

**EXH. TMH-3  
DOCKETS UE-240004/UG-240005  
2024 PSE GENERAL RATE CASE  
WITNESS: THOMAS M. HUNT**

**BEFORE THE  
WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION**

**WASHINGTON UTILITIES AND  
TRANSPORTATION COMMISSION,**

**Complainant,**

**v.**

**PUGET SOUND ENERGY,**

**Respondent.**

**Docket UE-240004  
Docket UG-240005**

**SECOND EXHIBIT (NONCONFIDENTIAL) TO THE  
PREFILED DIRECT TESTIMONY OF**

**THOMAS M. HUNT**

**ON BEHALF OF PUGET SOUND ENERGY**

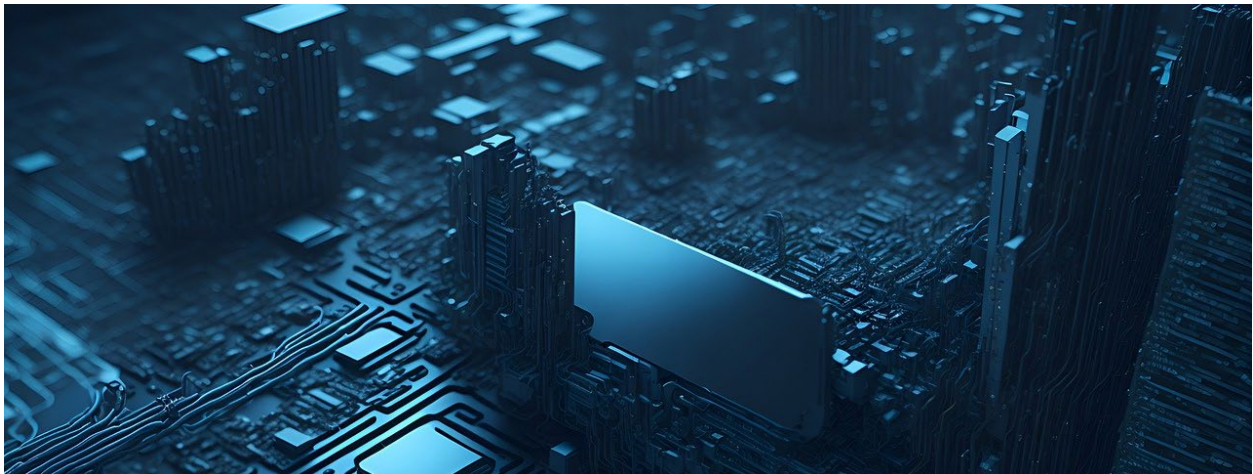
**FEBRUARY 15, 2024**



# Technology Sector Economic Outlook in Washington State and the Greater Seattle Region

# WASHINGTON TECHNOLOGY INDUSTRY ASSOCIATION

## TECHNOLOGY SECTOR ECONOMIC OUTLOOK IN WASHINGTON STATE AND THE GREATER SEATTLE REGION



May 2023

Submitted by:



Submitted to:





**High Peak Strategy LLC**

Spencer Cohen, PhD

Principal

Seattle, WA

[spencer@highpeakstrategy.com](mailto:spencer@highpeakstrategy.com)



## EXECUTIVE SUMMARY

The information and communication technology (ICT, or “tech”) sector is a leading pillar of Washington’s economy. The sector—which includes activities spanning software, e-commerce, cloud computing, telecom, electronics manufacturing, and various computer services—creates significant economic wealth and job creation across the state through both its sheer size and the multiplicative impacts of tech industry purchases and tech worker household spending.

Over the past three years, while large parts of the Washington state economy were severely hampered by the pandemic, the tech sector not only sustained, but expanded at a historic pace. Tech sector businesses and organizations were also critical partners with state and local governments and healthcare providers. The tech sector provided leadership in the fight against COVID-19 through several key areas, including: (1) early on, supporting testing, diagnostics, treatment, and broad-based, eco-system-based support; and (2) beginning in 2021, tech solutions to support vaccination drives. Some of the largest tech firms led the way in transitioning to remote work to contain the spread of the virus.

In recent months, after a historic workforce expansion, and as the economy regains its footing, many Washington state tech firms underwent a slowdown in hiring or even workforce reductions in the last quarter of 2022 and first quarter of 2023. Despite these reductions, the net increase in tech sector employment still far exceeds growth among all other major sectors of the economy.

This report reviews the tech sector’s growth over the past three years and the scale of the sector’s economic contributions to the state economy. Findings include important themes from more than 30 tech sector stakeholders who shared their perspectives on key issues and outlook for the sector in Washington state. These findings inform a discussion on major technologies and developments now and anticipated in the near future that will continue to propel Washington’s tech sector, and the state’s broader economic growth trajectory.

### *Tech Sector’s Increasing Share of the State Economy*

In 2022, the ICT sector directly employed **360,900** workers. Factoring in estimated self-employed workers, the tech sector directly supported **380,300** workers in Washington state in 2022, or more than a third of a million workers. Between 2019 and 2022, **tech sector employers added 89,000 workers** to their payrolls, a 33% increase. During the depths of the pandemic recession, in 2020, the tech sector added 20,900 jobs, while the remainder of the Washington state economy shed more than 200,000 jobs before rebounding in 2021 and 2022. Among ICT subsectors, only manufacturing and telecommunications experienced a decline in employment between 2019 and 2022 (3,000 and 400 jobs, respectively).

More than a quarter (26%) of all wages earned statewide were for tech workers in 2022. This was up from 10% as recently as 2007. Between 2010 (Great Recession) and 2022, the tech sector represented nearly 40% of state economy-wide wage and salary disbursements growth. Between 2015 and 2020, the sector was responsible for 46% of all wage and salary growth and 71% of net job growth. The tech sector has nearly doubled its share of statewide covered employment, rising from less than 5% in 2007 to more than 10% in 2022.

**Key Takeaway:** By far, the tech sector is the fastest growing sector in Washington state, with more than 380,000 workers in 2022.

## *Tech Sector Was Key to the State's Recovery from the 2009-2010 Great Recession and 2020 COVID-19 Recession*

The tech sector has been a catalyst of growth and economic recovery during the last two recessions. In 2010, during the Great Recession, ICT represented roughly 5% of Washington's statewide employment. However, between 2010 and 2019 (the post-Great Recession recovery period), ICT net employment increases represented 20% of all statewide covered net employment growth.

Amid the 2020-2021 pandemic and global recession, the ICT sector in Washington added more new jobs in 2020 than it did in 2019 (20,900 new workers, compared with 20,800 in 2019 and 16,000 in 2018). By contrast, statewide employment fell by 180,800 jobs in 2020. While statewide employment contracted 5.3% in 2020, ICT employment *grew* 7.7%.

**Key Takeaway:** Tech provided 20% of Washington state's job growth between the two recessions.

## *Tech Generates Employment and Economic Growth Across the Economy*

The tech sector plays a central role in increasing prosperity across other sectors of the state economy. In 2022, the tech sector was directly associated with an estimated \$99.8 billion in total income, including wage and salary outlays and benefits. Factoring in indirect and induced impacts, **more than 1.5 million jobs** in Washington state can be traced to the ICT sector, or a jobs multiplier of 4.0.

**Key Takeaway:** Washington's tech sector accounts for 1.5 million direct and indirect jobs, and for every one new tech job in the state, three more jobs are created. According to one national study, Washington's tech sector represents 22% of the state economy, higher than any other state in the union.

## *Tech Continues to be a Top Contributor to State Fiscal Revenues*

The tech sector shoulders a disproportionate share of state business taxes. In 2022, the ICT sector directly contributed an estimated \$512.2 million in business and occupation (B&O) taxes to the Washington state budget. The ICT sector's B&O contributions have also grown over time, increasing in real (inflation-adjusted) terms 86% between 2007 and 2022. Factoring in indirect and induced impacts, the tech sector supported \$4.3 billion in state taxes in 2022.

In addition to these taxes, a workforce education investment surcharge (also known as the advanced computing surcharge) of 1.22% is imposed on select advanced computing businesses. In 2021, the surcharge raised more than \$62.0 million in Washington state.

**Key Takeaway:** Factoring indirect and induced impacts, the tech sector in 2022 supported \$4.3 billion in state taxes.

Tech firms also collect and pay sales and use taxes. In 2022, these firms were directly associated with an estimated \$1.1 billion in sales and use taxes, equal to 8% of all statewide sales and use tax collections in 2022. ICT workers spent an estimated \$50.0 billion in personal consumption expenditures in Washington state in 2022. This spending alone supported nearly \$1.5 billion in state sales tax revenues, or \$4,300 per worker in 2022. ICT workers represent 7% of all workers

in Washington state (including covered workers and the self-employed), but 11% of retail sales taxes generated at the state level.

**Key Takeaway:** Through their purchases, tech workers alone provided \$1.5 billion in state sales taxes, or 11% of the state's sales tax revenue.

## *How the Tech Landscape Has Changed After Recent Layoffs*

**The recent layoffs are small relative to the tech sector's net growth.** Over the past several months, several large tech firms have announced sizable layoffs of their companywide and Seattle area staff. For example, Microsoft has since mid-January 2023 submitted notices for four rounds of layoffs in Washington state, affecting 2,901 workers. Amazon released a combined 2,749 workers (including Amazon Health Services), while Meta announced 726 local layoffs in November 2022.

These layoffs represent a small share of companywide layoffs. For example, Meta (parent company of Facebook) laid off 11,000 workers in November 2022; of this total, 726 jobs were in Washington, or less than 7% of all layoffs. Amazon has announced layoffs globally of more than 27,000 workers in late 2022 and 2023; of this, 9% were based in Washington state.

While layoffs incur economic pain on those affected, the scale of layoffs remains small relative to the overall growth in the tech sector in recent years. Announced layoffs equate to 15% of net increased employment across the sector in 2022, and 8% of net job growth since 2019.

Some of the factors driving layoffs include:

- **Reevaluating and recalibrating** business models and lines of business in the post-COVID era.
- **End of low interest rates.** The prolonged period of low interest rates allowed many firms to deploy low-cost capital toward hiring. U.S. Federal Reserve Bank policy during the pandemic ensured that there would be a large supply of money in the economy, which helped drive venture capital investments and company valuations. This was not sustainable, as proven later by rising inflation and Fed policy reversal, driving up interest rates and creating pressure on companies to reduce costs.
- **Some firms hired fast but not great.** Some interviewees pointed to the challenges of rapid, large-scale hiring, which resulted in suboptimal placements. This also resulted in many underemployed workers and challenges of placing them in the highest and best use.

**Ultimately, human capital is the most important asset in tech.** With low interest rates and high demand for tech products and services, many tech firms sought to bolster their ICT workforces. Firms sought to retain workers for fear of future staffing shortages, including offering considerable bonuses, even for underemployed workers. As the accelerated pace of activity eased, some tech firms determined they were overstaffed relative to workforce needs, prompting a correction.

**Key Takeaway:** The recent layoffs, while significant, are small relative to the overall net increase in tech sector employment in Washington state. Reported ICT sector layoffs as of early May 2023 are equivalent to 15% of net job growth in the sector in 2022, bringing statewide ICT jobs back to the same job levels as April 2022. In fact, there remain many unfilled tech positions, and many more are projected over the next decade.

## *Macroeconomic Factors Affecting the Tech Industry*

Interviewees raised three main macroeconomic and structural factors shaping their outlook for the tech sector: 1) interest rates; 2) geopolitical uncertainties; and 3) policy and regulatory issues.

Many interviewees expressed concern over the recent **rise in interest rates** and the impact of higher rates on the cost of borrowing and availability of venture capital. However, some interviewees were more sanguine about higher borrowing costs. Some pointed to the large amount of capital still available in the economy for investment, and the sustained appetite for certain core technologies, such as AI.

**Uncertainty** in the global and national economy has caused some hesitation on the part of investors and tech company executives. Investors, in a climate of high interest rates, have been more conservative in investment decisions. Tech executives have been increasingly reluctant to sign long-term office leases, given—in many cases—reduced office space needs under hybrid work models. Some corporations have, out of concern for growing macro uncertainty, pulled back on procurement, including tech products and services.

**Policy and regulatory Issues.** Several interviewees raised the issue of data privacy and the patchwork system of regulations around this issue. There is no national data privacy law, but some states, such as Connecticut, Colorado, and Virginia have passed state-level versions. The EU has its own regulatory system, called global data privacy regulations (GDPR).

Companies we spoke with emphasized concerns that, with a leveling off of recent tech workforce growth, state policymakers may redirect their focus areas away from tech. Despite recent layoffs, there are still thousands of unfilled science, technology, engineering, and mathematics (STEM) positions at tech firms. Interviewees were concerned the state will divert resources away from investments in fostering growth in the tech sector.

## *The Future Workforce and Office Environment in Washington State and Greater Seattle*

The wide-scale shift from office-based work to remote work during the pandemic may have lasting, long-term implications for the nature of work and commercial real estate in the region. Some firms, such as Zillow, have opted to transition to a nearly completely remote work model. Many others, such as Amazon, are requiring their workers to come into the physical office part of the week. Among many of the businesses we spoke with for this study, the hybrid model was the most common scenario. For many of these firms, the workplace will be reformatted as a collaborative space, with fewer built-out individual offices and workstations. Firms that adopt the hybrid work model are more likely to sublet out part of their existing leased space, adding more commercial real estate inventory to the market (and creating further downward pressure on lease rates). Nonetheless, many young tech workers still strongly desire urban living environments and the opportunities to interact in person with their colleagues. The return to office work for Amazon workers has already activated the Seattle downtown in positive ways.



## *Emerging Technology Trends Over the Next 5-10 years that Washington State and Seattle Should Work to Foster and Grow Locally*

Despite recent workforce reductions, Washington's tech sector is well-positioned to continue to be a global center of innovation. Washington is home to numerous new technologies that will shape the course of human society, manufacturing, clean energy, maritime activities, and healthcare. Some of these technologies highlighted by interviewees for this study include:

- **Generative artificial intelligence (AI).** Interviewees emphasized the role of AI as a “co-pilot” to human workers, helping to increase productivity by setting aside more mundane, routinized tasks to AI algorithms, rather than wholesale substituting for human labor. AI and machine learning (ML) will have profound impacts in areas of healthcare, telecom, and various consumer applications. Microsoft has already launched a new version of Bing that integrates ChatGPT to help users more quickly and seamlessly search and curate information. Zoox autonomous vehicles have been tested in Seattle over the past year without incident. Seattle-based Allen Institute for Artificial Intelligence is a leading source of research into AI and applications across the economy.
- **5G, edge computing, and digital transformation.** Advancements in 5G and edge computing will make it possible for the “internet of things” (IoT) on the factory floor, dramatically reducing latency and allowing machine-to-machine communication. In 2022, Washington-based startups attracted 23 venture capital deals in IoT worth \$116.2 million in new capital. The 5G Open Innovation Lab, based in the Spring District in Bellevue, has been an important nexus bringing together industry and innovators to conduct proof-of-concept testing of novel 5G solutions. In 2022, T-Mobile launched 5G Forward, a series of moves and partnerships focused on accelerating 5G developer innovation. In the space of maritime, a private cellular 5G network is being implemented at the Port of Tacoma, allowing for safer, more secure, and more efficient stevedoring, port-based manufacturing innovation, and as a test hub for new 5G and IoT technologies and solutions.
- **Continued growth of the cloud and Washington's status as one of the world's largest cloud computing hubs.** Washington is the birthplace of cloud computing and home to some of the largest cloud computing services in the world, including Amazon Web Services and Microsoft Azure.
- **Satellite broadband.** Amazon's Project Kuiper includes satellite manufacturing in Kirkland and an engineering hub in Redmond for low earth orbit broadband technology.
- **Healthcare and ICT.** Numerous Washington state firms are collaborating with healthcare providers, using “digital biology” to map RNA, specific proteins, and improve immunotherapy. For example, Microsoft has partnered with the Fred Hutchinson Cancer Research Center to develop a pilot test technology to help cancer patients avoid the emergency room through better management of their chemotherapy side effects. Amazon is an industry leader in the development and deployment of ICT platform-based healthcare solutions, including in telehealth.
- **Maritime sector and ICT.** ICT will be essential to the development of the “Blue Economy.” Washington-based ICT firms are leading the digital transformation of maritime through machine learning-based analytics platforms for vessels and integration of 5G into port operations.

- **Clean Energy, ICT, and commitment to climate action.** ICT solutions in the clean tech and clean energy are extensive, including big data and machine learning, 5G applications for monitoring remote wind turbine facilities, improved mechanical and production efficiencies on the factory floor, and even using drones leveraging 5G to monitor agriculture.

## Table of Contents

Executive Summary .....	i
Introduction .....	1
Background and Purpose.....	1
Methods and Definitions .....	2
Organization of Report .....	3
Tech Sector Statewide Economic and Fiscal Contributions: Updated Analysis for 2022 .....	4
Jobs and Wages .....	4
Tech Occupations and Workers Throughout the Economy.....	10
Economic Impacts of Tech .....	11
Tech’s State Fiscal Contributions .....	13
Interviews with Tech Industry Stakeholders .....	15
Impact of Recent Layoffs on the Tech Sector in the Seattle Region.....	15
Impact of Silicon Valley Bank Failure .....	19
Outlook for the Tech Sector in Washington State and Seattle Region .....	20
Health of the Startup Ecosystem .....	23
Leading Developments, Technologies, and Trends that Will Meaningfully Impact the Tech sector in the Next Ten Years .....	24
Summary and Conclusions .....	27
Sources .....	30
Appendix .....	35
Appendix A. Data Sources.....	35
Appendix B. Comparison with 2015 WTIA Study Economic Impacts.....	35
Appendix C. Economic Impact Analysis .....	36
Appendix D. List of Interviewees .....	37

## INTRODUCTION

### *Background and Purpose*

The information and communication technology (ICT, or “tech”) sector is the largest sector of the Washington state economy. In 2022, ICT firms statewide employed an estimated 324,900 workers, with major concentrations in software publishing, cloud computing, and e-commerce. Tech sector activities drive innovation, wealth generation, economic growth, and state and local tax revenues. In 2021, a report commissioned by the Washington Technology Industry Association (WTIA) found that, during the first year of the pandemic, while the majority of business activity either halted or slowed down significantly, the tech sector accelerated its growth in the region, adding more than 20,000 high-paying jobs. Between the Great Recession (2009-2010) and the COVID-19 pandemic, Washington’s tech sector provided 20% of Washington state’s job growth. Between the lowest point in employment during the Great Recession and 2019, just prior to the pandemic, the tech sector nearly doubled (84% growth), adding 120,100 jobs. By comparison, statewide employment across all other sectors grew by just 19%.

Beyond traditional economic impacts, the tech sector was a critical partner in the state’s efforts to combat COVID-19 throughout the pandemic. Tech firms took the lead in remote work; support for testing, diagnostics, and treatment; solutions to support vaccination drives; and providing solutions for small businesses.

Many tech firms aggressively expanded their workforces during the pandemic to meet surging demand for tech products and services, especially remote work and e-commerce solutions. In recent months, as pandemic disruptions recede and the economy regains its footing, several major tech firms have announced company layoffs, while others have slowed down new hiring. These workforce reductions, while painful for those directly affected, are still small relative to the overall net increase in ICT statewide employment between 2019 and 2022. Moreover, tech solutions developed by Washington state firms—including in 5G, quantum, and edge computing, the cloud, and generative artificial intelligence—will be critical for some of the most important, pressing challenges of the twenty-first century.

The Washington Technology Industry Association has commissioned this study to provide an updated assessment of the state ICT sector, including its recent growth and prospects for further expansion in the near future. This study specifically addresses the following:

- Updated analytics on the size, breadth, and impact of the tech sector to the Washington state economy.
- Recent layoffs and workforce reductions in the tech sector, and long-term implications of these developments.
- Discussion of macroeconomic factors affecting the tech industry, now and in the near future.
- The future of the tech industry and future growth in Washington state.
- The future tech workforce and models of work in the region.
- Implications for commercial real estate with the wide-scale adoption of remote, hybrid work by many tech employers.
- Emerging technology trends over the next 5 to 10 years that industry leaders and stakeholders in Washington state and Seattle should work to foster and support.



Findings will be used to highlight the essential and growing role of the ICT sector and tech roles in non-tech industries in our economy and advocate for policies to support the continued vitality and growth of the sector in Washington state.

## *Methods and Definitions*

### **Data Sources**

This report makes use of multiple data series, published from state, federal, and private vendor sources. Employment, wage, and estimated revenues come from the Washington State Employment Security Department, Washington State Department of Revenue, U.S. Bureau of Labor Statistics, U.S. Economic Census, and U.S. Bureau of Economic Analysis (see **Appendix A** for a summary of these sources). Auxiliary sources include tech sector business financial statements and public filings, reports, and published research. Economic projections draw on existing reports, news articles, forecasts, industry literature, and interviews with thirty-three (33) industry stakeholders in Washington state, including in the Greater Seattle region and Eastern Washington.

The periods defined in this report are: (1) the Great Recession, from 2009-2010; (2) the economic recovery period, from 2010 to 2019; and (3) the pandemic recession, from 2020 to 2022. In some cases, due to incomplete full 2022 data, annual averages were estimated based on the latest available data, such as the first three quarters of 2022.

### **Definition of the Tech Sector**

The tech sector is comprised of internet services and publishing activities, electronic retail, software and computer business services, software publishing, telecommunications, services, and related manufacturing. Business services includes cloud computing, computer training, and various software and computer business consulting. Amazon's activities are split between e-commerce and its cloud computing operations (AWS) under business services, while Microsoft constitutes the largest share of software publishing employment. Industry codes included in this definition are presented in **Exhibit 1** below.

**Exhibit 1. Components of Washington’s ICT Employment**

<b>Subsector</b>	<b>NAICS</b>	<b>Description</b>
Business Services	541511	Custom computer programming services
	541512	Computer systems design services
	541513	Computer facilities management services
	541519	Other computer related services
	611420	Computer training
	811211	Consumer electronics repair and maintenance
	811212	Computer and office machine repair
	811213	Communication equipment repair
	561499	All other business support services
Electronic Retail	45411	Electronic shopping and mail-order houses
	493110	General warehousing and storage
Telecom	517	Tecommunications
Manufacturing	334	Computer and electronic product manufacturing
	333316	Photographic and photocopying equipment mfg.
Internet Services & Publishing	518210	Data processing, hosting and related services
	519130	Internet publishing and web search portals
Software Publishing	5112	Software publishers

*NAICS stands for “North American Industry Classification System.” This NAICS definition is based on the WTIA ICT Economic & Fiscal Impact Study (2015).*

*Note: beginning in 2022, the software publishing NAICS has changed to 513210.<sup>1</sup>*

**Organization of Report**

The remainder of this report is organized as follows:

- **Tech sector statewide economic and fiscal contributions.** Updated analysis for 2022, including jobs, income, business output, and state taxes.
- **Impact of recent developments in the tech sector.** Discussion of recent layoffs, return to office, banking sector events, and other important recent developments.
- **Outlook for the tech sector in Washington state.** Feedback from stakeholders on key areas of growth and emerging technologies in Washington state.
- **Summary and conclusions.** Review of key findings.

<sup>1</sup> Some ICT companies, such as Amazon, have business units classified across more than one NAICS code. For example, Amazon Web Services, Amazon’s cloud computing division, is reported under “business services,” whereas most of its e-commerce operations are classified under “electronic retail.” Amazon’s tech-heavy fulfilment centers are captured under NAICS 493110.

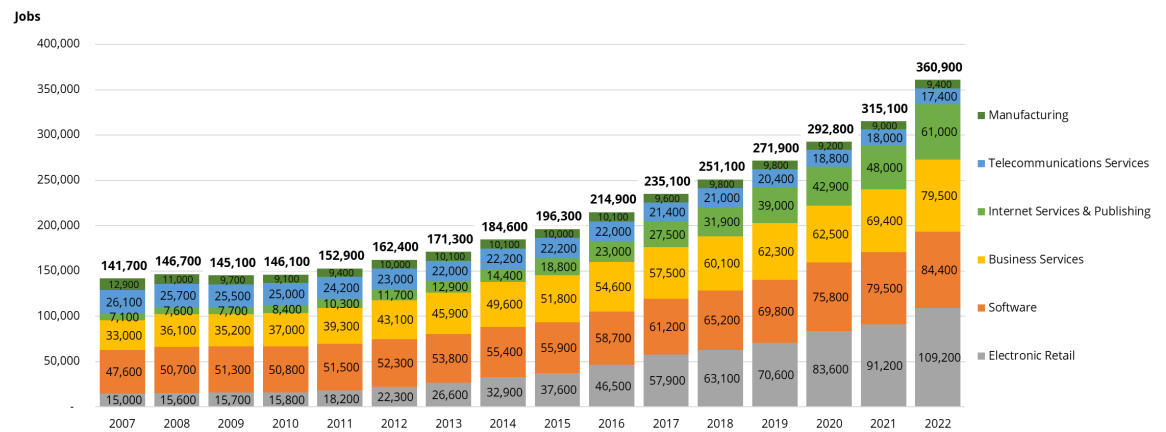
## TECH SECTOR STATEWIDE ECONOMIC AND FISCAL CONTRIBUTIONS: UPDATED ANALYSIS FOR 2022

### Jobs and Wages

By far, the tech sector is the fastest growing sector in Washington state. In 2022, the ICT sector directly employed more than 300,000 workers in Washington state (**Exhibit 2**). Factoring in estimated self-employed workers, the tech sector directly supported **380,300 workers** in Washington state in 2022, or more than a third of a million workers. Between 2019 and 2022, **tech sector employers added 89,000 workers** to their payrolls, a 33% increase. During the depths of the pandemic recession, in 2020, the tech sector added 20,900 jobs, while the remainder of the Washington state economy shed more than 200,000 jobs before rebounding in 2021 and 2022. Among ICT subsectors, only manufacturing and telecommunications experienced a decline in employment between 2019 and 2022 (3,000 and 400 jobs, respectively).

**Key Takeaway:** By far, the tech sector is the fastest growing sector in Washington state, employing more than 380,000 workers in 2022.

**Exhibit 2. Washington ICT Employment, Covered Workers, 2007-2022**



Sources: U.S. Bureau of Labor Statistics (2023a; 2023b); High Peak Strategy LLC (2023).

Note: covered workers refer to workers employed in a business or organization. It often does not include business owners or the self-employed.

The tech sector unquestionably powered Washington’s economy through the past two recessions. Between 2007 and 2019, Washington’s statewide covered employment increased by 17.5% (index value of 117.5), before falling to the equivalent of 11.4% of employment in 2007 in the first year of the pandemic. ICT sector employment is now nearly 154.7% larger than its employment base in 2007, or more than 200% when excluding manufacturing and telecom (**Exhibit 3**). Washington is the largest state for employment in e-commerce jobs, and second largest for software publishing jobs, behind only California (U.S. Bureau of Labor Statistics, 2023a).

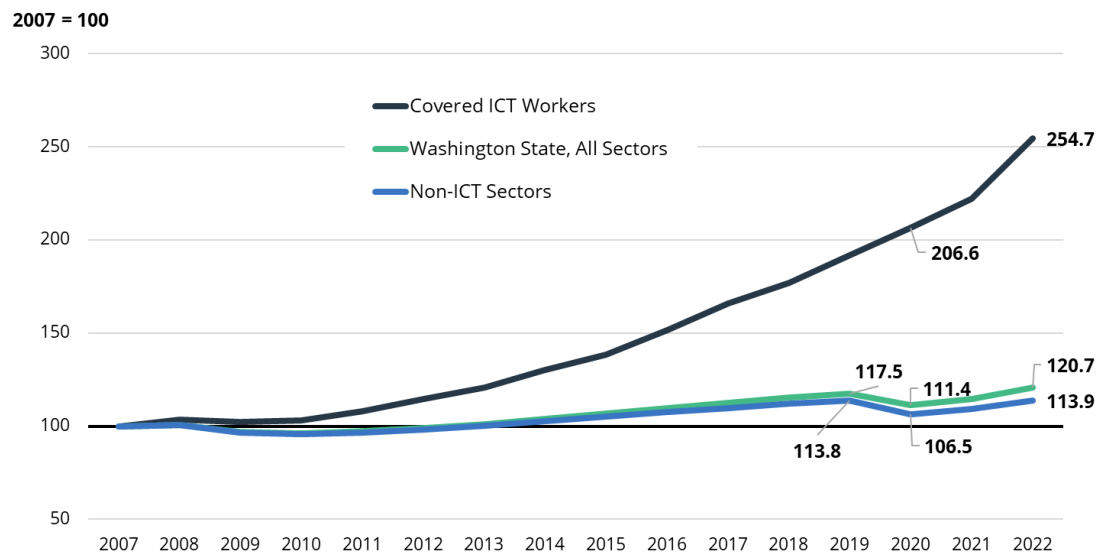
In 2011, the first year of statewide employment recovery following the Great Recession—and beginning a streak of nine straight years of employment growth—statewide employment increased by 1.3%. That same year, tech sector employment grew 4.7%, adding 6,800 jobs. The

ICT sector has experienced uninterrupted annual employment growth for 13 consecutive years. Between 2020 and 2022, the ICT sector employers increased their payrolls in net by 68,100 jobs, equal to 25% of the statewide net increase. In 2020 alone, the tech sector employers added 20,900 jobs, while the statewide employment base contracted by 180,800 jobs.

**Key Takeaway:** The tech sector unquestionably powered Washington’s economy through the past two recessions. Tech sector jobs in Washington state have grown 155% since the Great Recession.

From the low point in employment during the Great Recession (2010) until 2019, just prior to the pandemic, statewide employment across all sectors grew 22%; the tech sector, by comparison, nearly doubled (86% growth) and added 125,800 jobs. In 2010, ICT represented 5% of Washington’s statewide employment. However, between 2010 and 2019 (the post-Great Recession recovery period), ICT net employment increases represented 20% of all statewide covered net employment growth. Between 2009 and 2022, from the Great Recession to last year, the statewide tech sector has added 215,800 jobs, a net increase of 149%. According to the Washington State Economic and Revenue Forecast Council (2023), between 2022 and 2027 employment in the software publishing and e-commerce industries will increase by 5% and 9%, respectively, compared with 4% growth in nonfarm employment for the state overall.

**Exhibit 3. Washington State Overall and Tech Employment, 2007-2022, Indexed to 2007**

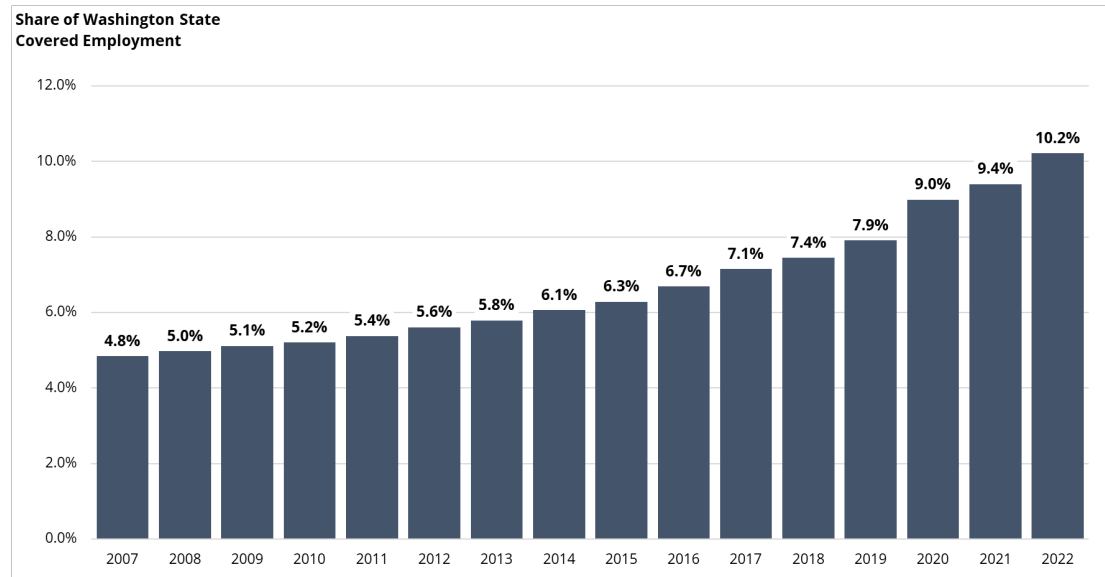


Sources: U.S. Bureau of Labor Statistics (2023a; 2023b).

The tech sector’s role in economic recovery has become much more profound during the latest economic downturn. The tech sector has nearly doubled its share of statewide covered employment, rising from less than 5% in 2007 to more than 10% in 2022 (**Exhibit 4**). The tech sector’s share increased more than one percentage point in 2020 alone, as the sector continued to grow while state overall employment declined due to the pandemic and business closures.



**Exhibit 4. ICT Covered Employment as a Share of Washington State Total Covered Employment, 2007-2022**



Sources: U.S. Bureau of Labor Statistics (2023a; 2023b).

In 2020, the pandemic upended state, national, and even global economies. However, the ICT sector, during this period of upheaval, added 20,900 jobs in Washington state. This compares with a loss of 20,900 manufacturing jobs—including an 8,500 net job loss in aerospace—and net losses of 66,700 jobs in accommodation and food services and 5,800 jobs in construction.

Between 2019 and 2022, tech sector employers added 89,000 jobs; this compares with overall net employment growth economywide in Washington state of 74,800 jobs. The tech sector’s growth over this period (33%) compared with an 8.5% contraction in manufacturing, including -20.5% in aerospace (**Exhibit 5**). Within ICT, the largest employment gains between 2019 and 2022 were in electronic retail (+38,600),<sup>2</sup> internet services & publishing (+22,000), business services (a subsector that includes cloud computing; +17,200), and software (+14,600). Only manufacturing and telecom experienced job losses (**Exhibit 6**).<sup>3</sup>

Many Washington state tech firms have also been key sources of job growth across the United States in 2020 through the pandemic. Amazon hired 175,000 workers in 2020 during the first two months of the pandemic—the largest peacetime worker mobilization in history (Amazon, 2020). Amazon is now the largest private employer in Washington state with 90,000 employees across thousands of diverse job types. More than 16,500 of those workers were new hires in 2020 as part of the statewide response to the COVID-19 pandemic. And those jobs are not just in Seattle. They are in 160 buildings in six counties across the state, which are home to 59% of Washington’s residents.

<sup>2</sup> The vast majority of operations under NAICS code 493110 (“general warehousing and storage”) are tech-heavy Amazon fulfilment centers. Businesses under this NAICS code employed an estimated 30,500 workers in 2022, a 58% increase over 2021.

<sup>3</sup> Estimated 2022 employment based on the percentage increase in covered employment between the first three quarters of 2021 and first three quarters of 2022 (latest available data at time of this analysis).

**Key Takeaway:** Amazon hired 175,000 workers in 2020 during the first two months of the pandemic—the largest peacetime worker mobilization in history.

While much of this growth has occurred among Washington’s largest tech firms, many smaller firms have also been important economic drivers in recent years. By the end of 2022, Washington state was home to 20 privately held companies with a post-fundraising valuation of at least \$1 billion, i.e., “unicorns.” Of these 20 firms, 17 fall within the “information technology” category, led by e-commerce site OfferUp, which raised \$453 million in 2020. Convoy, a machine learning and automation-based digital platform solution for freight logistics, has a valuation of \$3.4 billion and employs more than 1,000 workers; the company raised \$410 million in series E late-stage venture capital financing in April 2022. Examples of other unicorns in the Seattle area include video game studio ProbablyMonsters and sales engagement platform Highspot, each of which raised \$250 million and \$248 million in 2022, respectively (Pitchbook, 2023).

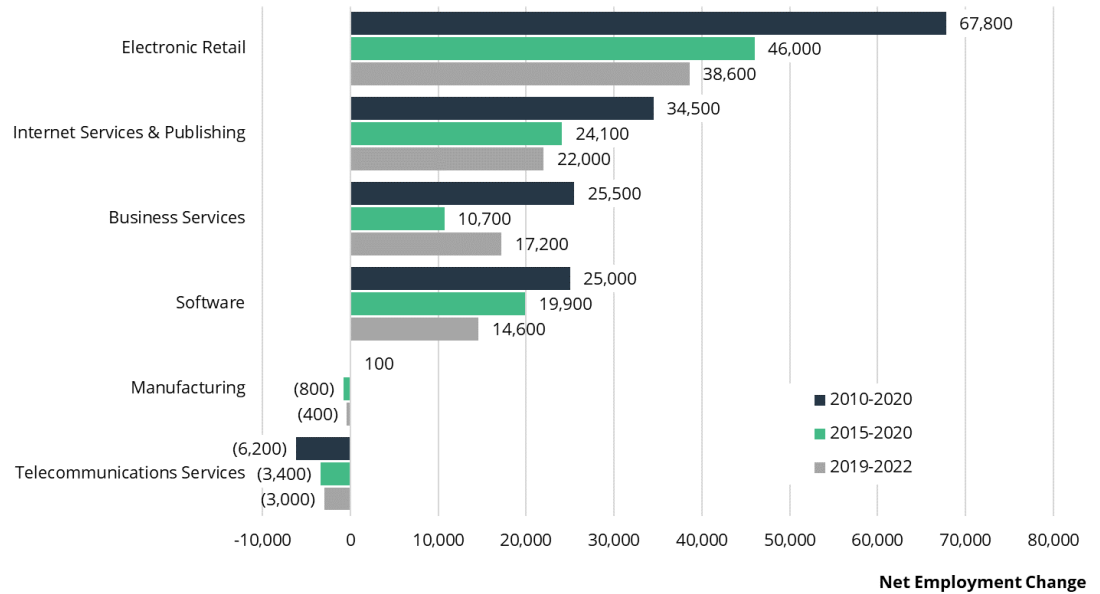
**Exhibit 5. ICT and Leading Sector Covered Employment Change, 2019-2022**

<b>Sector</b>	<b>2019</b>	<b>2022</b>	<b>Net Change</b>	<b>Percentage Change</b>
Manufacturing*	295,500	270,300	(25,200)	-8.5%
<i>Aerospace</i>	88,500	70,400	(18,100)	-20.5%
<i>Ship and Boat Building</i>	19,300	18,500	(800)	-4.1%
<i>Food and beverage processing</i>	49,500	51,300	1,800	3.6%
Construction	206,200	220,800	14,600	7.1%
Healthcare and social assistance	488,200	497,800	9,600	2.0%
Agriculture, forestry, fishing and hunting	103,300	94,700	(8,600)	-8.3%
Real estate and rental and leasing	58,100	60,500	2,400	4.1%
Accommodation and food services	288,600	280,300	(8,300)	-2.9%
<b>ICT</b>	<b>271,900</b>	<b>360,900</b>	<b>89,000</b>	<b>32.7%</b>
Statewide, all sectors	3,439,200	3,514,000	74,800	2.2%

Sources: U.S. Bureau of Labor Statistics (2023a; 2023b).

\*Manufacturing excludes activities captured under “ICT.”

**Exhibit 6. ICT Employment Net Growth by Subsector, 2010-2020, 2015-2020, and 2019-2022**

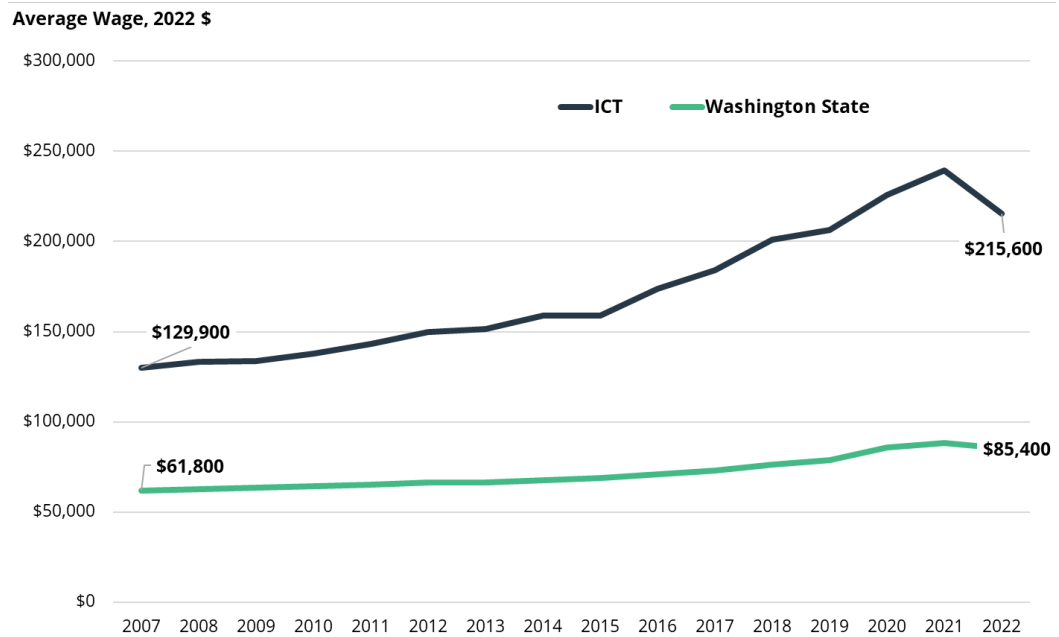


Sources: U.S. Bureau of Labor Statistics (2023a; 2023b).

Tech sector employment on average provides a much higher level of compensation compared with other sectors of the economy. For example, in 2022 the estimated average wage, before benefits (e.g., monetary value of healthcare) in the tech sector was \$215,600, 152% higher than the statewide average wage of \$85,400 (Exhibit 7).<sup>4</sup>

<sup>4</sup> Tech sector estimated average wages in 2022 were level with 2021, but in real terms declined due to the effects of high inflation.

**Exhibit 7. ICT and Washington State Average Wage, 2022 \$**



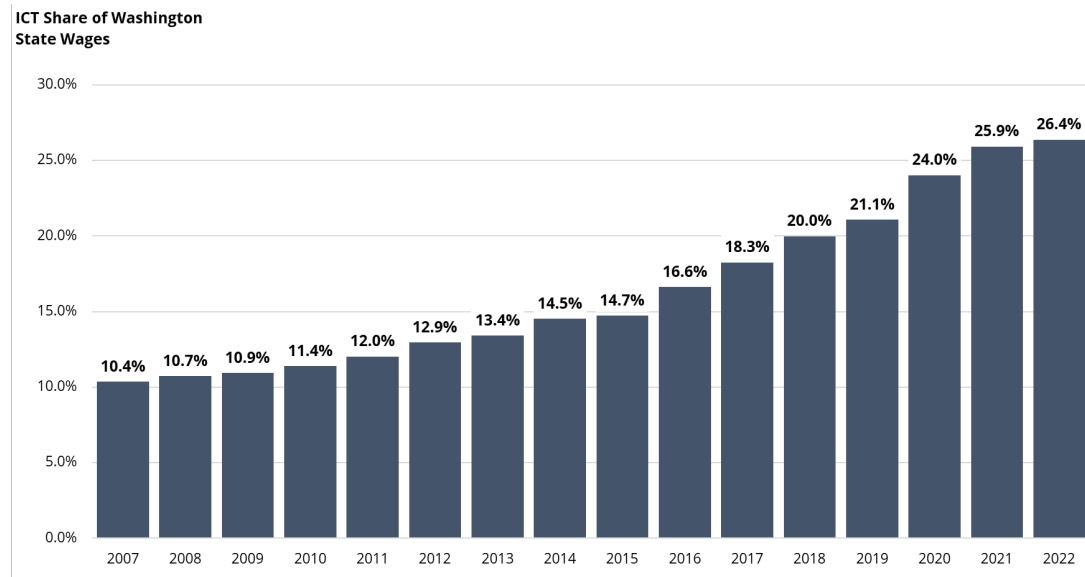
Sources: U.S. Bureau of Labor Statistics (2023a; 2023b); U.S. Bureau of Economic Analysis (2023).

The tech sector’s share of Washington’s statewide wages has likewise increased, from 10% in 2007 to more than a quarter (26%) in 2022, including a large jump in 2020 (**Exhibit 8**). Put differently, during the period of post-Great Recession economic expansion, from 2010 and 2019, the tech sector represented 34% of statewide wage and salary disbursements growth.

According to a recent nationwide report by CompTIA, Washington’s tech sector represents 22% of the statewide economy, the highest among all states in the union. Based on data from the same study, which uses a slightly different methodology, **Washington state ranked first in the entire United States for share its covered employment base directly employed in the tech sector, at 10%**, ahead of Virginia, Massachusetts, Colorado, New Hampshire, Maryland, and California (CompTIA, 2023; U.S. Bureau of Labor Statistics, 2023a)

Between 2015 and 2020, the sector was responsible for 46% of all wage and salary growth and 71% of net job growth (**Exhibit 9**). Between 2010 and 2022, in inflation-adjusted terms, tech sector wages increased by \$58.6 billion, whereas wages amongst the rest of the economy grew by \$62.8 billion. Between 2020 and 2022, tech sector real wages, before benefits, grew 18%, compared with 8% for the statewide economy overall (U.S. Bureau of Labor Statistics, 2023a; U.S. Bureau of Economic Analysis, 2023).

**Exhibit 8. ICT’s Share of Washington State Wage & Salary Disbursements, 2007-2022**



Source: U.S. Bureau of Labor Statistics (2023a).

**Exhibit 9. ICT’s Share of Washington State Net Growth in Wage & Salary Disbursements and Employment**

Period	Tech sector share of net wage growth	Tech sector share of net job growth
2010-2015	26%	16%
2015-2020	46%	71%
2020-2022	37%	27%

Source: U.S. Bureau of Labor Statistics (2023a).

All this data clearly demonstrates that a primary driver of Washington state’s booming economy is the tech sector, and the state’s recovery from the past two recessions would have been much weaker in the absence of tech sector growth. Excluding the tech sector, employment in the rest of the Washington state economy grew 19% between 2010 and 2019, just prior to the pandemic. Without the tech sector, growth would be much closer to North Dakota. During the 2020-2022 period, Washington’s employment base grew 7.8%, but just 6.1% sans the tech sector grew, or more than 1.5 percentage points lower.

**Key Takeaway:** Washington owes its booming economy to the tech sector, and without tech the state’s recovery from the past two recessions would have looked more like North Dakota.

*Tech Occupations and Workers Throughout the Economy*

ICT occupations include software developers, computer scientists, electrical engineers, and web developers. In total, there are 15 specific occupations identified as ICT occupations (**Exhibit 10**). Statewide, across all sectors, in 2022 there were an estimated 250,700 covered workers employed in ICT occupations, of which nearly half (123,100) were software developers. These jobs exist both within the tech sector and in other, non-tech sectors of the economy, such as

aerospace, healthcare, and retail. ICT occupations economywide are projected to grow 2.5% per year between 2022 and 2030. **By comparison, all other occupations in the statewide economy are projected to a whole percentage point less, at 1.5% per year.**

**Exhibit 10. ICT Occupations, Statewide, 2022 and Projected through 2030**

Occupation	Count, 2022	Inside ICT, 2022	Outside ICT, 2022	Projected Growth	
				All sectors, annual, '22-'30	
Software Developers	123,100	96,400	26,700		2.2%
Computer Systems Analysts	21,800	12,700	9,100		2.6%
Web Developers	20,300	16,600	3,700		2.7%
Computer User Support Specialists	18,800	9,800	9,000		2.4%
Computer and Information Systems Managers	17,800	10,000	7,800		1.9%
Computer Occupations, All Other	12,000	6,500	5,500		5.4%
Network and Computer Systems Administrators	8,500	3,400	5,100		3.1%
Electrical Engineers	6,500	900	5,600		1.3%
Computer Network Architects	4,100	2,800	1,300		2.0%
Computer Network Support Specialists	3,600	2,300	1,300		3.2%
Information Security Analysts	4,200	2,600	1,600		2.8%
Database Administrators	3,300	1,700	1,600		3.2%
Operations Research Analysts	2,200	1,000	1,200		5.3%
Computer and Information Research Scientists	2,500	2,100	400		4.6%
Computer Hardware Engineers	2,000	1,800	200		3.2%
<b>Total</b>	<b>250,700</b>	<b>170,600</b>	<b>80,100</b>		<b>2.5%</b>
<b>Non-ICT occupations</b>					<b>1.5%</b>

Sources: U.S. Bureau of Labor Statistics (2023a); Washington State Employment Security Department (2022; 2023); Washington Technology Industry Association (2021).

Some of the largest sectors outside ICT for ICT-specific occupations (listed above) include management of companies and enterprises (23,300 ICT workers), aerospace (6,200), and management, scientific, and technical consulting services (5,500 workers). There were nearly 2,200 ICT workers employed in freight, logistics, and transportation operations in 2020.

In addition to ICT sector-based firms and operations, there are divisions and units within non-tech firms that develop ICT-based solutions. For example, units within large companies such as Boeing and Starbucks that develop in-house software solutions or consumer apps.

Tech units are estimated based on the number of so-called ICT core occupations, defined in the 2015 WTIA economic impact report (2015, p. 17). Tech units include these occupations plus estimated additional non-ICT workers—such as accountants and administrative staff—whose labor is tied to the in-house production of ICT products and services. These jobs represent additional tech employment outside the ICT sector. These operations, referred to as “tech units,” employed an estimated **87,200 workers** in 2022, up from an estimated 75,700 workers in 2020.

***Economic Impacts of Tech***

The tech sector plays a central role in increasing prosperity across other sectors of the state economy. These broader impacts, referred to as “economic impacts,” include jobs, income, and revenues supported through direct activities of the tech sector, as well as secondary impacts, which are comprised of indirect and induced impacts. Indirect impacts refer to additional jobs, income, and revenues supported through upstream business-to-business transactions, such as supplies purchased by tech firms from other Washington state businesses. Induced impacts represent further economic activities supported through tech workers and workers employed among suppliers who spend earned income on household goods and services. These include

spending on groceries, gasoline, take-out, entertainment, appliances, and various other household expenditures.

In 2022, the ICT sector was directly associated with an estimated 380,300 workers and \$99.8 billion in total income, including wage and salary outlays and benefits. This higher employment count (349,900 versus 324,900) represents both workers employed in ICT firms (i.e., covered employment) and estimated additional business owners and sole proprietors.<sup>5</sup>

Factoring in indirect and induced impacts, **more than 1.5 million jobs** in Washington state can be traced to the ICT sector (**Exhibit 11**).

**Exhibit 11. Total Statewide Economic Impacts of the ICT Sector, Washington State, 2022**

	Direct	Indirect	Induced	Total
Employment	380,300	262,000	879,700	1,522,000
Labor Income (mils \$)	\$99,780.2	\$19,347.2	\$56,247.5	\$175,374.9
Output (mils \$)	\$168,430.2	\$58,564.2	\$157,672.7	\$384,667.1

Source: Washington State Office of Financial Management (2022).

The primary driver of this large impact is the much higher wages ICT workers earn relative to other sectors of the economy. A large share of these earnings is then spent on various household goods and services across the state economy. Each direct job in the ICT sector is associated with a total of 4.0 jobs across the state economy.<sup>6</sup> Put differently, total jobs traced to the tech sector (1.5 million) through multiplier effects is equal to 30% of total employment in Washington state, including covered and self-employed workers. By comparison, the jobs multiplier in 2022 was 2.4 for aerospace and 3.3 for credit intermediation (**Exhibit 12**).<sup>7</sup> The ICT sector has the highest jobs multiplier of any major sector of the state economy.

<sup>5</sup> Business owners who include themselves in payroll are accounted for under covered employment.

<sup>6</sup> The most recent (2012) Washington State Input-Output Model estimates a jobs multiplier of 4.7 for the I-O model sector “Software Publishers, Data Processing & Internet Service Providers” (Roberts & Beyers, 2021, p. 17). The ICT jobs multiplier is slightly lower due to the presence of other activities, such as ICT-related manufacturing, telecommunications, and various computer systems design and support services. The jobs multiplier for “sector “Software Publishers, Data Processing & Internet Service Providers” is also significantly higher than estimated in the prior Washington State Input-Output Model (3.96 total jobs per direct job), benchmarked to year 2007 (Beyers & Lin, 2012, p. 18).

<sup>7</sup> The jobs multiplier for ICT reported in the 2015 WTIA study was 3.7. The 14% increase in the size of the jobs multiplier, in addition to the higher jobs multiplier for software publishing in the 2012 Washington State Input-Output Model, is the rapid growth in wages relative to the rest of the state economy. Between 2013 (study year for the 2015 report) and 2019 (just prior to the pandemic), the statewide average wage grew in real (inflation-adjusted) terms 19%, whereas the ICT average wage growth was nearly double, at 36%.

**Exhibit 12. Jobs Multipliers for Select Sectors, Washington State, 2022**

<b>Sector</b>	<b>Jobs Multiplier</b>
Credit Intermediation and Related Activities	3.3
Wood Product Manufacturing	3.3
Ship and Boat Building	3.2
Highway, Street and Bridge Construction	3.0
Air Transportation	2.8
Aircraft and Parts Manufacturing	2.4
Truck Transportation	2.0
<b>ICT</b>	<b>4.0</b>

Sources: Washington State Office of Financial Management (2022); High Peak Strategy (2021).

**Key Takeaway:** Washington’s tech sector accounts for nearly 1.5 million direct and indirect jobs. Each job in the tech sector is associated with four jobs across the state economy. According to one national study, Washington’s tech sector represents 22% of the state economy, higher than any other state in the union.

*Tech’s State Fiscal Contributions*

Tech sector firms support state fiscal revenues through direct company operations, ICT workers who purchase goods and services in Washington state, and additional taxable economic activities supported indirect and induced effects. We summarize each of these fiscal impacts below.

**Direct State Tax Payments**

The tech sector shoulders a disproportionate share of state business taxes. In 2022, the ICT sector directly contributed an estimated \$512.2 million in business and occupation (B&O) taxes to the Washington state budget. The ICT sector’s B&O contributions have also grown over time, increasing in real (inflation-adjusted) terms 86% between 2007 and 2022 (**Exhibit 13**). By comparison, the aerospace sector contributed an estimated \$133.1 million in 2022. ICT B&O payments grew at more than double the rate of aerospace between 2007 and 2022. In addition to these taxes, a **workforce education investment surcharge** (also known as the advanced computing surcharge) of 1.22% is imposed on select advanced computing businesses. In 2021, the surcharge raised more than **\$62.0 million** in Washington state.<sup>8</sup>

**Key Takeaway:** Washington’s tech sector generated state B&O tax payments nearly four times those of aerospace in 2022.

Tech firms also collect and pay sales and use taxes. In 2022, these firms were directly associated with an estimated \$1.1 billion in sales and use taxes, equal to 8% of all statewide sales and use

<sup>8</sup> This surcharge applies to the taxable amounts subject to the service and other activities business and occupation (B&O) tax and is in addition to the service and other activities B&O tax. The amount of workforce education investment surcharge paid by all members of an affiliated group is capped at \$9 million per calendar year. Hospitals and provider clinics are exempt from the workforce education investment surcharge (Washington State Department of Revenue, 2022).

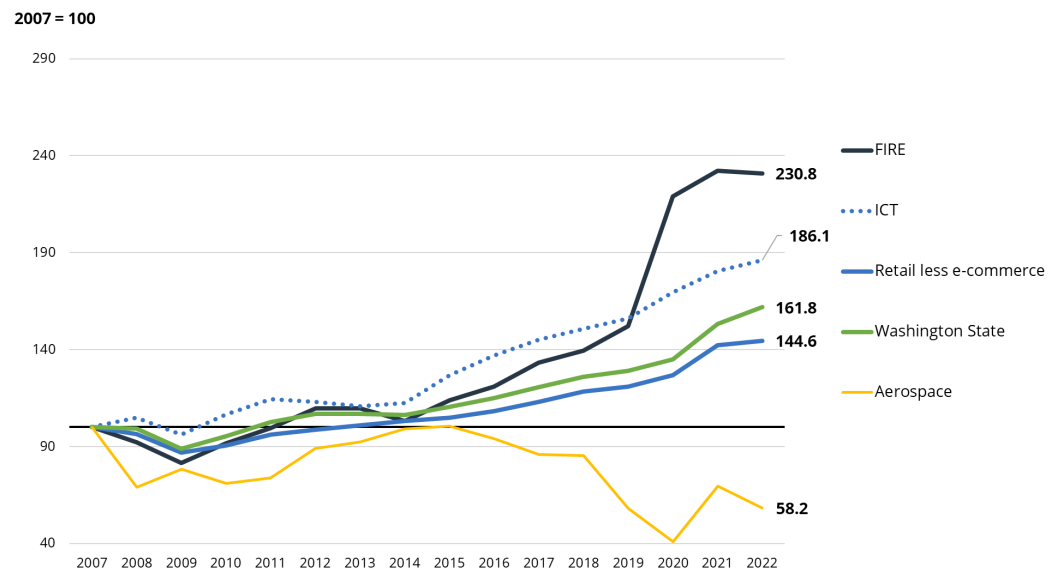


tax collections in 2022.<sup>9</sup> Tech firms contribute to state and local tax revenues through various other direct taxes, most notably property taxes. No statewide data on tech payments for these taxes is available, but some information is made available through news reports.

The tech sector has made enormous capital investments in rural Washington by building data centers, spurring property tax revenues. Data centers are the critical infrastructure necessary to provide cloud and online services to businesses, government agencies, and private consumers. Rural Washington is home to the largest concentration of data centers in the state. Between 2017 and 2021, qualifying data centers using Washington’s economic development program have paid \$334 million in taxes to the state and to various local jurisdictions, including \$238.5 million in state revenue, \$95.4 million in local taxes that support counties cities, schools, transit, libraries, hospitals and fire, and other vital public services. In Grant County alone, data center real and personal property taxes have increased to over 20% of the county’s property tax revenue (Washington Technology Industry Association, 2022).

**Key Takeaway:** Tech sector data centers in rural Washington contributed \$334M in state and local taxes between 2017 and 2021.

**Exhibit 13. B&O Tax Payments by Sector and Statewide, Adjusted for Inflation, Indexed to 2007, Washington State**



Sources: Washington State Department of Revenue (2023); U.S. Bureau of Economic Analysis (2023).  
 FIRE = “Finance, Insurance, and Real Estate.”  
 Note: sectors chosen based on largest contributors to state B&O tax in 2019.

ICT workers spent an estimated \$50.0 billion in personal consumption expenditures in Washington state in 2022. This spending alone supported nearly \$1.5 billion in state sales tax revenues, or \$4,300 per worker in 2022. ICT workers represent 7% of all workers in Washington

<sup>9</sup> At the time of writing, state sales & use tax revenues were not yet available for all of calendar 2022. To estimate an annual total, we took the average between fiscal year 2022 and projected total sales & use tax for fiscal year 2023, which ends in June 2023, reported by the Washington State Economic and Revenue Forecast Council (2023).

state (including covered workers and the self-employed), but 11% of retail sales taxes generated at the state level.<sup>10</sup>

**Key Takeaway:** Through their purchases, tech workers alone provided \$1.5 billion in state sales taxes, or 11% of the state's sales tax revenue.

In 2021 (latest data available), each job (covered and self-employed) in Washington state was associated with 1.7 residents. This ratio would imply that ICT workers were associated with 596,200 residents in 2022, or nearly 8% of the state's total population (Washington State Office of Financial Management, 2023; U.S. Bureau of Economic Analysis, 2023). ICT workers' household spending and associated sales taxes are disproportionate relative to their share of the workforce and population.<sup>11</sup>

#### **Total State Fiscal Impacts**

Factoring additional statewide economic activity through indirect and induced effects, the tech sector in 2022 supported \$4.3 billion in state taxes, including \$2.7 billion in sales and use tax and \$1.4 billion in B&O taxes.

**Key Takeaway:** Factoring indirect and induced impacts, the tech sector in 2022 supported \$4.3 billion in state taxes.

## **INTERVIEWS WITH TECH INDUSTRY STAKEHOLDERS**

We spoke with 33 individuals for this project (**Appendix D**). Our discussions were expansive, ranging from the recent trends and developments in the sector to long-term outlooks and the technologies that will drive future growth in the region. This section summarizes key takeaways from these discussions. We also introduce additional data and information to further expand on these findings.

### *Impact of Recent Layoffs on the Tech Sector in the Seattle Region*

Over the past several months, several large tech firms have announced sizable layoffs of their companywide and Seattle area staff. For example, Microsoft has since mid-January 2023 submitted notices for four rounds of layoffs in Washington state, affecting 2,901 workers. Amazon released a combined 2,749 workers (including Amazon Health Services), while Meta, parent company of Facebook, WhatsApp, and Instagram, announced 726 layoffs in November 2022 (**Exhibit 14**).

Software publishing jobs, seasonally adjusted, as of March 2023 totaled 72,500, down from a recent peak in June 2022 of 77,800, or decline of 5,300 jobs. Part of this decline is attributable to layoffs, while some firms may also be reducing new hiring. Firms classified as "computer systems design and related services," which includes many cloud computing activities, as of February employed 62,800, 400 more workers than in November 2022 (**Exhibit 15**).

<sup>10</sup> The difference between ICT and non-ICT workers based on retail sales revenues is even greater, given that a share of state sales tax revenues is generated by spending among non-Washington workers and outside residents.

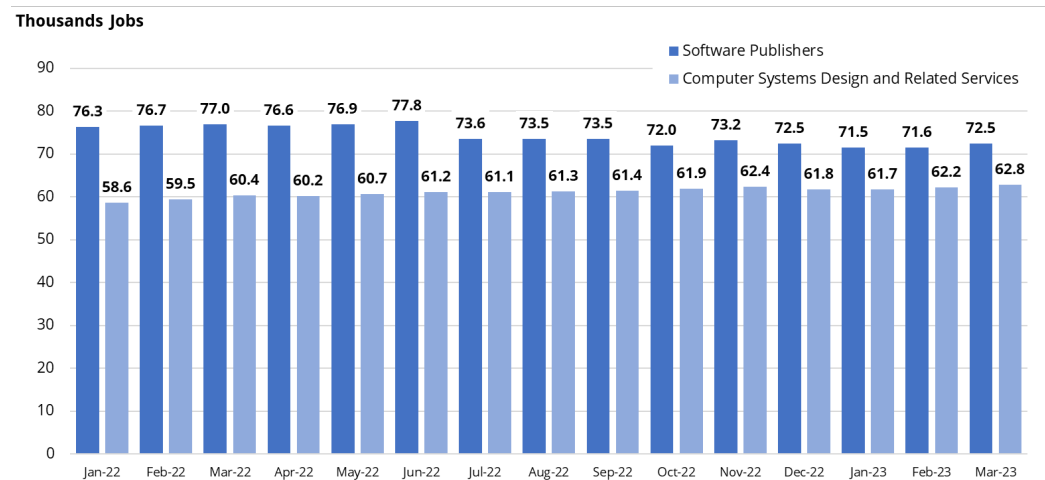
<sup>11</sup> During the last economic expansion, from 2010 to 2019, statewide sales tax revenues increased by more than \$5.2 billion, whilst wages grew by \$103.1 billion.

**Exhibit 14. Recent Tech Layoff Announcements in the Seattle Region**

Company	Date Reported to State	Effective Date	Type	Workers
Microsoft	3/27/2023	5/26/2023	Layoff	559
Blue Nile, Inc.	3/23/2023	7/14/2023	Closure	119
Microsoft	3/6/2023	5/5/2023	Layoff	689
Microsoft	2/9/2023	4/10/2023	Layoff	617
Bittrex, Inc.	2/1/2023	4/2/2023	Layoff	83
Microsoft	1/18/2023	3/20/2023	Layoff	878
Amazon	1/18/2023	3/19/2023	Layoff	2,320
Meta Platforms, Inc	11/11/2022	1/13/2023	Layoff	307
Meta Platforms, Inc	11/11/2022	1/13/2023	Layoff	419
Twitter, Inc	11/4/2022	1/4/2023	Layoff	257
Compass, Inc	9/21/2022	11/19/2022	Layoff	271
Amazon Health Services	9/7/2022	12/1/2022	Closure	159
Microsoft	5/9/2023	5/26/2023	Layoff	158
<b>Total</b>				<b>6,836</b>

Source: Washington State Employment Security Department (2023).<sup>12</sup>

**Exhibit 15. Monthly Employment in Select ICT Activities, January 2022 to March 2023, Seasonally Adjusted, Seattle Metropolitan Statistical Area**



Source: Washington State Employment Security Department (2023).

Not all layoffs are reported to Washington State Employment Security Department (ESD). In some cases, while the layoffs are significant, the local, in-state impact is less than 100 workers, and are thus not required to be reported to ESD.

For example, security and cloud management firm **F5** recently announced it would let go of 9% of its workforce, or 623 workers. According to the company’s CEO, "rising interest rates, geopolitical events, and macroeconomic uncertainty have dramatically affected [customer] spending patterns" (Reuters, 2023). In the summer of 2022, trucking analytics firm **Convoy** let

<sup>12</sup> Generally, the WARN Act requires companies with 100 or more employees to notify affected workers 60 days prior to closures and layoffs. ICT firms with less than 100 employees may thus not be represented in this data.

go of 7% of its workforce, or 90 workers (Schlosser & Soper, 2022). Bellevue-based telecom company **T-Mobile** announced layoffs to network operations and engineering group in 2022 (Schlosser, 2022). Seattle online cannabis marketplace **Leafly** announced in October 2022 layoffs for 56 workers, or 21% of its workforce (Schlosser, 2022). Online learning software company **DreamBox**, which specializes in K-12 education products, announced in September 2022 it would lay off an undisclosed number of workers (Schlosser, 2022). Salesforce, which in 2019 acquired Seattle-based Tableau, announced it will be reducing its Seattle area real estate footprint as part of larger cost-cutting measures, including a 10% companywide workforce reduction (Roberts & Geraldo, 2023; Geraldo, 2023).

It is important to note that while many large tech firms have undergone sizable layoffs, **the majority of these reductions have occurred outside Washington state**. For example, Meta (parent company of Facebook) laid off 11,000 workers in November 2022; of this total, 726 jobs were in Washington, or less than 7% of all layoffs. The company has more recently announced plans for additional companywide layoffs of 10,000 workers (Thorbecke, 2023), but has not announced specific layoffs in Washington. Amazon has announced layoffs globally of more than 27,000 workers in late 2022 and 2023 (Clark M. , 2023); of this, 9%, or 2,479 workers, were based in Washington state. Microsoft in January 2023 announced plans to reduce its global workforce by 4.5%, or roughly 10,000 workers. Of these separations, less than 30% have occurred in Washington state (Sawers, 2023). Microsoft's reductions will likely drop its ranking from second to third largest private sector employer in Washington state, behind Amazon and The Boeing Company (Halverson, 2023).

#### **Layoffs Small Relative to Overall Tech Sector Employment Growth**

While layoffs incur economic pain on those affected, the scale of layoffs remains small relative to the overall growth in the tech sector in recent years. Announced layoffs equate to 15% of net increased employment across the sector in 2022, and 8% of net job growth since 2019. Not all layoffs and workforce reductions are publicly reported. If we scale available layoff announcements and workforce reductions by 100% to capture other ICT firms across the state, the net reduction in jobs through May 2023 would still place ICT covered employment at a level above all of 2021, 19% higher than covered in 2020, and 28% above levels in 2019.<sup>13</sup>

**Key Takeaway:** Reported ICT sector layoffs as of early May 2023 are equivalent to 15% of net job growth in the sector in 2022, bringing statewide ICT jobs back to the same job levels as April 2022.

According to multiple interviewees for this study, the layoffs are viewed as a partial correction or "Great Reset" to some over-hiring during the pandemic years. During the deepest throes of the pandemic, there was a significant surge in demand for ICT products and services, especially in virtual meeting platforms, cloud computing, and online sales that accommodated remote work and shifts in household consumption. As workers return to full in-office or hybrid work models, there will likely be some decline in these services and solutions going forward. Companies have been reducing some of their recent net increases in labor to reflect these

<sup>13</sup> More recent monthly employment data is only available for some, but not all, ICT sectors. As of March 2023, the combined seasonally adjusted employment among sectors with available data (e.g., software publishing, computer systems design and related services, and computer and electronic product manufacturing) summed to 182,700 jobs statewide, or a little more than half of the entire ICT sector. March 2023 employment for this combined group of available industries was just 300 below a recent peak in November 2022.

changes. According to interviewees, one of the largest areas of workforce reduction has been in human resources. As firms cut back on hiring, there is a reduced need for staff whose primary work entails reviewing and vetting candidates.

Despite these changes, the tech sector remains very healthy, especially among its largest companies. For example, Microsoft generated a record \$198 billion in revenue and \$83 billion in operating income in fiscal year 2022 (Microsoft Corporation, 2022). Amazon's recent layoffs, while nonetheless painful to those directly impacted, are small relative to the company's historic net job growth over a very short period.

Prior to the pandemic, in 2019 Amazon's headcount took 25 years to reach, but then doubled in just two-years in response to surging demand for e-commerce and cloud computing; the 175,000 new hires companywide represent the largest ever peacetime worker mobilization by one company. In Q1 2023, Amazon employed approximately 90,000 workers in Washington state, making it the largest private sector employer in the state. Moreover, while Amazon has reduced its overall workforce in other states between the end of 2021 and early 2023 (e.g., 8,000 job reduction in California, 12,000 in New Jersey, and 10,000 in Florida), its employment base in Washington actually grew by 5,000 jobs above its job level in late 2021 (Bishop, 2023).

**Key Takeaway:** Despite recent layoffs at Amazon, much of that occurred in other states, and its employment base in Washington state actually grew by 5,000 jobs since 2021.

Layoffs may also ease pressure on startups looking for talent in the Seattle region. During the rapid hiring over the past three years, many tech startups were unable to compete on compensation with large tech firms for similar talent, spurring many to look outside the region or hire workers with nontraditional tech educational backgrounds. According to one founder, the recent easing in the labor market for tech workers offers a chance to compete for lots of great talent (though worker expectations for compensation remain elevated).

Despite the recent layoffs, there are still significant demand for skilled ICT workers. According to Code.org, there are currently nearly 11,000 open computing jobs in Washington state (Code.org, 2023). The Washington State Employment Security Department projects there will be an average of 89,300 jobs openings—from net growth and turnover—among computer and mathematical occupations in Washington state between 2025 and 2030 (Washington State Employment Security Department, 2022).

**Key Takeaway:** The recent layoffs, while significant, are small relative to the overall net increase in tech sector employment in Washington state and there is a continued need to build a skilled tech workforce to fill thousands of job openings.

### **Factors Driving Layoffs**

We spoke with more than 30 individuals on the scope, impact, and reasons behind recent layoffs. Many expressed the view that layoffs are a modest “course correction” from the rapid surge in hiring during the pandemic. Rising interest rates, some drop in demand for select platforms and services as a large share of the workforce returns (at least partially) to the office, and economic uncertainty have all contributed to tech sector workforce reductions. Some firms are following the lead of large tech companies, choosing this moment to reduce less profitable lines of business and excess labor they no longer need. Feedback from interviewees on the factors behind layoffs is summarized below:

- **The Great “Reset.”** Many tech companies—especially larger ones—went through a rapid hiring phase to keep up with demand for tech solutions, products, and services during the pandemic. Some of these firms now have a large surplus of labor. Compared to the 2019 employment numbers, these firms are still much larger, even after the layoffs. Some large tech companies, such as Apple, while still growing during the pandemic, did not carry out a rapid, large-scale ramp-up in hiring and have not announced large company layoffs. Apple was able to, until just recently, avoid layoffs; layoffs that will occur have been characterized as small (Clark M. , 2023).
- **Low interest rates.** The prolonged period of low interest rates allowed many firms to deploy low-cost capital toward hiring. U.S. Federal Reserve Bank policy during the pandemic ensured that there would be a large supply of money in the economy, which helped drive venture capital investments and company valuations. This was not sustainable, as proven later by rising inflation and Fed policy reversal, driving up interest rates.
- **Some firms hired fast but not great.** Some interviewees pointed to the challenges of rapid, large-scale hiring, which resulted in suboptimal placements. This also resulted in many underemployed workers and challenges of placing them in the highest and best use.
- **Opportunity to let go of unproductive workers.** Many tech firms needed to shed unproductive workers. Rising interest rates and reduced valuations helped accomplish this by providing a near-present reason for workforce reductions.
- **Reevaluating and recalibrating business models and lines of business.** For some tech firms, layoffs reflect a reevaluating—and recalibrating—of business models and lines of business during the pandemic. Zillow, for example, wound down its Zillow Offers business line in late 2021, resulting in the layoffs of roughly a quarter of their companywide workforce (Zillow Group, 2023).
- **Ultimately, human capital is the most important asset in tech.** Workers with advanced computer and mathematical skills are essential for the continuous innovation that defines and drives the tech sector. With low interest rates and high demand for tech products and services, many tech firms sought to bolster their ICT workforces. Firms oftentimes retained and expanded their workforces for fear of future staffing shortages, including offering considerable bonuses, even for underemployed workers.

### *Impact of Silicon Valley Bank Failure*

Prior to its collapse, Silicon Valley Bank (SVB) provided banking services to nearly half of all U.S. venture capital-backed startups (Bhaimiya, 2023; Allyn, 2023). The bank failure, brought on by rising interest rates and poor portfolio management, spurred widespread concerns about depositors’ ability to cover payroll and near-term operating costs. Hundreds of Washington state firms, including startups and venture capital funds, banked with Silicon Valley Bank and were directly impacted by the turmoil, though the federal government’s rapid response to secure depositors appears to have quelled the risks of broader financial contagion (Bishop, 2023). Among the firms we spoke with, banking concerns were ultimately resolved.

However, to many interviewees, the bigger concern was the loss of an institution that played an outsized role in supporting startups—including in the Greater Seattle region—beyond direct financing. Many venture capital (VC) firms in the Pacific Northwest enjoyed a close working relationship with Silicon Valley Bank. The bank, through these longstanding relationships built on trust, was often able to rely on the due diligence of its VC partners to extend a line of credit

or loan (and often at or near parity with major banks) to VC-backed startups and was thus a key node in the startup ecosystem.<sup>14</sup>

The bank also provided various advisory services to startups. According to one interviewee, the bank was a “lubricant” in the gears of the startup ecosystem. It provided introductions, fostering networking within the community, and was willing to invest the time in startups when most other institutions would not. One interviewee described SVB as “talking the language” of tech startups in ways traditional banks do not, such as in areas of software-as-a-service (SaaS) business models and patents and intellectual property.

Most firms have since migrated their deposits to other financial institutions, though it is unclear whether they will be able to continue to enjoy the same level of service as they received from SVB. According to several interviewees, larger banks that fill this void in VC-backed debt will likely be more conservative than SVB.

### *Outlook for the Tech Sector in Washington State and Seattle Region*

Washington state is well positioned for continued growth as a global leader in the tech sector. According to recent report by CompTIA (2023), **Washington’s tech sector workforce, despite recent layoffs, is projected to growth 3.9% in 2023**, the second fastest rate of growth among the ten largest states for tech workers (behind only Texas, at 4.4%). Below we report on key themes surfaced through interviews with tech sector executives and stakeholders on the sector’s outlook in Washington state.

#### **Macroeconomic and Structural Factors**

Interviewees raised three main macroeconomic and structural factors shaping their outlook for the tech sector: 1) interest rates; 2) geopolitical uncertainties; and 3) policy and regulatory issues.

##### *Interest rates*

Many interviewees expressed concern over the recent rise in interest rates and the impact of higher rates on the cost of borrowing and availability of venture capital. However, some interviewees were more sanguine about higher borrowing costs. Some pointed to the large amount of capital still available in the economy for investment, and the sustained appetite for certain core technologies, such as AI.

##### *Uncertainty*

Uncertainty in the global and national economy has caused some hesitation on the part of investors and tech company executives. Investors, in a climate of high interest rates, have been more conservative in investment decisions. Tech executives have been increasingly reluctant to sign long-term office leases, given—in many cases—reduced office space needs under hybrid work models. Some corporations have, out of concern for growing macro uncertainty, pulled back on procurement, including tech products and services.

##### *Policy and regulatory Issues*

<sup>14</sup> Venture debt is used to “top off” VC funding. For example, if a firm raises a series A round, SVB would provide a credit line equal to about half of the amount raised in the fundraising round.

Several interviewees raised the issue of data privacy and the patchwork system of regulations around this issue. There is no national data privacy law, but some states, such as Connecticut, Colorado, and Virginia have passed state-level versions. The EU has its own regulatory system, called global data privacy regulations (GDPR). The Washington State Legislature recently passed House Bill 1155, also known as the My Health My Data Act, which would grant consumers greater control over their health data. The bill would require companies to “establish, implement, and maintain administrative, technical, and physical data security practices...to protect the confidentiality, integrity, and accessibility of consumer health data appropriate to the volume and nature of the consumer health data at issue” (Washington State Legislature, 2023). Some companies we spoke with were concerned these and other laws, while agreeing on the premises of protecting personal data, may create unnecessarily costly compliance.

More broadly, companies we spoke with emphasized concerns that, with a leveling off of recent tech workforce growth, the state policymakers may redirect their focus areas away from tech. Despite recent layoffs, there are still thousands of unfilled science, technology, engineering, and mathematics (STEM) positions at tech firms. Interviewees were concerned the state will divert resources away from investments in fostering growth in the tech sector.

### **Future of Work and Commercial Real Estate in the Region**

Many tech firms (and other sectors) are now recalibrating how their employees use space in a workplace environment. Large tech firms have been reducing their workforces after a surge in hiring during the pandemic, while at the same time interest rate hikes have reduced the amount of new venture growth. All these combined are creating a stagnant demand for office space, at least in the near term.

#### *Shifting to a hybrid model and disruptions of commercial real estate market*

According to interviewees, many (but not all) firms are switching to a hybrid work model. Even without staff reductions, hybrid models (e.g., three days in the office, two days working from home, and many other variations) will require less physical office space. For firms that have signed long-term leases, many have sought to sublet underutilized office space. Sublets generally command lower rates than regular leases, creating further downward pressure on commercial lease prices.

As part of a reconfiguration of office space, some firms have done away with standalone offices, shifting to shared spaces, such as “hot desks” used by more than one worker, based on the days they come into the office. Others have taken a more decentralized office, using (reduced size) office as a convening space, allowing workers to primarily work out of their homes or remote locations.

The degree to which firms do bring their workers back into the physical office will vary based on whether the firm owns or leases their office space, the size of the firm, and the length or duration of existing leases. Several startups and small businesses we spoke with were already operating remotely prior to the pandemic, and thus were not as directly impacted by disruptions in workplace configurations.

#### *Moving back to the office, at least partially*

Larger tech firms (and many other employers outside tech) are gradually moving back to a primarily in-office work model, at least for part of the week. Amazon announced a return to the office May 1 for at least three days a week (Jassy, 2023). Microsoft adopted a hybrid work



model beginning in February 2022 (Weise, 2022). The return to office work for Amazon workers has already activated the Seattle downtown in positive ways (Schlosser, 2023).

Many firms have elected to go with a hybrid model, with workers coming into the office two to four days a week. According to several interviews, companies on average are likely to use 30% less office space compared with pre-pandemic levels. There will be a greater focus on shared workspaces, with fewer built-out offices. Meta, Amazon, and Google are using a staggering approach for when workers come in. For example, Instead of everyone coming at the same time, some people have a much smaller “touchdown” space where staff can set up their computer for the day. For many firms, cubicles are also likely going away, to be replaced with WeWork-like benchwork spaces. There will be more collaboration spaces and meeting rooms in place of individual offices.

#### *A more diffuse labor market*

One potential accelerating development will be the satellite office structure, or what one interviewee described as the “suburbanization of tech.” An example outside the tech sector is REI. The firm was originally poised to relocate its corporate headquarters from Kent to Bellevue. Just prior to the move, the advent of the pandemic and shift to (at least temporary) remote work altered the firm’s calculus. Its leadership ultimately opted to abandon plans for a Bellevue Spring District-based headquarters, instead selling the property and using an Issaquah remote office as its satellite headquarters (Stiles, 2021). The company’s satellite offices are also housed in Renton, and a Capitol Hill WeWork space (Thompson, 2022). The satellite model, or variations thereof, could spur tech-based economic growth in areas of Puget Sound that have not historically been major hubs for ICT activities, such as Renton.

#### *During the years before the pandemic, there was an overcommitment to office space*

The Seattle region has become very expensive over the last decade. Landlords purchased and refinanced buildings at a fast rate over the last decade; however, these investments may have much lower returns in the post-COVID commercial real estate market. In the first quarter of 2023, total existing commercial real estate inventory in downtown Seattle summed to 67.6 million square feet, with an additional 3.9 million square feet under construction, and with a vacancy rate of 15.8%; within the Central Business District, the vacancy rate was 19.0%. Subleases, after recovering to pre-pandemic levels, have since risen again over the twelve months ending in March 2023 (Newmark, 2023).

With more and more firms adopting hybrid or remote work models, the future demand for downtown corridor commercial real estate may drive up vacancies. Owners who purchased office buildings in 2017 or later will have debt maturing in the next couple of years, but the value of the debt could be well in excess of the value of the buildings purchased.<sup>15</sup> The

<sup>15</sup> According to one interviewee, construction underway—especially for projects financed before the recent uptick in interest rates—are at very low risk of not being completed. These projects likely benefited from low financing costs, while supply chain bottlenecks have been eased, reducing the cost of construction materials. Labor costs have also stabilized. On the residential real estate side, interviewees we spoke with emphasized the continued strong demand for high quality urban environments, especially among younger tech workers. The biggest concern is safety and continued availability of urban core services, such as restaurants, that were deeply impacted by remote work and loss of daytime foot traffic in the urban corridors.

occupancy rates are still quite healthy among buildings built in the last ten years. But class B commercial real estate in less desirable areas may struggle to find tenants.

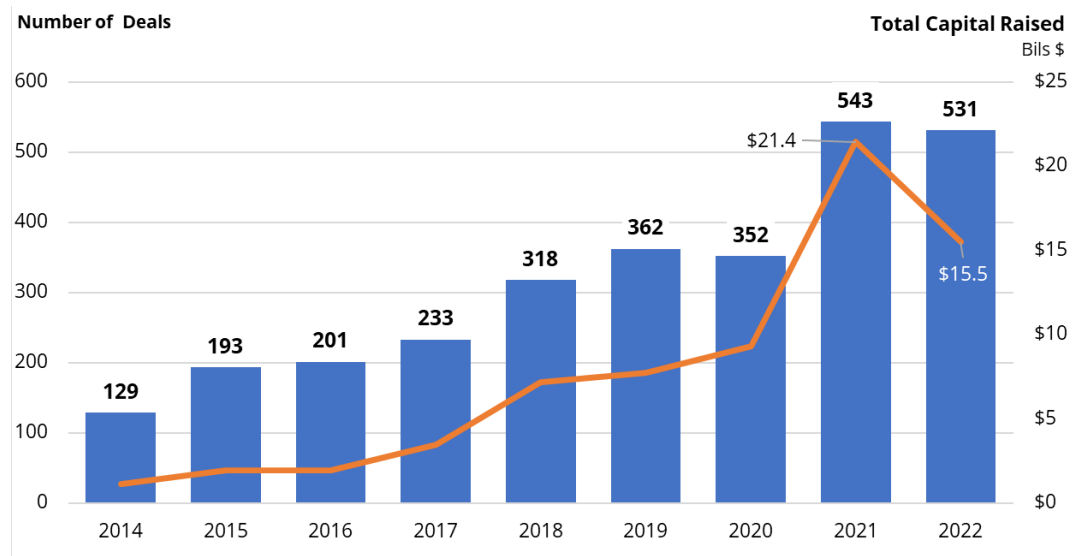
### Health of the Startup Ecosystem

In 2022, startups classified as “information technology” and headquartered in Washington state raised \$15.5 billion in venture capital funds, down from a historic peak of \$21.4 billion in 2021. Venture deals fell slightly between 2021 and 2022, from 543 to 531 (**Exhibit 16**). In 2021 and 2022 combined, startups in AI and machine learning and headquartered in Washington state raised \$3.2 billion across 247 venture capital deals (Pitchbook, 2023).

We spoke with founders and venture capitalists on their views on the startup ecosystem. According to several interviewees, the recent interest rate hikes have reduced the amount capital available for early-stage investments. For the same reasons, fundraising firms are often under greater scrutiny compared with the 2020-2021 period.

The intense competition over ICT labor during the pandemic created upward pressure on wages. Many startups are not able to compete with large tech firms on compensation packages alone. However, numerous interviewees representing startups and financing viewed this as not a significant concern; some workers actively seek out opportunities to work at startups, despite the higher salaries available from large tech firms. Startup founder are also quite resourceful in how they find talent, including individuals with non-traditional educational backgrounds who nonetheless possess skills in demand. The pandemic and partial normalization of remote work has also reset expectations for work—some startups have taken advantage of the broader and more diffuse labor market of remote workers to hire people from outside the Seattle region on a remote work basis.

**Exhibit 16. Washington State “Information Technology” Venture Deals and Capital Raised, 2014-2022**



Source: Pitchbook (2023).

## *Leading Developments, Technologies, and Trends that Will Meaningfully Impact the Tech sector in the Next Ten Years*

Washington is already leading in many transformative technologies and is strongly positioned for future growth. Below we discuss six key fields of innovation and growth in Washington's tech sector, including areas of overlap with other large sectors of the economy.

### **Generative AI and intelligent applications**

According to a report by Price Waterhouse Cooper (2018), artificial intelligence (AI) could contribute up to \$15.7 trillion to the global economy by 2030. Most interviewees we spoke with emphasized the impact of generative AI as a driver of economic growth and technological change both in Seattle and across the world in the coming years. AI and machine learning (ML) will be intricately tied to the "modern data stack," i.e., companies that leverage the cloud and cloud infrastructure, data warehousing, and cloud-based apps.

Within telecom, AI and ML will help revolutionize network management, including between satellite systems that provide critical backup to existing cell towers. Users currently have access to AI for facial recognition, completing sentences in texting and word processors, and other common apps. But the generative aspect of AI is entirely new, e.g., using ChatGPT, integrated into Bing, to produce a full travel itinerary based on user-entered criteria.

Washington is a major hub for generative AI and intelligent applications. Microsoft owns ChatGPT and is deploying this technology across a wide range of fields. **Microsoft AI** provides AI applications and uses in Windows, Xbox, Microsoft 365, Teams, Azure AI, Power Platform, Dynamics 365, Microsoft Defender1, and the new Bing (Microsoft Corporation, 2023). The **Allen Institute for Artificial Intelligence** is a Seattle-based global research institute focused on scientific breakthroughs through development of the most advanced AI systems. The institute's project teams focus on AI research in natural language processing, computer vision, AI environmental applications, and experimentation and communication (Allen Institute for Artificial Intelligence, 2023).

Examples of Seattle area-based AI startups include Retool, Shelf Engine, Cruise, Carbon Robotics, and Freshworks, among many others (Daley, 2023). In 2022, Washington-based AI startups raised \$1.3 billion in venture capital investments (Pitchbook, 2023). In 2020, three Seattle startups made CB Insights' list of "world's most promising AI startups": Algorithmia, which accelerates AI adoption; Lexion, a spinout from the Allen Institute for Artificial Intelligence (AI2) that supports in-house legal teams; and WellSaid Labs, another spinout from AI2 developing stable of AI-powered voices customized for different context (Soper, 2020). Amazon is a leader in generative AI and machine learning tools. Amazon subsidiary Zoox also builds and operates autonomous vehicles, leveraging AI technology, and has been testing in Seattle without incident (Rosenblatt, 2023).

Interviewees emphasized the role of AI as a "co-pilot" to human workers, helping to increase productivity by setting aside more mundane, routinized tasks to AI algorithms, rather than wholesale substituting for human labor. For example, software gaming companies can use AI to produce early mockup draft renderings of virtual landscapes and environments, based on some preliminary parameters, allowing designers and artists to focus more of their time and effort on enhancing these drafts, rather than from scratch. In the space of healthcare, AI and ML will augment radiologists and other physicians' review of patient images and detect anomalies.

## **5G, Edge Computing, and the Digital Transformation**

“Digital transformation” refers to the shift among enterprises away from analog technologies and towards edge computing, the cloud, and the deepening use and reliance on data; 5G and edge computing will be essential to economywide transformation. Edge computing refers to a distributed computing model that brings computation and data storage closer to the sources of data. It is often described as an “architecture” rather than a specific technology (IBM, 2023). Edge computing involves the development and deployment of small data centers to reduce latency. For example, autonomous vehicle (AV) sensors will communicate continuously with cloud-based servers; edge computing will reduce the physical distance between AVs and cloud servers to dramatically enhance latency performance—critical for safety.

Most humans will not notice the difference between 4G and 5G in how they view and consume online content through their devices, but 5G will have a significant impact on the growth and advancement of the “Internet of Things” (IoT). Dramatically reduced latency from 5G will enable scalable implementation of intelligent devices and robots on the factory floor, autonomous vehicles, augmented reality (AR) applications, and streamlined remote diagnostics at hospitals, to name just a few applications. Increasingly, companies are seeking to implement their own private cellular 5G networks (discussed further below under “Maritime Sector and ICT”).

Washington is a growing hub for 5G innovation. In 2022, there were **23 venture capital deals in IoT** among Washington-headquarter startups that raised **\$116.2 million** in capital (Pitchbook, 2023). The **5G Open Innovation Lab**, based in the Spring District in Bellevue, has been an important nexus bringing together industry and innovators to conduct proof-of-concept testing of novel 5G solutions. More than 100 teams have come through the program, both domestic and international (5G Open Innovation Lab, 2023).

Bellevue-based **T-Mobile**, the second largest wireless carrier in the United States (based on subscriber counts), is a co-founder of the 5G Open Innovation Lab and a major investor in 5G innovation and research. The company’s 5G Forward, launched in 2022, is a series of moves and partnerships focused on accelerating 5G developer innovation. These include “DevEdge, T-Mobile’s new developer platform; the Tech Experience 5G Hub, a new state-of-the-art innovation center; new T-Mobile Accelerator participants; venture funding for two growing companies; and strategic partnerships with Disney StudioLAB and Red Bull, to develop new 5G-powered experiences for fans” (T-Mobile, 2022).

## **Satellite Broadband**

Some of Washington’s largest firms, such as Amazon, are investing in solutions to broadband access. The company’s **Project Kuiper** is a low earth orbit satellite that will enable broadband connectivity for remote areas that do not have broadband access. The satellite can broadcast down at 400 MHz per second to reach remote regions, such as various tribal lands in Washington, that never received broadband fiber connections. Project Kuiper will launch in 2024 (Amazon, 2023).

## **Healthcare and ICT**

Numerous Washington state firms are collaborating with healthcare providers, using “digital biology” to map RNA, specific proteins, and improve immunotherapy. For example, Microsoft has partnered with the Fred Hutchinson Cancer Research Center to develop a pilot test technology to help cancer patients avoid the emergency room through better management of their chemotherapy side effects (Russell, 2018).

**Amazon** has been a national leader in the development and deployment of ICT platform-based healthcare solutions. **Amazon Clinic** is a virtual, telehealth healthcare service that delivers convenient, affordable care for common conditions (The Verge, 2022). In early 2023, Amazon completed its acquisition of **One Medical**, a telehealth and primary care service that provides patients with 24/7 virtual care access via a telehealth platform (One Medical, 2023). **Amazon Pharmacy** was launched in late 2020 and provides free, two-day home delivery of prescriptions to Amazon Prime subscribers (Valinsky, 2020).

### **Maritime Sector and ICT**

ICT will be essential to the development of the “Blue Economy.” The International Maritime Organization (IMO) has set a goal of reducing the shipping industry’s greenhouse-gas emissions by at least 50% by 2050, and to reduce the carbon intensity of emissions by 40% by 2030 and 70% by 2050, compared to 2008 levels (World Economic Forum, 2020). A large share of these reductions can be achieved through digital solutions and improved efficiencies.

Washington has long been a major hub for the maritime sector, directly employing 69,500 workers across the subsectors of shipyards, commercial fishing, maritime logistics and shipping, maritime services, and recreational boating (Washington Maritime Federation, 2017). Examples of ICT solutions applied to maritime environmental needs include marine carbon capture, plastic removal, and smart metering of marine vessel engines and operations. For example, Seattle-based **ioCurrents**, founded in 2015, has developed a machine learning-based analytics platform that aggregates diverse data sets into actionable insights for the maritime industry. The company’s platform provides operators and fleet managers with “descriptive, predictive, and efficiency analytics for engines, generators, and other vessel assets to improve efficiency, increase safety, and identify and prevent failures” (ioCurrents, 2023).

Another domain of intersection between ICT and maritime is in port security, cargo management, and supply chains. The Port of Tacoma and port tenants have been collaborating with the Bellevue-based **5G Open Innovation Lab** and **Washington Maritime Blue** to develop a private 5G network in the Tacoma Tide Flat (Washington Maritime Blue, 2022). The area currently has very weak cellular and Wi-Fi connectivity within the container stacks, forcing longshoremen to use pencil and paper to keep track of containers. The new private network will allow longshoremen to track containers using tablets connected to the network, helping to improve stevedoring operation efficiency, safety, and security.

Company tenants, such as marine vessel manufacturer Safe Boats, will enjoy shared network access. The 5G private network will enable companies to test new automation and Internet of Things (IoT) solutions. By gaining access to this network, participating companies will allow innovators to use the site as a test bed for new IoT and related technologies (Washington Maritime Blue, 2022). ICT solutions allow for real time reporting of marine vessel emissions and technology to support better analysis of vessel design and fuel consumption.

5G also enables **digital twin technology** applied to maritime structure repairs and monitoring. For example, a maintenance team in the North Sea repairing a wind generator can work with a team in Norway which can monitor the work in real time, with very low latency. If the on-site repair teams come across a problem, the land-based team can use the digital twin rendering of the facility to arrive at a solution and communicate this back to the on-site team in real time.

Large maritime firms in Washington are also actively bringing ICT expertise in-house, both through talent recruitment and acquisitions. Examples include Tide Works, American Seafoods, and Husky Terminal.

### **Cloud Computing**

The global technological evolution of cloud computing began in Washington state in the early 2000s. As early as 2003, Amazon recognized it had extensive inhouse expertise in managing complex networks and “running infrastructure services like compute, storage and database (due to those previously articulated internal requirements)” and “become highly skilled at running reliable, scalable, cost-effective data centers out of need [and] had to be as lean and efficient as possible” (Miller, 2016). Amazon was also in possession of an enormous amount of surplus computing server capacity, shaped by the ebb and flow of consumer traffic, just as many other firms were having scaling needs. A few years later, in November 2016, Amazon Web Services (AWS) was born, becoming the first cloud services provider in the world. Since then, Washington has emerged as a global leader in cloud computing services, including two of the largest providers in the world, Amazon Web Services and Microsoft Azure (Washington Technology Industry Association, 2022).

### **Clean Energy, ICT, and Commitment to Climate Action**

According to a recent report by the World Economic Forum, an estimated 20% reduction in carbon emissions could be achieved through digital technologies, if scaled across industries. In the energy, materials, and mobility industries, carbon emissions could already be reduced by 4-10% by quickly adopting digital technologies (World Economic Forum, 2022).

Washington is home to the 13<sup>th</sup> largest clean energy sector, with more than 85,000 clean energy workers in 2020 (E2, 2020). ICT solutions in the clean tech and clean energy are extensive, including big data and machine learning, 5G applications for monitoring remote wind turbine facilities, improved mechanical and production efficiencies on the factory floor, and even drones using 5G to monitor agriculture. In September 2022, Amazon announced it will add 2.7 gigawatts of clean energy capacity across 71 new projects as part of its goal of becoming 100% renewable across all its business lines by 2025 (Reuters, 2022). In addition, Amazon is a founder of The Climate Pledge—a commitment to be net zero carbon by 2040. Microsoft has committed to powering its data centers globally with clean energy.

## **SUMMARY AND CONCLUSIONS**

Washington is among the largest and most dynamic information and communication technology (“tech”) sector hubs in the world. In 2022, Washington state businesses employed 324,900 workers across the state, a net increase of 66,300 jobs since 2019; this compares with overall net employment growth economywide in Washington state of 74,800 jobs. The tech sector’s growth over this period (25.6%) compared with an 8.5% contraction in manufacturing, including -20.5% in aerospace. Factoring in upstream business-to-business supply chain transactions and tech worker household consumption, the tech sector supported a total statewide economic impact of nearly 1.5 million jobs in Washington state.

From the low point in employment during the Great Recession (2010) until 2019, just prior to the pandemic, statewide employment across all sectors grew 22%; the tech sector, by comparison, nearly doubled (84% growth) and added 120,100 jobs. In 2010, ICT represented roughly 5% of Washington’s statewide employment. However, between 2010 and 2019 (the post-Great Recession recovery period), ICT net employment increases represented nearly 20% of all statewide covered net employment growth. Between 2009 and 2022, from the Great Recession to last year, the statewide tech sector has added 186,400 jobs, a net increase of 135%.

The tech sector's role in economic recovery has become much more profound during the latest economic downturn. The tech sector has nearly doubled its share of statewide covered employment, rising from less than 5% in 2007 to more than 9% in 2022. Between 2015 and 2020, the sector was responsible for 46% of all wage and salary growth and 66% of net job growth. Between 2010 and 2020, in inflation-adjusted terms, tech sector wages increased by \$41.3 billion, whereas wages amongst the rest of the economy grew by \$47.7 billion. Between 2020 and 2022, tech sector real wages, before benefits, grew 17%, compared with 7% for the statewide economy overall.

The tech sector shoulders a disproportionate share of state business taxes. In 2022, the ICT sector directly contributed an estimated \$508.1 million in business and occupation (B&O) taxes to the Washington state budget. The ICT sector's B&O contributions have also grown over time, increasing in real (inflation-adjusted) terms 86% between 2007 and 2022.

Tech firms also collect and pay sales and use taxes. In 2022, these firms were directly associated with an estimated \$1.1 billion in sales and use taxes, equal to 8% of all statewide sales and use tax collections in 2022. ICT workers spent an estimated \$50.0 billion in personal consumption expenditures in Washington state in 2022. This spending alone supported nearly \$1.5 billion in state sales tax revenues, or \$4,300 per worker in 2022. ICT workers represent 7% of all workers in Washington state (including covered workers and the self-employed), but 11% of retail sales taxes generated at the state level.

Recent layoffs in the tech sector, while incurring economic pain for those affected, are still small relative to net overall tech sector employment growth in recent years. Announced layoffs equate to 22% of net increased employment across the sector in 2022, and 10% of net job growth since 2019. In the view of many individuals we spoke with for this study, layoffs represent a "reset" in labor force needs, following one of the most rapid hiring phases in U.S. economic history. Reasons behind the layoffs are manifold, including businesses reevaluating and recalibrating business models and lines of business in the post-COVID era; the end of ultra-low interest rates; the outcome of hiring fast, but not always optimally. In the tech sector, to a much greater extent than most other sectors of the economy, talent is the most important company asset. Many firms, with access to low interest rates and facing surging demand for tech products and services during the early period of pandemic-induced upheaval, hired fast, but may have over-hired relative to post-pandemic labor needs. Yet despite some workforce reductions, tech companies remain profitable and with a strong economic outlook.

Many of the gains illustrated in this report are hugely significant for the future of Washington state's economy, but they are also fragile. Tech sector businesses prior to the pandemic often made site location decisions based on the presence of a vibrant, dynamic ecosystem of other firms, institutions, and cluster-supporting assets, government policy, and the availability of Class A office space. But the new work-from-home model has upended many assumptions about corporate headquarters or hub-and-spoke models that center jobs in a particular region. Global competitiveness and efforts by other states to lure companies away is another continuous threat. Washington state should continue to find ways to cultivate and nurture the tech sector in order to retain and grow this incredible economic asset.

Washington state should continue to find ways to cultivate and nurture the tech sector in order to retain and grow this incredible economic asset. Specifically, this could include more public investment in transportation infrastructure, housing affordability, computer science education, and public safety, as well as a light regulatory touch on new technology and a favorable tax environment and business climate.

With the right support and opportunities to continue innovating, the tech sector can build a better world for all residents of Washington and beyond, and fuel many more decades of sustainable growth and prosperity in Washington state.



## SOURCES

- 5G Open Innovation Lab. (2023). *About*. Retrieved from <https://5goilab.com/about/>
- Allen Institute for Artificial Intelligence. (2023). *About*. Retrieved from Allen Institute for Artificial Intelligence: <https://allenai.org/about>
- Allyn, B. (2023, March 11). *Silicon Valley Bank failure could wipe out 'a whole generation of startups'*. Retrieved from NPR: <https://www.npr.org/2023/03/11/1162805718/silicon-valley-bank-failure-startups>
- Amazon. (2020, April 13). *The company has brought on 175,000+ new associates during the COVID-19 pandemic*. Retrieved from About Amazon: <https://www.aboutamazon.com/news/company-news/amazon-has-hired-175-000-additional-people>
- Amazon. (2023, March 14). *Here's your first look at Project Kuiper's low-cost customer terminals*. Retrieved from About Amazon: <https://www.aboutamazon.com/news/innovation-at-amazon/heres-your-first-look-at-project-kuipers-low-cost-customer-terminals>
- Beyers, W. B., & Lin, T.-W. (2012, September). *The 2007 Washington State Input-Output Model*. Retrieved from Washington State Office of Financial Management: [https://ofm.wa.gov/sites/default/files/public/legacy/economy/io/2007/I-O\\_2007\\_report.pdf](https://ofm.wa.gov/sites/default/files/public/legacy/economy/io/2007/I-O_2007_report.pdf)
- Bhaimiya, S. (2023, March 13). *A Silicon Valley Bank VP, whose grandmother and aunt also worked at the bank, said he's 'heartbroken' for startups affected by its implosion*. Retrieved from Business Insider: <https://www.businessinsider.com/silicon-valley-bank-vp-heartbroken-for-startups-affected-by-collapse-2023-3>
- Bishop, T. (2023, April 17). *Analysis: New jobs numbers show where Amazon has been adding and shedding U.S. workers*. Retrieved from GeekWire: <https://www.geekwire.com/2023/new-numbers-show-where-amazon-has-been-adding-and-shedding-u-s-workers/>
- Bishop, T. (2023, March 12). *Startups and investors relieved after U.S. vows to fully protect Silicon Valley Bank deposits*. Retrieved from GeekWire: <https://www.geekwire.com/2023/u-s-vows-to-fully-protect-silicon-valley-bank-deposits-beyond-fdic-limits-trying-to-reassure-rattled-tech-startups/>
- Clark, M. (2023, January 18). *Amazon begins another round of job cuts as it lays off more than 18,000 people*. Retrieved from The Verge: <https://www.theverge.com/2023/1/18/23560874/amazon-layoffs-18000-january-november>
- Clark, M. (2023, April 3). *The Verge*. Retrieved from <https://www.theverge.com/2023/4/3/23668889/apple-corporate-layoffs-retail-big-tech-cuts>
- Code.org. (2023). *Support K-12 Computer Science Education in Washington*. Retrieved from <https://code.org/advocacy/state-facts/WA.pdf>
- CompTIA. (2023). *State of the Tech Workforce 2023*. Downers Grove, IL: CompTIA.
- Daley, S. (2023, March 13). *17 Seattle AI Companies Making the Emerald City an Artificial Intelligence Powerhouse*. Retrieved from built in SEA: <https://www.builtinseattle.com/2018/07/12/artificial-intelligence-companies-seattle>
- E2. (2020, November 24). *Clean Jobs Washington 2020*. Retrieved from E2: <https://e2.org/reports/clean-jobs-washington-2020/>

- Geraldo, R. (2023, February 15). *Salesforce, owner of Seattle's Tableau, braces for investor pressures*. Retrieved from Seattle Times: <https://www.seattletimes.com/business/technology/salesforce-owner-of-seattles-tableau-braces-for-investor-pressures/>
- Halverson, A. (2023, March 7). *Microsoft job cuts in King County surpass 2,000 with latest round*. Retrieved from Puget Sound Business Journal: <https://www.bizjournals.com/seattle/news/2023/03/06/microsoft-layoffs-puget-sound-tech.html>
- IBM. (2023). *What Is Edge Computing*. Retrieved from <https://www.ibm.com/cloud/what-is-edge-computing>
- ioCurrents. (2023). *About Us*. Retrieved from ioCurrents: <https://iocurrents.com/about-us/>
- Jassy, A. (2023, February 17). *Update from Andy Jassy on return to office plans*. Retrieved from Amazon: <https://www.aboutamazon.com/news/company-news/andy-jassy-update-on-amazon-return-to-office>
- Microsoft Corporation. (2023, February 17). *What is Microsoft's approach to AI?* Retrieved from Microsoft: <https://news.microsoft.com/source/features/ai/microsoft-approach-to-ai/>
- Microsoft Corporaton. (2022). *2022 Annual Report*. Retrieved from <https://www.microsoft.com/investor/reports/ar22/index.html>
- Miller, R. (2016, July 2). *How AWS came to be*. Retrieved from TechCrunch: [https://techcrunch.com/2016/07/02/andy-jassys-brief-history-of-the-genesis-of-aws/?guccounter=1&guce\\_referrer=aHR0cHM6Ly93d3cuZ29vZ2xlMnVbS8&guce\\_referrer\\_sig=AQAAAM29Yau3ZPxMcAtqRz7ewjEs5P3GVJoOHDhhmrJRrN-zBwA6hzDYveThpq4m-MbX2VHsL8Z1IMfh8B-Kv5VsyhhucZd](https://techcrunch.com/2016/07/02/andy-jassys-brief-history-of-the-genesis-of-aws/?guccounter=1&guce_referrer=aHR0cHM6Ly93d3cuZ29vZ2xlMnVbS8&guce_referrer_sig=AQAAAM29Yau3ZPxMcAtqRz7ewjEs5P3GVJoOHDhhmrJRrN-zBwA6hzDYveThpq4m-MbX2VHsL8Z1IMfh8B-Kv5VsyhhucZd)
- Newmark. (2023, April). *Puget Sound Office Market*. Retrieved from Newmark: <https://www.nmrk.com/storage-nmrk/uploads/fields/pdf-market-reports/1Q23-Seattle-Office-Market.pdf>
- One Medical. (2023, February 22). *One Medical Joins Amazon to Make It Easier for People to Get and Stay Healthier*. Retrieved from One Medical: <https://www.onemedical.com/mediacenter/one-medical-joins-amazon/>
- Pitchbook. (2023). *Companies and Deals Database*. Seattle, WA.
- Plater, R. (2022, February 19). *Amazon Expands Its Telehealth Program Nationwide: How It Works*. Retrieved from healthline: <https://www.healthline.com/health-news/amazon-expands-its-telehealth-program-nationwide-how-it-works#How-it-works>
- Reuters. (2022, September 21). *Amazon drives renewable energy push with 71 new projects*. Retrieved from <https://www.reuters.com/business/sustainable-business/amazon-drives-renewable-energy-push-with-71-new-projects-2022-09-21/>
- Reuters. (2023, April 19). *Software firm F5 to lay off 9% staff, trims fiscal revenue guidance*. Retrieved from <https://www.reuters.com/technology/software-firm-f5-layoff-9-staff-trims-fiscal-revenue-guidance-2023-04-19/>
- Roberts, F., & Beyers, W. B. (2021). *The 2012 Washington input-output study*. Olympia: Washington State Office of Financial Management. Retrieved from [https://ofm.wa.gov/sites/default/files/public/dataresearch/economy/IO\\_2012\\_report.pdf](https://ofm.wa.gov/sites/default/files/public/dataresearch/economy/IO_2012_report.pdf)
- Roberts, P., & Geraldo, R. (2023, April 20). *Tableau shrinks Seattle-area offices as owner Salesforce cuts costs*. Retrieved from Seattle Times: <https://www.seattletimes.com/business/real-estate/tableau-shrinks-seattle-area-offices-as-owner-salesforce-cuts-costs/>

- Rosenblatt, L. (2023, February 15). *Amazon's self-driving unit Zoox puts driverless taxi on the road* . Retrieved from Seattle Times: <https://www.seattletimes.com/business/amazons-self-driving-unit-zoox-puts-driverless-taxi-on-the-road/>
- Russell, S. (2018, May 4). *Fred Hutch, Microsoft partner to improve cancer care delivery*. Retrieved from Fred Hutch News Service: <https://www.fredhutch.org/en/news/center-news/2018/05/a-fred-hutch-and-microsoft-partnership-in-cancer-care.html>
- Sawers, P. (2023, January 18). *Microsoft announces 10,000 job cuts, nearly 5% of its global workforce*. Retrieved from TechCrunch: <https://techcrunch.com/2023/01/18/microsoft-announces-10000-job-cuts-nearly-5-of-its-workforce/>
- Schlosser, K. (2022, September 8). *DreamBox Learning hit by layoffs, but promises strategy to take on 'troubling trends' in education*. Retrieved from GeekWire: <https://www.geekwire.com/2022/dreambox-learning-hit-by-layoffs-but-promises-strategy-to-take-on-troubling-trends-in-education/>
- Schlosser, K. (2022, September 21). *Real estate giant Compass lays off 84 workers in Washington state as it targets tech team for cuts*. Retrieved from GeekWire: <https://www.geekwire.com/2022/real-estate-giant-compass-lays-off-84-workers-in-washington-state-as-it-targets-tech-team-for-cuts/>
- Schlosser, K. (2022, October 21). *Seattle cannabis marketplace Leafly to cut 56 jobs*. Retrieved from GeekWire: <https://www.geekwire.com/2022/seattle-cannabis-marketplace-leafly-to-cut-56-jobs/>
- Schlosser, K. (2022, September 1). *T-Mobile makes layoffs in network operations and engineering group as part of 'organizational shift'* . Retrieved from GeekWire: <https://www.geekwire.com/2022/t-mobile-makes-layoffs-in-network-operations-and-engineering-group-as-part-of-organizational-shift/>
- Schlosser, K. (2023, May 3). *Amazon workers, and a familiar energy, return to Seattle HQ as new in-person office policy kicks in*. Retrieved from GeekWire: <https://www.geekwire.com/2023/amazon-workers-and-a-familiar-energy-return-to-seattle-hq-as-new-in-person-office-policy-kicks-in/>
- Schlosser, K., & Soper, T. (2022, October 24). *Convoy lays off more employees as part of reorganization at Seattle trucking startup*. Retrieved from GeekWire: <https://www.geekwire.com/2022/convoy-lays-off-more-employees-as-part-of-reorganization-at-seattle-trucking-startup/>
- Sizing the prize: What's the real value of AI for your business and how can you capitalise? (2018). London.
- Soper, T. (2020, March 4). *3 Seattle companies make CB Insights' list of world's most promising AI startups*. Retrieved from GeekWire: <https://www.geekwire.com/2020/3-seattle-companies-make-cb-insights-list-worlds-promising-ai-startups/>
- Stiles, M. (2021, February 24). *REI chooses new Issaquah building for its first satellite office*. Retrieved from Puget Sound Business Journal: <https://www.bizjournals.com/seattle/news/2021/02/24/rei-chooses-first-satellite-office.html>
- The Verge. (2022, November 15). *Amazon Clinic launches as a message-based virtual care service*. Retrieved from The Verge: <https://www.theverge.com/2022/11/15/23459873/amazon-clinic-announcement-healthcare-telemedicine>
- Thompson, J. (2022, June 16). *Flexibility is the key for REI's future without a headquarters, Ben Steele says*. Retrieved from Puget Sound Business Journal: <https://www.bizjournals.com/seattle/news/2022/06/15/grow-rei-steele.html>

- Thorbecke, C. (2023, March 14). *Facebook-parent Meta plans to lay off another 10,000 employees* . Retrieved from CNN Business: <https://www.cnn.com/2023/03/14/tech/meta-layoffs/index.html>
- T-Mobile. (2022, March 23). *T-Mobile Unleashes Innovators to Drive 5G Forward*. Retrieved from T-Mobile: <https://www.t-mobile.com/news/network/t-mobile-unleashes-innovators-to-drive-5g-forward>
- U.S. Bureau of Economic Analysis. (2023). Gross Domestic Product: Implicit Price Deflator [A191RI1Q225SBEA], retrieved from FRED, Federal Reserve Bank of St. Louis. Washington D.C. Retrieved July 8, 2021, from <https://fred.stlouisfed.org/series/A191RI1Q225SBEA>
- U.S. Bureau of Economic Analysis. (2023). Gross Domestic Product: Implicit Price Deflator [GDPDEF]. Washington D.C. Retrieved June 28, 2021, from retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/GDPDEF>
- U.S. Bureau of Economic Analysis. (2023, April). *SASUMMARY State annual summary statistics: personal income, GDP, consumer spending, price indexes, and employment*. Retrieved from <https://apps.bea.gov/itable/?ReqID=70&step=1#eyJhcHBpZCI6NzAsInN0ZXBljpbMSwyNCwyOSwyNSwzMSwyNiwzMF0sImRhdGEiOltbIlRyYmxlSWQiLCI2MDAiXSxbkNsYXNzaWZpY2F0aW9uLiwiTm9uLUluZHVzdHJ5Ii0sWyJNYWpvcl9BcmVhliwiMCJdLFsiU3RhdGUiLFsiMCJdXSxbkFyZWElFsiNTMwMDAiXV>
- U.S. Bureau of Labor Statistics. (2023a). Quarterly Census of Employment and Wages. Washington D.C.
- U.S. Bureau of Labor Statistics. (2023b). Current Employment Statistics. Washington D.C.
- Valinsky, J. (2020, November 17). *Amazon is now a drug store. It will ship prescriptions to Prime members*. Retrieved from CNN: <https://www.cnn.com/2020/11/17/business/amazon-pharmacy-launch/index.html>
- Washington Maritime Blue. (2022, January). *Tacoma Tideflats 5G Network Feasibility Study*. Retrieved from Washington Maritime Blue: [https://maritimeblue.org/wp-content/uploads/2022/01/Tacoma-Tideflats-5G-Feasibility-Study\\_Full-Report\\_Final.pdf](https://maritimeblue.org/wp-content/uploads/2022/01/Tacoma-Tideflats-5G-Feasibility-Study_Full-Report_Final.pdf)
- Washington Maritime Federation. (2017). *WMF Releases 2017 Maritime Economic Impact Study*. Retrieved from <https://www.maritimesfederation.com/wmf-2017-impact-study.html>
- Washington State Department of Revenue. (2022). *E0080-1: Advanced Computing Surcharge – Actual collections to date*. Olympia.
- Washington State Department of Revenue. (2023). Quarterly Business Review. Olympia, WA.
- Washington State Economic and Revenue Forecast Council. (2023, March). *Washington State Economic and Revenue Forecast*. Retrieved from <https://erfc.wa.gov/sites/default/files/public/documents/publications/mar23pub.pdf>
- Washington State Employment Security Department. (2023, April). *Washington employment estimates (WA-QB)*. Retrieved from <https://www.esd.wa.gov/labormarketinfo/employment-estimates>
- Washington State Employment Security Department. (2022, July). Long-term alternative occupational employment projections. Olympia, WA.
- Washington State Employment Security Department. (2023). Industry-Occupational Matrix. Olympia, WA.
- Washington State Employment Security Department. (2023, April). *Worker Adjustment and Retraining Notification (WARN)*. Retrieved from <https://esd.wa.gov/about-employees/WARN>

- Washington State Legislature. (2023, April 17). *ENGROSSED SUBSTITUTE HOUSE BILL 1155*. Retrieved from <https://lawfilesexternal.wa.gov/biennium/2023-24/Pdf/Bills/House%20Passed%20Legislature/1155-S.PL.pdf?q=20230426215712>
- Washington State Office of Financial Management. (2022). 2012 Washington State Input-Output Model. Olympia, WA.
- Washington State Office of Financial Management. (2023, January 10). *Total population and percentage change*. Retrieved from Population Estimates: <https://ofm.wa.gov/washington-data-research/statewide-data/washington-trends/population-changes/total-population-and-percent-change>
- Washington Technology Industry Association. (2015). *Information & Communication Technology Economic and Fiscal Impact Study*. Retrieved from <https://washingtontechnology.org/wp-content/uploads/2015/04/ICT-Economic-Report.pdf>
- Washington Technology Industry Association. (2021, September). *The Technology Sector's Role in Washington's Economy and Economic Recovery*. Retrieved from <https://www.washingtontechnology.org/wp-content/uploads/2021/10/2021-Technology-Sector-Role-in-Economic-Recovery.pdf>
- Washington Technology Industry Association. (2022). *2022 Cloud Computing Skills Demand Analysis*. Seattle: WTIA. Retrieved from <https://www.washingtontechnology.org/wp-content/uploads/2022/06/Cloud-Computing-Demand-Analysis.pdf>
- Washington Technology Industry Association. (2022, January). *The Outsized Impact of Data Centers in Rural Washington*. Retrieved from WTIA: <https://www.washingtontechnology.org/wp-content/uploads/2022/01/WTIA-Economic-Impact-of-Data-Centers-January-2022-Executive-Summary.pdf>
- Weise, K. (2022, February 14). *Microsoft tells workers to prepare to return to the office*. Retrieved from New York Times: <https://www.nytimes.com/2022/02/14/technology/microsoft-rto.html>
- World Economic Forum. (2020, July 7). *A new report outlines the shipping industry's plans for decarbonization*. Retrieved from World Economic Forum: <https://www.weforum.org/agenda/2020/07/shipping-industry-plans-to-decarbonize/>
- World Economic Forum. (2022, May 23). *Digital solutions can reduce global emissions by up to 20%. Here's how*. Retrieved from World Economic Forum: <https://www.weforum.org/agenda/2022/05/how-digital-solutions-can-reduce-global-emissions/>
- Zillow Group. (2023, February 15). *2022 Q4 Shareholder Letter*. Retrieved from [https://s24.q4cdn.com/723050407/files/doc\\_financials/2022/q4/Zillow-4Q22-Shareholders'-Letter.pdf](https://s24.q4cdn.com/723050407/files/doc_financials/2022/q4/Zillow-4Q22-Shareholders'-Letter.pdf)

## APPENDIX

### *Appendix A. Data Sources*

This report used the following data sources:

- **Quarterly Census of Employment and Wages (QCEW).** Quarterly employment, wage and establishment counts data reported by employers covering more than 95 percent of U.S. jobs, available at the county, metropolitan statistical area (MDA), state, and national levels by NAICS industry code. QCEW data represents workers covered by state unemployment insurance (UI) laws and federal workers covered by the Unemployment Compensation for Federal Employees (UCFE) program. It thus excludes self-employed workers and many business owners. Data for Washington state and King County is published by the U.S. Bureau of Labor Statistics and Washington State Employment Security Department. There is a 5 to 6-month time lag in the release of QCEW data, necessitating estimates for 2022 annual totals.
- **Current Employment Statistics (seasonally adjusted).** Nonfarm employment series by select industries on a monthly basis for Washington state and the Seattle MSA. CES data is more recent vintage than QCEW; the latest month of data available at the time of this report was March 2023. Data series for Washington state and Seattle MSA published by the U.S. Bureau of Statistics and Washington State Employment Security Department.
- **Non-employer Statistics.** Data on non-employer, self-employed workers by industry and state. Published by the U.S. Census Bureau.
- **Occupational Employment Statistics.** Data on employment by standard occupational classification (SOC) code for Washington state and Seattle MSA, including projections. Data published by the Washington State Employment Security Department.
- **Occupational-Employment Matrix.** Crosswalk between occupational employment headcount and industry headcount, providing estimates for number of workers by occupation in each industry. Data series for Washington state released by the Washington State Employment Security Department.
- **Gross Business Income.** Gross business income, or GBI, represent gross receipts reported by Washington state businesses for the purpose of assessing business & occupation tax obligations. GBI is reported quarterly by NAICS code by the Washington State Department of Revenue.
- **Implicit Price Deflators.** Indexed to 2012, used to adjust annual business revenues to 2022 dollars. Published by the U.S. Bureau of Economic Analysis.
- **Pitchbook.** Data on investment in Seattle and Washington-headquartered tech firms.

### *Appendix B. Comparison with 2015 WTIA Study Economic Impacts*

Statewide total economic impacts of the ICT sector differ by a total of 324,200 jobs between the current analysis presented in this report and figures reported in the 2015 WTIA study. The imputed jobs multiplier between these two studies increased from 3.7 to 4.0. Differences in impacts between these studies are due to the following reasons:

- Updates to the Washington State Input-Output Model. The most recent (2012) Washington State Input-Output Model estimates a jobs multiplier of 4.7 for the I-O model sector “Software Publishers, Data Processing & Internet Service Providers”

(Roberts & Beyers, 2021, p. 17). The 2007 Input-Output Model, used in the 2015 study, reported a jobs multiplier for this same sector of 3.96 jobs per direct job.

- The ICT jobs multiplier is slightly lower overall as compared with “Software Publishers, Data Processing & Internet Service Providers” due to the presence of other activities, such as ICT-related manufacturing, telecommunications, and various computer systems design and support services.
- Growth in ICT wages. Between 2013 (study year for the 2015 report) and 2019 (just prior to the pandemic), the statewide average wage grew in real (inflation-adjusted) terms 19%, whereas the ICT average wage growth was nearly double, at 36%. A large share of these high incomes is then spent on household goods and services throughout the statewide economy, spurring additional job creation.

### *Appendix C. Economic Impact Analysis*

The Washington State Input-Output (I-O) Model was used to compute indirect and induced impact estimates in this report. The Washington State Input-Output Model is a modeled representation of the Washington state economy broken out by 52 industries and industry groupings, including production functions by industry, sales by industry, and sources of final demand by industry (personal consumption expenditures, investment, gross exports, government purchases).

The total economic impact of the tech sector is the sum of direct, indirect, and induced impacts. In addition to direct impacts, indirect impacts refer to additional jobs, income, and business output (or revenue) supported through upstream business-to-business transactions, such as computer and electronic component suppliers. Induced impacts refer to additional jobs, income, and output through the spending of earned income on household consumption by workers employed through direct and indirect activities.

## Appendix D. List of Interviewees

For this report, we spoke with 33 individuals representing startups, small businesses, tech-focused law firms, industry associations, and major corporations.

Category	Company/Org Name	First Name	Last Name
Enterprise	Verizon	Michael	Bagley
Small or medium-sized business	Novaby	Julia	Beabout
Law	Corr Cronin	John	Bender
Organization	Washington Maritime Blue	Joshua	Berger
Enterprise	Zillow	Anna	Boone
Organization	5G Open Innovation Lab	Jim	Brisimitzis
Enterprise	Salesforce	Zach	Carstensen
Organization	Washington Clean Tech Alliance	Mel	Clark
Law	Fenwick	Kat	Duncan
Organization	Bellevue Chamber of Commerce	Joe	Fain
Corp Real estate	Newmark	Charlie	Farra
VC	Graham & Walker	Leslie	Feinzaig
Small or medium-sized business	OfferUp	Nathan	Garnett
Enterprise	ATT	Carl	Gipson
Enterprise	Instacart	Cat	Holm
VC	Madrona	Len	Jordan
Enterprise	Microsoft	Colleen	Kerr
HR	Reverb	Mikaela	Kiner
Enterprise	Amazon	Charles	Knutson
Small or medium-sized business	Popins	Bryan	Lee
Small or medium-sized business	StackMoxie	MH	Lines
Small or medium-sized business	Neu	Claudius	Mbemba
Enterprise	Flowplay	Derrick	Morton
VC	Voyager Capital	James	Newell
Small or medium-sized business	Hexas Biomass	Wendy	Owens
Enterprise	Microsoft	Irene	Plenefisch
Small or medium-sized business	Eleven11	Jonni	Ressler
Enterprise	Crown Castle	Mark	Reudnick
Organization	Downtown Seattle Association	Jon	Scholes
Organization	Ignite Northwest	Tom	Simpson
HR	Swift HR Solutions	Shannon	Swift
Law	Davis Wright Tremaine	Dan	Waggoner
Small or medium-sized business	JouleCase	James	Wagoner