No. 12-4

In the Supreme Court of the United States

METROPOLITAN EDISON COMPANY AND
PENNSYLVANIA ELECTRIC COMPANY,
Petitioners,

v.

PENNSYLVANIA PUBLIC UTILITY COMMISSION,
Respondent.

On Petition for a Writ of Certiorari to the Commonwealth Court of Pennsylvania

MOTION FOR LEAVE TO FILE BRIEF AS *AMICI CURIAE* IN SUPPORT OF PETITIONERS AND BRIEF OF ELECTRICAL ENGINEERS, SCIENTISTS, AND ECONOMISTS AS *AMICI CURIAE* IN SUPPORT OF PETITIONERS

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August 1, 2012

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MOTION FOR LEAVE TO FILE BRIEF AS *AMICI CURIAE*

Movants electrical engineers, scientists, and economists respectfully move for leave to file the attached brief as *amici curiae*. Petitioners have consented to filing this brief; respondents have not.

Movants are specialists in electricity, electricity markets, and the operation of electric power systems. Movants have a professional interest in and have played a significant role in the development and maintenance of electrical markets throughout the world, particularly North America. Some of the movants contributed to the development of the design of the specific market at issue in this case.

For the above reasons, movants respectfully request that this motion be granted.

Respectfully submitted,

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QUESTIONS PRESENTED

1. Whether, contrary to a decision of the Fifth Circuit, the Federal Power Act and filed rate doctrine permit a state public utility commission to deny recovery of FERC-mandated charges by classifying those costs differently from the entity responsible for administering the federal tariff on the ground that the tariff and FERC's orders do not "unambiguously" or "explicitly" foreclose the State's chosen classification.

2. Whether, contrary to a decision of the D.C. Circuit, "transmission line losses" reflect the costs of generating electricity rather than the costs of transmitting it.

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INTEREST OF *AMICI CURIAE*

Amici curiae[1] are electrical engineers, scientists, and economists specializing in the study of electricity, electricity markets, and the operation of electric power systems. *Amici* have a profound interest in and have played a significant role in the development of electrical markets throughout the world, particularly North America. Some of the *amici* contributed to the development and design of the specific market at issue in this case, the PJM Interconnection, known for its economic logic and efficient operations.

In this brief, *amici* demonstrate that scientific and engineering principles that underlie the Federal Power Act conflict with the decision below of the Commonwealth Court of Pennsylvania, which affirmed the decision of the Pennsylvania Public Utility Commission (Pennsylvania PUC). *Amici* also explain that the Pennsylvania PUC's unauthorized incursion into regulatory domain governed by the Federal Energy Regulatory Commission (FERC) destabilizes the federally regulated market for electricity.

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[1] The names and relevant qualifications of *amici curiae* are set forth in the Appendix, bound with this brief. *Amici curiae* appear here in their individual capacities as engineers, scientists, and economists, rather than as representatives of the institutions with which they may be affiliated, and no *amici* are affiliated with or otherwise employed in any capacity by petitioners. No counsel for any party authored this brief in whole or in part, nor did any party make a monetary contribution to the brief.

Petitioners consented to the filing of this brief. Pursuant to Rule 37.2, counsel of record for all parties received notice of *amici's* intent to file this brief at least 10 days prior to the due date for *amicus curiae* briefs.

INTRODUCTION

In the Federal Power Act (Act), 16 U.S.C. §§ 824 *et seq*., Congress allocated regulatory jurisdiction over electric energy along lines drawn, in effect, by electrical engineers, granting exclusive federal jurisdiction over "the *transmission* of electric energy in interstate commerce," 16 U.S.C. § 824(b)(1) (emphasis added), and reserving for the states jurisdiction over "facilities used for the *generation* of electric energy or over facilities used in local distribution." *Id.* (emphasis added).

The Act's separation of federal regulation of transmission from state regulation of generation is grounded in the science of electricity and has permitted FERC to consolidate much of the nation's electric energy infrastructure into regional wholesale markets. Over the past sixteen years FERC has guided these markets in perfecting the efficient operation and pricing of interstate transmission on the basis of open and non-discriminatory access, which this Court affirmed in *New York v. FERC*, 535 U.S. 1 (2002).

SUMMARY OF THE ARGUMENT

In the Act, Congress demarcated a line between state and federal jurisdiction over the electrical power industry. States regulate "generation," while the federal government regulates "transmission." *See* 16 U.S.C. § 824(b)(1). This Court has recognized that the boundary between these two regulatory domains is determined by scientific and electrical engineering principles. *See Conn. Light & Power Co. v. FPC*, 324 U.S. 515, 529 (1945); *FPC v. Fla. Power & Light Co.*,

404 U.S. 453, 467 (1972). *Amici's* concern here is that by jettisoning those principles, the Commonwealth Court and Pennsylvania PUC have made the efficient design and regulation of federally regulated wholesale electricity markets impossible.

The decision below misclassifies transmission losses as a cost of "generation." This misapprehends the basic physics of the flow of electricity. As we explain, transmission losses are losses of useful energy converted to heat, an inevitable consequence of long-distance transmission over wires. These losses are a component cost of transmission, completely independent of "generation." Because these losses result as a matter of physics from transmission, not generation, it follows that federal, not state, regulatory authority governs whether these losses can and should be recovered from retail customers in federally determined transmission rates.

In removing transmission losses from FERC-regulated wholesale transmission rates and transferring them for recovery (if at all) in state-regulated retail rates for generated energy—a protectionist result that shifts costs from Pennsylvanians to non-Pennsylvanians—the decision below distorts the well-developed mathematical model that determines the cost of electricity in federally regulated wholesale markets. This mathematical model, known as locational marginal pricing, or LMP, takes into account engineering and economic principles inherent in the efficient flow of electric energy over a large-scale system such as the interstate transmission grid.

ARGUMENT

I. THE DECISION BELOW IS ERRONEOUS BECAUSE TRANSMISSION LOSSES ARE TRANSMISSION COSTS UNDER THIS COURT'S "ENGINEERING AND SCIENTIFIC TEST"

This Court has long held that questions of jurisdiction under the Act turn in large measure on principles of science and electrical engineering. Congress wrote the Act "in the technical language of the electric art" and decreed that "[f]ederal jurisdiction was to follow the flow of electric energy, an engineering and scientific, rather than a legalistic or governmental, test." *Conn. Light & Power Co. v. FPC*, 324 U.S. 515, 529 (1945). Here, as in so many previous cases, it should be an "'engineering and scientific test' that controls this case." *FPC v. Fla. Power & Light Co.*, 404 U.S. 453, 467 (1972).

The court below deferred to the Pennsylvania PUC's interpretation of "transmission costs" as excluding transmission losses "because such costs are not incurred directly or indirectly to provide transmission service. Rather, line loss costs [that, is transmission costs] represent the generation-related costs associated with losses of energy." Pet. App. 18a.

Under this Court's "engineering and scientific test," the court below erred. The physics of electric energy transmission compel this conclusion.

When electric energy is generated and consumed at the same location, there are no losses because there is no transmission of energy. Losses of energy during

transmission are caused by energy heating the transmission wire, *thereby causing energy to be lost as heat* and unavailable to be delivered to consumers as useful electric energy. Referred to as I^2R losses or copper losses, these losses occur within the transmission system and are a product of the same physical principles that underlie the conversion of electric energy to useful thermal energy, such as in the glowing coils of an electric heater or electric pot. The difference is that in the transmission of electric energy the thermal energy performs no useful function and is considered a loss, while in an electric pot that same thermal energy supplies useful work; it makes coffee.

More than 150 years ago, James Prescott Joule developed the equation that expresses the relationship between energy lost to heat and the current that flows through a conductor, such as a transmission wire. Joule's first law ($L=I^2R$) states that the energy lost each second increases as the square of the current flowing in the transmission line and in proportion to the electrical resistance of the conductors. In other words, losses that occur in the transmission of electric energy are a function of the current flowing in the wire and the resistance of the wire. The court below failed to recognize that if one changes the electrical characteristics of the transmission wires that comprise the grid, then the losses change. If one reduces the current in the wire, then the losses decline by the square law. If one increases the current in the wire, then the losses increase by the square law. What is lost is energy. But it is the characteristics of the interconnected transmission system as a whole that determine the losses.

As transmission losses increase, additional energy must be generated to make up for the losses to meet consumer demand. The fact that the marginal cost of transmission losses can be measured as the marginal cost of replacement energy says nothing about whether the losses are a physical function of transmission or generation. That simply tells us how we can place a dollar valuation on transmission losses commercially. Transmission losses occur in the transmission system regardless of whether the magnitude of the losses is measured in physical units of energy or in the cost of replacing those lost units of energy. Without science, the Pennsylvania PUC presumed oppositely — that a commercial measure of losses determines their cause — and from that false premise fell into the conclusion that since the "price of losses is related to [i.e., can be measured by] generation," losses must be a cost of generation and not transmission. Pet. App. 58a.

This series of non-sequiturs makes a hash of the physical realities, quantified in Joule's first law, that create those losses. Losses occur in the transmission wires, and the quantity of losses is a function only of the current in those wires and the resistance of those wires. Based on these physical realities, economists developed LMP to charge each transmission user all of the costs of transmission service, including marginal transmission losses, but nothing more.

II. THE DECISION BELOW DISTORTS PRICING AND INVITES PROTECTIONIST RETALIATION FROM OTHER STATES

Pennsylvania is part of an electrical market operated by PJM Interconnection, LLC (PJM). PJM is the largest wholesale power market in the world. It

includes at least parts of thirteen states stretching from Washington, D.C. to Chicago. PJM "manages an electric wholesale market in this area and is responsible for interstate transmission within and through it." *Atl. City Elec. Co.* v. *PJM Interconnection, LLC*, 115 FERC ¶ 61,132, 61,473, *order on reh'g*, 117 FERC ¶ 61,169 (2006). Market participants in PJM operate according to a FERC-approved tariff.

PJM, along with all other FERC-authorized wholesale power markets,[2] uses LMP, a precise pricing scheme. As implemented through LMP, PJM comprises over 13,000 electrical nodes or buses. LMP calculations at each node or bus incorporate all of the economic information, including the marginal cost of transmission losses, that enables the market to provide correct and optimal price signals to all market participants. LMP informs investors where and when to build generating capacity, generation operators when and how much energy to generate, and wholesale purchasers, such as petitioners, how much generation and transmission to procure.

Petitioners correctly explain that in 2007 PJM incorporated the cost of marginal transmission losses into its calculation of LMP. Pet. 8-9. Central to *amici*'s support of petitioners is our opinion that PJM's current treatment of marginal losses in the calculation of LMP provides consistent and optimal price signals

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[2] Other FERC-authorized, organized wholesale power markets are the ISO-New England (ISO-NE), the Midwest Independent System Operator (MISO), New York ISO (NYISO), California ISO (CAISO), and the Electric Reliability Council of Texas (ERCOT). Southwest Power Pool (SPP), in addition, recently proposed to adopt LMP.

that markets such as PJM require to operate efficiently from both an economic and an engineering perspective. If the decision of the Pennsylvania PUC stands, then PJM will no longer be able to operate consistently in this highly efficient manner, and FERC will cease to be the single and consistent decision maker for interstate transmission pricing in wholesale power markets.

The court below's misclassification of transmission losses carves the Commonwealth out of the underlying logic of LMP around which the multistate PJM market is organized under the Act. The adverse consequences of carving Pennsylvania out of LMP are likely to be far reaching. Price signals indicating where and when to locate and how much to invest in generation and transmission will be distorted, as will be decisions on where and when to buy wholesale power.

In addition, Commonwealth utilities, such as petitioners, will not be able to recover from Pennsylvania ratepayers their cost of transmission losses, while other utilities in PJM will recover those costs in LMPs. Petitioners will either have to absorb the cost of transmission losses or, if possible, *shift those costs to other ratepayers outside of Pennsylvania.* Absent uniform rates for transmission losses on a going-forward basis, neighboring jurisdictions likely will be induced to retaliate by taking similarly protectionist steps to block the pass-through of the cost of losses in transmission charges. Cost recovery *per se* is the concern of others, such as Petitioners, not ours. Our concern lies elsewhere in the critical importance that, now and going forward, each transmission user sees in the LMP all of the cost elements of the

transmission service, including the marginal cost of losses.

Because transmission of electric energy is inherently interstate, Congress granted FERC "exclusive authority to regulate the transmission and sale at wholesale of electric energy in interstate commerce." *New England Power Co.* v. *New Hampshire*, 455 U.S. 331, 340 (1982). With this Court's affirmation, FERC has exercised that jurisdiction to promote organized markets, such as PJM, to operate on an open-access and non-discriminatory basis in the interest of all consumers of transmission services, without provincial favoritism of one group of customers at the expense of another. The decision below, as Petitioners argue, is inconsistent with FERC's exclusive jurisdiction. It does violence to the science of electricity and the efficient operation of wholesale markets organized around the logic of LMP. It should be reviewed and reversed.

CONCLUSION

For the reasons explained above and by petitioners, this Court should grant the petition for a writ of certiorari.

Respectfully submitted,

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APPENDIX

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Judith Cardell, **Ph.D.**, Associate Professor of Engineering and Computer Science, Smith College; Adjunct Researcher, The Power Systems Engineering Research Center.

Charles Cicchetti, Ph.D., Co-Founder and Senior Advisor to Pacific Economics Group; former Chair, Wisconsin Public Service Commission; former Jeffrey Miller Chair of Government, Business and the Economy, University of Southern California.

Peter Cramton, **Ph.D.**, Professor of Economics, University of Maryland; Author of widely-cited research on auctioning its applications to radio spectrum, electricity, financial securities, diamonds, timber and other products.

Philip Q. Hanser, **Ph.D.**, Principal, The Brattle Group, an economic and financial consulting firm; Adjunct Lecturer, Kennedy School of Government, Harvard University; former Program Manager, Electric Power Research Institute.

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James L. Kirtley, **Ph.D.**, Professor of Electrical Engineering, MIT; Member, National Academy of Engineering; Author of the textbook *Electric Power Principles: Sources, Conversion, Distribution and Use* (Wiley, 2010).

Ralph D. Masiello, Ph.D., Fellow, Institute of Electrical and Electronics Engineers (IEEE); 2009 recipient of the IEEE Power Engineering Society Concordia Award; Member, US Department of Energy, Energy Advisory Committee; Member, National Academy of Engineers; Senior Vice President, DNV KEMA for Innovation.

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