THE NEW YORK CITY TECH ECOSYSTEM

NOVEMBER 2022 UPDATE

HR&A   abny
association for a better new york   tech:nyc   Google

INTRODUCTION

In 2013, we published the seminal *The New York City Tech Ecosystem* report. Back then, our city was just beginning to emerge as a premier destination for tech companies and tech talent.

The report showed us something we didn't really know at the time: New York City was a tech town. Tech jobs were growing fast, outpacing other sectors and becoming a major pillar of the city's total employment.

The report helped us recognize our own potential in the wider tech economy.

Today, our status as one of the world's premier tech ecosystems is clear. We have 369,000 tech jobs in our city, and even as the industry navigates new challenges, its growth remains remarkable.

In the last decade, the tech ecosystem accounted for a quarter of the city's new job growth. Tech continues to offer high-paying career opportunities to New Yorkers, including for jobs that don't require a degree or higher education.

And over the course of the pandemic, tech has shown tremendous resilience, even as other sectors experienced sharp job loss.

This strength is a testament to the investments we have made collectively and deliberately as a city. The initial $10M public-private investment in the NYC Tech Talent Pipeline has resulted in meaningful workforce programs that have engaged over 400 employers and 17 local colleges. The City's $8M CS4All initiative and $20M CUNY 2X Tech program have both reached their targets to train 100,000 students and double the number of CUNY graduates with tech-related bachelors, respectively. Meanwhile, the Brooklyn Tech Triangle and Navy Yard are flourishing as a vibrant tech hub, thanks to intentional planning and targeted place-based investments.

We can look back at the past decade with some sense of accomplishment, but we cannot take the continued growth of the tech ecosystem for granted.

The city faces new challenges, particularly in today's post-COVID era where tech-enabled remote and flexible work lends uncertainties for where our talent will choose to live. HR&A's analysis shows that tech ecosystem workers have demonstrated unique trends for living increasingly outside of New York City, even prior to the pandemic. Without proactive intervention, we risk tech companies and tech talent choosing to anchor elsewhere.

And critically, we're not living up to our true potential as long as our tech ecosystem falls short of racial and gender equity. The growth and benefits of jobs in the tech sector continue to be spread unevenly, and our home-grown talent is not being fully utilized, even as employers are forced to search widely to secure workers with necessary skills. We must double down on equity-driven workforce initiatives that have proven to be effective, increase pathways for underrepresented populations into tech jobs by bridging employers with HBCUs, city colleges, and other diverse educational institutions, and invest in our people and neighborhoods across all five boroughs.

This will require close collaboration and partnerships between City government, employers, educational providers, nonprofits and more.

We invite you to join us in driving equitable tech growth for the next decade and beyond.

Steven Rubenstein,
Chairman, Association for a Better New York

Jason Clark,
Executive Director, Tech:NYC

ABOUT THE TEAM

Prepared by

HR&A Advisors, Inc. (HR&A) is an employee-owned company advising public, private, non-profit, and philanthropic clients on how to increase opportunity and advance quality of life in cities. We believe in creating vital places, building more equitable and resilient communities, and improving people's lives. HR&A's Urban Tech & Innovation practice works with governments, technology companies, institutions, advocates, and developers to leverage the technology and innovation economy to increase economic competitiveness, improve quality of life, and broaden economic opportunity in cities.

HR&A produced this report on behalf of the organizations listed below.

Commissioned by

The Association for a Better New York (ABNY) is a nonprofit organization that convenes, mobilizes, and activates the region's public and private sectors for the continuous growth and renewal of New York City's people, communities, and businesses. ABNY continues to carry out its mission as a leading forum where government officials and private sector leaders work together on solutions to New York's most pressing economic and social problems. ABNY achieves this by incorporating a comprehensive and diverse view of the issues and challenges facing New Yorkers to help solve public challenges and ensure New York is a better place for all those who live, work, and visit.

Tech:NYC is an engaged network of tech leaders working to foster a dynamic, diverse, and creative New York. The organization brings together New Yorkers to support a successful technology ecosystem, attract and retain top-tier talent, and celebrate New York and the companies that call it home. Tech:NYC mobilizes the expertise and resources of the tech sector to work with City and state government on policies that ensure New York's innovation economy thrives.

Google is a global technology leader focused on improving the ways people connect with information. Google's innovations in web search and advertising have made its website a top Internet property and its brand one of the most recognized in the world.

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New York City's tech ecosystem drives economic development across the entire city – offering high-wage opportunities even for jobs that have an average educational attainment below a bachelor's degree and generating 369,000 in direct jobs, $291B in economic output, and $3.63B in fiscal revenue for the city and state. New York City's tech ecosystem employed 369,000 people across tech and non-tech sectors, representing 7% of the city's entire workforce in 2021. These jobs pay 1.5 times higher than jobs in the rest of the economy today, and wages have grown faster compared to all jobs. Even for jobs that have an average educational attainment below a bachelor's degree, wages are 50% higher on average than those in the rest of the economy.

New York City's tech ecosystem contributed to a quarter of the city's total job growth in the last decade. However, tech ecosystem workers are increasingly living outside of the city as the ratio of residents to jobs has shrunk between 2012 and 2021. With the expansion of tech industries and maturing of startups, New York City's tech ecosystem has grown by 32% in the last decade and showed greater resilience during the COVID-19 pandemic when the city's overall workforce shrunk by 9%. However, tech ecosystem workers are more likely to live outside of the city than other occupations and at an increasing rate. In 2012, for every 1 tech ecosystem job in the city, there were 0.85 New York City residents working in a tech ecosystem occupation. In 2021, this ratio has dropped to 0.79. This trend is unique to tech.

While tech is concentrated in Manhattan, the decade between 2012 and 2021 saw high job growth of 42% in Brooklyn, reflecting investments in the Brooklyn Tech Triangle. By contrast, Queens, the Bronx, and Staten Island have seen minimal growth. Holding nearly three quarters of the city's entire tech ecosystem jobs, Manhattan serves as the nucleus of the tech ecosystem in New York City. Though Queens, the Bronx, and Staten Island saw minimal growth in tech ecosystem jobs since 2012, a third of all tech ecosystem workers reside in those boroughs.

Over the last decade, there have been slight improvements in non-white and female representation within the tech ecosystem, but it is still not reflective of the city's racial and gender diversity, despite numerous equity-driven workforce initiatives. While Black- and Latino/a-identifying New Yorkers make up 35% of the city's workforce, only 22% of tech ecosystem workers identify as Black or Latino/a. This underrepresentation is particularly stark across some of the larger and faster growing tech occupations, such as software developers. Black and Latino/a workers also currently see a pay gap of up to $26,000 compared to peers. Meanwhile, women make up 31% of the tech ecosystem and are still paid $5,000 less than their male counterparts.

369,000
TOTAL JOBS
7% of NYC Total Jobs

$291B
ECONOMIC OUTPUT
28% of NYC Economic Output

$3.63B
FISCAL IMPACT
2.6% of the City's Fiscal Revenues
1.5% of the State's Fiscal Revenues

1.5X
HIGHER EARNINGS
in the tech ecosystem compared to the overall economy

+1.2 JOB MULTIPLIER
Every 1 tech ecosystem job creates 1.2 additional jobs, higher than other industries in the city

City government and industry partners must work together to make intentional people-based and place-based investments that will grow and sustain New York City's tech ecosystem in an equitable and inclusive manner, prioritizing workforce development and job access for Black, Latino/a, and female workers and strategies to drive tech-supported economic development in the outer boroughs.

People-Based Investments:

Strengthen existing workforce programs that are driving equitable outcomes across the tech talent pipeline from K-12 students to degree graduates to prospective job seekers.

- The City should expand CS4All with support from industry leaders with a focus on developing quality K-12 computer science teachers in underserved schools.

- The City should continue to invest in CUNY 2X Tech with a continued focus on racial and gender equity.

- The City should collaborate closely with industry partners to identify quality and effective equity-driven workforce programs and drive investments to allow them to reach scale, particularly programs located in neighborhoods outside Manhattan and those focused on training software developers.

Build more inclusive on-ramps to tech jobs and careers by investing in stronger partnerships and collaboration across ecosystem actors.

- Industry partners should develop stronger outreach and pipelines with historically black colleges and universities (HBCUs) to ensure students come back to New York after school.

- The City and CUNY should target a share of its recently announced $16M Inclusive Economy Initiative towards tech.

- The City should reinvest in the Tech Talent Pipeline (TTP) to serve as a better convener across industry, academic institutions, training providers, and talent.

Place-Based Investments

Advance technology-based economic development across all five boroughs and in key non-tech sectors.

- The City should develop strategies to integrate technology into critical sectors to drive greater economic development and growth in boroughs other than Manhattan.

- The City should invest in neighborhood-based tech infrastructure and workforce development programs in boroughs other than Manhattan, leveraging existing assets such as libraries and community centers.

- Industry partners should launch a marketing and branding campaign with public sector support to publicize the growing tech opportunities in New York City to encourage people to return after graduation.

Make targeted neighborhood investments that are responsive to today's hybrid work environment to ensure tech ecosystem workers have positive experiences living and working in New York City.

- The City should work with industry partners to improve the experience of office districts for New Yorkers amidst current and future hybrid work trends.

- The City should invest in neighborhood-based quality of life initiatives to enable tech workers to work flexibly and remotely without leaving New York City.

- The City and industry partners should continue to encourage tech entrepreneurship and startup activity in existing tech hubs across the city.

KEY INSIGHTS

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1 **New York City's tech ecosystem** drives economic development **across the entire city – offering high-wage opportunities, including jobs that have an average educational attainment below a bachelor's degree, and generating 369,000 in direct jobs, $291B in economic output, and $3.63B in fiscal revenue for the city and state.**

2 **New York City's tech ecosystem contributed to** a quarter of the city's total job growth **in the last decade. However, tech ecosystem workers increasingly live outside of the city as the ratio of residents to jobs has shrunk between 2012 and 2021.**

3 **While tech is concentrated in Manhattan, the decade between 2012 and 2021 saw high job growth of 42% in Brooklyn, reflecting investments in the Brooklyn Tech Triangle. By contrast,** Queens, the Bronx, and Staten Island have seen minimal growth.

4 **Over the last decade, there have been slight improvements in non-white and female representation within the tech ecosystem, but it is still not reflective of the city's racial and gender diversity, despite numerous equity-driven workforce initiatives.** Black and Latino/a workers see a representation gap of 13% and a pay gap of up to $26,000 compared to peers.
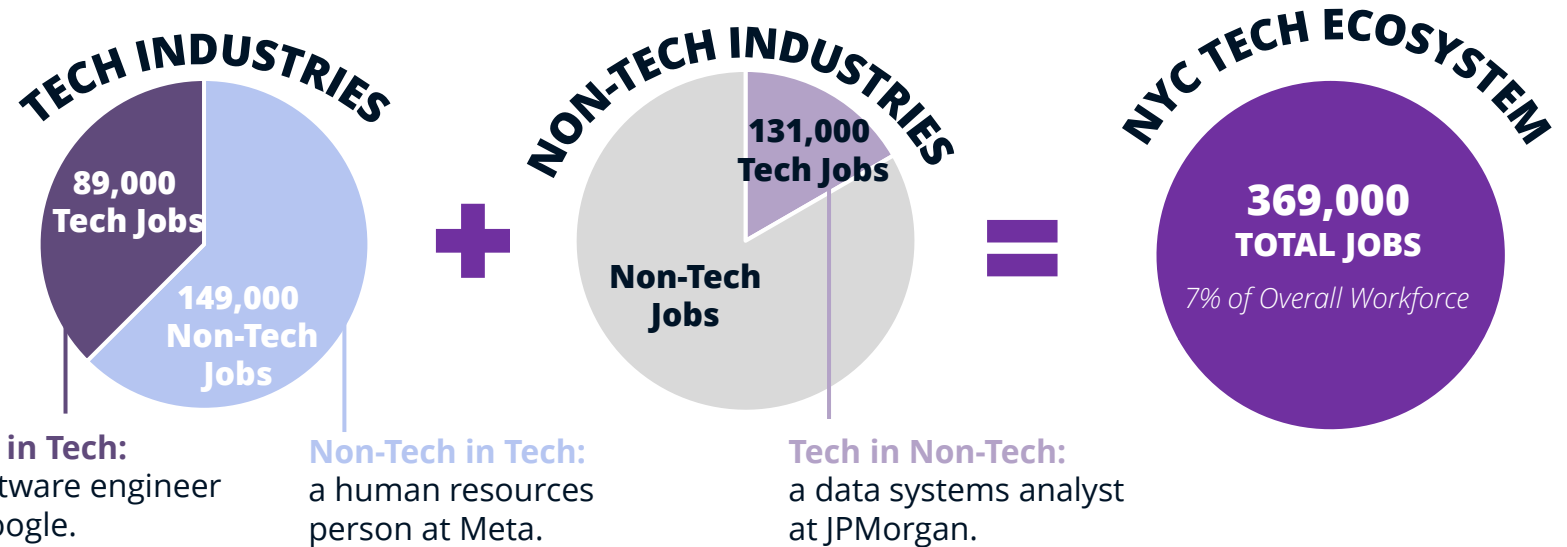
1

New York City's tech ecosystem drives economic development across the entire city – offering high-wage opportunities, including jobs that have an average educational attainment below a bachelor's degree, and generating 369,000 in direct jobs, $291B in economic output, and $3.63B in fiscal revenue for the city and state.

New York City's tech ecosystem employs 369,000 people across tech and non-tech sectors, representing 7% of the city's entire workforce in 2021.

New York City's tech ecosystem jobs are distributed throughout tech and non-tech industries and occupations, incorporating a broad range of jobs that either directly enable, produce, or facilitate technological growth. Tech ecosystem jobs fall into three broad categories:

1) **Tech Occupations in Tech Industries** – for example, a software engineer at Google.

2) **Non-Tech Occupations in Tech Industries** – for example, a human resources manager at Meta.

3) **Tech Occupations in Non-Tech Industries** – for example, an engineering manager at JPMorgan or any number of finance, healthcare, professional services, government, and other organizations.

In 2021, there were 89,000 tech workers and 149,000 non-tech workers within tech industries. Non-tech industries held an additional 131,000 tech jobs.

TECH INDUSTRIES

89,000 Tech Jobs

149,000 Non-Tech Jobs

+

NON-TECH INDUSTRIES

131,000 Tech Jobs

Non-Tech Jobs

=

NYC TECH ECOSYSTEM

369,000 TOTAL JOBS

7% of Overall Workforce

Tech in Tech: a software engineer at Google.

Non-Tech in Tech: a human resources person at Meta.

Tech in Non-Tech: a data systems analyst at JPMorgan.

Source: HR&A analysis of Lightcast data; diagram not to scale.

Tech jobs are increasingly prevalent across all sectors in New York City, including in industries not traditionally associated with "tech." While 65% of tech ecosystem jobs are in tech industries, a notable 35% share of jobs are in non-tech industries. Nearly 1.5X more tech workers are employed in non-tech industries (131,000) than in tech industries (89,000), particularly in sectors that are key to the city's current and future economic health – healthcare, film and media, finance, and advertising. About 60% of the tech jobs in non-tech industries can be considered "high-tech,"* focused on the creation and management of sophisticated tools, products, systems, and support services, such as network and computer systems administrators, data administrators, information security analysts, and computer and information system managers. In today's fast-changing world, these digital skills and jobs that leverage technology will only continue to grow in importance in every sector.
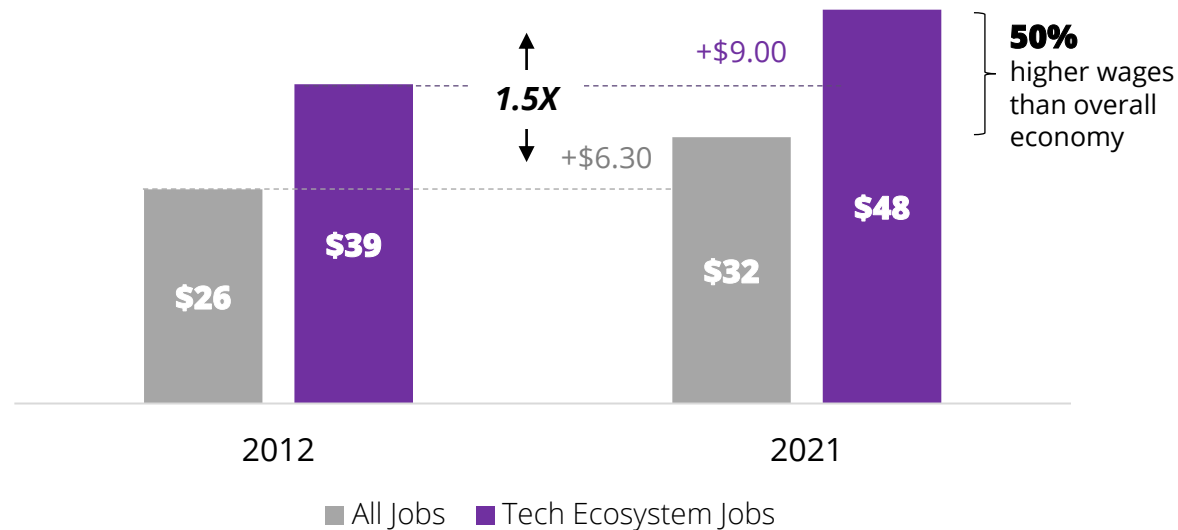
*See Appendix for a list of tech jobs classified as high-tech.

Tech ecosystem wages, including those for non-tech jobs, are significantly higher and grew faster than other jobs in the overall economy in the last decade. The average hourly wage in the tech ecosystem is $48/hour, compared to an average of $32/hour for the overall economy. Across the tech ecosystem, the highest wages are concentrated in tech jobs (both in tech and non-tech industries), although non-tech in tech jobs still pay more than the New York City overall economy.
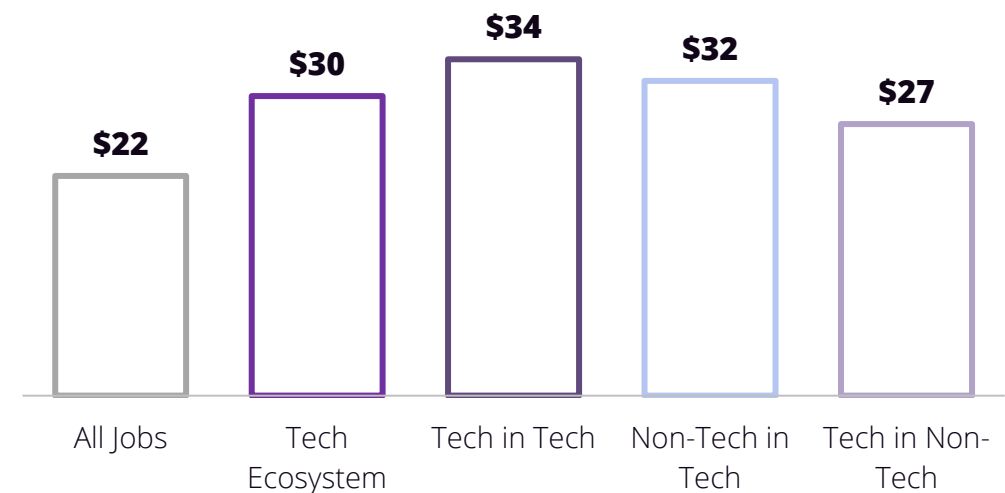
Between 2012 and 2021, wages in the tech ecosystem grew by $9 per hour on average, 1.5X faster than the wage growth experienced across the economy. The city also added 60,000 high-wage tech ecosystem jobs paying more than $40/hour. These high-wage jobs increased by 40% over the last decade, and today over 50% of tech ecosystem jobs pay more than $40/hour.

Given that wages are 50% higher on average relative to those in the rest of the economy, the tech ecosystem offers meaningful economic opportunities, even to workers that have an average educational attainment below a bachelor's degree. For jobs with an average educational attainment below a bachelor's degree, the median hourly wage in the city's tech ecosystem is $30 per hour compared to $22/hour in the overall economy. Some of the larger and faster-growing occupations with an average educational attainment below a bachelor's degree include Web Developers, Computer User Support Specialists, and Computer Network Support Specialists. By participating in the tech ecosystem, individuals who do not have bachelor's degree can better access well-paying jobs and economic mobility.

Median Hourly Wage Growth

+$9.00
1.5X
+$6.30

50% higher wages than overall economy

$26
$39
$32
$48

2012   2021

■ All Jobs   ■ Tech Ecosystem Jobs

Median Hourly Wage for Jobs with an Average Educational Attainment below a Bachelor's Degree (2021)

$22 $30 $34 $32 $27

All Jobs | Tech Ecosystem | Tech in Tech | Non-Tech in Tech | Tech in Non-Tech

Source: HR&A analysis of Lightcast data; wages are based on 2020 data. Average educational attainment indicates the typical education level needed to enter an occupation as reported at the national level by the Bureau of Labor Statistics.

New York City's tech ecosystem generates significant economic and fiscal impacts for the city. The direct, indirect, and induced impacts of the tech ecosystem account for a total of 809,000 jobs, $291 billion in economic output, and $3.63 billion in fiscal revenue for the city and the state.

Tech jobs have larger multiplier effects on employment compared to other industries. The 369,000 direct jobs in the tech ecosystem contribute 440,000 additional multiplier jobs in New York City, representing 15% of the city's total workforce. In 2013, this share was 13%. Every 1 tech ecosystem job creates an additional 1.2 jobs, considerably higher than other top industries in the city like Finance and Insurance or Professional Services.

The city's tech ecosystem generates $109 billion in worker earnings from direct and multiplier jobs, equivalent to 16% of the city's total worker earnings. Of that, $66 billion is generated from direct jobs and $43 billion from additional multiplier jobs. In other words, for every dollar of earnings within the tech industry, an additional $0.65 in earnings is created within the city's economy.

Economic output from the tech ecosystem accounts for 28% of the city's overall economic output. This is twice the share of the tech ecosystem's output in 2013. The tech ecosystem's $195 billion in direct economic output contributes an additional $96 billion in multiplier effects. In other words, tech ecosystem investments drive additional spending in the New York City economy: every $1 spent in the tech ecosystem supports an additional $0.49 in economic output.

New York City's tech ecosystem workers also contribute billions of dollars to City and State fiscal revenues in the form of sales and income taxes. In 2021, the tech ecosystem was responsible for $696 million, or 8% of the City's sales tax revenue, and $1.10 billion or 9% of the City's income tax revenue. Similarly for New York State, the city's tech ecosystem generated $677 million in sales tax collections and $1.15 billion in income tax collections. Overall, the tech ecosystem generated $1.80 billion and $1.83 billion in taxes for New York City and New York State, respectively, in 2021, contributing a total of $3.63 billion in fiscal revenues.

809,000 TOTAL JOBS
15% of New York City's Total Jobs

1
DIRECT TECH ECOSYSTEM JOB

=

+1.2
ADDITIONAL JOBS

$291B ECONOMIC OUTPUT
28% of New York City's Total Economic Output

$1
DIRECTLY SPENT IN TECH ECOSYSTEM

=

$0.49
ADDITIONAL SPENDING

$3.63B FISCAL REVENUE
2.6% and 1.5% of New York City's and New York State's Overall Fiscal Revenue

$1.08 B
CITY SALES & INCOME TAX

+

$1.83B
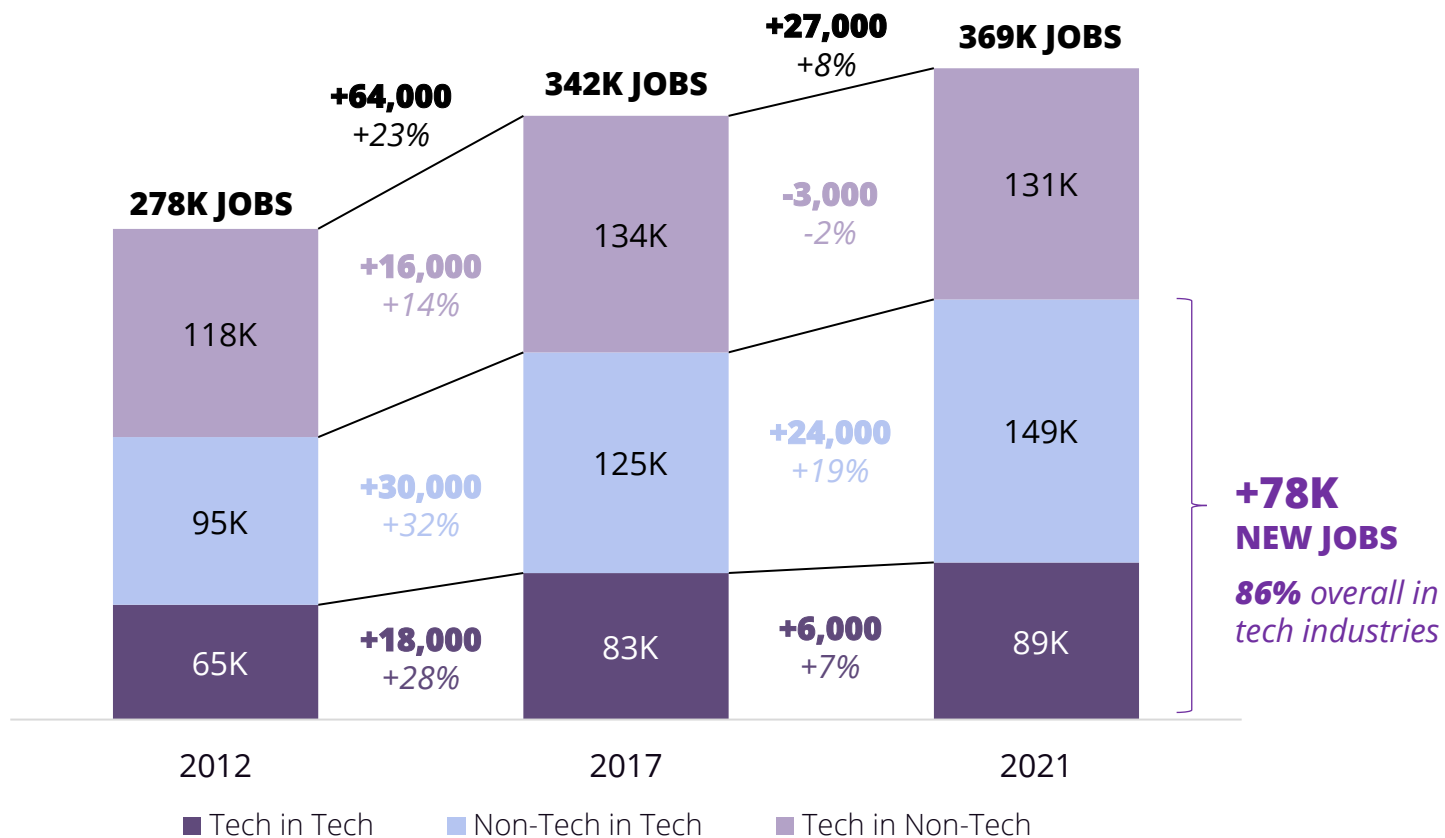STATE SALES & INCOME TAX

Source: HR&A's analysis of Lightcast data using IMPLAN (for economic impacts) and New York tax database (for fiscal impacts).

2 **New York City's tech ecosystem contributed to** a quarter of the city's total job growth **in the last decade; however, tech ecosystem workers are increasingly living outside of the city – the ratio of residents to jobs has shrunk between 2012 and 2021.**

NYC Tech Ecosystem Job Growth (2012-2021)

+27,000
+8%

+64,000
+23%

369K JOBS

342K JOBS

278K JOBS

131K

-3,000
-2%

134K

118K

+16,000
+14%

149K

125K

+24,000
+19%

95K

+30,000
+32%

+78K
NEW JOBS

89K

65K

+18,000
+28%

83K

+6,000
+7%

86% overall in tech industries

2012   2017   2021

■ Tech in Tech   ■ Non-Tech in Tech   ■ Tech in Non-Tech

New York City's tech ecosystem has grown by 32% in the last decade, fueled by the expansion and growing maturity of the tech industry. Since 2012, the tech ecosystem has added 91,000 jobs – a quarter of the total job growth in the city's economy between 2012 and 2021. Tech industries have predominantly contributed to the tech ecosystem growth. Of the 91,000 tech ecosystem jobs added over the last decade, tech industries accounted for 86%. At the same time, tech roles in non-tech industries grew by 13,000 jobs as more non-tech industries explore tech-based innovation.

Since 2012, the tech industry added 54,000 non-tech jobs compared to 24,000 tech jobs. This reflects the burgeoning network of tech firms and tech startups in New York City that have emerged over the past decade and invested in human resources, managerial, financial, sales, marketing, and legal functions.

New York City's tech industries showcased greater resilience during the COVID-19 pandemic compared to the overall economy. While the city's workforce shrunk by 5% from 2017 to 2021, the tech ecosystem grew 8%, with tech industries adding 30,000 jobs, demonstrating its strength and ability to adapt quickly compared to other sectors of the economy, even during the pandemic.

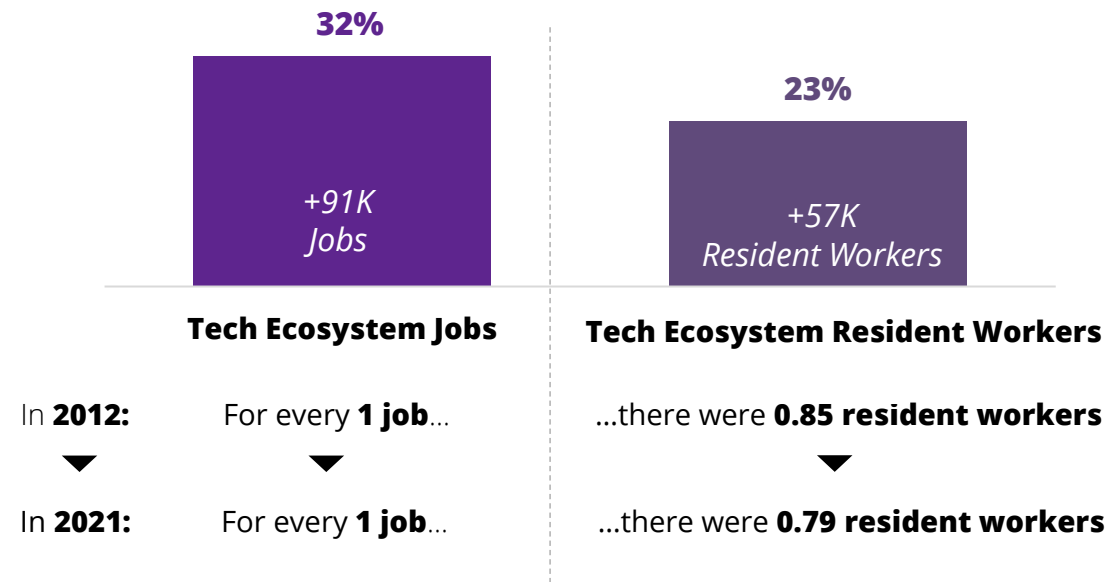*Source: HR&A analysis of Lightcast data.*

Despite strong job growth, HR&A's analysis suggests that tech ecosystem workers increasingly live outside of New York City. Over the last decade, the city added 91,000 tech ecosystem jobs but only 57,000 residents working in the tech ecosystem. This difference is driven by tech industries: of the 57,000 new resident workers*, 73% held jobs in tech industries and 27% in non-tech industries. Meanwhile, 86% of the 91,000 new jobs added were in tech industries compared to 14% in non-tech industries. This could reflect a higher propensity for tech companies to hire from a national talent pool and adopt remote work practices.

More significantly, the ratio between tech ecosystem jobs to residents has declined in the last decade. In 2012, for every 1 tech ecosystem job in the city, there were 0.85 New York City residents working in a tech ecosystem occupation. In 2021, this ratio dropped to 0.79. Specifically for tech industries, this ratio decreased from 0.84 to 0.74

between 2012 and 2021, while for tech in in non-tech industries, the ratio increased from 0.87 to 0.90 during the same period. This trend is unique to tech. Across the entire economy, the ratio between New York City jobs and residents has held constant in the last decade (1 to 0.89). Other occupations, such as financial, management, and healthcare roles, have a higher jobs to resident worker ratio that has also barely changed over the last decade.

Tech ecosystem workers may choose to live outside of New York City due to several factors: cheaper housing options and cost of living, and remote and flexible work. As remote and hybrid work continues in the foreseeable future, this pattern could be a harbinger of a larger trend. If this decline in tech residents to jobs continues, the city could be at risk of losing significant fiscal revenue and face a weakened ability to attract new businesses and residents to New York City.

Growth in Tech Ecosystem Jobs vs Tech Workers Residing in NYC (2012-2021)

32%

+91K Jobs

23%

+57K Resident Workers

Tech Ecosystem Jobs

Tech Ecosystem Resident Workers

In **2012:** For every **1 job**... ...there were **0.85 resident workers**

In **2021:** For every **1 job**... ...there were **0.79 resident workers**

Ratio of Jobs to Workers Residing in NYC for Select Occupations

	2012	2021
Management Occupations	0.89	0.89
Business & Financial Occupations	0.86	0.85
Computer & Mathematical Occupations	0.84	0.82
Healthcare Practitioners	0.94	0.94
Healthcare Support Occupations	0.89	0.89
All Occupations	**0.89**	**0.89**

*Source: HR&A analysis of Lightcast data. *Tech resident workers represent workers living in New York City who hold a tech ecosystem job. Resident workers may work within or outside of New York City.*
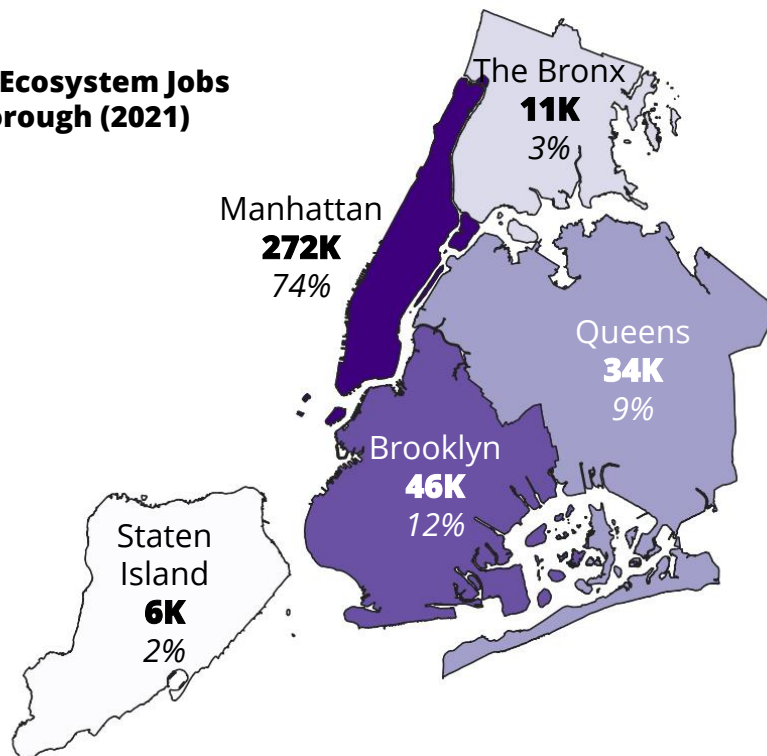
3

While tech is concentrated in Manhattan, the last decade saw a high job growth of 42% in Brooklyn between 2012-2021, reflecting investments in the Brooklyn Tech Triangle. By contrast, Queens, the Bronx, and Staten Island have seen minimal growth.

Manhattan serves as the nucleus of the tech ecosystem in New York City.
Adding 73,000 jobs over the last decade, the borough now contains nearly three quarters of the city's entire tech ecosystem workforce. Manhattan provides the advantage of density in businesses, workers, and office space and benefits from historic investments in tech incubators, accelerators, and other programs that grow the tech ecosystem. The remaining jobs are distributed across the outer boroughs, of which Brooklyn has the largest share with 12% of tech ecosystem jobs.
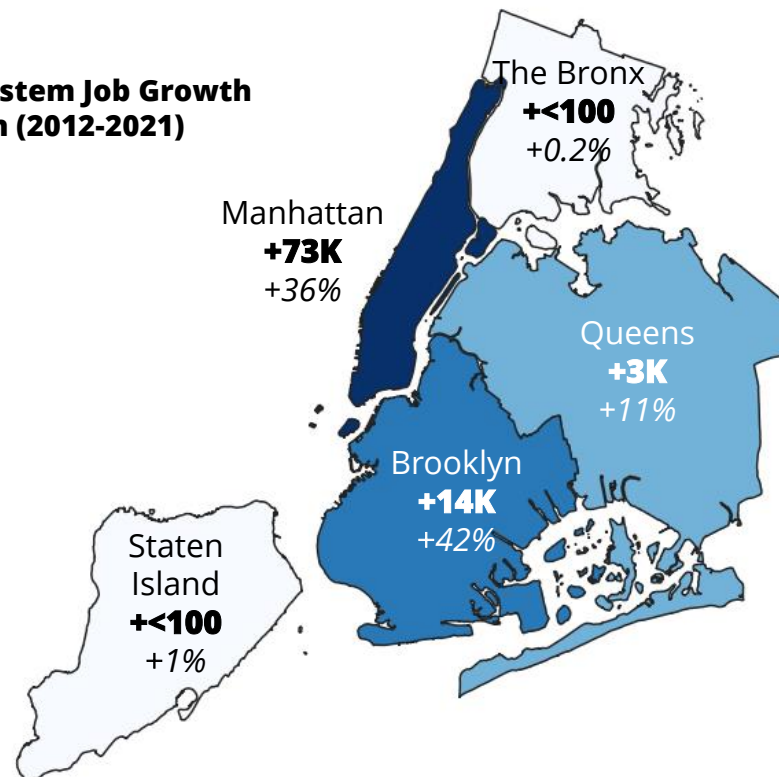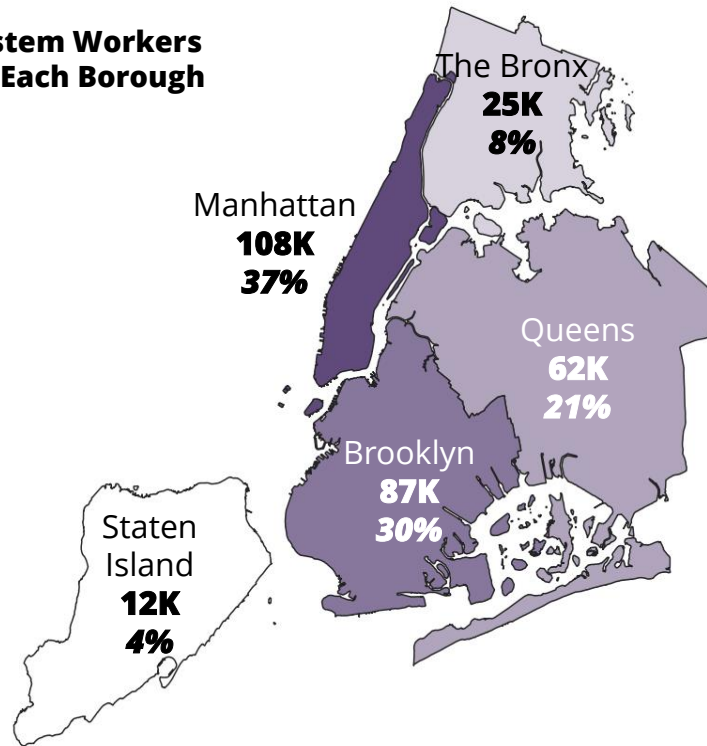
Brooklyn experienced the largest percent growth in tech ecosystem jobs of all the boroughs in the last decade. The unprecedented growth of Brooklyn's tech ecosystem can be attributed to investments in the Brooklyn Navy Yard and the Brooklyn Tech Triangle over the last ten years. By contrast, Queens, which held a similar share of jobs in 2012, has only added 3,000 tech ecosystem jobs in the last decade. The Bronx and Staten Island have seen no meaningful growth.

Tech Ecosystem Jobs by Borough (2021)

The Bronx 11K 3%
Manhattan 272K 74%
Queens 34K 9%
Brooklyn 46K 12%
Staten Island 6K 2%

Tech Ecosystem Job Growth by Borough (2012-2021)

The Bronx +<100 +0.2%
Manhattan +73K +36%
Queens +3K +11%
Brooklyn +14K +42%
Staten Island +<100 +1%

Source: HR&A analysis of Lightcast data. Note that totals may not sum due to rounding.

Tech Ecosystem Workers Residing in Each Borough (2021)

The Bronx
25K
8%

Manhattan
108K
37%

Queens
62K
21%

Brooklyn
87K
30%

Staten Island
12K
4%

Population by Borough (2021)

The Bronx
1.4M
17%

Manhattan
1.6M
19%

Queens
2.3M
28%

Brooklyn
2.6M
31%

Staten Island
0.5M
6%

Though Queens, the Bronx, and Staten Island saw minimal growth in tech ecosystem jobs since 2012, a third of all tech ecosystem workers reside in those boroughs. While 74% of tech ecosystem jobs are located in Manhattan, 63% of tech ecosystem workers live in the outer-boroughs. The geographic distribution of tech ecosystem workers across the boroughs is somewhat consistent with the population by borough. Brooklyn and Staten Island are home to 31% and 6% of the city's population, and 30% and 4% of tech ecosystem workers, respectively. However, these are exceptions. Manhattan hosts a disproportionately large share of tech ecosystem workers, at 37%, compared to 19% of the city's overall population. On the other hand, Queens and the Bronx are home to 28% and 17% of the city's population, but only 21% and 8% of tech ecosystems workers reside there, respectively.
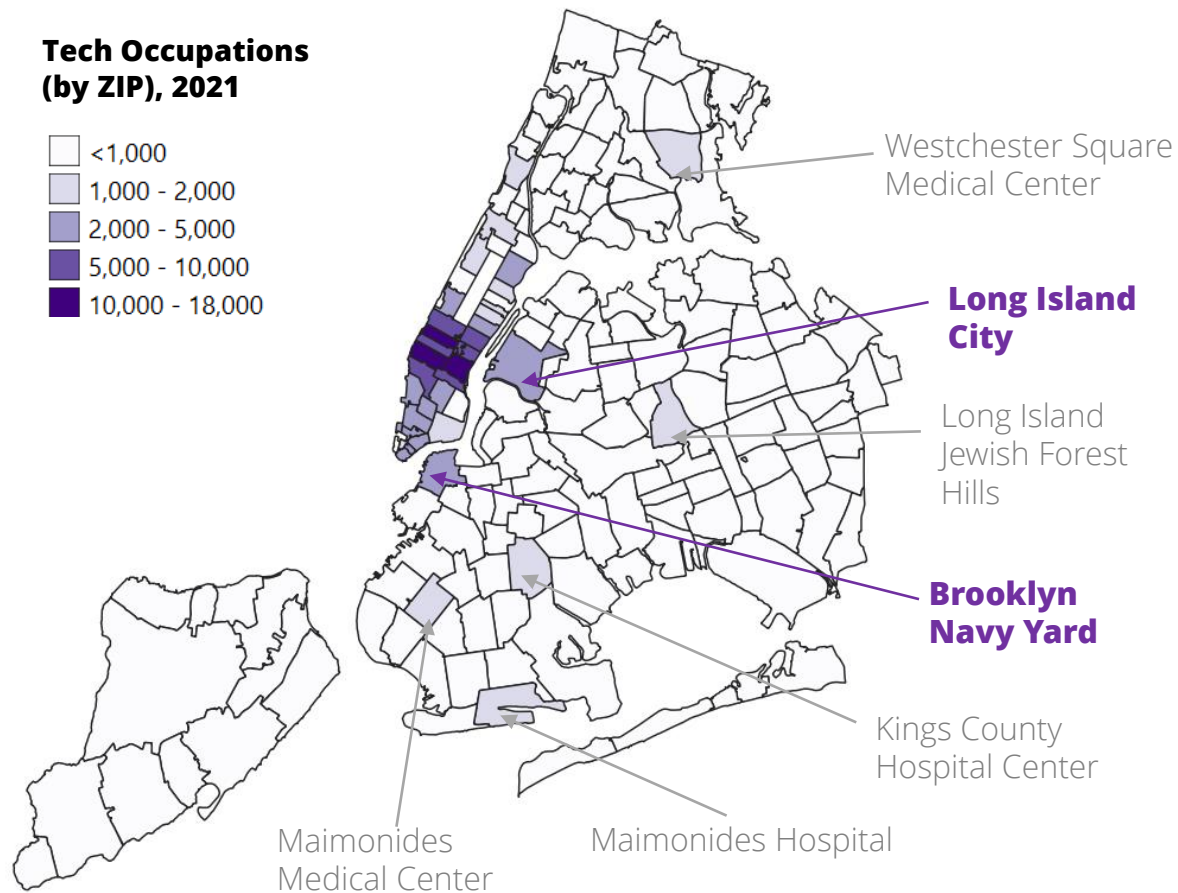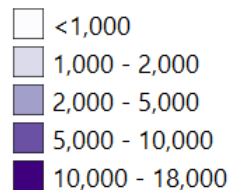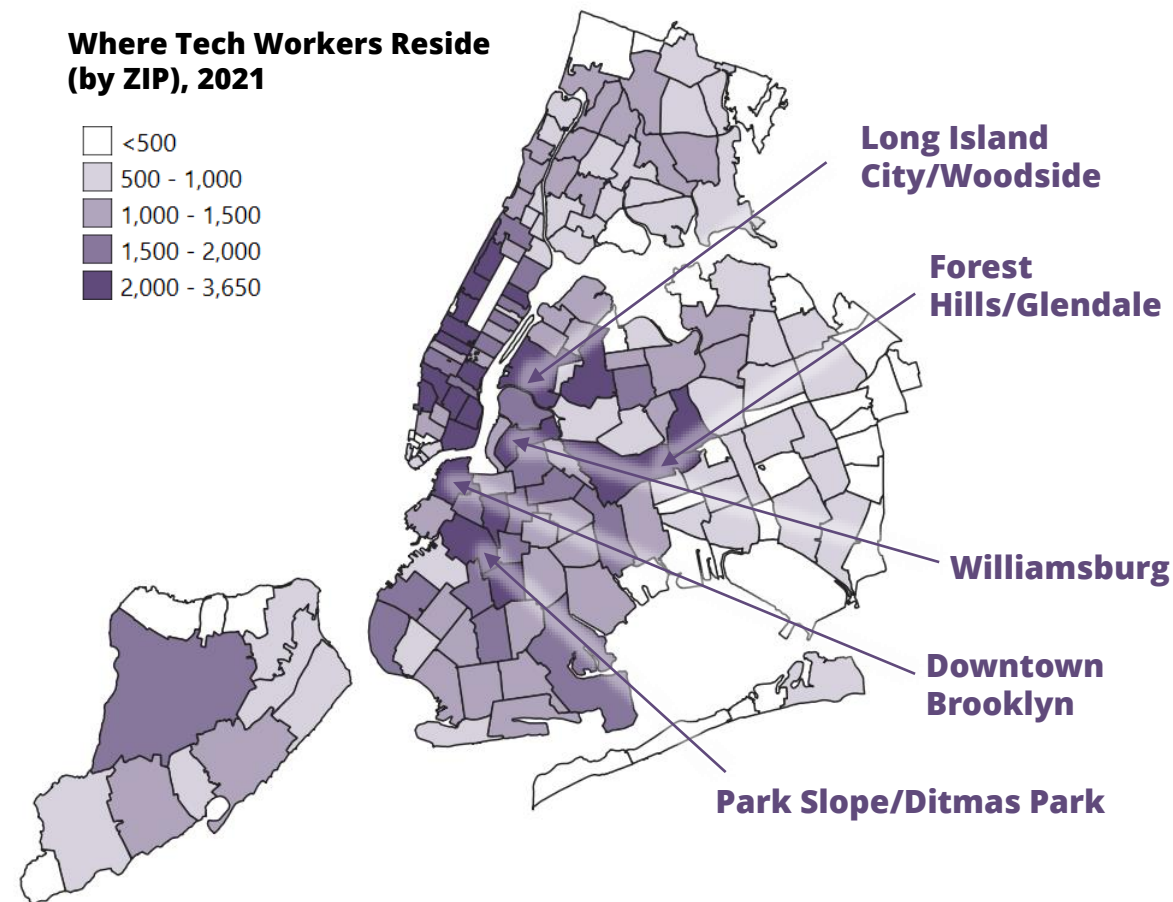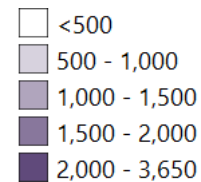
Queens, the Bronx, and Staten Island may be able to build upon their large base of residents who work in the tech ecosystem to encourage stronger job growth outside of existing clusters in Manhattan and Brooklyn. A third of top tech occupations, such as Software Developers, Web Developers, and Computer Support Specialists live in Queens, the Bronx, and Staten Island. Tech ecosystem workers in non-tech roles are also well-represented. More than a quarter of Sales Representatives, Customer Service Representatives, and Market Research Analyst occupations in the tech ecosystem reside in the boroughs. Strategic investments in employment and training in Queens, the Bronx, and Staten Island may not only benefit existing tech ecosystem workers living in those boroughs, but also enable more New Yorkers to access the benefits that the tech ecosystem provides.

Source: HR&A analysis of Lightcast data. Population data from "City Population" website. Note that totals may not sum due to rounding.

Tech Occupations (by ZIP), 2021

- ☐ <1,000
- ☐ 1,000 - 2,000
- ☐ 2,000 - 5,000
- ☐ 5,000 - 10,000
- ■ 10,000 - 18,000

Westchester Square Medical Center

Long Island City

Long Island Jewish Forest Hills

Brooklyn Navy Yard

Kings County Hospital Center

Maimonides Medical Center

Maimonides Hospital

Where Tech Workers Reside (by ZIP), 2021

- ☐ <500
- ☐ 500 - 1,000
- ☐ 1,000 - 1,500
- ☐ 1,500 - 2,000
- ■ 2,000 - 3,650

Long Island City/Woodside

Forest Hills/Glendale

Williamsburg

Downtown Brooklyn

Park Slope/Ditmas Park

Tech jobs are concentrated around office clusters, large institutions, and other hubs where strategic investments have supported ecosystem growth. Tech occupations exist in the highest density between Union Square and Midtown in Manhattan, with smaller pockets in Lower Manhattan, the Upper East Side, and the Upper West Side. Outside of Manhattan, tech jobs are present in areas where public and private investments have been made, such as the Brooklyn Navy Yard and Long Island City.

Source: HR&A analysis of Lightcast data.

Tech ecosystem workers tend to live in middle- and high-income neighborhoods that are either proximate to tech job clusters or are readily accessible to such clusters via transportation. While tech occupations are highly clustered around ecosystem-supporting districts and hubs, the geographic distribution of workers is far more dispersed across the city. While proximity (or commute) to workplace may influence some workers (as evidenced by the concentration of workers residing in Manhattan, Western Queens, Northern Brooklyn, and Downtown Brooklyn), others may prioritize other quality of life factors and choose to live further from the urban core, particularly with the emergence of remote work.

4

Over the last decade, there have been slight improvements in non-White and female representation within the tech ecosystem, but it is still not reflective of the city's racial and gender diversity, despite numerous equity-driven workforce initiatives. Black and Latino/a workers see a representation gap of 13% and a pay gap of up to $26,000 compared to peers.

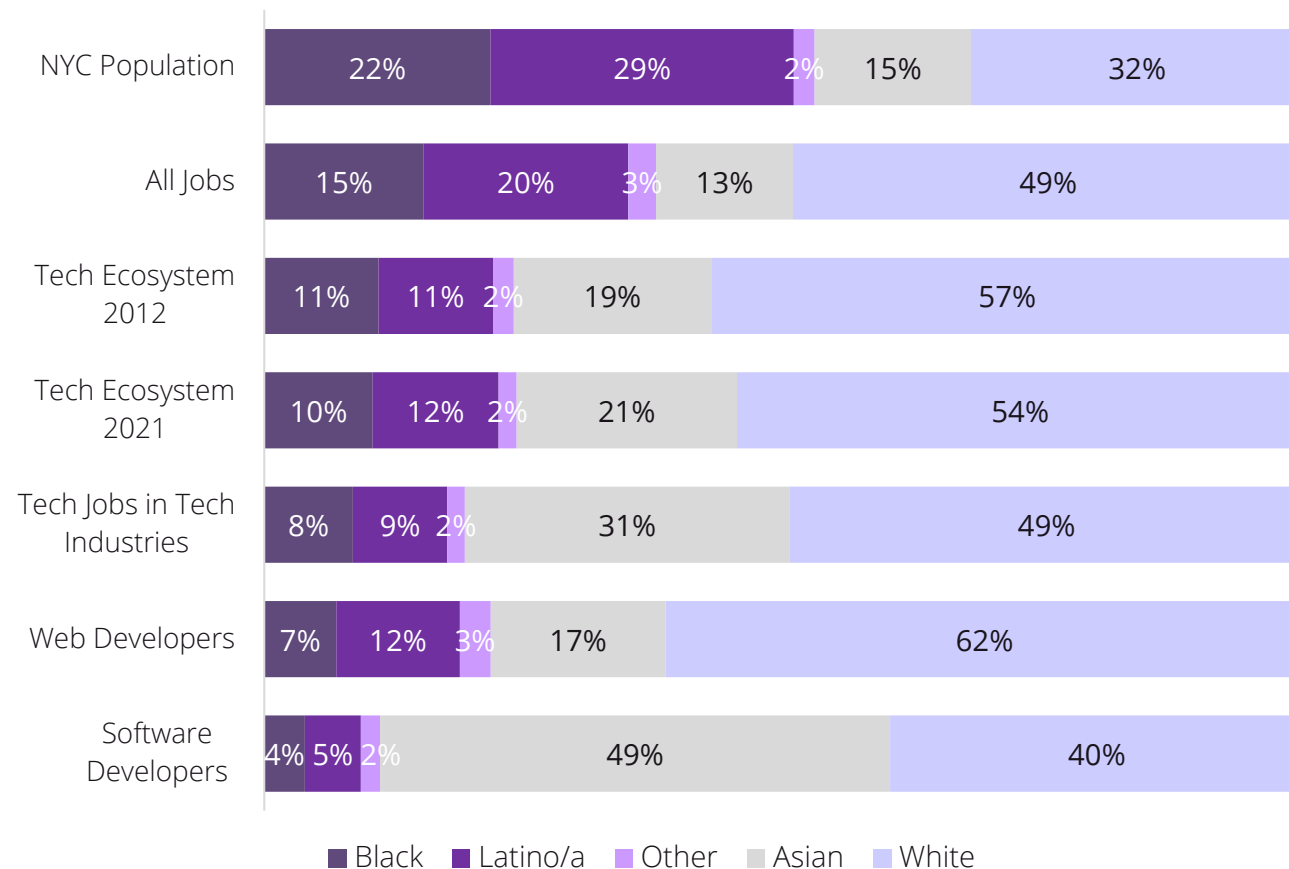**Racial disparities continue to persist in the tech ecosystem, particularly for Black and Latino/a workers.** While Black- and Latino/a-identifying New Yorkers make up more than half of the city's population and 35% of the city's workforce, only 22% of tech ecosystem workers identify as Black or Latino/a. Most significantly, over the last decade, the share of Black and Latino/a workers in the tech ecosystem has not changed.

The representation gap is starkest in occupations that tend to have higher credentialing and educational requirements. Only 17% of workers in tech jobs in tech industries identify as Black or Latino/a, and only 9% of the 53,000 Software Developers identify as Black or Latino/a. Jobs that have an average educational attainment below a bachelor's degree, such as Computer User Support Specialists, Web Developers, and Sales and Customer Service Representatives tend to have a higher level of racial and ethnic diversity. Similarly, the share of Black and Latino/a workers is highest in lower-wage jobs, such as Customer Service Representatives and Telecommunication Installers and Repairers, compared to high-wage jobs, such as Computer Systems Managers (see chart on next page).

While New York City is performing marginally better compared to the rest of the U.S., where 19% of the ecosystem is Black or Latino/a, it is still lagging similarly diverse cities like Houston (27% Black or Latino/a) and Chicago (32% Black or Latino/a) in terms of representation. More needs to be done to close the racial gaps in tech.

Source: HR&A analysis of Lightcast data..

Racial Representation, by Category

Category	Black	Latino/a	Other	Asian	White
NYC Population	22%	29%	2%	15%	32%
All Jobs	15%	20%	3%	13%	49%
Tech Ecosystem 2012	11%	11%	2%	19%	57%
Tech Ecosystem 2021	10%	12%	2%	21%	54%
Tech Jobs in Tech Industries	8%	9%	2%	31%	49%
Web Developers	7%	12%	3%	17%	62%
Software Developers	4%	5%	2%	49%	40%

■ Black ■ Latino/a ■ Other ■ Asian ■ White
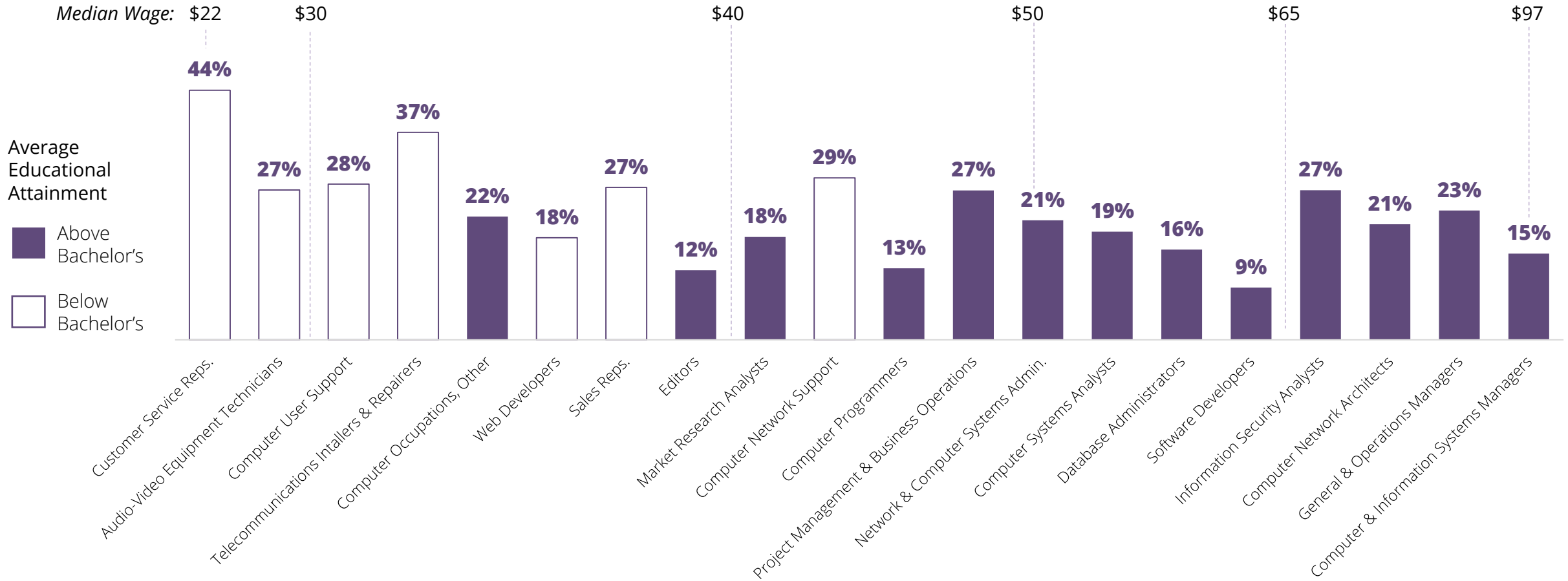
Black and Latino/a workers have a harder time accessing higher-paying tech jobs, which often require degrees or higher education. Of the top 20 largest tech ecosystem occupations, Black and Latino/a workers are represented to a higher degree in Customer Se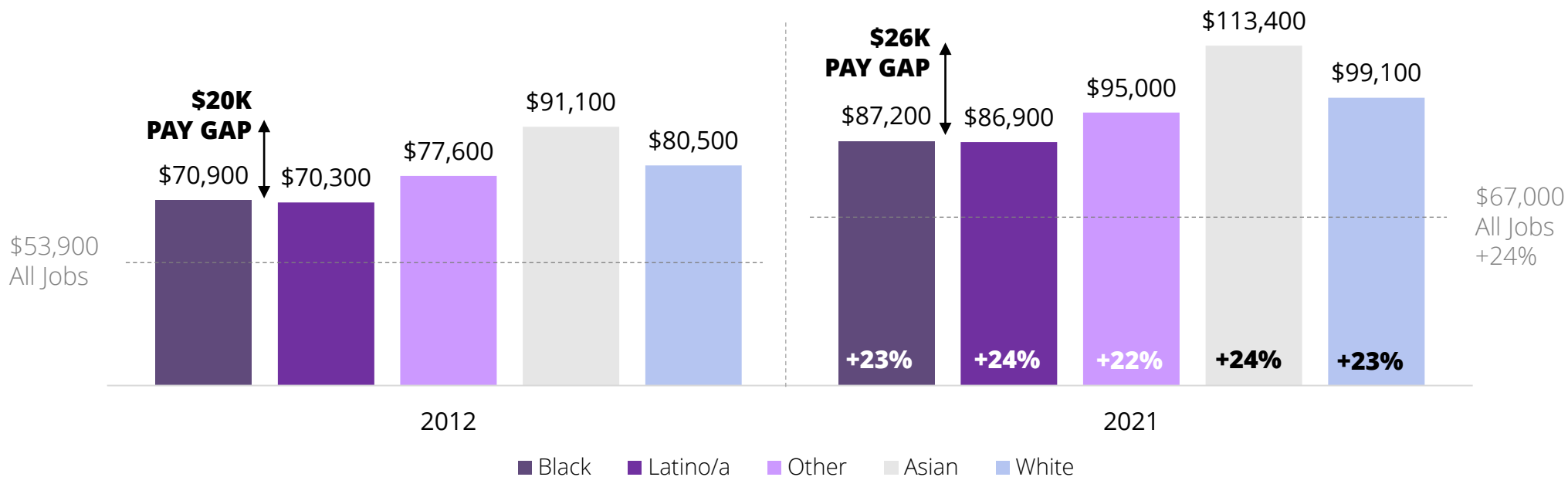rvice Representatives, Telecommunication Installers and Repairers, Computer Network Support Specialists, and Computer User Support Specialists. Only 9% of Software Developers are Black and Latino/a. Workforce training programs and initiatives must invest in lowering the barriers to high-paying tech jobs, while providing upward mobility opportunities for those in lower-paying roles.

Share of Black & Latino/a Workers in Top 20 Largest Tech Ecosystem Occupations (2021)

Median Wage: $22 $30 $40 $50 $65 $97

Average Educational Attainment

■ Above Bachelor's
□ Below Bachelor's

Occupation	Share
Customer Service Reps.	44%
Audio-Video Equipment Technicians	27%
Computer User Support	28%
Telecommunications Installers & Repairers	37%
Computer Occupations, Other	22%
Web Developers	18%
Sales Reps.	27%
Editors	12%
Market Research Analysts	18%
Computer Network Support	29%
Computer Programmers	13%
Project Management & Business Operations	27%
Network & Computer Systems Admin.	21%
Computer Systems Analysts	19%
Database Administrators	16%
Software Developers	9%
Information Security Analysts	27%
Computer Network Architects	21%
General & Operations Managers	23%
Computer & Information Systems Managers	15%

Source: HR&A analysis of Lightcast data; wages are based on 2020 data. Average educational attainment indicates the typical education level needed to enter an occupation as reported at the national level by the Bureau of Labor Statistics.

NYC Tech Ecosystem Average Annual Earnings, By Race

Black ■ **Latino/a** ■ **Other** ■ **Asian** ■ **White**

Within the tech ecosystem, pay gaps exist across race and have not improved over time – Black and Latino/a tech ecosystem workers currently earn approximately $26,000 and $12,000 less on average compared to their Asian and White peers, respectively. In addition to stark racial representation gap, Black and Latino/a workers also face a clear wage gap. On average, White and Asian workers within the tech ecosystem are paid 1.2X more than Black and Latino/a workers. While Black and Latino/a workers still earn higher than average wages compared to the city average, historic barriers continue to prevent these groups from accessing higher paying high-tech roles and promotions.

While average annual earnings have grown relatively consistently across racial and ethnic groups in percentage terms, the racial pay gap has increased over the past decade in absolute terms. In 2012, the wage gap between Black workers and Asian workers was approximately $20,000. By 2021, this pay gap grew to $26,000. This trend is similar for Latino/a workers. In order to bridge racial and ethnic wage gaps, it is essential to expand access to high-paying jobs in the tech ecosystem, particularly for historically marginalized workers from Black and Latino/a backgrounds.
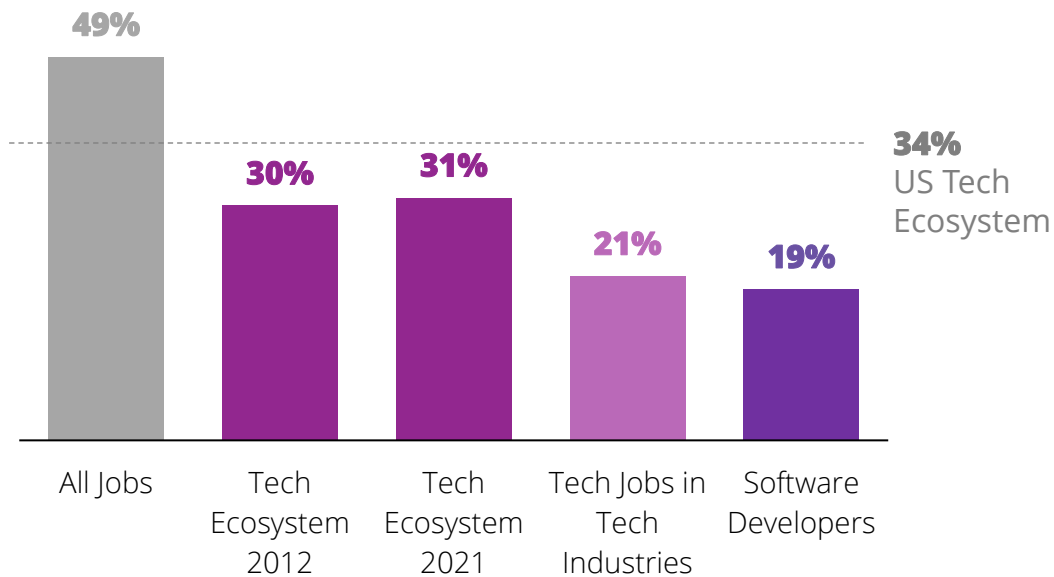
Source: HR&A analysis of Lightcast data; wages are based on 2020 data.

New York City's tech ecosystem also experiences an inequitable gender representation.* Female representation in the tech ecosystem is low – only 31% – and has only improved marginally (1 percentage point) in the last decade. Furthermore, for tech roles in tech industries and especially Software Developers, the share of female workers is even lower. While women comprise a meaningful share of workers in some high-paying tech roles, such as Computer Systems Analysts and Computer Programmers, female representation remains low in the top 5 highest-paying tech occupations. Meanwhile, Customer Service Representative is the only
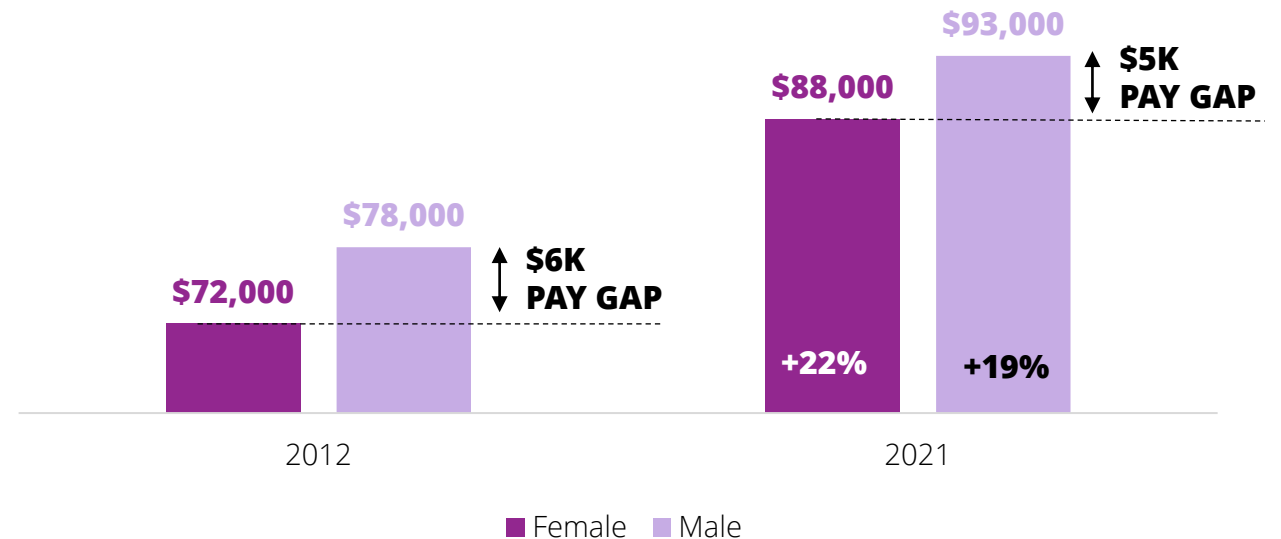
occupation that has appreciable female representation, but it is also one of the lowest-paid jobs in the tech ecosystem (see chart on next page).

While the gender wage gap has narrowed marginally over the last decade, the disparity between annual earnings between men and women remains sizeable. Between 2012 and 2021, the gap decreased by about $1,000 as the share of women in higher-paying jobs has increased. However, women are still paid $5,000 less than their male counterparts on average.

Gender Representation, by Category (2021)

Category	Percentage
All Jobs	49%
Tech Ecosystem 2012	30%
Tech Ecosystem 2021	31%
Tech Jobs in Tech Industries	21%
Software Developers	19%

34% US Tech Ecosystem

Annual Earnings in the Tech Ecosystem by Gender

2012
- Female: $72,000
- Male: $78,000
- $6K PAY GAP

2021
- Female: $88,000 (+22%)
- Male: $93,000 (+19%)
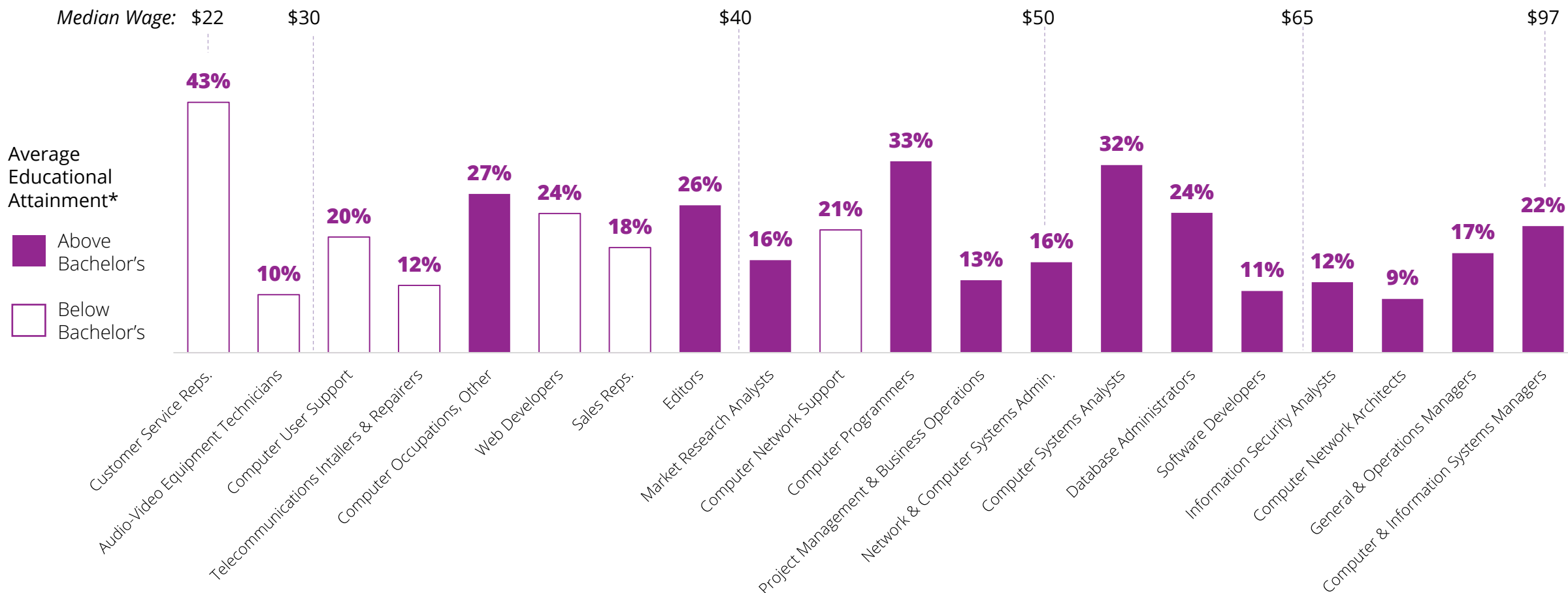- $5K PAY GAP

■ Female ■ Male

Source: HR&A analysis of Lightcast data; wages are based on 2020 data. *The data do not identify non-binary and other gender identities in its classification.

Unlike race, the relationship between educational attainment and female representation for a particular occupation within the tech ecosystem is less clear. Of the top 20 largest tech ecosystem occupations, women are represented to a higher degree in Computer System Analysts, Database Administrators, Web Developers, and Customer Service Representatives. Software development similarly remains a major challenge with a high barrier to entry for women – of the 53,000 Software Developers in New York City, only 5,800 (11%) are women.

Share of Women in Top 20 Largest Tech Ecosystem Occupations

Median Wage: $22 $30 $40 $50 $65 $97

Average Educational Attainment*
- Above Bachelor's
- Below Bachelor's

Occupation	Share of Women
Customer Service Reps.	43%
Audio-Video Equipment Technicians	10%
Computer User Support	20%
Telecommunications Installers & Repairers	12%
Computer Occupations, Other	27%
Web Developers	24%
Sales Reps.	18%
Editors	26%
Market Research Analysts	16%
Computer Network Support	21%
Computer Programmers	33%
Project Management & Business Operations	13%
Network & Computer Systems Admin.	16%
Computer Systems Analysts	32%
Database Administrators	24%
Software Developers	11%
Information Security Analysts	12%
Computer Network Architects	9%
General & Operations Managers	17%
Computer & Information Systems Managers	22%

Source: HR&A analysis of Lightcast data; wages are based on 2020 data. Average educational attainment indicates the typical education level needed to enter an occupation as reported at the national level by the Bureau of Labor Statistics.

RECOMMENDATIONS

RECOMMENDATIONS

City government and industry partners must work together to make intentional people-based and place-based investments that will grow and sustain New York City's tech ecosystem in an equitable and inclusive manner, prioritizing workforce development and job access for Black, Latino/a, and female workers and strategies to drive tech-supported economic development in the outer-boroughs.

PEOPLE-BASED INVESTMENTS

1 **Strengthen existing workforce programs that are driving equitable outcomes across the tech talent pipeline from K-12 students to degree graduates to prospective job seekers.**

2 **Build more inclusive on-ramps to tech jobs and careers by investing in stronger partnerships and collaboration across ecosystem actors.**

PLACE-BASED INVESTMENTS

3 **Advance technology-based economic development across all five boroughs and in key non-tech sectors.**

4 **Make targeted neighborhood investments that are responsive to today's hybrid work environment to ensure tech ecosystem workers have positive experiences living and working in New York City.**

#1 PEOPLE-BASED INVESTMENT

Strengthen existing workforce programs that are driving equitable outcomes across the tech talent pipeline from K-12 students to degree graduates to prospective job seekers.

Tech's continued growth and expansion in the last decade can be attributed to key initiatives such as CS4All, CUNY 2X Tech, and the Tech Talent Pipeline. These programs have proven a track record of success and should continue to be funded by the city with some improvements that align with Mayor Eric Adams commitment to addressing the tech opportunity gap and building a more equitable economy.

- **The City should expand CS4All with a focus on developing quality K-12 computer science teachers in underserved schools with support from industry leaders.** Launched in 2015, Computer Science for All (CS4All) is a $81M public-private partnership committed to ensuring all New York City students receive high-quality computer science education in elementary, middle, and high school, regardless of family income, race, nationality, disability, language spoken at home, sexual orientation, or gender identification. To date, the program has reached its goals to train over 100,000 students by 2025. However, it still has a long way of attaining its goal of training 5,000 qualified teachers by 2025 – currently the program has trained a little over 2,000 teachers. Considering the impact and disruption that COVID-19 has had on students, particularly those from lower-income families and schools with limited resources, the time to invest in computing education at the K-12 level could not be more critical, starting with expanding the current pipeline of equipped CS teachers. The City should work with industry partners to invest in expanding programs such as those offered by the New York City Department of Education and City University of New York's (CUNY's) Computing Integrated Teacher Education program to support current teachers with ongoing professional development and train future educators.

Industry partners also have a role to play to drive equitable access to CS education. Google recently invested $4M in a NYC Tech Opportunity Fund towards computer science education and teacher training. A quarter of the funds will go towards

CUNY's Computing Integrated Teacher Education program, designed to prepare teachers with integrating digital literacy into their curricula, both within and outside of Science, Technology, Engineering, and Mathematics (STEM) fields. The program launched in 2019 with funding from the Robin Hood Foundation and has since trained 1,700 teachers annually. Industry leaders should find opportunities to partner with the City and fund programs to train K-12 computer science teachers, particularly in underserved schools.

- **The City should continue to invest in CUNY 2X Tech with a continued focus on racial and gender equity.** CUNY has been recognized nationally for its track record of increasing economic and social mobility for low-income students; in fact, a 2020 Brookings report found that six of CUNY's colleges ranked among the top ten four-year and two-year colleges in the country with the greatest success of lifting low-income students into the middle class. Launched in 2017, CUNY 2X Tech is a 5-year $20M program with the aim of doubling the number of CUNY students graduating with tech-related bachelors by 2022 – a target it has met. Overall, the program has increased the number of female, Black, Hispanic, and Asian/Pacific Islander STEM graduates, however, continued improvements can be made to further racial and gender equity goals. While 55% of CUNY students are Black or Latino/a, only 31% of CS degree holders are Black or Latino/a. Similarly, 58% of CUNY's student population are women, but they represent only 19% of CS degrees earned. The demographic most underrepresented are Latina women, accounting for 18% of student body but only 7% of STEM degrees. The City should continue to fund CUNY 2X Tech, considering that it has proven to be a meaningful program for increasing and diversifying the city's local talent pipeline, and embed clear racial and gender equity metrics to ensure that the program continues to reach and benefit more students of color.

- **The City should collaborate closely with industry partners to identify quality and effective equity-driven workforce programs and drive investments to allow them to reach scale, particularly programs located in neighborhoods outside Manhattan and those focused on training Software Developers.** There are countless employers and training providers currently offering impactful programs that develop strong tech talent and close the racial and gender gap, but their reach is small. Equity-driven programs like The School of Cooperative Technical Education (COOP Tech) and Breakthrough Tech have supported over 2,000 people each. Creating an equitable tech economy requires a significantly greater magnitude of investment. These programs could be particularly impactful in addressing gaps in key occupations, such as software development, which accounts for 14% of the tech ecosystem jobs (53,000 jobs), yet only 9% are held by Black and Latino/a workers (4,770 jobs) and 11% are women (5,830 jobs). The city should also focus on training for tech and tech-adjacent occupations that have lower barriers to entry, such as Computer Network Support Specialists, Web Developers, and Sales Representatives – these jobs have an average educational attainment below a B.A. yet still pay higher than the average wage in New York City. These occupations offer a step in the door for many job seekers looking to enter tech, without the limitations of needing a four-year degree or having relevant coursework. Furthermore, identifying and pairing programs that then provide technical reskilling can support the upward career mobility for these workers. Industry partners should work with the City to identify effective, impactful equity-driven tech workforce programs and leverage dollars from philanthropy, employers, as well as State and Federal workforce grants and funding sources to help them scale.

Notable Case Studies:

- **COOP:** COOP is committed to closing the social capital gap by investing in diverse, low-income, and first-generation graduates from CUNY, California State Universities, and other urban public colleges. Since 2014, COOP has run over 100 cohorts of its Digital Apprenticeship program with over 2,000 alumni. 4 in 5 alumni overcome underemployment within a year, earning an average of $45,000 post-graduation after 12 months (which is triple pre-program salary) and $60,000 after three years.

- **Breakthrough Tech:** Launched in 2016 as an initiative of Cornell tech, in partnership with CUNY, this accelerator program begins in the early college years, with an emphasis on "welcoming Black, Latina, Indigenous, and first-generation women, trans, and nonbinary students." Since launch, the share of women who have majored in computer science has increased by 61%, and the percentage of women graduating from CUNY with computer science degrees has increased by 95%. Breakthrough Tech currently works with 80 different employers and has supported 2,500+ students.

- **Pursuit:** Launched in 2013, the Pursuit Fellowship is a four-year intensive tech program targeted at training adults with the most need. To date, Pursuit Fellows are 100% from low-income backgrounds, 50% women, 70% Black or Latino/a, and 40% immigrant. Graduates have been hired by more than 150 leading companies and startups and experience an almost 5X increase in their average annual salaries to over $85,000. Pursuit also has a unique funding model which allows fellows to join the program with no loans and upfront costs and payback Pursuit with future earnings.

- **Marcy Lab School:** Proposed as an alternative to college, the Marcy Lab School offers a one-year Software Engineering Fellowship aimed at preparing underestimated students for a career in tech. The program is free of cost to students and includes coaching, mentorship, and leadership seminars. In their first 2019-2020 cohort, they graduated 9 fellows from low-income, Black and/or Latino/a backgrounds, and are first- or second-generation immigrants. Students have gone on to make an average of $100K annually.

- **NPower:** This program focuses on launching digital careers for military veterans and young adults from underserved communities around the United States. To date they have had 5,400+ students, with 81% of them graduating with jobs or plans for continued education, and graduates seeing a 361% average salary increase. In New York City, NPower partnered with CUNY to launch the IT Partners Pathways which awards 15 college credits to NPower graduates towards completion of CUNY SPS bachelor's degrees. They aim to serve a total of 73,000 individuals nationally by 2030.

- **Per Scholas:** Per Scholas offers tuition-free training in cybersecurity, data engineering, information technology, software engineering, and cloud technology. It has produced over 16,000 graduates across 17 locations in the United States. 80% of graduates find full-time employment within one year of graduation, 85% of graduate's identify as people of color, and graduates have an on average 320% salary increase post completion. In New York, Per Scholas has six locations, including in the Bronx and Brooklyn, and four satellite locations in Queens, Brooklyn, Staten Island, and Manhattan. They aim to enroll 10,000 diverse learners annually by 2025.

#2 PEOPLE-BASED INVESTMENT

Build more inclusive on-ramps to tech jobs and careers by investing in stronger partnerships and collaboration across ecosystem actors.

Low-income populations, students of color, and first-generation college students have historically been disadvantaged when it comes to accessing job opportunities in tech, particularly as top tech firms have sought for the best engineering talent from selective schools across the country. While firms like Google, Apple, Microsoft, and others have built partnership programs in recent years, greater investments need to be made to develop stronger pipelines with historically black colleges and universities to close the existing representation gap.

- **Industry partners should develop stronger outreach and pipelines with historically black colleges and universities (HBCUs) and local colleges to ensure students come back to New York after school.** Tech employers recognize the scale of underrepresentation in tech and have begun to make more concerted efforts to broaden job access for diverse candidates, particularly in the last few years, but greater effort needs to be made. Tech firms have traditionally hired from a narrow pool of engineering talent from selective schools across the country and have a limited presence at public four-year programs or HBCUs, which are producing a significant number of computer science graduates. According to a report by the Kapor Center, though HBCUs account for roughly 3% of higher education institutions, they graduated 10% of all Black computer science majors in 2020. Tech recruiters must be more proactive to reaching this untapped talent. Tech employers and industry partners should dedicate resources to expand its presence to a greater network of HBCUs nationally and partner with affinity groups to widen its recruitment pipeline. Employers with existing partnerships with HBCUs should develop regional strategies to allow for more targeted recruitment and potentially lead to higher retention.

Notable Case Studies:

- **Grow with Google HBCU Partnership:** Launched in 2021, this initiative aims to provide 100,000 Black women with career development and digital skills training by 2022. Grow with Google plans to partner with four National Panhellenic Sororities, and two other organizations, Dress for Success and The Links, to support the growth of Black women in the tech sphere. This program follows Google's committed $175M to racial equity with a focus on Black-owned businesses and to support economic opportunity.

- **Grow with Google HBCU Career Readiness Program:** This partnership with the Thurgood Marshall College Fund (TMCF) launched in 2017, aims to provide digital skills training to support Black college students find and secure internships and jobs. Google has committed $1M+ to HBCU career service centers nationwide to be distributed by TMCF.

- **Apple's Community Education Initiative:** Launched in 2019, this program is partnering with 12 HBCUs across the United States to introduce students and adult learners to coding and app design. Each hub is designed to create a multitiered effect that works to extend beyond the campus and partner with local K-12 schools, community partners, local governments, and various community stakeholders.

- **Microsoft - HBCU Connect Partnership:** This partnership looks to support Microsoft's hiring efforts with HBCUs. Starting in 2020, this series hosts virtual hiring events that connect HBCU students to Microsoft.

- **Build Back Better:** As part of President Bidens Build Back Better plan, $6B has been allocated towards STEM programming at HBCUs and MSIs (Minority-Serving Institutions). This funding will be used to support intuitions in becoming Tier 1 level schools, alongside Stanford, Harvard, Duke, and University of Pennsylvania.

- **The City and CUNY should target a share of its recently announced $16M Inclusive Economy Initiative towards tech.** Developed in partnership with the Adams administration, the new initiative will pool $13M in city funds and $3M from private partners to create a campus-to-industry pipeline that improves career prospects for CUNY undergraduates and graduates. Based off CUNY's successful Career Launch internship program, this initiative is expected to provide more than 3,000 students with paid internships and apprenticeship opportunities with local employers in its first year. Given high-wage and growing opportunities in tech, CUNY should dedicate a share of funds to prioritize tech training and tech job placement, particularly for underrepresented talent.

- **The City should reinvest the Tech Talent Pipeline (TTP) to serve as a better convener across industry, academic institutions, training providers, and talent.** Since 2014, this public-private partnership has worked to define employer needs, through developing and testing training and education solutions in New York City. The partnership has successfully supported 30+ tech bootcamps in New York City, the largest number in the United States and developed successful training programs, including NYC Tech-in-Residence Corps, NYC Web Development Fellowship, Data Analyst Training Accelerator and others. In recent years, however, TTP has seen a lack of industry engagement and limited resources to continue to be a strong bridge across the tech ecosystem.

As companies look to diversify their workforce, New York City's incredibly rich racial and cultural diversity is a major asset. Google's Chief Executive Sundar Pichai recently mentioned his "long-term bullish" views on Google's growth in New York as a company because "we're optimistic to access to talent and being able to scale up." Companies are choosing to locate in specific cities like Atlanta, Houston, and Chicago because of their diversity. The City needs to lean into this strength and make it clear to employers that New York City has one of the largest populations of Black and Latino/a tech talent. Tech Talent Pipeline has succeeded in many ways – including connecting over 400 companies, 17 local colleges, and additional public and private partners, meeting initial training and educational commitments made by industry partners, and leading initiatives such as CUNY 2X amongst other impactful tech programs – but it needs a new goal, including a clear mandate for diversity, equity, and inclusion.

Between 2012-2021, New York City's tech ecosystem added roughly 20,800 Black and Latino/a workers, yet the share of Black and Latino/a workers has remained unchanged. The city would need to add over 46,000 Black and Latino/a workers to the tech ecosystem in order for the tech workforce to mirror the racial representation of the city's workforce. To maximize impact and extend the longevity of TTP, the City should set new targets to train and place 50,000 Black and Latino/a over the next ten years. This will allow TTP to serve all New Yorkers, and in turn, keep companies rooted in New York City for years to come.

Moreover, the City should use TTP to cultivate strong employer relationships and encourage industry commitments towards workforce development. A refreshed TTP can leverage the Inclusive Economy Initiative, developed in partnership between the Adams' administration and CUNY, which will launch the CUNY Office of Careers & Industry Partnerships and aims to engage 20,000 businesses across the city and support over 3,000 job placements by 2023. The City could also use TTP to encourage more private funding for educational and workforce programs. For example, CUNY recently announced a partnership with Amazon, who has pledged to provide tuition benefits for up to 30,000 workers to attend bachelor's or associate degree programs at one of eight CUNY colleges. This is a significant commitment with potentially profound impacts and a model that other private firms should follow and support.

#3 PLACE-BASED INVESTMENT
Advance technology-based economic development across all five boroughs and in key non-tech sectors.

New York City's tech ecosystem has been continually buttressed by the city's core sectors such as finance, healthcare, advertising, film and media, and many others. As the City looks to strengthen tech in boroughs other than Manhattan, it should lean into industries that are central to each borough's current and future economy. At the same time, it should continue to support the development of fast-growing areas like cybersecurity, web development, and e-sports in all five boroughs.

- **The City should develop strategies to integrate technology into critical sectors to drive greater economic development and growth in boroughs other than Manhattan.** Non-tech sectors such as hospitals (13,700+ jobs), film and media (7,000+ jobs), education (6,000+ jobs), finance (18,000+ jobs), and advertising (4,000+ jobs) are key drivers of tech employment. The City should identify unique opportunities and challenges facing these critical sectors where New York City holds a competitive advantage and build programming to advance technology and tech talent to position each borough well for the future. Fintech, for example, has grown significantly in recent years due to the city's strengths as a global financial center – the city is now home to over 1,000 active fintech startups, including at least 20 unicorn companies with $1B or more in private valuation.

The City should develop borough-based sectoral tech strategies that align with concurrent statewide and citywide workforce and economic development initiatives. In Brooklyn, outside of the Brooklyn Navy Yard, hospitals make up the largest hubs of employment – understanding how tech can continue to support and advance healthcare could provide greater employment and economic opportunities for New Yorkers. In Queens, the City could focus on developing greater tech capacity for industries such as aviation and advanced manufacturing. The City can build upon assets such as the CUNY Aviation Institute at York College, Health Information Technology program at Plaza College, and the NYDesigns design and hardware fabrication lab. In the Bronx, the City may focus on tech in healthcare and food
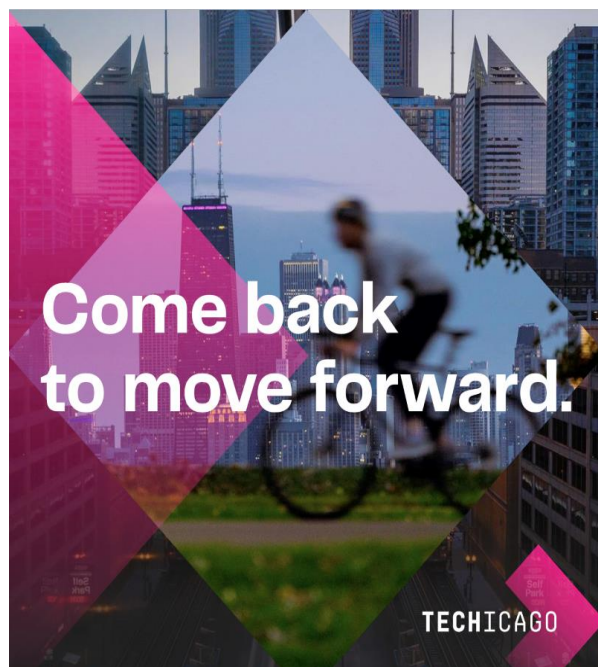
distribution, among other emerging sectors such as climate sciences and technology. Similarly, healthcare and social assistance sectors may be a focus on Staten Island.

- **The City should invest in neighborhood-based tech infrastructure and workforce development programs in boroughs other than Manhattan, leveraging existing assets such as libraries and community centers.** According to the Center for Urban Future and Tech:NYC's 2020 study, K–12 and adult tech skills-building programs are concentrated more in Manhattan than any other borough. Of the city's 55 census-defined neighborhoods, 17 contained 15 or more program locations, while six of the 55 neighborhoods (11%) had just one or no program. This inhibits underserved communities residing outside of Manhattan to participate in tech-skills building programs. As the City and industry partners look to invest in equity-driven tech educational and workforce programs, they need to ensure that these programs are not limited by geography and intentionally serve outer-boroughs and low-income neighborhoods.

The City should expand the use of its library system to enable greater tech access. According to CUF and Tech:NYC's 2020 report, libraries play an outsized role in providing access to tech skills training, accounting for 27% of program locations across the 15 neighborhoods with the lowest number of tech skills-building.

The City should also continue to support community efforts and initiatives to ensure neighborhoods are equipped with adequate tech infrastructure, tools, and programming to support local residents. In February 2020, the Bronx Digital Equity Coalition launched the Bronx Gigabit Center, a community space with high-speed internet, technology programming, and small business development powered by the city's LinkNYC public Wi-Fi network. Supported by the Bronx Community Foundation, the space is modeled after Silicon Harlem and aims to improve digital equity in the Bronx. Greater support and funding needs to go towards efforts like this.

- **Industry partners should launch a marketing and branding campaign, with public sector support, to publicize the growing tech opportunities in New York City and encourage people to return after graduation.** According to a Tech:NYC's 2018 survey of New York City's tech companies, 83% of tech companies planned to increase tech hiring in the years ahead, but just 50% said they were confident in finding the talent they need locally and nearly half said they will not be able to innovate at the same pace if they can't find the talent they need. Emphasizing and promoting tech in New York City is not about turning everyone into a programmer but demonstrating how tech and digital skills play a role across all jobs today and how they can offer greater economic opportunities and upward mobility. Employers can play a role in promoting the diverse range of career opportunities in the tech ecosystem, particularly in non-tech industries and tech-adjacent roles, such as healthcare, finance, advertising, and media industries, as well as Web Developers, Computer Network Specialists, and Sales Representatives, to ensure those jobs also continue to grow in New York City. Industry partners can work with the City to develop a marketing campaign, such as Chicago's "Come Back to Move Forward" program to incentivize people to return to the city for tech careers. This can also take the form of industry events, conferences, and other programming to expose those early in their career about the city's vast tech opportunities and reenergize the tech professional community.

Case Study: Chicago's Come Back to Move Forward Program

Launched in May 2021 by P33 and World Business Chicago, Come Back to Move Forward is a marketing campaign that aims to develop a diverse, tech-ready workforce in Chicago, targeting mid-career tech professionals with ties to the Midwest or those who attended school in Illinois and bringing them to Chicago. The campaign provides personalized career services and connects tech professionals with employers in Chicago seeking new hires. The campaign offers raffles to win a Welcome Backpack featuring Lollapalooza tickets, Airbnb experiences, and passes to The Forge, and other Chicagoland experiences to entice professionals. This digital campaign is running in a select number of markets including, San Francisco, New York, Seattle, Los Angeles, Boston, Atlanta, Denver, Austin, Dallas, and Washington, DC. This campaign is unique because it looks at talent attraction and retention from a strong Diversity, Equity, and Inclusion (DEI) lens, is employer-driven, and focuses on mid-career tech professionals. In addition to this program, P33 and World Business Chicago, also launched TechChicago in 2022, a storytelling movement tag-lined to redefine and showcase Chicago's diverse and thriving tech community.

New York City tech leaders and employers can learn from Chicago's efforts and launch similar marketing and promotional efforts to incentivize retention of local talent.

#4 PLACE-BASED INVESTMENT

Make targeted neighborhood investments that are responsive to today's hybrid work environment to ensure tech ecosystem workers have positive experiences living and working in New York City.

COVID-19 has changed the ways we live and work, and while no one knows for sure how the work environment will continue to evolve, flexible and hybrid work is likely to remain in some form for the foreseeable future, particularly in tech where so much is remote-enabled. In many ways, tech companies and tech talent are at risk for leaving the city to a greater degree, now more than ever. Already over the last decade, tech ecosystem workers have increasingly lived outside of New York – the city added 57,000 residents working in the tech ecosystem, despite growing 91,000 new tech ecosystem jobs. The tech sector, in particular, contributed a disproportionately lower share of resident workers. New York City has always been and is a place where people want to move to. At the same time, the City needs to better understand the mobility of workers in tech, including the extent to which growth is driven by homegrown or relocated talent, as well as the needs of the tech sector to keep tech tethered to New York City.

- **The City should work with industry partners to improve the experience of office districts for New Yorkers amidst current and future hybrid work trends.** Even prior to the pandemic, areas like Midtown and Lower Manhattan were perceived by many as uninviting places to work. The future of ground floor storefront space was in question, with retail vacancy rising in many high-end corridors of Manhattan, driven by cannibalization of brick-and-mortar retail by e-commerce and a rent bubble. COVID-19 only exacerbated these trends as office workers continue to work from home. To drive greater foot traffic and encourage workers to stay in New York, the City must invest in interventions that will improve the experience of going to the office. The Meatpacking District BID, for example, has noticed an increase in foot traffic during commuting hours in the neighborhood due to more organized events and the creation of permanent open streets. The City should partner with property owners and industry leaders to activate the public realm and ground floor, including extending open streets, installing art and landscaping, engaging temporary activations and pop-up experiences, and others.

- **The City should invest in neighborhood-based quality of life initiatives to enable tech workers to work flexibly and remotely without leaving New York City.** While each company may have its own approach, hybrid work is likely to remain in some form, particularly in tech. Today, while 74% of tech ecosystem jobs are located in Manhattan, 63% of tech ecosystem workers live in the outer-boroughs and a growing number are choosing to live outside of New York City. This could be for a variety of reasons, including more affordable housing options, public and open space, and safer and cleaner streets. On his 100th day in office, New York City Mayor Eric Adams listed significant steps towards creating a safer city and inclusive economy, including initiatives such as the establishment of the Subway Safety Plan, creation of 400 safe haven and stabilization beds, and a commitment to improving 1,000 street intersections, among many others. The City should continue efforts to improve quality of life for all residents with a focus on the outer-boroughs to ensure New Yorkers continue to call New York home.

- **The City and industry partners should continue to encourage tech entrepreneurship and startup activity in existing tech hubs across the city.** The City should lean into its existing startup infrastructure, such as NYCEDC led-initiatives Urbantech NYC and The Grid. Since 2013, Urbantech NYC has invested over $8M into flexible and affordable workspace, prototyping resources, partnership networks, programming and more to help seed and grow urban tech startups. Launched in 2019, The Grid is a member-based network and connective platform for tech entrepreneurs, investors, and innovators. Instead of developing more tech incubators and accelerators, the City should work with industry partners and community organizations to ensure equitable access to existing startup programs. The City should reestablish metrics for existing incubator and accelerator programs, such as The Grid and Urbantech NYC, and develop initiatives to ensure that entrepreneurs from all five boroughs are adequately represented and supported.

APPENDIX

METHODOLOGY

HR&A developed an analytical methodology to capture the entirety of New York City's tech ecosystem in both tech and non-tech industries, across all five boroughs.

Unlike most industries that are neatly defined by the North American Industrial Classification System (NAICS), tech jobs are embedded in industries throughout the economy, requiring a careful methodology for accurate measurement.

A guiding principle of HR&A's definitional process is that the tech ecosystem should be defined based on both industry and occupational data. There are tech jobs present in industries that should not be wholly classified as "tech," such as finance or healthcare. Accounting for these tech jobs requires a definition that captures tech jobs using **occupational data**. Similarly, there are non-tech jobs at tech industry firms, such as a sales associate working at a software company. Although such jobs are not "tech" jobs themselves, they provide necessary support to tech employers, and thus are directly enabled by tech. Accounting for these jobs requires a definition that captures tech-enabled jobs using **industry data**.

HR&A developed and refined a list of tech industries and tech occupations in conjunction with industry experts. HR&A first held a methodological discussion with a working group composed of experts in labor and economic data analysis. HR&A subsequently convened thought leaders drawn from firms and organizations in the tech ecosystem to test the working definition. These discussions allowed HR&A to develop the final definitions used in the report.

Industries are based on the 2022 NAICS codes as defined by the U.S. Census Bureau. Industries were selected based on whether the industry 1) is enabled by tech, or 2) primarily produces tech.

Occupations are based on the Standard Occupational Classification (SOC) codes as defined by the Bureau of Labor Statistics and the Occupational Information Network (O*NET), a comprehensive database of occupational attributes and characteristics which uses questionnaires to collect data on the educational levels and skills required to effectively perform a job. Tech occupations are selected based on whether the occupation 1) directly produces tech, 2) facilitates the use of tech by others, 3) would cease to exist without the presence of tech.

Further, HR&A used the demographic and wage information for the various occupations weighted averaged by the occupational share in the tech ecosystem to arrive at the demographic and wage composition numbers discussed in this report.

The next slides detail the tech industries and occupations as per the definitions included in this study. It also describes the methodology behind the economic and fiscal impact numbers in this report.

TECH ECOSYSTEM DEFINITIONS

Tech industries span Information, Professional Services, Manufacturing, and Retail Trade.

Tech Industries

NAICS	Description
3364	Aerospace Products and Parts Manufacturing
3342	Communications Equipment Manufacturing
3341	Computer and Peripheral Equipment Manufacturing
5415	Computer Systems Design and Related Services
5182	Data Processing, Hosting, and Related Services
4541	Electronic Shopping and Mail-Order Houses
3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing
5191	Other Information Services
5179	Other Telecommunications
5174	Satellite Telecommunications
5417	Scientific Research and Development Services
3344	Semiconductor and Other Electronic Component Manufacturing
5112	Software Publishers
5173	Wired and Wireless Telecommunications

TECH ECOSYSTEM DEFINITIONS

High Tech occupations are a subset of tech occupations which directly create or manage digital products, systems, and services.

High Tech Occupations

15-1111	**Computer and Information Research Scientists**
11-3021	**Computer and Information Systems Managers**
17-2061	**Computer Hardware Engineers**
15-1241	**Computer Network Architects**
15-1231	**Computer Network Support Specialists**
15-1299	**Computer Occupations, All Other**
15-1251	**Computer Programmers**
15-1211	**Computer Systems Analysts**
15-1232	**Computer User Support Specialists**
15-1245	**Database Administrators and Architects**
15-1212	**Information Security Analysts**
15-1244	**Network and Computer Systems Administrators**
41-9031	**Sales Engineers**
15-1256	**Software Developers and Software Quality Assurance Analysts and Testers**
15-1257	**Web Developers and Digital Interface Designers**

Other Tech Occupations

17-3021	Aerospace Engineering and Operations Technicians
17-2011	Aerospace Engineers
27-4011	Audio and Video Equipment Technicians
49-2091	Avionics Technicians
17-2031	Bioengineers and Biomedical Engineers
27-4012	Broadcast Technicians

29-2031	Cardiovascular Technologists and Technicians
17-1021	Cartographers and Photogrammetrists
17-2041	Chemical Engineers
29-2018	Clinical Laboratory Technologists and Technicians
49-2011	Computer, Automated Teller, and Office Machine Repairers
29-2032	Diagnostic Medical Sonographers
17-3012	Electrical and Electronics Drafters
17-3023	Electrical and Electronics Engineering Technicians
49-2093	Electrical and Electronics Installers and Repairers, Transportation Equipment
49-2094	Electrical and Electronics Repairers, Commercial and Industrial Equipment
49-2095	Electrical and Electronics Repairers, Powerhouse, Substation, and Relay
17-2071	Electrical Engineers
17-3024	Electro-Mechanical and Mechatronics Technologists and Technicians
49-2096	Electronic Equipment Installers and Repairers, Motor Vehicles
49-2097	Audiovisual Equipment Installers and Repairers
17-2072	Electronics Engineers, Except Computer
27-4032	Film and Video Editors
17-3026	Industrial Engineering Technologists and Technicians
17-2112	Industrial Engineers
29-2035	Magnetic Resonance Imaging Technologists
29-2033	Nuclear Medicine Technologists
15-2031	Operations Research Analysts
29-2034	Radiologic Technologists
27-4014	Sound Engineering Technicians
15-2041	Statisticians
29-2055	Surgical Technologists
49-2022	Telecommunications Equipment Installers and Repairers, Except Line Installers

LABOR DATA

In analyzing the characteristics of the tech ecosystem, HR&A relied on employment data provided by Lightcast.

Lightcast (formerly known as EMSI Burning Glass) is a leading national provider of employment data and economic impact analysis. Lightcast clients include the New York State Department of Labor, North Carolina Department of Commerce, and Oklahoma Department of Commerce. HR&A utilized Lightcast's Analyst tool to estimate the size of the New York City tech ecosystem and its associated wages, educational requirements, and demographics.

Lightcast gathers and integrates labor market data from a wide array of sources, including the U.S. Bureau of Labor Statistics Quarterly Census of Employment and Wages (QCEW) and Occupational Employment Statistics (OES), U.S. Bureau of Economic Analysis, O*NET, U.S. Census Bureau American Community Survey (ACS) and County Business Patterns (CBP), and state departments of labor.

Integrating data from multiple sources allows Lightcast to provide a broad accounting of employment that is unavailable from any one traditional source. To fully account for the New York City tech ecosystem, HR&A relied on Lightcast data pertaining to three classes of workers:

1. **QCEW/UI employees:** All jobs covered by federal/state unemployment insurance.

2. **Non-QCEW employees:** Jobs except from unemployment insurance coverage including the military, railroads, and small non-profits.

3. **Self-Employed:** Jobs held by people who consider self-employment a significant part of their income.

Lightcast"s proprietary estimation process enables it to accurately report detailed data for every county in the United States, and even employment data which is undisclosed by government sources due to confidentiality issues. Lightcast reports industry level data to the six-digit NAICS code, and occupational data to the five-digit SOC code. Moreover, Lightcast provides a "cross-walk" between industry and employment data (staffing patterns and inverse staffing patterns) that enabled HR&A to account for tech jobs in tech industries, tech jobs in non-tech industries, and non-tech jobs in tech industries. Lightcast also reports the most common educational or training requirements for each of the 800+ SOC codes based upon data from the U.S. Bureau of Labor Statistics.

ECONOMIC IMPACT ANALYSIS

HR&A's economic impact analysis estimates the multiplier effects of the tech ecosystem in the economy in terms of jobs, earnings, and economic output.
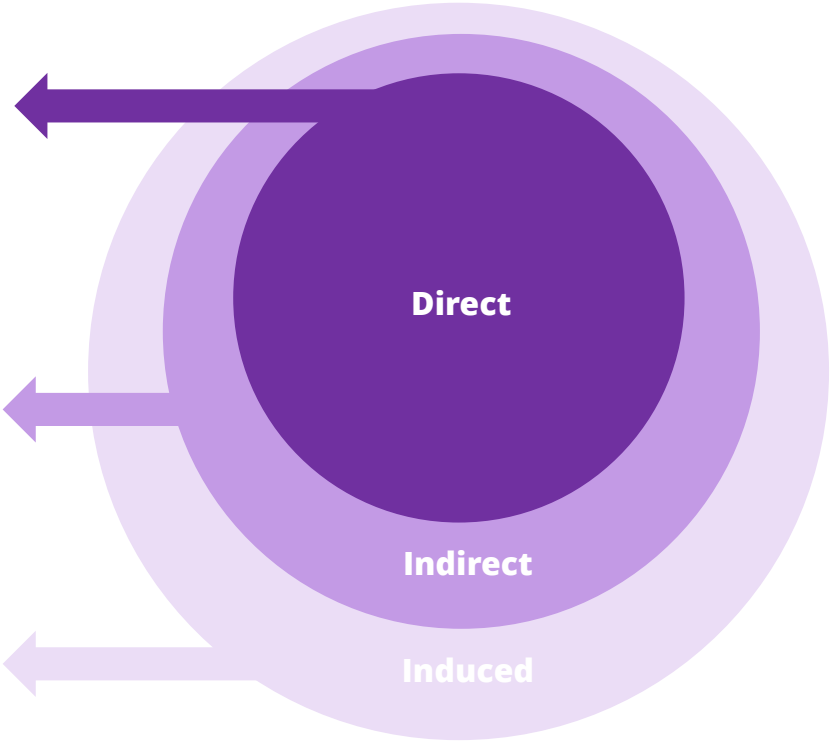
Direct Impacts

The direct impact is the employment, compensation, and output in the tech occupations or tech industries that collectively comprise the New York City tech ecosystem.

Multiplier Impacts

The indirect impact is the employment, compensation, or output associated with businesses that supply the industries comprising the New York City tech ecosystem.

The induced impact represents the employment, compensation, or output associated with household spending of employees who work in industries directly and indirectly affected by the New York City tech ecosystem.

Direct

Indirect

Induced

ECONOMIC & FISCAL IMPACT ANALYSIS

HR&A utilized the IMPLAN input-output model to estimate the economic impacts of the tech ecosystem and looked at income tax and sales tax generated by the tech ecosystem to determine the overall fiscal impact.

Economic Impact Analysis

Created by MIG, Inc. (formerly the Minnesota IMPLAN Group, Inc.) IMPLAN is a leading national input-output model. IMPLAN clients include many public and private sector organizations, such as the federal government, New York State Department of Labor, New York Office of the State Comptroller, and Cornell University. IMPLAN traces the pattern of commodity purchases and sales between industries that are associated with each dollar's worth of a product or service sold to a customer, analyzing interactions among 526 industrial sectors for New York City. IMPLAN reports direct impacts and multiplier (indirect and induced impacts) to sectors across the economy.

HR&A utilized the 2020 IMPLAN model, which is the most recent model year available. HR&A designated the five boroughs of New York City as the study area. The economic impact study is designed to measure the impact of existing employment in the tech ecosystem in terms of employment, employee compensation, and economic output (spending) generated:

- **Employment** includes full-time and part time jobs.
- **Employee compensation** includes wage and salary income as well as employee benefits and employer paid payroll taxes.
- **Economic output** is the total value of production across all industries in the economy. It is equivalent to total spending in the economy.

Direct employment in the tech ecosystem (including 89,000 tech workers in tech industries, 131,000 tech workers in non-tech industries, and 149,000 non-tech workers in tech industries) comprised the direct employment impact on the New York City economy. HR&A used IMPLAN to project the multiplier impacts of this direct employment.

To prevent double-counting of tech employment, HR&A subtracted multiplier impacts reported in tech industries, as 100% of tech employment was already accounted for by the direct impacts of the tech ecosystem. This subtraction prevented approximately 56,000 jobs in tech industries from being double-counted as both direct and multiplier jobs.

Fiscal Impact Analysis

Income Tax
HR&A calculated the income tax generated at the City and State level, based on New York City and State tax rates by household income. HR&A calculated the total number of workers in the tech ecosystem and the average salary per worker to determine the total annual income within the ecosystem. This value was multiplied by the relevant income tax rate to get total income tax generated by the tech ecosystem.

Sales Tax
HR&A used the Consumer Expenditure Survey from the U.S. Bureau of Labor Statistics to determine the proportion of income spent on taxable goods. Income was broken into 5 quintiles to get more specified spending data across the population. The number of tech workers and average income within each quintile were multiplied together to get the total income, which was multiplied by the proportion of income spent per category to get total spending on taxable goods. This value was multiplied by the City and State's respective sales tax rates to find the total sales tax revenues generated by workers in the tech ecosystem.