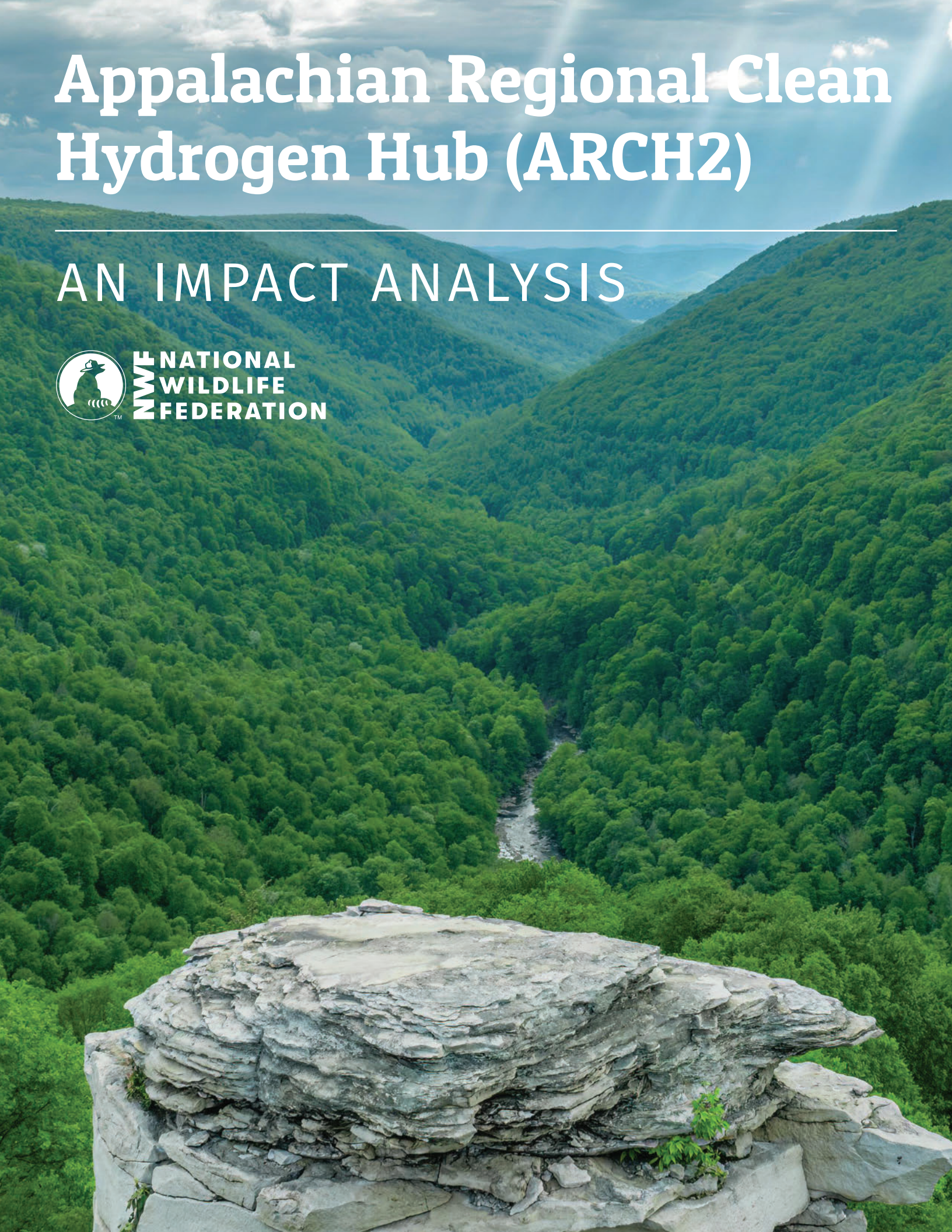
Appalachian Regional Clean Hydrogen Hub (ARCH2)

AN IMPACT ANALYSIS

NATIONAL WILDLIFE FEDERATION



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Authored by: Sarah Kallgren

Cover image: Lindy Point Overlook in Blackwater Falls State Park. Photo: Pexels

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NATIONAL WILDLIFE FEDERATION

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Pittsburg PA. Photo: U.S. EPA

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Clearing the Superfund Backlog. Photo: U.S. EPA

Introduction

One alternative for energy and industrial production may be hydrogen-based fuel.

Combustion of coal, natural gas, and oil since the Industrial Revolution has changed our planet's climate—already flirting with an average temperate rise of 1.5 degrees Celsius—and the future looks even more alarming if we do not replace these fuels with other, cleaner sources. One alternative for energy and industrial production may be hydrogen-based fuel. Hydrogen is the most abundant element in the universe, is highly combustible, and can be used as a fuel that, when consumed in a fuel cell, creates water vapor as its only output.[1] Industrial production of hydrogen fuel can have both positive and negative impacts for the climate, local environment, and public health, thus it is essential to look at the full lifecycle of production and use. This analysis will discuss preexisting environmental and socioeconomic disparities listed in the EPA's Environmental Justice Screening tool (EJScreen) for the Appalachian counties impacted by the Appalachian Regional Clean Hydrogen Hub (ARCH2) and will discuss how the development of ARCH2 may influence these disparities depending on choices that the developer makes throughout the project lifetime. We will then discuss recommendations for project developers and policymakers to consider in order to decrease existing disparities rather than exacerbate them.

Federal Incentives Grow U.S. Hydrogen Industry

Industrial hydrogen generation is a target of recent federal investment in the United States. ARCH2 is a hydrogen hub in Appalachia funded by the Bipartisan Infrastructure Law (BIL). This federal law sets aside $7 billion to establish 6-10 regional clean hydrogen hubs across the U.S., which with other investments in the BIL and the Inflation Reduction Act (IRA), work to combat climate change.[2]

The BIL and IRA also partly implement the U.S. Administration's Justice40 Initiative. The Justice40 initiative directs 40 percent of the overall benefits of certain Federal investments, including investments in clean energy, hydrogen and carbon management, to flow to disadvantaged communities.[3]

Projects receiving BIL and IRA funding via the Department of Energy must also submit a Community Benefits Plan (CBP) as a part of the federal application process that details how a project will benefit the host community. Justice-oriented strategies for project development ensure that industry is held accountable for the past harms they caused communities and are responsible for providing these same communities with environmental and socioeconomic benefits.

The federal government designed the hydrogen hub structure to create a national network of clean hydrogen programs that will help to decarbonize heavy industries like cement and steel production as well as heavy-duty transportation.[4] The

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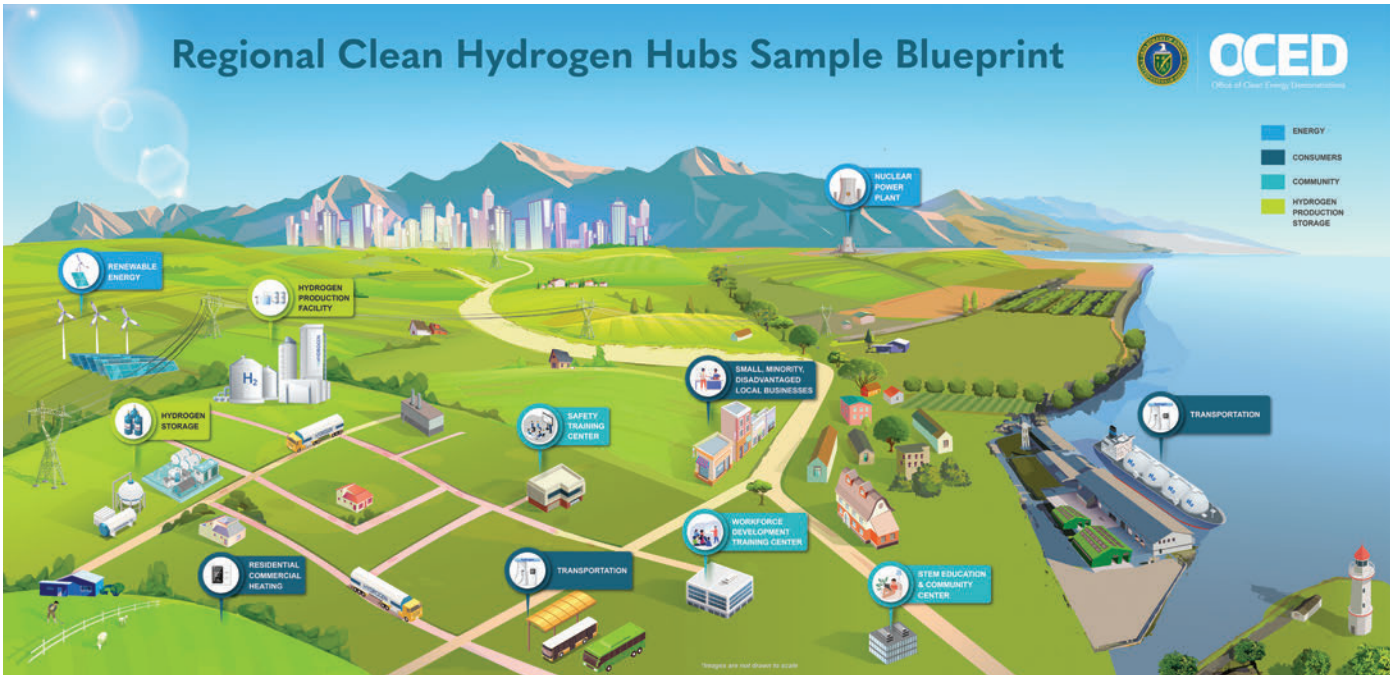
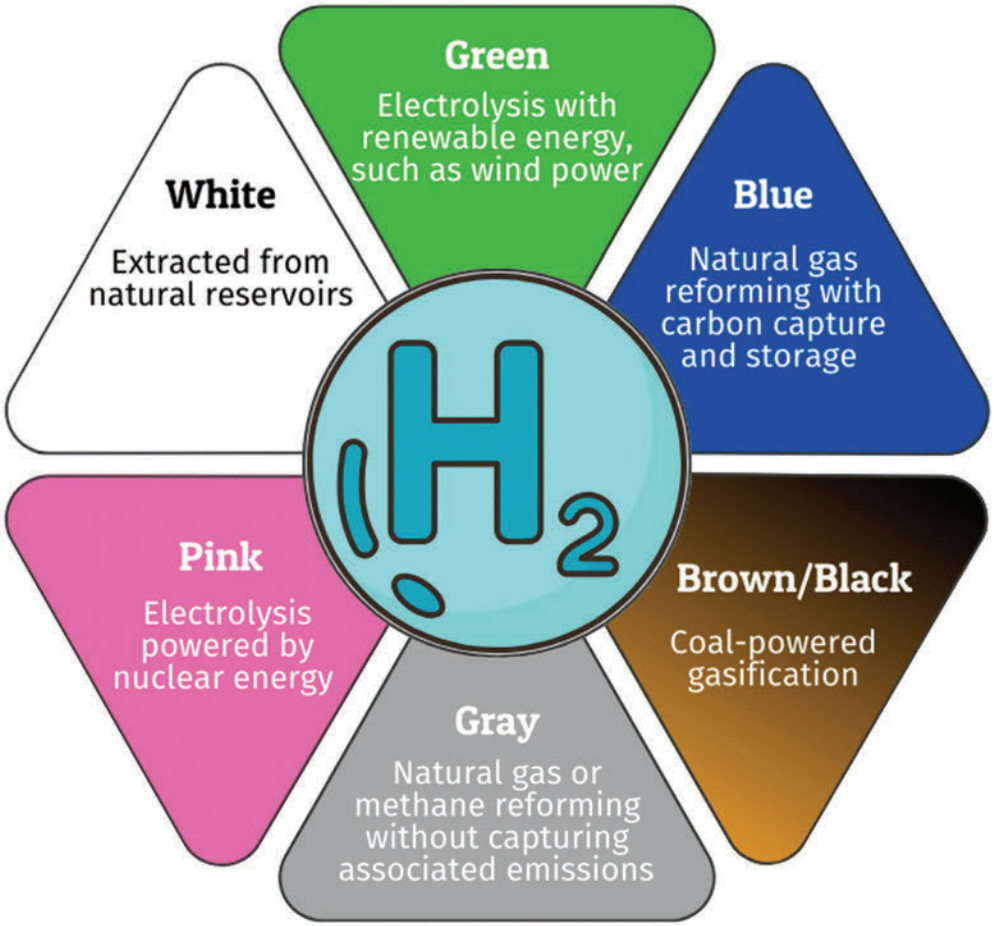


Hydrogen Hubs Sample Blueprint. Photo: U.S. Department of Energy

The BIL defines clean hydrogen as being produced in a process that emits at least 50 percent less carbon dioxide (CO_2) than fossil-generated hydrogen on a lifecycle basis.



Hydrogen Color Graphic. Photo: NWF

Department of Energy (DOE) funded seven hubs based on regional project demand and the availability of feedstocks, while maintaining geographic diversity as directed by Congress. Projects within the hubs can include producing, processing, delivering, storing, or using clean hydrogen. DOE projects that with the hubs in place, the U.S. will produce 10 million metric tons (MMT) of clean hydrogen annually by 2030, 20 MMT annually by 2040, and 50 MMT annually by 2050.[5] For context, it takes 50 kg or around 110 pounds of hydrogen to create one ton of steel, another commonly cited use for hydrogen production.[6] These metrics are ambitious and have implications for the places where hydrogen will be produced, stored, and used.

How hydrogen is produced determines how "clean"—or how carbon-intensive—the hydrogen is considered to be. The BIL defines clean hydrogen as being produced in a process that emits at least 50 percent less carbon dioxide (CO_2) than fossil-generated hydrogen on a lifecycle basis.[7] Hydrogen production methods are also categorized with different colors based on their fuel source. The vast majority of hydrogen produced in the U.S. today is made via natural gas reforming and is referred to as gray hydrogen. Currently, producing gray hydrogen is the least expensive option in most parts of the world, while green hydrogen—made with renewable energy—can be up to 16 times more expensive.[8] One of the goals of the

hydrogen hubs is to bring down costs for green hydrogen.

ARCH2 will produce blue hydrogen, or hydrogen made via natural gas reforming–with natural gas from Appalachia as its primary feedstock–combined with the use of carbon capture technology to prevent release of its associated CO_2 emissions. ARCH2 spans 118 counties across West Virginia, Ohio, Kentucky, and Pennsylvania, creating a network of hydrogen production, storage, delivery, and usage projects across the region. Hub developers claim that the existing energy workforce and energy-focused academic and technological institutions within the region will provide the necessary labor to build an Appalachian hydrogen economy.[9] They also see the hub as a way to uplift underserved communities in the region. However, many local advocates are concerned about the environmental and public health costs of continued fracking for natural gas in nearby Appalachian communities and lands, as well as the additional risks of housing a nascent industry in a region with complex historical relationships between resource extraction and industrial production. While combusting hydrogen fuel is considered clean due to the lack of byproducts, on a lifecycle basis, it is only as clean as the sum of its impacts from production to utilization.

Map of Appalachian Region. Photo: The Appalachian Regional Commission

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The History of Extraction in Appalachia

Greater exposure to pollution from coal mining increases the risk of cancer, for which Mississippi, West Virginia, and Kentucky lead the nation in deaths per capita.

Appalachia has grappled with the benefits and consequences of an economy based on the extraction of natural resources since the timber boom began in the late 1800s.[10] Since then, the region's primary extractive resource has shifted from timber to coal to natural gas. While the coal industry has declined precipitously since the early 2000s, with a drop of 62 percent in production between 2001 and 2022, the health, environmental, and socioeconomic impacts of coal mining persist.[11] Coal mining communities have higher unemployment and poverty rates compared with non-coal mining communities in the U.S. and Appalachia.[12] This economic hardship is in addition to poor health indicators for the people in the region.[13] Greater exposure to pollution from coal mining increases the risk of cancer, for which Mississippi, West Virginia, and Kentucky lead the nation in deaths per capita.[14]

Coal mining also has a variety of negative impacts on the natural environment. This includes disruptions to ecosystems through polluted runoff flowing into natural bodies of water, habitat destruction via mountaintop removal and valley fill mining, and the emission of toxic pollutants into the air or through other discharge pathways.[15] These pollutants can lead to acid rain, along with the accumulation of ash, mercury, and heavy metals in the environment.[16] Additionally, this type of pollution can lead to negative developmental and health outcomes for both humans and animals.[17]

Hydraulic fracturing, or fracking, is a process that involves drilling deep underground and injecting large amounts of water mixed with sand and chemicals to fracture the underground shale and release deeper stores of natural gas.[18] Fracking has a large number of associated risks to both human health and the environment. A study on the impacts of fracking in Michigan found the potential environmental impacts to be significant and include an increased risk of contamination of drinking water with chemicals used during the fracking process as well as during gas processing and refining.[19] Additionally, the construction of fracking pads often requires forests or grasslands to be cleared, which has effects on the environment including loss of biodiversity and critical wildlife habitat.[20] According to one study, this disruption of land use can lead to changes in local temperature extremes, which can harm plants, wildlife, and people.[21] Across West Virginia and Pennsylvania alone there are 2.4 million miles of underground and above ground natural gas pipelines. These distribution networks can also cause harm in the form of "forest fragmentation, spills of hazardous liquid and methane leaks, explosions, air pollution (such as VOCs, NOx, and greenhouse gasses), poor health outcomes and noise pollution."[22]

Environmental and Social Impacts in Appalachia

Power Plant Standards Meeting.
Photo: U.S. EPA

It is necessary to understand the environmental and social impacts that the Appalachian region still experiences due to its industrial and extractive history while also thinking about how ARCH2 can remediate or exacerbate existing harms, and potentially prevent future harm. To help understand this context for hydrogen hub development, the National Wildlife Federation used the EPA's Environmental Justice (EJ) Screening tool to run reports on each of the counties that will be impacted by the ARCH2 project. EJScreen is a mapping tool that allows its users to isolate a certain geography (individual address, city, county), run reports that show a variety of environmental and socioeconomic indicators present in that area, and compare them to national or state-level averages. These indicators include the amount of particulate matter present in the air, local unemployment levels, etc. Our analysis focused on the following indicators, found in Table 1, at a county level compared to U.S. national averages:

It is important to note that tools like EJScreen are helpful to show a snapshot of information in a given area, but they are not a holistic view of the community, nor are they a replacement for on-the-ground engagement. One critique of government funded mapping tools, including the EJScreen and the Climate

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Table 1: EPA EJScreen Indicators and Definitions

Indicator	EJScreen Indicator Definition
Toxic Releases to Air	Risk-Screening Environmental Indicators modeled toxicity-weighted concentrations in air of Toxic Release Inventory listed chemicals.
Superfund Proximity	Count of proposed Superfund sites within 5 km (or nearest site beyond 5 km), each divided by distance in kilometers.
Low Income	The percent of a census block group's population in households where the household income is less than or equal to twice the federal "poverty level."
Unemployment	The percent of a census block group's population that did not have a job at all during the reporting period, made at least one specific active effort to find a job during the prior 4 weeks, and were available for work (unless temporarily ill).
Less Than High School Education	Percent of people age 25 or older in a census block group whose education is short of a high school diploma.

Black Bear Sitting on Grassy Lakeside. Photo: Enric Cruz López

Appalachian communities are often disproportionately impacted by a number of challenges, such as exposure to toxic pollution and socioeconomic factors such as low income and unemployment.

and Economic Justice Screening Tool, for example, has been the lack of racial indicators, thereby potentially overlooking key factors affecting population exposure to environmental hazards such as a legacy of race-based decision-making in housing and other development (i.e., redlining). Still, comparing the EJScreen's county indicators to the national averages, and comparing project counties to one another, shows how Appalachian communities are often disproportionately impacted by a number of challenges, such as exposure to toxic pollution and socioeconomic factors such as low income and unemployment. These communities are, therefore, more vulnerable to added pollution and land degradation that may come from new natural gas-based hydrogen development, plus need remediation of existing harms.

Toxic Release Inventory Chemicals

One of the starkest disparities across counties in Appalachia is in the concentration of Toxic Release Inventory (TRI) chemicals. In this indicator, highly toxic compounds are given a higher value and less toxic compounds are given a lower value. The values of all the toxic compounds released in a given area are then combined to create a composite score that can be compared to other areas that use this same indicator.

There are counties across the ARCH2 project zone that are at or below the U.S. average for exposure to TRI chemicals, but it is important to note the wide range of exposure levels between counties. As shown on the graph below, exposure levels range from zero to 28,000 with the U.S. average falling at 4,600. Those communities with higher levels of exposure, in some cases 6 times the U.S. average, have more polluting facilities and may be prime candidates for more intensive components of ARCH2 facilities given their existing industrial infrastructure. Project developers must proceed with caution when choosing where project infrastructure will be placed in order to avoid the continuation of sacrifice zones, wherein communities already facing environmental and socioeconomic burdens are forced to endure more, purely by virtue of convenience for industry.

Fracking uses several of the chemicals on the TRI chemical list including benzene, xylene, ethylene glycol, methanol, and

propargyl alcohol.[23,24] This class of chemicals causes one or more of the following, according to EPA: "cancer or other chronic human health effects, significant adverse human health effects, and significant adverse environmental effects."[25] Fracking for natural gas to create hydrogen for the ARCH2 hub has the potential to add to the disproportionate presence of these harmful chemicals in communities across Appalachia, including those already experiencing substantial burdens caused by this chemical class.

Living close to facilities that release toxic pollutants is not only a public health issue, but one created by environmental injustice. According to EPA research, low-income communities may experience a greater burden of air pollution due to the socioeconomic factors that encourage polluting industries to exist in poorer communities, and also the inability of low-income community members to afford housing outside of their existing neighborhoods.[26] Ideally, fracking would no longer be needed to produce hydrogen, but until there are enough renewables to power hydrogen production, along with all the other existing demands for clean energy, there are several things industry can do to make fracking cleaner for surrounding communities.

According to a report from the International Energy Agency, it is critical to choose drilling sites carefully to reduce above-ground impacts and most effectively target the areas with gas deposits to minimize the risks of earthquakes and the passing of fluids between geologic fractures.[27,28] Additionally, wells must be designed with high standards to avoid gas leaking into aquifers that may have drinking water inside.[29] There must also be rigorous testing and monitoring of wastewater and

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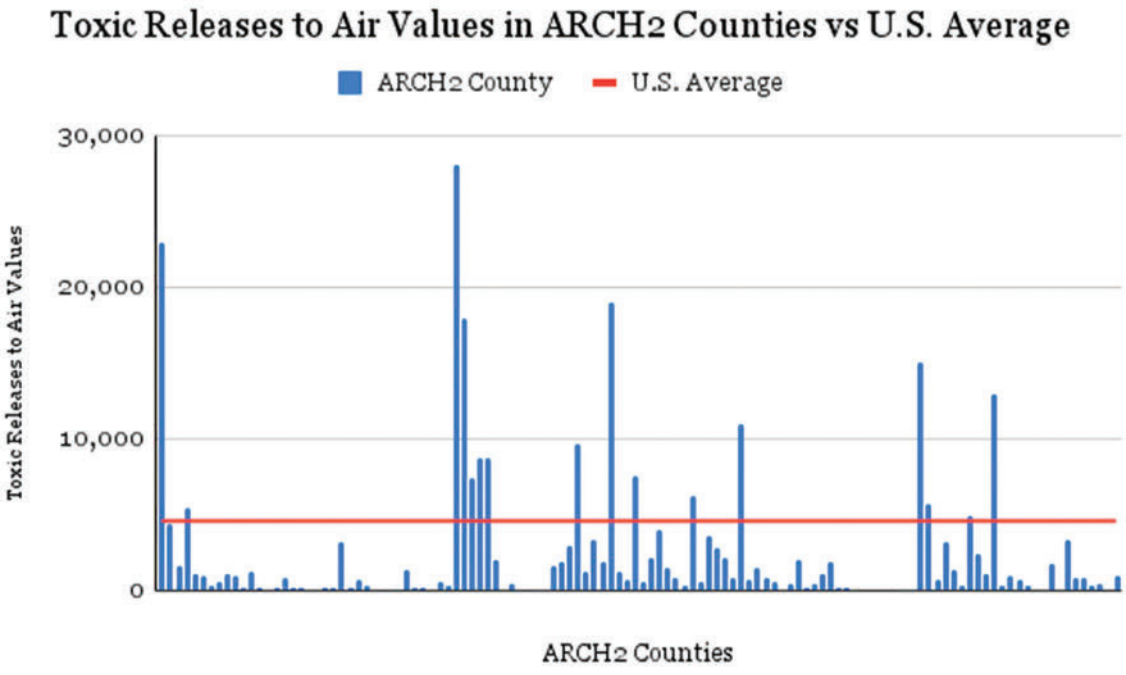


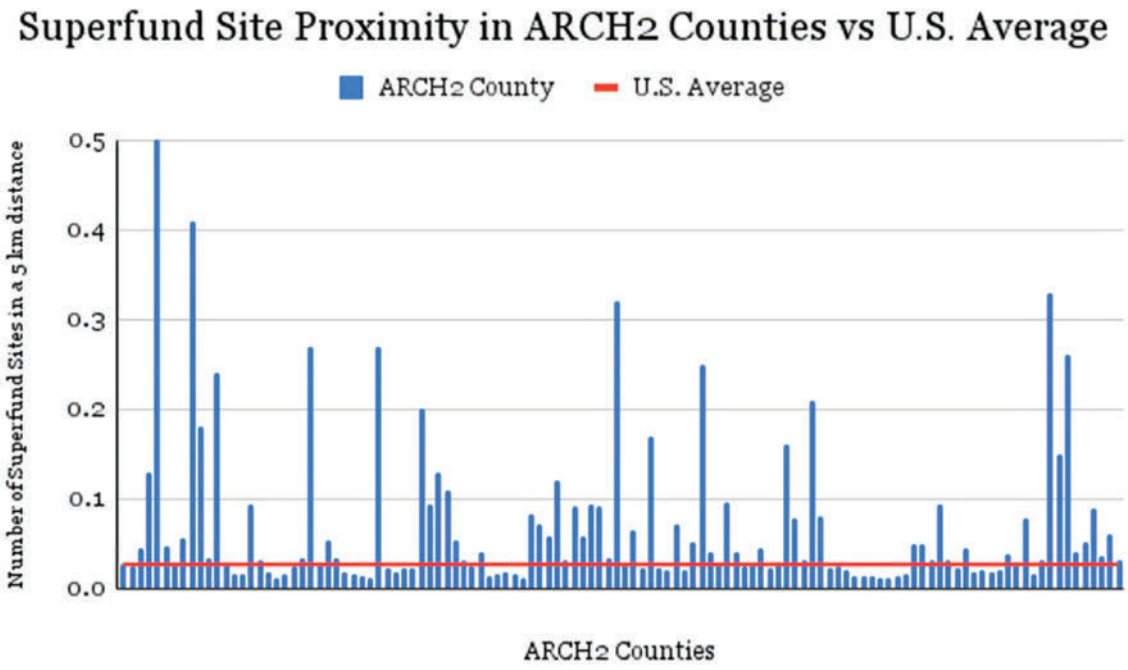
There are also strategies for reducing production-related emissions of local pollutants and greenhouse gasses—such as the super-pollutant methane—by eliminating venting and flaring during the well-completion phase.

surrounding bodies of water as well as monitoring of the treatment and disposal or reuse of wastewater.[30] The results of this testing and monitoring should be easily accessible to the public to build an environment of transparency and trust. There are also strategies for reducing production-related emissions of local pollutants and greenhouse gasses—such as the super-pollutant methane—by eliminating venting and flaring during the well-completion phase.[31] It is important to note that the onus of a safer, more environmentally-friendly industry should not solely be placed on the industry itself, but should be regulated and enforced at every level of governance. Measures like the Safe Drinking Water Act have been enacted to protect water quality and public health. However, measures like these are at times inadequate with poor enforcement and monitoring and limited funding, combined with rapid industrial development.[32]

Superfund Sites

Communities within the zone of ARCH2 have a larger number of Superfund sites within 5 kilometers compared to the rest of the U.S. On average, there are 40 percent more Superfund sites in an ARCH2 county than in an average U.S. county. Superfund sites are nationally registered sites that have been contaminated by hazardous waste. These sites can include manufacturing facilities, processing plants, landfills, and mining sites.[33] Sites can be contaminated through hazardous waste that was improperly stored, left out in the open, dumped out, or otherwise managed improperly.[34]

Contamination from Superfund sites and sites emitting toxic chemicals stems from the industrial sector's presence in the region and understandably causes some community members to express concern about the continuation of fracking and other industry in their region. Project



developers must take the lived experience of communities on the ground into account when starting a new project. The best way to prevent future harm from hazardous waste is to enforce strict hazardous waste management practices that prevent future spills and monitor waste transportation, storage, and recycling methods. Previous natural gas and mining operations have caused harm to both human and environmental health. If DOE projects, such as the Hydrogen Hubs, want to make these projects truly beneficial to communities, they must not exacerbate existing burdens and, instead, help alleviate them. To reduce previous industrial harms, project developers could implement measures like including language in a community benefits plan that requires project developers to offer funding or resources to remediate other hazardous waste cleanup sites in the project community, especially if it is waste from a similar industry.

Low-income and high-unemployment regions

Many counties within the ARCH2 Hub network have more low-income individuals than the U.S. on average and a wide strata of unemployment levels across the project zone. Ninety-two counties, or 78 percent of all counties in the ARCH2 zone, are at or above the national average of percent of low income populations in a county. In terms of unemployment only 34 percent of ARCH2 Counties have unemployment levels over the U.S. average of 6 percent. However, there are 14 counties–12 percent of the project geography–that have unemployment rates that fall between 10 percent and 16 percent. Project developers should focus employment opportunities and project benefits on these communities that have the greatest need for economic stimulation and consider how their project can promote workforce development, a key component of what could be considered a Justice40 program.

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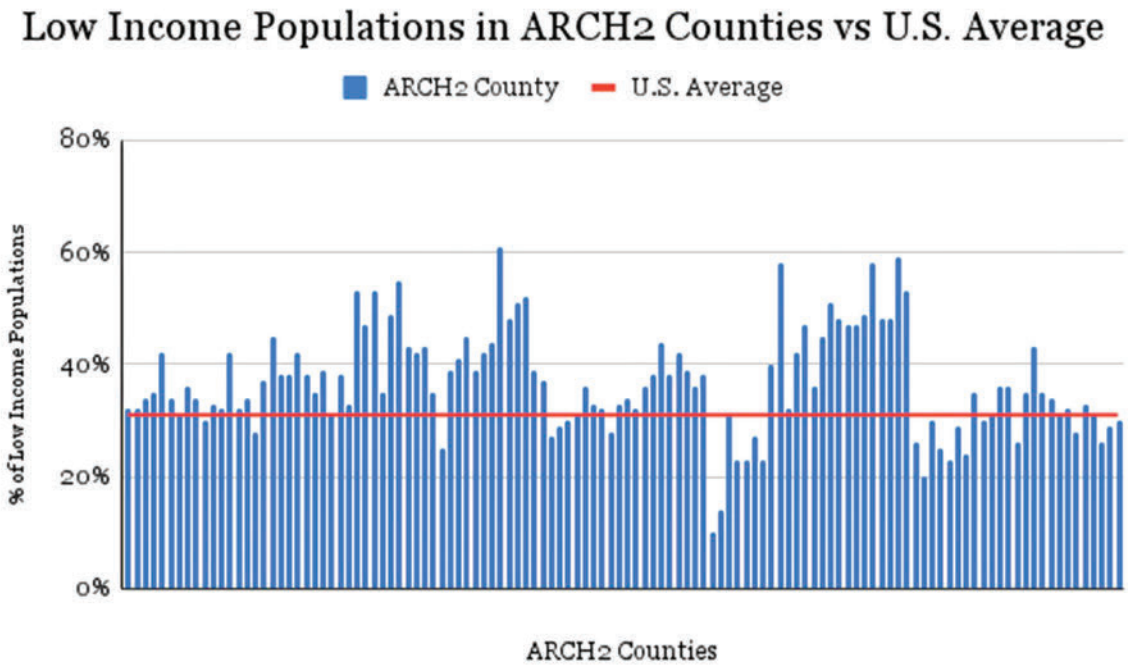
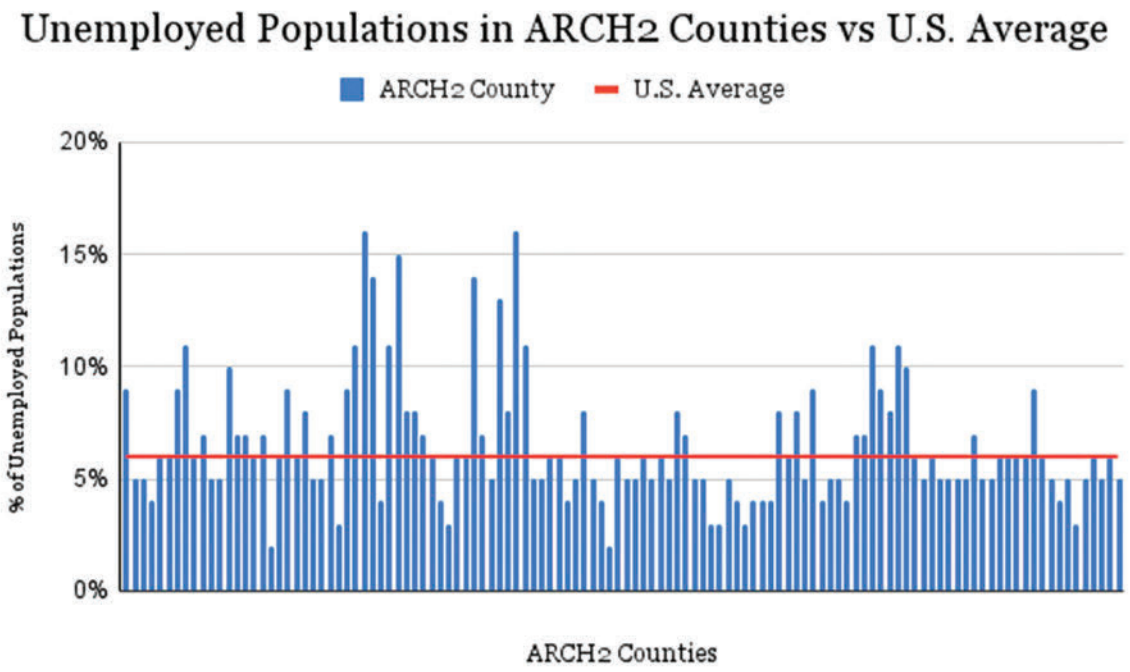




When people who live outside of the region benefit from these employment opportunities over local residents, it perpetuates existing regional demographic patterns of unemployment and poverty as the same people remain impoverished and without stable employment.

Labor and Worker Protections/Agreements

As part of a project developer's community benefits plan (CBP), a company can implement a project labor agreement or other workforce agreement. These are agreements between developers and construction unions that agree to a certain number of people to be hired to work on the project.[35] One of four tenets of DOE's CBPs is "Investing in America's workers through quality jobs."[36] Some communities in Appalachia fear that the high-paying jobs from the ARCH2 hub will primarily benefit workers from outside the region. When people who live outside of the region benefit from these employment opportunities over local residents, it perpetuates existing regional demographic patterns of unemployment and poverty as the same people remain impoverished and without stable employment.[37] Along with temporary construction jobs, the creation of long-term local jobs would make a significant and lasting impact on the community's socioeconomic situation. Given the concentration of individuals with limited education and training, project developers should offer apprenticeship programs for youth and underemployed populations.

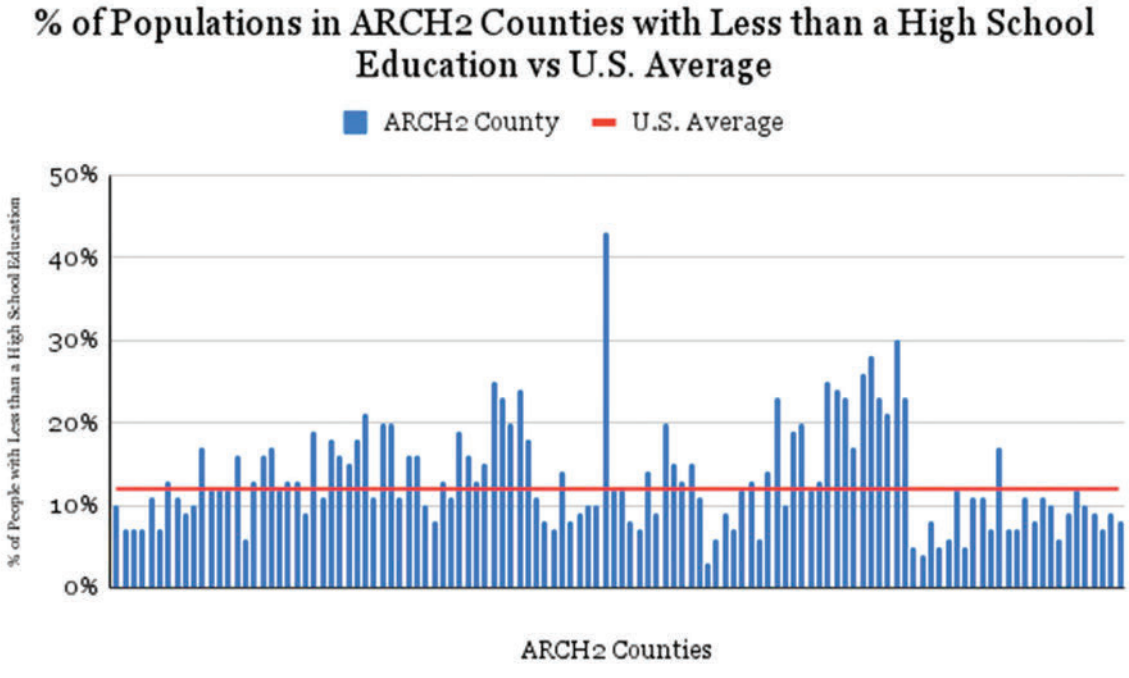
The average percentage of people with less than a high school education in the U.S. is 12 percent per county, and 53 percent of the project geography is at or above this average. Additionally, 15 counties–12.7 percent of counties within the ARCH2 zone–have higher than 20 percent and one county has 43 percent of individuals with less than a high school education. Given these numbers, the 47 percent of counties that are below the U.S. average of populations with less than a high school education might represent opportunities to host pipelines to employment that create a workforce for project-related jobs. Project developers should then focus their workforce development and potential training programs on the counties with

Cardinal Bird Among Branches. Photo: Mehmet Suat Gunerli

higher levels of people with less than a highschool degree to maximize social and project benefits. These findings speak to the widespread disproportionate socioeconomic burdens that Appalachian communities live with given the region's historically exploitative relationship with industry. The ARCH2 hub has an opportunity to help alleviate some of these socioeconomic burdens by investing in local union labor, underemployed populations, and those with limited education.

According to the DOE website, ARCH2 will generate 21,000 direct jobs, including 18,000 construction and 3,000 permanent jobs.[38] Focusing employment recruitment on individuals already living in the ARCH2 region will be paramount to benefiting the unemployed and low-income people in ARCH2 communities. Temporary jobs on extraction-based projects continue the historic boom and bust cycles that have led to the disproportionately high levels of low-income and unemployed individuals that Appalachia has dealt with for decades.

Focusing employment recruitment on individuals already living in the ARCH2 region will be paramount to benefiting the unemployed and low-income people in ARCH2 communities.



Conclusion

Even if project developers do all they can to make projects appealing to residents by enforcing strict safety guidelines and transparent monitoring, reporting, and verification practices, some communities may still have complex or negative feelings toward industrial projects. The years of environmental injustices that have led to high exposure to toxic chemicals and thus higher instances of cancer and other chronic diseases in addition to socioeconomic disadvantages has casued lasting harm to community members.[39]

To meaningfully engage in a just energy transition and the responsible deployment of decarbonization technologies, consistent and proactive community involvement in these projects must be enforced.

It is vital that project developers and funders, such as the federal government, prioritize restorative justice moving forward. This means that project developers must focus on righting the wrongs of industry and prioritizing the health and well-being of community members and the environment, along with their projects. To meaningfully engage in a just energy transition and the responsible deployment of decarbonization technologies, consistent and proactive community involvement in these projects must be enforced. The U.S. government, by funding these projects, has a great opportunity to ensure that industry takes these considerations into account and engages with communities at a level that matches the scale of the projects. The Hydrogen hubs are massive investments that will have broad effects across the regions they are deployed in. Given Appalachia's history of industrial harm and exploitative extraction—as well as greater economic opportunity associated with that extraction—communities deserve a seat at the table to ensure this investment matches their vision of their region's future.

Communities looking for additional resources on how to engage with project developers or the Department of Energy can look to the following resources:

- Hydrogen Hubs Community Benefits Plans Explained
- DOE Regional Clean Hydrogen Hubs
- Community Benefits Planning
- ARCH2 Hub Website

Those already involved in project development looking for community engagement best practices can look to the following resources:

- Hydrogen Communities: Getting it Right From the Start
- DOE About Community Benefits Plans
- Best Practices for Implementing a Community Benefits Program
- Reimagine Appalachia: Community Benefits

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