



Research and strategy for the land community.

To: Maya K. van Rossum, Delaware Riverkeeper
From: Spencer Phillips, Ph.D., Economist & Principal
Date: July 23, 2018
Subject: Economic Issues related to FERC Policy Regarding Certification of Interstate Natural Gas Pipelines, and FERC Docket No. PL18-1-000

Based on my and my colleagues' analyses of several recent pipeline projects, it is well—and long overdue—that the Federal Energy Regulatory Commission (hereinafter “FERC” or “the Commission”) is examining its policy regarding Certification of New Interstate Natural Gas Facilities (Docket No. PL18-1-000). Key-Log Economics is pleased to provide this expert review and comment on the existing certification policy and its application to date. We pay particular attention to the extent to which the Commission’s past evaluations and certification decisions have adequately considered the economic consequences of the construction, presence, and operation of interstate natural gas pipelines.

Our question is whether the Commission’s policy—as stated or as implemented—typically results in economically sound outcomes in which the public benefits delivered by new interstate natural gas transmission pipelines are likely to exceed the costs imposed on the public. Based on our independent review of several recent proposed pipelines and expansion projects¹ this is a very real and profound concern. Despite the stated intention of FERC’s existing policy on “Certification of New Interstate Natural Gas Pipeline Facilities”, namely, that projects “would be approved only where the public benefits to be achieved from the project can be found to outweigh the adverse effects” (88 FERC ¶ 61,227), the answer to our question is simply “no”: we find no evidence to date that either the Commission’s existing policy and its current practice are adequate to ensure the development of an interstate natural gas transportation system in which the public benefits exceed the public costs.

In particular and as detailed below, it is our observation that:

1. The Commission has not adequately assessed the potential public benefits from proposed interstate natural gas pipelines. It instead relies on the claims of projected benefits advanced by project applicants that, in turn, are based on outdated methods that are proven to be useless, at best, for making such projections. The Commission has not conducted its own expert, critical review of these claims, and this leaves the Commission’s decisions subject to the same bias inherent in applicants’ representations regarding their projects’ benefits.
2. The Commission has failed to evaluate the full economic effects, especially external costs—that is, costs borne by third parties like nearby landowners, businesses impacted by pipeline construction and operation, and the general public—of proposed interstate natural gas pipelines. Similar to its lack of due diligence regarding benefit claims, the Commission relies on information about costs that are provided by pipeline applicants and other industry stakeholders, such as the Interstate Natural Gas Association of America (INGAA). Not surprisingly, these vested interests promote the view that proposed pipelines and other projects would result in no damage to natural resources, no

¹ These include the proposed Atlantic Coast, Mountain Valley, PennEast, and Atlantic Sunrise pipelines, and the Millenium Eastern System Upgrade. Examples referenced in these comments are drawn primarily from these cases.

associated economic costs, and no adverse economic effects on the “surrounding communities” that are among the stated interests of FERC’s policy (88 FERC ¶ 61,227, p. 24).

A contributing factor to both of these failures is the Commission’s lack of capacity even to critically review and evaluate the economic information the Commission does receive, let alone to conduct analyses of its own. The Office of Energy Projects (OEP), whose “mission...is to foster economic and environmental benefits for the nation through the approval and oversight of hydroelectric and natural gas pipeline energy projects that are in the public interest”² has no economists among its staff.³ The Office of Energy Policy and Innovation, which otherwise collaborates with various FERC offices to evaluate industry proposals, reportedly does not support OEP in the form of economic review and analysis of pipeline certification projects.⁴ The Commission has, in effect, been flying blind with regard to the critical question of whether its actions in approving new pipelines does or does not meet the “economic test” it sets in the current policy.

Furthermore, and as suggested in the Notice of Inquiry, both the state of the natural gas industry and the state of knowledge regarding the impacts of natural gas exploration, development, transmission, and end use have changed since 1999. Just last month, for example, the journal *Science* reported findings that methane emissions along the U.S. supply chain are 60% higher than previous US Environmental Protection Agency (EPA) estimates had indicated (Alvarez et al., 2018). This makes the oft-repeated (but seldom examined) claim by industry representatives and government officials that increased natural gas transmission capacity will help solve climate change problems even more suspect. Without countervailing measures to control leaks, the construction and use of additional pipeline capacity will cause methane emissions to increase. Given that the global warming potential (GWP) of methane is approximately 30 times that of carbon dioxide, any fuel switching to natural gas encouraged by new transmission capacity could actually exacerbate, rather than mitigate climate change.

In short, the review of the 1999 policy is greatly needed and, one hopes, will result in upgrades in FERC policy, capacity, and practice that make it more likely that the benefits of natural gas transmission and use will outweigh the costs of that system.

I will conclude this review with a summary of our findings related to several pipeline projects. I will begin, however, by laying out a framework, grounded in standard neoclassical resource economics (NRE), against which to compare those examples and on which those upgrades should be based.

Ecological economics would provide a broader, more modern, approach to these questions. This transdiscipline includes the efficiency concerns of NRE, but adds considerations of equity/justice, as well as sustainable scale and puts them on an equal footing with efficiency (Daly & Farley, 2011). Equity does get some mention in the current policy. It comes in the form of concern for impacts of new pipelines on existing pipeline/natural gas customers and on current shippers. And some Environmental Impact Statements (EISs) have mentioned environmental justice concerns raised by members of the public. The Commission, however, has not been proactive or systematic in evaluating the distribution of impacts, positive and negative, of proposed interstate natural gas transmission pipelines. Such an evaluation would take into account whether negative impacts disproportionately affect minority,

² Federal Energy Regulatory Commission. (2017, February 21) Office of Energy Projects (OEP), “What we do.” Retrieved from <https://www.ferc.gov/about/offices/oep.asp>.

³ Federal Energy Regulatory Commission. (2017, February 3). 2017 Employee Phone Directory. Retrieved from <https://www.ferc.gov/contact-us/tel-num/phone.pdf>.

⁴ Personal communication with OEPI’s Administrative Officer. (2017, March 17).

low-income, or otherwise vulnerable populations. And if there are cases in which overall expected benefits outweigh overall expected costs (thus passing an efficiency test), the Commission's process should include a thorough evaluation of who would reap the the benefits and who would bear the costs. The Commission, furthermore, should require mitigation payments from the applicants and ensure that those payments are distributed in a way that equitably offsets the costs borne by various communities within the broader category of "the public."

Scale gets only a faint nod in that the Commission does weigh the "need" for new capacity, but that consideration begins and ends with the question of whether the applicant has identified customers for the gas it would transport in the proposed pipeline. There is no indication in the policy or in individual cases that FERC has concerned itself with the more important question of whether the transmission system is of *sustainable* scale. That is, the Commission has not attempted to determine whether proposed pipeline capacity is needed to make the overall system more efficient or effective in delivering natural gas to important markets. Indeed, in rejecting pleas to conduct regional environmental analyses, such as in the case of the Atlantic Coast and Mountain Valley Pipelines, FERC has likely missed opportunities to avoid a scenario in which further system buildout results in overcapacity in the transportation system and/or overuse of natural gas in general.

Market Failure: Pipeline Externalities

It is a firmly established economic principle that a change in economic organization—in the case at hand, this would be a change in land use/management—that leaves some people better off while harming others can still be said to be worth doing if it is at least hypothetically possible for those who gain to compensate those who lose as a result of the change. The reason is that the change produces a net benefit across all of human society. If one considers economic justice as well as overall welfare, then we would require that the compensation not only be hypothetical, but that it actually be paid so that those who lose something due to the change can at least receive the cash equivalent of what they have lost.

Setting aside for the moment the obvious question of whether any and all types of human suffering, including changes in physical, psycho-social, or cultural well-being could or should be assumed to have a monetary equivalent, this compensation principle provides a sound conceptual rationale for mitigating the adverse impacts of actions such as pipeline certification and subsequent construction and operation of pipelines. It also suggests the scope and scale of the compensation that should be paid if the change is to be deemed both efficient and just.

In the case of the natural gas transmission pipelines, those potentially gaining from increased pipeline capacity may include gas shippers who could pay less to move natural gas to market, the pipeline owners who will receive compensation for building and operating pipelines based on market and non-market processes (i.e. guaranteed rates of return), and, at least hypothetically, energy consumers. Pipeline applicants and their surrogates also often promise broader economic benefits in the form of jobs and income due to pipeline construction as well as further employment, income, and economic output stimulated by lower energy prices.⁵

⁵ As noted below, it is not at all clear that pipeline capacity translates into either lower energy prices or that any downstream or "multiplier" effects stimulated by additional capacity exist outside the realm of theory and promoters' wishful thinking.

Those suffering losses due to expanded natural gas pipeline transmission capacity include those “three interests” enumerated in existing FERC Policy: natural gas customers, owners of competing pipelines, and “landowners and communities affected by the proposed project” (FERC Docket No. PL99-3-000).

I do not wish to diminish the importance of the certification policy to first two of those interests, but effects on customers and competitors are “merely” financial. Customers may suffer if regulated rates exceed rates just sufficient to just cover pipeline operators costs. In other words, if regulated rates result in end-of-pipe natural gas prices that include a subsidy to the operators in addition to a price that covers the market costs of producing and delivering the gas to the end of the pipe, customers will suffer real financial harm. Competitors might lose some customers and revenue and, in the extreme, could be forced out of business by the operation of the new pipeline. Assuming there is no bias against existing pipelines’ operators, such “market discipline” is what one would normally expect, with the more efficient or lower cost firms ending up with a greater share of the market.

Both of these types of impact may represent economic inefficiency, including the costs of a landscape littered with pipeline corridors abandoned by bankrupt firms. It does seem at least possible, however, such concerns could be addressed through other of the Commission’s process. For example, if the Commission were to assess the need for additional pipelines systematically and at appropriate regional scales, problems of overcapacity leading to abandoned pipelines could be avoided. (This is the question of scale alluded to above.) In addition, the Commission’s rate setting process could be more carefully executed to ensure that operators are not permitted to garner excess profits at the expense of customers. If pipeline operators (and their investors) can expect only normal rates of return, there would be fewer incentives to propose, build, and operate unnecessary pipelines in the first place.

It is the third interest—of communities affected by pipelines built through them—that raises the more important economic questions regarding the certification of new natural gas pipelines. The reason is that the construction, presence, and operation of pipelines will impose “external costs” on members of those communities. External costs, also known as “negative externalities” are costs associated with a transaction imposed on individuals and entities who are not a party to the transaction. In this case the transaction is selling natural gas, which entails all of the activities associated with exploration, development, transportation, and use of natural gas. The negative externalities associated with transporting natural gas via the pipelines under FERC jurisdiction would include the following:

- The loss of physical use of/access to land occupied by pipeline rights of way;
- Diminished productivity of the land within or proximate to rights of way. Such land could otherwise be used (or used more effectively) for producing timber, crops, recreation services, clean water supply, erosion control, and other important ecosystem services
- A loss of physical and psychological well-being due to health and safety concerns imposed by the presence and operation of pipelines, compressor stations, and other infrastructure on one’s land or in one’s community;
- A loss of psychological well-being due to damage to home places, familiar landscapes, and cultural traditions associated with the use and enjoyment of those landscapes;
- Diminished local/regional economic activity as recreationists and tourists make decisions to spend their leisure and vacation time in locales without pipelines and, therefore, perceived to be safer and/or more aesthetically attractive, and/or more valuable for pursuits ranging from hunting and fishing, to bird watching, hiking, driving for pleasure, and others.

- Along similar lines, decisions by retirees, entrepreneurs, telecommuters and others who can locate where they want and who choose locations perceived to be safer and with more intact natural landscapes
- Accelerated climate change and associated secondary losses of ecosystem services due to the upstream and downstream effects of methane and carbon dioxide emissions
- Delayed transition to more sustainable, renewable, and increasingly lower-cost energy sources.

(These effects are of the sort that must be analyzed in order to comply with the National Environmental Policy Act (NEPA), regulations for which state that

Effects include ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative. Effects may also include those resulting from actions which may have both beneficial and detrimental effects, even if on balance the agency believes that the effect will be beneficial (36 CFR 1508.b.)

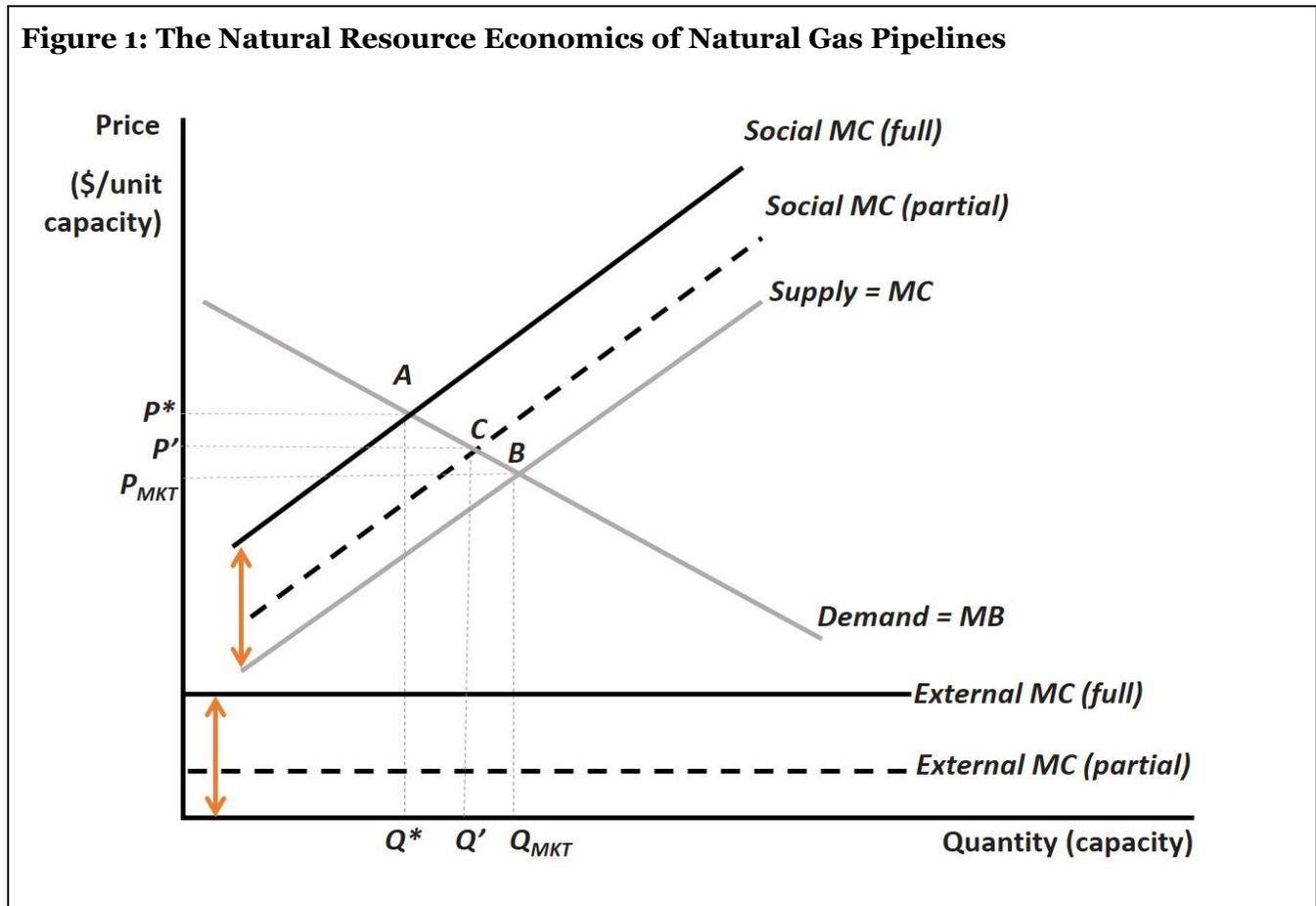
The costs associated with these effects can be measured as lost property value, higher insurance premiums, lost revenue for recreation and tourism businesses, employment and income forgone when businesses, retirees, and mobile workers choose to locate elsewhere, lost productivity in agriculture and forestry, higher costs to provide clean drinking water, flood and erosion control and other services that intact natural landscapes would otherwise provide for free⁶, and the diminution of human welfare (whether expressed in dollar-valued terms or not) of people living in constant fear of property loss, injury, or death due to pipeline accidents.

Figure 1, below, depicts presents the standard NRE view of such external costs, why they are “bad” for society, and how/where in the example at hand, the Commission could conceptualize cases in which “the public benefits to be achieved from the project can be found to outweigh the adverse effects” (88 FERC ¶ 61,227). The quantity of pipeline capacity is measured along the horizontal axis. The price per unit of capacity is measured on the vertical axis. Demand for pipeline capacity (also the marginal benefit, “MB”, of capacity) is shown by the downward-sloping grey line. It slopes downward because people get less additional benefit from the existence or use of each successive unit of capacity.⁷

The supply of pipeline capacity is the upward-sloping grey line. Supply is (generally) equal to firms’ marginal cost of production—that is, it is the cost of bringing the last increment of pipeline capacity online and including all *private* costs (land acquisition, materials, labor, insurance, financing, etc.) associated with constructing and operating pipelines. This line is therefore labeled “Supply = MC”. Under ideal conditions, including a lack of any external costs (impacts on parties other than pipeline operators and users), net societal benefit from pipelines would be maximized where demand (marginal benefit to buyers/users) equals supply (marginal cost to producers/sellers), or at point “B” in the diagram. At this point, buyers value the increment of capacity at exactly the cost of producing the last

⁶ See Balmford, et al. (2010) for a full description of this framework that maps ecosystem processes (what happens in ecosystems that is of potential value to humans) to ecosystem benefits (the particular ways in which humans make use of or enjoy the results of what happens in ecosystems).

⁷ This is one of the reasons that it is important that the Commission evaluate the addition to system-wide capacity that each pipeline represents—cumulative impacts in other words—rather than as single, stand-alone pipelines. Otherwise, it will be impossible for the Commission to gauge whether the next pipeline will be push capacity beyond the point at which even market costs exceed benefits.



increment of capacity. The amount produced/used will be Q_{MKT} , and that amount will be sold/bought for P_{MKT} . These are the “market-clearing” quantity and price of pipelines.

External costs are depicted in the diagram by the horizontal black lines. The dashed black line depicts a subset of external marginal costs (“External MC (partial)”), such as the effects of pipelines on the owners of properties crossed by the pipeline right-of-way (ROW). The solid line depicts the full external costs (“External MC (full)”), including the impact on the value of land near, but not crossed by, the ROW, the monetary value of diminished production or availability of ecosystem services, the cost of greenhouse gas emissions—i.e., the social cost of carbon—and the monetary equivalent of the other external effects listed above.⁸

To arrive at a socially optimal level of pipeline capacity, one must add the external marginal costs to the private marginal costs to get the “Social Marginal Cost” of pipeline capacity and then compare the

⁸ To keep the diagram as simple as possible, I have depicted these as horizontal lines, implying that the external marginal cost (partial or full) of the first unit of pipeline capacity is the same as the external cost of the nth unit. In the real world, it is quite likely that marginal external costs will increase with capacity and will be nonlinear if there are threshold effects.

social marginal cost to the marginal benefits. In the diagram, adding the External MC (partial or full) to the private marginal cost (“Supply = MC”) at each quantity gives us the darker upward-sloping “Social MC” curves. When all external costs are taken into account, the efficient level of pipeline capacity is lower, and the corresponding price per unit of capacity is higher than would be the case if external costs are not considered.

In the diagram, this economically efficient level of production and consumption is at point “A” with Q^* units of capacity provided and sold at a price equal to P^* dollars per unit. For all units of capacity beyond Q^* —any units up to or beyond Q_{MKT} —the social cost of producing another unit of capacity is higher than the value society of that additional unit of capacity. In other words, the added capacity imposes external costs on society that are not worth the benefit derived from the the additional use.

This excess of social costs over social benefits is, in essence and in economic terms, a “market failure” that entails a “deadweight loss” to society. It is this market failure that the current Certification Policy has the potential to address. The policy requires that adverse effects of new pipelines on “economic interests of landowners and communities affected by the route of the new pipeline” be weighed against “evidence of public benefits to be achieved [by the pipeline]” ((FERC Docket No. PL99-3-000, pp. 18–19). Further, “...construction projects that would have residual adverse effects would be approved only where the public benefits to be achieved from the project can be found to outweigh the adverse effects” (p. 23).

Policy Failure: Pipeline Certification without Sufficient Economic Review

Relative to the need to address the market failure presented by the construction, presence, and operation of natural gas transmission pipelines, the Commission has not gathered, created, or adequately considered sufficient information related to the benefits, and, especially, the external costs of natural gas transmission pipelines to know whether or not benefits outweigh the adverse effects. In terms of Figure 1, the Commission does not know where on the quantity (capacity) axis the natural gas transmission system is and, therefore, whether any addition to total capacity would create or exacerbate the deadweight loss associated with new transmission pipelines. Thus, rather than addressing and attempting to correct the market failure stemming from pipeline externalities, the Commission has practiced serial policy failure that has undoubtedly increased the effects of the market failure.

Some of the Commission’s failure is rooted in the language of the current policy. The policy states, for example, “if project sponsors...are able to acquire all or substantially all, of the necessary right-of-way by negotiation prior to filing the application...it would not adversely affect any of the three interests,” which are pipeline customers, competing pipelines, and “landowners and communities affected by the route of the new pipeline” (88 FERC, para. 61,227, pp. 18, 26). The Commission’s policy contends that the only adverse effects that matter are those affecting owners of properties in the right-of-way. Even for a policy adopted in 1999, this contention is completely out of step with long-established understanding that development that alters the natural environment has negative economic effects at an individual, community, and broader population level. It ignores the vast majority of the external costs of pipelines described in the preceding section.

The policy's confusion over what counts as environmental effects (again, most of which will have economic effects) is further expressed by the following statement:

Traditionally, the interests of the landowners and the surrounding community have been considered synonymous with the environmental impacts of a project; However, these interests can be distinct. Landowner property rights issues are different in character from other environmental issues considered under the National Environmental Policy Act of 1969 (88 FERC, para. 61,227, p. 24).

By the Commission's reasoning, environmental effects are a matter of the Commission's "traditions," not science, and environmental effects are deemed to be both synonymous with, and distinct from, interests of landowners and the surrounding community. This statement seems to contradict the statement one page earlier in the policy that "[there] are other interests [besides those of customers, competitors, and landowners and surrounding communities] that may need to be separately considered in a certificate proceeding, such as environmental interests (p. 23)." While it is true that separate/additional consideration of environmental "interests" must indeed be part of the Commission's review, the policy embodies such a muddle of contradictions on the question of what impacts to examine and why (tradition versus science), that it seems unlikely that any pipeline certification granted under the policy would be scientifically or economically sound.

FERC's own policies and track record, including an over-reliance on applicants' own estimates of project benefits, make it extremely unlikely that the project certification process would meet requirements of the National Environmental Policy Act (NEPA) that agencies consider all project costs and benefits, let alone produce a decision that could be construed as generating or supporting net economic benefits.⁹

A further weakness of the FERC policy is that it relies on applicants to provide information about benefits and costs. The policy's stated objective "is for the applicant to develop whatever record is necessary, and for the Commission to impose whatever conditions are necessary, for the Commission to be able to find that the benefits to the public from the project outweigh the adverse impact on the relevant interests" (88 FERC, para. 61,227, p. 26). The applicant therefore has an incentive to be generous in counting benefits and parsimonious in counting the costs of its proposal. And as reflected in the DEIS at hand, FERC has made no effort itself to ensure a full accounting of economic costs to landowners or the broader community despite the wealth of comments placed on the docket that could support such an assessment. Under these circumstances, it seems unlikely that the Commission's policy will prevent the construction of pipelines for which the full costs are greater than the public benefits they would actually provide.

Given the weaknesses of the policy, and as evidenced by the track record, FERC's "economic test" does not provide a robust evaluation of the public merits of natural gas transmission projects. It is a "test" in which difficult questions (such as about external costs borne by all stakeholders) are not asked, and where those taking the test (the applicants) provide the answer key. It is therefore not surprising that FERC's environmental reviews typically have not provided estimates of the magnitude of the full

⁹ It is important to note that NEPA does not require that federal actions necessarily balance or even compare benefits and costs. NEPA is not a decision-making law, but rather a law requiring decisions be supported by an as full as possible accounting of the reasonably foreseeable effects of federal actions on the natural and human environment. It also requires that citizens have opportunities to engage in the process of analyzing and weighing those effects.

external costs associated with natural gas transmission pipelines. Also not surprising, pipeline applicants typically employ methods, assumptions, and a selective review of effects that result in a rosy and grossly distorted picture of the net benefits of their projects.

In the following sections, we review examples of these problematic benefit estimates and present, as examples, independent estimates of some of the external costs of recently proposed pipeline projects.

Pipeline Benefits are Often Overstated

In the course of research over several years, my colleagues and I at Key-Log Economics have evaluated the claims of potential economic benefit put forward by the applicants seeking certification of several pipelines, including the Atlantic Sunrise Pipeline (Docket No. CP15-138), Atlantic Coast Pipeline (Docket no. CP15-554), PennEast Pipeline (Docket no. CP-15-558), Mountain Valley Pipeline (Docket no. CP16-10), and the Millenium Pipeline's Eastern System Upgrade (Docket No. PF16-3). In one form or another, including in Resource Reports 5, applicants typically make some form of the following claims regarding the benefits of their projects:

1. Construction of the project will have significant positive economic impacts, including the "creation" of jobs and increases in personal income.
2. Operation of the project will also have significant positive economic impacts (again in the form of jobs and income).
3. The project will result in sustained, lower end-user costs for natural gas and/or for electricity generated in gas-fired power plants.
4. Project-stimulated reductions in energy costs will stimulate output, income, and employment in energy-intensive manufacturing and other sectors and, thereby, cause further positive economic impacts.

For the impacts of project construction and operation, as well as for impact stemming from lower energy prices, applicants typically present as their evidence projections generated from an quantitative "input-output" model, typically IMPLAN.¹⁰ Rooted in economic base theory, input-output models purport to translate an exogenous change in the economy—the "input," which in this case is spending on the operation of the pipeline, including employees' wages—into "output," which includes spending by the project's employees, by other firms, by their employees, and so on. Additional rounds of impact occur as the businesses where those households spend their wages (grocery stores, gas stations, physicians, etc.) pay suppliers and their own employees. With each round of spending, some money leaks out of the study region's economy in the form of spending on imported goods or wages paid to workers who reside outside the study region.

While intuitively satisfying, empirical input-output models like IMPLAN are built on a very restrictive set of assumptions about how each and every spending and/or each and every hiring decision in the entire economy is made. Namely, the models assume that spending decisions are made the way they have always been made, and if wages or demand for a product goes up, the only way households and firms can respond is by doing more of what they did in the past to meet demand. They follow the same recipe, but just increase the amount of each ingredient. Households buy a larger quantity of the same

¹⁰ See, for example, Chmura (2014), ICF International (2014), Ditzel et al (2015 a,b), Econsult Solutions & Drexel University School of Economics (2015), Concentric Energy Advisors (2016), and Blumsack & Kleit (2015)

mix of goods and services, and firms employ more labor, buy more raw materials, and burn more fuel (among other inputs) in exactly the same proportions as before the exogenous change occurred.

Firms in the real world, by contrast, innovate and adjust their manufacturing and other processes to take advantage of economies of scale, new technology, changes in relative prices, and new business processes. That innovation leads to cost minimization, and cost minimization means firms will do less indirect spending, and that means less induced spending stemming from changes in workers' wages. As Hoffmann and Fortmann (1996) found, this disconnect from real world behavior means that that input-output models produce overestimates of firm spending and "multiplier effects."

Due to restrictive assumptions, economic base models possess a dismal track record when it comes to predicting economic growth in the real world and in the long run. Again, the "long run" is more than a year into the future, when firms change technology, prices can adjust, and people change what they want to buy. In a review of 23 studies, Krikelas (1991) compared predictions of the economic base model against the actual experience of subject regions and found only 4 studies where the models correctly predicted longer run economic growth. Similarly, Robertson (2003) tested predictions from input-output models against actual experience in 15 communities in Southeast Alaska (a region in which many of the restrictive assumptions of economic base theory might actually apply). He found that initial economic stimulus does not "cause changes in economic activity serving local demand for the average community...The implications of these results [are that] secondary economic impacts [i.e. "multiplier effects"] cannot be taken as a foregone conclusion in policy analysis" (p. iii).

Beyond these general problems with input-output analysis, there have been some particular problems when applied to the construction phase of the projects we have analyzed. One major complaint is that the regions analyzed have been too large. In the case of the Mountain Valley Pipeline (MVP), for example, the applicant's consultants chose to use the entire states of Virginia and West Virginia as regions for analysis (they analyzed impacts separately in the two states). Regional economic impact depends on the degree to which direct, indirect and induced spending can occur within the study region. The bigger the region, the more likely it is that you can find a firm in the region from which to buy materials or services, and the more likely it becomes that one could hire labor from someone living inside the region. In other words, the larger the region, the larger the multiplier effect. The MVP studies do not present a rationale for the choice of entire states as the study regions. While the appropriate regions might be somewhat larger than the 10 West Virginia and 5 Virginia counties the proposed MVP would cross, they should not consist of the entirety of both states.

A second pervasive problem with applicants' economic analyses—one crippling to claims of economic benefit stemming from the operation of pipelines and/or increased output due to energy cost savings—is the misuse of the input-output model to estimate long-term effects.

As Haynes et al. (1997) note:

Where the economic base approach gets into trouble is when it is used inappropriately as a tool for planning or predicting impacts of greater than one year in duration; A snapshot of current conditions tells little about the form a region's future economy may take.

The reason for this caution is that economic base theory and empirical input-output models grounded in that theory (i.e., the IMPLAN model used to generate numerous pipeline impact estimates) assume a static economy. In such an economy, there are no changes in relative prices, no input substitution or

technological change in the production processes, no labor mobility, no change in products or consumers' tastes and preferences, no regional migration, and no changes in state and local tax laws—to name a few. The constant technology assumption, for example, prevents firms from using cost-savings innovations, forcing them to be inefficient, and the result is higher multiplier effects than are actually experienced (Hoffmann and Fortmann 1996).

Due to these restrictive assumptions, economic base models have a dismal track record when it comes to predicting economic growth in the real world and in the long run. (The “long run” is more than a year into the future, when firm can change technology, prices can adjust, and people can change what they want to buy.) In a review of 23 studies, Krikelas (1991) compared predictions of the economic base model against the actual experience of the subject regions and found only 4 studies where the models correctly predicted longer run economic growth. Similarly, Robertson (2003) tested predictions from input-output models against actual experience in 15 communities in Southeast Alaska (a region in which many of the restrictive assumptions of economic base theory might actually apply). He found that initial economic stimulus does not “cause changes in economic activity serving local demand for the average community.... The implications of these results [are that] secondary economic impacts [i.e., “multiplier effects”] cannot be taken as a foregone conclusion in policy analysis” (p. iii).

To count indirect and induced jobs to the operation of natural gas pipelines as the cause of new, ongoing economic activity more than a year from the start of operations requires an assumption that workers in those indirect and induced jobs would otherwise be idle. Such an assumption is not realistic: idle workers in the real world typically retrain or relocate to take already open jobs, or they create new employment opportunities for themselves. Those “multiplier effect” jobs, in other words, will most likely exist somewhere with or without the direct jobs in pipeline operations. Operation of a pipeline, in other words, will no more create new jobs in the long run than it will create the methane pumped through it.

When it comes to estimates of long-term stimulus due to assumed (see below) reductions in lower energy costs due to the operation of new pipelines, input-output analysis and those basing economic benefits on it, run into a double bind. On the one hand, and for the reasons just discussed, input-output analysis should not be used to estimate longer-term effects of lower energy prices in the first place.

The bigger issue is that, ironically, these models assume that there are no changes in relative prices and no input substitution. Thus even if a change in the price of energy occurs, or if the price of natural gas drops relative to the price of other fuels, the assumption of no input substitutions means that manufacturers and other energy users cannot switch to the lower cost fuel, nor can they change production and other processes in ways that take advantage of the lower energy prices.

For residential consumers, whom several applicants claim will benefit from pipeline-induced reductions in energy prices, the situation is similar. Assuming such reductions materialize, there could be cost savings for energy users in the real economy as people respond to the changes in relative prices. People might respond by putting off an upgrade to a more energy-efficient furnace, for example. Or they might respond by selecting less-expensive, but more poorly insulating, windows for their home renovation project. After all, if energy gets cheaper relative to the cost of other goods, there will be less reason to use it as efficiently as possible.

But the input-output models employed by pipeline applicants to generate numeric estimates of assumed benefits are not the real world. Because the models do not allow for input substitution, the only thing

consumers in the models can do with their energy savings is buy more of everything, including more energy, more new furnaces, and more higher-quality replacement windows. Moreover, these models assume that consumers' desire for the same exact bundle of goods and services can never be sated. At no point do people get enough new furnaces and shift their spending into more elaborate vacations (perhaps to places where they can escape the now excessive heat in their homes), into saving for retirement, or into their children's college tuition.

In short, and in the words of H.W. Richardson (1985) it would be hard to "resist the conclusion that economic base models should be buried, and without prospects for resurrection (Richardson 1985)." With regard to pipeline certification, the Commission simply must require better information and analysis rooted in more appropriate models, such as computable general equilibrium, systems models and others, that are more likely to approximate the behavior of economic agents confronted with changes that new pipelines may bring.

Direct effects of added pipeline capacity have not been proven.

In the estimation of several pipeline applicants, reduced energy prices is an assumed initial economic change that constitutes direct economic benefits to energy users that, if acted upon via input substitution, stimulates additional direct, indirect and induced effects. Clearly two critically important considerations for evaluating claims of such benefits is whether or not new pipeline capacity does, in fact, result in persistent reductions in energy prices and whether or not new pipeline capacity results in greater output, employment, or income in energy-intensive industries or in the broader economy.

Key-Log Economics is currently conducting a thorough, retrospective, statistical analysis of the experience of the region affected by the Marcellus Shale-based boom in natural gas availability and natural gas pipeline construction since 2000. We look forward to sharing our research results with the Commission at a later date, but we include here some preliminary observations that bear on the question of whether and how natural gas transmission capacity affects natural gas and/or electricity prices. Namely, while natural gas prices have been falling for end users during the Marcellus Shale boom, electricity prices have not.

From 2001 through 2015—a period encompassing the beginning of the Marcellus Shale gas boom—the total natural gas transmission capacity available in the Marcellus region increased from 20,195 million cubic feet per day (Mmcf/d) in 2001 to 1,098,894 Mmcf/d (citation). That is an increase of more than 5,300%. If the contentions that increased pipeline capacity drives down electricity prices were true, we would expect to see dramatically lower electricity prices during this same period. What we observe, however, is the opposite: total electricity prices (including residential, commercial, and industrial customers for utilities), have increased from an average of 69.62\$/MWh in 2001 to 98.80\$/MWh in 2015 (in inflation-adjusted 2017\$)—a 42% increase. For residential customers, the price increase was 36%, from 86.65\$/MWh in 2001 to 118.12 \$/MWh in 2015 (in 2017 \$) (U.S. Energy Information Administration, 2017). During the same time period, however, the average price of natural gas to end users (i.e. "distribution price") did fall from \$9.04/Mcf to \$4.80/Mcf (in 2017\$) (U.S. Energy Information Administration, 2018).

Again, these are simply raw observations from the data, but they do call into question the assumption that natural gas transmission capacity, in and of itself, can bring about lower end-user electricity prices and, farther downstream, positive job and income benefits in manufacturing and other sectors.

Pipeline externalities are often discounted or ignored

However large or small the output, employment, and income impacts associated with new interstate natural gas pipelines, economic efficiency demands, and FERC's own policy requires, that the costs as well as any benefits of projects be thoroughly considered before certification. Unfortunately, the Commission and applicants routinely fail to seriously consider the external costs—that is, the residual adverse effects—of the proposed projects.

These costs can be significant and staggering. Key-Log Economics has developed conservative estimates of various external costs of several recently proposed pipeline and other natural gas infrastructure projects. Please see Table 1, below, for a summary of these estimates and the referenced studies for detailed descriptions of the the methods, data, and assumptions specific to each case.¹¹

We and other organizations have provided these estimates in comments on the projects respective dockets and have observed that the Commission itself has not provided any substantive response to the enumeration and valuation of most of the external costs of the projects. In the Final Environmental Impact Statements (FEISs) for the Atlantic Coast and Mountain Valley Pipelines, for example, the Commission ignores entirely the loss of ecosystem service value and the potential impact on recreation/tourism income and amenity-based development.

And where the Commission does focus some attention, which is on possible effects on property values, it simply repeats a selective and inadequate reading of the literature and echo's applicant's contention that pipelines have no effect on the value of nearby properties. Particularly troubling is that the Commission continues to rely on deeply flawed studies sponsored by INGAA. I have provided a substantive critique of these studies in previous comments to the Commission and include an updated version of that critique at the end of this section. I will first provide a brief review of some of the other impacts of natural gas pipelines and other infrastructure routinely discounted or completely ignored by the Commission in its deliberations and decisions.

Ecosystem Services: FERC should evaluate the potential loss of human benefit due to pipeline-induced land conversion.

The idea that people receive benefits from nature is not at all new, but “ecosystem services” as a term describing the phenomenon is more recent, emerging in the 1960s (Millennium Ecosystem Assessment, 2005). According to a White Memorandum titled “Incorporating Ecosystem Services into Federal Decision Making” (Donovan, Goldfuss, & Holdren, 2015), ecosystem services are “benefits that flow from nature to people.” They include tangible physical quantities, such as food, timber, and clean drinking water, life support functions like assimilating waste that ends up in air and water or on the land, as well as aesthetics, recreational opportunities, and other benefits of a more cultural, social, or spiritual nature.

¹¹ Each of these studies is available for download from <http://keylogeconomics.com/natural-gas-development-and-transmission/>

Table 1: Summary of Cost Estimates for Several Proposed Interstate Natural Gas Transmission Projects.

Estimated impacts (costs)	Atlantic Coast Pipeline ^a	Mountain Valley Pipeline ^b	PennEast Pipeline ^c	Atlantic Sunrise Pipeline ^d	Millennium Eastern System Upgrade ^e
Lost Property Value (one-time cost)	\$57.8 - 83.0 million	\$43.7 - 55.2 million	\$165.1 - 183.4 million	Not Estimated	\$2.1 million
Lost Property Tax Revenue (Annual loss for the life of the project)	\$0.29 - 0.42 million	\$.25 - 0.32 million	\$2.8 - 3.1 million	Not Estimated	\$0.0376 million
Lost Ecosystem Service Value during Construction (one-time)	\$17.5 - 63.2 million	\$23.6 - 85.0 million	\$6.5 - 22.8 million	\$6.3 - 23.1 million	Not Estimated
Lost Ecosystem Service Value during Operation (annual)	\$5.0 - 18.4 million	\$4.2 - 15.3 million	\$2.5 - 9.3 million	\$3.0 - 11.4 million	Not Estimated
Forgone Economic Development ^f (annual)	\$51.3 million 387 jobs	\$136.9 million 1,164 jobs	\$537.6 million 4,090 jobs	Not Estimated	\$85.3 million 745 jobs
Social Cost of Carbon ^g (annual)	Not Estimated	Not Estimated	\$301.8 - 2,339.0 million	\$466.5 - 3,615.1 million	\$51.8 - 434.5 million
Lifetime costs in Present Discounted Value	\$9.5 - 11.8 billion	\$23.7 - 25.8 billion	\$14.5 - 60.3 billion ^h	\$22.2 - 95.1 billion ^h	\$4.9 - 19.5 billion

Sources and Notes:

- Phillips, Bottorff, and Wang (2016). The study scope covered four Virginia counties and approximately 20% of the overall length of the pipeline.
- Phillips, Wang, and Bottorff (2016). The study covered three West Virginia and five Virginia counties, and approximately 50% of the overall length of the pipeline.
- Phillips, Wang, and Bottorff (2017)
- Phillips, Wang, and Alkire (2017a)
- Phillips, Wang, and Alkire (2017b)

- f. Includes lost visitor spending and related state and local taxes, lost retirement income, and lost proprietors' income. Job and income losses are direct only (no multiplier effects).
- g. The range of estimates for the social cost of carbon reflect different assumptions about how heavily future costs are discounted as well as differences over time in the impact of each tonne of CO₂ equivalent emitted.
- h. Economic development impacts were not included in the PDV calculations for these pipelines.

If ecosystem services are the products of nature, then ecosystems themselves—the land—are the factories where those products and values are produced. Just as with different man made factories, different types of ecosystems (forest, wetland, cropland, urban areas) produce different arrays of ecosystem services, and/or produce similar services to greater or lesser degrees. This is true for the simple reason that some ecosystems or land uses produce a higher flow of benefits than others.

By similar reasoning, a changes in ecosystems or more fundamentally, changes in land use, will change the type, amount, and value of the ecosystem services produced in the affected area. In the case of natural gas transmission pipelines, there is the conversion in the short run of all land in the construction zone from forests, cropland, urban open space, and other productive uses to barren land with very little, if any ecosystem service value.

In the longer run, a portion of the construction zone will revert to its pre-disturbance land cover, though the effects of soil compaction, introduction of invasive species, etc. may make even reverted land formerly in the construction zone less productive. In the right-of-way however, land that had been forested before construction, will revert to the (less productive) land cover of grassland, or perhaps shrub scrub, depending on the frequency of mowing to keep the right-of-way free of trees.

Cropland in the ROW could revert to cropland, but if there are restrictions on the weight of vehicles that can be operated on top of the buried pipeline, it may turn out to be the case that cropland reverts, at best, to pastureland. Moreover, there could be long-standing harm to agricultural productivity due to soil compaction, soil temperature changes, and alteration of drainage patterns due to pipeline construction. As agronomist Richard Fitzgerald (2015) concludes in the context of another proposed pipeline, “it is my professional opinion that the productivity for row crops and alfalfa will never be regenerated to its existing present ‘healthy’ and productive condition [after installation of the pipeline].” In the path of the PennEast pipeline, grower Ron Fulper of West Amwell, New Jersey has seen “very low [corn] yields” in the portion of his fields crossed by an existing natural gas pipeline (Colaneri, 2015).

By applying per-acre ecosystem service productivity estimates (denominated in dollars per acre per year) to the various arrays of ecosystem service types, one can estimate ecosystem service value produced per year in the periods before, during, and after construction. The difference between annual ecosystem service value during construction and before construction is the annual loss in ecosystem service value of construction. The difference between the annual ecosystem service value during ongoing operations (i.e., the value produced in the ROW) and the before-construction baseline (no pipeline) is the annual ecosystem service cost that will be experienced indefinitely.

FERC's failure to include an analysis of ecosystem services lost due to the construction and operation of pipelines has been is a glaring example of inadequacy of FERC's “traditional” conflation of the interests of landowners and surrounding communities with environmental impacts. The exclusion of ecosystem service losses means that many of the economic consequences of environmental effects, not to mention many environmental effects, have not been considered at all. This shortcoming renders many, if not all

FERC environmental assessments DEIS inadequate for informing decision making about natural gas transmission infrastructure.

As it revises its certification policy, FERC should develop the capacity to undertake its own assessments of the ecosystem services impacts of its proposed action. Such a review would be consistent with current executive branch direction and coming implementation guidance (Donovan, Goldfuss, & Holdren, 2015). FERC should follow the lead of other agencies and use existing resources, such as *Federal Resource Management and Ecosystem Services* (National Ecosystem Services Partnership, n.d.) and *Best Practices for Integrating Ecosystem Services into Federal Decision Making* (Olander et al., 2015) in its review. Such a review would help ensure that these important environmental effects (and their economic consequences) are no longer ignored in FERC's decision making.

Social Cost of Carbon: FERC should account for the upstream and downstream impacts of CO₂ emissions facilitated by each natural gas transmission project.

The social cost of carbon (SCC) is a comprehensive estimate of the economic cost of harm associated with the emission of carbon. The SCC is important for regulation because it helps agencies more accurately weigh the costs and benefits of a new rule or regulation. In April 2016, a federal court upheld the legitimacy of using the social cost of carbon as a viable statistic in climate change regulations (Brooks, 2016). In August 2016, The Council on Environmental Quality (CEQ) issued its final guidance for federal agencies to consider climate change when evaluating proposed Federal actions (Council on Environmental Quality, 2016). The CEQ states “agencies should consider applying this guidance to projects in the EIS or EA preparation stage if this would inform the consideration of differences between alternatives or address comments raised through the public comment process with sufficient scientific basis that suggest the environmental analysis would be incomplete without application of the guidance, and the additional time and resources needed would be proportionate to the value of the information included” (Council on Environmental Quality, 2016).

FERC must count this significant cost among the effects of the proposed pipeline.

Public Health: FERC should account for impacts on health and related societal costs of emissions from compressor stations and other infrastructure.

Compressor stations have been implicated in a variety of illnesses among nearby residents. (Subra, 2009, 2015). The stations can also be noisy, with low-frequency noise cited as a constant nuisance. (“Proximity of Compressor Station Devalues Homes by as much as 50%,” 2015). These issues have led some homeowners to pull-up stakes and move away and to reduced property value assessments for others (Cohen, 2015; “Proximity of Compressor Station Devalues Homes by as much as 50%,” 2015).

The negative effects of the compressor station include noise and air pollution from everyday operations plus periodic “blowdowns,” or venting of gas in the system to reduce pressure. As a recent study by the New York Department of Environmental Conservation indicates, pollution around compressor stations is common and severe. The five-state study found that “more than 40% of the air samples from compressor stations exceeded federal regulations for certain chemicals like methane, benzene, and hydrogen sulfide” (Lucas, 2015). The study also found high rates of illnesses such as nosebleeds and respiratory difficulties among people living near the stations.

While more definitive epidemiological studies are needed to determine the extent to which natural gas compressor stations add to background rates of various illnesses, these stations are implicated as

contributing to a long list of maladies. According to Subra (2015), individuals living within 2 miles of compressor stations and metering stations experience respiratory impacts (71% of residents), sinus problems (58%), throat irritation (55%), eye irritation (52%), nasal irritation (48%), breathing difficulties (42%), vision impairment (42%), sleep disturbances (39%), and severe headaches (39%). In addition, some 90% of individuals living within 2 miles of these facilities also reported experiencing odor events (Southwest Pennsylvania Environmental Health Project, 2015). Odors associated with compressor stations include sulfur smell, odorized natural gas, ozone, and burnt butter. (Subra, 2009). Finally, compressors emit constant low-frequency noise, which can cause negative physical and mental health effects (Luckett, Buppert, & Margolis, 2015).

FERC's review of each pipeline and infrastructure project should include an estimates of the exposure to noise and pollutants and the expected costs of any resulting illnesses. These costs would include the cost of treating illnesses, the cost of lost work, and impacts on the quality of life.

Air emissions associated with natural gas production and transmission can also cause damage to agriculture and infrastructure. One study found that shale gas air pollution damages in Pennsylvania already amount to between \$7.2 and \$30 million, with compressor stations responsible for 60-75% of this total (Walker & Koplinka-Loehr, 2014).

Property Value: FERC must inform and update its understanding of the effect of pipelines on property.

In several EISs, FERC repeats applicants contention that natural gas pipelines have, at most, an ambiguous and non-permanent effect on property values. The Commission relies on studies including Allen, Williford & Seale Inc. (2001), Fruits (2008), Palmer (2008), and Diskin et al. (2011). While the studies differ in methods, they are similar in that each fails to take into account two factors potentially voiding their conclusions entirely. First, the studies do not consider that the property price data employed in the studies do not reflect buyers' true willingness to pay for properties closer to or farther from natural gas pipelines. For prices to reflect willingness to pay (and therefore true economic value), buyers would have to have full information about the subject properties, including whether the properties are near a pipeline.

Second, and for the most part, the studies that find no difference in prices for properties closer to or farther away from pipelines are not actually comparing prices for properties that are "nearer" or "farther" by any meaningful measure. The studies compare similar properties and, not surprisingly, find that they have similar prices. Their conclusions are neither interesting nor relevant to the important question of how large an economic effect a proposed pipeline would have.

When the pre-conditions for a functioning market are not met, observed property prices do not (and cannot) indicate property value.

Economic theory holds that for an observed market price to be considered an accurate gauge of the economic value of a good, all parties to the transaction must have full information about the good. If, on the other hand, buyers lack important information about a good, in this case whether a property is near a potential hazard, they cannot bring their health and safety concerns to bear on their decision about how much to offer for the property. As a result, buyers' offering prices will be higher than both what they would offer if they had full information and, most importantly, the true economic value of the property to the buyer.

As Albright (2011) notes in response to the article by Disken, Friedman, Peppas, & Peppas (2011):

“The use of the paired-sales analysis makes the assumption of a knowing purchaser, but I believe this analysis is not meaningful unless it can be determined that the purchaser had true, accurate and appropriate information concerning the nature and impact of the gas pipeline on, near or across their property. ... I believe that the authors’ failure to confirm that the purchasers in any of the paired sales transactions had full and complete knowledge of the details concerning the gas transmission line totally undercut the authors’ work product and the conclusions set forth in the article. (p.5)”

Of the remaining studies, only Palmer (2008) gives any indication that any buyers were aware of the presence of a pipeline on or near the subject properties. For Palmer’s conclusion that the pipeline has no effect on property value to be valid, however, it must be true that **all** buyers had full information, which was not the case in the study.

In some cases, however, the location and hazards of petroleum pipelines become starkly and tragically known. For example, a 1999 liquid petroleum pipeline exploded in Bellingham, Washington, killing three, injuring eight and causing damage to property and the environment. In that case and as Hansen, Benson, and Hagen (2006) found, property values fell after the explosion, which is to say, once would-be buyers became aware of the pipeline in the neighborhood. The authors also found that the negative effect on prices diminished over time. This makes perfect sense if, as is likely, information about the explosion dissipated once the explosion and its aftermath left the evening news and the physical damage from the explosion had been repaired.

Today’s market is quite different. In contrast to Bellingham homebuyers in the months and years after the 1999 explosion, today’s homebuyers can query Zillow to see the history of land prices near the pipeline and explore online maps to see what locally undesirable land uses exist near homes they might consider buying. They also have YouTube and repeated opportunities to find and view news reports, citizens’ videos, and other media describing and depicting such explosions and their aftermath. Whether the pre-explosion prices reflected the presence of the pipeline or not, it is hard to imagine that a more recent event and the evident dangers of living near a fossil fuel pipeline would be forgotten so quickly by today’s would-be homebuyers.

In Resource Report 5 for the PennEast pipeline, for example, PennEast, LLC claims that “it has never been commonplace for consumers to identify the presence of natural gas pipelines as part of their real estate transaction diligence and therefore, it can be argued the presence of natural gas pipelines is not a significant determinant to the value for real estate transactions” (2015). This is grossly misleading and plainly illogical. One cannot conclude a lack of a negative effect from the fact that home sellers do not typically, and counter to their own self-interest, disclose information that could induce a drop in the sale price. There are many attributes of homes offered for sale that are not typically included in the information displayed on real estate marketing sites. Drafty windows or unpleasant neighbors are but two examples of things home sellers do not typically include in their description of a home one is trying to sell. They are nevertheless two attributes of a home that would diminish the value to prospective buyers and, once known by those buyers, would also diminish the price offered.

PennEast LLC would instead have FERC believe that all persons selling real estate always disclose any and all features of their property that could possibly reduce the offers they may receive. If that were true, there would be no need for the laws that require homeowners to disclose, for example, whether the

basement is damp or if the property is included in a homeowners association. Either PennEast LLC does not understand rational buyer/seller behaviour, or they expect that FERC and the public do not.

What Zillow.com or other sites do accomplish is lowering the effort required for homebuyers to visualize the location of properties relative to other land uses, including pipeline rights of way. Combined with other information, such as maps of pipeline routes and other searchable online information, real estate marketing tools do make it more likely that prospective buyers will gain information about the hazard they could be buying into.

With more vocal/visible opposition to large, high-pressure natural gas pipelines, it also seems likely that prospective home buyers will not have to wait for an incident involving the PennEast (or any other) pipeline to learn of its presence and, therefore, for the pipelines to affect home buyers' willingness to pay (and actual offer prices) for properties nearby. A drive down the street and a quick online search for information about a community one is considering a move to is likely to reveal "no pipeline" signs, municipal ordinances opposing the pipeline, and facebook groups created by local community members formed to raise awareness about the pipeline. Anyone with an eye toward buying property near the proposed pipeline corridor could quickly learn that the property is in fact near the corridor, that there is a danger the property could be adversely affected by the still-pending project approval, and that fossil fuel pipelines and related infrastructure have an alarming history of negative health, safety, and environmental effects.

When people have more complete information about a property, they are able to express their willingness to pay when it comes time to make an offer. Accordingly, the prices buyers offer for homes near a pipeline will be lower than the prices offered for other homes farther away or in another community or region.

Studies concluding that proximity to pipelines does not result in different property values do not actually compare prices for properties that are different.

While the studies typically cited in Resource Reports 5 and FERC's Draft and Final EISs purport to compare the price of properties near a pipeline to properties not near a pipeline, many or in some cases all, of the properties that the studies count as "not near" the pipelines are, in fact, near enough to have health and safety concerns that could influence prices. In both studies written by the Interstate Natural Gas Association of America (INGAA) the authors compare prices for properties directly on a pipeline right-of-way to prices of properties off the right-of-way. However, in almost all cases the geographic scope of the analysis was small enough where most or all of the properties not on the right-of-way were still within the pipelines' respective evacuation zones (Allen, Williford & Seale Inc., 2001; Integra Realty Resources, 2016).¹²

In the 2016 INGAA study, the specific distance from pipeline was reported for eight case studies. In those cases, an average of 72.5% of the "off" properties were actually within the evacuation zone and, like the "on" properties, are therefore likely to suffer a loss in property value relative to properties farther away. (I have based my estimates of the evacuation zones on available information about the pipelines' diameter and operating pressures.) For the other two cases, the study reported a simple "yes" or "no" to indicate whether the property abutted the pipeline in question. For these cases, I assume the

¹² Proximity of properties to pipelines is based on best estimate of the location of the pipelines derived from descriptions of the pipelines' locations provided in the studies and an approximation of the evacuation zone based on pipeline diameter and operating pressure (Pipeline Association for Public Awareness, 2007).

author's methods, while flawed, are at least consistent from one case study to the next meaning it is likely at least 50% or more of the comparison properties (the "off" properties) are in fact within the evacuation zone.

To adequately compare the price of properties with and without a particular feature, there needs to be certainty that properties either have or do not have the feature. It is a case where comparing apples and oranges is not only reasonable, but also essential. In the case of these studies, there is little to no variation in the feature of interest (i.e., the majority of properties are within the evacuation zone). The studies are looking at and comparing only "apples." In this case, the feature of interest is the presence of a nearby risk to health and safety. With no variation in that feature, a systematic variation in the price of the properties would not be expected. By comparing apples to apples when it should be comparing apples to oranges, the INGAA studies reach the obvious and not-very-interesting conclusion that properties that are similar in size, condition, and other features including their location within the evacuation zone of a natural gas pipeline, have similar prices.

To varying degrees, other studies commonly cited by FERC and pipeline applicants suffer from the same problem. Fruits (2008), who analyzes properties within one mile of a pipeline that has a 0.8-mile-wide-evacuation zone (0.4 miles on either side), offers the best chance that a sizable portion of subject properties are in fact "not near" the pipeline from a health and safety standpoint. He finds that distance from the pipeline does not exert a statistically significant influence on the property values, but he does not examine the question of whether properties within the evacuation zone differ in price from comparable properties outside that zone. A slightly different version of Fruits' model, in other words, could possibly have detected such a threshold effect. (It should go without saying that such an effect would show up only if the buyers of the properties included in the study had been aware of their new property's proximity to the pipeline.)

In short, the conclusion that pipelines do not negatively affect property values cannot be drawn from these flawed studies. To evaluate the effects of the proposed PennEast pipeline on property value, FERC and others must look to studies (including those summarized in the next section) in which buyers' willingness to pay is fully informed about the presence of nearby pipelines and in which the properties examined are truly different in terms of their exposure to pipeline-related risks.

Better information about the effect of pipelines on property values is available.

In a systematic review, Kielisch (2015) presents evidence from surveys of Realtors, home buyers, and appraisers demonstrating natural gas pipelines negatively affect property values for a number of reasons. His key findings include the following.

- 68% of Realtors believe the presence of a pipeline would decrease residential property value.
- Of these Realtors, 56% believe the decrease in value would be between 5% and 10%. (Kielisch does not report the magnitude of the price decrease expected by the other 44%.)
- 70% of Realtors believe a pipeline would cause an increase in the time it takes to sell a home. This is not merely an inconvenience, but a true economic and financial cost to the seller.
- More than three quarters of the Realtors view pipelines as a safety risk.
- In a survey of buyers presented with the prospect of buying an otherwise desirable home with a 36-inch diameter gas transmission line on the property, 62.2% stated that they would no longer

buy the property at any price. Of the remainder, half (18.9%) stated that they would still buy the property, but only at a price 21%, on average, below what would otherwise be the market price. The other 18.9% said the pipeline would have no effect on the price they would offer.

Not incidentally, the survey participants were informed that the risks of “accidental explosions, terrorist threats, tampering, and the inability to detect leaks” were “extremely rare” (Kielisch, 2015, p. 7). Considering only those buyers who are still willing to purchase the property, the expected loss in market value would be 10.5%.¹³ This loss in value provides the mid-level impact in our estimates. A much greater loss (and higher estimates) would occur if one were to consider the fact that 62% of buyers are effectively reducing their offer prices by 100%, making the average reduction in offer price for all potential buyers 66.2%.¹⁴ In our estimates (see below), however, we have used the smaller effect (-10.5%) based on the assumption that sellers will eventually find one of the buyers still willing to buy the pipeline-easement-encumbered property.

- Based on five “impact studies” in which appraisals of smaller properties with and without pipelines were compared, “the average impact [on value] due to the presence of a gas transmission pipeline is -11.6%” (Kielisch, 2015, p. 11). The average rises to a range of -12% to -14% if larger parcels are considered, possibly due to the loss of subdivision capability.

Kielisch’s findings demonstrate that properties on natural gas pipeline rights-of-way suffer a loss in property value. Boxall, Chan, and McMillan (2005), show that pipelines also decrease the value of properties lying at greater distances. In their study of property values near oil and gas wells, pipelines, and related infrastructure, the authors found that properties within the “emergency plan response zone” of sour gas¹⁵ wells and natural gas pipelines faced an average loss in value of 3.8%, other things being equal.

The risks posed by interstate natural gas transmission pipelines would be different—they would not be carrying sour gas, for example—but there are similarities that make Boxall et al.’s finding particularly relevant. Namely, the emergency plan response zones (EPZs) are defined by the health and safety risks posed by the gas operations and infrastructure. Also, and in contrast to the studies often cited by FERC which show no price effect the Boxall study examines prices of properties for which landowners must inform prospective buyers when one or more EPZs intersect the property.

In addition to the emerging body of evidence that there is a negative relationship between natural gas infrastructure and property value, there have been many analyses demonstrating the opposite analog. Namely, it is well-established that amenities such as scenic vistas, access to recreational resources, proximity to protected areas, cleaner water, and others convey positive value to real property.¹⁶ There are also studies demonstrating a negative impact on land value of various other types of nuisance that impose noise, light, air, and water pollution, life safety risks, and lesser human health risks on nearby residents (Bixuan Sun, 2013; Bolton & Sick, 1999; Boxall et al., 2005). The bottom line is that people

¹³ Half of the buyers would offer 21% less, and the other half would offer 0% less; therefore the expected loss is $0.5(-21\%) + 0.5(0\%) = -10.5\%$.

¹⁴ This is the expected value calculated as $0.622*(-100\%)+0.189*(-21\%)+0.189*(0\%)$.

¹⁵ “Sour” gas contains high concentrations of hydrogen sulfide and poses an acute risk to human health.

¹⁶ Phillips (2004) is one such study that includes an extensive review of the literature on the topic.

derive greater value from, and are willing to pay more for, properties that are closer to positive amenities and farther from negative influences, including health and safety risks.

Table 1, above, includes estimates based on the results established by Kielisch (2015) and Boxall, Chan, McMillan (2005) for several recently proposed pipelines.

Conclusion

In conclusion, FERC should update/upgrade both its policy, its capacity, and its practice regarding the economic effects of new interstate natural gas pipelines. To ensure that future certification decisions result in efficient use of land and other natural resource, FERC must establish procedures, and install analytical capacity sufficient to provide independent, rigorous, and credible analysis of the benefit claims promoted by pipeline applicants. It must also conduct (or contract to have conducted) thorough analyses of the external economic costs likely to result from the construction, presence, and operation of each pipeline. For any pipelines approved on efficiency grounds (i.e. benefits exceed costs), FERC should further ensure that the successful certification application pays compensation to the parties harmed by those external costs. Finally, to prevent problems of overcapacity and the associated problems of accelerated climate change and a delayed transition to safer, cleaner, more renewable fuels, FERC should ensure that all new pipeline capacity applications are considered in the context of existing (and previously certified) capacity in the entire gas transmission system.

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