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Important Dynamics and Considerations

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Important Dynamics and Considerations

While the roadmap lays out a clear path for Pennsylvania to strengthen its competitiveness in energy, data centers, and AI, there is also a set of complex and interconnected issues that can accelerate progress, slow it down, or reshape outcomes entirely. These are the "important dynamics and considerations." For many stakeholders, these issues are the ones that most directly shape their decisions and priorities.

They include permitting reform, the role of PJM, financing structures, energy sources, talent gaps, community buy-in, manufacturing supply chains, water and land use, and the tax implications of large-scale infrastructure investment. Each of these topics could stand on its own as a major policy paper, and many are already the focus of work by organizations across Pennsylvania and nationally.

In the context of this roadmap, these dynamics and considerations act as critical dependencies to the core strategies and actions, elevating the complexity of the moment and opportunity. At times they may provide opportunities to accelerate progress; at other times they may present barriers that must be addressed before forward movement is possible.

What follows is a set of concise write-ups for each consideration. They are not exhaustive but serve to recognize the issues, reflect stakeholder input, and outline the implications for Pennsylvania's ability to execute on the core roadmap. For readers who are most concerned with one of these areas, the details provide a clear entry point into how it connects to the larger strategy.

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Consumer Protection

Data center development, along with expanded domestic industrial manufacturing and electrification of transportation and building HVAC markets, is increasing expected demand for power, with estimates from the North American Electric Reliability Corporation and the Federal Energy Regulatory Commission projecting demand growth rates not seen in fifty years. Large load users present both an opportunity to manage grid costs by increasing utilization of assets that otherwise are used only in times of higher demand, but may present a challenge and potentially increase costs if their operations push up peak demand, which is when the system is exponentially more costly. Well-designed approaches to encourage flexible operations of large loads, increasing the availability of firm power capacity, and assuring fair cost allocation for new infrastructure can reduce cost pressures on ratepayers and avoid erosion of social license for this industry.

Public utility regulators in Indiana and Georgia have reached settlements with data center operators and consumer advocates with the goal of protecting ratepayers from the costs of the infrastructure needed to serve the data centers. Grid operators in Texas, PJM, and other jurisdictions are advancing proposals to encourage more flexible operations of data centers to keep them off peak hours so as to improve overall system efficiency and minimize cost increases. The Pennsylvania Public Utility Commission also has a pending rulemaking to address these issues in regulated electric utility tariffs. Well-designed approaches to encourage flexible operations of large loads can reduce cost pressures on ratepayers and avoid erosion of social license for this industry.

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Data Center Economic Impacts

Despite the recent surge in proposed data centers in Pennsylvania, broader economic impacts and tax implications particularly at a local level remain largely undefined. While property tax revenues may arise from land and buildings, the equipment housed within data centers is exempt from local property taxes, reducing the full potential fiscal impact for host communities. Still, for some communities, re-investment in older sites, or investment in new sites may provide a needed and sizable boost if the local industrial market is relatively stagnant. Sales and use tax effects at the state level are also uncertain, as are the total capital investments and employment numbers, which vary significantly by site. Rather than expecting each municipality to model these complex factors on their own, Pennsylvania would benefit from independent regional or statewide economic analyses that offer consistent, transparent projections. These analyses are especially important in the short term, as new projects continue to emerge and communities seek clarity on the true value of hosting this infrastructure.

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Demand-Supply Alignment

Balancing energy supply with evolving demand from data centers and AI infrastructure is one of Pennsylvania's most pressing challenges. This roadmap emphasizes the need to avoid building infrastructure simply for the sake of building. Instead, new generation, transmission, and data center assets must be strategically aligned with demonstrated and growing demand.

Market forces already limit the potential for overbuilding, since excess energy can often be sold into PJM and data center operators are typically contractually obligated for infrastructure costs. In this sense, developers are already positioned to internalize much of the risk, and state policy should continue to ensure that large-scale users bear responsibility for the infrastructure they require.

The greater risk to Pennsylvania lies not in overcapacity but in ensuring the right amount of strategic investment. PJM is experiencing a widening gap between projected peak demand and available supply due to rising AI loads, electrification, and retirements of existing generation. Addressing this risk requires timely additions of new generation capacity, modernization of the grid, and more accurate and transparent load forecasting. Improvements may include a return to integrated resource planning, stronger state-level oversight, and collateral commitments from developers to minimize uncertainty.

To guide these efforts, Pennsylvania should prioritize modular data center design, encourage the repurposing of existing infrastructure, and create mechanisms for coordinated oversight. A statewide coordination office or ombudsman, with expertise on the rapidly evolving technology and efficiencies, could play a vital role in aligning capacity expansion with actual demand. By pursuing this approach, the commonwealth can ensure reliability, affordability, and competitiveness while seizing the opportunities created by AI and data center growth.

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Infrastructure, Water, and Land Use

"Shovel-ready" means more than just available land. Competitive sites require reliable water and wastewater capacity, robust broadband and fiber connections, and firm, affordable power with clear interconnection options. Electricity and water remain immediate bottlenecks, while broadband and fiber expansion can extend benefits beyond a single project. Pennsylvania should map where water, power, and fiber converge and target upgrades that unlock multiple projects and broad benefits.

Data centers, in particular, demand large parcels of land and significant water for cooling, which can create conflicts with agriculture, residential development, and climate resilience. Careful siting and planning are essential to balance cooling technologies, hydrology, seasonal demand, and stormwater management, while coordinating permits across agencies. Brownfield and industrial sites can reduce conflicts and costs and pairing buildout with broadband extensions can close digital gaps in surrounding areas.

Parallel strategies such as substation upgrades, on-site or adjacent generation, and grid investments can ease long interconnection queues and transformer backlogs. Communities that host projects should see clear benefits, whether through infrastructure improvements, broadband access, or conservation set-asides. Impact fees or community benefit agreements can support water and wastewater upgrades, while transparent engagement with municipalities on resource sharing builds trust. Thoughtful planning across infrastructure, water, and land use will reduce opposition, accelerate approvals, and ensure growth that strengthens rather than strains communities.

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Large Tech Companies Focused on Immediate-Term Gains

Hyperscale developers today are prioritizing speed and short-term siting needs to meet their own goals and targets. Pennsylvania must ensure that these immediate projects also contribute to long-term public value. Clear expectations should be set at the outset: developers seeking expedited approvals should also invest in local talent pipelines, infrastructure that benefits communities, and community benefit agreements. Risk-sharing strategies can make this work more attractive for investment and collaboration. For example, flexible demand programs allow energy-intensive users to shift usage during peak hours, reducing costs for both businesses and utilities. Public-private cost-sharing can accelerate needed grid updates. Similarly, creative pilots that capture and reuse heat from data centers can lower operating costs. These types of partnerships align private investment with public benefit, making growth more efficient and broadly supported. Pennsylvania should learn from states where hyperscaler concentration has led to grid strain and community opposition and incorporate lessons learned.

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Local Land Planning/Local Dynamics

Local governments will determine where and how data centers and energy projects move forward in Pennsylvania. Many municipal zoning codes and comprehensive plans were not designed for facilities of this scale, which creates delays and uncertainty for investment. Pennsylvania can help communities that want to host these projects by providing model ordinances, zoning templates, and coordinated timelines that align state and local reviews. A state "no-wrong-door" function (a customer-service model that ensures communities and applicants can access the right contacts and resources across agencies, regardless of entry point) and a regulatory toolkit for local governments would simplify processes and reduce duplication. Communities need to understand trade-offs, benefits, and site realities such as land size, utility and other infrastructure demands. Accelerating brownfield or already-entitled sites may demonstrate benefits more quickly and clearly, and lower risk. Done well, local planning can become an accelerator, not a barrier, by aligning community priorities with statewide strategy and reducing the perception that projects are being imposed.

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Manufacturing Supply Chain

Pennsylvania has a unique opportunity to capture more of the value chain that underpins advanced energy systems and data centers. Localizing production of critical components such as transformers, switchgear, specialized cables, cooling systems, and backup generation equipment both plays to Pennsylvania's manufacturing strengths and drives broader economic impact. Western Pennsylvania already hosts firms like Mitsubishi, Hitachi, GE Vernova, and CorePower Magnetics, with strong capabilities in transformers and electrical equipment, offering a base to build upon. Addressing supply chain delays, particularly the national transformer backlog, should be an early focus, supported by procurement preferences, pooled purchasing, and in-state staging facilities.

Beyond hardware, Pennsylvania can lead by embedding artificial intelligence into manufacturing itself. More than 95 percent of the state's manufacturers are small or mid-sized enterprises (SMEs), and many face barriers in adopting advanced technologies. Team Pennsylvania's proposed AI Manufacturing Scaling Initiative aims to bridge this gap by connecting SMEs to the expertise and resources of tech companies investing in Pennsylvania data centers. Through partnerships, tools, and knowledge sharing, SMEs can adopt AI incrementally to improve efficiency, quality control, and supply chain resilience. This approach will help smaller firms grow into suppliers for data center infrastructure while enhancing their competitiveness in global markets.

Together, these efforts can strengthen Pennsylvania's role as both a supplier and an innovator. By pairing targeted investments in manufacturing capacity with programs that accelerate AI adoption among SMEs, the commonwealth can expand local supply chains, reduce project delays, and generate multiplier effects that reach well beyond the data center industry.

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Measuring Leadership in AI Commercialization

To lead in AI commercialization, Pennsylvania must pair strategic action with measurable results. Leadership will be defined both by the number of patents, licenses, and spinouts, and by how effectively ideas are moved from lab to market, scaled by businesses, and embedded in communities. To accelerate real-world impact, Pennsylvania must prioritize use-inspired research, that is, projects driven by practical problems and industry needs. Strengthening partnerships between businesses and higher education institutions will ensure that research is not only cutting-edge, but also immediately applicable, accelerating the cycle from discovery to deployment. Metrics should reflect the full commercialization lifecycle from early-stage innovation to product deployment, and include start-ups launched, jobs created, industry partnerships, investment attracted, and infrastructure leveraged.

Equally important is the ability to tell a story of broad-based growth. Pennsylvania's strength lies in the breadth of its ecosystem: world-class universities, a resilient manufacturing base, and growing public-private momentum. A strong commercialization scorecard should track outputs alongside ecosystem health, gauging how universities, talent systems, tech accelerators, and community partners are aligning to bring research to life. This balanced approach will help Pennsylvania demonstrate not just progress, but staying power, as it becomes a national hub for applied AI innovation.

Natural Gas

In the last two decades, natural gas has played a central role in Pennsylvania's energy economy, particularly due to the Marcellus and Utica Shale development. The rapid growth of production created significant export opportunities, but it remains an open question whether the commonwealth was able to maximize the downstream economic benefits brought on by shale gas. During that timeframe, large-scale in-state customers were limited to power generation as the market accelerated its shift from coal to natural gas. That landscape may now be shifting as data centers and other high-energy users emerge as potential demand drivers. As activity increases, the question facing us now is what type of coordinated approach can ensure that Pennsylvania fully leverages the broad-based economic development benefits that gas can lead to.

Looking forward, demand for natural gas is expected to increase nationally and internationally, with liquefied natural gas exports and expanded pipeline capacity likely to be important elements of this growth. Pennsylvania faces strategic decisions about the balance between new pipelines, additional transmission lines, or hybrid solutions that can meet both in-state and regional demand. Forthcoming grant opportunities could provide resources to advance these objectives, though success will require long-term planning since major initiatives such as the Regional Energy Transmission Infrastructure effort are measured in decades rather than years.

As demand for electricity increases, the need for additional baseload dispatchable power is anticipated to grow rapidly. For data centers, this type of reliable, on-demand generation remains a top priority in the near and mid-term, even as sustainable and renewable solutions continue to expand and mature. Storage is also becoming an increasingly viable option for backup power at data centers, including the large-scale deployment of new battery technologies. Compared with diesel or other higher-emitting backup generation, storage can reduce CO_2 emissions and, when paired with additional renewable capacity, can offer advantages in both cost and sustainability. Over the longer term, extended-duration storage may also be achieved through green hydrogen production, which can provide greater energy capacity than current battery technology when sited in proximity to data center development.

Because of constraints on gas transmission out of Pennsylvania, there will likely be an ongoing price advantage to converting natural gas resources into power within the state. This dynamic can complement the growth of renewables by providing reliable baseload power and supporting a balanced, resilient energy mix. Additionally, because natural gas already provides a significant share of electricity generation in the commonwealth and could play a larger role as near- and mid-term demand grows, Pennsylvania should consider statewide initiatives to

develop feasible, commercially viable pathways for carbon capture, utilization, and/or storage (CCUS).

Natural gas can also underpin broader economic development strategies. Data centers and industrial facilities that colocate with gas-fired power plants benefit from lower electricity costs, while their presence can attract investment in infrastructure such as broadband and fiber. These digital assets allow energy-intensive industries to connect and grow more efficiently, providing complementary benefits that extend beyond the fuel source itself. Natural gas can also serve as a lower-carbon alternative for hard-to-abate industrial sectors that may exist or co-locate in these same communities, supporting a transition to cleaner operations while maintaining reliability. Emerging fuel cell technologies, which generate power from natural gas without the same emissions associated with combustion, further illustrate the role natural gas can play in moving toward a lower-carbon future. Where feasible, Pennsylvania could also advance carbon utilization from captured CO_2 associated with new power generation, supporting industrial uses including the scaled production of common precursor chemicals and new carbon-based manufactured products.

Marcellus and Utica gas production and transmission are also among the lowest fugitive greenhouse gas emission-intensive basins in the United States and globally. Enhanced statewide initiatives to continue the push to lower methane emissions, aligned with certification of natural gas sourced in Pennsylvania that meets emissions targets, will be key to matching the sustainability goals of data center developers. Pennsylvania natural gas therefore offers an important bridge toward a lower-carbon future, particularly for heavy industry and other hard-to-abate sectors that could co-locate with new power and data infrastructure. Data center developers should also consider the upstream implications of natural gas and potential fugitive methane emissions through procurement choices such as sourcing lower-carbon concrete, including recycled lower-carbon ingredients such as fly ash from past power generation activities. Emerging fuel cell technologies that create power from natural gas without the same emissions profile as combustion may offer an additional pathway for energy security while maintaining reliability.

Behind-the-meter (BTM) gas-fired generation is another important and emerging component of this energy transition. With "speed to power" now a federal priority and many states working to add capacity on accelerated timelines, BTM systems are becoming central to how new capacity is deployed. Pennsylvania currently has nearly 6 megawatts of BTM gas generation, and the largest planned data center campuses are exploring this model. BTM capacity often connects to the grid while retaining the flexibility to provide supplementary power back to it. In some cases, data center operators are beginning to invest directly in upstream gas production

and infrastructure, including wells, pipelines, and compression, which reflects an evolving structure in the energy supply chain. In addition, BTM generation associated with new data center loads could be sited in locations where there is potential CCUS capacity, creating an opportunity to pair fast deployment with an emissions-reduction pathway.

To strengthen the regulatory foundation for long-term CO_2 storage, the Department of Environmental Protection has taken steps to pursue primacy for permitting Class VI CO_2 disposal wells in the commonwealth. To translate this regulatory structure into project readiness, Pennsylvania will also need a more robust assessment of its geologic storage capacity to ensure CO_2 can be stored safely and permanently underground.

Two sizable barriers continue to limit the pace of growth: long permitting timelines for new transmission pipelines and extended lead times for new gas turbines, especially the largest and most efficient models. Addressing these challenges will be essential to realizing the full value of Pennsylvania's natural gas resources.

A key question is how natural gas fits into Pennsylvania's long-term narrative. The past twenty years have seen the majority of Marcellus production exported out of state, with as much as 80 percent of molecules leaving the commonwealth. A different approach, ensuring that more gas stays in Pennsylvania to serve industrial parks and households, could create a more compelling story about natural gas as a foundation for economic growth. While cost competitiveness remains an important factor, the broader opportunity lies in positioning natural gas as one element of a diversified energy and economic development strategy, adding to the near-term energy demands of the commonwealth, supplementing expanding deployment of renewables, supported by infrastructure investment, and aligned with emerging industries such as data centers.

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Nuclear as the Cornerstone of "All-of-the-Above" Energy Approach

Nuclear power stands out as one of Pennsylvania's strongest assets for supporting the growth of data centers and AI-driven infrastructure. It offers clean, firm electricity that can run continuously regardless of weather, making it an essential complement to intermittent renewable sources. With the second-largest nuclear generation fleet in the nation, Pennsylvania already has the expertise, supply chain, and industrial base to build on this advantage.

Nuclear's role is increasingly tied to the needs of hyperscale data centers. Operators such as Amazon, Google, and Microsoft are seeking carbon-free, reliable baseload power, and nuclear energy can meet that demand. Opportunities extend from large reactors and grid-connected facilities to emerging technologies such as small modular reactors (SMRs) and microreactors like Westinghouse's eVinci™, which could provide scalable, on-site power for both large and medium-sized data centers. These modular technologies, once commercialized, would allow Pennsylvania to deploy nuclear solutions more flexibly and at lower cost than traditional large-scale plants.

Crane Clean Energy Center

While the Three Mile Island Unit 2 closure remains a cautionary note, discussions about restarting Unit 1 or repurposing the site highlight Pennsylvania's potential to repower legacy assets.

Talent and Supply Chain

Pennsylvania's nuclear workforce, engineering programs, and supplier networks form a ready-made base to expand into advanced reactors and next-generation nuclear technology.

Local suppliers across fabrication, machining, instrumentation, and maintenance further anchor the nuclear supply chain.

Challenges remain. Nuclear projects require high upfront capital investment, long permitting timelines, and continued attention on safe waste management. Advanced reactors may not be commercially available until the 2030s, meaning they are unlikely to power the first wave of data center buildouts. However, over the long term, nuclear power can deliver durable economic benefits: stable electricity prices, well-paying jobs, and reduced land footprint compared to other clean energy options.

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Positioning nuclear power as a cornerstone of Pennsylvania's "all-of-the-above" energy strategy will enhance energy security, promote resilience, and strengthen the state's leadership in advanced manufacturing.

Pennsylvania's Existing Nuclear Industry

Pennsylvania operates nine nuclear reactors at four plants, providing more than 30% of the state's electricity

BWX Technologies | Mt. Vernon
Manufactures nuclear components and fuels

Constellation Energy | Statewide
Operates multiple nuclear plants statewide, with intent to restart TMI-1 as the Crane Clean Energy Center

Curtiss-Wright | Cheswick
Supplies control rod drive mechanisms, pumps, and valves for nuclear reactors

Framatome | Cranberry Township
Provides nuclear services and fuel technology

Precision Custom Components, LLC | York County
Manufactures large pressure vessels and specialty equipment for the commercial nuclear industry

Talen Energy | Berwick
Operates the Susquehanna nuclear station, producing clean energy for the regional grid

Vistra Corp. | Montgomery County
Owns and operates Limerick nuclear power plant, supporting baseload power generation

Westinghouse Electric Corporation | Cranberry Township
A global leader in nuclear design, SMRs, and advanced fuels

**Non-exhaustive*

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Pennsylvania Tax Structure and Local/State Taxes Broadly

States across the nation are evaluating tax policy to influence where data centers and supporting industries choose to locate. Since 2022, Pennsylvania has offered a Computer Data Center Equipment Exemption Program, which exempts sales and use tax by certified data center owners, operators or tenants. Pennsylvania should evaluate additional tax tools tied to designated regional AI-activation corridors where performance-based abatements or credits could be available to projects generating verifiable community and statewide benefits. At a local level, revenue-sharing or revenue recycling approaches, such as impact fees or credits tied to performance, payment-in-lieu-of-taxes agreements or funding for local infrastructure, could fund notable economic development needs ranging from site preparation, utility upgrades, or training grants in host communities.

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Permitting Complexities and Streamlining

Permitting is one of the most complex and critical steps in developing data centers or energy infrastructure in Pennsylvania. These projects often require a broad range of approvals from local, state, and federal entities, and the process can vary significantly by location, project type, and site conditions.

At a minimum, developers or project owners typically need land use and zoning approvals from local governments to ensure the site is suitable for industrial use. Building permits, demolition permits (for redevelopment sites), and stormwater or erosion control approvals may also be required. If the project involves energy generation, transmission, or heavy electrical load, additional permits from the Pennsylvania Public Utility Commission (PUC), Department of Environmental Protection (DEP), and possibly PJM come into play. These permits might include air quality, water discharge approvals, wetland or stream encroachment, and interconnection studies or agreements for tapping into the electric grid.

The complexity arises not only from the number of permits but from how they interact. Different agencies have different timelines, data requirements, and stakeholder review processes. Local ordinances can add layers of variance or conditional use hearings. For greenfield sites, infrastructure like roads, water, and sewer may need to be expanded, triggering additional review.

Because permitting touches so many systems such as land, energy, water, and environmental impacts, it is often cited as a top barrier to investment. Streamlining, sequencing, and coordinating these reviews is essential to keeping Pennsylvania competitive while ensuring that development is responsible and community-aligned.

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PJM Dependencies

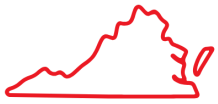
PJM remains one of Pennsylvania's most important assets, providing a large and well-regarded regional transmission organization that attracts investment to the commonwealth. At the same time, the pace of PJM's planning and interconnection processes does not always align with the urgency of data center and AI-related demand growth. Stakeholders widely recognize the need for more timely decisions and greater certainty for investors and utilities.

Pennsylvania should focus on using its position as a major energy exporter within PJM to advocate for reforms that improve planning and interconnection timelines. Recent updates to PJM's rules, including expedited review for shovel-ready projects, mark progress. Additional opportunities include commissioning joint studies with PJM, the U.S. Department of Energy, and the Pennsylvania Public Utility Commission (PUC) to identify priority transmission corridors and better align regional and state-level planning. Utilities also have tools available, including the ability to pursue supplemental transmission projects outside PJM's formal process. While this approach can be complex, it highlights the flexibility already within the system.

Transmission upgrades will be critical, and Pennsylvania should highlight the potential of strengthening existing infrastructure. Utilities such as PPL have shown leadership in this area, offering models that could be replicated more broadly. At the same time, data centers themselves can contribute to grid stability by offering flexible demand services or onsite generation, reducing pressure on the system.

By coupling strong advocacy within PJM with state-led planning, strategic transmission upgrades, and innovative partnerships with data centers, Pennsylvania can ensure that PJM continues to be a driver of reliability and competitiveness as the energy landscape evolves.

Lessons from Other States



Virginia leveraged its role in PJM to attract large-scale data center development, but slow interconnection timelines and grid strain have forced policymakers to revisit incentive and planning frameworks.

Illinois and New Jersey have pursued reforms that allow utilities to accelerate specific transmission projects outside of PJM's formal process, highlighting alternative ways to build to build critical infrastructure more quickly.

Maryland has increased coordination between its state energy office and PJM to better align state policy priorities with regional planning, ensuring that renewable and distributed resources integrate into the grid effectively.

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Renewables and Other Energy Technologies

As Pennsylvania prepares for a dramatic rise in electricity demand from data centers and advanced manufacturing, renewable energy paired with long-duration energy storage (LDES) will be one essential component of the commonwealth's all-of-the-above strategy. For data center developers, speed and reliability remain the top priorities, meaning natural gas, which can deliver firm, dispatchable power quickly and at scale, will continue to serve as the most immediate baseload option while renewables and storage ramp up. Rather than being in competition, gas and renewables can progress in parallel, complementing each other to ensure both rapid deployment and long-term energy security.

Corporate developers continue to signal strong demand for clean, firm power, particularly solar, wind, geothermal, short-term batteries, and longer-duration energy storage, as part of their long-term site selection and sustainability strategies. Yet, while interest and investment are growing, deployment remains uneven. As an aspirational goal, Pennsylvania is looking to increase renewable energy to 35% of total generation by 2035, but achieving this goal will require new policy mechanisms, siting solutions, and permitting efficiencies.

Renewables currently supply approximately 4% of Pennsylvania's electricity, and several barriers must be addressed to scale their role. Permitting remains fragmented and locally driven, particularly for large solar and wind projects that often face local opposition. Many municipalities, represented by groups such as PSATS and CCAP, are cautious about centralized permitting authority and will only engage if tangible, localized benefits are demonstrated. Building social license for renewable projects will require a new emphasis on community-level value through infrastructure investments, tax benefits, and other visible local returns. Community concerns, particularly around land use and long-term local benefit, have slowed development in many rural areas. A more predictable, uniform permitting framework paired with clearer economic and infrastructure benefits for host communities will be critical to earning social license and accelerating buildout.

Examples from other states and regions underscore this need. The Hydro-Québec transmission corridor to New York City succeeded after the project sponsors worked directly with 35 local communities along the route, ensuring benefits and shared ownership were clearly defined. In contrast, projects such as the recent Berwick proposal in Pennsylvania have faced strong opposition in the absence of perceived local gain. Clear, community-centered benefit structures can transform potential friction into support.

At the same time, the technical limitations of today's renewables must be acknowledged. Solar and wind are variable resources, and while batteries and long-duration energy storage technologies are improving, they are not yet widely deployed at the scale or cost necessary to provide firm, 24/7 power. Other states, however, are seeing long-duration energy storage options that can solve for these short term, intermittent issues that Pennsylvania can look to for guidance. For the foreseeable future, renewables will require complementary generation plus LDES to ensure grid reliability, resilience, and system balance.

Other emerging technologies such as hydrogen, biofuels, fuel cells, and long-duration energy storage may play supporting roles, including for industrial use cases, process heat, and behind-the-meter generation. In particular, long-duration energy storage can enhance resource adequacy, solicit capacity payments, and offer ancillary services. However, these options remain early-stage and require continued investment, market development, and policy alignment to become commercially viable at scale.

To unlock Pennsylvania's renewable and firm power potential, corporate power buyers, including data centers and manufacturing partners, must continue to play a catalytic role by signing long-term power purchase agreements that help de-risk projects and attract financing. In parallel, state and regional partners and regulators must work to streamline permitting, strengthen transmission planning, and ensure that renewable development delivers tangible value for local communities.

Renewables and storage technologies are not a silver bullet, but neither are they secondary. With the right enabling conditions, they can serve as essential components of Pennsylvania's energy future to enhance diversity, meet corporate and system demand, and support broader economic and environmental goals in tandem with firm power solutions that can be deployed quickly and affordably.

Social License/Community Buy-In

Securing community support will be essential to Pennsylvania's long-term success in attracting data centers and aligning them with broader economic development goals. Community Benefit Agreements (CBAs) provide one pathway, but they must be designed carefully to balance consistency with local flexibility. Standardization can help establish baseline expectations, yet each community has unique needs that should be addressed through negotiation and dialogue.

Fundamental elements of effective CBAs include commitments to talent strategy, particularly creating pathways to the middle class through apprenticeships, training centers, and partnerships with community colleges or trade schools. Agreements should also address broader issues such as energy cost containment, local infrastructure improvements, and the use of new tax revenues to fund community priorities. Lessons from other sectors, such as Pennsylvania's landfill impact fee model, show that it is possible to combine a standardized framework with room for municipalities to negotiate additional or alternative benefits.

At the same time, CBAs should not be the only tool. Local governments will need to revisit comprehensive plans and zoning ordinances to determine where data centers fit within their long-term vision. Communication between municipal officials and developers will remain critical at every step. Community buy-in will depend on whether residents and businesses can see real, lasting benefits from having high-performance computing infrastructure in their region. Data centers on their own may not create many direct jobs, but they can serve as anchors for broader innovation ecosystems from powering advances in sectors like energy, agriculture, life sciences, and manufacturing to supporting research and enabling local startups. An opportunity lies in intentionally connecting what happens inside these facilities to the surrounding economy, even through indirect or downstream activity. By linking data center development to tangible local outcomes and creating clear but flexible frameworks for community benefit, Pennsylvania can strengthen trust, minimize opposition, and ensure projects deliver shared prosperity.

Resources for Community Benefit Agreements:

https://www.wri.org/insights/community-benefits-agreements-us-clean-energy

https://climate.law.columbia.edu/content/community-benefits-agreements-database

Workforce/Talent Pipeline Gaps

Pennsylvania's challenge is both skills and scale. The state must train more people for construction trades, high-voltage work, controls engineering, and data center operations, while also attracting specialists in AI and advanced computing. To date, both Google and Amazon have announced broad workforce development initiatives as part of their commitments to investment in the commonwealth, opportunities that should be fully maximized. Pennsylvania should consider a statewide talent council, regional readiness assessments, and shared metrics that track completions, placements, and wage growth. Expanded apprenticeships, micro-credentials, and co-ops should connect students to in-demand roles. Community colleges, universities, and unions can co-design training programs using existing facilities and labs.

Just as important, Pennsylvania must embed AI literacy and technical exposure across the entire talent pipeline, starting in K–12 and continuing through higher education and adult learning. Preparing for an AI-enabled economy is no longer optional. It is foundational to long-term workforce competitiveness.