Seattle Green Economy: Vision and Asset Analysis

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I. Executive Summary

The entire economy is greening

The green economy is not a single sector that sits alongside manufacturing, software, or construction. It is a profound shift in how the entire economy operates. McKinsey describes the investment required to reach net zero emissions by 2050 as "the largest capital reallocation in history,"[1] and it will include actions like deploying enormous amounts of clean energy and storage, mass electrification, decarbonizing heavy industry, and creating and commercializing new technologies.

This is not an idealized vision. It is a transformation that's already underway, catalyzed by ambitious federal climate policy and growing consumer demand. The private sector invested $249 billion in clean energy projects between 2021 and 2023 alone. That figure is just the tip of the iceberg and doesn't include venture capital in cleantech startups, investment in new products and processes by existing businesses, or spending by the government. And this is just the beginning. Investment in decarbonization technologies is expected to grow for another 10 years and remain high for several decades thereafter.

This creates a huge opportunity to spur inclusive growth

The size of this multi-trillion-dollar economic opportunity presents an enormous opportunity for climate justice and economic inclusion. Seattle – and the metro region as a whole – has all the right ingredients to attract investment in these areas and be a critical hub in the global effort to combat climate change. Seattle can seize this opportunity by ensuring that green jobs workforce development pathways and business ownership and growth opportunities are equitable and accessible.

At the core of Seattle's inclusive growth challenge is the need for better jobs, accessible to more people. In the metro area, half of Black workers with bachelor's degrees earn less than $31 per hour, which is the living wage for the typical family in the region. Over a quarter of white workers also earn less than that wage. This data emphasizes that even for highly educated workers

[1] Bernd Heid, Martin Linder, and Mark Patel, "Delivering the Climate Technologies Needed for Net Zero," *McKinsey & Company*, April 18, 2022, https://www.mckinsey.com/capabilities/sustainability/our-insights/delivering-the-climate-technologies-needed-for-net-zero.

there are simply too few good jobs and they are not equally accessible. The greening of the economy will change skills demands in sectors that are rich in good jobs, creating inclusive workforce development.

Seattle also needs to grow and scale a wide range of new green businesses to both develop and deploy cleantech solutions. To successfully do so, it must elevate the entrepreneurial potential of all residents, including Black, Indigenous, and People of Color who are underrepresented in ownership of high growth-potential businesses.[2]

Seattle needs to expand its green economy focus to include invention and production

The green transition is often thought of as a switch in what we *consume* – we need to buy more solar panels, heat pumps, electric vehicles, sustainable aviation fuel, and so forth. But thanks to the federal government's recent embrace of industrial policy, many of those things are going to be *invented and produced* in the United States. The regions of the country that "own" production in the green economy are going to reap the rewards in terms of good jobs and wealth creation.

Seattle's commitment to sustainability is not in question. Seattle-area residents, businesses, and governments are going to spend a lot on goods and services to enable the green transition. But Seattle's commitment to winning economically – harnessing the green transition for inclusive growth – is less obvious.

Two years after the Inflation Reduction Act was signed, Seattle is being out-hustled by other cities (and Washington by other states), and inadvertently leaving many people behind in the process. Seattle – and its partner cities and regional agencies – need to decide whether they are content with Seattle importing green technologies built in Atlanta and San Francisco, or whether they are going to invest in local entrepreneurs and workers so that the clean energy technologies that Seattle needs can be built responsibly in the city and exported globally.

The green economy is an opportunity to shift from responsive to proactive

Economic development in Seattle has long been, by necessity, a *responsive* endeavor. Seattle has had to contend with disruptive outflows of capital (the aerospace decline) and equally disruptive inflows of capital (the Amazon-driven software boom). And then there was Covid-19 and its negative impacts on downtown and the city's fiscal situation.

The emergence of the green economy is also a disruption, but one that presents Seattle with a once-in-a-generation chance to go on the offensive – to proactively envision and create the economy that it wants. The market opportunity is huge, Seattle has a strong foundation from

[2] "Future of Seattle Economy: Investment Recommendations," *City of Seattle*, December 1, 2022, https://bottomline.seattle.gov/wp-content/uploads/sites/26/2023/08/Future-of-Seattle-Economy_Investment-Recommendations_Final-221201-1.pdf.

which to build, and there is time for Seattle to get in the game. Many key green industries are not yet clustering in specific regions, or have not reached technological maturity.

For Seattle to stand a chance against both its usual rivals and many ambitious up-and-comers, it will need to identify its niche among many opportunities; align local, regional, and state partners in the public and private sectors behind a clear vision; and drive and sustain resources and attention to develop and maintain its advantages in the green economy. This should be the next big thing on the City of Seattle Office of Economic Development's (OED) agenda – and that of City leaders and other departments.

Seattle has many assets that give it a potential competitive advantage

- The green economy will thrive in places, like Seattle, that have the blend of **talent** to design *and* manufacture products that blend software and hardware. Among a group of several dozen large metro areas, Seattle is second in terms of its concentration of software-related skills, fifth in terms of concentration in architecture and engineering jobs, and just outside the top 10 in terms of production (manufacturing) jobs. No other region except for the Bay Area offers this mix of talent required for "deep tech" innovation in the green economy – and Seattle boasts a significant cost advantage over the Bay Area.
- Seattle has abundant raw material for **innovation**, including pathbreaking R&D happening in both academia and industry. Innovative firms often spin off from large high-tech companies (of which Seattle has dozens) or universities (UW is a powerhouse in relevant fields). The state's most innovative industries, including aerospace and software, have large global greenhouse gas footprints and will face intense pressure to decarbonize in the coming years. These industries also possess workers with the right mix of skills to provide the city and region with a uniquely competitive workforce in the green economy.
- The city's **built environment** is also well-suited for the green economy. Its industrial lands provide a foothold for small- to mid-sized firms that want to manufacture in close proximity to key infrastructure, customers, researchers, and skilled workers. The Port of Seattle can be a platform for green maritime innovation and manufacturing in areas from alternative fuels to offshore wind. And the city's building stock – much of which will be upgraded and electrified to support sustainable cooling systems, industrial process improvements, electric vehicles, distributed power generation, and more – offers a potential proving ground to test and scale new clean technologies.
- State and local **policy** environment offers some advantages. Washington State has one of the nation's most ambitious clean energy commitments, mandating that all power come from clean sources by 2045. The Climate Commitment Act, passed in 2021, will generate up to $1 billion annually for clean energy projects across the state and sets new efficiency standards, allowing for tens of millions of dollars respectively in heat pump adoption, multifamily housing efficiency, EV charging station deployment,

industrial decarbonization, and community-based initiatives for places facing intense pollution. Seattle benefits from the presence of Seattle City Light (SCL), a nimble and forward-looking public utility, which allows for strategy and policy alignment. Policies that stimulate demand for clean energy and energy efficiency will attract businesses that want to locate in regions with early adopters and large markets.

But this potential competitive advantage will only be realized if large and coordinated investments are made in shoring up real weaknesses

- Washington is known for its **clean energy** from cheap and reliable hydroelectric power, but this capacity is almost certainly tapped out and may even decline. The state's energy infrastructure is under strain. Washington already does not produce enough energy to meet demand across the state at all times, and thus increasingly imports more expensive and dirtier energy sources. ~~And~~ Washington is not well positioned to deploy the cheapest and most dependable sources of clean energy – solar and onshore wind – as states like Texas, California, Arizona, and New York are doing rapidly. Without some kind of breakthrough or greater prioritization by the Federal Government and the Bonneville Power Administration to approve new grid-scale clean energy projects in the Northwest, the marginal electron in Seattle's electrical grid will continue to get dirtier and less dependable while the opposite is true in other regions – including those often written off as laggards in terms of environmental policy.
- Seattle currently lacks the capabilities to translate **invention to innovation**. While Seattle is a hotbed of invention, the region trails its peers in its ability to translate those inventions into innovations that reach the market and create jobs. The University of Washington ranks highly for R&D funding overall, but many universities with less funding generate more patents. While Seattle benefits from the presence of organizations including Cleantech Alliance, VertueLab, Elemental Accelerator, and Maritime Blue, these entities are smaller and less well-funded than peer organizations in the most ambitious cities. For example, no Seattle-based accelerator or nonprofit fund offers funding directly to participating companies, but many leading cleantech accelerators and nonprofit funds elsewhere provide firms with anywhere from $100,000 to $2 million.
- Seattle's ability to compete for larger businesses that may offer more middle-wage, middle-skill jobs is significantly limited by high **costs** of land and labor compared to other cities within the metro area or elsewhere in the country. Some of these costs are inherent to Seattle's position as a center of innovation. But these costs are not proactively being offset by **policy**. Interviewees referenced permitting frictions and other regulatory requirements in the city. Nor is the state investing much in offsetting Seattle's cost disadvantages. Key green economy programs are very small ($1 to $2 million annually), and not structured to fully leverage or unlock additional investments. In

contrast, Michigan has invested $125 million in a Battery and Advanced Manufacturing challenge which offers a match to projects receiving federal funding.

- The **workforce development** system in the Seattle region currently lacks the ability to act at the speed and scale required to react to the growing demand for clean energy careers. The green economy, especially if Seattle's strategy is effective, will create new occupations and demand that existing workers attain new skills. These new skill demands will appear across many industries and occupations, and may therefore escape the attention of workforce development entities. Further, the Inflation Reduction Act provides very little funding directly for workforce development, so organizations in Seattle will not only need to detect these opportunities but organize to secure funding, deploy it effectively, and minimize duplication of effort. To date, Seattle and King County combined have invested just over $1 million annually for short-term training programs to grow green jobs. Meanwhile, Massachusetts (1.5 times the population of the Seattle MSA) announced $19 million in climate workforce funding in early 2024.

Seattle doesn't just need more investment, it needs to build civic capacity

Innovation and inclusion both depend on dynamic and diverse networks within and between government entities, businesses, and nonprofits. This work needs to be prioritized and funded. Three needs stand out:

- Seattle needs more capable and better-networked organizations **building connections between businesses, entrepreneurs, and researchers**. Seattle's entrepreneurial support system appears to be diffuse and disconnected, without a clear "hub" entity that's proactively connecting entrepreneurs with each other, with potential corporate customers, funders, researchers, and government agencies. One interviewee bemoaned the difficulty involved in getting large Seattle-based businesses to engage with or invest in local startups (in contrast to the Bay Area).
- Seattle needs to better **link community-based and industry-facing initiatives**. Both for the purposes of ensuring that underrepresented populations are aware of and connected to workforce development opportunities in emerging sectors~~,~~ and ensuring that low-income households and nonprofits are maximizing uptake of funding/subsidies for clean energy (thus creating demand that can be met by local entrepreneurs/workers).
- Seattle needs more formal and purposeful **coordination among local, regional, and state government and nonprofit economic/workforce development organizations**. This coordination is needed for both technical reasons (expediting permitting for green manufacturing projects) and strategic reasons. Without a coherent and shared strategy – and the ability to execute across multiple areas in service of it – Seattle is at risk of spreading limited resources too thinly across a variety of loosely-related, small-scale initiatives. If Seattle does so, it risks losing out to places with a clearer niche and/or more strategic discipline – such as Silicon Valley and Boston on one hand (R&D, software,

startups) and Georgia and Michigan on the other hand (manufacturing).

There are several opportunities around which Seattle can build its strategy

Given its assets, Seattle has several strategic pathways that it can choose to go down. These are not totally discrete or mutually exclusive. But Seattle must choose from among these pathways and maintain strategic discipline: competing in any area of the green economy will require focus, attention, and targeted investment of limited local resources in the most promising domains.

Based on its existing assets, Seattle has six high-potential opportunities that can be considered either “foundational” (building a platform for all ~~of~~ its green economy ambitions), “vertical” (focused on a specific green industry where the city has distinct assets that could be strengthened), or “horizontal” (developing assets relevant to a wide range of green industries).

Foundational

Seattle should be focused on *decarbonizing everything*. It should work to become one of the most rapidly-electrifying and energy-efficient cities in the country across the residential, commercial, and industrial spheres, leveraging generous federal incentives that support energy efficiency and equity in the clean economy. In doing so, the city should intentionally catalyze inclusive workforce development, small business development, and wealth creation, including the creation of career pathways that ultimately service both local and traded sectors. By developing the electrification and efficiency skills required for local decarbonization, Seattle will also position itself for success in business attraction and retention.

Vertical

- *Next generation clean energy and storage technologies:* Make Seattle a leader in clean energy generation and storage technologies that are not yet technologically mature and have not been deployed at scale (such as novel battery technologies and chemistries, offshore wind, green hydrogen, and fusion energy). Use the region’s geographic and political constraints, which limit the ability to expand existing hydroelectric capacity or deploy extensive solar or wind power, as a platform for innovation.
- *Clean transportation:* Establish a competitive advantage in specialized clean transportation technologies other than electric vehicles, especially maritime and aerospace. Translate the region’s global leadership in air travel, its niche strengths in space and maritime industries, into a position as a hub for zero-carbon transportation technologies.

Horizontal

- *De-risk markets:* Become the best city for businesses to test demonstration projects and scale new technologies to decarbonize the built environment. Leverage public and private procurement, electrical, port, and transportation infrastructure, and diverse land uses to establish a testbed for emerging clean technologies.
- *Climate computing:* Lean into existing software-related strengths to develop systems and applications for smart electrification and efficiency across various economic assets, such as energy demand forecasting, smart building systems, EV fleets and charging networks, sustainable supply chains, and environmental impact compliance and assessment.
- *Cleantech startup:* Break into the top tier of cities for cleantech startup formation and growth, especially at the intersection of software and hardware that is happening across industries. Given limited resources for the attraction of established businesses, draw the smartest innovators – especially from underrepresented populations – out of Seattle's top businesses and labs, and work in communities, to unleash their entrepreneurial potential.
- *Cleantech scaleup:* Develop a set of industry-agnostic capabilities focused specifically on the scale-up phase, to both grow existing startups and attract small firms from other innovation hubs with higher operating costs (e.g., the Bay Area). This includes tailored capital, talent development services customized to the needs of scaleup firms, testing and pilot-scale manufacturing infrastructure, and connections to potential corporate and public sector partners.

II. Introduction

The Green Economy Moment

It is hard to overstate the size and scope of the movement to decarbonize the economy. McKinsey refers to the investment that will be required to reach net zero emissions by 2050 as "the largest capital reallocation in history".[3] This is not an idealistic vision – it is a policy and market reality that is already underway. In the United States, the federal government has committed hundreds of billions of dollars, largely through the Bipartisan Infrastructure Law (BIL) and Inflation Reduction Act (IRA), to meet ambitious economic, environmental, and equity goals. The private sector, meanwhile, announced $249 billion in investment in 376 clean economy projects across the U.S between 2021 and 2023.[4] This figure does not include the investment in

[3] Jonathan Woetzel, Patrick Dupoux, and Daniel Pacthod, "Five-Fifty: The Great Reallocation," *McKinsey & Company*, July 5, 2023, https://www.mckinsey.com/capabilities/sustainability/our-insights/five-fifty-the-great-reallocation.

[4] This is about half of the $525 billion in announced private investment associated with federal industrial policy legislation from 2021-2023 (most of the rest is accounted for by semiconductor investments). Robert Maxim and Mark Muro, "Strategic Sector Investments Are Poised to Benefit Distressed US Counties." https://www.brookings.edu/articles/strategic-sector-investments-are-poised-to-benefit-distressed-us-counties/.

cleantech startups nor the subtler ways that established supply-chain businesses are updating products and processes to meet the demands of “greening” customers.

The most visible, headline-grabbing manifestation of the green economy to date might be the dozen or so multi-billion dollar industrial megaprojects that have sprouted up across the Midwest and Southeast since the IRA passed, such as electric vehicle and battery investments from Hyundai and LG in Savannah, GA ($7.8 billion), Ford outside of Memphis, TN ($5.7 billion), and General Motors in Metro Detroit, MI ($4 billion).[5] But over time, the green *transition* will have far more profound, if sometimes less visible, economic impacts than suggested by the ongoing profusion of exurban battery plants and solar farms.
The green transition is a process that will touch or transform nearly every aspect of the economy and society, implicating:

1. The goods and services we produce and how we do so;
2. Where and how people live, work, and get around;
3. The quality of community health and wellbeing;
4. The preservation of natural resources and our environment; and
5. Whether we deliver on the promise of a more just society and economy.

A Vision for Seattle

For Seattle, where tech has driven growth for the last decade, the green transition represents an opportunity to not just grow more, but to grow differently. New skills required to decarbonize the built environment, manage energy efficient systems, and produce climate-friendly products , are transforming industries and offering more equitable opportunities. It is a chance to develop an economy that’s not only more prosperous, but also more purposeful – where solving environmental problems, both those created by Seattle-based industries or affecting Seattle residents, becomes an engine for innovation. **Seattle can develop and export its own model of decarbonization: one based on its advanced technologies, created by diverse entrepreneurs and workers, built in the city rather than exurban industrial sites, and informed by progressive values.** Seattle has a potential niche as a place that is more innovative than most manufacturing centers while being more suited to manufacturing than most innovation centers. This also creates opportunities for the creation of middle-wage, middle-skill jobs. What would it look like if Seattle seized this opportunity?

- Green **manufacturing** facilities producing zero-emissions transportation technologies on urban industrial lands, like First Mode in SoDo or Electric Era in InterBay.
- Startups and established firms creating the **clean energy** generation and storage technologies that Washington needs to achieve its climate goals, from offshore wind to fusion to hydrogen.

[5] Trevor Higgins, Puzzanghera, Jim, and Galen Hendricks, "Biden Administration Investment Tracker," *Center for American Progress*, August 2023, https://www.americanprogress.org/article/biden-administration-investment-tracker/.

- Seattle's smartest **software** developers using their skills to solve climate problems like carbon accounting, renewable energy management, and building information modeling.
- Legacy firms employing **green processes,** like renewable energy integration, efficiency improvements, and development and utilization of less carbon intense supply chains, to enter new markets, retaining and creating middle-wage jobs in the process
- Architects, engineers, and contractors developing new skills to create **green buildings** and infrastructure.

While some of the examples cited above are small today, the medium-term opportunity for Seattle is anything but. By one estimate, the IRA will lead to the creation of 10 times as many jobs over the next decade as it has thus far– about 1.5 million green jobs.

The Challenge & The Path Forward

But none of this is guaranteed. While the emergence of the green economy will *impact* every region and industry, that doesn't mean that every region will *benefit* equally. Every region will *consume* greener products, but a small number of regions are likely to dominate the *invention and production* of innovative goods and services that will enable the green transition – and reap the benefits in terms of quality job creation, tax revenue, and economic inclusion.

To be a leader, the City of Seattle must first elevate the urgency of creating and aligning regional stakeholders behind a strategy. This will require recognizing that Seattle's historic or perceived strengths – such as commitment to urban decarbonization, abundant hydroelectric power, and a cultural affinity for the environment and great outdoors – are not guarantees of success in the green economy. The City must call attention to the need for a strategy to confront its challenges and shortcomings relative to other regions that are described in this report, from limited clean energy generation potential to limited ability to deploy public finance to build green industries.

The City of Seattle needs to answer two questions in order to design and implement a strategy to secure its position as a hub of the green economy:

1. Where *can* Seattle compete in the green economy?
2. Where *should* it compete to ensure the economic dividend is equitable?

Can Seattle leverage its existing strengths to become a national and global leader in parts of the green economy that drive regional economic growth?

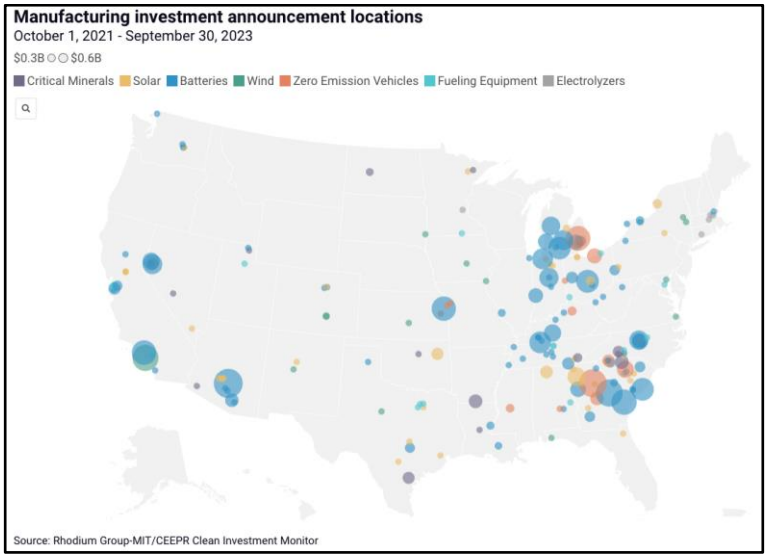
Economic development is an evolutionary process. Rarely do new sectors take root in places without a relevant history. A region's ability (or inability) to transition to new sectors is determined by its existing sectors. This is clear in Seattle's economic history. Its location positioned it for the timber trade, connecting Pacific Northwest forests with fast-growing West Coast markets, and the creation of transport infrastructure that would build the foundation for its

position as a commerce and maritime hub. Seattle's ready access to timber and the skills of its shipbuilding workforce provided an important input to early aircraft production. The aerospace cluster, bolstered by the University of Washington's research and training expertise, fostered a skilled engineering and technology workforce that made the Puget Sound region a destination for software innovators looking to scale their businesses outside of Silicon Valley.

Seattle's ability to navigate waves of technological change over the past several decades has made it one of the most prosperous metro areas in the country – even taking into account cost of living and racial disparities. As the green economy arrives, Seattle will have a chance to proactively navigate a new wave of technological change as a leader of alignment between climate action and market development.

The assets that allowed Seattle to "win" in the digital economy, along with its legacy manufacturing strengths, give it an advantage in the green economy. But so far, Seattle's potential has not been realized. According to Brookings and MIT, the western U.S. as a whole has received only 60% as much cleantech investment from 2021-2023 as would be expected based on its share of GDP. Only one or two of these investments is close to the Seattle area.[6]

As the green transition begins, Seattle will need to prioritize growing green economy technology strengths in order to become one of many industry leaders. If Seattle stays on its current course, the green economy will be created in San Francisco, Chicago, Atlanta, or Boston – not Seattle. Our region will miss out on a significant opportunity.



There is reason for optimism, however, for three broad reasons.

First, as this report reveals, Seattle has significant assets and strengths that lend themselves to clean economy growth and competitiveness:

[6] The main exception to the Pacific Northwest's underperformance is $1 billion in Regional Clean Hydrogen Hubs funds spread across Washington, Oregon, and Montana, with no projects in the Seattle metro area.

- a uniquely balanced mix of computer, engineering, and manufacturing talent;
- world-class research and development;
- businesses and governments with major climate ambitions that can serve as first customers; and
- a concentration of industries, from AI to aviation, that demand climate solutions.

Second, we are in the early days of the green transition. The Pacific Northwest's underperformance to date, at least by some measures, does not mean it is already locked out of the competition. The $250 billion in private investment in cleantech projects over the past two years is a fraction of what will be invested over the next two decades. The majority of investment to date has been in electric vehicles and batteries. Decarbonization will require investments of similar scale in a host of other sectors, which is why McKinsey estimates that the peak of capital investment for decarbonization won't happen for another 10 years.[7] Deloitte estimates that the IRA created 170,000 jobs through 2023, but in the next decade will create 1.5 million jobs– almost ten times as many jobs..[8]

And third, the green economy, more than most other industries, is shaped by state and local policy. The tools and resources that public sector leaders need to have access to in order to deliver environmental, social, and quality of life outcomes can be leveraged for economic impact. For example, the government makes infrastructure-related decisions that will either accelerate or hinder the ability of businesses to green their processes and products. And the public sector is capable of creating markets for green products and services, either directly through procurement or indirectly via policies that generate consumer demand.

These transitions do not happen automatically. The cities that successfully evolve despite constant waves of technological change don't just have the right ingredients – they have the ability to strategically redeploy existing strengths for new economic opportunities. This ability rests on a few foundational civic capabilities:

1. shared strategic vision;
2. robust cross-sector partnerships; and
3. patient investment.

When it comes to the green transition, Seattle will need to strengthen and grow these civic capabilities. Without the ability to create and drive a shared strategy, the city's high-value assets (research strengths, innovative firms, and highly-skilled workers) won't be reinforced and reoriented. The lack of a coherent and shared strategy also means Seattle is at risk of losing out to places like Silicon Valley and Boston for R&D, headquarters, software, and startups, and to places like Georgia and Michigan for their manufacturing. While often viewed as places that win

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[7] McKinsey & Company. *The Net-Zero Transition: What It Would Cost, What It Could Bring (Executive Summary)*. January 2022. https://www.mckinsey.com/~/media/mckinsey/business%20functions/sustainability/our%20insights/the%20net%20zero%20transition%20what%20it%20would%20cost%20what%20it%20could%20bring/the-net-zero-transition-executive-summary.pdf.

[8] William D. Eggers, Nes Parker, and Kelly Marchese, "A Systems Approach to Climate Change: Enabling a Low-Carbon Future," *Deloitte Insights*, April 23, 2024, https://www2.deloitte.com/us/en/insights/industry/public-sector/systems-approach-to-climate-change-for-low-carbon-future.html.

primarily based on low costs, these regions are making major investments in their innovation capabilities.

This situation should provoke urgency, not pessimism. Seattle's role in the green economy will only be achieved and realized through action, partnership, and investment. To thrive in the coming economic era, Seattle must decide that it will make the necessary investments of money and civic and political energy.

Can Seattle leverage the green transition to drive inclusive growth, and equitable access to opportunities created through new investment, business and job expansion?

The previous section concerns Seattle's ability to win at least its fair share of investment and jobs in the green economy. A separate, and equally critical, question is whether Seattle can ensure that its green economy is inclusive and an engine for equitable growth.

Greater Seattle's economy has been one of the nation's strongest over the past decade. But Seattle's economy is still not providing abundant opportunity to middle-skill workers. Among workers with two-year degrees, less than 40% of Black workers and just over 50% of white workers earn a living wage.[9] Black and Hispanic workers in Seattle earn substantially less, on average, than White workers in the same industries and those with the same level of educational attainment; and they are more likely to face housing cost and transportation burdens.[10] **PolicyLink concludes that the "equity dividend" of achieving racial equity in the workforce would be a $33.2 billion boon to the regional economy, and a primary barrier to achieving more equitable growth is the relative scarcity of good jobs.**

The green economy has potential to counter these problematic trends – both in the short-term and long-term.

- **In the near-term,** there is federal money on the table for deployment of clean energy technology in low-income communities, which could – and is designed to – be used to create high-quality, accessible jobs for people underrepresented in the construction trades.
- **In the long-term,** Seattle can intentionally grow a different set of industries than those that have been growing over the past decade – industries that are richer in high-quality, accessible jobs. Notably, the green transition could be an opportunity to grow Seattle's manufacturing and R&D base and associated well-paying production jobs, and connect opportunities in building trades to piloting and scaling clean technologies.

[9] Good jobs are defined as those that pay $31/hr for workers with 2-year degrees (this is essentially a weighted average of the living wage for six different family types across the three counties that make up the Seattle MSA).

[10] Abbie Langston, Justin Scoggins, and Matthew Walsh, *Advancing Workforce Equity in Seattle: A Blueprint for Action*, PolicyLink, January 2021, https://www.policylink.org/sites/default/files/Advancing%20Workforce%20Equity%20in%20Seattle_FINAL_0.pdf.

But just as Seattle is not guaranteed to excel in terms of competitiveness and growth in the green economy, there is nothing inherently inclusive about the jobs that will be created via green economy growth. Success in the green economy will almost certainly lead to a more diverse set of industries and occupations, which is a good starting point for inclusion efforts, but no more than a starting point. Some new green economy jobs will be in high-wage, high-skill occupations (e.g., climate-related software) for which intentional effort will need to be made to build inclusive pathways that haven't been built in the tech economy at the necessary scale to date. And the more accessible jobs in the green economy (e.g., clean energy infrastructure) are in industries in which people of color and women are extremely under-represented.[11]

Ensuring the green economy is inclusive will demand more strategic and organizational capacity than ensuring that Seattle is competitive in the green economy. Fortunately, there is a strong foundation within the City of Seattle's workforce development system – and that of its sister agencies – that is already prioritizing inclusive training pipeline development in the local deployment of clean energy.

III. Purpose of this report

The City of Seattle's Office of Economic Development (OED) recognizes that building the civic capacity, collaborative leadership, and cross-sector alignment required to establish competitive strengths in the green economy starts with a **shared vision**. This report lays out a vision for the role Seattle can play in inventing and producing climate-focused products and services to meet decarbonization demand around the world, and why sizing these opportunities matters to inclusive growth. This vision is rooted in **pathways** that Seattle could pursue to realize that vision, based on an assessment of its **assets** (where it can compete) in the context of its inclusive growth goals (where it should compete). While this document does not attempt to define Seattle's strategy, the process of evaluating assets and constraints narrows the set of strategic choices for the City and its partners to consider.

Alignment

Our focus is on where Seattle can and should *compete* in the green economy – and thus developing its traded sector strengths. This is complementary to other efforts to reduce emissions, improve the local environment, and advance inclusive economic growth, including the Green New Deal for Seattle, Seattle City Light's Electrification Strategy, and King County's Green Jobs Strategy. While these initiatives focus primarily on ensuring that Seattle is enabling the *consumption* of clean technologies (in particular, deploying them in low-income communities

[11] Mark Muro, Adie Tomer, Ranjitha Shivaram, and Joseph W. Kane, *Advancing Inclusion Through Clean Energy Jobs*, *Brookings Institution*, April 20, 2022, https://www.brookings.edu/articles/advancing-inclusion-through-clean-energy-jobs/.

and employing underrepresented workers to do so), this report focuses on ensuring that Seattle is a hub of *invention and production* of clean technologies.

However, in many cases, there are important connections between consumption and production: what Seattle chooses to consume can create conditions for growth of traded-sector industries, and what Seattle develops the capability to export can be more easily deployed locally. This could be the City allowing or supporting piloting new technologies locally, or using its procurement functions to help an early-stage business scale to a level that it can reach customers across the country and the world. Workers trained in green economy-related skills could be a pipeline of talent for both local-serving and exporting companies. For example, an electrification training program can prepare workers to do both residential electrical work as well as improve industrial process electrification for a manufacturing firm.

Why distinguish between local-serving (consumption) and traded sectors (production)?

Traded sectors, such as advanced manufacturing and specialized services that are sold across the country and globe, play a critical role in regional economies. They are the primary source of quality jobs in an economy, both directly and indirectly, and they generate tax revenue. In terms of job quality, the share of jobs that are family sustaining in traded sectors is about 50% higher than local sectors, (29% versus 21%. Jobs in utilities and certain construction-related industries are often cited as sources of high-quality jobs, but these sectors cannot grow (in net terms) unless traded sectors are growing. Importantly, the wage premium of working in the “advanced industries” portion of the traded sector (advanced manufacturing, software, etc.) is not just a reflection of higher educational attainment in those sectors: a 2016 Brookings Institution study found that a worker with an associate’s degree made $58,000 in an advanced industries job versus $38,000 in other industries. There is a risk of Seattle overlooking the importance of traded sectors in the green economy because these sectors don’t generate the visible and near-term job gains that come from, for example, infrastructure projects.

This report brings a traded sector focus to the green economy. It is not primarily concerned with how Seattle should *consume* more green goods and services to reduce the carbon emissions of its economy (i.e. how to promote local sustainability or grid modernization), or what workforce development efforts would enable that consumption. Rather, this report aims to articulate **how Seattle is uniquely well-positioned to *produce* for national and global markets in which trillions of dollars will be invested in decarbonization in the coming decades, which of those opportunities is most likely to produce inclusive growth, and where Seattle can invest in service of competitiveness and inclusion.**

Choosing which traded sectors to focus on requires methodical analysis of Seattle’s latent, emerging and established strengths, determining whether they can or should be scaled, and the resources required to do so. In these sectors, firms and talent are “footloose,” meaning they naturally gravitate towards a few hubs (where there are large positive spillovers from the exchange of tacit knowledge that comes from dense clusters of researchers, peer firms,

suppliers, etc.). Figuring out Seattle's competitive opportunities requires multi-faceted analysis of where it has distinct and valuable assets relative to cities like San Francisco, Boston, Chicago, and Atlanta. It takes significant public and private investment – in R&D, talent, infrastructure, etc. – over the course of at least five or ten years to solidify an advantage in a given sector, especially when this requires out-competing other regions that have more federal funding and substantial state or philanthropic funding as well. Since any region only gets to make a few of those big bets, they need to be carefully considered.

IV. Defining the green economy

A shared vision and strategy depends on a shared definition. There are widely differing viewpoints on what counts as part of the green economy. This is not just due to technical debates about industry definitions, but rather differences in priorities among stakeholders. Some audiences take a local view – a green economy is whatever economic activities preserve and protect the local environment. Others take a global view – a green economy is one in which businesses are inventing and manufacturing products that will reduce emissions globally, even if not directly "greening" locally. These tensions are not irreconcilable, but they will need to be addressed in order to create clear and compelling visions for the green economy.

This report's definition of the green economy is broad, because its purpose is not to delineate which sectors or occupations are sufficiently impactful on the environment to count as "green", but rather **to identify where there are market opportunities for Seattle in a world that is undergoing a green transition**. Some of these opportunities will seem obviously green to outside observers, and others less so (e.g., software, changes in industrial processes).

In summary, this report defines the green economy as **the set of industries, technologies, or occupations (often combined as "sectors") that are growing as a result of the global movement to decarbonize the economy**. This leads us to consider a wide range of industries related to manufacturing, software, and the built environment. We consider both the production of green products and the implementation of green processes in seemingly non-green businesses or sectors.

The following is a non-exhaustive list of technologies we considered. It is helpful to think in terms of technologies, because technology facilitates the greening of products, processes, and services. In addition, technologies represent capabilities that might be deployed across multiple domains or industries: there are hardware and software opportunities in each of these, and we consider themes like "maritime" less a technology type and more an area in which many of these technologies can be applied.

Clean energy (incl. renewables, nuclear, hydrogen)	Sustainable fuels

Batteries and energy storage	Carbon capture, utilization, and storage
Electric vehicles	Green agriculture and food production
Circular technologies (heat recovery, plastics recycling, renewable deconstruction & material recovery)	Water and soil remediation
Building technologies (incl. energy efficiency, heat pumps)	Natural climate solutions (terrestrial ecosystems, agricultural carbon removal)
Industrial process innovation (incl. green steel)	Alternative proteins

V. Pathways

There is intense competition among regions seeking to become centers of the green economy. Seattle can emerge as a winner in this competition. But to do so it must choose its area(s) of specialization. The City of Seattle and its partners must therefore make clear decisions about where to invest limited resources in order to gain a durable advantage. These decisions should be based on:

- **Growth potential:** which sectors (vertical industries or horizontal functions, like software development) does Seattle have an advantage in?
- **Impact opportunities:** which assets can improve the most with a given amount of investment ("upside potential") and where is there existing civic/political momentum?
- **Inclusion potential:** which sectors are likely to generate quality jobs, wealth-creation opportunities, and other positive local outcomes?
- **Coherence:** which investments would reinforce one another, creating a distinct position for Seattle in which it is insulated from competition from lower-cost regions?[12]

To inform OED and the City of Seattle's strategic direction, this analysis identifies potential pathways, which represent coherent bundles of activity that meet most of the above criteria – they have inclusive growth potential, high-impact investment opportunities, civic/political momentum, and synergies. Leaders in Seattle could "pick and choose" pieces of these pathways – investing in R&D assets related to one industry vertical, workforce training related to another, infrastructure related to another – but the sum of such a portfolio would likely be less than its parts.

[12] Per McKinsey, climate technologies are interdependent, increasing the need for coherent bundles of investments: "Most climate technologies are viable only if other climate technologies are also implemented at the level of facilities, enterprises, regions, or value chains." See: Heid, Linder, and Patel, "Delivering the Climate Technologies Needed for Net Zero."

Types of Pathways

This set of pathways is divided into three types. First, there is the **"foundational"** pathway that involves "decarbonizing everything" in Seattle – in other words, taking full advantage of abundant federal funding and local climate advocacy momentum – and using that as a means of inclusive job and business creation. This is considered foundational because it will create visible inclusive impacts (and thereby build momentum for the broader effort) and because electrification and efficiency skills are also relevant to the ability of every industry to decarbonize (and thereby stay in or move into high-value supply chains).

The other pathways are divided into two categories:

- **"Vertical"** pathways create or improve assets related to a specific green industry in which the City has distinctive advantages that could be strengthened. For example, investing in every input related to the offshore wind industry, from R&D to entrepreneurship to workforce development to infrastructure.
- **"Horizontal"** pathways, on the other hand, involve investing in assets relevant to a particular need shared by a wide range of green industries. For example, establishing a range of supports that make Seattle the best place to scale any green economy business from 5 to 50 employees. Another "horizontal" pathway is investing in workforce development efforts relevant to a wide range of industries. For example, investing in foundational electrical skills that can apply equally to residential or industrial electrification efforts.

These "horizontal" pathways can, and should, be pursued with the same strategic discipline as "vertical" pathways require. And though each pathway may look enticing to City decision-makers, Seattle should not, and realistically can not, pursue all of them. Choosing a limited number of pathways across each category will be a critical decision Seattle should weigh with stakeholders across sectors, in and outside of government.

Note that these pathways – and the actions that advance them – are not totally discrete, or mutually exclusive. In some cases, they may be complementary to one another, depending on specific strategies. There might be substantial overlap between strategies to accelerate the offshore wind supply chain and scale efforts to decarbonize maritime transportation, for example.

Pathways Overview

Pathway	Description/Vision	Potential focus areas	Relevant assets	Relevant actors
Foundational				
1. Decarbonize everything	*Make Seattle one of the most rapidly-electrifying and energy-efficient cities in the country, and in doing so become a leader in inclusive workforce development and wealth creation* Leverage significant federal resources available through the Inflation Reduction Act to enable electrification, from heat pumps in homes, to solar power on schools, to industrial process efficiencies Coordinate across sectors to maximize uptake of subsidies, secure competitive grants, and train a diverse workforce and support BIPOC and women-owned firms to carry out electrification projects	Accelerate electrification of existing facilities and processes Create and scale locally-serving businesses to serve residential/ commercial/industrial electrification demand	Energy (constraint) Policy Land and Built Environment Talent (constraint)	Seattle City Light City of Seattle and King County (especially to lead on electrifying public facilities and procurement) Community colleges Labor
Vertical				
2. Next generation clean energy generation and storage technologies	*Make Seattle a leader in clean energy technologies that are not yet technologically mature (beyond solar and onshore wind) and have not been deployed at scale* Use the region's geographic and political constraints as a platform for innovation, such as designing solutions for other regions facing	Offshore wind Fusion Batteries Hydrogen	Energy (constraint) Built Environment Talent Innovation	Port of Seattle and Seattle City Light (especially for procurement and demonstration) Maritime industrial lands (for wind

	constraints such as limited solar or wind generation potential, and respect for natural and tribal lands		(constraint) Policy	manufacturing, hydrogen infra) Large corporations (to leverage sustainability spending, e.g. on AI) Pacific Northwest Hydrogen Association (winner of Hydrogen Hub designation) Emerging regional fusion cluster
3. Clean transportation aerospace and maritime	*Make Seattle a leader in specialized clean transportation technologies, especially maritime and aerospace (beyond electric vehicles)* Translate the region's global leadership in aerospace, its niche strengths in the space and maritime industries, into a position as a hub for zero-carbon transportation technologies While other regions focus on the electric vehicle supply chain, seize an advantage in emerging platforms	Maritime Aerospace Industrial (e.g., heavy-duty vehicles - electric or hydrogen) Batteries	Talent Land and Built Environment Innovation (constraint) Policy	Port of Seattle (demonstration partner) Leading firms in industries under pressure to decarbonize (Boeing, Alaska Airlines) Other innovative firms (e.g., Blue Origin, Paccar, FirstMode) Maritime Blue (cluster convening)
Horizontal				

4. De-risk markets through demonstration projects	*Become the best city for businesses to deploy demonstration projects and scale new technologies to decarbonize the built environment* Contrary to the approach in many regions of pursuing green manufacturing projects with big subsidies, bring a unique combination of sustainability commitments and risk tolerance required to become a testbed for emerging technologies Leverage constraints on future clean power generation to create opportunities for innovation in energy efficiency	Allow pilot and demonstration projects on public infrastructure Use city procurement as a market-creating opportunity for Seattle-based firms	Land and Built Environment Talent	Seattle City Light, Port (demonstration, procurement) University of Washington (Clean Energy Test Beds, demonstration) Policymakers (building performance standards)
5. Climate computing	*Pivot globally-leading tech strengths to drive innovation and inclusion in green software* Support the development and scaling of software solutions to support producing, deploying, and maintaining green infrastructure, products and services Make strategic investments and partnerships to ensure this area of software is more inclusive than the last tech boom	Could apply to existing and/or startup companies Does not require making a bet on a particular industry or technology	Talent Innovation Land and Built Environment (downtown office real estate to repurpose)	Leading software companies Tech-focused academic research and training programs
6. Cleantech startup creation	*Break into the top tier of cities for cleantech startup formation, especially at the intersection of software and hardware, across industries* Bolster Seattle's startup formation rates, which lags other top-tier innovation centers, especially at the intersection of hardware, software, and/or	Industry-agnostic	Talent Innovation (constraint - few resources for startup firms)	Universities (as sources of commercialization) Accelerators (local and national)

	the built environment Given the lack of business attraction resources, focus attention on high-growth startups for new job creation, via increased early-stage funding, more and better accelerators, and networks among startups and researchers, corporations, and funders Draw the smartest innovators – especially from underrepresented populations – out of Seattle's top businesses and labs and unleash their entrepreneurial potential			Investors (angel, venture capital, etc.) Corporations (as potential customers or acquirers of firm)
7. Cleantech scale-up	*Become the best place for cleantech entrepreneurs to go to become employers* Leverage Seattle's cost advantage over other startup hubs like San Francisco and Boston, which have a higher density of universities and venture capital, while Seattle boasts many of the same assets at a lower cost Carve out a niche between cities focused on early-stage entrepreneurship on the one hand an business attraction on the other by investing in a set of industry-agnostic capabilities focused on the scale-up phase Engage large corporate presence not found in many peer cities to create both customers and talent base relevant to growing a business	Industry-agnostic	Talent Innovation (constraint - few resources for scale-up firms) Built Environment (commercial real estate) Energy (constraint - cleantech firms will want assurance of clean energy abundance) Policy	Funders (venture capital, financial institutions, green bank) Universities and community colleges (sources of talent relevant to scale-up phase) Corporations and government agencies (as potential customers or partners)

Considerations for pathway selection

OED has a role in supporting and advocating for work that is ongoing in each of these pathways. To outcompete other regions, inspire collaboration, and maximize the impact of public investments, OED and its partners should endeavor to make a “big bet” on three of these pathways. A logical approach would be to select one vertical and one horizontal pathway in addition to the foundational (“decarbonize everything”) pathway. As the City of Seattle assesses these pathways to identify which to focus on, it should keep in mind the following considerations, some of which are clear constraints to operate within (based on the following asset analysis) and some of which are questions to investigate.

1) **Seattle’s lane is between Silicon Valley and Boston on the one hand, and Chicago and Atlanta on the other.** Seattle’s niche is being lower-cost and better at manufacturing than centers of research and venture capital (Silicon Valley and Boston), and more innovative than centers of large-scale production (Chicago and Atlanta). In assessing any pathway, Seattle should ask what version of that pathway allows it to strengthen its position in the territory in which companies are past the early-stage R&D and venture capital stage, but have not yet routinized production to such an extent that labor and land costs are the main consideration in their growth decisions.
2) **Is the City of Seattle, along with other public and quasi-public agencies, able to be flexible and innovative when it comes to piloting and procurement?** Some of these pathways – especially “decarbonize everything”, “next generation clean energy”, and “de-risk markets” – depend fairly heavily on the willingness of government agencies to work with cleantech firms to allow pilot and demonstration projects on public infrastructure, and to use procurement as a method for supporting young firms. If key departments in the City of Seattle and other partners - such as the Port of Seattle, Sound Transit, University of Washington, can commit to being more nimble and supportive than governments in other regions, then these pathways are promising.
3) **Are startup support and industry organizations – and their funders – willing to reorient to achieve scale around cross-cutting opportunities?** While other regions have cleantech funds with varied portfolios (e.g., Massachusetts 2030 Fund) or accelerators that serve a range of cleantech firms (e.g., LA Cleantech Incubator or Chicago’s mHub), Seattle’s cleantech supports appear to be more narrowly focused (e.g., Maritime Blue) or not fully focused on Seattle (e.g., VertueLab, Cleantech Alliance). The “clean transportation” pathway, for example, is somewhat dependent on the willingness of funders to push various organizations focused on aerospace, maritime, and other industries to collaborate more to achieve greater scale.
4) **Are government agencies able to find ways to deploy public funding in service of business creation and growth?** Some of these pathways involve technologies with high capital requirements – for example, developing “hard” technologies like electric engines or small modular reactors is much more capital-intensive than developing software products. If state and local policymakers enable the government to deploy public funding in support of cleantech business growth in areas like clean energy and clean transportation, then Seattle has the other assets necessary to compete.

VI. Asset analysis

Economic assets are, broadly speaking, tangible or intangible resources that have value to the regional economy. They can be privately owned (intellectual property or real estate), collectively held (human capital), public goods (geographic location, proximity to natural resources), or civic capacity (social capital, leadership networks). For the purposes of this analysis, what distinguishes these assets from other local or regional characteristics is that when they interact, they create positive spillovers that redound to the benefit of the economy as a whole, or advance a broad-based economic objective, rather than just returns to their primary owner or stakeholder. It is, in fact, the interaction of these assets that defines the economic trajectory of a region.

The analysis walks through five assets that matter in the green economy:

- **Energy**: access to abundant, clean power
- **Land and the Built Environment**: space to house green industry in high value locations, along with infrastructure to test, demonstrate, and scale new technologies
- **Talent:** skills for both developing and deploying green solutions
- **Innovation:** capability to turn inventions into commercially viable products
- **Policy**: potential to unleash public and private investment at scale

The analysis below details why each asset matters from a competitiveness standpoint, how strong (or weak) Seattle is relative to other regions, and identifies how much can Seattle improve these assets, through both government investment and mobilizing business, nonprofit, and philanthropic resources.

Earlier, we suggested that Seattle's green economy strategy should be based on four considerations: growth potential, impact opportunities, inclusion potential, and coherence. This asset analysis primarily addresses the first two of those four considerations: where does Seattle have a competitive advantage, and which assets can it improve most? It is beyond the scope of this analysis to deeply investigate the varying levels of potential inclusion impact from different investments in different assets, and therefore it is beyond the scope of this analysis to strongly prioritize among potential pathways. This should be the central focus of a future strategy development process.

Energy

Why it matters to the green economy

Competitiveness in the green economy demands both more abundant and cleaner energy. Energy abundance is a key determinant of green economic growth because (1) the green economy will involve a boom in manufacturing, and manufacturers will seek to locate in places with abundant energy, and (2) there must be abundant energy to enable the electrification of homes, transportation, and existing industrial facilities. This electrification process can both create jobs (for electricians, HVAC technicians, etc.) and create an environment conducive to startup creation and growth (companies developing innovative clean energy products and services will seek out locations with a large base of early adopter customers).

Ensuring that this abundant energy is clean is important because businesses – especially corporations and small businesses in their supply chains – face policy and market pressure to disclose and reduce emissions. The SEC's proposed climate disclosure rules[13] are one force that will push large firms and their suppliers to decarbonize their processes; another is a new law in California that will require large firms operating in the state to report direct and indirect emissions[14]; a third is the EU's carbon tariff, which only applies to a few sectors (e.g., fertilizers, iron and steel) but may be a sign of things to come[15]. Various federal agencies and approximately 15 state governments, including Washington, also have green procurement policies.[16] Further, there is growing - although not definitive - evidence that customers are willing to pay a price premium for green products.[17] All this adds up to more demand for reliably clean energy, even from businesses that are not major energy users.

How strong is Seattle?

The policies and technology trends that shape energy generation and distribution are complex. There is some consensus about what is possible in the near-term (the policy and technology constraints are known) and long-term (when those constraints can be relaxed), but there is much disagreement about what's possible in the medium-term horizon (5-15 years) that is the focus of this assessment. This assessment makes some claims that might be disputed, but there is little debate about these five points:

1. Washington used to have abundant and clean electricity. This was a clear national differentiator.
2. Washington will experience significantly increased demand for electricity as residents and businesses electrify (electric vehicles, heat pumps, etc.).
3. Amid rising demand for electricity, Washington is pursuing further decarbonization. The Clean Energy Transformation Act mandates a 100% clean electricity supply by 2045, and the Climate Commitment Act ("cap and invest") provides further urgency for businesses to decarbonize.

[13] U.S. Securities and Exchange Commission, "SEC Adopts Rules to Enhance Cybersecurity Safeguards for U.S. Treasury Market Clearing Houses," *U.S. Securities and Exchange Commission*, February 22, 2024, https://www.sec.gov/news/press-release/2024-31.

[14] Lily Hsueh, "Analysis: The Potential Global Impact of California's New Corporate Climate Disclosure Laws," *PBS NewsHour*, October 17, 2023, https://www.pbs.org/newshour/nation/analysis-the-potential-global-impact-of-californias-new-corporate-climate-disclosure-laws.

[15] Philip Blenkinsop and Kate Abnett, "EU Launches First Phase of World's First Carbon Border Tariff," *Reuters*, September 30, 2023, https://www.reuters.com/business/environment/eu-launches-first-phase-worlds-first-carbon-border-tariff-2023-09-30/.

[16] U.S. General Services Administration, "Buy Clean," *Sustainability.gov*, accessed September 12, 2024, https://www.sustainability.gov/buyclean/index.html.

[17] Sherry Frey, Jordan Bar Am, Vinit Doshi, Anandi Malik, and Steve Noble, *Consumers Care About Sustainability—And Back It Up with Their Wallets*, McKinsey & Company, December 14, 2020, https://www.mckinsey.com/industries/consumer-packaged-goods/our-insights/consumers-care-about-sustainability-and-back-it-up-with-their-wallets

4. Washington faces greater challenges than other states in expanding clean electricity. Its hydroelectric sources are tapped out, the state has limited solar/wind potential, and its ability to import clean electricity from elsewhere is inhibited by backlogs in necessary grid upgrades ("interconnection queues").
5. Without aggressive action, these limitations will severely weaken Washington's ability to attract large manufacturers, and businesses in general, and likely slow the pace of electrification among existing businesses and residents.

Within this challenging state context, what is Seattle City Light's situation, and what are its ambitions and constraints to achieving those? Seattle City Light offers a very clean mix of power, nearly half through the hydroelectric facilities that it owns. Over the 10 years from 2022-2031, City Light intends to add 175 megawatts (MW) of solar and 225 MW of wind to its portfolio, while also adding 24 MW of customer (rooftop) solar and identifying 85 MW of energy efficiency improvements.[18] The non-rooftop solar energy will come from eastern Washington and southeast Oregon, and the wind from the Columbia River Gorge. In other words, Seattle City Light's plans to add more clean energy capacity depends on the rapid build-out of long-distance transmission lines, which is a serious challenge. The challenge intensifies in the 2030s, when Montana and offshore wind will be needed. Further, this additional capacity is based on assumptions of modest load growth (0.5% per year), but a "rapid electrification" scenario – a scenario that this strategy calls for OED to try to catalyze and enable – would increase load by 32% compared to the baseline scenario. In summary, Seattle City Light is an asset because it is City-owned and therefore more willing and able to align with City economic development initiatives, but it is in the same boat as other utilities in terms of the imbalance between growing energy demand and supply constraints.

Taking a regional view does not strengthen Seattle's position. Puget Sound Energy (PSE) serves most of the region outside the City of Seattle (double the total customers as SCL). It offers a far less green energy mix than Seattle City Light. As of 2022, 46% of the energy that PSE delivered to customers came from coal and natural gas (23% each). Seattle's potential green economy strengths are significantly influenced by the types of companies that are likely to locate and grow in Everett, Tacoma, Bellevue, and beyond, so PSE's energy mix is a drag on Seattle's green economy competitiveness.

Finally, we return to the state level. State energy assets matter not only because the city is dependent on them to meet its own demand, but because Seattle's ability to attract and grow certain types of firms (e.g., R&D and prototype-scale manufacturing) depends on the ability of the state to attract and grow complementary types of firms for which energy abundance may be a primary consideration (e.g., large-scale manufacturing).

[18] It is possible that rooftop solar installation could outpace this assumption, but even a doubling of rooftop solar would only reduce the need for utility-scale solar by 15%.

There is a general perception in Washington that electricity is abundant, cheap, and clean. This perception is understandable. The electricity *produced* within Washington's borders, primarily from hydroelectric sources, is very clean. And Washington has long benefitted from some of the cheapest energy in the country. Only five states have cheaper energy, and none are economic competitors (e.g., North Dakota, Nebraska). Washington enjoys a huge advantage over other states with clean economy strengths: compared to our state power in Texas costs, on average, 10 percent more, Illinois is 24 percent more, New York is 50 percent more, and in California it is 59 percent more expensive. Because of Washington's past performance and its ambitious commitments to future decarbonization, there is likely a perception that Washington will continue to offer abundant, cheap, and clean electricity.

But this perception is, by most accounts, increasingly at odds with reality. Clean electricity is very rapidly changing from an asset to a liability for Washington. The hydroelectric power that vaulted Washington to a leading position nationally in the pre-IRA era is not going to get it to where it needs to go next. Washington faces the following challenges:

- **Surging demand for electricity:** Meanwhile, electricity demand is beginning to surge – the share of new vehicles registered in Seattle that were electric doubled to 17% in 2022 alone. Washington is expected to double its energy needs by 2050. Washington already does not produce enough electricity to meet demand across the state at all times, and thus increasingly imports more expensive and dirtier energy sources from neighboring states.
- **Limited ability to expand existing sources of clean electricity:** Existing dams are already operating at maximum capacity, and no more are going to be built. Hydroelectric generation may even decrease, whether because of removal of dams due to environmental concerns or changing weather patterns in the region – such as lower snowpack in British Columbia).[19]
- **Limited ability to add sufficient capacity via Washington-based wind and solar:** Washington as a whole, especially western Washington, is poorly situated for wind and solar electricity generation compared to other states and compared to surging demand. There are a limited number of sites that offer sufficient wind and sun, those that exist typically aren't proximate to where energy is needed, and proposed projects have faced pushback related to conservation and tribal lands.[20] According to a 2023 analysis by the Washington State Department of Commerce: "Building [clean energy] resources in the state is not necessary. A more reliable and productive resource portfolio includes wind from the Rocky Mountains and solar from the Southwest. These resources are complementary and will ensure affordable and reliable power. Electricity imports are projected to continue to increase to 43% of Washington's electricity supply by 2050."[21]
- **Limited ability to import clean electricity from other states:** While in theory there is no reason that Washington can't import energy from states with massive wind and solar potential and relatively little demand, there are significant barriers to building the transmission infrastructure necessary to bring electricity from those states to Washington. New high capacity transmission lines take a decade or more to complete, and hundreds of wind and solar projects are waiting to be connected to the grid.

It is beyond the scope of this assessment to determine the likelihood that Washington will be able to add enough capacity to meet its 2045 goals. Rather, this assessment asks whether Washington can provide *far more* clean electricity than it needs according to current projections, such that rates remain lower and ease of access remains higher than in other states. This is not the case currently.

One stakeholder interviewed for this analysis described a company seeking to expand its manufacturing facility in Washington and was quoted a rate for the additional electricity quadruple what they had been paying in previous years. The same interviewee noted that it's not uncommon for a large facility to express interest in locating in Washington, only to be told that it will take six or seven years for the Bonneville Power Administration to provide electricity – and it will cost the company $200 million for transmission infrastructure. The interviewee – who has broad oversight of many aspects of economic development – said, "if there's one thing that keeps me up at night, it's how much green energy do we have, how much does it cost, and when are we going to get it?"

Challenges related to scaling clean energy production and transmission are obviously not unique to Washington. It might be reasonable to expect that Washington could be experiencing headwinds but still be able to claim clean electricity as a competitive advantage if other states were struggling even more to add clean energy capacity. This, however, is also not the case. Other states, including those written off as laggards in terms of environmental policy, are rapidly outpacing Washington.

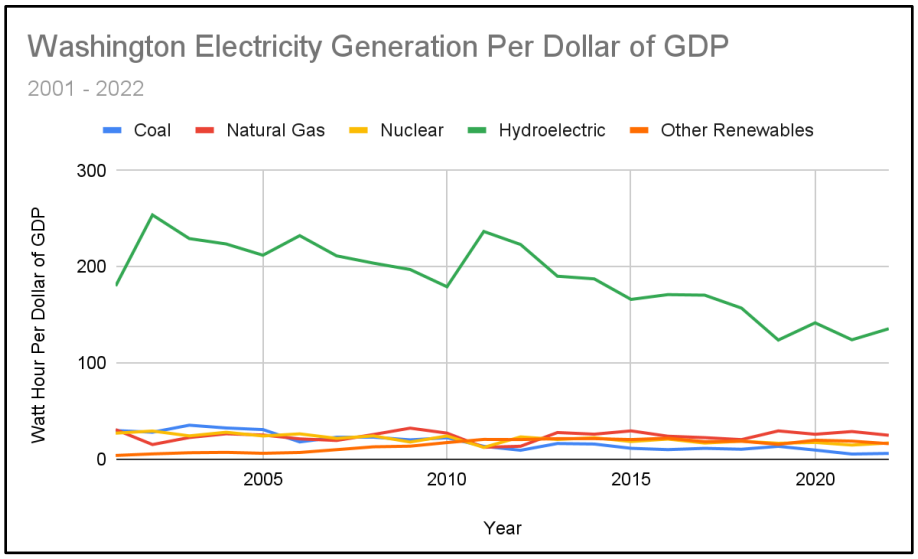
Take Texas for example. Since 2003, the state's wind industry has skyrocketed, as shown in the two charts below.[22] It has grown so rapidly, in fact, that the growth since 2003 alone is greater than the entirety of net electricity generation in Washington. Counterintuitively, a company locating in Austin would likely find it easier to access clean electricity there than in Seattle.

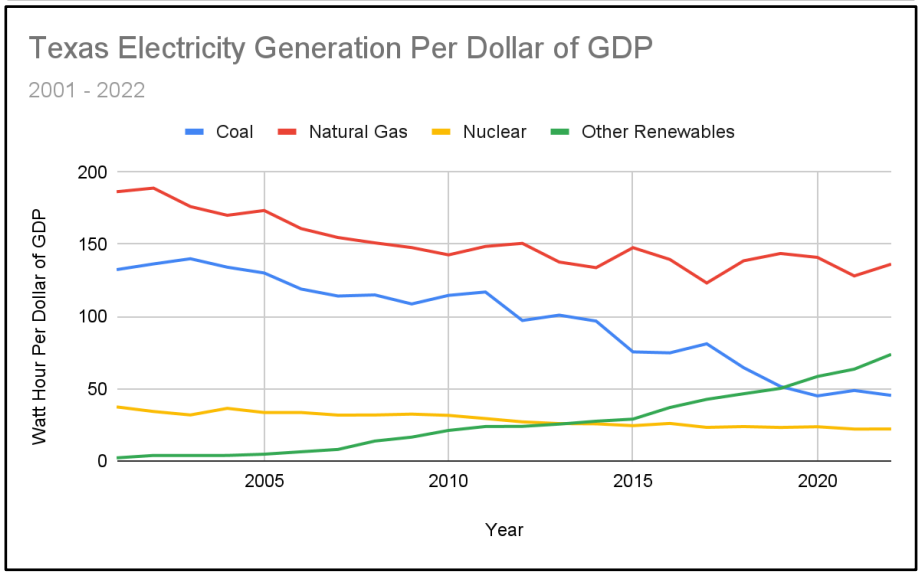
[19] Ivan Penn, "Canada's Hydropower Offers Promise for U.S. Electric Grids," *The New York Times*, June 3, 2024, https://www.nytimes.com/2024/06/03/business/energy-environment/canada-hydropower-electric-grids.html.

[20] For example: Conrad Swanson, "Inslee Rejects Recommendation to Slash Proposal for WA Wind Farm," *The Seattle Times*, August 15, 2023, https://www.seattletimes.com/seattle-news/climate-lab/inslee-rejects-recommendation-to-slash-proposal-for-wa-wind-farm/.

[21] Washington State Department of Commerce. *2023 Biennial Energy Report*. January 2023. https://app.leg.wa.gov/ReportsToTheLegislature/Home/GetPDF?fileName=2023BiennialEnergyReport_Final_Approved_97baa6be-4da3-4d0a-9f6a-efab82d2ec5f.pdf.

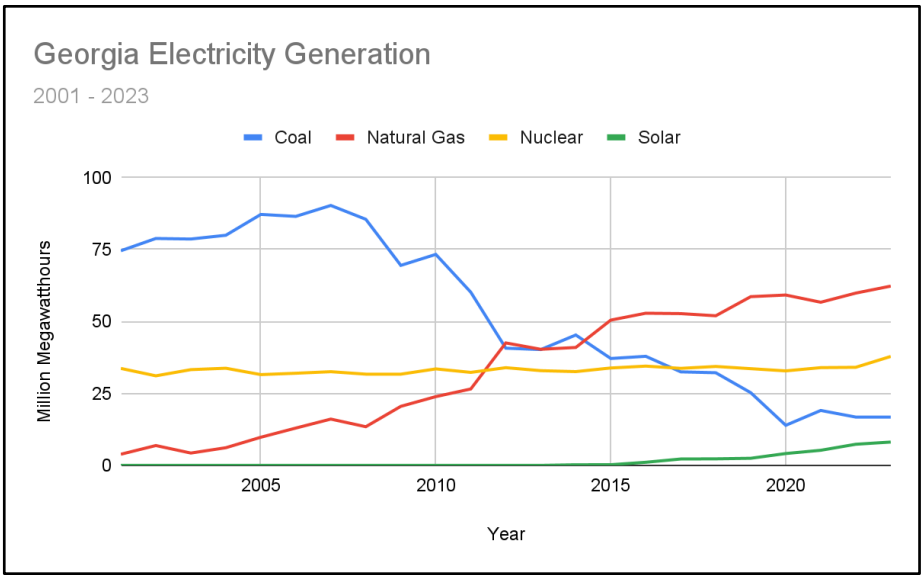
[22] Note that the below charts are adjusted by GDP to allow for comparison, which results in Washington's hydroelectric generation look like it's declining and Texas' wind generation growth look more muted.





Like Texas, Georgia may not be green but it is *greening*. While shying away from addressing climate change directly, Republican Governor Brian Kemp has adeptly promoted his state as the future home of green manufacturing in the country. Despite a poor track record on environmental policy generally, Georgia's per capita emissions have declined by 22% between 2011 and 2021, the second largest decline for a state in the country. The state recently attracted national attention by completing two large nuclear reactors, the first built in the country in over 30 years.[23] Beginning in 2015, utility solar projects began to generate energy in a meaningful way in Georgia, with the state currently ranking third out of the seven southeastern states (and it's projected to reach second by 2025).

[23] Although not without serious delays and difficulties – the first was 7 years late and $17 billion over budget, despite substantial investment from the Department of Energy.



It is not just states with conservative state governments and low regulations that are pushing ahead. California, for instance, has made huge recent progress on installing grid-scale batteries to provide clean electricity at night. It has installed more of these batteries than anywhere other than China since 2020, and for part of one evening in Spring 2024, these batteries delivered as much electricity as seven large nuclear reactors.

How much can Seattle improve?

In one sense, the problems above are very solvable. There is a ton of proposed solar and wind capacity being held back due to insufficiencies in grid infrastructure – in 2022, there were 144 requests for transmission submitted to the Bonneville Power Administration (BPA), the federal agency that owns most of the high-voltage transmission lines in the Northwest. These 144 requests represented 11 gigawatts of power – far more than the 7 gigawatts produced by the Grand Coulee Dam at maximum capacity.[24]

But, according to Sightline, BPA and NorthernGrid (the organization of 11 utilities across Washington, Oregon, Montana, and Wyoming with which BPA makes federally-mandated 10-year regional transmission plans), are reluctant to invest in additional transmission capacity. For a variety of reasons: these 10-year transmission plans[25] are not required to enable achievement of state decarbonization goals; utilities are unaccustomed to proactively building additional transmission capacity in the way that the coming surge of electrification demands; utilities are concerned about local opposition to new infrastructure build-out, which has delayed or scuttled major projects in recent years.[26] Building out transmission lines in Washington can take time and be costly. There are the geographic realities – these lines must cross mountain ranges. The

[24] Emily Moore, "Northwest States Need to Build New Power Lines—Fast," *Sightline Institute*, October 13, 2022, https://www.sightline.org/2022/10/13/northwest-states-need-to-build-new-power-lines-fast/#fn-6.

[25] In 2024, the Federal Energy Regulatory Commission (FERC) announced a new policy that will require 20-year transmission planning, which will push utilities to factor in the electricity demand unleashed by the IRA.

[26] Moore, "Northwest States Need to Build New Power Lines."

State of Washington would also have to take into consideration conservation concerns and working with Tribal Nations on the placement of these lines.

In summary, the optimal scenario identified in Washington's energy strategy calls on Washington to import 36% of Washington's electricity from wind projects in Wyoming and Montana by 2050.[27] Today, Washington gets 5% of its electricity from wind power from any state. The transmission issues described above, which are largely outside the control of local and even state policymakers, suggest that achieving this goal is going to be extremely difficult.

This leaves OED and the City of Seattle with clear pathways to improve this asset:

1. OED and the City overall must be energetic advocates and supporters of any effort by SCL to add clean electricity capacity and reduce demand on the grid via, for example, expansion of rooftop solar and batteries or investments in energy efficiency.
2. OED and the City can push for state-level solutions to transmission issues. Texas, Colorado, and New Mexico are all examples of states that have recently taken it upon themselves to build transmission projects (Texas' were paid for by ratepayers, New Mexico's by wind farm developers).

Perhaps most aligned with the broader vision for Seattle's green economy is that OED can try to turn its constraints – a commitment to decarbonization amid surging demand and insufficient interstate transmission infrastructure – into a catalyst for innovation. If Washington must deliver abundant clean electricity and cannot do it simply via mass deployment of mature technologies like wind and solar, then Washington must be the place to figure out how to scale other solutions like offshore wind, small modular nuclear reactors, hydrogen, energy storage, and advanced energy efficiency. The urgency to invest in innovation in these areas will not arise, however, unless policy and economic development leaders understand the severity of Washington's clean electricity challenge.

Land and the Built Environment

Why it matters to the green economy

As in other areas of this analysis, when considering the impact of land on the green economy, we find that local environmental and green traded sector strategies compliment one another. Land use has an obvious connection to any city or state's desire to decarbonize. Dense, mixed-use, and transit-oriented development that locates people closer to each other and the places they go reduces carbon intensity in commercial and residential buildings and transportation, which collectively contribute nearly 60 percent of greenhouse gas emissions. Housing

[27] Washington State Department of Commerce, *Appendix A: Washington State Energy Strategy EER/DDP Modeling Final Report*, December 11, 2020, http://www.commerce.wa.gov/wp-content/uploads/2020/12/Appendix-A.-WA-SES-EER-DDP-Modeling-Final-Report-12-11-2020.pdf.

concentrated on less land has lower per-capita energy consumption with lower requirements for cooling, heating, and lighting, and in the case of multifamily housing, benefits from economies of scale and efficiencies afforded by shared walls in climate control. Mixed-use communities facilitate reduced automobile use with shorter trips and ease of walking and biking to facilitate shopping, working, and entertainment needs. And transit-oriented development significantly lowers the carbon intensity of inter-urban travel for trips outside of one's neighborhood, with transit options that have a fraction of the carbon intensity of gas-powered cars.

However, it is critical to note that lowering a city's carbon footprint, while an important economic and environmental function, falls well short of establishing that city's green economy potential. For that, we must consider more broadly how the green economy happens in places, whether that is the research labs where new ideas are created, factory floors where products are built, embedded within businesses where technologies are adopted and processes are improved, deployed with new or existing infrastructure, or integrated into personal, community, and commercial homes and facilities where energy efficiency is enhanced and sustainable practices are adopted. Thus, the characteristics of a particular region's physical dimensions – including the availability of land, qualities of existing facilities, connectivity between assets (whether transportation, electrical, or otherwise), and concentration of opportunities to deploy green products and services – will determine in large part how it will contribute to, and benefit from, the green transition.

Practically speaking, we believe that three elements are most important:

1. Availability of land for **manufacturing** facilities, including **research and development** activities that value proximity to both academic centers and infrastructure where innovations can be piloted or demonstrated.
2. Concentration of **built environment** assets of all types (transportation and shipping systems, commercial and industrial districts, residential areas, etc.) where green technologies can be deployed at scale.

Manufacturing and R&D

Many of the largest clean technology investments in recent years are characterized by industrial sprawl and located far from vibrant city centers. This is due in part to the sectors they are in, such as electric vehicle manufacturing and supply chain, as well as the need for large tracts of land that are either unavailable or cost-prohibitive in most cities. For example, Toyota is creating a $13.9 billion, 7 million square foot battery manufacturing facility in Liberty, North Carolina, 15 miles from Greensboro and 70 miles from Raleigh; Rivian operates it's main EV manufacturing facility spread over 4 million square feet in Normal, IL, on the outskirts of the small city of Bloomington, more than 130 miles from Chicago; and Waaree Energies is investing more than $1 billion in a 546,000 square foot solar panel assembly plant in Brookshire, Texas, 40 miles

outside of Houston.[28] (For comparison, downtown Seattle's largest real estate project is the Seattle Convention Center, totaling 1.5 million square feet.)

These facilities, largely exurban or rural greenfield developments, reflect the advantages of cheap land, a desire for uncluttered infrastructure, and a legacy economic development model that orients toward big-ticket transactions over diligent and incremental transitions. But these deals will prove to be the exception, rather than the rule, in the green transition over time. Pivoting a $500 billion regional economy to become incrementally more green, incubating and growing new clusters, will never create the same kind of headlines as those created by the opening of a multibillion dollar manufacturing facility. But its impact – in terms of overall investment, jobs, and environmental sustainability – could be far more significant.

Research and development activities, further detailed in the "Innovation" section below, thrive in urban environments due to several key characteristics:

1. They benefit from being close to other university and private sector research, often concentrated in specific urban districts.
2. Access to a highly trained and specialized workforce, typically found in cities, also enables these activities.
3. Particularly in the realm of "hard tech" – products that exist in the physical world – unique urban assets such as infrastructure and facilities are vital to applied research and often serve as platforms for development.

For highly innovative firms, these factors can outweigh the comparatively high cost of real estate and logistical hurdles such as retrofitting existing buildings and permitting.

Of the recent clean energy-related private sector investments in urban areas, many spun out from or have ties to research universities and bring together research and development activities with small-scale manufacturing. Given the complexity of many green economy businesses – which require research and design, small-scale pilot or prototype production, deployment of technology in place, and manufacturing at scale – cities should think not just of "companies" that might thrive within their borders, but "functions." Large manufacturing facilities are not necessarily co-located with their R&D facilities – so Seattle may well have opportunities to contribute to critical green industries like sustainable transportation, even if large-scale manufacturing will likely not take place within Seattle's borders. While Toyota is building batteries in North Carolina, and Ford has new EV and battery manufacturing facilities in Ohio, Tennessee, Kentucky, and Ontario, both located their battery R&D centers in Greater Detroit, the center of automotive innovation.

Similarly, First Mode, which works to manufacture hydrogen- and battery-powered engines to retrofit carbon-intensive mining vehicles, recently opened a 40,000 square foot manufacturing facility in Seattle's SoDo neighborhood. It was motivated to do so given the city's highly skilled

[28] U.S. Department of Energy, "Investing in American Energy," *U.S. Department of Energy*, https://www.energy.gov/invest.

aerospace and tech workforce, cheap and clean energy, access to major international ports, and state government partners willing to help expand the business through projects like the Centralia proving grounds (the site of a former coal mine, allowing the company to test the deployment of its products in a real-world context while continuing its R&D work in Seattle's urban core).

Built Environment

The design and location of urban environments significantly impact greenhouse gas emissions. Cities, inherently more carbon-efficient due to their density compared to suburban and rural areas, house a large proportion of the population, buildings, and a disproportionate share of economic activity. This concentration makes them pivotal in climate response and offers substantial market opportunities. Cities that develop innovative strategies for decarbonizing buildings, transportation, and industrial processes not only advance their sustainability objectives, but also have a chance to spearhead or enhance emerging specialties within the climate sector that can be exported across the United States and around the rapidly-urbanizing world.

While the fundamental approaches to decarbonizing the built environment (e.g. installation of distributed power generation and energy storage, the adoption of heat pump HVAC and water heating systems, and the expansion of high-speed electric vehicle charging infrastructure) may be similar across different locales, specific regional infrastructure or characteristics can present distinct challenges and, as a result, market opportunities. Places with abundant sunshine, for example, might focus more intensively on developing microgrids powered by distributed solar generation. Areas with unique energy needs, such as concentrations of data centers, might lead to developing industry-specific approaches to efficiency. Regions with robust transit networks have the opportunity to focus on innovations in electrification or efficiency of buses,trains, or ferries.

How strong is Seattle?

Seattle boasts enviable physical resources—including the Port of Seattle, industrial districts, the University of Washington, business clusters, and robust transportation and electrical infrastructure—all of which are advantageous for various green economy activities. Given the intense demand for and scarcity of land, businesses must justify the premium they pay for real estate (relative to smaller cities and suburban areas) by leveraging the increased value derived from proximity to these strategic assets. Similarly, city planners must carefully weigh different objectives in zoning and development strategies, such as balancing the need for more affordable housing with the retention of industrial activities that offer good jobs and enhance the city's tax base. However, the high cost and limited availability of land within the city's boundaries pose significant challenges.

Manufacturing and R&D

While it won't be home to the next million square foot manufacturing facility, production remains a critical component of Seattle's competitiveness in the green economy. As detailed in the following section on talent, the city's economy is somewhat unique in its combination of software and manufacturing strengths, which is also reflected in its land uses.

Seattle was one of the nation's critical nodes of industry, with its role in increasingly sophisticated regional and then global supply chains fueling its growth. Like many U.S. cities, it has seen a decline in urban industry over the latter half of the 20th and beginning of the 21st century. However, thanks in large part to the continued importance of the Port of Seattle – centrally located within the city – to the regional economy, it has retained a sizable share of industrial land. Through recent legislation, Seattle preserved 7,000 acres of industrial land, equal to 11 percent of the City's land area. This is equivalent to Portland and San Diego, slightly less than San Francisco and Oakland combined (approximately 8,000 to 9,000 acres), about one-third to one-half as much as Chicago and Atlanta (15,000 to 20,000 acres), and less than one-fourth as much as Los Angeles (about 30,000 acres).

Not surprisingly, however, this land is among the country's most expensive industrial parcels. According to CommercialEdge, the average industrial rent in Greater Seattle places the region behind only Orange County, Los Angeles, and Miami, but still higher than other West Coast areas like Portland and the Bay Area.[29] And CBRE reports that areas close to central Seattle command a significant premium compared to more suburban locations like Kent Valley and Tacoma/Fife, as well as the core Puget Sound region, covering King, Pierce, and Snohomish Counties.[30]

In sum, the city has ample land for additional medium-scale research and production facilities within the city limits, so long as the value proposition of the location – considering access to relevant infrastructure and facilities and a talented workforce – outweighs its relatively high cost.

This is true from a maritime perspective. Much of Seattle's industrial land was established and has been preserved to leverage its position on the water. The city's industrial lands are concentrated in the Duwamish Manufacturing Industrial Corridor (DMIC) and the Ballard-Interbay Northend Manufacturing Industrial Corridor (BINMC) on the south and north ends of Eliot Bay, respectively. DMIC is 4,178 acres, of which 83 percent is industrial with nearly a quarter of that dedicated to marine industry, and 25 percent is utilized for rail transportation. DMIC is a hub for transportation and logistics due to its proximity to highways like I-5 and SR-99, rail lines, and the Port of Seattle. SoDo, in its northeast corner and just south of downtown, might be particularly well-suited for integrated innovation-industrial development, illustrated by First Mode's facility in that area.

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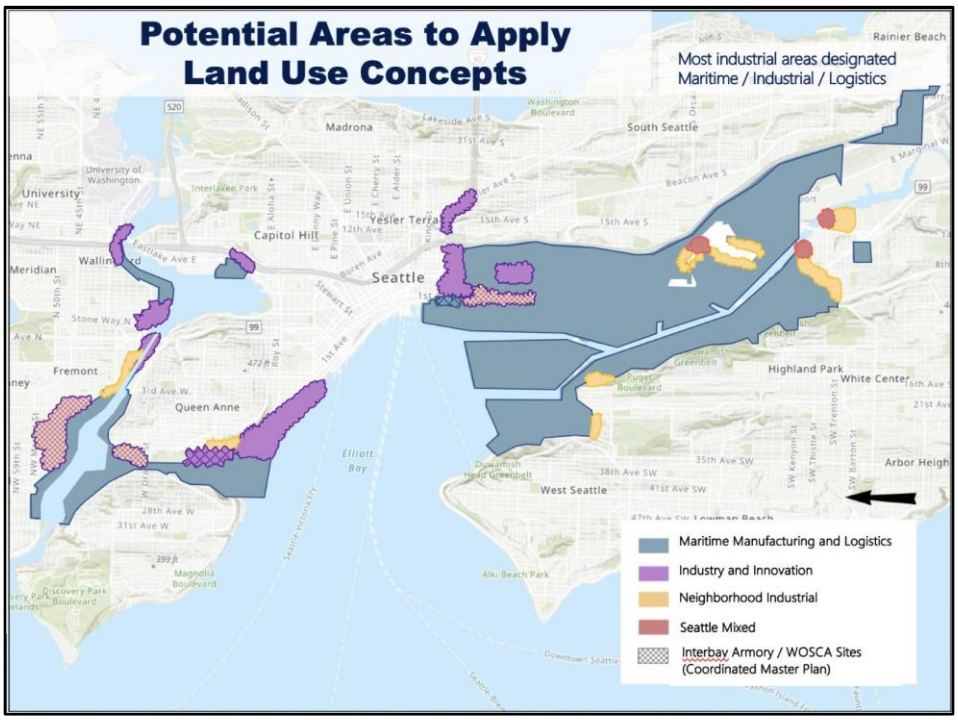
[29] CommercialEdge. "National Industrial Report." *CommercialEdge*. June 2024. https://www.commercialedge.com/blog/national-industrial-report/.

[30] CBRE. *Puget Sound Industrial Figures Q1 2024*. March 2024. https://mktgdocs.cbre.com/2299/3585565f-1567-4893-ad32-2310ad004fd4-762784572/v032024/Puget_Sound_Industrial_Figures_Q1_2024.pdf.



Source: OPCD

BINMC is 879 acres, of which 70 percent are industrial with 40 percent of that marine-related. It is strategically located near significant maritime facilities, including the Ballard Locks, Fisherman's Terminal, and the Port of Seattle's Terminal 91, which supports a variety of industrial activities such as cargo handling, cold storage warehousing, and seafood processing. Its largest employment area is information, communication, and technology, however, with a district on its southeastern corner that includes Expedia Group headquarters and biotechnology firms. BINMC will be the home to the Maritime Innovation Center, a partnership between the Port of Seattle and Maritime Blue slated to open in 2025, which will offer 15,000 square feet of space customized for maritime research and development activities, and a blue economy-focused startup incubator and accelerator. Startups growing in this space will benefit from nearby maritime infrastructure and related firms.

The University of Washington is the key node of research that could shape local innovation in the green economy. It houses the Washington Clean Energy Testbeds, for example, which provides a platform for cleantech innovators designing, testing, and demonstrating sustainable technologies in solar, energy storage, and system integration. The Testbeds serve entrepreneurs and companies worldwide, however, and its impact within the city of Seattle has been limited. Dan Schwartz, head of the University of Washington Clean Energy Institute and Executive Director of the Clean Energy Testbeds attributes this in part to the lack of "cheap, junky" real estate and lab space nearby for early-stage companies seeking to commercialize innovations emerging from UW research.

While Seattle has a significant amount of land suitable for green economy applications, preparing industrial land for these uses can pose challenges for new and growing businesses. Permitting can be slow and complex, creating uncertainty that can deter investment. Navigating these processes requires substantial time and resources, and might be particularly daunting for startups and companies with novel requirements related to innovative green technologies. If a business expansion requires new power infrastructure, for example, upgrading electrical systems to meet increased or different demands can be lengthy, including securing permits, coordinating with utility providers, and might require significant modifications to existing infrastructure. In a dense urban environment like Seattle, additional challenges could include changes to the streetscape, soil remediation, and other necessary modifications. These efforts demand coordination across multiple agencies, further extending both development time and cost. The cumulative effect of these hurdles can be a significant barrier to the timely and cost-effective implementation of green economy projects.

Built Environment

The greening of Seattle's built environment offers a potential competitive advantage for two reasons:

1. The speed at which it is happening could position Seattle as a first-mover to deploy new technology at scale.
2. The way that it navigates unique challenges – such as developing and deploying solutions that are reflective of its renewable energy constraints or advancing sustainability in its maritime infrastructure and sector, offer opportunities to develop expertise relevant to regions around the world facing similar issues.

Seattle for reasons of policy, local climate, culture, and natural resources, is heading into a period of intense electrification and efficiency of buildings and transportation. Companies could be well-served by locating and growing in Seattle to meet local "early adopter" demand for building electrification and then expand to serve what will be a market worth tens of billions of dollars by 2030 as other cities adopt policies similar to Seattle's (such as Seattle's Building Emission Performance Standard).[31]

Key drivers of electrification in Seattle are:

- **HVAC upgrades:** Seattle's historically temperate climate has meant that the region still has only about half the indoor cooling system adoption of other large metro areas, despite nearly doubling the number of homes with air conditioning between 2013 and 2021.[32] A large share of new AC installations in existing buildings, and HVAC upgrades

[31] National Renewable Energy Laboratory, *2023 Standard Scenarios Report: A U.S. Electricity Sector Outlook*, November 2023, https://www.nrel.gov/docs/fy23osti/85654.pdf.
[32] Hannah Weinberger, "Seattle Is No Longer the US's Least Air-Conditioned Big City," *Crosscut*, December 21, 2022, https://crosscut.com/environment/2022/12/seattle-no-longer-uss-least-air-conditioned-big-city.

will be energy efficient heat pumps, which can require electrical panel, circuit and/or wiring upgrades.

- **EV adoption:** King County is estimated to have the highest EV penetration of any large county outside of California, measured in EV vehicle miles traveled (VMT) per capita, and the 9th highest EV VMT overall.[33] Seattle City Light estimates that one in three new cars within the city is a plug-in electric vehicle. This means the city has an imperative to rapidly expand EV charging infrastructure, which requires similar infrastructure and technology deployment, including both level 2 chargers at people's homes, and public charging stations.
- **Maritime decarbonization:** the maritime sector deserves special attention here, as it is concentrated in a relatively small number of domestic and international regions, but contributes 2.8 percent of global greenhouse gas emissions.[34] Wasington has already made notable commitments – largely funded by the Climate Commitment Act – to decarbonize the Washington State ferries system, including $150 million to convert three of its largest vessels to hybrid-electric power at Vigor's Harbor Island shipyard, up to $1.1 billion for building five new hybrid ferries, and $100 million to upgrade terminals to accommodate electric charging for the new fleet. Through these and other carbon-conscious maritime infrastructure improvements, Seattle could proactively look to identify and support the development of products and services that could be in-demand for other coastal regions.

How much can Seattle improve?

Seattle has already taken important steps to preserve its industrial land, which houses many of its most important green economy physical assets, and has proven to be an attractive environment for growth-potential cleantech firms referenced elsewhere in this report, including First Mode, Electric Era, and Radical Aero. The cost and complexity of development within the city, particularly in areas outside the industrial districts, provide significant headwinds to growing green economy businesses within its borders. Of particular note, the competition for the best use of Seattle's land given the city's housing shortage and high cost of shelter – which featured prominently in the debates surrounding the industrial lands – will continue to be a relevant backdrop for siting green economy growth.

The City of Seattle has several important levers to incentivize and accelerate green economy development within the city:

1. **Seattle can assess underutilized publicly-owned land for green economy development potential.** While this assessment may have been done for other uses such as housing, applying green economy criteria could reveal new opportunities. This

[33] "Large" defined as 500k residents. ~140 counties meet this definition. "Mapping EV VMT by County," *Replica*, https://www.replicahq.com/?popup_name=Mapping+EV+VMT+by+county.

[34] Estela Morante, "Transport and Trade Facilitation Newsletter No. 99, Fourth Quarter 2022," *United Nations Conference on Trade and Development (UNCTAD)*, December 2022, https://unctad.org/news/transport-newsletter-article-no-99-fourth-quarter-2022.

step would involve identifying parcels of land that are currently underused and evaluating their potential for supporting green economy projects and businesses.

2. **The city can improve the marketing of its industrial land.** By effectively promoting these areas, Seattle can attract more green economy businesses that require industrial space. This could involve creating detailed marketing materials that highlight the benefits and opportunities of the industrial lands, as well as actively reaching out to potential investors and companies in the green economy sector and clearly articulating Seattle's commitment to green industry and value proposition for high-value sectors.
3. **Seattle could reform its permitting processes to support green economy projects.** This could include creating streamlined approaches or a "concierge" service for projects that meet certain green and equity criteria. By simplifying and expediting the permitting process for these projects, the city can reduce barriers to development and encourage more green economy initiatives. This approach could mirror the eligibility criteria for the Inflation Reduction Act (IRA) and layer subsidies to further incentivize development.
4. **Increasing pre-development work on and around high-potential sites can significantly accelerate the development timeline for new prospective tenants.** This could involve activities such as brownfield remediation or electrical grid improvements. By addressing these pre-development needs, Seattle can make sites more attractive to green economy businesses and reduce the time it takes for them to become operational.
5. **Seattle should consider the potential to leverage IRA tax credits, such as 48c, as part of the capital stack for industrial land redevelopment projects**.[35] By utilizing these subsidies, developers may be able to offset some of the costs associated with green economy projects, making them more financially viable. This can attract more investment into sustainable industrial developments within the city.
6. **Seattle should coordinate with partners in Everett, Tacoma, Renton, Bothell, and even Moses Lake to understand broader regional cluster development trends.** This understanding would enable Seattle to identify the land and infrastructure needs of the types of companies (functions) that might locate in Seattle.

Talent

Why it matters to the green economy

There is no doubt that the green transition will generate demand for green skills. The IRA is expected to create about 1.5 million green jobs by 2033, and only about 15% of those have been created so far. And green skills will be demanded in occupations far beyond those associated with clean energy deployment. (Machinery maintenance workers and computer systems administrators, for example, will each see a large surge in demand for skills related to

[35] U.S. Department of Energy, "Qualifying Advanced Energy Project Credit (48C) Program," *U.S. Department of Energy*, https://www.energy.gov/infrastructure/qualifying-advanced-energy-project-credit-48c-program.

energy management and conservation.)[36] The coming "green jobs" moment is generally well-understood by leaders in and around Seattle.

The question for this analysis, however, is not how many jobs of what types will ***result*** from a given amount of investment in decarbonization, but what types of skills might ***cause*** Seattle to attract more private sector investment than it otherwise might (which will in turn, via tax revenue, enable more public investment in decarbonization). In other words, what distinct workforce assets exist in Seattle that would attract investment from businesses that have choices about where to locate and grow? These could be businesses with a Seattle presence deciding where to expand, or businesses from outside of Seattle that are looking at a set of nationwide sites.

Our assumption is that two kinds of skills – development and deployment – are relevant to this analysis:

1. **Development: does Seattle have a distinct workforce profile that is attractive to firms that are creating clean technologies or innovative business models?** Here our assumption is that what matters to such firms is skills at the intersection of software and engineering. We make this assumption for two reasons. First, because this is what matters to cleantech firms: software firms often need to integrate their products with hardware and thus benefit from being in a region with abundant manufacturing talent, and manufacturing firms need access to software-related talent – an executive at a hardware firm said the fact that the "internet runs out of Seattle" is a major draw. (The term "deep tech" is often used to distinguish firms that develop products based on science/engineering innovations, as opposed to just software innovation.) The second reason we make this assumption is that Seattle wants to attract firms that care about both software and engineering talent, because those firms are more likely to create manufacturing jobs that are conducive to inclusive growth.
2. **Deployment: does Seattle have the workforce necessary to stimulate and meet demand for electrification?** We consider workers with skills relevant to electrification to possess "hybrid" skills in that their skills are relevant to both traded and non-traded sectors. Typically electricians (and related roles) are thought of as being needed to fulfill a given amount of demand spurred by the IRA and other forces. Equipping more workers with these skills can also be a way to generate demand. This can happen in two broad ways: First, businesses are increasingly going to want to grow in places in which they can easily decarbonize their operations, which means places that are producing a lot of zero-carbon electricity (one factor in the speed of infrastructure build-out is the clean energy workforce), and where there is abundant expertise and workforce to allow them to easily electrify their industrial facilities. Second, households may fail to take full advantage of various home electrification technologies subsidized by the IRA (solar, batteries, heat pumps, etc.) because there are too few contractors with the necessary skills. While workforce training programs are typically created in response to demand,

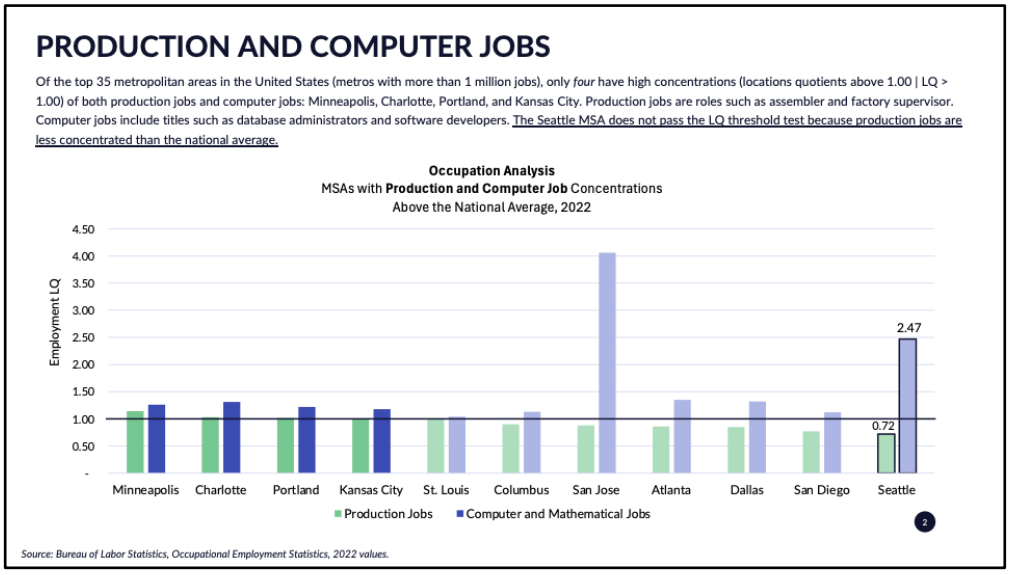
[36] Lee Domeika, Meena Naik, Stuart Andreason, and Molly Dow, "Growing Quality Green Jobs," *Burning Glass Institute*, https://www.burningglassinstitute.org/research/growing-quality-green-jobs.

this is a situation in which training could unleash pent-up demand (which could also be a basis for creating/scaling contracting firms owned by people of color and women).

How strong is Seattle?

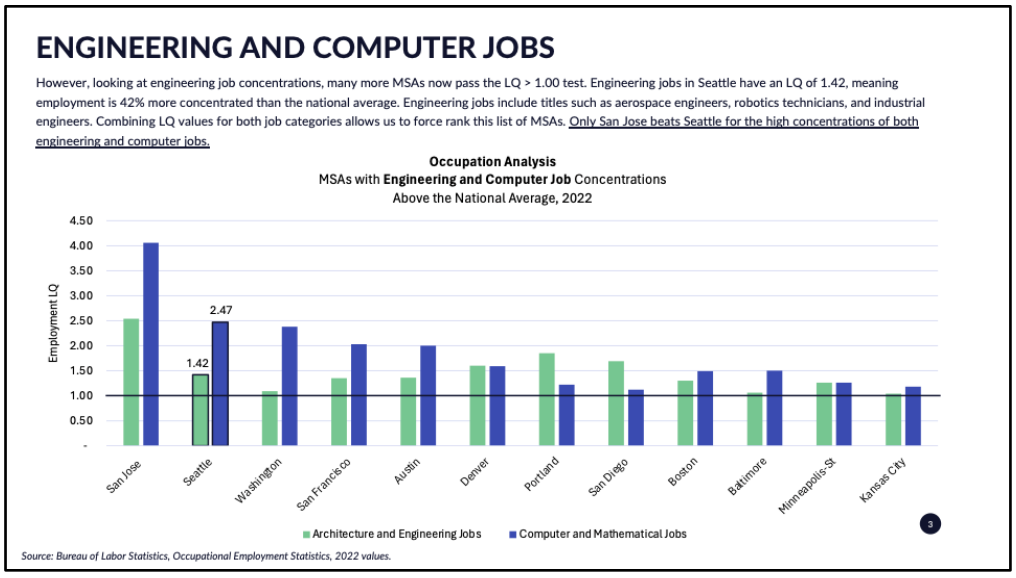
Part 1: development (software and manufacturing skills)

If it is true that cleantech firms will prioritize access to both software and manufacturing talent, then Seattle is very well-positioned relative to peer metro areas. Only four of the 35 largest metro areas in the country have a location quotient (LQ) over 1.0 for both production (manufacturing) and computer jobs.[37] Seattle has a far higher concentration of computer/mathematical jobs than any large metro area except for San Jose, but a slightly lower concentration of production jobs relative to top competitors.

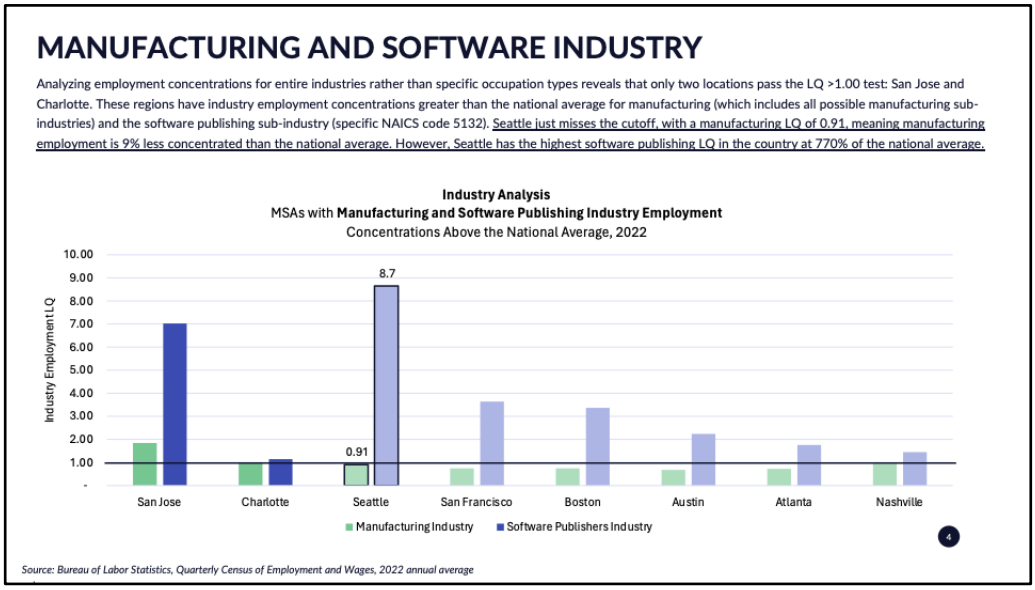


However, after the Bay Area (combining San Jose and San Francisco), Seattle clearly ranks second among large metro areas for its mix of *engineering* and computer jobs. (Washington and Austin are its closest competitors in terms of this mix).

[37] A location quotient measures the relative concentration of an economic activity in a place – an LQ over 1.5 indicates that activity (industry, occupation) has a 50% larger footprint in a place than in the U.S. overall (i.e., that place has a "specialization").

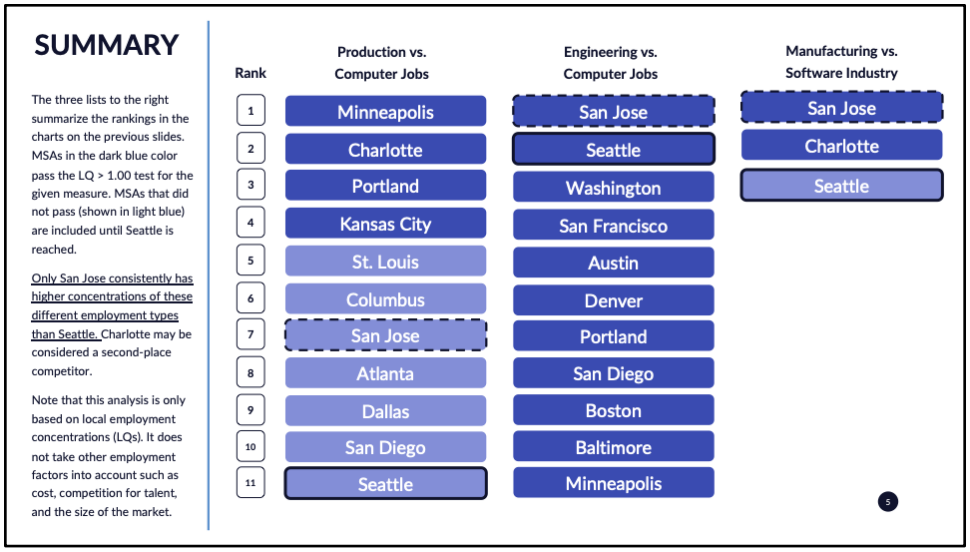


It is also important to look at the full range of jobs in key industries, not just specific occupations. For example, companies are attracted to regions that not only have software development talent, but a deep pool of talent in the software industry, including lawyers, bankers, marketers, and so forth. In these terms, Seattle is again a clear second after the Bay Area, with a much higher concentration of software industry jobs and somewhat higher concentration of manufacturing industry jobs than any other large metro area.



In summary, among the largest metro areas in the country, Seattle is second to the Bay Area in terms of its concentration of software-related skills, fifth in terms of concentration in architecture and engineering jobs, and just outside the top 10 in terms of production jobs. It is also, along with the Bay Area, a clear winner in terms of the wider range of occupations involved in the manufacturing and software industries**.** Taking each of these angles into consideration, it is

clear that Seattle's only real competitor for the mix of talent required for "deep tech" innovation in the green economy is the Bay Area. However, Seattle offers a similar talent mix to the Bay Area at significantly lower cost. Places like Charlotte, Austin, Portland, and Minneapolis are in the running for a distant third.



Part 2: deployment (clean energy workforce)

As noted, the clean energy deployment workforce should be thought of in two categories: grid operation and construction, and the installation and maintenance of clean energy products in the residential, commercial, and industrial sphere.

According to existing studies conducted prior to the IRA, Seattle does not appear to face a significant shortage of workers relevant to clean energy deployment in the residential, commercial, and industrial contexts. In an analysis for Emerald Cities and SCL, the Seattle Jobs Initiative (SJI) found that only a few occupations related to "energy efficient building operations and construction" will experience more than 5% growth between 2020-2024 (e.g., insulation, electricians, solar installers, construction managers).[38] Despite concerns about a "silver tsunami" of retiring workers in these occupations, SJI found that workers in these jobs skew young (more than 50% of the workforce is under 44 in most occupations). In another analysis for King County, SJI found that, as of 2021, estimated labor shortages for construction-related occupations in King County were small in absolute terms (e.g., deficits of less than 150 workers county-wide for electricians and HVAC mechanics/installers).[39] The Seattle area construction

[38] Elodie Marlet and Kathleen Carson, *Seattle's Energy Efficient Construction and Building Occupations Workforce*, Seattle Jobs Initiative, November 2021, https://www.seattlejobsinitiative.com/wp-content/uploads/Seattles-Energy-Efficient-Construction-and-Building-Occupations-Workforce.pdf.

[39] Elodie Marlet, Kathleen Carson, and Eileen Calderon, *King County Green Jobs Strategy: Sectors and Occupations*, Seattle Jobs Initiative, May 2022, https://www.seattlejobsinitiative.com/wp-content/uploads/KCGJ_GreenJobsReport_FINAL.pdf.

workforce shrank by 2,500 jobs – more than most metro areas – in 2023, further suggesting that there are not significant workforce shortages.[40]

However, there is still cause for concern, for two reasons:

1. As the SJI analysis demonstrates, these occupations are substantially more white and male than the working-age population overall; perhaps more strikingly, these occupations became more white between 2014 and 2020 in every sub-category except engineering professionals.
2. These analyses don't fully take into account the expected growth in demand caused by the IRA (many rebates that will stimulate demand have still not yet been deployed via states). Indeed, that demand could be artificially limited if the workforce does not grow in lockstep with demand.

In terms of grid operation and construction, SJI found in a report for the Bonneville Power Administration that: "utilities face ongoing workforce challenges, particularly related to a chronic labor shortage of hydro-operators, competing with large technology companies for highly qualified candidates, and recruiting and developing a diverse workforce."[41] This shortage of operators is different from a shortage of workers who could build out new clean energy generation and transmission capacity. The other SJI reports above find that there are generally not significant shortages of workers in various construction-related occupations, which are likely more relevant to infrastructure construction. And in any case, given the transmission issues covered in the Energy section of this assessment, workforce is not the binding constraint for grid-scale clean energy deployment.

In sum, Seattle's clean energy deployment workforce is not obviously characterized by significant shortages in any major occupational category, but that may quickly change as demand booms. And the workforce is far less diverse than it should be. There is little reason to believe that Seattle stands out relative to other regions on any of these points. The question is whether Seattle's workforce development system (including community colleges, unions, and other actors) is, relative to other regions, organized and resourced enough to quickly stand up inclusive workforce development training programs as demand grows.

It is impossible to answer this question definitively. In general, Seattle's workforce development system is arguably less organized and less resourced than many, if not most, of Seattle's peer regions. As one simple but suggestive data point shows, the Workforce Development Council (WDC) of Seattle-King County has a smaller budget ($23M) than its peer organizations in Portland ($29M) and San Diego ($38M). Equally if not more importantly, other regions' workforce development systems often have a clearer "hub" entity that convenes and holds the vision/strategy. Increasingly this is a regional economic development entity with business

[40] Neetish Basnet, "Seattle's Construction Workforce Shrinks in 2023," *Puget Sound Business Journal*, February 23, 2024, https://www.bizjournals.com/seattle/news/2024/02/23/seattle-construction-workforce-shrinks-2023.html.

[41] Elodie Marlet, and Kathleen Carson. *Clean Energy in the Bonneville Power Administration Area*. Seattle Jobs Initiative, March 2021, https://www.seattlejobsinitiative.com/wp-content/uploads/CECE_Report_2021.pdf.

membership, which is essentially lacking in Seattle – or at least dispersed across three or four organizations. Compared to the WDC, the workforce development board in other regions is often a more nimble, entrepreneurial nonprofit with a mix of public and philanthropic funding (less than five percent of WDC funding is from private sources). And many other regions' systems have developed the muscle memory for quickly standing up new training programs due to more intensive business attraction efforts in those regions (Georgia's Quick Start program is commonly cited as a best practice).

In terms of the green economy in particular, most regions are not yet organized or active. Brookings analyzed the climate action plan of 50 large U.S. cities and found that only nine of the 50 took workforce development seriously (i.e., provided details on collaboration, funding, and timelines). Seattle underperformed even by these relatively low standards: it was one of three of the 50 cities (along with Las Vegas and Rochester, NY) that did not mention workforce development *at all* in its climate action plan. There may be other venues in which the City of Seattle has plans for climate-related jobs – besides the City's involvement in King County's Green Jobs Strategy – but besides the SJI analyses cited above (one for King County's Green Jobs Strategy) there is no clear public statement from the City, County, or WDC about what green jobs are being prioritized in terms of workforce development, or how.

While further research would be required to make a definitive statement, it is hard to escape the conclusion that although Seattle's clean energy deployment workforce does not currently seem to be a major constraint, Seattle is arguably in a significantly weaker position than other regions in terms of its ability to foresee and respond to shifts in demand at the necessary speed and scale – not just in general, but in the green economy in particular.

How much can Seattle improve?

Development

Seattle is not likely able to significantly grow the number of workers with a mix of software, engineering, and other advanced STEM skills. The argument in this section is that what would motivate a firm to move to, or expand in, Seattle despite its high labor costs, is a set of skills that can't easily be created by any region in the near- to medium-term in response to increased industry demand. In other words, skills that generally require at least a four-year degree. The implication is that Seattle is insulated from competition from other regions because its skills base reflects many decades of strength in advanced manufacturing and, later, software. On the other hand, this also means that Seattle can't significantly change its fundamental workforce profile in the next five to ten years – it takes a long time to organize employers in a sector partnership, or even create new degree programs, recruit students, and graduate them.

The question then is given a certain quantity of workers within the STEM industries, are there ways in the near-to medium-term for Seattle to increase the share of those workers that have skills directly related to the green economy? There are several areas in which local economic development investments could make a difference.

- Creating climate-related certificate programs within existing STEM programs within universities: The Yale School of the Environment, for example, has created two online programs aimed at professionals (one on financing and deploying clean energy) that take less than a year, and has three more in the works.[42]
- Creating internship opportunities for university students in green economy roles: such programs could have multiple impacts. First, they allow students to develop green economy knowledge regardless of their field of study. Second, they allow small- to mid-sized firms that lack sophisticated HR functions to identify talent. And third, if targeted at students of color, could reduce attrition rates in STEM programs.[43]
- Creating a sustainability professionals network for knowledge exchange: early- to mid-career professionals can develop relevant skills and knowledge via informal knowledge exchange with others in their field and adjacent fields. The Greater Cleveland Partnership, the region's chamber of commerce, has created a Sustainability Leaders Group composed of executives from more than 30 of the region's largest companies.

Deployment

In contrast to the above, local investments can have a more substantial impact in the size and diversity of the clean energy deployment workforce. While many occupations that are likely to experience workforce shortages require approximately four years of training, that training is typically in the form of an apprenticeship (i.e., the four years of training does not have to precede workers' entry into the workforce).

To improve substantially, government and nonprofit partners in Seattle will need to work with intention to avoid the status quo as described by Brookings:

> "Too often, policymakers overemphasize short-term job creation and a narrow range of fast-growing positions—such as solar installers and wind turbine technicians. They may overstress short-term construction projects and needed labor inputs. Or they may overemphasize short-term training and other needed credentials to get more workers on the job quickly, rather than supporting more portable, stackable credentials."[44]

To avoid this outcome, Seattle can:

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[42] Dieter Holger, "America's Green-Skills Gap Raises Concerns About Energy Transition," *The Wall Street Journal*, August 28, 2023, https://www.wsj.com/articles/americas-green-skills-gap-raises-concerns-about-energy-transition-90095ab0.

[43] The UT-Austin Freshman Research Initiative has been shown to do in several evaluations. While focused on enabling undergraduates to attain research experience, the same effect may occur if undergraduates are able to attain meaningful professional experience. Stacia E. Rodenbusch, Paul R. Hernandez, Sarah L. Simmons, and Erin L. Dolan, "Early Engagement in Course-Based Research Increases Graduation Rates and Completion of Science, Engineering, and Mathematics Degrees," *CBE—Life Sciences Education* 15, no. 2 (2016): 1–10, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4909342/.

[44] Joseph W. Kane, "Why Green Jobs Plans Matter—and Where U.S. Cities Stand in Implementing Them," *Brookings Institution*, April 20, 2023, https://www.brookings.edu/articles/why-green-jobs-plans-matter-and-where-u-s-cities-stand-in-implementing-them/.

- Convene key employers and industry leaders to identify a few key workforce needs and then identify, fund, and connect the full range of training and support needed to enable underrepresented workers to attain needed skills. This group should be consulted on an ongoing basis to ensure that potentially fast-changing market dynamics and skills needs are incorporated into funding and programming decisions across multiple training providers.

Currently, the relatively small investments being made in Seattle are also less impactful because they are scattered, sporadic, and under-coordinated. There are various programs across government and nonprofit entities in Seattle and the broader region: Seattle City Light offers apprenticeships, there are apprenticeship programs offered by unions, various nonprofits such as the Urban League offer pre-apprenticeships, Shoreline Community College offers an associate degree in Clean Energy Technology. Recently OSE/OED provided approximately $150,000 to $200,000 each to six short-term training programs using $1 million Green New Deal funding.

While this planning and coordination would have some impact, it is important to note that there is little federal funding that is designed to directly and flexibly fund climate-related workforce development efforts. According to Brookings, in the IRA and IIJA there are about 54 programs representing $75 billion in funding that can be used for workforce development. But these 54 programs are scattered across a dozen agencies, they deploy money via a mix of grants and tax credits to companies, and they target one specific occupation. Only four programs in the IRA and IIJA directly target workforce development (these represent $260 million in funding, or 3.5% of the money that *can* be used for workforce development). In addition to planning and coordination in terms of strategy, Seattle organizations would also need to build significant capacity to identify, secure, and blend federal and other funding.

Besides leading on overall strategy and coordination, the City of Seattle could do a few specific things to improve deployment-related workforce development:

- Use its own hiring as a catalyst for program design and development. We know that demand for various occupations will soon surge, but nonprofit workforce development entities cannot proactively create programs for demand that does not yet exist. But to the extent that the City and other government partners (SCL, Port, King County) know what their hiring needs are, those can be aggregated and used to enable the creation of programs, even if many graduates may ultimately enter jobs in the private sector (i.e., at contractors of various types).
- Secure funding that enables trainees to participate in longer-term training programs that enable more substantial career shifts. The federally-funded workforce development system is largely oriented around very short-term training programs for what are often low-wage jobs. If Seattle wants to enable disadvantaged residents to move into new and growing sectors of the economy (moving from unemployment or jobs in low-wage sectors), it will need to provide more financial support than are typically available. One model is Social Finance's "pay it forward" loans, which cover living expenses and tuition

and only need to be paid back if workers earn more than a certain salary ($40,000 in the Colorado program).[45] Another is the ON-RAMP program in Syracuse, which will provide minimum wage stipends for the duration of training for semiconductor jobs.

Innovation

Why it matters to the green economy

Greening the economy is fundamentally an act of innovation – it will require creating new materials and products as well as the processes and services that will allow those products to be adopted at the scale necessary to dramatically lower carbon emissions. Innovation in the green economy can be broken down into three categories:

- **Novel inventions:** for the U.S. to achieve its decarbonization goals, it will need more than the mass deployment of solar and wind power – there will be political barriers to their deployment at the necessary scale and speed, and these technologies do not address the needs of "hard to abate" sectors (e.g., aviation, steel, cement). Anecdotally, only half the technologies we need to get to zero carbon emissions exist today. There are also many environmental challenges beyond clean energy that require novel solutions, from destruction of "forever chemicals" to bioproducts that can replace plastics.
- **Production and deployment:** firms that develop new products in the lab have to figure out how to manufacture them at scale and reduce production costs, which often presents an entirely distinct set of innovation challenges. This is true for not only manufactured products, which often need access to pilot-scale production facilities, but also other goods and services. Firms inventing green approaches to construction will need to build prototypes, test them in the real world, and refine. Software companies working to, for example, facilitate adoption of green technologies or manage energy usage will also need to test and refine their business models (a different challenge than creating the initial software product).
- **Process innovation:** existing firms that are not typically seen as being innovative are going to come under significant pressure to innovate in terms of integrating new technologies and/or changing business models to reduce emissions. An example could be a manufacturer of metal components for the aerospace industry electrifying processes, or a manufacturer of plastic components using bio-based inputs, or a firm adopting circular production models (or industrial symbiosis).

Innovation, in other words, is more than just invention. As important as novel breakthroughs are, those discoveries and iterative improvements that drive costs down over time, contribute to deploying solutions at scale, and create the greatest opportunities for inclusive growth. Boosting innovation in a way that's conducive to inclusive growth, therefore, requires not just more R&D

[45] Social Finance, "Colorado Pay It Forward Fund," https://socialfinance.org/work/colorado-pay-it-forward-fund/.

funding or venture capital or accelerators for early-stage startups, but a comprehensive system of supports. Three principles define a strong innovation system.

- **Comprehensive:** supports should exist both "upstream" of typical innovation supports (e.g., fellowships that allow people from underrepresented backgrounds to develop skills and ideas over a year or more) and "downstream" (e.g., capital and pilot/demonstration opportunities for post-accelerator "scale-up" firms). These upstream/downstream supports tend to be in very short supply, because creating a 3- to 6-month accelerator is easier and more rewarding.
- **Sector specific:** the nature of these supports will vary significantly by sector – software innovation and hardware innovation, for instance, are very different in terms of capital and infrastructure needs (with further differences within various hardware industries). Cities therefore need to choose the sectors around which they want to build innovation systems, but this rarely happens because such choices are difficult (technically and politically).
- **Networked:** networks, between businesses within and across sectors, between businesses and researchers, and between businesses and government, matter hugely for innovation. San Francisco and Los Angeles, for example, have the same R&D and talent assets in the life sciences, but economists have found that San Francisco has far higher innovation output due to its deeper and more diverse university-industry networks. These networks don't emerge and sustain themselves naturally; they require care and feeding. Yet this crucial networking function is under-provided in cities because it does not produce the obvious, direct impacts that funders seek.

The above principles are especially important in the green economy, in which innovation is particularly challenging for the following reasons:

- **Longer timelines for technology development:** Because the green economy involves creating hardware, which often must be deployed in/on public infrastructure and therefore must be extensively tested, the entrepreneurial "valley of death" is longer and deeper than for software-based innovation.[46] This type of innovation is increasingly referred to as "tough tech." Whereas a firm creating a consumer-facing software product could potentially achieve scale and profitability over the course of a 6-month accelerator, a firm creating an electric aircraft engine or a hydrogen-powered truck will likely need more like six years to achieve profitability. There are dozens of stories of well-funded cleantech entrepreneurs running into major challenges while trying to build "first of a kind" production facilities.[47]
- **Dependence on policy and public sector:** Government creates and shapes markets in the green economy to a greater degree (or at least, more directly) than in many other

[46] For example, see: Tim De Chant, "Climate Tech's Valley of Death," *TechCrunch*, April 27, 2024, https://techcrunch.com/2024/04/27/climate-startup-valley-of-death/, and Tim De Chant, "Trellis Wants to Fill Climate Tech's 'Missing Middle'," *TechCrunch*, April 18, 2024, https://techcrunch.com/2024/04/18/trellis-climate-missing-middle/.

[47] Ed Ballard and Amrith Ramkumar, "Climate Change Startups Face Funding Challenges Amid Investment Shifts," *The Wall Street Journal*, May 12, 2024, https://www.wsj.com/business/climate-change-startups-investment-business-8f5c83be?st=oi74w65p0y7992v.

sectors. Governments are responsible for energy infrastructure, are likely to be the primary customers for many other green economy products, and shape demand for other products through policy choices (e.g., tailpipe emission standards significantly affect EV adoption). Therefore entrepreneurs need to understand the needs of government customers and the policy landscape to produce relevant products and services.

- **Multidisciplinarity:** In an interview with Canary Media, a cleantech venture capital veteran recently described how innovation in the green economy will require unconventional pairings of expertise: "What we've seen a lot is some very smart former Google engineers that can write an amazing piece of software, but they're then trying to completely change the way utilities work - but not one member of the team has ever worked for a utility, understands how they work, has ever sold to a utility. So we need to marry the ability to write software code with a true understanding of how the utilities work or what the auto industry or any other industry needs."[48]

How strong is Seattle?

To answer this question, we first assess Seattle's inventive capacity and then its innovation capacity – how likely Seattle is to create novel, commercially relevant ideas, and how likely Seattle is to be the place where those ideas turn into businesses with then 50 then 100 employees.

Inventive capacity

Innovative firms are likely to come either from spin-offs of existing high-tech firms (e.g., the CEO of Electric Era was formerly at SpaceX) or spin-outs from universities. In this regard, Seattle is clearly well-positioned – by most measures it is in the top ten, if not top five, U.S. metro areas in terms of the raw material required for innovation.

As described in the Talent section, Seattle is a national standout in terms of the abundance of computer and engineering talent in the region, creating an enviable pool of potential cleantech entrepreneurs. Seattle is one of eight so-called "superstar metros" that have a large and growing share of tech employment (including software- and hardware-related), and, along with San Francisco, is one of only two that meaningfully grew their share of national tech employment from 2015-2020 (this includes all workers in tech-related industries, not just workers in tech-intensive occupations).

The University of Washington, meanwhile, ranks fifth nationally in R&D expenditures and boasts top-rated programs in computer science, oceanography, aeronautics, and nuclear physics, among others.

[48] "Key Players Weigh in on the New Era of Climate Tech Investing," *The Carbon Copy* (podcast), Canary Media, August 25, 2023, https://www.canarymedia.com/podcasts/the-carbon-copy/key-players-weigh-in-on-the-new-era-of-climatetech-investing.

This talent and R&D capability sits alongside a concentration of industries with major innovation needs related to decarbonization. As University of Washington researchers have pointed out, Washington State houses innovation-intensive clusters that touch a meaningful share of global greenhouse gas emissions (GHGs), including aerospace (aviation contributes 2-2.5% of global GHGs), and information and communication technologies (nearly 2%). Because of their concentration in the local economy, "they have large potential for Washington science, engineering and technology innovations to impact global carbon."[49]

Innovation capacity

However, Seattle appears to be significantly underperforming when it comes to translating talent and R&D assets to innovation outcomes.

Overall, Seattle has not performed well in terms of basic measures of entrepreneurship. In 2021, only 7.1% of jobs were in young firms (less than five years old), compared to over 10% in peer regions like Austin (11.2%), San Francisco (10.3%), and San Jose (8.5%). From 2011 to 2021, Seattle's share of employment in young firms fell from 7.6% to 7.1%.[50] This decline occurred in most regions, but some of Seattle's peer regions became more entrepreneurial during this decade, including Austin, Boston, and Portland.

Young firms are not a perfect measure of innovation. Looking more closely at patents, another imperfect but useful indicator of innovative entrepreneurship, the same basic story holds. While ranked fifth nationally for R&D funding overall, the University of Washington is ranked 28th nationally for R&D funded by businesses, which could signify that UW's R&D is not as commercially-oriented as other universities. One indication of this: the University of Washington produced only 74 utility patents in 2022, far fewer than many universities that receive substantially less R&D funding (including Georgia Tech, University of Colorado, University of Minnesota, Arizona State University, among others).[51]

While neither of the above data points are perfect measures of innovation capacity, a scan of innovation support organizations in Seattle versus peer regions offers further confirmation that Seattle has limited capability to transform its raw material into successful businesses. This is true both overall and seemingly in the green economy:

- **Overall:** Seattle has relatively few organizations devoted to innovation and entrepreneurship. Techstars Seattle, probably the city's highest-profile accelerator, shut down in early 2024. Seattle's innovation supports are highly dispersed, without a central entity that enables them to function as a system. In contrast, places like Columbus have a well-resourced central entity, and places like Pittsburgh have more diffuse

[49] *Symposium Pre-Read: Creating a Model for Global Decarbonization through Washington State Science, Engineering, and Technology*, provided by Dan Schwartz, UW Clean Energy Testbeds. Note that they included agriculture and forestry in their analysis, but it is excluded here as less relevant to Seattle than other areas of the state.

[50] Alan Berube and Joseph W. Kane, "Metro Monitor 2024," *Brookings Institution*, February 2, 2024, https://www.brookings.edu/articles/metro-monitor-2024/.

[51] National Academy of Inventors, *Top 100 Worldwide Universities Granted U.S. Utility Patents in 2022*, April 2023, https://academyofinventors.org/wp-content/uploads/2023/04/2022-Top-100.pdf.

organizations paired with a "system hub" that orchestrates and fills gaps. And there is relatively little capital: while Seattle is comparable with Boston on many measures that indicate innovation potential, Boston has attracted three to five times as much venture capital in recent years. Far smaller regions, like Syracuse, have accelerators that offer firms $500,000 to $1,000,000 to participating firms; nothing equivalent exists in Seattle.

- **Green economy:** Seattle benefits from the presence of innovation organizations with a green economy focus like Cleantech Alliance and VertueLab (which partner on the Cascadia Cleantech Accelerator) and Maritime Blue (which offers an Innovation Accelerator). These accelerators are relatively small, short in duration, and do not offer any investment or other funding for participants. In contrast, Chicago's mHUB offers a Climate and Energy Tech Accelerator with $105,000 in investment per participant, the LA Cleantech Incubator has an Impact Fund that invests $100,000 to $500,000 in portfolio companies, New York's The Clean Fight offers $100,000 demonstration grants, and Boston's new (for-profit) $117M Propellor Fund offers an "Ocean MBA" to founders and has plans to invest $500,000 to $2M in 30 to 40 startups. Beyond the money that these programs offer, they appear to generally be more fully-featured and well-connected to customers and funders than any in Seattle. Looking beyond the startup phase, the State of Washington offers Evergreen Manufacturing Growth Grants (which could be used for process innovation related to decarbonization) and Industrial Symbiosis grants, but these add up to about $3 million in statewide funding (to 10-15 businesses) annually.

How much can Seattle improve?

Innovation is significantly influenced by local factors – numerous studies demonstrate that, holding constant the number of talented individuals or R&D dollars, some regions produce far more innovation than others. A key factor is the depth and diversity of networks (i.e., formal and informal mechanisms for entrepreneurs, researchers, and funders to interact, share ideas, and collaborate). Seattle could therefore improve significantly without making massive investments in growth capital or R&D. Opportunities include:

- Facilitating access to potential customers in both the private and public sectors. One of Seattle's biggest potential assets is its concentration of global businesses with significant climate commitments. But interviews suggested that, compared to other regions, Seattle has brittle or nonexistent networks among large businesses and entrepreneurs.
- Expanding prototyping and testing facilities like the University of Washington's Clean Energy Testbeds. Pilot and demonstration opportunities are crucial for early-stage (and even relatively large) cleantech businesses, and the Clean Energy Testbeds are a remarkable but underappreciated asset that provides easy access to both equipment and expertise that firms could not afford on their own. Opening this facility up to more firms and adding more equipment and more expertise is likely a very high-impact investment.
- Strengthening the city's accelerator and incubator offerings. Firms need low-cost space, including manufacturers and firms doing R&D and software development. High vacancy rates in urban commercial real estate create an opportunity to do this relatively

inexpensively. And as noted, firms also need early-stage funding from patient investors (i.e., willing to wait longer for returns than software-focused VCs). Relatively small investments would make Seattle's accelerators more competitive with those in other regions.

- Fellowship opportunities to develop entrepreneurial talent, especially those underrepresented among business owners. Programs like Tulsa Cyber Fellows and Pittsburgh's Pathways Fellowship provide people with relevant technical skills (at least a four-year degree) the opportunity to engage with industry and develop entrepreneurial skills.

Policy

Why it matters to the green economy

The green economy brings together environmental, social, and economic systems and objectives. The public sector at the local, state, and federal levels, with strong interests in each of these areas, have helped shape how and where the green economy has grown over time. This includes prohibiting environmentally harmful products and practices, spurring investment in low carbon technologies, incentivizing the adoption of energy efficient approaches, and speeding deployment of clean energy projects large and small.

Solving the climate crisis requires people doing that which might not otherwise be in their immediate interest (e.g. installing a highly-efficient heat pump with a high up-front cost), and making "big bets" on new technologies and strategies that have inherent risk (e.g. building pieces of the offshore wind supply chain without full knowledge of how much or where that clean energy resource might be installed). Policy can enable these actions through a combination of investments, subsidies and incentives, and regulations.

Each of the assets described above has policy implications, which are referenced in those sections. This includes workforce development efforts, procurement, land use, building codes and other built environment regulations, and embracing a leadership role in helping key public and private sector stakeholders come together around new opportunities and a shared vision. In this section, we consider policies that have implications across asset types and classes. These are primarily market-shaping actions (usually investments of one form or another) that accelerate the demand for, or supply of, climate solutions in a particular place.

At the federal level, we are in the midst of an entirely new policy regime on climate with implications for nearly every aspect of existing climate-related policy and significant areas of economic policy. Demand-side investments, often in the form of subsidies, come largely from IRA, which provides tax breaks for consumer spending and investment on products and services that lower greenhouse gas emissions, as well as (to a lesser extent) industrial processes. Supply-side investments have shown up through a range of competitive grant programs that, while not necessarily exclusively green-focused, have over-indexed on climate

solutions given pressing environmental concerns and new market opportunities. These include the Good Jobs Challenge (GJC), Build Back Better Regional Challenge (BBBRC), Regional Technology and Innovation Hubs (Tech Hubs), National Science Foundation Regional Innovation Engines (NSF Engines), and IRA and IIJA awards supporting transportation, energy, and other sustainable infrastructure development.

States, and to some degree localities, are increasing levels of and finding new ways to drive investment in the green economy to solidify their position in this emerging market. On the supply side, this includes using traditional economic development tools, such as incentives and subsidies to influence site selection – tweaked to recognize the opportunities offered by, and industry dynamics present in the clean economy. To support both the development and manufacture of green technologies as well as their deployment, places are also using financing mechanisms, often in the form of "green banks," to mobilize private investment in green economy projects. On the demand side, cities and states – and partners such as anchor institutions and large corporations – can use their procurement power as early customers for emerging green firms to meet the dual need of accelerating decarbonization of their functions and spurring the growth of the local green sector.

How strong is Seattle?

Seattle and Washington's policy environment was historically a major differentiator, but their status as paragons of environmental policy is far from assured. Overall, the local and state policy apparatus is strongly oriented towards emissions reductions and less attentive to building the state's productive potential – in other words, using products and services from other states to reduce Washington's emissions, rather than developing the products and services in Washington that can help other states reduce their emissions.

While Seattle created one of the first climate action plans in the country, for example, Brookings analysis finds that as of 2022, 20 of the 50 largest cities in the U.S. have a climate plan that is as good or better than Seattle's (e.g., Dallas, Columbus, Chicago). And a review of Seattle's progress, amidst a revision of the plan in 2018, found that while the city was making progress, it was still not on track to meet its objectives, including becoming completely carbon neutral by 2050.[52] Similarly, Washington's Clean Energy Transformation Act, which aims to get the state to 100% clean energy by 2045, is ambitious but does not have significant resources or objectives related to incubating or growing green industry in the state.

Washington is investing in the green economy, but not at the scale of other states. The Climate Commitment Act (CCA), which uses a "cap and invest" approach, is one of only two such state policies in the nation and generated $300 million in 2023. The economic development impacts of the Act, however, may not be as significant as some observers assume, for three reasons: First, the money that it inspires firms to spend on decarbonization is not necessarily going to be

[52] City of Seattle, *Seattle Climate Action*, April 2018, https://durkan.seattle.gov/wp-content/uploads/sites/9/2018/04/SeaClimateAction_April2018.pdf.

spent on clean technologies invented or produced by firms in Washington. Second, the money that it raises to spend across the state is largely being invested in deployment of clean technologies (e.g., heat pumps), as opposed to supporting the invention and production of clean technologies by firms in Washington. Likewise, in 2024, the Department of Commerce announced $8 million in grants through its decade-old Clean Energy Fund, but these were also focused on deployment of technology, not production of technology. Third, CCA funds are largely deployed as grants rather than investments, which limit the impact of public funds and hinder their ability to bring in and leverage sizable private sector resources.

The State is making some other investments in the state's productive potential in the green economy, but they are small – roughly $1 to $2 million annually for programs like industrial symbiosis, Evergreen Manufacturing Growth grants, and support for cluster initiatives around the state.

In contrast, other states are pairing their public resources for clean energy adoption with support for cleantech innovation and production, and doing so in ways that maximize aligned federal and private sector investments. On a map of investment locations for federally-subsidized green manufacturing facilities in recent years, Washington has a single dot. Meanwhile, dozens of green manufacturing projects in excess of $100 million have sprouted up across the Midwest and Southeast since the IRA passed.[53] The early winners are moving to solidify their advantage: Michigan recently created a $125 million Battery and Advanced Manufacturing Challenge, which is matching federal grants to projects located in that state.

Nor are Seattle or Washington State marshaling public and private capital to create a vibrant and inclusive cleantech innovation ecosystem and create opportunities for scaled investment. Seattle has several nonprofits doing admirable work, but it has nothing to match the Boston-based Propeller fund, which is investing $100 million in ocean-based cleantech companies, nor the $750 million that New York City is investing in three cleantech innovation hubs.

States, local governments, and recently the federal government (in the form of the IRA's Greenhouse Gas Reduction Fund) have established and funded "green banks" that utilize financing, rather than grants, to stimulate private investment in clean energy projects, thereby amplifying the available resources. The Connecticut Green Bank (the first in the nation), has utilized $362 million of its own funds to attract more than $2 billion of private investment since 2011. Similarly, the New York Green Bank has committed $1.7 billion since 2013, leading to $4.5 billion in total capital deployed in sustainable infrastructure across the state.[54] Green bank investment is accelerating, subsidized by federal investments: at least fifteen states have either introduced or passed legislation to create green banks, or launched new green bank operations

[53] The main exception to the Pacific Northwest's underperformance is $1 billion in Regional Clean Hydrogen Hubs funds spread across Washington, Oregon, and Montana, with no projects in the Seattle metro area. See: Maxim and Muro, "Strategic Sector Investments Are Poised to Benefit Distressed US Counties."

[54] Connecticut Green Bank, *Annual Report 2023*, https://www.ctgreenbank.com/strategy-impact/reporting-and-transparency/connecticut-green-bank-annual-report-2023/.

since 2021.[55] Public-private green bank investments increased more than 50 percent from 2022 to 2023, reaching $7 billion that year.[56]

How much can Seattle improve?

Washington (and Seattle) faces challenges in competing with other states for economic development subsidies that attract large manufacturing companies. The state's prohibition on the gifting of public funds, at least as interpreted by legislators or the State Department of Commerce, mean that it will be a step behind states like Michigan, Illinois, North Carolina, and Georgia that are likely to capture the lion's share of big-ticket economic development deals with manufacturers in more mature industries of the green economy like the battery supply chain, solar and wind power, and electric vehicles.

However, Seattle can make meaningful improvements to its deployment of existing public sector resources to spur development and deployment of emerging technologies.

- **Seattle could seek to maximize uptake of IRA tax credits and grants** for decarbonization activities, including within the industrial sector. This could range from organizing trusted community organizations to encourage low-income households to take advantage of tax credits and rebates, to providing technical assistance to help nonprofits take advantage of the "direct pay" opportunity, to raising awareness among firms of opportunities such as 48c tax credits.
- **Seattle could also mobilize non-monetary resources to leverage IRA credits**, such as priority permitting or a regulatory concierge to IRA-eligible firms, which could make federal funds go farther within city limits, while helping companies that locate in Seattle take advantage of federal subsidies.
- **Seattle's green economy could also stand to benefit substantially if Washington created a financing mechanism, such as a green bank, to deploy its meaningful resources from the CCA and elsewhere alongside private capital.** While it may face some constraints related to the prohibition of public gifting of funds, there are many ways in which to effectively leverage public capital to create investable clean energy projects that would provide economic and environmental benefits to local communities. While many green finance structures are established at the state level, Seattle could also explore a range of local green financing activities ranging from creating a municipal green bank (though this could require state enabling legislation), help establish an independent green finance nonprofit (similar to the New York City Energy Efficiency Corporation and Montgomery County Green Bank) that could be capitalized with both

[55] Carbon to Green Consortium, *Annual Report 2023*, https://mcusercontent.com/3e3337737c870aa879b2ef144/files/58657110-26b4-3ee5-a3e4-45fda1bb6594/CGC_Consortium_AnnualReport.01.pdf.

[56] "Preliminary Findings: American Green Bank Consortium Already Hits a Record $7B in Public-Private Investment in 2023," press release, *Coalition for Green Capital*, https://coalitionforgreencapital.com/preliminary-findings-american-green-bank-consortium-already-hits-a-record-7b-in-public-private-investment-in-2023/.

public and private funds, and working with existing local entities such as CDFIs to prioritize financing for green economy projects.[57]

- **Seattle could more effectively use procurement to spur demand.** This requires more than just sustainable purchasing goals. Purchasers need to have tolerance for increased complexity of working with smaller and early-stage firms alongside existing and larger contracts, changing processes and expected outcomes to reflect new technologies, and thinking creatively about cost to take into account ancillary benefits (e.g. higher procurement costs that generate increased local economic output, or cost savings in a different department and balance sheet). This may imply the need for policy change.

VII. Conclusion

The green economy will impact every region, it will not benefit every region equally. If Seattle wants to reap the economic benefits of the green transition, in terms of both inclusive access to good jobs and equitable wealth creation opportunities, then Seattle will need to compete. To compete, Seattle will need to choose a few areas in which it wants to align and strengthen its assets. As this report demonstrates, Seattle has many enviable assets, and also many constraints – including some that may be overlooked given Washington's well-deserved reputation as an innovative and ambitious state in terms of climate policy. If the City and its partners focus on activating these assets and addressing these constraints, Seattle has a rare opportunity to achieve not just more growth but a different kind of growth – one that transforms Seattle's values into innovations that are as essential to achieving environmental ambitions as they are to enabling inclusive prosperity.

[57] "Clean Energy Finance: Green Banking Strategies for Local Governments," *U.S. Environmental Protection Agency*, https://www.epa.gov/statelocalenergy/clean-energy-finance-green-banking-strategies-local-governments.