

Puerto Rico Transformation —
Importance
of an
Independent
Regulator

Vision for the Future

BY TOMÁS TORRES AND CATHY KUNKEL



hurricane Maria's devastation of Puerto Rico in September 2017 reinforced the general understanding that the Puerto Rico Electric Power Authority (PREPA) cannot stand on its own.

Unnecessary delays, lack of coordination with national utilities and dubious contracts resulted in intermittent service restoration to just fifty percent of customers three months after the hurricane.

PREPA needs fundamental reform, alongside strong supervision from the Puerto Rico Energy Commission (PREC) and the Fiscal Oversight and Management Board (FOMB).

We propose basic strategies that can transform the current electrical system into one that is strongly regulated in line with U.S. mainland standards.

The new system should be resilient, environmentally compliant, competitive, and compatible with robust development of distributed energy resources. It should be built around diverse sources of energy, including a significant amount of indigenous renewable electricity.

Puerto Rico has an opportunity to design a resilient system based on a diverse and competitive energy portfolio with much greater use of renewables than is currently the case.

It is clear that the present generation system is unsustainable. PREPA pays over one billion a year for fossil fuel energy resources that include oil, coal, and gas. Those resources are not indigenous to the island.

Current policy supports off-island fuel providers and outdated power stations, many of which are out of compliance with federal air quality regulations. In fiscal year 2017, forty-eight percent of Puerto Rico's electricity was generated from oil, and an additional fifty percent from coal and gas.

The island's grid is poorly configured, with sixty-five percent of electricity generation facilities located in southern Puerto Rico. However, most power consumption is in the north. The reliance on long-distance south-to-north transmission has been a major barrier to PREPA's ability to restore power after Hurricane Maria.

PREPA has suffered from highly-politicized management. And from the retirement of a large number of skilled workers who left because of the Puerto Rican government's fiscal crisis.

While PREPA workers are in favor of having the utility become a hundred percent reliant on renewables, management has consistently prioritized politically-driven investments and contracts.

A long-term practice of putting unqualified political appointees into high-level positions that require technical and professional competence has not served PREPA or the people of Puerto Rico well.

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Puerto Rico needs a strong energy regulator to implement a new vision for an electrical system built around resiliency, indigenous renewable energy and competition.

In fiscal year 2017, PREPA generated less than two percent of its electricity from renewable sources, putting it out of compliance with the legal mandate of twelve percent by 2015.

In 2015, PREPA filed its first-ever Integrated Resource Plan with the PREC, proposing continued heavy reliance on centralized fossil fuel generation. That plan would have had PREPA get only fifteen percent of its electricity from renewables and three hundred twenty-two megawatts from distributed energy by 2035.

It included the construction of a second LNG import terminal on the south of the island, planned as a floating storage and regasification unit instead of a land-based one. And the plan called for the retrofit and conversion to natural gas of most units at the existing Aguirre site.

Questioning many of the underlying assumptions, the PREC rejected the plan, approving one that called for greater reliance on energy efficiency and renewable energy. And it required further economic analysis before continuing with the proposed LNG terminal at Aguirre.

Until recently, PREPA has had no independent regulator. Legislation in 2014 and 2016 expanded regulatory oversight to two entities: the Puerto Rico Energy Commission (PREC) and the Financial Oversight and Management Board (FOMB).

Each has regulatory jurisdiction over different aspects of PREPA and the electrical system. The PREC, under Act 57 of 2014, has the authority to develop a long-term vision for the electricity system and to create applicable rules and regulations.

In the short term, the PREC's regulatory oversight forced PREPA to exit from or renegotiate out-of-market contracts for renewable energy that had been entered into without regulatory oversight.

It also initiated a proceeding to develop regulations that can facilitate private capital investment in distributed energy and microgrids as a way to assist in restoring power and to modernize the system.



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The FOMB, established by Congress, has focused on developing ten-year fiscal plans for PREPA and other insolvent Puerto Rican government agencies. But in the absence of a long-term vision for the energy system, these fiscal plans alone will not provide financial stability for PREPA.

Decisions about energy resource planning made over the next ten years should be made in the context of a long-term integrated resource plan designed to avoid wasting capital. And to discourage PREPA from relying on centralized fossil-fuel-based generation located far from demand.

It is of utmost importance that the FOMB and the PREC establish a protocol for cooperation and avoidance of conflict in their oversight responsibilities.

The PREC is the entity with clear, independent authority to regulate Puerto Rico's energy system as a whole. That system includes more than just PREPA. The island's future energy system should include community-owned and privately-owned distributed energy and microgrid facilities.

The PREC has the expertise and legal authority to develop rules to facilitate competitive development of these resilient renewable resources. They also have the know-how to ensure that deployment of these technologies fits into a long-term vision for the energy system and for PREPA.

The near-term future of Puerto Rico's power system, in terms of rebuild and investment, will involve significant reliance on fossil fuels. However, we believe that is imperative to re-think

investment priorities and encourage private solar and microgrid developers who have recently expressed interest in Puerto Rico.

Electrical-system modernization has been hampered by years of mismanagement by PREPA, resulting in a severely deteriorated and outmoded generation and transmission system. This lack of effective governance has hindered competitive private sector participation.

That said, two areas in which PREPA retains significant value are its ability to charge customers and its knowledge and skill base of remaining and retired employees. Any plan that does not consider both factors will likely fail.

Recently, the governor of Puerto Rico announced his intention to sell PREPA's generation assets and lease or establish a management services agreement for its transmission and distribution system.

Whatever form of ownership results from this transaction, such as investor-owned, state-owned, municipal utilities, customer-owned utility cooperatives, or some combination, the key to successful electric system redevelopment is strong regulation and a legal framework that harmonizes the interests of all players for the benefit of the public.

Importantly, whatever form new ownership takes should not worsen the exodus of employees who serve as the system's institutional memory. We see new forms of partnership as essential, and believe that any viable financial plan will require investment in stable, professional, well-managed employees.

In summary, if true modernization of Puerto Rico's electrical system is to be achieved, regulation in line with U.S. standards, bringing transparency for the benefit of both investors and customers, is a must.

Although the importance of regulation is well understood on the U.S. mainland, the concept is still new in Puerto Rico.

If the PREC can proceed with its urgent work regulating the modernization of Puerto Rico's electricity system, we see no reason why Puerto Rico cannot rebuild its electricity system to deliver widespread public benefits. But it must utilize a far more ambitious long-term vision than the one articulated by PREPA thus far.

In the short to medium term, the energy sector, including PREPA, is likely Puerto Rico's largest economic development opportunity, with the potential of attracting billions of dollars in capital investment. That investment should result in billions of dollars in avoided fuel and energy costs.

Background

The proposed plan is based on seven main elements:

The Integrated Resource Plan approved by the Puerto Rico Energy Commission (PREC) on September 23, 2016 should be

the basis for the re-design of Puerto Rico's energy system.

System redesign should be based on a long-term vision.

Existing outdated steam and combined cycle units should either be retired as expeditiously as possible or designated limited-use. Existing purchased power contracts should be re-evaluated in light of their expiration dates.

Demand response and energy efficiency programs should be implemented immediately.

The generation mix should be comprised of utility-scale generation, including renewables and highly-efficient fossil generation and distributed energy, including combined heat and power and microgrids with energy storage.

New and efficient utility-scale dual fuel diesel-natural gas generation should be installed on a transitional basis in San Juan, Palo Seco, and in the south, with the objective of propelling the deployment of renewable energy resources.

Utility-scale demand will unavoidably decline as ratepayers shift toward distributed energy, that is, private, behind-the-meter generation.

The 2016 Approved IRP

The redesign of Puerto Rico's energy system need not start from scratch. The Integrated Resource Plan approved by the Puerto Rico Energy Commission on September 23, 2016, should be the basis of any redesign initiative.

The approved IRP would, for the first time, have PREPA's operation guided by plans that meet the uniform, professional standards required of every public and private utility in the U.S.

These standards require adherence to practices of sound energy planning, responsible management, prudent budgeting and borrowing, affordable rates, professional workforce development, and responsive customer service.

The PREC has already started on the process of updating PREPA's approved IRP to reflect post-hurricane Maria conditions.

In October 2017, it launched an investigation to identify the strategies and regulatory actions needed to modernize the energy system and on January 3, 2018, issued a draft microgrid regulation.

Over the longer term, the PREC will be identifying the regulatory actions needed to transition towards a more sustainable model of electric service delivery. This will feed into the next round of revisions of PREPA's Integrated Resource Plan.

Redesign Vision

From a technical standpoint, there is no reason why Puerto Rico cannot rebuild its grid to support the goal of a hundred percent

renewable energy by 2050. This would require modification of the current twenty percent-by-2035 renewable energy target currently articulated in Commonwealth law.

Other island electricity systems have articulated long-term visions for moving to renewable energy-based systems.

Hawaii, for example, has a goal of a hundred percent renewable energy by 2045. The Hawaii Public Utilities Commission has ensured that Hawaii's main utility has a plan for achieving that target five years ahead of schedule.

The U.S. Virgin Islands has a target of thirty percent renewable energy by 2025 and has been moving aggressively to reduce its dependence on imported oil.

As part of the IRP process in Puerto Rico, we believe it is reasonable to bring forward the target for a minimum of twenty percent renewable energy to 2023 and to set a fifty percent renewable target by 2035 and a hundred percent by 2050.

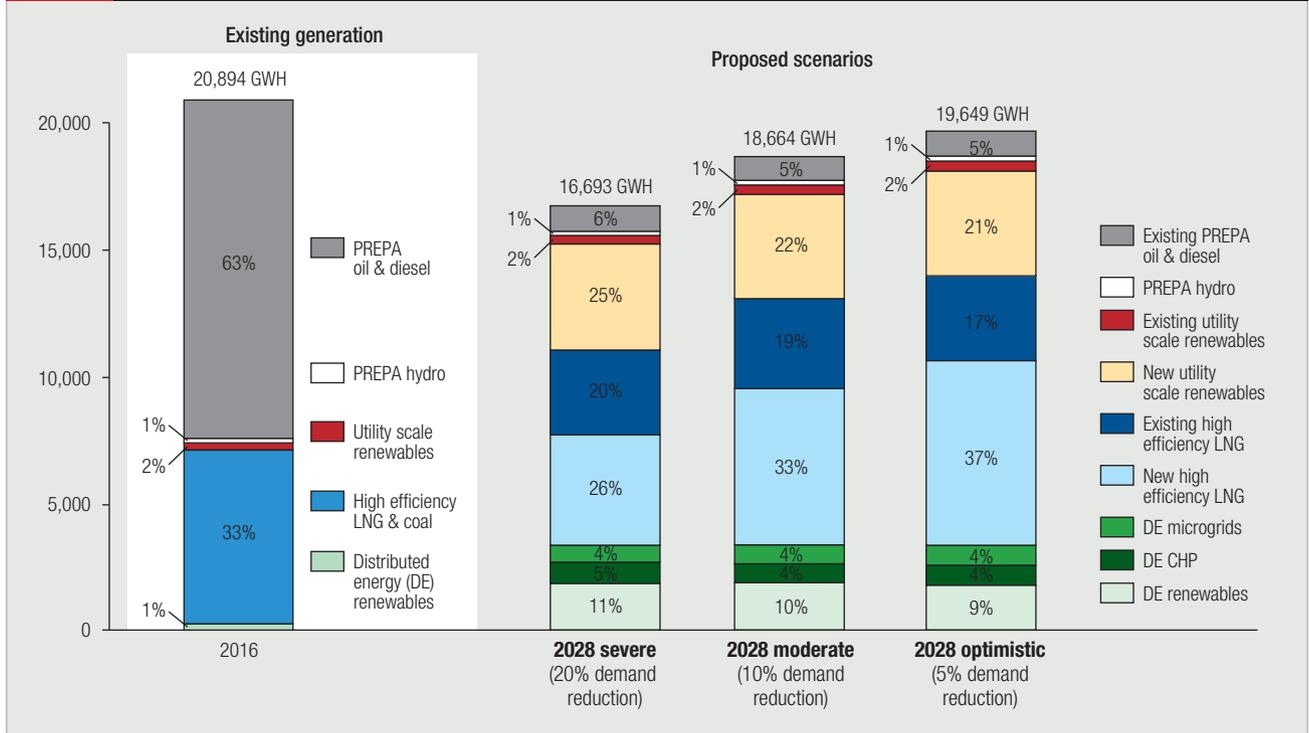
The rate of growth and ultimate amount of renewable energy is not a function of the technical and engineering capability of renewable technologies. Rather, it is a question of the governance of PREPA and the strength of regulatory oversight.



One of the largest uncertainties over the next few years is how quickly Puerto Rico's electricity demand will drop. We estimate that the decrease of electricity demand from PREPA could be more than the twenty-three percent projected by PREPA pre-Maria.

We consider three scenarios: significant demand loss (twenty percent of overall demand loss and a thirty-five percent demand loss for PREPA by 2028); moderate demand loss (ten percent overall demand loss and twenty-five percent for PREPA); and an optimistic scenario (five percent overall demand loss and twenty percent for PREPA).

As a result of the significant, though uncertain, projected drop in sales, we believe that incrementally building out smaller-scale generation aimed at propelling renewable energy resources

FIG. 1**PUERTO RICO ELECTRICAL SYSTEM TRANSFORMATION PLAN – ELECTRIC SYSTEM GENERATION (GWH)**

while retiring older oil-fired units is more appropriate, and more capital-efficient, than building large centralized generating plants.

Additionally, as photovoltaic, wind generation, other renewables and energy storage costs decrease, the implementation of energy storage will allow renewable energy to be dispatched at any time of day.

For example, if the proposed installed capacity of utility-scale and distributed renewable energy is increased by fifty-five percent by 2035 and complemented by the use of battery storage at competitive dispatchable energy prices, assuming no change in demand after 2028, fifty-seven to sixty-seven percent of energy generation by 2035 could be achieved through renewables.

Retirement of Existing Units

The September 2016 Approved IRP modified by the PREC discussed the retirement of existing PREPA oil-fired steam units. Although the schedule for retirement of the existing steam fleet will be revised post-Maria, retirements of these units should occur within the next five years.

Our proposal considers the retirement of all oil-fired units, with the exception of the units mentioned below, which should be designated as limited-use, meaning a capacity factor of less than eight percent.

Due to high maintenance costs and unreliable service, the oil-fired steam units are a burden for PREPA and its ratepayers.

Additionally, none of the oil-fired steam units, with the exception of Costa Sur 5 & 6, which co-fire natural gas and oil, are in compliance with the federal Mercury and Air Toxics Standard

unless they are retired or designated limited use.

Because maintaining generation in the north side of the island is so important, we assume that the recently retrofitted Palo Seco Units 3 & 4 can be designated as limited-use and that the remainder of the steam units can be retired.

This plan also considers the Aguirre and San Juan combined cycle units. Based on our estimates of declining energy demand, the Aguirre combined cycle can be retired, and the San Juan 5 & 6 placed under limited use.

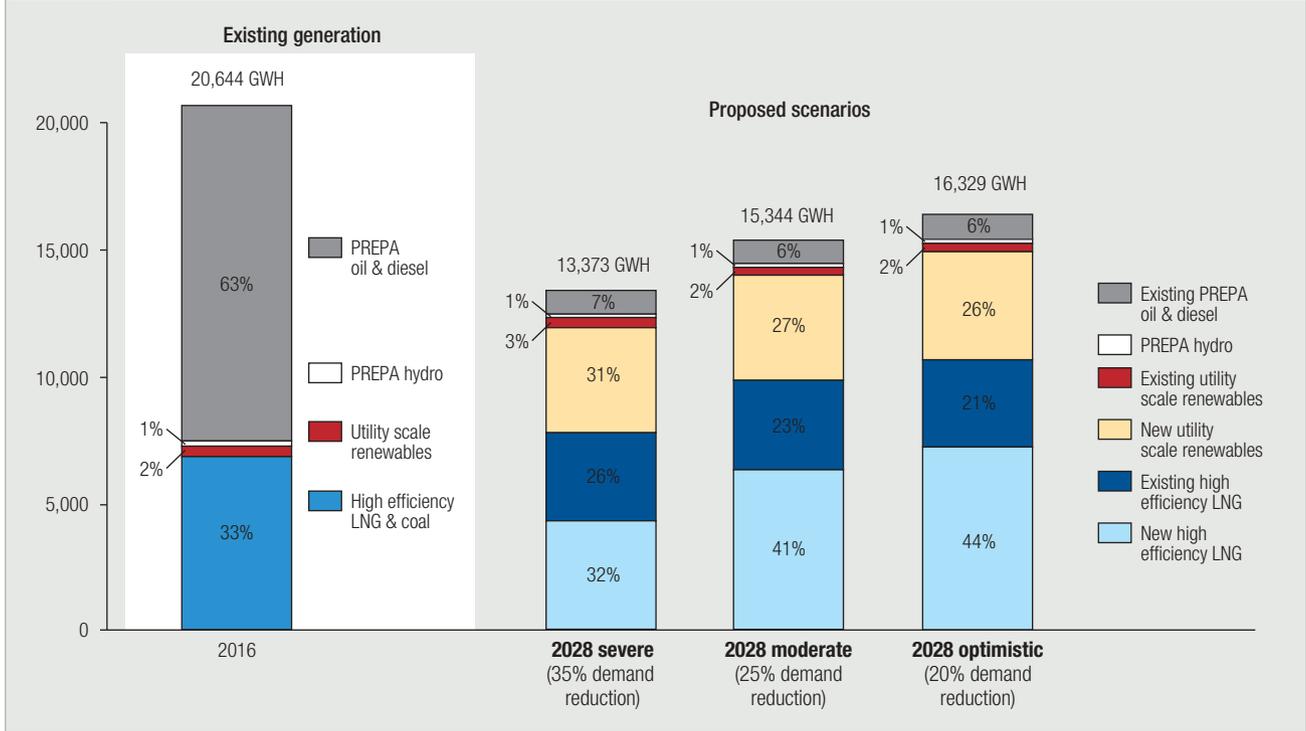
The capacity factor for the peaking units, including Cambalache, Mayaguez and other units, averaged five percent for fiscal years 2012 to 2016. The proposed capacity factors considered under this analysis for those units were based on those historic values.

Retired units under our proposal would be replaced as needed by a combination of demand response and energy-efficiency programs; new utility-scale renewable generation; new distributed generation comprised of renewables and combined heat and power; and new high-efficiency dual-fuel natural gas/diesel generation.

Immediate Implementation of Demand Response and Energy Efficiency Programs

Puerto Rico's average electricity demand in 2016 was 1976 megawatts and peak demand was 3087 megawatts.

Peak demand is fifty-six percent higher than average demand. Puerto Rico could avoid building peak generation capacity if it were to develop ways to decrease peak demand.

FIG. 2**PUERTO RICO ELECTRICAL SYSTEM TRANSFORMATION PLAN – UTILITY SCALE GENERATION (GWH)**

Typically, on the U.S. mainland and abroad, this is achieved through demand response and energy efficiency programs, and more recently, energy storage facilities. Puerto Rico's demand peak occurs in the afternoon, evening, and night, until eleven p.m. That is followed by a well-defined demand valley from midnight to six a.m.

This suggests a need for programs to help reduce and shift the highest demand to the demand valley and/or to the renewables generation peak between ten a.m. and three p.m.

By reducing peak demand to 2570 megawatts or so (1.3 times the base demand), approximately five hundred megawatts of generation capacity could be saved and/or avoided. This would reduce generation-fleet costs and related financial and environmental costs.

We propose that by 2028, Puerto Rico implement demand response and energy efficiency programs, with the goal of reducing peak demand to one hundred thirty percent of average demand.

This will be challenging, representing an approximate seven-teen percent reduction in the 2016 peak.

Generation Mix of Distributed Energy and Utility Scale Generation

According to the 2017 PREPA fiscal plan, the amount of distributed energy in 2016 was 136 megawatts. Our proposal includes an additional 1,500 megawatts of distributed energy by 2028.

In all scenarios, this is comprised of 1000 megawatts of distributed solar, 400 megawatts of microgrids and 100 megawatts of CHP.

In terms of utility-scale generation, 650 megawatts of new high efficient dual fuel generation is included in the significant (thirty-five percent) demand loss scenario; 950 megawatts in the moderate (twenty-five percent) demand loss scenario; and 1,100 in the optimistic scenario, plus 2,555 megawatts of utility-scale renewables (including hydroelectric) in all demand loss scenarios.

Utility-scale generation, including renewables, amounts to 5,430 megawatts in the significant (thirty-five percent) demand loss scenario, 5,730 megawatts in the moderate (twenty-five percent) scenario and 5,880 megawatts in the optimistic (twenty percent) demand loss scenario.

See Figures One and Two.

This proposed energy portfolio improves the electrical system's reliability and exceeds the legislatively-mandated renewable energy target. It also promotes local investment in distributed energy generation. This is essential under prevailing economic conditions post-Maria.

New High Efficiency Small-Scale Dual Fuel Units

All scenarios considered under this analysis include new transitional high efficiency dual fuel diesel-natural gas generation.

By 2028, the thirty-five percent demand decrease scenario considers 650 megawatts, the twenty-five percent reduction scenario 950 megawatts and the optimistic twenty percent decrease scenario 1,100 megawatts, to be split among small generating units mainly between the San Juan and Palo Seco plants, located in the north side of the island, with a few units in the south.

While our scenarios assume new dual fuel combined cycle

generation, it is possible that a more detailed economic analysis of fossil fuel options would reveal that repowering existing combined cycle units is a more cost-effective approach to ensuring baseload power generation.

Either way, new investment to improve the efficiency and flexibility of fossil fuel generation is clearly required. Our scenario of new dual fuel generation in the north would require natural gas to be delivered to the north coast of Puerto Rico. Further analysis is needed on natural gas delivery options.

In addition to new generation at the San Juan and Palo Seco plants, and considering EcoEléctrica's contract expiration by 2022 and AES's by 2027, this proposal assumes the renegotiation of EcoEléctrica's contract to the end of the IRP period in 2035, and the termination of AES's contract by 2027.

Depending on the relative cost of replacement technologies and anticipated energy demand at the time new generation proposals are being evaluated, the new generation from high efficiency dual fuel (diesel/natural gas) units assumed in this plan could be partially or entirely replaced by solar and battery storage plants.

The regulation and governance of new high efficiency generation should emphasize competitive pricing and utilization of existing infrastructure. It should incentivize low operating costs. This plan assumes a maximum useful life of twenty-five years for new natural gas generation equipment.

Existing fossil generation, as well as the new proposed dual fuel generation under the twenty-five-year contract, is assumed to be replaced with a combination of utility-scale and distributed energy renewables with battery storage to achieve a hundred percent renewable energy by 2055.

Unavoidable Reduction in Utility Scale Demand

Before Hurricane Maria, the projected decrease in demand from the utility between 2006 to 2026 was estimated at thirty-nine percent. From 2006 to 2016, PREPA's energy sales decreased sixteen percent and 2017 projections to year 2026, according to PREPA's fiscal plan, is a sales decrease of an additional twenty-three percent.

A reduction in population could lead to an additional demand decrease. A population loss of approximately four hundred seventy thousand residents between 2017 and 2019 is expected after Hurricane Maria.

Additional reductions in projected demand from PREPA are related to the implementation of demand response and energy efficiency programs, the switch from a traditional centralized

generation model to distributed generation, and the installation of co-generation and CHP units at industrial plants.

Additional Considerations and Conclusion

Additional basic principles were considered as part of this evaluation, including differentiation between overall generation requirements and utility scale generation, definition of a minimum reserve margin, the importance of achieving sustainable debt levels for PREPA, battery storage, and the implementation of new suitable governance structures to ensure cost-effective integration of new resources.

A transformed energy system will be required to develop new dispatch models, similar to wholesale energy markets, and new protocols for integrating new generating sources and structures into a coherent and cost-effective whole.

Regulation will be needed to ensure that investors and the public interest are protected. This process should be managed so

It is of paramount importance that system stakeholders have transparency into capital needs and operating costs and that all parties can participate.

as to avoid discrimination against new generators, to ensure that large- and small-scale generators are treated equitably, and to ensure that all sectors of Puerto Rican society have equitable participation in the new system, promoting energy democracy.

It is of paramount importance that system stakeholders have transparency into capital needs and operating costs and that all parties can participate with equal opportunity.

The current lack of competitive price formation (marginal pricing), uniform tax framework (public versus private), market access and independent grid operations creates dubious management incentives that do not align with the public interest.

Transformation of Puerto Rico's energy system requires not only physical changes to generation, transmission and distribution but strong regulation to ensure successful implementation.

How changes are implemented will significantly affect their effectiveness. A strong, independent regulator is needed to implement a comprehensive planning process and provide certainty to consumers and investors as the energy system is modernized. **PDF**

For a full copy of this article go to: <http://ieefa.org/all-reports/> and <http://icsepr.org/press/>.

Why does it seem that electricity has become cheaper? One reason is the trend in electric rates, inflation-adjusted. From January 2009 to January 2018, the overall Consumer Price Index increased 17.4 percent. During this same period, the CPI for electricity increased 10.3 percent. That's forty-one percent less than the overall CPI.