



# PENNSYLVANIA ENERGY HORIZONS





*Scenarios are a tool for helping us to take a long view in a world of great uncertainty... Scenarios are stories about the way the world might turn out tomorrow, stories that can help us recognize and adapt to changing aspects of our present environment.*

- Peter Schwartz, *The Art of the Long View*<sup>1</sup>

## Pennsylvania Energy Horizons Participants and Process: Who and How?

Creating scenarios is a collaborative process. It requires people with very different “mental maps” to provide a range of views on how they view Pennsylvania today, and what they think might happen in the Commonwealth’s energy future.

To accomplish the task of developing scenarios, we convened a group of diverse professionals and thought leaders from across the state and from varied backgrounds. They represent, first and foremost, concerned citizens who believe energy is an important and compelling force in our society and were also capable of drawing from their own experience to help shaping Pennsylvania’s future energy story. Representatives from non-governmental organizations, private businesses, public officials, academics and experts from all aspects of the energy spectrum contributed to our conversations.

Scenario planning is a long and thoughtful process and requires patience. We took care to avoid pushing any agenda or jumping into “solutions mode.”

Instead, we came together and analyzed available data to describe the state today and imagined the various ways in which it might change.

For over a year in a series of day long workshops, the participants embarked on a journey with enthusiasm, passion, enlightenment, and curiosity. They were asked to reflect over the last several generations and to recall some of the profound technological, economic, and social changes that have occurred from then to now. The group sought to “connect the dots” across their expertise and experiences to generate new ideas from diverse views, enabling us to build contrasting versions of the future.

The process was a challenging experience for all the participants. The sheer amount of information and the improvisational nature of the process itself led to feelings of apprehension at times - that the scenarios that we sought to draft could not be written. The inclusion of different points of view often made it seem as there was no consensus. At the end of the process, however, the scenarios were written based upon consensus – a true testament to the value of listening to diverse viewpoints and creating a path forward.

# Executive Summary

“The role of scenarios is to arrange the factors so they illuminate the decision, instead of obscuring it.”

– Peter Schwartz, “The Art of The Long View”

During a 12-month period beginning in 2017 and culminating in 2018, a group of Pennsylvanians representing a wide-ranging set of backgrounds and expertise were convened by Team Pennsylvania Foundation to debate, and ultimately attempt to answer, the following question:

## **How might Pennsylvania’s energy system evolve in 25 years, and what might it mean for Pennsylvanians?**

Their work culminates in this document – Pennsylvania Energy Horizons, which was developed using a world-renowned energy scenarios methodology. Energy scenarios are plausible and challenging alternative futures that can provide “strategic foresight.”

The group produced two different scenarios: Rivers and Roots, which highlight a range of drivers and uncertainties which take Pennsylvania’s energy future along divergent paths. The scenarios are also susceptible to the conscious choices leaders make today. The scenarios were neither “good” nor “bad” – they simply represent how today’s decisions could impact the long-term evolution of Pennsylvania’s energy system.

In our Rivers scenario, the commonwealth breaks political gridlock, becomes a competitive player in the global economy, pursues a strategy around energy to become a vanguard of the 4th industrial revolution, and reduces carbon dioxide through a confluence of policy and technology.

In our Roots scenario, Pennsylvania learns to operate by exploring our home ground and nurturing local economies. The energy system evolves around regional investments leading to natural gas, distributed energy generation, and renewables growth, with decreases in carbon dioxide realized partly through slower economic growth and locally-inspired energy solutions.

In each of these scenarios, our energy system influences – and is influenced by – the wider social fabric that defines Pennsylvania: the outcome of political debate in Harrisburg; the commonwealth’s demographics; the emergence of new technologies

and innovative business models; grassroots priorities and activism as well as economic prospects for the USA and world.

Scenario planning is not just about anticipating what could happen in the future; it is about helping policy-makers, business executives, community leaders and politicians shape that future.

The Rivers and Roots scenarios do not advocate for specific outcomes; they do not suggest priorities; and they do not embrace one set of values or principles over another. They simply provide a methodology for examining options within a complex system of drivers and uncertainties; for creating a kind of architectural rendering of policy designs; for looking around corners and over horizons at the consequences – intended or not – of today’s actions and developments.

If these scenarios are meant to promote any point of view at all, it is that the commonwealth’s leaders can use them as a tool to calibrate certain policies, initiatives, and actions. Those who participated in Pennsylvania Energy Horizons consider these next few years a critical inflection point as our energy system rapidly evolves within the backdrop of global climate concerns. Decisions made today will have consequences for decades to come. Failure to make those decisions may have even greater consequences.

While developing Pennsylvania Energy Horizons, we learned over the course of a year that we were able to share, debate, and listen to perspectives of a very diverse group representing a broad range of viewpoints.

What is next?

Throughout 2019, we intend to host Pennsylvania Energy Horizons sessions across the commonwealth with a range of stakeholders – governments, associations, non-profits, businesses and universities – to spark conversation, gain critical input, and perhaps even arrive at a common understanding that will help shape Pennsylvania’s long-term energy future.

We hope Pennsylvania Energy Horizons are useful, informative and evocative; and we welcome comments and challenges our readers may have.



# Introduction

Energy is the lifeblood of a vibrant economy and culture. It allows us to live, and it enables us to thrive. It provides light, comfortable temperatures, mobility, productivity, entertainment, communications, agriculture, life-saving medical equipment and manufactured goods ranging from synthetic clothing to locomotives.

Energy also comes with costs – direct and indirect – that are manifest in the sources and amounts we use, the state of domestic and global markets, and the impacts to the environment.

It is easy to see that energy choices are complex, and the ones facing us today will shape the way Pennsylvania lives and grows for generations to come.

The leaders responsible for these choices are at a strategic crossroad. This is a challenging time for the energy industry and new frameworks for thinking are needed. We are amid a major energy transition – from a precipitous loss of coal-fired electric generating stations, to the rise of natural gas-fired electric generating stations, to the disruption in our nuclear electric generating capacity, to the desire for more renewables in our energy portfolio.

The discussions about how to respond to our rapidly evolving energy system have occurred largely in isolation and at the ends of the ideological spectrum. To have a comprehensive and balanced analysis for a desirable energy future, we searched for a way to refresh the conversation and found it in creating scenarios.

As an integral part of planning, we cannot assume the future will look like the present. Government and business leaders alike need tools for assessing the implications for tomorrow of decisions that need to be made today. They need ways of getting beyond ideology to consider the trade-offs, the possibilities and the implications of the options before them.

Team Pennsylvania Foundation offers Pennsylvania Energy Horizons as research regarding our shared future – a tool that can help to improve decision making today.

Pennsylvania Energy Horizons was developed using energy scenarios methodology, which provides a set of qualitative tools that enable us to extrapolate much longer-term developments than our traditional two- to four- year forecasts. When data fails to provide a clear answer, scenarios can help decision makers understand what their actions might look like 20 to 30 years from now.

Energy scenarios are plausible and challenging alternative futures that can provide “strategic foresight” regarding choices related to energy. Working with the Pennsylvania Department of Community and Economic Development and using this widely-used and highly-regarded methodology developed by Herman Kahn (a U.S. military strategist), and later refined by entities like RAND Corporation and Royal Dutch Shell and others for long-term energy analysis, Team Pennsylvania Foundation convened a diverse group of stakeholders over a 12-month period to develop multiple answers to a very specific question:

## **How might Pennsylvania’s energy system evolve in 25 years, and what might it mean for Pennsylvanians?**

Royal Dutch Shell’s Global Scenarios Team provided facilitation for this process – they have been developing energy scenarios within Shell for almost 50 years. Their expertise in employing scenario methodology enabled participants to grapple with tough energy and environmental issues as they developed the stories of two alternative energy futures for Pennsylvania.

The year-long process began with hosting several workshops with a diverse group of over 40 collaborators with expertise in a wide variety of areas that intersect with energy. With rigorous facilitation, the group peered at Pennsylvania’s energy system through a range of lenses and data: political, cultural, demographic, technological, and environmental. The process involved analyzing trends, drivers, signals and signposts. It also involved testing multiple competing assumptions and choices.



From that crucible of divergent perspectives, debate and dialogue, emerged two alternative narratives about how Pennsylvania's energy future might unfold over the next two decades.

We call them Rivers and Roots.



These are two stories of how Pennsylvania's future might unfold, as told by Pennsylvanians. They are not prescriptions, they are predictions of where we might end up given a certain set of choices. They are stories about our future that serve as decision-making tools. They expose possibilities and blind spots that might not emerge with traditional, linear thinking.

The detailed energy model that accompanies them provides a way of quantifying various combinations of inputs and outcomes, which enabled us to put numbers behind the various scenarios and calculate potential impacts to our environment and our economy based on the evolution of our energy system.

Rivers and Roots highlight a range of drivers and uncertainties that could push Pennsylvania's energy future along divergent paths. Political gridlock may continue, or it may be broken. The commonwealth may turn outward, competing vigorously in the global economy; or it may turn inward, content to nurture its small-town virtues. The commonwealth might leverage its natural gas as part of a disciplined economic growth strategy;

or it may prefer a laissez-faire approach in which natural gas finds its own way in the market.

Pennsylvania's economy could see technology and innovation become a central component of its energy strategy, and in doing so may become a vanguard of the 4th industrial revolution, that simultaneously opens more room for more diversified energy resources in our electricity mix as part of a decarbonization strategy, or we might rely instead on cities and municipalities to create more localized, sustainability strategies made manifest through the undeterred individualism that has underpinned many of the commonwealth's communities since their inception.

The commonwealth may pursue a decarbonization agenda, or it may decide that anything more than minimal compliance is simply unaffordable for Pennsylvania's businesses and residents.

It is up to individual Pennsylvanians to read these stories, to draw their own conclusions about the ideal facets of our shared future; and then to act, and encourage society's leaders to act, in a manner that helps shape our future.

Rivers and Roots were developed as part of a conscience effort to bring divergent stakeholders together to discuss difficult and complex energy matters. Our hope is that these scenarios enable thought leaders to continue to make progress towards aligning our energy future in a way that benefits Pennsylvania.

The next section lays the groundwork for the two scenarios by examining Pennsylvania's current cultural, political and economic landscape. Once the groundwork is laid, the following two sections describe how these two scenarios emerge.





# || A Picture of Now: Inflection Point

“When you come to a fork in the road, take it.”

– Yogi Berra

Scenarios, like maps, are only helpful if we understand where we are right now.

Today, Pennsylvania has a unique convergence of resources, culture, politics and economics at a unique moment in time. The commonwealth’s energy system is also at an inflection point, confronting us with urgent questions and complex choices, and we must make decisions now that help us to manage future outcomes.

Our Picture of Now is our shared understanding of the present, framed by the rich diversity of Pennsylvania’s energy resources. The abundance of energy is only one example, but an important one, with deep historical roots that have shaped both the state’s culture as well as its economy. Rivers and Roots both depart from this common picture and their stories will emerge in different ways.

**Our shared energy history:**



Immigrant Pennsylvanians began mining coal in late 1700s. Historically, coal was a catalyst for the industrial revolution and was primarily used to power steam engines and heat buildings, and later, to fuel power plants and generate electricity.

Colonel Drake famously struck oil in the world’s first commercial oil well in 1859. Iconic oil brands – Quaker State and Pennzoil – took their name from here.

Beginning in the 1970s, Pennsylvania began using nuclear energy as source for generating power, enabling the commonwealth to export considerable electricity to neighboring states by wire.

At the same time, the commonwealth became the first state with a Department of Environmental Protection, a result of Rachel Carson’s ‘Silent Spring’ detailing the negative impacts of industrial development on the environment.

More recently, new “unconventional” drilling techniques unlocked the vast potential of the Marcellus shale basin and as low cost natural gas has flooded the market, higher-priced coal has been displaced. Natural gas liquids production is also attracting petrochemical investments seeking lower cost feedstock.

Meanwhile, renewable energy sources – solar, modular hydro, and wind – have begun to increase their share of the energy market space.

As all of this has been happening, Pennsylvanians have sought to protect the value of their equally treasured “above-ground” natural resources – forests, waterways, wildlife, ecosystems, and clean air. Our storied history of natural resource development is one punctuated by environmental externalities; we have often used our resources for industrial growth without fully addressing the long-term environmental impacts associated with those choices. With this legacy in mind, the energy industry has often struggled to win their social license to operate in the face of concerns about greenhouse gases, land disturbance, water usage and quality, pipeline impacts, and road congestion.

**Unpredictable weather:**

Extreme weather events are becoming more common and more dangerous, the costs of which are in-

curred across all levels - globally, nationally, locally. Climate change is acknowledged by many to be the culprit for more frequent and intense storms and protracted and severe droughts. Pennsylvanians are becoming increasingly aware of the need to understand how this trend will impact our immediate resiliency and long-term sustainability.

The U.S. has experienced more wildfires, floods, and droughts than in the past. In 2017, a new record was set of nearly \$400 billion in damage from 16 events across the country. Pennsylvania, with the most miles of streams and rivers in the lower 48 states, is not immune to the unpredictable costs of flooding. From 1998-2018, Pennsylvania property damage totalled over \$2 billion, which is \$9.3 million/month over the last 20 years.<sup>ii</sup>

#### **Energy transitions:**

What the global energy community calls “the energy transition” can best be described as the accelerated search for ways to produce energy with less carbon dioxide (CO<sub>2</sub>) – and to do so economically. The displacement of coal with lower-emitting natural gas is part of that transition. So is the deployment of low carbon technologies (solar, wind and battery storage), research into carbon capture, utilization and sequestration (CCUS) technologies, and the proliferation of energy efficient product offerings. The energy transition is further being shaped by the commitment of local cities (Allentown, Ambler, Bethlehem, Downingtown, Erie, Lancaster, Milford, Mount Pocono, Philadelphia, Pittsburgh, State College, and Swarthmore) to the terms of the Paris Agreement.<sup>iii</sup> And it is manifest in debates about carbon pricing and the composition of our power generation fleet.

Meanwhile, Pennsylvania is at a critical inflection point regarding natural gas production, transmission, and distribution from the Marcellus and Utica shale formations. With over ten thousand unconventional wells producing trillions of cubic feet per year, we currently account for 19% of total U.S. natural gas production.<sup>iv</sup>

The surprise of natural gas has catapulted Pennsylvania to becoming a domestic and international

energy provider. This is happening amidst a global push for deep decarbonization measures. Can natural gas be a lower carbon bridge fuel to less carbon intensive sources? If so, what will Pennsylvania’s role be? In this sense, Pennsylvania is not just feeling the influence of a national and global energy transition; in many ways we are at its epicenter. Although we may be content to enjoy the resources our state offers, we are now at a moment in time when the world is as interested in Pennsylvania’s future as we are in our own.

Complicating this Picture of Now even further is Pennsylvania’s uneven cultural, economic and political landscape. The state is anchored by its two major – if very different – urban centers: Philadelphia, with its historical and economic links to the eastern seaboard and New England; and Pittsburgh, which emerged from the gritty cocoon of its industrial legacy to become a post-industrial hotbed of innovation, the arts and learning. These two growing cities and the suburbs that serve them enjoy access to new digital technologies, global markets, world-class educational opportunities and relatively low energy prices.

But between them lies a broad, diverse expanse of forests and farms, small cities and suburbs, many struggling towns and a few flourishing “boutique” villages.

Since 2010, both state GDP<sup>v</sup> and population<sup>vi</sup> have grown steadily, albeit at a generally slower pace than U.S. averages. What’s more, our workforce has continued to age and the jobs supporting the next generation of workers have shifted dramatically from relatively high-paying industrial work to lower-paying service sector jobs or highly-skilled digital-age roles.<sup>vii</sup> Entrepreneurship is active in the state, but we do not yet enjoy the innovative ecosystem and the critical mass of venture capital to be found in places like Boston, Austin and Silicon Valley.

#### **National and Global Drivers:**

Forces shaping this energy transition, and Pennsylvania’s energy system broadly, are by no means confined to the state’s geography. National and global forces shape the environment in which decisions about the commonwealth’s approach to complex energy matters are made.





Chronic slow growth, wage stagnation, and rising income inequality are manifested throughout Pennsylvania in a number of ways. It's easy to see how this has been connected to the widespread opioid abuse, emotional stress and the angry brand of divisive politics that erupted into view across the country in 2016.

Indeed, the national politics of gridlock and polarization currently hang over the commonwealth's complex mosaic of strengths and weaknesses, opportunities and risks. This divisiveness has resulted in political inertia. Could there be a breaking point? Can we make progress to better take advantage of our burgeoning natural resources, or is it more likely that the progressive change needed to guide energy infrastructure development will be lost in legislative battles?

Pennsylvanians are also faced with the unpredictable impacts of global forces that often are out of their control. Shifting patterns of global economic production, finance and trade affect both the U.S. and Pennsylvanian economies. Globalization, combined with sweeping advances in technology, have led to population growth, longer lifespans, and a need for expanding access to goods and services. This, in turn, is rapidly increasing the demands placed on our global energy system.

We are also confronted with the position of the U.S. in the arena of global governance. Even before the U.S. announced its intention to pull out of the Paris Agreement, many have begun to question our country's role as the leader of the international system. Will the U.S. endeavor to maintain the post-World War II geopolitical framework for which it was the primary architect? Or, will it be increasingly content to leave the work of multilateral institutions to others in favor of bilateral diplomatic and economic arrangements? In Pennsylvania, this impacts us and our economy; much of the natural gas resources we can produce are attractive to European markets, and demand for our resources is likely to come as much from beyond U.S. borders as internally.

Clearly the future of energy in Pennsylvania will shape – and be shaped by – a range of drivers and

uncertainties. How the future unfolds could be as much a product of decisions government fails to make as of the options it chooses to pursue. It is important for Pennsylvania to decide what we want to be both now and in 2050.

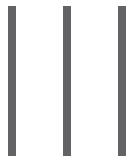
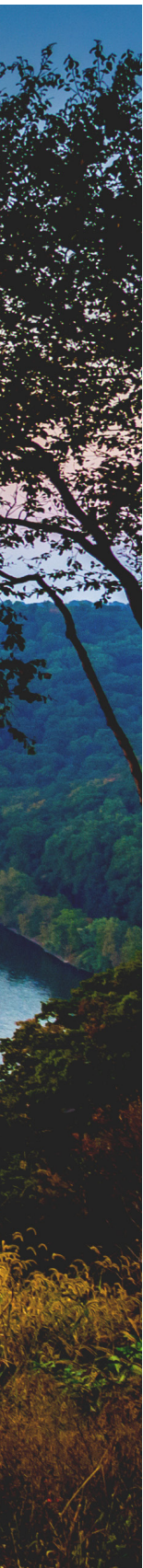
Rivers and Roots are two plausible “histories” of that future and embody the work of Pennsylvania Energy Horizons.

Rivers allows us to explore how Pennsylvania overcomes political gridlock, actively leverages its energy resources to compete in the global market and turns its cities into hubs of white hot innovation. At the same time – as no path of development is ever perfect – the commonwealth struggles to meet the needs of its under-served rural communities. Rivers tells a story about how Pennsylvania adopts a plan to help the state become a national leader in energy resource development. Pennsylvania begins addressing environmental externalities and uses our natural gas as a low-carbon fuel source, and as a resource for economic experimentation. In this scenario, Pennsylvania becomes more globally focused and relies on attracting new industries and partners for innovation.

Roots explores a future in which Pennsylvania state government fails to break free of its political divisions, which leads Pennsylvanian's to actively explore their home ground and rely more on municipal governments to leverage the strengths embedded in local communities and economies. As the challenges of more modest economic growth are navigated increasingly at the local level, some communities thrive while others fall behind. Absent a state-wide strategy, the commonwealth's energy remains a resource to be monetized, rather than a fuel for innovative growth. In Roots, transmission pipeline projects become more complex and difficult, resulting in moderate growth of natural gas production that is primarily driven by demand for localized, in-state heating and power opportunities. In this scenario, Pennsylvania relies almost exclusively on existing businesses as the mainstay of our economy – a reality that is generally accepted in exchange for a more intimate and supportive community life.



# RIVERS



# Rivers

“A river cuts through rock, not because of its power, but because of its persistence.”

– Jim Watkins

In the Rivers scenario, Pennsylvania breaks through its political gridlock and turns outward to grow and thrive. Much like the commonwealth’s great rivers, economic and cultural innovations flourish and flow through its cities and on to national and global markets. A new spirit of bipartisan political reform enables energy policies that incent economic growth, balancing near term government revenue with long term sustainable goals. But as investment and talent concentrate in urban areas, large parts of the commonwealth get left behind and wealth inequality continues to fester.

- Political gridlock is broken. A new generation of politics builds political dialogue and compromise, enabling economic and energy policy consensus
- A focused energy strategy taps the abundant natural gas supply for energy intensive industries, and addresses environmental worries by harnessing lower-carbon energy sources and implementing CCUS measures
- State revenues are invested to seed a globally competitive state economy. New, innovative technologies and enhanced job skills underpin Pennsylvania’s move into Industry 4.0
- Political compromise helps close the wealth gap between the commonwealth’s cities and rural regions, but by the 2040s, the spectre of inequality is emerging again

## Swelling undercurrents:

The Rivers scenario opens with Pennsylvania heading into a fiscal crisis, driven by political gridlock, a multi-billion-dollar state budget gap, lack of new

revenue sources, and a struggle to compete for inward investment.

Confrontational politics has led to ineffective governance. Political gerrymandering and restrictive voting practices drive legislators toward opposite ideological poles and away from compromise. Pennsylvanians no longer believe that Harrisburg works.

With no clear pathway for new investments, the economy slows. Long term issues continue to plague the state budget and there is no real appetite for any new taxes or investments which leaves Pennsylvania remaining fiscally challenged.

## Breaking the logjam (2020s):

Then, early in the Rivers scenario, a confluence of simmering social issues boils over into a crisis. The crisis could be prompted by issues like the epidemic of opioid abuse, concerns over gun violence, and/or fears related to climate change. Whatever the root causes, it galvanizes citizens who are newly emerging in or were previously disengaged from politics. Fresh faces enter politics and form the leading edge of a shift toward more centrist, pragmatic and collaborative governance. This new generation of political leaders moves the policy debate back toward a middle ground. No longer crippled by political gridlock, the commonwealth is finally able to adopt long-overdue reforms. In turn, Harrisburg rediscovers the art of compromise and shared vision, which in turn enables bold policy decisions on a state-wide scale.

On the energy front, while regional opposition to natural gas drilling continues, legislators leverage this new appetite for political consensus to develop and implement a state-wide energy strategy. Their immediate goals are to optimize the potential of economic growth from production of the commonwealth’s natural gas and to address the environmental footprint of our energy system.

Over time, abundant natural gas resources merge with a new political pragmatism to achieve reasonable – if imperfect – accommodation over revenue sharing and policy direction. Pennsylvania promotes the use of natural gas as a fuel and feedstock to regenerate economic activity, and to grow energy-intensive industries that create new jobs as well



as a critical mass of “heavy” industries, like petrochemicals, that support a range of additional “downstream” manufacturing enterprises.

Pennsylvania’s energy strategy also recognizes the critical link between energy generation and sustainable prosperity. This includes more strategic public and private investments in new entrepreneurial technology and innovation ventures, and programs to upgrade workforce education and training. Over time, the gap is bridged between primary research, where Pennsylvania’s world class universities have long excelled, and the commercialization of new products and technologies where capital is invested, and new economic opportunities are brought into the market.

Despite identifying the need to address carbon as part of the agreement reached to support Pennsylvania’s energy strategy in the 2020s, there is not a marked impact on the frequency and severity of weather-related events. There are increasing calls among the public for government to address them. During this time, the polarizing ideological tension around the issue of climate change eases as consensus builds around the practical need for the commonwealth to maintain diversity in its energy system, to compete in a low-carbon energy economy, and to hedge against the potential long-term impact of destructive weather events.

This consensus supports the near-term attractiveness of natural gas as a lower-carbon alternative to coal. And it creates more robust market space for renewables like wind and solar. Eventually, Pennsylvania leads a region-wide PJM carbon trading program that creates economic incentives for greenhouse gas reductions.

What’s more, the spirit of political compromise and pragmatism leads to a rapprochement between environmentalists and the nuclear industry leading to a new – if modest – lease on the life of the commonwealth’s fleet of nuclear power plants.

#### **Uneven waves of progress (2030s):**

By the end of the 2020s, the commonwealth’s stable, long-term policies, carefully-managed revenues,

and investments in technology and innovation have attracted enough venture capital and Generation Z talent to position Pennsylvania as a global player in the “4<sup>th</sup> industrial revolution” – the common tag for an economy driven by digital automation, artificial intelligence, internet of things and cognitive computing.

Pennsylvania is well-prepared to innovate and compete in the marketplace of products, services and ideas.

Despite progress, by 2030, the call for climate action in Pennsylvania intensifies. This sentiment is mirrored at the global and federal levels, which results in significant and sustained investment in CCUS research – leading to lower costs and more effective technology.

Tighter caps are established in PJM’s carbon trading program. Pennsylvania, with its vast and varied geological resources, becomes a hub for CCUS deployment, resulting in measurable improvements in atmospheric carbon dioxide. Renewable energy has also been ramped up and further integrated into the power sector.

The power grid grows and transforms, with new business models that drive decarbonization and efficiency which, in turn, enables a significant move towards electrification of cars and trucks. Smart grids more fully evolve to channel resilient and efficient power to consumers at a state-wide scale. The grid supply mix is diversified, comprising natural gas, nuclear and an increasing share of renewables, with technology improvements in energy storage unlocking greater opportunities for renewables in the energy supply mix.

The natural gas industry continues to operate in the state. It remains a major producer, consumer and exporter. The energy strategy enacted in the 2020s results in more in-state use of natural gas for energy intensive industries and manufacturing operations. Debates over the best long-term use of natural gas continue, but exports help support in-state use of natural gas over the long term.

The coal industry has slowly dwindled as the fuel costs and policies to address carbon mean it is



no longer competitive in Pennsylvania's energy generation mix.

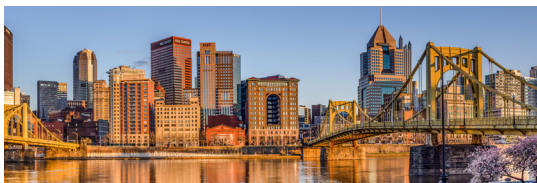
Over time, the wealth generated from natural gas production becomes less important to the economy than the human wealth of venture capital, intellectual capital and digital capital – which focus economic activity even more on concentrated hubs of innovation and investment.

However, the benefits of this burgeoning Rivers future are not equally distributed. Prosperity tends to adhere to large – or specialized – cities geared up for this global digital economy. Automation and AI creates new jobs, but not everyone has access to these new opportunities, especially those who lack access to the educational resources and innovation hubs necessary to develop fundamentally new skill sets. Strategic workforce initiatives become important to providing career ladders and employment pipelines.

In short, Pennsylvania's major cities are becoming an attractive place for capital, customers and highly skilled workers. They become a destination of choice for young talent immigrating from across the U.S. and the world.

But urban revival is leaving some rural communities behind. The gap could widen further as the state focuses its wealth and resources on marketing itself as a globally competitive player.

**Surging ahead (2040s):**



In a Rivers scenario, Pennsylvania approaches the middle of the century with a thriving, cosmopolitan political and economic culture.

It also leads the global energy transition as its abundant natural gas helped serve as a “bridge” to a diversified, efficient and low-carbon energy economy.

It is also better prepared to deal with natural disasters – including storms, flooding, and rising sea levels – thanks to more resilient infrastructure and a diversified energy system.

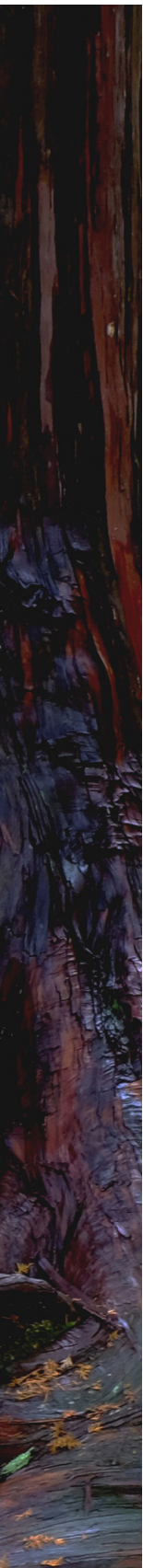
Or at least that's the view from the cities that connect with the global market. In the sparsely populated, more remote towns and villages the view is less vibrant. Wealth generated in the 2020s and 2030s by natural gas brought some respite to rural Pennsylvania – enough to quell the furious eruption of populism of the 'teens.

But growth in these regions has subsided again even amid the 4<sup>th</sup> industrial revolution. There are pockets of the petrochemical industry supporting the urban economies, but they are just that – pockets. Foundational education, training and entrepreneurial capital often fail to escape the gravitational pull of the cities. Many are still left behind, by geography or lack of opportunity and training.

In the “go-go” forties of Rivers, it may be time for Harrisburg to think again about how to balance the pursuit of growth with the well-being of all the commonwealth's people.



# ROOTS



# IV Roots

“All things must come to the soul from its roots, from where it is planted.”

– Saint Teresa of Avila

In the Roots scenario, macroeconomic growth is tempered, and both federal and state politics remain gridlocked. As Pennsylvania’s unfunded pension liabilities grow, critical infrastructure funding gets slashed and the commonwealth’s credit rating suffers. Pennsylvanians respond by trying to strengthen focus on their own communities, some of which do better than others. Pennsylvania relies on its tightly woven world of relationships and places strong value in finding local solutions. The locus of problem solving shifts from top-down federal and state policies to localized collaboration and innovation.

- Continued political gridlock in Harrisburg means deepening state deficits and chronic underfunding for critical infrastructure, like roads and bridges
- Pennsylvanian civic life is strongly cultivated in local communities, giving rise to a patchwork of differing priorities and relationships across the state
- Slow U.S. economy and weak state-level policies constrain Pennsylvania’s economy and additional pipeline infrastructure for Pennsylvania natural gas is halted; more Pennsylvania energy moves to export markets by wire rather than pipelines
- Natural gas resource benefits are localized and variable; forward-thinking communities grow energy self-sufficiency through distributed generation, renewables, electrification, and smart grids
- Entrepreneurial businesses continue to emerge and some flourish, but Roots sees Pennsylvanians turning inward out of necessity, valuing

community social cohesion over global economic competitiveness

## Fertile ground:

Where Rivers describes a Pennsylvania that confronts political crisis to become outward-looking and globally ambitious, Roots imagines a future that returns to more traditional strengths and where Pennsylvania’s citizens have few alternatives but to solve problems at the local level. In doing so, Pennsylvania is represented by a patchwork of economic, cultural and social priorities.

The opening scenes of Roots are as familiar as Rivers – political gridlock and animus, economic uncertainty, chronic statewide fiscal crisis. But here, occasional attempts at compromise and reform fail to bridge the distance between opposing parties. No catalyst emerges to break the stalemate, which in turn prevents the commonwealth from developing a long-term vision and, together with an anemic national economy, weighs persistently on its growth.

Yet deep in the commonwealth’s cultural soil lies a history of self-reliance and stubborn local independence; behind the fraying institutional and physical infrastructure are the attributes of cohesive communities, small-town intimacy, local civic engagement and creative problem solving.

A Roots future focuses less on building global competitiveness through Harrisburg, Pittsburgh, Philadelphia and beyond – and more on recovering and relying on its local community virtues and preserving Pennsylvania as a good place to live.

## Grounded outlook (2020s):

In a Roots future, development of Pennsylvania’s natural gas continues. However, the commonwealth lacks a state-level policy framework for using natural gas as a catalyst for industrial growth and large-scale transformational investments for deep decarbonization, like CCUS, or next generation nuclear.

Instead, natural gas blindly chases the market, with some unintended consequences. In the 2020s, the full benefits of natural gas production have not yet been realized for Pennsylvanians and disagreements about natural gas arise. More landowners resent attempts to



construct pipelines on their property, and as a result most new pipeline projects are cancelled. It becomes easier for Pennsylvania's natural gas to be transported to newly built plants where it is used to generate electricity and then exported "by wire" to other locations. The abundance of inexpensive natural gas used to generate electricity continues to accelerate coal's decline; and undermines the viability of zero-emissions nuclear energy. Our laissez-faire reliance on abundant natural gas creates little incentive for the development of energy diversity.

Pennsylvania's statewide economy drifts and there is little in the way of job creation. Without adequate and properly managed revenues to address a persistent budget deficit, the commonwealth is unable to invest in critical infrastructure – roads, bridges, ports, public works. Businesses see uncertain policy and therefore limit their spending and investment to lower risk enterprises like natural gas power plants.

In some communities, natural gas has played a role in strengthening local budgets through impact fees and providing a moderate boost for local enterprises that create jobs. During the 2020s, the sluggish economy reduces demand and associated income for many businesses, including natural gas drilling. Municipal governments in some areas of the commonwealth find their budgets stretched. Local success increasingly depends on good governance, and some areas lacking natural gas resources and/or effective civic engagement struggle – a problem that persists in the absence of proactive state government.

As the twenties fail to produce effective policy in Harrisburg, frustrated leaders in towns, rural counties, suburbs and small cities step in to seek local answers. Self-reliance in enterprise, services, and, increasingly, energy becomes their goal.

The most creative of these leaders successfully promote local citizen-owned companies to provide services, including energy. Distributed generation, community solar and wind projects – supported by creative local public-private financing models – are a way to increase self-sufficiency, protect land, and reduce the risk of power failures during natural disasters.

Around this time, several powerful weather events hammer the United States – including Pennsylvania – with hurricanes, tornadoes, and floods. The federal government, responding to unsustainable deficits compounded by increased demands for federal funding to address damage from extreme weather, leaves national lawmakers with few options. The costs to recover from multiple, unrelenting weather events that cause widespread emergency response operations and disaster-related property damage puts a strain on federal and state funding to help communities recover. Although the link between weather-related events and climate change is still being debated by some, the public overwhelmingly concurs that these pressing catastrophic issues must be addressed and heightens concerns to the national level. The fundamental need to find a revenue solution for addressing weather-related events, and persistent push to address climate change with environmental policy coalesce. As a result, Congress imposes a federal carbon tax as a means of addressing these recurring events that require billions of dollars to remedy, and consequently takes action on climate. This action provides some fiscal relief, and ultimately makes renewables more cost competitive.

However, it falls to Pennsylvania's local civic and governmental leaders to shape sustainable energy strategies that enhance the resilience of their towns and cities to weather events.

The success of these efforts is a product of good governance – management, initiative, and a willingness to work with neighbors and new ideas. A patchwork of local alliances and collaboration develops. Voting patterns ultimately change, with loyalties near the commonwealth's boundaries shifting towards regional neighbors.

#### **Deepened connections (2030s):**

In the Roots scenario, a decade of modest growth has reduced Pennsylvania's budgets to protracted austerity, and Harrisburg becomes less and less relevant to the commonwealth's towns and small cities.

Pennsylvanians continue to stay within their own corners, and younger citizens move out of state for better opportunities in more progressive cities. Those who remain see benefits from investing





in themselves and see renewed value in their local communities.

Green shoots of local entrepreneurship – which initially emerged as a last resort for economic opportunity – begin to flourish as a source of community pride and connection. Many small employee-owned enterprises grow. Stronger relationships keep business local and personal. Not everyone agrees with this new way of life – critics say it is narrow minded and isolated – but most Pennsylvanians are comfortable feeling grounded, connected and self-sufficient. Innovative small businesses serving regional markets become the hallmark of Pennsylvania’s economy.

During the 2030s, there is a renewed interest in farming. In the Roots scenario, agriculture – a major industry in Pennsylvania – becomes stronger as we find opportunities to fill food supply shortages occurring in other areas disrupted by climate. We retain and grow our commercial farms that produce commodity crops, and idealistic young people who stay in Pennsylvania rediscover the value of land and experiment with small-scale agriculture. A regional effort is initiated on small farms, especially near upscale population centers, to provide local and specialty produce that support the in vogue “buy local” mentality.

Because of a strong focus on land, there are more efforts in the 2030s to protect and restore open spaces as communities turn to green solutions to address the impacts from flooding induced by more frequent and severe weather events.

As initiated in the 2020s, customers continue to supplement the more expensive and less reliable electric grid with newer and cleaner local power options. Using the levers within their reach, combined with the inherent advantages of a federal carbon tax, they turn to fees collected from the establishment of a new type of municipal improvement district to fund local, low-carbon distributed energy systems. There is also a concerted, albeit localized effort to seek new technologies in community-scale solar and energy storage solutions. These shifts prompt new economic challenges with Pennsylvania’s cen-

tralized transmission system.

In short, social capital supersedes financial capital as the currency of Pennsylvania’s quality of life and aspirations.

#### **A world of relationships (2040s):**



By 2040, Pennsylvania still relies on fossil fuels for some 80 percent of its energy, but total energy consumption has fallen by over 25 percent – mostly due to slow economic growth. Nuclear energy is a fraction of its former self, with renewables now serving much of the smaller residential and commercial sectors.

The mid-century generation of Pennsylvanians – far removed from Harrisburg and even further from Washington, D.C. and the global marketplace – has turned 20 years of frustration with ineffective state government into a quiet pride in the communities they have created. While success is uneven across the commonwealth, Pennsylvania is now known for its small-town cohesion, local resilience and community-scale innovation.

But this acceptance of simple back-to-the-earth civic virtues poses longer-term challenges for the following generation of Pennsylvanians. Slower economic growth, along with a lack of investment in critical infrastructure, creates few opportunities for renewed growth and job creation; and the considerable decline in Pennsylvania-based energy demand – coupled with a substantive increase in exported electricity to other places – creates tensions over the economic value of our energy resources.

Citizens born around 2018 are coming of age with little memory of the political polarization that pushed their parents down the path of slower growth in exchange for cohesive community building. They represent a new wave of restless ambition – keen either to move away from their home state or to shake up its culture and economy.



# Summary

Scenarios are tools for focusing discussion, developing shared vision and determining strategy. We hope our two scenarios – Rivers and Roots – have presented plausible snapshots of two possible futures and expanded our collective understanding about how we might better guide change and develop strategy as we approach what is next for Pennsylvania.

Rivers and Roots are intended to increase our readiness for an uncertain future – they allow us to develop more extensive insight into the underlying drivers of change and challenge a myopic view of our future by instilling a deeper appreciation of the myriad factors that could, indeed shape it.

In the next year, we will discuss Rivers and Roots with numerous stakeholders - governments, associations, non-profits, businesses and universities - to spark conversation, gain critical input, and perhaps even arrive at a common understanding that will help shape Pennsylvania's long-term energy future.

We invite you to join the discussion.



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To learn more about Pennsylvania Energy Horizons:  
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