of carbon capture and storage technologies to remove CO₂ from hard-to-abate sectors is crucial to mitigate their environmental impact during the transition to a fully decarbonized energy future.

The utilization of hydrogen and biofuels, introduces an additional perspective to the renewable energy landscape. Hydrogen, with its versatility and clean potential, can be produced through various decarbonized methods, including but not limited to electrolysis or by reforming natural gas with carbon capture, utilization and storage.

Its significance lies in its capacity to store and transport energy efficiently, making it invaluable for mitigating the variability of renewable sources like wind and solar power. Hydrogen also holds great potential for decarbonizing sectors like transportation and heavy industry. In industries such as steel manufacturing, hydrogen can replace carbon-intensive processes, resulting in substantial reductions in greenhouse gas emissions. However, since it's a vector rather than a source of energy it has to be considered only when no other sources can be used. Green ammonia and green urea for fertilizer industries can nurture robust agricultural practices, enhancing the resilience of food systems through sustainable practices that align with energy transitions and fostering a collaborative approach to economic and environmental challenges. Biofuels, derived from organic materials like crops, algae, and waste biomass, provide a renewable and low-carbon alternative to fossil fuels and can be used in existing internal combustion engines with minor tweaking. Ethanol and biodiesel, for example, are already widely used to decrease the carbon footprint of the transportation sector. An increase in the use of biofuels should move to the utilization of second and third generations involving less competition with food and more use on non-alimentary source of carbon.

Ocean energy sources, including tidal, wave, and ocean thermal energy, should also be considered to generate electricity. These sources have the advantage of being predictable, as ocean tides and waves follow natural patterns and the ocean thermal energy is reasonably constant. While the ocean's potential energy is enormous, substantial investments are still required to yield energy competitively.

Perspectives on Energy Transition Pathways

Incorporating hydrogen, biofuels, and ocean energy into the energy transition contributes to diversifying the energy mix and achieving a more sustainable and resilient future. These technologies, together with batteries, complement traditional renewable sources like solar, wind and hydropower, offering energy storage, transportation, and baseload power generation solutions. Moreover, the energy transition can foster energy independence. Renewable energy sources are more evenly distributed globally than fossil fuels, which are often concentrated in specific regions. This decentralization of energy production helps reduce dependence on a few energy-exporting countries, enhancing energy security and reducing geopolitical tensions.

A significant economic benefit of the energy transition is job creation. The renewable energy sector has emerged as a source of employment opportunities, from the manufacturing and installation of renewable energy systems to their ongoing maintenance, research and development. Including all stakeholders in the transition process, particularly marginalized communities, ensures that employment benefits are equitably shared, enhancing social acceptance and support for the initiatives. These opportunities extend beyond highly industrialized nations, contributing to local economies, deployment of skilled manpower and fostering growth in regions that need it the most.

The transition to renewable energy sources also drives technological advancements. As governments and businesses invest in research and development, efficiency and innovations in energy storage and grid management become more prevalent. Technological breakthroughs not only benefit the energy sector but also have far-reaching impacts on industries and society, addressing the technology divide between developed and developing nations through technology transfer agreements and capacity-building initiatives.

Social considerations are important in the energy transition. It is crucial to ensure that everyone has access to sustainable, clean, affordable and reliable energy, addressing the persisting issue of energy poverty in many parts of the world. The transition offers an opportunity to rectify this imbalance and uplift people from poverty; monitoring per-capita energy consumption in urban, peri-urban and rural areas would allow precise numbers to follow the decrease in imbalance. Social and public perception is essential to foster widespread acceptance and support for the transition. Working with legislators is also necessary ensuring regulatory frameworks conducive to innovation and deployment.

Community engagement is another crucial dimension of the transition. Renewable energy projects often take place at the local level, providing communities with the chance to be actively involved and empowered. Community-owned renewable energy projects enable residents to have a stake in their energy production, and share the benefits. These projects provide economic benefits and enhance social cohesion and collective ownership, reinforcing the transition's social foundation, based on the business model.

A fair deal to all types of stakeholders is critical in the energy transition process. As we move away from fossil fuels, it is essential to consider workers in the fossil fuel industry. A just transition involves providing support, retraining to address changing skill demands, and alternative employment opportunities for those affected by the decline of fossil fuel industries. Environmental justice is another important issue in the energy transition. Vulnerable communities have historically borne the brunt of pollution and environmental degradation associated with fossil fuel production. The transition to renewable energy can help rectify these injustices by reducing pollution and protecting marginalized communities.

The renewable energy sector has the potential to stimulate economic growth. Direct job creation is just one facet of this potential growth, as the industry also stimulates demand for materials, equipments, and services. However, it is crucial that all countries participate in ambitious climate policies, otherwise economic growth could be hampered in those countries that take the lead and implement climate measures.

Likewise, the energy transition reduces the economy's vulnerability to price volatility and supply chain risks. By diversifying the energy mix, economic resilience can be enhanced reducing the impact of global energy market fluctuations. The variability of certain renewable energy sources, such as wind and solar power, depends on weather conditions, which can be unpredictable. This variety of sources presents several opportunities for developing new technologies in energy storage, materials recycling and grid infrastructure.

Political and regulatory obstacles need to be addressed to avoid hindering the energy transition. Overcoming these obstacles requires strong political will and the development of supportive regulatory frameworks. The continued increase in greenhouse gas emissions indicates the limited success of previous approaches and calls for more effective strategies, including market-based global approaches, and the growing importance of capture, storage and removal of greenhouse gasses from the atmosphere. Implementing the energy transition will require monitoring systems to understand and guide the achievements in reducing emissions.

Social acceptance is essential. While many communities embrace renewable energy projects, others may resist them due to concerns about aesthetics, noise, or impacts on property values. Public outreach, education and stakeholder engagement are needed to address these concerns and gain community support.

Challenges

Coal is the most carbon-intensive fossil fuel and needs to be phased out of the energy system. Currently, coal still contributes just over a third of global electricity generation. Deployment of carbon capture and storage technologies should be further promoted. As the world moves towards phasing out coal from the energy system, alternatives to coal in iron and steel production must be urgently sought, mainly through coke production process. Direct reduction of iron using hydrogen, electric arc furnaces using renewable sources, and hydrogen-based steelmaking are examples of technologies that can be employed.

Adoption of a diverse set of renewable generation technologies, such as solar and wind, critically depends on the efficient storage, so energy storage technologies like batteries, supercapacitors, water electrolyzers for green hydrogen generation, or compressed-air energy stored need to be affordable. Several innovative, yet inexpensive nanomaterials have been developed recently, so that solar and wind generation can be made easily dispatchable. Geothermal energy has a large potential and also could represent a valuable source for generating electricity “on demand”, to be used when the wind speed is not strong and the sunshine is absent.



The need for low and zero carbon fuels to power transportation sources such as aviation, shipping and long-distance land transport of goods by trucks and trains should also be addressed since this represents an opportunity for development of synthetic fuels produced with renewable energy.

Final Remarks

The key elements for sustainable energy systems are available. Research and technological developments in bioenergy, ocean energies, solar energy, wind energy, geothermal energy and other emerging renewable energy sources are essential to further advancing the energy transition as well as energy efficiency. These fields hold significant potential for providing sustainable and resilient energy solutions that can replace fossil fuels and reduce greenhouse gas emissions. Continued innovation and investment in these areas are crucial for achieving a cleaner and more sustainable energy future.

Energy transition is driven by the need and the will to address climate change, enhance energy security, create economic opportunities, and yield social and environmental justice. While challenges exist, the benefits of the energy transition far outweigh the obstacles, offering a pathway to a sustainable and resilient future. This transition is not just a necessity; it is an opportunity for a better world for all. To ensure the success of these initiatives, it is important to establish an ongoing international dialogue that facilitates regular updates and the sharing of best practices among nations. This collaborative approach should not only focus on technological innovation but also prioritize harmonizing regulations and fostering global partnerships that leverage collective strengths.