GROWING CLEAN AND EFFICIENT MANUFACTURING

ReImagine Appalachia

This white paper was prepared in conjunction with the Reimagine Appalachia coalition by Amanda Woodrum, Policy Matters Ohio, and Matthew Mehalik, BREATHE Project. Thanks to the dozens across the ReImagine Appalachia coalition that contributed.

Reimagine Appalachia was created out of a broad recognition that the economy has not been working for most people and places in the Ohio River Valley. In response, a diverse set of economic, environmental and community leaders, and grassroots organizations, came together to find common ground and build the future we want to see—a 21st century economy that's good for workers, communities, and the environment as demonstrated in our campaign video.

Our policy blueprint, endorsed by nearly 100 organizations, was created with the intent that we can rebuild our economy by expanding opportunity through public investments, building a 21st Century economy with investments that create green jobs; and rebuilding the middle class including by strengthening workers' right to form unions in all sectors and boosting local ownership.

These whitepapers are the next stage in ReImagine Appalachia's work to show that federal investments in the people, communities and infrastructure of Appalachia can work to revitalize the region, if politicians are willing to step up to the challenge.

"With public funding to retool existing facilities, Appalachia could be a hub for creating the responsible products of the future, such as alternatives to single-use plastic, green building materials, or the electric vehicle supply chain. As the world demands more socially and environmentally conscious products, we are well-positioned to rise to the occasion."

--ReImagine Appalachia Blueprint

INTRODUCTION

The coalition to ReImagine Appalachia is advancing a sustainable economic vision for a 21st century Appalachia — one that is good for working people, communities, the environment and our health. ReImagine Appalachia's vision builds on the region's assets while understanding that vision can't be achieved without significant public investment, strong public policies, and responsible economic development approaches designed to maximize the benefit to the community as a whole. If done right, national climate change legislation represents an opportunity to secure much-needed federal resources for an Appalachian infrastructure plan, to reimagine our trade policies, and to create a path to more and better jobs in the region and elsewhere.

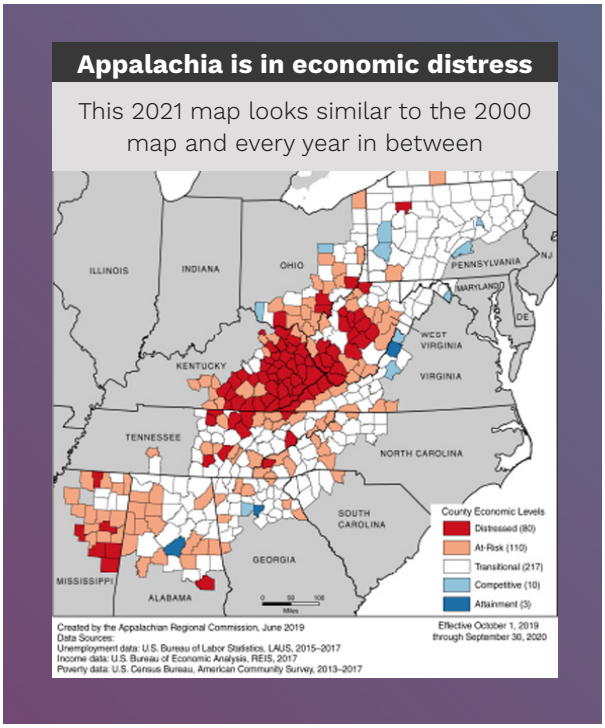
The Ohio River Valley of Appalachia has pumped energy through the nation's veins for generations. Appalachians working in coal, timber and other extractive industries have long provided raw materials to fuel prosperity in other regions while Appalachians themselves have been exploited by absentee corporations, the land left scarred, workers and neighbors made sick, and communities left suffering perpetual economic distress.

Too many Appalachian communities in Ohio, West Virginia, Kentucky and Pennsylvania rank in the bottom 10 percent of all U.S. counties due to their high rates of unemployment and poverty and low incomes. This is not a new phenomenon.

The map of economic distress for the region looks today much like it did 20 years ago and every year in between, through multiple presidents from both parties and many failed promises of change.

There is a better way.

Chart 1



Source: Appalachian Regional Commission

Appalachia can be the epicenter of a new, more sustainable and inclusive economy. Many of the people in this region possess skills suitable for building the foundational infrastructure needed for a more prosperous future, one that creates wealth locally rather than lining the pockets of absentee corporations. With the right federal infrastructure investments and fair-trade policies, the region could become a 21st century manufacturing powerhouse making the socially and environmentally responsible products of the future.

ReImagining manufacturing in Appalachia means investing in industrial energy efficiency, including combined heat and power technology, to grow clean and efficient manufacturing in the region and good union manufacturing jobs. Shuttered coal plants can be repurposed into eco-industrial parks where:

- One company's waste becomes another's raw material.
- Companies have access to clean and efficient energy and shared resources and services (green incentives).
- Coal plant boilers and turbines at existing sites can be repurposed for combined heat and power purposes, providing a more efficient way to meet the heat and power needs of manufacturers.
- Industrial assessment centers and manufacturing energy partnerships can provide low-cost industrial energy audits and energy-efficiency training for the workforce.
- To help manufacturers modernize, the federal government can require labor-community-management partnerships and union apprenticeships with greater access to opportunities generated for Black, Indigenous and other working people of color.

With public funding to retool existing facilities, and investments in research and development of next generation technologies, Appalachia can become a hub for creating products responsive to the needs of the future, such as energy storage technology, alternatives to single-use plastic, green building materials, data processing and electric vehicles. The region can also tap into its creativity for developing materials needed for the future. For example, plastic alternatives can be made from farm-grown resources in the region, such as hemp.

IN BRIEF

This paper builds on the ReImagine Appalachia blueprint, adding greater detail to our vision for growing clean and efficient manufacturing in the region. In order to develop a climate change investment strategy for our region's manufacturing sector, we must start by understanding how industry uses energy and spends its energy dollars, and where greenhouse gases come from in the region.

We then explore energy-saving opportunities in the manufacturing sector and systemic barriers to achieving those savings. We also explore Appalachia's amazing assets at shuttered and shuttering coal-fired power plants, and the role these assets can play to make Appalachia a manufacturing powerhouse. We examine how investing in clean and efficient manufacturing infrastructure can position Appalachia to be a hub for the responsible industries of the future, such as alternatives to single-use plastic, electric vehicle production, and energy storage technology. We look at good union jobs that can be created if we break down systemic barriers to industrial efficiency and provide a model of how an Ohio manufacturing facility, working with energy partners, reduced its energy use and operating costs while creating jobs

for former coal power plant workers. Finally, we make recommendations for a federal Appalachian manufacturing infrastructure plan designed to lay the foundation for a 21st century sustainable manufacturing sector in Appalachia.

Below is an outline of the paper exploring ReImagine Appalachia's vision to grow clean and efficient manufacturing:

1. Meeting the climate challenge: Energy use, Energy spending, and Emissions
2. Energy-saving opportunities
    a. Energy efficiency in the manufacturing process
    b. Generating cleaner energy: Save the heat (and recycle it)
3. Barriers to energy choice for manufacturers
4. Tackling barriers: Repurposing shuttered coal plants into eco-industrial parks
5. Identifying potential industry hubs for the responsible products of the future
6. Industrial efficiency and R&D investments generate good jobs
7. Example: Solvay, DTE Energy & AEP
8. Policy recommendations

MEETING THE CLIMATE CHALLENGE IN THE OHIO RIVER VALLEY

Appalachia can do its part to help our nation achieve carbon neutrality while building an inclusive and sustainable economy for the people who live in the region. With the right infrastructure investments, we can bring the electric power and manufacturing sectors into the 21st century, creating thousands of good jobs in the process while laying the foundation for permanent jobs in the new economy.

We start with an energy and greenhouse gas emissions inventory of the central Appalachian states of the Ohio River Valley: Pennsylvania, West Virginia, Kentucky and Ohio. The inventory shows how energy is being used and identifies the region's top emission sources. The three charts below provide a summary of how our four states use energy, where our energy dollars go and where our emissions come from.

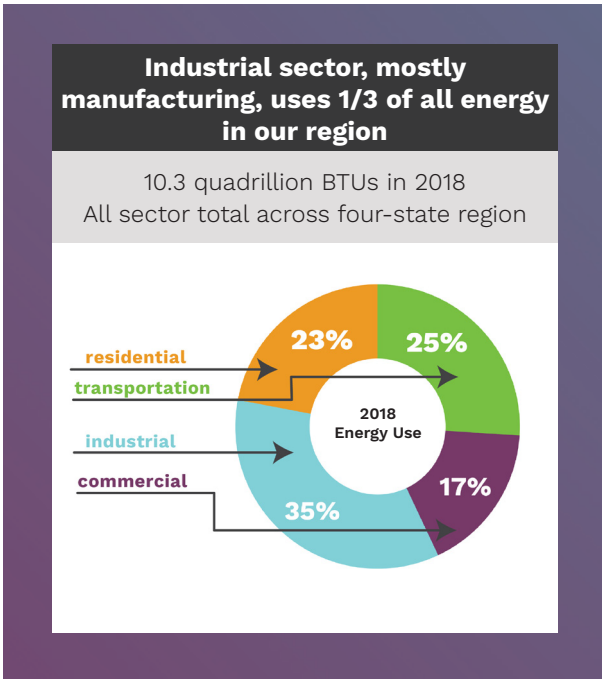
Armed with this information and our recommendations, policymakers can promote dual sector-based strategies designed to clean up the region's manufacturing and electric power sectors and prevent further climate devastation. The challenges we face are also opportunities. The federal investment response to climate change can deliver economic and job benefits, a win-win for working people in the region.

HOW DOES INDUSTRY USE ENERGY IN THE OHIO RIVER VALLEY?

Across our four-state region, the industrial sector consumes more energy than any other sector, accounting for one-third of all energy used.

Manufacturers burn fossil fuels on-site to heat metals, chemicals, and glass, and —separately — purchase electricity from the grid to light their factories and power electric motors, welding tools, conveyor belts and the like.

Chart 2

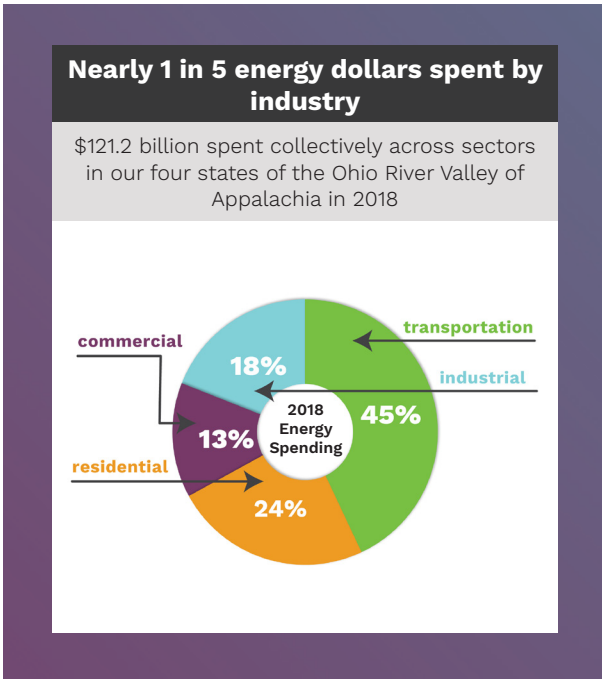


Source: Energy Information Administration, 2018

HOW DO WE SPEND OUR REGION'S ENERGY DOLLARS?

Nearly one in five of our region's $121 billion in energy dollars spent in 2018 — $22 billion — went toward meeting the heat and power needs of industry in our four-state region.

Chart 3



Source: Energy Information Administration, 2017

WHERE DO OHIO RIVER VALLEY EMISSIONS COME FROM?

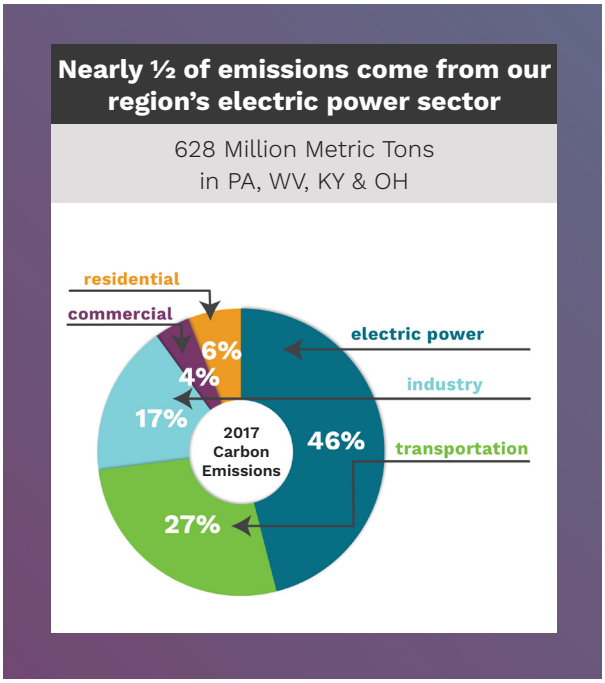
Manufacturers pull electricity from our electric grid while burning fossil fuels on site to create heat for bending metals and processing chemicals. Both uses of energy produce emissions and contribute to the carbon footprint of manufacturing.

Together, the electric power and manufacturing sectors are responsible for nearly two-thirds (63%) of carbon emissions in our four-state region.

In addition to carbon pollution's contribution to climate change, pollutants from industry and power plants are responsible for thousands of cases of respiratory disease, asthma attacks and premature deaths.

These pollutants disproportionately burden the poor. Eight out of every 10 coal-fired power plants in Ohio, for instance, are in communities with high concentrations of low-income families.[i]

Chart 4



Source: Energy Information Administration, 2017

It's time to bring our manufacturing and electric sectors into the 21st century by upgrading our antiquated grid and making our manufacturing sector cleaner and more efficient. An often-overlooked component of clean energy is combined heat and power (CHP) technology, a 100-year-old technology that harnesses both the heat and power produced during electricity production to meet the energy needs of manufacturers more efficiently while reducing emissions.

ENERGY-SAVING OPPORTUNITIES FOR MANUFACTURING

By making our manufacturing sector cleaner and more energy efficient, industry can reduce their energy costs and emissions while increasing productivity, wages and jobs. On average, manufacturers spend hundreds of thousands of dollars on energy—roughly 40% for fuels consumed on site and 60% on electricity.[ii] Policy and investment incentives can encourage and assist manufacturers in adopting better practices.

ENERGY EFFICIENCY IN THE MANUFACTURING PROCESS

For energy-intensive industrial consumers, such as the chemical sector, energy can represent as much as 60 percent of total costs.[iii] For most manufacturers, it represents less than 5 percent of total operating costs. But in both cases, it is a much higher percentage of controllable costs. It is in the interest of

society as a whole, as well as manufacturing firms and their employees, to dedicate public resources to educating manufacturers on energy saving opportunities, encourage manufacturers to take steps to achieve these savings, and help ensure availability of capital financing. The result will be increased effectiveness, more jobs, and reduced emissions.

Nationwide, even manufacturers that receive thorough energy assessments identifying ways to save energy and money implement fewer than 40 percent of recommendations, on average. According to manufacturers and industry analysts, this low adoption rate occurs because capital costs for energy saving measures compete with other capital investment projects that may have higher returns on investment and faster payback periods. Social benefits from reduced emissions are typically not factored into the cost/benefit equation. Short term demands and gains take priority. Public sector requirements and incentives can alter the equation.

The Department of Commerce's Manufacturing Extension Partnerships (MEPs) and the Department of Energy's Industrial Assessment Centers both provide technical expertise and education to manufacturers on how to achieve energy savings. An analysis by Policy Matters Ohio of data from the University of Dayton Industrial Assessment Center found:[vi]

- Industrial energy auditors recommended an average of seven efficiency improvements. Only about half the recommendations were implemented.
- The average cost per manufacturer to implement recommended measures would have been recouped within slightly less than one year, on average. Some payback periods were instant, while others, such as using the most efficient type of electric motors, had paybacks between 20 and 65.5 years. Manufacturers were more likely to adopt measures with instant paybacks than measures with longer payback periods.
- More than 1,100 of the recommendations had no cost (e.g., rescheduling to avoid peaks, turning off equipment when not in use, less wasteful packaging).
- Energy savings recommendations range from low cost measures involving changing procedures, equipment, or operating conditions to higher price measures such as installing sensors to detect defects.
- Other recommendations included installing storm windows and doors, turning off equipment during breaks, repairing faulty insulation in furnaces, reusing or recycling hot and cold exhaust air, more efficient lighting, rescheduling plant operations to avoid peak load hours, and recovering heat from exhaust steam.

Downturns in the economy spur companies to investigate options to streamline. Energy efficiency measures can cut costs and often increase plant capacity for expanded production in the future. It is a good time for federal leaders to help manufacturers invest to become cleaner and more energy efficient, so they can come out of this recession ready to compete in the global marketplace.

GENERATING CLEANER ENERGY: SAVE THE HEAT (AND RECYCLE IT)

Decentralizing electricity production by adopting CHP will result in more efficient use of scarce resources and lower associated emissions by burning smaller amounts of fossil fuels. Where there is a need for both electricity and process steam at an industrial location, CHP facilities use fuel to make steam in order to turn an electric generator, and then use the leftover steam in the factory's processes.

Manufacturers consume energy mostly in two ways: They burn fuels on site for heat, and they use electric power. Manufacturers use heat primarily to heat chemicals, metals, and glass in industrial processes, and for drying paint, but also to provide heating and cooling of buildings and to power vehicles. They access the electric power grid largely to run electric motors that drive metal cutting tools and conveyor belts, but also to power welding tools, electric furnaces, and electric forklifts. Electricity is also used to light, heat, and cool buildings. Both sources of energy (on-site fuel burning and electricity) produce carbon dioxide emissions.

Our current system of producing electricity is enormously inefficient. This inefficiency yields vast amounts of wasted energy and unnecessary emissions, largely the result of heat wasted in the electricity production process. Nationally, 63 percent of all energy created by burning fuels to produce electricity is lost while generating electricity. An additional 7 percent of electricity generated is lost during transmission and distribution through our antiquated grid system.

Between heat loss during electricity production, and grid losses during transmission, we lose nearly 70 percent of energy used to produce electricity. In other words, every kilowatt-hour of electricity we use in our homes, businesses, and industry, means 3.3 kilowatt-hours worth of polluting fossil fuels must be burned at an electric power plant. Or, for every three lumps of coal you put in, you only get one lump out.

Heat generated during the production of electricity is discarded through pressure release vents and cooled using lake or river water, or cooling towers. At the same time this heat is being discarded, however, manufacturers are purchasing fuel to create heat to meet their heating and cooling needs. If we could transfer the heat lost from the electric power sector to our manufacturers and others, we could reduce enormous amounts of waste in electrical production, while also reducing the need for manufacturers to purchase additional fuel for heating and cooling. However, transporting heat requires the use of expensive, heavily insulated pipes, with great losses over any distance, and so becomes impractical beyond three miles. Our existing power plants are currently too far from our industrial centers to do so.

We can remedy the problem by co-locating electricity production with industry and business. We discuss below two opportunities that can be created by taking advantage of existing infrastructure at shuttered and shuttering coal plants and repurposing them into industrial parks with access to CHP facilities and other industry services.

Untapped CHP potential. According to a study of untapped CHP potential, conducted by the Department of Energy in 2016, Kentucky, Ohio, Pennsylvania and West Virginia, combined, have roughly 27.9 gigawatts of CHP potential: enough to power more than 17 million homes. The tables below provide greater detail on CHP potential in the Ohio River Valley states.

Table 1

Ohio River Valley states have 27.9 GW of CHP potential

That would be enough to power 17 million homes

	Total On-site Potential (MW)	Total Export Potential (MW)	Total CHP Technical Potential (MW)
Kentucky	2,721	1,796	4,517
Ohio	7,005	4,082	11,087
Pennsylvania	7,025	3,872	10,896
West Virginia	929	449	1,378
4 State Total	**17,680**	**10,199**	**27,878**
U.S. Total	**148,936**	**91,709**	**240,644**
4-state share of total potential	12%	11%	12%

Source: U.S. Department of Energy, Combined Heat and Power (CHP) Technical Potential in the United States (March 2016).

Table 2 below shows that while combined heat and power is a technology that can be employed by commercial and institutional entities, the largest potential lies in manufacturing (56%). The Department of Energy defines technical potential as the ability of CHP to meet customer energy needs — constrained only by technological limitations (without regard to market conditions).[vii]

Table 2

Ohio River Valley on-site CHP potential lies largely in the manufacturing sector

	Market Sector	Kentucky	Ohio	Penn.	W. Virginia	% Capacity
Manufacturing	Paper	152	586	408	45	56%
	Chemicals	643	1,630	1,561	204	
	Primary metals	414	444	485	79	
	Food, Lumber	132	356	321	46	
	Other industrial	467	1098	949	52	
Commercial / Institutional	Hospitals, Universities, Schools, Public Sector	911	3,000	3737	356	44%

Source: U.S. Department of Energy, Combined Heat and Power (CHP) Technical Potential in the United States (March 2016).

Despite our region's vast potential for CHP deployment, Table 3 shows relatively low rates of adoption of CHP technology relative to overall electric power capacity in our states. Nationally, combined heat and power accounts for nearly 8 percent of total capacity.[viii] CHP is heavily used by the petroleum industry in Louisiana, which ranks first in the nation for existing deployment, with over 23 percent of the state's electric capacity made up of combined heat and power.

Other nearby states do better: 14.5 percent of New York's electric power capacity is in CHP technology; 11.5 percent in Michigan, 9.4 percent in Wisconsin, 8.5 percent in Indiana. Pennsylvania comes close to the national average with 7.6 percent of its electric power capacity coming from CHP. Ohio (1.6%), West Virginia (2.3%) and Kentucky (0.6%) rank near the bottom for the nation.

Table 3

Ohio River Valley states have relatively low rates of CHP adoption

State	Electric Capacity (MW)	CHP Capacity (MW)	% CHP Capacity	Rank
Louisiana	26,227.9	6,106.3	23.3%	1
Maine	4,494.9	935.5	20.8%	2
Alaska	2,430.2	482.7	19.9%	3
Oregon	15,664.9	2,712.1	17.3%	4
Hawaii	2,663.0	435.9	16.4%	5
NJ	18,742.7	3,049.1	16.3%	6
Texas	109,919.3	17,557.3	16.0%	7
NY	39,918.2	5,775.2	14.5%	8
Michigan	30,104.8	3,452.9	11.5%	11
Wisconsin	17,351.5	1,629.2	9.4%	13
Indiana	27,216.0	2,323.1	8.5%	14
PA	43,029.8	3,269.0	7.6%	16
Illinois	44,950.3	1,328.7	3.0%	34
WV	16,276.5	371.2	2.3%	38
Ohio	32,335.5	517.0	1.6%	42
Kentucky	21,005.6	134.9	0.6%	48
U.S. Total	**1,061,651.9**	**82,727.9**	**7.8%**	

Source: U.S. DOE Combined Heat & Power Installation Database; EIA Net Summer Capacity (2016)

ELECTRIC MARKET BARRIERS LIMIT ENERGY CHOICE FOR MANUFACTURERS

Given all the benefits to investing in CHP for the manufacturing sector, why are we not doing more of it? Manufacturers need energy partners to make the transition. Electric utility companies or third-party energy suppliers can provide energy-related expertise, shoulder some of the inherent risks, provide upfront capital, participate in project development, and handle operations and maintenance. However, electric utility companies lack incentive to seriously engage in these critical partnerships and have blocked the development of third-party energy providers, viewing them as competitors.

The primary obstacles to this partnership include:

1. **Lack of competition in the electricity market, dominated by monopolies, removes incentive for utilities to produce power more efficiently.** Our region's mostly centralized system of producing electricity in remote locations from antiquated coal-fired power plants yields an electric power sector that operates at very low levels of efficiency. Nearly 70% of the energy from coal burned at these facilities is lost during generation, transmission and distribution.
2. **Electric monopolies put up barriers to competition from Independent Power Providers (IPP).** Electric utilities impede efforts of third-party energy providers working with manufacturers to install CHP. The three biggest barriers to competition come in the form of 1) utility rate structures that integrate power-generation charges from the utility into unavoidable distribution charges for all customers; 2) exorbitant charges by utilities to manufacturers for back-up power that may be needed during routine maintenance of CHP facilities or unplanned outages ("stand-by charges"), and 3) side deals with manufacturers for below-market prices subsidized by residential and commercial ratepayers that render independent power producers unable to compete.
3. **Without assistance from an energy partner, there is limited interest from manufacturers in self-generating power.** Many manufacturers are not inclined to self-generate for their power needs in the absence of an energy partner because most manufacturers are not in the energy business and do not have the expertise or desire to become experts. Plus, manufacturers have many competing needs for capital and tend to put the money they have into projects with short payback periods, thwarting a more long-term investment approach like CHP that requires sizeable upfront capital.

REIMAGINING SHUTTERED COAL POWER PLANTS: ECO-INDUSTRIAL PARKS

We can break down market barriers to industrial efficiency and CHP technology by bringing industry together with the right partners and services, along with the right policies, requirements, incentives and capital financing. The innovative concept of eco-industrial parks is designed to do just that.

Eco-industrial parks bring together local businesses and manufacturers to share services, transportation infrastructure, energy, and waste streams. Indigo Development defines an eco-industrial park as "a community of manufacturing and service businesses seeking enhanced environmental and economic performance through collaboration in managing environmental and resource issues, including energy, water, and materials."

CHP technology requires co-location of electricity production with consumers of heat energy, such as commercial businesses and industrial parks, something that can be achieved in eco-industrial parks.

With the right resources, shuttered or shuttering coal plant sites, with their existing infrastructure, can be turned into eco-industrial parks that provide businesses and manufacturers access to clean and efficient energy. Boilers and turbines at these sites can be repurposed for use in CHP facilities.

Table 4 below provides a number of examples of eco-industrial parks, in communities across the country, as well as the basic elements of eco-industrial parks.

Table 4

Elements and examples of eco-industrial parks

Network of businesses, manufacturers, and/or services companies	Some parks are a mix of residential, office, retail, tech and consulting groups. Others include warehouse/ distribution companies, heavy and light manufacturers, environmental service companies, and industries that re-manufacture and re-use existing products.	Chattanooga, TN; The Green Gold Initiative (Buffalo, NY); Red Hill Ecoplex (Choctaw County, MS); Coffee Creek Center (Chesterton, IN)
Co-location with power plant, access to clean energy resources	Can develop industry network around anchor power plant and/ or incorporate energy systems. Examples include parks that convert landfill gas into energy, run a biomass electricity generation plant, co-locate with a gas-fired power plant; demonstrate and promote technologies that use indigenous renewable resources.	Berks County, PA; The Cabazon Resource Recovery Park (Indio, CA); Intervale Food Center (Burlington, VT); Red Hill Ecoplex (Choctaw County, MS)
Offer businesses lower overhead costs, access to infrastructure, incentives	Some attempt to bring new industry into town by offering infrastructure, lower overhead costs, and incentives. Some house companies in a solar-powered or eco-enterprise building. One marine-based park includes an oil recycling business, an ecologically-designed water reclamation system, renewable energy, and a compost business.	Brownsville Eco-Industrial Park (TX); Port of Cape Charles Sustainable Technologies Industrial Park (VA); Franklin County Eco-Industrial Park (NC); Shady Side Eco-Business Park (MD);
Resource recovery facility and joint operations	Nearly all eco-industrial parks facilitate opportunities to identify where one industry's waste can serve as another industry's raw material. Many parks incorporate resource recovery facilities, or centers for reuse, recycling, remanufacturing, and composting. Some redistribute usable materials to the public. One park focuses on selling salvaged building materials. Developers can ID businesses with core capabilities that could benefit from coordinating activities, sharing resources, and participating in joint operations, such as water treatment, reducing dependence on transportation and increasing competitiveness.	East Shore Eco-Industrial Park (Oakland, CA); Green Institute Eco-Industrial Park (Minneapolis, MN); NWLCC-Northwest Louisiana Commerce (Shreveport, LA); Trenton Eco-Industrial Complex (NJ); Civano Environmental Technologies Park (Tucson, AZ)
Maximize use of intermodal transportation of raw materials and waste streams	Transportation is treated as an important element in a number of eco-parks. Port, rail, and interstate access will be used to maximize the intermodal transit of raw materials and waste streams, and facilitate creation of industrial "closed loop" production process.	Fairfield Park (Baltimore, MD); Plattsburgh Eco-Industrial Park (NY)
Process waste streams on site	One park, located within a sustainably harvested forest, processes waste streams on site to avoid transporting waste to overloaded wastewater and solid waste facilities.	Raymond Green Eco-Industrial Park (WA)
Brownfield development	Redevelop a brownfield, former military base, coal plant or existing industrial park into an eco-industrial park. Can include both new development land and redevelopment of former industrial land.	The Green Gold Initiative (Buffalo, NY); Fort Devens (Devens, MA); Port of Cape Charles Sustainable Technologies Industrial Park

EXPLORING POTENTIAL INDUSTRY HUBS FOR APPALACHIA

With an aggressive strategy to invest in industrial efficiency and CHP technology, and to repurpose former coal plants into eco-industrial parks, the Ohio Valley region could become a hub for the socially and environmentally responsible products of the future. With additional investments to develop the supply chain and to invest in research and development, there are opportunities for Appalachia to lead in the industries of the next generation such as alternatives to single-use plastic, energy storage technology for renewable energy resources, or electric vehicles.

Appalachia already has a number of important assets for engaging in the production of next generation technology. Carnegie Mellon in Pittsburgh is internationally renowned for its battery research and the community also has strength in automation. Ohio has a long history in the auto supply chain and a strong Fuel Cell Coalition. Warren, Ohio is also home to an energy tech incubator. The region as a whole has a strong chemicals sector, positioning it well to play a role in the production of batteries and fuel cells for renewable energy storage. As global leaders in plastics, we can also lead in the next generation of plastic, single-use plastic alternatives that can be grown from agricultural products produced in the region, like hemp.

Federal resources and economic development practitioners should prioritize identifying opportunities for existing local businesses and manufacturers when developing supply chains in the region. Companies and industries can be assisted and even converted to serve different markets. For example, the US assisted auto companies to convert to tank production during WWII. The same could be accomplished to help firms transition to climate change-sensitive markets, and to seize opportunities in clean manufacturing.[x]

The federal government should allocate resources for:

- Mapping opportunities for local companies to enter new markets.
- Conducting feasibility studies to assess local company needs and options to gain entrance to new markets.
- Providing services that enable companies to enter new markets.
- Promoting capital investment in Appalachian companies for any necessary retooling or upgrades.
- Offering union apprenticeship, pre-apprenticeship and training services.
- Investigating opportunities for legacy companies to re-shore in Appalachia.

All federal resources should be made contingent on a firm's willingness to promote circular manufacturing and industrial efficiency practices, diversity in hiring and training, and workers' rights to form unions should they choose to do so.

INDUSTRIAL EFFICIENCY AND CHP INVESTMENTS GENERATE ENERGY SAVINGS AND GOOD JOBS

Federal investments to grow clean and efficient manufacturing in the region will create good jobs. Investments in industrial efficiency, including CHP technology and research and development, can put people to work in the short term, as a counterforce to the economic collapse associated with COVID-19, while also laying the foundation for a more sustainable and vibrant manufacturing sector in Appalachia going forward.

The investment amounts, job numbers and compensation figures outlined in this section are based on an October 2020 report titled, Impacts of the ReImagine Appalachia & Clean Energy Transition Programs for Ohio: Job Creation, Economic Recovery, and Long-Term Sustainability. The report's authors— Robert Pollin, Jeannette Wicks-Lim, Shouvik Chakraborty, and Gregor Semieniuk from the Department of Economics and Political Economy Research Institute at University of Massachusetts-Amherst— also shared similar preliminary findings for the state of Pennsylvania.

OHIO

$1.1 billion investment into Ohio's manufacturing sector for industrial efficiency and research and development would leverage an estimated $990 million in private investments and create more than 17,000 jobs. Table 5, below, provides greater detail.

Table 5

Modernizing manufacturing job creation through total annual spending of $2.1 billion

$1.1 billion in federal investment creates more than 17,000 Ohio jobs annually

	Spending amounts	Direct jobs	Indirect jobs	Direct + indirect jobs	Induced jobs	Direct, indirect + induced jobs	Average compensation (including benefits)
Industrial efficiency, including CHP	$1.1 billion	2,970	1,980	4,950	3,300	8,360	$64,300
Manufacturing R&D	$500 million	1,650	1,350	3,000	1,500	4,500	$72,200
Bioplastics R&D	$500 million	1,650	1,350	3,000	1,500	4,500	$72,200
TOTALS	$2.1 billion	6,270	4,680	10,950	6,300	17,360	

Source: PERI: *Impacts of the ReImagine Appalachia & Clean Energy Transition Programs for Ohio*

PENNSYLVANIA

According to preliminary PERI findings, $1.3 billion in federal investments in Pennsylvania's manufacturing sector, for industrial efficiency and research and development, would leverage an estimated $1.2 billion in private investments while creating more than 17,000 jobs in the state of Pennsylvania. The table below provides greater detail.

Table 6

Modernizing Manufacturing Job Creation Through Total Annual Spending of $2.1 billion

$1.3 billion in federal investment creates 17,070 Pennsylvania jobs annually

	Spending amounts	Direct + indirect jobs	Induced jobs	Direct, indirect + induced jobs
Industrial efficiency, including combined heat and power	$1.3 billion	4,160	2,470	6,630
Manufacturing R&D	$580 million	3,306	1,914	5,220
Bioplastics R&D	$580 million	3,306	1,914	5,220
TOTALS	$1.5 billion	10,772	6,298	17,070

Sources: PERI, The Impacts of the ReImagine Appalachia and Clean Energy Transition Programs for Pennsylvania.

Table 7 describes in greater detail the kinds of jobs associated with investments to modernize the grid and promote cleaner and more efficient manufacturing.

Table 7

Modernizing grid and industry creates jobs

Clean & Efficient Manufacturing	Upgrading the grid, reducing waste heat	Energy engineers, electricians, electrical power-line installers and repairers, boilermakers, power distributors and dispatchers, stationary engineers and boiler operators, pipefitters and steamfitters, power plant operators, service unit operators, storage and distribution managers
	Eco-Industrial Parks	Energy managers/ sustainability officers, green marketers, refuse and recyclable material collectors, hazardous materials removal workers, brownfield redevelopment specialists and site managers, commercial and industrial designers, industrial engineers, architectural drafters, landscape architects, soil and plant scientists, water and soil conservationists, marketing managers, supply chain manager, electrical and electronics repairers, commercial and industrial equipment, industrial production managers, industrial ecologists, sustainable design specialists, water resource specialists, water/wastewater engineers, industrial machinery mechanics, and repair workers, helpers--installation, maintenance, and repair workers, transportation managers, logistics analysts, engineers, and managers, production, planning, and expediting clerks, shipping, receiving, and traffic Clerks, transportation vehicle, equipment and systems inspectors, maintenance

Sources: Pollins & Wicks-Lim, Political Economy Research Institute (PERI), UMass, Job Opportunities in the Green Economy (2008); Bureau of Labor Statistics at http://www.bls.gov/green/greencareers.htm#greendata

Investments in CHP, in particular, can be an important strategy for using the skills of the existing coal plant workforce. Due to skill overlap between operations and maintenance of CHP facilities and traditional electric power sector work — related to running boilers and turbines — workers currently employed at coal-fired power plants or recently laid off could do the work needed at CHP facilities, with some skill upgrades.

Table 8

Long-term CHP Operations & Maintenance

	Jobs per $1 million spent
Operation & Maintenance (facilities, equipment, machinery)	19.8
Natural gas distribution	6.6
Electric power generation, transmission, distribution	5.7
Mining coal, refining petroleum	7.4

Source: Georgia Tech School of Public Policy, The Job Generation Impacts of Expanding Industrial Cogeneration (2014)

CHP - OPERATIONS AND MAINTENANCE

Investments in CHP create permanent jobs. Table 8 shows that for every $1 million spent on operation and maintenance of CHP facilities, for instance, nearly 20 workers are employed to operate and maintain CHP facilities, equipment and machinery.

CHP CONSTRUCTION: BILL OF SALE

Direct and indirect jobs are also created during the construction phase. Table 9 shows that every $1 million spent to increase our CHP capacity generates 14.5 full-time equivalent jobs in the design, construction, and installation of equipment.

Nearly 40 percent of every CHP project dollar goes toward manufacturing the necessary turbines and boilers; 20 percent to construct facilities; 9 percent to fabricate metals and machines, and a combined 11 percent to manufacture electrical equipment and computer components.

Engineering and other technical services are needed, as well as plastic, pipe, hose and cement manufacturing.

CHP systems can also nearly double the efficiency of our current system of producing heat and power separately, thereby reducing energy spending and emissions. According to a 2014 report from the Georgia Tech School of Public Policy, *The Job Generation Impacts of Expanding Industrial Cogeneration*, new CHP technology creates net industrial savings of $3.9 million per gigawatt-hour generated. These savings account for loan amortization, operations and maintenance, and increased expenditures on natural gas.

According to an emissions reduction formula from Oak Ridge National Research Laboratory, *Combined Heat & Power: Effective Energy Solutions for a Sustainable Future* (2008), CHP produces 72% percent fewer emissions than coal-fired power plants.

Table 9

Long-term CHP Operations & Maintenance

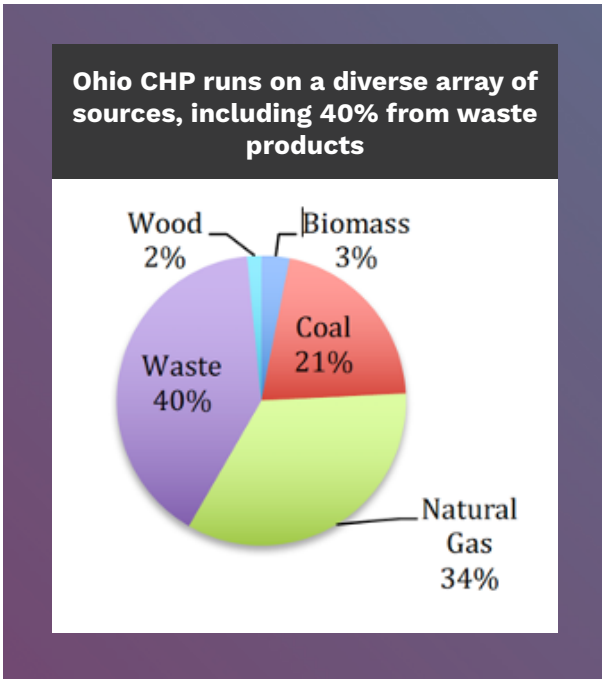
CHP Bill of Sale	Investment Allocation	Jobs per $1 million spent
Manuf. of Turbines & Boilers	39%	12.6
Construction	20%	18
Electrical equip manufacturing	7%	11.6
Fabricating metal & machinery (i.e. pipes, pumps)	9%	13.7
Computer component manuf.	4%	11.1
Air purification and condition equipment	6%	13.1
Plastic and rubber pipes, hoses, paint, and cement manuf.	3%	11.3
Engineering and technical services	8%	22.1
Insurance and financial services	4%	14.8
Weighted Average		**14.5**

Source: Georgia Tech School of Public Policy, The Job Generation Impacts of Expanding Industrial Cogeneration (2014)

In addition, CHP facilities can also be built to use a flexible array of energy resources as fuel, including biowaste.

Figure 5 demonstrates Ohio CHP runs primarily on waste products.

Chart 5



Source: U.S. DOE CHP Installation Database

PRIME EXAMPLE AEP-OHIO, SOLVAY, AND DTE ENERGY SERVICES [xi]

MARIETTA, OHIO

Public policy can help tackle the institutional barriers to CHP adoption by driving stakeholder partnerships. Until very recently, Ohio had clean energy laws in place that required its investor-owned electric utilities to achieve certain levels of efficiency. CHP projects qualified as a mechanism for utilities to achieve their efficiency requirements. As a direct result, AEP-Ohio, an electric utility with 1.5 million customers in Ohio, adopted a performance-based incentive program designed to encourage CHP project development. To qualify, CHP projects had to pass a basic cost-effectiveness test showing a net benefit to the utility and its customers (i.e. costs avoided from having to generate and deliver the energy to the customer must be greater than incentive program costs).

The Solvay site in Marietta, Ohio, an industrial complex built in 1950, with more than 300 full-time employees, specializes in high-performance polymers found in plumbing, water filtration, medical and cell phone components, the aviation market and kidney dialysis filters. Solvay was driven to CHP technology from a need for a more reliable supply of steam and electricity, following a number of outages that caused the plant to shut down, sometimes for weeks.

In February 2015, in partnership with DTE Energy Services and AEP-Ohio, a new CHP plant went into operation to increase energy reliability and reduce costs. DTE Energy Services, a third-party publicly traded energy company headquartered in Ann Arbor, Michigan, designed, built, owns, operates and maintains the CHP facilities, in close partnership with Solvay. Solvay partnered with DTE Energy Services because it did

not have the expertise within its organization for steam and power production and preferred to maintain its focus on its core business of producing polymers. Plus, as with many manufacturers, Solvay did not have capital set aside for utility-related investments.

The 8-megawatt CHP facility consists of a gas turbine with a large heat recovery steam generator that serves 100 percent of Solvay Marietta's steam needs and 97 percent of its electric requirements. The CHP facility helped save more than 300 jobs at Solvay Marietta as well as 50 jobs at the neighboring industrial plant, Americas Styrenics, by providing the steam the company needed. Both companies were affected by the shutdown of the AMP-Ohio Gorsuch plant, which they had previously relied on for meeting their steam needs. In addition, DTE Energy Services hired nine employees previously laid off from the AMP-Ohio Gorsuch coal-fired power station (including experienced boiler and turbine operators).

The overall project cost was $35 million. The AEP incentive — AEP paid ½ cent for every kilowatt- hour generated for the first five years in operation — amounted to more than $1 million over the five-year life of the incentive program. DTE Energy Services also used a federal investment tax credit for efficiency projects to finance the transition.

Solvay remains an AEP-Ohio customer, and AEP provides the balance of its electricity from the grid while also serving as back-up power. Solvay Marietta dramatically reduced its operating costs and estimated it would see a net benefit of $6 million in savings over the 20-year life of its supply agreement with DTE. However, natural gas prices have declined since the start of the project and the company now expects to save substantially more.

RECOMMENDATIONS FOR ACTION:

GROWING CLEAN AND EFFICIENT MANUFACTURING

Aggressive industrial efficiency and electric power sector strategies can complement an equally aggressive strategy to absorb carbon emissions with natural infrastructure. Together with the promotion of a more sustainable transportation system for the efficient movement of goods, these strategies paint a clear picture of how policy and investment can attain carbon neutrality in the region.

To ReImagine Appalachian manufacturing, we call upon our federal leaders to take the following concrete actions:

1. **Promote sustainable development.** Provide federal funding to finance sustainable development projects with significant greenhouse gas benefits. These federal resources should come with greenhouse gas reduction, job quality and diversity/inclusion requirements.
2. **Provide federal funding to repurpose shuttered coal power plants.** Funds should be designated to remediate coal ash ponds on decommissioned power plant sites and nearby water systems; provide electric grid, freight rail and port improvements; and to turn these sites into eco-industrial parks. When possible, the federal government should seek recovery from the corporate entities responsible for creating these brownfields.

3. **Adopt union preference requirements and labor standards for federally funded projects** developed by independent power producers.
4. **Significantly expand funding for Manufacturing Extension Partnerships and Industrial Assessment Centers** to provide industrial energy audits, asset assessments for repurposing (i.e. boilers and turbines), support the development and ongoing needs of eco-industrial parks, including the provision of eco-services, industrial energy audits, recycling centers, and training of workers to identify energy efficiency opportunities.
5. **Provide free or low-cost industrial energy assessments**, efficiency training, and implementation assistance to manufacturers to encourage private investment. Provide resources to do the assessments and ensure availability of capital for this purpose, by ensuring access to low-interest loans from revolving loan funds. Companies receiving state or federal public funds for retooling should be required to undergo energy assessments and implement recommendations.
6. **Develop a modern freight rail system in the region and a national strategy to better fund it.** Every rail project should set aside 2% of total project dollars for union apprenticeship training and pre-apprenticeship workforce development purposes, the latter effort targeted toward ending labor market segregation and bringing higher numbers of women, Black, Indigenous, and people of color into high quality, unionized manufacturing and construction jobs.
7. **Enact fair trade policy, global carbon footprinting, consider border tax for countries with lesser environmental and labor standards.** In the recent past, global markets and trade practices have prioritized corporate profits at the expense of working people in the U.S. and abroad, while undermining domestic manufacturing. Trade practices and policies encourage corporations to hold down workers' wages and cut corners on protecting our health and the environment. It's time to take the high road with our trade policies rather than taking part in a race to the bottom. Federal policymakers should explore the value of a border tax on countries that have lower wage, safety and environmental standards than in the U.S. National climate change legislation must start by quantifying the carbon footprint of outsourcing, including assessing whether there should be a carbon tax on greenhouse gases imported from countries with lesser environmental standards. Consider also the carbon cost of shipping products around the world.
8. **Provide federal funding to map Appalachia's potential to enter new markets**, such as electric vehicles, energy storage, plastic alternatives and other responsible products of the future. Allocate resources for identifying and assisting local companies to enter these new markets and build related networks. Promote early adoption of these technologies.
9. **Coal plant workers and coal miners should be given priority in the hiring process for the new economy.** The Ohio River Valley can create a pool of existing energy workers for employers. This sort of "first source referral system" creates a pipeline of qualified workers. Whenever possible, workers at outdated coal plants slated for closure, and those who have already been laid off from coal plants or coal mines, should be moved to new jobs created from federal investments. We can start the process by identifying any skills overlap between building, operating and maintaining conventional power plants, or working in coal mines, with the skills required to remediate brownfields, or build, operate and maintain CHP facilities. Coal workers have many existing skills that can be applied to this work.
10. **Stop electric monopolies from engaging in anti-competitive behavior.** Eliminate the ability of electric utilities to engage in secretive side deals with manufacturers. These side deals thwart efforts of independent power producers to work with manufacturers to develop CHP projects. In exchange for federal CHP development funding to states for CHP development purposes, require state public utilities commissions to develop a statewide, uniform system for reasonable stand-by charges from electric utilities. Manufacturers need a back-up plan for emergency power. Utility companies should not be allowed to take advantage of this and charge exorbitant rates designed to hinder competition.

ENDNOTES

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[vi] Woodrum, Policy Matters Ohio, Greening Ohio Industry (2009) at https://www.policymattersohio.org/wp-content/uploads/2011/09/GreeningIndustry2009.pdf

[vii] U.S. Department of Energy, Combined Heat and Power (CHP) Technical Potential in the United States (March 2016).

[viii] Combined Heat and Power (CHP) as a Compliance Option under the Clean Power Plan (2015), Prepared by David Gardiner and Associations & Institute for Industrial Productivity.

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[x] Century Foundation, High Wage Project, “Revitalizing America’s Manufacturing Communities” Joel Yudken, Tom Croft, & Andrew Stettner

[xi] Case study derived from Ohio Environmental Council Webcast, Case Studies in Ohio CHP Success, and updated with the following resource: U.S. DOE Technical Assistance Partnerships, Solvay Specialty Polymers: 8 MW CHP System (2019) at http://s7d2.scene7.com/is/content/Caterpillar/CM20190108-44231-07674