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Accelerating the Jordanian Energy Transition

How regional cooperation, stakeholder involvement,
and electricity market reform can drive change

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This policy brief was written by Silvia Weko, Judith Hermann, Maria Apergi, Laima Eicke, Andreas Goldthau, Jude Kurniawan, and Esther Schuch. Research for this policy brief is funded by the Investigating the Systemic Impacts of the Global Energy Transition (ISIGET) project financed by the Federal Ministry of Education and Research (BMBF) under the "Make our Planet Great Again – German Research Initiative"; Grant Nr. 57429628, implemented by the German Academic Exchange Service (DAAD).

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This policy brief was prepared by the ISIGET team based on findings gathered in desk-top research as well as interviews and policy workshops. The energy system scenarios were modelled using Cross Impact Balance Analysis to determine factors preventing or facilitating a sustainable energy future. The subsequent succession analysis, an exercise to assess system dynamics, reveals the factors that need to be addressed in order to trigger changes in the entire modelled system. The recommendations in this policy brief are based on the results of the succession analysis, which suggests that regional cooperation is the main leverage point for further energy system transformations. Regional cooperation should be accompanied by a shift towards a liberalised electricity market structure and greater stakeholder involvement in policy decisions. More details on the method will be available in a forthcoming study.

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Jordan's energy transition has been rapid and ambitious: in 2021 renewables accounted for 26% of electricity production in Jordan, up from less than 1% in 2014.^{1,2} This massive leap forward was prompted by energy security concerns in the wake of the Arab Spring that forced the government to scramble for alternatives to Egyptian gas. Today, Jordan is a regional clean energy industry frontrunner, with over 300 PV companies and around 13 000 employees in the sector.^{3,4} However, recent policy decisions have stalled further progress. Auctions for new projects have been scaled back or postponed, and new ventures in excess of 1 MW were indefinitely suspended in January 2019.⁵ At the same time, changes to electricity tariff structures have dampened demand for residential PV.⁶

This loss of momentum is largely due to financial constraints on Jordan's state-owned National Electric Power Company (NEPCO), which is caught in long-term purchasing agreements for fossil fuels that conflict with the goal of growing Jordan's renewable energy sector and are exacerbating NEPCO's already significant debt burden. With 20% of public debt linked to the electricity sector, this also has ripple effects for the rest of the Jordanian economy.⁷ Increased regional cooperation will be needed to re-negotiate Jordan's commitments to purchase fossil fuels and to expand the regional market for renewable energy, allowing Jordan to export surplus electricity and establish itself as a clean energy hub while at the same time giving neighbours the chance to sell energy elsewhere and increasing regional stability. And while Jordan's top-down approach to energy policy was crucial to driving the rapid growth of renewables, the current risk of stalling progress makes it clear that stakeholders from different ministries as well as industry and civil society must be involved in future

policy development processes to accelerate Jordan's energy transition and shift the country from the current single-buyer model towards a more competitive market for electricity.

■ **Message 1:**
Increase regional cooperation

Efforts to expand cross-border energy interconnections should be scaled up and accelerated, targeting neighbouring countries as well as the Gulf and Europe. Other forms of regional cooperation that could reduce NEPCO's debt burden should be investigated, such as re-negotiating power purchase agreements or joint green hydrogen and ammonia projects.

■ **Message 2:**
Involve stakeholders in energy policy development and decision-making

Relevant stakeholders from industry and finance should take part in national energy planning efforts. International donors should ensure their engagement in Jordanian energy issues involves local industry, research, and finance experts so that the broader impacts and implications of energy decisions are understood.

■ **Message 3:**
Reform the electricity market

The single-buyer model has not served Jordan well and efforts to liberalise the electricity market should be pursued at pace. As part of these reforms, NEPCO should be restructured and repositioned as a transmission system operator. An action plan for market liberalisation should be developed in cooperation with relevant ministries and stakeholders, ensuring the involvement of actors beyond NEPCO.

Context and background

Jordan aims to generate 50% of its electricity from renewable energy sources by 2030. Renewables accounted for 26% of Jordan's electricity generation in 2021, up from less than 1% in 2014.^{8,9} The rapid growth of renewables in Jordan since 2010 is part of a larger bid to reduce the country's energy dependency, given that over 90% of Jordan's total energy needs are covered by imports.¹⁰ This also makes Jordan vulnerable to outages and fluctuations in energy imports. Attacks on the Arab Gas Pipeline disrupted the supply of Egyptian gas to Jordan in 2011, affecting plants that generated up to 80% of the electricity supply.^{11,12} The resulting energy crisis had a profound impact on public debt, as Jordan's National Electric Power Company (NEPCO) and the state scrambled to fill the energy shortfall by securing expensive oil imports and new sources for the gas supply.^{13,14}

In addition to diversifying the fossil fuel supply, the Jordanian government has sought to harness the country's abundant solar resources as a means to tackle energy security concerns with electricity 'Made in Jordan'.^{15,16} Ramping up clean energy has also proved attractive because the sector generates employment (a key policy challenge) and offers an affordable solution to the country's growing demand for energy for heating, cooling and desalination plants to alleviate the extreme climate stress and water scarcity already affecting Jordan.¹⁷

The policy agenda subsequently pursued by Jordan aims to increase the share of renewables in the energy mix. Measures to increase the use of renewables included power purchase agreements in which NEPCO guaranteed to purchase all electricity generated, as well as feed-in-tariffs and preferential taxation. A wheeling scheme and net metering projects brought businesses and households on board, who were encouraged by the lower cost of solar PV electricity.¹⁸ A first round of auctions for larger renewable energy projects was launched in 2011, followed by a second in 2013. These auctions set record-low prices at the time of US\$0.0613/kWh.¹⁹ The policies were very successful at attracting both regional and

international investment and thereby increasing installations of both centralised and distributed solar PV, as well as some onshore wind.^{20,21,22} As the clean energy industry gained momentum, its workforce expanded, creating new jobs in the areas of installation and maintenance. Today, Jordan is a regional clean energy industry frontrunner, with over 300 PV companies and around 13 000 employees, including highly skilled engineers and technicians.^{23,24}

However, a series of abrupt policy changes beginning in late 2018 and early 2019 has generated uncertainty about the energy transition's future. While Jordan's third round of clean energy auctions saw record low bids (0.02488/kWh), the government abruptly reduced the auction volume in September 2018 and then delayed its announcement of the auction winners.²⁵ In November 2018, NEPCO received a US\$256 million loan from the European Bank of Reconstruction and Development (EBRD) to improve its infrastructure with the explicit intent of better integrating renewables.²⁶ However, in January 2019, the government suspended all renewable energy projects exceeding 1 MW, arguing that technical studies were needed to assess electricity grid capacity.²⁷ Plans for energy storage projects were cancelled in 2020, and the third round of wind auctions was (unofficially) scrapped.²⁸ Following this, changes to electricity tariff structures in 2022 have dampened the uptake of PV solutions for consumers.²⁹ In July 2022 the government announced that it would begin to grant permits for new projects exceeding 1 MW provided that they complied with a number of regulations, including local employment and content requirements.³⁰ However, to the dismay of the industry, the government announced at the same time that existing renewable energy producers would have to re-negotiate their power purchase agreements.³¹

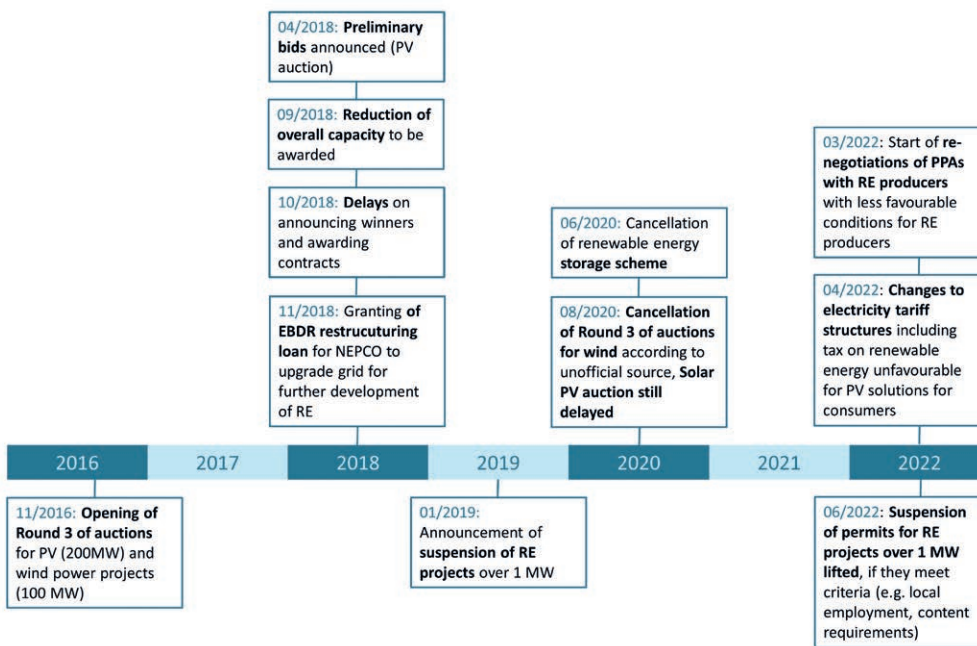


Figure 1:
Timeline of energy policy decisions in Jordan 2016–2022.³²

Source: IASS/Authors

The root cause of the stalled Jordanian energy transition lies in the country's electricity market structure and the fact that the state-owned electricity company NEPCO is responsible for buying, selling, and transmitting energy. Although electricity generation was liberalised in the 1990s, the structure of the electricity market is that of a single-buyer market in which NEPCO secures oil and gas via long-term purchasing agreements to sell to power producers, buys electricity from power producers, and sells it to distribution companies and large industrial consumers both within Jordan and abroad. Decision-making on energy issues is largely determined by the Ministry of Energy and Mineral Resources (MEMR), which is responsible for planning and policymaking, while the Energy and Minerals Regulatory Commission (EMRC) serves a regulatory function.³³

In recent years NEPCO's commitments to purchase fossil fuels and fossil electricity combined with the rapid growth in renewables, has led to a situation of oversupply. When renewables operate at full capacity (approximately 2.5GW in 2022), they can easily cover the minimum load (see Figure 2). However, NEPCO incurs costs for capacity payments to fossil energy generators and take-or-pay gas supply agreements even if fossil energy is not needed. With 20% of public debt linked to NEPCO³⁴, the implications of NEPCO's debt for Jordan's political economy are significant. This debt burden has only increased since Covid-19 and is a major barrier to Jordan's economic growth. Indeed, the country has narrowly avoided insolvency in recent years and is heavily reliant on foreign aid.³⁵

The costs of fossil fuel oversupply

Jordan imports both natural gas and crude oil from neighbouring countries. Natural gas is sourced mainly from Egypt and Israel via pipelines and crude oil from Saudi Arabia and Iraq. Over the past years, the bulk of Jordan's fossil fuel imports have been supplied under an agreement between NEPCO and US-based Noble Energy to source natural gas from the Leviathan Gas Field in Israel over a period of 15 years.³⁶ NEPCO supplies this gas to thermal power plants and then buys the electricity they produce. With Jordan's installed renewable energy capacity reaching 2,445.7 megawatts in 2021, total electricity production now exceeds demand on days when renewable output peaks. The single buyer, NEPCO, is obliged to purchase all electricity produced by renewable energy generators first. Even if there is no need for additional electricity from (all) fossil fuel power plants, the company must still make "capacity payments" to gas power plants that are not producing electricity as their output would exceed the capacity of the electricity grid. Long-term take-or-pay contracts also require NEPCO to pay fossil fuel suppliers under these circumstances. As a consequence, NEPCO's expenses for natural gas outstripped revenues in 2020 and 2019.³⁷

NEPCO now finds itself in a state of carbon lock-in, in which its debts are worsened when renewables 'force' fossil capacity off the grid. The resulting risk of stalling or delaying the energy transition to avoid further debt is harmful to the country in several ways. On the one hand, from a climate perspective, Jordan needs to transform its energy systems as quickly as possible in order to reduce emissions. From an economic perspective, Jordan risks stifling its emerging clean technology sector and dropping behind in the transition towards a global low-carbon economy, which would incur even greater costs in the long run. An overhaul of the Jordanian electricity market and greater regional cooperation, especially increased grid connectivity will be key to overcoming these challenges. This

would enable Jordan to export electricity to its neighbours at a profit rather than curtailing generation and piling on more debt. NEPCO's rapid accumulation of debt could be somewhat eased by increasing exports to other countries in the region; currently there are already electricity interconnections with Palestine, Egypt, and Syria. Expanding opportunities to market surplus electricity regionally would eliminate the financial pressures from oversupply and resolve the current political and regulatory dilemma that has stalled growth in the clean energy sector. To achieve this, efforts to expand cross-border interconnectors should be pursued as a priority ahead of electricity market reforms and the development of inclusive planning processes to foster innovation.

Jordan: Electricity generation capacity vs. demand (in MW)

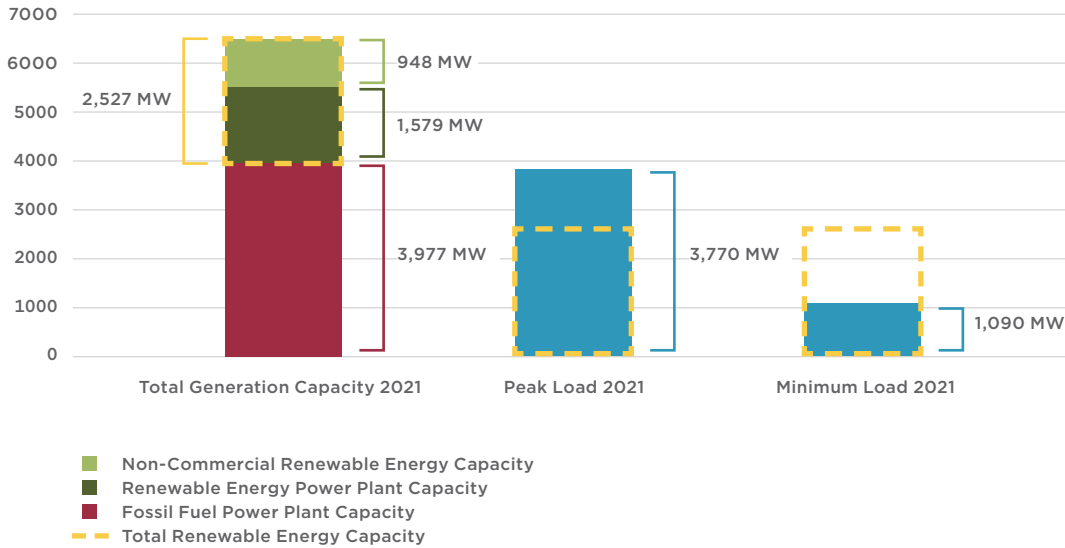


Figure 2: Jordan’s electricity generation capacity vs. demand. Under ideal conditions, renewable energy can cover around two thirds of the peak load, and it can easily cover the minimum load.³⁸

Source: IASS/Authors

NEPCO Operating Balance (in million JD)

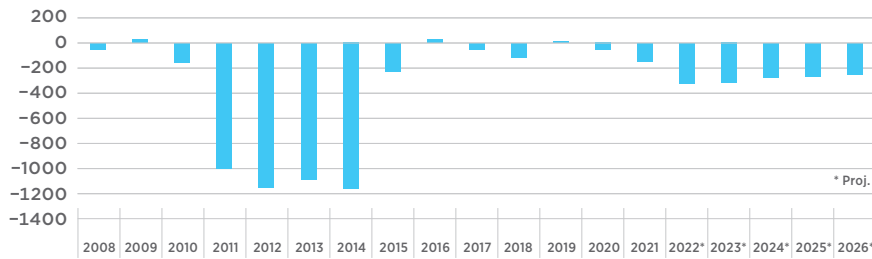


Figure 3: NEPCO made heavy financial losses during and in the wake of the Arab Spring. According to current projections NEPCO will not return a profit in the period through to 2026.³⁹

Source: IASS/Authors

1. Increase regional cooperation

Jordan's government should strengthen energy cooperation with neighbouring countries with the aim of revitalizing its energy transition and escaping the carbon lock-in effects that have stalled progress. Improved regional grid connectivity would facilitate the export of surplus electricity, helping NEPCO to minimise losses. Various long-term purchasing and supply agreements should be renegotiated in order to alleviate the financial burdens imposed by excess fossil-fired generating capacities. Opportunities for joint Power-to-X options should be explored as a means to harness renewable resources to the fullest extent possible.

Improve regional connectivity: Current efforts by the government of Jordan to expand electrical interconnections with neighbouring countries and develop a regional power market by connecting Jordan's grid with those of Iraq and Saudi Arabia should be continued and accelerated. Existing interconnections to Egypt, Syria and Palestine should further be expanded in line with current planning.^{40,41} Projects for integration with other large markets like Europe and the Gulf (following the Med-TSO network and Gulf Cooperation Council on electricity trade) should be promoted by using these platforms to raise international interest and investment in interconnections. However, it should be noted that most electricity exports to Europe would flow through Egypt or Syria, where energy infrastructure has been vulnerable to damage in past conflicts.⁴²⁻⁴³ Jordan's energy transition planning needs to be both robust and flexible enough to adapt should connections to Egypt and/or Syria be interrupted.

Collaborate on renegotiating PPAs for fossil fuel power plants: Disbursing capacity payments to power plants even if they are not generating electricity is costly for NEPCO, and the government should renegotiate its agreements with the operators of fossil-fired power plants, just as it is doing with renewable energy producers.⁴⁴ Key stakeholders in these power plants include government actors from Saudi Arabia, which is an important donor in Jordan. If the Jordanian government can bring these stakeholders

to the table and show that NEPCO's debt is causing major economic issues, they might be willing to renegotiate PPAs with less burdensome terms such as reduced capacity payments.

Collaborate on renegotiating gas supply contracts: The government should seek to renegotiate current take-or-pay agreements with fossil fuel suppliers such as Noble Energy, which supplies NEPCO with natural gas from Israel. Here, too, Jordan can make a strong case that the lack of flexibility afforded to NEPCO under these agreements jeopardises the company's financial stability, with broader implications for public finances and future energy cooperation. This is of particular relevance to Israel given the recent signals of interest in an energy-for-water deal between the two countries, under which Jordan would sell electricity to Israel.⁴⁵ Greater flexibility could also be achieved by allowing importers to pay a minimum price instead of take-or-pay, or allowing re-exports to other destinations.^{46,47}

Promote regional cooperation on power-to-X uses: Jordan should build on its favourable conditions for renewables to generate revenues from surplus renewable energy through power-to-X solutions. This would enable electricity to be used to make secondary products such as green hydrogen or green ammonia. It will require considerable investment and regional cooperation to establish cross-border markets, regional hydrogen supply networks, and transportation and storage infrastructure. The Saudi firm ACWA Power, with which Jordan has cooperated extensively, is currently planning a massive green hydrogen project just across the border from Jordan in Neom (Saudi Arabia), providing an opportunity for cooperation in this sector.⁴⁸ As Jordan and Neom have already expressed their interest in cooperation in the future⁴⁹, and Jordan possesses the necessary technical capacities and experience with renewables, this could be a promising avenue for future collaboration. However, any involvement in hydrogen production, which is especially water-intensive, would need to take into account Jordan's existing water scarcity issues.

2. Involve stakeholders in energy policy development and decision-making

Jordan's current top-down approach to energy policy should be opened up to enable multi-level decision-making. Bringing relevant stakeholder groups into the policy development process will reduce the risk of miscalculation and improve the overall fit of future policies.

Increase stakeholder involvement in national energy decisions: Intensive exchange is needed between policymakers and experts from finance, industry, and research to ensure that decision-makers are well-informed and understand the consequences of proposed policies for various actors, in order to avoid unintended consequences like current overcapacity. An “Energy Market Platform” should be established as a forum for stakeholders to discuss key issues such as overcapacity and recommendations for long-term policy development and infrastructure planning. An example of such a forum is Germany's “Electricity Market Platform”, which brings together relevant stakeholders from government, industry associations, non-governmental institutions, and scientific organisations. The platform's working groups discuss energy security and market design, flexibility, evolving renewable energy incentives, and electricity market integration and, where appropriate, their recommendations inform new policies.⁵⁰ Italy takes a more government-driven approach in which stakeholders are invited to discuss government proposals in workshops on specific issues.⁵¹ Both approaches provide governments with valuable information from different sectors about the most pressing challenges and potential solutions.

Increase stakeholder involvement in international finance projects: International institutions like the International Monetary Fund (IMF), the European Bank for Reconstruction and Development (ERBD) and the World Bank have provided NEPCO and the Government of Jordan with funding for emergency liquidity, corporate governance, market reforms, and more. International institutions need more contextual information to ensure that funds are directed towards investments that consider needs and limitations in the Jordanian context. This could be obtained through consultations with a range of domestic stakeholders (e.g. from the financial and industrial sectors and research) when planning and implementing new funding projects. Their perspectives could offer insights into possible developments beyond the immediate interests and debt-driven considerations of NEPCO and ensure that institutions mandated to align their work with the Paris Agreement do not cement current carbon lock-in effects.

3. Reform the electricity market

As regional electricity trading grows, additional steps should be taken towards market reforms to enable sustainable development. NEPCO should be repositioned as a transmission system(s) operator (TSO), and retain its responsibilities in the operation, maintenance, and expansion of the transmission network and connection to other networks. Measures should be put in place to ensure that providers of technical assistance are aware of the political context and implications.

Ensure contextualised technical assistance for market reform: NEPCO has been working with international institutions like the EBRD on corporate transparency and governance changes, and receives technical assistance for reforms focused on restructuring and unbundling.⁵² In light of the serious political and economic implications of the company's debts, efforts to restructure NEPCO will need to account for the specific context (i.e. stranded fossil assets, existing carbon lock-in effects and latent risks, regional political implications). It is therefore important that actors providing technical assistance for market reforms gather information from a broad range of stakeholders from energy, finance, research, and civil society as to the structural challenges and implications of restructuring. In addition, technical assistance providers must take into account that energy security is a key concern for the Jordanian government, and that it is not seen as appropriate by the Energy and Minerals Regulatory Commission (EMRC) to privatise NEPCO.⁵³ NEPCO can continue safeguarding energy security as a transmission system operator and work closely with government as the market moves away from a single-buyer model. While reforms in the EU and other countries often focussed on ownership unbundling (separating ownership infrastructure from sales), other approaches may be more appropriate to the Jordanian context.

Create an action plan for market liberalisation with impacted stakeholders: The Ministry of Energy and Mineral Resources (MEMR) notes the need to move away from the current single-buyer model in its 2020–2030 strategy, but the task of implementing liberalisation has been left to NEPCO.⁵⁴ To identify how market liberalisation can be implemented in harmony with other policy priorities, the action plan's creation and implementation should be led by ERMC and MEMR and pursued in collaboration with ministries representing other affected sectors, including the Ministries of Transport, Planning and International Cooperation, and Industry and Trade and Supply. Part of the action plan should include setting up monitoring and regular evaluation processes to track progress and assess impacts on other key sectors and industry. It is vital that industry and professional associations be invited to offer feedback on the impacts of market liberalisation as part of these processes.

Conclusion and outlook

The developments in Jordan's energy transition in the last years have shown that energy transition processes do not necessarily follow a linear path and may be constrained by national political and economic issues. In this case, the key obstacle is a situation of carbon lock-in created by the single-buyer electricity market in which NEPCO has overcommitted to purchasing more energy than it can use, as well as take-or-pay contracts to supply electricity producers with gas. This leads to a situation where NEPCO's debts are worsened when renewables 'force' fossil capacity off the grid. NEPCO's rapid accumulation of debt could be somewhat eased by increasing exports to other countries in the region. Improved regional energy market integration could be the starting point for further regional cooperation on PtX projects and the re-negotiation of current PPAs and take-or-pay contracts. Regional cooperation is a pre-requisite to any further changes to the energy system. To ensure a long-term and comprehensive energy strategy for the country, stakeholders should be involved in policymaking and assessments of the current situation

and future needs. NEPCO's role within the electricity market should be repositioned as a transmission system operator. The implementation of these measures will provide a basis on which Jordan can then tackle other important energy-related issues, such as the expansion of storage options for renewable energies and the transition to e-mobility.

These reform proposals are not only of interest to actors within Jordan. There are also implications for international donors like the EBRD and IMF, who should be aware of the underlying structural issues in the Jordan energy system when deciding on interventions. A larger point to consider in other countries and for donors interested in energy transitions, is that it is not enough to build up supply – it must also be considered where fossil and renewable energies will eventually come to compete. Long-term planning about available capacity can help other utilities avoid being locked into fossil fuel contracts where they must pay fossil and renewable energy suppliers simultaneously. ■

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