Road Map for the Deployment of Carbon Management and Hydrogen Projects in the Commonwealth of Pennsylvania

October 2022

PA Energy Horizons Cross-Sector Collaborative

Prepared by the Great Plains Institute Carbon Management Team on behalf of Team Pennsylvania

TEAM PENNSYLVANIA

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Discussion Items

- Deployment potential
- Main Issues
- Next Steps

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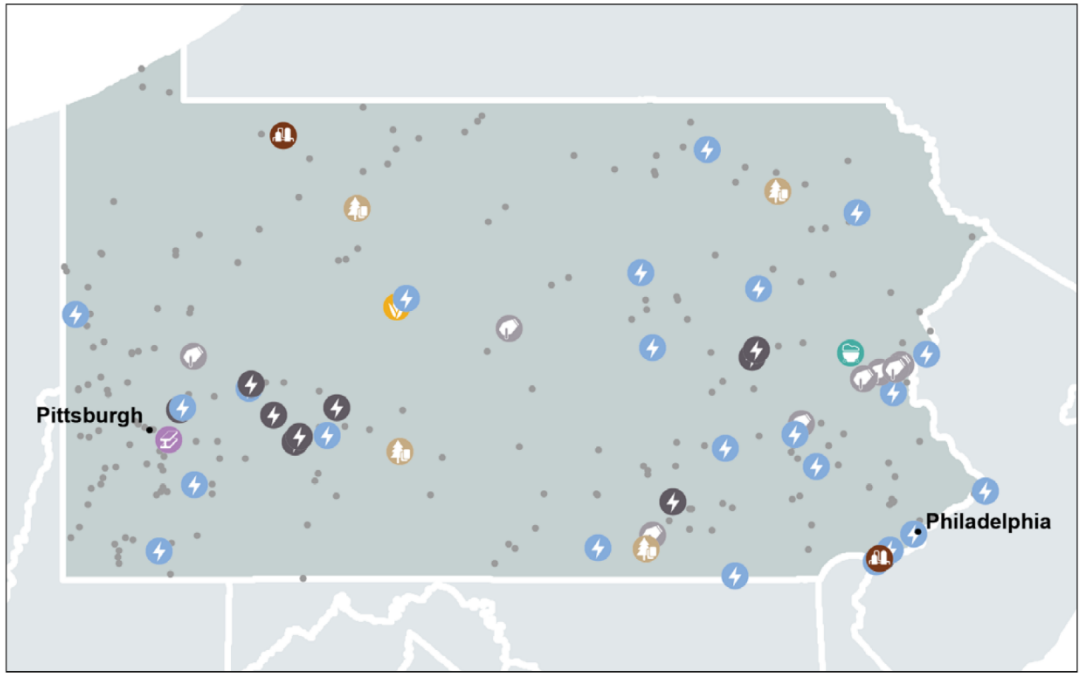
Pennsylvania's Carbon Management Deployment Potential

Pennsylvania has a large potential capacity for CO_2 storage, estimated at 88.5 billion metric tons ($GtCO_2$), or roughly 300 years of Pennsylvania's CO_2 emissions.

- Section 45Q of the US Tax Code provides a financial incentive for the capture and long-term storage of CO_2
- Fifty facilities in Pennsylvania are eligible for 45Q and account for 89 percent of all emissions from stationary combustion sources in Pennsylvania*
- Twenty-two facilities of the commonwealth's 45Q-eligible facilities are identified as near-term capture opportunities

45Q-Eligible Facilities in Pennsylvania



Source: Figure authored by Elizabeth Abramson, 2022. Based on data from EPA GHGRP, 2020.

45Q-eligible facilities

Cement & lime
Coal power
Ethanol
Gas power
Metals, minerals & other
Pulp & paper
Refineries
Steel
Waste
Additional emitting facilities

**The modeling developed for this Road Map was conducted prior to the signing of the Inflation Reduction Act, which provides several changes to the 45Q tax credit.*

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Pennsylvania's Carbon Management Deployment Potential

45Q-Eligible Facilities*

Sector	Number of facilities	CO_2 emissions MMTPA CO_2	Potential capture quantity MMTPA CO_2
Cement	8	3.9	3.3
Coal power plants	9	24.4	20.8
Ethanol	1	0.2	0.4
Gas power plants	23	44.4	34.7
Metals, minerals & other	1	0.9	0.1
Pulp & paper	4	2.7	1.0
Refineries	2	1.8	0.4
Steel	1	3.5	1.0
Waste	1	0.9	0.8
Total	**50**	**81.8**	**62.4**

Near-term Capture Opportunities

Sector	Number of facilities	CO_2 emissions MMTPA CO_2	Potential capture quantity MMTPA CO_2
Cement	3	2.0	1.7
Coal power plants	5	18.5	15.9
Ethanol	1	0.2	0.4
Gas power plants	9	18.1	14.2
Pulp & paper	1	1.0	0.6
Refineries	1	1.1	0.3
Steel	1	3.5	1.0
Waste	1	0.9	0.8
Total	**22**	**45.4**	**34.7**

**The modeling developed for this Road Map was conducted prior to the signing of the Inflation Reduction Act, which provides several changes to the 45Q tax credit.*

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Two Scenarios: Near-Term & Midcentury

Near-term carbon capture opportunities scenario

Source: Figure authored by Elizabeth Abramson, 2022. Based on results of the SimCCS model and data from EPA GHGRP, 2020; NATCARB, 2015; SCO_2T, 2020.

Optimized transport network for near-term CO_2 capture and storage

- Regional CO_2 infrastructure (modeled)
- Potential CO_2 storage area

Geologic storage opportunity

- Assessed low-cost saline storage
- Saline CO_2 storage formation

Capture sources

- Cement & lime
- Coal power
- Ethanol
- Gas power
- Pulp & paper
- Refineries
- Steel
- Waste

Midcentury carbon capture opportunities scenario

Source: Figure authored by Elizabeth Abramson, 2022. Based on results of the SimCCS model and data from EPA GHGRP, 2020; NATCARB, 2015; SCO_2T, 2020.

Optimized transport network for midcentury CO_2 capture and storage

- Regional CO_2 infrastructure (modeled)
- Potential CO_2 storage area

Geologic storage opportunity

- Assessed low-cost saline storage
- Saline CO_2 storage formation

Capture sources

- Cement & lime
- Coal power
- Ethanol
- Gas power
- Metals, minerals & other
- Pulp & paper
- Refineries
- Steel
- Waste

Next Steps Prioritized

The Road Map presents issues with longer implementation times first. All steps should address environmental justice concerns during their respective processes.

- Update & Revise PA's Statutory Framework
- Apply for UIC Class VI Primacy
- Consider Regional Approaches (intra- and inter-state opportunities)
- Prepare for DOE Hydrogen Hubs
- Solicit Bipartisan Infrastructure Law (BIL) Funding
- Commission Future Studies
- State-wide Digitization of Geologic Data
- Comment and Engage Where Possible
- Use/Acceptance of Standards and Best Practices

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Statutory Framework

Immediately commission a study to address the statutory issues necessary for full scale deployment of carbon management, including:

- Pore space ownership
- Define CO_2 ownership, from capture to post-closure
- Establish or confirm mineral rights primacy
- Define how subsurface activities will be coordinated and establish unitization or amalgamation rules/thresholds for CO_2 storage reservoirs
- Establish CO_2 stewardship requirements for each stage of a carbon storage project
- Establish an organization within the state government to administer and provide the statute and regulations to enforce CO_2 storage activities and regulate projects
- Establish a stewardship fund to administer CO_2 storage projects and provide for long-term stewardship needs post-closure

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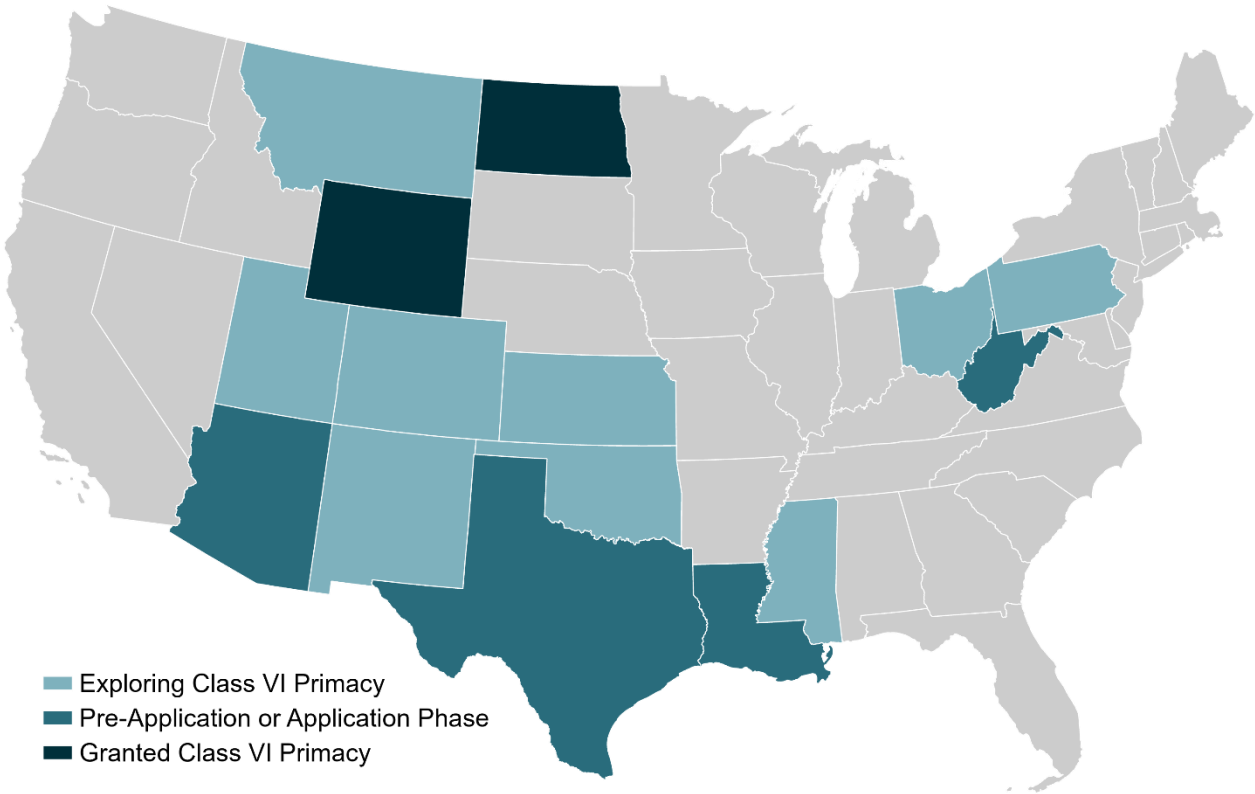
Apply for Class VI Primacy

Determine State interest in:

- Controlling the timing of the review of Class VI permits
- Obtaining the human and technical resources needed to review Class VI permits

Determine commonwealth willingness to make legislative and statutory changes necessary to apply for primacy of the UIC Class VI program, including:

- Program startup to address unavoidable delays between the approval of permits and actual operation of permitted wells such that the EPA funding will be necessary.
- Training to provide the additional support for the hiring and training of commonwealth Class VI personnel
- Submit, as requested by EPA, a request letter for commonwealth access to BIL funds to support primacy.



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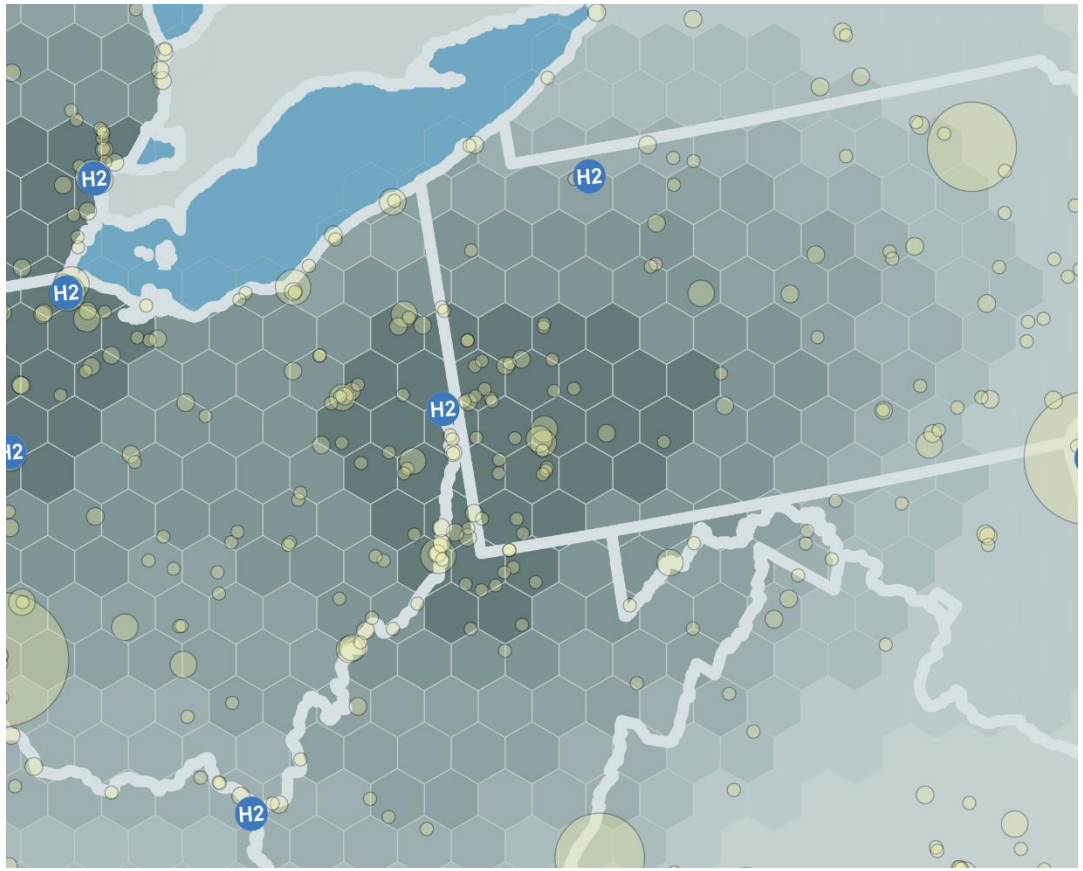
Consider Intra- & Inter-State Opportunities

Pennsylvania can connect northeastern US emission sources with low-cost, high-capacity geologic storage in the Ohio River Valley. This is the only mechanism to allow states to partner and cross borders.



- These efforts, including the upcoming BIL hydrogen hub funding opportunity announcement (FOA), will require predetermined discussions, decisions, and execution of agreements defining these inter-state relationships.
- The entity submitting a response to the hydrogen hub must be a corporation or agency capable of actioning the tasks required by the FOA (pursuant to the RFI and NOI released by DOE).

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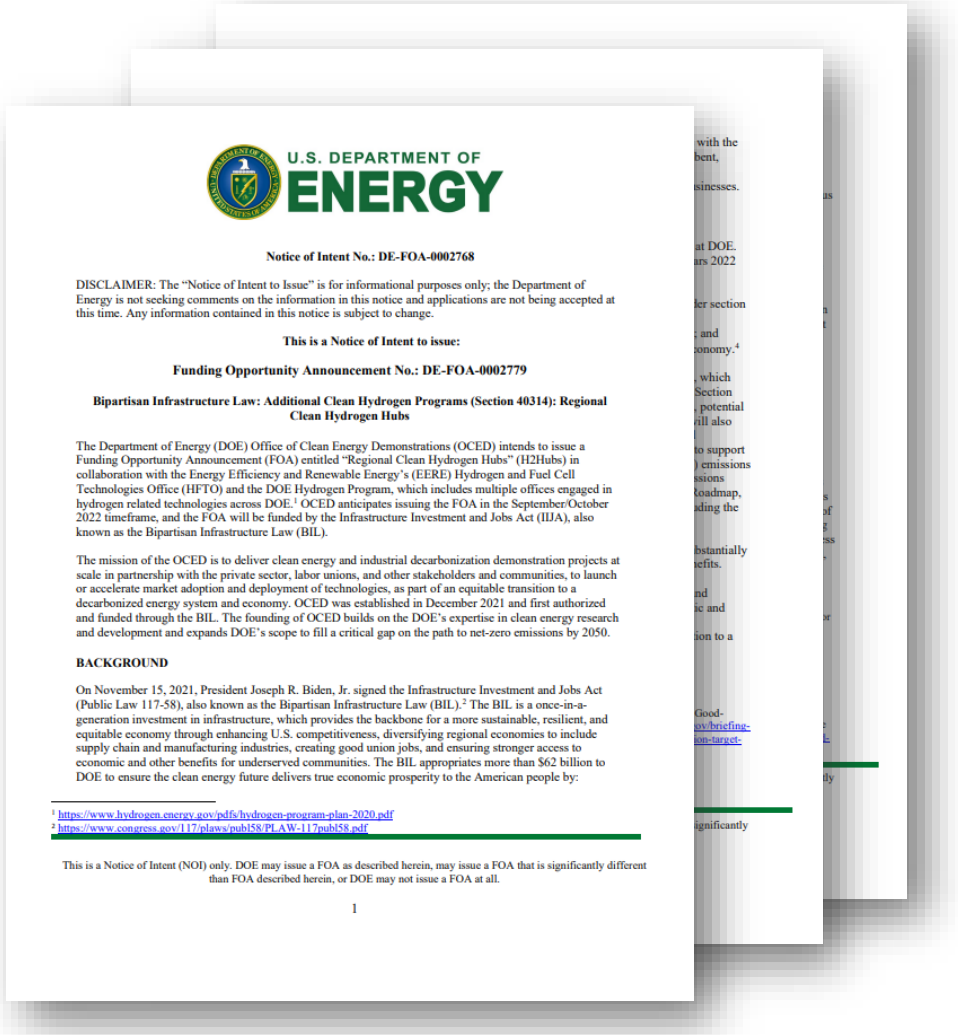
Prepare for DOE Hydrogen Hubs FOA

The commonwealth does not have the agreements and structures in place to be an applicant compliant with the Funding Opportunity Announcement (FOA).

- The DOE released the H2Hubs FOA (DE-FE-0002779) on September 22, 2022.
  - Concept Paper due November 7, 2022.
- Immediately identify any teaming partners, likely neighboring states, and prepare the necessary agreements, MOUs, and structures to allow the commonwealth to engage as a prime partner.
- Immediately prepare the commonwealth as a possible submitter in the event the commonwealth must submit as a stand-alone entity.



U.S. DEPARTMENT OF ENERGY

Notice of Intent No.: DE-FOA-0002768

DISCLAIMER: The "Notice of Intent to Issue" is for informational purposes only; the Department of Energy is not seeking comments on the information in this notice and applications are not being accepted at this time. Any information contained in this notice is subject to change.

This is a Notice of Intent to issue:

Funding Opportunity Announcement No.: DE-FOA-0002779

Bipartisan Infrastructure Law: Additional Clean Hydrogen Programs (Section 40314): Regional Clean Hydrogen Hubs

The Department of Energy (DOE) Office of Clean Energy Demonstrations (OCED) intends to issue a Funding Opportunity Announcement (FOA) entitled "Regional Clean Hydrogen Hubs" (H2Hubs) in collaboration with the Energy Efficiency and Renewable Energy's (EERE) Hydrogen and Fuel Cell Technologies Office (HFTO) and the DOE Hydrogen Program, which includes multiple offices engaged in hydrogen related technologies across DOE.[1] OCED anticipates issuing the FOA in the September/October 2022 timeframe, and the FOA will be funded by the Infrastructure Investment and Jobs Act (IIJA), also known as the Bipartisan Infrastructure Law (BIL).

The mission of the OCED is to deliver clean energy and industrial decarbonization demonstration projects at scale in partnership with the private sector, labor unions, and other stakeholders and communities, to launch or accelerate market adoption and deployment of technologies, as part of an equitable transition to a decarbonized energy system and economy. OCED was established in December 2021 and first authorized and funded through the BIL. The founding of OCED builds on the DOE's expertise in clean energy research and development and expands DOE's scope to fill a critical gap on the path to net-zero emissions by 2050.

BACKGROUND

On November 15, 2021, President Joseph R. Biden, Jr. signed the Infrastructure Investment and Jobs Act (Public Law 117-58), also known as the Bipartisan Infrastructure Law (BIL).[2] The BIL is a once-in-a-generation investment in infrastructure, which provides the backbone for a more sustainable, resilient, and equitable economy through enhancing U.S. competitiveness, diversifying regional economies to include supply chain and manufacturing industries, creating good union jobs, and ensuring stronger access to economic and other benefits for underserved communities. The BIL appropriates more than $62 billion to DOE to ensure the clean energy future delivers true economic prosperity to the American people by:

[1] https://www.hydrogen.energy.gov/pdfs/hydrogen-program-plan-2020.pdf
[2] https://www.congress.gov/117/plaws/publ58/PLAW-117publ58.pdf

This is a Notice of Intent (NOI) only. DOE may issue a FOA as described herein, may issue a FOA that is significantly different than FOA described herein, or DOE may not issue a FOA at all.

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Solicit BIL Funding

BIL funding is set aside for states to address many tasks necessary for the full-scale commercial deployment of carbon management projects and hydrogen production

Funding Purpose	Funding Amount
UIC Class VI Primacy Support	$50MM
Abandoned or Orphaned Well Program	$25MM per state
Abandoned or Orphaned Well Program – regulatory improvements	$20MM per state
Abandoned or Orphaned Well Matching Grants – plugging, remediation, reclamation, and mitigation	$30MM per state
Abandoned or Orphaned Well Program – plugging, remediation, reclamation, and mitigation on Federal Lands	$30MM from DOE, IOGCC, BLM, and states
Hydrogen Hubs	$8B

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Commission Future Studies

Additional studies will be required to provide details, structure, models, and estimates for many aspects of the Road Map. Consider commissioning the following studies:

- Potential Pennsylvania CO_2 Capture & Storage Opportunities to evaluate potential projects, not just the projects that folks talk about.
- Advancement of Pennsylvania-specific jobs and economic analysis of the impact of CCUS commercial deployment on the commonwealth.
- Hydrogen production study that will serve as the basis for DOE FOA 2664 Hydrogen Hub submittal.
- Hydrogen color-blind study to assist in addressing several topics that include Environmental, Energy, and Social Justice (EESJ), stakeholder engagement, social license to operate, and outreach. The suggested hydrogen color-blind study evaluates the fuel feedstock used by the process to produce hydrogen and the carbon intensity of the production process.

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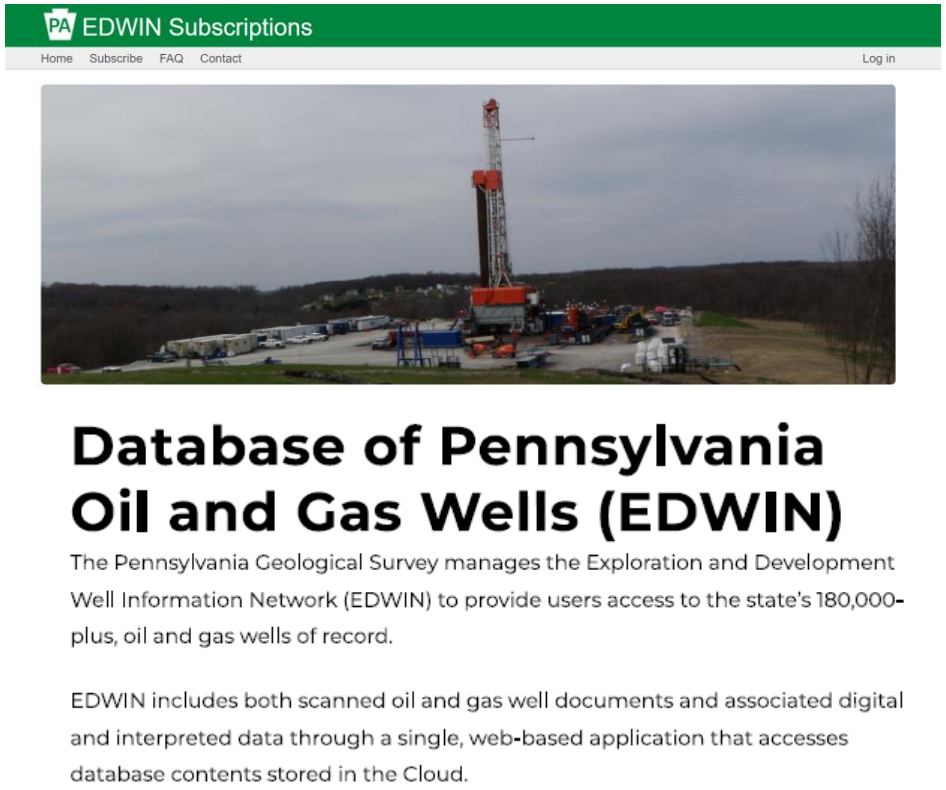
State-wide Digital Transformation

Digitizing the commonwealth's subsurface data to allow for consistency in curation, updates, and one-stop-shopping for project developers looking for the latest screening data for pore space decisions

- Immediately digitize the commonwealth's data.
- Decide which agency should lead this effort
- Start with EDWIN and build out
- Incorporate data from Department of Conservation and Natural Resources, Bureau of Geological Survey (DCNR-BGS) and DEP-Oil and Gas Management with public data from EDX, NATCARB, and USGS, private data from industry, and academia



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Comment and Engage Where Possible

Make stakeholders aware that the commonwealth is engaged. Comment on proposed regulatory changes and possible public policy opportunities, which include:

- EPA GHG Report Tool Subpart PP, to include Direct Air Capture (DAC), as part of 45Q
- EPA GHG Report Tool Subpart VV, to allow EPA to post 45Q applications using CSA/ANSI ISO 27916:19 Carbon dioxide capture, transportation, and geological storage — Carbon dioxide storage using enhanced oil recovery (CO_2-EOR) to be shared publicly
- 45Q Direct Pay Conversations on direct pay and credit transferability in conjunction with the Carbon Capture Coalition (116th Congress, renewable-specific)
- SEC Release Nos. 33-11042; 34-94478, The Enhancement and Standardization of Climate-Related Disclosures for Investors Registrants with Exchange Act reporting obligations pursuant to Exchange Act Section 13(a) or Section 15(d)

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Standards and Best Practices

Standards and Best Practices offer an independent and pre-approved method to accomplish many aspects or tasks within the carbon management value chain. They can provide regulatory certainty and de-risk projects. Consider adopting, citing, or referencing:

- CSA/ANSI ISO 27916:19 Carbon dioxide capture, transportation, and geological storage — Carbon dioxide storage using enhanced oil recovery (CO_2-EOR)
- DOE BEST PRACTICES for CCUS
- ISO 27914:2017 Carbon dioxide capture, transportation, and geological storage — Geological storage
- CSA Z741-12 (R2018) Geological storage of carbon dioxide for North America Society of Petroleum Engineers CO_2 Storage Resources Management System (2017)

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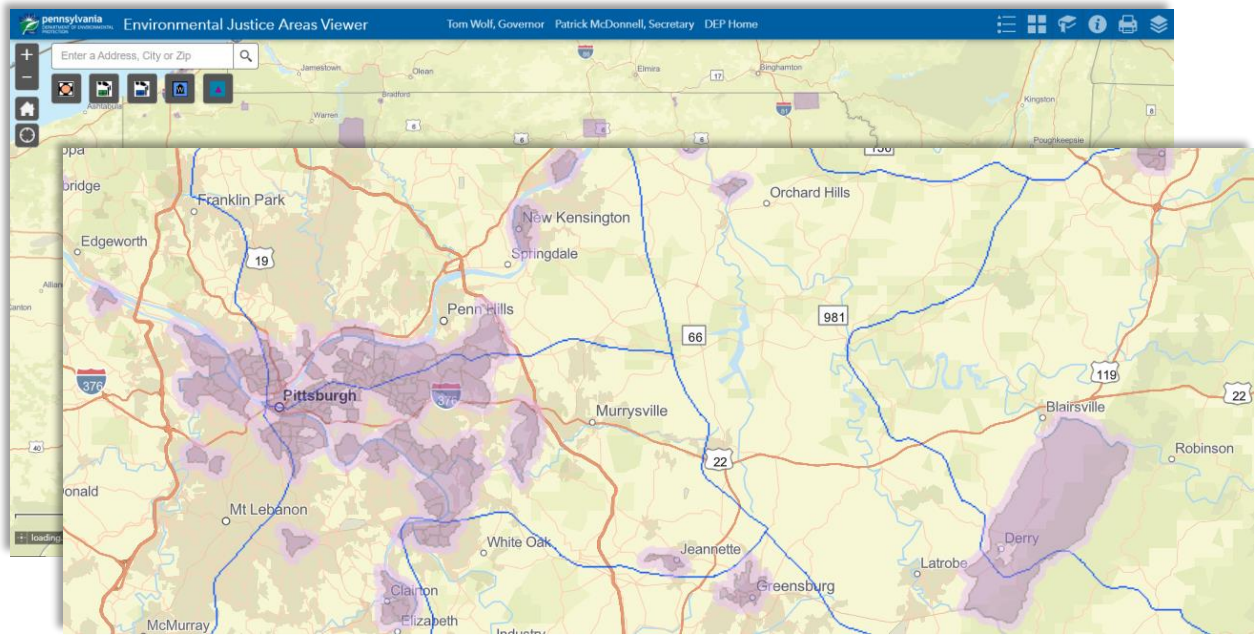
Environmental, Energy, & Social Justice

EESJ screening and mapping is required for all federally funded work. Consider the continued development of PDEP's Environmental Justice Areas Viewer



- This tool is an outgrowth of the digitalization effort and can improve data, mapping, and analysis
- Can position Pennsylvania alongside other states advancing this effort that include California, Colorado, Connecticut, Illinois, Indiana, Maryland, Massachusetts, Michigan, Minnesota, New Jersey, New York, North Carolina, Virginia, and Washington.

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Questions, Comments, and Concerns

Matt Fry
Sr. Policy Manager,
Carbon Management
mfry@gpisd.net

Patrice Lahlum
Vice President,
Carbon Management
plahlum@gpisd.net

Ryan Kammer
Research Manager,
Carbon Management
rkammer@gpisd.net

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