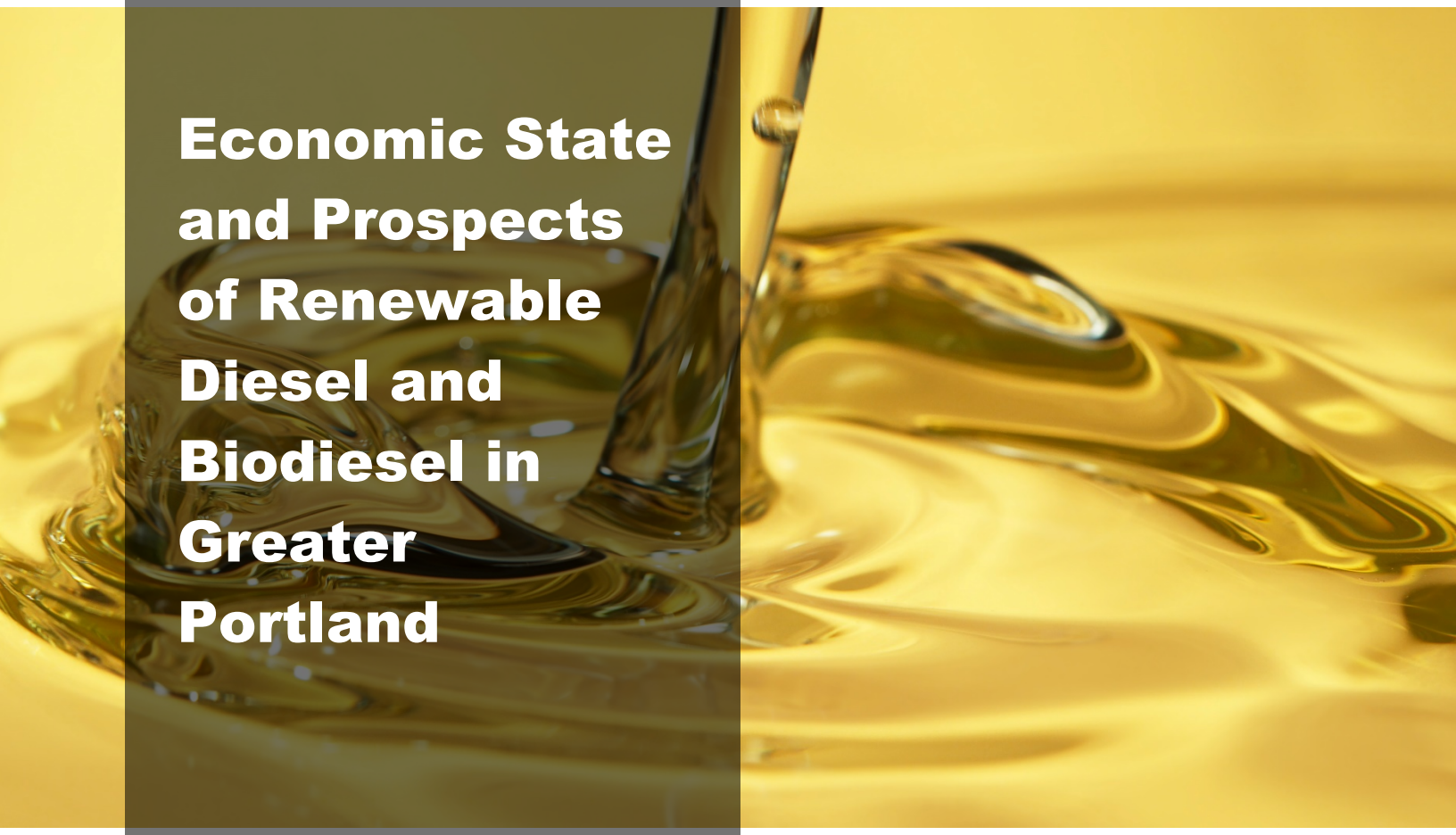
PROSPER PORTLAND



Economic State and Prospects of Renewable Diesel and Biodiesel in Greater Portland

[bw] RESEARCH PARTNERSHIP

Table of Contents

Executive Summary 3

Key Findings and Recommendations 3

Introduction 6

Biodiesel and Renewable Diesel 7

Biodiesel 7

Renewable Diesel 7

The Opportunities and Challenges of B&RD in the Greater Portland Area 8

The Current B&RD Economy 9

Workforce Demographics and Challenges 13

Workforce Dynamics and Challenges 13

Workforce Demographics 13

Adjacent Industry Analysis 14

Immediate Adjacent Industries 15

Secondary Adjacent Industries 20

Support Industries 24

Adjacent Occupations and Just Transition Opportunities 27

Key Occupations in Immediate Adjacent Industries 28

Key Occupations in Secondary Adjacent Industries 29

Key Occupations in Support Industries 32

Appendix A: Research Methodology 34

Appendix B: Definitions 35

Executive Summary

Prosper Portland engaged BW Research Partnership to examine the Biodiesel and Renewable Diesel (B&RD) supply chain and workforce. The B&RD sector in the Greater Portland area has several strong key advantages, including a robust set of renewable fuel standards and incentives, an established B&RD economy, an abundant workforce that could easily transition to meet increased demand, and a "foodie" culture that provides significant feedstock via restaurants' grease traps. However, several headwinds present obstacles to the advancement of B&RD activity in the Greater Portland area, including neighboring California's stronger renewable fuel incentives and limited regional feedstock production. The region's unsatiated demand for B&RD make the sector a promising area for economic growth, though supporting efforts will be necessary to combat the factors that are currently limiting the sector's potential.

This research relies on executive interviews and secondary data to provide a granular perspective of the B&RD economy. This report includes an examination of the employment, economic activity, and just transition opportunities[1] for the B&RD sector in the Greater Portland area. The report also emphasizes the economic opportunity within Adjacent Industries—industries that conduct work similar to B&RD firms. These Adjacent Industries have workers who could either transition to B&RD-related roles with relative ease or see increased demand for their own goods and services as a result of increased B&RD activity. The findings of this report suggest that the Greater Portland area's economy and workforce are well prepared for increased production and use of B&RD, and local policies that increase the region's ability to produce B&RD could drive economic activity and job growth. The increased use of B&RD can also play an important role in Portland's climate goals.

Key Findings and Recommendations

Efforts to support research and development around the production of B&RD could help the Greater Portland area meet its social, environmental, and financial goals. Discussions with B&RD employers suggest that the demand for B&RD far outpaces the current supply. This supply shortage is, in part, due to Portland's own supply constraints of B&RD feedstock. While the region could import greater quantities of B&RD fuel to increase renewable fuel usage, importing greater quantities of B&RD would do little to create new jobs or spur economic opportunity in the region. To create new jobs and drive economic activity, the Greater Portland area would have to increase its local production of B&RD, requiring significant quantities of additional feedstock. While Portland's geography and climate do not predispose the region to producing, or even cost-effectively importing, significant quantities of traditional feedstocks (such as soybean oil), several experimental B&RD production methods could allow Portland to produce quantities of B&RD that are closer to meeting the region's demand. Because these processes remain largely experimental, further research and development are needed to enhance efficiency and scalability of these processes.

[1] Just transitions emphasize a rethinking and restructuring towards a living economy that is centered around Regeneration, Deep Democracy, Ecological and Social Well-being, and Caring & Sacredness. For more information on Just Transitions, please visit the Oregon Just Transition Alliance at https://chartreuse-circle-jyp8.squarespace.com/just-transition-principles

The strong interest and usage of B&RD among businesses and consumers in the Greater Portland area provide a foundation that offers fertile ground to foster an innovation-oriented sector that creates and supports jobs in the cutting-edge field of B&RD research and development. This sector—and the workers in this sector—would also be actively engaged in mitigating the Greater Portland area's carbon footprint while also generating economic activity and supporting other areas of the economy.

The development of a B&RD incubator and accelerator program could be an important next step following significant investment in research and development. A B&RD incubator could help foster the growth of the region's most promising B&RD research and development projects, and eventually support the scaling and commercialization. This step will be valuable in turning promising research and development into scalable production that is able to support the Greater Portland area's thirst for B&RD.

Although additional investment in production technologies is needed to create new jobs and economic activity around B&RD, the Greater Portland area is already home to a sizable workforce that actively works with B&RD. There are 512 workers currently involved in B&RD activities in the Greater Portland area. This workforce is comparable in size to that of Bookstores as well as Dry Cleaning and Laundry Services[2] in the Greater Portland area. A little more than half (273) of these workers are involved in the Wholesale Trade, Distribution, and Transport of B&RD, while another 230 are involved in the production of B&RD. Another nine workers in the region are involved in Professional and Business Services that support these industries.

B&RD activity also accounts for more than $174 million in Gross Regional Product (GRP). This is roughly equivalent to GRP contribution of Furniture Stores and Industrial Building Construction. The total GRP contribution of B&RD activity will increase as the utilization of B&RD rises across the region and the state.

The Greater Portland area is well-positioned to meet any talent needs induced by additional B&RD activity. The Greater Portland area has a large pool of talent that is qualified for the most common B&RD jobs. As B&RD activity in the Greater Portland area increases through research and development initiatives, many non-B&RD employees working in Adjacent Industries could likely transition to B&RD work with relative ease. For more information about these workers who could easily transition to B&RD-related work, please see page 14.

Increased B&RD activity can also serve as a lifeline to displaced workers in Adjacent Industries. While the Greater Portland area saw a new increase in Immediate Adjacent jobs between 2014-2019, dozens of zip codes—particularly those in the industrial areas in North and Northwest Portland—saw Immediate Adjacent employment decline during this time. Additional B&RD activity could offer employment

[2] Specific industries (as defined by NAICS codes) and specific occupations (as defined by SOC Codes) are capitalized throughout this report to designate their formal definitions. For more information on NAICS codes, please see https://www.census.gov/naics/. For more information on SOC codes, please visit: https://www.bls.gov/soc/. Adjacent Industries and Occupations are also capitalized to designate their status as a proper noun that is defined within this report.

opportunities to these workers, who could likely transition with relatively little training or upskilling required. Please see page 18 for more information.

Additional B&RD activity could bolster workers in Support Industries as well. Support Industries employ more than 72,200 workers in the Greater Portland area, and additional B&RD activity would increase demand for these workers and their services. This is particularly relevant when considering that several zip codes in the Greater Portland area have recently seen a decline in Support Industry employment. Zip codes 97201, 97217, and 97210 (near Overlook and the Northwest District) have seen hundreds of Support Industry jobs disappear between 2014 and 2019. For more information on Support Industries, please see page 32.

The current and future B&RD workforce may benefit from additional efforts to increase representation among higher-wage employment opportunities. While the B&RD workforce is generally reflective of the overall workforce, women and non-white workers are under-represented among higher-earning occupations. Workers who are White and men comprise a disproportionately high share of the highest-earning occupations that are most common among B&RD activity. These high-earning occupations are general manager roles and sales positions.

Several initiatives should be considered to remediate these gaps:

1) Partner with local Minority Serving Institutions[3] (MSIs), including Warner Pacific University, Pacific University, and Chemeketa Community College, to improve the pipelines of minority talent with four-year degrees. Since the highest-paying B&RD occupations typically require a four-year degree, it is important to ensure that students of all backgrounds have access to these educational opportunities.

2) Work with these same MSIs to develop research collaboration opportunities. Research and development efforts are inextricably linked with educational institutions, so collaboration with MSIs will be crucial to the region's B&RD research and development goals. Sponsoring events, such as hackathons, that spur innovation and creation, could be a productive way to bring B&RD research and innovation to regional MSIs. Importantly, collaboration with MSIs will help ensure that participation in research and development initiatives are available to a diverse range of students.

3) Consider city policies that give preference to vendors with diverse management or ownership. If diversity in executive and management roles is a considered factor in city contracts, employers will take diversity and inclusion initiatives seriously and adapt accordingly.

4) Expand and promote existing programs to increase worker diversity. Some of these initiatives, including Emerging Leaders, The Contingent, and Prosper Portland's Inspiring

[3] Minority Serving Institutions are postsecondary institutions with a significant percentage of undergraduate minority students. For more information on MSIs, please see https://www2.ed.gov/about/offices/list/ocr/edlite-minorityinst.html

Diversity Grants, leverage grants to encourage local businesses to expand diversity and equity programs, foster cultural change within organizations, and solidify pathways to leadership for traditional and non-traditional students of color.

5) Encourage diversity and inclusion in management tracks. This could include working with employers to reform their current management track pipelines, or city-sponsored management bootcamps that are held at no cost and available to women and minority candidates. Similarly, city-sponsored bootcamps that support development in sales-related skills could help give women and minority candidates an added boost in developing key skills.

Licensed and qualified truck drivers are a hiring pain point across the industry. Discussions with B&RD employers revealed that drivers with Class B or A CDLs are in short supply. This challenge is not unique to the B&RD sector or the Greater Portland area, though regional and sector-specific factors may intensify the shortage of truck drivers seen nationally. Data suggest that national hiring challenges around truck driving are driven largely by high turnover rates, inflating the need to onboard new workers. Efforts that help increase driver retention—such as working with employers to offer retention bonuses or more local routes that allow drivers to stay close to home—may alleviate some of these hiring challenges. For more information on hiring challenges and the trucking industry, please see page 13.

Introduction

Prosper Portland engaged BW Research to examine the composition of the Biodiesel and Renewable Diesel (B&RD) supply chain in the Greater Portland area.[4] As the world seeks to reduce greenhouse gas emissions, B&RD presents an opportunity to utilize existing technology and infrastructure to decrease the emission of harmful gases and the use of fossil fuels. B&RD also presents economic opportunity in the Greater Portland area, as workers across the supply chain already work to produce and supply the B&RD that accounts for 31% of the alternative fuel used in Portland in 2019.[5] As this report outlines, there is substantial economic potential to support regional jobs and provide just transitions for workers across the Greater Portland area.

This study also examines the current workforce involved in the Renewable and Biodiesel supply chain, and Adjacent Industries that present opportunities for workforce transitions. The research also includes an examination of the potential for growth among the B&RD market and workforce in the Greater Portland area.

[4] This area is defined by the Portland-Vancouver-Salem CSA.
[5] "PROSPECTS FOR RENEWABLE, LOW-CARBON FUELS IN PORTLAND." Marti Frank. Efficiency for Everyone. October 2020.

Biodiesel and Renewable Diesel

This report focuses on two specific types of biofuels: Biodiesel and Renewable Diesel. While both fuels are renewable diesel fuels, they differ in several important factors. These factors impact each fuels' production, uses, emissions, and market demand. It is also important to note that these fuels are typically produced exclusively, and that most producers do not produce *both* Biodiesel and Renewable Diesel.

Biodiesel

Biodiesel is a fuel that must be blended with traditional diesel fuel. Biodiesel is produced through a process called "transesterification," and more than half of all US-produced biodiesel is generated from soybean oil.[6] The produced biodiesel is then blended with traditional diesel. These blends (often noted as 'BX', where 'X' represents the percentage of biodiesel in the fuel) can come in a range of concentrations. B5, which contains 5% biodiesel mixed with 95% traditional diesel, is the most common, and is the concentration mandated by Portland's Renewable Fuel Standards (RFS). Biodiesel accounted for 24% of alternative fuels in Portland in 2019,[7] and may see greater demand as consumers find new uses and higher concentrations of it. While historically biodiesel has combatted some challenges and negative connotations surrounding purity and engine wear, new processes and technologies have greatly improved the use cases for biodiesel. As some B&RD employers note, this stigma still lingers in some areas of the market.

Renewable Diesel

Renewable diesel is a full substitute for traditional diesel fuel. The primary method of producing renewable diesel is hydrodeoxygenation or "hydrotreating," which requires high heat and pressure applied to oils or grease, often collected from restaurants and food processing plants. Once production is complete, renewable diesel can be added directly to a diesel engine mixed with or in lieu of traditional diesel fuel. In 2019, renewable diesel accounted for 7% of alternative fuels used in Portland;[8] however, high demand for renewable diesel suggests that this rate was likely higher in 2020 and will be in 2021 as well. The growing thirst and easy substitution of renewable diesel means that there is likely great potential for this fuel in Portland and the broader US. Renewable Diesel's reliability and easy substitution for fossil fuels makes it an attractive commodity. Virtually every B&RD employer who spoke with the research team emphasized that renewable diesel is increasingly regarded as a 'miracle fuel' and one that markets seemingly cannot get enough of.

[6] Energy Information Agency. U.S. Department of Energy.
[7] Ibid.
[8] Ibid.

The Opportunities and Challenges of B&RD in the Greater Portland Area

The Greater Portland area's geographic, economic, and political characteristics all factor into the opportunities and challenges for a creating a larger B&RD economy. The region's political will and environmentally oriented legislation support the increasing demand for B&RD in the region. In fact, under the policies shaped at the state and local levels, B&RD are often more economically attractive than their petroleum-based counterparts. This economic landscape means that the demand for B&RD in the Greater Portland area is robust and growing stronger. As one B&RD fuel distributor stated, "We love to use as much B&RD as we can get." This growing demand presents opportunity for the area, though some headwinds will require additional policy and intentional action to build a larger B&RD economy around this demand.

Driven by the substantial demand for B&RD, more than half of B&RD-related activity and employment in the Greater Portland area is concentrated around the distribution and sale of B&RD. Much of this employment is transitionary—workers involved in fossil fuels are increasingly spending time involved in B&RD. While this is a positive change toward reducing greenhouse gas emissions, this transitionary effect does little to create new jobs in the area. The opportunity for the creation of new jobs lies primarily within the production of B&RD. The production of B&RD in the Greater Portland area is largely conducted by SeQuential, though the planned NEXT renewable diesel plant in Clatskanie, Oregon, will add additional production to the region in 2024. While SeQuential utilizes grease collected from local restaurants, the NEXT plant will be able to rely on imported feedstocks, thanks to its access to a deep-water dock that is closer to the mouth of the Columbia River. B&RD production in Oregon is limited primarily due to constraints in the supply of feedstock. Currently, virtually all the waste oil generated in the area is collected and used to produce B&RD. Other traditional feedstocks, such as oilseeds, including soybean, canola, and grapeseed, are not economically attractive to transport in large quantities to the area, and the climate and terrain dampens prospects of largescale farming of these feedstocks. Thus, the supply of economically viable feedstock is the primary restricting factor of the economic opportunity that B&RD presents in the area.

Innovation and the use of alternative feedstocks present significant opportunity to create a substantial B&RD economy in the Greater Portland area. One such area of opportunity is the increased use of animal waste fat products. B&RD created with high proportions of animal fat waste feedstock face some challenges in usability and cost-effectiveness,[9] but research continues to reduce or eliminate many of these barriers. "Second Generation" biofuels, which use non-food feedstock (such as biomass) to produce fuel,[10] present another opportunity for cost-effective feedstocks that may be a better fit for the Greater Portland area's climate. The development of "Third Generation" biofuels, which use algae or genetically modified organism to produce biofuels, are also being prototyped, though these technologies at a commercial scale are in the more distant future.

The Greater Portland area's thirst for B&RD presents substantial opportunity for an innovation-driven economic development via green technology. Similar to the initial efforts of state and local government

[9] "Trends in Biodiesel Production from Animal Fat Waste." Fidel Toldrá-Reig, Leticia Mora, and Fidel Toldrá. Published May 25, 2020. https://www.mdpi.com/2076-3417/10/10/3644

[10] "THIS IS ADVANCED ENERGY: Second and Third Generation Biofuels." Caitlin Marquis, Advanced Energy Economy. July 5, 2016.

which led to the development of the current robust B&RD economy, an initiative to increase the research and development, prototyping, and scaling of second and third generation B&RD technologies could help foster an innovation-oriented sector with substantial ripple effects throughout the economy. By creating jobs, reducing greenhouse gas emissions, and increasing the area's tax base, such an initiative would reinforce the area's triple bottom line, supporting the social, environmental, and financial goals of the Greater Portland area.

The Current B&RD Economy

This report focuses on the production and distribution of B&RD fuels. Retail, or consumer-facing operations, are not included in these analyses, except in cases where wholesale distribution and retail are housed under one location. The research team uncovered 21 different company locations in the Greater Portland area across 18 unique businesses. These businesses span the supply chain segments, from the collection and preliminary processing of feedstocks to wholesale distribution of B&RD (Table 1).

Table 1. B&RD Supply Chain Companies

Feedstock Collection, Refinery	Terminal	Wholesale	Testing
Oregon Oils	Global	WSCO Petroleum Corp	FOI Labs
SeQuential (Acquired by Crimson Renewables)	NuStar Energy (REG)	Bretthauer Oil Company	
NW Biofuel (includes Cloudburst Acquisition)		Carson Oil Company	
Baker Commodities		Christensen Inc	
Darling International (Joint Venture with Green Diamond and Valero Energy)		McCall Companies (Terminal as well)	
Next Renewable Fuels		Star Oil	
		Tyree Oil	
		World Kinect (bought Associated Petroleum)	

While most B&RD firms are located in or around downtown Portland and Vancouver, several firms are outside urban centers, near Interstate 5 and other transportation arteries, such as the Columbia and Willamette Rivers. In the north is the Global Clatskanie Terminal, which added renewable diesel in 2020, as well as the planned NEXT Renewable Fuel production plant in Port Westward. South of downtown Portland, near Salem, is the SeQuential biodiesel refinery (Figure 1). Fifteen B&RD locations are in the immediate Portland and Salem downtown regions (Figure 2).

Figure 1. B&RD Asset Map for the Greater Portland Area

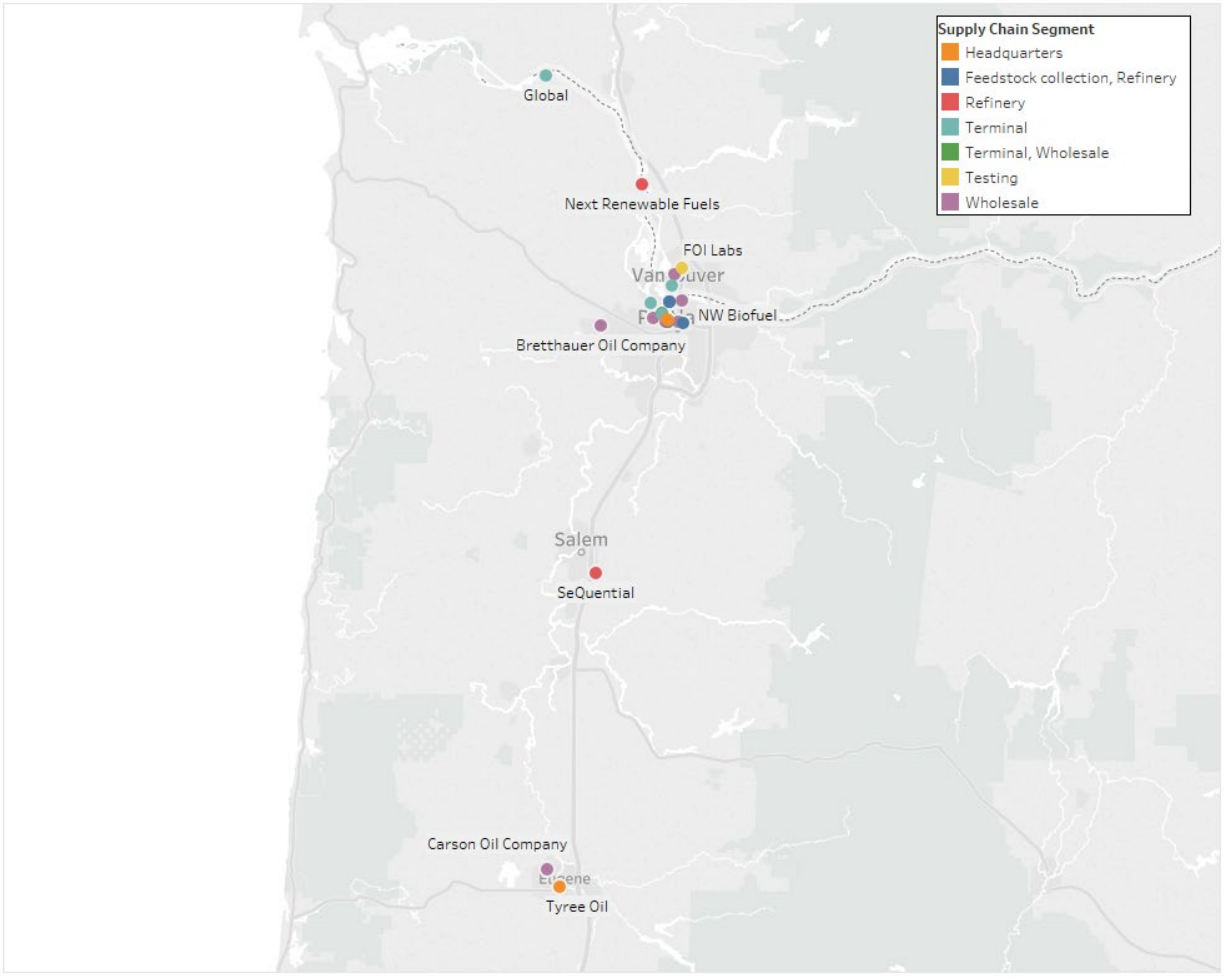
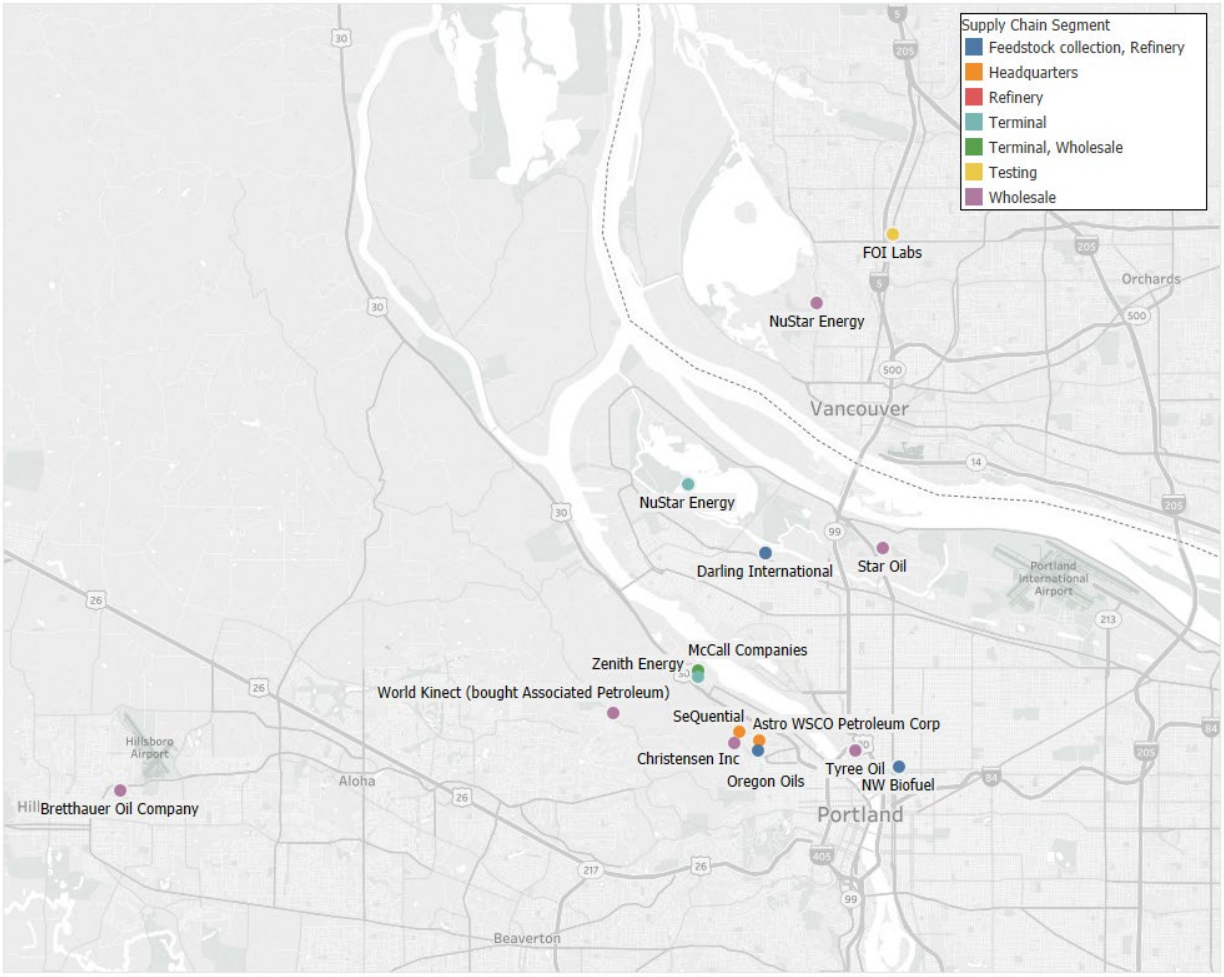
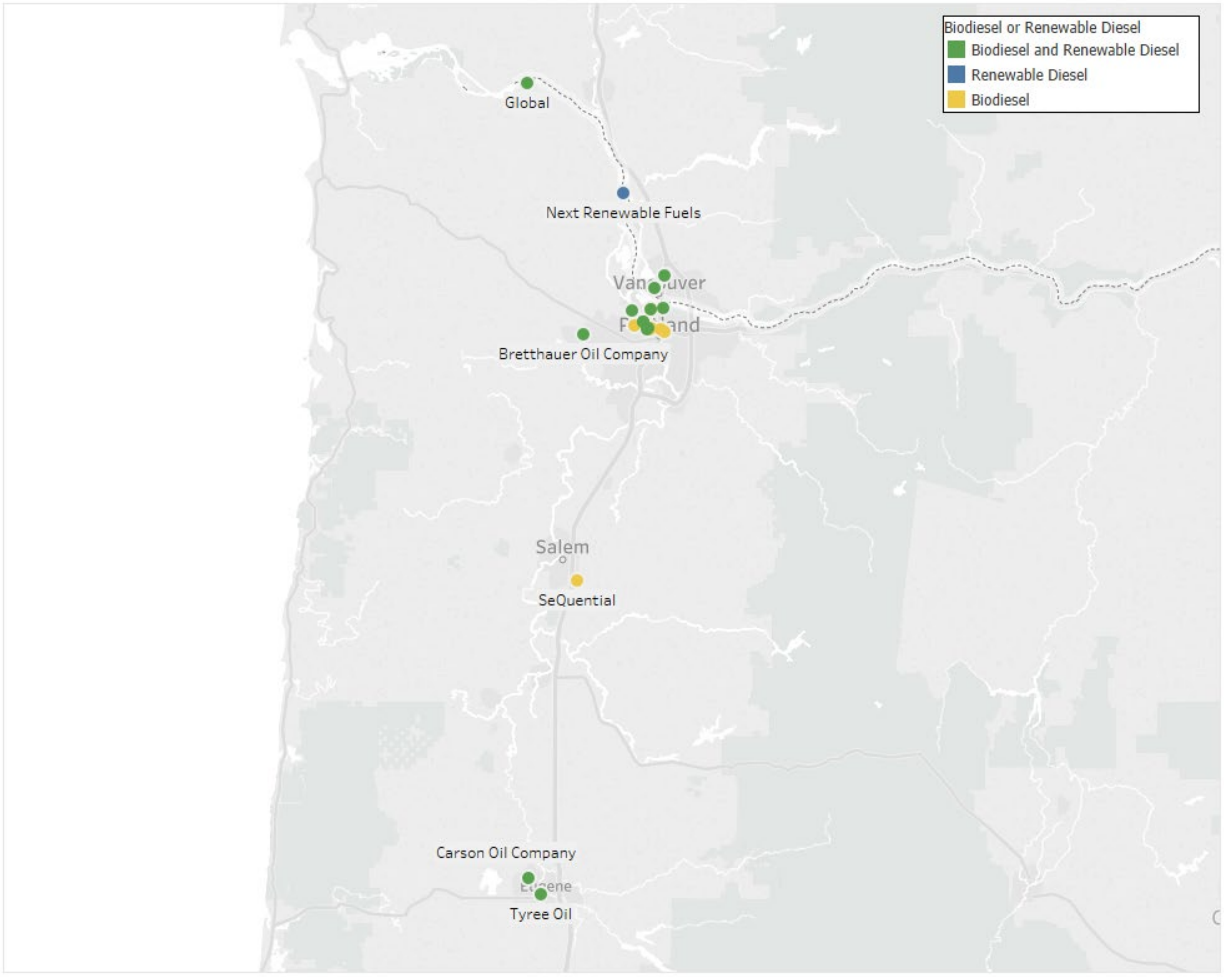


Figure 2. B&RD Asset Map for Portland and Vancouver



Most of the B&RD wholesale distributors in the Greater Portland area offer both Biodiesel and Renewable Diesel (Figure 3). Eight locations deal exclusively with biodiesel and only one location works with only renewable diesel (the planned NEXT production plant that won't break ground until 2022). The tendency for firms to carry both fuels reflects the broader market sentiment; biodiesel is nearly ubiquitous because of its long history and the B5 mandate. Renewable diesel is growing in prevalence as well. More than one business operator told the research team that they feel the regional appetite for renewable diesel will only continue to increase.

Figure 3. Business Locations by Fuel Type



There are 512 workers in the Greater Portland area involved in B&RD activity. This workforce is about the same size as that in Bookstores or the Dry Cleaning and Laundry Services industry in the region. Roughly half (273) of these workers are involved in the Wholesale Trade, Distribution, & Transport of B&RD. This activity includes the collection of feedstocks from local grease traps, and the transportation and sale of inputs and finished products. Another 230 workers are involved in the production of B&RD (Table 2). Professional and Business Services workers predominantly work in fuel testing.

Table 2. B&RD Employment by Supply Chain Segment

Supply Chain Segment	Employment
Wholesale Trade, Distribution, & Transport	273
Production	230
Professional and Business Services	9

B&RD activity accounts for nearly $174 million in Gross Regional Product annually. This amount is roughly equivalent to the annual contribution of Furniture Stores and Industrial Building Construction.

Workforce Demographics and Challenges

Workforce Dynamics and Challenges

Licensed truck drivers are the primary workforce pain point for the B&RD industry. When asked about hiring challenges, every employer the research team spoke with mentioned the challenges of finding drivers with class B or A CDL licenses. This shortage is not unique to the B&RD industry nor the Greater Portland area; a 2019 report by the American Trucking Associations found that the shortage of truck drivers in 2019 was just under 60,000 workers nationwide. Worse, the report also suggests that if trends continue, this shortage could reach more than 100,000 workers nationally by 2023.[11] Other literature from the U.S. Bureau of Labor Statistics suggests that this shortage is largely the result of a "tight" labor market driven by high turnover rates in the industry.[12]

Oil recyclers, as one employer mentioned, likely have even greater difficulty finding qualified truck drivers, as these workers also must deal with heavy lifting, dirty grease traps, and food waste. One way to remediate the challenges of finding licensed truck drivers would be to promote policies that help retain drivers, whether through higher wages, retention bonuses, routes that are more local (allowing drivers to spend more time with their families), or other incentives.

Most B&RD employers cited that their hiring efforts were often geared toward folks with warehouse experience. Fortunately, the Greater Portland area has a sizeable pool of workers with these skills. As Table 3 highlights, there are nearly 22,000 Stockers and Order Fillers and 25,200 Laborers, and Freight, Stock, and Material Movers in the Greater Portland area. This represents a sizable pool of talent with experience and skills that would transfer well into B&RD roles.

The proposed NEXT Renewable Fuels plant that will begin producing Renewable Diesel in 2024 will employ 233 skilled workers on site once completed.[13] In preparation for these substantial talent needs, the company has already begun working with state and county officials to ensure there are enough workers to fill these roles. While many of these workers will work in warehouse-oriented roles, the company also plans to leverage existing corporate training facilities in Houston for the refinery workers who will be working closely with the highly instrumented and automated process.

Workforce Demographics

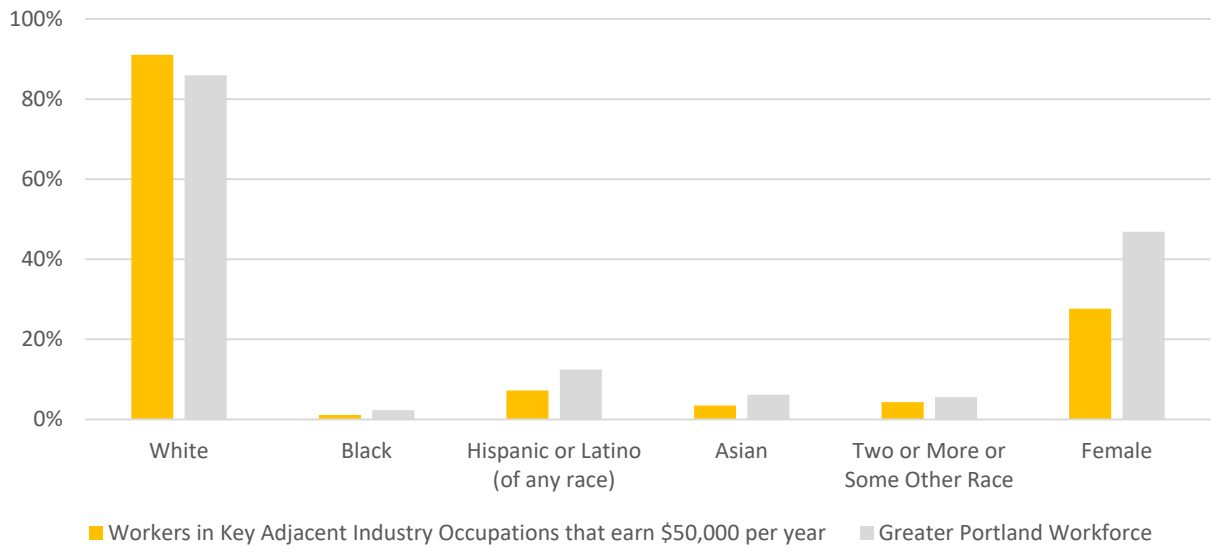
The B&RD workforce is largely representative of the overall workforce in the Greater Portland area. Most of the current B&RD workforce is dispersed among firms that operate within the broader fuels

[11] "Truck Driver Shortage Analysis 2019". American Trucking Associations.
[12] "Is the U.S. labor market for truck drivers broken?" Monthly Labor Review, U.S. Bureau of Labor Statistics. March 2019.
[13] "Economic Impacts of Renewable Fuels Facility in Columbia County, Oregon." Greene Economics 2021.

landscape. As such, the demographics of the Immediate Adjacent Industry[14] workforce is an appropriate representation of the B&RD workforce. As Figure 17 and Figure 18 demonstrate, this workforce is relatively in line with the overall workforce in the Greater Portland area. While interviews with B&RD employers suggest that this is largely true, some employers suggested that the share of women employees involved in B&RD and fuels may be lower than the overall labor market.

While the B&RD workforce may be representative overall, there are some discrepancies between the types of roles different demographics tend to have. White and male workers hold a greater share of the highest paying key Adjacent Industry jobs relative to their share of the labor force.[15] Conversely, women and non-White workers tend to be under-represented among these higher paying roles (Figure 4). These higher-paying roles are general manager or sales positions, suggesting that initiatives that promote pathways and equal access to management development programs is an important consideration. City-led policies that prioritize contracts with businesses with diverse management teams may help ensure proportionate representation. Additionally, programs that aim to increase the pipeline into sales positions for women and racial minorities would help erode some of these discrepancies.

Figure 4. Demographics of Key Higher-Paying Occupations



Adjacent Industry Analysis

The B&RD sector is intertwined with many industries across the Greater Portland area. To develop a thorough understanding of the impact of increased B&RD activity in the Portland economy, the research team identified "Adjacent Industries" that have similar workforce competencies, supply chains, and

[14] See page 12 for more information on Adjacent Industries.
[15] Three of the ten occupations earn $50,000 or more per year in average wages. The three occupations are General and Operations Managers and Sales Representatives, Wholesale and Manufacturing (of both Technical and Scientific and Non-Technical Non-Scientific Products).

activities to current firms involved in B&RD. The Adjacent Industry analysis identifies talent with similar or complementary skillsets that could easily transition from one industry to another.

Many of businesses within these Adjacent Industries currently have little or no involvement in B&RD activities. Their importance lies in the workers who have skill sets that would allow them and the companies that employ them to move into the B&RD supply chain with relatively little training and transition. Identifying these industries and their workers highlights a potential workforce that increased demand for B&RD could support or grow, in some cases offsetting recent job losses.

For the purposes of this study, the research team segmented Adjacent Industries into three categories: Immediate Adjacent Industries, Secondary Adjacent Industries, and Support Industries. The three Adjacent Industry categories distinguish industries in the same industry group and progression of the supply chain and those that provide input goods and services to the B&RD sector. Formal definitions by NAICS are available in Appendix B: Definitions.

Immediate Adjacent Industries This category includes the industries that share a federal industry classification code (six-digit NAICS) with companies currently involved in B&RD. Some of these companies may already have B&RD related operations that comprise a minor portion of their activity. Transition to B&RD-related work would be most rapid for workers in Immediate Adjacent Industries.

Secondary Adjacent Industries This category includes industries in the same general industry classifications (four-digit NAICS codes) but differ at the more granular level (six-digit NAICS codes). These industries conduct the same family of activities as firms involved in B&RD, but their transition to B&RD work would take more investment and time than Immediate Adjacent Industry firms.

Support Industries This category includes industries that are upstream of Immediate Adjacent Manufacturing Industries. They are typically industries that involve the manufacture of component parts or input goods. Growth in the B&RD market might require changes in operations, but as these companies tend to focus on raw materials and upstream components, those changes are likely to be minimal. These industries are expected to strongly benefit from the growth of the B&RD industry in the Greater Portland Area.

Immediate Adjacent Industries

More than 4,200 Immediate Adjacent jobs are in the Greater Portland area. While roughly 2,000 of these jobs are concentrated around Portland (Figure 6), a notable number are in the surrounding Longview, Washington area as well (Figure 5). Immediate Adjacent Industries include Ethyl Alcohol Manufacturing, Fuel Dealers, and All Other Basic Organic Chemical Manufacturing.

Figure 5. Immediate Adjacent Industry Jobs in the Greater Portland Area (2019)

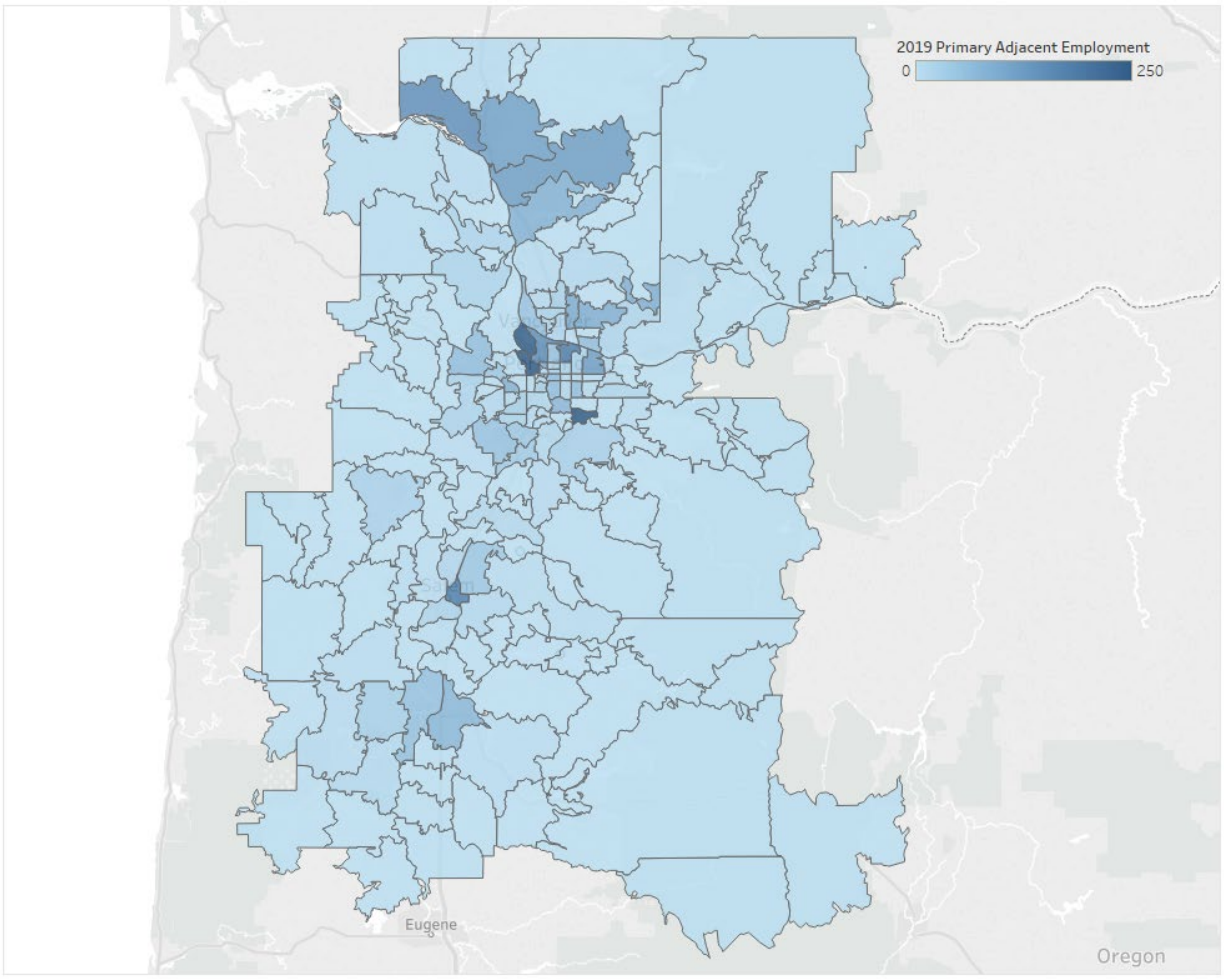
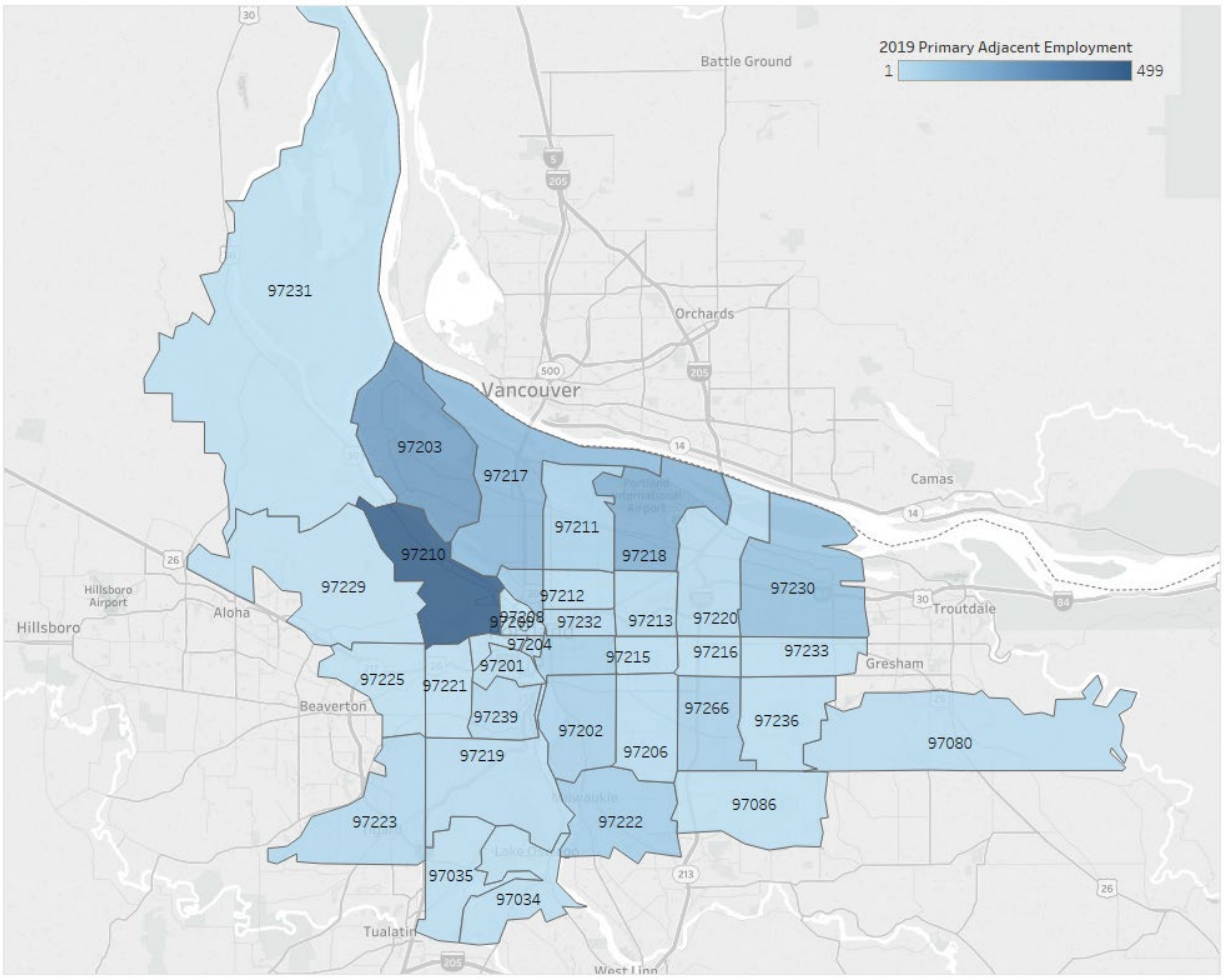


Figure 6. Immediate Adjacent Industry Jobs in Portland (2019)



Between 2014 and 2019, the number of Immediate Adjacent Industry jobs grew by roughly 200 jobs, representing a 6% increase. In comparison, the broader number of jobs in the Greater Portland area increased at twice the rate (13%) during this same time. Zip codes in and south of Longview saw the strongest Immediate Adjacent Industry growth in the region (Figure 7). The heaviest employment losses seen during this time were among zip codes on the Northwest riverfront in Portland, though Salem saw notable declines as well (Figure 8). Workers in Immediate Adjacent Industries—those which primarily currently work with fossil fuels-- also represent the workers who could most easily transition to B&RD work as B&RD activity increases in the region. As such, B&RD activity may serve as a lifeline in regions where Immediate Adjacent employment has declined, with minimal barriers to transitions.

Figure 7. Change in Immediate Adjacent Industry Jobs in the Greater Portland Area (2014-2019)

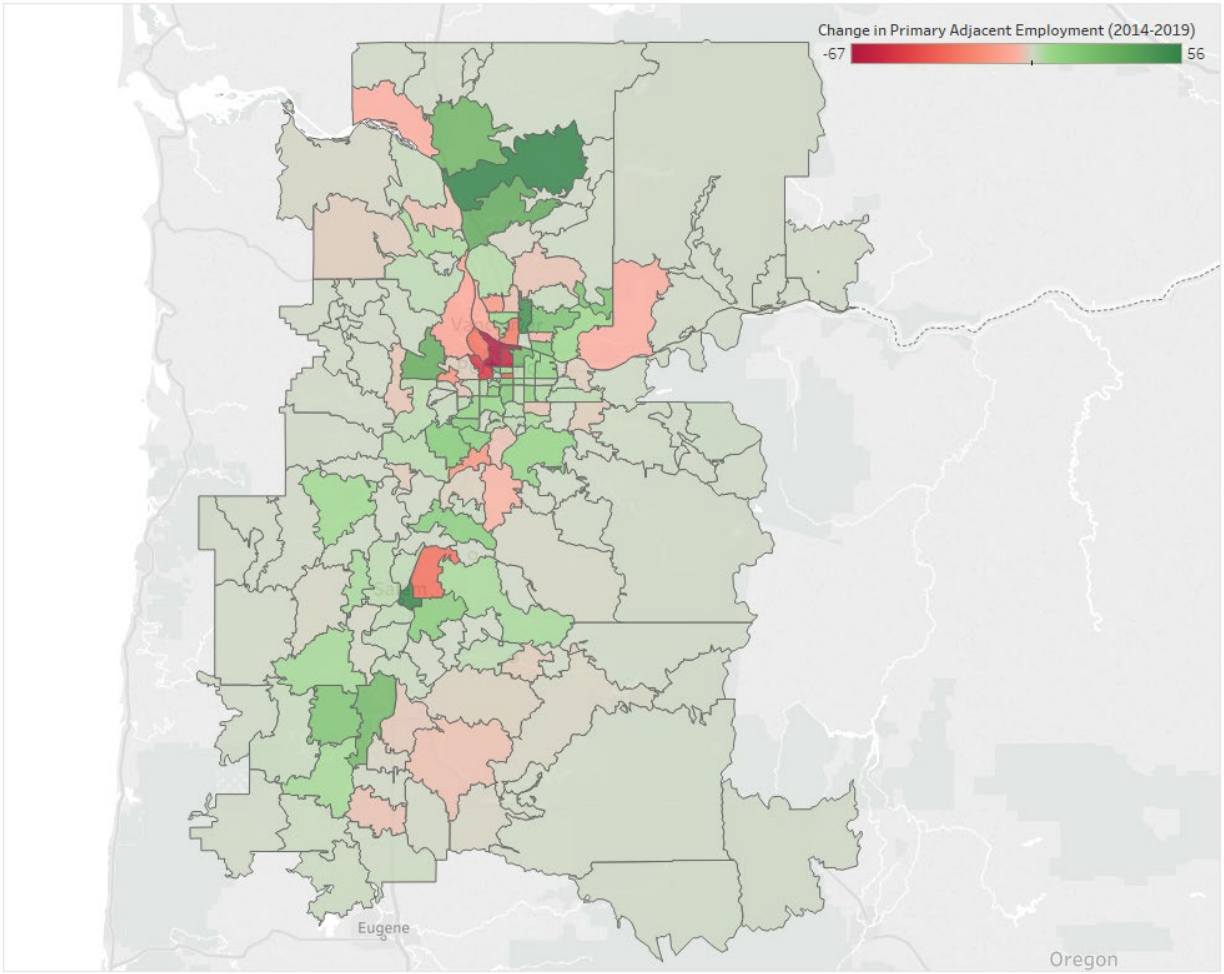
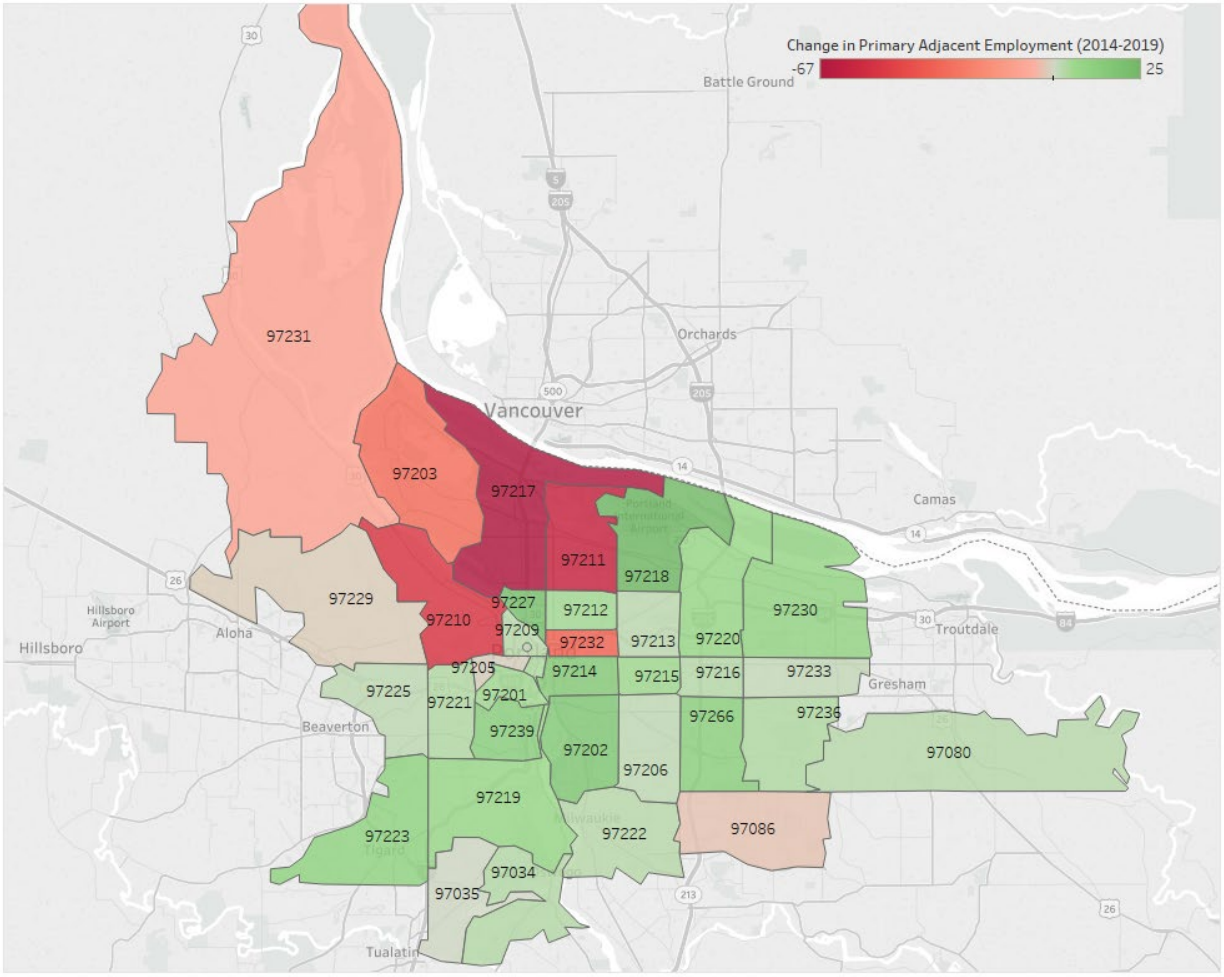


Figure 8. Change in Immediate Adjacent Industry Jobs in Portland (2014-2019)



Secondary Adjacent Industries

The Greater Portland area had nearly 11,000 Secondary Adjacent Industry jobs in 2019. Many of these jobs were concentrated around Portland, Vancouver, Longview, and Tualatin (Figure 9). More than 2,900 jobs were in Portland zip codes, and the greatest number of jobs were in the zip codes 97217, 97210, and 97230 (Figure 10). Secondary Adjacent Industries include Petroleum Lubricating Oil and Grease Manufacturing, Industrial Gas Manufacturing, and Synthetic Dye and Pigment Manufacturing.

Figure 9. Secondary Adjacent Industry Jobs in the Greater Portland Area (2019)

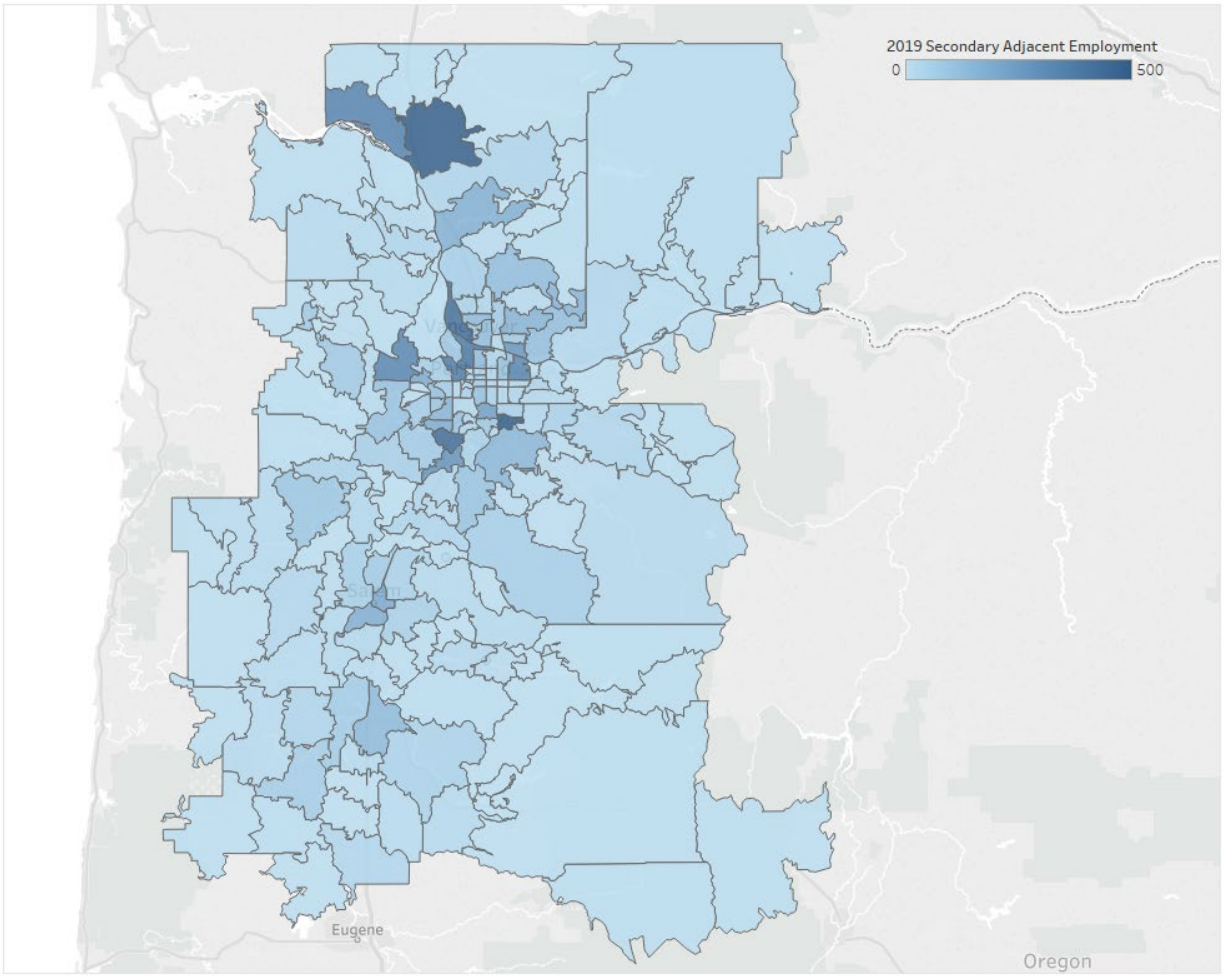
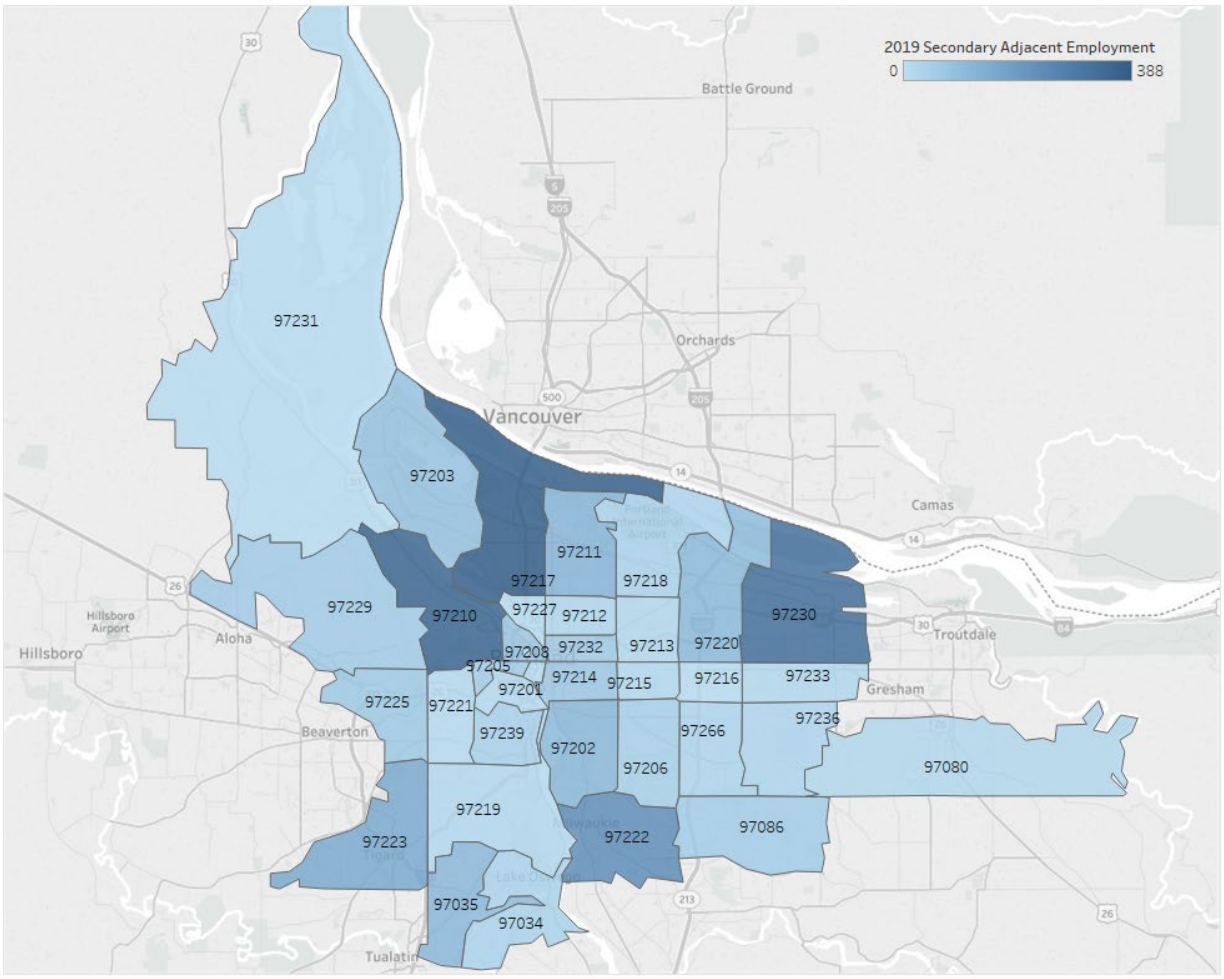


Figure 10. Secondary Adjacent Industry Jobs in Portland (2019)



The Greater Portland area added nearly 1,600 Secondary Adjacent jobs between 2014 and 2019. Many of these jobs were added around Hillsboro, Tualatin, and Watsonville (Figure 11). Areas in the surrounding Vancouver area and several zip codes in Portland (Figure 12) saw substantial losses of Secondary Adjacent jobs. Employees in Secondary Adjacent industries could also transition to B&RD-related work with relative ease, but would likely require more training and upskilling than workers in Immediate Adjacent Industries.

Figure 11. Change in Secondary Adjacent Industry Jobs in the Greater Portland Area (2014-2019)

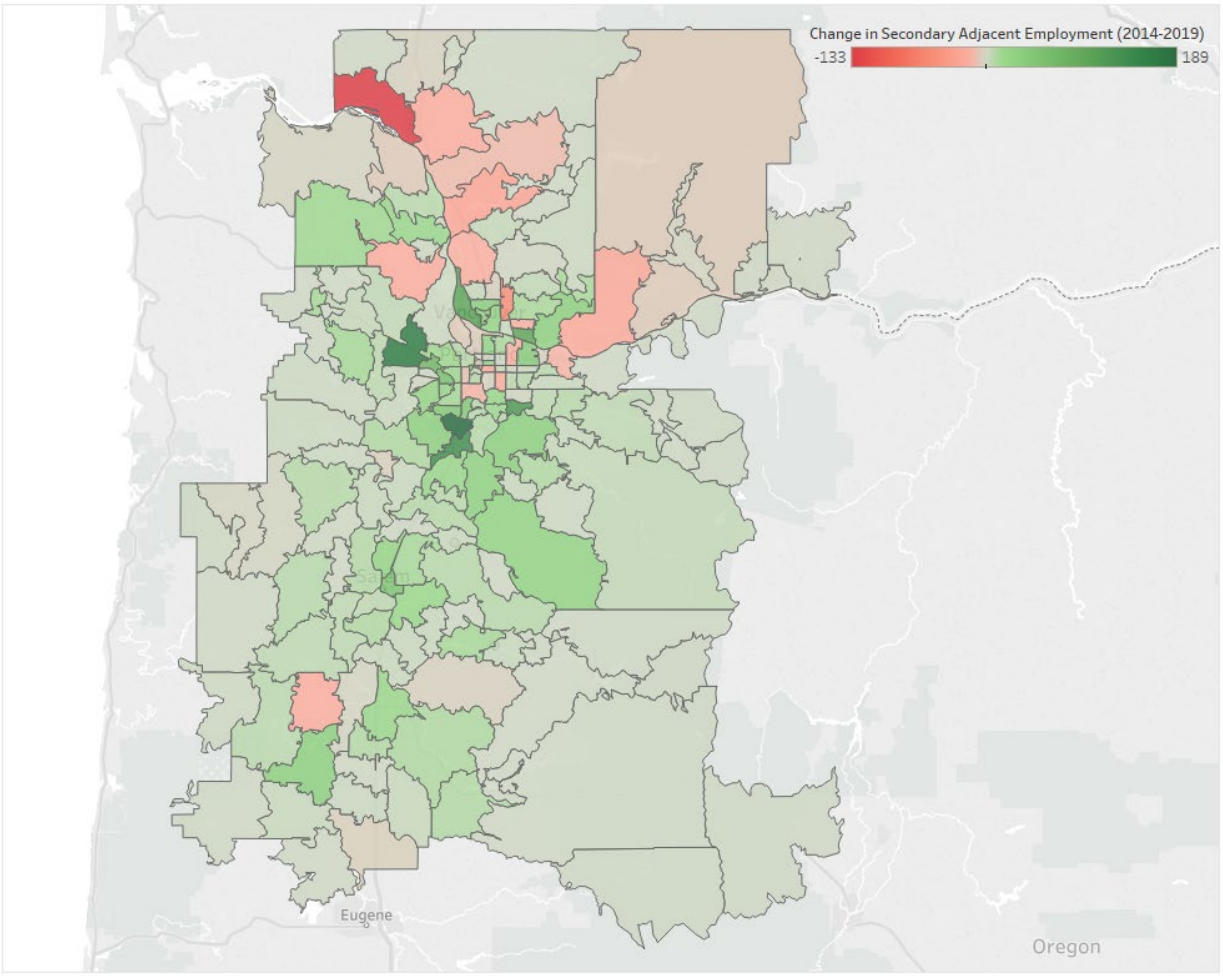
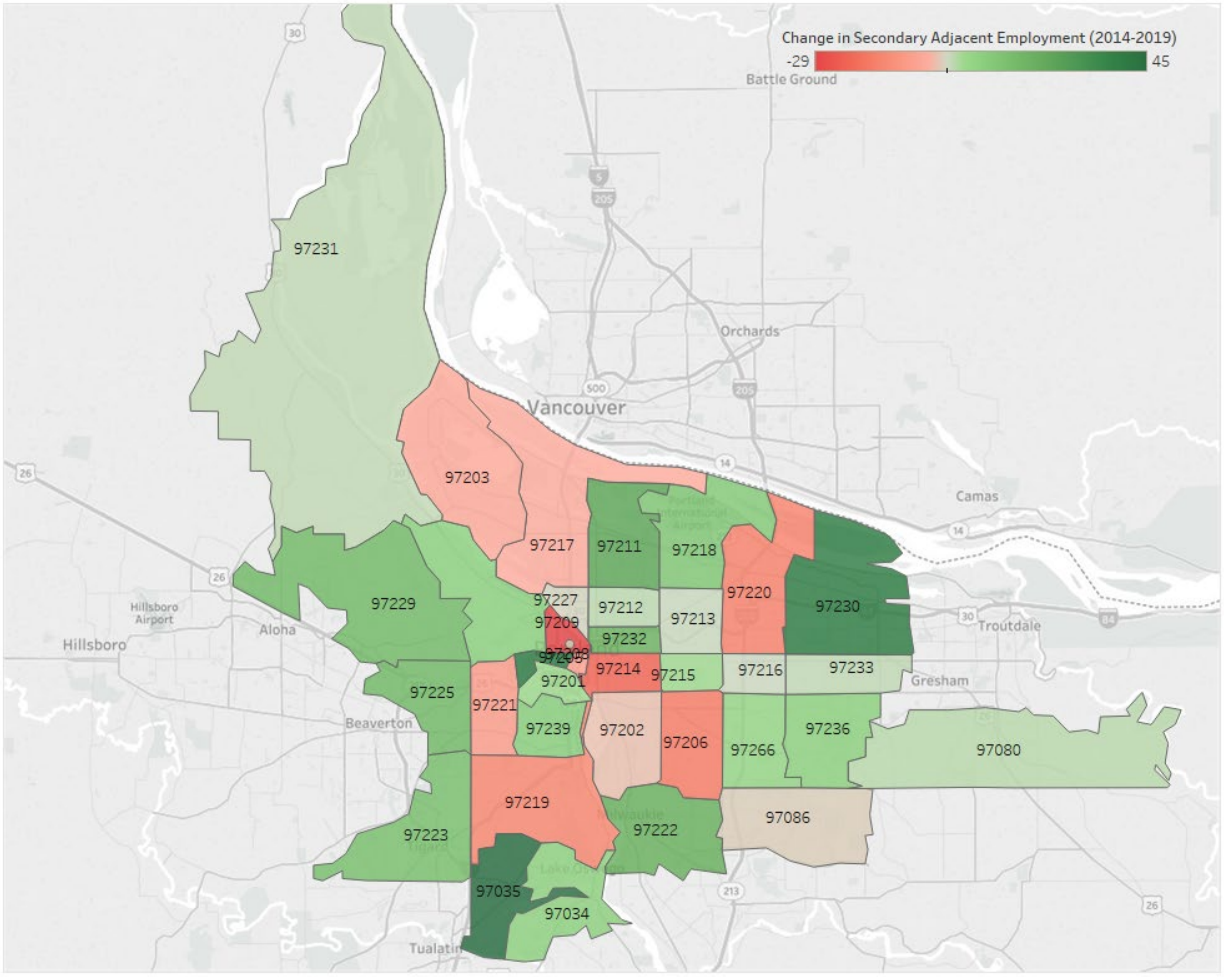


Figure 12. Change in Secondary Adjacent Industry Jobs in the Portland (2014-2019)



Support Industries

More than 72,200 Support Industry jobs are in the Greater Portland area. The greatest number of these jobs can be found in the surrounding Portland and Vancouver areas (Figure 13). Zip codes near Tigard (97223 and 97035) and the downtown Portland (97204) have the greatest number of jobs within Portland (Figure 14). Support Industries include Semiconductor and Related Device Manufacturing, Engineering Services, and Computer Systems Design Services.

Figure 13. Support Industry Jobs in the Greater Portland Area (2019)

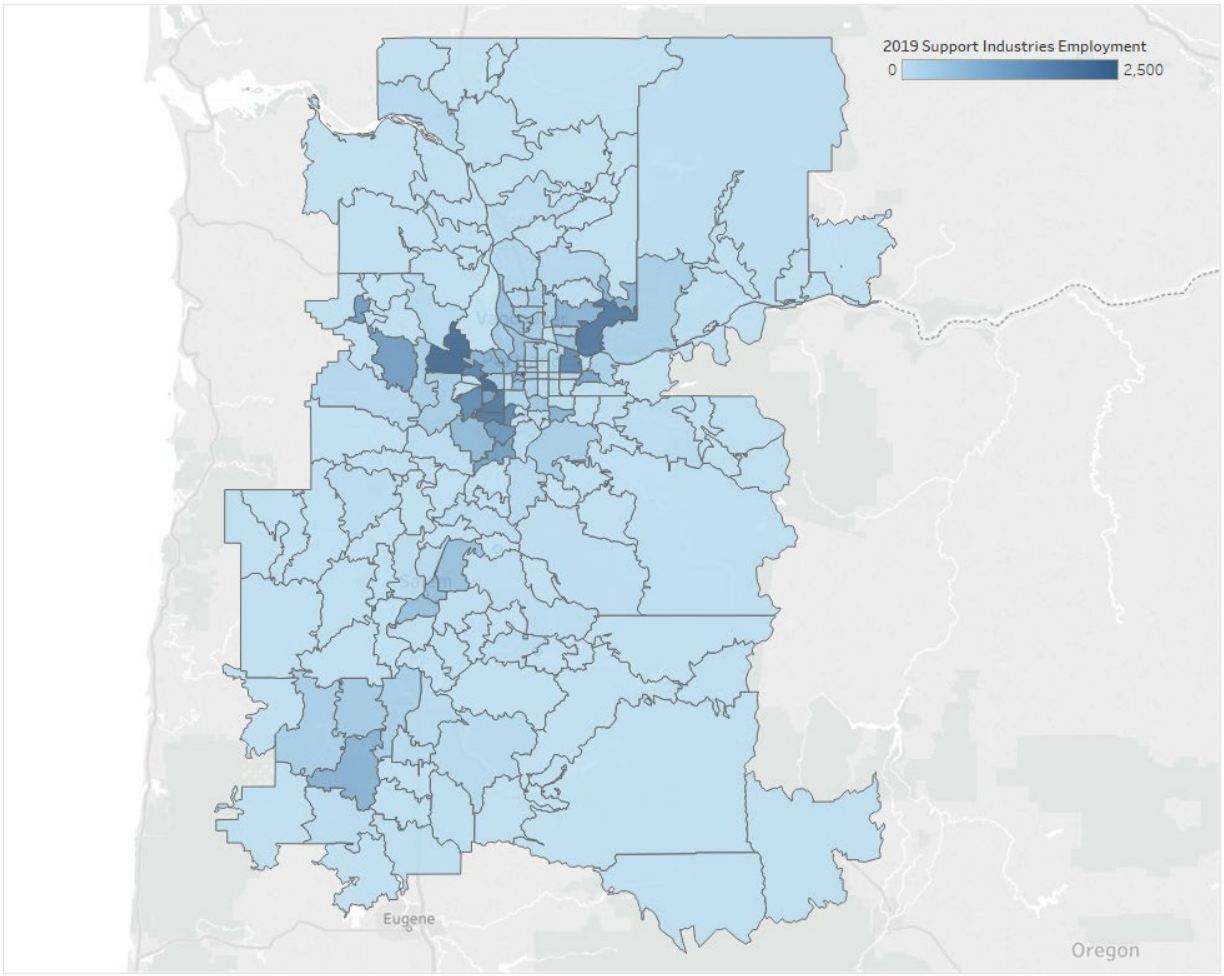
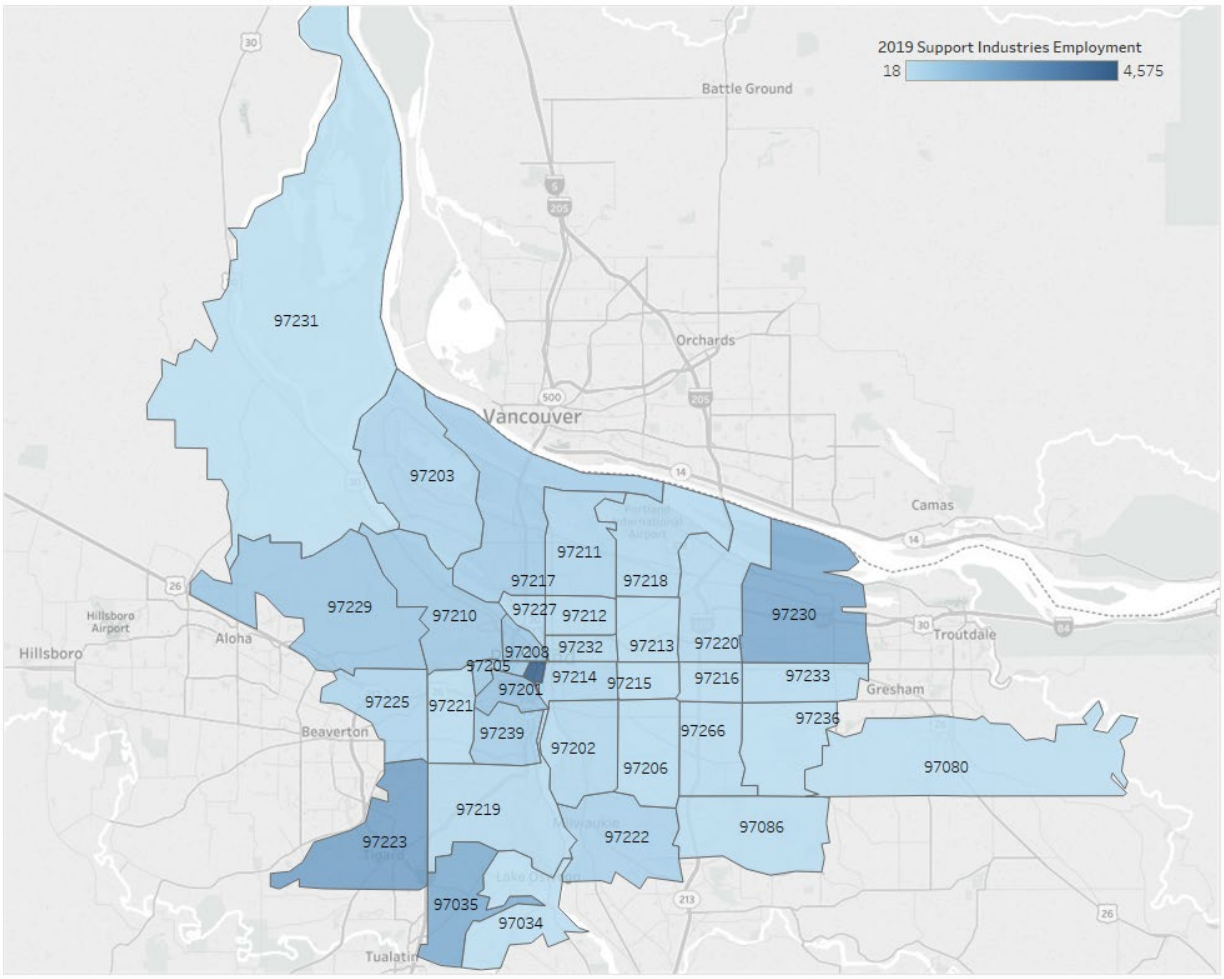


Figure 14. Support Industry Jobs in Portland (2019)



The Greater Portland area saw Support Industry jobs grow by nearly 9,800 workers between 2014 and 2019, representing a 16% increase. The greatest employment gains were seen around Hillsboro, Beaverton, and Camas, Washington. The largest losses in employment were seen in zip codes in Portland and Vancouver (Figure 15). The zip codes 97201 and 97217 in Portland saw 300 and 100 Support Industry jobs disappear during this time (Figure 16). Support Industries and their employees would benefit from additional B&RD activity, which would drive additional demand for the goods and services that Support Industries provide.

Figure 15. Change in Support Industry Jobs in the Greater Portland Area (2014-2019)

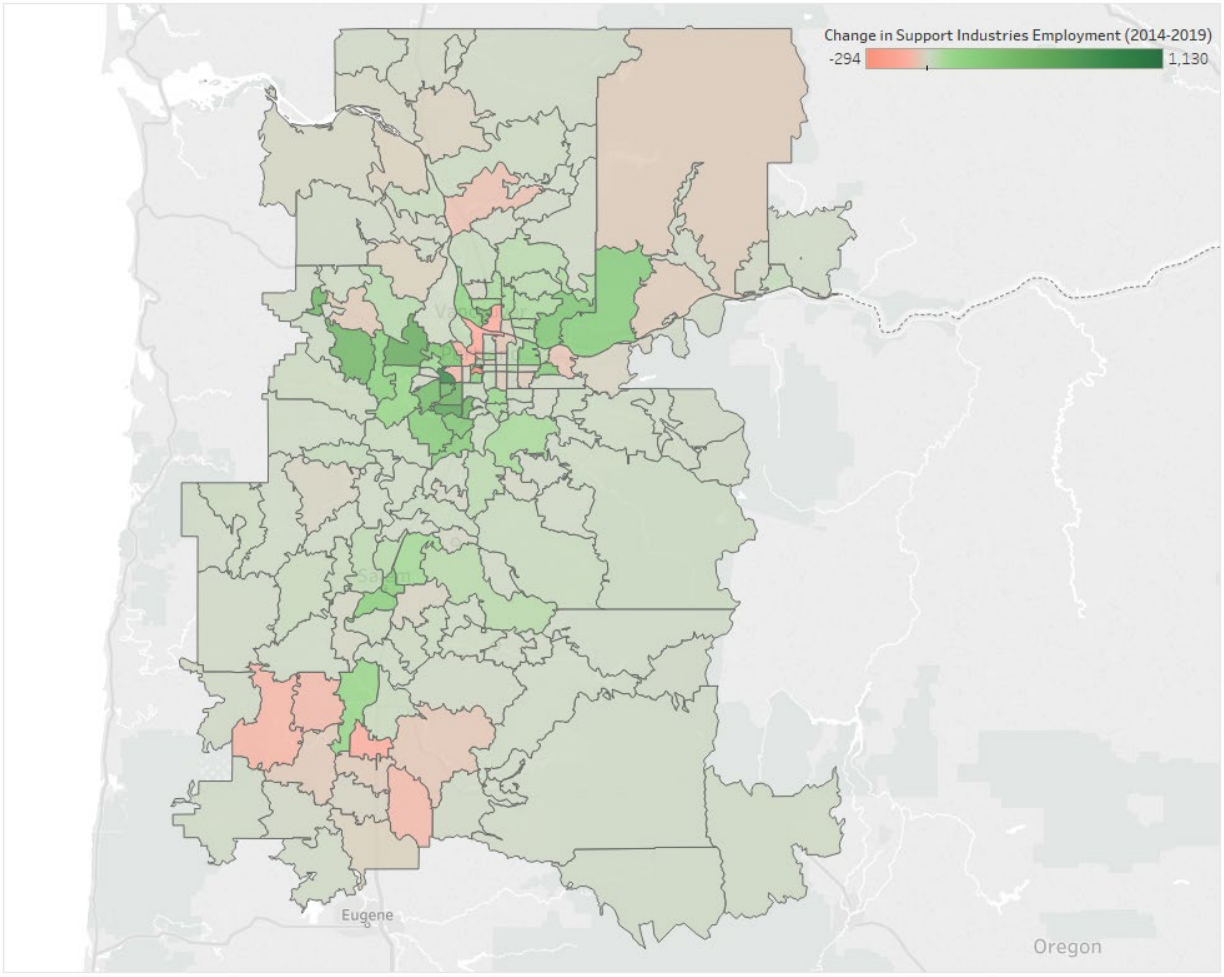
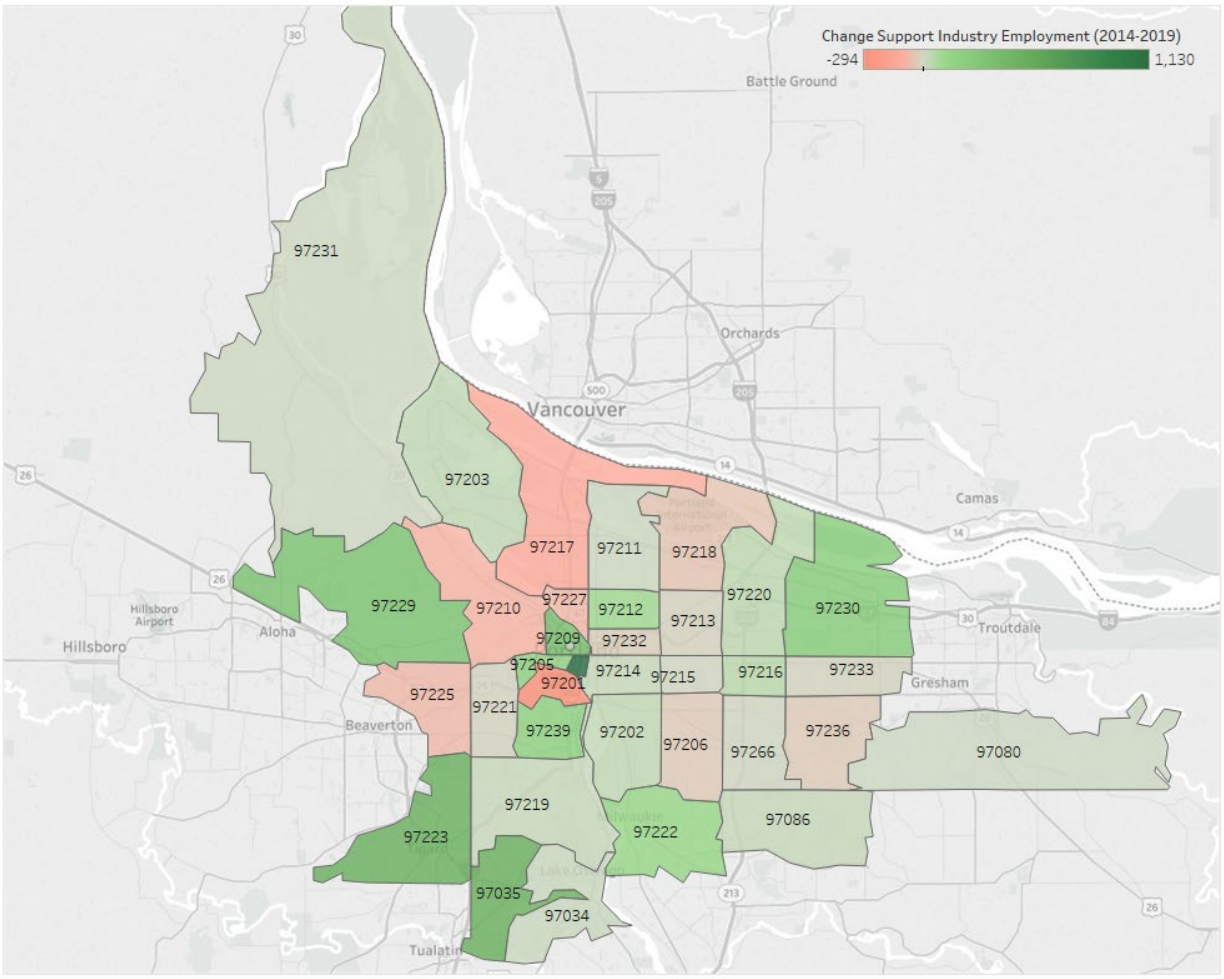


Figure 16. Change in Support Industry Jobs in Portland (2014-2019)



Adjacent Occupations and Just Transition Opportunities

An Adjacent Occupational analysis is different from an Adjacent Industry analysis in that the occupational analysis is conducted through a workforce lens. Adjacent Occupational analyses select occupations that are most common among Adjacent Industries and examine their frequency throughout the entire statewide economy. This analysis identifies occupations with similar knowledge, skills, abilities, tasks, and other work activities, regardless of the industry the workers are currently in. The result is a list of occupations that share enough similarities such that the required workforce or on-the-job training to transition to a B&RD-related job would be minimal or modest. Ultimately, an Adjacent Occupational analysis provides an occupation-oriented perspective of the potential talent pool for B&RD work.

Key Occupations in Immediate Adjacent Industries

The ten most common occupations within Immediate Adjacent Industries account for 185,300 workers across the Greater Portland area. Eight of these ten occupations also offer average annual wages above the living wage for an individual with no dependents (Table 3).[16] A transition to B&RD activity would be relatively easy for these workers, as the types of work tasks and duties required would change very little. Some training surrounding the material differences would be required, but tasks and responsibilities would remain largely unchanged.

Table 3. Ten Most-Common Immediate Adjacent Occupations

Occupation	2019 Employment	Avg. Annual Wages	Typical Entry-Level Education
Office Clerks, General	27,927	$38,800	High school diploma or equivalent
Laborers and Freight, Stock, and Material Movers, Hand	25,243	$34,500	None
General and Operations Managers	25,000	$117,500	Bachelor's degree
Customer Service Representatives	24,396	$39,900	High school diploma or equivalent
Stockers and Order Fillers	21,695	$32,900	High school diploma or equivalent
Heavy and Tractor-Trailer Truck Drivers	18,719	$49,900	Postsecondary non-degree award
Bookkeeping, Accounting, and Auditing Clerks	17,471	$45,000	Some college, no degree
Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products	14,680	$75,500	High school diploma or equivalent
Shipping, Receiving, and Inventory Clerks	7,061	$39,800	High school diploma or equivalent
Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	3,125	$106,000	Bachelor's degree

The workers in key occupations in the Immediate Adjacent Industries are relatively representative of the overall Greater Portland area workforce. Workers in these occupations throughout the Greater Portland area economy have slightly greater representation among workers between the ages of 45 and 64 and a lower share of workers between 35 and 44 (Figure 17). Along gender, racial, and ethnic lines, workers across all industries in key Immediate Adjacent occupations are relatively representative of the overall workforce in the area (Figure 18).

[16] Based on MIT Living Wage Calculator. Portland-Vancouver-Hillsboro MSA. $37,440 for single adult with no dependents and $74,800 for a family (with one working adult and two children). https://livingwage.mit.edu/metros/38900

Figure 17. Age Distribution of Key Occupations in Immediate Adjacent Industries

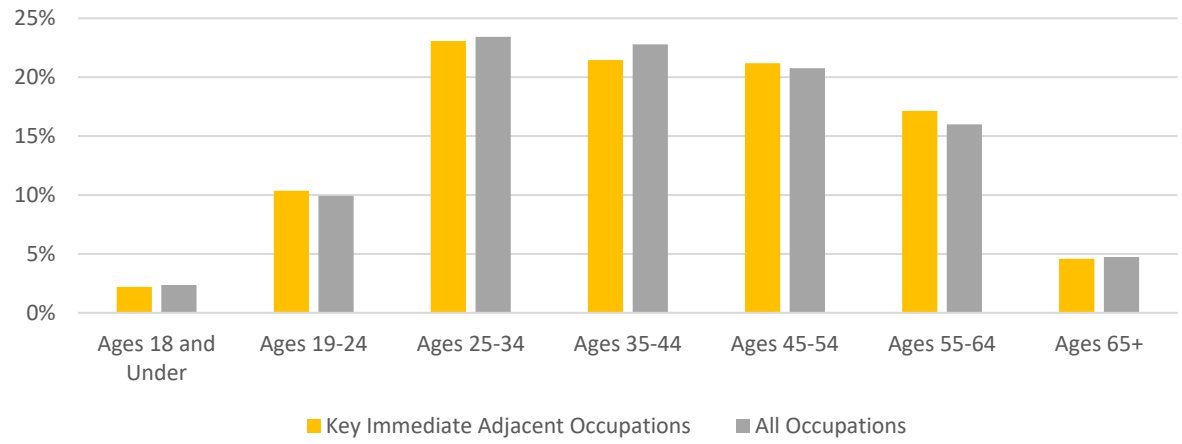
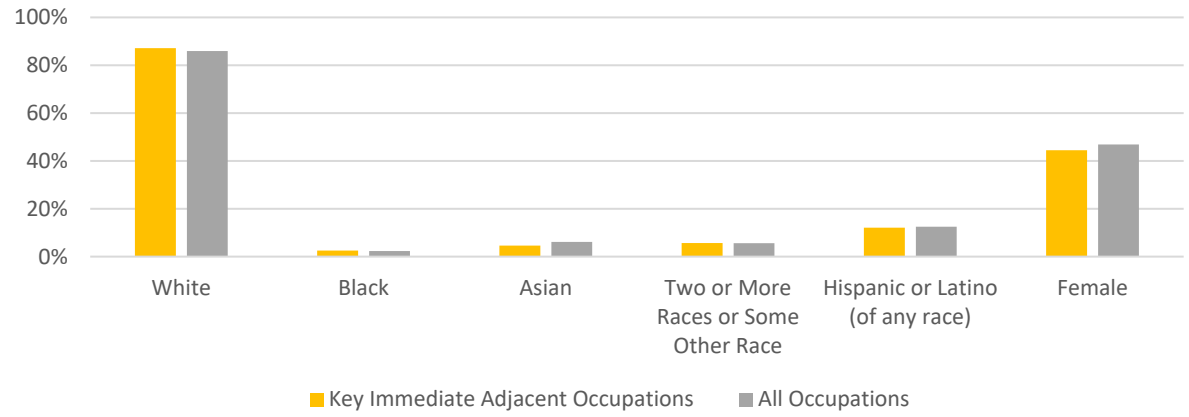


Figure 18. Demographics of Key Occupations in Immediate Adjacent Industries



Key Occupations in Secondary Adjacent Industries

There are 122,500 workers in the ten most common occupations in Secondary Adjacent Industries across the Greater Portland area. All but one of these occupations typically require a high school diploma or equivalent, or less, for entry-level roles (Table 4). Additionally, five of the ten occupations provide average annual wages that exceed the regional living wage.[17] Due to the similarity in the types of tasks and responsibilities, workers in Secondary Adjacent Industries could likely transition to B&RD-related roles with modest additional training or certification.

[17] Based on MIT Living Wage Calculator. Portland-Vancouver-Hillsboro MSA. $37,440 for single adult with no dependents and $74,800 for a family (with one working adult and two children). https://livingwage.mit.edu/metros/38900

Table 4. Ten Most-Common Secondary Adjacent Occupations

Occupation	2019 Employment	Avg. Annual Wages	Typical Entry-Level Education
Retail Salespersons	39,685	$31,400	None
Laborers and Freight, Stock, and Material Movers, Hand	25,243	$34,500	None
Heavy and Tractor-Trailer Truck Drivers	18,719	$49,900	Postsecondary non-degree award
Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products	14,680	$75,500	High school diploma or equivalent
First-Line Supervisors of Retail Sales Workers	13,575	$44,500	High school diploma or equivalent
Driver/Sales Workers	5,114	$37,000	High school diploma or equivalent
First-Line Supervisors of Non-Retail Sales Workers	3,647	$78,300	High school diploma or equivalent
Door-to-Door Sales Workers, News and Street Vendors, and Related Workers	759	$33,000	None
Meat, Poultry, and Fish Cutters and Trimmers	707	$28,100	None
Hazardous Materials Removal Workers	402	$45,700	High school diploma or equivalent

Workers across the Greater Portland economy that work in occupations essential to Secondary Adjacent Industries have slight differences from the overall regional workforce. Workers in these occupations are more likely to be between the ages of 25 and 64, with fewer workers on either end of the age distribution (Figure 19). These workers also tend to be men; only 30% of workers in these occupations are women, compared to 47% of the overall workforce (Figure 20).

Figure 19. Age Distribution of Key Occupations in Secondary Adjacent Industries

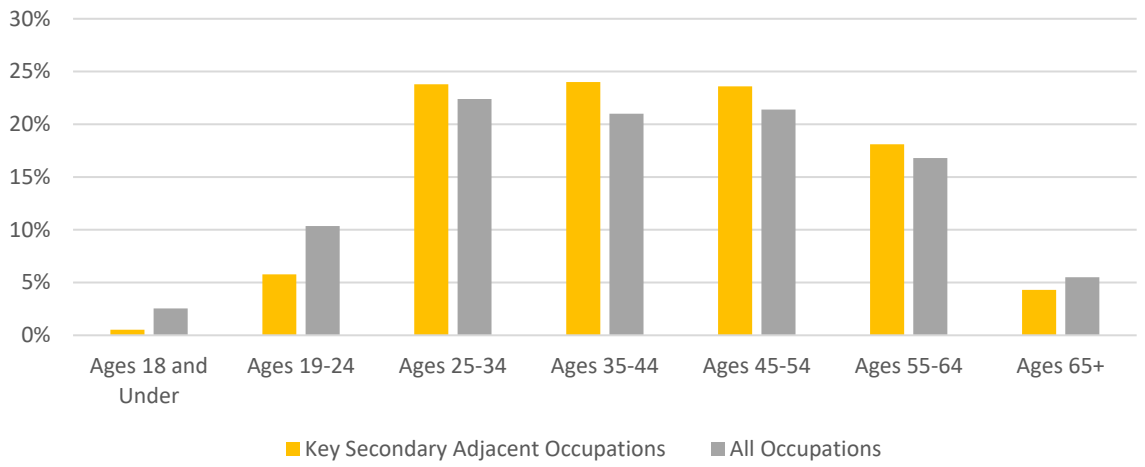
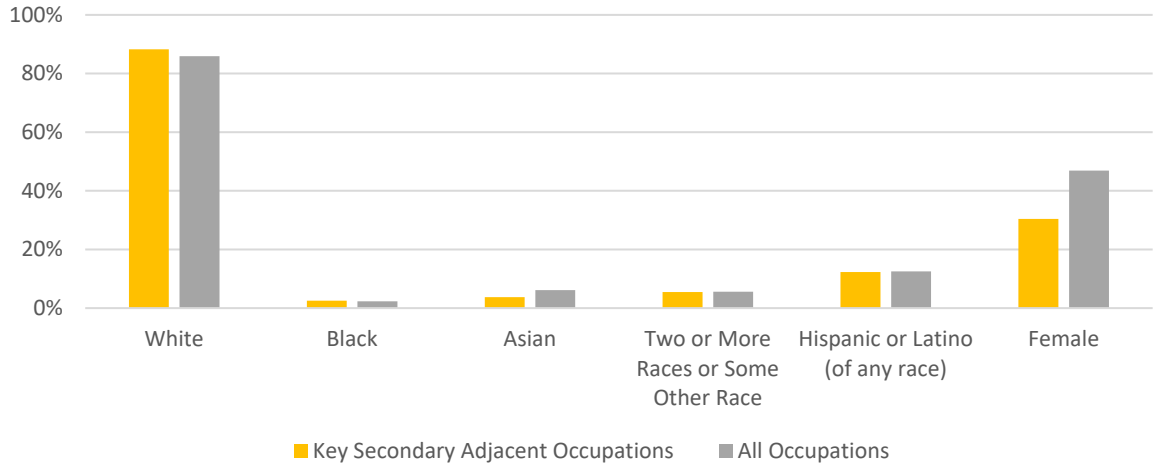


Figure 20. Demographics of Key Occupations in Secondary Adjacent Industries



Key Occupations in Support Industries

More than 94,100 workers in the Greater Portland area work in the ten most common occupations in Support Industries. Half of these occupations typically require a bachelor's degree for entry-level positions (Table 4). Eight of these occupations also provide average annual wages that exceed the regional living wage.[18] Workers in Support Industries are most likely to benefit from increased B&RD activity as the increased activity drives additional demand for the goods and services their industry creates.

Table 5. Ten Most-Common Support Industry Occupations

Occupation	2019 Employment	Avg. Annual Wages	Typical Entry-Level Education
General and Operations Managers	25,000	$117,500	Bachelor's degree
Heavy and Tractor-Trailer Truck Drivers	18,719	$49,900	Postsecondary non-degree award
Software Developers and Software Quality Assurance Analysts and Testers	16,512	$107,400	Bachelor's degree
Team Assemblers	10,928	$37,200	High school diploma or equivalent
Electrical, Electronic, and Electromechanical Assemblers, Except Coil Winders, Tapers, and Finishers	5,691	$37,500	High school diploma or equivalent
Industrial Engineers	3,938	$93,200	Bachelor's degree
Civil Engineers	3,858	$92,100	Bachelor's degree
Electronics Engineers, Except Computer	3,650	$90,800	Bachelor's degree
Semiconductor Processing Technicians	3,244	$40,100	High school diploma or equivalent
Electrical and Electronic Engineering Technologists and Technicians	2,608	$63,900	Associate's degree

Like workers in occupations that are essential to Secondary Adjacent Industries, workers in occupations essential to Support Industries tend to be heavily concentrated in the prime working ages and have relatively few female workers. Ninety percent of these workers are between the ages of 25 and 64 (Figure 21) and only 23% of the workforce are women, roughly half the rate of the overall workforce (47%) (Figure 22).

[18] Based on MIT Living Wage Calculator. Portland-Vancouver-Hillsboro MSA. $37,440 for single adult with no dependents and $74,800 for a family (with one working adult and two children). https://livingwage.mit.edu/metros/38900

Figure 21. Age Distribution of Key Occupations in Support Industries

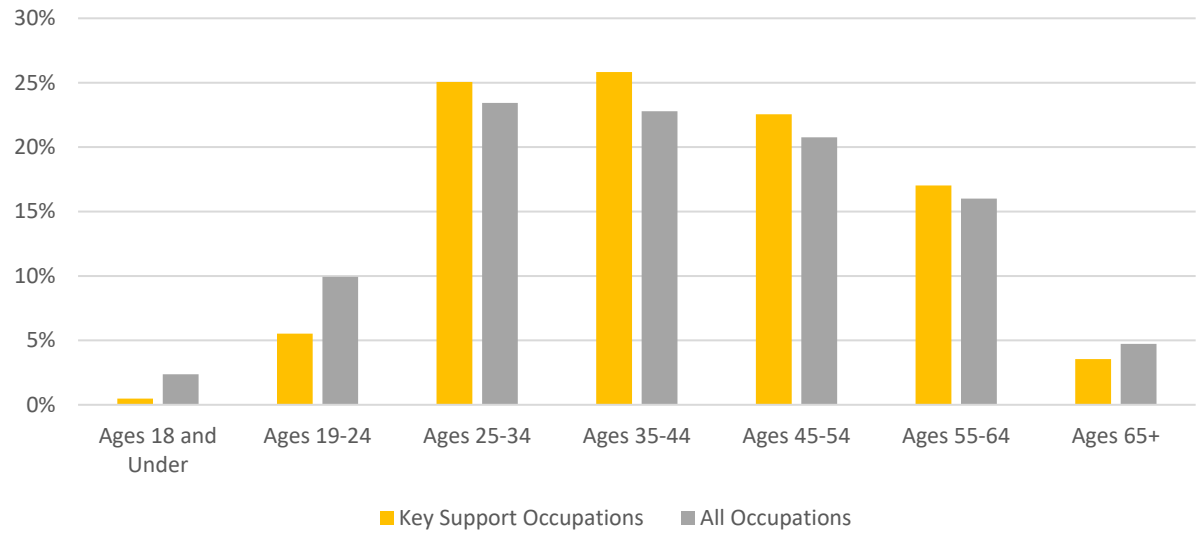
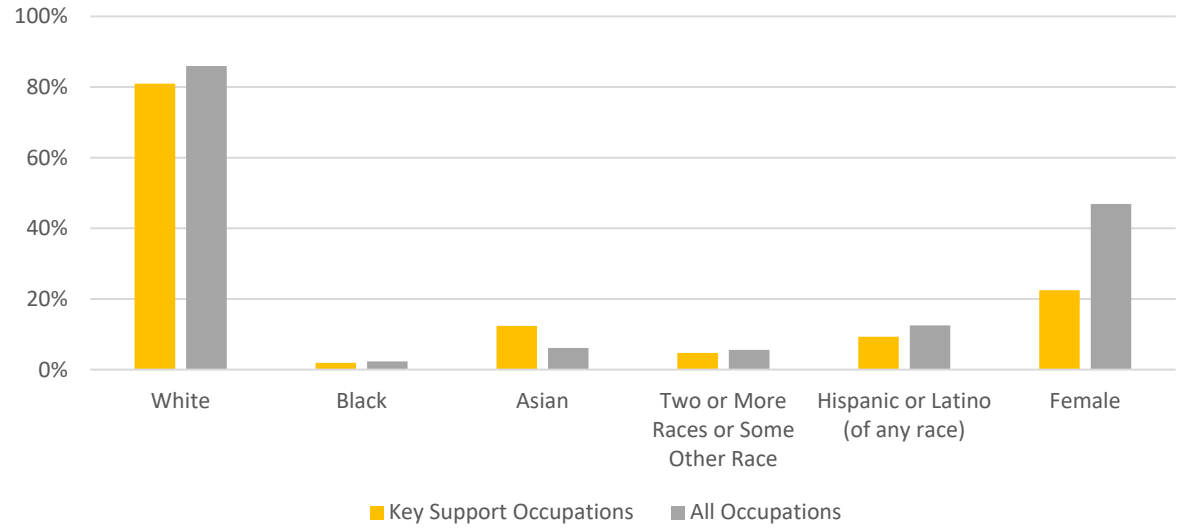


Figure 22. Demographics of Key Occupations in Support Industries



Appendix A: Research Methodology

EMPLOYMENT AND GSP

Employment and GSP extrapolations were performed using data collected for this report, as well as data from the 2019 United States Energy Employment Report (USEER) and JobsEQ. The methodology used for the 2019 USEER meets the highest statistical and methodological standards and has been reviewed by the Bureau of Labor Statistics (BLS) and the Department of Energy (DOE). More details about the methodology can be found here: usenergyjobs.org.

DATA COLLECTION

The research team utilized previous research, desktop research, phone calls, email, and other forms of outreach to generate a database of companies known to be active in B&RD. Firms from the potential database (this database was composed of companies from industries which were believed to be involved in B&RD) were first examined through desktop research to determine if they were related to ET activity. All firms were called via telephone up to two times. Once phone contact was established, BW staff would confirm involvement in B&RD, and ask supplementary questions confirming employment counts and asking about in-state suppliers and customers. If phone contact could not be established, voicemails were left and, when possible, emails sent. The research team called 291 firms and sent more than 150 emails. The research team also leveraged warm leads from Prosper Portland.

Appendix B: Definitions

Table 6. Immediate Adjacent Industries

NAICS	Industry
423930	Recyclable Material Merchant Wholesalers
424690	Other Chemical and Allied Products Merchant Wholesalers
424710	Petroleum Bulk Stations and Terminals
454310	Fuel Dealers
325199	All Other Basic Organic Chemical Manufacturing
562920	Materials Recovery Facilities
325110	Petrochemical Manufacturing
562119	Other Waste Collection
311225	Fats and Oils Refining and Blending
325193	Ethyl Alcohol Manufacturing
311613	Rendering and Meat Byproduct Processing

Table 7. Secondary Adjacent Industries

NAICS	Industry
454390	Other Direct Selling Establishments
562910	Remediation Services
423910	Sporting and Recreational Goods and Supplies Merchant Wholesalers
311612	Meat Processed from Carcasses
423990	Other Miscellaneous Durable Goods Merchant Wholesalers
311615	Poultry Processing
311211	Flour Milling
562991	Septic Tank and Related Services
324122	Asphalt Shingle and Coating Materials Manufacturing
325120	Industrial Gas Manufacturing
424720	Petroleum and Petroleum Products Merchant Wholesalers (except Bulk Stations and Terminals)
311213	Malt Manufacturing
325180	Other Basic Inorganic Chemical Manufacturing
311611	Animal (except Poultry) Slaughtering
562998	All Other Miscellaneous Waste Management Services
424610	Plastics Materials and Basic Forms and Shapes Merchant Wholesalers
423920	Toy and Hobby Goods and Supplies Merchant Wholesalers
423940	Jewelry, Watch, Precious Stone, and Precious Metal Merchant Wholesalers
325130	Synthetic Dye and Pigment Manufacturing
324121	Asphalt Paving Mixture and Block Manufacturing

311230	Breakfast Cereal Manufacturing
324191	Petroleum Lubricating Oil and Grease Manufacturing
311224	Soybean and Other Oilseed Processing
311221	Wet Corn Milling

Table 8. Support Industries

NAICS	Industry
334413	Semiconductor and Related Device Manufacturing
541330	Engineering Services
541512	Computer Systems Design Services
484121	General Freight Trucking, Long-Distance, Truckload
518210	Data Processing, Hosting, and Related Services
326199	All Other Plastics Product Manufacturing
423830	Industrial Machinery and Equipment Merchant Wholesalers
811310	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance
423430	Computer and Computer Peripheral Equipment and Software Merchant Wholesalers