Advancing EE through Pay-for-Performance and Procurement

Today's energy-efficiency programs are typically designed around rebates and incentives that are paid upfront and are based on a predicted result. Because energy efficiency is paid in advance, without transparency and with little accountability as to results, there is a misalignment of incentives that rewards a race to the bottom and results in the need for complex and costly regulations that make innovation nearly impossible -- rarely yielding the intended outcomes. Think of it this way: if farmers were paid based on predictions and got the same income no matter what they actually harvested, they would have no incentive to water or fertilize their crops. In order for such a system to work, investors would have to regulate and monitor every step in the farming process.

Energy-efficiency programs are in the same boat. Not only does our system often reward the wrong behavior, but when we finally do get around to measuring results, we introduce even more uncertainty. We currently spend over $200 million every year to evaluate, measure and verify savings, resulting in complex and often subjective reports that often retroactively reduce savings and create substantial uncertainty.

In one example, NRDC estimated that an evaluation incorrectly and retroactively lowered the value of PG&E's upstream lighting incentives by $1 billion. In describing the fundamental challenge of the current system of evaluation, measurement and verification (EM&V), the DOE State Energy Efficiency Action Network put it succinctly: "EM&V is sometimes seen as expensive, not credible, not timely, not transparent, and as a burden, not a benefit."
So why are costs so high?

The simple answer: when money pours into a program that lacks competition or transparency, costs increase -- a common problem for systems with competition in general. By comparison, in competitive, transparent markets, prices drop as the market grows and competition increases, rewarding those who deliver results more efficiently and encouraging innovation.

The recent success and rapid growth of solar energy provides an instructive example of such innovation. It's a real-time example of the power of market forces to reward business models that work for customers and industry while being held accountable to results. As the California Solar Initiative rebate program trended from a subsidy of nearly 50 percent to zero, a strong industry, driven by billions in private capital, has emerged in its wake. Costs have plummeted as financial and technology innovations have delivered solutions to meet customer demand, resulting in a huge influx of private investment and innovation in technology, finance and business models.

By contrast, the energy efficiency industry has been conducting a grand experiment for the past 40 years to prove the theory that top-down programs can "transform markets." At this point, we have proven conclusively that the program-centric approach to energy efficiency does not appear to benefit from economies of scale found in competitive markets. Furthermore, it is highly vulnerable to cyclical political changes, especially in states that are less environmentally sensitive than Massachusetts. In just the past six months, public utility commissions in Ohio, Arizona and Florida have begun the process of shutting down their state's energy efficiency programs, citing cost as the primary motivator.

Simply put, it is not reasonable to expect building owners to voluntarily dip into their wallets and directly fund the massive infrastructure investment in distributed energy efficiency. Instead, we must engage private capital to invest in this emerging new market that will value energy efficiency as a reliable resource, and we must pay for these investments in the same way we finance power plants -- through project finance that monetizes cash flows from savings, rather than the balance sheets of the building owner.

Energy efficiency is a resource that delivers clear public benefits (in addition to enormous private benefits such as improved comfort and lower bills). It creates local jobs, reduces the need for new power plants, and moves us closer to meeting our emissions goals. Getting paid for that value is not charity; instead, monetizing these unrealized benefits simply aligns interests and pays for this distributed negawatt power plant by rewarding the homeowners and companies making the actual investments energy efficiency -- just as if they were building new generation capacity.

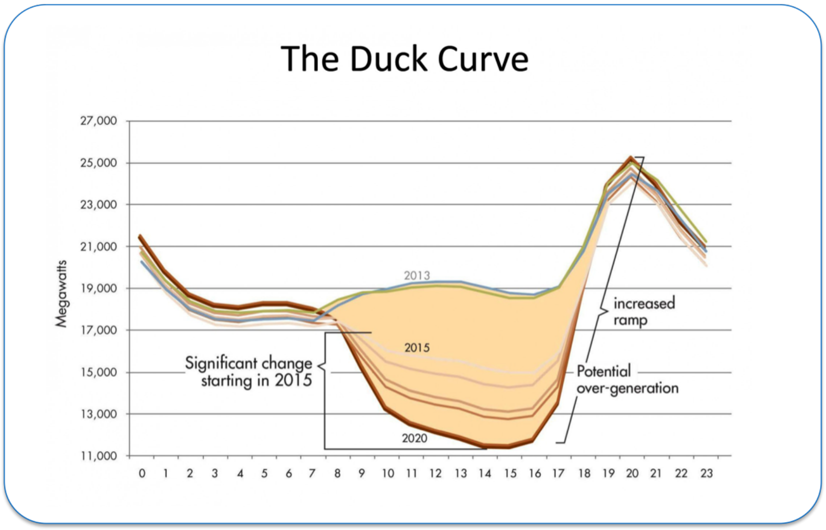
By creating a more transparent marketplace for energy efficiency as a grid and climate resource, we can increase private funding, increase flexibility in delivery, and truly add efficiency to the pool of resources that will make up Grid 2.0.

The coming paradigm shift will not the eliminate the need for public and ratepayer funding and regulations to ensure a fair and transparent market, but it will require a different, simplified regulatory role -- a role that looks essentially like the public sector involvement in every established market.

The Grid is Changing, and Efficiency Needs to Adapt

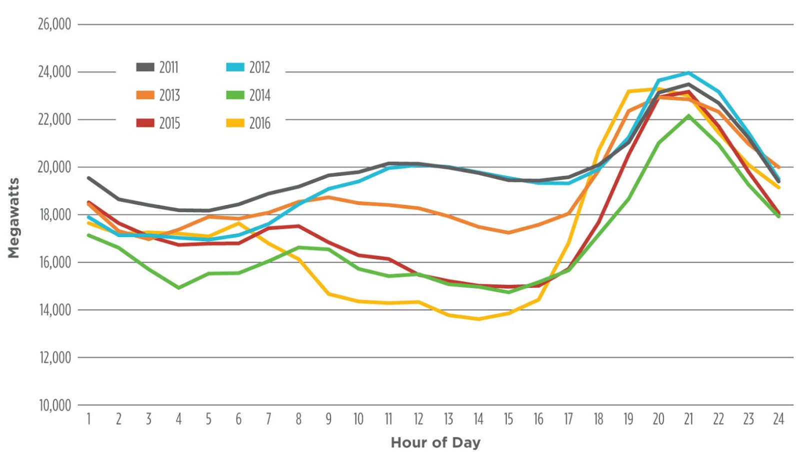
Distributed generation is changing the load shape of the grid. Increasingly, the traditional afternoon peak is being replaced by an afternoon valley, when solar generation is at its highest. The valley period is in turn followed by a steep and problematic peak in the late afternoon, as power from solar generation decreases, people return home from work and school, and residential loads increase.

This new load shape, emerging with a vengeance especially in high penetration markets such as California, is often referred to as the "duck curve" for reasons which should be clear from the chart below.

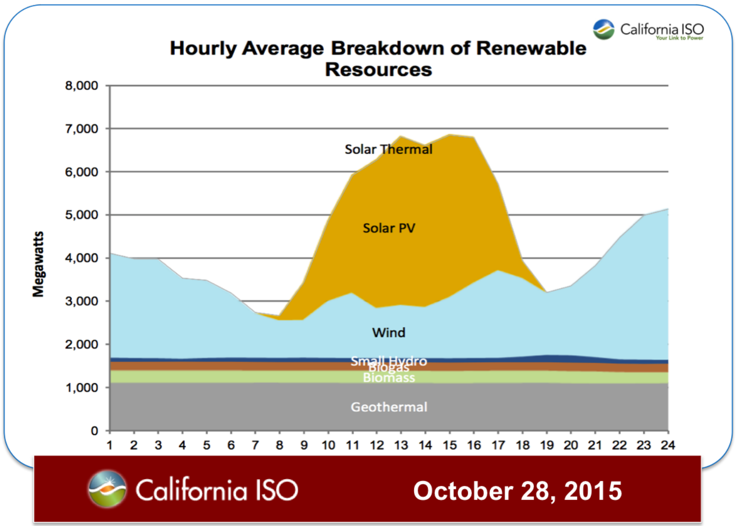


Because power plants can't respond quickly enough to manage this new evening ramp-up, expensive and dirty power sources are kept idling during the day to step in when demand suddenly increases. During the day -- in the duck's "belly" -- solar over-generates, pushing the cost of energy into negative territory (which means it actually pays to use power).
While energy policy nerds like me have long worried about the hypothetical impact of these changes, we are now seeing the real effects. For California, which has by far the most solar generation in the country and a newly increased renewable energy target of 50 percent, this new reality is here today.

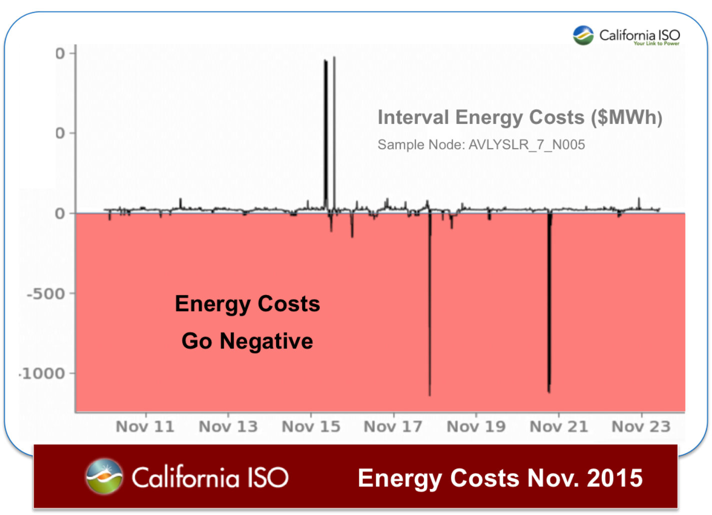
Turns out that in California, the actual empirically measured effects of accelerating renewables is proving to exceed predictions.

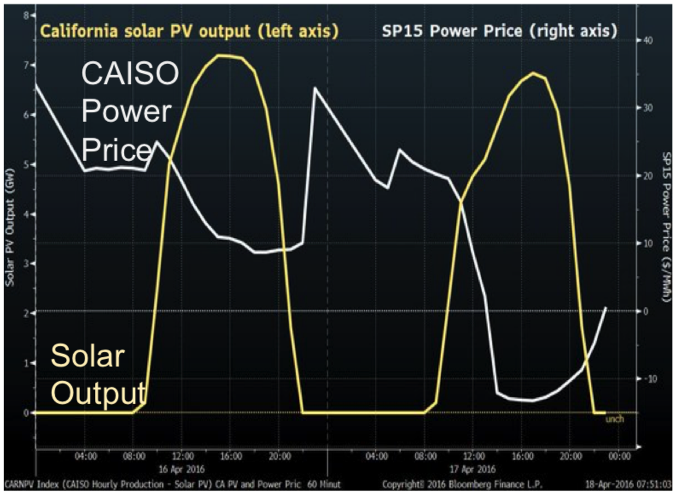


Solutions to this problem will come from a variety of technologies and load management approaches, including storage, demand response, and energy efficiency, to create permanent load shape change. There’s a whole new set of rules, and we are just starting to learn how to play the game.



As predicted, this bubble of solar generation is changing the load shape in California. The following chart shows the total load on the CAISO grid and the new shape created by production from renewable resources. As you can see, the “duck curve” is no longer theory, but a daily reality.





So what does this mean for energy efficiency?

Given this changing load shape, the role of energy efficiency can no longer be a focus on lowering overall kilowatt-hours and British thermal units consumed. Instead, we'll all have to change the way we think about and deploy energy efficiency. Rather than a measure taken to reduce demand to meet a particular efficiency target, satisfy a performance standard, or fulfill the needs of a utility program, energy efficiency will now have to be treated as actual energy capacity.

It will need to become a form of "supply" that can be deployed in real time to help climb the steep neck of the duck curve.

If efficiency is to be deployed as a resource, we'll need to know when and where it is occurring with enough confidence to satisfy those making procurement choices and working to keep the lights on.

Doing so requires system-wide data about buildings, energy use, and a new level of transparency about how energy savings are calculated. In California, we finally have those necessary building blocks in place to make this leap possible. In residential efficiency in particular, we have standardized project data using the national HP-XML standard through the CalTRACK process (meaning contractors can pick their software, but all tools can output the same interoperable data set). Thanks to PG&E's newly released version of its "Share My Data" Green Button solution, it has become simple to access both hourly electric interval data and daily gas consumption through a simple API.

While there's a lot of work to be done to shift from programs and standards to deployable resources, there's also a lot of momentum. Efforts like the EDF Investor Confidence Project are helping to design protocols and standards for quantifying the savings of energy-efficiency investments, as is the Open EE Meter, an open-source platform to make savings transparent and available to all market participants. These open protocols, designed to facilitate a competitive market, will also be invaluable to grid operators and planners who can start to count efficiency gains as they make procurement choices.

In this new grid paradigm, energy efficiency's true potential will shift from baseload savings toward a market-oriented approach, where the value of saving energy at the right times -- and in the right parts of the grid -- will climb dramatically. The opportunity to capture the full value of load shape will have a major impact on the design of efficiency projects and the types of technologies that drive the best returns for building owners and investors.

As an example, in a "duck curve" world, air-conditioning efficiency will no longer be primarily about reducing energy use during the hottest afternoon hours. Instead, grid operators and building managers will need to collaborate on new approaches that use the building like a thermal battery to store cooling energy and coast through the neck of the duck, reducing loads during the most valuable periods.

The eventual mix of load-shaping technologies and business models that provide valuable grid services and save measurable carbon are yet to be fully determined -- and they are evolving too quickly for regulatory processes to keep up. This kind of complexity can only self-organize through competitive markets.

The good news is that energy efficiency is, in general, less expensive than many alternative services available to meet grid demand. Efficiency as demand capacity that delivers permanent load shape change can capture savings that are worth substantially more than current programs. Valuing investments that use efficiency to permanently change load shape will increase its value.

The duck has landed, and it represents a new opportunity for energy efficiency to evolve from simple energy savings to delivering demand capacity as a true grid resource that can help the duck start to fly.

Energy Storage is Critical, But Not a Silver Bullet

Renewable portfolio standards are on the books in 37 US states, Washington, D.C., and four American territories. Together, these requirements cover 55 percent of all U.S. retail electricity supply, and have driven 60 percent of all growth in renewable electricity generation. Going forward, meeting these standards will require the addition of 60 more gigawatts of renewable energy capacity by 2030.

Aggressive states such as New York and California that are targeting 50 percent renewable generation by 2030 are entering uncharted waters as they integrate new intermittent sources of clean energy at scale.

California, which currently houses almost half of all installed solar capacity in the country, is already experiencing grid challenges at a rate faster than expected. Just a few years ago, some analysts were warning of the transformation of California's load shape into a "duck curve" due to this growth of utility-scale solar capacity and distributed generation. Today we are exceeding their projections -- the duck curve has arrived with a vengeance.

A recent study by the consulting firm ScottMadden found that the lowest daytime net load (the deepest curve of the "belly" of the duck) was declining each year. "Results indicate a substantial number of individual days are lower -- and in some cases substantially lower -- than [previous forecasts]...found in the duck curve chart. Further, oversupply risks attributable to variable generation resources have grown more rapidly than [shown in] the duck curve chart."

More short, steep ramps which require the ISO to bring on or shut down generation resources to meet an increasing or decreasing electricity demand quickly.

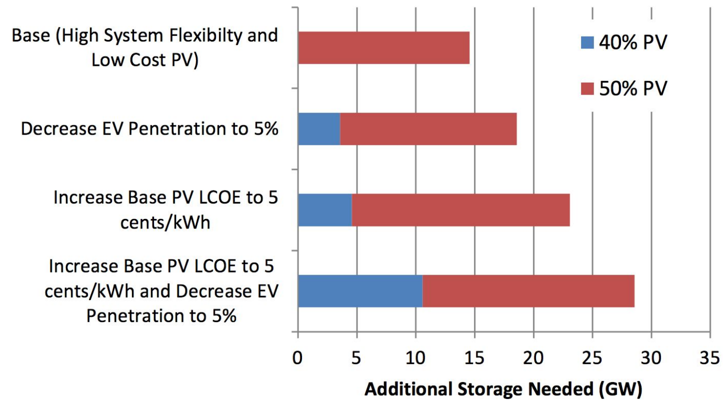
- More frequent periods of oversupply (times when more electricity is supplied than is needed to satisfy real-time electricity requirements).

- Decreased frequency response, as fewer flexible generation resources are operating and available to automatically adjust electricity production to maintain grid reliability.

Storage is often heralded as the grid savior, and it will undoubtedly play a crucial role. But in reality, meeting the renewables load challenge is going to take an aggressive, all-hands approach that includes a range of distributed energy resources and strategies such as more flexible generation, exporting excess solar power, demand response and shiftable load, and optimized electric-vehicle charging, in order to balance the influx of variable solar energy that will continue to come on-line.

The recently published NREL report, Energy Storage Requirements for Achieving 50% Solar Photovoltaic Energy Penetration in California, models likely scenarios for storage deployment, and finds that even in an aggressive scenario that maximizes grid flexibility with storage and other available DERs, we still come up far short of what's needed.

The report found that "in a case with very low-cost PV (3 cents per kilowatt-hour) and a highly flexible electric power system, achieving 50% PV penetration would require about 15 gigawatts of energy storage beyond what is expected to be installed in California by 2020."



Source: NREL

That means that even with flexible generation, transmission, demand response, and electrification of 25 percent of the vehicle fleet in California with largely optimized charging, we will still need nearly four times as much storage as is projected -- and at an untold cost.
To illustrate this gap, a recent GTM Research study estimated that by 2020, there will be approximately 4.5 gigawatts of storage online across all sectors nationwide.

The only way for California and other states to achieve the high renewable penetration rates required by their RPS goals, while maintaining a stable and affordable grid, is for that grid to become dramatically more flexible.

The NREL report "found we could minimize the storage requirements to get to 50% PV penetration through a combination of flexibility options. Along the way, however, we identified a highly non-linear increase in PV integration challenges, even under increasing system flexibility."
The authors of the NREL report also found that "considering additional sources of flexibility is another important direction for research. The literature on [demand response] and fuel switching evaluates only a fraction of existing loads. Thus, additional work is needed to consider the full potential for load shifting and fuel switching."

A recent report by the Lawrence Berkeley National Lab discusses how load can be altered to have additional flavors that include not just "shedding" load, but "shaping" load, "shifting" load and "shimmying" load to meet the needs of the grid.

While the NREL report touches on energy efficiency in terms of shiftable load, the efficiency sector has not had a full seat at the table, and efficiency is not yet seen as equivalent to capacity -- or as a true resource. This is true in part because traditional forms of energy efficiency are often based on model estimates and measured over monthly averages, rather than by the hourly confidence that is required by grid planners and procurement departments.

However, with advances in the use of smart meter interval data to track permanent reductions in demand over portfolios of project, it is now becoming possible to quantify energy savings -- including time and locational data -- that can finally allow this plentiful and low-cost resource to be treated as a distributed energy resource. This change represents one of the most promising opportunities to close the gap and enable us to hit these critical RPS targets.

As a result, states like California and New York are finally starting to take efficiency seriously as a grid resource. In California, PG&E's recent proposal to decommission the Diablo Nuclear plant and replace it with carbon-free and flexible resources, including procurement of 2,000 gigawatt-hours of energy efficiency by 2025 based on normalized metered performance. Similarly, New York State's REV Energy Efficiency Procurement & Markets Working Group issued a report to define how to create a more lasting market structure to catalyze investment in energy efficiency and clean energy. Efforts like these promise new approaches to meter-measured energy efficiency that will allow it to compete as a viable, cost-effective, and reliable distributed energy resource.

Closing the duck curve grid gap will require all the storage we can get our hands on, as well as a strategy that includes accelerated adoption of every other distributed load balancing energy resource we can deploy. Beyond currently available resources, new forms of load-shifting distributed energy resources will need to be brought on-line, including procurement of metered demand capacity coming from permanent changes to buildings resulting in more favorable resource curves.

There is no silver bullet to hit our RPS goals while maintaining a stable grid. It's going to take handfuls of buckshot instead.

The first step toward energy efficiency as a market is agreement on how to measure a standard unit of savings. While it can be complex to measure efficiency gains on individual buildings, by metering portfolios of similar project assets, it's possible to calculate aggregated savings with a very high degree of confidence.

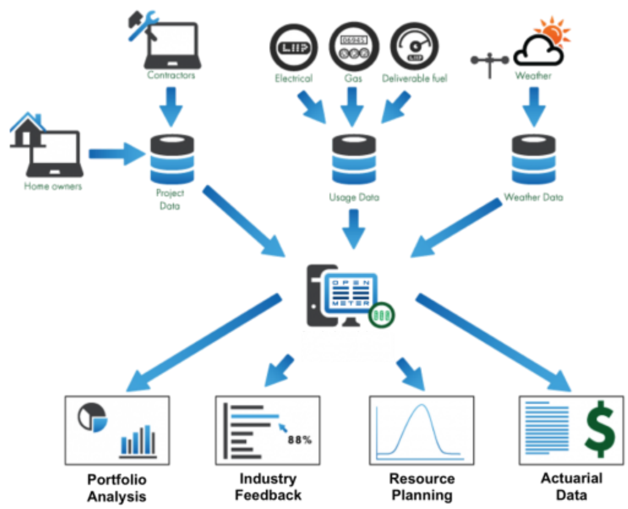
Investing in efficiency as a portfolio of assets rather than as individual projects results in consistent returns, washing out outliers and managing the uncertainty of the individual-building counterfactuals through the law of large numbers. For example, for a portfolio of car loans, an investor can expect a known percentage of defaults, even if there is no way of knowing how any individual loan might perform.

Markets abhor uncertainty, which is when you know neither what will happen next, nor what the possible distribution of outcomes looks like. However, risk is the cornerstone of markets and differs from uncertainty only in that the distribution of outcomes is known.

The solution for energy efficiency is not the pursuit of perfection on individual projects but manageable risk at the portfolio level to enable investment-grade energy efficiency.

In the last few years, a host of standards and technologies have come on-line that allow the accurate, reliable, and near-real-time measurement of energy savings and load shapes. Some of these innovations include the Green Button standard for energy data transfer, standard XML dictionaries for project data such as ICP's Building Button (commercial) and HPXML (residential), the open-source DOE SEED Platform that provides a distributed system to track project and building data, and a smart metering infrastructure that provides granular access to energy usage data.

Just as with kilowatt-hours and pounds, nobody should own the standard for measuring energy efficiency. Efforts such as the CalTRACK system, developed jointly by California utilities and regulators, can truly change the game by aligning industry, utilities and regulators around a standard measurement of savings. The process of reaching consensus on this unit of measurement continues through a joint Building Performance Institute and Air Conditioning Contractors of America standard that is now in development for the American National Standards Institute.



Building on our newly available data infrastructure and standards, it is now possible to meter energy efficiency with a high degree of confidence and repeatability. The OpenEEMeter is an example of how the energy-efficiency industry can leverage data and an open-source platform to standardize and democratize energy savings and provide a standard EE meter as the basis for future markets based on energy efficiency as a resource.

EE metering differs from current EM&V approaches in the fact that results are replicable and available to all market participants based on available data. In simple terms, this means that private companies, utilities and regulators will all calculate the same level of savings for a given set of building efficiency projects.

What's energy efficiency worth?

While it is likely that early markets will price energy efficiency based on what we are spending for savings in current programs, in the future and with more data, markets can be employed to allow supply and demand to arrive at a price for efficiency as another capacity resource that utilities can procure to keep the lights on.

One example of a market-driven approach is the use of a reverse auction, where a utility or other load-serving entity requests offerings from providers for efficiency and providers compete to establish the price. The lowest-cost solutions receive power-purchase agreements based on a clearing price and are paid based on savings calculated using actual performance at the meter. This is already how California procures utility-scale solar, and this approach could be applied to allow the market to establish a price for saved energy.

In the future, more complex pricing signals could also emerge, incorporating energy efficiency's many dimensions including carbon, load shape and location of savings.

When one combines the consistent savings found in portfolios of energy-efficiency projects with a market and a price, it results in stable long-term cash flows. These cash flows allow efficiency projects to be financed the same way one would finance a power plant, through project finance, rather than just the balance sheet or credit of the building owner. Power plants are financed based on the value of the energy they will produce and sell, not merely on the credit of the borrower or the value of the asset.

It makes sense that if we want efficiency to compete with power plants as part of the utility of the future we need to start financing it in the same way.

Evolving M&V to Meet the Market

While the art of evaluation for regulated programs is well established, the movement of energy efficiency towards pay-for-performance markets and procurement requires a rethinking of how efficiency is regulated, measured and transacted.

In traditional programs, where incentives are set and paid in advance, savings measurement is an after-the-fact regulatory tool that doesn't directly affect program operations or incentives. This means that using ex-post adjustments based on survey results and quasi-experimental control groups to understand program effects makes sense for regulators who need to understand additionality and net savings for the purposes of passing regulatory cost tests.

However, as efficiency shifts towards pay-for-performance and resource procurement, the role of measurement is shifting as well. What, when, and how we measure savings directly affects the alignment of incentives, program operations, and market design. And yet, we cling to traditional EM&V methods that are akin to putting an old engine in a new car.

Flipping the Script on Measurement and Verification

This doesn't mean that traditional EM&V is suddenly wrong, or that implementing pay-for-performance should mean giving up on methodological rigor. It simply means that traditional EM&V methods and processes weren't designed to provide information to markets. Efficiency measurement in the era of procurement and pay-for-performance has to take a market-first approach.

Market information comes in two essential flavors: quantities and prices. Typical program design sets incentives based on upfront savings estimates, and then uses EM&V to adjust actual savings after the fact.

In pay-for-performance and EE procurement, the script is flipped: utilities say how savings will be counted and what value they will place on those savings, and market actors figure out what business models, technologies and market approaches work best to maximize their cash flow. This means that the way savings is quantified suddenly matters for the organizations delivering it.

In this setting, measurement plays a dual role. We can use measurement to both quantify the savings that are being purchased, as well as to value those savings. We also have an additional variable at our disposal: pricing. Savings that would normally be subject to quantity adjustments after the fact can instead be adjusted through changes in the price or locked in for the term of a contract that is similar to a power purchase agreement. This creates manageable risk for the market by providing a reliable cash flow that is not subject to after-the-fact adjustment uncertainty.

In this new landscape, different approaches to measuring energy efficiency can play complementary roles depending on context.

For Building Owners: Measurement and Verification (M&V)

M&V is designed to quantify site energy savings for building owners and investors in energy efficiency projects on individual buildings. This approach calculates weather-normalized bill savings and allows for adjustments for both routine and nonroutine factors that impact savings, such as changes in occupancy or operating hours.

M&V measures the effectiveness of a retrofit and helps communicate the value of energy savings to building owners. Typically, it relies on establishing a baseline from past consumption and comparing it to energy use after a retrofit. This approach is best enumerated through the Efficiency Valuation Organization IPMVP protocols and is spelled out in contracts between building owners and efficiency providers.

For Markets and Aggregators: Normalized Metered Savings (EEMetering)

EEMetered savings quantify normalized metered site-based savings based on monthly or interval meter data before and after an intervention for portfolios of buildings. Rather than accruing to the building owner as bill savings, the benefits of efficiency accrue as a demand resource to load serving entities.

The purpose of EEMetering is to allow those entities to quantify the gross site-level impacts from energy efficiency. An EEMeter is designed to provide a consistent measure of the results of energy efficiency projects at a portfolio level that can be used to send a payable price signal to market actors for the value of the savings.

The definition of a meter is an instrument that "automatically measures and records the quantity of something, as in gas, water, miles, or time, when it is activated." An EEMeter is a standard weights and measures for efficiency savings that is transparent to all parties, and can be replicated and verified to produce that same output regardless of who is doing the metering or where.

Just as a metered cubic foot of natural gas is the same on any house, and on any day of the year, wherever it is located, a unit of efficiency as measured by the EEMeter is constant.

However, the value of the natural gas is not fixed. In fact, PG&E tests the BTU intensity of natural gas on a weekly basis and adjusts the price per cubic foot accordingly.

Similarly, an EEMeter tracks weather-normalized metered savings, wherever you are located, on any house, and on any day of the year in exactly the same way using a transparent calculation that can be verified and replicated.

However, the value of that energy savings is not fixed. Regulators or utilities can use EM&V to test the the "intensity" or "net" savings. The value of normalized EEMetered gross savings is then adjusted through pricing and forward contracts to reflect the net intensity of the resource being delivered.

For Regulators and Procurement: Evaluation, Measurement, and Verification (EM&V)

EM&V is an effort to identify net savings that can be attributed directly to a set of interventions for regulated programs, and to identify net effects on load for utilities. In order to identify "net" savings, evaluators must utilize control groups, phone polls, and other techniques to differentiate savings associated with exogenous factors, like economic conditions, impacts of code, and consumer behavior, from savings that are attributable to the program.

The purpose of EM&V is to monitor the cost effectiveness of ratepayer-funded programs and to meet regulatory requirements for claimable savings.

When To Use Control Groups

In a regulated EM&V context, control groups allow evaluators to estimate the energy savings that are attributable to isolated effects of a program. However, both M&V and EEMetering are designed to estimate gross site savings from a building baseline that reflect savings at the meter to a customer, counting all normalized metered savings.

Both M&V and EEMetering are designed to estimate gross site savings from a building baseline based on methods that are transparent and replicable. Control groups are important when estimating “net” impacts of efficiency, but distort actual gross site savings to the point where they won't agree with savings at the meter, or demand to the utility.

Control group adjustments to measurement, often after the fact, creates uncertainty for markets that are antithetical to investment. This is because using control groups requires either population-level customer energy data and quasi-experimental design to attempt to create a match pair a control group that simply cannot be replicated or predicted by market participants..

From Evaluation to Valuation

When applied to metered efficiency as a utility-procurable resource, “evaluation” simply becomes “valuation.”

The utility has an interest in identifying savings that have a net impact on the utility's load shape. This version of net savings is simpler than regulated net-to-gross ratios used for cost tests, and simply controls for any naturally occurring savings already accounted for in a utility’s load forecast to avoid double counting. Utilities care about what the net effect will be on their load shape.

If a utility were to procure a megawatt of energy savings, but 20% of what was being EEMetered was already accounted for in the load forecast (savings from things like code or efficient appliances that are already baked into projects), then only 800K kWh would actually impact the utility's load shape. In a resource procurement paradigm where an EEMeter is used to track normalized site savings, utilities would discount the amount of savings being bid based on a forecasted naturally occurring effect, resulting in a higher per-unit price for efficiency that has a high percentage of naturally occurring savings, favoring efficiency that has greater attributable impacts.

A change in price has the same net effect on per-unit cost as an adjusting of measurement. The advantage of adjusting the price is that it can be set through contracts up front, allowing markets to engage and invest with manageable risk.

The Right Type of Measurement Depends on the Use Case

M&V and EEMetering do not replace the need for EM&V to comply with requirements to derive net-to-gross ratios for regulators, and control groups have an important place. At the same time, not every EE measurement problem requires an EM&V answer. Rather than trying to apply a one-size-fits-all solution to a complex question, it’s important to use the right measurement approach for each efficiency use case.

- If one is attempting to quantify savings on individual buildings, then M&V based on IPMVP makes perfect sense.
- If a utility or aggregator is quantifying normalized metered savings at a portfolio level, then an EEMetering approach is the way to go.
- If a regulatory entity requires a net-to-gross ratio to apply a cost-effectiveness test, or if a utility is valuing savings as a net resource, then EM&V and control groups will be necessary.

As an industry, we need to strive for more quantitative, replicable, and open methods across all three use cases, and keep in mind that there will never be a single solution that works in every case.

Aligning interests through markets will grow the pie

Moving to energy-efficiency procurement that pays for efficiency at the meter will unshackle contractors and the broader energy-efficiency industry from the trap of current incentive programs and the stifling regulation that inevitably goes with them.

Turning energy efficiency into a cash flow, rather than relying on upfront rebates, will enable innovative efficiency product offerings that incorporate the long-term value of savings into innovative solutions for building owners and profitable business models for contractors. There is no perfect one-size-fits-all energy assessment, software tool or consumer value proposition; a market that rewards results will allow for diverse ideas to flourish and those that deliver to get ahead.

As this new market-based approach takes hold, utilities will finally be able to get out of the business of trying to figure out how to deliver energy-efficiency services through programs, and instead can focus on procuring demand-side resources in much the same way they already procure capacity.

With the marketplace being paid based on actual performance and taking on performance risk, regulators will be able to focus on protecting consumers, establishing the “weights and measures” for integrated demand-side resources, and creating well-regulated market structures that send the right price signals. Rather than attempting to directly design the delivery of energy efficiency services through programs, regulators will be able to influence outcomes through market design, while leaving execution up to the market.

Today’s program implementers are also well positioned in this new market, since they are already performing many of same functions one would typically find in an efficiency business, including marketing, contractor management and quality control.

Most importantly, building owners will benefit from a competitive industry incentivized to develop innovative business models and products that drive demand for the broad range of homeowners and buildings in the market.

A good analogy can be seen in the solar market today, where multiple solar companies offer a range of business models from PPAs and leases to franchisees and solar loans, all of which are competing for contractors and customers. We will see the same in energy efficiency as we create the space for innovation by rewarding results.

Imagine a day when homeowners are offered a choice: a business-as-usual contractor selling a mid-range furnace and offering something akin to a credit card as financing, competing with a contractor who is offering efficient equipment and a more comprehensive upgrade with a performance guarantee at a lower price by fully monetizing the value of the savings generated. The homeowner would have every reason to choose the second contractor, saving on both upfront costs and long-term energy bills.

We can learn from experience

The concept of treating energy efficiency as a resource that can be procured through a market is not new. In the early 1990s, there were a number of “standard offer” and demand-side bidding programs where auctions were used to acquire energy efficiency. These case studies provide important insights and lessons to draw from. While these 22-year-old pilots were successful in generating “a high level of interest and support among various types of energy service providers” and “host customers were very satisfied,” they were far from perfect.

These early energy-efficiency markets have been criticized for costing more than program-based alternatives. However, these outcomes should be expected in the early days of a market, especially given the uncertainties associated with traditional evaluation methods, early markets with little competition, and fixed pricing for savings.

Learning from these early prototypes, we can move forward with new market designs. These designs promise game-changing advances that will allow functional and transparent energy efficiency markets to emerge. The availability of meter data and open methods for calculating savings, when combined with a substantially more mature and competitive marketplace, will serve as a foundation for a transparent, data-driven approach to energy efficiency that can overcome previous barriers.

This transition is underway

The good news is that the transition to markets based on metered energy efficiency and pay-for-performance is already underway.

On April 13, NRDC and The Utility Reform Network submitted a response to a CPUC ruling arguing for "a residential sector pilot based on the existing Home Upgrade program, but with savings paid to an aggregator of projects only when savings show up at the meter using the open-source CalTRACK / Open EE Meter system."

This proposed pilot was also supported by Pacific Gas and Electric, which wrote in its filing that "[t]his pilot design has the potential to facilitate comprehensive upgrades while simultaneously minimizing implementation costs through leveraging private capital."

The fact that diverse interests including utilities, industry, and environmental and consumer advocates can agree on the promise of this approach suggests we are approaching a tipping point.

The great innovation in this new paradigm for energy efficiency is not the technology that enables it. The real innovation is how the combination of data, technology and standards will finally allow energy efficiency to function like every other energy market.

By aligning industry with policy goals through metered savings and pay-for-performance, we will encourage innovation through competition, allowing the best solutions to rise to the top -- and a true energy efficiency market to emerge.

California's Senate Bill 350 requires the state's utilities to get 50 percent of their energy from renewables by 2030 and increase building efficiency by 50 percent in the same time frame. California already has some of the strictest building codes and efficiency standards in the U.S., so getting to the new targets will require some novel approaches.

For years, most utility efficiency programs have focused on individual widgets: consumers could change out a light bulb or refrigerator and receive a rebate. The amount of energy saved is not guaranteed, but rather estimated by complex modeling. The models employed are not always correct.

Moving to Pay-For-Performance

PG&E is currently deploying Pay-for-Performance through a range of initiatives, starting with the Residential P4P Pilot.

PG&E officially submitted plans for a residential pay-for-performance program that has the potential to shape the way energy efficiency is monetized and delivered to market. This innovative program, put forward by the utility as a "high-opportunity program" under the state's new AB-802 efficiency law, represents a step toward a creating a real market for energy efficiency as a distributed energy resource.

In its proposal to the California Public Utilities Commission (CPUC), PG&E describes a residential pay-for-performance pilot that uses newly available and standardized energy and project data, combined with open-source standard methods to calculate savings, to enable a marketplace that pays for results measured at the meter, rather than upfront estimates. This approach aligns incentives so that we can better engage private companies and capital markets, develop new business models that increase demand for efficiency retrofits, and boost innovation and competition to drive down costs.

California is a leader in cleantech and "fintech" innovation. But energy-efficiency program design and regulation has created perverse incentives that block the most promising innovations. By contrast, metered pay-for-performance programs will invite innovation while protecting ratepayers by only paying for actual performance at the meter and thus aligning public policy goals with business interests in a competitive market.

“Pay-for-performance and metered efficiency send the signal that will further increase demand for financing while encouraging those projects that deliver the most efficiency," said Cisco Devries, the CEO of Renew Financial.

PG&E’s proposed approach solves both of these problems. Rather than pick technologies or business models, PG&E will pay for results at the meter regardless of how businesses deliver them. Whether savings come from the newest technologies, well-trained crews, customers who change their behavior, or some other approach, PG&E will pay for the savings delivered, similar to how it procures supply-side resources.

PG&E described the shift this way: “This program allows technical innovations, leverages innovative intervention and market strategies, and is designed to provide scalable savings with less ratepayer funds than existing segment offerings. The program grants aggregators the freedom to tailor a mix of interventions based on customer needs, granting them unparalleled flexibility to introduce new measures to help customers save energy as long as these measures lead to persistent measurable consumption reductions, measured at the customer’s meter.”

Energy savings will be measured using the CalTRACK system, which is an open-source platform for tracking energy savings that “will access smart meter data via the PG&E’s Share My Data platform allowing for near-real-time transmittal of usage data,” according to PG&E. PG&E’s innovation promises to simplify the roles of both utilities and regulators, as well as reducing the cost of program overhead. Regulators will be able to focus on protecting customers, creating a market that correctly values efficiency and allowing customers and the market to determine the ways that work.

There is a long way left to go. This initial pilot is a leap forward in a number of key respects, including the use of standard open-source metering savings, and payments based on delivered results. However, it represents just a first step toward a future where energy efficiency can become capacity that includes the dimensions of time and location, in order to take its place as a true grid resource.

The multi-year pilot at PG&E, which was proposed by the Natural Resources Defense Council, will allow third-party stakeholders to sell efficiency services to customers. Those projects will be bundled, and the aggregate savings will purchased by the utility. That income stream can be used by the aggregators to lower their costs, thus passing savings onto consumers. The steady stream of products, backed up by meter data, should theoretically allow for even cheaper efficiency offerings.

Aggregators will be paid based on the difference between metered usage and adjusted baselines. Rather than paying for the savings at each home, however, the payments will be made on a portfolio-wide basis. The NRDC proposal outlines that payments will be made biannually, although that could change in the final proposal.

Energy Efficiency as a Grid Resource Through Procurement

Due to structural limitations on available funding for energy efficiency through ratepayer programs, combined with the ability to meter time dependant savings, known as the resource curve, energy efficiency is moving from programs to procurement.

PG&E recently announced its planned closure of the aging Diablo Nuclear power plant. The proposal calls for filling 50% of the outstanding capacity needs, 2,000 gigawatt-hours with procurement of energy efficiency.

This takes the notion of pay-for-performance to the next step and treats time and locationally dependant efficiency in the same way as other DERs.

PG&E can identify the times and locations where load shapes are affecting grid stability, and run a request for offers program where third parties bid in resource curves (time dependant savings) and sign forward contracts based on delivered and metered results.

This moves efficiency into procurement, which is a much larger bucket -- which is critical, as even the $1B California spends on efficiency today is a drop in the bucket compared to what is required. It also changes the way one can evaluate cost effectiveness from program cost test such as Total Resource Cost Test, towards a Utility Cost Test that looks only at the investment required by the utility to drive outcomes.

Cost effectiveness in this paradigm is based on the marginal cost of the alternatives, where efficiency is specifically displacing other, and more expensive, DER investment. If it's cheaper then storage or grid upgrades, then it's a good deal.

So what does this mean for energy efficiency?

Given this changing load shape, the role of energy efficiency can no longer be a focus on lowering overall kilowatt-hours and British thermal units consumed. Instead, we'll all have to change the way we think about and deploy energy efficiency. Rather than a measure taken to reduce demand to meet a particular efficiency target, satisfy a performance standard, or fulfill the needs of a utility program, energy efficiency will now have to be treated as actual energy capacity.

It will need to become a form of "supply" that can be deployed in real time to help climb the steep neck of the duck curve.

If efficiency is to be deployed as a resource, we'll need to know when and where it is occurring with enough confidence to satisfy those making procurement choices and working to keep the lights on.

Doing so requires system-wide data about buildings, energy use, and a new level of transparency about how energy savings are calculated. In California, we finally have those necessary building blocks in place to make this leap possible. In residential efficiency in particular, we have standardized project data using the national HP-XML standard through the CalTRACK process (meaning contractors can pick their software, but all tools can output the same interoperable data set). Thanks to PG&E's newly released version of its "Share My Data" Green Button solution, it has become simple to access both hourly electric interval data and daily gas consumption through a simple API.

While there's a lot of work to be done to shift from programs and standards to deployable resources, there's also a lot of momentum. Efforts like the EDF Investor Confidence Project are helping to design protocols and standards for quantifying the savings of energy-efficiency investments, as is the Open EE Meter, an open-source platform to make savings transparent and available to all market participants. These open protocols, designed to facilitate a competitive market, will also be invaluable to grid operators and planners who can start to count efficiency gains as they make procurement choices.

In this new grid paradigm, energy efficiency's true potential will shift from baseload savings toward a market-oriented approach, where the value of saving energy at the right times -- and in the right parts of the grid -- will climb dramatically. The opportunity to capture the full value of load shape will have a major impact on the design of efficiency projects and the types of technologies that drive the best returns for building owners and investors.

As an example, in a "duck curve" world, air-conditioning efficiency will no longer be primarily about reducing energy use during the hottest afternoon hours. Instead, grid operators and building managers will need to collaborate on new approaches that use the building like a thermal battery to store cooling energy and coast through the neck of the duck, reducing loads during the most valuable periods.

The eventual mix of load-shaping technologies and business models that provide valuable grid services and save measurable carbon are yet to be fully determined -- and they are evolving too quickly for regulatory processes to keep up. This kind of complexity can only self-organize through competitive markets.

The good news is that energy efficiency is, in general, less expensive than many alternative services available to meet grid demand. Efficiency as demand capacity that delivers permanent load shape change can capture savings that are worth substantially more than current programs. Valuing investments that use efficiency to permanently change load shape will increase its value.

The duck has landed, and it represents a new opportunity for energy efficiency to evolve from simple energy savings to delivering demand capacity as a true grid resource that can help the duck start to fly.

California Legislative Changes Make Room For Innovation

In 2015 California legislature passed SB-350 Clean Energy and Pollution Reduction Act of 2015, a bill that set the state on a path to at achieving Governor Brown's ambitious clean energy goals by 2030. The Governor's "50/50/50" plan aims to increase electricity from renewable sources by 50 percent, reduce petroleum consumption by 50 percent, and increase building efficiency 50 percent by 2030. While most media reports focused on the audacity of trying to increase the renewable portfolio standard and energy efficiency goals, and some observers expressed justified concern about items left on the cutting room floor, there was little discussion of some of the bill's most important provisions, specifically those that address the details about how energy efficiency will be measured and delivered going forward.

Not only does the bill essentially double California's energy efficiency goals, it does so in by making a number of very important changes in how we approach energy efficiency in the state. These changes, if implemented, represent the beginnings of a major paradigm shift.

First, SB-350 specifically changes the way that energy efficiency is counted. Rather than rely on a series of ex-post studies, including a stack of regulation that includes considerations for energy code and attempts to account for "free ridership" and other subjective impacts, SB-350 is clear that "energy efficiency savings and demand reduction reported for the purposes of achieving the targets established pursuant to paragraph (1) shall be measured taking into consideration the overall reduction in normalized metered electricity and natural gas consumption where these measurement techniques are feasible and cost effective." Additionally, this new law defines "energy efficiency savings" as "reducing the quantity of baseline energy services demanded" and includes both the adoption of efficiency measures and practices (such as behavior). The law also directs that the CPUC "achieve greater energy efficiency in existing residential and nonresidential structures that fall significantly below the current standards in Title 24 of the California Code of Regulations." In essence, this means that what's important is results at the meter, not how one gets there, and that those results are the difference between the buildings' baseline use before interventions and consumption levels during the performance period.

While this may seem like commons sense to many people, in reality, it is a huge shift from current practices, one that promises to standardize how efficiency is measured based on meter data, and evaluate it based on straight reductions in demand. More importantly, it has the potential to finally put in place a standardized and replicable system for measuring efficiency as capacity in a way that markets can treat as a reliable demand-side energy commodity. These new directives are also closely aligned with the process underway to implement the residential CalTRACK system based on the Open EE Meter.

Building on this data-driven approach, SB-350 goes on to "Authorize pay for performance programs that link incentives directly to measured energy savings. As part of pay for performance programs authorized by the commission, customers should be reasonably compensated for developing and implementing an energy efficiency plan, with a portion of their incentive reserved pending post project measurement results." Later SB-350 goes on to specifically state that "Incentive payments shall be based on measured results."

This approach, is similar to a pay-for-metered performance pilot that was proposed to the CPUC by NRDC and TURN, and supported as well by PG&E, which said in their CPUC filing that "PG&E supports a residential pay-for-performance pilot that we understand NRDC will propose in its workshop comments. This pilot design has the potential to facilitate comprehensive upgrades while simultaneously minimizing implementation costs through leveraging private capital."

Though it received less attention, another bill that passed last week was AB-802, which also specifically moves the State towards meter-based energy efficiency, in addition to its primary goal of implementing benchmarking across the State. This law directs the California Publis Utilities Commission (CPUC) "determine how to incorporate meter-based performance into determinations of goals, portfolio cost-effectiveness, and authorized budgets, the commission, in a separate or existing proceeding, shall, by September 1, 2016, authorize electrical corporations or gas corporations to provide financial incentives, rebates, technical assistance, and support to their customers to increase the energy efficiency of existing buildings based on all estimated energy savings and energy usage reductions, taking into consideration the overall reduction in normalized metered energy consumption as a measure of energy savings."

In addition AB-802 addresses the festering issue of Code Baseline in California, which has meant that the CPUC can only pay utility incentives for above CEC Title24 Energy Code, which represent an existential problem as code is increased to net zero energy, directing that "programs shall include energy usage reductions resulting from the adoption of a measure or installation of equipment required for modifications to existing buildings to bring them into conformity."

Taken as a whole, these changes represent a fundamental shift in California's approach to energy efficiency. As these changes come into effect, we will be moving from a programmatic regulated approach to efficiency to markets that treat energy efficiency as a capacity resource and rely on private capital and innovation to create the business models necessary to achieve the scale required to hit Governor Brown's goals.

While largely overlooked, these rather weedy changes to how energy efficiency is measured, and the directive to the CEC and CPUC to begin piloting pay-for-performance approaches to measured savings represent a true paradigm shift. Supported by an unusually diverse group of stakeholders, including environmental advocates, local governments, industry, utilities, and ratepayer advocates, these landmark bills represents a major advance and new opportunity for energy efficiency in California.

The Future of Energy Efficiency in Europe

This approach to energy efficiency as a infrastructure and as a distributed energy resource leveraging the power of markets and competition can equally be applied in the european marketplace.

Rather than continue to attempt to design programs and determine what the right technologies and business models may be, instead member countries and utilities can identify the needs of the grid and send a price signal to the market that rewards the most effective outcomes.