Energy Subsidies within PJM:
A Review of Key Issues in Light of Capacity Repricing and MOPR-Ex Proposals

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1. Introduction

This paper evaluates a proposal by PJM Interconnection to address certain state subsidies that it contends harm the competitiveness of capacity auctions within its territory. Subsidies, whether through state, federal, or local policies, are pervasive in the energy sector. This paper assesses PJM's proposed method for screening actionable subsidies in the context of an extensive literature on energy-sector subsidization to highlight ways in which their approach fails to address subsidies in a neutral manner.

In an April 9, 2018 filing submitted to the Federal Energy Regulatory Commission (FERC), PJM proposed two mutually exclusive options to protect capacity auctions from the impacts of these subsidies.[1] *Capacity repricing* would increase the market clearing capacity price paid to all bidders that clear by adjusting bids to account for subsidies received by certain generators, though would not alter which specific bidders cleared. A second option, *MOPR-Ex* would adjust the bid price for subsidized resources prior to evaluating their competitiveness, changing the mix of facilities that would clear the capacity auction. PJM believes the first option would be more accommodative to allowing state preferences and goals within the power sector to continue to survive in the market place.

PJM's filing describes the types of subsidies that would be "actionable" under its proposals, including policy types, materiality, and exclusions. In doing so, PJM embarks upon a challenging task: subsidies flow to all forms of generation, and nearly every upstream and downstream stage of each power-related fuel cycle as well. Moreover, focusing only on currently-active supports ignores the fact that historic subsidies may have underwritten long-lived capital investments that remain in place, even if the subsidies themselves have been reduced or eliminated. These older policies may thereby have the same type of market effect as current subsidies: allowing affected units to offer in at lower prices than otherwise would have been possible. Further, gaps either in PJM's definition of actionable subsidies, or in the data needed to quantify actionable interventions, may result in material interventions being ignored. Finally, equity issues may arise where units reliant on subsidies that pre-date the inception of capacity markets are suddenly being penalized for them and potentially forced out of the marketplace.

PJM's description of which subsidies are actionable initially seems broad enough to capture most types of potential subsidy. However, exclusions added just a few paragraphs later winnow down coverage in ways that are likely both material and unequal in how they affect different fuel cycles. Even if the wording suggests particular subsidies should be included for review, how PJM interprets these definitions in practice remains unknown. The particular subset of actionable subsidies that PJM highlighted in its April filing was quite narrow and ignores many subsidies that affect the market in similar ways (PJM 2018; Giacomoni 2018).

[1] PJM, *Capacity Repricing or in the Alternative MOPR-Ex Proposal: Tariff Revisions to Address Impacts of State Public Policies on the PJM Capacity Market*," filing before the Federal Energy Regulatory Commission, April 9, 2018, pp. 1,2 citing *ISO New England, Inc.*, 162 FERC ¶ 61,205 at P21 (2018) ("CASPR Order").

PJM's listed examples consist almost exclusively of "purchase mandates," which are statutory targets for consumption of particular forms of power that must be met within a geographic region even at above-market prices. Most commonly, these take form of renewable portfolio standards, tradeable renewable energy credits, and newer zero emission credits that attempt to protect incumbent nuclear generators.

But many subsidies that affect energy production decisions do not fall into this category; rather, the most important subsidy mechanisms can vary widely by energy type. As a result, if there are data gaps related to particular policy types, some fuel cycles may be unaffected while estimates for others are highly inaccurate. There is some predictability to the patterns: capital-intensive generation will be more affected by build times, financing conditions, and changes in demand during the build period. Electricity reliant on high volume flows of input fuels are affected by subsidies to key transport links, favorable policies for pipeline building, and subsidies to extraction. Accordingly, PJM's focus on one category of subsidies will have the effect of discriminating based on technology type.

More specifically, purchase mandates are very significant for renewable power and increasingly for old nuclear plants as well, though play no role for natural gas. Credit support such as subsidized loans, tax exempt debt, or government guarantees on private borrowing, are important for nuclear power but fairly immaterial for wind and all but the largest centralized solar installations. Liability caps are material primarily for nuclear and oil transport; subsidized state ownership for nuclear (waste management) and large hydroelectric power facilities. Royalty reductions, uncompetitive lease auctions, and subsidies to linking infrastructure (often at both the state and federal levels) bolster fossil fuels but are immaterial for renewables.

This paper provides a brief introduction to the types of subsidies often flowing to energy facilities, and evaluates the planned scope of subsidy review proposed by PJM to identify areas of potential concern. There is no single data source that tracks and values all subsidies flowing to PJM facilities and associated production, and this paper makes no claim to play that role. Rather, by piecing together available data and actual examples, the goal here is to illustrate potential gaps and hidden distortions in the current policy formulation.

Identifying and quantifying relevant subsidies within a short time frame and limited budgets is not easy. Even if bidders are required to submit this information, some ability to validate the data provided will be needed within PJM. Further, because estimates of actionable subsidy magnitude drive bid adjustments that may have large and expensive competitive ramifications, challenges by affected parties would seem likely, further complicating the process.

2. Actionable Subsidies as defined by PJM leave a great deal out

In defining which subsidies would be "actionable" under its proposal, PJM aims to capture key supports that materially reduce the price at which a resource can bid into the capacity auction. The proposal also aims to exclude programs and policies that have a small

effect and won't alter the clearing price. Using a number of metrics listed below, this paper evaluates whether there are gaps in PJM's proposed approach and whether those gaps will result in a system that is not neutral across market competitors.

- **Political jurisdiction.** Are there types of governmental entities or levels of government being excluded from review, but that are likely to provide material subsidies?

- **Materiality at plant level**. Do any of the subsidies that PJM's definition would exclude have material impacts on generator revenue? Is the measurement of subsidy impact on cost structure being done in a neutral way?

- **Intervention type**. Subsidies to PJM market participants take many forms. Some are easy to see and to measure; others are complicated and may be largely missing even from available government data. What are the policy gaps in the PJM proposal, and what type of bias might they introduce? Are there notable differences between available data on state subsidies and the examples included by PJM in its FERC filing?

- **Energy type.** Are subsidies to both incumbents and new entrants being addressed equally? Are particular forms of energy being treated differently? Are subsidies to upstream (extraction, transport) and downstream (facility decommissioning) relevant to the economics of power generation in the region? If so, are they being included?

3. Systematic exclusion of federal subsidies and many sub-national supports will bias results

PJM's definition initially appears fairly inclusive, reflecting any "material payments, concessions, rebates, or subsidies directly or indirectly from any governmental entity connected to the construction, development, operation, or clearing in any RPM Auction, of the Capacity Resource, or other material support or payments obtained in any state-sponsored or state-mandated processes, connected to the construction, development, operation, or clearing in any RPM Auction, of the Capacity Resource." (PJM 2018: 69).

"Any government entity" would seem to include local, state, or federal support, recognizing that it is often the combination of support from these different jurisdictions that tips projects from non-investable to investable; or keeps marginal facilities from shutting down.[2] As PJM Senior Market Strategist Anthony Giacomoni observes, state subsidies generally have the effect of causing certain resources to be viable where they might not otherwise be: (Giacomoni 2018: 6):

[2] Erickson, Downs, Lazarus and Koplow (2017) modeled the effect of state and federal subsidies on 800 US oil fields to evaluate the degree to which they relied on subsidies to hit investment hurdles. Nearly half of the fields were uneconomic at $50 per barrel oil (the price at the time of publication), and the modeling illustrated the importance of not looking at a single subsidy in isolation.

> *While my affidavit does not attempt to calculate whether each resource that receives a state subsidy would not enter service, or would not remain in service, without the subsidy, it is reasonable to conclude, as a general matter, that these subsidies cause more MWs of the favored resource types to be in service than would be the case without the state subsidies. In other words, without these subsidies from outside the PJM wholesale market, some portion of these subsidized resources would not be economic.*

Yet the basic principle he highlights applies to all subsidies, regardless of the level of government that grants it, the policy instrument used, or the stated purpose for which it was granted. A large subsidy is likely to distort market behavior, creating winners and losers in the process, regardless of its form. Any system of oversight must be carefully constructed such that the full array of influences is visible, and it is in this context that the many exclusions indicated by PJM must be evaluated.

3.1. Blanket exclusion of federal interventions is unjustified

Federal interventions can be large and targeted. PJM excludes all federal-level subsidies. While it argues that federal subsidies inherently have a broader reach and don't discriminate based on geography, and therefore are less likely to have a discriminatory impact on the marketplace, that is often not true (PJM 2018, 70, 71).

Although federal subsidies may be open to all states, they can also be both large and highly targeted. The Department of Energy's Title XVII loan guarantee program, for example, has provided federal credit support on the order of hundreds of millions or billions of dollars to a handful of specific facilities, including power generation. The tenders are somewhat competitive; however, so is state-level bidding for RPS capacity. Title XVII projects often have some technology risks; but so do new offshore wind facilities planned within PJM member states and that are called out specifically as problematic subsidies within PJM's filing (Giacomoni 2018). Structurally, there is no reason to believe that Title XVII credit subsidies would not affect capacity market bids in a very similar manner as state subsidies.

While a review of DOE's current loan portfolio (DOE 2018) found no active generation projects within the PJM region (one solar project was discontinued and there are a couple of large loan guarantees to advanced vehicles, another part of the program), it remains possible that loans will be granted under the program in the future. The scale of support under Title XVII can be so large that ignoring its impact on capacity markets simply because the subsidy originated at the federal level seems unsupportable. DOE continues to have open rounds for new lending, so a PJM-based generation project is a real possibility. Subsidized projects in the existing portfolio in nearby states could also sell into the region.

Federal interventions can disproportionately benefit a class of firms. Even where federal spending is not targeted to a single facility, it may support a particular type of generation in a manner that provides a competitive advantage to that class of facilities. Federal support to nuclear power is an example of this. There are fewer than 100 operating reactors in

the US, of which roughly 45 are in the PJM service area (NEI 2017). Federal subsidies are largely additive to state subsidies. Federal tax and insurance subsidies, as well as *de facto* state ownership of parts of the fuel cycle, all subsidize the operating costs of nuclear plants. This includes plant decommissioning (tax breaks on earnings of Nuclear Decommissioning Trust Funds), insurance against liability for reactor accidents (capped under the Price Anderson Act of 1957), and building and managing a long-term repository for high level nuclear waste (a complicated and complex endeavor that has effectively been nationalized) (Koplow 2011). Even where federal subsidies flow to a much larger set of beneficiaries, such as oil field operators (Erickson, Downs, Lazarus and Koplow 2017), data indicate both that the competitive impacts are significant and that the magnitude of federal subsidies frequently exceeds that of the state support.

Large new federal subsidy programs could also affect the PJM market. Finally, the Trump Administration continues to promote one plan after another to use federal leverage and treasure to stem the market-based decline in coal and nuclear. The most recent iteration of this push is to use the Defense Production Act (DPA) to bolster the facilities (Dlouhy and Jacobs 2018). Were the DPA, or any of the other proposals that have been floated, actually to take effect, the use of federal credit, purchasing power, or other support to specific plants would be large. Yet, under the PJM repricing and MOPR-Ex rules as currently proposed, these enormous subsidies would be left unaddressed. This could result in a situation where adjustments were being made to one class of generators (because they rely on state subsidies) but not others (who receive mostly federal support).

3.2. Many state and local subsidies would also be ignored by PJM

Subsidies to "incent or promote" either general industrial development in an area or to lure production or jobs from one county or locality to another county or locality are not actionable under PJM's proposal (PJM 2018, 70). While these types of subsidies are more common at the sub-national level, federal subsidies may also sometimes be designed to trigger development in a particular region (and so would be excluded from consideration under two separate limitations proposed by PJM).

But subsidies deployed for purposes that would be excluded under PJM's proposed definition are sometimes both very large and narrowly targeted to specific energy assets. These large subsidies to individual facilities would affect the structure of power markets no differently than an energy-related grant of similar size or a targeted tax break. The effect of subsidies on bid prices within PJM capacity markets will depend on the scale of the subsidy, not its justification.

An example from the federal level demonstrates how such subsidies can flow to entities with significant political and economic power. After Hurricane Katrina battered the Gulf Coast in 2005, the US Congress authorized billions of dollars in tax-favored Gulf Opportunity Zone bonds. The bonds were supposed to help rebuild the entire region, though in that region the oil and gas industry is both large and powerful. Within the state of Louisiana, $7.8 billion in

bond capacity was created, of which the oil and gas industry captured 57%. Once joint projects with the sector and related industries were included, their share rose to 65%. Two oil and gas projects received more than $1 billion in bond capacity each (Koplow 2012).

Good Jobs First, a Washington, DC- based organization, has been tabulating government subsidies to specific industrial facilities for many years. Their *Subsidy Tracker* database compiles information from hundreds of different government agencies around the country.[3] Table A.1 is an extract of subsidies to energy-related activities within PJM states that exceeded $20 million. While the subsidies are both large and targeted, they are often granted under the auspices of regional development or plant location; as a result they would be immediately discarded by PJM. Some examples help illustrate common issues that arise when evaluating power-sector related distortions.

Coal conversion plants in Kentucky. Heavily reliant on coal jobs, and facing declining demand in the power sector, Kentucky was looking to diversify one if its core products. Between 2007 and 2011, the state provided large subsidies to five different coal-to-liquids plants. Despite most of these projects stalling out (it's hard to sell expensive gas from coal when fracked gas from the ground is so cheap), the examples raise a number of relevant issues.

- *Scale.* The multi-year support packages totaled more than $1.1 billion. The support to individual plants was as high as $550 million. These subsidies would be of equal or greater scale to many of the tax expenditures benefitting the sector.

- *Power-sector relevance?* At first glance, these subsidies are to coal, not the power plant – though coal is primarily used to make electricity. Further, these particular facilities were making liquid fuels that mostly were destined for heating and transport applications. So are they irrelevant to PJM power production? If subsidies are small, the likely answer is "yes". If they are billions of dollars, further evaluation would be needed, as subsidizing the coal ecosystem could have important ancillary benefits for coal-fired power plants. For example, the conversion plants could have kept mines and railroad links open and running at efficient utilization levels, allowing them to continue to serve particular power plants too old to retrofit for a different type of coal or too marginal to incur higher transport costs. For large subsidies, some screening would be warranted before dismissing them as irrelevant.

- *Development or not?* The awarding agency for all of these subsidies was the Kentucky Economic Development Finance Authority. As noted earlier, under PJM's proposal, subsidies to regional development would be excluded from being actionable. But the specific program was through the Incentives for Energy Independence Act, which in Kentucky is nearly all about coal. The larger subsidies on offer from states often pull from multiple programs run out of multiple state agencies. Functionally, they may span excluded regional development and included oversight or energy-focused missions.

[3] Available at https://www.goodjobsfirst.org/subsidy-tracker.

Some may receive a mix of state and federal support. The lines are often gray, making PJM's proposed test hard to administer.

Natural gas infrastructure for Marcellus Shale. Gas prices in the Marcellus region continue to be significantly lower than the Henry Hub benchmark. At least part of this is due to gas being stranded in the region as surging production ran into limited offtake capacity. Boosting gas exports to other parts of the country, and to the world, would increase the likelihood of prices equalizing across regions. A related issue involves constrained outlets for wet gas in the region.

Are massive subsidies to natural gas infrastructure relevant to consider for PJM capacity markets or not? Natural gas plants are the most significant cause of disruption to incumbent plants within PJM (Jenkins 2018), including reducing the infra-marginal revenues that older nuclear plants can earn to stay afloat. This "missing money" in turn has opened the political spigot for billion dollar bailouts to reactors. To the extent PJM undertakes to address subsidies, PJM should be carefully and systematically evaluating whether subsidies of any type within the natural gas fuel cycle are accelerating or exacerbating the disruption of older baseload generators.

Richard Porter of FTI Consulting in Houston remarked to *Bloomberg* that as natural gas transport stabilizes, producers will have "a surety of market and revenue stability," as well as additional cash flow to fund exploration programs (Kovski 2017). And while gas prices to electric power may rise, the transport component, which "at times has been as much of a market factor as the value of the gas" should fall (Kovski 2017). Rising demand for Marcellus gas is driven by the power sector. However, increased capacity to process natural gas liquids and to liquefy gas for export will both help to feed continued production as well. The degree to which subsidies to related infrastructure result in more gas, cheaper and more reliable gas to power plants, and a continued undercutting of other capacity supplies is not easy to gauge. But it is reasonable to believe there are relationships, and those need to be explored in more depth.

Some of the subsidies of relevance:

- **Shell Ethane Cracker plant in Pennsylvania.** The facility will add desired capacity to handle natural gas liquids, boosting returns to natural gas fields. Pennsylvania has provided $1.65 billion in tax credits to the facility, the single largest subsidy to the energy sector in PJM identified in the *Subsidy Tracker* Database.

- **Dominion Cove Point Natural Gas Liquefaction facility in Maryland**. An increasing share of Marcellus gas is heading for export, and Cove Point will accelerate this shift. Tax abatements worth about $500 million over 14 years were offered to the plant by the Board of County Commissioners in Calvert County. This is a very large subsidy for a county government. It is also one that has been criticized by some tax experts who argue that much of the infrastructure needed to move in the gas was already on the site, that it will be the only LNG facility on the East Coast, and that the site has prime

access to gas from the Marcellus region. While Dominion threatened to leave absent the tax abatements, the company would have lost a great deal from doing so, these analysts argue, and likely would have stayed even with no subsidy. (Ehrenfreund 2014).

Build it and they will come: the Appalachian Storage Hub. As PJM works to ensure competitive transparency among its capacity providers, very large moves by state actors appear to be afoot within the region, with investments approaching $100 billion. This creates a new and difficult set of challenges to protect markets.

On this particular project, a combination of state and local support justified on economic development grounds, subsidy terms hidden in private contracts, federal support, and subsidy targets upstream of power plants are all interventions that would fall into PJM's exclusions or on which public data would not be available. As a result, all would escape consideration by PJM as actionable subsidies – no matter how large they end up being.

The planned hub will straddle PA, OH, WV, and KY (Horn 2018), all parts of PJM. It is likely to include a mixture of investments, including natural gas liquids storage, a market trading center, feed capabilities into multiple key pipelines, and chemicals production. Some of these may be irrelevant to gas-fired power generation; other assets may be dual use, or create subsidized offtake capacity that allows market-based frackers to boost supply to power markets at an artificially low delivered price. This will be an issue of particular import where the investments are in states – like Pennsylvania – with severance and property tax rates at zero.

The major player at this point is China Energy Investment Corporation (CEIP), a massive state-owned Chinese firm formed from a merger of China Shenhua Group, China's largest coal producer, and China Guodian Corp, one of its largest utilities. CEIP signed a memorandum of understanding with the State of West Virginia in November 2017 to invest $83.7 billion over 20 years. A first phase plan, with $4 billion in investment, is supposed to take place over the next two years (Smith 2017).

Details of the MOU have not been made public. Multiple Freedom of Information Act requests are pending, but so far have unearthed few details on the scope or magnitude of public subsidy at play on either the Chinese or the US sides of this deal. One detail that has come out is a potential $1.9 billion subsidized loan for the project under the Department of Energy's Title XVII program discussed earlier (ADC 2018).

Big subsidies from the Chinese side are also likely. China has been active worldwide with state-led development deals to secure access to strategic minerals, including energy. Chinese state-owned enterprises routinely benefit from state support, including through preferential taxation and access to favorable credit terms.[4] This project is unlikely to be

[4] A detailed review of China's foreign aid strategy by Wolf, Wang, and Warnerthe (2013) found that "such programs have burgeoned in recent years, with emphasis on development of increased foreign supplies of energy resources, as well as supplies of ferrous and nonferrous minerals. Loans finance many of these programs and feature substantial subsidization, but are also accompanied by rigorous debt-servicing conditions that distinguish

different. CEIP itself is viewed as a strategic enterprise by Moody's; it is likely the Chinese government shares this view, and will use the leverage of the State to support it.[5]

In March 2018, the State of Ohio announced an ethane cracker with an estimated cost of $10 billion was going to move forward in Belmont County with backing from Thailand's PTT Global Chemical and South Korea's Daelim Industrial Co. (Junkins 2018). As with the other portions of this deal, information on state subsidies, either foreign or US, remains sparse.

In mid-April, the US and other trading partners raised a concern at the World Trade Organisation about state subsidies leading to creation of overcapacity in key industries, and how that overbuilding harms market competitors. While the communication mentioned steel and aluminum, similar arguments apply to mega projects such as the Appalachian Storage Hub. The submittal noted that

> *…capacity is often created pursuant to industrial policies to develop national strategic industries or to maintain the companies in these industries if they begin to fail. The overarching point in these instances of creation and maintenance of capacity is that the relevance of market forces diminishes when the state – functioning as the leading economic actor – owns, controls, or influences large industrial enterprises and banking entities. Simply put, direct or indirect government ownership and control can result in political considerations dominating what should be exclusively commercial decisions. This is especially problematic when the state owns or controls both the lender and borrower in a financial transaction. (WTO 2018).*

4. Simplifying Actionable Subsidies: PJM focuses on the revenue side, but reducing costs or return uncertainty affects market offers in the same way

PJM's definition of actionable subsidies focuses on revenue impacts, but these are not the only way subsidies boost expected returns of a subsidized activity. Policies that increase revenues, reduce costs, or reduce the uncertainty or volatility of cash flows can all have similar effects on investment and operational decisions. PJM appears to focus only on revenues, stating that capacity repricing "is including only those subsidies that would have a material impact on the seller's overall **revenues** from the subsidized resource" [emphasis added] (PJM 2018: 69).

Similarly, its *de minimis* test focuses on revenues as well. If PJM intends this to capture "net revenues" (though the proposed tariff language suggests it does not), that would

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China's foreign aid from the grant financing that characterizes development aid provided by the United States and other nations of the Organization for Economic Co-operation and Development."

[5] In a note discussing the merger last year, the firm wrote "Moody's also believes that the combined entity will continue to have a high strategic importance to China's energy sector, due to its positions as the largest power generation company and coal producer in the country. The combined entity will also be the largest wind power generation company in China." (Moody's 2017).

incorporate reduced costs to some degree. However, there is some risk – as is common with royalty calculations that allow deductions for expenses such as transportation – of gaming by bidders. The overall magnitude of support, whether on the cost, revenue, or risk stabilization side, would be a more neutral metric. Further, definitions that leave only revenue impacts as the focal point suggest that PJM intends to focus primarily on purchase mandates, rather than other forms of government support as well.

5. Definitional and data problems will systematically exclude some types of support from review

Subsidies can be created by many different policy mechanisms. These vary widely in complexity. Direct spending and research and development (R&D) support involve visible line items in budgets, where both the amounts and the purpose are clear. Revenue losses to the government Treasury from tax expenditures are increasingly estimated as part of the standard budgeting process, even at the state level. Even with this positive trend, however, the estimates are less precise than direct spending, and are much more difficult to allocate to beneficiaries. Most tax expenditure data sets, including the ones used to support this paper, also have some gaps. Understanding where they are, which are material, and whether different states have the same gaps, can all be challenging. Assessing the competitiveness of natural resource lease auctions, or the value of liability transfers, is also quite difficult to do. As a result, these types of supports are often missing entirely from subsidy assessments.

A lack of information, unfortunately, is not correlated with a lack of subsidization. In fact, because receiving large subsidies can sometimes create reputational risks for both the politician and the recipient firm, there may be perverse incentives to shift larger value subsidies to less visible and more-difficult-to value mechanisms.

To the extent that PJM is ignoring entire classes of subsidies, such as those arising from state tax policies, the risk of bias across fuel cycles rises substantially. This is true whether the exclusion results from a definitional oversight in what PJM wants to track; or from policies that PJM's definitions seem to include, but for which data allowing valuation and attribution aren't readily available.

5.1. Assessing category gaps in PJM subsidy definitions

Translating a general definition of actionable subsidies into a more detailed roadmap of what types of policies might be overlooked is an important step in gauging areas where the current proposal may need adjusting. Definitional gaps are assessed by comparing my generic overview of key subsidy mechanisms (Table 1, below, left column) to information from PJM. This includes the definition PJM incorporated into its FERC filing, and a breakout of subsidy types assembled by the Capacity Construct Public Policies Senior Task Force (CCPPSTF) over the

course of work prior to PJM's filing. Potential gaps are noted in Table 1 as well. Despite the length of the table, the exercise is a useful way to identify potential gaps in a structured way.

Tracking subsidies via direct spending appears to be well addressed by PJM. Tax revenue foregone and credit support are both also covered in the PJM definitions and state action categories. However, significant holes likely remain regarding how well these classes of support are tracked in practice. Liability subsidies and subsidized provision of energy-related goods or services are not well captured in current PJM actionable subsidy formulations. With the exception of direct spending, all of these subsidy types result in reduced costs or capping or shifting of operating risks. They do not directly boost revenues, and so face potential exclusion in a narrow interpretation of PJM's materiality test.

In contrast, PJM's filing, including its definition of actionable subsidies and the examples it provides to illustrate policies of concern, capture purchase requirements (such as RPS) quite granularly.

The final category in Table 1 involves environmental externalities. Power resources differ widely in the environmental and health impacts they cause, though the PJM filing is largely silent on the topic. PJM mentions a preference for a separate system of pricing carbon, and notes that state preferences – including for carbon reduction – would be respected under their Capacity Repricing proposal (PJM 2018: 54, 55). However, given the degree to which actionable subsidies are primarily instruments trying to move the markets towards lower carbon, more focus on this issue would have been beneficial.

Addressing externalities such as pollution or health effects through market instruments is a well-recognized strategy in environmental economics. Taxing the pollutant is a first-best strategy; regulation or other approaches such as subsidies to pollution-reducing substitutes (e.g., an RPS) are less optimal. But broadly, subsidies to address externalities can improve market efficiency if they are done properly (policy design matters with these interventions, and there are more- and less-efficient ways to underwrite pollution reduction). It is a mistake to "treat externality payments like distortive, rent-seeking subsidies that simply provide financial aid to a group of producers without being directly tied to a quantifiable external benefit" (Bialke and Unel 2018: 11).

Table 1. Capture of Key Subsidy Mechanisms in PJM's Actionable Subsidy Definition

Mechanisms of Value Transfer to Energy Sector[1]	How Characterized in PJM FERC Filing and State Action Listing?[2]
Direct transfer of funds	
Direct spending Direct budgetary outlays for an energy-related purpose.	*Filing:* Material payments *CCPPSTF:* 8. Grant Programs *Potential Gaps:* Energy-relevant activities by the state, rather than through grants to a private party.
Research and development Partial or full government funding for energy-related research and development.	*Filing:* Material payments *CCPPSTF:* 8. Grant programs *Potential Gaps:* None. R&D affects costs of future resources; unlikely to be material to current bidding.
Tax revenue forgone* Special tax levies or exemptions for energy-related activities, including production or consumption; includes acceleration of tax deductions relative to standard treatment.	*Filing:* Concessions or rebates *CCPPSTF:* 9. Tax incentives *Potential Gaps:* -Workgroup description focuses on tax exemptions and tax credits. There is another whole class of support through more rapid deductions (generating a time-value benefit) and organizational structures (such as Master Limited Partnerships) that are not being picked up. -At present the inventories are not capturing the pass-through of federal subsidies into the state tax code that often happens by default. -Consistent data gaps regarding artificially low extraction tax rates relative to other jurisdictions, and county or municipal tax subsidies. -Aggregate revenue loss data does not always translate easily into tax subsidy estimates at the facility level.
Other government revenue forgone	
Access* Policies governing the terms of access to domestic onshore and offshore resources (e.g., leasing auctions, royalties, production sharing arrangements).	*Filing:* Potentially captured via inclusion of "concessions". *CCPPSTF:* Not captured. *Potential Gaps:* Non-competitive lease tenders on public land; royalty reductions; state rules allowing royalty-free flaring, venting, or on-site use of extracted minerals on public or private leases.
Information Provision of market-related information that would otherwise have to be purchased by private market participants.	*Filing:* Provision of free information could fall under "concessions". *CCPPSTF:* Not captured. *Potential Gaps:* Examples would include geological surveys for mineral location or seismic risks to energy infrastructure; or data and statistics collection of relevance to producers.

Mechanisms of Value Transfer to Energy Sector[1]	How Characterized in PJM FERC Filing and State Action Listing?[2]
Transfer of risk to government	
Lending and credit Below-market provision of loans or loan guarantees for energy-related activities.	*Filing:* Potentially captured under concessions or subsidies categories. *CCPPSTF:* 7. Loan programs. *Potential Gaps:* -PJM excludes broader credit programs not stated as for energy; in practice, powerful industries within a state will capture large portion of more general loan programs as well. -Advanced Cost Recovery or CWIP schemes act as interest-free loans from customers to utilities, and would fit well within this category. These were included in CCPPSTF discussion documents, though ultimately excluded.
Government ownership* Government ownership of all or a significant part of an energy enterprise or a supporting service organization. Often includes high risk or expensive portions of fuel cycle (oil security or stockpiling, ice breakers for Arctic fields).	*Filing:* Definition broad enough to potentially incorporate many subsidies that arise with state ownership. However, cooperative and municipal utilities, which are tax-exempt and benefit from other subsidies as well, are excluded as a category. *CCPPSTF:* 10. State takeover, though this is defined quite narrowly. *Potential Gaps:* -Subsidies to publicly-owned utilities. -Federal takeovers of generators (e.g., under DPA) or ownership of key portions of the fuel cycle (e.g., nuclear waste). -State responsibility for ensuring private market safety (e.g., mine inspections) or repairing public ways damaged by energy-related activities (e.g., highways) with insufficient fees from industry.
Risk Government-provided insurance or indemnification at below-market prices.	*Filing:* Possibly includible as a concession. No risk examples included by PJM however. *CCPPSTF:* Not captured. *Potential Gaps:* -Federal involvement to cap liability for nuclear accidents and oil spills. States may also have some liability for oil spill cleanup. -Liability risks associated with hydro dam failures is poorly characterized, but likely affects all levels of government. -Legacy liabilities for improperly insured private risks in the past often fall to government; reclamation of abandoned coal mine lands is an example.
Induced transfers	
Cross-subsidy* Policies that reduce costs to particular types of customers or regions by increasing charges to other customers or regions.	*Filing:* Not addressed. Focus on facility-level bid prices. Subsidies via RECs and ZECs often borne entirely by retail customers. *CCPPSTF:* 11. Rate-based cost recovery for certain resources. *Potential Gaps:* -Rate basing cross subsidies in CCPPSTF seemed limited to DSM and efficiency. High cost power resources such as advanced coal may also be rate-based, but would not seem to be included. In contrast, high cost offshore wind would be handled via a REC carve-out, so would be easily measurable and actionable by PJM. -Rate class cross-subsidies probably not relevant to capacity auctions, which focus on unit-level costs.

Mechanisms of Value Transfer to Energy Sector[1]	How Characterized in PJM FERC Filing and State Action Listing?[2]
	-Power trading between ISOs may give rise to some relevant issues if an out-of-region generator is heavily subsidized.
Purchase requirements* Required purchase of particular energy commodities, such as domestic coal, regardless of whether other choices are more economically attractive.	*Filing:* Captured as "other material support or payments obtained in any state-sponsored or state-mandated process." Used as examples of actionable subsidies. *CCPPSTF:* 1. State renewable portfolio standards; 4. Feed-in tariff; 5. Mandated purchase agreements; 6. Zero emission credits. Possible gaps: Any federally-implemented purchase mandates (e.g., for coal or nuclear) would be excluded from review.
Regulation* Government regulatory efforts that substantially alter the rights and responsibilities of various parties in energy markets or that exempt certain parties from those changes. Distortions can arise from weak regulations, weak enforcement of strong regulations, or over-regulation (i.e. the costs of compliance greatly exceed the social benefits).	*Filing:* Possibly captured as benefits from a "state-mandated process." *CCPPSTF:* Not captured. Possible gaps: -Regulatory exemptions for particular industries can provide significant cost reductions, but do not seem captured. -Regulated returns may provide subsidies to selected infrastructure (e.g., affiliate pipelines), contributing to overbuilding certain segments of the fuel cycle.
Costs of externalities Costs of negative externalities associated with energy production or consumption that are not accounted for in prices. Examples include greenhouse gas emissions and pollutant and heat discharges to water systems.	*Filing:* Not addressed. *CCPPSTF:* 2. Emissions tax; 3. Cap-and-trade. *Potential Gaps:* -Likely to be residual negative externalities not being well captured even after these carbon constraints are incorporated. -CCPPSTF shows cap and trade schemes in DE and MD as generating a negative value (i.e., they act as a tax on capacity). Application of capacity pricing or MOPR-Ex rules could possibly be interpreted to add back these fees, making the capacity *more competitive* in the auctions and obviating state efforts to address environmental externalities of the power source.
Sources: [1]Koplow (2017a) and Koplow (2017b). [2]Review of CCPPSTF (2017) and PJM (2018).	

5.2. Review of state-level data on energy subsidies

After exclusions for federal support and state or local support targeted at regional redevelopment or plant location, PJM seems to be focusing primarily on purchase mandates as actionable subsidies (PJM 2018; Giacomoni 2018). Such a focus is narrower than the subsidies that had been identified by the CCPPSTF (2017). In turn, the subsidies included by the CCPSTF seem not to have incorporated any of the additional interventions flagged in a subsidy "short-list" suggested to the workgroup by CCPPSTF member Natural Resources Defense Council (Koplow 2017).

An updated review of available data on state level support indicates that there are many other types of subsidies currently in place. This review incorporated updated information from the *Subsidy Tracker* database, included in the Appendix as Table A.1. OECD updated its data on US state and federal subsidies to fossil fuels earlier this year as well, adding revenue loss and expenditure information that has become available since its last inventory in 2015. An extract of that data (OECD 2018a) for the PJM region can be found in Table A.2 (tax expenditures) and A.3 (direct outlays). Because OECD has been tracking subsidies for many years, the tables show subsidy values both for recent years and for the 2007-2018 period during which PJM capacity markets have been in place.

The vast majority of entries in the OECD inventory are tax expenditures. Direct expenditures are also captured, and sometimes large as well. However, the direct expenditures relating to fossil fuels in the PJM region are much smaller than the largest tax breaks. The direct spending focuses primarily on safety, inspection and worker training for the coal industry.

Systematic tracking and quantification of subsidies other than direct spending and tax expenditures has been a technical and administrative challenge. The Compendium to the OECD 2018 Subsidy Inventory (OECD 2018b) includes important information on the tracking and valuation of credit support. Credit subsidies are frequently provided by governments to private industry around the world, and the quantification approach discussed is a big step forward in trying to track the value of these supports. In future years, the subsidies associated with individual loan and loan guarantee programs will hopefully start to be tracked routinely. Detailed tracking of subsidies employing still more complex value transfer mechanisms such as natural resource leasing, state-owned enterprises, liability caps, and insurance remain many years off.

Most tax expenditures within the OECD inventory are self-reported by member governments or pulled from state tax expenditure budgets. These sources sometimes have gaps. Tax breaks at the local level such as property taxes may not be included and often don't show up in state tax expenditure reports either. Pennsylvania's exemption of gas reserves and related infrastructure from property taxes is an example. Another gap occurs is when taxes on energy minerals are well below levels found in other jurisdictions. The state won't necessarily flag this as a tax subsidy, though clearly the low rate accelerates resource development.

Overall, OECD provides the most comprehensive inventory of national and state subsidies to fossil fuels. However, because it captures only a slice of government support, the disparity between the inventory and the full level of subsidization can sometimes be large. For example, with a surging natural gas industry, Pennsylvania's lack of severance or property taxes on natural gas is worth more to the industry than any of the PA tax expenditures listed in Table A.2.

This paper does not tally up OECD figures for a few reasons. First, their application to generation potentially bidding into PJM capacity markets will vary by resource. Second, individual provisions serve as useful illustrations for some of the challenges of accurately assessing impacts on capacity auctions. As shown in Table A.2, for example, Pennsylvania has a special sales tax exemption for coal that results in revenue losses of about $125 million per year, and about $1.5 billion over the 2007-2018 period. This does not apply to all fuels, so is clearly a targeted subsidy to the coal fuel cycle. A similar tax expenditure in Kentucky is valued at $34 million for 2018, and almost $700 million during the 2007-2018 period.

In contrast, a Pennsylvania tax exemption for utility sales to residential customers, generated much larger revenue losses, estimated at $458 million in 2018. However, this provision applies to all forms of electricity, natural gas, LPG and fuel oil rather than to a single fuel. The portion flowing to electricity would be of most relevance to PJM capacity auctions; but the point of incidence is consumers. The likely result is that consumers buy more electricity, which would clearly disadvantage demand reduction or efficiency options. But it is not clear that this type of subsidy would tip the scale in any one direction with respect to type of power generation. Extraction subsidies, discussed in the next section, are more likely to do that.

6. Distinctions by Energy Type

PJM's definition of an actionable subsidy results in greater coverage of supports directed at some types of energy than others. As noted above, this partly results from definitional gaps in the types of policy instruments captured. Additional variability in coverage also results from direct exclusions for particular forms of energy. This section reviews which energy resources are either subject to different rules, or exempt entirely from them; and assesses how these exclusions could affect the neutrality of the proposal.

In addition, and particularly in light of surging production of natural gas and natural-gas fired electricity, the section also addresses the significance of subsidies to upstream or downstream stages of production for key electricity fuel cycles.

6.1. Energy resource neutrality

Power as a byproduct. The proposal excludes a number of resources from consideration for actionable subsidies including energy efficiency and facilities that produce electricity as a

byproduct, such as landfill gas, wood waste, municipal solid waste, black liquor from paper manufacturing, coal mine gas and distillate fuel oil (PJM 2018: 74). PJM argues that "because the economics of energy production and energy market participation for these resources is much more complicated than for a typical Generation Capacity Resource," and capacity market revenues are not critical for continued operation, they "do not present the price suppression concerns that these market rules address" (PJM 2018: 74).

It is true that power production may be ancillary to the core business for some of these industries and sales may vary somewhat based on production demands. But these are mostly large scale process industries that run every day all day. Because they have other revenue streams, and need to process the wastes for their operations to run smoothly, they might have an incentive to bid low in capacity auctions in order to get at least some capacity revenue for their power operations. It is also the case that the energy conversion process at these facilities is subsidized, sometimes heavily so, both through the federal tax code and via many state renewable portfolio standards. Absent the subsidies, nearly all would continue operations, including power generation. Perhaps the prices in their core industry would rise slightly, though this could actually have environmental benefits. For example, lower prices at landfills and waste-to-energy plants due to subsidies to ancillary energy operations can erode the economics of source reduction and recycling (Koplow 2001), both of which have a better environmental footprint. Whatever the driver, underpricing of these resources in capacity auctions would seem to raise the same concerns with suppressed clearing prices as PJM worried about in other contexts.

Renewables under RPS. In its filing, PJM focuses heavily on renewable purchase mandates (via either RPS or REC systems). The programs currently exist in some form in 11 of the 14 PJM states (including the District of Columbia). Five of the 11 instituted programs prior to the inception of the first capacity market delivery in 2007-08, with the first two in the late 1990s. Three programs were instituted in 2007, and only three states after the capacity market in PJM was already functioning (Barbose 2017; PJM Environmental Information Services 2017; NC Clean Energy Technology Center 2018). In the world of energy subsidies, these are late entrants.

Aside from large scale hydroelectric power projects owned by the federal government, federal subsidies to renewables were near zero in 1989 (Koplow 1993). This started to change only with the introduction of tax breaks, primarily production tax credits for qualified renewable resources, in the federal Energy Policy Act of 1992. In contrast, OECD data in Table A.2 show many large state tax breaks to fossil fuels being introduced in the 1950s, 1960s, and 1970s. Core federal tax breaks to conventional energy are even older. Expensing of intangible drilling costs for oil and gas began in 1913; percentage depletion for oil and gas started in 1926, and for coal in 1932. Liability limits on nuclear accidents took effect in 1957, and responsibility to store and monitor high level nuclear waste was effectively nationalized in 1982 (Koplow 2017).

Nonetheless, PJM analysis indicates the subsidies per MWh in the RPS programs can be large. As such, if resources procured pursuant to these policies were subject to the minimum offer price rule, many would likely fail to clear the capacity market auction. The MOPR-Ex proposal includes an exemption for resources supplying a state-sponsored renewable portfolio standard so long as that RPS program meets certain conditions. PJM's approach under MOPR-Ex is to grandfather renewables for which at least an RFP was issued prior to December 31, 2018, regardless of the structure of the RPS procurement.[6] Procurements under RPS or REC regimes after that date would continue to be exempt from the minimum offer price rule, despite generating non-market revenues, where they are acquired via a "competitive and non-discriminatory" process. Such a process must include at least three bidders, select winners based on the lowest price, set payments based on the auction clearing price, and treat existing capacity equally to new capacity, among other factors (PJM 2018: 113-114).

There is some question as to how important renewables covered by renewable portfolio standards are to capacity markets in general. A combination of low market share and heavily discounted capacity values result in a fairly small footprint as a capacity supplier. Total installed capacity as of December 31, 2017 was 35.4% coal, 36.8% gas, 18% nuclear, 3.6% oil and 4.8% hydro. Wind, waste-to-energy plants, and solar capacity were only 0.6%, 0.4%, and 0.2% respectively (Monitoring Analytics LLC 2018: 36).

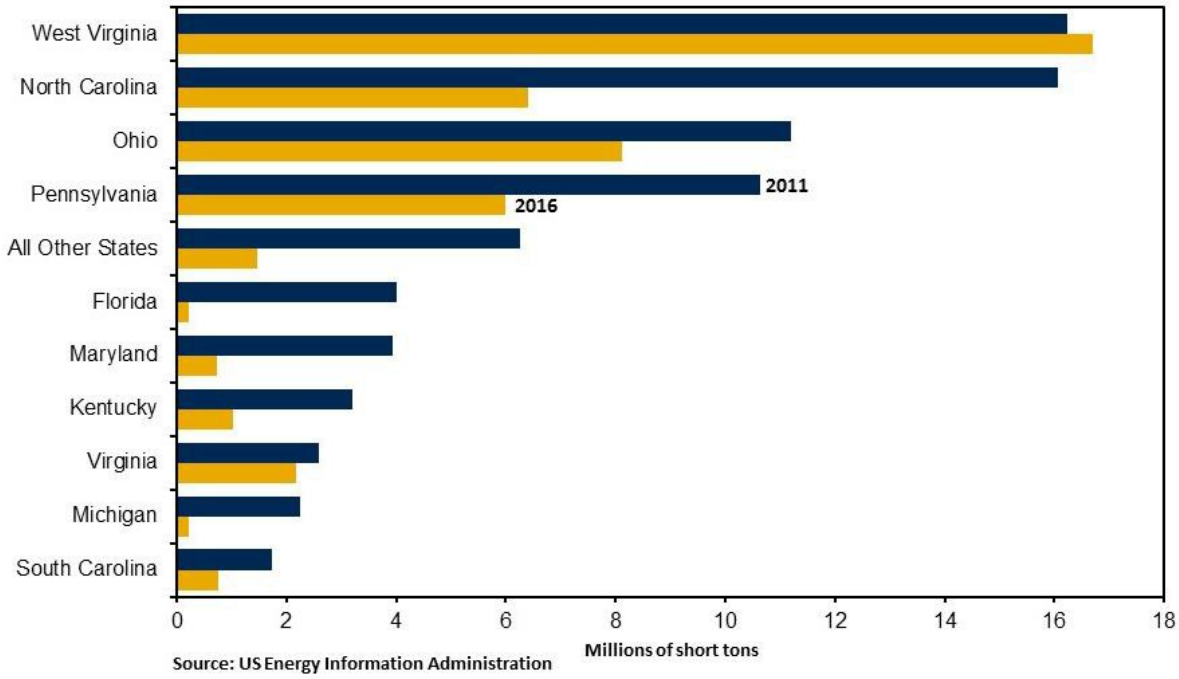
6.2. Relevance of fuel cycle subsidies to electric power capacity markets

Subsidies to fuel extraction and transport; fuel processing (e.g., uranium enrichment or gas plants); reclamation of mine sites and management of wastes; and infrastructure decommissioning all play an important role in the economics of the associated form of electricity. Focusing only on subsidies targeted directly at power production or sale will skew policy oversight away from forms of electricity that have more, or more complicated, upstream and downstream steps. The result will likely be to undercount supports to nuclear, fossil, and hydroelectric power relative to "fuel free" resources such as wind and solar.

It is also likely that at least some of these subsidies are important enough to affect the minimum bid prices in PJM capacity auctions. Indeed, the CCPPSTF did incorporate some subsidies to input fuels in Key Work Assignment #2 of its State Policy Options workbook (CCPPSTF 2017). While this is an indication that some Task Force members viewed them as relevant, upstream subsidies are not addressed directly in the subsequent PJM filing with FERC. Further, the connection between extraction and power plants within particular regions is often a close one -- more than 80% of coal from West Virginia went into electric power production, and most of it within PJM (Figure 1).

[6] Resources procured pursuant to a voluntary RPS are not grandfathered.

Figure 1. Destination States for WV Coal Shipments to Electric Utilities, 2011 vs 2016



Source: Figure is from Lego and Deskins (2017: 4).

Surging natural gas in Pennsylvania is another example of these important links. PJM capacity auctions in 2010 through 2017 added 50,792 MW of new generation capacity, more than three quarters of which was natural gas (PJM 2018: 10). Gas deliveries for Pennsylvania electric generation increased from 3% of total deliveries in 1997 to 46% in 2015, growing from 20 Bcf to 501 Bcf (Stewart 2017: 5). And despite electric power already being the largest end use sector for natural gas, the transition is not abating: nearly all new planned power capacity is natural gas (Stewart 2017:10). Despite growing in-state consumption, gas exports – including to other PJM states -- are even larger, comprising nearly 77% of total demand in 2015 (Stewart 2017: 18).

6.2.1. Upstream tax subsidies

Extraction of hard rock and fuel minerals has been subsidized through the tax code for more than a hundred years. Tax breaks at the federal, state, and local levels remain today. For most industries, investment costs are deducted over the service life of the investment. For oil and gas, many expenses can be deducted from taxable income immediately (intangible drilling costs, tertiary injectants) or more quickly than their service life (geological and geophysical expenses, gathering lines). Acceleration of tax deductions boosts the after-tax income of recipients on a present value basis. The percentage depletion allowance allows mineral firms to deduct investments based on the market value of the mineral rather than the actual investment spending. As a result, deductions can exceed the total amount invested. In many cases, federal tax breaks are mirrored in state statutes, increasing their total value to the firm.

Natural gas production in Pennsylvania is partly supported by sub-national tax breaks as well, particularly regarding severance and property taxes.

Revenue losses to the State or municipal governments can be very large when a state decides to impose no taxes, or much lower rates, on extraction activities relative to surrounding jurisdictions. This is the case in Pennsylvania, one of only two states in the country with no severance tax. Pennsylvania also fully exempts oil and gas (though not coal) reserves and related equipment from local property taxes, something most oil states don't do.

This information, however, won't be visible in most of the standard compilations of tax breaks. Property taxes are local, even though statutes on exemptions may have been determined at the state level. And OECD treats each taxing jurisdiction as setting its own baseline, so doesn't impute "missing" taxes if levels are below average. But industry notices, and drilling activity rises.

Raimi and Newell evaluated the state and local tax structure for the 16 largest oil and gas producing states. Thirteen of these levied property taxes on oil and gas reserves. Pennsylvania does not. Severance taxes compensate states for the permanent extraction of a non-renewable resource. Of the 16 largest producing states, only Pennsylvania and California have no severance taxes. As shown in Table 3 (Raimi and Newell 2016: 5-7), PA and OH had the lowest tax take among the whole sample, at 2.33 and 1.11 percent, respectively in 2013. West Virginia was higher, at 7.79%, though the chart focuses only on oil and gas. WV historically has had a relatively small oil and gas industry and many subsidies to coal instead. The effective rates for 2013 actually represent an improvement: for the period 2004-13 state and local taxes on oil and gas averaged roughly half the 2013 level, at 1.2%, 0.3%, and 4.2% in PA, OH, and WV. Three other PJM states were also in the lowest tier for effective state and local taxation of oil and gas nationally: IL (0.1%), IN (0.9%), and VA (0.0%) (Weber, Wang and Chomas 2015: 27).

Applying the same effective tax rate as Texas in Pennsylvania would have generated roughly $400 million in additional revenue in 2013, even ignoring the continued full property tax exemption on billions of dollars in natural gas infrastructure. The revenue losses to county governments from the oil and gas exemptions to property taxes in Pennsylvania were estimated by a mineral appraiser at $477 million in 2012, rising to $660m in 2013 and nearly $1 billion in 2014 as the surge in investment continued (Kern 2011 in Simeone 2012: 12). Attempts to get updated figures from this analyst were not successful.

In lieu of a severance tax, PA introduced an "impact fee". It is not really a substitute, however. Severance and property taxes should finance general government operations. To the extent that impact fees are used mostly to offset the impacts that gas drilling has on community budgets through road damage, congestion or higher public safety costs, it is not really contributing to ongoing general state operations as taxes on other sectors of the economy do. The fee should supplement severance and property taxes rather than replacing them. Even so, revenues from Pennsylvania's impact fee have been falling despite rising production. Between 2014 and 2016, unconventional gas production jumped by 25%, an

increase of more than 1 billion cubic feet; yet impact fees dropped 22%, by near $50 million. Impact fees as a percent of sales is projects to be only 1.2% for 2018, down from 4.5% in 2011 (Polson and Herzenberg 2017: 3,4).

Table 2. Implicit tax breaks to oil and gas extraction in PA and OH appear large

State	Severance tax	Other state taxes/fees	Local property taxes	State leases	State share of federal leases	Value of Production	State and local taxes/ production value
	$millions	*$millions*	*$millions*			*$millions*	*%*
AK	3,972	107	429	2,804	19	18,900	23.85%
AR	91	—	42	No data	2	4,400	3.02%
CA	—	64	505	407	105	21,000	2.71%
CO	136	—	367	104	99	10,200	4.93%
KS	123	8	175	1	3	4,900	6.24%
LA	821	5	202	591	27	17,100	6.01%
MT	213	—	—	27	21	2,600	8.19%
ND	2,408	—	—	345	92	24,600	9.79%
NM	781	21	147	543	460	13,200	7.19%
OH	3	2	5	0	0	900	1.11%
OK	494	29	545	90	6	16,500	6.47%
PA	—	226	—	144	—	9,700	2.33%
TX	4,485	1	2,475	1,239	17	107,000	6.51%
UT	53	6	53	69	131	4,300	2.60%
WV	88	27	72	0	0	2,400	7.79%
WY	597	—	639	140	472	11,200	11.04%
Total	14,264	495	5,657	6,504	1,454	268,900	7.59%
Total, ex AK	10,293	389	5,227	3,700	1,436	250,000	6.36%

Source: Raimi and Newell (2016)

6.2.2. Tax-exempt corporate structures

Firms able to organize their activities in corporate forms that are eligible for lower corporate-level income taxes, or exempt from them entirely, garner a competitive advantage. The oil and gas sector has been particularly adept at doing this. An analysis by the Pennsylvania Budget and Policy Center estimated that as of February 2017, at least 65% of the oil and gas companies in PA were pass-through entities, paying no corporate-level taxation. These firms accounted for "68% of the gas produced in the state and 71% of active wells" (Polson and Hetzenberg 2017: 9). Standard corporations would have incurred a state corporate income tax of nearly 10%.[7]

[7] Shareholders of both partnerships and standard C-corporations would also include the individual income taxes, at a rate of just over 3%. The effective rate on pass-throughs would be a bit higher, since paying no taxes on

For the much larger pipeline companies, the corporate structure of choice has been the Master Limited Partnerships (MLP). MLPs are one the very few corporate structures that are both exempt from corporate taxation and are also publicly traded. Issuing shares on the stock market allows these firms to reach the massive scale they need in order to build and operate pipelines, and also to raise capital more cheaply than would be possible otherwise. Not surprisingly, these attributes would be attractive to industries well beyond the oil and gas sector. In fact, during the early 1980s MLPs were expanding so fast across the US economy that Congress worried about huge drops in tax revenues. Their response was to disallow the structure in the Tax Revenue Act of 1987 (Koplow 2013). But their reforms had a few exemptions -- one of which was extractive minerals. Renewable energy firms are not eligible. As of August 2007, 82% of MLPs were in the natural resources segment, of which the vast majority were oil and gas. This subset of MLPs had a market capitalization of $300 billion (MLPA 2017).

MLPs are most active in the mid-stream area, often owning pipelines. Increasingly, private equity firms are also investing in these assets (Morris 2017). A handful of private equity firms are publicly traded as MLPs; many of the rest are privately held partnerships that also pay no corporate income taxes. MLPs are not just pipelines. The new Dominion Cove Point LNG facility is structured as a tax-exempt MLP as well. Its ability to eliminate corporate income taxes is bundled on top of the large property tax abatements it received from Calvert County to reduce the breakeven cost of the plant.

Between 2007 and 2016, FERC has approved pipeline projects involving PA that encompass 12,939 MM cf/day of capacity. An additional 7,292 MM cf/day of capacity was approved in 2017 alone (Simeone 2017). Most of these lines appear to be using tax exempt corporate structures. The dollars are big. Six major pipeline projects within the PJM service area have cost estimates totalling $16.6 billion (McKenna 2017).

6.2.3. Bulk fuel transport

Because coal and natural gas power plants burn so much fuel, subsidies to transport links can artificially reduce plant costs of operation. A combination of very heavy trucks, secondary roads with thinner road beds, and many trips to construct and service fracking operations and coal mine sites, can result in very rapid road wear. While most states have some supplemental fees paid by heavy trucks, these tend to be much lower than the actual damage.

The most detailed work on this issue has been done by the state of Texas. They found road damages exceeded user fees by roughly $2 billion per year. In assessing how various federal and state subsidies to oil affected the ability of oil fields to hit their minimum investment hurdles, the road subsidy to fracking operations in Texas turned out to have the

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corporate level means that slightly more earnings would pass out to shareholders to then be taxed at the individual level.

largest impact of any state-level support. The subsidy lifted the internal rate of return for projects in the Permian Basin by nearly 2 percentage points, a significant portion of the project hurdle rates (Erickson, Downs, Lazarus and Koplow 2017).

Damage from coal hauling is also problematic. A 1981 Kentucky legislative report found widespread road damage from coal hauling. Estimated costs to repair the damage were prohibitive. A major cause of the problem: "too many heavy and improperly loaded trucks have been traveling the state's highways. Laws enacted to protect the roads have been ignored" (VanArsdall 1981). The problem has persisted. A detailed assessment of the impact of the coal industry on the Kentucky state budget conducted by the Mountain Association for Community Economic Development (MACED) found annual road damage costs of more than $230 million per year in 2006 (Konty and Fry 2009). The scale of this subsidy was an important driver of MACED's calculation that, on net, the coal industry cost the state more money than it brought in. Yet coal trucks continue to be allowed to exceed the weight limits by 10 percent on Kentucky's secondary roads, though a 10 percent increase in weight limits can increase the damages to bridges by a third. (Cheves 2017 and Kentucky House Bill 174).

As noted already, pipeline systems benefit from an array of subsidies including accelerated depreciation, property tax exemptions, and tax-exempt MLP corporate structures. They have also had a fairly strong capability to obtain land needed for their lines using the power of eminent domain, a contentious and often litigated aspect of many of the lines going in to move gas from the Marcellus. Historically, coal has also moved in significant quantities on the inland waterway system, where coal and petroleum have long comprised more than half of the domestic tonnage. Fees on users have been insufficient to finance the inland waterway system, with more than 90 percent of funding coming from taxpayer subsidy rather than user fees, according to analysis by the Nicollet Island Coalition (2011). This is significantly higher than the public subsidy share to roads or rail.

6.2.4 Post-closure cleanup

Extraction sites, fuel processing, power plants, and pipelines all require remediation, reclamation or decommissioning after the minerals have been removed or the productive life of a facility ends. These costs often come at a time when company revenue drops sharply and management may be interested in moving on to other things. To prevent liabilities from continually being dumped on taxpayers, lawmakers have adopted a variety of approaches to better protect against financial shortfalls. These include reclamation bonding, mandated contributions into post-closure trust funds, or user fees on current market participants to help pay cleanup costs from firms no longer in business. While better than nothing, these approaches continue to face challenges (see, for example, Davis 2012 and Boomhower 2016).

One measure of the scale of these problems is the backlog on cleaning up old coal mining sites. Despite some continuing funding of this backlog from an excise tax on coal, the fee levels are too small and the pace of clean up too slow, to work through the backlog in a reasonable time frame. Table 4 provides some additional perspective on this. Within PJM,

many states have funded less than half of the reclamation cost to date. Unfunded reclamation liabilities total more than $11 billion within PJM, and the region accounts for more than three-quarters of the reclamation backlog nationally. Allowing bonding and reclamation accruals to be too low artificially reduces the operating costs for those mines. Further, if site owners expect they won't actually be held to account for the messes they leave behind, they also have far less incentive to make more prudent decisions during operations.

Table 3. PJM dominates unfunded coal mine land reclamation nationally

State	Unfunded Cost	Funded Cost	Completed Cost	Total Cost	Unfunded as % of Total
Pennsylvania	5,044,014,727	217,966,725	644,151,172	5,906,132,623	85.4%
West Virginia	1,563,561,572	72,272,703	676,163,130	2,311,997,405	67.6%
Kentucky	474,998,682	93,356,966	574,968,101	1,143,323,749	41.5%
Virginia	421,442,333	10,793,610	138,930,246	571,166,189	73.8%
Ohio	359,051,851	4,123,774	171,939,330	535,114,954	67.1%
Illinois	156,707,030	28,134,366	197,692,405	382,533,801	41.0%
Indiana	187,453,029	9,256,929	160,824,519	357,534,477	52.4%
Maryland	64,897,199	2,625,198	42,517,583	110,039,979	59.0%
Tennessee	44,666,578	1,550,510	47,368,888	93,585,976	47.7%
Michigan	3,360,000	1,610,000	5,959,034	10,929,034	30.7%
North Carolina	0	0	163,252	163,252	0.0%
PJM summary	**8,320,153,001**	**441,690,780**	**2,660,677,659**	**11,422,521,440**	**72.8%**
PJM share of national total	**79.3%**	**78.2%**	**66.8%**	**76.0%**	
Notes: Includes only SMCRA funding, so data should include only coal mining operations. Other funding mechanisms in e-AMLIS include both coal and non-coal sites. Not all AML costs are included, only those potentially addressable under SMCRA. Won't necessarily tie to state estimates.					
Source: US Office of Surface Mining Reclamation and Enforcement, Abandoned Mine Land Inventory System (e-AMLIS), accessed 3 May 2017.					

7. Case Study: Exemption of Coal from Sales and Use Tax in PA

As the PJM filing is so focused on purchase mandates, it is useful to test a different type of policy to see whether it might also be deemed actionable under PJM's proposed tests. Quantifying other types of subsidies requires several more steps, but is possible with the right data inputs. Whereas the value of support under an RPS or REC approach is a known amount per unit energy produced, valuing other types of support often requires a baseline against which to compare. In addition, most other forms of subsidy don't flow directly to generator revenues. Rather, they affect net revenues by reducing cost or risk, or support other parts of the fuel cycle. While time permitted only one test case, running additional screens on a variety of subsidy types in the future would be useful.

Table 4 estimates the impact of Pennsylvania's exemption of coal from sales and use taxes on the economics of coal-fired power plants. The subsidy value is in the form of "revenue loss," which measures how much additional revenues the taxing authority would have realized

if not for the special tax breaks. This is a loss to the Treasury, but a gain to the industry that gets to pay lower taxes. The baseline for tax breaks is how much a "normal" taxpayer would have had to pay on a comparable activity. For credit support, it would be what interest rate and loan terms a borrower of the same risk level would have received in the marketplace absent a government guarantee program.

Frequently, subsidy data is available only at an aggregated level. This is nearly always the case with tax breaks since tax returns are kept confidential. Aggregated values need to be allocated to specific beneficiaries based on the details of a particular tax break. Section III of Table 4 shows two adjustments made to the coal tax break: the first is to exclude subsidies flowing to coal that is exported out of state for use. The second is to exclude the portion of the subsidy flowing to coal consumers inside PA, but outside of the power sector. In both of these allocations, the estimates are likely conservative. Nearly three-quarters of coal exports in 2011 went to other PJM states (Pennsylvania Economy League of Greater Pittsburgh 2014), and a portion of industrial users of coal that were excluded from the calculation in Table 4 also generate power and may partake in PJM capacity markets.

After adjustments, the subsidy per MWh ranged from $0.83 to $1.57 per MWh.

The next step is to assess whether that level of support would be actionable under PJM's proposed rules. Wholesale market revenues for all Pennsylvania coal plants were estimated for the years 2014-2017 on a MWh basis because plant or unit-level revenue data are not publicly available. Energy market revenues were determined based on the average annual day-ahead locational marginal price at the Western Hub, where all but one Pennsylvania coal plant sells power. As with any average, individual coal plants may have higher or lower average energy revenues per MWh than the group, depending on whether they tend to dispatch at peak or off-peak times. This energy market revenue estimate also excludes any uplift payments these generators might have received.

Capacity revenues were determined based on the RTO-wide clearing price in the base residual auction for delivery years 2013/14 through 2017/18. Capacity revenues were converted to per MWh basis for the purpose of this revenue analysis using the average capacity factor for Pennsylvania coal units that had operated in the previous year. This analysis conservatively assumes that all coal units cleared the base residual auction in these years; if any of these units did not clear, their wholesale market revenues would have been lower and therefore the value of the subsidy received as a percentage of revenue would be higher.

As shown in Section IV of Table 4, the tax savings from the subsidy were equivalent to more than 1 percent of revenues in all three years evaluated, reaching a high of 4.4% for 2016. Section V of Table 4 evaluates whether the affected MW of capacity would exceed the 5,000 MW threshold of actionable units system-wide in order for the subsidy adjustments to be acted on by PJM. Assuming all of the active units are clearing the capacity market, the 5,000 MW action threshold would be exceeded by a factor of more than two. This means about half of the PA units could not have cleared capacity markets and the threshold for action would still be

met. Further, the MW test applies PJM-wide. Thus, actionable coal units in PA even well short of 5,000 MW could nonetheless combine with actionable subsidies to other fuels and locations to tip the region over the action threshold.

Under PJM's proposal as currently formulated, this tax break might be ignored because it doesn't flow directly to revenues. It might be ignored because the point of impact is on input fuels, rather than directly to the power plant; or because it is more difficult to measure by PJM oversight staff than a simple RPS payment. But it is clear that the subsidy is material, likely part of a fairly big group of material subsidies outside of purchase mandates. Yet, if material subsidies are ignored because they are hard to measure, come in an excluded form from an excluded political jurisdiction, or reduce risks and costs rather than boosting revenues, the PJM system predicated to make wholesale capacity markets better could end up making them worse.

Table 4. Revenue test: Sales tax exemption for Pennsylvania Coal

I. Description				
Sales Tax Exemption for Coal. The purchase or use of coal in Pennsylvania is exempt from the sales and use tax normally levied on sales of most goods and services in that state; introduced to encourage the consumption of coal and sustain employment in the state's coal-mining industry (OECD 2018a). The tax exemption is provided to coal as an input, not at the point of power generation. This calculation adjusts subsidy amounts to remove the portion flowing to coal that is shipped to other states for consumption, or is used within Pennsylvania at industrial facilities not producing power.				
II. Magnitude of tax expenditure				
	2014	**2015**	**2016**	**Notes and data sources**
Sales tax exemption, bituminous coal in Pennsylvania	84,866,463	116,275,801	117,813,333	OECD, 2018 inventory; allocation to coal types done as a matter of course by OECD. Revenue loss estimates for 2014 seem to have been adusted upwards in later PA budget cycles, suggesting the subsidy share of revenues for 2014 may be higher than is shown here.
Sales tax exemption, anthracite coal in Pennsylvania	2,633,537	4,724,199	4,786,667	
Total	87,500,000	121,000,000	122,600,000	
III. Adjust subsidy value for reflect portion flowing to power sector inside PA				
A. Coal exports				Subsidy to in-state generators is reduced by share of coal mined in PA but exported out before use.
Export as share of total	8.9%	14.2%	15.3%	EIA Coal Annual, for years 2014, 2015, 2016. Table 8, coal disposition by state
Implied subsidy "export" to other states	7,790,034	17,175,692	18,762,805	Assumes conversion efficiency at PA power plants is, on average, the same as states receiving PA coal exports.
Estimated net subsidy flowing to consumption of coal within PA	79,709,966	103,824,308	103,837,195	
B. Power sector share of total in-state coal consumption	82.4%	80.4%	82.5%	EIA, Coal Annual, for years 2014, 2015, 2016. Table 26, U.S. Coal Consumption by End Use Sector, Census Division, and State
Estimated net subsidy flowing to consumption of coal by PA power producers	65,681,012	83,474,744	85,665,686	This is a conservative assumption, as some excluded facilities produce CHP and sell into the PJM capacity market.

Table 4, continued

	2014	2015	2016	
IV. One percent of revenues test				
A. Subsidy magnitude/MWh				
Estimated net subsidy flowing to consumption of coal by PA power producers	65,681,012	83,474,744	85,665,686	From section III, above
Coal fired generation in PA, MWh	78,985,629	64,637,233	54,672,030	Power output from PA utilities, independent power producers and combined heat and power. (EIA, State Electricity Profiles for PA, Tab 5).
Subsidy, $/MWh of coal-fired power produced in PA	0.83	1.29	1.57	Assumes subsidies to coal flow to coal users.
B. Capacity and energy revenues for PA coal-fired generators				
Capacity Revenue per MWh	5.00	8.05	6.78	Specific units clearing PJM capacity auctions, and the amount they receive, is not made public. Capacity revenue estimates calculated by Sierra Club analyst Joe Daniel based on RTO-wide Base Residual Auction results for delivery years 2013/14 through 2017/18 (PJM data). Conversion of capacity to MWh basis based on average capacity factor for all Pennsylvania coal units in each calendar year, as determined from EIA net generation and capacity data reported in S&P Global Market Intelligence. Small generators that had not reported generation data in a year were not included in the calculation of capacity factor.
Energy Revenue per MWh	51.01	35.82	29.22	Energy revenue estimates determined by Sierra Club analyst Joe Daniel based on average annual day-ahead LMP at the PJM Western Hub (PJM data reported in S&P Global Market Intelligence).
Total Revenue per MWh, PA average	56.01	43.87	36.00	
C. Subsidy exceeds the 1% revenue threshold for all three years				
Subsidy/average wholesale revenues	1.5%	2.9%	4.4%	Tax breaks do not increase revenue because they are on the cost side. However, *net* revenues will rise.
V. Affected units exceed the 5,000 MW PJM-wide threshold for action				
PA coal clearing capacity auctions that benefit from this subsidy	11,433	10,755	11,478	Sierra Club analyst Joe Daniel analysis of data reported in S&P Global Market Intelligence.
System-wide threshold for proposed capacity repricing rules to be implemented, MW	5,000	5,000	5,000	PJM (2018: 52)
Ratio of potentially affected coal units/capacity repricing threshold	2.29	2.15	2.30	

8. Conclusions

In its proposed tariffs to remove potential distortions caused by subsidies in capacity markets, PJM includes a number of limitations and exclusions that appear to result in unequal evaluation of subsidies across different fuel cycles. This will likely impede PJM's core objective of ensuring competitive, nondiscriminatory auctions in the wholesale capacity market. Because subsidies flow to all forms of generation, and nearly every upstream and downstream stage of each power-related fuel cycle as well, a comprehensive review process is needed if PJM is to address these subsidies in a neutral way.

- **Blanket exclusion of federal and many state and local subsidies will reduce the accuracy of subsidy screening significantly.** PJM excludes all federal subsidies, and any state or local support that is in place for regional economic development or to convince a plant to locate (or stay) in a particular region. Federal subsidies can be both large and highly targeted to an industrial facility. State and local subsidies excluded on the basis of their stated purpose can also be very large. They may represent multiple state programs, originating from more than one agency – some of which may be excluded and others not based on the PJM proposal. In all of these areas, it is the scale of support rather than the justification for granting it that will drive capacity market distortions.
- **Revenue-based metrics for actionable subsidies need to be broadened to incorporate cost- and risk-reducing subsidies.** Subsidies operate using three main levers: boosting revenues, reducing costs, and reducing the volatility of expected return by absorbing or capping credit, liability, or other operating risks. The PJM proposal, as currently worded, focuses only on revenues and as a result will not treat different power sources equally. If a policy of mitigating subsidies is to be pursued, then the materiality test should shift from 1% of revenues to "a subsidy equal in magnitude to one percent of revenues" to incorporate the broad array of subsidy mechanisms.
- **Purchase mandates are one technique of many that governments use to transfer value to the energy sector; subsidy screening needs to incorporate all of them.** Not every form of electrical power has the same cost structure. Some are capital-intensive, rolling out new technologies, or face long or uncertain build times. Others require complex fuel supply chains, have risks of severe accidents, or significant and complex post-closure concerns. Still others have variability in their ability to produce electricity. As a result of these differences, the importance of particular types of subsidy support varies significantly across fuels, and rules that by definition or effect limit review to a small subset of subsidy approaches will materially disadvantage some energy resources over others.
- **PJM's current focus almost entirely on purchase mandates will understate the level of subsidies to other forms of energy.** In addition, where interventions are focused on internalizing environmental or health externalities that are not being addressed in other ways, PJM needs to evaluate the impact on efficiency using more than just generator costs of operation.

- **Large subsidies to upstream or downstream fuel cycle steps need to be addressed to determine when a subsidy should be actionable.** These types of supports are most relevant regarding subsidies to coal and natural gas extraction and transport; coal mine land reclamation; large state support to ancillary infrastructure to move or process fuels; or state subsidy for high risk, long-term parts of the nuclear fuel cycle.
- **Subsidy combinations matter.** If there are multiple subsidies flowing to the same beneficiaries that in total exceed PJM's action threshold of support equal to 1% of revenues, these should be reviewed as a group for action even if individually they don't hit 1%. Subsidy "stacking" is common across the world, and it is the joint effect of multiple subsidies that will drive the distortions in market behavior.
- **Test case illustrates the importance of a more systematic inclusion of subsidies as potentially subject to PJM action.** A test case relating to tax exemptions for coal in the state of Pennsylvania indicates that more subsidies than just purchase mandates would exceed the PJM's proposed revenue threshold. Additional analysis would likely illustrate a similar situation in multiple other parts of PJM, though this one example is useful in illustrating why a narrow focus on purchase mandates will be insufficient in addressing potential distortions.

9. Appendix – Subsidy Tables

Table A.1. Subsidies to specific energy facilities within PJM Interconnection (showing >$20 million only)

Company	Location	Project Description	Year of Decision	Subsidy Value (multiple years)	Program Name	Awarding Agency
Royal Dutch Shell	Pennsylvania	ethane cracker plant	2012	$1,650,000,000	special state tax credits	state legislature
Clean Coal Power Operations (KY) LLC	Kentucky	coal to diesel plant (inactive)	2008	$550,000,000	Incentives for Energy Independence Act	Kentucky Economic Development Finance Authority
Dominion Cove Point LLC	Maryland	expansion of a facility for the liquefaction of natural gas	2013	$506,000,000	Payment in Lieu of Tax	Calvert County Board of County Commissioners
Hemlock Semiconductor (controlled by Dow Corning)	Michigan	solar cell and semiconductor manufacturing	2008	$372,300,000	multiple	multiple
Holtec International	New Jersey	small nuclear reactors manufacturing facility	2014	$260,000,000	Grow New Jersey Assistance Program	Economic Development Agency
Kentucky Syngas, LLC	Kentucky	Coal to gas plant	2007	$250,000,000	Incentives for Energy Independence Act	Kentucky Economic Development Finance Authority
Dow Kokam (previously known as KD Advanced Battery Group)	Michigan	advanced battery manufacturing	2009	$194,300,000	multiple	multiple
Marathon Petroleum	Michigan	refinery expansion	2007	$186,000,000	multiple	multiple
Cash Creek Generation	Kentucky	coal gasification plant	2008	$150,000,000	Incentives for Energy Independence Act	Kentucky Economic Development Finance Authority

Company	Location	Project Description	Year of Decision	Subsidy Value (multiple years)	Program Name	Awarding Agency
Dow Chemical	Michigan	manufacturing facilities for renewable energy materials	2010	$129,300,000	multiple	multiple
fortu PowerCell, Inc.	Michigan	advanced battery manufacturing	2010	$112,600,000	multiple	multiple
Dow Kokam Advanced Battery Group	Michigan	advanced battery manufacturing	2010	$100,000,000	Michigan Business Tax Battery Credit	Michigan Economic Development Corporation
United Solar Ovonic (no longer operating)	Michigan	solar panel production facility	2008	$96,900,000	multiple	multiple
Secure Energy Kentucky	Kentucky	coal-to-liquid gasification plant	2011	$85,000,000	Incentives for Energy Independence Act	Kentucky Economic Development Finance Authority
Coal Synthetics (inactive)	Kentucky	coal-to-gas plant	2008	$80,000,000	Incentives for Energy Independence Act	Kentucky Economic Development Finance Authority
Marathon Petroleum	Ohio	oil company headquarters	2011	$78,500,000	multiple	Department of Development
Marathon Petroleum Corporation	Ohio	oil company headquarters	2011	$72,128,036	Job Retention Tax Credit	Department of Development
Dow Kokam Advanced Battery Group	Michigan	Hybrid and electric car batteries	2010	$42,000,000	Michigan Business Tax Battery Credit	Michigan Economic Development Corporation
S&C Electric Co., a Delaware corp.	Illinois	Project Name: S & C Electric TIF District: Pratt/Ridge; switching and protection products for power distribution.	2005	$39,735,000	Chicago: Tax Increment Financing	Chicago Department of Housing and Economic Development

Company	Location	Project Description	Year of Decision	Subsidy Value (multiple years)	Program Name	Awarding Agency
NRG Energy Inc.	New Jersey	facility expansion	2013	$37,520,000	Grow New Jersey Assistance Program	Economic Development Authority
Dow Kokam Advanced Battery Group	Michigan	advanced battery manufacturing	2010	$29,007,000	MEGA (Michigan Economic Growth Authority) Tax Credits	Michigan Economic Development Corporation
Plains and Eastern Clean Line LLC	Tennessee	purchase renewable wind energy, construct direct current electric transmission line that terminates at a new converter station and then ties into the Tennessee Valley Authority network	2014	$23,369,368	Shelby County PILOT Agreements	Economic Development Growth Engine

Source: Good Jobs First *Subsidy Tracker* Database, extract 27 April 2018.

Table A.2. Estimated Revenue Loses to State Treasuries in PJM Region from State-level Tax Expenditures Provided to Fossil Fuels

Program Description	Start Date	Fuel Cycle Stage	Fuel Category*	State	2015 Revenue Loss	2016 Revenue Loss	2017 Revenue Loss	2018 Revenue Loss	Revenue Loss during Period of PJM Capacity Auctions (2007-18)
Sales Tax Exemption for Residential Utilities. Exemption includes sales of electricity, natural gas, LPG, and fuel oil to residential users in Pennsylvania from the sales and use tax normally levied on sales of most goods and services in that state. It is meant to ensure that households retain access to basic services or commodities. Allocated to fuels based on state consumption data.	NR	END	ELECTR	PA	416,000,000	423,300,000	440,300,000	458,400,000	4,987,500,000
Sales Tax Exemption for Coal. The purchase or use of coal in Pennsylvania is exempt from the sales and use tax normally levied on sales of most goods and services in that state; introduced to encourage the consumption of coal and sustain employment in the state's coal-mining industry.	NR	END	BITCOAL	PA	116,275,801	117,813,333	119,254,768	122,233,735	1,473,079,772
Sales Tax Exemption for Energy and Energy Producing Fuels. All energy and energy-producing fuels used in manufacturing, processing, mining, or refining and any related distribution, transmission, and transportation services, to the extent that the cost of the energy or energy-producing fuels used exceeds 3% of the costs of production, are exempt from Kentucky's sales and use tax.	1960	INDUS	NATGAS	KY	36,376,202	36,165,121	37,290,884	38,557,367	321,894,747

Program Description	Start Date	Fuel Cycle Stage	Fuel Category*	State	2015 Revenue Loss	2016 Revenue Loss	2017 Revenue Loss	2018 Revenue Loss	Revenue Loss during Period of PJM Capacity Auctions (2007-18)
Coal Used in the Manufacture of Electricity. Special sales and use tax exemption on the purchase of coal used to generate electricity; coal consistently ranks as the top fuel used for electricity generation in Kentucky, with more than 90% of the State's electricity generated in coal-fired power plants.	1960	GENER	BITCOAL	KY	55,000,000	33,800,000	35,900,000	34,100,000	667,402,000
Coal Refuse Energy and Reclamation Tax Credit. Credits may be awarded at a rate of $4 per 2,000 pounds of qualified coal refuse, capped at 22.2 percent of the available budget allocation per fiscal year. Credit may be used against personal income tax, corporate net income tax, capital stock and franchise tax, bank shares tax, title insurance company shares tax, insurance premiums tax, and mutual thrift institutions tax liabilities.	2016	EXTRACT	BITCOAL	PA	-	7,207,178	9,609,570	9,609,570	26,426,318
Sales Tax Exemption for Energy and Energy Producing Fuels. All energy and energy-producing fuels used in manufacturing, processing, mining, or refining and any related distribution, transmission, and transportation services, to the extent that the cost of the energy or energy-producing fuels used exceeds 3% of the costs of production, are exempt from Kentucky's sales and use tax.	1960	INDUS	BITCOAL	KY	7,779,806	7,734,662	7,975,430	8,246,294	89,460,708

Program Description	Start Date	Fuel Cycle Stage	Fuel Category*	State	2015 Revenue Loss	2016 Revenue Loss	2017 Revenue Loss	2018 Revenue Loss	Revenue Loss during Period of PJM Capacity Auctions (2007-18)
Sales Tax Exemption for Energy and Energy Producing Fuels. All energy and energy-producing fuels used in manufacturing, processing, mining, or refining and any related distribution, transmission, and transportation services, to the extent that the cost of the energy or energy-producing fuels used exceeds 3% of the costs of production, are exempt from Kentucky's sales and use tax.	1960	INDUS	LPG	KY	6,706,984	6,668,065	6,875,632	7,109,144	66,290,137
Sales Tax Exemption for Coal. The purchase or use of coal in Pennsylvania is exempt from the sales and use tax normally levied on sales of most goods and services in that state; introduced to encourage the consumption of coal and sustain employment in the state's coal-mining industry.	NR	END	ANTCOAL	PA	4,724,199	4,786,667	4,845,232	4,966,265	51,620,228
Excess of Percentage over Cost Depletion. Extends the corresponding federal provision for percentage depletion to Kentucky's own corporation tax system. Allows companies to calculate deductions from their taxable income based on a percentage of the gross income derived from mining or drilling for natural resources. Under normal income-tax treatment, producers would recover investment costs over time as resources are depleted. In the case of percentage depletion, the sum of	1954	EXTRACT	BITCOAL	KY	3,058,703	2,893,368	2,893,368	2,893,368	31,285,793

Program Description	Start Date	Fuel Cycle Stage	Fuel Category*	State	2015 Revenue Loss	2016 Revenue Loss	2017 Revenue Loss	2018 Revenue Loss	Revenue Loss during Period of PJM Capacity Auctions (2007-18)
deductions can exceed the actual cost of investment.									
Coal Incentive Tax Credit. Can be claimed by any eligible electric-power company or entity operating coal-fired electric generation plants, alternative fuel facilities, or gasification facilities. The tax credit amounts to USD 2 per short ton of coal purchased in excess of the amounts purchased in a reference year. The eligible quantities of coal must be used to generate electric power or used as feedstock in an alternative fuel facility or a gasification facility.	2000	GENER	BITCOAL	KY	3,389,374	2,893,368	2,810,700	2,728,033	21,781,575
Railroad Improvement Tax Credit. Tax credit to certain railroad companies against the costs incurred for maintenance and improvement, and for railroad expansion or upgrades to accommodate the transport of fossil energy or biomass resources.	2009	TRANS	BITCOAL	KY	-	2,700,000	2,600,000	2,500,000	11,100,000

Program Description	Start Date	Fuel Cycle Stage	Fuel Category*	State	2015 Revenue Loss	2016 Revenue Loss	2017 Revenue Loss	2018 Revenue Loss	Revenue Loss during Period of PJM Capacity Auctions (2007-18)
Thin Seam Tax Credit. Allows mining companies operating in the state to get a tax credit for coal mined from thin seams or from areas with a high overburden ratio. The credit is on a sliding scale from 2.25% to 3.75% of the value of the severed coal and based on the thickness of the seam, the ratio of overburden removed to coal severed, and the sulphur content of the coal.	2000	EXTRACT	BITCOAL	KY	1,901,356	1,818,688	1,901,356	1,901,356	18,497,073
Coal Incentive Tax Credit. Can be claimed by any eligible electric-power company or entity operating coal-fired electric generation plants, alternative fuel facilities, or gasification facilities. The tax credit amounts to USD 2 per short ton of coal purchased in excess of the amounts purchased in a reference year. The eligible quantities of coal must be used to generate electric power or used as feedstock in an alternative fuel facility or a gasification facility.	2000	GENER	COKCOAL	KY	686,901	586,379	569,625	552,871	4,677,064

Program Description	Start Date	Fuel Cycle Stage	Fuel Category*	State	2015 Revenue Loss	2016 Revenue Loss	2017 Revenue Loss	2018 Revenue Loss	Revenue Loss during Period of PJM Capacity Auctions (2007-18)
Coal Refuse Energy and Reclamation Tax Credit. Credits may be awarded at a rate of $4 per 2,000 pounds of qualified coal refuse, capped at 22.2 percent of the available budget allocation per fiscal year. Credit may be used against personal income tax, corporate net income tax, capital stock and franchise tax, bank shares tax, title insurance company shares tax, insurance premiums tax, and mutual thrift institutions tax liabilities.	2016	EXTRACT	ANTCOAL	PA	-	292,822	390,430	390,430	1,073,682
Excess of Percentage over Cost Depletion. Extends the corresponding federal provision for percentage depletion to Kentucky's own corporation tax system. Allows companies to calculate deductions from their taxable income based on a percentage of the gross income derived from mining or drilling for natural resources. Under normal income-tax treatment, producers would recover investment costs over time as resources are depleted. In the case of percentage depletion, the sum of deductions can exceed the actual cost of investment.	1954	EXTRACT	ANTCOAL	KY	21,411	20,253	20,253	20,253	358,291

Program Description	Start Date	Fuel Cycle Stage	Fuel Category*	State	2015 Revenue Loss	2016 Revenue Loss	2017 Revenue Loss	2018 Revenue Loss	Revenue Loss during Period of PJM Capacity Auctions (2007-18)
Coal Incentive Tax Credit. Can be claimed by any eligible electric-power company or entity operating coal-fired electric generation plants, alternative fuel facilities, or gasification facilities. The tax credit amounts to USD 2 per short ton of coal purchased in excess of the amounts purchased in a reference year. The eligible quantities of coal must be used to generate electric power or used as feedstock in an alternative fuel facility or a gasification facility.	2000	GENER	ANTCOAL	KY	23,725	20,253	19,675	19,096	243,360
Thin Seam Tax Credit. Allows mining companies operating in the state to get a tax credit for coal mined from thin seams or from areas with a high overburden ratio. The credit is on a sliding scale from 2.25% to 3.75% of the value of the severed coal and based on the thickness of the seam, the ratio of overburden removed to coal severed, and the sulphur content of the coal.	2000	EXTRACT	ANTCOAL	KY	13,309	12,731	13,309	13,309	215,181
Sales Tax Incentive for Alternative Fuel or Gasification Facilities. Exempts eligible taxpayers from the sales taxes paid on tangible personal property used in the process of constructing an alternative fuel or gasification facility (all related to coal).	2008	REFIN	BITCOAL	KY	-	-	-	-	4,305,929

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Program Description	Start Date	Fuel Cycle Stage	Fuel Category*	State	2015 Revenue Loss	2016 Revenue Loss	2017 Revenue Loss	2018 Revenue Loss	Revenue Loss during Period of PJM Capacity Auctions (2007-18)
Sales Tax Incentive for Alternative Fuel or Gasification Facilities. Exempts eligible taxpayers from the sales taxes paid on tangible personal property used in the process of constructing an alternative fuel or gasification facility (all related to coal).	2008	REFIN	ANTCOAL	KY	-	-	-	-	70,393
Coal Transportation Expense. Values used for calculating taxes and royalties due allow deduction of transportation expenses incurred to move coal from mine to a processing plant, loading point, or customer.	1978	TRANS	BITCOAL	KY	-	-	-	-	110,637,409
Coal Transportation Expense. Values used for calculating taxes and royalties due allow deduction of transportation expenses incurred to move coal from mine to a processing plant, loading point, or customer.	1978	TRANS	ANTCOAL	KY	-	-	-	-	1,521,009
Gross-Receipts Tax Exemption for Sales of Natural Gas. Sales of natural gas by regulated companies in Pennsylvania are exempted from the gross receipts tax normally levied on most sales by utilities. This exemption was introduced in January 2000 to reduce the gas bills of Pennsylvania consumers.	2000	END	NATGAS	PA	-	-	-	-	108,000,000
Reduced Tax for Thin-Seamed Coal. Coals seams with a thickness of less than 45 inches pay a 1-2% severance tax instead of the normal rate of 5%. Only new underground mines may	1997	EXTRACT	BITCOAL	WV	60,000,000	60,000,000	-	-	516,000,000

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Program Description	Start Date	Fuel Cycle Stage	Fuel Category*	State	2015 Revenue Loss	2016 Revenue Loss	2017 Revenue Loss	2018 Revenue Loss	Revenue Loss during Period of PJM Capacity Auctions (2007-18)
qualify for this reduction.									
Coalbed Methane Exemption. WV exempts coalbed-methane wells placed in service after 1 January 2000 from the state's severance tax (5% of the gross value of severed coalbed methane). This exemption can be used for five consecutive years and is meant to encourage the capture and use of coalbed methane. Subsequent legislation added a provision making the exemption only applicable to coalbed-methane wells placed in service before 1 January 2009. Qualifying wells can, however, continue to use their five year exemption provided they were placed in service before 1 January 2009.	NR	EXTRACT	NATGAS	WV	-	-	-	-	15,000,000
Exclusion of Low Volume Oil & Gas Wells. WV wells producing less than one-half barrel per day or less than 5,000 cubic feet per day are exempted from the state's severance tax (5% of the gross value of severed oil and gas). A similar exemption also applies to natural gas provided for free by producers to surface land owners.	2000	EXTRACT	NATGAS	WV	4,373,252	4,373,252	-	-	49,313,831

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Program Description	Start Date	Fuel Cycle Stage	Fuel Category*	State	2015 Revenue Loss	2016 Revenue Loss	2017 Revenue Loss	2018 Revenue Loss	Revenue Loss during Period of PJM Capacity Auctions (2007-18)
Exclusion of Low Volume Oil & Gas Wells. WV wells producing less than one-half barrel per day or less than 5,000 cubic feet per day are exempted from the state's severance tax (5% of the gross value of severed oil and gas). A similar exemption also applies to natural gas provided for free by producers to surface land owners.	2000	EXTRACT	CRUDEOIL	WV	126,748	126,748	-	-	1,686,169
Industrial Expansion and Revitalization Credit. Eligible companies operating in West Virginia with a tax credit worth 10% of certain qualifying investment expenditures in both real and tangible property. Since 2003, has applied only to power sector; state data indicates it is mostly going to coal utility modernization and pollution control.	NR	GENER	BITCOAL	WV	45,000,000	45,000,000	-	-	270,000,000
Realty-Transfer Tax Exemption for Resource Leases. Transfers of leases for the extraction of oil, natural gas, coal, and minerals in Pennsylvania are exempted from the state's realty transfer tax. The realty transfer tax is a stamp tax levied on all transactions of interests in real estate. No data located by OECD.	NR	EXTRACT	NATGAS	PA	-	-	-	-	No data

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Program Description	Start Date	Fuel Cycle Stage	Fuel Category*	State	2015 Revenue Loss	2016 Revenue Loss	2017 Revenue Loss	2018 Revenue Loss	Revenue Loss during Period of PJM Capacity Auctions (2007-18)
Realty-Transfer Tax Exemption for Resource Leases. Transfers of leases for the extraction of oil, natural gas, coal, and minerals in Pennsylvania are exempted from the state's realty transfer tax. The realty transfer tax is a stamp tax levied on all transactions of interests in real estate. No data located by OECD.	NR	EXTRACT	CRUDEOIL	PA	-	-	-	-	No data
Realty-Transfer Tax Exemption for Resource Leases. Transfers of leases for the extraction of oil, natural gas, coal, and minerals in Pennsylvania are exempted from the state's realty transfer tax. The realty transfer tax is a stamp tax levied on all transactions of interests in real estate. No data located by OECD.	NR	EXTRACT	BITCOAL	PA	-	-	-	-	No data
Coal Waste Removal Tax Credit. In effect through 2012. Tax credit encouraged investment in facilities that produce fuels from coal and coal dust. OECD was unable to get data, though budget documents indicated only a few facilities benefits. Credit was capped at $18m/year.	1971	EXTRACT	BITCOAL	PA	-	-	-	-	No data
Sales of Electricity. The West Virginia Tax Code exempts the sales of electricity from the Consumers Sales and Service Tax due to the Business and Occupation Tax on businesses providing electricity.	NR	END	ELECTR	WV	150,000,000	150,000,000	-	-	1,370,700,000

Program Description	Start Date	Fuel Cycle Stage	Fuel Category*	State	2015 Revenue Loss	2016 Revenue Loss	2017 Revenue Loss	2018 Revenue Loss	Revenue Loss during Period of PJM Capacity Auctions (2007-18)
Where a provision benefits multiple fossil fuels, OECD will include allocated shares for each one as separate line items in their database in order to facilitate fuel-specific totals.* ***Key:* *Start Date: "NR" = not reported within OECD database; Fuel Cycle Stage: "EXTRACT" = extraction; "GENER" = power generation; "END" = end-use/point of consumption.* ***Source:*** *Data extract from Organisation for Economic Cooperation and Development, Inventory of Support Measures for Fossil Fuels, 2018.*									

Table A.3. Direct Outlays to Fossil Fuels by State Governments in the PJM Region

Program Description	Start Date	Fuel Cycle Stage	Fuel Category	State	2015 Revenue Loss	2016 Revenue Loss	2017 Revenue Loss	2018 Revenue Loss	Revenue Loss during Period of PJM Capacity Auctions (2007-18)
Department for Energy Development and Independence	2006	EXTRACT	ANTCOAL	KY	7,777	7,850	7,182	7,229	200,043
Department for Energy Development and Independence	2006	EXTRACT	BITCOAL	KY	1,111,053	1,121,469	1,026,071	1,032,684	17,046,378
Department for Energy Development and Independence	2006	EXTRACT	COKCOAL	KY	225,169	227,280	207,947	209,287	2,909,096
Coal Academy Mining Workforce Development	2006	EXTRACT	ANTCOAL	KY	17,360	17,360	17,360	17,360	353,308
Coal Academy Mining Workforce Development	2006	EXTRACT	BITCOAL	KY	2,480,030	2,480,030	2,480,030	2,480,030	30,029,712
Coal Academy Mining Workforce Development	2006	EXTRACT	COKCOAL	KY	502,610	502,610	502,610	502,610	5,616,977
Mine Safety and Licensing	NR	EXTRACT	ANTCOAL	KY	63,092	60,855	58,347	58,071	1,487,586
Mine Safety and Licensing	NR	EXTRACT	BITCOAL	KY	9,013,140	8,693,661	8,335,297	8,295,865	121,561,614
Mine Safety and Licensing	NR	EXTRACT	COKCOAL	KY	1,826,630	1,761,884	1,689,256	1,681,265	23,111,555

Source: Data extract from Organisation for Economic Cooperation and Development, *Inventory of Support Measures for Fossil Fuels*, 2018.

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