

POWERING THE GLOBE: LESSONS FROM SOUTHEAST ASIA FOR CHINA'S GLOBAL ENERGY INTERCONNECTION INITIATIVE

BY EDMUND DOWNIE
APRIL 2020

CHINA ENERGY AND CLIMATE RESEARCH PROGRAM

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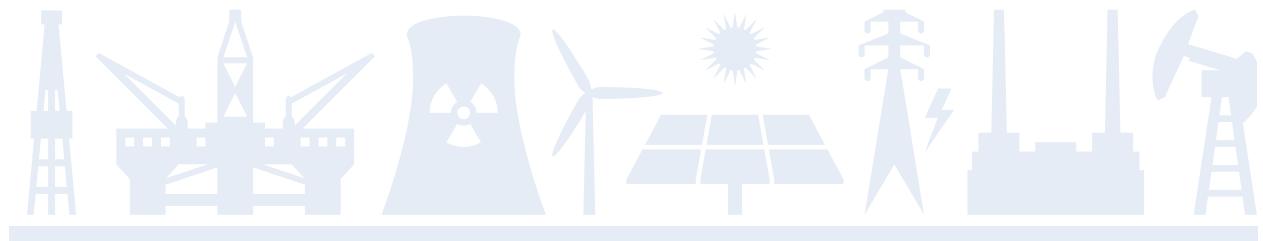
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FOREWORD

Belt and Road Initiative Paper Series

The Belt and Road Initiative is the largest infrastructure initiative ever. From geopolitics to markets to the natural environment, across much of the globe, its impacts are far-reaching. This report is part of the Center on Global Energy Policy's paper series on the Belt and Road Initiative.

In this report, author Edmund Downie examines power trade in the Mekong region and assesses the prospects for China State Grid's Global Energy Interconnection (GEI) initiative catalyzing cross-border electricity trade around the world. It discusses why electric interconnections in the Mekong region have been slow to develop and lessons the region offers for the GEI initiative.

In this series we offer research and commentary on the Belt and Road Initiative and its impacts around the world. We cover a range of energy-related topics and offer different points of view. We welcome submissions for this series. (Please send proposed topics and outlines to energypolicy@columbia.edu.) Our guiding principle is to inform readers with objective, research-based analysis. We hope to contribute to constructive global dialogue on these important topics in the months and years to come.

David Sandalow

Inaugural Fellow and Director, China Program
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EXECUTIVE SUMMARY

China's Global Energy Interconnection (GEI) initiative presents a transformational vision for meeting the world's growing power demand with a globally interconnected electricity grid. The concept involves ultra-high-voltage transmission lines strung across vast distances and smart grid technology tapping large-scale renewable power sources. Chinese President Xi Jinping first touted GEI's goal to "facilitate efforts to meet the global power demand with clean and green alternatives" at the UN General Assembly in 2015.

The ambition of the GEI vision is enormous, especially since there is very little cross-border trade in electricity around the world today. Regional electricity integration initiatives championed by development banks and multilateral organizations have largely struggled against the formidable political, economic and technical complications that accompany interstate electricity trade. China has seen these challenges firsthand in its participation in the Asian Development Bank's Greater Mekong Subregion electricity trade endeavor, which has progressed fitfully since the 1990s amid regional infrastructure gaps and uneven political support from member states.

This report, prepared as part of the Belt and Road Initiative series published by Columbia University's Center on Global Energy Policy, uses a case study of power trade in the Greater Mekong Subregion to assess the prospects for GEI in catalyzing energy integration around the world. It discusses why Greater Mekong Subregion integration has been slow, how GEI might help accelerate interconnection in the area, and what lessons the region offers for understanding the overall outlook for GEI. Based on this study, the author finds the following:

- Establishing a GEI-style global energy grid backbone by 2070 would require overcoming an extraordinary set of political challenges. The global grid outlined by GEI for the coming decades serves more as a demonstration of technical potential than a strict blueprint to be implemented.
- The limited scale attained thus far by the Greater Mekong Subregion project for grid integration and cross-border electricity trading demonstrates the headwinds such multinational efforts can face. Weak internal power sector development in recent decades has left some member states without the generation surpluses and robust power grids necessary to support meaningful levels of trade. In addition, power trade requires a strong degree of interstate political trust, motivated engagement by national utilities, and support from civil society players for the specific generation and transmission projects involved. Integration backers have historically struggled to build consensus across this diverse array of stakeholders.
- While enormous generation and transmission infrastructure projects are core components of the GEI vision and dovetail with the interests of China's domestic proponents, considerable debate persists about their merits for fostering the renewables transition. Ultra-high-voltage transmission, a specialty of Chinese utilities, is a particular flashpoint.



- State interest in cross-border trade has been increasing across many regions in recent years, and more gradual gains in power trade around the world that can aid the renewable transition and bolster regional solidarity are possible. China can contribute greatly to this process: as an investor and contractor in grid projects abroad, as a member state of integration initiatives in Asia, and as an advocate of grid integration in international fora.
- GEI's ultimate impact will depend in part on how advocates within China reconcile tensions between strengthening cross-border power trade and promoting domestic priorities, such as advancing the country's own industrial policy objectives.



INTRODUCTION

On September 26, 2015, Chinese President Xi Jinping gave his first speech to the United Nations General Assembly at its Sustainable Development Summit, where the assembly set out the 17 Sustainable Development Goals that define the UN's development agenda through 2030.¹ The speech listed six steps China would take to aid the “post-2015 development agenda,” including a particularly ambitious vision for the world's energy future: “China will propose discussion on establishing a global energy internet [全球能源互联网 *quanqiu nengyuan hulianwang*] to facilitate efforts to meet the global power demand with clean and green alternatives.”²

Xi's speech gave official backing at the highest level to an initiative that would later be known in English as Global Energy Interconnection (GEI). The GEI concept was first set forward in 2015 by the State Grid Corporation of China (SGCC)—the world's largest utility, and the owner and operator of transmission assets covering 90 percent of China's territory. It envisions a worldwide energy grid that will transmit clean energy across continents, replacing the global trade in fossil fuels with a global trade in green electricity. Its vision for interconnection represents one extension of China's Belt and Road Initiative (BRI) into the electricity grid sphere.

What may be expected of this initiative? The ambition is clear. GEI envisions an 18-line global backbone by 2070 that would span 80 countries and accelerate the displacement of fossil fuels by clean electricity. It would be an improbable transformation for a world where multicountry power-trade schemes have struggled to translate bold blueprints into concrete progress. Over the past several decades, regional organizations and development banks have sought to mobilize support for regional power-trade initiatives throughout the world: South Asia, the Persian Gulf, East Africa, West Africa. But progress has been slow. Outside of a handful of areas—southern Africa, Central America, and (in particular) Europe—regional electricity trade has been characterized by low volumes of trade, little cross-border infrastructure, and minimal institutional integration. State interest in deepening trade has been growing in many parts of the world recently, but these efforts are building on a very limited foundation.

China has firsthand experience with one of these integration projects: the Asian Development Bank's (ADB) Greater Mekong Subregion (GMS) regional interconnection initiative. Power trade has been a part of this initiative since the late 1990s with the support of all six member states—Thailand, Vietnam, Laos, Cambodia, China,³ and Myanmar. Yet power trade comprised just under 3 percent of regional power consumption in 2014. Trade volumes have shown some increase since then, with a number of states signing ambitious MoUs for expanded exchanges. But cross-border transmission infrastructure is restricted, and the region still lacks a power-trading secretariat to coordinate further integration.

This report will describe the forces that have slowed GMS integration and the lessons the region offers for understanding the prospects of GEI. Two factors have hindered power trade efforts in this region. First, weak internal power sector development within member states



has meant that for much of the past two decades, key GMS member states have lacked the generation surpluses and robust power grids necessary to support meaningful levels of trade. Second, power trade is politically an enormously difficult project. It requires strong levels of interstate trust, motivated engagement by national utilities, and support from civil society players for the specific transmission and generation projects involved. Electricity trade advocates have often been unsuccessful with attempts to build consensus across this diverse array of stakeholders.

The trajectory of GMS power trade since the late 1990s highlights one of the biggest challenges that GEI backers face in advancing their global vision. Chinese power companies are major players in grid contracting and investment around the world, taking on projects that will lessen the sorts of grid infrastructure deficiencies hindering regional integration. But scaling interconnection beyond one-off bilateral efforts requires a level of stakeholder consensus around benefit sharing and concessions in state authority that has eluded most regional integration schemes to date, particularly in the Global South.

Against this backdrop, establishing a GEI-style global energy grid backbone by 2070 would require overcoming an extraordinary set of political challenges. The intermediate steps that GEI sketches—trading routes running from Russia to Southeast Asia and from Northeast Asia to Europe by 2035, for instance—are no more straightforward. In these circumstances, GEI's vision may be better regarded as a demonstration of technical potential and as a rallying cry for global action than as strict blueprints to be implemented. Even if they are possible, they may not be desirable. How does a global energy grid backbone square with the improving economics of small-scale “micro grids”?⁴ Will a global grid drive a shift toward clean energy, or will its developers prefer to link up to coal and hydropower megaprojects?⁵

Nonetheless, there is plenty of potential for more gradual gains in cross-border power trade in regions around the world that can aid the renewable transition and bolster regional solidarity. China can contribute greatly to this process: as an investor and contractor in grid projects abroad, as a member state of integration initiatives in Asia, and as an active advocate of grid integration in international forums.

But the nature of this contribution will depend on two tensions in the GEI approach toward interconnection. First, while GEI calls upon countries to expand power trade, China has shown deep reluctance to cooperate within the Mekong region on building the political institutions needed for such trade. Efforts to deepen power trade in other parts of Asia may require a negotiating strategy more open to consensus building and multilateral decision-making than what China has relied on in Southeast Asia. Second, beyond its vision for interconnection, GEI also serves as a vehicle for national industrial policy goals such as strengthening the global standing of China's power sector state-owned enterprises and promoting China's high-tech ultra-high-voltage (UHV) transmission technology. These elements may arouse states' concerns about Chinese influence in their electricity sectors, particularly given debates about the merits of UHV for tackling the challenges of the global energy transition. The ability of GEI and its Chinese backers to build the multilateral coalitions needed for power trade depends on their ability to—indeed, their desire to—reconcile competing priorities in the regions where Chinese interests are active.



This report is divided into five sections:

1. The first section will introduce the GEI vision, from its introduction by the current Global Energy Interconnection Development and Cooperation Organization (GEIDCO) chairman, Liu Zhenya, in 2015 to its most recent regional plans in 2019. It will also describe the challenges that cross-border power trade initiatives have faced over the past decades around the world.
2. The second section will discuss the state of power trade in the GMS today, describing the limited scale of grid integration and cross-border electricity trading between GMS states.
3. The third section will explain the forces that have restricted progress on GMS power trade in the past several decades, emphasizing in particular gaps in political trust.
4. The fourth section will discuss the significance of GEI for power trade in the GMS region. It will describe GEI's potential as a catalyst for investment but also its limits in addressing trust gaps.
5. The fifth section will examine what China's experiences with GMS power trade mean for GEI's prospects in other parts of the world: Asian initiatives where China is a direct participant in proposed power trade regimes, and regions outside Asia where China's contributions would come instead as an investor or facilitator. (There is also a sidebar in this section about the implications of GEI for US policy makers in the context of the US's current strategies on climate and clean energy issues and on United Nations [UN] cooperation.)



GEI: THE VISION

Advocacy for GEI today is led by the Global Energy Interconnection Development and Cooperation Organization (GEIDCO), a nongovernmental organization established in 2016 and sponsored primarily by SGCC. GEIDCO chairman Liu Zhenya founded the organization directly after an enormously influential 12-year stint as chairman of SGCC; he had begun developing the GEI concept in his last years at SGCC, publishing a first comprehensive vision for the idea in his 2015 book, *Global Energy Interconnection*.⁶ During Liu's tenure at SGCC, Liu drove the company's major (and heavily debated) investments in UHV transmission, a technology that significantly reduces the costs of sending electricity over long distances by transmitting it at very high voltage levels.⁷ (The International Electrotechnical Commission, the standard-setting body for electrical technologies, identifies UHV lines as those operating at 1,000 kilovolts (kV) or greater for alternating-current (AC) lines or at ± 800 kV or greater for direct-current (DC) lines.)⁸

As of January 2018, China had deployed 19 UHV lines, all since 2006, and they supplied 4 percent of national electricity demand.⁹ Deployment outside China is much thinner: India has two UHV lines in full commercial operation, and Brazil's utility—owned by SGCC—used Chinese developers to build its first UHV line in 2017.¹⁰ In this way, SGCC and its domestic suppliers are well-positioned to secure a strong market position in any global expansion of UHV deployment.

It is perhaps no surprise, then, that the GEI vision incorporates UHV as one of its pillars in a global transformation of the energy sector to supplant fossil fuels with low-carbon electricity.¹¹ Robust endowments of wind, solar, and hydropower resources are often concentrated in remote and low-demand areas—the steppes of Central Asia, the deserts of the Middle East and North Africa, the gorges of southwest China. They also do not provide the stable flows of power that traditional fossil fuel and nuclear plants offer, a challenge for grid planners in balancing demand and supply. Long-distance transmission can link remote renewables to demand centers to create transnational backbone power lines. These sorts of links could help mitigate renewable supply intermittency by offering diversity of supply: in particular, per the GEI vision, where the links span multiple time zones. For instance, late afternoon solar output in the Middle East could meet early evening demand peaks in South Asia that followed sunset there. Smart grid technology would enable the complex operational demands of optimizing dispatch and maintaining grid stability over these enormous areas.¹²

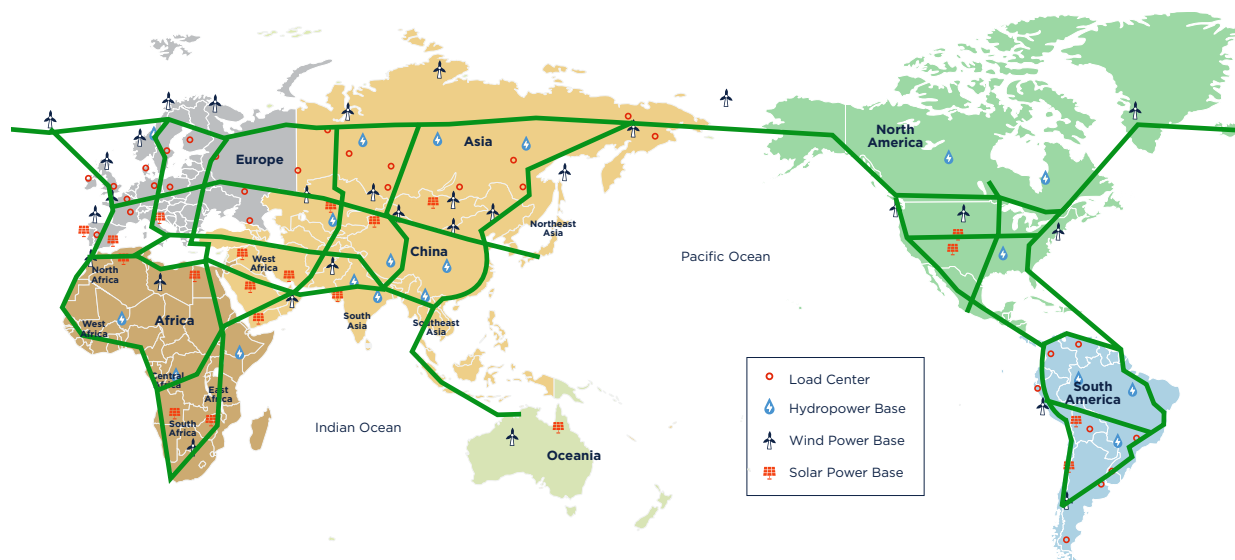
The initial GEI vision for a global grid was set forward in Liu Zhenya's 2015 book, which established the core pieces of the GEI vision: “a globally interconnected, ubiquitous robust smart grid, supported by backbone UHV grids (channels), and dedicated primarily to the transmission of clean energy.”¹³ It laid out the general regional and transcontinental backbone routes that would undergird this grid, as well as the “large-scale clean energy bases” in areas like the Arctic and the equatorial regions that would play a major role in supplying it.¹⁴ It also proposed a highly centralized governance structure for this global grid: a specialized “Global Energy Network Alliance” under the UN, led by a decision-making committee of member



state officials. Its secretariat would operate global market operations and dispatch centers, with the latter at the head of a sprawling network of regional and national dispatch centers.¹⁵

Since its establishment in 2016, GEIDCO has released its own strategic plan whitepapers that adopt and build on Liu's core concept of "smart grid + UHV + clean energy." Its most comprehensive recent plan for the GEI global grid, released in March 2018, charts an 18-line backbone structure to be realized by 2070, as well as a series of intermediate steps: a network of Europe-Asia-Africa interconnections by 2035, for instance, and 18 synchronous grids worldwide by 2050.¹⁶ More recent presentations and reports have further fleshed out and tweaked some of these intermediate steps: its 2019 report on Belt and Road Energy Interconnection, for instance, identified 36 target interconnection projects across seven corridors in Europe, Asia, and Africa with a transmission capacity of 190 GW.¹⁷ The interstate projects discussed in this report and throughout GEIDCO's backbone planning reports involve long-distance UHV and high-voltage (HV) lines, as well as back-to-back grid connections. UHV, in particular, is called upon for the construction of transcontinental lines running several thousands of kilometers—for instance, between the Arctic and North America, or Asia and Europe.¹⁸ As for global governance structures, GEIDCO materials present versions of Liu's proposals that preserve his major ideas but use more flexible language. They make no mention of a UN superstructure and drop specific terminology on global dispatch and market operations "centers," speaking instead of "a unified global dispatch mechanism" and "a global electricity market" with "a transcontinental, transregional electricity settlements system."¹⁹

Figure 1: GEI's vision for the global backbone grid



Source: Global Energy Interconnection Development and Cooperation Organization, "About GEI," <https://en.geidco.org/aboutgei/>, accessed January 20, 2020.

GEIDCO has sought to build a coalition of both Chinese and international partners to advance



GEI as a multilateralist solution to the low-carbon transition. It has found particular success with the UN. It signed a collaboration memorandum of understanding (MoU) in 2016 with the UN Economic and Social Commission for Asia and the Pacific (UNESCAP),²⁰ and it hosted in 2017 the High-Level Symposium on Global Energy Connection with the UN Department of Economic and Social Affairs (UN DESA) that featured opening remarks from UN Secretary-General António Guterres himself.²¹ Guterres praised GEI in a video greeting to the 2018 GEI Summit in Beijing, calling the initiative “a key to solutions that can efficiently use rich renewable energy resources . . . to deliver modern energy services to all even at long distances.”²² GEI has also served as one of 10 “nongovernmental organization partners” at the UN Framework Convention on Climate Change (UNFCCC) COP24 and COP25 conferences, cohosting events with UN DESA and announcing MoUs and joint report releases with the UNFCCC and the World Meteorological Organization (WMO).²³ (The WMO is a specialized UN agency.)

Outside of the UN, GEIDCO also incorporates within its membership and leadership ranks an array of non-Chinese participants. GEIDCO's four vice-chairmen include former US Secretary of Energy Steven Chu and Oleg Budarin, the CEO of Russian state utility company Rosseti.²⁴ Its several hundred members—corporations, financial institutions, research bodies—are mostly Chinese, but they also feature major multinationals like ABB, Siemens, and Morgan Stanley Asia.²⁵ It has also signed cooperation MoUs with a range of regional organizations and national ministries, including the African Union, the League of Arab States, and the Latin American Energy Organization.²⁶

Such moves strengthen the global ties of an organization whose core institutional backing comes from bodies within the Chinese party-state. The lynchpins here are Liu Zhenya and his allies at SGCC. SGCC is one of China's most powerful state-owned enterprises; its chairman holds ministerial-level rank within the Chinese Communist Party, on par with the leaders of other government ministries.²⁷ Liu's influence within SGCC may well have waned since his successor (and GEIDCO vice-chairman) Shu Yinbiao swapped positions in 2018 with Huaneng Group CEO Kou Wei. Kou Wei has not joined Liu and Shu on the GEIDCO board, but SGCC continues to fund the organization, and Kou did give the opening keynote in September 2019 for GEI's fourth anniversary event.²⁸ Liu also remains chairman of the China Electricity Council, the trade association for the power sector. His position is a useful perch for preserving relationships throughout the industry, and co-sponsors for GEIDCO's conference in November 2019 on GEI in Africa included major hydropower developers Three Gorges Corporation and Powerchina.²⁹

Of course, the most important endorsements of GEI within China have come from Xi Jinping. He introduced the initiative to a global audience in 2015 at the UN General Assembly, as noted above, and publicly reiterated his support for GEI at the International High-Level Forum on Belt and Road Cooperation in Beijing in May 2017.³⁰ The latter statement affirmed GEI's standing as one of many Chinese outbound initiatives today associated in one way or another with the BRI. (GEIDCO, for its own part, links itself to the BRI throughout its own messaging.³¹) Of course, endorsements have a shelf life, and Xi has not made any public statements on GEI since 2017, although a June 2018 *Financial Times* article quoted a “senior power official” who described GEI as “a personal priority” for Xi.³² But GEIDCO has continued to rally support outside the electricity sector over the past year from the Ministry of Foreign Affairs, whose



diplomats have aided GEI's promotion by meeting with GEIDCO leadership and endorsing GEI in meetings with officials and business community representatives.³³

If GEI is to translate its domestic support base into progress on global electricity trade, it will need to reverse a long record of failure in cross-border power trade schemes around the world. The handful of transcontinental visions have gone nowhere. The most recent failure was the Desertec initiative, a consortium of major electricity sector and financial companies that sought to transmit solar power from North Africa and the Middle East to Europe. Five years after its establishment in 2009, it had lost most of its shareholders.³⁴ A few regional efforts have been more successful. Europe has established the world's largest regional power trade market; cross-border exchanges within the 35 countries in the European Network of Transmission System Operators for Electricity (ENTSO-e) in 2018 equated to around 12 percent of members' total net generation.³⁵ Data on forecasted utility electricity demand from the 2018 annual report of the Southern African Power Pool (SAPP) suggest that many of its member states rely significantly on imports to meet demand; for five of the nine trading members, their net imports from April 2017 to March 2018 equated to at least 5 percent of 2018 projected demand.³⁶ The Central American Electrical Interconnection System (SIEPAC) has facilitated electricity exchange across six countries from Guatemala to Panama since transmission interconnection was achieved in 2013; it stands out among multilateral power pools worldwide for implementing regionally optimized hourly economic dispatch for its exchanges.³⁷

But cross-border trading outside these areas has taken place mostly through low-volume bilateral exchanges between neighbors; multistate efforts to broaden these activities have picked up only in the past several years. The South Asian Association for Regional Cooperation (SAARC) signed an MoU on a SAARC Energy Ring in 2004, but interconnection remains limited to a handful of modest links between India and its neighbors, and India only opened up its power lines for pass-through power exchanges between neighboring countries in December 2018.³⁸ The conceptual framework for the ASEAN Power Grid was established in the late 1990s; its first three-state power trade deal, between Malaysia, Thailand, and Laos, was signed only in 2017.³⁹ The West African Power Pool, founded in 2000, and the East African Power Pool (EAPP), founded in 2005, have been limited by significant generation and transmission gaps, though major transmission links under construction in East Africa will substantially improve conditions for bilateral and multistate trade among some EAPP participants.⁴⁰ In the Middle East, the six Gulf states developed interconnected grids during the 2000s but only began using these links for nonemergency trading in earnest in 2016.⁴¹

Low levels of electricity trade are unsurprising given several of the peculiarities of electricity as a commodity. First, the type of infrastructure that transmits electricity—power lines—is used exclusively for that purpose. Roads, railroads, and ports suffice to trade most commodities, but states need build the infrastructure for trading power only if they specifically want to trade power. Second, electricity imports are highly substitutable with domestic production. Like electricity, oil and natural gas are often transported on specialized pipelines. But these are commodities that must be imported by countries without their own reserves. Power plants can be built at home, even if their fuel must be purchased from abroad.

Beyond these issues, trade in electricity requires intensive levels of institutional and regulatory



cooperation around a highly politically sensitive commodity.⁴² Major importers of US soybeans can face politically painful price hikes if US production suffers from a drought, but these manifest over a period of time and can be managed through tools like subsidies and food aid. However, malfunctions in the electricity grid—a transmission equipment malfunction, say, or an operational failure to maintain grid frequency—can cause expensive and disruptive power blackouts immediately.⁴³ Thus, states and utilities may prefer to keep supply channels within their own territory, especially if political relations with potential power trading partners are fraught.⁴⁴ They may also have preferences on domestic power sector development that run counter to the least-cost regional planning solutions that maximize trade.⁴⁵ Establishing an electricity interconnection involves building cross-border consensus on a broad array of complex technical parameters and regulatory mechanisms. The political obstacles described above make a difficult task even more challenging.

To be sure, there are good reasons as well for states to want power trade. Imports might be cheaper than domestic production. Poor states may struggle to raise the capital they need to build enough power plants for their citizens. And in the age of renewables, having access to a large and diverse set of power plants helps grid operators cover the irregularities in supply that come with generating power from the sun and wind. But that age is only in its early days, and in the meantime, the inherent obstacles to electricity trade remain formidable. We see just how formidable in the challenges to interconnection in the GMS.



GMS POWER TRADE: BACKGROUND AND STATE OF PLAY

After more than two decades of discussion, progress in GMS power trade remains limited. Through the mid-2010s, trade flows took place at small or moderate volumes on a bilateral basis and, outside of Laos-Thailand exchanges, served primarily as a second-best option for poorer states with less capital to develop their own power resources. The conditions for trade have started to improve in the past several years, especially as investments in generation and transmission infrastructure have reduced the grid instability issues and generation shortages that can weaken states' ability or desire to trade. But political disputes have slowed efforts to establish a permanent institutional framework to coordinate potential expansion.

ADB officials first examined the prospects for GMS power trade with a set of studies in 1995, shortly after the ADB's establishment in 1992. Thailand at that time had already begun signing MoUs with neighbors for electricity imports to power its booming economy,⁴⁶ and to this day, Thai imports of power from Laos comprise the bulk of cross-border power flows in the region. Trade levels at present within the region are otherwise quite low, though they cover important chunks of electricity demand for some of its poorer countries. ADB statistics for trade in 2014 offer the most recent comprehensive window into overall flows in the region.

Table 1: GMS power trade flows in 2014 (GWh)

NGCC with CCUS (IOU)

To	2014 From	Lao PDR	Myanmar	PRC	Thailand	Vietnam
Cambodia		13.77			396	1,219
Lao PDR		—		221	1,286	35
Myanmar			—			
PRC			1,496	—		
Thailand		11,936			—	
Vietnam		small		1,976		—

— = not applicable, GWh = gigawatt-hour, Lao PDR = Lao People's Democratic Republic, PRC = People's Republic of China

Note: Exports from Cambodia are not listed in this table; Cambodia does not appear to have been exporting any power as of 2016, when the ADB released the report from which this table is drawn. For more on Cambodian exports, see Asian Development Bank, "Cambodia: Energy Sector Assessment, Strategy, and Road Map," December 2018, <https://www.adb.org/sites/default/files/institutional-document/479941/cambodia-energy-assessment-road-map.pdf>, accessed January 20, 2020.

Source: Asian Development Bank, "Greater Mekong Subregion: Energy Sector Assessment, Strategy, and Road Map," June 2016, <https://www.adb.org/sites/default/files/institutional-document/188878/gms-energy-asr.pdf>, p. 11, accessed December 28, 2018.



The pattern of trade today remains broadly unchanged, though magnitudes have shifted—Thai imports of Laos power more than doubled between 2014 and 2018.⁴⁷ Otherwise, most other flows represent small-scale bilateral trade where the importers are looking to cover supply shortfalls in underdeveloped regions. Laos and Cambodia in particular are small consumption markets with weak internal grid systems for transmitting power across different parts of their territory, and so such imports have historically covered important chunks of demand; imports in 2015 equated to almost 50 percent of Laos's national consumption and 30 percent of Cambodia's.⁴⁸ But generation and transmission capacity additions in Cambodia have been steadily reducing its reliance upon power imports since the early 2010s.⁴⁹ China-Laos and China-Vietnam trade has followed a similar trend over the past decade, as electricity sector projects in northern Laos and Vietnam during this period have allowed these regions to become more self-sufficient.⁵⁰

Low levels of bilateral trade correspond to limited cross-border transmission line infrastructure. GMS member states had 21 cross-border power trade lines running between them at 110 kV and above as of 2014, with several more lines constructed since then.⁵¹ For contrast, the ENTSO-e region in 2017 had more than 300: about 9 to 10 lines per member state as opposed to about four lines per state in the GMS.⁵² Of course, larger electricity loads in Europe mean greater demand for transmission interconnections. Yet a large proportion of the GMS lines are cross-border lines from Laos to Thailand or Vietnam that are earmarked for export of power by specific large hydropower projects under 25- to 30-year power purchase agreements between project developers and the Thai and Vietnamese grid authorities. Laos earns foreign exchange from these exports. But the lines themselves are not integrated into Laos's own grids. They function in essence as extensions of the Thai and Vietnamese power grids onto Laos soil; Laos receives no power from them, and they do not support third-party grid access.⁵³ As such, they do not involve the sort of more complicated institutional cooperation in systems operation entailed in any broader grid integration scheme, as exists in Europe.

The institutional framework of GMS power trade remains thin as well. Power trade discussions are entrusted to the Regional Power Trade Coordinating Committee (RPTCC), a committee of electricity sector authorities from each country established in 2002 by the Asian Development Bank that meets semiannually to coordinate progress in this sphere.⁵⁴ More recently, in 2013, the six member states signed an MoU to set up a Regional Power Coordination Centre (RPCC) as a permanent secretariat for power trade.⁵⁵ But the center has yet to be established, and in the meantime, ADB staff and external consultants continue to take the lead on key tasks like the Regional Master Plan. The present version of this plan was last updated in 2010; the ADB is currently preparing a new one to cover the period of 2022–35.⁵⁶

The past several years in the GMS and surrounding regions have seen an uptick in state interest in expanding power trade volumes and building new multistate exchange arrangements. China, Myanmar, and Bangladesh reached an agreement in 2018 to promote trilateral power trade between the countries, with technical working groups launched to explore potential arrangements.⁵⁷ Thailand, Laos, and Malaysia began piloting a three-way arrangement in 2016–17 and tripled their pledged trading levels in September 2019 from 100 MW to 300 MW.⁵⁸ Laos has signed a series of bilateral MoUs to significantly boost trading volumes with other member states, and Thailand has set forth ambitions to develop as an



electricity trading hub wheeling power from Laos to its southern neighbors.⁵⁹ Pledges and MoUs are not guarantees of implementation, of course. A China-Thailand MoU in 1998 agreed that China would export 3,000 MW of power to Thailand by 2017, but the China-Laos-Thailand transmission infrastructure required has yet to be constructed and the MoU expired in 2017.⁶⁰ But they do show substantive interest in expanding power trade through available state-to-state channels, even as the regional institutional framework for cooperation lags.



GMS POWER TRADE: DRAGS ON INTERCONNECTION

The slow pace of GMS grid integration owes to two reasons. First, member states are all developing countries that have faced major gaps in their domestic power systems over the past two decades, in the form of generation shortages and weak and/or incomplete transmission grid systems. As a result, states have not necessarily had surplus generation for exporting or robust transmission networks that can safely take and receive additional flows from trade. Power system weaknesses tripped up visions of a Thailand-Laos-Vietnam interconnector proposed by a World Bank-sponsored expert group in the mid-2000s. According to an ADB report, Thailand did not pick up on the project in part because of concerns that Vietnamese grid instability would impose costs on Thailand's own grid operator.⁶¹ Vietnam's grid has since improved significantly. Nonetheless, several member states today—including Laos and Myanmar—still lack unified national power grids and experience frequent power blackouts.⁶²

But the obstacles to GMS grid interconnection have not been just issues of infrastructure capacity; they have also been political. Integration schemes require coalition building across a wide array of stakeholders. States must see trade as a boon to grid stability and efficiency rather than a backdoor threat to national sovereignty. Transmission and generation developers, and the lenders they work with, must see value in undertaking these projects for themselves, while major domestic players in states looking to import must accept new competition. Developers must also manage community relations at project sites to avoid inciting public opposition that can delay or even scupper a project.

This region's experiences show how elusive these coalitions can be. For instance, the initial pathway set forward by the ADB for the proposed Vietnam-Laos-Thailand link in the mid-2000s had to be dropped after the (Thai) owner of a key transmission line section along that pathway in Laos refused to allow it to be used for that purpose.⁶³ GMS regional planning throughout the 2000s envisioned Myanmar exporting large volumes of hydropower to China from dams to be constructed in the north of the country. But a political turn in Myanmar against Chinese hydropower, as well as resumed conflict in Myanmar's civil war near the proposed dam sites, has stalled progress on these projects over the past decade.⁶⁴

Perhaps the most damaging failure in coalition building has come in discussions around the RPCC.⁶⁵ Member states signed in 2012 an MoU to establish such a center as a permanent secretariat to deepen power trade arrangements. The center is essential for tackling the complex demands of regional power trade arrangements, from building technical capacity and facilitating investment to coordinating regional planning and implementing a unified grid code. The existing coordinating committee (the RPTCC) has neither the mandate nor the capacity to take on these tasks.⁶⁶ On a broader level, endowing a specialized organization to advance power trade serves as an expression of regional political consensus that can improve the prospects of resolving thorny interstate disputes going forward.

Yet eight years later, the center has not been established. China and Thailand lodged bids in



2014 to host the center, but the committee has not produced a winner. The dispute nominally centers on unclear technical criteria for bid evaluation, but the political sensitivity of hosting decisions is clear, with hosting privileges a potential channel for influence and intelligence gathering. (World Bank staff, writing during negotiations about the establishment of the Southern African Power Pool's coordination center, noted "deciding on a neutral location" as one of the "key steps" for executing this "politically challenging task."⁶⁷) Published ADB records from coordinating committee meetings from 2014–16 suggest that China has shown little flexibility on this dispute; notably, in summer 2015, it blocked a push for rebidding supported by the five other states.⁶⁸ The countries in 2016 sent the issue up to the senior minister level, and a presentation by an ADB official at the June 2018 coordinating committee meeting listed the center among its "future directions for the energy sector (beyond 2022)."⁶⁹

The RPCC dispute highlights the low levels of interstate trust in the GMS among states that are a fundamental obstacle to interconnection. These gaps in trust have been perhaps most significant in China's relations with its southern neighbors, where states seek to balance in different ways the advantages of close economic ties with China with the strategic vulnerabilities that can follow. An ASEAN Study Centre 2019 survey on elite Southeast Asian opinions toward China indicated that 46 percent of GMS respondents had "little confidence" or "no confidence" that China would "'do the right thing' in contributing to global peace, security, prosperity, and governance"; only 23 percent said they were "confident" or "very confident" on this front.⁷⁰ As with the RPCC, China's unilateral stances on the South China Sea and Mekong water-sharing disputes indicate that on some important political disputes, China can prefer assertions of sovereign rights to making concessions in pursuit of collaboration with its southern neighbors.⁷¹



GEI: CATALYST FOR THE GMS?

The GEI initiative envisions a single synchronized grid in Southeast Asia by 2050 linked into networks of grids stretching across Eurasia and Africa.⁷² The state of interconnection progress in the GMS—where China is a direct participant—underscores how difficult this project will be.

That said, GEI could contribute to accelerating interconnection in this part of the world as part of a broader set of forces encouraging the Chinese transmission sector to expand its overseas activities. Chinese companies were active as contractors for engineering, construction, and procurement (EPC) projects in Southeast Asia well before GEI's debut, and they remain major players in the EPC market throughout much of the region.⁷³ Representatives from one Chinese grid contractor active in Myanmar spoke in an interview with the author of fierce bidding between Chinese companies for EPC contracts in Myanmar in the past decade that was significantly reducing project margins.⁷⁴ In Cambodia and Laos, Chinese financing also funds transmission infrastructure upgrades.⁷⁵ A December 2017 presentation at the ADB by a Laos official listed funding sources for 15 medium-voltage transmission lines that were completed in 2017 or were under construction and would be completed by 2020. The funding for 11 of these projects was Chinese.⁷⁶ GMS power integration requires infrastructure upgrades in Myanmar, Cambodia, and Laos. High-level political support in China for transmission sector companies to “go out” deepens the incentives for Chinese companies and policy banks to participate in these upgrades.⁷⁷ GEI is one of a variety of forces that are encouraging this sort of expansion.

A network of infrastructure deals and MoU-based trade pledges can form a sort of minimal framework for expanding power trade in the GMS region. But these trading arrangements cannot support the sorts of regionally integrated practices that maximize power trade's economic benefits: multistate short-term electricity markets, for instance, or regionally integrated planning procedures. The RPCC is essential for these gains, as well as more basic tasks like harmonizing regional technical standards.⁷⁸ Member countries continue to recognize its importance: the summary of proceedings from the coordinating committee's November 2019 meeting stated that they had “expressed strongly ... the need to drive coordination work by revitalizing the establishment of the RPCC.”⁷⁹

The dispute around the RPCC is not at its core to be solved by marshaling resources and technology. Rather, it requires actions that build interstate trust: efforts by China, for instance, to assuage its neighbors' concerns about Chinese hosting or to even cede this dispute to Thailand. On this front, it is worth noting the practices of other regional power pools. The EU set up its agency for internal energy integration in Slovenia, in keeping with its practice of spreading its specialized agencies across member states; major legislation, of course, comes out of Brussels, historically selected to host the EU in part as a neutral location between France and Germany.⁸⁰ More directly relevant is SAPP's decision to host its secretariat not in South Africa but in Zimbabwe.⁸¹ For powerful states, making concessions in international organization hosting decisions can be one way to assuage member state concerns that regional hegemony will exploit hosting privileges to their own advantage.⁸²



Giving way to Thailand in the RPCC deadlock could benefit China in two ways. First, a breakthrough on the RPCC would significantly improve the environment for further interconnections of interest to the Chinese grid sector. Second, a concession, done right, could fit into a broader Chinese strategy that tries to counter the trust gaps that have dogged China's diplomatic rise in Southeast Asia on issues like water sharing and cross-border investment. Chinese policy makers get to decide whether these benefits outweigh the costs: for instance, the sacrifice to Thailand of a useful channel for influencing and monitoring RPCC operations.

Renewed member discussion around the RPCC may bring this issue directly before China again in the next several years. But the ADB-led GMS might not be China's preferred forum for managing the politics of trade. A 2019 article in GEI's member journal by China Southern Grid deputy general manager Bi Yaxiong on bolstering electricity trade in this region referred instead to the Lancang-Mekong Cooperation Mechanism (LMCM), an alternative regional body for the GMS member states established under Chinese initiative in 2016.⁸³ Bi spoke of developing Myanmar as a long-term power exporter and establishing Laos and China as the centers of Lancang-Mekong trade—and made no mention of the GMS.

The preference for a Chinese-sponsored regional initiative in coordinating progress on regional power trade suggests that at the level of high politics, China may continue to have reservations about making significant concessions in grid sovereignty for the sake of deeper integration. Of course, whether the LMCM can establish itself in electricity trade in the coming decades remains to be seen; between the GMS's efforts and the ASEAN Power Grid, the Mekong subregion is already a crowded area for interconnection initiatives. In the meantime, however, without a resolution to the RPCC debate, advocates of interconnection will continue to lack a dedicated body to help coordinate the translation of bilateral interests around cross-border power trade into regional plans of action.



GEI'S PROSPECTS: MULTILATERALISM AND LEARNING FROM THE GMS

The challenges of GMS power trade highlight how difficult the politics of grid interconnection can be. Integration requires building consensus and trust among an intimidatingly diverse mix of stakeholders: state government authorities, utilities, generators, civil society actors. These challenges are difficult enough within a country: in China itself, local government protectionism has been a persistent obstacle to deepened interprovincial electricity exchange.⁸⁴ Coordinating across states makes these challenges even more complex, and so a united front among state participants is essential for tackling them. A 2010 World Bank-sponsored report on power sector integration made this point succinctly: “if there is one overriding requirement for regional integration to be successful, it is that countries need to have the political will to cooperate with their neighbors.”⁸⁵ Liu himself, in laying out the initial GEI vision in 2015, recognized the need for “a mechanism and an organizational base of mutual trust and benefit to carry out energy cooperation at a global level.”⁸⁶

Grid integration schemes around the world underscore the importance of such “political will.” The three global success stories in integration all had their own peculiar advantages for fostering cooperation on this issue. Europe, of course, is the global standard-bearer for political cooperation; its multilateral institutions have exceptional levels of authority in directing regional policy. As for Central America, the members of SIEPAC are all small states with broadly similar levels of political and economic power; there are no dominant hegemons to attract the concern of the other members. Southern Africa is in some ways a more surprising instance of grid integration, given the power disparities between South Africa and its neighbors. But many of these states came into existence already with grid system linkages to their neighbors that had been built during the colonial era, when the new borders had not yet been drawn.⁸⁷ SAPP itself was formed in the aftermath of Apartheid; positive attitudes toward the new South African government created a political window for South Africa’s neighbors to lock down the obvious benefits of importing cheap South African power for their energy-starved states.⁸⁸ This basic pattern more or less persists today. South Africa’s power exports comprise almost 90 percent of net exports in SAPP, though power shortages in the past decade have shifted South African trading priorities towards domestic reliability.⁸⁹

Meanwhile, power trade among the Mekong states is not the only such initiative in Asia with Chinese involvement that has a mixed record in securing interstate trust. The Asian Super Grid (ASG) project envisions an interconnected grid stretching from Northeast Asia down southward, and it has already received high-level support from China, Russia, Mongolia, and South Korea.⁹⁰ But the ASG’s first two proposed projects both link to Japan—and there is little support within the Japanese government for the project, as Japanese project backers have themselves acknowledged.⁹¹ The issues lie partly in the domestic politics of the Japanese electricity sector, a highly centralized industry in the midst of competitive reforms. But Japanese anxieties also certainly tie to regional politics. Japan-China relations feature close economic cooperation alongside deep political division, and Japan has yet to formally endorse the BRI, though its icy stance in the BRI’s early days has been replaced by deliberate engagement with the initiative.⁹² Japan’s hesitation certainly does not doom Northeast Asian



interconnection: China and Korea set up a joint working group in December 2017 to examine interconnection options.⁹³ But the Japanese stance has forced adjustments from the other participants in the project, and no public progress in China-Korea discussions has been announced since the working group's formation.

Grid integration experiences in the GMS and beyond, then, underscore the attention that GEIDCO and its allies in China must pay to politics in advancing GEI. Interconnection requires multilateral cooperation that lasts. How will China try to build this? And how does this aim rank amid China's other priorities around interconnection and GEI: its own grid sovereignty and its industrial policy aims?

The answers, of course, will vary by region. In its own neighborhood, China has to confront these trade-offs through its participation in institutions of power trade governance—a pooling of sovereignty that must be undergirded by interstate trust. With the GMS, it has in essence demanded that the RPCC be located in China. A crucial piece of the integration process has stalled amid this dispute. Northeast Asia has not reached this stage, but progress beyond isolated cross-border line projects could likewise prove more challenging without a permanent institution to sit above the utility-level MoUs in place right now.

On a broader level, China's influence on power interconnection worldwide comes as a global advocate for interconnection and as an investor and contractor in the power sector. On the former front, GEIDCO's partnership with the UN is the most high-profile plank of a broader effort to build an alliance around its initiatives through MoUs with companies, utilities, and regional organizations from every continent. It has developed particularly fruitful relationships in Africa, reflected in a pair of forums in 2018 and 2019 specifically on GEI and Africa. GEIDCO's 2020 work plan identifies as one of its nine focus areas for 2020 accelerating the establishment of the African Energy Interconnection Sustainable Development Alliance (AEISDA), originally announced in 2018 as a joint project of GEIDCO and the Republic of Guinea; it is the work plan's only region-specific focus area.⁹⁴ Meanwhile, Chinese state-owned grid companies have over the past 15 years acquired large minority stakes in utilities in South America (Chile and Brazil), southern Europe (Portugal, Greece, and Spain), and Asia (Australia and the Philippines).⁹⁵ These acquisitions give Chinese state-owned grid companies a foothold in a number of regional markets, one that could be used to advance interconnection initiatives beyond Asia. Chinese companies have also obtained line construction contracts on at least two major cross-border transmission infrastructure schemes in East Africa: the Kenya-Ethiopia and Kenya-Tanzania-Zambia interconnection projects.⁹⁶

In these regions, GEI's biggest political challenge is heading off perceptions that the initiative is a one-sided vehicle for China to accrue economic influence and meet industrial upgrading targets. State security concerns blocked attempted Chinese purchases in Germany and Australia in recent years.⁹⁷ Politicians and officials in Brazil and the Philippines have periodically raised concerns about China's ownership of grid assets in their states, though Brazilian president Jair Bolsonaro's rhetoric against Chinese grid interests disappeared after his election.⁹⁸

GEIDCO has also been pairing its multilateral advocacy work around GEI with a set of country-level initiatives to support individual states in their energy sector development paths and give them the foundation to participate in GEI-style interconnection.⁹⁹ GEIDCO's standing within



the Chinese party-state creates the potential that its work will unduly advocate development strategies that favor Chinese economic interests, for instance, or push procurement from Chinese suppliers—a criticism levied at BRI more broadly in various quarters.¹⁰⁰ Of course, many state-backed international development initiatives seek to leverage their sponsor's economic strengths. The challenge for GEIDCO lies in matching these efforts with the needs and preferences of their host partners at regional and national levels.¹⁰¹ GEIDCO's advocacy for developing hydropower along the Congo River offers an example where this tension may prove present. The organization has laid out a master plan for African interconnection that centers upon an enormous 110 GW set of hydropower cascades on the Congo River, supplying load centers across the continent through a network of 11 UHVDC lines. This proposal expands dramatically upon the long-mooted \$80 billion, 40 GW Grand Inga project for this region. It also aligns quite well with the interests of the Chinese hydropower sector, the biggest builder of large dams internationally. Yet the ecological impacts and economic benefits of the Grand Inga project for its host country, the Democratic Republic of the Congo, have been a subject of fierce debate for decades; the scale of GEIDCO's master plan promises even more controversy.¹⁰²

All that being said, macro-level concerns about GEI have not been aired much in public so far. Meanwhile, coalition-building efforts at the UN and in regions like Africa and the Middle East have given GEIDCO opportunities for progress at the regional and national level. As the organization builds on that foundation, then, the specific approaches to meeting the challenge of interconnection and global renewables integration in GEI will remain a subject of debate in grid planning circles.¹⁰³ Liu's discussion of market design in his GEI book emphasized long-term contracts supplemented by short-term trading to adjust for resource intermittency; can such a model support the efficient integration of highly variable resources like renewables?¹⁰⁴ GEI envisions distributed energy as a supplementary piece of the global grid, with a greater emphasis on large-scale renewable energy "bases" as a source of supply; does this approach handle properly the growing potential of distributed resources?¹⁰⁵

A full treatment of these many debates is beyond the scope of this paper. Instead, I will focus on discussions around the most controversial plank of GEI's "clean energy + ultra-high-voltage transmission + smart grid" formula: UHV. There can be, of course, no globe-spanning backbone grid without UHV deployment. But there are a variety of reasons to question its value. UHV projects cost hundreds of millions of dollars and are designed specifically for carrying enormous volumes of power over very long distances.¹⁰⁶ Most regional interconnection schemes worldwide are not developed enough to consider these sorts of megaprojects and, indeed, can make plenty of progress in infrastructure build-outs and regulatory reform without them. From a grid security standpoint, too, there are many reasons to prefer a series of smaller lines for transmission lines for imports rather than a single big line whose failure could cause major blackouts.¹⁰⁷ These questions featured in China's heated debate over UHV during the past decade,¹⁰⁸ but such security concerns are even more important in cross-border trade. UHV interconnection would work best through transregional and transcontinental grid backbones where the power from individual lines supplies enough countries to avoid inducing disproportionate dependency for any one grid. But these kinds of backbones—while very much within GEI's stated ambitions—would require major leaps forward in multilateral political cooperation to coordinate the regulatory arrangements and the physical asset build-outs needed.¹⁰⁹



From an energy economics standpoint, too, the value of deploying UHV on the scale that GEI proposes remains unproven. Evidence from China about the economic efficiency of its UHV projects is murky. Chinese officials have noted lagging utilization rates on a number of major UHV and HVDC lines, an important determinant of revenue for interprovincial transmission in China; but system-wide measures of economic value are harder to determine.¹¹⁰ A significant subset of UHV lines in China are also associated with massive hydropower dams, a type of investment with questionable economic and environmental track records; Congo River development plans, mentioned above, would extend these initiatives into Africa. GEI advocates UHV as a means to unlock large-scale renewable generation bases, in line with the Chinese grid's traditional emphasis on large generation assets and highly centralized planning and dispatch. Yet the global energy transition is also bringing with it advances in smart grid technology, battery storage, and distributed generation that can support increasingly decentralized and two-way grid structures while advancing renewable penetration.¹¹¹ For all these reasons, in the opinion of the author, the real work of interconnection today is at a more modest level than GEI's elevation of UHV would suggest. It lies in painstaking political work to marshal regional support for integrated planning processes and market structures in service of least-cost, low-carbon power sector development.

Yet Liu Zhenya and his allies have other reasons for centering UHV in GEI. The expansion of UHV offers a chance for China—and particularly for SGCC and other Chinese firms—to set technical standards and achieve a leading position in a nascent global high-tech market. These aims fit well in China's broader push to strengthen its place in high-tech industries. GEI's publicity—combined with a project or two in more developed power-trading regions in Africa or even southern Europe—can build enthusiasm for the use of UHV in large countries with high power demand. Expanding UHV's presence in these markets will in turn position China to take advantage should technological gains and institutional advances improve the environment for cross-border UHV in the coming decades.

GEI's ambit is also much broader than UHV alone; it is very much actively involved in research and advocacy around energy transition issues of all sorts, from cross-border interconnection to rural electrification. It also, as noted above, complements its multilateral advocacy work with bilateral initiatives around energy sector development that flow out of the GEI vision. In this context, the global UHV grid concept serves as a sort of marketing pitch to governments around the world that bolsters China's green credentials while promoting the technological and financial capabilities of the Chinese energy sector in the clean energy transition. The opportunities gained in this manner can serve the many non-UHV activities in GEI and Chinese electricity sector diplomacy, particularly in the bilateral energy sector development initiatives that GEI seeks to facilitate. But these benefits do not make UHV any more immediately applicable to grid integration. UHV's significance to Chinese transmission developers is much clearer than its practical significance for interconnection—a disjuncture that GEIDCO and its allies are already fighting, and will continue to fight, as they press forward on this initiative.



GEI's Strategy on Renewables and the UN: Implications for US Policy Makers

GEI touches upon a broad array of US interests, from development assistance to exports to technical standards-setting. A full review of these spheres is beyond the scope of this paper,¹¹² but two elements of GEI deserve particular attention from US officials: its focus on accelerating the renewables transition, and GEIDCO's partnerships with multilateral institutions to promote GEI's role in that transition. These efforts strengthen GEI's international legitimacy while offering GEIDCO and its Chinese affiliates useful platforms for advancing their many priorities.

GEIDCO has been particularly successful positioning itself as a climate leader at the UN. It has established cooperation with the UN Department of Economic and Social Affairs and World Meteorological Organization, served as a partner at the UN Framework Convention on Climate Change's COP24 and COP25, and received endorsements from the Secretary-General himself. These achievements build upon China's more active approach to UN diplomacy since the accession of President Xi Jinping in 2012, which has included an expanded Chinese presence across a number of UN institutions.¹¹³

GEI's successes at the UN expose two key features of American energy diplomacy under the Trump administration: the absence of a strategy on climate and clean energy and the US's disengagement from the UN.¹¹⁴ While GEIDCO has cultivated a network of UN partners and supporters, the US has pulled out from the Paris Agreement and withdrawn contributions to the UN Green Climate Fund.¹¹⁵ American diplomacy toward the UN as an institution has also taken

a markedly more confrontational turn under the Trump administration, which has proposed repeated budget cuts to American UN funding, withdrawn from several UN agencies, and subjected delegations from states viewed as hostile to the US to periodic harassment that has drawn a rebuke from the UN's legal counsel.¹¹⁶ Several reports have indicated growing disquiet within the Trump administration over China's influence at the UN. But a pair of unsuccessful campaigns at the UN against Chinese-nominated candidates in 2019 has underscored how this confrontational approach has hampered the United States' influence in UN institutions.¹¹⁷

US officials do not appear inclined to help mobilize meaningful discussion on climate and clean energy. But as the world embarks on the renewables transition, such a discussion is central to the future of the electric grid. GEI stresses large-scale clean energy and transmission projects in its vision for decarbonization. Where are these investments useful? Where can Global South states reach the same goals through less capital-intensive packages: generation and transmission investments on more conventional scales, complemented by institutional reforms and newer grid technologies like distributed energy resources and demand response? GEI's ties to State Grid and advocacy of technologies like ultra-high-voltage transmission (UHV) underscore challenges around industrial policy and grid cybersecurity in the renewables transition that echo some of the most sensitive elements of Chinese economic relations with the US and Europe right now. How can major states like the US and



China handle these challenges, and in what ways should they shape the major-power cooperation the climate crisis demands?

GEI, and the greater landscape of Chinese clean energy diplomacy, pose these questions to the US. Yet the climate policy of the current administration means the US can only answer them in partial fashion, by imposing solar panel tariffs, for instance, or exerting pressure on Huawei's solar inverter business.¹¹⁸ In the past several years, the US government has shown little interest in developing a comprehensive and thought-out strategy for the renewables transition.

GEI is not quite four years old. It is hard to tell at this stage how the network

of partnerships GEIDCO has built will translate into new infrastructure projects or institutional reforms in the regions where it is finding an audience. But GEI is at least offering answers to one of the biggest global governance challenges of the 21st century: the reinvention of the energy sector to meet the climate crisis. These answers should be discussed thoroughly. What are the benefits of UHV and large-scale renewable bases, for instance? What are the ties between GEI and Chinese industrial policy, and how should they affect GEI's global reception? The US's current policies on climate and the UN make it more challenging to contribute to this dialogue.



CONCLUSION

The GEI vision is a captivating one: a global electricity grid underpinning a transition from fossil fuels toward clean power as the world's leading source of energy. Its core support comes from powerful coalitions in the Chinese party-state centered around Liu Zhenya and his allies at SGCC. It seeks to spread worldwide one of China's signature technologies in the transmission sector, UHV, in concert with large-scale renewable bases and smart grid technology, and to use these three pillars to drive a major growth in cross-border power trade.

But the world's track record on interconnection is not promising. Only a handful of regions worldwide have succeeded in building up platforms for multilateral electricity exchange. The obstacles lie partly in the state of the world's grid infrastructure: states with weak domestic grids face challenges in meeting the complex demands of cross-border electricity trade. These gaps should shrink as global development advances, but the political obstacles are more durable. Scaling cross-border power trade requires winning political consensus across a diverse range of stakeholders. Utilities for prospective importers must accept competition from generators in neighboring countries. Generation projects built with exports in mind must avoid civil society opposition that can hold up their implementation. And states must see trade as a means of improving energy security by expanding sources of supply rather than a threat to their control over a key piece of national infrastructure. The challenges of GMS power interconnection over the past two decades demonstrate just how difficult it can be to overcome these sorts of challenges.

Can GEI improve conditions for interconnection? China's utilities have the capital and experience to strengthen grid systems around the world. But building sustained regional trading networks for electricity may require China to put its weight behind multilateral political institutions for trade in the regions where its interests are active. In Asia, it has been reluctant to make concessions to its weaker southern neighbors over the location of the RPCC; its stance has hindered efforts under the GMS framework to advance power trade. Meanwhile, GEI also serves industrial policy goals that do not necessarily align with the needs of interconnection. UHV is one of GEI's pillars and a key part of GEI's presentation as a transformative initiative for fighting climate change—but it may not address the demands of interconnection in the short term, while major uncertainties remain about its value for interconnected, high-renewables grids in the long term as well. GEI's country-level initiatives on bolstering energy sector development likewise will have to navigate similar challenges around aligning the interests of Chinese electricity sector developers with host country needs.

The GEI impact on interconnection will depend upon how GEIDCO and other Chinese electricity sector actors reconcile the competing priorities of Chinese grid sovereignty, cross-border power trade, and national industrial policy. The audience, in one sense, is an international one: the global, regional, and national stakeholders in electricity trade around the world. But it is more significantly a domestic one, where support from Xi Jinping and the various coalitions within the party-state is the precondition for GEI's activities. Endorsements from Xi Jinping in 2015 and 2017, combined with Liu's position as the just-retired SGCC CEO,



gave GEI a strong domestic foundation for its first several years. But those endorsements are not eternal, and nor is Liu's political power. To build on its early foundation, GEI's supporters must craft a strategy for reconciling the competing priorities around this initiative that wins over international support while maintaining a strong coalition at home. Success on this front would be an impressive achievement for Liu Zhenya and his allies.



NOTES

1. “Remarks of Xi Jinping at the UN Development Summit (Full Text),” Xinhua, September 27, 2015, http://www.xinhuanet.com/world/2015-09/27/c_1116687809.htm (Chinese), accessed December 28, 2018; “Remarks by Chinese President Xi Jinping at UN Sustainable Development Summit: Towards Win-Win Partnership for Sustainable Development,” Embassy of the People’s Republic of China in Ireland, November 26, 2015, <http://ie.china-embassy.org/eng/zltt/2d2/t1321132.htm>, accessed December 28, 2018.
2. “Remarks by Chinese President Xi Jinping at UN Sustainable Development Summit: Towards Win-Win Partnership for Sustainable Development,” Embassy of the People’s Republic of China in Ireland, November 26, 2015, <http://ie.china-embassy.org/eng/zltt/2d2/t1321132.htm>, accessed December 28, 2018.
3. The ADB’s definition of the GMS formally includes only two provinces of China: Yunnan and Guangxi. But Chinese diplomatic participation in the GMS takes place via central government ministries.
4. Walt Patterson, “Why an Asian Super Grid Is a Political Fantasy,” *chinadialogue*, February 6, 2016, <https://www.chinadialogue.net/article/show/single/en/8973-Why-an-Asian-super-grid-is-a-political-fantasy>, accessed December 28, 2018.
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107. The US National Renewable Energy Laboratory has summarized concisely this trade-off in its discussion of the potential for UHV applications in the US: "the advantage of using higher voltages is the decline in per unit costs; the disadvantage is the risk of losing a larger portion of transmission capacity in a single contingency failure." National Renewable Energy Laboratory, *Renewable Electricity Futures Study*, Vol. 4. (Bulk Electric Power Systems: Operations and Transmission Planning), <https://www.nrel.gov/docs/fy12osti/52409-4.pdf>, 26–5, accessed December 1, 2019.
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109. UHV is not actually yet technologically ready for this sort of application, either. China hopes to complete by 2020 the world's first UHV "direct current" (UHVDC) system with two receiving ends. That said, the pace of innovation in UHV technology within China over the past two decades suggests promise for a technical breakthrough here in the coming years. "The World's First Mixed UHVDC Line Project Begins Construction--The Wudongde-Guangxi-Guangdong DC Transmission Project," OFweek Smart Grids Online, March 13, 2018, <https://smartgrids.ofweek.com/2018-03/ART-290010-8120-30209272.html> (Chinese), accessed December 28, 2018.
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