BERKS COUNTY TECHNICAL ACADEMY

A PARTNERSHIP PROGRAM:

Berks Career & Technology Center

Reading Muhlenberg Career & Technology Center

RACC Reading Area Community College

Bloomsburg University

ACCEPTING APPLICATIONS FOR CLASSES TO BEGIN IN THE 2016/2017 SCHOOL YEAR!

TECHNICAL ACADEMY

Berks Career & Technology Center, Reading Muhlenberg Career & Technology Center, Reading Area Community College, and Bloomsburg University, have partnered to create the TECHNICAL ACADEMY.

ACCEPTING APPLICATIONS FOR CLASSES TO BEGIN IN THE 2016/2017 SCHOOL YEAR!

The Technical Academy provides college-bound students with the opportunity to develop advanced technical skills and earn college credit toward an associate and/or bachelor's degree while still in high school. The programs in the Academy are highly selective and have strict entrance criteria.

BCTC – Berks Career & Technology Center
RMCTC – Reading Muhlenberg Career & Technology Center

EARN COLLEGE CREDITS

BUSINESS & INFORMATION TECHNOLOGY CLUSTER

academy program	career center offering program	college courses and credits earned while in high school	college degree pursued while in high school
Business Management & Entrepreneurship	BCTC	8 Courses for 24 Credits	AA or AAS in Business Management
IT Applications	RMCTC	8 Courses for 24 Credits	AA or AAS in Business Management
IT Networking	BCTC	9 Courses for 27 Credits	AA or AAS in Computer Technology
IT Programming	BCTC	8 Courses for 24 Credits	AA or AAS in Computer Technology
IT Web Design	RMCTC	8 Courses for 24 Credits	AA or AAS in Computer Technology

ENGINEERING TECHNOLOGY CLUSTER

academy program	career center offering program	college courses and credits earned while in high school	college degree pursued while in high school
Engineering & Automation Technology	RMCTC	8 Courses for 27 Credits	AAS in Mechatronics Engineering Technology
Mechatronics Engineering Technology	BCTC	8 Courses for 27 Credits	AAS in Mechatronics Engineering Technology

HEALTHCARE CLUSTER

academy program	career center offering program	college courses and credits earned while in high school	college degree pursued while in high school
Healthcare Information Technology	BCTC	8 Courses for 24 credits	AAS in Electronic Health Records & Healthcare Information Technology

Berks Career & Technology Center

Reading Muhlenberg Career & Technology Center

RACC Reading Area Community College

Bloomsburg University

COURSE OF STUDY **WHILE IN HIGH SCHOOL**

Electronic Health Records & Healthcare Information Technology Degree

BCTC's Healthcare Information Technology

The following courses are part of RACC's Electronic Health Records and Healthcare IT program of study and may be taken for college credit at the CTC. The courses students may take at RACC in the 12th grade are indicated with an asterisk.*

EHR	100	Medical Terminology	3 credits
EHR	200	Medical Office Procedures	3 credits
EHR	210	Legal and Ethical Issues in Healthcare	3 credits
IFT	100	Introduction to Information Technology	3 credits
IFT	110	Microcomputer Applications	3 credits
EHR	110	Computerized Medical Office	3 credits*
IFT	120	Advanced Microcomputer Applications	3 credits*
ORI	103	College Success Strategies	3 credits*

Total Credit Hours Available for HS Students **24 credits**

Computer Technology Degree

BCTC's IT Networking Students

The following courses are part of RACC's Computer Technology program of study and may be taken for college credit at the CTC. The courses students may take at RACC in the 12th grade are indicated with an asterisk.*

IFT	100	Introduction to Information Technology	3 credits
IFT	110	Microcomputer Applications	3 credits
NET	100	Computer Networking	3 credits
NET	106	Installation and Maintenance of PCs I	3 credits
NET	120	Server Administration	3 credits
NET	206	Installation and Maintenance of PCs II	3 credits
ORI	103	College Success Strategies	3 credits*
MGT	215	Human Relations in Business	3 credits*
IFT	120	Advanced Microcomputer Applications	3 credits*

Total Credit Hours Available for HS Students **27 credits**

Business Management Degree

BCTC's Business Management & Entrepreneurship and RMCTC's IT Applications Students

The following courses are part of RACC's Business Management program of study and may be taken for college credit at the CTC. The courses students may take at RACC in the 12th grade are indicated with an asterisk.*

BUS	100	Introduction to Business	3 credits
IFT	110	Microcomputer Applications	3 credits
BUS	110	Business Math	3 credits
MGT	100	Principles of Management	3 credits
ACC	105	Financial Accounting	3 credits
ORI	103	College Success Strategies	3 credits*
MGT	215	Human Relations in Business	3 credits*
ACC	110	Managerial Accounting	3 credits*

Total Credit Hours Available for HS Students **24 credits**

Computer Technology Degree

BCTC's IT Programming and RMCTC's IT Web Design Students

The following courses are part of RACC's Computer Technology program of study and may be taken for college credit at the CTC. The courses students may take at RACC in the 12th grade are indicated with an asterisk.*

BUS	100	Introduction to Business	3 credits
IFT	100	Introduction to Information Technology	3 credits
IFT	110	Microcomputer Applications	3 credits
WEB	100	Web Design I (HTML)	3 credits
PRG	100	Introduction to Programming	3 credits
ORI	103	College Success Strategies	3 credits*
MGT	215	Human Relations in Business	3 credits*
IFT	120	Advanced Microcomputer Applications	3 credits*

Total Credit Hours Available for HS Students **24 credits**

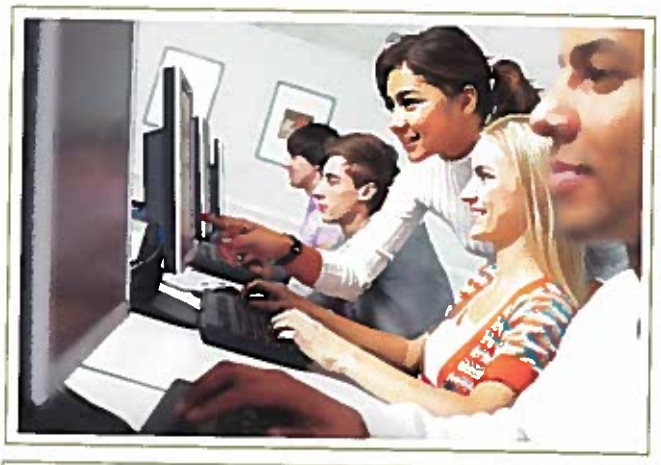
Mechatronics Engineering Technology Degree

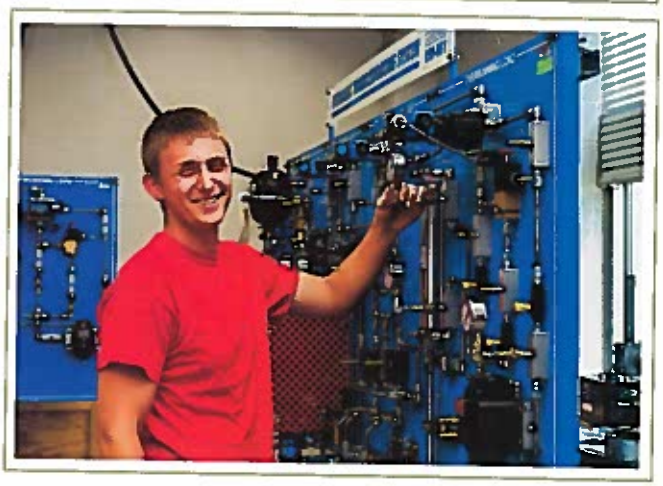
BCTC's Mechatronics Engineering Technology and RMCTC's Engineering & Automation Technology Students

The following courses are part of RACC's Mechatronics Engineering Technology program of study and may be taken for college credit at the CTC. The courses students may take at RACC in the 12th grade are indicated with an asterisk.*

IFT	110	Microcomputer Applications	3 credits
MET	100	Introduction to Shop Machinery	1 credit
MET	120	Industrial Mechanics I	5 credits
MET	130	Industrial Electrical Systems	4 credits
MET	140A	Introduction to PLCs – Part 1	2 credits
MET	140B	Introduction to PLCs – Part 2	2 credits*
MET	150	Industrial Mechanics II	6 credits*
MET	160	Rotating Electrical Machines	4 credits*
Total Credit Hours Available for HS Students			**27 credits**

After completion of the eight courses, students shall earn the AMIST Level 1 and Level 2 industry certifications.





Bloomsburg UNIVERSITY

Another Step to Your Success!

Complete your Bachelor's Degree on the RACC Campus

Bachelor of Applied Science in Technical Leadership

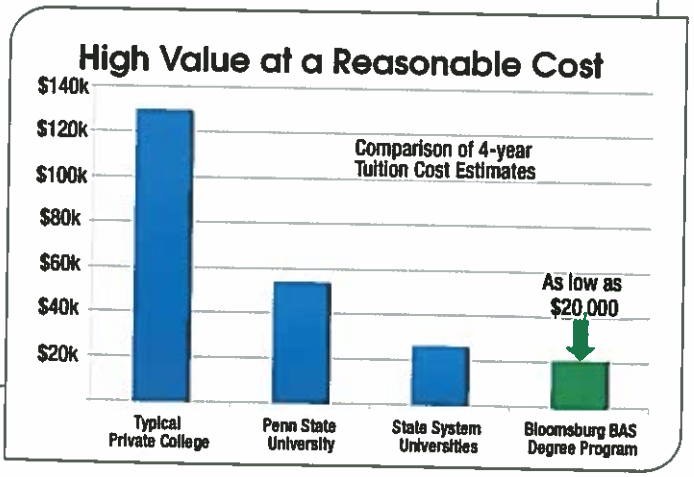
Earn a bachelor's degree from Bloomsburg University by taking courses at the RACC campus at a fraction of the cost of other 4-year degree programs.

BCTC and RMCTC Technical Academy students may **dual enroll during their junior and senior years,** complete an associate degree at RACC, then transfer seamlessly into Bloomsburg University's Technical Leadership B.A.S. degree program with admission as a college junior.

Full-Time and Part-Time options: Earn your bachelor's degree in as little as two years after your associate degree or take courses at your own pace.

Evening classes — some taught onsite at RACC and others online — to meet the needs of working professionals.

- Build on the foundation of your associate degree.
- Develop the leadership, communication, supervisory, management, and financial skills employers seek.
- Improve your chances to be hired and promoted, and increase your earning potential.



GET A JUMP ON COLLEGE

GO FROM LEARNING TO EARNING. FAST!

TECHNICAL ACADEMY

TECHNICAL ACADEMY CLUSTERS:

* BUSINESS & INFORMATION TECHNOLOGY
* ENGINEERING TECHNOLOGY
* HEALTHCARE

HOW THE TECHNICAL ACADEMY WORKS:

- A pathway for developing advanced skills and college credits toward an associate degree at RACC and/or bachelor's degree while still in high school!
- Students are enrolled at the CTC (Career & Technology Center) and RACC while in high school. Depending on the program selected, students may complete up to six college courses at the CTC during the first and second year of the program, earning up to 18 college credits. The college credits earned while at the CTC will be **tuition free.**
- In the third year of the program, students may take an additional three courses on the RACC Campus, earning up to an additional 12 college credits while in high school (depending on the program selected).
- All credits earned will appear as completed courses on a college transcript establishing the transferability of these courses.
- Tuition for the final courses taken on the RACC Campus (while students are still in high school) may be subsidized by the CTC and is dependent on state and federal funding.
- Students can enter the workforce at multiple points prior to earning a degree.
- Students have the opportunity to earn recognized industry certifications and prepare for jobs that are in high demand.
- After completing an associate degree, academy students may earn a Bachelor of Applied Science in Technical Leadership from Bloomsburg University by taking courses at the RACC Campus at a fraction of the cost of other 4-year degree programs.

STUDENT ENTRANCE REQUIREMENTS

- Students must be in grades 10 or 11.
- 3.0 overall GPA *
- Math Proficiency
- Reading Proficiency
- To remain in the Academy, students must complete a college prep academic sequence throughout high school.
- Signed Letter of Understanding to attend RACC to earn an associate degree.
- Students transitioning to RACC after graduation and completion of the Technical Academy courses will be required to complete RACC's placement assessment. SAT, ACT, and AP scores may be evaluated to determine the need to take RACC's placement assessment.

* *With special permission a student may be accepted on a provisional basis with a 2.5 GPA or higher.*

FOR MORE INFO
OR TO APPLY:

TECHNICAL
ACADEMY

FOR ADDITIONAL INFORMATION
OR TO APPLY FOR
AN ACADEMY PROGRAM:

BCTC Students:
Contact Student Services
610-374-4073

RMCTC Students:
Contact Student Services
610-921-7310

www.berkscareer.com
www.rmctc.org

STUDENT COSTS

The courses that students complete on the CTC campus will be provided with college credit being issued on a RACC transcript and will be **tuition free**. *Students will be expected to purchase textbooks and all other course materials for all courses.*

The three courses that students complete at RACC while still enrolled in high school will be handled as "early admissions" and may be partially subsidized by the CTC when state and federal funding is available. Once students graduate from high school, the costs associated with the remaining courses will be the responsibility of the student. Students may apply for financial aid in the same fashion as any other RACC student.

9/15 (PR-406)

HIGH SCHOOL CAREER AND TECHNICAL EDUCATION:

Serving Pennsylvania's Student and Workforce Needs

February 2016

eplc

The Education Policy and Leadership Center

BACKGROUND OF EPLC

The Education Policy and Leadership Center was established in 1998 as a 501(c)(3) not-for-profit corporation. The Center has offices in Harrisburg, PA and began to operate on a full-time basis in January 1999. The corporation is governed by a board of directors that includes members who have significant experience with education policy, government and not-for-profit organizations. The Center conducts its policy and leadership programs in cooperation with numerous local, statewide and national organizations.

MISSION OF EPLC

The Mission of The Education Policy and Leadership Center is to encourage and support the development and implementation of effective state-level education policies to improve student learning in grades P-12, increase the effective operation of schools, and enhance educational opportunities for citizens of all ages.

Ronald Cowell, President
Mattie Robinson, Manager of Operations and Communications

Career and Technical Education Project
The Education Policy and Leadership Center

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Harrisburg, PA 17102

717.260.9900
eplc.org

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High School Career and Technical Education:
Serving Pennsylvania's Student and Workforce Needs

The Education Policy and Leadership Center

RECOMMENDATIONS

INTRODUCTION

Youth unemployment rates in Pennsylvania and nationally are significantly higher than the overall state and national unemployment rates, and unemployment among African-American and Hispanic youth is even greater.

The cost of postsecondary education has increased at a rate far greater than the increase in cost-of-living while public financial support in Pennsylvania has decreased in recent years. In Pennsylvania, the cost of public higher education and the level of student indebtedness for those who leave college with or without a degree are among the highest levels in the nation.

Meanwhile, there is a very large gap between available and prospective jobs in Pennsylvania and the skills of available workforce. Leaders of business and industry and state and regional policy leaders worry about the capacity of Pennsylvania's workforce to fulfill the needs of employers in the Commonwealth, now and in the decades ahead.

In this environment, there are increasing calls among education, community, business, workforce, and public policy leaders for greater attention to career and technical education (CTE) and the public policies that currently or potentially impact on the availability, relevancy and quality of CTE in Pennsylvania.

Although career and technical education in Pennsylvania exhibits significant change and many success stories, there are many opportunities for improvement. This report is a call to action to build upon many excellent foundations, learn from and replicate some highly successful CTE programs found in district high schools and in career and technical centers (CTCs), and adopt state and local policies and practices that will assure we establish and sustain a system of career and technical education for high school students in Pennsylvania that is the envy of other states.

While Pennsylvania's workforce development efforts and CTE assets are important for a broad range of students and workers, this project and report are focused on CTE at the secondary level for students in grades 9 to 12. Nonetheless, we note that much of this report, including many recommendations, are predicated on the reality that CTE for secondary students in Pennsylvania is very much affected by much of what educators and policymakers do concerning all of P-12 education and all of postsecondary education in the Commonwealth.

This report focuses on and organizes recommendations around several broad issues that are fundamental to improve the effectiveness of Pennsylvania's CTE system for secondary students. These are:

- Leadership and Governance
- Regional and Local Coordination
- Building Student and Parent Awareness About Career and Technical Education
- Relevancy and Rigor of CTE Programs
- Assuring CTE Opportunities for All Students
- Accountability for Effectiveness
- State Funding

The recommendations in the report are intended to provoke discussion and action. The recommendations are all proposed with some specificity about "who" should do "what". They are intended to assign responsibility and prompt the named entities or groups to take action soon.

The Education Policy and Leadership Center (EPLC) initiated its Career and Technical Education Project in 2014 and worked throughout 2015 with a 30-member Study Group

that has worked in an advisory role to help identify significant CTE issues, exemplary programs, and recommendations that are cited in the report. Members of the Study Group and their affiliations are noted in **Appendix A**.

Study Group members were able to participate in several site visits. Each visit included very informative meetings and conversations with administrators, instructional staff, and students, as well as wide-ranging discussions in forums with invited guests. Forum participants represented many stakeholder perspectives including regional K-12 education, postsecondary education, employers, organized labor, workforce development and community development. The sites we visited are listed in **Appendix B**.

This report, including its findings and recommendations, is solely the responsibility of The Education Policy and Leadership Center. But the report would not have been possible without the valuable assistance of all who served on the Study Group, the hundreds who contributed to the success and value of our site visits and related forums, those organizations that contributed financial support for this work, and the many other individuals and organizations that provided helpful information and ideas for consideration.

Career and Technical Education (CTE) for high school students in Pennsylvania is not the vocational education of years past. In many regions of the Commonwealth, major changes have occurred as new programs have been created, new technologies embraced, more relationships developed, and new opportunities established for students to pursue varied pathways that lead to substantial employment and careers. This progress is found in career and technical centers (CTCs) as well as in CTE programs that are embedded in many school district high schools.

However, this transformation of career and technical education for high school students has not occurred uniformly across Pennsylvania. New or upgraded programs that offer contemporary and meaningful opportunities for all students remain elusive in too many communities.

Outdated views about CTE still persist among many education and policy leaders, and certainly among many students and their parents. The failure in too many instances to have clearly defined career pathways that include CTE options contributes to the attitude that CTE is only for those "not going to college" or a "dead end" option even for those students with postsecondary aspirations.

Insufficient attention to CTE is also apparent at the state level where CTE is not sufficiently represented on key policy boards and funding for CTE has been inadequate and unpredictable.

The observations and recommendations we offer are rooted in a belief that CTE is more vital than ever before for Pennsylvania's students, employers, workforce and, subsequently, for the Commonwealth's economic and community health.

PROFILE OF CAREER AND TECHNICAL EDUCATION FOR HIGH SCHOOL STUDENTS IN PENNSYLVANIA

[From Pennsylvania Department of Education (PDE) for 2013-2014 school year.]

Of 550,758 Pennsylvania students in grades 9 through 12, there were 65,563 students (approximately 12%) enrolled in CTE programs.

PDE worked with 135 high schools that hold PDE approval for CTE, with 14,994 students in grades 9 through 12 in CTE programs.

PDE worked with 86 Career and Technical Centers (CTCs) that enrolled 50,569 students.

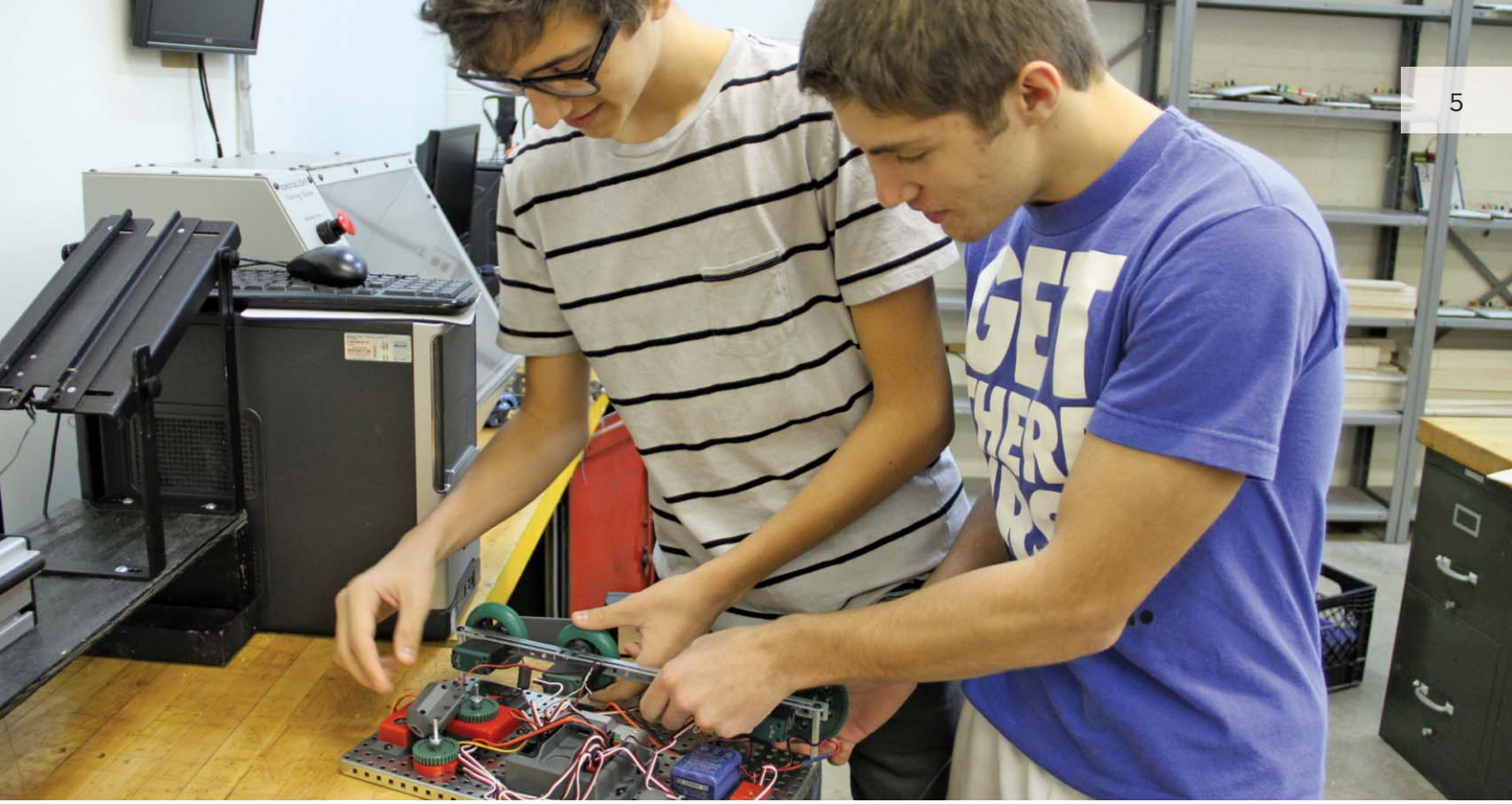
CTCs are joint schools consisting of school districts within an approved Area Vocational Technical School attendance area that agree to offer their students CTE at a common location/campus. As a member of a CTC, each member school district has representation on the joint operating committee (JOC). The JOC performs the same duties as a school board, which includes approving the CTC budget. Member school districts fund the operation of the CTC as determined by the articles of agreement.

The 2014-2015 state budget included $62,000,000 for career and technical education and $3,000,000 for CTE equipment grants.

Pennsylvania receives approximately $40 million related to the federal Carl D. Perkins Career and Technical Education Improvement Act of 2006 which support 97 secondary schools and 34 postsecondary entities.

PDE's Bureau of Career and Technical Education works with the 34 postsecondary institutions which receive federal Carl D. Perkins funds. These institutions include 14 community colleges, two private licensed schools, one state university, one specialized associate degree granting institution, four private 2-year colleges, one private state-aided university, three private colleges, one state-related university, and one college of technology. In addition, six career and technical centers offer Licensed Practical Nursing programs and receive Perkins funds to offer the programs.

Other postsecondary institutions that do not receive federal Carl D. Perkins funds are also engaged with school districts and CTCs through dual enrollment and articulation agreements and benefit many high school CTE students. These include public and private colleges and private licensed schools.



LEADERSHIP AND GOVERNANCE

Effective leadership takes many forms, including effective governance. Pennsylvania's CTE system for high school students is very dependent on effective leadership, both formal and informal.

Leadership by state policymakers is critical especially because state policymakers have so many policy levers at their disposal to affect directly or indirectly the condition of CTE throughout the state. From their use of the "bully pulpit," to enacting statutes and regulations, to the exercise of appointing authority to convening and planning activities, and to appropriating funding and attaching conditions to funding, state policymakers are in a position to dramatically make a difference – often very quickly.

Current staff members of the Pennsylvania Department of Education dedicated to CTE issues deserve kudos for commitment and effectiveness. However, current policies and practices at the state level leave opportunity for state policy leaders to demonstrate more serious attention and commitment to – and to effectively support – a strong statewide system of CTE for high school students.

The governor can strongly influence the statewide environment for CTE by his public statements, his direction to key cabinet officials, his appointments to key agencies, and his recommendations for agency staffing and for legislation and budgets.

State agencies such as the State Board of Education (which is also the State Board of Vocational Education) and the State Workforce Development Board must each give substantial and strategic attention to CTE issues, genuinely engage all relevant stakeholders, and more regularly collaborate with each other about CTE issues.

The Pennsylvania House of Representatives is commended for establishing a Select Committee to consider a variety of career and technical education issues. A report on the findings of the Select Committee is due by the end of 2016. The committee should consider the findings and recommendations of this EPLC report, especially those directed to state agencies and state officials, including the Legislature. The committee is also gathering important information from many stakeholder organizations and will have an important opportunity through its report to acknowledge the importance of CTE and the responsibility for the General Assembly to take action to more effectively support CTE.

Leadership at the regional and local level is also vital. Site visits and many discussions with Study Group members

and others have emphasized repeatedly the importance of effective leadership in community and region to support CTE. Leadership at the regional and local level inevitably shapes public perceptions about CTE, resources for CTC and district programs, opportunities for students, and ultimate value for the workforce.

There is no "magic bullet" or single prescription for local and regional leadership. It takes many forms, but usually occurs when one or more individuals and organizations step forward.

On site visits, our Study Group learned more about various entities taking the lead to bring together relevant organizations to collaborate about CTE activities. Each is a model that might be replicated in whole or in part. Lessons can be learned from all. They included:

- Intermediate unit leadership for consolidating and operating CTCs in Chester County.
- Leadership by CTC boards and administrators in Lehigh Valley and in Berks County.
- Community college leadership providing a regional Advanced Technology Center in Westmoreland County.
- School district leadership in expanding CTE in the Chartiers Valley School District in Allegheny County.
- Regional leadership by the nascent Westmoreland County Leadership Forum on Workforce Development led by business organizations and workforce development agencies.

In each instance, there are present seasoned and dedicated school leaders who have a thorough knowledge of CTE, recruit a strong administrative and instructional team, and build a strong and widespread network of relationships and CTE supporters.

At each of the sites visited, regional collaboration is seen as a key "success" ingredient. Ideally, regardless of who is the primary convener, the regional collaboration brings to the table CTCs, school districts, intermediate units, postsecondary schools, local workforce development boards, and other workforce, economic, and community development agencies.

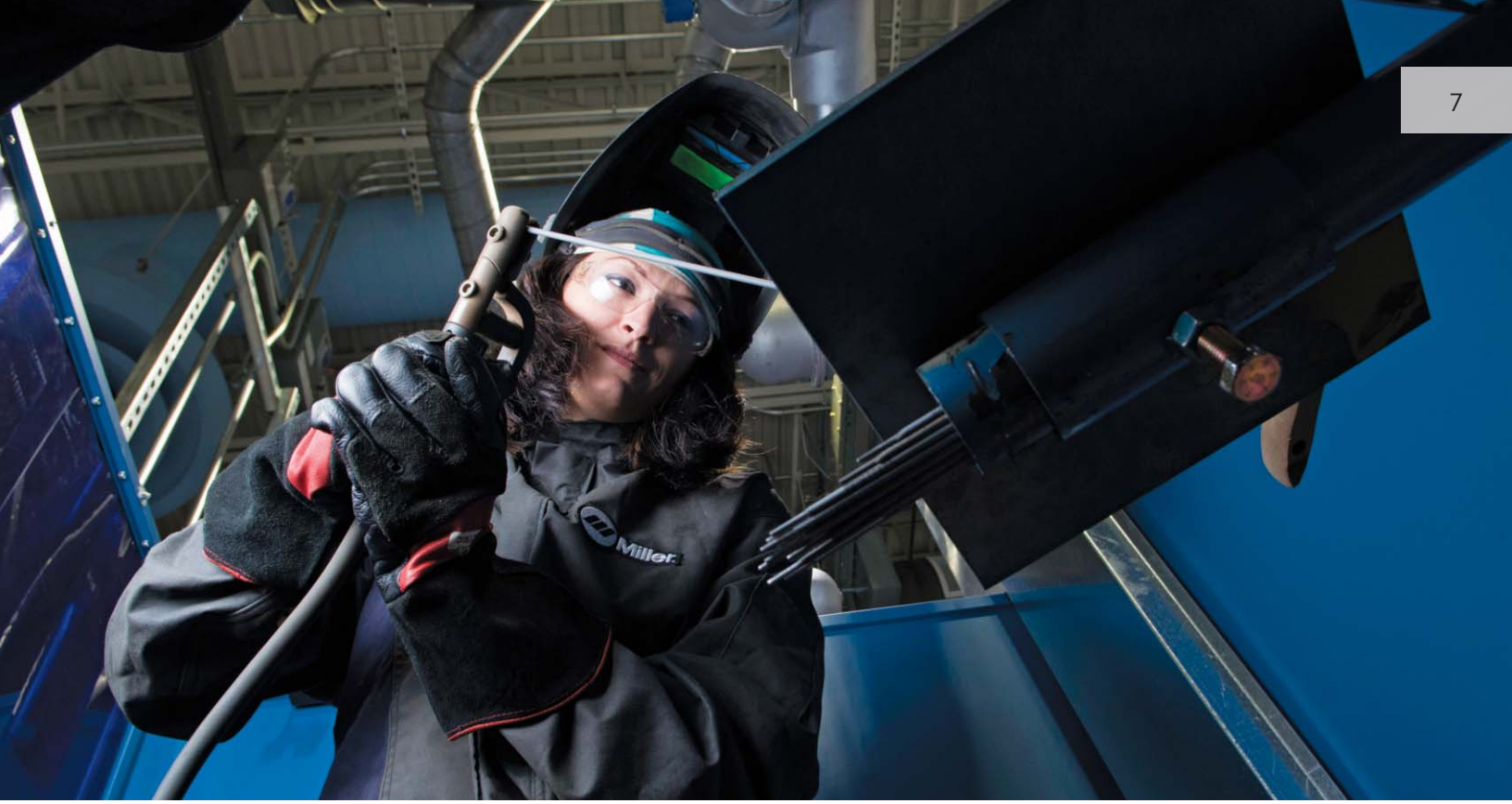
It is often stated that business and industry needs to be more involved in the decision-making about CTE programs, be they in CTCs or in district high schools. This employer perspective leadership is essential, but cannot simply be ordained.

It must be noted that thousands of employers already serve on occupational advisory committees for CTE programs in CTCs and in district high schools. These employers are in very important positions to influence the programs and curricula for CTE offerings and undoubtedly play a very influential role in the decision-making about such matters. And some seek a larger role for employers in CTC governance.

We recommend a modest and voluntary change for the governance of CTC boards (joint operating committees). The members of CTC boards are now selected by the school district boards of directors that are a part of a CTC's joint operating agreement. We recommend state legislation to allow a CTC board to expand its membership by adding by appointment no more than two individuals who represent a local private sector employer perspective.

But the commitment and attention of all school district boards of directors to CTE issues can be enhanced if more individuals with an employer perspective would choose to seek — and win — election to the boards of directors in school districts. Such individuals then would be very logical candidates to also represent their school district on the joint operating committees for their regional CTC. Statewide and local business organizations should encourage their members to consider school board service.

The interest of CTE and CTE students would be better served if all superintendents, school principals, and school board directors were well-informed about CTE issues and opportunities. The report therefore includes suggestions to enhance professional development about CTE for all school leaders and school board members.



REGIONAL AND LOCAL COORDINATION

The challenges confronting CTE planners and providers – including funding and other resources, the varied needs of students and employers, the complexity of forecasting workforce needs, and the multiplicity of education providers and CTE stakeholders – demand regional and local cooperation among all the relevant parties.

Who convenes this disparate group of interests and organizations may vary from region to region, but they must be convened and must collaborate. Only through effective collaboration will opportunities for students be maximized, workforce needs identified and addressed, and finite public and private resources most effectively utilized.

Site visits by our Study Group identified various sources of leadership as cited elsewhere in this report. But a common element present in all the sites visited was a broad base of relationships and partners, and genuine collaboration for planning and execution.

Most of the relevant "partners" for coordinated planning and execution of CTE efforts receive some form of state funding. If a coordinated effort for regional and local CTE planning and execution is important – and it should be valued – the Governor and General Assembly should reasonably require relevant entities receiving state funding to demonstrate that they participate in regional and local partnerships for planning and delivering CTE programs for high school students, out-of-school youth, and others.

In most regions if not all, the local Workforce Development Board (WDB) is a key instrument for planning and coordinating workforce development efforts. In all cases, this has implications for CTE programs for students of all ages, including high school students. In all cases, therefore, the Workforce Development Board membership should include at least one administrator of a career and technical center, an intermediate unit, and a school district, and where such institutions are present in the region, at least one administrator of a community college, Pennsylvania State System of Higher Education (PASSHE) university, and private licensed career college or school. The federal requirement for a certain percentage of members on the WDB to be from

The challenges confronting CTE planners and providers — including funding and other resources, the varied needs of students and employers, the complexity of forecasting workforce needs, and the multiplicity of education providers and CTE stakeholders — demand regional and local cooperation among all the relevant parties.

business and industry is acknowledged, but does not detract from the necessary role of education providers to effectively address workforce development needs.

Business-education partnerships exist in many regions of the state and are a form of collaboration that can provide many kinds of support for effective CTE programs. These partnerships vary greatly in scope of activity and real engagement in CTE planning and implementation, but they offer another model for regional and local CTE coordination that is so necessary. A little more than a year ago, all local WDBs (WIBs at the time) received $100,000 grants from state government to support the development or maintenance of business-education partnerships.

To develop regional leadership and operational partnerships among school districts, career and technical centers, postsecondary institutions, business and industry, labor, and other workforce and economic development entities, the Pennsylvania Department of Labor & Industry or the Department of Community & Economic Development should:

- Review and evaluate the use and effects of the recent round of state grants to WIBs to support business-education partnerships;
- Identify and make available information about the characteristics of successful business-education partnerships, especially those affecting CTE; and
- Offer competitive grants to regional business-education partnerships to develop and implement regional strategies to deliver CTE programs to high school students and others.

BUILDING STUDENT AND PARENT AWARENESS ABOUT CAREER AND TECHNICAL EDUCATION

Throughout this project, we have heard many times that CTE suffers an "image" problem. Many students and their parents, and even many educators, consider career and technical education to be of insufficient quality or relevancy for the vast majority of students. This "image" problem will not go away if it is left to CTE leaders alone to make the case for CTE.

The "image" issue is central to improving the effectiveness of the state's CTE system to serve the needs of students and workforce and requires attention by state policy leaders and statewide leaders of the business community.

We recommend that the state departments of Education, Community and Economic Development, and Labor & Industry work with statewide business organizations to develop and implement through a public-private partnership a statewide public awareness campaign that promotes the importance of CTE and the multiple career pathways available to students, including CTE.

Many school districts and CTCs are already taking effective steps to address the CTE "image" issue. There are many excellent examples of outreach to students and parents about CTE options and career pathways that include, but do not stop with, CTE. Successful efforts to address the image problem need to be identified and replicated in other areas.

It is generally agreed that the information needs to reach students and their parents, and that the flow of information needs to start early – no later than, and preferably earlier than, the middle grades.

Student and parent visits to CTCs are highly recommended, and it has been emphasized that the best "ambassadors" for CTE are students who are themselves in CTE programs. Messages from recent successful CTE graduates are a big plus!

It is equally important to familiarize school leaders, counselors, and teachers with the full-range of CTE options available. Everyone who can influence the education and career opportunities considered by students with whom they work needs to be fully aware of CTE value and options. This can be accomplished in many ways including visits by K-12 teachers and school counselors to CTE programs and centers and through professional development. These professional development opportunities should be prioritized and presented by CTCs, school districts, professional associations, and the Department of Education.

"Career and Technical Education in the past was viewed as the path for those students who were not going to college. Career and Technical Education today provides an opportunity for all students, those preparing for employment directly after graduation and those planning to continue their education at a postsecondary institution."

Jacqueline L. Cullen
Executive Director, Pennsylvania Association of Career and Technical Administrators (PACTA)

It is particularly important that all school counselors be fully informed about CTE value and options, and that there are a sufficient number of counselors to provide all appropriate services to students, including information and advice about CTE options. It is generally agreed that many districts and schools have far too few school counselors to adequately serve the needs of all students. This longstanding problem was made worse in many districts that have reported counselor position cuts blamed on deteriorating fiscal circumstances in recent years.

While we do not suggest a mandatory student-to-counselor ratio in the schools, the current ratio is estimated to be about 450:1, nearly double the ratio of 250:1 that is often suggested by the professional community in Pennsylvania and nationally. State policymakers and local decision-makers need to work together to address a problem that has serious implications for all students. Thus far, the General Assembly has ignored the 2015-2016 budget request made by the governor for $8 million to improve the number of school counselors with attention given to CTE opportunities.

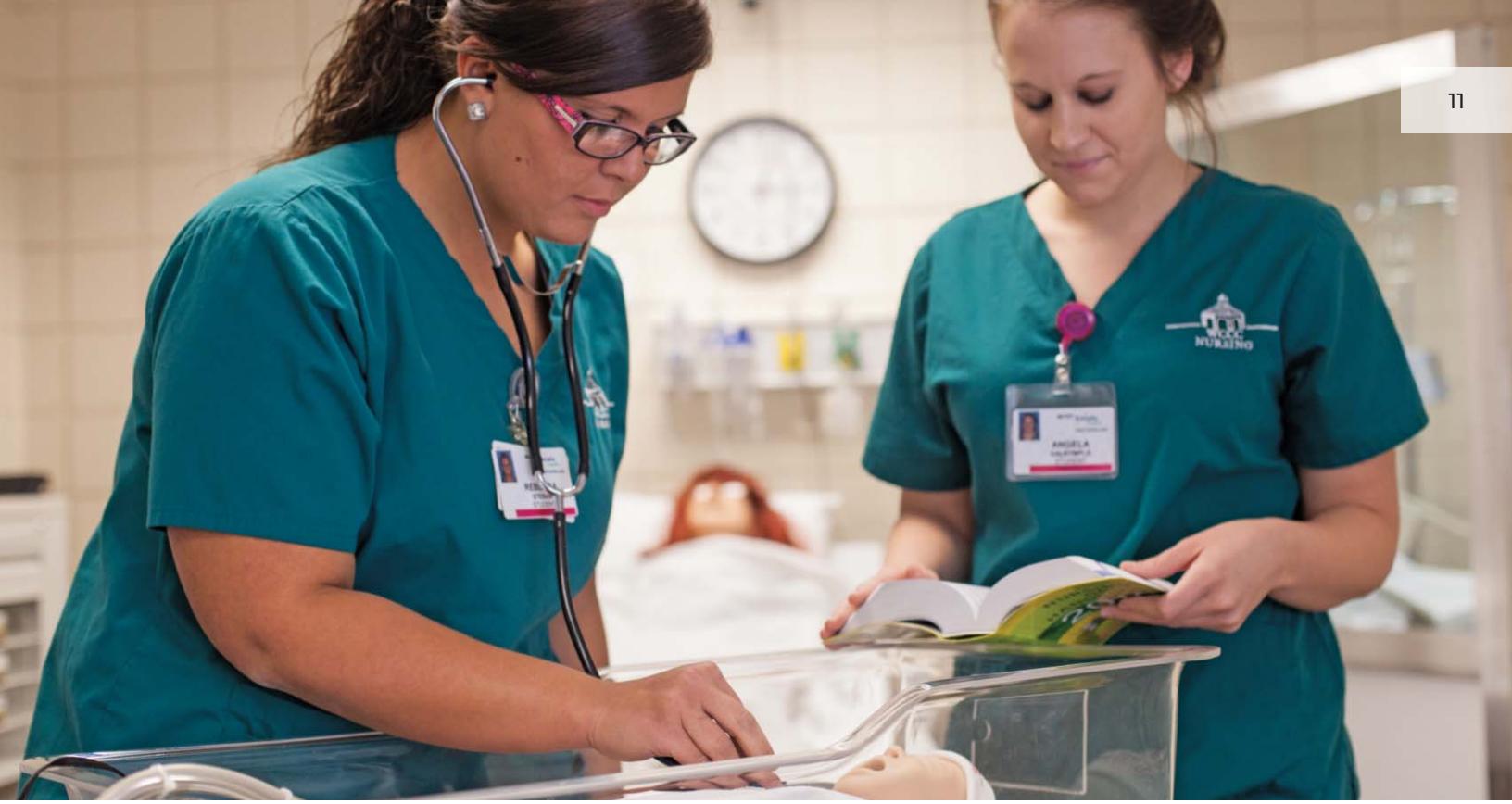
The staff capacity of the Pennsylvania Department of Education has been adversely impacted by repeated budget cuts during the tenure of several governors and legislative leadership of both parties. These cuts have had widespread and damaging effects for school districts, educators, and students. We recognize the precarious and unenviable budget reality that the General Assembly repeatedly presents to the Department, but some staff cuts must be reversed in order to serve educators and the interests of students.

The Governor and Secretary of Education can dramatically improve the capacity of the Department of Education to support the school counselor community by filling at least one full-time position in the Department of Education dedicated to working with school counselors. This will obviously benefit the entire school counselor community, but the position could be structured to have special impact on counseling for students about CTE value and options. There may already be sufficient flexibility in the use of federal Perkins funds to provide resources for this needed position in the Department.

The Pennsylvania Department of Education can help further to address the CTE image and information issue by developing and maintaining a one-stop on-line resource center about career and technical education for students, parents, educators, and school leaders. This resource center is in addition to the "best practices" site that is also recommended elsewhere in this report.

"A Pathway Program of Study is a program of interconnected academic and elective classes revolving around a career or subject theme, integrated with experiential learning and close connections between secondary and postsecondary education, training and apprenticeship, so that the individual can successfully enter and advance in a Career Pathway."

Hans Meeder
President of the National Center for College and Career Transitions
Manager of Pennsylvania Pathways Innovation Network



RELEVANCY AND RIGOR OF CTE PROGRAMS

CTE programs are often criticized as too often not very rigorous or not relevant to real job opportunities and current or future careers in a workplace that increasingly requires technical competencies. In addition, too many CTE students are not performing well on the state assessments that are required of all high school students.

We support the current expectation that all students, including those in CTE programs, will demonstrate the same academic proficiencies and complete the same assessments provided in state regulations for high school students. It is not in the interest of CTE students or the long-term interest of CTE programs to create any appearance or reality of lesser academic requirements and expectations.

It is noteworthy, however, that many CTE students also complete one or more NOCTI exams and earn industry-related credentials that demonstrate competencies beyond the regular high school diploma. This fact should be celebrated widely rather than lamented as an undue burden. This is the reason why elsewhere in this report we recommend that this information be included on the School Performance Profile (SPP).

On site visits, our Study Group witnessed remarkable examples of modern, high quality, and rigorous CTE programs challenging students and preparing them with experience and skills that will serve them well in continuing education and the workplace. But one must not assume this is the fact for all students in all schools and all CTE programs.

Nor do we dismiss the suggestion that too many CTC and district high school programs still offer programs that prepare too many students for occupations that lack equivalent job openings – and not enough students for positions that offer opportunities for careers with higher wages and prospects for long-term employment and promotion in a workplace demanding ever more sophisticated skills.

For this reason, we recommend several specific actions to improve the capacity of policy leaders and educators for informed decision-making about establishing, strengthening, or curtailing CTE programs, and the advice given to students.

- The Department of Labor & Industry and local workforce development boards must assure high quality labor market data are provided to those

who develop and implement CTE programs and advise students. High quality and reliable data that is timely and user-friendly are vital for program planning and advice to students.

- The Department of Education should have responsibility to routinely identify and disseminate information about effective CTE programs and best practices to CTE policymakers, administrators, and faculty. This work to identify and disseminate information can build upon the current collaboration of the Pennsylvania Association of Career and Technical Administrators and the Pennsylvania Department of Education to provide a website that shares resources, tools and promising practices among Pennsylvania's CTE Community.

  The information and resources found at pacteresources.com were submitted by CTE administrators, instructors, and educational leaders and are intended for use by the CTE community. A number of the posted resources are the result of the Technical Assistance Program supported by the Pennsylvania Department of Education, Bureau of Career and Technical Education.

- The Department of Education and the board of directors of each school district and CTC should conduct program review, evaluation, and revision to ensure CTE programs are relevant and reflect the labor market demands of the district and CTC regions. This review, evaluation, and revision process must be at regular intervals, be informed by high quality data, and engage all relevant stakeholder groups.

- All approved secondary CTE programs should provide the opportunity for their students to earn recognized industry related certifications or credentials that lead to increased employability. Not all current CTE programs comply with this recommendation, thus denying students a valuable asset upon program completion.

The relevancy and rigor of CTE programs in district high schools and in CTCs can also be better assured where there is effective coordination among all relevant CTE providers and stakeholders. Our several recommendations to enhance coordination at the regional and local level will help to better assure the relevancy and rigor of CTE programs.

On site visits, our Study Group witnessed remarkable examples of modern, high quality, and rigorous CTE programs challenging students and preparing them with experience and skills that will serve them well in continuing education and the workplace. But one must not assume this is the fact for all students in all schools and all CTE programs.

NOCTI (National Occupational Competency Testing Institute) delivers a battery of assessments or standardized tests for students studying career and technical programs in high schools and technical colleges in the United States. The assessments, based on a job and task analysis process, incorporate input from subject matter experts representing regions of the United States in secondary and postsecondary education as well as business and industry. The assessments are updated on a regular basis and are aligned with national academic standards (math, science and language arts) as well as business and industry standards.

ASSURING CTE OPPORTUNITIES FOR ALL STUDENTS

Career and technical education is one of the very valuable options on the public education "choices" or opportunity menu for students, but this choice varies substantially for students depending on the school district where they live. This inequity is not due to financial considerations alone and is often attributable to matters more easily addressed.

We urge policy and education leaders to prioritize the interests of students in considering important CTE policy and program issues. Our recommendations build on existing law and successful practices that are the routine in some districts and CTCs.

Current law requires every school district to integrate Career Education and Work standards throughout the curriculum for all students. Every superintendent and school board needs to ensure their district is fulfilling this basic obligation.

Districts typically do some form of comprehensive planning. The comprehensive plan of every district should clearly articulate its commitment to multiple career pathways available to its students, and how the district will ensure that every student has the opportunity to pursue a career pathway appropriate to the student's interests and capabilities. School counselors and CTE administrators and instructional leaders should be engaged in the development of this part of the comprehensive plan and the school board should hold the superintendent and itself publicly accountable for the implementation of the district's commitment to a career pathway for every student.

Promoting student and parent awareness about CTE value and options and ensuring student access to high quality CTE options will be advanced by appropriate professional development in the school district. Every school district should clearly articulate its commitment to professional development that will be provided to assure that all educators, administrators, and board members are informed about CTE needs and opportunities that are or should be available to its students. The school board should hold the superintendent and itself publicly accountable for the implementation of this commitment to professional development.

In too many instances, students prefer a CTC program or school that is not available to them under existing agreements. Often these are programs and schools that are closer to their home school or residence than

"Modern CTE is far different from the days of 'Vocational Education.' Students have the opportunity to take several pathways for the end goal of being gainfully employed and having a fulfilling life. With added academic rigor and the ability to earn college credits while in a Career and Technical program, CTE provides opportunities for a very academically diverse population."

Seth Schram
Principal
Chester County Technical College High School
Brandywine Campus

is the CTE program usually available to them. In many cases, the interest of the student is accommodated, but not always. The interest of the student should be prioritized and the General Assembly should enact legislation that will require every school district and CTC to enter into any necessary agreements that will enable any student the option to attend any secondary-level career and technical program that is not available to them under existing agreements.

Transportation issues are often a practical barrier to students exercising this form of CTE school or program choice and current state law limits a school district's obligation to transport a student only to a CTC of which the district is a member. The General Assembly should consider how to reduce the financial burden to students in these circumstances.

There are many examples throughout the state of CTE options for students that include "dual enrollment" opportunities for students to be earning postsecondary credits even while completing their CTE program and before high school graduation. We heard of one example of a student who was awarded his associates degree just days before he walked across the stage to receive his high school diploma. These dual enrollment agreements are an important part of career pathways for many students. They enhance the learning opportunities for students, can better prepare them for work, and can make postsecondary education more affordable for many students.

There are exemplary examples of dual enrollment agreements in many districts and CTCs and they involve community colleges, PASSHE universities, non-public colleges, and many private licensed career colleges and schools. But these opportunities are not available to all otherwise academically qualified students.

State government has been inconsistent and unpredictable in its financial support for dual enrollment agreements for high school students. The General Assembly should provide some funding support as it did until 2010 and as proposed in 2015 by the Governor. The funding is important, but the funding also gives the Department of Education some leverage to influence the nature of these agreements that should be structured to promote greater access, affordability, and transferability of earned credits for students.

But dual enrollment agreements do not and should not exist only when and where there is dedicated state funding to help. Dual enrollment agreements should be the norm wherever they can serve the best interests of students and this is a responsibility of school districts, CTCs, and postsecondary education.

Dual enrollment agreements of necessity must remain voluntary and will vary in scope and details. However, the General Assembly should enact legislation to encourage every community college, PASSHE university, and private licensed career college and school, to enter into dual enrollment agreements with school districts and career and technical centers, and to report to the Secretary of Education annually all such dual enrollment agreements.

Similarly, articulation agreements between and among school districts, CTCs, and postsecondary institutions are increasingly vital to establishing predictable and industry relevant career pathways for students in CTE programs. But such relationships and agreements are not prevalent enough to benefit all students who could be better served. Many students can benefit when they see a predictable path forward, knowing that if they successfully complete certain courses and programs, they are assured access to next steps on the path to a career objective.

Like dual enrollment agreements, articulation agreements must remain voluntary and will vary in scope and details. But especially among publicly funded institutions, it is reasonable to expect articulation agreements will become more commonplace. The General Assembly has previously enacted legislation creating certain expectations pertaining to articulation between and among community colleges and PASSHE universities.

Articulation agreements can help to ensure the development and implementation of career pathways for all students, including those in CTE programs, and therefore the General Assembly should enact legislation to encourage every community college, PASSHE university, and private licensed career college and school to enter into articulation agreements with school districts and CTCs that will establish predictable and industry relevant pathways for students to move from high school to postsecondary education to career, and to report to the Secretary of Education annually all such pathways agreements.

CTE opportunities for students can be enhanced, public resources efficiently used, and additional private resources attracted when school districts, career and technical centers, and postsecondary education institutions strategically and routinely work together. We have elsewhere addressed the merits of regional and local coordination, but here want to stress the importance of educational institutions — especially those that are publicly funded — working together as much as is practical. Such collaborative efforts should routinely extend to the planning of new programs and facilities and include the efficient sharing of existing and future facilities, faculty, and other resources.

State policies pertaining to requirements for school administrator preparation programs and professional development opportunities for all educators can help to improve a school culture that historically has undervalued career and technical education. The State Board of Education and Department of Education should revise requirements for administrator preparation programs to assure that these programs promote CTE familiarity and understanding for every educator seeking superintendent certification. Also, the Department of Education should include in its online menu of professional development for teachers, school counselors, and administrators courses that promote awareness and capacity building to support CTE opportunities for all students.

Real workplace experience is an important part of the CTE experience for students. State and local organizations representing employers should routinely encourage their members to create opportunities for high school students to have real work experiences through internships, apprenticeships, work co-ops, and summer employment.

We must note that the Study Group frequently heard about and discussed the challenges for some employers presented by state-required background checks for employers or their representatives who would have “regular contact” with students. The law was recently amended to ease some of this burden, but the issue was repeatedly cited as a barrier to securing more real work opportunities for students. We believe the interest of the students reflected in the current law is paramount and make no recommendation for changes. However, state lawmakers should be mindful of this issue whenever the law is further reviewed.

ACCOUNTABILITY FOR EFFECTIVENESS

Although there are frequent demands from policymakers and others for more accountability in the K-12 public education system, there is in fact more accountability than ever before. Expectations for student performance are more demanding than ever, and there is publicly available much more information about how schools are performing than in any past era.

Students in CTE programs in district high schools and in CTCs are expected to demonstrate proficiency on state assessments as are all other high school students. And in fact they are usually required to pass additional exams related to occupational fields for which they are studying.

In recent years, state government has begun to report on the performance of schools through the School Performance Profile (SPP). As with any report card, the items reported on the SPP suggest what is valued by those who require the reporting, and it would be quite natural that such an indication of "value" would influence the behavior of those who are required to do the reporting.

The Department of Education is currently conducting a review of the content of the SPP and is entertaining suggestions about what changes might be made to the SPP. We recommend that the SPP should recognize school performance relative to career preparation and CTE by including items related to student performance on National Occupational Competency Testing Institute (NOCTI) exams and achievement of occupation certifications. It is also recommended that the SPP require districts to report on the percentage of students for whom an individual career and work plan has been developed by the 8th grade, and how many students complete a CTE program with an industry recognized credential.

In an environment in which CTE advocates and this report emphasize the importance of CTE and call for additional public and private investments in CTE, it would be helpful to education leaders and to policymakers at the state and school district level – and quite reasonable as well – to have better information about what happens to students after they complete various CTE programs in district high schools and in CTCs. Such information would better enable educators and policymakers to gauge the effectiveness of programs and schools to prepare students for postsecondary education, jobs, and careers.

Survey and anecdotal information provide some incomplete answers to this very fundamental question, but there is no systematic statewide data system to follow-up on CTE students after graduation. A collaborative effort by the departments of Education and Labor & Industry to use existing data would need to assure anonymity for individual students, but would produce valuable information to help inform educator and policymaker decisions about the value and effectiveness of programs and the direction of future investments. However, all should be cautioned to not make judgments about the "success" of students or the value or effectiveness of programs based upon wage information alone.

All school districts are required to integrate Career Education and Work standards throughout the K-12 curriculum, and also to have a career path plan identified for every student by the 8th grade. The fulfillment of these two requirements should complement other efforts to engage more students to seriously consider CTE options as part of one or more pathways to work and career.

State policy can further support these two K-12 requirements by requiring districts to publicly report on how the Career Education and Work standards are being implemented in the district and (as suggested above) to include a report on the SPP about the percentage of 8th grade students with completed career path plans. If state policymakers are serious about these two current requirements that are intended to improve student readiness for work and career, these modest accountability measures are very appropriate and necessary.

In an environment in which CTE advocates and this report emphasize the importance of CTE and call for additional public and private investments in CTE, it would be helpful to education leaders and to policymakers at the state and school district level — and quite reasonable as well — to have better information about what happens to students after they complete various CTE programs in district high schools and in CTCs.

STATE FUNDING

Funding is a significant variable that influences the availability of quality CTE programs and student access to such CTE opportunities. Currently, there is wide disparity of availability and student access, often dictated by the relative wealth of a student's home district or the regional CTC. The inadequate level of state support for public schools generally, and for career and technical education in particular, contributes to this great disparity.

It is not irrelevant to this discussion that Pennsylvania is judged by many to have the most unequal statewide system of resources and, subsequently, opportunities for K-12 students. This has serious implications for CTE opportunities as well.

For less wealthy school districts – those that are most dependent on state funding help – they often do not have sufficient financial capacity to initiate and maintain their own high quality CTE programs, especially those requiring large investments for equipment or for which there may be a small number of students interested. These same districts often do not easily absorb additional costs of sending students to CTCs.

Even wealthier school districts hard hit by state funding decisions and steeply increased pension costs in recent years have had powerful disincentives to increase the number of CTC students or the amount of financial support for CTCs.

Direct state support for career and technical education has been stagnant for several years. Dedicated funding proposed by Governor Wolf for 2015-2016 to encourage innovation in CTE has been caught up in the state budget impasse, and the future for all CTE-related funding looks cloudy and unpredictable.

The cost of equipment, especially high tech equipment that is costly and needs to be updated frequently, is a significant barrier for the establishment and maintenance of many of the programs that can best prepare students for new or evolving industries that promise job-growth in the foreseeable future. While better coordination and sharing among institutions can be of some relief, school districts and CTCs need more state help in meeting these extraordinary costs. This should include greater tax incentives for business and industry to provide support for CTE.

These are very challenging circumstances in which to hope many school districts and CTCs will expand and improve CTE opportunities for a larger number of students. It is therefore imperative that state policymakers increase financial as well as the rhetorical support for career and technical education for secondary students.

The forthcoming report from the House Select Committee on Technical Education and Career Readiness (due late 2016) will be an important opportunity to demonstrate real support for CTE. The committee needs to remind House and Senate colleagues of their responsibility to support CTE opportunities for all students, and to make recommendations about specific ways in which to increase state funding support.

We recommend that improved state support for CTE include increased basic education funding to all districts and increased dedicated funding for CTE. Ideally, the General Assembly will see fit to incorporate a component for CTE into the new basic education funding formula recommended in June 2015 by the Legislature's Commission on Basic Education Funding. Other important support should be in the form of CTE equipment grants, competitive CTE innovation grants, and grants to expand student counseling, especially pertaining to CTE opportunities. An expanded EITC program can help direct business and industry grants to CTE programs as well.

"The CEOs of Pennsylvania agree. If we want to improve our workforce in the Commonwealth, we have to invest in modern, high quality Career Technology Education. The hardest jobs to fill are the 'middle skills.' The best career pathway for these good paying jobs starts with Career Technology Education."

David W. Patti
President & CEO
Pennsylvania Business Council

LEADERSHIP AND GOVERNANCE

Leadership in Harrisburg and local communities is vital to assure that an effective statewide system of career and technical education that recognizes and addresses the needs of students and employers is available. The need for leadership starts with elected state policymakers, and must include other state and local officials and agencies, and every school district and career and technology center (CTC) governing board, along with their postsecondary school partners.

1 The Governor should direct state cabinet-level officials who oversee relevant departments and agencies to develop and implement a strategic plan to support and promote high-quality career and technical education opportunities for all Pennsylvania students, thus preparing all students for success in the workplace.

2 The Governor and the State Senate, exercising their respective authority to nominate and approve members of the State Board of Education, should assure the State Board of Education includes at least two members on each of the two councils of the Board who have meaningful experience with career and technical education, as intended by language currently in the School Code. For at least one member on each council, this experience should include significant service as a CTE instructional leader or CTE administrator at the secondary level.

3 The Governor should assure that at all times one or more appointed members of the State Workforce Development Board has current or recent experience as a secondary level CTE instructional leader or administrator.

4 At least once a year, the State Workforce Development Board and the State Board of Education should meet concurrently to consider career and technical education issues and other education issues related to workforce development.

5 The General Assembly should amend the School Code to provide that the board of directors of a career and technical center shall have the authority to appoint on a staggered basis, for terms of four years, no more than two individuals representing business and private employer perspectives as additional board members with voting authority.

6 A comprehensive and strategic review of the Commonwealth's Perkins Plan and state CTE programs and policies should be initiated by the State Board of Education and the Department of Education as soon as practical, engaging all relevant stakeholders and recognizing that the CTE environment is dynamic and has changed significantly.

7 The State Workforce Innovation and Opportunity Act (WIOA) Plan to be submitted to the U.S. Department of Labor in March 2016, and the periodic revisions that are permitted thereafter, should not substitute for the need for comprehensive review and revision of the state's Perkins Plan, but should nonetheless reflect how career and technical education for high school students will be supported and strengthened as an integral part of the state's workforce development strategies.

8 State and local organizations representing employers should routinely encourage their members to serve on local boards of school directors, the governing boards of regional career and technical centers, and occupational advisory committees for secondary CTE programs.

9 The Governor and General Assembly must assure each annual state budget provides the Department of Education and other relevant state agencies the financial resources and authorized staff complement to effectively implement the recommendations of this report.

REGIONAL AND LOCAL COORDINATION

Within any geographic region of the state, there are usually many and varied educational and workforce development entities that contribute to preparing students for success in the workplace and careers, and to fulfilling the workforce needs of business and industry in the region. These objectives for students and workforce development can best be addressed where there is planning and implementation coordination and cooperation among relevant regional and local organizations.

10 The Governor and General Assembly should consider applying appropriate conditions and expectations to appropriations for funding school districts, intermediate units, career and technical centers, postsecondary institutions, and workforce development boards. These conditions and expectations should require funding recipients to demonstrate that they participate in regional and local partnerships for planning and delivering CTE programs for high school students and others.

11 Every local Workforce Development Board should include at least one administrator of a career and technical center, an intermediate unit, and a school district, and, where such institutions are present in the region, at least one administrator of a community college, state system university, and private licensed career college or school.

12 To develop regional leadership and operational partnerships among school districts, career and technical centers, postsecondary institutions, business and industry, labor, and other workforce and economic development entities, the Pennsylvania Department of Labor & Industry or the Department of Community & Economic Development should offer competitive grants to regional business-education partnerships to develop and implement regional strategies to deliver CTE programs to high school students and others.

BUILDING STUDENT AND PARENT AWARENESS ABOUT CAREER AND TECHNICAL EDUCATION

Career and technical education suffers to a significant extent an "image" problem among many students and their parents, and even many educators. Too often, they consider career and technical education as being of insufficient quality or relevance for the vast majority of students. Unfamiliarity and misinformation need to be combated with broadly disseminated information about the value of career and technical education and opportunities for students.

13 Through a public-private partnership, the Pennsylvania departments of Education, Community and Economic Development, and Labor & Industry and statewide business organizations should develop and implement a statewide public awareness campaign that promotes the importance of career and technical education and the multiple career pathways available to students, including CTE.

14 School district superintendents and board members should assure that all middle school and high school students, and their parents, are regularly informed about the multiple career pathways available to students, depending on the individual student's interests and capabilities.

15 School district superintendents and board members, working with administrators and the governing boards of regional career and technical centers, should adopt policies and practices that assure every middle school student will have at least one orientation presentation and visit to a regional career and technical center to observe and to explore the programs and opportunities available to high school students.

16 Statewide professional associations representing school board directors, school administrators, principals, teachers, and school counselors should incorporate into the professional development activities for their respective members multiple opportunities to develop greater awareness of career and technical education programs and related workforce opportunities for students.

17 School boards and the boards of career and technical centers should ensure that there are sufficient school counselors in middle schools, high schools, and career and technical centers to provide appropriate career pathway information to all students and their parents.

18 The Pennsylvania Department of Education should develop and maintain a one-stop on-line resource center about career and technical education for students, parents, educators, school leaders, and others.

19 The Governor and the Secretary of Education should ensure that there is at least one full-time position in the Department of Education dedicated to working with school counselors.

RELEVANCY AND RIGOR OF CTE PROGRAMS

The relevancy and rigor of career and technical programs in regional centers and high schools should be assured by timely information from state agencies to school leaders, regional coordination among relevant agencies, continuous review by district and center boards, and the sharing of information about effective programs and practices.

20 The Pennsylvania Department of Labor & Industry in partnership with the state's local workforce development boards should periodically review the quality, accessibility and utility of labor market data provided to state agencies, school districts, career and technical centers, postsecondary education institutions, workforce development boards, and other workforce development organizations that use such data to advise students and for CTE program development and improvement.

21 The Pennsylvania Department of Education should routinely identify and disseminate information about effective CTE programs and best practices, serving as a reliable resource for CTE policymakers, administrators, and faculty.

22 The Pennsylvania Department of Education and the board of directors of each school district and each CTC should conduct CTE program review, evaluation, and revision processes to ensure CTE programs are relevant and reflect the labor market demands of the district and CTC regions.

23 All approved secondary CTE programs should provide the opportunity for their students to earn recognized industry related certifications or credentials that lead to increased employability.

Also see Recommendations 10, 11, and 12 concerning Regional Coordination.

ASSURING CTE OPPORTUNITIES FOR ALL STUDENTS

Assuring the opportunity for career readiness for every student is a core obligation of education policymakers, and CTE must be a vital part of the opportunity menu available to all students in all schools districts. Decision-making by CTE policy leaders and administrators at the state, school district, and CTC level must prioritize the interests of students.

24 The superintendent and board of every school district should ensure that their district fulfills the obligation to integrate Career Education and Work standards throughout the curriculum for all students.

25 Every school district should clearly articulate in its comprehensive planning a commitment to multiple career pathways available to its students, and how the district will ensure that every student

has the opportunity to pursue a career pathway appropriate to the student's interests and capabilities. The school board should hold the superintendent and itself publicly accountable for the implementation of this commitment.

26 Every school district should clearly articulate in its comprehensive planning the professional development that will be provided to assure that all educators, administrators, and board members are informed about career and technical education needs and opportunities that are or should be available to its students. The school board should hold the superintendent and itself publicly accountable for the implementation of these professional development plans.

27 The General Assembly should enact legislation that will require every school district and CTC to enter into any necessary agreements that will enable any student the option to attend any secondary-level career and technical program that is not available to them under existing agreements.

28 The General Assembly should enact legislation to encourage every community college, PASSHE university, and private licensed career college and school, to enter into dual enrollment agreements with school districts and career and technical centers, and to report to the Secretary of Education annually all such dual enrollment agreements.

29 The General Assembly should enact legislation to encourage every community college and every PASSHE university, and private licensed career college and school, to enter into articulation agreements with school districts and career and technical centers that will establish predictable and industry relevant pathways for students to move from high school to postsecondary education to career, and to report to the Secretary of Education annually all such pathways agreements.

30 School districts, career and technical centers, and postsecondary education institutions should strategically and routinely work together wherever practical to maximize career and technical education awareness and opportunities for students, including collaboration relative to programs, facilities, and faculty.

31 The State Board of Education and Department of Education should revise requirements for administrator preparation programs to assure that these programs promote CTE awareness for every educator seeking superintendent certification.

32 The Department of Education should include in its online menu of professional development for teachers, school counselors, and administrators courses that promote awareness and capacity building to support CTE opportunities for all students.

33 State and local organizations representing employers should routinely encourage their members to create opportunities for high school students to have real work experiences through internships, apprenticeships, work co-ops, and summer employment.

ACCOUNTABILITY FOR EFFECTIVENESS

Education leaders and policy leaders can benefit from improved information about the quality and effectiveness of career and technical education programs, especially pertaining to outcomes for students. Such information should help to inform decisions about the establishment, content, and curtailment of programs and schools; the use of financial resources; and advice to students.

34 The Pennsylvania Department of Education's School Performance Profile (SPP) report card should be revised to additionally report on career and technical education information such as: a) number of students successfully completing NOCTI exams and the number of NOCTI exams successfully completed; b) the percentage of students for whom an individual career and work plan has been developed by the 8th grade; and c) how many students complete a CTE program with an industry-recognized credential.

35 The General Assembly should enact legislation that requires each school district to periodically report publicly about how the statewide Career Education and Work standards for students are implemented in their district.

36 The state departments of Education and Labor & Industry, using student data and wage record data (while respecting the anonymity of individual students), should establish a data system and protocol to report on the effectiveness of career and technical education programs and to provide guidance for subsequent policy-making by school and public policy leaders.

STATE FUNDING

The unevenness of CTE opportunities for students, and the uneven capacity of districts and CTC's to support high quality CTE programs, is often related to funding issues. There are several state budget-related actions that the Governor and General Assembly should support to enhance career and technical education opportunities for all students and strengthen workforce development efforts for the Commonwealth. Most important, of course, is the state's general support for basic education since it is this annual appropriation that strongly influences each district's capacity to support educational opportunities and services for all students, including options for career and technical education. But several other areas of directed funding also can significantly affect CTE choices and quality.

37 The Governor and General Assembly should support and annually fund a statewide K-12 education finance system that is based on the principles of equity, adequacy, predictability, and accountability, and that assures sufficient resources to prepare every student to be ready for success in postsecondary education, career, and citizenship.

38 The Select Committee of the House of Representatives, in its report on technical education and career readiness due in 2016, should acknowledge and make recommendations that address the responsibility of the General Assembly to provide more sufficient financial resources to support career and technical education at the secondary level in order to address serious underfunding issues that serve as substantial barriers to the availability of high-quality, contemporary career and technical education opportunities that meet the needs of all students as well as the state's employers.

39 The Governor and General Assembly should support an amendment to the recently adopted Basic Education Funding Formula to reflect an added weight factor for career and technical education enrollment as a basic component of the cost of education for all school districts.

40 The Governor and General Assembly should provide an annual increase in the Career and Technical Education line item in the state budget at least equal to the annual published "index" increase allowed for school district revenues.

41 The Governor and General Assembly should provide for an annual appropriation of at least $10 million to support equipment purchases for career and technical education programs.

42 The Governor and General Assembly should enact and annually fund a five-year School Counseling Improvement Program designed to assist school districts to enhance career counseling, with an emphasis on building more awareness among students and their parents concerning career and technical education opportunities.

43 The Governor and General Assembly should amend the Educational Improvement Tax Credit (EITC) program to provide for a separate category of tax credits for eligible taxpayers to support career and technical education equipment purchases, and to fund this category with an additional EITC allocation so as to not reduce current allocations for any other EITC categories.

APPENDIX A

EPLC Career and Technical Education Project Study Group Members

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David Namey, Pennsylvania State Education Association

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Cynthia Pulkowski, ASSET STEM Education

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Kirk Williard, Chester County Intermediate Unit

Stephen Zori, The College Board

APPENDIX B

Study Group Site Visits

The EPLC CTE Study Group visited several sites to learn more about CTE leadership models and CTE opportunities available to students.

EPLC and Study Group members want to express appreciation to the board members, administrators, instructional staff, and students at each site.

Appreciation is also extended to all of the community representatives who participated in very informative forums that were conducted in conjunction with each site visit.

Chester County Technical College High School — Brandywine Campus (October 26, 2015)

Advanced Technology Center at Westmoreland County Community College (November 4, 2015)

Berks Career and Technology Center (November 23, 2015)

Lehigh Career and Technical Institute (December 15, 2015)

Chartiers Valley High School (January 7, 2016)

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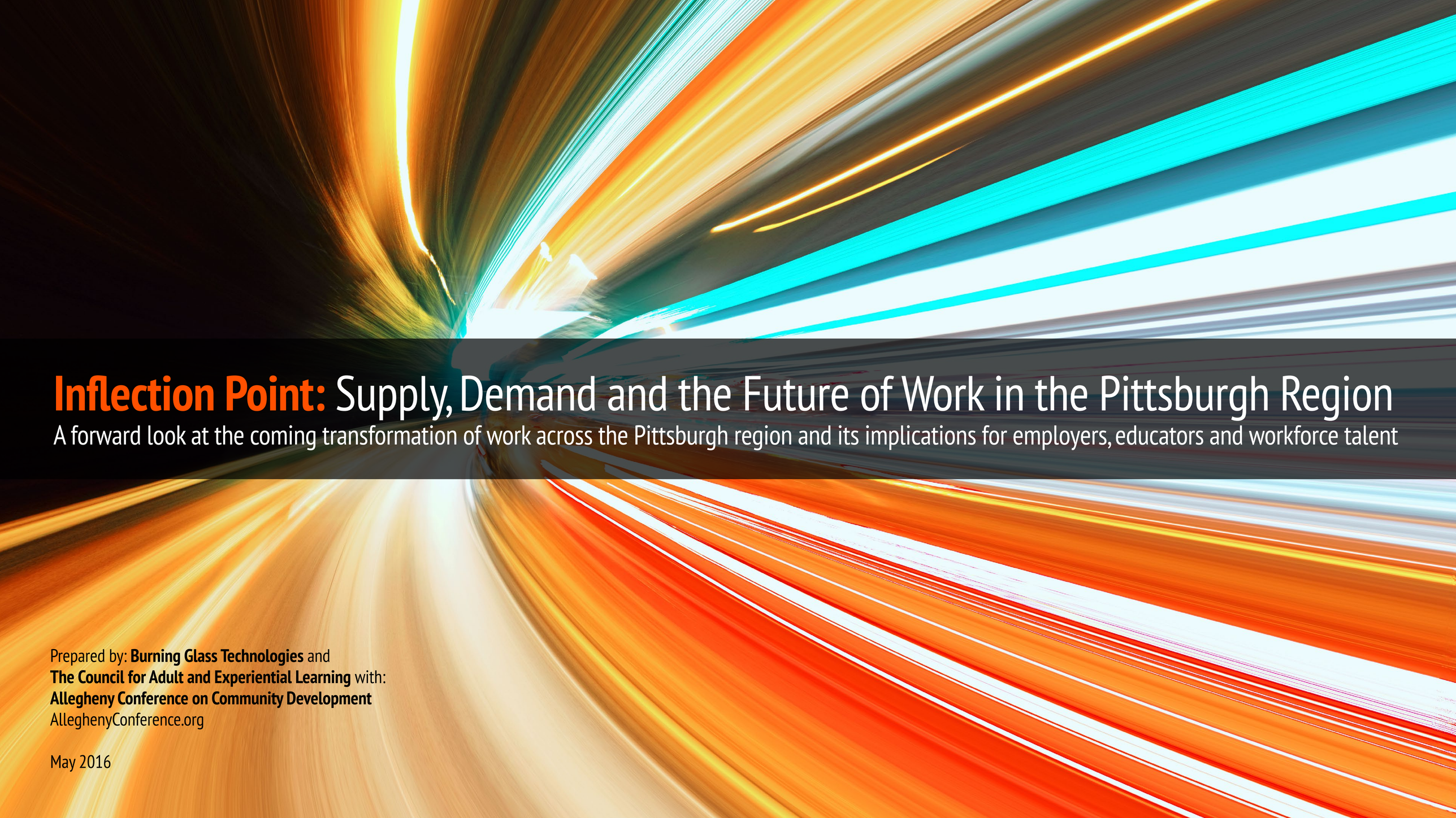

Inflection Point: Supply, Demand and the Future of Work in the Pittsburgh Region

A forward look at the coming transformation of work across the Pittsburgh region and its implications for employers, educators and workforce talent

Prepared by: **Burning Glass Technologies** and
The Council for Adult and Experiential Learning with:
Allegheny Conference on Community Development
AlleghenyConference.org

May 2016

INTRODUCTION

The Allegheny Conference has been sounding an alarm for some time that the Pittsburgh region is on the leading edge of a serious shortfall in our working age population, and that we have lagged behind other regions when it comes to inward migration. As the Chair of the Conference's Workforce Steering Committee, last year I asked a working group to dive into this issue and to examine our challenges and opportunities over the next 10 years.

Inflection Point: Supply, Demand and the Future of Work in the Pittsburgh Region is the result of this effort, and should serve as a wake-up call and catalyst for all employers, educators, civic leaders, and our current and future workforce.

The findings in this report are clear: Over the next decade, the Pittsburgh region's workforce will be entirely transformed due to retirements, growth and occupational transitions that will require upskilling. Technology will drive change and disrupt entire sectors, and every employer and worker must keep pace with this change to remain competitive.

The challenge is made greater by the fact that, as a regional workforce, our numbers do not add up. With Baby Boomers now retiring, not enough skilled workers to take their place and slow inward migration, the report estimates our region could be short by more than 80,000 workers over the next 10 years if we just keep doing what we are doing today. The implications of that are substantial. We need to connect everyone to opportunity and a path to success, including the thousands who are un- and under-employed across our region.

To be clear, we are at a critical moment for the future of our region. As employers, we need to move from being simply consumers of talent, to becoming investors in the labor marketplace. That means investing in training and bridging what has been identified as a great divide between educators and employers so that we can align our labor supply and pipeline with the market and where it is headed. It also means that we must act as a region, rather than just as individual employers, to attract the high-skilled talent we will all need to compete.

Business, education and civic leaders all have a role to play, to combine our resources and expertise on a shared path that will position us for progress and prosperity.

I urge you to read this report with that view in mind and to join us in our efforts to forge a stronger, more competitive workforce for our future.

Sincerely,

Bill Demchak
Chairman, President and Chief Executive Officer
The PNC Financial Services Group, Inc.

Inflection is a change in form or pitch, and that is an apt metaphor for what we hope the impact of this report will be on community conversations about workforce and opportunity. As you will read, we face very real challenges relative to future employer demand and the trajectory of our overall demographics. However, for a region of our size we can lay claim to unequaled assets: a diverse economy, a density of world class educational institutions, a network of highly engaged corporate and civic leaders, and a long history of collaboration. These can be harnessed to meet our workforce challenges, just as we have done in the past with our environment and our economy.

This forward looking examination of both specific employer demand and the characteristics of the region's workforce and talent pipeline presents a fresh and nuanced picture, one we believe best suited to engender a strategic and energetic community response.

Burning Glass Technologies and the Council for Adult and Experiential Learning utilized multiple data sources for their analysis that allow them to capitalize on the strengths of each. The analysis is focused on occupations – the actual jobs – rather than industry sectors, in order to give a more complete picture, as industries comprise many different types of occupations. Publicly available state and federal labor data has been augmented by two additional data sources that provide a very specific picture of actual employer demand. Real-time market insight across the entire economy is provided by Burning Glass Technologies' analysis of web-based job postings, offering current and detailed information about employer skill demands and nascent trends. To validate these findings, focus groups were held with more than 130 CEOs and industry leaders, including those in secondary and postsecondary education.

The findings in this analysis confirm that we are entering a period of rapid transformation spurred by innovation and technological change across every industry. Our region is not unique in experiencing these changes; but, if we embrace our history of working together to develop and implement appropriate strategies, we will create the conditions needed to ensure a prosperous future for our region.

I was pleased to chair a highly engaged Working Group who informed and framed the execution of this work at every stage. The inclusion and diversity of their perspectives, and their shared commitment to the Pittsburgh region, has enriched this work.

Sincerely,

Dmitri Shiry
Managing Partner, Deloitte, LLP

ACKNOWLEDGEMENTS

This report was made possible by generous funding by Allegheny Conference on Community Development Regional Investors as part of Opportunity 2025, and through the input and expertise of the Demand Analysis Working Group and outside analysts, as well as business, education and civic leaders.

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- Aquatech International Corporation
- ASKO, Inc.
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- Builders Guild of Western Pennsylvania
- Carmeuse Lime and Stone
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- Duquesne Light Company
- Eat'n Park Hospitality Group
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- Three Rivers Workforce Investment Board
- Uber
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- UPMC Enterprises
- West Penn Power
- Westinghouse
- Westmoreland County Community College
- Winchester Thurston School
- Wyndham Grand Pittsburgh

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   b. Occupation Family Data, all occupations including employment, projected growth rate, projected annual openings
   c. Opportunity Occupations Data, including employment, projected growth rate, replacement rate, projected annual openings, time-to-fill, location quotient, median salary
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EXECUTIVE SUMMARY
THE PITTSBURGH REGION IS APPROACHING AN INFLECTION POINT.

Competition for jobs and talent in the global economy is putting greater pressure on communities. Increasingly, the success of regional economies is defined by their people and the quality and alignment of their workforce. The Pittsburgh region has made internationally recognized gains over the past 30 years, but it must transform itself once again to meet this competitive challenge. Decisions made, or left unmade, by community and business leaders over the next three to five years will lead in one of two directions: slow change or inaction that will erode competitiveness, or focused attention, investment and leadership that will cement Pittsburgh's role as an innovation hub that attracts top talent and serves as an axis for ideas and solutions with global resonance.

The nation as a whole is challenged by the unprecedented numbers of Baby Boomer retirements; Pittsburgh's challenge is that its demographics put it first in line, and it lacks a deep pipeline of younger talent. Over the next ten years, 1.2 million workers will need to be hired or upskilled here, while more than a quarter of a million enter retirement.[1] In the Pittsburgh region 22% of workers are over age 55, compared to 19% nationally,[2] with no comparably sized group of younger workers behind them. This is particularly pronounced in the 'Gen X' category of people in their 40s, which has led to a hollowing out of middle management that would presumably be ready to step into top management.

This demographic issue poses a substantial risk to Pittsburgh's workforce ecosystem and economy, but it is compounded by the reality that the region has not been able to attract enough people to replace those leaving, and has a death rate that exceeds the birth rate.

Exacerbating this dynamic is the fact that occupational skill demands in the workforce are changing rapidly and are dramatically different from those of the past. This has important implications at both ends of the pipeline: there is a need to develop new strategies to manage knowledge transfer and retain skilled workers, and concomitantly, a need to ensure those new to employment are adequately prepared.

The Pittsburgh region reflects a disparity of economic opportunity. There is a concentration of high-wage, high-skill occupations with relatively low unemployment such as Information Technology (IT) and Engineering. However, there are also 32,000 long-term unemployed residents, most commonly in occupations such as Production or Administrative Support with slower than average growth prospects. While the region must continue to expand innovation and growth of high-skill roles, it needs to redouble its efforts to address the skill and workforce needs of residents who are not currently on pathways to high-wage jobs.

Education and training providers at every level must be able to adjust, and workers will need to be able to rapidly adapt to the changing realities of workforce demand. Employers must work to establish and clearly communicate new expectations and roles. Too often, however, an information gap about emerging high-demand jobs and skills exists between employers and training providers. Without an in-depth understanding and consistent monitoring of the changing nature of the labor market, private and public sector stakeholders will be at a disadvantage when attempting to formulate the right plan to position the Pittsburgh region's labor shed for sustainable long-term employment and successful employment outcomes.

In response to these changing conditions, the Allegheny Conference on Community Development commissioned Burning Glass Technologies and the Council for Adult and Experiential Learning (CAEL) to conduct a labor market supply and demand analysis to examine the issues and opportunities facing the region.[3] This report offers a comprehensive analysis of the job market demand over the next decade, 2015-2025. It also serves as a call to action to the region's employers and educators, whose collective community leadership will be required to ensure that the region has a workforce trained for the jobs and skills of the future.

QUESTIONS ADDRESSED IN THE REPORT

This study utilizes a range of data sources and analytic approaches including: traditional economic data for long-term trend analysis, job postings analysis to measure the skills and credentials in demand, and in-depth focus groups to provide robust contextualization to the quantitative indicators. This report focuses on occupations, or the jobs that people are doing, rather than industry sectors, meaning the employers. The following questions are addressed:

What are the jobs and skills in demand in the Pittsburgh region now and over the next decade?
- What occupations will be in demand across the economy and what are the associated skill sets?
- What occupations will grow fastest and need additional supply?
- Where are employers' skill needs changing and how will training programs need to adjust?
- What are the areas where Pittsburgh's talent base has unique capabilities worthy of promotion?

What are the strengths and risks in the Pittsburgh region's future talent pipeline?
- Where are employers able to attract the talent they need and where are they struggling?
- Where are there robust pipelines that offer opportunity to attract new employers to the Pittsburgh region?
- Where are the risks in the pipeline due to insufficient supply, misaligned programs, or high outward migration?

What can the community of employers and training providers do to capitalize on positive findings and address the challenges identified in this report?

UNIQUE ASSETS WHICH THE PITTSBURGH REGION CAN LEVERAGE

Diverse industry mix: The diversity of Pittsburgh's industrial sectors and its incumbent workforce represent a unique blend of strengths. A base of IT, engineering and healthcare talent and related university research allows Pittsburgh to serve as an innovation hub driving the future of science and technology. The historically strong production and construction labor force that most recently allowed the region to capitalize on shale gas production similarly provides a talent base that allows for the absorption of future fluctuations in energy and manufacturing workforce needs.

World-class higher education institutions: The 61 local universities, community colleges, and training providers comprise a strong base of talent development, and cutting-edge research institutions provide the ability to both recruit talent and lead on innovative changes in the coming decade. This base also represents an unparalleled economic opportunity to reshape Pittsburgh's economy. The talent associated with the universities serves as an important source of economic development and a major attraction for IT, Engineering and other advanced technology firms.

Engaged CEO network: The Allegheny Conference on Community Development represents a strong network of engaged CEOs who are personally invested in the community and are seeking to actively address the training and workforce challenges of the coming decade.

Culture of Collaboration: There is strong momentum for action on both the workforce supply and demand sides due to a longstanding culture of public-private partnership in the region. The various stakeholders have worked together for generations to overcome challenges and capture opportunities for the region. They are well-prepared to do so again.

CROSS-CUTTING TRENDS IN THE MARKET

Four themes emerged consistently throughout the analysis of dozens of data sources and over 25 hours of focus groups and interviews with 130 CEOs and HR Directors from 85 companies in the region, across all sectors, as well as K-12 and post-secondary education leaders. These four themes influence every occupational group and industry sector and are examined in more granular detail later in this report. The four key themes are:

Aligning supply and demand: Changing skill sets across virtually all occupations means that a much tighter education and industry connection must be created to align supply and demand. In addition to new focus on the K-12 and post-secondary pipeline, continual training and upskilling of people already in the workforce will be required. Technological innovations are changing daily routines for workers in almost every occupation, and will continue to do so. A culture of continuous learning must become the norm, and employers and the workforce system must develop effective and ubiquitous tools to support upskilling.

A changing 21st century workforce: Technology is also increasing demand for some roles, while rendering others obsolete. Companies across many sectors now identify themselves as technology companies. Ensuring a future workforce with digital fluency must begin with the K-12 system. Further, many industries are being rapidly reshaped by technology and forces in the marketplace resulting in new business models; incumbent workers must adapt to these changes and those seeking opportunity must understand how to become adequately skilled for emerging roles.

Hybrid jobs, the blending of diverse skill sets into a single role: Many jobs are merging discrete skill sets into single roles that are more complex than in the past. For example, technology enablement has increased the demand for technology skills in non-technology-focused jobs. Customer service is becoming an important skill in a range of occupations including those in healthcare and computer support roles for staff which may not have previously been customer facing.

Upskilling and upcredentialing: employers want demonstrated higher-level skills and credentials: The changing nature of jobs means that many occupations require new, more advanced skills. Relatedly, employers are increasingly seeking credentials where no credential, or a lesser credential, would previously have sufficed, constraining opportunities for upward mobility, increasing time to fill jobs and impacting starting salaries. Building closer industry and educator connections to focus on a comprehensive understanding of skill requirements and related assessment can help to alleviate upcredentialing.

RECOMMENDATIONS FOR ACTION

This report should be viewed as an initial stake in the ground to advance a community dialogue. It is clear that the region has strong momentum and the appetite for a more systematic approach to workforce planning and partnership development between employers and training providers.

Discrete strategies are suggested in all of the occupational cluster profiles that appear later in the report, and specific tactics will need to be developed for each. Program and policy changes and activities necessarily will vary among occupations as well as among different cohorts of talent. However, the high level recommendations here have emerged directly from the data and qualitative input provided by employers and educators as those with greatest potential impact to help align the region's demand and talent supply.

THE EMPLOYER COMMUNITY MUST LEAD CHANGE AND SHIFT FROM BEING CONSUMERS OF TALENT TO BECOMING INVESTORS IN THE LABOR MARKETPLACE

Industry needs to frame and support a more effective and sustainable model to enable education and training providers to better understand changing skill demands: The need for increased alignment and coordination between training providers and industry demand is a consistent finding throughout this study. Connections between employers and their feeder training providers are uneven. Employers should lead the creation of a standing, cross-industry structure to support alignment of business needs and training demand at all levels.

A first step would be convening employers with common occupational needs. This approach will identify which industry sectors have demand for the same occupational skill set. Such a convening would also be an opportunity to identify and engage the start-up community and smaller employers who have similar talent demand. Engaging educators to work with employers to identify and build consensus on the most important skills and competencies would lead to the development and adoption of common curriculum. This type of infrastructure could also spur consistent development and dissemination of well-articulated career pathways.

Large, long-established employers and start-up and technology companies should form a partnership to attract and retain top level talent: Pittsburgh faces a talent shortfall both in the overall number of workers and in the high-skill professions that drive the innovation economy. A coordinated, sustained and well-funded marketing effort to promote inbound migration and talent retention is needed. There are many organizations promoting the region but a coordinated effort is required to amass sufficient resources to have a visible impact. If employer demand for talent in critical emerging occupations is not clear and compelling, existing talent may leave the region.

Engage employers directly in a collaborative effort to retain more college graduates: As home to several of the nation's leading colleges and universities, the Pittsburgh region should consider a concerted effort by employers and educators to promote the region and its opportunities to college students. If this were coupled with active engagement of students early in their college career around high-demand occupations, the region could decrease the level of outward migration following graduation. At the same time, however, employers must be willing to hire recent graduates knowing they will not yet have the three to five years of experience often requested.

FOCUS ON UPSKILLING TALENT IN THE REGION

Create explicit pathways to upward mobility: As the market places an increasing premium on workers with higher skills, the development and clear articulation of career pathways is critical to ensuring employers have an adequate talent supply and that workers have opportunities to advance. Too often existing pathways are unclear, either because of lack of information available to workers about the jobs and skills in demand, or lack of awareness or limited options for training that is aligned with employer skill needs.

Focus on the development of emerging, cross-cutting skills and competencies: There are a set of baseline skills and competencies which are increasingly in demand in the market and which employers across all sectors cited as gaps. These include customer service skills, leadership/management skills, and various emerging digital skills. Training providers, particularly CTE and other technical programs, are well served to balance their focus both on baseline skills and on occupationally-specific, technical skills.

Focus resources on opportunity occupations and high priority occupations: This report highlights the rapidly changing labor market, including identifying occupations that offer strong potential to earn a living wage, many of which the state does not presently recognize as a High Priority Occupation eligible for increased training funding. Career pathway initiatives can be framed around these occupations as a basis for upskilling workers who are unemployed, in declining occupations or in occupations which offer sub-living wage pay.

CAPITALIZE ON INNOVATION IN INFORMATION TECHNOLOGY, ADVANCED MANUFACTURING AND FINANCE

Build a bridge to connect larger regional employers and the start-up and innovation economy: The presence of multiple top-tier universities in a city the size of Pittsburgh, numerous corporate and federal R&D facilities in the region, and a highly engaged community of corporate leaders, is a unique combination of assets and has made the region a leader in innovation and cutting-edge technologies across a broad set of sectors.

While the number of jobs specific to this growing hub of innovation is relatively small when compared to overall regional employment in 2016, we know that demand for these innovation skills will continue to grow rapidly—in the Pittsburgh region and around the world. If the region's future will continue to be shaped by people here, the region must focus attention and resources to skill, attract and retain the world-class talent that fuels the innovation ecosystem.

Focus on opportunities for growth in innovation technology: Particular occupation clusters which the local employer and training community might consider investing in include:

- Cybersecurity
- FinTech, (shorthand for financial technology), and
- Predictive analytics, especially in the healthcare and energy sectors

In addition, special focus should be given to solidifying Pittsburgh's role as a center of innovation for robotics, additive manufacturing and other advanced manufacturing technologies.

HOW TO USE THIS REPORT

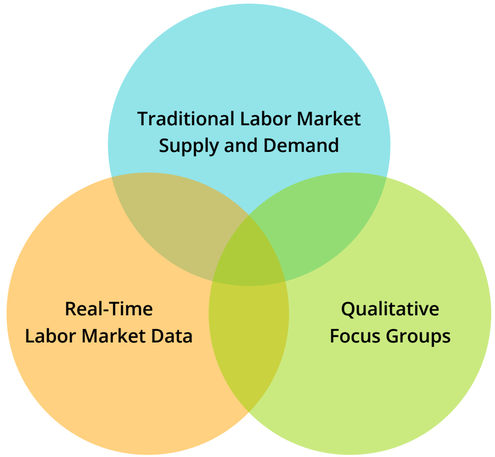
BLENDED APPROACH TO DATA AND ANALYSIS

This study draws from a range of data sources and analytic approaches including traditional economic data, job postings analysis and in-depth focus groups. Capitalizing on the unique strengths of each data source, we can validate key findings across diverse sources and multiple methodologies and identify and track nascent trends as early as possible. Data sources used in this study include:

Traditional labor market supply and demand data, available from sources such as the Bureau of Labor Statistics, US Census Bureau, Pennsylvania Department of Labor and Industry, and National Center for Education Statistics.

Real-time labor market data, including job postings data developed by Burning Glass Technologies was used to analyze the skills in demand by location employers, and LinkedIn's Alumni Tool was used to analyze the migration patterns of local graduates.

Focus groups and interviews with more than 130 CEOs and HR Directors from 85 Pittsburgh region employers across all sectors, as well as leaders in K-12 and post-secondary education, facilitated by the Council for Adult and Experiential Learning (CAEL) and hosted by the Allegheny Conference in March 2016. Additional information about the focus groups can be found in Appendix: Methodology.



DEFINING THE OCCUPATIONAL FOCUS OF THE REPORT

In this workforce supply and demand analysis, we focus on *occupations*, or the jobs that people are doing. This differs from most traditional economic analyses, which focus on *industry* sectors in the economy. Industries employ many occupation types. For example, the Healthcare industry not only employs Physicians and Nurses, but also Financial Analysts, Custodians and Receptionists. Instead, we focus on questions such as: How many software engineers will be required, not just in IT firms but across every industry in the economy? By orienting this report on occupations (i.e. the jobs) as opposed to industries (i.e. the employers) we are able to focus on dynamics relating to the training pipelines and skill demands that cut across multiple employers and market sectors; moreover, this framing allows workers and training providers to understand the breadth of opportunity, and the demand for skills based on the work they are interested in doing, rather than the specific employer they may work for.

In order to directly address the workforce needs that are most critical to the economic competitiveness of the region, we have identified the roles that are most in demand and important in the industries that provide the greatest contributions to the local economy.

To this end, we focus on five *occupational* clusters:
1. Information Technology
2. Business and Finance
3. Engineering, Science and Production
4. Healthcare
5. Construction

We have also selected two *industry* sectors to expressly analyze:
6. Energy
7. Retail and Hospitality

Energy was selected because of its rapidly changing profile in the local economy and the importance of understanding its unique workforce dynamics. Many of its occupations are also common to production (manufacturing). Retail was selected because it employs large numbers of workers and acts as a vital entry-point to the workforce for the young and low-skilled, potentially acting as a stepping stone to higher paid jobs. It is also undergoing a shift with new categories of competitors in the market creating increased demand for certain high-skilled talent such as logistics and IT.

INTERPRETING THE DATA IN THE REPORT

UNDERSTANDING LABOR DEMAND

Labor demand consists of employers' current and future hiring needs, based on recent labor market trends, and projections of industry and occupational growth. Labor demand is comprised of two parts:

1. Growth rates signify the projected addition of new positions to the regional economy, based on industry growth and changes in the structure of the labor market.

2. Replacement rates represent positions that need to be filled due to individuals leaving the occupation, either to pursue unrelated occupations (for example, shifting from work in retail to a business role) or to leave the labor market due to retirement or moving from the region.

Not included in labor demand is churn: the movement from one job to another with the same basic responsibilities.

Labor demand is captured using a combination of traditional labor market information collected by the Bureau of Labor Statistics and analysis of job postings data, collected by Burning Glass Technologies. More detailed discussion of the growth projections methodologies is included in the Appendix.

UNDERSTANDING LABOR SUPPLY

Information on labor supply is collected from a range of government data sources which cover educational outcomes such as degree completion and K-12 performance and demographic analyses such as migration and retirements. Specific data sources used to describe labor supply include:

- Higher Education enrollment and degree completion data, National Center for Education Statistics' Integrated Post-Secondary Database (IPEDS)
- K-12 performance data, Pennsylvania Department of Education
- Migration information, American Community Survey (ACS)
- Occupational projections. Pennsylvania Department of Labor and Industry, Bureau of Labor Statistics (BLS)

In this study we used LinkedIn's alumni tool, a unique private data source, to track the migrations of recent graduates. Based on the sample of students with LinkedIn profiles, these data allow us to estimate how many students from local universities remain in Pittsburgh and how many leave.

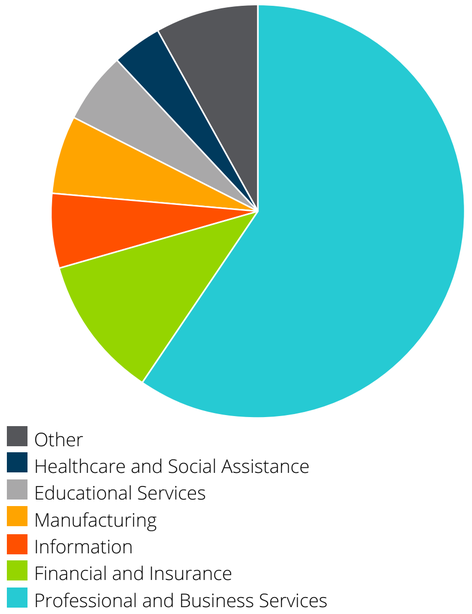
HOW TO INTERPRET OCCUPATION GROUP SUMMARY CHARTS

We provide a demand and supply analysis for each occupation group based on three charts showing employment growth, demand by industry and key skill demand highlights, as depicted in this sample chart.

2015 Employment	50,000
Annual Openings 2015-2025	3,500
% of Openings Requiring Bachelor's Degree	65%

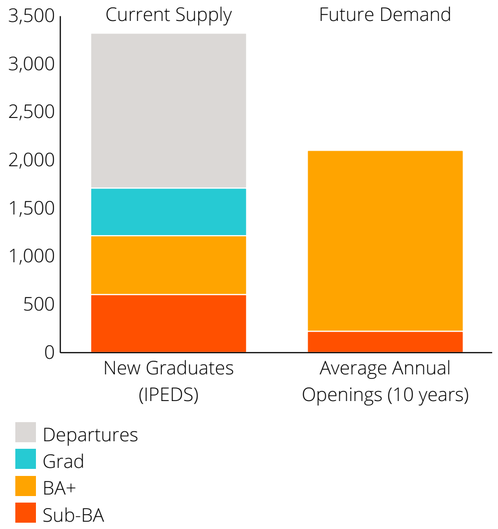
Numbers in above charts are for example only.

Industry Demand for IT Workers



Data Element	Description and Source	Key Question Addressed by this Indicator
2015 Employment	Number of workers employed in these occupations in the Pittsburgh region, May 2015. *Source: Model based on Occupational Employment Series, Bureau of Labor Statistics, and Burning Glass job postings data.*	How large is this occupation group?
Annual Openings	Average number of projected annual openings in these occupations over the next decade. *Sources: Occupational Employment Series, Bureau of Labor Statistics, PA Department of Labor and Industry and Burning Glass.*	How many new workers are needed in these occupations each year?
% of Openings Requiring a Bachelor's Degree	Percentage of job postings in the last year which call for a bachelor's degree. Jobs which require a license or other occupational training are assumptively assigned a degree level. For example, all LPNs are sub-baccalaureate and all Engineers are baccalaureate or masters-level roles. Openings for jobs such as Administrative Assistants, which can be either BA or sub-BA level roles, are assigned a degree level based on the distribution of demand in online job postings. *Source: Burning Glass job postings data*	What are the educational qualifications employers are seeking in order to address their workforce needs?
Industry Demand for Workers	Percentage of jobs postings in each industry sector in the last year. Industry sectors are classified according to the NAICS system developed by US federal statistical agencies. *Source: Burning Glass job postings data.*	In which industries is demand for this type of worker greatest?

Supply and Demand of Workers



Data Element	Description and Source	Key Question Addressed by this Indicator
Supply and Demand	**Demand:** Average annual openings broken out by roles requiring a bachelor's degree or those which do not according to the approach described on the previous page. Roles specifying a graduate degree are included in the bachelor's degree category because in many cases a graduate degree serves as a proxy for additional experience or expertise on top of a bachelor's degree rather than an explicitly demanded credential. *Sources: PA Department of Labor and Industry and Burning Glass* **Supply:** The size of the local supply pipeline is determined by aggregating the total number of graduates of relevant degree programs from the 61 institutions of higher education in the Pittsburgh region and proportioning them by how many graduates remain in Pittsburgh. The number of graduates who stay in Pittsburgh is derived with school specific data from LinkedIn's Alumni Tool. For example, if 80% of LinkedIn members who graduated from a given university over the last five years still live in Pittsburgh, we include 80% of the graduates of each degree program from the university in the local supply. *Sources: National Center for Education Statistics' Integrated Post-Secondary Education Data System, and LinkedIn's Alumni Tool.*	How does the size of the pipeline of available workers graduating from local institutions align with projected annual demand? Additional questions which can be addressed include: To what extent would attracting more graduates to remain in Pittsburgh address talent supply gaps? (Departing students are shown in the shaded cell on the supply chart.) How much will education institutions need to expand enrollment in order to address supply gaps? (The data show current availability of supply against projected future growth, allowing analysis of how the pipeline must adjust to meet future workforce need.)

OCCUPATIONAL DEMAND AND TALENT SUPPLY

AGGREGATE LABOR DEMAND

The Pittsburgh region will require 34,000 new workers per year from 2015-2025: Over the next 10 years, Pittsburgh employers will need to replace 29,000 retirees annually, while adding 5,000 new positions per year. Coupled with occupational shift, the market will see 1.28 million job openings in the coming decade.

Occupational growth in Pittsburgh is projected at 4.2%: Covering the period 2015-2025, the overall workforce is projected to grow by 4.2%[4]. The forecasted decline in the overall population of the Pittsburgh region (including slight decline 2010-2015)[5] means the region will need to focus on retaining students trained locally, and also increase inbound migration in order to meet workforce demand.

- The occupational families projected to grow most rapidly are Healthcare Support (15%), Healthcare Practitioners (12%), and Computer and Math (11%).

DEMOGRAPHIC IMPLICATIONS FOR SUPPLY AND DEMAND ALIGNMENT

Pittsburgh will have a significant need for both new talent and upskilling of existing workers as population trends leave employers short of the number of workers needed and occupations increasingly require new skills. Further, upskilling will be required to tackle persistent concentrations of un- and underemployment. There are 32,000 long-term unemployed in the region. Pittsburgh's workforce skews older than its benchmark cities.[6] 22% of workers in the Pittsburgh region are over age 55, compared to 19% nationally. The magnitude of hiring and upskilling required to meet need over the next decade is already putting pressure on the training system.

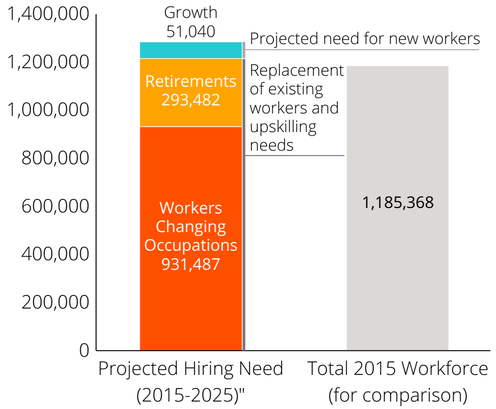
Breaking down this challenge we found:

- 4%—approximately 5,000 positions per year—represents additional hiring demand due to growth;
- 23%—approximately 29,000 positions per year—represents the hiring need for additional workers due to retirements; while
- 73%—or 930,000 positions over the ten-year period—represents the hiring and/or training and upskilling needed to replace workers leaving their occupations. This could be due to promotions to a higher-level occupation, to pursue unrelated occupations (for example, shifting from work in a retail occupation to a finance role), or from temporarily leaving the workforce, for example to care for young children. These workers will typically need training either from their employers or from an external provider in order to successfully transition from one role to another. Training for these roles falls both to employers to upskill incumbent workers and to the region's training institutions serving adult learners.

At the same time, the K-12 pipeline alone is not large enough to meet the projected growth in workforce demand. There is a gap of nearly 8,000 workers between the projected annual demand of 34,000 new workers and the number of high school seniors per year, 26,000, who would be entering the workforce at some point following high school and/or post-secondary training.

With little room or no room for slack in the supply pipeline, the importance of alignment increases dramatically. Every graduating job seeker must have the skills he or she needs to contribute to the local economy.

Projected Hiring Demand, 2015-2025



ROLES DECLINING DUE TO AUTOMATION AND TECHNOLOGY

Automation and technology are leading to the elimination of low-skill roles. For example, traditional occupations such as Word Processors and Typists, and Grinding Machine Operators are increasingly being replaced by employees with additional or higher order skill sets who can incorporate this work into a broader occupation. What was a singular occupation is becoming a skill embedded in an occupation with a broader scope.

"In our utility business, we see the future combining computer and communication skills with all of the technical skills we already require. The bar gets higher all the way up the food chain."

Table 1: Employment Summary by Occupation Family

Occupation Family	2015 Employment	Annual Openings 2015-2018	Annual Openings 2015-2020	Annual Openings 2015-2025	Projected Growth Rate	Unemployment Rate
Office and Administrative Support	**204,283**	**21,084**	**21,087**	**21,094**	**0%**	**7.6%**
Food Preparation and Serving Related	104,112	18,612	18,617	18,628	5%	13.2%
Sales and Related	128,943	17,185	17,186	17,188	0%	10.1%
Transportation and Material Moving	75,503	8,972	8,974	8,979	4%	11.9%
Personal Care and Service	45,890	7,169	7,175	7,190	10%	8.9%
Production	**62,906**	**6,538**	**6,539**	**6,542**	**-1%**	**10.4%**
Construction	**57,739**	**5,414**	**5,416**	**5,422**	**5%**	**15.7%**
Business and Financial Operations	**64,767**	**5,344**	**5,347**	**5,356**	**5%**	**5.4%**
Building and Grounds Cleaning and Maintenance	41,112	5,249	5,250	5,252	4%	10.1%
Healthcare Support	**40,514**	**5,064**	**5,075**	**5,103**	**15%**	**6.1%**
Healthcare Practitioners and Technical	**75,042**	**4,133**	**4,144**	**4,174**	**12%**	**3.3%**
Installation, Maintenance, and Repair	**46,691**	**3,918**	**3,920**	**3,927**	**5%**	**9.5%**
Education, Training, and Library	50,531	3,842	3,842	3,844	2%	3.1%
Management	51,133	3,591	3,592	3,596	4%	3.7%
Community and Social Services	25,890	2,713	2,715	2,720	7%	3.2%
Protective Service	22,207	2,165	2,166	2,166	3%	11.0%
Computer and Mathematical	**31,373**	**2,087**	**2,092**	**2,104**	**11%**	**2.3%**
Arts, Design, Entertainment, Sports, and Media	14,054	1,495	1,495	1,496	2%	5.9%
Architecture and Engineering	**22,736**	**1,347**	**1,348**	**1,350**	**3%**	**5.0%**
Life, Physical, and Social Science	**8,490**	**670**	**670**	**671**	**7%**	**6.3%**
Legal	9,962	557	558	559	7%	4.7%
Farming, Fishing, and Forestry	1,490	243	243	243	-7%	18.1%
Grand Total	**1,185,368**	**127,393**	**127,452**	**127,604**	**4%**	

Sources: Employment data from Burning Glass Application of Bureau of Labor Statistics Projections Methodology; Unemployment data from Pennsylvania Department of Labor and Industry
Bold Occupations are those areas explored in depth in "High Demand Occupational Sectors"
Red indicates negative projected growth

Table 2: Top-10 Sub-BA Occupations by Growth Rate (min 500 employed)

	Projected Growth Rate
Physical Therapist Assistants	31%
Occupational Therapy Assistants	30%
Diagnostic Medical Sonographers	21%
Electrical Power-Line Installers & Repairers	20%
Industrial Machinery Mechanics	20%
Cardiovascular Technologists & Technicians	19%
Emergency Medical Technicians & Paramedics	16%
Computer-Controlled Machine Tool Operators	16%
Medical Secretaries	15%
Licensed Practical & Licensed Vocational Nurses	15%

Sources: Employment data from Burning Glass Application of Bureau
**Note: Mininum 500 employed, 2015. Only considers occupations that pay a living wage ($15/hr) based on median wage.*

This table provides a summary of the occupational demand and projections in the Pittsburgh region including the number of people working in the occupational family in 2015, projected annual openings in the short, medium, and long-term, and the growth rate. Bold occupational families are those that this report examines in greater depth in subsequent sections.

Table 3: Top-10 BA+ Occupations by Growth Rate (min 500 employed)

	Projected Growth Rate
Speech-Language Pathologists	28%
Personal Financial Advisors	23%
Operations Research Analysts	21%
Diagnostic Medical Sonographers	21%
Physical Therapists	21%
Information Security Analysts	20%
Occupational Therapists	20%
Computer Systems Analysts	19%
Healthcare Social Workers	18%
Market Research Analysts & Marketing Specialists	15%

Sources: Employment data from Burning Glass Application of Bureau of Labor Statistics Projections Methodology

Note: Mininum 500 employed, 2015. Only considers occupations that pay a living wage ($15/hr) based on median wage.

LABOR DEMAND BY EDUCATION LEVEL

Highlighting the fastest growing jobs at the bachelor's degree level and sub-baccalaureate levels will allow training providers and their partner employers to focus on building a supply pipeline that is responsive to upcoming labor demand.

BACHELOR'S LEVEL JOBS ARE GROWING, PARTICULARLY IN STEM FIELDS

Bachelor's degree roles are projected to grow at 4.5%, but the region faces a challenge retaining recent graduates: Bachelor's level growth addresses emerging high value skill sets, such as cybersecurity, analysis, and healthcare. Bachelor's degree graduates leave the region with higher frequency (33% retention rate from local universities) than sub-baccalaureate graduates (79% retention rate). Pittsburgh's retention rate of graduates is among the lowest of major cities in the country.[7] One factor relative to low retention is that many of the most commonly awarded degrees do not align directly with regional demand. Sharing demand data and selling opportunity in the Pittsburgh region early in a college student's career here could help to retain more of the approximately 20,000 students who leave the region each year for other opportunities following graduation.

Projected growth aligns with key sectors of the regional economy: Each of the ten fastest projected growth occupations (minimum 750 projected employed in 2025) connect to key sectors of energy, information technology, and healthcare, and represent priorities for retaining talent from local universities. These roles include Information Security Analysts, Operations Research Analysts, and Physical and Occupational Therapist Assistants. See Appendix for additional occupation-level details.

Cybersecurity jobs have grown quickly and represent a regional economic development opportunity: Information Security Analysts have the highest projected growth over the next decade, reflecting the growing demand for cybersecurity talent in Pittsburgh, and the potential to develop a broader pipeline and expand the cyber workforce across the economy. Just a few years ago, employers had to 'raid the federal government' for information-security talent, but many now have high-end talent in place to run their cybersecurity efforts and are now working to fill in the departmental needs at lower skill levels.

> "We have a great opportunity in this region to build the cybersecurity talent pipeline which currently doesn't exist. Initially our hiring need was so acute that we were focused on talent with a minimum of five years of experience. Now we should turn our attention to developing an entry-level pipeline."

ALIGN UPSKILLING INITIATIVES WITH HIGH GROWTH SUB-BACCALAUREATE ROLES

Sub-baccalaureate roles have particularly high growth in Healthcare. Five of the ten roles projected for fastest growth at the sub-baccalaureate level are in the Healthcare Support occupation group.

More generally, sub-baccalaureate growth projections align with available funding for training. The fastest projected growth of sub-BA occupations align with those identified by the state's Department of Labor & Industry as High Priority Occupations, especially around healthcare, utilities, and transportation. Continued investment in training infrastructure for these roles will support the development of productive pipelines of workers.

Researchers at the Federal Reserve Bank have developed a framework for Opportunity Occupations[8], those paying more than median wage, with fewer than 50% of postings requiring a bachelor's degree. These occupations, particularly when factoring in overall demand and projected growth, represent strong targets for job seekers without a bachelor's degree to pursue.

In the Pittsburgh region, Opportunity Occupations represent 24% of local employment and 27% of projected growth. This group of roles is diverse, including Nurses, Truck Drivers, Bookkeeping Clerks, and more. Skilled trades are well represented among opportunity occupations locally, in many cases reflecting demand from the region's diverse energy industries. Maintenance Workers, Carpenters, Construction Laborers, and Operating Engineers are all among the largest Opportunity Occupations as measured by number of employed workers. However, these roles are not projected to grow as quickly as the overall economy. Truck Drivers, also associated with the energy sector, project to be a fast-growing opportunity occupation (7% projected growth). Fast growth Opportunity Occupations in Healthcare include Registered Nurses (average salary: $62,470), LPNs ($41,490), Radiologic Technicians ($49,560), and Dental Hygienists ($56,160).

Table 4: Opportunity Occupations

Occupation Family	Employment	Projected Growth Rate	% of Opportunity Occupation Employment
Construction and Extraction	54,358	6%	18%
Healthcare Practitioners and Technical	47,834	12%	16%
Office and Administrative Support	45,556	-3%	15%
Installation, Maintenance, and Repair	40,680	6%	13%
Production	35,802	2%	12%
Transportation and Material Moving	25,431	6%	8%
Other	55,897	3%	18%
Total	**305,558**	**5%**	

Sources: Bureau of Labor Statistics and Burning Glass Technologies

Connecting High Priority Occupations to the career ladder initiatives recommended in this report and already underway in the region provides an important opportunity for upskilling the existing workforce in those jobs which offer the strongest career opportunities. Using the list of Opportunity Occupations highlighted in the online appendix, local employers and training providers can petition the state for recognition as High Priority Occupations and increase funding to appropriate training programs.

A CHANGING 21ST CENTURY WORKFORCE

Technology is changing the workforce, increasing demand for some roles, while rendering others obsolete. Many of these technology-driven trends have particular implications for Pittsburgh given its standing as a manufacturing center and hub for the finance industry. Establishing well-articulated career ladders and upskilling opportunities in these roles will be critical to helping ensure that workers are able to move from declining occupations to growing ones with robust opportunities.

"What skills are we confident will be in demand in 10 years? Learning agility, problem solving, sound decision making, trouble shooting, team work, technical savvy."

High-technology occupations are at the leading edge of these changes. The workforce implications of many transformative technologies such as big data, robotics, and additive manufacturing, and healthcare innovations such as gene therapy are only beginning to be felt. Two important implications of the evolving needs of the workforce are highlighted below, and described in greater detail in the relevant occupational sections.

- **A smaller, higher skilled workforce will drive the future of manufacturing in the region:** The value of manufacturing output has increased by over 10% in Pittsburgh since 2010, almost returning to pre-recession levels. However, employment has remained flat. The manufacturing workforce of the future will be smaller, but higher skilled. Roles supporting advanced manufacturing processes such as robotics or additive manufacturing are projected to grow rapidly while many lower-skilled production roles are in decline.

"The whole world of manufacturing is being transformed by our digital age. Additive manufacturing is the future, and its leadership is up for grabs. This is the first 15 minutes."

Table 5: Manufacturing Output and Manufacturing Employment in Greater Pittsburgh

Year	Manufacturing Output	Manufacturing Jobs
2010	100.0	100.0
2011	103.1	101.7
2012	107.8	102.7
2013	110.8	102.3
2014	112.4	101.4
2015	N/A	100.2

Sources: Output data from Bureau of Economic Analysis; Employment data from Bureau of Labor Statistics

GROWING WORKFORCE IMPACT OF THE INNOVATION ECOSYSTEM

- **The region has world-class IT research, and a community of top-tier tech employers whose expansion is gaining momentum.** Google, Amazon, Uber, Facebook and Duolingo, among others, have all chosen to move into or expand in Pittsburgh in recent years. These firms bring excitement to the region and establish it as a vibrant technology hub. Per capita demand for the most sophisticated and highest value IT skills, such as those in demand by the firms listed here, is currently below the national average, but growing quickly. The region must act now to retain this talent. Currently the talent is moving faster than employers.

This innovation economy, thriving in a region the size of Pittsburgh, coupled with numerous corporate and federal R&D facilities and a highly engaged community of corporate leaders is a unique combination of assets. This has made the region a leader in innovation and technology across a broad set of sectors. Its historic strengths in finance, energy, and advanced manufacturing have been joined by computer science, robotics, engineering, cognitive science, design, information systems, healthcare and life sciences, making Pittsburgh a magnet for industry partners who want to collaborate on research and recruit the best talent.

EMPLOYERS ARE BLENDING TRADITIONAL SKILL SETS TO CREATE HYBRID JOBS

Employers are increasingly combining skills sets that do not typically train together, such as LPNs with the management skills to oversee a team of Certified Nursing Assistants or Home Health Aides. As a result, employers are finding gaps between the talent they need and what is available in their own workforce or on the open market.

Analysis of job postings and focus group findings identified a number of skills which cut across multiple occupations and industries and which employers highlighted as important yet in short supply in the workforce. Many of these are "hybrid skills," that is, skill sets from previously discrete jobs that are being combined into one role. One senior energy sector executive said his organization was moving towards, "fewer people with more skills." Trends we have observed in the Pittsburgh region as well as nationally demand that workers develop an increasingly broad skill set to stay competitive in the job market and productive in the workforce.

DIGITAL SKILLS ARE IN DEMAND ACROSS OCCUPATIONS

Across the labor market, employers are expressing demand for technology skills. This is apparent for office work, as well as for work in the field away from standard desktop computers. Digital skills are increasingly becoming a pre-requisite for roles that offer middle class wages. In both manufacturing and financial services, several employers described their primary identification increasingly as technology companies.

> "Our perfect combination? Technical proficiency and market-facing talent."

Digital skills begin with computer literacy and the ability to use programs such as Microsoft Office. These skills are now necessary across occupations and families, including Customer Service Representatives, Retail Supervisors, Office Clerks, and Production Clerks. More advanced digital skills, such as CRM Software, are now demanded across Sales, IT, Marketing, and Human Resources positions. These digital skills are not just for advanced roles, but many sub-baccalaureate roles as they become more complex. Executive Secretaries, HR Specialists, and Event Planners continue to use advanced digital skills in their day-to-day work.

Healthcare roles require increased digital skills overall, especially as technological and regulatory changes impact the industry. With the increase in electronic medical records and online patient portals, employers expect staff to be able to interact with computers and digital records. In Construction, Energy, and Retail, employers expect workers to take work orders in the field using tablets and smartphones. Employers in the skilled trades increasingly are moving blueprints to digital format, requiring stronger digital fluency. Computer skills are a top-five baseline skill for Production workers, a reflection of this move to digital work.

CUSTOMER SERVICE SKILLS AND OCCUPATIONS ARE INCREASINGLY IMPORTANT

Customer service is one skill set that is very difficult to automate. It is particularly important in Pittsburgh given the concentration of financial and corporate headquarters. Customer Service Representatives are projected to have nearly 3,000 annual openings, more than any other occupation paying over $15/hour (the living wage threshold for Pittsburgh). However, there are few clear training pipelines for this role.

> "As we look 10 years out, I think any repetitive task could potentially be replaced by technology, but customer service can never be automated."

Beyond Customer Service and Sales Representative positions, customer service skills are important across a broad range of occupations. They are among the top 10 skills requested for positions including Computer User Support Specialists and Computer Systems Analysts, Medical Secretaries, Mechanics, and Installation Workers. As many front-line customer service positions are replaced by computer systems, workers that previously did not have any direct interaction with customers now will, and thus have to develop or enhance service skills. Similarly, many employers seek customer service skills for internal tech support staff working with internal customers across the organization.

> "Our nursing aides increasingly will need a hospitality focus as their patients are essentially their long term customers."

Representatives from the healthcare sector noted their industry is experiencing a paradigm shift to a customer service driven model. Positions at all ends of the healthcare spectrum, from physicians to laboratory technicians to certified nursing assistants, now have increasing potential to be customer facing and the need to communicate and provide customer service will only increase. Healthcare leaders indicate that as the first point of contact for patients and family members, LPNs must have strong service skills.

In internally facing roles, teamwork, a close correlate of customer service, is increasingly important. Employers note a shift in IT processes toward agile development, requiring more teamwork and internal customer service. Construction and Manufacturing employers similarly cite teamwork, not only as a core skill set for their work, but also as a skill for which K-12 and post-secondary graduates are not prepared. Employers would like to see more teamwork training embedded in the secondary curriculum to create a job-ready workforce. Of note, many schools in the region have added, or increased, their use of project-based learning or team building concepts in their curriculum.

HYBRIDIZATION OCCURS ACROSS INDUSTRIES AND OCCUPATIONS

Many employers are seeking workers with both domain expertise, such as business or healthcare, and robust IT and analytic skills. In other cases, employers are introducing new baseline skills into roles that had been narrower and more specific. Specific examples of hybridization include:

- **Business skills for IT workers and IT skills for business workers:** Financial services employers are requiring that business professionals become more tech savvy, and that IT professionals better understand the business. For example, IT roles often require knowledge of business processes and information security when working in Finance, while Business Analyst roles require knowledge of increasingly technical data tools such as SQL and SAS.
- **Business and analysis skills in healthcare:** As healthcare becomes increasingly focused on outcomes measurement and cost control, workers are expected to have a stronger understanding of the business implications of their care decisions and to be savvier working with various forms of health data now available to them in real-time.

- **Increased demand for sales skills:** Within retail banking, employers note a shift from transactional customer service to a sales approach while providing digital assistance to customers.
- **Broadened demand for welding skills:** In 2015, welding skills were in demand 10 times more often in occupations defined as other than actual "welding" jobs. Welding skills are necessary for Maintenance Workers, Automotive Service Technicians, Bus and Truck Mechanics, as well as many Engineers and Production Workers. This impacts training both for Welders, who may have fewer opportunities as specialists, and in other roles that require welding knowledge.

UPSKILLING: EMPLOYERS WANT DEMONSTRATED SKILLS AND HIGHER-LEVEL CREDENTIALS

The changing nature of jobs has meant that many occupations require new, more advanced skills. Conversely, employers are now seeking credentials where no credential, or a lesser credential, would previously have sufficed. Employers appear to be substituting higher level credentials as an equivalent to skill mastery. This phenomenon is known as "upcredentialing" and can increase time to fill an occupation, impact starting salaries and limit upward mobility.

CHANGING SKILL DEMANDS WITHIN OCCUPATIONS

Analyst roles are calling for stronger programming and analytics skills; other roles such as Drafters are upskilling as improved AutoCAD technologies brings their skill requirements closer in line with engineering roles. The hybridization trends described here, especially the increased demand for digital skills, are another form of upskilling. Manufacturing jobs are more complex and computer operated, and Administrative Support workers require more sophisticated knowledge of the Microsoft Office suite.

EMPLOYERS STRUGGLE TO HIRE MIDDLE MANAGERS

An aging workforce is leading to a hollowing out of management positions. Employers are facing challenges identifying talent with leadership and management skills and filling managerial roles. This ranges across industries, and applies both to finding the skills within broad occupations, and building a pipeline to supervisory occupations, especially in the skilled trades.

In skilled trade occupations, which have the highest concentrations of older workers, employers are finding these positions particularly difficult to fill despite potential pay raises; Construction Supervisors earn an average of almost $21,000 more annually than Carpenters.[9] Some employers indicate this is due to resistance from employees who would lose overtime opportunities that may amount to more than the promotion pay raise, and to having increased reporting requirements and regulations. Simultaneously, as a result of the Great Recession, employers lost many qualified individuals as promotion opportunities waned due to deferred retirements. This exacerbates the crisis for management talent as the workers now begin to retire. Some manufacturing employers have developed new mentor roles in order to create a pathway into management.

> "One of our real challenges is generational. Leadership roles in construction used to be a badge of honor, but the younger workforce often seems to see the higher level of responsibility as more trouble than it's worth."

In healthcare, employers indicate a need for stronger management skills as front-line clinical workers take on additional supervisory responsibilities. This includes RNs moving into Nurse Management roles or LPNs overseeing Nursing Assistants or Aides. Educators and employers both noted that management skills are not core to the licensing and certifications for these roles, which in turn makes it difficult to devote curriculum to training for these skills. Employers may need to work with accrediting bodies and educators to embed this training for new LPNs and RNs.

Some employers have begun to require talent development as a core responsibility of all managers. This progressive HR practice broadens the opportunities for line workers to learn management skills and increases the pipeline of middle management candidates.

CREDENTIAL INFLATION CAN CONSTRAIN PIPELINES AND REDUCE OPPORTUNITY

In the slack market of the recession, when labor was in more abundant supply, employers were able to increase the credential requirements for many roles, requesting a bachelor's degree where it had not been required before. For example, 44% of job postings for Executive Secretaries in the Pittsburgh region now cite a requirement for a bachelor's degree, compared to just 21% of incumbent Executive Secretaries who actually hold this degree. Upward pressure on credential requirements can have the unintended consequence of limiting employers from filling positions effectively, while at the same time leaving behind many middle-skill workers who have the skills (but not the degrees) that employers are looking for.

Computer help desk roles, another area where a bachelor's degree is often requested, highlights the particular dysfunction of this phenomenon. The technical skills requested for the one-third of help desk roles that request a BA don't differ from the remaining two-thirds that only request sub-baccalaureate credentials. However the bachelor's degree jobs take employers 15% longer to fill and cost them 20% more in initial salary.

Given the pressure employers will face to find qualified workers, competency based hiring, where employers focus initial hiring screens on demonstrated skills (instead of degrees or credentials) is an important approach that will increase the pool of qualified applicants. This approach opens opportunities to job seekers who are well qualified for a job, even if they do not have a bachelor's degree or other specific credentials an employer is seeking.

DEMOGRAPHICS AND THE TALENT PIPELINE

Pittsburgh has a large cohort of high-skill, high-wage talent working in industries with little unemployment. At the same time, 19% of its occupations, representing 39% of regional employment, have average wages of less than $15/hour. The region's demographics, coupled with the increasingly skilled nature of high-demand occupations, will require not only upskilling of incumbent workers but also new employer and educator partnerships to ensure the region's future talent has the technical, academic and behavioral skills that will be required.

THE IMPACT OF IN- AND OUT-MIGRATION PATTERNS

The Pittsburgh region demonstrated a slow increase in population from migration during and immediately after the Great Recession (2009-2013)[10], including among young professionals aged 25-34, with bachelor's degrees. However, this modest increase (less than 3,000 net inbound annually) had a small effect on the regional workforce. Since the recession, as growth resumed in other metros, migration patterns have begun to reverse, with outmigration outpacing inward migration (Current Population Statistics). Incoming and outgoing migrants have similar profiles in terms of age, gender, income, and education levels. A key local challenge is a decrease in educated African American employees. Only 10% of incoming African American migrants have a bachelor's degree, compared to 14% of those that are leaving, further diminishing the diversity of the region's future leadership and workforce.

While Pittsburgh's migration rates are about average among benchmark cities , any growth is countered by "natural" population decline, which is that the death rate exceeds the birth rate. No other benchmark region is in this position. To offset natural population decline, *the region must attract skilled workers at a higher rate than is the case today*. Some companies have already begun working on this; Google, for example, interviews all applicants from regional colleges in the Pittsburgh office, regardless of the Google office they may be interested in, in an effort to showcase the office and the region. In so doing, they expose them to the exceptional opportunities here and have won over some recruits who had originally hoped to work in another office. Such novel efforts may address pipeline issues at individual employers, but employers across the region will have to step up collective efforts to address the overall migration challenge and meet the needs of the future workforce.

TABLE 6: Migration Patterns for Pittsburgh and Benchmark Regions

Metropolitan Area	How much higher is inflow than outflow
Austin-Round Rock, TX Metro Area	70%
Seattle-Tacoma-Bellevue, WA Metro Area	36%
Nashville-Davidson—Murfreesboro—Franklin, TN Metro Area	32%
Denver-Aurora-Lakewood, CO Metro Area	31%
Charlotte-Concord-Gastonia, NC-SC Metro Area	26%
Boston-Cambridge-Newton, MA-NH Metro Area	26%
Greater Pittsburgh 10-County Region	**20%**
San Jose-Sunnyvale-Santa Clara, CA Metro Area	19%
Minneapolis-St. Paul-Bloomington, MN-WI Metro Area	10%
Cincinnati, OH-KY-IN Metro Area	8%
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD Metro Area	2%
Indianapolis-Carmel-Anderson, IN Metro Area	2%
Milwaukee-Waukesha-West Allis, WI Metro Area	1%
St. Louis, MO-IL Metro Area	-5%
Cleveland-Elyria, OH Metro Area	-12%

Source: American Community Survey

K-12 AND CAREER AND TECHNICAL EDUCATION (CTE) SYSTEM

The K-12 system represents the region's long term talent supply pipeline, and Career and Technical Education (CTE) will be a critical element of its ability to develop high skill talent. However, a decline in the number of graduates and inconsistencies in the overall quality of the K-12 system present a substantial risk to employers' long-term ability to fulfill hiring needs in an increasingly skill-driven economy. Areas of excellence exist within the region, but large scale policy and spending reforms are necessary to minimize performance gaps and better prepare students for postsecondary training and the workforce.

The number of students in the K-12 system is declining: There are 336,227 students enrolled in public schools in over 500 high schools in the Pittsburgh region's 125 school districts (2014-2015). This projects to declining numbers of local graduates, from 27,359 annually from 2015-2018, to 24,779 annually from 2021-2025. Further, this figure does not account for local graduation rates (88%). Pittsburgh has one of the highest workforce shares of workers with "high school diplomas only" (36%) amongst the top 75 metro areas,[11] and only 61% of Pennsylvania students go directly to college following graduation[12], resulting in a projected pipeline of just over 13,000 local students earning college degrees.

Table 7: K-12 Enrollment by Grade Level

Cohort	Total Enrolled, 2015	Annual # of Potential Graduates
Total in PreK-12, 10-county	336,227	
Projected Potential Graduates 2015-2018	109,434	27,359
Projected Potential Graduates 2019-2020	51,744	25,872
Projected Potential Graduates 2021-2025	123,896	24,779

Source: Pennsylvania Department of Education[13]

The Pittsburgh region has an 88% graduation rate: Local graduation rates range from 77% (Beaver County) to 94% (Butler County).[14]

Table 8: Graduation Rate by County

County	Graduation Rate, 2015
Allegheny	90%
Armstrong	91%
Beaver	77%
Butler	94%
Fayette	79%
Greene	80%
Indiana	92%
Lawrence	92%
Washington	90%
Westmoreland	92%
Average	**88%**

Source: County Health Rankings

There are great disparities between school districts: In addition to broad variations in the graduation rates within the 10-county southwestern Pennsylvania region, the state rankings of public schools show inconsistent opportunities for students. Thirty-four regional school districts are in the top 25% of the state, while 32 are among the lowest performing districts.[15] The talent pipeline from regional schools is imbalanced.

"What gets measured gets reported, and that's why test scores get so much public attention. It would be great if businesses called attention to successful career awareness programs and if those schools got public recognition for them."

School districts also have varying levels of ability and capacity to implement effective career awareness and workforce standards that are mandated by the state. The goal is to have K-12 students become knowledgeable about career opportunities and be able to develop a personalized pathway that can guide their education choices. Clearer accountability associated with the standards is needed, as are opportunities to share best practices and scale programs that have strong industry engagement.

"Many kids simply don't 'see' what success a good job, a positive community environment, etc. look like or genuinely understand how to get there. We need to focus on providing kids with both a good education and skill development in the classroom as well as really substantive, creative opportunities that help drive and motivate kids as well as their families."

Career and Technical Education (CTE) providers face strong challenges with respect to funding levels and student recruitment: The system is operating below its potential, attracting too few students, and is often hampered by complex funding models that discourage broader participation and stronger overall investment in the system. Funding specifically for CTE has remained flat, and the current funding model, where schools must provide funding along with students, provides disincentives to regional high schools who may otherwise send students to workforce specific programs or retain them in the existing academically focused program.

The Career and Technical Centers (CTCs) lag behind traditional high schools in academic performance measures, and many of the programs offered are not well-aligned to the local labor market or well connected to local employers. This report identifies significant opportunities for CTCs to fill existing gaps for training for high-demand occupations as well as upskilling students and workers in technical fields.

CTE providers indicate dual challenges around funding and student recruitment. They also face recruitment and enrollment challenges which stem in part from outdated perceptions of many careers as well as persistent stigma associated with blue-collar occupations more generally.

Half-day, non-comprehensive CTCs struggle to connect academic skills: The CTCs embedded within larger schools indicate a challenge motivating students toward pure academic skills, such as mathematics, despite the high demand for these skills in skilled trade occupations. Several regional CTC directors noted a disconnect between academic learning and career-focused learning.

CTE enrollment is focused on skilled trades: 38% of CTE enrollment is in programs training students for skilled trades, particularly Installation, Production, or Construction. These providers indicate strong industry partnerships, including development of internships.

Several of the largest individual CTE programs are for careers with low salaries and limited opportunities for direct career advancement: The largest single program for enrollment is Cosmetology, at 12%. In the health fields, employers indicate a lack of alignment with the program offerings.

Table 9: Top 10 CTE Programs by Program Enrollment

Program	Enrollment (2015)
Cosmetology General	1,215
Health/Medical Assisting Services, Other	910
Institutional Food Worker	883
Automotive Mechanics Technology/ Technician	813
Autobody/Collision and Repair Technology	599
Welding Technology/Welder	541
Commercial and Advertising Art	411
HVAC Maintenance Technology	404
Homeland Security, Law Enforcement	389
Machine Tool Technology	358
Total	**10,379**

Source: Analysis of Program Enrollment data from Pennsylvania Bureau of Career and Technical Education.
Note: Total reflects full CTE enrollment. Full data can be found in the appendix.

POST-SECONDARY EDUCATION AND TALENT RETENTION

Pittsburgh's 61 institutions of higher education produce more than 40,000 graduates per year; however only 50% of all completers and just one-third of graduates of bachelor's and master's degree programs remain in Pittsburgh five years after graduation.[16]

The Pittsburgh region produces a robust supply of graduates: The 61 institutions of higher education in the Pittsburgh region graduate more than 40,000 students per year from certificate, two-year, four-year, and graduate programs. However, many industry leaders question the connection between the skills obtained at many of these institutions and the needs of local employers. As noted earlier, many of the most commonly awarded degrees do not align with regional demand. Ensuring easy access to workforce demand data can help more students select courses of study aligned to industry demand.

"It would be great if there were a technology solution where businesses could post their needs and allow educational institutions to bid on providing training for them."

Pittsburgh demonstrated a slow increase in population from migration (2009-2013)[17], including among young professionals aged 25-34, with a bachelor's degree: The overall increase is modest, at net migration of positive 12,524 over three years. Incoming and outgoing migrants have similar profiles in terms of age, gender, income, and education levels. The key local challenge is a decrease in educated African American employees. Only 10% of incoming African American migrants have a bachelor's degree, compared to 14% of those that are leaving, exacerbating existing issues with creating a diverse workforce.

"Diversity is a challenge for recruitment and for retention across just about every industry. Affinity groups at larger companies can help, but that doesn't solve for welcoming and integrating into the broader community, and it doesn't help for the smaller and mid-size companies."

LABOR SUPPLY AND UNEMPLOYMENT

Skilled trades such as production and construction have large numbers of long-term unemployed workers. High unemployment numbers in occupations that have clear current and future demand suggest a skills gap that calls for assessment, retraining or upskilling.

Unemployment in the Pittsburgh region is 5.2%: The local unemployment rate ranges from 4.7% in Allegheny County to 7.2% in Fayette County, as of February 2016. This rate is slightly above the national rate (4.9% in February, 2016).

"What we see in the workforce system is that six out of ten jobs are low wage. This factors into the employers' ability to fill a job and people's willingness to work in that field. We also see a trend of fewer middle class jobs. We need strategies that will put people to work in family-sustaining jobs."

Unemployment, including long-term unemployment, is high in the skilled trades: Construction (16%) and Production (10%) have double-digit unemployment rates, providing potential workers back into the labor market. These also have high levels of long-term unemployed (9% in Construction, and 7% Production). Decreasing unemployment in these areas will be crucial to filling the future demand for related roles, but will require focused training based on the increasing skill expectations of employers. Should one or more ethane crackers be built in the region, engaging this talent will be a critical factor in meeting demand. See Table 10: Unemployment by County for details.

Unemployment is low in Healthcare, IT, and Business and Finance: These occupations have lower than average unemployment, and fewer long-term unemployed. These are high-growth occupations that do not have a pool of unemployed workers to fill new jobs in the region. Cross-training unemployed from other fields, especially where similar competencies or skills can be identified will offer more potential to fill gaps. In this case, low unemployment indicates low supply of labor for high-demand occupations.

Table 10: Unemployment by County

County	Unemployment Rate
Fayette County	7.2%
Armstrong County	6.9%
Greene County	6.9%
Indiana County	6.5%
Lawrence County	6.3%
Beaver County	5.8%
Washington County	5.7%
Westmoreland County	5.3%
Allegheny County	4.7%
Butler County	4.7%
TOTAL	5.2%

Source: PA Department of Labor and Industry

LABOR SUPPLY AND WORKFORCE DIVERSITY

Employers across industries express difficulty identifying and recruiting a diverse workforce. A diverse workforce is a critical business need, even more so for employers in sectors such as in Healthcare and Hospitality, where workers must provide customer service to a diverse set of clients and be able to interact and respond to cultural differences. Healthcare employers describe diversity of the workforce as a "service delivery imperative." However, in professional occupations, Pittsburgh sees a brain drain of workers of color; 14% of departing African Americans have a bachelor's degree, compared to only 10% of those entering the region. Women are similarly underrepresented in many occupation groups.

"Our patients represent the diversity of our community, not just in terms of color, but also different generations, cultures, veterans, etc. In order to deliver the best care, our workforce needs to match that diversity."

Only 8% of local workers are African American. While this is proportional to the local population, the demographics are particularly stark in several economically critical occupations: African Americans make up 5% of Healthcare Practitioners, 4% of Healthcare Support workers, 4% of Engineering workers, and 1% of local IT workers.[18]

Lack of diversity, especially in professional occupations, makes recruiting external talent significantly harder for local employers. Some firms offer affinity or internal groups to help build a support network for new recruits but the broader lack of community diversity poses challenges to retaining new workers, especially those with spouses and families.

Additionally, employers state that millennials increasingly indicate a preference for diversity when making choices about where they want to live and work.

Large employers, such as hospitals, which hire across a range of occupations, typically have higher levels of diversity among lower skilled or lower paying roles. This provides an opportunity for those employers to develop articulated career pathways into higher skill, higher wage occupations that are less diverse.

Table 11: Workforce Demographics by Occupation Group

Occupation	% African American	% Latino	% Asian/ Other	% Female
Business and Financial Operations	4.8%	1.3%	4.1%	47.3%
Computer and Mathematical	1.2%	2.1%	11.5%	20.1%
Architecture and Engineering	4.1%	1.9%	2.6%	9.7%
Life, Physical, and Social Science	9.3%	3.1%	19.3%	41.2%
Healthcare Practitioners and Technical	4.6%	0.5%	1.4%	83.1%
Healthcare Support	3.6%	7.1%	1.8%	97.3%
Food Preparation and Serving Related	14.2%	1.1%	1.0%	70.0%
Office and Administrative Support	8.3%	1.5%	1.1%	72.1%
Construction and Extraction	3.5%	1.5%	0.4%	2.6%
Installation, Maintenance, and Repair	3.5%	2.0%	0.9%	3.7%
Production	6.5%	1.9%	3.3%	20.8%
Transportation and Material Moving	9.0%	2.5%	4.9%	19.5%
Total Workforce	**7.9%**	**1.5%**	**2.0%**	**50.8%**

Source: American Community Survey

RECOMMENDATIONS FOR ACTION

This report was undertaken as a broad analysis of workforce trends in the Pittsburgh region and should be viewed as an initial stake in the ground to advance concrete action to effectively align talent supply and demand. It is clear is that the region has strong momentum and the appetite for a more systematic approach to workforce planning and partnership development between employers and training providers.

The recommendations below are a call to collective action. Discrete strategies are suggested in all of the occupational cluster profiles that appear later in the report, and specific tactics will need to be developed for each. Program and policy changes and activities will necessarily vary among occupations as well as among different cohorts of talent. However, the high level recommendations below have emerged directly from the data and qualitative input provided by employers and educators as those with greatest potential impact to help align the region's demand and talent supply.

THE EMPLOYER COMMUNITY MUST LEAD CHANGE AND SHIFT FROM BEING CONSUMERS OF TALENT TO BECOMING INVESTORS IN THE LABOR MARKETPLACE

Industry needs to frame and support a more effective and sustainable model to enable education and training providers to better understand changing skill demands. The need for increased alignment and coordination between training providers and industry demand is a consistent finding throughout this study. Connections between employers and their feeder training providers are uneven. There is strong desire to strengthen ties in support of the local job market and economic development; however, successful partnerships are uneven and not sufficiently scaled. Employers should lead the creation of a standing, cross-industry structure to support alignment of business needs and training demand at all levels.

A first step would be convening employers with common occupational needs, as this approach will identify which industry sectors have demand for the same occupational skillset. Such a convening would also be an opportunity to identify and engage the start-up community and smaller employers who have similar talent demand. Engaging educators to work with employers to identify and build consensus on the most important skills and competencies would lead to the development and adoption of common curriculum. This type of infrastructure could also spur consistent development and dissemination of well-articulated career pathways.

"We have four community colleges in our region and they are critical to our manufacturing pipeline. But they all seem to be offering training in a vacuum. I'd like to see them work together, maybe even sharing high-level instructors that they can't afford to hire on a part-time basis."

Large, long-established employers and start-up and technology companies should form a partnership to attract and retain top level talent: Pittsburgh faces a talent shortfall both in the overall number of workers and in the high skill professions that drive the innovation economy. A coordinated, sustained and well-funded marketing effort to promote inbound migration and talent retention is needed. There are many organizations promoting the region but a coordinated effort is required to identify sufficient resources to have a visible impact. If employer demand for talent in critical emerging occupations is not clear and compelling, existing talent may leave the region.

"We recruit a lot of IT talent from local colleges and universities, and also work to attract top-level talent here. We end up too often having to create our own marketing material for this. We need to have a one-stop shop to find information and to help sell the City to talent."

Engage employers directly in a collaborative effort to retain more college graduates: As home to several of the nation's leading colleges and universities, a concerted effort by employers and educators is needed to promote the region and its opportunities. Recent focus groups conducted by the Allegheny Conference with nearly 100 students from five area colleges and universities revealed a low level of awareness of the region and its employment opportunities and quality of life. When students were presented with the Pittsburgh region opportunity "story" they showed strong positive response and interest.

Recent STEM graduates and high skill workers coming to Pittsburgh are a major part of the region's attractiveness to technology employers. Engaging employers in selling the Pittsburgh region, specifically for entry-level college graduates, is needed. If this were coupled with active engagement of students early in their college career around high demand occupations, the region could decrease the level of outward migration following graduation. At the same time, however, employers must be willing to hire recent graduates knowing they will not yet have the three to five years of experience typically requested.

FOCUS ON UPSKILLING TALENT IN THE REGION

Create explicit pathways to upward mobility: As the market places an increasing premium on workers with higher skills, the development and clear articulation of career pathways is critical to ensuring employers have an adequate talent supply and that workers have opportunities to advance. Too often existing pathways are unclear, either because of lack of information available to workers about the jobs and skills in demand, or lack of awareness or limited options for training that is aligned with employer skill needs. Employers can create explicit pathways that lead to advancement within their firms, within industries and across industries. Alignment and clear expectations between employers and training providers can accelerate workers' advancement into higher value roles.

Focus on the development of emerging, cross-cutting skills and competencies: There are a set of baseline skills and competencies which are increasingly in demand in the market and which employers across all sectors cited as gaps. These include customer service skills, leadership/management skills, and various emerging digital skills. Training providers, particularly CTE and other technical programs, are well served to balance their focus both on baseline skills and on occupationally-specific, technical skills.

"We've had a lot of success developing new skills in our workforce by taking advantage of high quality programs found on Udacity and Coursera."

The Pennsylvania Department of Education's Career Education and Work Standard provides a structure through which businesses and K-12 can partner to address employability skills. Engaging students early in meaningful activities around career exploration needs to be scaled in order to create an effective means to engage businesses directly for the long term.

Focus resources on opportunity occupations and high priority occupations: This report highlights the rapidly changing labor market, including identifying occupations that offer strong potential to earn a living wage, many of which the state does not presently recognize as a High Priority Occupation eligible for increased training funding. Immediate consideration should be made toward petitioning for high priority recognition in order to properly allocate resources. These primarily support the energy and skilled trades, such as Control & Valve Installers, and Surveying and Mapping Technicians. Additional opportunities are with Health Technologists.

Career pathway initiatives can be framed around the High Priority Occupations as a basis for upskilling workers who are unemployed, in declining occupations or in occupations which offer sub-living wage pay.

CAPITALIZE ON INNOVATION IN INFORMATION TECHNOLOGY, ADVANCED MANUFACTURING AND FINANCE

Build a bridge to connect larger regional employers and the start-up and innovation economy: The presence of multiple top-tier universities in a city the size of Pittsburgh, numerous corporate and federal R&D facilities in the region, and a highly engaged community of corporate leaders, is a unique combination of assets and has made the region a leader in innovation and cutting-edge technologies across a broad set of sectors. Its historic strengths in finance, energy and advanced manufacturing have been enriched by new strengths in computer science, robotics, engineering, cognitive science, design, information systems, healthcare and life sciences, making the Pittsburgh region a magnet for industry partners who want to collaborate on research and recruit the best talent.

The critical question is how best to leverage all this expertise—technological, medical, financial—to maximum impact? While the number of jobs specific to this growing hub of innovation is relatively small when compared to overall regional employment in 2016, we know that demand for these innovation skills will continue to grow rapidly—in the Pittsburgh region and around the world. If the region's future will continue to be shaped by people here, the region must focus attention and resources to skill, attract and retain the world-class talent that fuels the innovation ecosystem.

Focus on opportunities for growth in innovation technology: Particular occupation clusters which the local employer and training community might consider investing in include:

- Cybersecurity
- FinTech, (shorthand for financial technology), and
- Predictive analytics, especially in the healthcare and energy sectors

In addition, special focus should be given to solidifying Pittsburgh's role as a center of innovation for robotics, additive manufacturing and other advanced manufacturing technologies.

High Demand Occupational Sectors

Information Technology | Business and Finance | Engineering, Science and Production | Healthcare | Construction

INFORMATION TECHNOLOGY

Pittsburgh's IT sector serves as a key driver of growth in the region and represents an unparalleled economic development opportunity to reshape Pittsburgh's economy. Currently, there is a dual market for IT with the majority of jobs (70%) centered in financial, business and professional services, and a smaller, but growing number, in the startup and broader technology community that are significant in their cutting-edge nature and ability to shape our economy, and to drive industry innovation here and worldwide.

"The duality in IT demand becomes less pronounced as industries across sectors increasingly require skill domains such as machine learning and analysis. The overall employment curve will emphasize these growing skills."

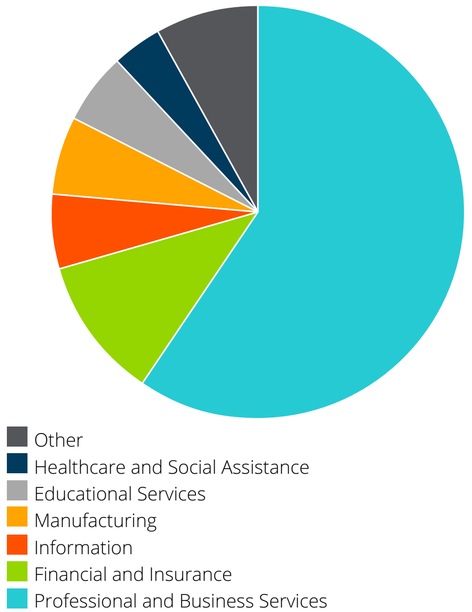
The software sector in Pittsburgh is gaining momentum with "landing party companies" such as Google, Facebook, Amazon, and Uber choosing to locate significant parts of their operations in the city. The recent decisions of these firms to expand their offices in the region speaks to available talent from research institutions generally, and Carnegie Mellon in particular. The shape of Pittsburgh's future IT workforce depends in large part on the region's ability to leverage this momentum to create a mutually reinforcing ecosystem for high-end IT skills, with graduates from the area's universities acting as a beacon for high-tech companies, and those high-tech companies in turn, acting as a pull for high caliber talent and cementing Pittsburgh's standing as a tech hub.

While the excitement about the potential of a transformative IT sector is palpable, it is relatively nascent. In the larger Business and Finance IT workforce, employer demand is being shaped by skill hybridization, upskilling and upcredentialing, with employers seeking employees who can interpret and understand the business implications of technology across a whole range of occupations.

Table 12: Information Technology Occupation Family Summary

2015 Employment	31,372
Annual Openings 2015-2025	2,103
% of Openings Requiring Bachelor's Degree	89%

Figure 1: Industry Demand for IT Workers



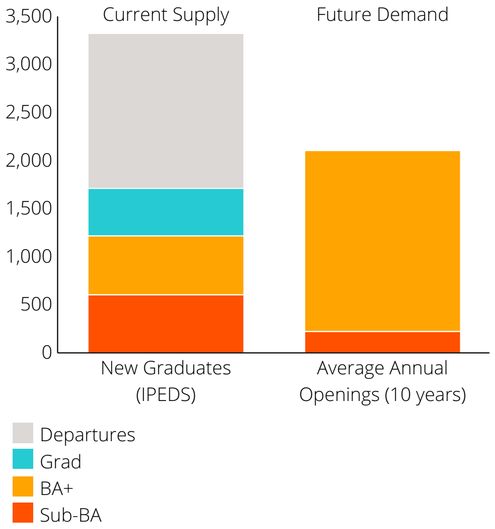
ALIGNMENT OF WORKFORCE SUPPLY AND DEMAND

Supply of IT talent does not meet demand: Supply and demand in IT is mismatched. IT Jobs will grow extremely rapidly over the next decade (11%) – 2.6x faster than the market overall. But graduates from local universities are leaving at high rates, creating a supply shortage of workers. However, better retention of the IT graduates from local universities, as well as increased talent attraction efforts would help to close this gap. A barrier to attracting and retaining talent in the area may be the lower-than-average salaries for IT occupations in the Pittsburgh region compared to the nation ($34/hour v. $41/hour).

"When we hire for IT positions, we are really looking for those who are clearly 'learning agile.' Too many get de-selected in our hiring process because of a lack of a specific degree, but technical aptitude trumps all."

The current workforce and future pipeline lack diversity: Diversity is a large local challenge; only 1% of the local IT workforce is African American compared to 7% nationally. At the college level, African American students are 50% less likely to be enrolled in Computer Science and other STEM majors than all other students. At the high school level, only 37 African American students in the entire state took the AP Computer Science exam.

Figure 2: Supply and Demand of IT Workers



CHANGING 21ST CENTURY WORKFORCE

Pittsburgh has dual IT job markets: Pittsburgh's demand for IT workers is currently concentrated in Professional Services and Finance, with the responsibilities of these roles generally focused around providing enterprise systems support and application integration. IT jobs in the Financial Services sector represent strong career opportunities for workers, but they do not typically serve as beacons for talent attraction.

What has begun as a dual IT market can evolve to higher skill levels overall as new domains gain market importance: The region's greatest opportunities for growth and for talent attraction lie in the software industry ecosystem inhabited by start-ups and high-profile consumer tech firms. To the extent that these firms continue to locate in Pittsburgh, the region will become an even stronger magnet for top tier engineers looking to work on cutting-edge solutions. A strong presence of recognizable technology firms can help to cultivate a robust network and culture of software developers and aid in talent attraction and recruitment efforts for employers across all industries.

Cybersecurity demand is strong and growing: Cybersecurity postings have grown rapidly in Pittsburgh, at three times the rate of IT jobs overall since 2010. There were 2,625 job postings for cybersecurity professionals in the region in 2015.[19] Information Security Analysts are projected to grow at 20% over the next ten years, one of the top IT occupations, and among the top 5% of all occupations. Local cybersecurity demand is concentrated in Professional Services and Finance and Insurance. The demand in Financial Services is twice the national average, with the largest employers being BNY Mellon and The PNC Financial Services Group, Inc. Although the cybersecurity marketplace is not as well established beyond these two industries, the healthcare, retail, and utilities industries cited this as a fast-emerging need as recent data breaches in all three of these sectors have prompted regulatory and investor demands for failsafe information security and grid safety.

DATA TABLES

Table 13: Information Technology Occupation Summary Table

Occupation	Employment 2015	Median Salary	Projected Growth Rate	Projected Annual Openings, 2015-2025	% Requested BA	LQ[20]
Computer Systems Analysts	6,252	$70,760	19%	462	91%	1.24
Computer User Support Specialists	5,352	$44,100	11%	378	44%	1.33
Network & Computer Systems Administrators	4,330	$69,410	7%	261	75%	1.06
Software Developers, Applications	4,086	$84,740	12%	270	90%	0.99
Software Developers, Systems Software	2,493	$75,660	12%	166	83%	0.53
Computer Programmers	2,421	$69,080	-5%	135	83%	1.32
Database Administrators	1,229	$74,400	11%	78	78%	1.09
Computer Occupations, Other	1,210	$73,260	3%	73	87%	0.59
Computer Network Support Specialists	1,171	$58,150	9%	81	61%	0.75
Operations Research Analysts	681	$65,620	21%	55	87%	0.88
Computer Network Architects	675	$93,870	3%	34	75%	0.67
Information Security Analysts	625	$59,780	20%	46	91%	0.67
Statisticians	353	$52,220	15%	25	94%	1.65
Actuaries	282	$98,360	15%	21	100%	1.31
Web Developers	212	$53,810	23%	18	86%	0.67
Grand Total	**31,372**	**$67,790**	**11%**	**2,103**	**89%**	**1.00**

Sources:
Employment: Bureau of Labor Statistics and Burning Glass model
Median Salary: BLS Occupational Employment Statistics
Growth Rate: See methodology; projections based on Burning Glass job postings, Bureau of Labor Statistics projections, and Pennsylvania Department of Labor projections.
% Requesting BA: Burning Glass job postings data
Location Quotient: BLS Occupational Employment Statistics

INFORMATION TECHNOLOGY SKILLS AND CREDENTIALS

Leading technology companies are coming to Pittsburgh to hire researchers and engineers with specific advanced skill sets. For example, in just the last six months, Uber announced the expansion of its autonomous vehicle research facility[21], Facebook announced that it will be opening an Oculus virtual reality research center,[22] and Amazon acquired Safaba for the firm's machine translation expertise.[23] However, the top-tier IT skills that are most attractive to software engineers have relatively low advertised demand in Pittsburgh, reflecting the potential for continued growth for employers who can tap into a robust supply of talented programmers and researchers graduating from local universities.

The roles with highest demand in the region, those in Professional Services and Finance, are being affected by trends in skill hybridization, upskilling and upcredentialing. For example, many employers noted a shift in software development processes. Where development used to follow a waterfall method, which follows a sequential, linear process, firms increasingly use agile development, which uses more frequent iterations and is cross functional. This method requires greater team work, communication, and customer service skills in technology project management roles. Employers also noted an increasing need for baseline business acumen in technology roles, suggesting that the ability to understand the business implication of technology solutions is critical. Similarly, as retail becomes more heavily concentrated in e-commerce, the demand for more advanced technical roles is increasing.

HYBRID JOBS: BLENDING DIVERSE SKILL SETS INTO A SINGLE ROLE

IT workers are expected to be business-savvy; Business workers are expected to be IT-savvy: Information Security Analysts (20% projected growth), Operations Research Analysts (21%), and Computer Systems Analysts (19%) are projected to grow more quickly over the next decade than the rest of the occupation family (11%). Each of these roles requires strong technical skills with specific business skills, an important hybridization of the market. Computer Systems Analysts call for SAP and Business Process and Analysis skills; Operations Research Analysts call for accounting skills along with operations analysis, Oracle, and SQL. This business acumen is increasingly critical for technical roles, as employers expect their IT workforce to understand "how technology solutions tie into the business functions."

UPSKILLING: EMPLOYERS REQUEST HIGHER-LEVEL SKILLS AND CREDENTIALS

Demand for front-end development, cloud computing and big data skills, is coming: The fastest growing skills in the nation over recent years are displayed in Table 14: Fastest Growing IT Skills in Terms of National Online Demand. Demand for these skills in Pittsburgh is currently clustered around a small number of innovative firms. But as the high-end sector in IT grows, and as these skills become mainstream and spread into professional services, and other industries, demand for these skills will spike. Big Data and Apache Hadoop, for example, have grown very quickly in Pittsburgh (12x and 6x faster than the market respectively).

"Data science is a new field, but it will be crucial across all industries. We all have more data, but key is having the talent that can clearly articulate the story the data is telling us."

Table 14: Fastest Growing IT Skills in Terms of National Online Demand

Fastest Growing IT Skills in Terms of National Online Demand
Programming and Development Skills
AngularJS
CoffeeScript
Node.js
Backbone.js
Jenkins
Pandas for Python
Big Data Skills
Data Science
Big Data
Sqoop
Apache Pig
Tableau
Cloud Computing
New Relic
CEPH
Other
Internet of Things

Source: Burning Glass Technologies
Bold skills are those with more than 500 job postings in the Pittsburgh region, indicating local demand.

Upcredentialing is impacting sub-baccalaureate positions: Computer User Support Specialists are a common sub-baccalaureate entry point into the IT workforce: 56% of postings for this role call for less than a bachelor's degree. When employers request a bachelor's degree for this role, they typically look for the same set of technical skills, but take 12% longer to fill the roles, suggesting employers are asking for credentials even where they are not needed.

DATA TABLES

The next table displays top skills in demand for the occupation family. Skill demand is based on an analysis of job postings data. While employers do not name every skill required for an occupation, the postings reflect those skills that employers are looking for in candidates, both specialized (technical, occupation-specific) and baseline (cross-cutting, or soft skills). Baseline skills represent 25% of all skill demand in IT occupations. The high relative demand for baseline skills reflects the importance of these capabilities to employers in the hiring process.

Table 15: Demand for Information Technology Skills in the Pittsburgh Region

	Specialized Skills	Software Skills	Baseline Skills	Top Certifications
1.	Technical Support	SQL	Communication Skills	Project Management Certification (e.g. PMP)
2.	Software Engineering	JAVA	Writing	Certified Information Systems Security Professional (CISSP)
3.	Web Site Development	Oracle	Problem Solving	Cisco Certified Network Associate
4.	Business Process	Microsoft Windows	Organizational Skills	SANS/GIAC Certification
5.	Systems Analysis	JavaScript	Troubleshooting	Certified A+ Technician
6.	Systems Integration	LINUX	Project Management	Certified Information Security Analyst (CISA)
7.	Software Development	Microsoft Excel	Research	Security Clearance
8.	System and Network Configuration	Microsoft Office	Planning	
9.	Data Management	Microsoft C#	Microsoft Windows	
10.	Collaboration	.NET Programming	Customer Service	

Source: Burning Glass Technologies

INFORMATION TECHNOLOGY RECOMMENDATIONS

Given the two distinct IT markets within Pittsburgh, initiatives in IT should aim to grow the future high-end workforce, while sustaining the region's longstanding strength in employment of enterprise IT staff.

REGIONAL TRAINING STRATEGIES TO DEVELOP FUTURE WORKFORCE

Continue to invest in Pittsburgh's areas of strength:
Pittsburgh has strengths in cutting-edge fields such as robotics and machine learning, stemming from strong local research institutions. As these domains move from primarily research capabilities to the mainstream and become drivers of growth in the region, it will be important to continue to invest and promote Pittsburgh's existing talent and innovation in these areas. Employers point to the strength of local universities in high-level technology roles, e.g. cybersecurity, data analytics, computer science and high-end software development, as a major opportunity for the region moving forward. But, we caution that employers in the region may need to pro-actively hire in front of demand or risk losing the high-end talent to other markets. Talent is currently moving faster than employers.

Build a pipeline to scale emerging technology companies:
Startup and later stage technology companies have a limited but skilled pipeline of technical talent available in the region. However, as these companies begin to scale, they often must fill key sales, marketing, and C-level roles with experienced managers who continue to live in other cities. While this situation is not unique to Pittsburgh, the region should consider building and attracting a stronger management pipeline for these companies or face potential "flight risks."

Innovate and compete with FinTech firms:
Given its strength in both IT and Financial Services, Pittsburgh may consider pursuing FinTech, a hybrid of the two. Local financial services firms note the rapidly changing industry, and banks increasingly view themselves as software companies. They are in direct competition with many of these emerging FinTech firms, given the online nature of most financial transactions and the broad array of consumer choice. The local strengths in these areas allow innovation to occur locally as FinTech grows in importance, particularly in the early warning services and customer protection fields.

Develop and highlight supply of fast growing skills:
The supply of high-end IT skills from local universities and the innovation sector provides opportunities to advertise the presence of this talent in the region. By establishing an identity as a strong market for these skills, the region can expand the strength of its workforce and more successfully retain computer science graduates from local colleges and universities, which will in turn help to attract more brand-name IT companies. This will require collaborative efforts between industry and educators that must be adequately structured and funded.

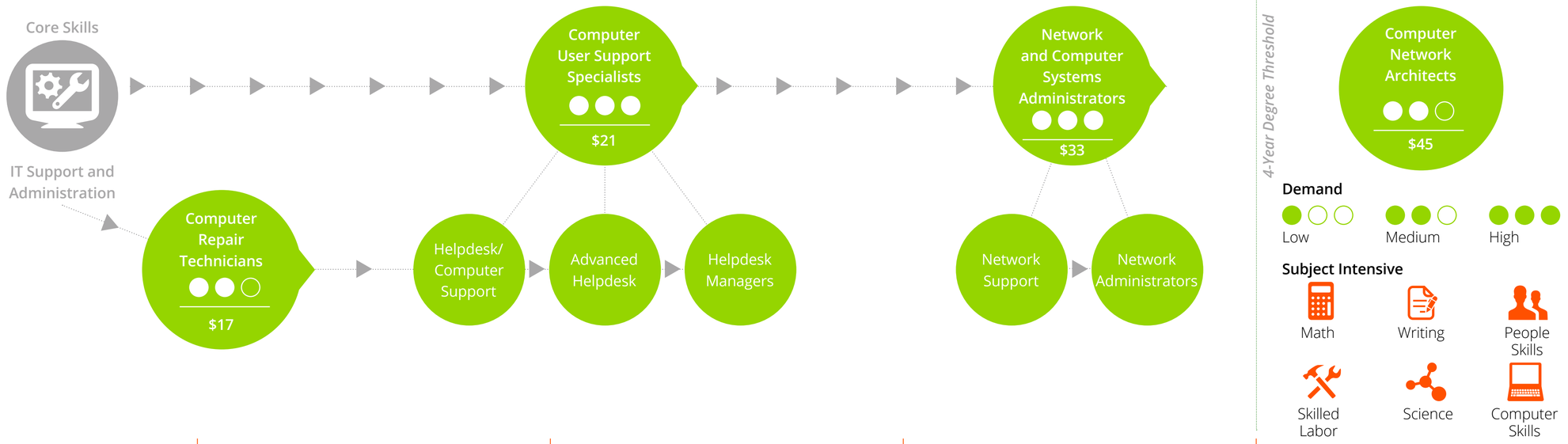
Table 14: Fastest Growing IT Skills in Terms of National Online Demand displays the fastest growing IT skills nationally. As Pittsburgh works to expand its position as an IT hub, the skills listed here represent strong bets for investment, both for training and talent retention. Many of these skills, especially the data skills, are specifically cited by employers as upcoming trends across industry as businesses, healthcare organizations, and more utilize data.

Incorporate business training with IT programs:
Understanding of business functions is critical to IT professionals. For example, understanding of both business processes and advanced IT skills are critical for Computer Systems Analysts, BI Analysts, and Computer Systems Engineers as they use technology to support a company's operational functions.

Help students and educators identify value-add credentials that feed into clear career pathways:
When asked about IT certifications, employers indicated that there would be winners and losers in the certification world, but the certification model is generally a "loser". The sense among most employers is that the high volume of certifications has watered down their value and many employers have come to view them as merely resume fillers. This is reflected in certification demand; the 50 most commonly demanded certifications account for two-thirds of all employer demand for certifications.[24] Development of robust career pathways will support the identification of skills and certifications that lead to advancement.

Figure 3: Example of IT Career Pathway

IT Support and Administration Pathway



	Computer Repair Technician & Helpdesk	Helpdesk Manager	Network & Computer Systems Administrators	Computer Network Architects
	• Set up computer hardware and installing software. • First-line troubleshooting a variety of computer problems. • Set up and troubleshoot computer networks.	• Management skills such as supervision and mentoring of helpdesk staff.	• Advanced computer network skills such as network storage and disaster recovery planning. • Advanced network support and security skills.	• Look for improvements in the efficiency of networks through network modeling and analysis. • A bachelor's degree is typically needed to advance to this role.
Certification In-Demand	• CompTIA A+ Technician • CompTIA Network+ • Cisco Certified Network Associate (CCNA) • VMWare Certified Associate	• IT Infrastructure Library (ITIL) • Project Management Professional Certification (PMP) • CompTIA Project+ • CompTIA Server+	• Cisco Certified Network Associate & Professional • VMWare Certified Professional • Microsoft Certified Solutions Expert • Red Hat Certifications	• VMWare Advanced Certificates • Red Hat Advanced Certificates • Cisco Certified Network Professional • CompTIA Security+

Source: Burning Glass Technologies

Prepare for expansion in Cybersecurity hiring demand in Manufacturing and Retail: Compared to the nation and key comparison cities, Pittsburgh has a lower percentage of cybersecurity job postings in the Manufacturing sector (5% vs 11% nationally). This suggests that there is likely to be an expansion of need for cybersecurity workers in manufacturing in Pittsburgh. For example, as autonomous vehicles gain traction and the "Internet of Things" becomes ubiquitous, expertise is likely to be needed to ensure the security of Internet-connected electronics. Similarly, retailers cite cybersecurity hiring as "blazing hot" as they work to secure their customer data.

ECONOMIC DEVELOPMENT AND EMPLOYER RECOMMENDATIONS

Increase and emphasize competency- and skill-based hiring to fill immediate gaps: The Pittsburgh region's two- and four-year institutions are not retaining enough students to keep up with demand. As a result, the market relies on strong inbound migration for IT roles. Additionally, only 12% of the demand for IT talent is advertised at the sub-baccalaureate level, while 35% of graduates who remain in Pittsburgh are at this level.

Table 16: Cybersecurity Postings

Industry Sector	% of Cyber Postings Local	% of Cyber Postings National	2010-2015 Average Annual Local Postings Growth
Professional Services	43%	43%	23%
Finance and Insurance	26%	13%	45%
Healthcare	5%	6%	28%
Manufacturing	5%	11%	12%
Information	5%	7%	23%
Retail	2%	2%	29%
Other	13%	18%	

Source: Burning Glass Technologies

In cybersecurity, employers are seeking workers with credentials requiring at least five years of experience, meaning that shortages in this area are going to take some years to overcome. In the short run, gaps can be addressed through competency-based (as opposed to credential-based) hiring, and through employer/training provider partnerships. This ensures that graduates from sub-BA programs have the skills to qualify for jobs which might typically request a more advanced degree. Employers indicate a willingness to move toward competency-based hiring, including hiring based on "portfolios over degrees." An emerging source of talent throughout the nation is from IT boot camps, which can help to upskill the existing workforce in a rapid manner.

BUSINESS AND FINANCE

Hiring for Business and Financial Services talent is being shaped by the changing nature of the industry. This includes the shift of transactional banking to online and mobile channels, and the rise of powerful techniques and technologies that allow customer behaviors and other trends to be mined for rich insights into new ways of doing business. This changing landscape means that workers with strong customer service skills will be vital for building lasting customer relationships at a time when most customer interactions with banks are becoming more impersonal. Additionally, workers with strong technical and analytical skills who are able to deliver the analytical insights or agile services that customers and employers expect are also in high demand.

These trends are affecting Business and Finance roles, and Administration roles, in different ways. At the high-skill end, technology and the rise of big data has driven strong growth in demand for Analysts of all varieties; conversely administrative roles are declining as many of their functions are being absorbed by other occupations or replaced by automation.

Table 17: Business and Finance Occupation Family Summary

	Business and Finance	Office and Administrative Support
2015 Employment	64,767	204,283
Annual Openings 2015-2025	5,359	21,094
% of Openings Requiring Bachelor's Degree	89%	19%

Figure 4: Supply and Demand of Business and Finance Workers

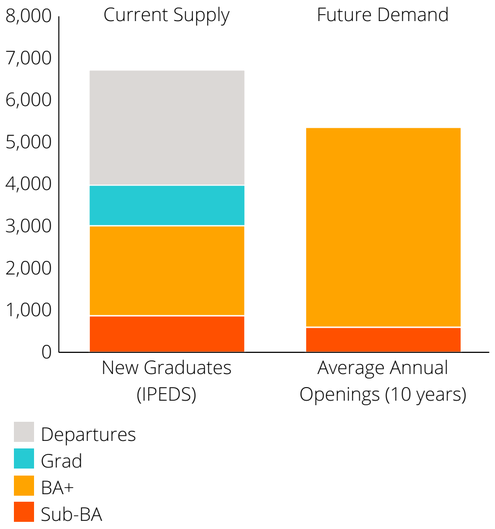
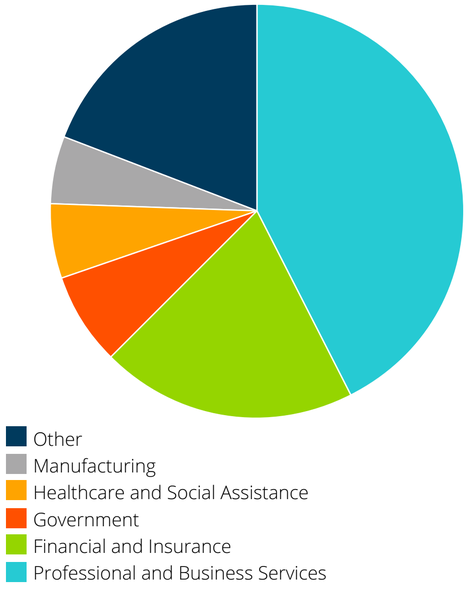


Figure 5: Industry Demand for Business and Finance Workers



ALIGNMENT OF WORKFORCE SUPPLY AND DEMAND

Demand for Business and Finance talent is outstripping local supply: Growth of Business and Finance occupations (5%) is slightly above the regional average (4.2%), and cannot currently be met by the local pipeline. The gap is especially prevalent at the bachelor's and graduate level, where there are 4,000 annual openings being met by only 3,000 new graduates.

Conversations with employers illuminated challenges attracting and retaining local talent. They indicate an attempt to build a stronger hook, through employee perks and other activities, to increase regional retention.

"We try to take our interns around town and create a sense of community within each class to increase our chances of convincing them to stay after graduation. We've also found that involving them in community service projects helps interns develop an affinity for the city."

Slow growth and changing credential requirements of Administrative roles reduce opportunities for workers: While demand for high-end bachelor's level occupations is strong, demand for Administration occupations is projected to be flat over the next 10 years (0% growth) , and two of the top 10 occupations, Tellers (-21%) and Shipping and Receiving Clerks (-2%) are projected to decline. Many of these roles are responsibilities are being absorbed by other occupations or by automation.

Despite slow growth, administrative roles have high replacement rates due to turnover, with over 21,000 open positions per year. Only 62% of these openings pay a living wage ($15/hour), and many of these roles have increasing credential requirements, such as Executive Secretaries, where 44% of job postings require a bachelor's degree, compared to 21% of incumbent workers, indicating employers' desire to upskill the role. Employers imposing credentials where they are not needed constrains their pool of applicants, raises costs, and limits the diversity of their hiring pool.

UPMC recently announced that it will raise entry level wages to a minimum of $15 over the next three years. This development has the potential to reshape the market for many administrative roles, particularly if other major employers follow suit, as UPMC is among the top-3 hirers for these roles. Increased wages will make these careers more attractive to job seekers, and could increase retention.

CHANGING 21ST CENTURY WORKFORCE

Analytical occupations are large and projected to grow: In large part, the demand for Business and Finance talent is being driven by increased demand for Analysts. Two of the five Finance occupations with the fastest projected growth are Management Analysts (7%) and Market Research Analysts (15%) – these are also two of the largest occupations. Financial Analysts are projected to increase at a rate of 6%, slightly above the region overall. In addition to analyst roles, core functions in the Finance sector require higher levels of analytical skills. Project managers, market research specialists and human resources staff call for higher sophistication with analysis, from utilization of the Microsoft Suite to HRIS systems when hired within Finance.

DATA TABLES

Table 18: Business and Finance Occupational Summary Table

Occupation	Employment 2015	Median Salary	Projected Growth Rate	Projected Annual Openings, 2015-2025	% Requested BA	LQ
Accountants & Auditors	14,232	$62,560	7%	1,206	99%	1.23
Market Research Analysts & Marketing Specialists	5,654	$60,230	15%	544	80%	1.20
Management Analysts	4,542	$73,220	7%	371	96%	0.76
Business Operations Specialists, Other	4,441	$69,490	2%	354	84%	0.46
Human Resources Specialists	4,153	$58,970	3%	336	72%	1.02
Financial Analysts	3,584	$68,200	6%	288	100%	1.21
Purchasing Agents	3,319	$58,460	-1%	247	76%	1.24
Training & Development Specialists	2,823	$54,270	5%	222	66%	1.14
Loan Officers	2,577	$51,880	1%	197	51%	1.31
Claims Adjusters, Examiners & Investigators	2,420	$59,210	3%	194	62%	1.06
Cost Estimators	2,354	$61,850	5%	188	64%	1.24
Personal Financial Advisors	2,217	$84,440	23%	216	50%	1.02
Compliance Officers	2,042	$63,350	2%	144	89%	1.17
Wholesale & Retail Buyers	1,313	$52,080	5%	117	92%	0.85
Financial Specialists, Other	1,088	$72,750	4%	86	98%	0.93
Grand Total	**64,767**	**$61,070**	**5%**	**5,359**	**89%**	**1.01**

Sources:
Employment: Bureau of Labor Statistics and Burning Glass model
Median Salary: BLS Occupational Employment Statistics
Growth Rate: See methodology; projections based on Burning Glass job postings, Bureau of Labor Statistics projections, and Pennsylvania Department of Labor projections.
% Requesting BA: Burning Glass job postings data
Location Quotient: BLS Occupational Employment Statistics
Table reflects top occupations within the family. Grand totals represent the full occupation family, which can be found in the Appendix.

Table 19: Administration and Office Support Occupational Summary Table

Occupation	Employment 2015	Median Salary	Projected Growth Rate	Projected Annual Openings, 2015-2025	% Requested BA	LQ
Office Clerks, General	29,817	$28,100	0%	3,197	19%	1.13
Customer Service Representatives	26,530	$30,900	5%	2,973	18%	1.19
Secretaries	24,717	$31,820	2%	2,420	23%	1.24
Stock Clerks & Order Fillers	16,577	$21,500	6%	1,916	7%	0.91
Bookkeeping, Accounting & Auditing Clerks	16,442	$34,900	-5%	1,577	38%	1.02
Supervisors - Office & Administrative Support Workers	12,555	$52,230	4%	1,107	64%	0.95
Receptionists & Information Clerks	9,340	$25,670	4%	1,139	2%	0.88
Billing & Posting Clerks	5,871	$32,710	8%	604	13%	1.26
Shipping, Receiving & Traffic Clerks	4,758	$30,740	-2%	424	6%	0.76
Tellers	4,494	$23,640	-21%	546	6%	0.98
Medical Secretaries	4,369	$30,290	15%	488	14%	0.93
Bill & Account Collectors	2,958	$34,680	-2%	295	25%	0.85
Production, Planning & Expediting Clerks	2,730	$48,670	3%	242	44%	0.96
Insurance Claims & Policy Processing Clerks	2,500	$34,070	3%	241	42%	1.16
Data Entry Keyers	2,327	$27,600	-4%	231	7%	0.99
Grand Total	**204,283**	**$31,640**	**0%**	**21,094**	**19%**	**1.04**

Sources:
Employment: Bureau of Labor Statistics and Burning Glass model
Median Salary: BLS Occupational Employment Statistics
Growth Rate: See methodology; projections based on Burning Glass job postings, Bureau of Labor Statistics projections, and Pennsylvania Department of Labor projections.
% Requesting BA: Burning Glass job postings data
Location Quotient: BLS Occupational Employment Statistics
Table reflects top occupations within the family. Grand totals represent the full occupation family, which can be found in the Appendix.

BUSINESS AND FINANCE SKILLS AND CREDENTIALS

Among the most important trends in the job market today is that of "hybrid skills" where skill sets are entering in jobs where they did not previously exist. This trend is particularly noteworthy among business, financial, and associate support roles, as employers are asking these employees to become even more versatile. For office and administrative roles, employers are looking for a combination of strong technical skills and strong employability skills. Neither category is sufficient to get a job on its own. Along with this increased skill requirement, employers are requiring more bachelor's degrees than in the past.

HYBRID JOBS: BLENDING DIVERSE SKILLS SETS INTO A SINGLE ROLE

Skill requirements are changing for Administrative Support: Many administrative support roles have gradually upskilled over the last several years; for example, increasing demand for writing and computer skills across roles. With regard to technical skills, a high degree of proficiency in Microsoft Office is becoming the table stakes for competitive candidates. These skills are requested more often than traditional administrative support skills such as scheduling. In many cases, employers are also looking for candidates with experience on enterprise software systems such as SAP or PeopleSoft.

Baseline employability skills are particularly critical: Employers also demand a high level of proficiency in baseline employability skills such as communication, customer service, and organization. Half of the skills requested in these roles are "baseline" skills (e.g. cross-cutting non-technical skills), compared to a third of skills in the market overall. This occupation has a higher demand for baseline skills than any other occupation family.

Figure 6: Baseline Skill Demand

Importance of Baseline Skills
(Percent of skills requested by category)

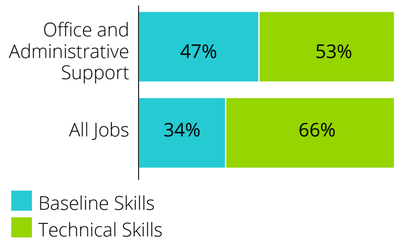


Table 20: Commonly Requested Baseline Skills

	Commonly Requested Baseline Skills
1.	Communication
2.	Customer Service
3.	Organizational Skills
4.	Writing
5.	Detail Oriented
6.	Problem Solving
7.	Research
8.	Multi-Tasking

Table 21: Baseline Skills Gaps

	Baseline Skills Gaps
1.	1. Customer Service
2.	2. Writing
3.	3. Problem Solving
4.	4. Basic Mathematics

Source: The Human Factor: The Hard Time Employers Have Finding Baseline Skills. Burning Glass Technologies, 2015. http://burning-glass.com/research/baseline-skills/

Customer service skills are in high demand across the industry: Customer service occupations and skills are increasingly important, and demand in the region is especially concentrated as employers base their financial and customer service operations in the Pittsburgh region. Customer Service Representatives are highly concentrated in Pittsburgh (LQ=1.19), and are projected to have nearly 3,000 annual openings over the next decade, more than any other occupation paying a living wage ($15/hour). Many of these customer service jobs have higher skills requirements than in the past.

> "People who used to just take your money are now being asked to have a deeper understanding of the bank's products and services, they are asked to be sales people. We are also adding digital specialist roles within each bank given that many of our customers need help accessing and using online banking technology."

UPSKILLING: EMPLOYERS REQUEST HIGHER-LEVEL SKILLS AND CREDENTIALS

Business and Finance roles require stronger analytics skills and greater technical savvy: The fast growing analyst roles require a complex set of skills, combining business expertise with use of tools such as SQL to analyze big data sets. Employers expect a continued growth of these skill sets, including moving more toward predictive analytics. Market research analysts have higher demand for analysis skills, such as Google Analytics and SAS, and database skills, such as SQL, when working within Finance firms. This pattern is consistent across occupations in the Finance industry.

DATA TABLES

The tables below display top skills in demand for the occupation family. Skill demand is based on an analysis of job postings data. While employers do not name every skill required for an occupation, the postings reflect those skills that employers are looking for in candidates, both specialized (technical, occupation-specific) and baseline (cross-cutting, or soft skills). Baseline skills represent 38% of skill demand for Finance roles; and 43% of skill demand for Clerical and Administrative roles. The high relative demand for baseline skills reflects the importance of these capabilities to employers in the hiring process

Table 22: Top Skills in Demand for Business and Finance Workers

	Specialized Skills	Software Skills	Baseline Skills
1.	Accounting	Microsoft Excel	Communication Skills
2.	Business Analysis	Microsoft Office	Organizational Skills
3.	Financial Analysis	Microsoft PowerPoint	Writing
4.	Business Process	Oracle	Microsoft Excel
5.	Financial Reporting	SAP	Research
6.	Financial Statements	SQL	Problem Solving
7.	Account Reconciliation	Enterprise Resource Planning (ERP)	Microsoft Office
8.	Spreadsheets	Microsoft Windows	Planning
9.	Public Accounting	Microsoft Visio	Detail-Oriented
10.	Risk Management	PeopleSoft	Customer Service

Source: Burning Glass Technologies

Table 23: Skill Demand for Administrative Support Workers

	Specialized Skills	Baseline Skills
1.	Data Entry	Communication Skills
2.	Administrative Support	Customer Service
3.	Accounting	Organizational Skills
4.	Scheduling	Microsoft Excel
5.	Accounts Payable and Receivable	Writing
6.	Spreadsheets	Detail-Oriented
7.	Cash Handling	Microsoft Office
8.	Appointment Setting	Computer Skills
9.	Mathematics	Problem Solving
10.	Product Sale and Delivery	Multi-Tasking

Source: Burning Glass Technologies

BUSINESS AND FINANCE RECOMMENDATIONS

REGIONAL TRAINING STRATEGIES TO DEVELOP FUTURE WORKFORCE

Expand university partnerships to develop analytical skills: Employers project analytical skills to be core, baseline skills within the industry moving forward. Some employers suggested that regional schools should be more proactive in reaching out to industry, and some are bypassing the career centers and forming individual relationships with professors to try to attract the best students.

> "The region produces great candidates, I just wish there were more of them."

Focus on training pathways to Customer Service Representatives and other administrative roles: Customer Service Representatives and other administrative roles are an important entry into the middle class. There is a core set of skills such as customer service, writing, and problem solving which are key to these roles and are also are taking on growing importance across the market. These skills can be addressed with progressive levels of sophistication and increased focus on workforce development in K-12, higher education, and other workforce training providers. Creating career ladders that focus on these skills and guide job seekers into Customer Service Representative and other administrative roles can help to support an expanded pool of workers for administrative roles and open up a broad range of professional jobs for workers.

ECONOMIC DEVELOPMENT AND EMPLOYER RECOMMENDATIONS

Leverage regional IT strengths to grow finance operations: Pittsburgh's cybersecurity workforce is already heavily focused in the Finance industry, led by large national companies headquartered locally. The local community should work to leverage this strength to build a more robust pipeline into IT in Finance and Professional Services to retain top talent graduating from local institutions.

In addition to the Information Security Analysts already present in Pittsburgh, the region should proactively begin to build the broader cybersecurity infrastructure. Pittsburgh has lower demand cybersecurity trained Software Application Developers and Network Administrators than the national average. A more robust training infrastructure will encourage IT professionals to move into cybersecurity locally.

ENGINEERING, SCIENCE AND PRODUCTION

Pittsburgh is a national leader in advanced manufacturing technologies such as additive manufacturing, and while the region is well positioned to take advantage of the benefits, there are also important workforce implications in these trends. The manufacturing workforce of the future will have fewer, but higher skilled jobs. While manufacturing output in the region has risen to be close to pre-recession levels, the total number of people employed in engineering and production roles has not moved above 2010 levels.

Engineering, science, and production occupations employ 118,000 workers, or roughly 10% of the total workforce. Because of their criticality to the manufacturing industry, they have deep importance to the local economy.

Looking at projected occupational growth, engineering and production roles will grow more slowly than average, but strong need and opportunities exist for the roles most closely linked to advanced manufacturing, such as machinists, industrial maintenance technicians, and mechanical engineers.

Table 24: Engineering, Science, and Production Occupation Families Summary

	Architecture & Engineering	Production and Maintenance	Life and Physical Science
2015 Employment	22,736	86,802	8,490
Annual Openings 2015-2025	1,350	8,499	671
% of Openings Requiring Bachelor's Degree	76%	7%	89%

Figure 7: Industry Demand for Engineering Workers

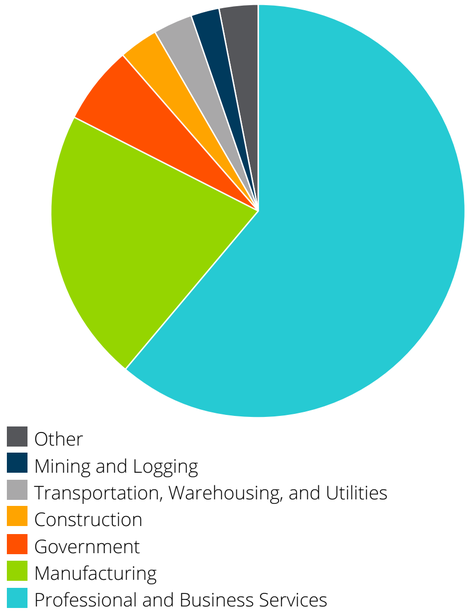
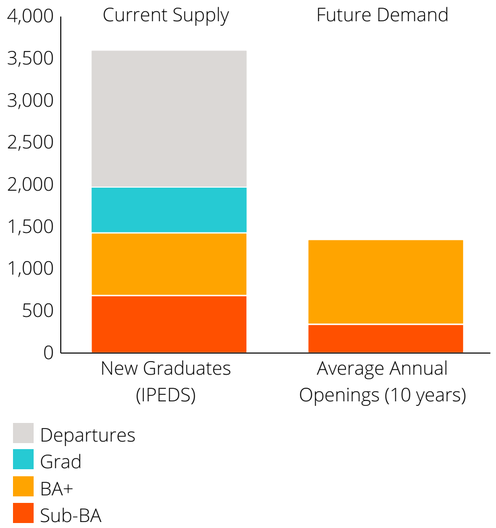


Figure 8: Supply and Demand of Engineering Workers



ALIGNMENT OF WORKFORCE SUPPLY AND DEMAND

Engineering Workforce: While the volume of graduating engineers at the bachelor's and master's level appears to align with the local demand overall, employers commonly report struggling to fill positions. Engineering roles take 20% longer to fill in Pittsburgh than nationally. Additionally, local employers indicate that they have national recruitment strategies for engineers and research scientists, in part because of an inability to find qualified graduates locally. This suggests potential misalignment between local programs and local need.

At the same time, employers may be able to adjust their processes to cultivate and attract local talent. Employers may not have the necessary internships in place to train and recruit students or may be asking for too much experience (75% of advertised posts request three or more years of experience). Further study of the alignment between local engineering programs, local workforce needs and the potential risk of misalignment is warranted.

Production and Maintenance Workforce: Demand for production work is shifting towards the roles that support advanced manufacturing and away from many of the lower-level roles that have traditionally been important sources of employment in the region. As a result, there are high levels of unemployment in the production workforce. More than 6,000 production workers and engineering technicians—the equivalent of one year of demand—are long-term unemployed. While overall growth of production workers is projected to slightly decline (-1% over the next 10 years), an aging workforce means employers will need to fill nearly 7,000 roles per year due to replacement. Looking more narrowly at welders, machinists, and other roles which typically utilize post-secondary programs, there are over 1,000 projected annual openings, against only 472 completions in the last year.

"Unions do an excellent job of training, and the training is free, but certain fields are not attracting enough candidates. The need for highly skilled mechanics is large and will remain so, but while we had more than 1,000 interested in becoming an operating engineer, we had only 75 applicants seeking a career as a mechanic."

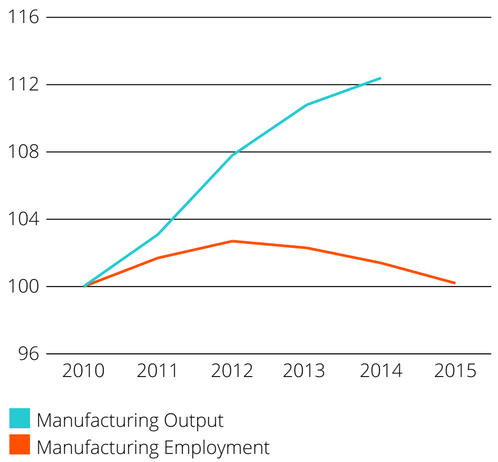
As the job market has evolved, it does not appear that the training ecosystem for production roles has kept pace, as Career and Technology Centers (CTCs) are not projected to fill gaps in the Production workforce. Skilled production roles will grow fastest among the production occupations, but total enrollment in CTC programs is under 1,000 for Machine Tool Technology, Precision Metal Work, and Welding programs. At the community college level, employers would like to see educational alignment strengthened.

"It seems like all of the community colleges are fragmented causing them to have similar, overlapping programs. They appear to be in competition rather than collaboration with one another."

CHANGING 21ST CENTURY WORKFORCE

Advanced manufacturing leads to smaller quantity, but higher skilled employees: The value of manufacturing output has increased by over 10% in Pittsburgh since 2010, almost returning to pre-recession levels, while employment has remained flat. The increased ratio of the value of manufacturing output to the number of people employed is a national trend that will likely continue. Increases in automation, the scaling of additive manufacturing, and the development of new more efficient production techniques will continue to transform the manufacturing workforce.

Figure 9: Manufacturing Output and Manufacturing Employment in Greater Pittsburgh



Sources: Output data from Bureau of Economic Analysis; Employment data from Bureau of Labor Statistics

Many of the fastest growing roles in the engineering and production workforce are those which support advanced manufacturing, mechatronics, and the automation of traditional processes. Employers pointed to automation controls and increased robotics expertise as critical future skills for many positions within manufacturing. These include Mechanical Engineers (+10% projected growth), CNC Machine Tool Programmers (19%) and Industrial Machinery Mechanics (20%). This growth is offset by slower than average growth in roles such as Drafters (-6%) and Production Helpers (-4%) whose work has been automated by software or machinery.

DATA TABLES

The tables that follow provide data on engineering, production, and industrial maintenance occupations. The first table combines similar occupations (e.g. combining three types of drafters into one category). The tables that follow provide more data on individual occupations within the Architecture and Engineering family, and within Production and Industrial Maintenance.

Table 25: Summary Table by Similar Occupations

Occupation Category	Employment 2015	Salary	Projected Growth Rate	Projected Annual Openings
Production	62,906	$ 35,780	-1%	6,542
Industrial Maintenance	23,896	$ 43,434	6%	1,957
Engineers	15,191	$ 79,261	5%	910
Drafters	3,000	$ 51,111	-6%	171
Technicians	2,915	$ 50,407	-3%	174

Source: Employment data from Burning Glass Application of Bureau of Labor Statistics Projections Methodology; Salary: Occupational Employment Survey

Table 26: Engineering Occupations Summary Table

Occupation	Employment 2015	Median Salary	Projected Growth Rate	Projected Annual Openings, 2015-2025	% Requested BA	LQ
Civil Engineers	3,847	$76,410	9%	247	98%	1.52
Industrial Engineers	3,112	$81,880	2%	176	98%	1.13
Mechanical Engineers	2,548	$84,190	10%	163	99%	1.11
Electrical Engineers	2,045	$85,980	2%	110	98%	1.20
Electrical & Electronic Engineering Technicians	1,268	$52,560	-9%	74	14%	1.01
Architectural & Civil Drafters	1,261	$50,280	-15%	71	28%	1.59
Mechanical Drafters	1,205	$48,750	0%	68	13%	1.74
Electronics Engineers	1,065	$74,770	-3%	55	90%	0.51
Architects	807	$78,020	4%	47	99%	0.52
Environmental Engineers	625	$82,940	7%	37	100%	1.89
Civil Engineering Technicians	586	$48,530	2%	36	45%	1.28
Electrical & Electronics Drafters	534	$58,410	2%	31	2%	1.21
Engineers, Other	407	$94,610	11%	26	91%	0.63
Industrial Engineering Technicians	388	$49,360	4%	24	7%	0.66
Mechanical Engineering Technicians	363	$49,100	3%	22	22%	0.96
Grand Total	**22,736**	**$69,990**	**3%**	**1,350**	**76%**	**1.10**

Sources:
Employment: Bureau of Labor Statistics and Burning Glass model
Median Salary: BLS Occupational Employment Statistics
Growth Rate: See methodology; projections based on Burning Glass job postings, Bureau of Labor Statistics projections, and Pennsylvania Department of Labor projections.
% Requesting BA: Burning Glass job postings data
Location Quotient: BLS Occupational Employment Statistics
Table reflects top occupations within the family. Grand totals represent the full occupation family, which can be found in the Appendix.

Table 27: Production and Maintenance Occupations Summary Table

Occupation	Employment 2015	Median Salary	Projected Growth Rate	Projected Annual Openings, 2015-2025
Maintenance & Repair Workers, General	15,378	$37,800	3%	1,227
Team Assemblers	7,430	$29,020	-1%	790
Supervisors - Production & Operating Workers	5,503	$58,620	0%	485
Machinists	4,567	$37,270	11%	483
Inspectors, Testers, Sorters, Samplers & Weighers	4,469	$39,680	0%	446
Welders, Cutters, Solderers & Brazers	3,691	$38,840	3%	368
Industrial Machinery Mechanics	3,677	$46,920	20%	342
Helpers - Production Workers	3,466	$29,180	-4%	452
Supervisors - Mechanics, Installers & Repairers	3,355	$64,320	2%	251
Electrical & Electronic Equipment Assemblers	2,294	$31,340	-3%	249
Packaging & Filling Machine Operators	2,049	$37,140	6%	239
Cutting, Punching & Press Machine Operators	1,921	$36,020	-15%	192
Computer-Controlled Machine Tool Operators	1,499	$37,830	16%	163
Grinding, Lapping, Polishing & Buffing Machine Tool Operators	1,258	$35,860	-11%	141
Printing Press Operators	1,229	$31,760	-19%	118
Water & Wastewater Treatment Plant & System Operators	1,222	$46,290	2%	101
Tool & Die Makers	581	$44,250	-2%	56
Computer Numerically Controlled Machine Tool Programmers	248	$46,590	19%	28
Grand Total	**86,802**	**$38,777**	**1%**	**8,499**

Sources:
Employment: Bureau of Labor Statistics and Burning Glass model
Median Salary: BLS Occupational Employment Statistics
Growth Rate: See methodology; projections based on Burning Glass job postings, Bureau of Labor Statistics projections, and Pennsylvania Department of Labor projections.
% Requesting BA: Burning Glass job postings data
Location Quotient: BLS Occupational Employment Statistics
Table reflects top occupations within the family. Grand totals represent the full occupation family, which can be found in the Appendix.

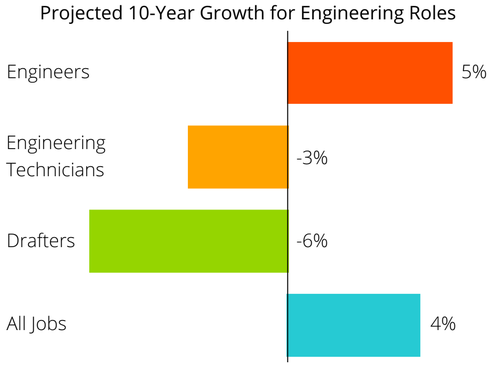
KEY FINDINGS: SKILLS AND CREDENTIALS

UPSKILLING: EMPLOYERS REQUEST HIGHER-LEVEL SKILLS AND CREDENTIALS

Changing skill requirements leave middle-skill workers at risk of being left behind: In order to help the workforce adapt, advanced manufacturing training programs should be reoriented to help upskill the 6,000 unemployed production workers and engineering technicians. Stronger and better articulated career ladders are necessary to help job seekers move into the roles which represent the future of the Manufacturing industry.

Drafting and technician roles, both declining relative to the overall market, are becoming more specialized. This has created a more challenging market for sub-baccalaureate engineering roles. Drafters represent almost 25% of the unemployed workers from the Engineering family; however, these roles are declining by 15% over the next 10 years, compared to 4.2% for the economy overall. Fewer drafters are needed because software has made the process more efficient and a new generation of engineering workers is well versed in using design software directly. The positions that remain have become more sophisticated and are asking for greater levels of specialization and expertise, becoming more similar to engineers.

Figure 10: Growth of Engineering Occupations



Source: Burning Glass Application of Bureau of Labor Statistics Projections Methodology

Demand for production workers is similarly skewing toward roles such as machinists. The high growth roles in the advanced manufacturing economy represent upskill opportunities for workers in declining occupations.

Opportunities for the region to build on its advanced manufacturing strengths:
Pittsburgh has important assets that position it well to succeed in the 21st century manufacturing economy. Its status as a research hub, particularly in fields such as robotics, make it a center for innovation and job creation in the region. In April 2016, General Electric opened a $39 million additive manufacturing plant in Findlay Township.

Similarly, the area has attracted firms focusing on autonomous vehicles (such as Uber) which are eager to locate near Pittsburgh's leading engineering research facilities. As with additive manufacturing, the industry is in its infancy. Pittsburgh can promote the development of these industries by cultivating a talent base that has the skills which these emerging fields will draw from. The table above shows the top job titles, occupations and skills related to autonomous vehicles.

Table 28: Top Jobs and Skills Related to Autonomous Vehicles

Top Titles, Autonomous Vehicle Roles	Top Occupations	Top Skills	Concentration in Pittsburgh
Machine Learning Engineer	Software Developer, Applications	LINUX	Average
Systems Engineer	Electrical Engineer	Robotics	High
Software Development Engineer	Computer Systems Engineer	C++	Average
UI/UX Designer	Computer and Information Research Scientists	Simulation	Average
Risk Analyst	Mechanical Engineer	MATLAB	Average
Analytic Data Scientist	Geospatial Information Scientists and Technologists	Electrical Engineering	Very High
Java Software Developer	Business Intelligence Analysts	Python	Low
Mechanical Engineer	Software QA Engineers and Testers	Prototyping	Very High
Transportation Engineer	Risk Management Specialists	Systems Engineering	Average

Source: Burning Glass job postings

DATA TABLES

The tables here display top skills in demand for the occupation family. Skill demand is based on an analysis of job postings data. While employers do not name every skill required for an occupation, the postings reflect those skills that employers are looking for in candidates, both specialized (technical, occupation-specific) and baseline (cross-cutting, or soft skills). Baseline skills represent 29% of skill demand in Engineering occupations, and 32% of demand for Production. The high relative demand for baseline skills reflects the importance of these capabilities to employers in the hiring process.

Table 29: Skill Demand for Engineering Workers

	Specialized Skills	Baseline Skills
1.	AutoCAD	Communication Skills
2.	Electrical Engineering	Project Management
3.	Mechanical Engineering	Writing
4.	Computer Aided Drafting/Design (CAD)	Organizational Skills
5.	Civil Engineering	Planning
6.	Repair	Microsoft Office
7.	Inspection	Microsoft Excel
8.	Manufacturing Processes	Troubleshooting
9.	Technical Support	Problem Solving
10.	Engineer in Training	Quality Assurance and Control

Sources: Burning Glass job postings

Table 30: Skill Demand for Production and Maintenance Workers

	Specialized Skills	Baseline Skills
1.	Repair	Communication Skills
2.	Inspection	Troubleshooting
3.	Hand Tools	Organizational Skills
4.	Welding	Preventative Maintenance
5.	Machining	Computer Skills
6.	HVAC	Writing
7.	Power Tools	Problem Solving
8.	Machinery	Customer Service
9.	Blueprints	Detail-Oriented
10.	Mathematics	Microsoft Office

Sources: Burning Glass job postings

ENGINEERING, SCIENCE AND PRODUCTION RECOMMENDATIONS

REGIONAL TRAINING STRATEGIES TO DEVELOP FUTURE WORKFORCE

Addressing the challenges in the Pittsburgh region's engineering workforce requires the development of stronger, more structured career pathways. These will take different forms at different levels, but in all cases they require strong coordination between employers and training providers and rich, actionable information for job seekers.

Encourage development of high-skill internships with local universities to shift hiring from national to local: Many of the advanced manufacturing jobs in the Pittsburgh region are in research and development, requiring highly-skilled engineers and scientists. Local institutions, especially Carnegie Mellon and the University of Pittsburgh, have the potential to feed students into this work via internships and retain local talent. At present, employers are using national recruiting to fill positions in Pittsburgh, with the Biological and Physical Scientist occupations among the highest net importers of talent.

Create explicit pathways to upward mobility in Engineering and Production roles: As the manufacturing workforce changes and many production roles decline due to automation, the employers and training institutions may need to rethink traditional pathways into these roles. The large number of unemployed production workers and engineering technicians will likely need additional training to move into the advanced manufacturing jobs which are driving growth. Creating well-defined, well-articulated and commonly agreed upon career ladders can help address the scale of this challenge by bringing workers, training providers and industry together around a common language with shared expectations. The diagram below provides an example of the kind of career ladders that regional stakeholders can develop and rally around. It demonstrates a series of related jobs and the skills that workers should seek to obtain for promotion.

Similarly, the identification, by employers, of common cross-cutting skills which make workers more resilient to economic and technical changes in the market, will help to smooth transitions for workers and create a larger pool of available talent for employers.

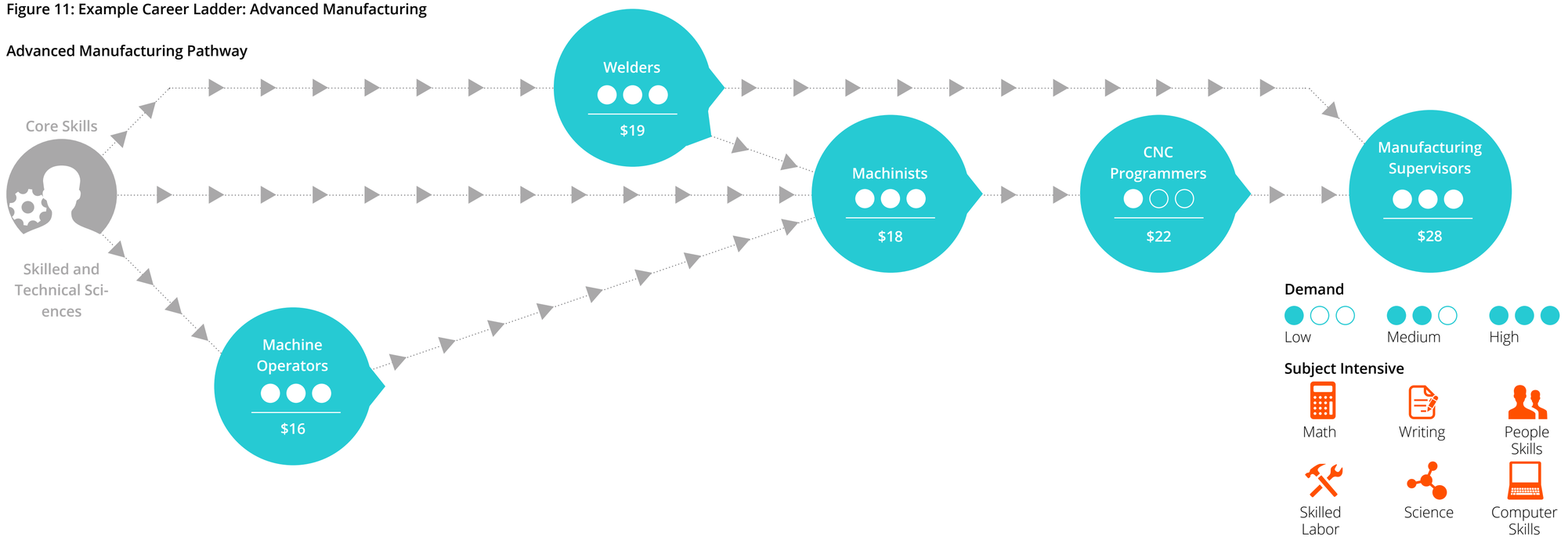
Broaden CTE pathways to bring more students into Production and Engineering: Employers, training providers, and the full range of community stakeholders must work to address the stigma associated with production and manufacturing jobs. Students and their parents push against pathways into production work which is often perceived as "dirty" and volatile given the layoffs that have occurred in recent years. The heavy emphasis on attending 4-year colleges draws students away from traditionally constructed CTE programs. One promising approach is to broaden the scope of the CTE programs so that they prepare students for the full range of jobs in a professional pathway, not just those which do not require a BA. This means creating engineering and production programs which provide a broad range of competencies from the occupational area such as strong math skills, specialized software skills, and introductions to robotics.[25] From these, students can be equally well prepared to continue toward a Bachelor's in Engineering or move into a production or technician role with shorter term post-secondary training requirements.

"The schools need to do more than just have industry advisory boards; they need to build real partnerships with industry. Retired HR professionals might be willing to go into the schools to share what employers are looking for."

ECONOMIC DEVELOPMENT AND EMPLOYER RECOMMENDATIONS

Focus on and Build from Strengths as an Advanced Manufacturing Cluster: Pittsburgh is viewed as a leader in advanced manufacturing with recent investments from Uber in autonomous vehicles, GE in additive manufacturing and others confirming this trend. The region should double down on investments in cutting-edge research in order to reinforce the advanced manufacturing cluster in the region. In particular, this means employers and universities should work together to explicitly reinforce, develop, and promote a workforce with the engineering research, computer science research, and advanced production skills that power research and manufacturing innovation.

Figure 11: Example Career Ladder: Advanced Manufacturing



	Machine Operators	Welders	Machinists	CNC Programmers	Supervisors
	• Use of hand tools, interpreting blueprints and basic machine operation • Responsible for cleaning and maintaining manufacturing floor	• Knowledge of metallurgy and various welding techniques	• Operate specialized machine tools to perform precision operations • Fabricate, inspect and modify machinery parts	• Ability to prepare machinery for operation using numerical computer programming techniques and CAD software	• Coordinate and assess the operations of the manufacturing team • Manage manufacturing floor for efficient operation
Certification In-Demand		• American Welding Society Certification			

HEALTHCARE

Industry demand for healthcare talent is being shaped by an aging population. Employers face the dual challenge of replacing older workers in the workforce as well as increasing workers as the population ages. Healthcare occupations are projected to grow nearly twice as fast as the job market overall over the next ten years.

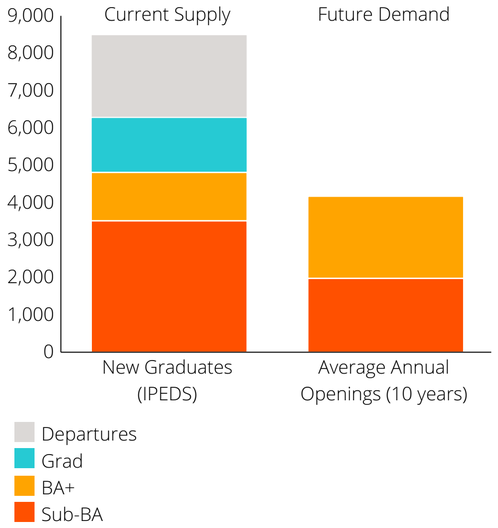
Table 31: Healthcare Occupation Family Summary

	Healthcare Practitioners	Healthcare Support
2015 Employment	75,042	40,514
Annual Openings 2015-2025	4,174	5,103
% of Openings Requiring Bachelor's Degree	53%	—*

**Not typically relevant.*

ALIGNMENT OF WORKFORCE SUPPLY AND DEMAND

Figure 12: Supply and Demand of Healthcare Practitioners



Supply and demand dynamics for specific healthcare roles: In the aggregate, local healthcare graduates meet the expected future annual demand at the Practitioner level. This leads to a below average time to hire locally compared to national averages.

But shortages are projected at the sub-baccalaureate level. Occupations at risk of being undersupplied include Licensed Practical Nurses, Medical Records Technicians, Dental Hygienists, and Respiratory Therapists, which all have fewer annual degree completions than projected openings. The rapid expansion of healthcare roles and the volume of hiring needed will put pressure on employers to have well-articulated pipelines and hiring systems in place. Three of the four fastest projected growth (minimum 500 employed) healthcare occupations directly respond to an aging population: Physical and Occupational Therapist Assistants and Home Health Aides. Many employers noted the reduction in high school level training, suggesting the need for healthcare CTE programs to return.

> "Education and training providers are not ready for the scope and scale of changes within the industry."

UPMC recently announced that it will raise entry level wages to a minimum of $15 over the next three years. This development has the potential to reshape the market for many lower skill healthcare roles, particularly if other major employers follow suit. Increased wages will make these careers more attractive to job seekers, and could increase retention.

Nursing and related patient care roles are in high demand: The occupations with the largest number of annual openings are Registered Nurses, Home Health Aides, Nursing Assistants, Medical Assistants, and Licensed Practical Nurses. Except for Registered Nurses, the demand for these roles outstrips supply at present. CTE programs could help close the gap for sub-baccalaureate talent, with over 900 students presently enrolled in Health/Medical Assistant programs regionally. However, employers and training providers indicate a lack of alignment and coordination in these efforts.

The workforce does not represent the diversity of the population: Employers express difficulty finding a diverse workforce for practitioner and support roles. Employers seek workers that can support both cultural differences in the community and understand health disparities across the population and create a more welcoming provider environment.

CHANGING 21ST CENTURY WORKFORCE

Employer demand and training programs are not aligned for many positions: Several critical practitioner roles – LPNs, Technologists, etc. – require direct training and licensure. However, employers are not finding the talent needed from traditional programs and must seek new pipelines. For example, one employer indicates adapting its need for Medical Technologist positions by hiring unlicensed life science degree holders. The employer then trains employees and works toward obtaining licensure. More broadly, employers do not believe training programs are prepared to adjust to the speed and scope of industry changes.

Advanced technologies are changing healthcare delivery: New technologies are radically transforming healthcare. In some cases, the workforce implications are clear: the rise of electronic health records has created a new class of clinical analyst jobs and nurses with IT and data analysis skills. In others, the technologies are only now being developed. CMU's Quality of Life Technology Center provides an opportunity for Pittsburgh to be on the front lines of innovation around the technologies needed to support an aging population.

> "Healthcare is traditionally behind in technology changes. In the future, networking, development and automation technology skills will shift from technical to core skills for most key positions."

DATA TABLES

Table 32: Healthcare Practitioners Occupation Summary

Occupation	Employment 2015	Median Salary	Projected Growth Rate	Projected Annual Openings, 2015-2025	Completions, 2014	Completions: Openings Ratio	Typical Degree Level	LQ
Registered Nurses	29,579	$61,220	13%	1,705	2,244	1.0	37% BA	1.35
Licensed Practical & Licensed Vocational Nurses	5,632	$42,140	15%	362	312	0.7	HS	1.00
Physicians & Surgeons, Other	4,365	**	9%	165	150	0.5	Doctorate	1.60
Pharmacy Technicians	3,122	$28,700	5%	189	62	N/A*	HS	0.90
Emergency Medical Technicians & Paramedics	3,072	$31,160	16%	193	0	N/A*	HS	1.30
Pharmacists	2,677	$107,140	2%	106	299	2.0	Doctorate	1.06
Physical Therapists	2,451	$80,050	21%	147	197	1.0	Graduate	1.46
Radiologic Technologists	2,375	$48,430	6%	119	189	1.4	24% BA	1.50
Medical & Clinical Laboratory Technologists	1,953	$53,280	4%	94	5	N/A*	83% BA	1.31
Dental Hygienists	1,889	$55,800	9%	101	51	0.4	31% BA	1.46
Medical & Clinical Laboratory Technicians	1,866	$35,980	3%	89	25	0.2	24% BA	1.39
Occupational Therapists	1,573	$67,720	20%	97	179	1.5	Graduate	1.67
Medical Records & Health Information Technicians	1,534	$36,680	11%	95	86	0.8	31% BA	0.91
Respiratory Therapists	1,335	$51,770	10%	67	66	0.8	30% BA	1.35
Physician Assistants	1,056	$84,460	11%	58	242	3.7	Graduate	1.29
Grand Total	**75,042**	**$57,470**	**12%**	**4,174**	**6,281**	**1.5**	**53%**	**1.21**

** Roles with near-zero completions:openings ratios are listed as N/A. Pharmacy Technicians are N/A'd as the positions typically require on-the-job experience.*
*** Physicians and Surgeons salary data not available from the BLS.*

Sources:
Employment: Bureau of Labor Statistics and Burning Glass model
Median Salary: BLS Occupational Employment Statistics
Growth Rate: See methodology; projections based on Burning Glass job postings, Bureau of Labor Statistics projections, and Pennsylvania Department of Labor projections.
% Requesting BA: Burning Glass job postings data
Location Quotient: BLS Occupational Employment Statistics
Table reflects top occupations within the family. Grand totals represent the full occupation family, which can be found in the Appendix.

Table 33: Healthcare Support Occupation Summary

Occupation	Employment 2015	Median Salary	Projected Growth Rate	Projected Annual Openings, 2015-2025	LQ
Nursing Assistants	13,579	$27,380	7%	1,609	1.14
Home Health Aides	12,242	$21,030	25%	1,671	1.22
Medical Assistants	5,661	$27,750	15%	733	1.10
Dental Assistants	2,001	$32,050	6%	234	0.83
Medical Transcriptionists	1,238	$34,820	-9%	118	1.83
Phlebotomists	1,094	$28,160	11%	125	1.03
Orderlies	900	$24,580	5%	105	2.09
Physical Therapist Assistants	863	$47,920	31%	117	1.33
Occupational Therapy Assistants	705	$47,670	30%	99	2.71
Pharmacy Aides	471	$26,840	0%	59	1.16
Medical Equipment Preparers	412	$28,710	8%	53	1.16
Physical Therapist Aides	389	$31,610	40%	57	1.64
Healthcare Support Workers, Other	285	$37,140	3%	35	0.69
Massage Therapists	215	$29,550	17%	26	0.44
Veterinary Assistants & Laboratory Animal Caretakers	210	$22,880	0%	29	0.84
Grand Total	**40,514**	**$26,920**	**15%**	**5,103**	**1.13**

Sources:
Employment: Bureau of Labor Statistics and Burning Glass model
Median Salary: BLS Occupational Employment Statistics
Growth Rate: See methodology; projections based on Burning Glass job postings, Bureau of Labor Statistics projections, and Pennsylvania Department of Labor projections.
% Requesting BA: Burning Glass job postings data
Location Quotient: BLS Occupational Employment Statistics
Table reflects top occupations within the family. Grand totals represent the full occupation family, which can be found in the Appendix.

HEALTHCARE SKILLS AND CREDENTIALS

HYBRID JOBS: BLENDING DIVERSE SKILL SETS INTO A SINGLE ROLE

Management skills are required, especially to support home health staff: Increased management skills are in demand across occupations, particularly in nursing and related roles. Cost pressures are pushing additional responsibility, including management, into new roles. Additionally, as home healthcare becomes a larger portion of the care delivered by healthcare organizations, employees across occupations are required to have relevant skills to support this population. Nurses and other practitioners must be able to perform home health assignments and oversee the support level home health staff in the field. Employers face a challenge with the supervision of remote staff in healthcare, which is a new skill set that will continue to grow.

Customer service skills are increasingly important across clinical care occupations: Employers seek customer service skills across nursing roles, registrars, phlebotomists, and more, due to the importance of building relationships with patients and the increased importance of quality of care metrics. Finding and training workers with these skills has been a challenge for employers. Entry level clinical positions need these skills as employers view patients as long-term customers.

"Healthcare is moving to a new customer-focused model, but we still need the clinical and technical expertise."

UPSKILLING: EMPLOYERS REQUEST HIGHER-LEVEL SKILLS AND CREDENTIALS

Employers desire specialist roles and clinical experience from new entrants: Many healthcare employers noted an increased demand for specialized nurses (e.g. trauma, geriatrics, etc.) however training for these roles is typically on the job, meaning that new entrants to the field are not immediately qualified for these roles. Employers express a desire for new entrants to the market to have more robust clinical experience than is commonly available through training programs.

Business and analysis skills in healthcare: As healthcare becomes more outcome focused, healthcare workers are expected to have a stronger understanding of the business implications of their care decisions and to be savvier at working with various forms of health data.

DATA TABLES

The table here displays top skills in demand for the occupation family. Skill demand is based on an analysis of job postings data. While employers do not name every skill required for an occupation, the postings reflect those skills that employers are looking for in candidates, both specialized (technical, occupation-specific) and baseline (cross-cutting, or soft skills). Baseline skills represent 26% of all skill demand in Healthcare occupations. The high relative demand for baseline skills reflects the importance of these capabilities to employers in the hiring process.

Table 34: Healthcare Skills

	Specialized Skills	Baseline Skills
1.	Patient Care	Organizational Skills
2.	Treatment Planning	Communication Skills
3.	Collaboration	Teaching
4.	Patient/Family Education and Instruction	Research
5.	Home Health	Quality Assurance and Control
6.	Rehabilitation Services	Problem Solving
7.	Patient Safety	Writing
8.	Cancer Knowledge	Critical Thinking
9.	Therapy	Building Effective Relationships
10.	Pharmacist	Planning

Sources: Burning Glass Technologies

HEALTHCARE RECOMMENDATIONS

REGIONAL TRAINING STRATEGIES TO DEVELOP FUTURE WORKFORCE

Ensure Close Alignment of Training Programs with the Jobs and Skills in Demand: Healthcare is relatively unique in that each occupation typically has its own specific training program. This makes alignment of supply and demand more directly measurable and also limits the options of jobseekers who enter misaligned or oversupplied fields. To that end, it is critical that employers and training providers work together to calibrate needs in this transformational time for the industry. Among the areas of current shortage are Occupational Therapist Assistants and Physical Therapy Technician/Assistants, occupations serving an older population and where graduates fall short of demand.

The demands put on healthcare workers are changing and the importance of non-clinical skills for clinical workers has grown. For example, the top 10 skills required for LPNs include traditional healthcare (patient care, medication administration), customer service skills (patient/family education and instruction), and care leadership (treatment planning). Employers and training providers should work together to develop creative approaches to address non-clinical skill training that is targeted to structured certification requirements.

Create pathways to bring new workers into the field: The Healthcare industry hires large numbers of individuals in sub-baccalaureate, non-clinical roles. Employers can develop internal management and talent identification systems to transition workers into the high-demand clinical roles that project supply gaps. This approach can also help to support efforts to increase diversity.

However, the outward migration of educated workers of color is hampering the effort to create a representative employee base. Only 5% of Healthcare Practitioners, and 4% of Healthcare Support workers locally are African American, compared to just over 8% of the population as a whole. Developing a regional training strategy for bringing a diverse workforce to healthcare can help address this critical need. This can include training diverse workers in non-clinical roles to shift to clinical positions.

CONSTRUCTION

Almost 58,000 workers are employed in construction in the Pittsburgh region. But slow growth and cyclicality provide challenges for the local market outside of roles with specific apprenticeships. The majority of supervisors are in the Baby Boomer generation, and the quantity of talent coming from CTE providers is not high enough, especially with the potential for spikes from large ethane cracker projects.

Table 35: Construction Occupation Family Summary

2015 Employment	57,739
Annual Openings 2015-2025	5,422
% of Openings Requiring Bachelor's Degree	—

ALIGNMENT OF WORKFORCE SUPPLY AND DEMAND

Few occupations will grow faster than the overall workforce, but there is the potential for large demand spikes: Brick masons (11%), Laborers (9%), and Paving, Surfacing & Tamping Equipment Operators (8%) are among the few occupations projected to grow faster than 4.2%, the overall market rate for the next decade. Construction and Building Inspectors, projected to grow at 6%, is one of the few construction roles where employers regularly request a Bachelor's degree.

While the occupation group is not projected to expand based on traditional econometric models, there are two proposed ethane cracker projects (by Shell Chemical Appalachia LLC and PTT Global Chemical) that will potentially place stress on the 10-county southwestern Pennsylvania region's construction workforce.[26] For example, the construction phase of the project proposed by Shell Chemical Appalachia LLC is projected to directly employ 1,900 to 2,300 workers in the region; and indirectly support up to an additional 1,300 workers.[27]

> "There have always been employment fluctuations in construction that create waves, but never a tsunami; these crackers would represent a tsunami."

Construction occupations are difficult to fill despite high long-term unemployment: Several occupational groups take longer to fill in the Pittsburgh region than the national average: Carpenters (21% longer), Construction Inspectors (11% longer), Electricians (10% longer), and Laborers (9% longer). Many of these positions require formal technical training through apprenticeship programs which are not producing enough new candidates. The construction trade unions expect that the 2017 class will be the largest in over a decade, expecting seventeen apprenticeship schools to take in 1,100 apprentices. This includes 300-350 projected for 2017 in carpentry, which falls short of the estimated number of openings (1,095). Employers noted the quality of these programs, but lamented the low volume.

This is despite the Construction and Extraction occupation family having over 9,000 long-term unemployed workers (Source: American Community Survey), who alone could fill more than one year of demand. The largest segment of long-term unemployed are laborers, indicating a need to upskill those working into more specialized roles and/or to provide training which allows them to seek employment across a range of industries such as energy or production.

Career and Technical Education and Apprenticeship programs provide a strong pipeline: The largest set of CTE enrollment is in skilled trades (38%), and the employers and trade unions have strong partnerships with them. While graduates are often prepared, the raw numbers are not sufficient to fill the more than 5,000 annual openings. The Builders Guild of Western Pennsylvania, Inc., representing unions and contractors, provides tours and is working to support education administrators in better understanding the opportunities in order to recruit into the apprenticeship programs. The trade unions noted a misperception that apprenticeships were only for recent high school graduates, but the average age of an apprentice is 27. Unions note the career payback is of value for candidates into their 40s. As is the case in production and other skilled trade jobs, students and parents resist these opportunities in K-12 education due to a stigma regarding the roles.

CONSTRUCTION SKILLS AND CREDENTIALS

HYBRID JOBS: BLENDING DIVERSE SKILL SETS INTO A SINGLE ROLE

Employers require math skills that candidates commonly struggle with when graduating from high school: Employers are looking for algebra and geometry skills, but struggle to find candidates with sufficient abilities; apprenticeships require aptitude tests.

> "Math skills are a big issue across many businesses. We've been successful in focusing math training to what will actually be required on the job. The math you need as an operator is different than the math for carpentry. Narrowing the breadth of math training has created something very achievable for students."

Roles, especially supervisory roles, are tech enabled: Employers emphasize that many jobs, especially supervisory roles are now tech enabled. For example, work orders and blueprints are now being delivered through iPads. Similarly, as construction equipment becomes more complicated, the need for a technology-literate workforce also grows. Mechanics were noted as an occupation that was particularly affected by this change. Employers seek workers able to be trained on equipment technology, including for repair and maintenance.

> "These positions use laptops more than they use wrenches."

UPSKILLING: EMPLOYERS REQUEST HIGHER-LEVEL SKILLS AND CREDENTIALS

Adding supervisory-level skills is a hard sell to the construction workforce: Several construction roles include clear ladders from apprenticeship through journeyman, foreman, and superintendent. However, employers find that many employees are "not interested" in promotions. This resistance is due to paperwork and non-trade tasks, as well as loss of overtime pay. Carpentry apprenticeship programs have begun working to move the top 3rd year (of 4) apprentices to earn management training.

DATA TABLES

Table 36: Construction Occupation Summary

Occupation	Employment 2015	Median Salary	Projected Growth Rate	Projected Annual Openings, 2015-2025	% Requested BA	LQ
Carpenters	12,209	$44,840	4%	1,095	—*	1.68
Construction Laborers	11,196	$36,610	9%	1,171	2%	1.25
Operating Engineers & Other Construction Equipment Operators	5,958	$46,750	6%	557	—*	1.58
Plumbers, Pipefitters & Steamfitters	5,928	$58,910	5%	525	—*	1.17
Supervisors - Construction Trades & Extraction Workers	5,687	$65,300	5%	489	43%	0.98
Electricians	5,583	$49,700	5%	505	—*	0.98
Painters, Construction & Maintenance	1,891	$37,330	5%	180	—*	0.87
Construction & Building Inspectors	1,522	$51,070	6%	149	24%	1.93
Cement Masons & Concrete Finishers	1,452	$51,880	6%	131	—*	0.94
Brickmasons & Blockmasons	936	$50,270	11%	91	—*	1.56
Paving, Surfacing & Tamping Equipment Operators	799	$53,420	8%	78	—*	1.26
Sheet Metal Workers	783	$62,210	3%	73	—*	0.77
Roofers	649	$37,180	-1%	60	—*	1.01
Rotary Drill Operators, Oil & Gas	536	$43,880	7%	54	—*	1.96
Mine Cutting & Channeling Machine Operators	529	**	-26%	46	—*	0.00
Grand Total	**57,739**	**$45,350**	**5%**	**5,422**	**N/A**	**1.17**

**This occupation does not typically call for a Bachelor's degree.*
*** Mine Cutting salary data not available from the BLS.*
Sources:
Employment: Bureau of Labor Statistics and Burning Glass model
Median Salary: BLS Occupational Employment Statistics
Growth Rate: See methodology; projections based on Burning Glass job postings, Bureau of Labor Statistics projections, and Pennsylvania Department of Labor projections.
% Requesting BA: Burning Glass job postings data
Location Quotient: BLS Occupational Employment Statistics
Table reflects top occupations within the family. Grand totals represent the full occupation family, which can be found in the Appendix.

CONSTRUCTION RECOMMENDATIONS

REGIONAL TRAINING STRATEGIES TO DEVELOP FUTURE WORKFORCE

Convene local leaders to develop a regional pipeline and strategies for incentivizing managerial roles: Construction Manager positions are more difficult to fill (9% longer) locally than across the country. Industry leaders should develop a joint strategy for creating a pipeline into these roles. Similarly maintaining active communication between employers and training providers is critical to building the supply needed to handle rapid increases in demand such as would occur if the ethane cracker projects move forward.

Work with cohort of unemployed workers and non-traditional pipeline to identify candidates for upskilling: Promote career ladders for laborers to help provide advancement into more technically specific roles with lower unemployment. Electricians are one of the largest segments of unemployed workers locally; electrician positions are also 10% more difficult to fill than national averages. This indicates a direct opportunity to solve a local employment need while addressing unemployment through targeted training. Employers also point to a need to look outside traditional candidate pools and point to veterans as a population that could potentially be tapped.

In addition, workers with backgrounds in construction, production and energy roles share many similar skills. Cross training allows workers to flex between industries as demand fluctuates based on local economic needs. Creating training structures that support and encourage this flexing can help to create a workforce that is more resilient.

Profiled Industry Sectors

Energy | Retail and Hospitality

ENERGY

In this report, Energy is investigated as an industry, covering a range of occupations from Engineers and Construction Workers to Truck Drivers and other transportation workers. Energy Sector Jobs in Greater Pittsburgh Report, produced in 2012 by Development Dimensions International for the Allegheny Conference on Community Development identified the "Targeted Jobs" for the industry.[28] These are jobs for which employers projected high-volume hiring and difficulty finding qualified applicants. The outcome included the identification of 14 priority occupations in energy that connectively employ 54,000 workers in the Pittsburgh region. Many of these represent strong opportunities for sub-baccalaureate candidates, but are difficult for workers to commit to due to the cyclicality of the sector which grew by more than a third from 2010 to 2014, then contracted by 18% in just over one year.[29]

ALIGNMENT OF WORKFORCE SUPPLY AND DEMAND

Employers are struggling to fill high-priority energy occupations economy-wide: The priority occupations (Table 37: Energy Occupation Summary Table) for energy continue to be pain points for employers. Employers will need to fill more than 5,000 openings annually, and are already finding difficulty filling these roles compared to national averages. For example:

- Machine Tool Operators take 40% longer to fill locally than nationally, and Welders and Machinists take more than 15% longer.
- Engineering Technicians, crucial to designing electrical power systems, are specifically cited by employers as a difficult role to fill with qualified candidates. This challenge extends beyond energy, with Electrical Engineering Technicians (14%) and Mechanical Technicians (13%) showing a higher time to fill than national averages for the region as a whole.
- Employers specifically address a lack of qualified candidates for driving jobs; one challenge is that, even while many recently transitioning military are qualified for heavy duty tractor trailer driving, the Pennsylvania Military Skills Test Waiver process is challenging to navigate and still requires veterans to undergo testing, therefore reducing time to employment.

Locally, perception of industry careers among younger workers is that they are undesirable, and the career ladders within the industry are not well articulated, hampering talent attraction. National recruitment efforts for corporate and engineering roles has been difficult.

> "Public perception of the energy sector makes it hard for qualified candidates to feel comfortable with job stability."

Energy companies have passed the initial wave of retiring workers, and utilities are taking proactive measures to handle retirements: Local energy employers faced a retirement wave in recent years, and do not envision another wave approaching soon. Utility companies are proactively managing transitions, including offering early retirements, and are beginning to see a balancing of the workforce.

Proposed projects could lead to rapid expansion in demand for energy workforce: The two proposed ethane cracker projects in Beaver County, PA and Belmont County, OH, have the potential to shake up the energy workforce of the 10-county southwestern Pennsylvania region. These projects are estimated to add significant construction positions; the proposal by Shell Chemical Appalachia LLC is projected to employ 1,900-2,300 direct workers during the construction phase.[30] These projects would also spur significant downstream activity, such as new manufacturing locations.

DATA TABLES

These data look at the 14 priority occupations identified by the 2012 Energy Occupational Analysis Report. Building from the survey done at that time, this analysis provides insight into how easily employers are able to find talent in the occupations which are most critical to the energy industry. The next table shows the size, salary, growth, and concentration of these occupations in the Pittsburgh region.

DATA TABLES

Table 37: Energy Occupation Summary – Priority Occupations

Occupation	Employment 2015	Median Salary	Projected Growth Rate	Projected Annual Openings, 2015-2025	% Requested BA	LQ
Heavy & Tractor-Trailer Truck Drivers	16,135	$40,900	7%	1,750	13%	0.89
Supervisors - Construction Trades & Extraction Workers	5,687	$65,300	5%	489	43%	0.98
Supervisors - Production & Operating Workers	5,503	$58,620	0%	485	44%	0.95
Machinists	4,567	$37,270	11%	483	--*	1.23
Inspectors, Testers, Sorters, Samplers & Weighers	4,469	$39,680	0%	446	33%	0.71
Welders, Cutters, Solderers & Brazers	3,691	$38,840	3%	368	--*	1.13
Industrial Machinery Mechanics	3,677	$46,920	20%	342	--*	1.1
Sales Managers	2,569	$120,010	3%	185	81%	0.67
Mechanical Engineers	2,548	$84,190	10%	163	99%	1.11
Electrical Engineers	2,045	$85,980	2%	110	98%	1.2
Computer-Controlled Machine Tool Operators	1,499	$37,830	16%	163	--*	1.29
Helpers--Installation, Maintenance & Repair Workers	981	$26,710	5%	110	--*	0.67
Property, Real Estate & Community Association Managers	880	$63,140	3%	69	65%	0.55
Petroleum Engineers	228	$112,890	9%	16	100%	1.61
Grand Total	**54,479**	**$67,790**	**6%**	**5,179**	**39%**	**1**

**This occupation does not typically call for a bachelor's degree*

Sources:
Employment: Bureau of Labor Statistics
Median Salary: BLS Occupational Employment Statistics
Growth Rate: See methodology; projections based on Burning Glass job postings, Bureau of Labor Statistics projections, and Pennsylvania Department of Labor projections.
% Requesting BA: Burning Glass job postings data
Location Quotient: BLS Occupational Employment Statistics

Alternatively, the data in Table 38: Energy Occupation Summary — Nationally Critical Occupations references occupations critical to the energy industry nationally. These data provide a set of additional roles for local focus in the energy workforce, and demonstrate areas where there is high concentration locally.

The energy industry has a broad demand for computer, HR, and engineering talent. Many of these positions show high levels of employment and concentration in the Pittsburgh region, providing opportunity for energy companies to recruit locally from other industries. In some cases, these are higher-skill roles than the previously identified list of fourteen occupations, and should be considered priorities to ensure the full energy industry thrives.

DATA TABLES

Table 38: Energy Occupation Summary - Nationally Critical Occupations

Occupation	Employment 2015	Median Salary	Projected Growth Rate	Projected Annual Openings, 2015-2025	% Requested BA	LQ
Computer Systems Analysts	6,252	$70,760	19%	462	91%	1.24
Plumbers, Pipefitters & Steamfitters	5,928	$58,910	5%	525	0%	1.17
Computer User Support Specialists	5,352	$44,100	11%	378	44%	1.33
Civil Engineers	3,847	$76,410	9%	247	98%	1.52
Managers, Other	3,374	101,230	2%	232	91%	0.46
Supervisors - Mechanics, Installers & Repairers	3,355	$64,320	2%	251	52%	0.87
Industrial Engineers	3,112	$81,880	2%	176	98%	1.13
Training & Development Specialists	2,823	$54,270	5%	222	66%	1.14
Compliance Officers	2,042	$63,350	2%	144	89%	1.17
Industrial Production Managers	1,613	$93,710	1%	99	89%	1.01
Database Administrators	1,229	$74,400	11%	78	78%	1.09
Computer Occupations, Other	1,210	$73,260	3%	73	87%	0.59
Financial Specialists, Other	1,088	$72,750	4%	86	98%	0.93
Supervisors - Helpers, Laborers & Material Movers	958	$50,210	2%	97	14%	0.63
Chemists	935	$63,700	4%	71	99%	1.7
Grand Total	**43,118**	**$67,233**	**6%**	**3,141**	**65%**	**0.89**

Note: Data represents the occupation across Pittsburgh, not focused on the energy industry.
Sources:
Employment: Bureau of Labor Statistics
Median Salary: BLS Occupational Employment Statistics
Growth Rate: See methodology; projections based on Burning Glass job postings, Bureau of Labor Statistics projections, and Pennsylvania Department of Labor projections.
% Requesting BA: Burning Glass job postings data
Location Quotient: BLS Occupational Employment Statistics

ENERGY INDUSTRY SKILLS TRAINING

Energy roles are hybrid, with an increasing demand for technical skills across roles. Employers provide significant training internally, with an emphasis on hiring for personality fit and willingness to work in sometimes difficult and remote locations.

Skills are highly transferrable to and from construction and manufacturing: The energy sector hires construction, production, and engineering workers that are in demand in other sectors, such as Advanced Manufacturing and broader construction. Employers view the required skills as highly transferrable, offering opportunities for cross-training to build a robust pipeline of talent that can weather industry waves.

Employers have developed internal training programs: Energy employers describe a hiring and training pipeline that is based around personality traits and attitude, followed by strong employer-specific training. This practice may lead to workers with industry-specific skills that are less transferrable, decreasing the ability to weather economic cycles.

ENERGY INDUSTRY RECOMMENDATIONS

ECONOMIC DEVELOPMENT AND EMPLOYER RECOMMENDATIONS

Develop partnerships with local universities to retain engineering talent: The engineering roles in the energy industry are in demand across the Pittsburgh region, and are difficult to fill. The industry should aim to enhance local partnerships with the universities to build internships and ensure to highlight the importance of the industry.

Encourage and expand competency-based hiring: Echoing the recommendations from the 2012 Energy Occupational Analysis Report, these roles represent strong opportunity for sub-BA candidates. More than 80% of the projected openings in these target occupations require less than a bachelor's degree, and all but one are difficult for employers to fill. Employers across the industry have developed training programs at the entry-level and supervisory levels, and these programs are beginning to adapt to technology needs. CTE programs and community colleges must effectively articulate and teach the competencies required for these occupations, and employers should develop apprenticeship opportunities to bring young workers into the field.

Develop an internal management pipeline through communication and management training: Communication and supervisory skills are the top two baseline skills for first-line supervisors of both construction and production workers; these are not the top skill requirements for any other predominantly sub-baccalaureate role. Employers should develop internal training to move employees into these roles.

REGIONAL TRAINING STRATEGIES

Develop technology-enabled skills that protect against cyclicality: Pittsburgh's diverse energy opportunities, from wind to nuclear to natural gas, provide a unique opportunity for workforce training that cuts across segments and is responsive to cyclicality in the energy markets. Core skills, such as understanding of inspection, basic computer skills, and understanding of environmental health and regulations, are critical for workers across energy sectors.

Refocus career and technical education on high growth, hard-to-fill roles: Machine Tool Operators, Welders, and Machinists are three of the most difficult roles for local employers to fill. Local CTE and post-secondary providers can train students to enter these careers. Post-secondary credentials are not filling the gaps, with fewer than 500 completers of welding and machinist programs in the region in 2014. There are approximately 1,000 students enrolled in Welding, Machining, or Power Installer CTC programs today, which is well short of the necessary demand. Due to broad need for machinist positions across energy and advanced manufacturing, this training is lower-risk for job seekers.

Expand industry and career awareness at the K-12 level: With the changing shape of local energy production, direct and sustained efforts must be made toward enhancing the career awareness of young audiences. The potential for career advancement and innovation can work well for a young audience and build a future pipeline into the industry if elements of the industry work together to grow interest. This career awareness should be developed across manufacturing and energy sectors, introducing students to the opportunities in manufacturing, life sciences, production, and construction, and requiring various levels of education.

Leverage dual expertise in energy and engineering to expand renewable energy: The Pittsburgh region's educational strength provides an opportunity to continue to build the local energy sector and expand the workforce. In addition to Carnegie Mellon's Scott Institute for Energy Innovation, the region has a base of renewable energy work with companies such as EverPower Wind Holdings and the recent growth of SolarCity. Many of the electrical, installation, and pipeline skills already present in the market will allow innovative power generation companies to grow locally, including in declining occupations.

RETAIL AND HOSPITALITY

Retail and Hospitality Services industries employ over 18% of the Pittsburgh region's workforce, spanning roles in retail stores, corporate headquarters, hotels, and food service establishments. These industries have large numbers of entry-level positions, and they also have comparably fewer opportunities for career advancement. In addition to the large entry-level workforce, these industries employ a high-skill workforce, especially in corporate headquarters, with business and IT work in growing demand.

ALIGNMENT OF WORKFORCE SUPPLY AND DEMAND

Entry-level roles are filled by young workers and exhibit high turnover: Food service and hospitality roles are filled by young workers and often have high turnover, as they do not typically offer the wages or upward opportunities to make them desirable career track roles. 43% of hotel clerks are younger than 25. However, these jobs act as an important entry point to the workforce for young people. The ability to fill entry-level retail and hospitality positions is directly correlated to access to public transportation and dense areas of worker supply. Employers cite growing suburban locations as particularly difficult to staff.

Finding qualified candidates for many culinary and hospitality occupations is increasingly challenging as high quality training programs have either disappeared or are unable to produce sufficient volume. The many new restaurants and hotels that have opened in Pittsburgh recently also constrain supply, and employers noted significantly higher numbers of interview no-shows and increasing online applications from unqualified candidates.

> "Our grocery stores are rapidly diversifying and offer more prepared foods and even in-store dining. We now find ourselves in competition with restaurants for workers for the first time."

The five largest occupations, Retail Salespersons, Cashiers, Combined Food Preparation and Serving Workers, Waiters and Waitresses, and Custodians will all experience more than 100% turnover of staff over the next decade. This pattern of churn leads to constant internal training by employers, who seek opportunities to train more systematically rather than "just-in-time" training models. As front-line roles take on more complex skill requirements, a rapid training model becomes more difficult to execute.

Upward mobility is limited; higher-level roles are outsourced: Nationally, half of all workers in the industry (47%) are in front-line sales roles. This is also true in restaurants, where 42% of the market is in fast-food work. The size of these roles relative to managers and corporate opportunities, leaves limited room to advance within the industry, especially as managers cite limited time to train new workers.

Exacerbating this issue, employers indicate a number of positions being outsourced or filled by independent contractors (1099 employees). Outsourced roles include data analytics and high level customer service. The tendency for these to be higher level roles further constrains development and promotion opportunities for entry level workers.

CHANGING 21ST CENTURY WORKFORCE

The Retail industry is changing as lines of competition overlap: Retail in Pittsburgh is changing; e-commerce is creating national competition and an increased demand for delivery of products quickly and efficiently. Inventory systems have been made more precise through the use of scanning and tracking systems. Additionally, many traditional retailers are finding a need to diversify their inventory with lower margins, modeled after the growth of big box stores, which combine grocery, clothing stores, gas stations, and more under a single brand. As a result, employers require higher level skills for their staff, requiring them to have hybrid traditional retail and e-commerce/technology skills, while store managers are expected to have higher levels of logistics and supply chain management skills as they take on additional inventory and shipping responsibilities.

IT roles in Retail and Hospitality are small but growing and important: As firms collect more customer data, adopt more sophisticated point of sales systems, and expand their e-commerce operations, they are hiring greater numbers of IT workers. For those that have not yet done so, local employers expect to ramp up their cybersecurity workforce in the near future. Those with local headquarters are hiring more technical staff, taking advantage of the existing pipeline from local universities. Increased digital services within retail offer broad opportunity to expedite the growth of IT roles within Pittsburgh.

Retailers are investing heavily in software development as websites and mobile platforms are increasingly important. Rapidly changing customer expectations, from free shipping to one-day delivery to online ordering and curbside pickup also increase the pressure for companies to effectively differentiate themselves, thus increasing the need for internal branding and marketing expertise.

> "Amazon is putting huge pressure on many of us and it is really impacting margins. People value convenience more than price."

Regulatory issues and potential policy changes are creating uncertainty: Healthcare changes, possible new regulations relating both to minimum wage and earnings from tips, as well as food safety regulations are creating uncertainty and constraining employers' abilities to manage future workforce demand.

> "Depending on what happens with minimum wage, we may have fewer people in our restaurants and will need to look at how technology can replace people, such as getting and paying your bill on your phone."

RETAIL AND ACCOMMODATION SKILL FINDINGS

Retail occupations require a set of skills beyond simply sales and customer service. Top skills in demand include mathematics, collaboration, and leadership. These roles require a set of teamwork skills and basic mathematics skills that are crucial to success.

Hospitality occupations – in hotels and food services – demand a combined set of management, mathematics, and communication skills similar to retail. These roles also carry some understanding of legal requirements, such as with food safety and inspection requirements legally mandated for restaurants and lodging establishments.

UPSKILLING: EMPLOYERS REQUEST HIGHER-LEVEL SKILLS AND CREDENTIALS

Management positions are difficult to fill: Developing a pipeline into management was highlighted as a key challenge in employer focus groups. One industry leader indicated that exit surveys of employees indicated managerial issues as a primary factor for departure, causing the employer to revamp their manager training program. Within retail, problem solving and overcoming adversity were cited as common skill requirements for managers, while lack of math skills was commonly cited as an issue, especially for internal pipelines. Management skills in retail provide opportunities to build ladders into higher paying occupations in the region. The sales and management skills that are in high demand for retail managers provide cross-training opportunities in other industries.

HYBRID JOBS: BLENDING DIVERSE SKILL SETS INTO A SINGLE ROLE

Customer Service Representatives need digital skills: Increased savvy among consumers requires customer service representatives in retail having stronger IT skills, as brick and mortar retail becomes a digitally-enabled experience. Retail employees are required to support both in-person and online shopping.

> "Our biggest challenge is in adapting traditional retail roles to ones that also have significant technology skills. In the end, we still need people who will know the customer."

Retail has an increasing need for data analytics and cybersecurity: While data analytics have grown in retail headquarters, employers indicate outsourcing these across the country or to 1099 (contract) employees. Employers project increased hiring for cybersecurity talent in Pittsburgh, especially in light of recent high-profile cyber-attacks at national retailers. Pittsburgh's cyber talent, which is heavily concentrated in Professional Services and Finance firms, can begin to expand into retail.

DATA TABLES

Table 39: Retail Skills

Specialized Skills	Baseline Skills	Occupations
Sales	Customer Service	Retail Salespersons
Merchandising	Communication Skills	Cashiers
Store Management	Organizational Skills	First-Line Supervisors of Retail Sales Workers
Mathematics	Writing	Stock Clerks and Order Fillers
Description and Demonstration of Products	Problem Solving	Customer Service Representatives
Scheduling	Detail-Oriented	Automotive Service Technicians and Mechanics
Retail Sales	Time Management	Laborers and Freight, Stock, and Material Movers
Collaboration	Multi-Tasking	Pharmacy Technicians
Loss Prevention	Leadership	Pharmacists
Product Sale and Delivery	Supervisory Skills	Combined Food Preparation and Serving Workers, Including Fast Food

Sources: Burning Glass Technologies

Table 40: Hospitality Skills and Occupations

Specialized Skills	Baseline Skills	Occupations
Cleaning	Communciation Skills	Combined Food Preparation and Serving Workers, Including Fast Food
Scheduling	Organizational Skills	Waiters and Waitresses
Cooking	Customer Service	Cooks, Restaurant
Restaurant Management	Writing	First-Line Supervisors of Food Preparation and Serving Workers
Cash Handling	Problem Solving	Bartenders
Mathematics	Supervisory Skills	Food Preparation Workers
Food Safety	Multi-Tasking	Dishwashers
Repair	Research	Maids and Housekeeping Cleaners
Inspection	Computer Skills	Hosts and Hostesses, Restaurant, Lounge, and Coffee Shop
Product Sale and Delivery	English	Dining Room and Cafeteria Attendants and Bartender Helpers

Sources: Burning Glass Technologies

RETAIL AND ACCOMMODATION RECOMMENDATIONS

ECONOMIC DEVELOPMENT AND EMPLOYER RECOMMENDATIONS

Bet on data analytics locally and expand partnerships with universities for software talent: Retail growth, especially in competing with online retailers, will increasingly require strong supply chain management and data analytics to ensure rapid delivery to clients. This requires highly technical data analysts and data scientists that employers have been outsourcing to 1099 contractors. As with data analytics, software development will be increasingly important to competition in retail. Strong websites and mobile applications are critical. In both these areas, employers should expand existing, or develop new, partnerships with local schools to create a strong pipeline and encourage students to work in the area.

REGIONAL TRAINING STRATEGIES TO DEVELOP FUTURE WORKFORCE

Create cross-industry partnerships to create career ladders and pipelines for staff: Partnerships across firms that hire retail, hospitality, sales and customer service workers can be developed to attract and retain well-qualified workers in the retail ecosystem. Providing strong training to retail workers can be a benefit to retailers in that it helps them to create a stronger pool of managers and to workers who can use the training to advance, whether in retail-specific occupations or into related roles in consumer banking or general customer service.

Cybersecurity is also an area where the workforce would benefit from cooperation. Cybersecurity demand is strong in both the short- and long-term. Industry leaders from retail to manufacturing should collaborate with local universities to develop a robust training ecosystem for cyber workers at all levels. Through collaboration with training providers, each industry can include the unique features necessary for success.

Appendices: Methodology

APPENDIX: METHODOLOGY

This study draws from a range of data sources and analytic approaches including traditional economic data, job postings analysis and in-depth focus groups. The types of data used are described in detail in the How to Use This Report section. Below, we provide additional detail on the sources and methodology for the data included in this report.

ABOUT BURNING GLASS JOB POSTING DATA

To supplement traditional sources of labor market data with more comprehensive and up-to-date information on employer demand for jobs and skills, Burning Glass has mined its comprehensive database of over 100 million unique online job postings dating back to 2007. Burning Glass' spidering technology extracts information from close to 40,000 online job boards, newspapers, and employer sites on a daily basis and de-duplicates postings for the same job, whether it is posted multiple times on the same site or across multiple sites. All Burning Glass postings data in this report reflect all job postings collected in the U.S. during the 2015 calendar year, localized to the 10-county southwestern Pennsylvania region where appropriate.

In this report, job postings data is used primarily to measure the skills and credentials that are in demand by employer. These data are uniquely able to assess the specific skills that employers request in real-time and segmented by location, industry and other factors not possible using traditional, static skill profiles.

OCCUPATIONAL PROJECTIONS

The occupations projected included in this report are based on those developed by the Bureau of Labor Statistics and the Pennsylvania Department of Labor and Industry. For this project we have implemented the technical approach developed by the Bureau of Labor Statistics for the 2016-2026 projections which improves substantially upon the methods currently used.[31] This improved method results in significantly higher numbers of projected occupational openings than the current methodology.

In particular, the old BLS method assumes that workers enter a field at a young age, work in their field until they are about 65, and then retire. The new framework allows for the reality that many workers will work in multiple occupations over the course of their careers.

The new methodology breaks occupational demand into three parts: openings due to occupational growth, openings due to workers retiring (or otherwise permanently exiting the workforce), and openings created by workers moving to different roles, but staying in the workforce. This third category is not captured in the current BLS models and accounts for the difference between the data included here and the lower projections numbers that are currently provided by state and federal statistical agencies. Beginning with the 2016-2026 projections, this method will become the standard way of tracking openings.

All projections included in this report represent the aggregate of the 10-county region of the study. 2015 employment estimates are based on OES employment data and state and national projections.

ANALYSIS OF RETENTION OF GRADUATES

LinkedIn's Alumni Tool is used to estimate the number of graduates from local institutions who remain in Pittsburgh, following graduation. Replicating methodology developed at the Brookings Institution, we estimate the total number of graduates remaining in the region by degree area and level. Based on the sample of graduates with LinkedIn profiles, we measure the proportion of recent graduates (over the last five years) who list Pittsburgh as their current location. We apply those proportions across the number of degree completions by major and degree level at each school to estimate the number of graduates who remain in Pittsburgh. (Completions data are sourced from IPEDS.) Finally, we sum the completions and the estimated proportion of students who have stayed across all local institutions. Limitations of this approach include the following: It is assumes that the proportion of students with LinkedIn profiles is a representative sample with respect to geography. Because we are not able to segment the LinkedIn data by major, it assumes that students from a given institution are equally like to stay in the region or leave regardless of their specific major.

QUALITATIVE METHODOLOGY

To validate and deepen the quantitative labor market supply/demand analysis, the Council for Adult and Experiential Learning (CAEL) conducted a series of facilitated conversations with representatives from industry, education and workforce development. This process drew upon CAEL's deep experience working with firms and community leaders to address skills shortages and training needs.

Eight focus groups were held at the offices of the Allegheny Conference between March 1st-3rd with another dozen follow-up interviews during the months of March and April. In total over 125 CEOs, HR directors and other representatives from 85 employers, as well as leaders in education and training, participated in the process.

Scope & Process – Each conversation was approximately 2 ½ hours in length and averaged 15 participants. CAEL conducted the conversations within the context of three distinct time horizons of workforce demand:

- Short Term – Past 6 Months & Next 6 Months
- Medium Term – 3-5 Years Out
- Long Term – 5-10 Years Out

Each of these time horizons utilized a data point from the quantitative demand analysis as a starting point and then participants were asked to speak to workforce demand, challenges and trends. In the short-term time horizon, employers were asked to speak to specific jobs and roles that they were looking to fill as well as the mechanics of how they interact with the supply side, i.e. how they go about finding talent. In the medium-term time horizon, industry trends and changes were discussed with an eye toward how those changes will affect the required employee skills and training. Finally, the long-term discussion focused on foundation skills as well as emerging technologies that will transform and create the occupations of the future.

Participant Profiles – Each focus group comprised industry participants who represented one of three key business functions, senior leadership (Presidents and CEOs), operations (COO and Operations Managers) and human resources (heads of HR and recruiters). The mix of these three functions was critical in ensuring that information could be gathered across the three time horizons with both tactical and strategic perspectives.

Focus group invitations were facilitated through the Allegheny Conference membership team who reached out to 150 employers and industry consortia in the 10-county Pittsburgh region. Special consideration was given to regional diversity in terms of location and size of the organizations.

For the supply side focus group, participants represented the spectrum of education and training providers including, K-12 and Career and Technical Education, Community Colleges, traditional four-year colleges and universities, workforce investment boards and education associations.

The following is a list of businesses and institutions that provided direct feedback throughout the process:

- A.W. Beattie Career Center
- Allegheny Health Network
- Allegheny Intermediate Unit
- ATI
- American Eagle Outfitters
- Aquatech International Corporation
- ASKO, Inc.
- Big Burrito Restaurant Group
- Boyden
- Builders Guild of Western Pennsylvania
- Carmeuse Lime and Stone
- Carnegie Mellon University
- Carnegie Mellon University CERT
- Catalyst Connection
- Chatham University
- Chevron
- Columbia Gas of Pennsylvania, Inc.
- Comcast
- Community College of Allegheny County
- CONSOL Energy, Inc.
- Constructors Association of Western Pennsylvania
- Convergys
- Covestro LLC
- Duquesne Light Company
- Eat'n Park Hospitality Group
- Elliott Group
- Ellwood Group, Inc.
- EQT Corporation
- EverPower Wind Holdings, Inc.
- Expedient
- FCG Solutions, Inc.
- Federated Investors, Inc.
- FirstEnergy Corp.
- Forbes Road Career & Technology Center
- Gateway Health Plan
- Giant Eagle
- Google
- Healthcare Council of Western Pennsylvania
- Hefren-Tillotson, Inc.
- Herbert, Rowland, Grubic
- Highmark Health
- Independence Excavating, Inc.
- Indiana University of Pennsylvania
- Innovation Works
- Jendoco Construction & Real Estate
- Joseph Wynn
- KPMG
- Lenape Technical School
- MARC USA
- Mascaro Construction Co.
- Mercer
- Michael Baker International
- Parkway West Career and Technology Center
- Pennsylvania State University
- Peoples Natural Gas
- PITT OHIO
- Pittsburgh Council on Higher Education
- Pittsburgh Technical Institute
- Pittsburgh Technology Council
- Plus Consulting, LLC
- Point Park University
- PPG
- Presbyterian Senior Care
- Quest Diagnostics Incorporated
- Range Resources
- Robert Morris University
- Rosedale Technical College
- S&T Bank
- Slippery Rock University
- Staffmark
- Summa Technologies
- The Hite Company
- The PNC Financial Services Group, Inc.
- Three Rivers Workforce Investment Board
- Uber
- UPMC
- UPMC Enterprises
- West Penn Power
- Westinghouse
- Westmoreland County Community College
- Winchester Thurston School
- Wyndham Grand Pittsburgh

Topics Covered – Each industry focus group followed the same basic structure. However, the unique needs of each industry shaped much of the conversation. The focus groups were asked to provide feedback on:

- Whether the volume of job postings accurately represents demand
- The mechanics of recruitment and hiring practices for in-demand jobs
- Industry trends which affect workforce demand (e.g. increased automation, process improvements, internet of things, etc.)
- Levels of in-house training and continual upskilling of existing workforce
- The degree to which employers are satisfied with the workforce supply system, and where there may be concerns about the quantity and quality of job seekers coming from area education and training providers
- Skills and competencies that will be most valued in the workforce of the future

During the supply side (education and training providers) conversation the following topics were covered:

- Validation of the quantitative supply and demand data - does the data reflect what they hear from employers?
- Insights on levels of industry engagement and partnership with training providers
- Best practices from industry partnerships
- Areas where training and credentialing may not be addressing employer needs
- Barriers that appropriately skilled/credentialed job seekers face in applying for positions within each cluster of interest

Incorporation of Findings – The findings from each focus group were incorporated seamlessly into the overall analysis. Qualitative data gathered through the focus group process helped shape each industry's findings and analysis, but perhaps more importantly, helped identify some of the cross-industry findings. This blended approach should be considered a core strength of this report, contextualizing nearly every finding with industry testing and feedback.

ABOUT THE AUTHORS

ABOUT BURNING GLASS

Burning Glass Technologies delivers job market analytics that empower employers, workers, and educators to make data-driven decisions. Burning Glass is reshaping how the job market works, with data that identify the skill gaps that keep job seekers and employers apart and tools that enable both sides to bridge that gap and connect more easily. The company's artificial intelligence technology analyzes hundreds of millions of job postings and real-life career transitions to provide insight into labor market patterns. This real-time strategic intelligence offers crucial insights, such as which jobs are most in demand, the specific skills employers need, and the career directions that offer the highest potential for workers.

Burning Glass' applications drive practical solutions and are used across the job market: by educators in aligning programs with the market, by employers and recruiters in filling positions more effectively, and by policy makers in shaping strategic workforce decisions. At the same time, Burning Glass' data-driven applications for workers and students help them choose career goals and build the skills they need to get ahead.

Based in Boston, Burning Glass is playing a growing role in informing the global conversation on education and the workforce, and in creating a job market that works for everyone.

ABOUT CAEL

CAEL is a national non-profit leader in the field of workforce and economic development, providing consulting, research, tools, and strategies needed to create effective talent development solutions. In the last five years alone, CAEL has supported various workforce skill needs and sector specific initiatives in more than 150 communities in 43 states. CAEL brings significant experience working with workforce and economic development practitioners, on-the-ground ability to facilitate employer engagement, analysis of labor market and target sector information, and a national perspective on best practices to align talent development with regional economic clusters. In addition to workforce and economic development, CAEL has built a national reputation as the thought leader in the field of adult education, putting meaningful learning, credentials and work within reach for all.

ONLINE APPENDICES: Click the page to download the full data tables.

1) Appendix 1: Occupational Data
   a. Individual Occupation Data, all occupations including employment, projected growth rate, replacement rate, projected annual openings, time-to-fill, location quotient, median salary
   b. Occupation Family Data, all occupations including employment, projected growth rate, projected annual openings
   c. Opportunity Occupations Data, including employment, projected growth rate, replacement rate, projected annual openings, time-to-fill, location quotient, median salary
2) Appendix 2: High Demand Occupational Sector Data, including expansion of all occupation data tables within the report
   a. Occupation Family Data, by occupational sector, including employment, projected growth rate, replacement rate, projected annual openings, time-to-fill, location quotient, median salary
   b. Sectoral Data for energy, including employment, projected growth rate, replacement rate, projected annual openings, time-to-fill, location quotient, median salary
3) Appendix 3: Industry Data
   a. Occupation Family Data by Industry Group
   b. Manufacturing Output v Employment Data
   c. Bureau of Economic Analysis Data
4) Appendix 4: Education Data
   a. K-12 Enrollment, 10-county region
   b. IPEDS Completions, 10-county region
   c. High School Graduation Rates, 10-county region
   d. CTC Enrollment, 2014
5) Appendix 5: Demographics and Unemployment
   a. Unemployment rates
      i. By County
      ii. By Occupation Family
   b. Employment by Age Group
   c. Occupation Family racial demographics
   d. Occupation Family gender demographics
6) Appendix 6: Migration Data
   a. Total migration estimates, Pittsburgh region and benchmark cities
   b. Destinations of migrants from the Pittsburgh region
   c. Origins of inflow of migrants

END NOTES

1 These data were produced through Burning Glass's application of the improved projections methodology which the Bureau of Labor Statistics will use beginning with the 2016-2026 projections. The differences between this methodology and the model currently used are discussed in the methodology section of the appendix.
2 American Community Survey.
3 In this study, the Pittsburgh region (or 10-county southwestern Pennsylvania region) is classified as a 10-county region including: Allegheny, Armstrong, Beaver, Butler, Fayette, Greene, Indiana, Lawrence, Washington, and Westmoreland counties.
4 These data were produced through Burning Glass's application of the improved projections methodology which the Bureau of Labor Statistics will use beginning with the 2016-2026 projections. Differences between this methodology and the model currently used are discussed in the methodology section of the appendix.
5 U.S. Census Bureau Population Estimates.
6 The benchmark cities are: Austin, TX; Boston, MA; Charlotte, NC; Cincinnati, OH; Denver, CO; Indianapolis, IN; Milwaukee, WI; Minneapolis, MN; Nashville, TN; Philadelphia, PA; San Jose, CA; Seattle, WA; and St. Louis, MI. Pittsburgh has the highest percent of the workforce above 55 at 22%, followed by St. Louis with 20%. All other cities are 17% or under. Data are from the American Community Survey.
7 http://www.citylab.com/work/2016/03/which-metros-are-best-at-keeping-their-college-graduates/473604/
8 Definition developed in Wardrip, Keith, et al. Identifying Opportunity Occupations in the Nation's Largest Metropolitan Economies. Federal Reserve Banks of Philadelphia, Cleveland, and Atlanta. 2015. https://www.philadelphiafed.org/community-development/publications/special-reports
9 OES Average Salary Carpenters: $44,840; Construction Supervisor: $65,300
10 Migration numbers based on the Current Population Survey, and demographics based on the American Community Survey.
11 American Community Survey.
12 2010 data. National Center for Higher Education Management Systems. http://www.higheredinfo.org/dbrowser/?year=2010&level=nation&mode=data&state=0&submeasure=63.
13 Commonwealth of Pennsylvania Department of Education. Enrollment Reports and Projections. http://www.education.pa.gov/Data-and-Statistics/Pages/Enrollment%20Reports%20and%20Projections.aspx#.Vw6p7PkrLIU
14 Graduation Rate accessed from www.countyhealthrankings.org
15 2016 Guide to Western Pennsylvania Schools: Overachiever Rank – State Public Districts. Pittsburgh Business Times Spring 2016.
16 http://www.citylab.com/work/2016/03/which-metros-are-best-at-keeping-their-college-graduates/473604/
17 Migration numbers based on the Current Population Survey, and demographics based on the American Community Survey across age groups.
18 Pittsburgh's Racial Demographics 2015: Differences and Disparities. University of Pittsburgh Center on Race and Social Problems., http://www.crsp.pitt.edu/sites/default/files/REPORT.pdf
19 Cybersecurity jobs defined as those that have a cybersecurity-related title, require a cybersecurity certification, or request cybersecurity-specific skills. Cybersecurity-related titles used to define the roles analyzed in this report include 'network security', 'information security', 'information assurance', and 'penetration tester'. Cybersecurity skills include information assurance, cryptography, computer forensics, malware analysis, 800-53 and ArcSight.
20 Location quotients (LQ) are a measure of occupation concentration within a region. National average demand equals 1.0 while an LQ of 1.2 indicates 20% higher demand than the national average (or 1.2 times the national concentration).
21 http://www.theverge.com/2016/2/24/11109972/uber-self-driving-cars-pittsburgh-expansion-test-roads
22 http://venturebeat.com/2016/01/18/facebook-is-opening-an-oculus-research-office-in-pittsburgh/
23 http://www.bizjournals.com/pittsburgh/news/2015/09/25/exclusive-amazon-acquires-pittsburgh-tech-firm.html
24 Certification demand based on Burning Glass Technologies job posting data.
25 See Symonds, William C., Robert Schwartz, and Ronald F. Ferguson. 2011. Pathways to prosperity: Meeting the challenge of preparing young Americans for the 21st century. Cambridge, MA: Pathways to Prosperity Project, Harvard University Graduate School of Education for a more detailed explanation of this approach, its rationale and its implications.
26 Shell and PTT have not yet made final investment decisions nor committed to construction timelines for these projects.
27 Clinton, Foreman, Litzinger and Minutolos (December 2014), Economic Impact Analysis: Proposed Petrochemical Facility in Beaver County, Pennsylvania, Robert Morris University School of Business.
28 Jim Kauffman and Laura Fisher. Workforce Analysis Report: Energy Sector Jobs in Greater Pittsburgh. Allegheny Conference on Community Development. 2012.
29 Current Employment Statistics survey. Bureau of Labor Statistics. Based on the mining industry. Employment: January 2010: 619,100; September 2014: 852,500; January 2016: 698,500.
30 Clinton, Foreman, Litzinger and Minutolos (December 2014), Economic Impact Analysis: Proposed Petrochemical Facility in Beaver County, Pennsylvania, Robert Morris University School of Business.
31 Technical details and a helpful set of FAQs about the Bureau of Labor Statistics' new methodology are described here: http://www.bls.gov/emp/ep_separations.htm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