State energy factsheet: Pennsylvania

Contents

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This report provides a fact-based overview of Pennsylvania's power sector. It presents key metrics, highlights recent trends and discusses the state's progress toward compliance with the EPA's Clean Power Plan.

Findings

- Pennsylvania (PA) is a net exporter of both electricity and natural gas; its retail electricity prices are on par with regional and US averages, and nuclear and coal are its largest sources of electricity generation.
- Significant changes in the state's power mix are underway, as the duel forces of coal retirements and cheap natural gas (driven largely by in-state gas production) have given way to gas-fired generators and – to a lesser extent – renewables. A 'gasified' power sector is here to stay, as the state has retired 4.3GW of coal capacity from 2011.
- PA built 930MW of renewable capacity (mostly wind) between 2010 and 2015, bringing cumulative installed renewable capacity to 4.7GW by the end of 2015. Renewables composed 4% of in-state generation in 2015.
- PA leads some of its neighbors and lags others in terms of energy efficiency; electric distribution companies dedicated 1.31% of total revenues to efficiency programs in 2014.
- Under the final Clean Power Plan (CPP), states can demonstrate compliance by meeting either a rate- or a mass-based goal. PA is already about halfway to achieving compliance with its mass-based goal.

Table 1: Key power system metrics, PA versus other US states, 2015

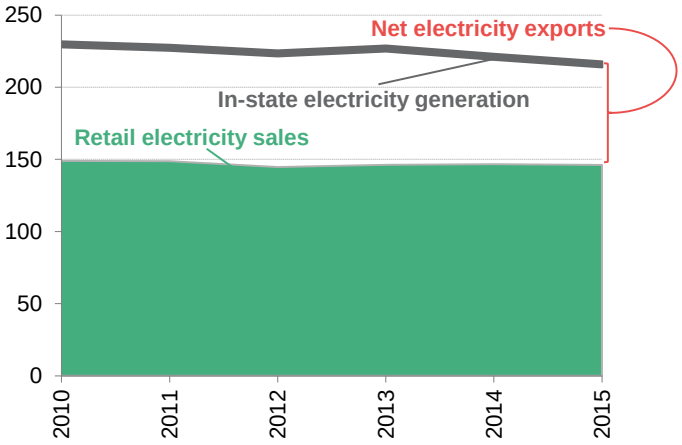
Metric	Units	PA	US average	Comment	Rank
Total retail electricity sales	TWh	146	73	***Above average*** electricity demand	6
Total generation	TWh	216	80	***Above average*** in-state generation	3
Retail electricity sales per capita	MWh	11.4	11.6	***Roughly average*** per capita demand	33
Retail electricity prices	¢/kWh	10.4	10.4	***Roughly average*** electricity prices	18
Generation from gas	%	28	33	***Below average*** reliance on gas for electricity	23
Generation from gas and renewables	%	32	47	***Below average*** on gas and renewables	34
Energy efficiency score	ACEEE index	22	19	***Above average*** on efficiency efforts	17
Utility energy efficiency budget*	% state revenue	1.3	1.6	***Below average*** utility efficiency budget	24
CO2 emissions rate	tCO2/MWh	.43	.49	***Cleaner than average*** generation profile	32
2030 CPP CO2 emissions reductions-mass goal	% cut from 2012	-25	-26	***Roughly average*** 'ask' for CPP mass reduction goal	29

Source: Bloomberg New Energy Finance, EIA, US Census Bureau, American Council for an Energy Efficient Economy Notes: The utility energy efficiency budget shown is from 2014; all other data are for 2015. US ranks are in descending order (ie, 1 being highest, 50 being lowest). For some metrics it is 'good' to have a high ranking (eg, generation from renewables, energy efficiency score); for other metrics it is 'good' to have a low ranking (eg, retail electricity prices, CO2 emissions rate).

1. BIRD'S EYE VIEW OF PENNSYLVANIA'S POWER SECTOR

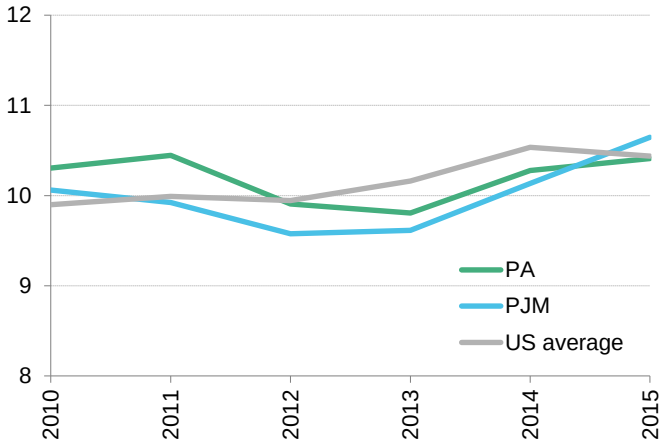
Pennsylvania (PA) produces more electricity than it consumes (215TWh of generation versus 146TWh of consumption in 2015), making it a net exporter to its neighbors. In the past couple years this domestic generation gap has shrunk, as coal-fired retirements have resulted in falling production: between 2010 and 2015, in-state generation contracted at a compound annual growth rate (CAGR) of 1.2% (Figure 1).

Figure 1: PA electricity sales and generation, 2010-15 (TWh)



Source: Bloomberg New Energy Finance, EIA

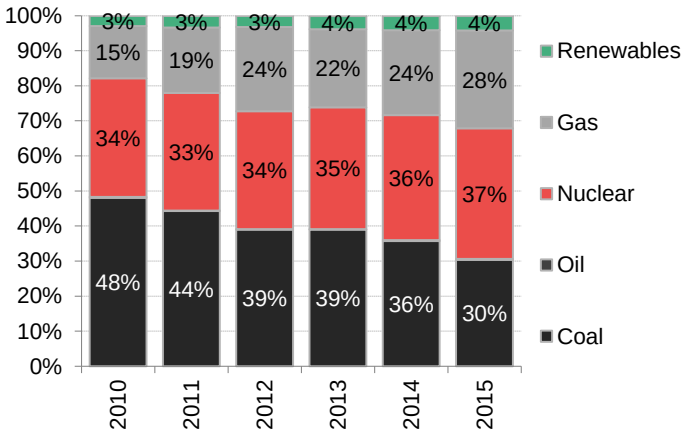
Figure 2: PA electricity prices relative to regional (PJM) and US averages, 2010-15 (¢/kWh)



Source: Bloomberg New Energy Finance, EIA Note: PJM is PA's wholesale power market, composed of 13 neighboring states.

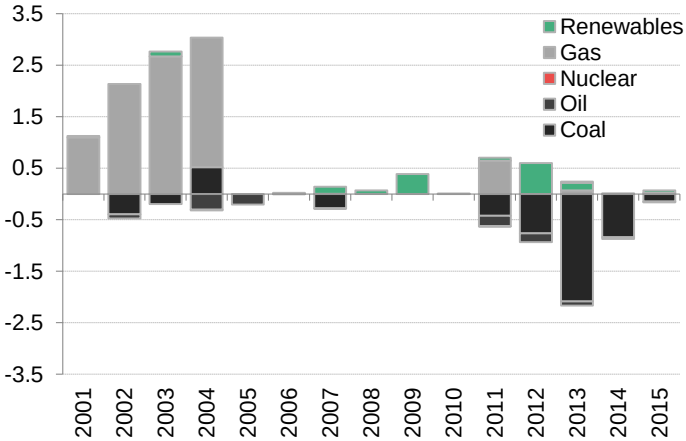
The average retail price of electricity in PA was 10.4¢/kWh in 2015 – only 1% higher than in 2010, and just below both the regional and the US average (Figure 2). Nuclear continues to provide baseload power for PA but significant changes in the state's fossil mix are well underway, with natural gas-fired generation rapidly displacing coal, and generation from renewables on the uptick, driven by wind (Figure 3).

Figure 3: PA electricity generation mix by technology, 2010-15 (%)



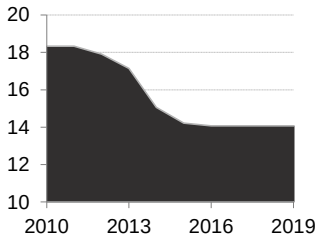
Source: Bloomberg New Energy Finance, EIA

Figure 4: PA utility-scale capacity additions (build, above x-axis) and retirements (below x-axis), 2000-15 (GW)



Source: Bloomberg New Energy Finance, EIA

Figure 5: PA operational coal capacity, 2010-19 (GW)



Source: Bloomberg New Energy Finance

Table 2: PA policies relevant to sustainable energy sectors

Renewables
Alternative energy portfolio standard (AEPS)
Mandates 8% of retail sales come from Tier I renewable energy sources by 2021; of this, 0.5% must come from solar PV. Tier II resources must represent 10% of retail sales by 2021.
Net metering
Provides customers with net excess generation (NEG) from eligible systems (<3MW for non-residential; <50kW for residential) with a kWh credit on their bill
Energy efficiency
Energy efficiency resource standard (EERS)
Calls for cumulative energy savings of 2.3% by 2016 and 3.5% by 2020 (relative to 2009-10) from the state's seven-largest distribution utilities (EDCs)
Utility business model
No utility rate 'decoupling'
No policy in place that decouples utility profits from sales; leaves distribution utilities with little incentive to promote efficiency measures

Source: Bloomberg New Energy Finance, ACEEE, DSIRE, Pennsylvania Department of Commerce

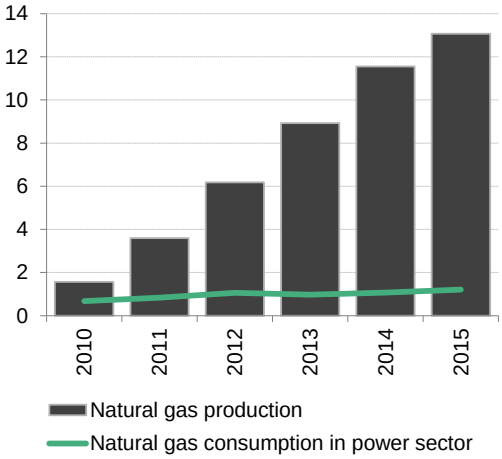
Natural gas has been the fuel of choice for building new power plants in PA, accounting for 81% of capacity additions between 2000 and 2015; since 2010, wind power has come in a close second, representing 36% of build to natural gas's 45%. Meanwhile, coal-fired capacity has shrunk by 4.6GW as operators have succumbed to competition from low-priced natural gas, less-frequent dispatch, and strengthening environmental regulations. (Figure 5).

2. SUSTAINABLE ENERGY DEPLOYMENT

2.1. Natural gas

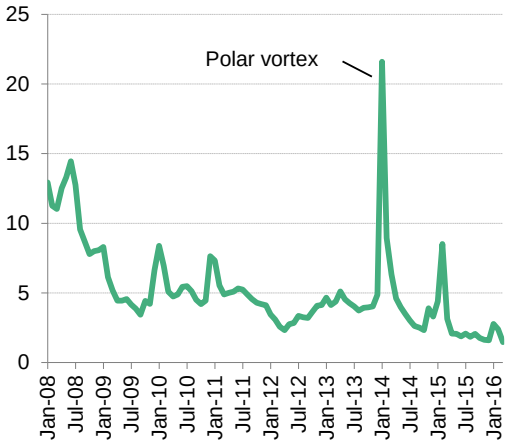
The state is driving a sea change in US natural gas markets, as PA natural gas production growth (from 0.5Bcfd in 2008 to 13Bcfd in 2015 and rising; Figure 6) has contributed to falling natural gas prices, lowering fuel costs for the state's gas-fired generators to under $2/MMBtu in 2015 (Figure 7). This has improved the economics not only for the state's own gas fleet, but for nearly all gas-fired units in the Northeast and across the US.

Figure 6: PA natural gas production and power sector consumption, 2010-15 (Bcfd)



Source: Bloomberg New Energy Finance, EIA

Figure 7: PA natural gas price for electric power consumers, 2008-Jan 16 ($/MMBtu)



Source: Bloomberg New Energy Finance, EIA

A combination of coal retirements and access to cheap natural gas supplies will serve to reduce PA's dependence on coal and will increase its reliance on other sources of electricity – namely, nuclear (existing facilities), natural gas, renewables and demand-side resources (such as energy efficiency and demand response).

2.2. Renewables

PA has a *mandatory* alternative energy portfolio standard (AEPS) requiring 8% of retail sales to come from Tier I renewable resources by 2021, but these resources need not be located within Pennsylvania's borders. Utilities can meet their AEPS standards by sourcing renewable energy credits from any eligible[1] project that delivers power into PJM. In 2015, renewables provided just over 4% of in-state generation – below the 2015 interim AEPS goal of 5% of retail sales.

PA built 930MW of renewable capacity (including 595MW of wind) between 2010 and 2015 (Figure 8).

This brought cumulative installed utility-scale renewable capacity to 4.7GW in 2015 (Figure 9).

Figure 8: PA renewable capacity additions, 2010-15 (MW)

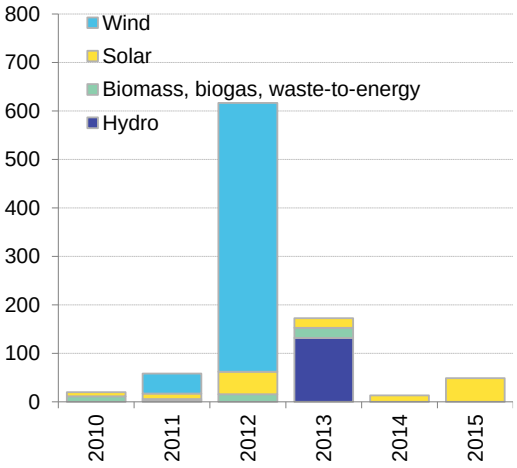
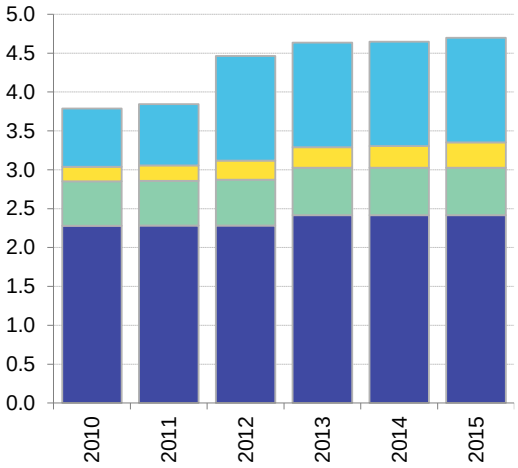


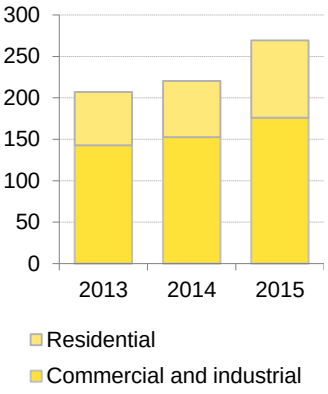
Figure 9: PA cumulative renewable capacity, 2010-15 (GW)



Source: Bloomberg New Energy Finance, EIA Note: includes BNEF data on distributed (ie, residential, commercial, and industrial) solar capacity.

From 2010-15, Pennsylvania added 827MW of utility-scale renewable capacity, including 595MW of onshore wind and 134MW of hydro. On top of this, distributed capacity continues to grow, with 176MW of commercial and industrial and over 90MW of residential solar PV installed in PA by the end of 2015 (Figure 10), incentivized, in part, by the solar PV requirement carved out of the state's AEPS.

Figure 10: PA cumulative installed residential and commercial solar capacity, 2013-15 (MW)



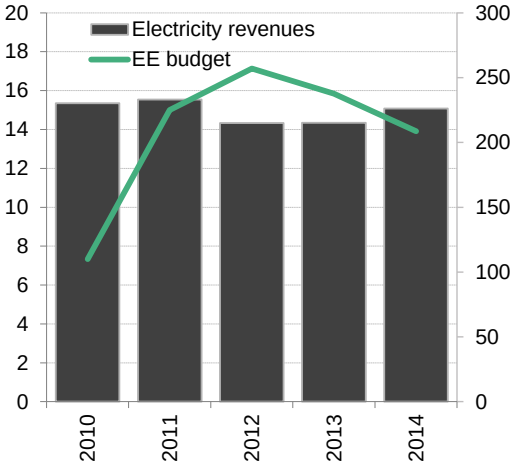
Source: Bloomberg New Energy Finance

2.3. Energy efficiency

PA is a relative leader in terms of its overall energy efficiency efforts, based on the American Council for an Energy Efficient Economy's (ACEEE) state scorecard (PA received 22 out of 40 possible points in 2015, the 17th highest score in that year). But its energy efficiency budget has not kept pace with its electricity revenues, falling from 1.8% of revenues in 2012 to only 1.3% in 2014 (Figure 11); meanwhile, it lags nearby states Maryland (4.3% of revenues), Illinois (2.1%) and New Jersey (2.0%) in terms of efficiency spending.

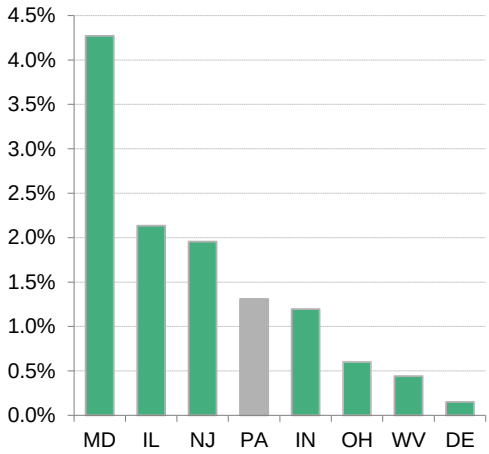
1 Eligible Tier I resources include solar, wind, small hydro, geothermal, fuel cells, biomass, biogas and coal mine methane. Eligible Tier II resources include waste coal, integrated-gasification combined cycle coal, large hydro, waste-to-energy, distributed resources under 5MW, and demand-side management.

Figure 11: PA utility electricity revenues (left axis, $bn) and electricity efficiency budget (right axis, $m), 2010-14



Source: ACEEE

Figure 12: States' utility electricity efficiency budgets as a fraction of state-wide electricity revenue, 2014 (%)



Source: ACEEE

Electric distribution companies (EDCs) in Pennsylvania dedicated 1.31% of revenues to efficiency in 2014.

Historically, energy efficiency spending had resulted in all of the state's EDCs achieving 2TWh/yr cumulatively through May 2015, with a reported benefit-cost ratio one of 1.64; and, state-wide, EDCs posted 93% of the energy savings needed to meet their mandatory 2015 EERS target, passed into law in 2008.

3. CLEAN POWER PLAN

The US Environmental Protection Agency (EPA) released the finalized Clean Power Plan (CPP), its landmark power sector regulation, on 3 August 2015. The final CPP assigns Pennsylvania slightly less stringent emissions targets than those proposed in its earlier draft plan. Under the final plan, Pennsylvania must reduce the carbon emission rate of its existing fossil fleet to 0.50tCO2/MWh by 2030, equivalent to a 33% cut from the 2012 baseline rate of 0.74tCO2/MWh. The earlier draft had proposed a stricter target rate of 0.48tCO2/MWh for the state. In addition to the 2030 target, the final CPP also requires the state to meet an interim emission rate goal of 0.57tCO2/MWh, on average over 2022-2029.

Pennsylvania is already roughly halfway toward meeting its 2030 mass-based goals under the CPP.

To facilitate compliance for states aiming to use mass-based approaches, the CPP also finalized mass goals for all affected states which may be used for compliance instead of rate-based targets. If Pennsylvania adopts the mass-based goals, it must achieve a target emissions level of 81.5MtCO2 by 2030, a 25% decrease from the 2012 baseline of 109MtCO2.

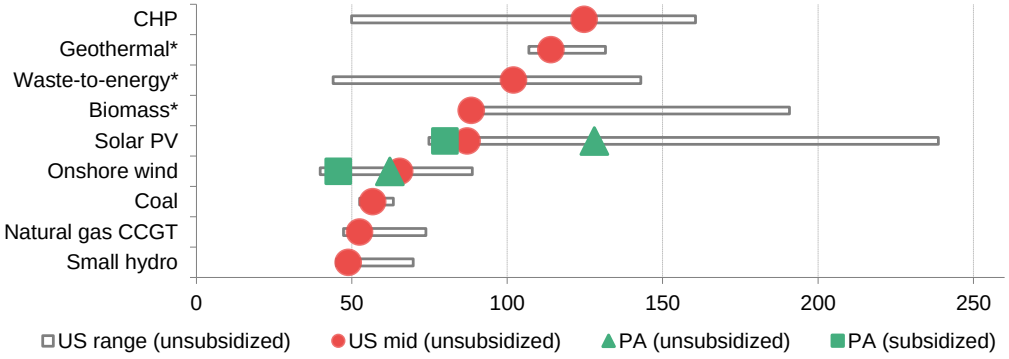
Given its current and pending pipeline of emission reduction activities, the state has made significant progress toward meeting its 2030 targets. Plant retirements from its fossil fleet and current and pending renewables build only take Pennsylvania 9% toward meeting its 2030 rate-based target. However, recent and pending retirements of covered fossil plants mean that Pennsylvania is already 46% of the way towards achieving its 2030 mass-based target.

4. OPPORTUNITIES

The Bloomberg New Energy Finance levelized cost of electricity (LCOE) analysis compares the cost of producing electricity from different technologies in the US (Figure 13). The red circles show US averages (not accounting for policy – ie, unsubsidized); the green triangles and squares show

subsidized and unsubsidized Pennsylvania-specific LCOEs, respectively, for onshore wind and solar PV.

Figure 13: Unsubsidized levelized cost of electricity (LCOE) of select technologies in the US compared to subsidized and unsubsidized LCOE of onshore wind and solar PV in PA, H1 2016 ($/MWh)



*Source: Bloomberg New Energy Finance Notes: *LCOE for waste-to-energy in this report is a global estimate; biomass and geothermal LCOEs are Americas region estimates; all other LCOEs in Figure 13 are either US or PA-specific. Variations in PA versus US average result from variations in capacity factor, capex and financing rates. Bars indicate the range of unsubsidized LCOE for each technology in the US. Key policies such as the $23/MWh Production Tax Credit (PTC) and accelerated depreciated (MACRS) bring down unsubsidized LCOEs to subsidized levels. LCOE for combined heat and power (CHP) is for reciprocating engines with CHP. LCOE for small hydro assumes 56% capacity factor, but this can vary significantly depending on annual rainfall conditions.*

Several clean energy technologies are already, or are on the verge of being, economically viable without incentives

Renewables

- The LCOE analysis indicates that several clean energy technologies are already, or are on the verge of being, economically viable without incentives in PA (unsubsidized LCOE close to or below the levelized cost of energy from a combined-cycle natural gas-fired plant): namely, small hydro and onshore wind; in addition to waste-to-energy and CHP (on the lower end of their respective LCOE ranges).
- Pennsylvania has introduced several bills in recent years attempting to strengthen the state's Alternative Energy Portfolio Standard (AEPS), whose 'open-door' renewable energy credit (REC) policy allows utilities to comply by importing out-of-state resources, at the expense of in-state renewable deployment. Especially for the state's solar carve-out, a 'closed-door' policy *could* help to revive a sputtering local solar industry. The current policy has allowed out-of-state utility-scale solar (from places such as North Carolina, where the economics are strong) to flood the market. These imports have depressed the value of solar renewable energy credits to the same amount captured by onshore wind ($13-15/MWh), rendering it difficult for the in-state solar industry to compete.

Natural gas

- The LCOE analysis highlights the economic merit of combined-cycle gas-fired plants, especially given PA's proximity to the Appalachian Basin, the chief driver of natural gas production growth in the US.
- The Marcellus formation, which spreads across the majority of western PA, has been the largest contributor to overall 'App Basin' production growth, and will soon be producing at an even higher rate when additional pipeline capacity is put in place.

- A potential additional driver of future natural gas demand may come from combined heat and power (CHP) plants, which use natural gas more efficiently by making use of waste heat. In February 2016, the state's Public Utility Commission (PUC) proposed creating a policy statement to encourage investment in CHP, jointly with electric and natural gas utilities. Further details will be forthcoming.

Energy efficiency and demand response

- Pennsylvania can do more on efficiency: its Public Utility Commission conducted the *2015 Energy Efficiency Potential Study for Pennsylvania*, which estimated that the state could feasibly achieve 13.2% in cumulative energy savings (relative to a June 2009 – May 2010 baseline) by 2025. But without new PUC efficiency mandates, EDCs will have little incentive to promote new efficiency measures, especially because PA does not feature utility rate decoupling. That is to say, for utilities today, reducing retail energy demand through energy efficiency reduces sales and therefore revenues.
- Under Phase III of PA's Act 129 (the framework for the state's energy efficiency targets) demand response targets for EDCs were introduced for the first time. Beginning in June 2016, EDCs will target total savings of 424MW annually through 2021. The targets represent a peak shaving potential of 1.6%, based on peak demand witnessed from 2007-2008.

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