BEFORE THE

COUNCIL OF THE CITY OF NEW ORLEANS

IN RE: INFORMATION REGARDING PROPOSED RULEMAKING TO ESTABLISH INTEGRATED RESOURCE PLANNING COMPONENTS AND REPORTING REQUIREMENTS FOR ENTERGY NEW ORLEANS, INC (ENO).

DOCKET NO. UD-08-02

Building Science Innovators (BSI) hereby submits two letters and a published article from *Scientific American* as a means of illustrating its two most important assertions from its contributions to the 2015 Integrated Resource Planning (IRP) process (See https://www.dropbox.com/sh/a7ohwfd2lpqfdaj/AADOci7fvR9-JDEB_sbj7ubSa?dl=0 .)

1. ENO's IRP process could not achieve its primary goal of identifying a set of supply- and demand-side options that minimize total capital costs while ensuring that supply fulfils demand at reasonable rates because it did not consider a host of supply- and demand-side practices (e.g., battery storage, price arbitrage) successfully implemented in New York and California, and other states, which have greatly decreased the need for gas turbine peaking plants and would do the same for New Orleans.
2. Customer Lowered Electricity Price (CLEP), a related model, is a particularly cost-effective, fast, and easy to roll out program that accomplishes the above and can position New Orleans as a forward-thinking model of energy use.

In recent conversations with concerned members of the official distribution list, it became apparent that, to date, the above ideas were not clearly understood. Hence, this submission includes: (1) comments about Los Angeles' 2014 Integrated Resource Planning process; (1) a 2-page letter that succinctly explains alternatives to building a new power plant, with an emphasis on the Customer Lowered Energy Price (CLEP) program; (2) Bullet points for a meeting with Councilman Gray; and (4) a *Scientific American* article that explains part of Los Angeles' plan to shut down a peaking plant and replace it with a 100 MW battery that will purchase and store energy at the least expensive times of day for use during hours of peak demand.

The above link also provides a 2014 grant submission to the Department of Energy to promote the installation of storage batteries in buildings and the final report of the New Orleans Energy Policy Taskforce of 2007 which originated the Integrated Planning Process in New Orleans the first place. The grant was highly considered but not awarded; however, the above exemplifies BSI's committed, well-informed, and decade-long efforts to promote the storage battery concept, both on the demand- and supply-sides, for New Orleans. Thank you for your consideration.

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December 12, 2016

Los Angeles' 2014 Integrated Resource Planning Process

Five months after New Orleans initiated its current IRP, Los Angeles resolved theirs. Like New Orleans, Los Angeles had, many years earlier, built peaking plants that needed replacement. New Orleans decommissioned its plant this year and may be *en route* to replacing it with another combustion turbine, but, contrary to ENO's IRP process, Los Angeles decided to hold an auction to meet demand. In November 2014, their utility purchased nearly 1900 MW.

West LA Basin

Seller	Resource Type	MWs	Number of Contracts
NRG	Energy Efficiency	102.5	8
Onsite Energy Corporation	Energy Efficiency	11.0	11
Sterling Analytics LLC	Energy Efficiency	16.7	7
NRG	Demand Response	75.0	7
SunPower Corp.	Behind-the-Meter Renewable	44.0	4
Ice Energy Holdings, Inc.	Behind-the-Meter Thermal Energy Storage	25.6	16
Advanced Microgrid Solutions	Behind-the-Meter Battery Energy Storage	50.0	4
Stem	Behind-the-Meter Battery Energy Storage	85.0	2
AES	In-Front-of-Meter Battery Energy Storage	100.0	1
AES	Combined Cycle Gas Fired Generation	1284.0	2
Stanton Energy Reliability Center	Peaking Gas Fired Generation	98.0	1
	TOTAL:	1891.8	63

[1]

Among the winning bids was a 100 MW battery system, "peaking" plant that can output for four hours; but even more cost-effective were the almost 22 winning bids that purchased more than 200 MW of "Behind-the-Meter Energy Storage" (i.e., batteries installed in buildings).

This begs the question: Why didn't a battery system on either side of the meter compete within the local IRP decision process? Without a doubt—despite BSI's recommendations throughout the process—this happened because ENO excluded consideration of these options.

Also, please notice that Los Angeles's utility even more cost-effectively purchased a 10% reduction in peak demand, i.e., over 200 MW. The least cost-effective choice, representing only 5% of the solution, was a combustion turbine.

[1] www.greentechmedia.com/articles/read/The-Worlds-Biggest-Battery-is-Being-Built-in-Southern-California

November 29, 2016

Dear Councilmember :

At this 11th hour, this letter hopes to convince the Council to adopt the affirmative position within the Final 2015 Entergy New Orleans Integrated Resource Plan that there is inadequate justification to build a new power plant and, instead, let this $200 million avoided cost be the rationale for proving that it is faster and cheaper to use the free-market to rapidly increase capacity and/or decrease demand. Empower the marketplace to forestall, or even permanently eliminate, the forecasted need for another power plant: Allow *demand reduction* (efficiency and/or storage) to directly compete with renewable energy—at the lowest, market-clearing price.

Such a course-correction not only makes good economic sense but, beyond pure economics, decreased greenhouse gas production helps preserve our city and nearby coastal areas. How synergistic would it be it if New Orleans pursued a course that lowers costs and simultaneously models to the rest of the world a novel and outstanding way to remediate global climate change?

"***From the grid edge in***" approaches to integrated utility planning have been very successful in a few prominent states because of its ability to cost-effectively ensure that supply matches demand —and has resulted in lowering implementation costs by as much as 80% to 90%.[2] "The 'edge', in this case, means the proximity to end-use customers (at their homes, businesses, or at distribution systems very close to both) rather than at power plants or along transmission lines."[3] California periodically holds multi-megawatt auctions for delivery three years later.[4] New York's ConEd uses a more granular approach by making purchases in much smaller increments; it pays $2000/kW rebates to commercial interests who deliver demand reductions within a few months.[5] ConEd's market-based strategy is to set the rebate low and slowing increase it over years.

Among these market-based approaches, *Customer Lowered Electricity Price* (*CLEP*), designed by Building Science Innovators (BSI), is distinguished by its win-win-win solution for the resident, the utility and the regulator. In simple terms, CLEP incentivizes customers to alter energy use behaviors to make pre-planned or automated electricity purchases which occur at cheaper times of day when aggregate demand is lower. Such smart purchases and demand cuts save the utility money, a reasonable share of which can be distributed back to these customers.

CLEP's key idea is that the most successful way to achieve and maintain the optimal balance between utility and consumer investment is to pay customers via timely rewards which do not exceed the actual utility cost reductions generated by that customer.

In turn, customers will make timely investments that lower utility costs and raise the associated reward payments. Such payments could be purposefully set to reward the customer who generated the savings at roughly 95% of the avoided utility costs, with the remaining 5% being shared with all customers.

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[2] See, for example, Stanton, Tom, *Getting the Signals Straight: Modeling, Planning, and Implementing Non-Transmission Alternatives,* National Regulatory Research Institute, Report No. NRRI 15-02, and Stanton, Tom, *Consultant Report for Maine PUC Docket 2010-267: Smart Grid Coordinator,* National Regulatory Research Institute, Report No. NRRI 12-02. Available at www.nrri.org

[3] www.ase.org/blog/so-what-exactly-grid-edge-thing-anyway

[4] green.blogs.nytimes.com//2009/08/28/a-reverse-auction-market-proposed-to-spur-california-renewables/

[5] commercial.coned.com/incentives-and-rebates/

When compared to the more traditional approaches—building fossil fuel plants, energy-efficiency demand side management, varying electricity prices, and integrated planning every three years—CLEP may offer the most competent strategy because it is (a) market-based, (b) "from the grid edge in", (c) even more granular[6] in the demand unit size it rewards than ConEd and (d) much more granular in the time period within which it operates. Unlike all other means of integrated planning, which take years, months or weeks, CLEP can respond much faster.

As a practical example, an average dishwasher runs on 1800 watts for an hour and consumes electricity at a cost of $65 a year @ $0.10 /kWh (energyusecalculator.com/electricity_dishwasher.htm). A resident who chooses CLEP and habitually runs his dishwasher with its built-in timer set to start around 2 a.m., will be paid $6 a year from cheaper-than-average wholesale electricity purchases, but will also generate a much greater "negative demand charge" of around $20. With no upfront capital cost, this resident will be paid a $26 annual CLEP incentive to wash dishes at night—resulting in a net cost of operating the dishwasher of $65 minus $26, or $29.

Note that CLEP pays residents to reduce demand even when there is no energy efficiency: in this example, demand during peak hours dropped but the number of kWh purchased did not change.

CLEP income is most enhanced when used with a $5000–$15,000 battery/inverter system that can be remotely controlled. Resulting in a $1000/year, the battery system pays for itself in ten years—but in less than five years if aided by energy efficiency. 1000 system group would be more effective than a 10 MW peaking plant. This is not new, but its use with CLEP is.[7,8]

CLEP also provides an application for multi-megawatt sized, locally-sited, *community solar farms*, resulting in enough economic benefit to subsidize low income customers.

Conservatively, CLEP should be able to reduce demand within Entergy New Orleans at least at 5% a year because it pays for non-energy-efficiency investments, pays back energy-efficiency investments twice as fast, provides demand response as well or better than proposed by Entergy in its September 2015 Draft IRP filing and incentivizes community solar. 5% a year is probable because Energy Smart is on track to generate an annual 2% drop in demand, and Entergy estimated that demand response would reduce demand 2/3 as fast as Energy Smart.

Vetted and highly recommended by tens of industry experts, but not yet tested in actual use, the next step would be to implement CLEP pilots and/or a simulate CLEP using computer modeling.

This is a defining point in New Orleans' energy usage. Decisions made now will be critical in defining our city's energy future. Now is a perfect time to make choices that are increasingly cost-effective, and, at the same time, position New Orleans as a forward-looking city that has joined major coastal regions with proactive planning for an economical and sustainable future.

A longer discussion is needed to fully explain CLEP. My colleagues and I are eager to educate you and other Council members about CLEP.

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[6] www.mckinsey.com/business-functions/marketing-and-sales/our-insights/using-marketing-analytics-to-drive-superior-growth
[7] insideevs.com/green-mountain-power-offer-tesla-powerwall-starting-37-50-per-month/
[8] www.bloomberg.com/news/articles/2015-12-22/batteries-gaining-favor-over-gas-peaker-plants-in-california

Bullet Points for a Meeting with Councilmember James Gray on 10/31/16

The 2015 ENO Integrated Resource Plan (IRP) process is structured in a manner that does not permit it to be as effective as it needs to be to reach its stated goal.

1. Both Building Science Innovators [BSI] and the Alliance for Affordable Energy [AAE] came to the above conclusion in early 2016 and, thus, have stopped trying to rehabilitate it. Instead, they provided solutions that are much more consistent with the goal of the IRP process. That goal can be described as identifying a set of supply- and demand-side options that minimize total capital costs while ensuring that supply fulfils demand, safely, reliably, and with just and reasonable rates.

2. Both BSI and AAE agree that a combustion turbine is not part of the solution (although reaching that conclusion through different approaches).

3. AAE provided an alternative blueprint to meet ENO's current and projected needs by using heretofore underutilized or neglected but existing resources. It also projects the use of strategies on both the demand and supply side that are well-accepted elsewhere but not yet commonly used in Louisiana. ***AAE assumes the accuracy of ENO's projections of supply needs are correct.*** Laudable as AAE's plan is, BSI believes that its additions improve upon AAE's plan in identifying the crux of what's wrong with the IRP process.

4. Among the reasons that the IRP process is broken, perhaps most important is that the primary premise of the process is wrong.

   Because ENO's IRP process assumes that a solution can be calculated in advance, ENO's IRP is missing several very cost-effective supply and/or demand technologies that cannot be included in the process because they are new and innovative, and have yet to be computer-modeled. Nevertheless, in the last few years, these technologies have been proven to be faster and more cost-effective than those actually considered in the ENO's IRP.

   ENO's IRP process assumes that financial investment decisions on both sides of the meter can be reasonably calculated in advance so that their costs and effectiveness can be compared. However, neither ***supply-side*** nor ***demand-side software*** can currently provide complete sets of feasible alternatives, nor good estimates of their costs or effectiveness. Therefore, an accurate and reliable comparison and prediction of the costs of alternatives is impossible.

Problems with Estimating the Cost and Effectiveness of Investments on the Demand Side

1. Standard residential energy-design software and its algorithms are incompatible with the primary IRP goal. The most significant reasons for this are that ***Energy Conservation by Control*** is intentionally left out and ***Energy Conservation by Timing*** is under-modelled. Conservation by Control saves energy via the choice of when, where, and how it is used, e.g., via light switches and dimmers, thermostat settings, multiple-speed equipment, cooling and heating zones, operable windows and shutters, etc. Conservation by Timing recognizes that it is possible to greatly reduce the carbon-dioxide production caused by an end-use by storing cleaner energy for later consumption on the same day, e.g., heating water to be used in the daytime by using wind-powered electricity generated at night.

2. RESNET, the residential energy services network which certifies energy rating software, decided to disallow ***Control*** in order to encourage banks to provide larger mortgages to homes with better construction that save energy: like insulation and AC equipment, as opposed to rewarding homes which exhibit lower consumption because of the lifestyle choices of their residents. ***Timing*** is missing from energy-design software because most technologies that can be employed to exploit it are far too new and existing utility rate structures often produce little to no payback for doing this.

3. We should **change the goal** from **reducing kWh use** to **reducing CO2 production**.

4. The carbon content of a delivered kWh varies greatly during in a single day. Wind generators usually operate at night. Congestion on power lines, which is common in the afternoon, wastes energy and increases the carbon content per delivered kWh.

5. The wholesale electricity price of a kWh positively correlates with its production and transmission carbon footprint, but retail electricity prices typically do not do this at all.

6. Retail customers, under existing residential and commercial rates, are not permitted to make economic choices that benefit their self-interest while significantly lowering ENO's costs, and, more importantly, decreasing the need for more power. Time-of-use pricing, which sets lower, non-prime time rates and higher, prime time rates common in Europe and California, is a step in this direction—even though burdensome for many people.

7. In their choice of rate-design, utility regulators have inadvertently stymied marketplace innovation in reducing electricity consumption in three ways:
   i. kWh price is independent of the time-of-day it is received from the grid,
   ii. the price of demand for electricity (measured in kW) suppresses the appropriate and real cost borne by commercial customers, and
   iii. forces residential customers to subsidize commercial demand—even though no kW usage is disclosed to residential customers in their bills.

8. CLEP enables customers who only narrowly pursue improved utility cash flow to unwittingly generate substantially decreased CO2 production as an indirect by-product.

Some relatively new supply side choices are also poorly modelled by IRP software because they have some structural components common to demand side resources.

1. Batteries have yet to be broadly applied even though industry professionals recognized in 2014 that large batteries banks and inverters can outperform peaking plants.

2. That analysis does not consider the additional economic benefits provided by an "array" of synchronized battery-inverter systems installed in individual homes. Perhaps the greatest advantage of such an array exploits highly cost-effective demand-response by its ability to defer the usage of selected home appliances every day in response to rising wholesale energy prices and/or the cost of demand. Perhaps second or even more valuable is the greatly improved [R&R] reliability (ability to cover short-term, unexpected outages) and resilience (ability to ameliorate long-term or expected outages). The economic value of R&R probably pays at least half of a battery system's original investment cost—not to mention the lives saved. Now, with 20th century rate design, without any compensation to residential customers for timely consumption or decreased demand, there is no way for batteries to repay their up-front installation costs—expected to be around $10K per home. CLEP solves this problem.

3. Another supply-side option excluded from the IRP analysis is called ***community solar***. This approach finances the construction and maintenance of a grid scale (roughly 1 MW or bigger) solar farm that is sited within the distribution system of the utility and jointly owned or rented by a collaboration of residents or business tenants served by the same distribution utility—who share the value of its monthly production. Such systems produce MW's of supply without necessarily requiring any investment by the utility or its ratepayers. This supply option has been developed in many more than 18 jurisdictions around the US but the compensation scheme most often employed—net energy metering [NEM—is presently under attack in many utility districts. CLEP provides a remuneration approach that is as big or bigger than NEM and does this without any subsidy—much less subsidizing one customer class against another.

4. BSI believes that both the total costs and effectiveness of these demand side and supply side investments as well as the decreased need for fossil-fueled generation they create are not completely predicable by any **<u>current</u>** software. (Some progress with incremental IRP planning "from the grid edges backwards towards the center" has recently been successful in CA, NY, VT and ME; they employed a novel software approach which resulted in "costs on the order of 1/5 to 1/10 as much", commented Tom Stanton. His paper on NTA's sets the stage for this.) BSI believes that the route to the goal of a high-quality IRP result is to implement CLEP via aggressive use of all three pilots that BSI has proposed.

5. BSI believes that the path to an optimally efficient economy with no subsidies is also the path to minimize CO2 production. This is not a coincidence; after implementing CLEP, it is automatic. This is effect has great importance to New Orleans.

What the Experts are saying about CLEP and Why It's So Important

1. At the 2016 national RESNET conference this winter, David Goldstein, PhD, physics, stated that talks given on CLEP "were not receiving one hundredth as much attention as they deserve." Dr. Goldstein is a recent past president of RESNET and current co-leader on energy Issues for the Natural Resources Defense Fund.

2. Attendees of RESNET talks and signatories of a letter in support of CLEP include: Gary Klein, past member of the staff of the California Energy Commission; Gary Nelson, CEO of the Energy Conservatory (the leading manufacturer of equipment used by RESNET-certified professionals); Jeffrey T. Rhodin, Managing Director —Sustainable Energy Analytics of MA ; Les Lazareck, runs Home Energy Connection—in 2009, he established Nevada's Home Performance with ENERGY STAR program, HomeFree Nevada; Peter Moncada, Coastal Carolina Construction; Paul Mrzlak, Advanced Environment Imaging; Kevin Hannon, Horizon Residential Energy Services NH; Richard Faesy, founding president of the board of the Northeast HERS Alliance, and was a founding board member of the Residential Energy Services Network (RESNET); Grady Harper, auditor at EnergyWise Consultants of CO; and Russ Derickson, developer of the first residential energy design software, REM—which morphed into the default standard for RESNET.

3. Tom Stanton, Principal Researcher for Energy and Environment, National Regulatory Research Institute (NRRI serves as a research arm to NARUC and its members) — www.nrri.org, (tstanton@nrri.org, www.linkedin.com/in/tsstanton/) (517) 775-7764, 9a-5p, M-F recently wrote to a colleague: "I have worked with Myron a bit on his concept. I think it would be valuable for local folks to recognize what Myron is talking about. … "Customer Lowered Electricity Price … is very interesting and worth looking into. Myron's concept is a lot like what is being discussed for "Transactive Energy," but is intended to work "on top" of a regular flat-rate tariff, like what LBWL has." On 10/17, Tom proposed a $50,000-funded study designed pre-qualify and simulate CLEP pilots using a *what-if* analysis, real MISO data following procedures and tools already published in technical literature. Tom has edited this document.

4. Clinton Vince, Dentons Law Group, and leader of the legal advisors team for the NO City Council [COUNCIL] regulatory activities, expressed on 10/27 that he is very enthusiastic about Community Solar… seeing it as a no losers project which can benefit all customer classes. By way of this document, BSI is requesting the COUNCIL for Dentons' personnel to be authorized to work with BSI to pursue the development of CLEP and Community Solar.

5. CLEP can make a major impact on and can greatly ameliorate the causes of climate change.

BSI has asserted to all mentioned on this page that CLEP's best chance for experimental pilots will be in New Orleans. This is a great opportunity for New Orleans to lead the world—while it is clearly pursuing its own self-interest.

HTTPS://WWW.SCIENTIFICAMERICAN.COM/ARTICLE/WORLD-S-LARGEST-STORAGE-BATTERY-WILL-POWER-LOS-ANGELES/

ENERGY

World’s Largest Storage Battery Will Power Los Angeles

More than 18,000 lithium ion battery packs would replace a gas-fired power plant used to meet peak demand

- By John Fialka, ClimateWire on July 7, 2016 *Credit: Arman Thanvir/Flickr, CC BY 2.0*

By 2021, electricity use in the west Los Angeles area may be in for a climate change-fighting evolution.

For many years, the tradition has been that on midsummer afternoons, engineers will turn on what they call a “peaker,” a natural gas-burning power plant In Long Beach. It is needed to help the area’s other power plants meet the day’s peak electricity consumption. Thus, as air conditioners max out and people arriving home from work turn on their televisions and other appliances, the juice will be there.

Five years from now, if current plans work out, the “peaker” will be gone, replaced by the world’s largest storage battery, capable of holding and delivering over 100 megawatts of power ([sic] an hour) for four hours. The customary afternoon peak will still be there, but the battery will be able to handle it without the need for more fossil fuels. It will have spent the morning charging up with cheap solar power that might have otherwise been wasted.

Early the next morning, the battery will be ready for a second peak that happens when people want hot water and, again, turn on their appliances. It has spent the night sucking up cheap power, most of it from wind turbines.

The politics for this to happen are now in place because California’s Public Utilities Commission set a target requiring utilities to build their capacity to store energy, to use more renewable energy and to cut the state’s greenhouse gas emissions 80 percent by 2050. The economics are there, too, because the local utility, Southern California Edison Co., picked the designer of the battery, AES Corp., an Arlington, Va., company, against 1,800 other offers to replace the peaker. It was the first time an energy storage device had won a competition against a conventional power plant.

And the technology seems mature. AES has spent nine years working with manufacturers of electric-car batteries. It has learned how to assemble and control ever-bigger constellations of these lithium-ion batteries. The Long Beach facility, when it is completed, will have 18,000 battery modules, each the size of the power plant of the Nissan Leaf.

But the timing is terrible.

CHEAP SOLAR SPURRING STORAGE WOES

The mega-battery won’t be up and running for five years, and Southern California needs more energy storage capacity yesterday. Officials warn that this summer, the region could face as many as 14 days of scheduled blackouts because of a huge leak earlier this year at the Porter Ranch natural gas storage facility. While the leak has stopped, the facility—which feeds fuel to 17 Los Angeles-area power plants—may not be fully recovered and tested for months.

Meanwhile, other utilities are suddenly feeling the need to store substantial quantities of electricity. As John Zahurancik, president of AES’s energy storage company, put it, “It’s a bit of a Wild West open market right now.”

The United Kingdom is shopping for energy storage systems to be installed around London, and New York state, Hawaii and Chile are looking at energy storage as an alternative to building more expensive power plants.

What's driving this scenario is a growing abundance of cheap solar and wind power and entrepreneurs looking for ways to store and sell more of it. Meanwhile, power projections of older coal- and gas-fired power plants are leading owners to shut more down, leaving more gaps in electricity distribution systems because they will no longer be able to compete with cheaper solar and wind power.

"We're already caught up in the onset of a major transformation that's going to happen. There are over a million solar rooftops now" in the United States, explained Guenter Conzelmann, a power sector analyst at the Department of Energy's Argonne National Laboratory near Chicago. Within two or three years, he estimates, there could be as many as 800,000 electric vehicles in the United States, an event that could drive prices for lithium-ion batteries further down and result in the storage of more renewable energy in the suburbs, at the edges of power systems that feed cities.

Car companies such as Tesla Motors Inc. are also offering big home batteries, close cousins of their car batteries, to store more renewable energy in homes. There are also "smart" appliances, such as dishwashers, water heaters, thermostats and refrigerators, coming into the market that are equipped to communicate with utilities to minimize electricity use during peak periods when electricity is most expensive.

"Eventually, homeowners could become almost energy self-sufficient. You may only need a few hours of electricity from the grid per year," Conzelmann said.

Noting that the current power grid is not designed to handle big two-way power and communication flows, he suggests that more renewable energy will be beneficial and politically unstoppable.

"Everyone has an end vision. That's pretty clear," he said. "The problem is, how do we get there? That's where a lot of the research that's going on is all about. Can we have all these different attributes that we want without screwing up?"

LARGE-SCALE SOLAR BATTERIES GO FROM 'CUTE' TO CRITICAL

So far, most utilities have finessed the issue of accumulating solar power by allowing homeowners with solar arrays to sell some of their power back to the grid, a practice called net metering.

"You're basically using the grid as a battery. This is why some utilities are a little bit leery about this. The big question is, who pays for it?" said Haresh Kamath, a senior manager at the Electric Power Research Institute (EPRI), a nonprofit group funded by the electric utility industry.

Big, grid-sized batteries can run into the millions of dollars, but the damages from blackouts and power surges caused by wildly fluctuating voltages can easily run into the billions.

"You can get some interesting effects on the grid which are not good if the voltage gets too high or you get some reliability issues," Kamath said.

The need for renewable energy storage has emerged relatively recently among the engineers who worry about the health of the grid. "Starting off a few years ago, it was a novelty. 'Oh, that's cute,' people would say. You're trying to do large-scale batteries," said Vince Sprenkle, a chief engineer for energy storage at the Pacific Northwest National Laboratory in Washington state.

Five years ago, he recalls, the Energy Storage Association held its annual meeting in Charlotte, N.C., and 300 people showed up. “This year, they came back to Charlotte, and there were 1,500.”

According to Sprenkle, energy storage solutions and timetables will be different for different regions of the United States.

California is already feeling the crunch, but it may not come to the Pacific Northwest for another five or 10 years. Wind and solar power are beginning to penetrate the Northwest’s part of the grid, but when it fluctuates—as it always does—power demands can easily be balanced by the region’s hydroelectric power. Hydroelectric dams, with excess storage capacity and pump storage facilities that pump water up to a hilltop reservoir when electricity is cheap and then run it through turbines when it isn’t, can function like big batteries.

But the demand for more renewable electricity is going up, and the capacity for more hydro is small. Fielding more and bigger batteries may be much cheaper than building new hydroelectric facilities, Sprenkle thinks.

“Ideally, storage is your greatest flexible asset you can put on the grid,” he said.

WAITING FOR BIG BATTERIES TO HIT THE ROAD

At the moment, utilities are just beginning to use pilot projects to explore how bigger batteries might help them use the nation’s increasingly congested electric highway.

Fittingly, most of these pilots explore the storage uses of lithium-ion batteries. They were invented in the United States and languished for years until Sony Corp., the Japanese electronics company, commercialized them to power tiny machines like video cameras and cassette players. Soon, they were bringing more power and longer life to cellphones, power tools and model airplanes. And these led to more ambitious commercial experiments. In 2006, Tesla put 6,800 lithium-ion model airplane batteries under the hood of a kit-built roadster. That led to Tesla’s first car, the sporty Tzero, and a small but accelerating movement in the auto industry toward the plug-in electric vehicle.

AES, the Arlington, Va., company that is designing the 100 MW battery to store power for the western region of Los Angeles, was the first to take the next and probably the most ambitious and expensive leap by bringing lithium-ion car batteries to power one of the world’s biggest machines: the North American power grid.

For reference, the output of 100 MW is roughly a tenth of the power delivered by a modern nuclear power plant.

“We tend to not be focused on pilots, but on more commercial ventures,” explained Zahurancik, president of the company’s storage unit.*

The parent company owns and operates power plants in 17 countries around the world. It has the money, the expertise and the ambition to create new businesses and partnerships. One of the partners in its earlier grid project, which was based in West Virginia, was A123 Systems LLC, a Waltham, Mass., developer and manufacturer of advanced lithium-ion car and bus batteries.**

HOW REFINING ‘FREQUENCY REGULATION’ PAVED THE WAY TO LA

In 2010, a caravan of AES trucks hauled a line of 53-foot shipping containers up Laurel Mountain in West Virginia. Blazoned with labels saying “Smart. Power. Delivered,” the containers carried 320 A123 electric vehicle batteries. They were parked in parallel rows near a wind farm, whose 61 turbines were generating electricity near the windy hilltop.

More trucks arrived, pulling shorter shipping containers. They contained the transformers, inverters and other control equipment needed to connect the batteries to power lines leading from the wind farm. Other containers had the air conditioning equipment to keep the growing maze of big batteries from overheating. Finally, a master control system was added.

What looked like a wire-strewn commercial parking lot was connected to a substation of what was then Allegheny Power, one of the utilities involved in the massive PJM Interconnection LLC, a regional transmission organization whose lines feed wholesale electricity to 13 states in the eastern United States.

Before 2011, when this giant, outdoor battery was turned on, PJM had run out of pump storage to control the growth of wind power, which accumulates most quickly at night. In some areas, PJM was forced to pay utilities to take wind power to keep its frequency of power delivery balanced.

On that point, the grid is very demanding. The frequency of oscillations in its alternating current must be pegged at a measure defined as 60 hertz.

If the current goes above that, the switches protecting expensive power equipment from overloads begin to shut down the system. "If it goes too low, you can start to cause systematic failures that lead to brownouts and other things," said Zahurancik.

What the Laurel Mountain project was designed to do is called "frequency regulation." The wind power stored in the batteries feeds more juice onto the grid when power demands increase. When there is too much electricity coming into the system, its batteries suck more into storage. It can make these adjustments in a second, thus saving the excess power to sell at higher prices the next day. It was good for the grid, good for expanding markets for renewable energy and good for the innovator. It led to bigger jobs for AES, including the Los Angeles project.

"AES has always been a company that's trying to look at where do you go next. Is there a better way to serve?" said Zahurancik.

**Editor's Note (7/19/16): This sentence was edited after posting. The original erroneously stated that the company's storage unit was nuclear.*

***Editor's Note (7/19/16): For purposes of clarification, this paragraph was edited after posting.*