



# COMPARATIVE PATHWAYS



FOR REGIONAL  
ENERGY TRANSITION

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## INTRODUCTION

OVER THE PAST YEAR, THE KLEINMAN CENTER HAS DEVELOPED A RESEARCH PROJECT TO BETTER UNDERSTAND ENERGY POLICY MAKING AT THE LOCAL AND REGIONAL LEVEL. We have argued for a new approach in a series of essays in diverse venues, including newspaper [op-eds](#) and science [journals](#). We have socialized the approach in a series of presentations, including at [conferences](#) of subnational governments and in meetings with federal agencies. And we have supported teams of [researchers](#) to build a long-term [project](#) around the approach.

- First, science has provided global targets for reductions in greenhouse gas (GHG) emissions to limit the impacts of climate change. For example, the [best scientific estimates](#) suggest that reducing global GHG emissions by 80 percent from the 2005 level by the year 2050 provides a 66 percent probability that global mean temperature will increase less than 2 degrees Celsius from pre-industrial levels.
- Second, national governments have developed various pledges, programs, and policies to meet these targets. For example, under the 2015 Paris Agreement resulting from the international COP21 process, [195 nations](#) agreed to the 2-degree target and submitted for national contributions toward meeting the target.
- Third, subnational governments are positioned as key actors in these pledges. For example, it is

[estimated](#) that half the national contributions under the Paris Agreement require action by subnational governments and many [accounts](#) have stressed the importance of cities and states in the process.

- Fourth, all estimates of the current efforts to limit GHG emissions (which mostly derive from various parts of the energy system) conclude they will fall far short of the reductions need to meet the 2-degree target. For example, one [survey](#) of a dozen estimates of warming by the year 2100 ranges from 2.7 to 3.7 degrees Celsius and the [scientific consensus](#) is grim on the impacts of warming above 2 degrees and dire about human ability to adapt to 4 degrees of warming.
- Fifth, we believe that these four factors together raise a serious red flag for policy makers. While cities are undoubtedly a source of innovation and leadership on climate mitigation policy, they are already challenged by current and foreseeable impacts of climate change now [underway](#). As these impacts accelerate in coming years, subnational governments will have strong incentives to invest more resources on climate adaptation efforts (from which they capture virtually all the benefits of their local actions) and fewer resources on climate mitigation efforts (from which they capture virtually none of the benefits of their local actions). Thus, national and international policy regimes that rely on subnational governments to achieve their mitigation policies are dangerously vulnerable to failure.

These observations lead us to conclude that several important empirical questions demand attention.

- **First, what are the local net benefits of various energy-related policy strategies?** This is a different question than what is asked in most assessments of subnational policy options, which typically ask “how much emissions reduction can be achieved in our city or region?” or “is an 80 percent reduction in local emissions by year 2050 feasible?” We believe that maximizing local net benefits and treating emissions reductions as a derived output provides a far more relevant and reliable basis for local decision making and for predicting the sustained efforts of subnational governments over the longer term.
- **Second, what are the local co-benefits of mitigation and adaptation policies?** Local efforts at emissions reductions are likely to generate far more local net benefits from improved air quality than from climate change mitigation. This creates a potential (but not self-implementing!) alignment between local and global policy efforts. Also, any local policy that generates both mitigation and adaptation benefits creates another opportunity to leverage local efforts for global impacts.
- **Third, what policy options and debates about energy characterize actual decision making at the local and regional scale?** Rather than backward-mapping from an end-state based on a global problem (such as deep decarbonization), we propose to tether our analysis to interests, issues, and opportunities already mobilized in a specific region. We believe this better reflects the realities of local decision making.

These three questions express the core concerns and intended contributions of the Pathways Project. Building on our longstanding relationships with key partners, we have developed Pathways around policy development in the Philadelphia metropolitan area. We have convened a team of researchers, advisers, and stakeholders to develop this research agenda and a methodology to implement it. The process has identified four different policy strategies under development and discussion in Philadelphia and we are translating these strategies into model inputs that can be used to estimate local net benefits associated with each strategy over time. We are evaluating the following four policy strategies for the region.

## PGW

The Philadelphia Gas Works is the largest municipally owned gas utility in the United States. This ownership of the distribution system and ancillary gas assets presents numerous opportunities to use technology (e.g., CHP, district heating and cooling, etc.) to create value across the building, transport, and processing sectors of energy demand. Visionary possibilities arise when PGW is connected with City control over a large inventory of buildings and vehicles, over the regulation of land use and the planning of transportation, and over the long-term mission, financing, and ownership of the utility. This topic has been the subject of intense and ongoing debate:

- <https://energy.gov/eere/amo/benefits-combined-heat-and-power>
- <http://neca-pdj.org/wp-content/uploads/2014/07/Forging-New-Business-with-CHP.pdf>
- <http://www.burnsmechanical.com/is-chp-poised-for-growth-in-the-philadelphia-region>
- <http://www.bondbuyer.com/news/regionalnews/p3-discussed-for-philadelphia-gas-works-1072770-1.html>

## Hub

Hydraulic fracturing has made recoverable large amounts of natural gas and natural gas liquids in nearby parts of the state. This, in turn, has generated interest in some quarters for major investments to transport these fuels and feedstocks to the Philadelphia area for processing and/or export. This increased capacity is an opportunity for substantial employment and earnings growth as industry expands to exploit the reliable delivery of inputs into the production of a value-chain of linked intermediate and final products. This topic has been the subject of intense and ongoing debate:

- <http://www.triplepundit.com/2015/05/can-philadelphians-forge-energy-hub/>
- <https://stateimpact.npr.org/pennsylvania/2016/12/08/energy-hub-vision-challenged-by-rinaldis-departure-from-pes/>
- <http://www.metro.us/philadelphia/philadelphia-as-the-next-global-energy-hub/zsJpkB---wml1IWk894ao/>
- <http://www.gridphilly.com/grid-magazine/2016/12/28/the-kenney-administration-sets-its-sights-on-social-impact>



## EDGE

New energy assets are being developed at the edge of the traditional centralized electricity grid, such as solar and wind (and more experimental sources such as thermal production and storage in municipal sewage) as well as the virtual generation provided by sophisticated load management through building and other controls. These distributed energy assets create opportunities for local control over renewable and resilient energy systems. Efficiency within existing systems can be implemented without requiring structural changes to energy markets or significant behavioral shifts. Energy conservation measures can improve operational efficiencies in buildings, transportation, and industry but are still not widely adopted. This topic has been the subject of intense and ongoing debate:

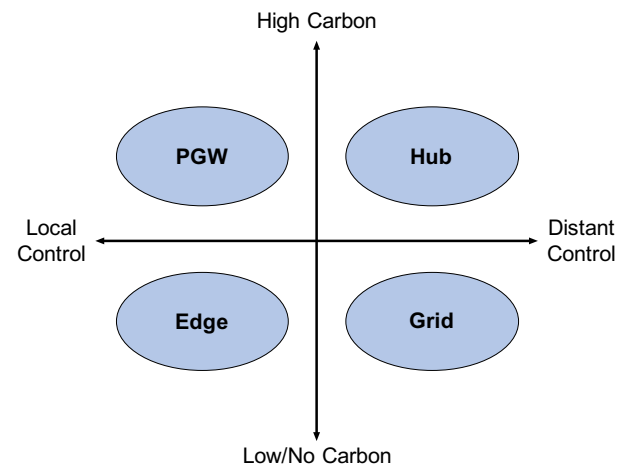
- <http://www.alstom.com/press-centre/2015/6/alstom-partners-with-penn-state-university-to-establish-microgrid-center-of-excellence-at-the-philadelphia-navy-yard>
- [http://images2.americanprogress.org/CAP/2009/06/factsheets/peri\\_pa.pdf](http://images2.americanprogress.org/CAP/2009/06/factsheets/peri_pa.pdf)
- <http://www.bizjournals.com/philadelphia/news/2016/03/28/department-energy-navy-yard-pidc-renewable-energy.html>
- <http://phlcouncil.com/wp-content/uploads/2016/02/Final-Report-The-Philadelphia-Energy-Campaign-PEA.pdf>

## GRID

Many argue that “electrify everything” is the only pathway that can feasibly mitigate the worst effects of climate change. This will require substantially more power than local sources alone can provide, especially in a dense metropolitan region. This pathway would involve the infrastructure needed to electrify personal transportation, the capacity of the grid in the face of an aging nuclear fleet, and so on. This topic has been the subject of intense and ongoing debate:

- [https://www.pachamber.org/assets/pdf/advocacy/2016\\_12\\_05\\_pa\\_nuclear\\_report.pdf](https://www.pachamber.org/assets/pdf/advocacy/2016_12_05_pa_nuclear_report.pdf)
- <http://www.utilitydive.com/news/pennsylvania-puc-approves-pecos-274m-reliability-microgrid-program/407915/>

These four energy policy agendas represent four very different pathways toward regional prosperity. It is possible to characterize the four pathways along two dimensions: first, whether they seek to leverage hydrocarbon energy sources or, inversely, leverage renewable energy sources; and second, whether they seek to leverage local control over assets and/or jurisdiction or, inversely, leverage access to markets and/or policymakers beyond the region.



**Figure 1:** A four-quadrant graphical representation of the pathways scenarios along two axes or dimensions: high vs low carbon, and local vs distant control.

Our analysis focuses on the local net benefits associated with each pathway. Each quadrant is capable of maximizing local net benefits according to the advocates of competing policy agendas. Because these agendas have all been discussed and debated in the region for years, each pathway has generated some number of opponents who argue costs outweigh benefits. Comparing pathways from each quadrant using a common method can inform local decision makers and constituents about the costs and benefits of widely divergent approaches. Each pathway uses a mix of strategies (energy efficiency, urban density, technology investment) to improve the productivity of sectors (buildings, transport, processes) to maximize the economic, environmental, and equity value of the region.

But how do they compare? How much local value does each pathway generate, and for whom, and at what cost for whom? And as local policies are designed to maximize local net benefits, what are the implications for the region’s GHG footprint, and more specifically would regional GHG emissions rise or fall under the pursuit of local net benefits?

These are complex empirical questions and the Kleinman Center has worked with experts at ICF to develop a methodology capable of providing useful estimates. That methodology links nine empirical models to estimate the local net benefits of policy pathways at the regional scale. The chain begins with the impacts of regional pathways on emissions, then on air quality, then on health, then on economic outputs including regional, state, and national gross product, employment, income, consumer prices, and fiscal impacts.

## DRAFT DESCRIPTIONS OF THE FOUR PATHWAYS FOR EXPERT INPUT

The next step in the Pathways Project is to develop four regional pathways into specific bundles of connected actions that can be quantified as inputs in the linked sub-models used to estimate the local net benefits of each pathway over time. From experts and advocates for each of the pathways (which exist because each pathway is based on real policy agendas being debated in the region), we seek input into the bundles of connected actions that would constitute each pathway designed to maximize local net benefits to 2050. To do this, we require two things for each pathway:

- A short but sufficient narrative that captures the possibilities of the pathway, including: who would be needed to approve and implement the pathway, how it would unfold over time, what benefits it would seek to generate, what costs it would seek to minimize, and what risks it would seek to manage.
- A list of essential elements that would constitute a plausible version of the regional pathway between now and midcentury. These elements are a set of connected actions (investments, policies, programs) that can be conceptualized and quantified. These elements must have enough complexity and detail to adequately capture the benefits and costs of the pathway agenda but without becoming unwieldy.

## ABOUT THE AUTHORS

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