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 identifies energy-related opportunities for the Keystone State in light of 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 coal and nuclear are its largest sources of electricity generation.
- Significant changes in the state's power mix are underway, as coal retirements and low-cost natural gas (driven largely by in-state gas production) have given way to gas-fired generation and – to a lesser extent – renewables. Gasification of the state's power sector is set to continue as it loses another 18% of coal capacity between 2014 and 2020.
- PA built 1.4GW of utility-scale renewable capacity (mostly wind) between 2008 and 2013, bringing cumulative installed utility-scale renewable capacity to 4.5GW by the end of 2013. Renewables composed 4% of in-state generation in 2013.
- PA leads some nearby states and lags others in terms of energy efficiency; distribution utilities dedicated 1.66% of total revenues to efficiency programs in 2013.
- EPA arrived at PA's Clean Power Plan target with a large emphasis on increased renewable output and energy efficiency. It is important to note that PA has flexibility in developing its compliance approach (strategy) and a range of options to consider in its plan.

Table 1: Key power system metrics, PA versus US average, 2013

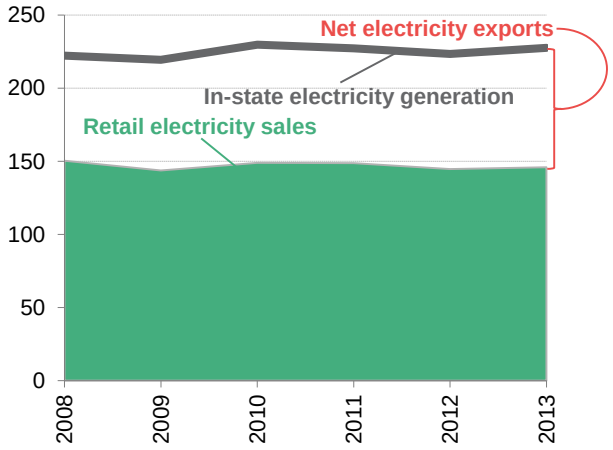
Metric	Units	PA	US average	Comment	Rank
Total retail electricity sales	TWh	146	72	***Above average*** electricity demand	5
Total generation	TWh	228	80	***Above average*** in-state generation	2
Retail electricity sales per capita	MWh	11.4	11.6	***Roughly average*** per capita demand	32
Retail electricity prices	¢/kWh	9.8	10.1	***Roughly average*** electricity prices	19
Generation from gas	%	22	28	***Below average*** reliance on gas for electricity	23
Generation from gas and renewables	%	26	41	***Below average*** on gas and renewables	33
Energy efficiency score	ACEEE index	22.0	19.2	***Above average*** on efficiency efforts	19
Utility energy efficiency budget	% state revenue	1.66	1.13	***Above average*** utility efficiency budget	20
CO2 emissions rate	tCO2/ MWh	0.48	0.52	***Cleaner than average*** generation profile	21
'Adjusted' emissions rate cut	%	31	38	***Below average*** 'ask' under the Plan	30

Source: Bloomberg New Energy Finance, EIA, US Census Bureau, ACEEE Notes: 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

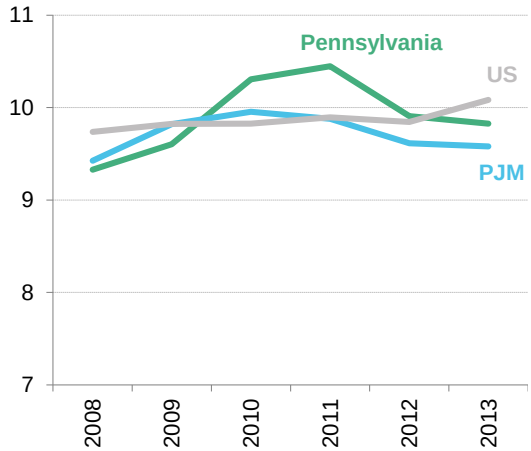
Pennsylvania (PA) produces more electricity than it consumes (228TWh of generation versus 146TWh of consumption in 2013), making it a net exporter of electricity to nearby states. And PA is growing its domestic generation gap: between 2008 and 2013, the difference between in-state generation and retail electricity sales increased at a compound annual growth rate (CAGR) of 2.6% (Figure 1).

Figure 1: PA electricity sales and generation, 2008-13 (TWh)



Source: Bloomberg New Energy Finance, EIA

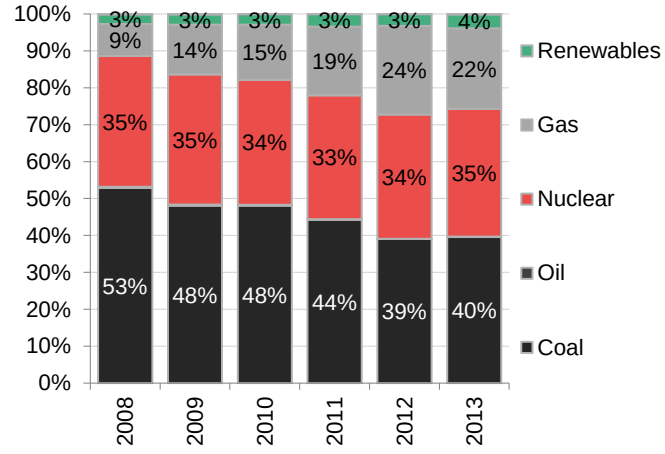
Figure 2: PA electricity prices relative to regional (PJM) and US averages, 2008-13 (¢/kWh)



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

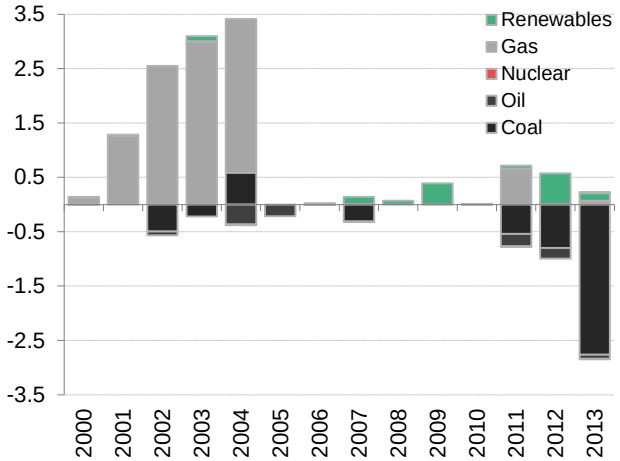
The average retail price of electricity in PA was 9.8¢/kWh in 2013 – 5% higher than in 2008; just above the regional average; and below the US average (Figure 2). Nuclear continues to provide baseload power for PA but significant changes in the state's fossil mix are well underway, with natural gas-fired generation displacing coal and generation from renewables on the uptick, driven by wind (Figure 3).

Figure 3: PA electricity generation mix by technology (%)



Source: Bloomberg New Energy Finance, EIA

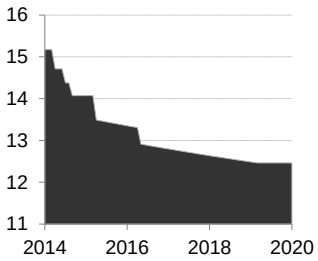
Figure 4: PA utility-scale capacity additions (build, above x-axis) and retirements (below x-axis), 2000-13 (GW)



Source: Bloomberg New Energy Finance, EIA

Figure 5: PA operational

coal capacity, 2014-20 (GW)



Source: BNEF

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
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 PA' seven-largest electric distribution companies (EDCs, see note on page 7)
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, PA DOC Note: *2020 EERS target based on tentative PUC order from March 2015. Policy information accessed May 2015.*

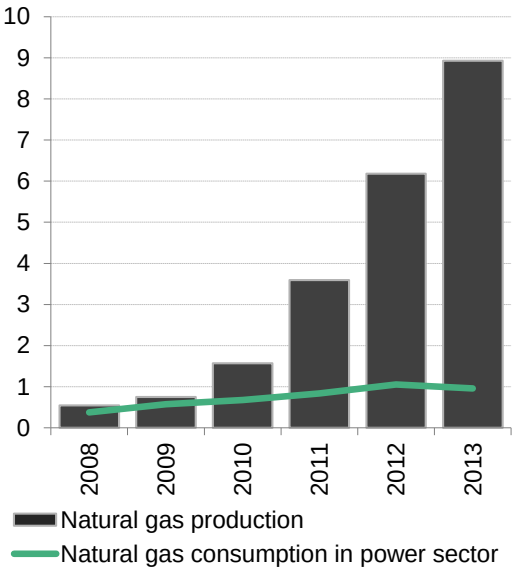
Natural gas has been the fuel of choice for building new power plants in PA, accounting for 83% of capacity additions between 2000 and 2013; and the gasification of the state's power sector is set to continue as it loses another 18% of coal capacity between 2014 and 2020 (Figure 5).[1]

2. SUSTAINABLE ENERGY DEPLOYMENT

2.1. Natural gas

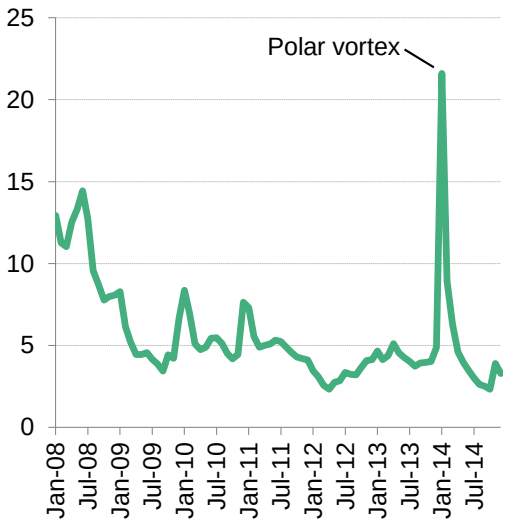
The state is driving a sea change in US natural gas markets, as PA natural gas production growth (from 0.5Bcfd in 2008 to 9Bcfd in 2013 and rising; Figure 6) has contributed to falling natural gas prices, lowering fuel costs for the state's gas-fired generators (Figure 7). This has improved the economics 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, 2008-13 (Bcfd)



Source: Bloomberg New Energy Finance, EIA

Figure 7: PA natural gas price for electric power consumers, 2008-14 ($/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. Obligated entities can meet their AEPS standards by sourcing renewable energy credits from any eligible project that delivers power into PJM. In 2013, renewables provided 4% of in-state generation – roughly aligned with 2013's interim AEPS goal of 4% of retail

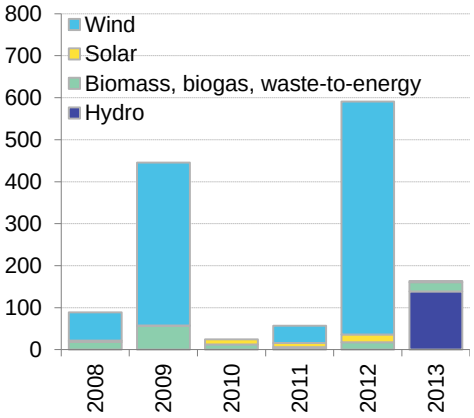
1 Bloomberg New Energy Finance, Wave goodbye to 17% of US coal capacity, March 2015.

sales. [2] Of this 4% (7TWh) of in-state renewable generation in 2013, wind accounted for 39%, followed by biomass, biogas and waste-to-energy (36%), hydro (24%) and solar (1%).

PA built 1.4GW of utility-scale renewable capacity (including 1.1GW of wind) between 2008 and 2013 (Figure 8).

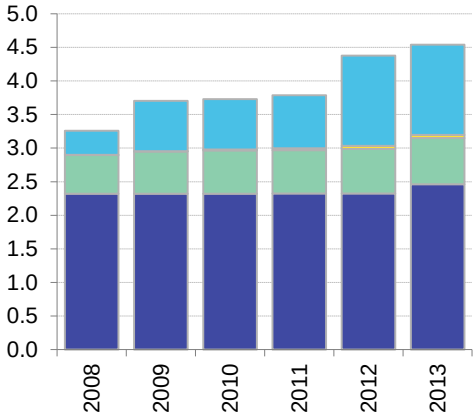
This brought cumulative installed utility-scale renewable capacity to 4.5GW in 2013 (including 2.5GW of hydro) (Figure 9).

Figure 8: PA utility-scale renewable capacity additions, 2008-13 (MW)



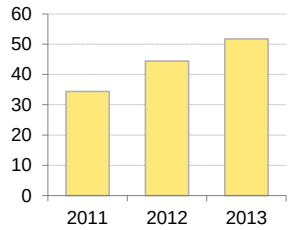
Source: Bloomberg New Energy Finance, EIA

Figure 9: PA cumulative utility-scale renewable capacity, 2008-13 (GW)



Source: Bloomberg New Energy Finance, EIA

Figure 10: PA cumulative installed residential solar capacity, 2011-13 (MW)



Source: Bloomberg New Energy Finance, IREC

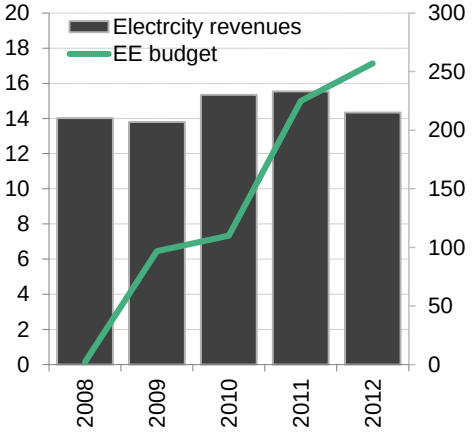
On top of this, over 50MW of residential solar PV was installed in PA through 2013 (not included in Figure 8 and Figure 9, shown in Figure 10), incentivized, in part, by the solar PV requirement carved out of the state's AEPS.

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 2013, the 20th highest score in that year). Figure 11 shows PA's annual electricity revenues and utilities' energy efficiency budget from 2008 to 2012; Figure 12 shows how PA stacks up against nearby states in terms of efficiency spending.

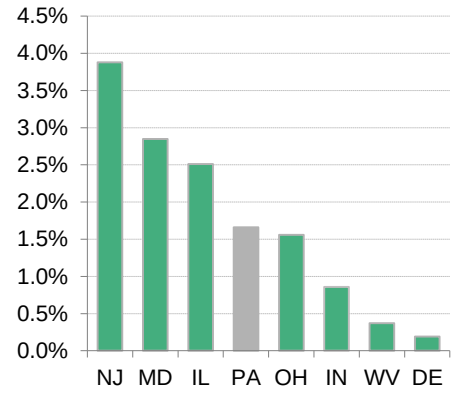
Utilities in Pennsylvania dedicated 1.66% of revenues to efficiency in 2013.

Figure 11: PA utility electricity revenues (left axis, $bn) and electricity efficiency budget (right axis, $m), 2008-12



Source: ACEEE

Figure 12: States' utility electricity efficiency budgets as a fraction of state-wide electricity revenue, 2013 (%)



Source: ACEEE

Between 2008 and 2013,

2 Eligible Tier I resources include solar, wind, small hydro, geothermal, fuel cells, biomass, biogas and coal mine methane.

utilities cost-effectively achieved their energy efficiency targets

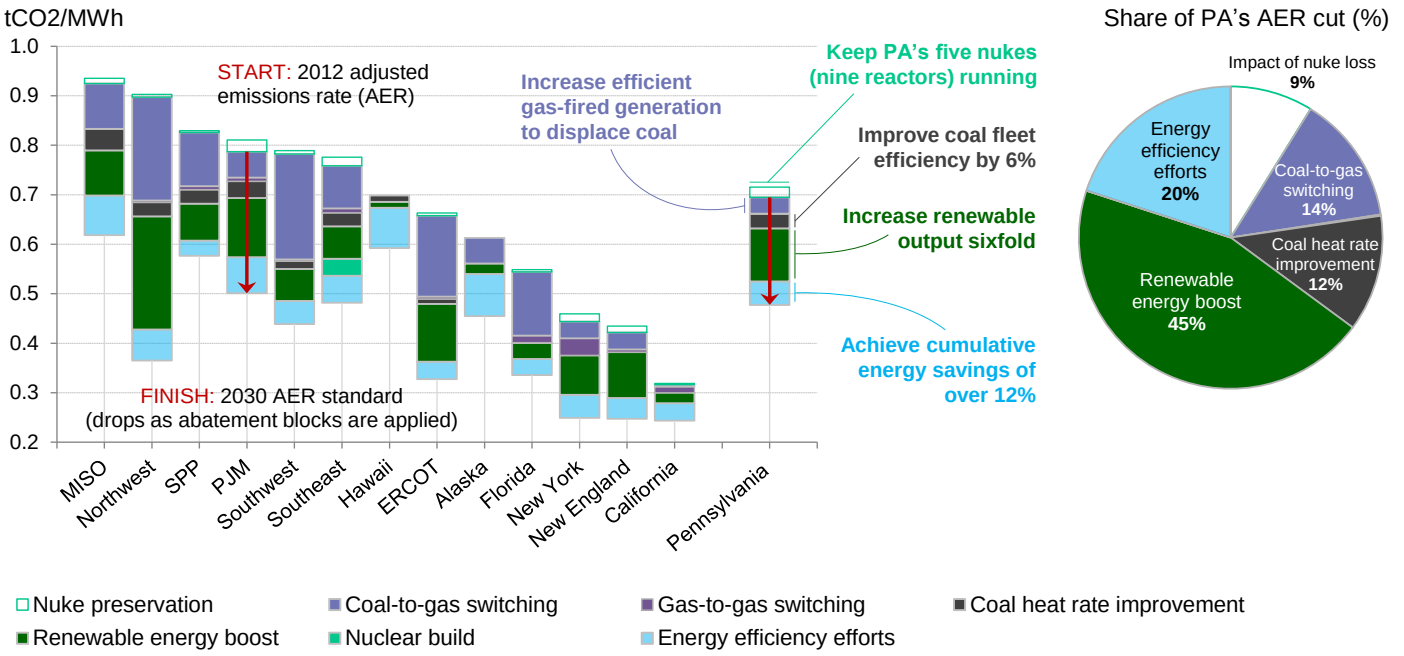
Historically, energy efficiency spending has resulted in all of the state's utilities achieving their mandatory 2013 EERS target, passed into law in 2008, with reported benefit-cost ratios higher than two to one; and, state-wide, utilities have already posted 62% of the energy savings needed to meet their 2016 EERS target.[3]

3. CLEAN POWER PLAN

PA's 'adjusted' emissions rate target

The EPA's *draft* Clean Power Plan tasks PA with reducing its 'adjusted' emission rate (AER) by 31% by 2030 – the 30th most stringent cut in the US. Figure 13 shows how the agency constructed PA's 2030 AER target – by applying various 'abatement blocks' (essentially, EPA assumptions) to the state's generation profile – and the relative importance of each (highlighted in the pie chart).

Figure 13: How the EPA constructed PA's 2030 AER target, compared with other states and regions



Source: Bloomberg New Energy Finance, EPA's Clean Power Plan Note: These charts show a proposed approach for achieving the reduction targets, but the Plan does not require that a state adopt this particular approach (it only requires that the state achieve the final target).

EPA's methodology emphasizes renewable energy and energy efficiency…

According to EPA, boosting renewable energy generation represents the most important 'abatement block' for PA (45% of its total AER cut), followed by ramping up energy efficiency efforts (20%), coal-to-gas switching (14%), coal fleet efficiency improvement (12%) and keeping its five nuclear plants online (9%). Under the regulations as written, EPA asks for less in the way of coal-to-gas switching – since the state ran its CCGT fleet with one of highest capacity factors in the nation in 2012 (the EPA's baseline year for calculating AER targets) – and more in terms of renewable energy (a sixfold increase from 5TWh in 2012 to 35TWh in 2030).

3 Based on Pennsylvania PUC-commissioned evaluations of utilities' energy efficiency and conservation programs from March 2014 (for Program Years 1-4, June 2009-May 2013) and February 2015 (for Program Year 5, June 2013-May 2014).

Compliance options

Pennsylvania need not follow the EPA's suggested 'abatement block' methodology (above) to comply with the Clean Power Plan. The state has flexibility and strategies to consider:

…but the state has various options and flexibility to reduce its emissions intensity

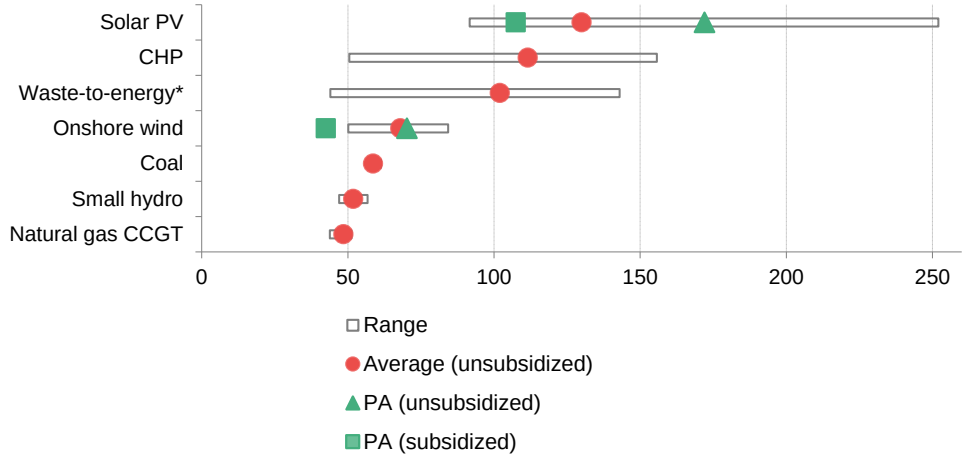
- *Mass-based versus rate-based:* the Plan provides all states with the option to convert the rate-based targets (measured in tCO2/MWh) to mass-based targets (ie, an absolute limit on emissions). For PA, joining RGGI would constitute a form of mass-based compliance.
- *Markets versus mandates:* PA may use a market-based mechanism (eg, a trading scheme) to comply with the Plan; or it could do so by further strengthening the existing renewable energy standard and/or energy savings goals.
- *Multistate versus state-level:* PA can band together with one or more nearby states and submit a joint implementation plan to EPA. For PA, a multi-state approach need not be limited to joining RGGI; it could also include a PJM-based scheme (among others).

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 14). The red circles show US averages (prior to the inclusion of policy – ie, unsubsidized); the green triangles and squares show subsidized and unsubsidized Pennsylvania-specific LCOEs, respectively, for onshore wind and solar PV.

Figure 14: 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 2015 ($/MWh)

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



*Source: Bloomberg New Energy Finance Notes: *LCOE for waste-to-energy in this report is a global estimate, as opposed to all other LCOEs in Figure 14, which 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 58% capacity factor, but this can vary significantly depending on annual rainfall conditions.*

Renewables

- The LCOE analysis indicates that, in PA, several clean energy technologies are already, or are on the verge of being, economically viable without incentives (unsubsidized LCOE close to or below CCGT): namely, small hydro and onshore wind; in addition to waste-to-energy and CHP (on the lower end of their respective LCOE ranges).

- PA 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 domestic solar industry.
- Waste-to-energy and hydropower have important roles in the Keystone State as well.
  - Given that PA is the largest waste-importing state in the nation, there is room for growth in the waste-to-energy sector.
  - Currently, there are nine original hydropower licenses (for 141MW of hydro capacity) pending before the Federal Energy Regulatory Committee; and significant portion of the states hydro fleet will require relicensing to operate through 2030.
- And other renewables could potentially play larger roles in PA provided stronger support from policymakers and utilities alike.

Natural gas

- The LCOE analysis also highlights the economic merit of natural gas CCGT – especially given PA's proximity to the Appalachian Basin, the chief driver of natural gas production growth nationwide.
- 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.

Energy efficiency

- Pennsylvania achieved cost-effective energy efficiency savings between 2008 and 2013 (see Section 2.3 above), yet additional low-cost opportunities remain. The state's own analysis showed it could economically achieve 17.3% of cumulative energy savings (relative to the June 2009-May 2010 baseline) by 2023. But without new PUC efficiency mandates, utilities will have little incentive to promote new efficiency measures, especially because PA does not feature utility rate decoupling. That is to say, for utilities, reducing retail energy demand through energy efficiency reduces sales and therefore revenues.

Note on terminology: Throughout this report, we refer to 'EDCs' as utilities for simplicity. However, since PA has a deregulated retail electricity market (ie, customers have 'retail choice' as to their electricity supplier), EDCs may not provide the billing to all end-user (as do utilities in regulated retail electricity markets).

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