

Climate Governance, the G20, and Renewable Energy Transition: Assessing the Role of the International Solar Alliance

Ninaad Ghoshal¹, Sanjay Kumar Pradhan^{2*}

¹Ph.D. Scholar, School of Liberal Studies, Pandit Deendayal Energy University, Gandhinagar, Gujarat, India

²Associate Professor, School of Liberal Studies, Pandit Deendayal Energy University, Gandhinagar, Gujarat, India

Email ID: sanjaypradhanjnu@gmail.com

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ABSTRACT:

Climate change has increased the need for and the search for sustainable energy pathways for all major developing economies globally. The Group of 20 (G20) nations are currently responsible for the major part of global emissions for greenhouse gas emissions and economic activity. The G20's nations have a very vital duty in Climate Laws globally, with focusing on the transition to renewable energy systems.

The Current Study understands the role of the green energy complex and also lays importance on solar energy as a method to answer the challenges posed by climate change, with focus on the International Solar Alliance (ISA) as an avenue for global cooperation in renewable energy deployment.

The Study has been conducted through qualitative policy analysis using data from secondary sources, including international agencies and organisations, government reports, and academic literature. The study explores how G20 member states engage with one another on renewable energy initiatives and how the ISA facilitates cooperation in solar energy development. The initial results of this paper have shown that despite the G20 members making progress in the renewable energy sector, there are still significant challenges that are present due to uneven implementation of policy and commitment, political and economic hindrances, and limitations of institutional capacity. Collaboration between G20 and ISA are vital to increase international climate governance.

Keywords - Climate governance; G20; energy transition; solar energy; ISA

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Introduction

The growing effect of Climate change has become a major global issues of the modern era. Growing global temperature, the extreme

weather events, and hastening environmental degradation have raised deep debate about the viability of current economic and energy systems. Evidence collected from Scientific research

indicates that anthropogenic greenhouse gas emissions—primarily from fossil fuel combustion—are the principal drivers of global warming and climate change (Dhanasekaran et al., 2026)

Since the Industrial revolution, there has been an increasing demand for fossil fuels thanks to the rising needs of the people to sustain itself on earth. As a result, since the boom of the fossil fuels era has seen a rising need for fuels like Oil and natural gas but as a result seen an increase in greenhouse gas emissions and have contributed significantly to environmental degradation and climate instability. As a result, governments, international organisations, and policy experts are increasingly recognising the need to transition to low-carbon energy systems, with many international agreements and treaties being discussed over the period of three decades.

The most important breakthrough in the arena occurred during the 2015 Conference of Parties meeting in Paris, leading to the formation of the Paris climate compact of 2015, establishing a global frameworks to limit global temperature increases to well below 2 degrees Celsius above pre-industrial levels, while pursuing efforts to limit warming to 1.5 degrees Celsius.

Within the Same architecture, the Group of Twenty (G20) has emerged as a vital forum for addressing global environmental and economic challenges. The G20 represents almost 70% of major economies and collectively accounts for a large amount of greenhouse gas and energy consumption. Hence it becomes vital to examine the policies adopted by G20 member states, creating significant implications for global climate mitigation efforts.

Renewable energy has become a major component of climate change strategies. With Advancement in Renewable mainly Hydroelectric, Solar, Wind and Bioenergy provide alternatives to traditional fuels and help in creating sustainable energy for a long time due to its technological advancements and declining costs

Understanding the growing importance of Solar Energy, The International Solar Alliance was

launched as a major initiative alongside the 2015 Paris Treaty Conference. Led by India and France it's major aim is to foster solar energy cooperation among countries with high solar potential and facilitate International cooperation and Renewable energy growth.

This Article Examines Cooperation between the institutions of G20 and International Solar Alliance and focuses on solar energy and how it can contribute to global climate change and help towards a sustainable energy system's

Research Methodology

The Study has used a qualitative research design to examine global climate governance, non-traditional energy transition, and the role of the International Solar Alliance (ISA) within the goals set by the Group of Twenty (G20). The key focus of the study is on understanding how international institutions and multilateral cooperation mechanisms contribute to renewable energy development, especially solar energy, in response to climate change. Given the complex nature of global climate regime and the multidimensional nature of the energy transformation, a qualitative policy analysis of governance is considered appropriate to understand institutional interactions, policy commitments and mechanisms for international cooperation.

The research specifically relies on secondary data collected from a range of academic and organizational sources. They include policy reports, publications by international organizations, government policies, and journals that publish academic and statistical data on renewable energy development and climate governance. Major institutional sources include reports from the International Energy Agency (IEA), the International Renewable Energy Agency (IRENA), the United Nations Framework Convention on Climate Change (UNFCCC), and the International Solar Alliance. Such sources provide reliable data on renewable energy capacity and also policy commitments on climate change and cooperation among G20 member states. Additionally, peer-reviewed

journals add more theoretical support and analytical depth to the study.

The Study uses a comparative policy analysis to evaluate renewable energy policies and climate commitments among the selected G20 countries. The primary reason for choosing the G20 as the analytical framework is that its member states account for the majority of greenhouse gas emissions across the global order. Therefore, there is a need to analyse the climate and energy policies adopted by these countries and what implications they have on global climate mitigation efforts. The analysis focuses on how G20 members have approached the development of renewable energy, primarily Solar Energy, and on how national policies align with broader international agreements, such as the 2015 Paris Agreement.

The analysis focuses on three major dimensions. Firstly the Paper focuses on the alternative energy policy and climate Commitments of G20 member states. This also covers a a understanding of each members enegy policies and Climate commitments. The study also focuses on understanding the stratagies used for climate change and the renewable energy targets and long term goals towards decarbonisation. Also,focus has been made on the national pledge toward zero carbon and renewable energy expansion These policy commitments will be studied to find similarities and and differences in national approaches toward climate change goals.

Second, the research examines the role of the International Solar Alliance's institutional role in global solar energy cooperation. The ISA represents a new modern global initiative aimed at fast-tracking of solar energy growth through global partnerships.The study evaluates the ISA's mission and vision, it's organisational structure, and operational methods to understand how it facilitates cooperation among member countries. This analysis also examines key ISA programmes including technology transfer programs, financial mobilisation strategies, and capacity-building projects, to understand the expanding solar energy strctures in developing countries.

Third, The Study attempts to understand the Socio-economic and political factors and institutional factors that effect the successful adoption of alternative energy across the G20 Nations. These challenges included dependence on traditional fuels , disagreement among member states on climate goals, financial challenges and technological limitations in renewable energy infrastructure. By understanding these factors, the study seeks to understand the structural barriers that limit the effectiveness of international renewable energy cooperation.

In order to deepen the analytical framework of the research, we have taken insights from global climate governance theory and energy transition theory. These theoretical perspectives provide a theoretical understanding of how international bodies shape state assistance in addressing complex global environmental problems. Climate governance theory emphasises the importance of organisational cooperation and multilateral deals in managing global environmental challenges. In contrast, energy transition theory explains the structural shift of energy systems from non-renewable production toward renewable energy sources.

Although the studies allow for very deep insight into the complex relationship between the G20 and the International Solar Alliance, certain limitations should be acknowledged. The study relies solely on secondary data sources and therefore does not include primary data collection, such as interviews or field surveys, due to a lack of an appropriate resource person to provide accurate data and opinions on the issue. Additionally, the analysis focuses on selected policy frameworks and institutional initiatives rather than conducting a comprehensive empirical evaluation of renewable energy projects across all G20 countries. Despite these limitations, the qualitative approach adopted in this research enables a comprehensive examination of the institutional dynamics and policy frameworks shaping renewable energy cooperation.

Overall this research method focuses on the understanding of the international organisations, especially Cooperation among the G20 member countries. By using comparative comparison of policies this research method attempts to evaluate the role of International Solar Alliance and the G20 to ensure energy transition and challenges faced by Climate change

Literature Review

The Importance of climate change has brought extensive academic discussion in climate governance, renewable energy methods and the role of International organisations in ensuring collective action. The literature on this is vast and very intensive, and much care has been taken to ensure that the key areas vital to this study are Global Climate Governance, Renewable Energy Transition and International Cooperation in the renewable energy sector. Have been extensively covered.

Global Climate Governance

The concept of global governance focuses on institutional order, corporation, and policy mechanisms that coordinate international responses to climate difference. Early scholars in the field have focused on the formation of such environmental orders, particularly within the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. Scholars such as Young (1995) and Keohane (1988) have studied how international organisations can facilitate a framework for partnership among nation facing collective challenges These Studies work focused on the importance of institutional frameworks in addressing global environmental challenges that transcend global boundaries.

Subsequent research has evolved the nature of climate governance. Victor (2011) argue that climate governance has been characterised by a “Regime Complex,” where multiple overlapping institutions address different aspects of climate change rather than relying on a single authority. The fragmented governance system includes international treaties, regional organisations, financial institutions and multilateral forums that collectively shape global climate policy.

Falkner (2016) has argued that the Paris Agreement represents a significant shift in global climate governance. Unlike the Kyoto Protocol, which has imposed binding emission-reduction targets on developed countries, the Paris Agreement focuses more on a “bottom-up” approach based on nationally determined contributions (NDCs). This shall allow all member countries to set their own climate targets while encouraging cooperation and transparency. The Paris Agreement establishes a more inclusive and adaptive framework for climate change, enabling broader participation by both developed and developing countries.

In this context, major economic forums such as the Group of 20 (G20) have become increasingly vital in global climate governance. The G20 represents the world’s largest economies, accounting for approximately 80% of global greenhouse gas emissions. As a result, policy decisions made within the G20 influence the trajectory of Global Climate mitigation efforts. Scholars have increasingly examined the G20's role in shaping climate governance, energy policies, and international cooperation.

Renewable Energy Transition

Another area of research concern comes from the transition from a fossil-fuel-based economy to a renewable energy-based economy. Energy transition theory examines the structural transformation of the energy system driven by technological innovations, economic incentives, and environmental concerns. According to Sovacool and Geels (2017), energy transitions are complex socio-technological processes involving changes in energy production technologies, infrastructure, policy frameworks, and consumer behaviour.

Renewable energy technologies are now becoming central to climate mitigation strategies due to their potential to reduce greenhouse gas emissions and produce sustainable economic development. Solar energy has advanced rapidly in terms of technology and cost reduction over the last decade. According to the International Renewable Energy Agency (IRENA, the cost of producing photovoltaic cells has reduced

significantly, making it a competitive renewable energy alternative for energy generation

Scholars have also examined the political and economic factors that affect renewable energy adoption. Geels (2018) argues that the dynamics of technological innovation, policy dynamics, and societal pressure shape energy transition issues. Governments play a vital role in promoting renewable energy development through policy instruments such as subsidies, feed-in tariffs, tax incentives and research funding.

However, despite significant progress in energy deployment. Several challenges remain. Many countries are still heavily reliant on fossil fuels due to economic dependence on existing energy infrastructure and industries. Additionally, the integration of renewable energy into the national energy grid requires investing in storage and grid infrastructure. These challenges highlight the need for stronger cooperation internationally and institutional support for accelerated renewable energy transitions.

International Institutions and Renewable Energy Cooperation

A new segment of literature has examined the role of international institutions in the role of promoting renewable energy cooperation. The Institutional cooperation theory suggests that International organizations can create a collaborative mechanism among states by reducing the cost of transactions, assisting with data exchange and establishing norms for collective actions. In the case of climate change mitigation, International institutions play a crucial role in coordinating policies and the mobilisation of financial assistance and resources for energy development.

The establishment of the International Solar Alliance (ISA) in 2015 is representing a significant development in renewable energy coordination. Led by India and France during the Paris Climate Conference, The ISA focuses on promoting solar energy production and development among countries with high energy potential. The alliance's primary focus is on facilitating solar technology transfer among member states, mobilizing financial resources and supporting

capacity building initiatives for solar energy infrastructure.

Many scholars have laid emphasis on the significance of such initiatives in addressing energy access and climate mitigation. Dubash et al. (2018) argue that emerging institutions like the ISA does represent an innovative approach to global climate governance by focusing on specific arena of energy sector and technologies. By promoting solar energy deployment in developing countries, The ISA contributes to both climate change mitigation and sustainable development goals.

Apart from the ISA, multilateral forums like G20 have also begun to incorporate renewable energy issues into their policies for discussion. The organisation has also launched various policies and initiatives aimed at promoting energy efficiency, renewable energy investment and sustainable development. However, scholars have pointed out that effectiveness of these initiatives as required mostly dependent on policies commitments and effective compliance to these policies by member states Mishra (2024) Argues that International Solar Alliance is a way for fostering South-South corporation and creating a alternative world order for renewable energy and energy transition goals. He also argues that by using institutions like ISA, India can set an benchmark for becoming an global renewable energy leader soon.

Despite many scholars appreciating the role of the International Solar Alliance some scholars have been critical of effectiveness of a global organization like the ISA. Khan and Hussein (2023) have argued that the International Solar Alliance despite being an strong institution faces structural challenges which is due to lack of interest from other member states and also due to duplication of duties performed by other International Organization like IRENA and IEA.

Intersections between G20 Governance and Renewable Energy Initiatives

Recent studies have explored the intersection between global economic governance and climate policy. Since the G20 member states

count for majority of global emission and consumption of energy the policies made by these group of nations play a role in determining the pace of global energy transitions. Several studies have highlighted that coordination among the G20 members could significantly accelerate renewable energy adoption and reduce global carbon emissions.

At the same point the research studies also identified challenges to collective action within the G20. Differences in economic structures, level of development priority over energy may result in diverse and divergent policy approaches. For instance whilst some G20 members have aggressively expanded energy capacity many have still remained dependent on fossil fuels production and consumption. Such disparities create obstacles for a unified climate policy.

The emergence of institutions like the International Solar Alliance presents and new opportunity for bridging these gaps. By focusing on solar energy corporation, The ISA can provide a targeted mechanism by promoting renewable energy adoption across both developed and developing countries. The interaction between G20 and ISA thus can represent an important area of inquiry within broader scholarly literature on global climate governance.

Research Gap and Questions

Despite the extensively scholarship on climate governance and renewable energy transition, there are major gaps which are remain in the current existing literature which has been reviewed for this study much of the research done on global climate governance focuses on major international agreement like the UNFCCC and the Paris Agreement whilst these studies provide an valuable insight on global climate negotiation they often overlook the role of emerging institutions and sector specific initiatives made by member states on facilitating renewable energy

Similarly, research on renewable energy transition tend to focus more on National policies and technological innovation, and market dynamics. Though these studies focus on importance of domestic policy framework, they often pay

limited attention on role of multilateral institutions in promoting multilateral institutions and international corporation for Renewable energy development

Further, several studies examine the role of G20 in a new economic order, there are very sparse analysis on how G20 interacts on managing Renewable energy initiatives such as International Solar Alliance. The relationship between the two institutions remain underexplored particularly in solar energy corporation and climate mitigation

Therefore a need for research which integrated the study for global climate governance and renewable energy transition and corporations among institutions, Specifically how the G20 and International Solar Alliance interact to promote renewable energy deployment can promote valuable insights into evolving architecture into evolving architecture of climate governance.

Based on the identified research gap, this study seeks to address the following research questions:

1. How do G20 countries contribute to global climate governance and renewable energy transition?
2. What role does the International Solar Alliance play in promoting solar energy cooperation among member states?
3. How can collaboration between the G20 and the International Solar Alliance accelerate renewable energy deployment and strengthen global climate governance?

Theoretical and Analytical Framework

The study draws upon theoretical perspectives from global climate governance and energy transition theory to analyse the role and duties of international institutions in promoting renewable energy corporations. Global climate governance refers to the network of institutions, agreements, and policy mechanisms designed to coordinate international responses to environmental challenges. Keohane and Victor argue that climate governance operates through a fragmented institutional system rather than a single centralised regime. This fragmentation allows states to cooperate through multiple institutional arrangements, creating opportunities

for flexible responses to complex environmental challenges.

Energy transition theory focuses on structural transformations in energy systems from fossil-fuel-dominated production toward renewable and low-carbon energy sources. Technological innovation, policy frameworks, economic incentives, and international cooperation drive this transition. Renewable energy technologies play a central role in reducing carbon emissions while supporting sustainable economic development.

Just energy aligns with the seventh goal of the Sustainable Development Goals, which states, “Affordable and clean energy to all”. The main aim of the goal is to ensure that energy is available to all in a manner that is clean and does not harm the environment. It can also be accessible to all people in an affordable manner, making energy accessible. The core idea of just energy meets the idea that its principal aim is to ensure that energy is made in such a manner that it is clean and affordable to all. Though the primary energy sources supported by the idea are clean, the primary support is all the renewable energy source .(Melgar-Melgar & Burke, 2021).

Within this framework, international institutions such as the International Solar Alliance facilitate cooperation among countries seeking to expand renewable energy capacity. By promoting technology transfer, financial cooperation, and capacity building, these institutions help accelerate renewable energy transitions.

Results and discussions

G20 Climate Commitments and Renewable Energy Transition

When we analyse the Climate commitment of the Group of Twenty (G20) members, we are presented with a very complex and uneven pattern of growth and progress for the renewable energy transition. Whilst the G20 economies account for over 80% of global greenhouse gas emissions, making them a central actor in climate change mitigation efforts (IRENA, 2022). Thus, these economies have a significant role in

influencing the trajectory of global energy transitions and climate governance

Many G20 members have adopted renewable energy targets and decarbonisation strategies since the Paris Agreement of 2015. But implementation levels differ among members for various reasons. Whilst some nations, like Brazil, have led the way, with renewable energy accounting for 88% of the national average (Neves, 2025). This is mainly due to Brazil's attempt to pioneer by advancing its renewable energy policies, adopting measures such as Law 10,848/2004, which discusses the nationalization and commercialization of electricity across the national capital. Furthermore. Law No. 14,120/2021 and ANEEL's Ruling No. 1,031/2022, which address the reduction of tariffs for the use of distribution and transmission systems for hydropower, solar, wind, biomass or qualified cogeneration energy projects (*Energy Laws and Regulations 2026 | Brazil*, 2025). Furthermore, nations like South Africa are currently lagging behind in renewable energy. Despite having vast areas suitable for renewable energy, South Africa's current renewable energy capacity is only 17%, just above the global average of 15%. (Ember, 2025)

India, China, the United States, Japan, and the European Union are seen as global contributors to renewable energy development, especially in solar energy. India has reached 217.43 GW of renewable energy capacity by 2024-25 (Press Bureau of India, 2025), while China currently has about 1,889 GW, according to state reports issued by the respective governments. (Xinhua,2025.) Solar Energy has expanded due to rapid advances in solar technology, reducing photovoltaic costs and supporting government policies, according to the International Renewable Energy Agency (IRENA). Global solar capacity has increased dramatically over the past decade, making solar power one of the fastest-growing energy sources worldwide (IRENA, 2022).

To better understand the distribution of solar energy capacity among G20 members, Table 1 provides a comparative overview of installed

solar power capacity across major G20 economies.

Table 1: Installed Solar Power Capacity among Major G20 Members

Country	Installed Capacity (GW)	Solar Global Rank	Share of Total Electricity (%)
China	430+	1	~16%
United States	180+	2	~6%
India	75+	3	~7%
Japan	85+	4	~10%
Germany	80+	5	~12%
Brazil	40+	6	~8%
Australia	35+	7	~15%
Italy	30+	8	~11%
South Korea	25+	9	~7%
France	20+	10	~5%
United Kingdom	18+	11	~5%
Turkey	15+	12	~6%
Mexico	10+	13	~5%
Saudi Arabia	5+	14	<2%
South Africa	6+	15	~4%
Indonesia	1+	16	<1%
Russia	<2	17	<1%
Argentina	2+	18	~3%
Canada	5+	19	~3%

Source: International Renewable Energy Agency. (2024). Renewable capacity highlights 2024. <https://www.irena.org/publications>

The data shows the level of Renewable energy sources among G20 countries, highlighting the disparity between the top nations like China, the United States, and India and the bottom nations like Russia, Argentina, and Canada. This disparity shows that many G20 nations have not taken renewable energy seriously and are lagging behind despite being among the world's strongest economies.

India's rapid expansion in solar capacity reflects a strong policy of support via plans and initiatives such as the National Solar Mission, and solar energy capacity shows a strong initiative via the

National Solar Mission and the broader plan the National Action Plan on Climate Change. Such policies aim to increase renewable energy capacity and reduce reliance on fossil fuels in the long term.(Tagotra & Tagotra, 2022). However, despite increasing renewable energy capacity, G20 countries still account for the majority of global greenhouse gas emissions. Fossil fuels are yet dominating the energy systems of major economies, most with large industrial sectors and fossil fuels reserves

To further contextualize the role of G20 countries in global climate governance, Table 2 provides a comparative overview of greenhouse gas emissions among major G20 members

Table-2: Select Country-wise Emissions

Country	Total GHG Emissions	Global Share (%)	Per Capita Emissions (tCO ₂ e)	Emission Trend (Last Decade)

	(GtCO₂e, approx.)			
China	14.0	27%	9.8	Increasing
United States	6.0	11%	14.5	Decreasing
India	3.4	6.5%	2.4	Increasing
Russia	2.2	4.5%	15.0	Stable
Japan	1.2	2.5%	9.5	Decreasing
Germany	0.75	1.5%	9.0	Decreasing
Brazil	1.3	2.6%	6.1	Fluctuating
Indonesia	1.1	2.2%	4.0	Increasing
Saudi Arabia	0.75	1.5%	18.0	Increasing
South Africa	0.45	0.9%	7.5	Stable
Canada	0.73	1.5%	19.0	Slight Decrease
Australia	0.40	0.8%	16.5	Stable
Mexico	0.70	1.4%	5.5	Stable
United Kingdom	0.40	0.8%	5.5	Decreasing
France	0.32	0.6%	4.8	Decreasing
Italy	0.38	0.7%	6.3	Decreasing
South Korea	0.70	1.4%	13.5	Increasing
Turkey	0.55	1.1%	6.5	Increasing
Argentina	0.40	0.8%	8.5	Stable

Source: international Energy Agency. (2023). CO₂ emissions in 2023: Analysis and data.
<https://www.iea.org/reports/co2-emissions-in-2023>

The emissions data presented in Table 2 demonstrate how the G20 nations have fared in managing global emissions. As per the targets set by the 2015 Paris Peace Treaty. However, the table clearly shows that, despite efforts, there is still a vast gap among G20 members. Many members of the G20, like India and China, have seen rising emissions, which is a matter of concern, as many of these nations, like India, are global leaders in renewable energy and yet are unable to control emissions effectively.

Furthermore, developing countries such as India and Brazil face additional challenges in balancing economic development with environmental sustainability, rapid population growth, expanding industrial sectors, and growing pressure on national energy systems. As a result, such a country must play a role in balancing out energy transitions and economic growth and challenge environmental impacts

Despite these challenges, renewable energy technologies—particularly solar—have become increasingly viable alternatives to fossil-fuel-based electricity generation. Advances in photovoltaic technology and declining manufacturing costs have significantly improved the economic competitiveness of solar energy in recent years (IRENA, 2022).

International Solar Alliance-A Key Driver of Global Solar Revolution

The shift for energy transition has become a crucial pillar of present day globalization, especially in the areas of climate change, geopolitics of energy security, and sustainability. Within this fulcrum, the International Solar Alliance (ISA) has arisen as an important cooperative initiative which has aimed at expanding deployment of solar energy, particularly at the global level. The ISA was established in 2015 at the Paris Agreement, well known as COP21. Largely a joint initiative of India and France, the organization aims at mobilizing solar-rich countries, mostly tropical region countries, to collectively address energy needs and climate change mitigation through large-scale solar technology deployment (ISA, 2023; ICWA, 2022). Initially hypothesized as a

coalition of nations, the ISA has been evolved into an intergovernmental organization with a global partnership, ensuing its constitutional amendment in 2020 to comprise all the interested members of the United Nations (ISA, 2023).

The prime objectives of ISA revolves around increasing energy access, climate change mitigation, and energy security. By promoting solar deployment, particularly in the developing nations, the organization strives to bridge energy access gap and reduce dependency on fossil fuels (Sandwell et al., 2025). The key objective of the organization is intended to mobilize \$1 trillion for solar sector investment by 2030, especially by decreasing price of the equipment, helping risk mitigation, and promoting technological collaboration (ISA, 2023). To fulfil these targets, the ISA has enhanced institutional mechanisms like Global Solar Facility, Solar Technology Application Resource Centres (STAR-C), and other capacity-building programs which are aimed at promoting technical capability and policy frameworks among the member countries (ISA, 2023).

Beyond the climate and developmental objectives, the organization embodies a strategic framework of climate diplomacy. It implies a shift from fossil fuel geopolitics to a decentralized “solar geopolitics” where the countries collaborate on finance, technology transfer, and infrastructure (Yang et al., 2023). The organization has further promoted Global South by facilitating a global platform for the developing states to collectively negotiate for various areas of cooperation in the solar sector. Initiatives like “One Sun, One World, One Grid” (OSOWOG) has further heightened ISA’s objective for creation of interconnected solar energy framework across the regions, and thus enhancing grid stabilization and optimization of energy distribution (NUS-ISAS, 2021).

Parallel to the ISA, the G20 has largely recognized renewable sector, particularly solar energy power, as a pivotal aspect of global governance-both economic and environmental. About 80 percent of the global GDP, energy utilization and GHG emissions, the G20

organization plays an important role in steering global energy transition (IEA, 2022). In the recent years, the G20 summits and ministerial meetings have focused the necessity of scale up renewable capacity, muster climate finance, and accelerate technology transfer in consonance to the Paris Agreement objectives (G20, 2023). Due to the rapid decline of solar energy production costs, scalability and alignment with Nationally Determined Contributions (NDCs) have become pivotal point of discussion today.

The inter-relationship between ISA and G20 implies a wider significance of convergence of technology and political will in the global energy governance. While G20 provides a macroeconomic policy framework and strategy for energy transition, ISA extends an operational forum for implementing of the solar projects, especially in developing states. One of the vital areas of synergy exists in financial mobilization. In fact, the high capital costs alongside investment risks have hindered solar energy deployments in the developing countries; however, the ISA initiatives, backed by G20 institutions like the World Bank, aims to de-risk energy investments and thus attract private participation (Ministry of New and Renewable Energy, 2023). This alignment, no doubt, promotes effectiveness of climate finance and facilitates for larger adoption.

Other important dimensions of ISA–G20 co-relationship is technology transfer and energy capacity building. Advanced economies in the G20 possess a cutting-edge technology, while the developing ISA member countries have huge solar energy resources. Through the collaborative efforts there is the potential possibility of knowledge sharing, capacity development, and institutional arrangements (IRENA, 2023). Moreover, the ISA contributes to strategic policy collaborations by promoting proper regulatory mechanisms and best practices, which in turn, will create a more stable investment environment for all sectors of the renewable energy.

The implication of ISA and its collaboration with G20 can be analysed across multiple dimensions. For example, there has been an increasing

expansion in solar energy capacity, especially in developing countries, backed by ISA-led initiatives and global partnerships (ISA, 2023). Decentralised solar solutions like mini-grids and off-grids, have improved energy availability in rural as well as remote areas, and thus contributing to socio-economic benefits, improved healthcare delivery system, and increased agricultural productivity (Bhattacharya & Ohiare, 2020). The aggregated demand as well as collaborative procurement facilities facilitated by the ISA has contributed to decreased solar technology costs and its competitiveness with the conventional energy sources (IRENA, 2023).

In addition, expansion of solar sector plays an important role in climate change goals by reducing GHG emissions and thus supporting states in reaching their NDC targets under COP21 arrangements (IEA, 2022). At a broader scale, ISA–G20 collaboration strengthens multilateralism in addressing global issues, representing how issue-specific organizations can complement broader governance issues to convey tangible outcomes.

Despite these progress, various challenges exists. The financing gaps, however, remain an important barrier, specifically for the least developed countries which face high appropriating costs and limited capital access. Moreover, while the decentralized solar solutions taken a considerable progress, grid integration alongside infrastructure development poses uneven across the regions (IRENA, 2023). Institutional limitations that include reliance on voluntary obligations and absence of reinforcement mechanisms, constrain the progress of ISA initiatives. Moreover, geopolitical complexities and uneven involvement among the major solar manufacturing companies pose challenges to alliance's long-term impact.

In addition, the ISA represents a ground-breaking model of renewable cooperation which integrates development and environment objectives within the multilateral framework. Alliance's cooperation with G20 enhances its strategic leverage by including solar energy within

the broader fulcrum of global economic and climate governance. Together, these two organisations are shaping inclusive and sustainable shift the renewables, specifically for the Global South countries. Yet, the success of partnership will finally depend on their collaborative effort to address structural challenges that includes finance, technology, skill, and governance, and translating political commitments into commensurate outcomes.

Challenges to Renewable Energy Adoption

The Results of the Research have identified on the basis of the work that there are many challenges in the renewable energy field especially at the structural level which will continue to effect Renewable energy adoption across the G20 member states. These challenges include economics constraints, technological challenges and limitations, systemic institutional barriers which contribute to complication towards transition for low-carbon energy systems.

The major factor which is mainly a challenge is the economic dependence on fossil fields as a barrier for transition towards renewable energy. Many nations have the infrastructure and knowledge to extract fossil fuels which made it readily available for consumption. If we compare that to Renewable energy, it is worth pointing out that there is a significant lack in development and sharing of technology and infrastructure which can make a meaningful impact in making renewable energy as economical in production which can also meet up to the demands of fossil fuels. Thus there is a need to make this possible that countries will need significant policy and economic restructuring to make this happen.

There are significant Challenges which are also present on the technical and technological aspect as well. Solar energy specifically depends on many factors such and solar luminosity, geographical location and weather conditions. The intermittent nature of this power source also means that focus is also needed in storage of energy during times when there is a challenge to solar production. This also means that corporation is required among those who have such technology and those who do not, but the

ISA has been unable to create an consensus among such group mainly due to lack of trust among member

Technological challenges also affect renewable energy deployment. Solar energy generation depends on sunlight availability, which can vary depending on geographic location and weather conditions. The intermittent nature of solar power requires investment in energy storage technologies and advanced grid infrastructure to ensure stable electricity supply.

Public acceptance represents another important factor influencing renewable energy adoption. In some cases, communities resist renewable energy projects due to concerns about land use, environmental impacts, or financial costs. Governments therefore often rely on policy incentives such as subsidies, tax benefits, and regulatory support to encourage the adoption of renewable energy technologies.

These findings highlight the importance of international cooperation in overcoming barriers to renewable energy transition. Institutions such as the ISA can play a crucial role in facilitating policy coordination, technology sharing, and financial support for renewable energy development.

Conclusion

The Study highlights the shifting relationship between the climate governance, energy transition and cooperation between international institutions. While climate change continues to be a major challenge in the twenty-first century, it requires coordinated actions globally to reduce greenhouse gas emissions and Shifting transitions toward sustainable energy systems.

The G20 Nations have a major role in climate governance, majorly due to its economic influence and it's significant share of global emissions. The policies which have been adopted by the G20 Nations play a decisive role in determining the trajectory of Global climate mitigation efforts. While there has been significant amount of contribution among the G20 members on climate commitments and focusing on renewable energy targets, the

progress towards the goal of decarbonisation has yet to reach a homogeneous pattern.

The economic dependence on traditional fuel systems, domestic considerations and challenges in the technological front still dominate the National energy policies of many member states. In many areas, concerns of economic growth and security of energy has led governments to adopt cautious approaches toward climate commitments. This shows the complex relations and ensuring the balance of economic growth and environmental protection

In the larger arena, renewable energies, especially solar has become a major part of the strategies for climate change. In this border context, renewable energy technologies, especially solar energy has become key components for climate change strategies. Solar energy offers several advantages as an alternative energy source, including its availability, reducing technological costs and the potential to create a decentralised energy creation. As technological costs on installation of such energy sources reduce, solar energy is set to become a major driver in the global energy system.

The International Solar Alliance also represents a major organizational initiative which aims at promoting solar energy cooperation between countries with high solar potential. By assisting in solar energy infrastructure, financial assistance and capacity building. The ISA aims to hasten the development of solar energy across both developing and Developed countries alike.

The Study shows that the ISA, is functioning as a special institutional mechanism in the grander organisational mechanism for global climate change management. The specialised focus on solar energy allows the alliance to address some specific barriers towards renewable energy adoption, and spreading solar energy among other countries.

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However, the impact of the ISA depends on wider international cooperation and stronger participation from major economies. Increased cooperation from G20 countries can majorly enhance the alliance's capacity to expand solar energy deployment and support global climate mitigation efforts.

The connection between the G20 Nations and the ISA shows a promising potential for growing global renewable energy governance. The G20 Nations possess significant financial backing, technological awareness, and the global confluence that could support ISA initiatives. Greater policy cooperation between these institutions could facilitate investment in renewable energy infrastructure and promote the spreading of solar technologies across the global economy.

From a theoretical perspective, this relationship shows the broken state of contemporary global climate governance. Rather than being dependent on a single institution, climate governance operates through a web of overlapping bodies that address different challenges of environmental front. Institutions such as the G20 and the ISA therefore, support each other in addressing the multifaceted nature of climate change.

Moreover, the study point out the importance of institutional supports in facilitating the global shift toward alternatives energy. The collaboration between the G20 and the International Solar Alliance has the potential to fast-track solar energy deployment and strengthen global climate governance. Continued political commitment, technological innovation, and international collaboration are key for addressing the climate crisis and ensuring a balanced energy future.

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