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Coal: a duel between policy and markets

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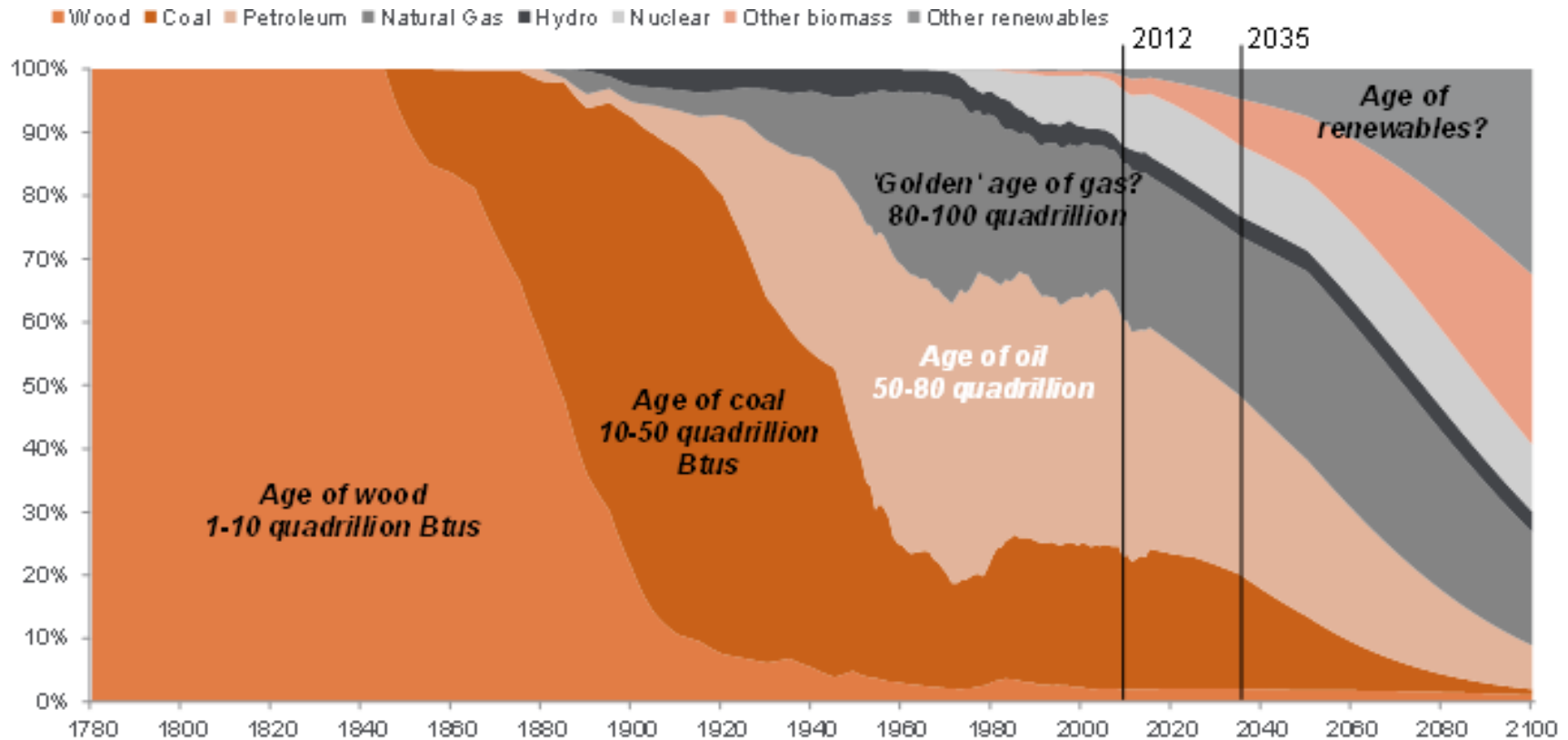
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The energy system is supposed to move from fossil fuels to renewables...

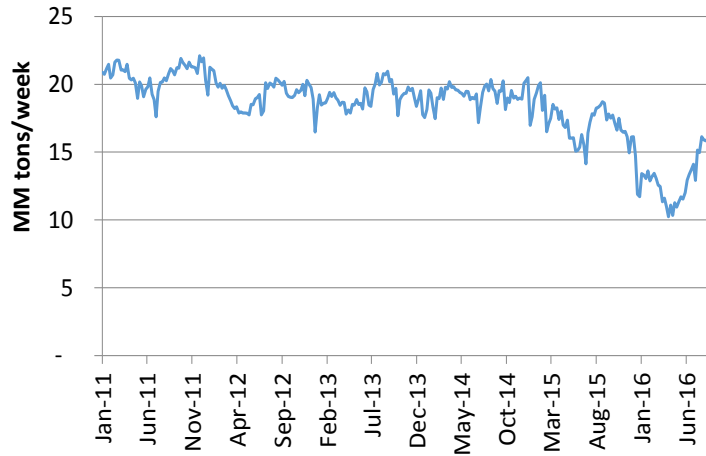
The ages of energy: History suggests a process of substitution

US primary energy demand 1780-2100

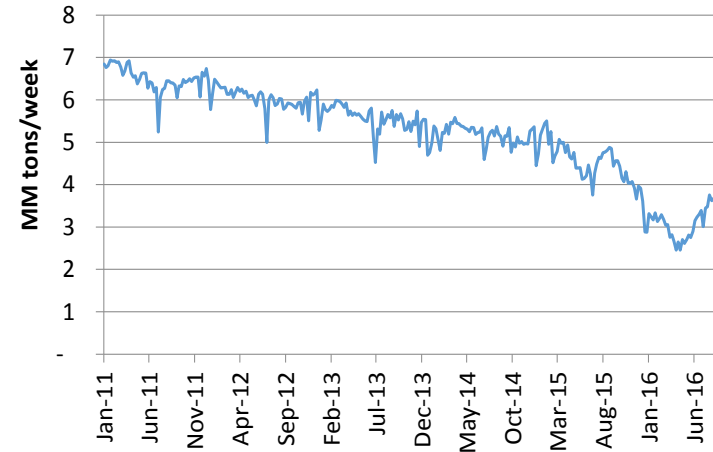


US coal production, after falling sharply in the last 2 year, is staging a rebound

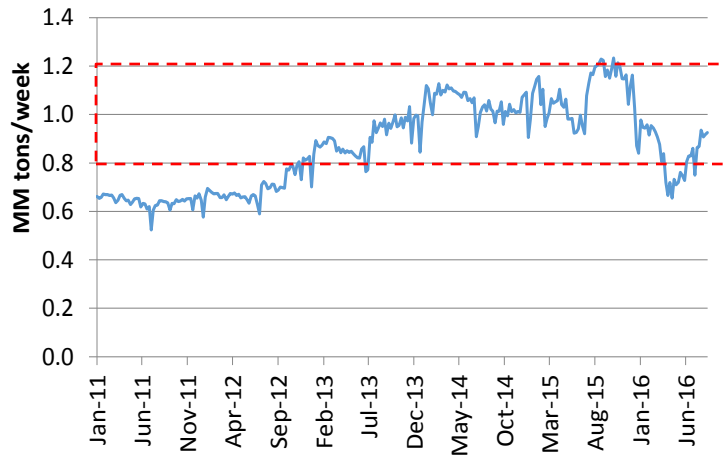
US coal production has had a partial rebound...



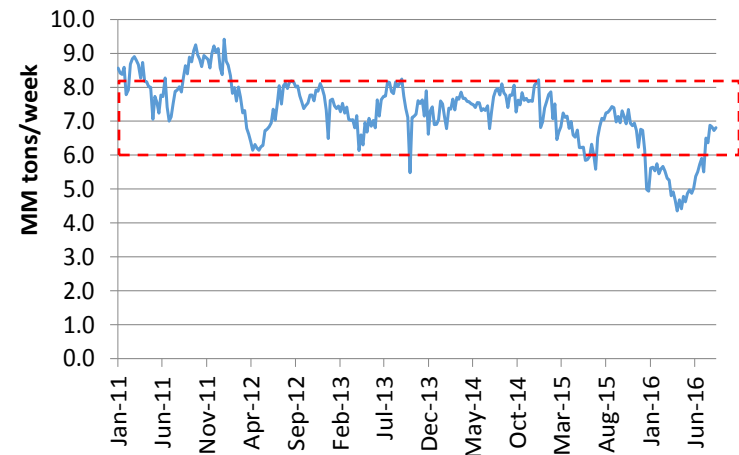
...As the production rebound in Appalachian coal still leaves its production level below prior years' levels



Illinois coal production has had a strong recovery...



...And Wyoming coal production, representative of PRB, has risen back to the average range seen in prior years



Coal prices have recovered somewhat as stronger demand is expected in '17

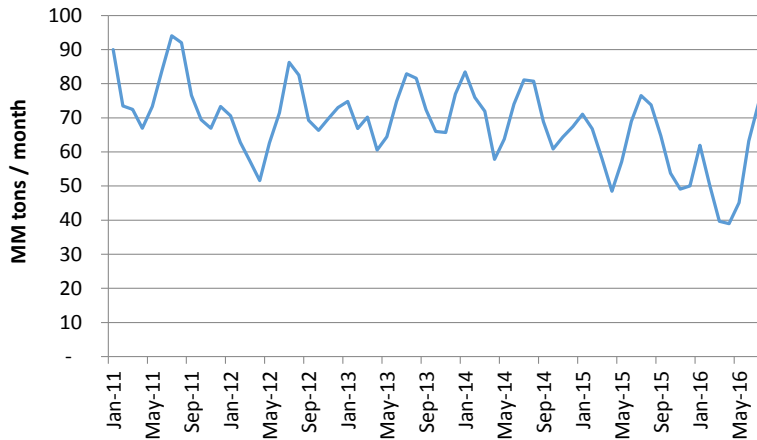
CSX rail coal prices have edged higher...



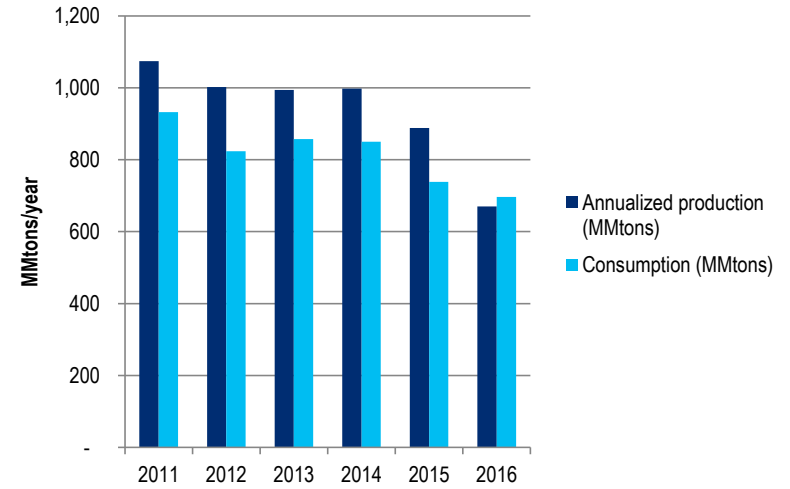
...Powder River Basin coal prices also rose



US coal demand in the power sector has risen as natural gas prices edged higher and summer weather got hotter

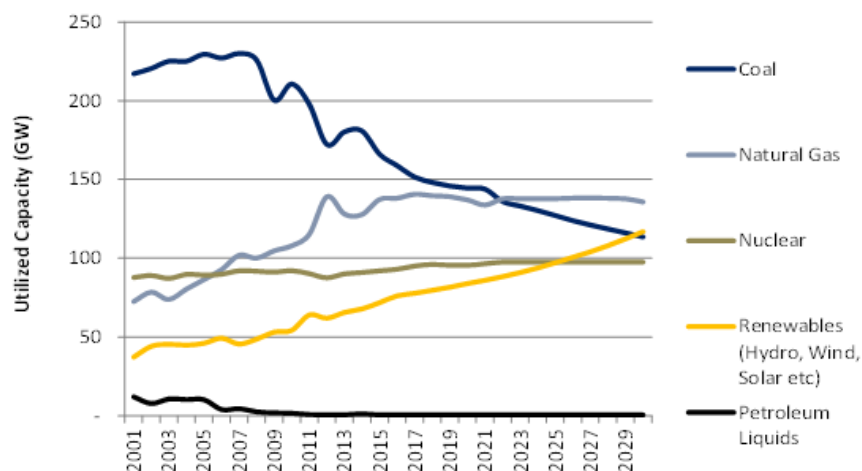


Even with the coal production rebound, production still looks to be below consumption

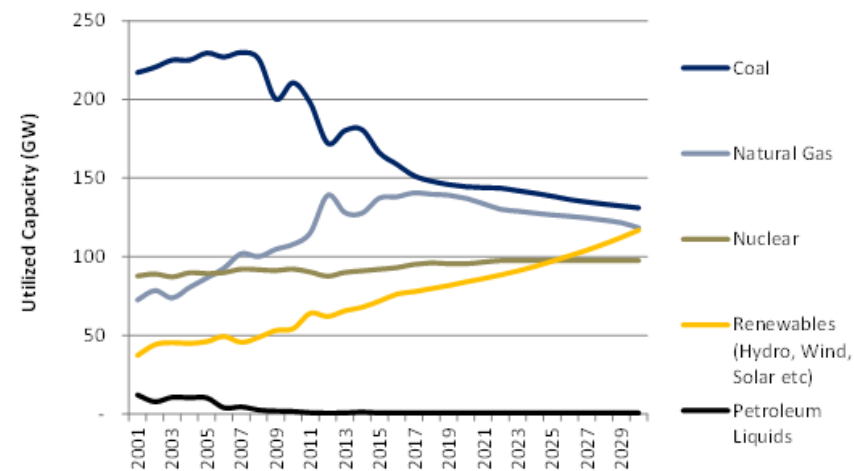


Longer term: Clean Power Plan - To Plan, or Not To Plan; That is the Question

Coal and gas should both be squeezed, with coal's share thought to be most hurt: generation forecasts by fuel

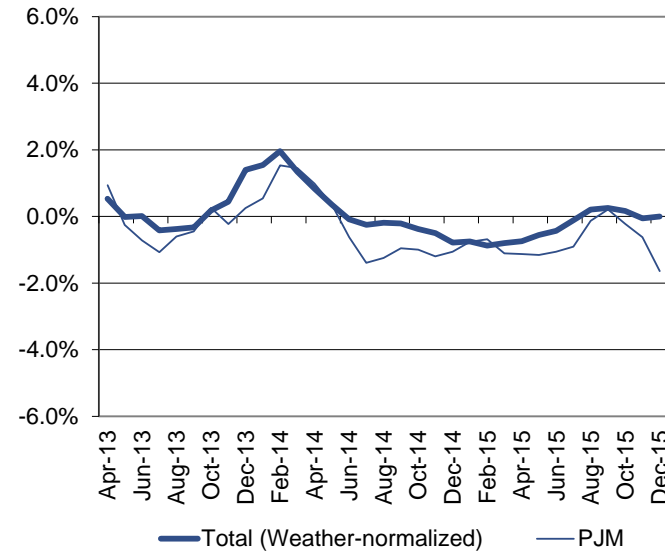


...But loosening the emission cap slightly could keep coal's share above gas: a repeat of EU power market

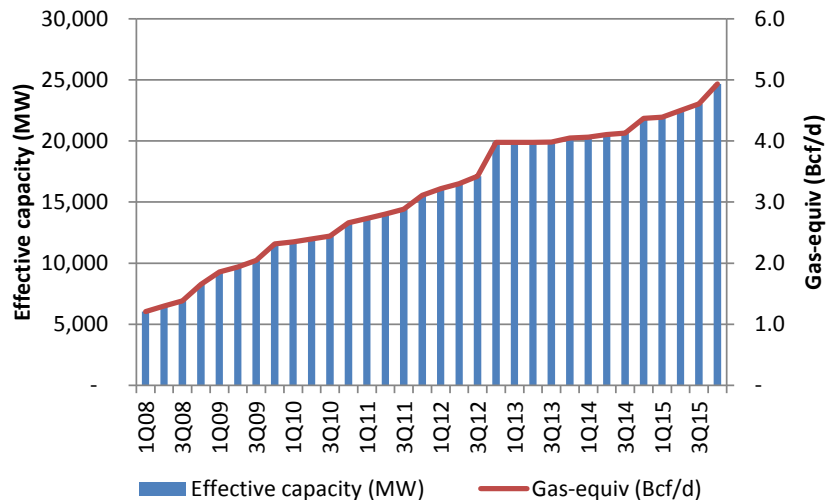


Weak power demand and rising renewables put a squeeze on coal and gas

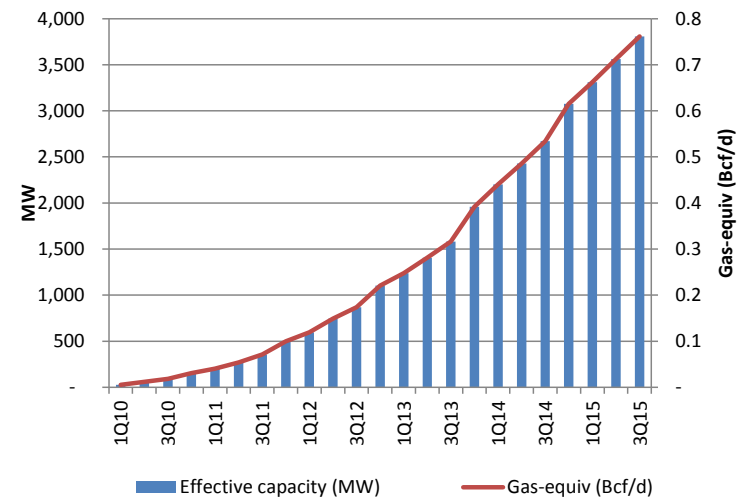
Weather-normalized power demand growth nationally and in PJM, for example, has been flat to negative



Renewables: surging incremental and cumulative wind installs...



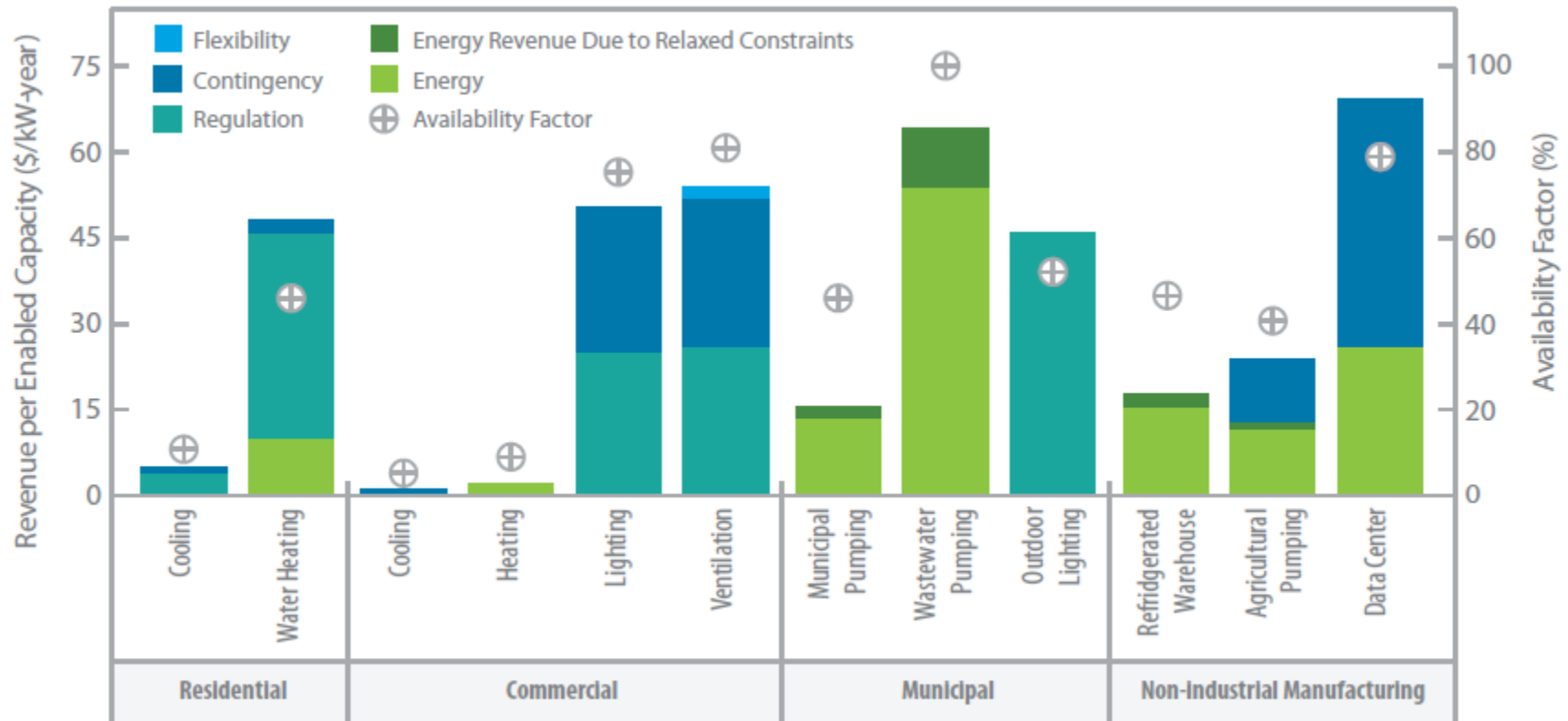
...And rising solar PV installs, to be helped by the 5-year extensions of tax credits, instead of annual extensions



Demand response resources could keep power demand growth flat to negative

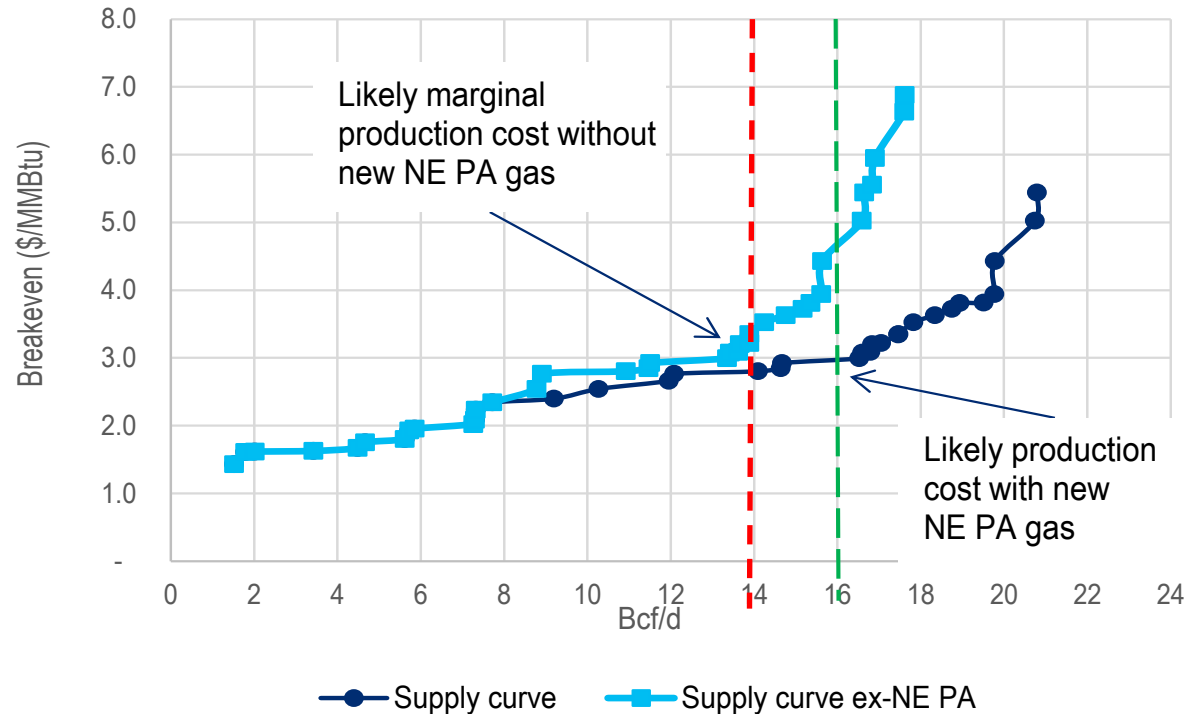
Value of demand response resources for energy and grid services

More from grid services (~80%) than energy (~20%)



US natural gas prices could stay range-bound

New pipes in 2018 could bring on more NE PA gas, lowering the marginal cost to ~\$3*



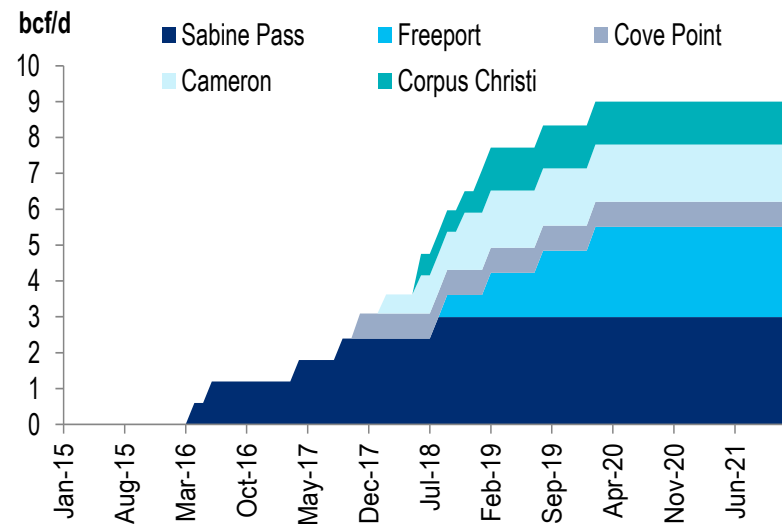
- We look into the supply curve bringing new gas online to satisfy both natural production decline and production growth needed to meet new demand and exports.
- Assuming new pipes come online and debottleneck the northeast Marcellus, the cost to get this gas online could be around \$3/MMBtu, as indicated by the cost curve below.
- Indeed, many market participants also believe that, with \$3 gas at Henry Hub, plenty of new Marcellus/Utica gas could be profitably produced.

Source: Woodmac, EIA, Citi Research

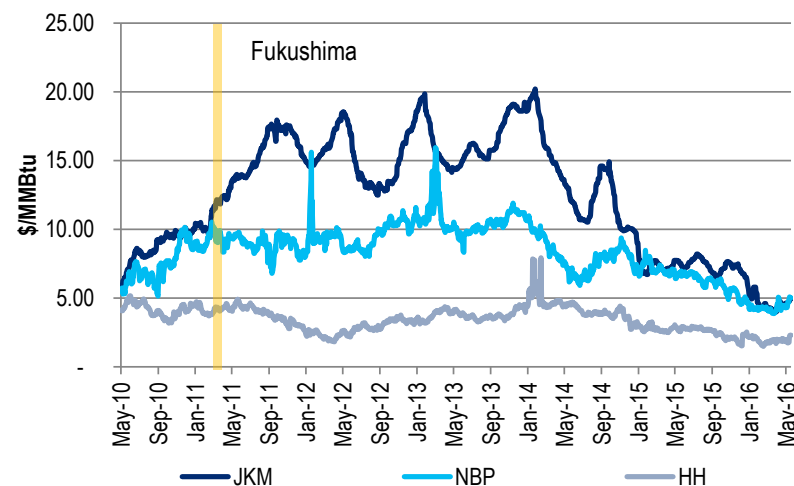
* The red dashed line is the amount of new gas needed in 2017 to offset natural production declines at key plays and meet the growth of exports and demand; the green dashed line is what's needed in 2018

A critical part of US gas demand, LNG exports to face oversupplied LNG market

US LNG Exports (bcm/year)

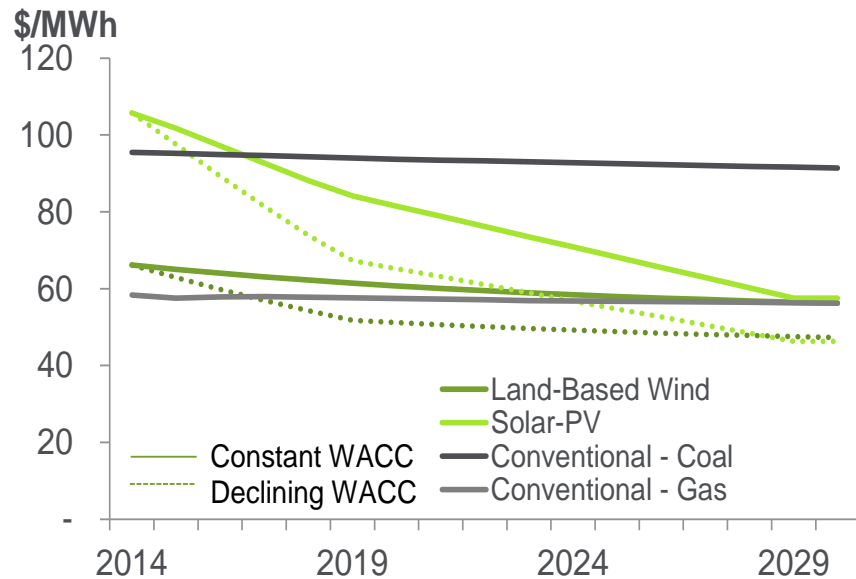


Global gas prices, particularly LNG, fell sharply on low oil prices and weak supply-demand balance.

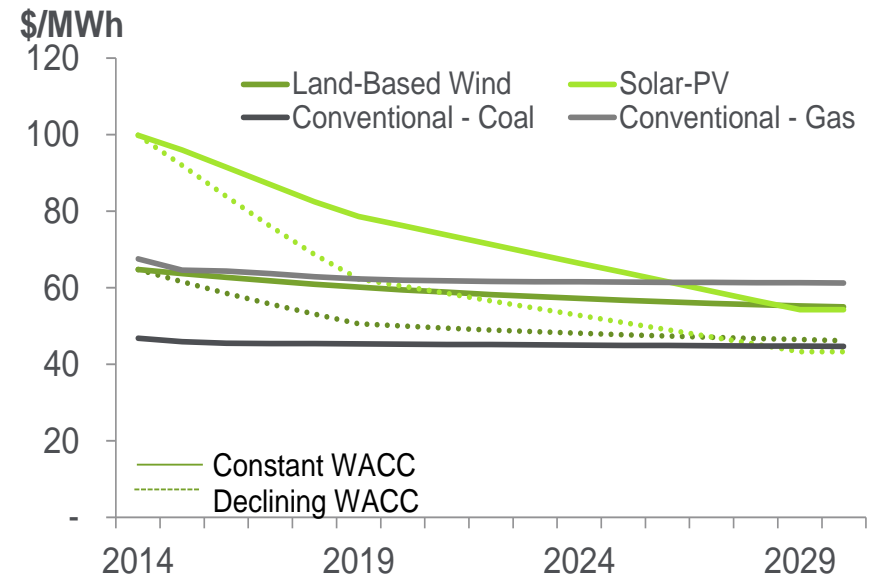


But comparative analyses of electricity show that global coal could stay resilient

US: onshore wind is already nearly competitive with natural gas generation (country-wide average, may vary regionally). Solar would become competitive with gas in the mid-2020s under cheaper financing.



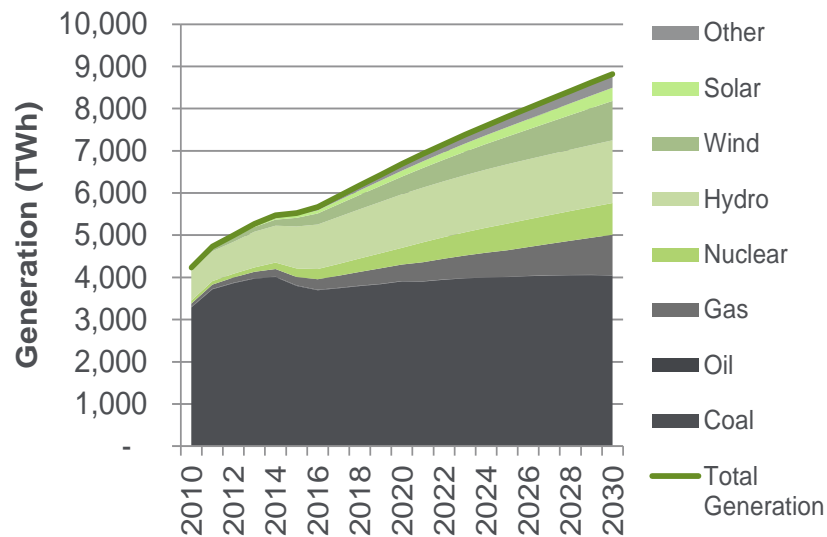
Developing Asia: cheap coal is hard to dislodge in developing Asia, but cheaper financing would make both solar and wind competitive by 2030



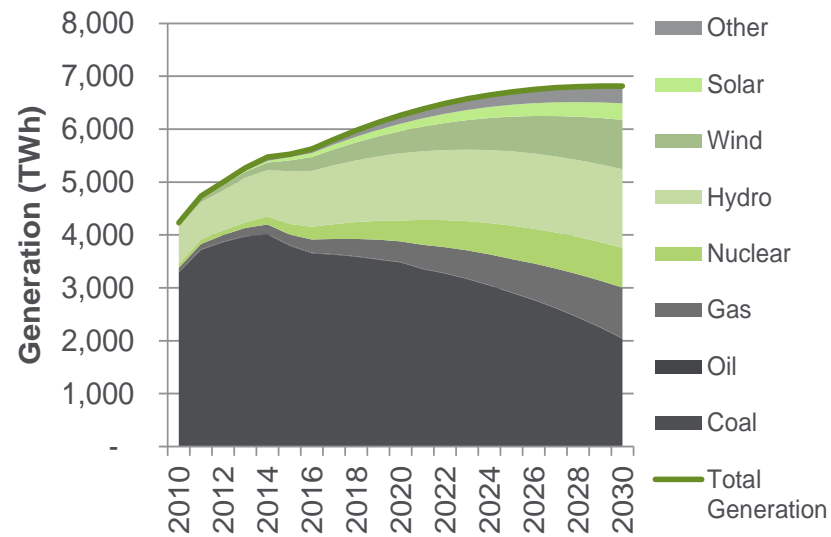
...Even with China having probably reached peak coal demand...

Peak coal demand in China to put further pressure on coal prices

Stable economic growth



Sharper economic slowdown



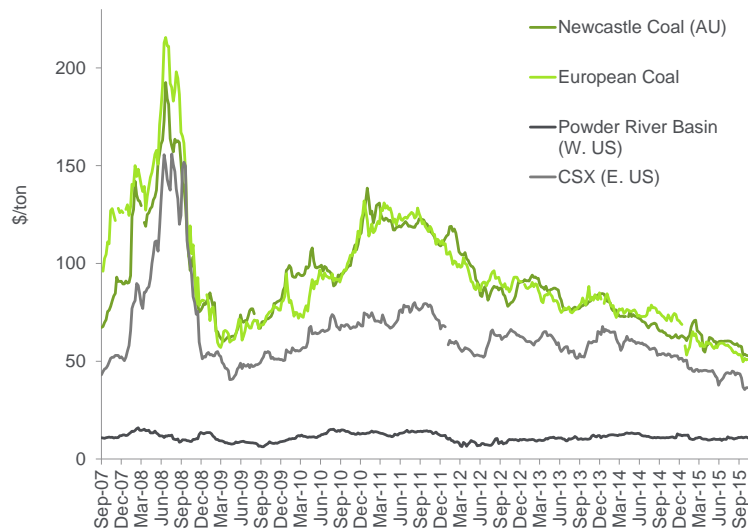
...As many top consuming countries may be looking to use more coal

In regions with falling coal demand, gas may not substitute coal 1-for-1; in regions with growing power demand coal often wins vs. gas

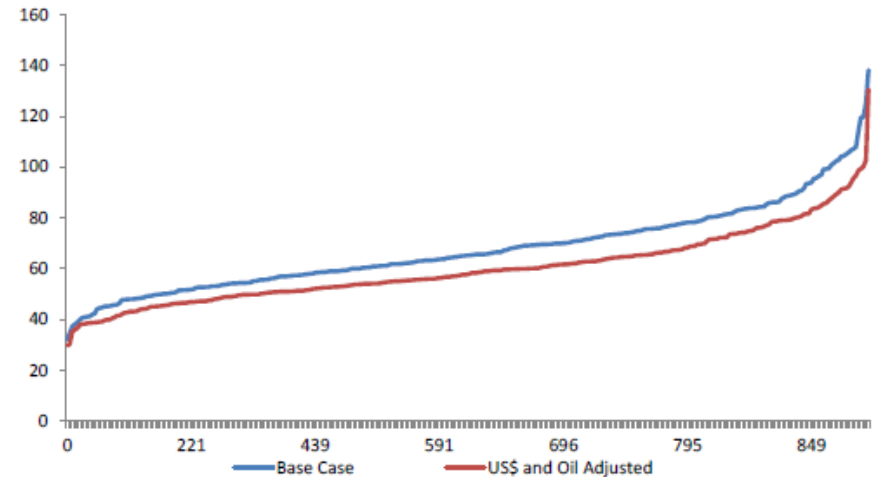
Country/region	2014 demand (mtoe)	Cumulative demand (mtoe)	Share of total world demand	Growth mode	Comment
China	1.96	1.96	51%	No	Coal demand peaked, but gas use minimal and likely only partially substituting coal-fired power generation
North America	0.49	2.45	63%	No	Coal demand peaked, but possible for coal's share in power generation to stay above gas as renewables partially take shares
India	0.36	2.81	72%	Yes	Coal - a less expensive generation fuel for wide-spread electrification vs. gas
EU	0.28	3.10	80%	No	Coal demand more resilient than gas due to pricing
Japan	0.13	3.22	83%	No	Nuclear restarts backing out oil, then gas, with government's plan looking for both coal and gas to have similar generation shares
South Africa	0.09	3.31	85%	Yes	Major coal producing country
Russian Federation	0.09	3.40	88%	Yes	Major gas and coal producing country
South Korea	0.08	3.48	90%	Yes	Previous government plans (the 6th and 7th Basic Plans) looked to ramp up coal-fired generation capacity (6th Basic Plan PDF)
Indonesia	0.06	3.54	91%	Yes	Major coal producing country building new coal power plants
Australia	0.04	3.59	92%	Yes	Major coal and gas producing country; the country's Bureau of Resources and Energy Economics still expects coal demand to grow, particularly in the power sector

Coal's competitiveness enhanced by drop in coal cost curve, challenging gas

The coal market remains in a “hangover” of overcapacity



Thermal coal costs fall, particularly at higher cost mines



Appendix A-1

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