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Growing the Green Energy Economy: Workforce Development and Cluster Growth in the Pioneer Valley of Massachusetts

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Growing the Green Energy Economy: Workforce Development and Cluster Growth in the Pioneer
Valley of Massachusetts

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August 22, 2016

A MASTER'S RESEARCH PAPER

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Kathryn Madden, Chief Instructor

ABSTRACT

Workforce development programs have a positive effect on the formation of a cluster. Incorporating these programs into cluster theory is essential to creating more robust and dynamic local growth in the emerging green energy sector. Studying programs in the green energy sector in the Pioneer Valley has shown an increase in collaboration, local and regional connectivity, and industry communication. These aspects reinforce the comparative advantage of organizations within the cluster, while downplaying their challenges. Applying this focus on workforce development is important for cementing the green energy cluster into an enduring force in the domestic economy in the 21st century.

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Introduction

The transition to a greener, more sustainable economy has been hailed as the cure-all to unemployment, job quality, and economic stagnation. However, research on what is directly being done to adapt the workforce for this new, greener economy is still in its early stages.

Workforce development programs have a positive effect on the formation of a cluster. Incorporating workforce development programs into cluster theory can assist in creating more robust and dynamic local growth in the emerging green energy sector. Massachusetts can reinforce growth in its emerging green energy cluster by strengthening the state-wide workforce development system. Groups within the Pioneer Valley of Massachusetts have made a concerted effort in recent years to build a green energy cluster. The cluster remains in a fledgling stage due to demographic, labor market, and workforce pressures. But despite this, a healthy ecosystem of training programs, government support, and business partnerships has formed in recent years to spur greater development.

Motivation

Climate change has had a profound effect on our planet. It has changed societies, economics, governance, and cultures across the world. Sustainable development will prove to be a major driver of societal change in the 21st century and beyond. This research hopes to help spur conversations, new ideas, and possible solutions to a changing world. Creating a more sustainable and green world will create a healthy fulfilling life for everyone, not

just those who can afford to pay their way out of the effects of climate change.

Workforce development programs play a major role in bringing about a more sustainable United States by supporting the transition of workers from traditional industries and professions into newer, greener ones. There is a demand for skilled labor among green companies, especially those in the green energy sector. Strengthening current workforce development programs and integrating them into our understanding of clusters can lead to a more dynamic and durable green energy cluster in the future.

Purpose of Research

This research establishes workforce development as an important addition to cluster growth theory. This is illustrated through the specific efforts underway in the Pioneer Valley region of Massachusetts. This work attempts to assist green growth taking place in other parts of the United States by revealing the challenges and successes inherent in the Massachusetts and Pioneer Valley.

Cluster theory has emerged as a way to conceptualize local and regional economies, allowing people to better map the capacities and institutions at work. Clusters are groups of interconnected firms, suppliers, related industries, and specialized institutions that arise in particular locations.¹ This definition was pioneered by Professor Michael Porter of the Harvard Business School in 1990 and has been used widely since then.

¹ "Frameworks and Key Concepts," Harvard Business School: Institute for Strategy and Competitiveness, Accessed May 10, 2016, <http://www.isc.hbs.edu/competitiveness-economic-development/frameworks-and-key-concepts/Pages/default.aspx>.

Clusters lay the groundwork for different groups to better coordinate efforts, allowing a mixing of talent and investment to mutually grow a region's economy. It is vital to frame the conversation about green job growth within the idea of clusters of industry because of the emergent nature of the sector, and the mature nature of the businesses and institutions involved.

Workforce development and training programs have evolved into local and regionally focused nodes within a much larger national network. These programs have become valuable to businesses and workers as a point of contact, a joiner of missions, and as an advocate of skilled labor and career pathways. Workforce development programs have seen a constant influx of new ideas, programming, and concepts. These programs will prove vital for individuals employed in the emerging green energy economy as a means to initiate new and old job seekers alike into emerging sectors. Cluster theory currently does not include workforce development programming in its understanding of how clusters operate. Bridging this gap will help to strengthen the ability for local and regional groups to build resilient markets in emerging sectors.

Significance

Massachusetts and the Pioneer Valley are an important case study because they can act as a catalyst for best practices for creating new policies. The Massachusetts economy represents an ideal case to investigate green job development due to the infusion of government and private funding and capital for policies, a solid foundation of higher education support, and a massive expansion of business activity in recent years.

Massachusetts has done better than almost any other state in regards to turning its policies into practice; coordination between different groups is growing, government facilitation and support has been increasing, and the creation of stable funding sources and climate change policy have taken shape. Greater understanding of these areas and implementation of these strategies can lead to the strengthening of the local, regional, and state-wide green energy economy.

Research Design

This paper is designed around four sections. The first three sections make up the conceptual framework and literature review. The first section discusses cluster theory and its effects. This section goes on to further describe the effects of proximity on businesses, workers, and innovation. The second section presents the history and evolution of the workforce development system in the United States. This section also discusses the issues inherent in the contemporary labor force and the importance of middle skilled positions. The third section defines the green economy and the effects of the economic transition towards this greener economy.

Section four is based around the case study of the Pioneer Valley region of Massachusetts. This section presents an overview of the jobs legislation, funding sources, general labor market information which defines the green energy economy in Massachusetts. The case study then moves to a demographic overview of the region, with a focus on workforce issues. Green job policies and programs set forth within the region are then detailed, outlining strategic goals and effects. And finally this section gives an

overview of the green job situation in the Pioneer Valley, with a discussion of recent projects and activities of local groups.

Cluster Growth Theory

Cluster theory is vital to the growth of the green economy because allows groups and organizations to connect with diverse resources to create greater success early on in their lifecycles and careers. There have been widespread drives to build clusters on the local and regional level, in fields ranging from manufacturing, to education, agriculture, and beyond. Rodriguez-Clare claims that externalities provide impetus to form clusters by stating that firms benefit from the production and innovation activities of firms in related industries.² Rodriguez-Clare further shows that policies should remain focused on realizing and building on the benefits of clustering in existing sectors, not distorting markets to promote development of potential sectors.³ Hess has stated outright that “Clusters maximize economic value.”⁴

Berger discusses “industrial consortiums” as partnerships utilizing new programs, avenues of growth and learning, and public-private partnerships, many times utilizing cost-sharing strategies.⁵ She claims that industrial collaboration through public intermediaries such as regional employment boards and educational institutions, cooperative curriculum

² Andres Rodriguez-Clare, *Clusters and Comparative Advantage: Implications for Industrial Policy* (State College: Pennsylvania State University, 2005), 43.

³ Rodriguez-Clare, *Clusters and Comparative Advantage*, 55.

⁴ David Hess, *Good Green Jobs in the Global Economy: Making and Keeping New Industries in the United States* (Cambridge: The MIT Press, 2012), 131.

⁵ Suzanne Berger, *Making in America: From Innovation to Market*. (Cambridge: The MIT Press, 2013), 193.

development, and career fairs and company visits help to boost cluster capacity.⁶ This discussion helps to further expand our thinking on clusters to include collaboration revolving around training and outreach, instead of business associations or official partnerships. The development of industrial ecologies requires developing embedded networks, connecting firms and individuals, and developing trust and shared actions.⁷

Pessoa acknowledges that cluster theory remains popular due to its vague, sprawling definition. This vagueness allows for it to be applied to different realities and geographies. Pessoa goes on to demonstrate that through empirical analysis, agglomeration positively effects productivity at local geographic levels in both the United States and Europe.⁸ Clusters represent self-reinforcing ecosystems made up of catalysts such as research breakthroughs and intellectual property, nourishment such as the local and regional human capital stocks, and supportive environments such as social, institutional, and regulatory frameworks.⁹

In contrast to the positive dimensions by cluster theorists, Pessoa believes that the association between positive externalities and clusters is in many cases overemphasized. In many instances, externalities are usually assumed rather than data-driven. This is due to the difficulty in quantifying actors, markets, and institutions. Policy must not focus on

⁶ Berger, *Making in America*, 193-194.

⁷ Berger, *Making in America*, 193-194.

⁸ Argentino Pessoa, *Externalities, Clusters, and Economic Growth* (Porto: University of Porto, 2011), 5.

⁹ John McCarthy, "Catalyzed Networks: Government as a Network Facilitator in Regional Economies" (M.S. thesis, Rutgers, the State University of New Jersey, 2014) 2..

externalities to drive regional cluster growth, but use local strengths.¹⁰ The focus needs to be placed on local and regional growth, not externalities, to drive cluster policy.¹¹

While Pessoa raises a proper rebuttal of blind support for clusters, the concept transcends hard data in many regards. Through this research into the green economy, many signs have pointed to clusters being more social and cultural than quantitative in scope. The local and regional congregation of people, technologies, and organizations helps to build trust, mutual goals, and a shared vision. These qualitative aspects should not be understated, as companies gain an advantage over others who are isolated from these systems of ideas, innovation, and people. Partnerships can alleviate systemic issues by coordinating and realigning policies and programs to suit the context. Partnering leads to programs being better informed, targeted, and easier to combine with other initiatives.¹² There is a wide scale lack of development plans utilizing disciplined frameworks, data-centric methods, and analytical approaches focused on local specialization.¹³

Clusters are more than coalitions of businesses, they are discussions, conversations, and above all collaborations to grow a common region or locale together. Clusters must by virtue of physical space be defined by geography, but they are populated by workers, businesses, and institutions. The proximity of any geography has a major effect upon what

¹⁰ Pessoa, *Externalities, Clusters, and Economic Growth*, 21.

¹¹ Pessoa, *Externalities, Clusters, and Economic Growth*, 21.

¹² Sylvain Giguere, ed., *More than Just Jobs: Workforce Development in a Skills-Based Economy*, (OECD: 2008), 41.

¹³ Mark Muro, Jonathan Rothwell, and Saha Devashree,, *Sizing the Clean Economy: A National and Regional Green Jobs Assessment*, The Brookings Institute, 2011, 42

is done locally. Workforce development is an important asset implemented to build local capacities for workers and businesses. Workforce development is also important to creating a robust supply of skilled labor to be utilized by businesses operating within clusters. More dynamic clusters can be created by integrating workforce development into cluster theory.

The Effects of Clusters

Clusters build upon and reinforce local and regional capacities. Building diverse and powerful local economies breeds higher levels of social capital, voter turnout, average incomes, low poverty, and low crime rates.¹⁴ By networking local and regional funding sources, specific local challenges can be understood and met more effectively.¹⁵

The building of social norms, trust, and shared understandings between actors is difficult to imitate on a global scale. The interdependence of complementary activities produce higher rates of growth and job creation.¹⁶ Professional relationships, informal exchanges among the regional labor pool, and on the job collaboration are difficult to replicate outside of their specific contexts.¹⁷

Clusters remain an important concept in economic development due to the divergence taking place between American cities. Talent and skills have agglomerated to

¹⁴ David Hess, *Localist Movements in a Global Economy: Sustainability, Justice, and Urban Development in the United States*, (Cambridge: The MIT Press, 2009), 91.

¹⁵ Berger, *Making in America*, 129.

¹⁶ Berger, *Making in America*, 99.

¹⁷ D. Finegold et al, ed., *Transforming the U.S. Workforce Development System: Lessons Learned from Research and Practice*, (Champaign: University of Illinois Press, 2010), 184.

specific geographies over the past thirty years. And this agglomeration and divergence is accelerating. Colleges have a disproportionate effect on localities; within a region with 25% or more college graduates, there have been significant jumps in wages.¹⁸ The complimentary factors formed through clusters are unique to their locales. The people, firms, and local culture inform and effect the work being done. Geographic proximity effects not only supply chains but effects the innovation and production processes.

There is a dearth of local funding policies while federal and international incentives are reinforcing globalization trends.¹⁹ Increasingly, finance has aggregated towards either small scale microfinance or to larger capital projects. Approaching the missing middle ground of capital projects can create new opportunities on the local and regional levels.²⁰ Funding workforce development programs can bridge this gap and reach a greater number of those disadvantaged by the current economy.

McCarthy warns that those in leadership positions must not force excessive top-down pressure to build clusters. He notes that "... foolishness of directive public-policy efforts to jump start clusters or to make top-down or directive efforts to organize them," because "clusters of innovative activity do not respond well to being directed..."²¹ There is a need to organically build clusters from the bottom-up; to grow them with specific targeted programs and policies.

¹⁸ Enrico Moretti, *The New Geography of Jobs*, (New York: First Mariner Books, 2013), 195.

¹⁹ Hess, *Localist Movements in a Global Economy*, 243.

²⁰ Fernando Caneque and Stuart Hart, ed., *Base of the Pyramid 3.0: Sustainable Development Through Innovation & Entrepreneurship*, (Sheffield: Greenleaf, 2015), 80.

²¹ McCarthy, "Catalyzed Networks." 60.

Proximity

Clusters are concretely based in geography. The gravitational pull of like industries to one another is powerful. Firms tend to agglomerate in areas with diverse and specialized skills on which to build upon.²² Geographic proximity provides opportunities for comparative advantage and increased firm synergies.²³ The point must not be understated that context matters greatly for clusters.

The proximity between innovation and production breeds cohesion and efficiency.²⁴ Manufacturing and other production firms function within a cluster as important sources of innovation and enablers of scaling up designs. Many small and medium enterprises share potential for growth and are unlikely to relocate due to sheer size and community connections. In recent years, companies are beginning to re-shore capabilities due to the pool of talent, American intellectual property laws, and shorter supply chains.²⁵ The ability to buy local, bank local, and invest locally helps to shorten supply chains and increase efficient transfers of goods.²⁶ In local and regional contexts, governments give large scale retail and manufacturing companies' incentives and rewards for co-location when small and medium enterprises could fulfill the same role with greater community effect.²⁷

²² Berger, *Making in America*, 76-77.

²³ McCarthy, "Catalyzed Networks." 1.

²⁴ Berger, *Making in America*, 5.

²⁵ National Governors Association, *"Making Our Future: What States are Doing to Encourage Growth in Manufacturing through Innovation, Entrepreneurship, and Investment"*, Washington D.C., 14.

²⁶ Hess, *Localist Movements in a Global Economy*, 248.

²⁷ Hess, *Localist Movements in a Global Economy*, 85.

In many regions there is a need to ‘connect the dots’ between different forces. Tax incentives and infrastructure are ineffective if universities and other actors cannot catalyze their work into products. Other regions may produce top quality research but lack the ability to facilitate connections between actors.²⁸ Relationships within regional economies that are the most valuable stem from buyer-supplier trust, coordination, and informal information sharing. The linkages between scientists, innovators and workers diffuse and become regionally embedded within different clusters.²⁹

As the gravitational pull of globalized networks has grown, the need for local and regionally based groups to pool assets to remain competitive and productive has increased. Incorporating workforce development into cluster theory is vital for local groups to maintain an advantage by creating a supply of adaptable, skilled workers. Workforce development has evolved over the past fifty years to become decentralized and rooted in local and regional economies. Despite local and regional embeddedness, there is a need for creating up to date, scalable programs focused on solving deficiencies in the labor markets they serve.

Workforce Development has never been specifically considered a facet of a cluster. The absence of workforce development from cluster theory weakens the ability for local policymakers and program providers to fully grow capabilities. Positive changes in the supply of skilled workers and students can be made by strengthening the training,

²⁸ McCarthy, “Catalyzed Networks.” 14.

²⁹ McCarthy, “Catalyzed Networks.” 62.

certification, and outreach programs and further incorporating them at the local and regional levels.

Workforce Development

What matters is the tool-box of ideas with which, by which, through which, we experience and interpret the world.”³⁰

Workforce development is a vital component of supporting the growth of the green economy, not just at a local level, but nationally and internationally. The United States has a long history of workforce development training legislation and programming. However, this system remains lacking in many respects even though many groups are trying to effect change. The systemic issues created by decentralization, a lack of coherent funding, and a loss of connectivity all effect the inability of new sectors to establish themselves.

The workforce development system has seen a number of major trends in the past fifty years. Programming since the 1960s has sought to reevaluate the relationships between federal, state, and local governments, the relationships between business and government, and the relationship between training and income and other supports.³¹ These relationships have increasingly been steered towards decentralizing the system, allocating more power to local and state authorities to administer and manage programs. And while this has created more flexible programs easily tailored to local and regional needs, it has

³⁰ E.F. Schumacher, *Small is Beautiful: Economics as if People Mattered*, (New York: Harper Collins, 1973), 86.

³¹ “Job Training Partnership Act: New Help for the Unemployed,” Robert Guttman, (Bureau of Labor Statistics), accessed April 7, 2016, <http://www.bls.gov/opub/mlr/1983/03/art1full.pdf>. 4.

bred a disjointed, incoherent policy ecosystem.

The failure of investment in wide scale unified programs has been affected by many separate issues. American firms have low levels of workforce development practices across the board. Short term markets, adversarial labor relations, and weak industry organization all play a major role. Low road employment strategies which emphasize cheaper labor and turnover in return for low staffing costs and higher profit margins have been utilized as well. Moreover, low innovation levels, and a lack of coordination have also had negative effects on training efforts within the United States.³²

The changing structure of large American companies has had a major effect on the economic landscape and supplemental programming which maintains economic support programs. The divergence of corporate and national interests occurred and the culture of the firm took its place as companies have grown and globalized.³³ On average, vertically integrated companies tended towards greater training. This halo effect was felt by companies and localities all along value chains when they began transitioning overseas.³⁴ The ecosystem of suppliers, financiers, training, and industry groups withered away as the large anchor institutions transitioned to international growth.³⁵

The Situation Facing the Labor Market

The lack of a national skills development policy has hurt economic prospects for

³² Robert Huggins and Stuart Harris, "The Skills Economy and Workforce Development: A Regional Approach to Policy Intervention," *European Journal of Education* 39 1 (2004), 56.

³³ Finegold et al, *Transforming the U.S. Workforce Development System*, 64.

³⁴ Berger, *Making in America*, 182.

³⁵ Berger, *Making in America*, 125.

many. There exists no long term focus or comprehensive response to the changing economy. The ‘loosely coupled’ strategic systems in the United States no longer give advantages to businesses or workers.³⁶ The poorly developed connections can trace themselves back to Taylor’s theory of “scientific management” separating management, labor, and government.³⁷ This “American System” has low levels of workforce development due to low levels of trade protection and a widespread fear of collaboration leading to releasing secrets.³⁸ These systems have largely ignored the major trend of a growing number of jobs which require moderate and middle levels of skill. These moderate skill jobs focus on non-academic and occupational training and are being left by the wayside.³⁹

Overall, the workforce development system in the United States has not kept pace with the needs of workers and students who enter the workforce. Higher education spending in the United States made up approximately \$1.1 trillion.⁴⁰ Compare this with all other workforce development spending at 6.6 billion, or only 0.04% of the total gross domestic product in 2013.⁴¹

Small and medium firms remain largely disconnected from the wider systems they live in, with only 5 to 8% receiving federal workforce services. In this ecosystem many

³⁶ Finegold et al, *Transforming the U.S. Workforce Development System*, 2

³⁷ Finegold et al, *Transforming the U.S. Workforce Development System*, 131.

³⁸ Berger, *Making in America*, 118.

³⁹ Harry Holzer and Robert Lerman, *America’s Forgotten Middle-Skill Jobs: Education and Training Requirements in the Next Decade and Beyond*, Urban Institute: 2008 9.

⁴⁰ Finegold et al, *Transforming the U.S. Workforce Development System*, 154.

⁴¹ Finegold et al, *Transforming the U.S. Workforce Development System*, 154.

struggle to remain solvent.⁴² Many traditional mechanical and engineering companies have declined due to large-scale infrastructure stagnation and the lack of the “right” training for workers.⁴³ Moreover, Berger reports that up to seventy-four percent of firms in the United States are deficient on skilled labor, which has hindered growth.⁴⁴ For forty percent of small and medium enterprises, the barrier to training was the amount of time lost and financial costs of externally training workers.⁴⁵ To exacerbate this, it was estimated in 2007 that thirty to forty million jobs are vulnerable to offshoring in the information technology and processing industries in the coming decades.⁴⁶

For domestic industry to survive and compete in today’s world, workers must be trained in new and old skills. Cross-training of people assigned to a specific area must encompass the duties of more than one classification, and new skills must be learned because of changing technology.⁴⁷ The rapidly changing nature of technology and its role in the workplace necessitates flexible training systems. Workers can no longer just be given a single role, they must be able to cross pollinate their skill set to fit changing scenarios. While public perception thinks of these constantly evolving skills and training as an expanded need for bachelors, masters and doctoral degrees, it remains jobs in the middle skill range which hold an increasingly vital role in the United States’ economy.

⁴² National Governors Association, *“Making Our Future,”* 12.

⁴³ Finegold et al, *Transforming the U.S. Workforce Development System,* 70.

⁴⁴ Berger, *Making in America,* 183.

⁴⁵ Huggins and Harris, *“The Skills Economy and Workforce Development,”* 52.

⁴⁶ Finegold et al, *Transforming the U.S. Workforce Development System,* 5.

⁴⁷ Finegold et al, *Transforming the U.S. Workforce Development System,* 225.

And these roles play an important role in growing the emerging green energy sector.

The State of Middle Skills in the United States

When we're talking about these middle skill jobs, it's not that we hope that they're out there and we're going to begin programs for students, it's that we know that they are out there. We're actually looking at the demand from employers." – Anne Kress⁴⁸

There has been an underestimation of the importance of middle skills in the United States economy. Middle skilled jobs include positions in "...clerical, sales, construction, installation/repair, production, and transportation/material moving."⁴⁹ On the wider scale, the existing notion many families hold that middle skills have been declining in importance has proven to be a simple matter of perception.⁵⁰

A vital need exists to strengthen vocational and high school linkages to create more effective pathways to careers and prosperity.⁵¹ Half of the American workforce is made up of middle skill occupations. These occupations maintain solid wages and advancement pathways. In addition, many of these positions have been going unfilled in recent years.⁵² By 2016, sixty-three percent of all jobs in the United States will require a post-secondary credential.⁵³ Employment in skilled construction crafts is expected to grow by 10 to 15%

⁴⁸ EMSI. "Middle-Skill Spotlight: An Analysis of Four in-Demand Sectors with a Community College Focus," Accessed June 1, 201, http://www.economicmodeling.com/wp-content/uploads/ccreport-2014_web1.pdf, 3.

⁴⁹ Holzer and Lerman, *America's Forgotten Middle-Skill Jobs*, 8.

⁵⁰ Holzer and Lerman, *America's Forgotten Middle-Skill Jobs*, 6.

⁵¹ Daniel Hodge et al, *Knowledge Corridor Talent and Workforce Strategy*, (Hadley: UMass Donahue Institute: 2014), 23.

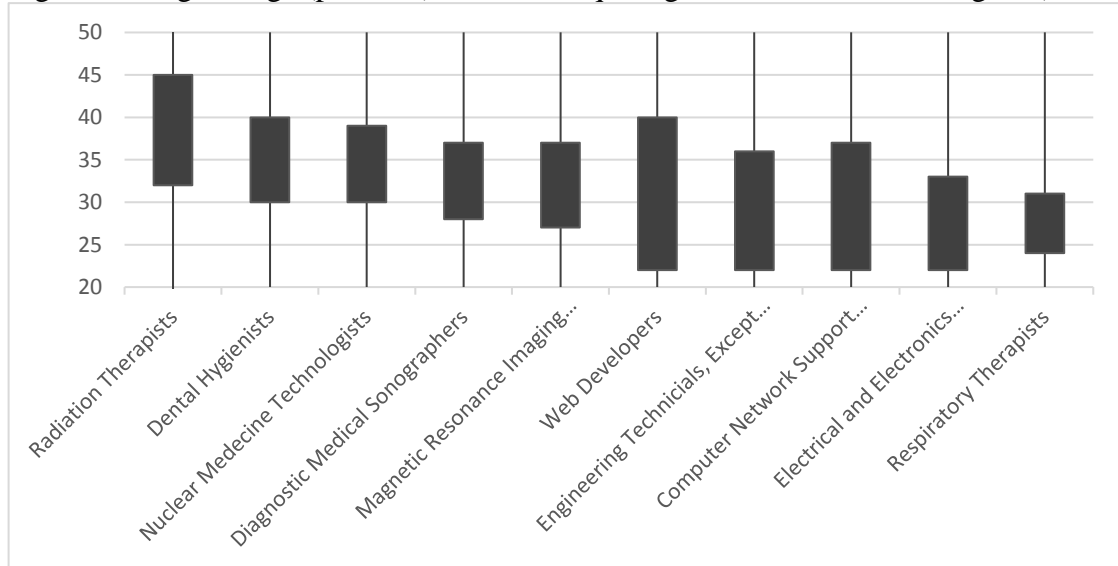
⁵² Achieve Inc., *The Future of the US Workforce: Middle Skills Jobs and the Growing Importance of Postsecondary Education*, 2012, 2.

⁵³ Achieve Inc., *The Future of the US Workforce*, 2.

and create six million openings.⁵⁴

Negative perceptions pervade the middle skill and vocational fields however. Families have misconceptions about and a general lack of knowledge of middle skill careers.⁵⁵ A stigma exists around vocational schools and people do not see skilled occupations as viable with or without college. The fact that young people do not see middle-skilled occupations as positive opportunities and the jobs themselves as undesirable has fueled skill and job shortages across the United States economy.⁵⁶ But in spite of these perceptions, the fact of the matter is that middle skill positions have maintained high average wages without many times requiring a four year degree. Figure 1 reinforces this fact by showing the hourly wages for common middle skilled positions.

Figure 1: Wage Range (per hour) for Jobs Requiring Certificate/ 2 Year Degree (National)



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⁵⁴ Holzer and Lerman, *America's Forgotten Middle-Skill Jobs*, 4.

⁵⁵ Daniel Hodge et al, *Knowledge Corridor Talent and Workforce Strategy*, 23.

⁵⁶ EMSI. "Middle-Skill Spotlight," 14.

⁵⁷ EMSI. "Middle-Skill Spotlight," 4.

STEM education and workplace organizations need to bring in new ideas and concepts. Classic academics, hands-on experience, digital proficiency, and face to face relations are all imperative for future programming.⁵⁸ A mixing of roles, testing of products, and increasing collaboration are all important elements around which to structure workforce development programming.⁵⁹

Similarly, new programs have focused on “working-learners.” These programs sponsored by employers, unions, and non-profits are effective but many times lack official credentialing, and they come at a time when blue collar and middle skill positions have seen consistent employment growth.⁶⁰ The many fields that have seen growth are carpenters at a 20% growth rate, heavy vehicle maintenance at a 25% increase, and HVAC technicians increasing at 21%.⁶¹ Jobs in all middle skill categories combined are estimated to generate 21 million new openings between 2007 and 2017.⁶² This represents 40% of the total openings estimated. Middle skills are vitally important to the green energy economy. Many green energy jobs are based in local installation, manufacturing, and related production and support positions.

The workforce development system has been in transition since its earliest days in the 1960s. It has shifted to a more regional and local model, seeking to build on local geographic capacities. These programs play a key role in the fabric of the economy by

⁵⁸ Berger, *Making in America*, 189.

⁵⁹ Berger, *Making in America*, 192.

⁶⁰ Finegold et al, *Transforming the U.S. Workforce Development System*, 128.

⁶¹ Holzer and Lerman, *America's Forgotten Middle-Skill Jobs*, 12.

⁶² Holzer and Lerman, *America's Forgotten Middle-Skill Jobs*, 19.

connecting governments, private enterprises, and workers. Workforce Development must be considered a priority for the development of a cluster. Programs are directly related to creating a proper supply of skilled workers to fill hiring gaps, and create a more robust clustered economy. These gaps are closed by connecting students and prospective workers with businesses through outreach, maintaining up to date training standards, and joining partnerships with sector specific groups. Linking workforce development with sustainable economic development strategies can work to create regionally focused sustainable economies with greater long term opportunities for residents, businesses, and related industries.

Green Jobs

The green economy is a sprawling idea. The idea covers thousands of occupations across all manner of geographies and sectors. The proliferation of definitions which try to rein in this idea have not helped create a unified front. There is a definite need to grow the green economy through targeted training and workforce development efforts. Green jobs are part of a fledgling economy, one which needs proper inputs of workers, policy supports, and industry partnerships to grow.

Understanding Green jobs

Understanding the varied interpretations by the many groups operating in the green economy is important to understand the lack of a coherent response to its challenges and opportunities. The definition of the green economy and green jobs has been constantly

evolving for many decades. An important element to highlight is the need for more than an occupational definition, and the inclusion of social capacity, and equitable growth.

Peters et al defines green jobs as those involved in environmental protection, climate change mitigation, energy security, and energy and natural resource conservation. These primary sectors are supported by secondary aims including social good in regard to upward mobility, education and retraining opportunities, revitalizing neighborhoods, and economic aims including rejuvenating portions of domestic manufacturing, developing new markets for producers of agricultural commodities and stabilizing rural areas.⁶³ This definition is important because it links “green jobs” directly to local needs through discussions of mobility, retraining, and neighborhood revitalization. Definitions rarely have sufficient real world applications, seeking to categorize and outline specific occupations. The concepts discussed as secondary aims by Peters have been at the forefront of the debate for green jobs and are an important precedent for this current research. Presenting these real world objectives moves the definition beyond the simple theoretical stage.

Martinez-Fernandez has written that there is a common tendency to use the concept of a “green job” as a one size fits all idea to cover any job relating to environmental quality improvement. They state that it is imperative for local policy makers to better understand what these jobs really are before designing and implementing policies supporting their

⁶³ David Peters, Liesl Eathington, David Swenson, “An Exploration of Green Job Policies, Theoretical Underpinnings, Measurement Approaches, and Job Growth Expectations,” (Ames: Iowa State University: 2011), 13.

growth.⁶⁴

Green jobs represent a transition to a newer economy focused on more than the bottom line. The framework put forth by Peters et al has been used throughout this research process to help understand green jobs and their effects. Peters et al connects green jobs directly with the human element by not only defining specific occupations, but the real world applications of creating upward mobility, training options, and revitalization.

The vast array of ideas relating to the definition of related terms breeds confusion at the start for professionals and policy makers focusing on green, clean, or sustainable fields of work. The world of sustainable development and green jobs has been splintered by the proliferation of different understandings. This proliferation has created a barrier to regional economies situating themselves within a national context.⁶⁵ While the economic, social, political, and environmental worlds are cementing these terms into a coherent set of policies and frameworks to build on, there is a need to bring together the many disparate strands of thought surrounding cluster theory and workforce development to expedite the transition to greener jobs.

The Transition to Green Jobs

According to various proponents, the “greening” of our economy will improve national energy security, address global climate change, stimulate rural development, revitalize urban neighborhoods, revive the domestic manufacturing sector, and provide poor and disadvantaged workers with pathways out of poverty.⁶⁶

⁶⁴ C. Martinez-Fernandez, C. Hinojosa, and G. Miranda, “Green Jobs and Skills: The Local Labour Market Implications of Addressing Climate Change,” CFE/LEED, OECD: 2010, (working paper), 16.

⁶⁵ Mark Muro, Jonathan Rothwell, and Saha Devashree, *Sizing the Clean Economy*, 7.

⁶⁶ David Peters, Liesl Eathington, and David Swenson, “An Exploration of Green Job Policies...,” 5.

There is a great deal of promotion of the idea that green jobs and renewable energy can be an effective alternative to traditional extractive industries and manufacturing. This alternative has come with a shift of focus towards longer term policies and legislation. Establishing longer term development horizons and timelines helps the Federal and State governments to drive short and medium term growth more effectively.⁶⁷ Old skills and occupations will be repurposed to fit the green economy.⁶⁸ Much of what will be accomplished in the transition to green jobs will be an updating of worker skills and industry methods.⁶⁹

Groups across the political and economic spectrum have made claims of job losses or gains as old industries are abandoned or transition to greener practices. And while much speculation still exists as to its positive or negative effects, some researchers have already begun to study real world cases. Thompson found that generally 36% of displaced manufacturing and construction workers in the United States can find new, greener employment.⁷⁰ Those employed in manufacturing have a 53.17% probability of new employment in green jobs, and those with a B.A. or a B.S. are 9.4% more likely.⁷¹

Sustainability was originally believed to be a development fad, simply a buzz word.

⁶⁷ David Peters, Liesl Eathington, and David Swenson, "An Exploration of Green Job Policies..." 20.

⁶⁸ International Labor Conference. "Sustainable Development and Decent Work, and Green Jobs," (Geneva: International Labor Office Publications, 2013), 58

⁶⁹ Alex Bowen, "'Green' Growth, 'Green' Jobs, and Labor Markets," (London: the World Bank, 2012), 28.

⁷⁰ E. Thompson et al, "Green Jobs for Displaced Manufacturing, Construction, and Construction-related Service Workers," (Lincoln: University of Nebraska, 2011), 16.

⁷¹ E. Thompson et al, "Green Jobs for Displaced Manufacturing, Construction, and Construction-related Service Workers," 30.

This proved somewhat true during the recessionary climates of the late 1970s and subsequent growth in the 1980s.⁷² Since that time policy has begun to shift toward supporting the green transition on a wider scale. Hess contends that the free trade methodology espoused by the United States is reasonable for a country with foremost crediting and manufacturing in a sector, but as others have grown their local advantages in green fields, this ideology loses much meaning.⁷³ By following a mercantilist approach and supporting green industries early on and then “kicking away the ladder” and transitioning back to a neo-liberal model the United States can build a solid footing for activity and help build industry advantages.⁷⁴

Structural changes would take place as industries and workers realign with their respective areas of use. Wind energy development will shift to areas in which wind energy is better utilized.⁷⁵ Workers will be reallocated from declining to emerging sectors which are in and utilize information technology, navigation, and service delivery.⁷⁶ The need for improved labor policy is coupled with greater specific focus on green policy and coordination.⁷⁷ Green jobs are overwhelmingly permanent and full time, which can contribute to poverty alleviation.⁷⁸ Major support has been given to green and sustainable

⁷² David Peters, Liesl Eathington, and David Swenson, “An Exploration of Green Job Policies...” 6.

⁷³ Hess, *Good Green Jobs in the Global Economy*, 225-226.

⁷⁴ Hess, *Good Green Jobs in the Global Economy*, 217

⁷⁵ David Peters, Liesl Eathington, and David Swenson, “An Exploration of Green Job Policies...” 31.

⁷⁶ Annette Cox and Beth Foley, “Public Employment Services and Green Jobs,” (Brussels: Institute for Employment Studies, 2013), 6.

⁷⁷ David Peters, Liesl Eathington, and David Swenson “An Exploration of Green Job Policies...” 10.

⁷⁸ International Labor Conference. “Sustainable Development and Decent Work, and Green Jobs,” 17.

jobs due to the implications that they will be good, decent jobs. People see green jobs as a cure for stagnant wages and a failing middle class.

Strong coherent leadership is necessary to communicate goals and create coalitions with associated groups engaged in the process.⁷⁹ Coalitions have begun forming in support of sustainable development and greater labor policy. The BlueGreen Alliance has been a major organization in support of green jobs. This organization is made up of workers, businesses, unions, and environmental groups, all advocating for increased policy and planning.⁸⁰ These different organizations all strongly emphasized the need for adoption of adequate policy tools in order to manage a ‘just transition.’⁸¹

There was a widespread belief that climate change regulations were a job killer; hitting small and medium enterprises especially hard. This idea has since been flipped, as it has been shown that greening is not the cause of job losses, but that growing levels of automation and growing productivity is the cause.⁸² Consensus now sees green policies as a way to create jobs and offset those lost in economic restructuring.⁸³ Green policies have created a net gain of jobs in the labor market,⁸⁴ although this trend may not be permanent as green restructuring might shift workers in traditional sectors out of the workplace.⁸⁵

⁷⁹ CEDEFOP, *Future Skill Needs for the Green Economy*, (Luxembourg: Publications Office of the European Union, 2009), 1.

⁸⁰ Hess, *Good Green Jobs in the Global Economy*, 2.

⁸¹ C. Martinez-Fernandez, C. Hinojosa, and G. Miranda, “Green Jobs and Skills,” 29.

⁸² International Labor Conference. “Sustainable Development and Decent Work, and Green Jobs,” 49.

⁸³ C. Martinez-Fernandez, C. Hinojosa, and G. Miranda, “Green Jobs and Skills,” 13.

⁸⁴ Bowen, “‘Green’ Growth, ‘Green’ Jobs, and Labor Markets,” 9.

⁸⁵ Bowen, “‘Green’ Growth, ‘Green’ Jobs, and Labor Markets,” 27.

Researchers at the Brookings Institute found that clustered establishments in the green economy grew 1.4% faster per year than non-clustered firms.⁸⁶ There was clear data showing that research and development operations were aggregating within the largest 100 metropolitan areas in the United States. These metropolitan areas also housed two thirds of the national research and development universities and laboratories, three quarters of science and engineering programs, and 48 out of 83 environmental science and energy research laboratories.⁸⁷ These Metropolitan areas accounted for 78% of the national ‘green’ patents.⁸⁸ Through clustering, the rate of job growth increased more rapidly when co-located with establishments within the same county and industry segment. When the size of the industry segment was doubled, job growth increased 21% over the study period (2003-2010).⁸⁹

Workforce development acts as a positive force in the formation of clusters. Local and regional capacities can be strengthened through clustering. This effect is vital to growing the green energy economy due to its current early stage of development. The cluster of green energy in the Pioneer valley is an important example of how to best incorporate workforce development into the growth of a cluster. Creating a pool of skilled labor is important to ensuring a dynamic regional economy. The upcoming section outlines the methods and research design used in order to prove the importance of

⁸⁶ Mark Muro, Jonathan Rothwell, and Saha Devashree, *Sizing the Clean Economy*, 4.

⁸⁷ Mark Muro, Jonathan Rothwell, and Saha Devashree, *Sizing the Clean Economy*, 11.

⁸⁸ Mark Muro, Jonathan Rothwell, and Saha Devashree, *Sizing the Clean Economy*, 11.

⁸⁹ Mark Muro, Jonathan Rothwell, and Saha Devashree, *Sizing the Clean Economy*, 30.

workforce development programs and policy to cluster formation.

Methodology

The research presented here discusses workforce development as a means to improve the effectiveness of cluster theory in developing local and regional economies. Massachusetts and the Pioneer Valley are an important case study for the investigation of workforce development in regards to growing a green energy cluster because their early successes can act as a guidepost for similar growth nationally. Greater understanding of the connection between workforce development and cluster theory can lead to a strengthening of the green energy industry and state and national policies. This research began utilizing grounded theory which is created by constructing research based off a research question or piece of existing data. This research began as an investigation of the quality of opportunities available to workers in the emerging green energy sector. As time went on this research shifted to an investigation of the factors which effect the development of these jobs and the emerging industry as a whole. The finished research presented here uses the lens of cluster theory and workforce development to investigate how

Why Massachusetts and the Pioneer Valley?

Massachusetts is an ideal geography to investigate green job development due to the infusion of government and private funding and capital for policies, a solid foundation of higher education support, and a massive expansion of business activity in recent years. Massachusetts has championed green jobs at the policy level. Legislation put in place since

2008 has utilized green regulations and legislation tools to spur economic development, climate change mitigation, sustainable development, and poverty alleviation. Cities across the Commonwealth have adopted green energy and regulatory standards to harness funding for sustainable, long term growth. This focus on green jobs has paid off with economic and job growth rates exceeding the state average.

The Pioneer Valley region is the focus of this research due to the current work being done in the green energy sector involving cross sector collaboration, industry partnerships, government funding and policy, and the expansion of related workforce development and educational program support. Despite its relatively small population, governments, industry groups, and educational institutions have actively adopted the banner of green jobs.

Data Collection

Data was collected through outreach to groups active in the green economy, database searches, and investigating institutional websites. Groups within the Pioneer Valley such as the Pioneer Valley Planning Commission have collections of documents relating to their strategic goals, labor market information, policy framework, and areas of future growth. Sources detailing policy initiatives related to green energy created an understanding of the wider forces effecting the green energy ecosystem statewide. Labor market and demographic data established a concrete understanding of the current jobs, and the demographic pressures facing the cluster. Finally, the active partnerships, programs, and local and regional regulations currently in place reinforce the claim of green energy

activism and leadership in the region. This information presents workforce development as integral in creating a cluster of green energy.

Data Analysis

Cluster theory was a vital tool to analyze the information surrounding the Massachusetts green energy economy. The state-wide green energy economy has interconnected regulations, legislation, workforce development programs, and public-private partnerships. Cluster theory has allowed for the synthesis of the vast array of interconnected sources of information to be brought into one cohesive idea of the green energy economy in the Pioneer Valley. Creating a system of levelling has created a clearer picture of what activities take place and how they affect one another.

Businesses and the labor market directly interact within the cluster. These two actors are effected by educational institutions and workforce development programs. Educational institutions can leverage funding for business growth, research, and degree programs. Workforce development programs work to connect businesses and the labor force and tailor training and certificate programs to specific gaps and needs. These four actors are effected by government action in the vein of legislation, regulation, subsidy programs, and funding. This hierarchy of needs including those on the ground, institutions supporting those on the ground, and government policies and programs, help to frame the work being done at different levels regionally and state-wide.

Limitations

Massachusetts and especially its Pioneer Valley are not representative of the ethnic

and cultural makeup of the United States. The Pioneer Valley is very monolithic in its ethnic composition. The regional economy is more diversified than other regions in the United States. There is a bigger focus on manufacturing and production jobs than in other regions. The region and the state as a whole are also geographically concentrated, allowing for much easier industry support and communication than other large states and widespread industries.

This research also lacked a large-scale stakeholder engagement strategy. Individuals from the Franklin-Hampshire Regional Employment Board, Massachusetts Workforce Alliance, North East Sustainable Energy Association, and the Worcester CleanTech Incubator were contacted. The topics in these meetings discussed the history of programs in the Pioneer Valley, and their challenges and triumphs regarding programming in the regional green energy sector. Much of this information was left out of the final product due to a lack of an official process. But despite this, these meetings highlighted the ongoing work taking place within the sector and how supporting organizations are approaching inherent issues.

Pioneer Valley Case Study

“Our region’s agricultural, forestry, and manufacturing heritage and history of innovation and creativity will provide a strong foundation for increased local living-wage jobs, more affordable and energy efficient housing, increased utilization of locally grown and produced wood products, greater availability and security of locally grown food, locally-produced clean energy, and revitalized town centers.”⁹⁰

⁹⁰ Peggy Sloan et al, *Sustainable Franklin County: Franklin County’s Regional Plan for Sustainable Development*,” Franklin Regional Council of Governments, 2013, E3.

The Pioneer Valley of Western Massachusetts has had an outsized place in the history, culture, and politics of not only Massachusetts, but the United States. In spite of the great recession, globalization, and demographic trends, the region maintains competitive advantages in manufacturing, healthcare, education, and finances when compared with other regions of the United States.⁹¹ These competitive advantages have allowed the region to maintain stronger growth than the statewide average even during the recession of 2009.⁹² Communities in the Pioneer Valley also have a long history of cooperation and collaboration due to its shared history and its rural character.⁹³ This collaboration has been instrumental in the creation of new training programs, research efforts, and industry partnerships related to the green energy economy. With new research, job creation, increased renewable services and production facilities, there are very few communities left untouched by recent green initiatives.⁹⁴

Cities and towns in the Pioneer Valley have begun to focus on growing skilled, renewable and sustainable trades in recent years. A 2004 report on the northern Pioneer valley and nearby areas initiated by Congressman John Olver highlighted the positive future potential of small growth manufacturing and renewables and alternative energy in

⁹¹ Franklin Regional Council of Governments, *The Northern Tier's Key Economic Clusters: Then and Now*, 2014, 1.

⁹² Federal Reserve Bank of Boston, *Labor Market Trends in the Pioneer Valley Region*, Boston: 2012, 3.

⁹³ Peggy Sloan et al, *Sustainable Franklin County*, 8.

⁹⁴ Pioneer Valley Planning Commission. "Clean Renewable Energy: Fueling the Pioneer Valley Economy." 2013. 10.

the region.⁹⁵

The Pioneer Valley is currently faced with not only a transitioning economy, but with demographic, educational, and infrastructure hurdles to handle. Several overarching trends exist in the Pioneer Valley Region. Population growth has been stagnant. Workers are not being trained at sufficient rates to replace retiring workers. High school graduation rates within urban areas are significantly lower than state averages.⁹⁶ These trends are further effected by reductions in public funding for workforce development.⁹⁷

Geography

The geography of the Pioneer Valley has had a major effect on the economic and political activity in the region. The Pioneer Valley region lies in Western Massachusetts between the Quabbin Reservoir and the Berkshire Mountains. The region is made up of 1,849 square miles which are covered in large part by the Connecticut River and its watershed. This feature has given the region an advantage first for agricultural production and subsequently for industrial manufacturing. The majority of the region remains overtly rural in character despite the urban agglomeration surrounding Springfield. To highlight this trend, Franklin County has remained the least populous county on the Massachusetts mainland. The region is also bisected by interstate-91, which acts as a major transportation corridor through the States of Vermont, Massachusetts and Connecticut. The city of

⁹⁵ Franklin Regional Council of Governments, *The Northern Tier's Key Economic Clusters: Then and Now*, 7.

⁹⁶ Daniel Hodge et al, *Knowledge Corridor Talent and Workforce Strategy*, 3.

⁹⁷ Craig Brown and David Cruise, *Strategic Plan 2015-2017*, (Springfield: Regional employment Board of Hampden County, 2015), 14.

Springfield has remained the third largest city in Massachusetts and the economic and political hub of the Pioneer Valley region.

Historic Advantages

Communities in the region remain closely connected to each other and also the wider economy. The region is only three hours from New York City, two hours from Albany, two hours from Boston, and one hour from Hartford. Infrastructure such as Interstates 91 and 90 have only reinforced this connectivity by decreasing travel time and shipping costs.

Water has been a major force in the growth of the Pioneer Valley region. The many rivers and tributaries in the region have spurred growth in agricultural communities from the mid-17th century up until today. These waterways were also vital in creating the power to fuel industrial mills in the 19th and 20th centuries. These many waterways are currently being utilized for hydropower projects.

The Pioneer Valley is also a major center of education. Fourteen colleges and universities are located throughout its cities and towns. This institutional advantage has led to a more diversified economy and workforce. These institutions collectively educate 65,000 students and 12,000 graduate students every year. Furthermore, there is a strong presence of local and regional trade schools and technical education in the region.⁹⁸ These institutions also attract millions of dollars in research funding.

⁹⁸ Plan for Progress Coordinating Council, *Building on Success: Economic Strategies for the Region*, (Springfield: Pioneer Valley Planning Commission, 2015), 13.

Companies in the Pioneer Valley have focused their growth locally and regionally. 50% of Pioneer Valley businesses surveyed by the UMass Donahue Institute saw Western Massachusetts as their primary market and 22% saw the Northeast as their primary market.⁹⁹ This local and regional focus helps to cement local capabilities and organizations. A majority of firms in the region see the Pioneer Valley as a good or excellent location for their business to succeed.¹⁰⁰ The Pioneer valley workforce has been an important factor for businesses locating in the region. 45% of firms see the availability of skilled workers in the area has a major contributor to successes.¹⁰¹

Origin of Cluster

The transition to green energy and occupations can strengthen the local advantages of businesses and adapt the region's manufacturing and production cluster for a greener future. The Pioneer Valley region is well situated to build a cluster of green energy activity. This assessment is based on the geography, history of industry, and current economic and workforce base of the region. The regional labor market is heavily based in middle skilled sectors such as manufacturing, trades and transportation, and business services. The environment has many rivers to utilize for hydroelectric power, and the variety of regional institutions are suited to support new economic activity.

The three largest super sectors in the Pioneer Valley are education, trades,

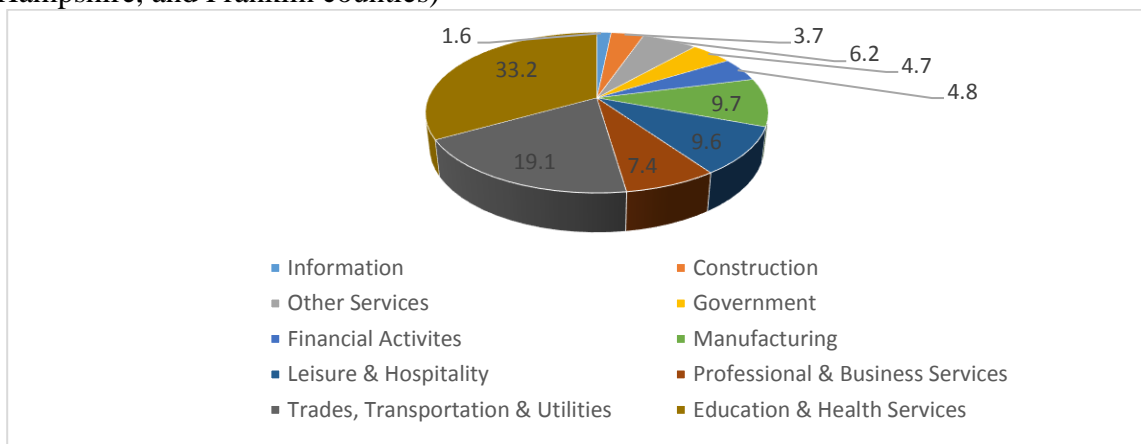
⁹⁹ University of Massachusetts Amherst, *Pioneer Valley Growth Business Study*, (Hadley: UMass Donahue Institute, 2013), 26.

¹⁰⁰ *Pioneer Valley Growth Business Study*. 3.

¹⁰¹ *Pioneer Valley Growth Business Study*. 33.

transportation and utilities, and manufacturing. Together they make up more than sixty percent of the regional economy. These sectors are also all deeply involved in the green energy sector. Education is intertwined with workforce development programs, credentialing, and certification. Manufacturing is involved in producing the parts necessary to build green energy related products and services. Finally, trades, transportation and utilities are involved in the transportation, installation, and management of green energy products and services. These statistics reveal the Pioneer Valley to be a stable location to transition businesses and services to more sustainable practices.

Figure 2: Distribution of Employment by Supersector, 2010 (Percent) (Hamden, Hampshire, and Franklin counties)



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Table 1 presents the frequency of firms by super sector. This further builds on the statistics from 2010. In this there are five major economic pillars in the Pioneer Valley. These five pillars all have a part to play in supporting the regional green energy economy. Education and professional and business services are vital to building the skills base of

¹⁰² Federal Reserve Bank of Boston, *Labor Market Trends in the Pioneer Valley Region*, 23.

workers, supporting local economic activity, and connecting and advertising businesses and new technology. Manufacturing companies in the region can begin to focus on producing products related to green energy generation and production, including solar panels and related systems. Through trade, transportation and utility-related companies these systems can be bought and sold, transported, and connected to the power grid. Construction companies can further utilize manufactured systems to directly install private or public generation systems.

Table 1: Firms by Industry Supersector (Hampden, Hampshire, and Franklin counties)

| Industry Supersector | All Firms | |
|------------------------------------|-----------------|----------------------|
| | Number of Firms | Percent of Total (%) |
| Natural Resources & Mining | 7 | 1 |
| Construction | 59 | 11 |
| Manufacturing | 87 | 16 |
| Trade, Transportation & Utilities | 158 | 28 |
| Information | 10 | 2 |
| Financial Activities | 40 | 7 |
| Professional and Business Services | 67 | 12 |
| Education and Health Services | 64 | 11 |
| Leisure & Hospitality | 44 | 8 |
| Other Services | 25 | 4 |
| Total | 561 | 100 |

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Dimensions of the Cluster

The many communities and organizations throughout the Pioneer Valley have worked hard to fulfill the climate goals and regulations set by state agencies. There is an

¹⁰³ University of Massachusetts Amherst, *Pioneer valley Growth Business Study*, 16.

array of new renewable power generating stations being built, communities adopting green specifications in their town governance, and a renewed concern for the economic fallout due to climate change. The sheer numbers of workers and businesses working within the Pioneer Valley green energy cluster are at first glance unimpressive. But the Pioneer Valley has four more green jobs per capita than the state average, an above average photovoltaic capacity at 18.6% of total state capacity, and almost half of its communities already committed officially to transitioning to greener energy and jobs.¹⁰⁴

Table 2 displays the number of establishments and workers employed in the Massachusetts green energy sector by county. In 2015, the Pioneer Valley had 568 businesses, and 8,497 workers in the green energy sector. The green energy sector grew at a rate of 2.7% in Western Massachusetts in 2015.¹⁰⁵ While these numbers lag behind the sheer numbers present in Middlesex and Suffolk counties, The Pioneer Valley has made great strides in boosting job growth and strengthening their growing cluster of green companies.

Table 2: Clean Energy Employment and Establishments by Massachusetts County, 2015

| County | Clean Energy Establishments | Clean Energy Employment |
|-----------------|-----------------------------|-------------------------|
| Barnstable | 265 | 3,582 |
| Berkshire | 143 | 1,947 |
| Bristol | 402 | 4,804 |
| Dukes | 40 | 576 |
| Essex | 617 | 8,174 |
| Franklin | 77 | 1,347 |

¹⁰⁴ "Renewable Energy: Fueling the Pioneer Valley Economy," Pioneer Valley Planning Commission, accessed, June 17, 2016. http://www.pvpc.org/sites/default/files/Clean_Energy_Data_Digest_2013x.pdf. 1.

¹⁰⁵ Phil Jordan et al, *2015 Massachusetts Clean Energy Industry Report*. Massachusetts Clean Energy Center, 2016, 8.

| | | |
|------------------|------------|--------------|
| Hampden | 351 | 4,708 |
| Hampshire | 140 | 2,442 |
| Middlesex | 1,965 | 34,917 |
| Nantucket | 25 | 165 |
| Norfolk | 644 | 8,745 |
| Plymouth | 370 | 3,441 |
| Suffolk | 783 | 15,712 |
| Worcester | 616 | 8,335 |
| Total | 6,439 | 98,895 |

¹⁰⁶

There has been a clear increase in construction of renewable energy projects in the past eight years. This trend should continue as more green energy workers are trained and as cities and towns push for a greater emphasis of renewable energy standards. By 2012, Hampden and Hampshire counties had an installed capacity of 110 MW of solar power.¹⁰⁷ Between 2008 and 2012, there was a total of 181 million kilo watt hours of green energy produced per year in that region alone. As is apparent in Figure three, recent renewable production has focused on hydroelectric and waste-to-energy projects while also maintaining growth in landfill energy utilization and Solar PV generation. In the northern Pioneer Valley, Franklin County has a combined capacity for hydro generation equivalent to 110 MW.¹⁰⁸ Further, between 2010 and 2012 an additional 18.8MW of capacity has been sited within the county. This is made up of the Berkshire East Wind Turbine, Northfield Mountain First Light and power, Greenfield Landfill Solar Farm, and the Hoosac Wind Power Project.¹⁰⁹

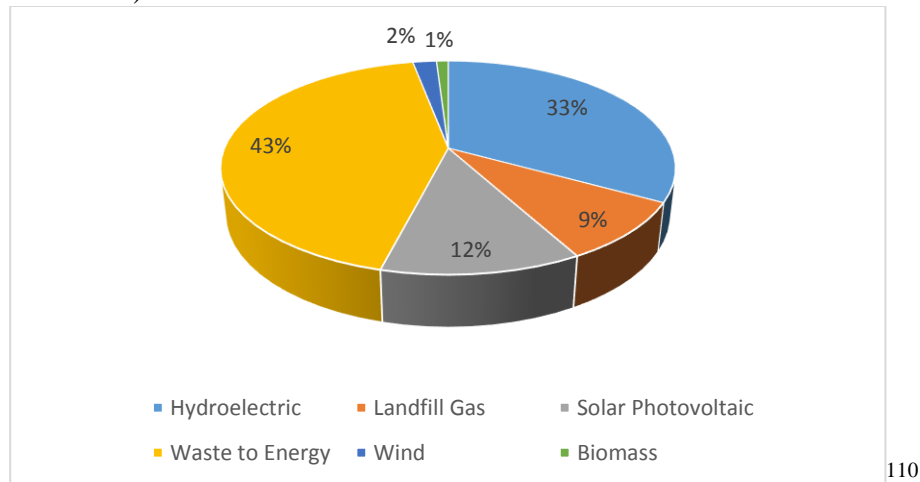
¹⁰⁶ Phil Jordan et al, *2015 Massachusetts Clean Energy Industry Report*. 28.

¹⁰⁷ Timothy Brennan et al, *Pioneer Valley Climate Action and Clean Energy Plan, Springfield: Pioneer Valley Planning Commission, 2014*, 16.

¹⁰⁸ Peggy Sloan et al, *Sustainable Franklin County*, 149.

¹⁰⁹ Peggy Sloan et al, *Sustainable Franklin County*, 150.

Figure 3: New Clean Energy Production in the Pioneer Valley 2008 to 2012 (Hampden and Hampshire counties)



The green economy in the Pioneer Valley has grown at a steady pace. This growth has been made possible by an ecosystem of institutions including governments, businesses, and partnerships. The ecosystem of support growing in the region can be leveraged to retain current residents and attract new ones. These training systems are working to transition workers from traditional industries, build connections, and fund innovative actions.

Government Policies

Massachusetts has been ranked as one of the top leaders in the emerging green energy economy in the United States. The Massachusetts green energy economy has gone through rapid growth in the past fifteen years. New legislation, research and development programs, sources of capital, and improved educational facilities have all attributed to stable and rapid growth. But there still remain mismatches in skills and hiring. Solutions to

¹¹⁰Brennan et al, *Pioneer Valley Climate Action and Clean Energy Plan*, 53.

these issues must be solved through greater industry collaboration, government support, and stable funding supplies. It has been seen that firms within clusters maintain higher growth and profitability. Businesses and workers must endeavor to transition from isolated actors, into a cohesive supportive atmosphere of work and growth.

Major strides have been taken within Massachusetts to establish a green economy for the 21st century. Governor Deval Patrick's administration made key advances for the Massachusetts sustainable economy and important strides in green energy especially. During the Patrick Administration, energy and environmental concerns were consolidated into one cabinet post. The first exemptions from state gasoline taxes for cellulose biofuels also took place. The Global Warming Solutions Act was passed, the Massachusetts Clean Energy Center was established, and the Green Communities Act was enacted. Furthermore, Massachusetts has joined and taken leadership in the Regional Greenhouse Gas Initiative and has continued to fund its programs and efforts during major economic downturns.¹¹¹

The Global Warming Solutions Act established ecological benchmarks to reduce greenhouse gas emissions 25% by the year 2020, and to reduce emissions 80% by 2050. The Green Jobs Act was based around creating 'green collar' jobs administering funds supporting clean energy research, workforce development, and building a robust clean energy economy. The Green Jobs Act also created the Massachusetts Clean Energy Center

¹¹¹ Massachusetts Clean Energy Council, "A Future of Innovation and Growth: Advancing Massachusetts' Clean Energy Leadership," (Boston, 2011), 20.

in order to accelerate the success of clean energy technology, companies, and projects.¹¹² Massachusetts has also put in place the Green Communities Act to better support clean energy solutions for all the towns in the Commonwealth. This act helps to provide technical assistance and financial support to towns to improve energy efficiency and increase use of renewables in major community institutions.¹¹³ To further reinforce the green economy, the Massachusetts government created a Green Bond program in 2013, which leveraged \$100 million in support of green sectors. In total, there was a demand for upwards of \$130 million in bonds.¹¹⁴ The bond sectors focused on clean drinking water, land acquisition and open space protection, river rehabilitation and habitat restoration, and energy efficiency.¹¹⁵

The Massachusetts government has also created the Environmental Literacy Plan to further support these green initiatives throughout the Commonwealth. The vision of the plan is to have Massachusetts residents “Develop an understanding of the interconnected relationship between community, economy, and the environment.”¹¹⁶ This plan brings together environmental education for pre-k through 12th grade curricula, integrated higher

¹¹² Office of Administration & Finance, *FY2015-2019 Five Year Capital Investment Plan*. (July, 2014), 19.

¹¹³ Office of Energy and Environmental Affairs, “Green Communities,” Accessed April 3, 2016, <http://www.mass.gov/eea/energy-utilities-clean-tech/green-communities/>.

¹¹⁴ “Investing in a Greener, Greater Commonwealth,” Commonwealth of Massachusetts Investor Program, accessed August 20, 2015, [http://www.massbondholder.com/sites/default/files/files/QE%20August%202014%20Green%20Report\(1\).pdf](http://www.massbondholder.com/sites/default/files/files/QE%20August%202014%20Green%20Report(1).pdf), 3.

¹¹⁵ “Investing in a Greener, Greater Commonwealth,” 6.

¹¹⁶ “Massachusetts Environmental Literacy Plan Brochure,” Secretary’s Advisory Group on Energy and Environmental Education, accessed 5/6/16, <https://sageee.files.wordpress.com/2014/02/mass-elp-flyer.pdf>.

education curricula, teacher training, career programming, the utilization of informal learning environments to enhance the presented ideas, and to bring together actors within the sustainability field.¹¹⁷ The many policies enacted under the Patrick administration and current efforts have helped to build a solid foundation of support to further grow efforts state-wide.

Local organizations in the Pioneer Valley have taken a lead in establishing benchmarks, greenlighting projects, seeking out funding, and connecting training programs to meet the goals set by the Massachusetts state government. Institutions such as Greenfield Community College, the Franklin Hampshire Regional Employment Board, and the Pioneer Valley Planning Commission to name a few have taken actions to collaborate, cooperate, and connect different groups in order to better serve workers, businesses, residents, and the environment.

The Green Communities Program was started in order to help cities and towns throughout Massachusetts find green energy solutions which can reduce energy costs and strengthen local communities.¹¹⁸ Becoming a certified Green Community involves pledging a 20% reduction in energy within five years of signing onto the program, adopting a stretch energy code for improving building efficiency, and providing as-of-right siting for different forms of renewable energy projects including generation,

¹¹⁷ "Massachusetts Environmental Literacy Plan Brochure."

¹¹⁸ "Green Communities," Department of Energy and Environmental Affairs, Accessed July 7, 2016, <http://www.mass.gov/eea/energy-utilities-clean-tech/green-communities/>.

development, and manufacturing.¹¹⁹ These designations award funding based on population, socio-economic status of residents, and the status of the local Green Communities Action Plan. By 2013 \$6 million in funding was given to communities in the Pioneer Valley region.¹²⁰ As of 2015, twenty-nine of the sixty-seven Pioneer Valley communities were designated as green communities. This demonstrates a real commitment to sustainability and growing local communities via greener means.

The Pioneer Valley Clean Energy Plan had the overarching goals of reducing energy use, replacing fossil fuels, reducing global climate change emissions, and creating local jobs.¹²¹ The Pioneer Valley Planning Commission established a series of policies to follow moving forward with sustainable development and climate planning. These policies revolved around a focus on cost effective energy efficiency projects, setting appliance and product standards, establishing advanced building energy codes, building efficiency rating and labelling, and modernization of the electric grid.¹²² The Pioneer Valley Planning Commission highlighted the need for cross cutting policies across many sectors regarding permitting, licensing, and other regulations in regards to crafting high impact projects. There was a need to look across a full range of energy related fields such as building and construction, electrical supply, transportation, and non-energy emissions.¹²³

¹¹⁹ Peggy Sloan et al, *Sustainable Franklin County*, 137.

¹²⁰ "Renewable Energy: Fueling the Pioneer Valley Economy," Pioneer Valley Planning Commission, accessed, June 17, 2016. http://www.pvpc.org/sites/default/files/Clean_Energy_Data_Digest_2013x.pdf. 7.

¹²¹ Peggy Sloan et al, *Sustainable Franklin County*, 137.

¹²² Matthew Beaten, *Massachusetts Clean Energy and Climate Plan for 2020, 2015 Update*. Boston: Executive Office of Environmental Affairs, 2015, 31.

¹²³ Timothy Brennan et al, *Pioneer Valley Climate Action and Clean Energy Plan*, 10-11.

The Franklin-Hampshire Regional Employment Board, or FHREB, has been a major force behind supporting green jobs and collaboration in the upper Pioneer Valley. In recent years the FHREB has been working to expand the scope and scale of their green jobs work. Growth goals are to be met through an expansion of the Green Careers Coach position with more hours and locations available, working with new partners to map regional green career pathways, connecting with employers to identify and promote green jobs across major sectors, and by securing additional resources to support the green workforce and businesses.

Greenfield Community College has been an anchor of renewable energy and energy efficiency workforce training in the Pioneer Valley for many years. This has been accomplished by aligning programming with emerging trends.¹²⁴ Greenfield Community College has most importantly established certificate programs for Renewable Energy and Energy Efficiency.¹²⁵ In addition to this, they have focused on workforce development and training program growth, and were instrumental in the Northern Tier Energy Sector Partnership, which will be discussed below. In 2012, Greenfield Community College received a Department of Labor grant as part of the Workforce Development Transformation Program. This program has five focus areas including the clean energy sector. This grant was given in order to shorten the time of graduation, increase graduation

¹²⁴ "GCC Ramps up Workforce Development Transformation Program," Greenfield Community College, Accessed June 15, 2016, <http://www.gcc.mass.edu/marketing/2012/06/11/gcc-ramps-up-workforce-development-transformation-program/#.V3RdUKL43d6>.

¹²⁵ Peggy Sloan et al, *Sustainable Franklin County*, 106.

rates, and increase job placement rates.¹²⁶ Furthermore, this grant funding is hoped to be utilized to redesign the math curriculum and build new facilities.¹²⁷ These new facilities include the Clean Energy Instruction Center in Montague, MA which acts as a testing house for preparation and working with renewable energy and energy efficiency.¹²⁸

The FHREB has remained a leader in workforce training in the Pioneer Valley region. This has come from its STEM programs which have included outreach, career coaching, training, and placement, and their close partnership with Greenfield Community College in order to nurture the green economy.¹²⁹ The FHREB has also sought to explore linkages between adult basic education and occupational training, and to network with AFL-CIO representatives to create career pathways.¹³⁰ Moreover, the FHREB has worked in conjunction with Greenfield Community College to create three tracks for students in the Renewable Energy and Energy Efficiency program. These three tracks are towards a Photovoltaic certification with the North American Board of Certified Energy Practitioners, or NABCEP, a Photovoltaic installation track, and an NABCEP solar thermal track. Moreover, they have helped to establish an Energy Auditor training course and a weatherization training course.

The Center for EcoTechnology, or CET, is a non-profit located in the Pioneer

¹²⁶ Peggy Sloan et al, *Sustainable Franklin County*, 112.

¹²⁷ "GCC Ramps up Workforce Development Transformation Program."

¹²⁸ "GCC Ramps up Workforce Development Transformation Program."

¹²⁹ Peggy Sloan et al, *Sustainable Franklin County*, 112.

¹³⁰ Susan Gardini Cavanaugh, *American Recovery and Reinvestment Act (ARRA) Plan Checklist*, (Greenfield: Franklin Hampshire Regional Employment Board, 2009), 23.

Valley with the express mission of researching, developing, demonstrating and promoting low impact technologies on Earth's natural ecology.¹³¹ CET organizes three in depth professional training courses designed to train contractors, builders, code enforcement officials, HVAC and installation installers and home energy raters for work in the green energy field.¹³² The weatherization workshops involve a Massachusetts-specific weatherization boot camp, a weatherization crew chief training workshop, and a custom weatherization training session. The High Performance Construction workshops involve constructing high R-Value walls, building airtight houses, and an International Energy Conservation Energy Code (IECC) 2012 overview workshop.¹³³ The Diagnostic testing workshop involves sessions based around blower door diagnostics, duct leakage testing, and combustion safety testing.¹³⁴

Holyoke Community College has two programs in its curriculum dedicated to the green energy economy. The Clean Energy Certificate was developed to prepare students for employment in the clean energy sector by teaching the use of specific equipment and

¹³¹ "Mission, Goals, and Impact," The Center for EcoTechnology, accessed August 4, 2016, <http://www.cetonline.org/about-center-for-ecotechnology/center-ecotechnolog-mission/>.

¹³² "Professional Training Courses," The Center for EcoTechnology, accessed August 4, 2016, <http://www.cetonline.org/training/>.

¹³³ "High Performance Construction Workshops," The Center for EcoTechnology, accessed August 4, 2016, <http://www.cetonline.org/green-for-contractors/high-performance-construction-workshops/>.

¹³⁴ "Diagnostic Testing Workshops," The Center for EcoTechnology, accessed August 4, 2016, <http://www.cetonline.org/green-for-contractors/diagnostic-testing-workshops/>.

providing hands on experience.¹³⁵ Courses in this program include training in energy efficiency and conservation, green building practices, solar thermal energy, and solar photovoltaics.¹³⁶ The Sustainability Studies program is focused on preparing students for more supportive aspects of the green energy economy. This course of study emphasizes health and safety, environmental research, public policy, corporate social responsibility and advocacy. While it prepares students for direct work in the field, it is also focused towards preparing students to continue their education in a related field to support the green economy.¹³⁷

The University of Massachusetts at Amherst, or UMass, has a vast array of education and research related to renewable energy. UMass currently has twenty-five sustainability related undergraduate programs and Masters level programs in programs such as an M.S. in Environmental Conservation, an M.S. in Design and Historic Conservation, and an M.S. in Sustainability Science.¹³⁸ The UMass Center for Renewable Energy Science and Technology, or CREST, is a research center focused on renewable technologies. Fuel Cells and Batteries, Photovoltaic Devices, and Cellulosic Biofuels are

¹³⁵ "Clean Energy Certificate Program – H091," Holyoke Community College, accessed August 4, 2016, <http://www.hcc.edu/courses-and-programs/college-catalog/areas-of-study/clean-energy-certificate-program>.

¹³⁶ "Clean Energy Certificate Program – H091," Holyoke Community College, accessed August 4, 2016, <http://www.hcc.edu/courses-and-programs/college-catalog/areas-of-study/clean-energy-certificate-program>.

¹³⁶ "Clean Energy Certificate program – H091."

¹³⁷ "Sustainability Studies – H084," Holyoke Community College, accessed August 4, 2016, <http://www.hcc.edu/courses-and-programs/academic-divisions/health-and-natural-sciences/sustainability-studies>.

¹³⁸ "Sustainable UMASS Academics," University of Massachusetts Amherst, accessed August 4, 2016, <https://www.umass.edu/sustainability/academics>.

the three main subjects currently being researched.¹³⁹ Furthermore, UMass operates a Wind Energy Center, An Institute for Massachusetts Biofuels Research, and the Polymer-based Materials for Harvesting Solar Energy (PHaSE) Energy Frontier Research Center.¹⁴⁰

These many programs are reinforced by ongoing sectoral partnerships in the region. These partnerships are organized around finding solutions to collective issues such as the need for a skilled workforce, and marketing to new customers.

Green Energy Collaboration

The FHREB has been one of the key partners in the Northern Tier Energy Sector Training Partnership, or NTESP. This partnership was formed to provide a framework for an integrated system of education and training in renewable energy and energy efficiency for groups across the Northern Tier region.¹⁴¹ This region encompasses northern Berkshire, Franklin, Hampshire Counties, and north-western Worcester Counties. It was created in order to both promote skill attainment and career pathway development, and to be a benefit of both job seekers and current and emerging businesses in the emerging green energy sector. This partnership has been created with the help of \$800,000 in funding over three years to ensure that partnerships, training developments, and job placement remains cohesive in the 3 workforce regions. Each region will utilize \$76,000 to \$126,000 per year to ensure proper program administration.¹⁴² Within the partnership, 72% of all resources

¹³⁹ "MASS CREST," University of Massachusetts Amherst, accessed August 4, 2016, <http://www.chem.umass.edu/masscrest/reu/>.

¹⁴⁰ "Renewable Energy: Fueling the Pioneer Valley Economy," 9.

¹⁴¹ Franklin Hampshire Regional Employment Board. "The Northern Tier Energy Sector Training Partnership, NT-ESP 2010-2012." Handout. 2016. 1.

¹⁴² "The Northern Tier Energy Sector Training Partnership, NT-ESP 2010-2012," 1.

has been dedicated to coaching, training development, tuition fees, support, placement and follow-up.¹⁴³

The NTESP programs were directly focused on unemployed and dislocated workers, with a focus on Veterans and older youth. The programs would allow some incumbent workers if their employers were able to commit to the program outcomes.¹⁴⁴ These different organizations have worked to develop a cohesive industry character in the Pioneer Valley region. By utilizing stable funding sources and building on government support they built partnerships to create new local jobs, businesses, and sustainable progress.

The Northern Tier has seen stable growth in the green energy sector. While the number of firms has decreased slightly, employment in the sector has posted growth of 17%. Aggregate wages in the green energy sector have increased 66% to \$107.2 million.¹⁴⁵ The current regional plan for growing the green energy sector is focused on building design and construction. This sub-sector is important for its share of employment in the region, statewide, and nationally, and for its skilled labor base. Green energy has excellent growth potential, especially in light of the fact that compliance requirements and regulations will extend to a majority of buildings in Massachusetts by 2050.¹⁴⁶

An influx of outside funding has come into the region. Holyoke Community College,

¹⁴³ "The Northern Tier Energy Sector Training Partnership, NT-ESP 2010-2012," 2.

¹⁴⁴ "The Northern Tier Energy Sector Training Partnership, NT-ESP 2010-2012," 2.

¹⁴⁵ Franklin Regional Council of Governments, *The Northern Tier's Key Economic Clusters: Then and Now*, 31.

¹⁴⁶ Franklin Regional Council of Governments, *The Northern Tier's Key Economic Clusters: Then and Now*, 59.

UMass Amherst, and Hampshire College have been rewarded \$810,000 to benefit programming at all three schools. The funding is meant to create collaborative programs dealing with clean energy and sustainable agriculture. This process will bring students from the three schools together to mingle and cooperate and collaborate on different projects.¹⁴⁷ Collaborations such as this are important to maintaining a dynamic cluster of actors and spurring new innovation.

Demographic Issues

The demographic issues emerging in the Pioneer Valley have been a cause for concern in regards to economic growth, labor market shortages, and overall stability. The Pioneer Valley is made up of 680,610 residents. Eighty-eight percent of the population is native born; and eighty percent of the population is made up of non-Hispanic whites. The population is aging; the largely native born population is having less offspring while immigration has remained relatively low. Forty-seven percent of the civilian labor force was 45 years or older in 2010. In contrast, only thirty-two percent of the population was 34 or younger.¹⁴⁸

While there has been modest growth through immigration, a declining native population has offset these gains. Between 2000 and 2012, the population aged fifty-five to sixty-five increased from nine to thirteen percent. In addition to this the population aged sixty-five and over increased to fifteen percent. To further exacerbate the aging of the workforce, the population aged thirty-five to forty-four decreased from sixteen to twelve

¹⁴⁷“Grant to Expand Sustainability Education Options,” Holyoke Community College, accessed August 4, 2016, <http://www.hcc.edu/news/nsf-clean-energy-grant>.

¹⁴⁸ Federal Reserve Bank of Boston, *Labor Market Trends in the Pioneer Valley Region*, 4.

percent of the population, and those aged eighteen to twenty-four decreased from twenty-four to twenty-one percent.¹⁴⁹

It has been estimated that 72% of all jobs in Massachusetts will require post-secondary education by 2020¹⁵⁰. As it stands, a high school diploma is the most common level of education in the Pioneer Valley.¹⁵¹ The rate of those in the Pioneer Valley with a bachelor's degree or higher is only 30.5%, compared with 41.2% statewide.¹⁵²

The Need for Workforce Development

Greater levels of workforce development are necessary to adequately adapt local and regional economies to future challenges. Retraining of incumbent workers insures longevity. Connecting with students and prospective workers creates career pathways and partnering with businesses creates a system based solidly in real-world demands.

Increasing the role workforce development plays in cluster theory and economic development is an important strategy to ensure the proper supply of skills to meet local and regional industry needs. Workforce development is vital to counteracting the demographic pressures in the region of an aging workforce, low levels of replacement, and low immigration. Outreach and training programs work to connect students and prospective workers to applicable training and businesses. These connections will work to maintain a steady workforce as time goes on. These programs also grow talent from local assets, reinforcing the local and regional focus of

¹⁴⁹ Daniel Hodge et al, *Knowledge Corridor Talent and Workforce Strategy*, 35.

¹⁵⁰ Daniel Hodge et al, *Knowledge Corridor Talent and Workforce Strategy*, 32.

¹⁵¹ Federal Reserve Bank of Boston, *Labor Market Trends in the Pioneer Valley Region*, 4.

¹⁵² Federal Reserve Bank of Boston, *Labor Market Trends in the Pioneer Valley Region*, 4.

its industries. Workforce development is important to help keep incumbent workers' skills up date to maintain a competitive edge.

A dynamic workforce development system can provide a collaborative model of economic activity. Clusters require an ecosystem of different support groups to remain competitive. Workforce development can help to not only train new workers, but reach out to incoming workers and unconnected businesses. Student outreach can create awareness of the opportunities in emerging fields, and work-study programming can give students hands on experience in the field. This is closely connected with building business support networks. Partnerships and collaboration between workers, workforce development, and businesses work to lessen deficiencies and boost capacities of connected groups. The Pioneer Valley has begun many partnerships revolving around solving similar business and sectoral gaps. These partnerships not only help fill gaps businesses have, but increase industry knowledge, and help attract prospective workers.

Conclusion

Workforce development programming has a positive influence on the formation of clusters. These programs have been on the frontlines of training workers and connecting businesses to lessen systemic issues at the local and regional levels. But even with this mandate, there is a greater need to incorporate workforce development into our thinking of how to grow clusters.

Massachusetts and the United States are at a crossroad in the global economy. The decision is whether to embrace the growing focus on the green energy economy taking

place worldwide, or to continue with business as usual and miss out on the growing opportunities in the manufacturing, agricultural, and service industries which are being created. The existing green economic sectors in the United States can be strengthened by increasing the importance of workforce development programming.

The existing skills shortage in Massachusetts has hindered growth for businesses and organizations seeking to expand. This can be linked to a gap of middle-skilled labor in the wider United States. Workforce development collaboration between different organizations can help alleviate these shortages by sharing industry information on occupations, vocations, required experience, and more. Furthermore, businesses can work with local institutions to communicate financing needs and other services which might be helpful.

The work being done highlights the importance of workforce development in growing a regional cluster. The area organizations provide certifications, trainings, and workshops to prospective and incumbent workers. Moreover these organizations provide outreach for businesses through outreach in high schools to connect with students and challenge their perceptions of the work they are doing. Workforce development organizations also act as important facilitators of industry partnerships, working to connect businesses to help collectively strengthen the industry.

Implications for Community Development and Planning

Cluster growth theory is increasingly used to influence economic development programs across the nation. This theory can be made more robust and dynamic by

including workforce development programs into its scope. Workforce development has increasingly been seen as a means to train new workers and adapt incumbent workers to an ever-changing economy. Incorporating workforce development into our understanding of clusters can help to boost support for these emerging businesses and jobs and adapt the economy for a changing world.

This research shows that government policy can have great effect at supporting cluster growth without a top-down, heavy handed approach. This bottom-up approach reveals the positive influence government direction can have on economic growth. In a climate of reactionary sentiments and calls to cut government to the bone, there are signs of life showing that effective policies, regulations, and programs can create positive growth for those on every level of the economy. Workforce development will be a vital tool to grow the capacity of the green energy economy in the 21st century. We will be able to create more robust local economies by incorporating workforce development into our understanding of developing industry clusters.

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