



**“Green Jobs in Manufacturing”:
A Roadmap for Progressively Greener Solutions through a
Sustainable and Green Workforce**

National Council for Advanced Manufacturing (NACFAM)
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Executive Summary

Vision: America needs partnerships that can make the promise and benefits of “Green Jobs” a reality within manufacturing. NACFAM can participate in these and help organize them.

Mission: Successfully design, develop and implement a “Green Jobs in Manufacturing” strategy to cover the multiple “shades of green” jobs for sustainable manufacturing, the manufacturing of “green” products and throughout all other sectors of manufacturing, by utilizing NACFAM’s unique set of skills and experiences in leading collaborative workforce initiatives.

Benefits: The benefits of a “Green Jobs in Manufacturing” strategy are needed and realized by both the workforce and the private sector. Blue collar job loss has increased and many workers are looking for jobs. Manufacturing employment was reported at 13.3 million by the Bureau of Labor Statistics (BLS) on September 5, a loss of 416,000 (-3.0%) jobs over the past year, of which 252,000 were production worker “blue collar” jobs in durable goods. Later BLS reports showed the U.S. has lost 56,000 manufacturing jobs in the month of September and 90,000 jobs in the month of October. The resulting increases in unemployment have been a long-term trend.

Sustainability and a skilled workforce are important to the success of manufacturing firms. Sustainable manufacturing and a sustainability-trained workforce can translate into short and long term success for a company due to a happier and more productive workforce, a healthier community, increased resource efficiency and effectiveness, waste minimization, risk mitigation, expense reduction, a dependable and collaborative supply chain, increased innovation, new revenue-generating opportunities, customer attraction and retention, improved shareholder value, and more. Sustainability is ever-more important for success in a tough global economy with people who need jobs and companies who need stability.

Scope: Concentrate first on how this strategy can help keep jobs, create jobs, enhance existing jobs, and create pathways for upward mobility and career development. Initial efforts will focus on front-line manufacturing, and then move into the other professions and levels of manufacturing as upward mobility tracks and pathways are developed.

The strategy will be to develop national skill standards that can then be used to train anybody throughout the country, all communities and all sectors of manufacturing. Skill standards will cover:

- Sustainability concepts,
- How to apply existing manufacturing skills (defined by previous standards) within a sustainability context,
- Standards for sustainability skills that can be used throughout “green” product manufacturing sectors (e.g. all renewable energy manufacturing sectors),
- Standards for skills that are unique to certain industry sectors (e.g. heavy equipment or solar vs. wind), and
- Standards unique to certain aspects of sustainable manufacturing; e.g., designing for closed loop systems, waste minimization and related revenue generating opportunities, energy efficiency, etc.

The stakeholders will develop the training needed for these skill standards, the implementation of workforce development programs for manufacturing workers, develop channel strategies to get the skills and training to the people who need work, and work with industry to realize the benefits of these skills and of the newly trained workforce. NACFAM’s role would be to collaborate with other stakeholders to collect all of the applicable skills in one place, develop necessary new skill standards, and then combine it all into an organized, nation-wide standard for benchmarking and training. The goal is to have a virtual



(in some cases, real) bookshelf of green workforce development training for many potential industries available to all people. It needs to be well-organized to minimize confusion and maximize training productivity.

Approach: NACFAM will work in collaboration with all stakeholders to design, develop and implement a complete “Green Jobs” workforce development strategy and program including the following actions:

- Dialogue among manufacturers, workforce, labor unions, trade associations, environmental groups, government, community and technical colleges, universities, social justice groups, chambers of commerce, regional partnerships, and other relevant stakeholders
- Define and categorize “Green” jobs in manufacturing
- Determine and catalog necessary skills for “Green Jobs”
- Develop applicable training frameworks, models and programs
- Implement training and workforce development programs
- Connect people with “Green Jobs”
- Skills Standards, Assessment, Certification – build off existing skill standards and assure the ultimate use of the results by industry to provide jobs to all workers.



Full Proposal on “Green Jobs in Manufacturing” Strategy

Vision

The American people have seen many reports and studies illustrating the benefits of “Green Jobs” (many are referenced below). These reports promote and some organizations (Apollo Alliance, Blue Green Alliance, Green For All, Natural Resources Defense Council, and more) have developed and are promoting policy proposals to help grow “Green Jobs” overall. NACFAM supports these efforts and will partner with these organizations to implement its “Green Jobs” strategy in manufacturing. NACFAM’s role is to participate in and organize partnerships that can make the promise and benefits of “Green Jobs” a reality within manufacturing. The partnerships and collaborations that NACFAM is engaging in will:

- Facilitate dialogue among and engage manufacturers, workforce, labor unions, trade associations, environmental groups, government, community and technical colleges, universities, social justice groups, chambers of commerce, regional partnerships, and other relevant stakeholders
- Define and categorize “Green” jobs in manufacturing
- Determine and catalog necessary skills for “Green Jobs”
- Develop applicable training frameworks, models and programs
- Implement training and workforce development programs
- Connect people with “Green Jobs”

It is imperative that we all collaborate in this effort and that we build off of existing programs to develop national standards and programs moving forward. NACFAM is not competing with other efforts, rather connecting them and learning from them to develop a successful national program. We believe a national program involving all the stakeholders is important to helping grow jobs and make existing jobs greener. A successful “Green Jobs in Manufacturing” initiative will reduce unemployment rates, increase access to jobs for ALL people, and allow for life-time career pathways and upward mobility for the workforce. The U.S. will be a leader in sustainable manufacturing and the manufacturing of “sustainable” or “green” products.

NACFAM will partner with and try to engage all relevant stakeholders in these efforts. In addition to working with labor, government, education, social justice, and environmental organizations; NACFAM will bring industry to the table and engage its members from the very beginning. Sustainability and a skilled workforce are important to the success of manufacturing firms. Sustainable manufacturing and a sustainability-trained workforce can translate into short and long term success for a company due to a happier and more productive workforce, a healthier community, increased resource efficiency and effectiveness, waste minimization, risk mitigation, expense reduction, a dependable and collaborative supply chain, increased innovation, new revenue-generating opportunities, customer attraction and retention, improved shareholder value, and more. Sustainability is ever-more important for success in a tough global economy with people who need jobs and companies who need stability.

This position in the global economy will help the U.S. solidify its leadership position as the world’s most productive, and therefore competitive, manufacturing economy due to an expanded rate of non-inflationary growth through increased productivity from successful implementation of sustainable manufacturing concepts throughout all manufacturing industry sectors. The principal path to this increase in manufacturing productivity is through increased investment in both process technologies and related workforce education and training. The workforce and those in need of jobs will have equal access to



training in the application of manufacturing skills to sustainable manufacturing and unique skills for the manufacturing of “sustainable” products (like renewable and energy efficiency products). This training and job placement strategy should provide opportunity for all people from all socioeconomic levels, races, genders, disabilities, circumstances, etc. This falls in line with the concept of eco-equity, from Van Jones’ book *The Green Collar Economy*¹.

Mission

Successfully design, develop and implement this “Green Jobs in Manufacturing” strategy to cover the multiple “shades of green” for all sectors of manufacturing, not just the manufacturing of green products, by utilizing NACFAM’s unique set of skills and experiences in leading collaborative workforce initiatives. The mission of the “Green Jobs in Manufacturing” program is to enable America’s greatest resource, its people, to lead us toward being a world leader and living example of sustainable manufacturing. Manufacturing is important to the health of the U.S. economy and we believe that building toward sustainable manufacturing is imperative for strengthening the U.S. manufacturing industry. This program will facilitate the effort to provide opportunity for all Americans, help manufacturing move towards sustainability and industrial ecology, and help U.S. manufacturing become a global leader in sustainable manufacturing and manufacturing as a whole.

Why We Need Green Jobs to be a Reality

As of September 2008, durable manufacturing profits have dropped 33.8%. A movement toward more sustainable manufacturing will create new efficiencies in resource and energy use, which will decrease costs and find new revenue generating opportunities (RGOs) by closing resource and supply chain loops. More qualified workers will increase the efficiencies, the effectiveness and sustainability in manufacturing. This will lead to an increase in both durable and nondurable manufacturing profits through decreases in costs and increases in RGOs. Further, more qualified workers in the manufacturing of “sustainable” products will also increase both durable (e.g., wind turbines and components) and nondurable (e.g., green cleaning supplies) profits.

Manufacturing employment was reported at 13.3 million by the Bureau of Labor Statistics (BLS) on September 5, a loss of 416,000 (-3.0%) jobs over the past year, of which 252,000 were production worker “blue collar” jobs in durable goods. Later BLS reports showed the U.S. has lost 56,000 manufacturing jobs in the month of September and 90,000 jobs in the month of October. The resulting increases in unemployment have been a long-term trend (see Figure: Total NonFarm and Manufacturing Employment Seasonally Adjusted).

Sustainable manufacturing and the manufacturing of “sustainable” goods can help slow, if not reverse this trend. In order for this to happen successfully and create more jobs for those who need them we must design a program to adequately train and enable everyone who is searching for employment. This is exactly why developing a “Green Jobs in Manufacturing” comprehensive program is essential.

The Center for American Progress and Political Economy Research Institute detailed in their report, *Green Recovery: A Program to Create Good Jobs and Start Building a Low-Carbon Economy*, a 2-year \$100 Billion investment in a green economic recovery program. They note that this program would reduce the number of unemployed by 2 million (i.e. providing 2 million new jobs) and reduce the unemployment rate from the July 2008 level of 5.7% to 4.4%. “Green investments generate not only sig-

¹ Van Jones, *The Green-Collar Economy: How One Solution Can Fix Our Two Biggest Problems*, Harper One, 2008



nificant numbers of well-paying jobs with benefits but also a relatively high proportion of lower, entry-level jobs that offer career ladders that can move low-paid workers into better employment positions over time.” The authors go on to say in the endnotes that “many of the initial low-paying jobs in renewable energy-related jobs will be in manufacturing where career ladders are substantially more effective than in service-sector areas.”²

This may be true and some career ladders do exist. But, in order to ensure that people who find new jobs in manufacturing do have upward mobility, NACFAM believes it is imperative that we put together a comprehensive strategy for “Green Jobs in Manufacturing”. This strategy will develop the initial skills needed for the unemployed to enter the workforce; these skills must be helpful to, accepted by and applicable to the manufacturing industry and moving towards sustainable manufacturing. This strategy will also address continuing skill development for the existing and future workforce to grow in their careers. This necessitates easily available training and certification programs as well as successful channels to get these programs to the people who need them most.

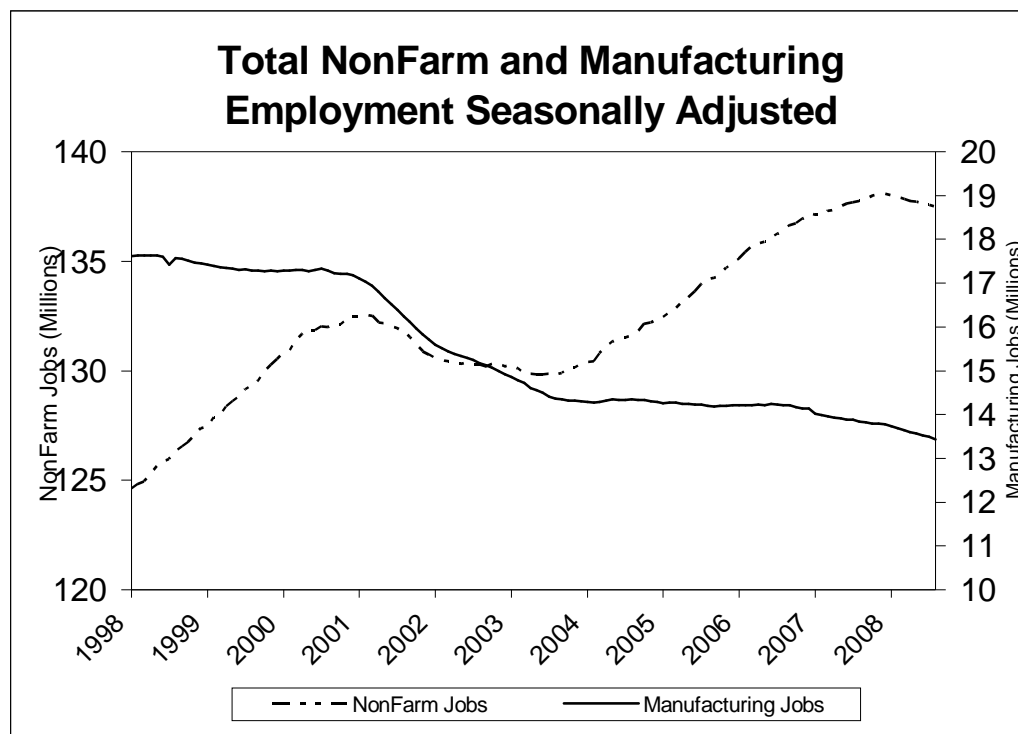


Figure from NACFAM Manufacturing Metrics: Volume 7, Issue 3; September 2008

The Apollo Alliance, in their report *The New Apollo Program*, calls for:

“expanded investment in state and local green-collar worker training initiatives, higher education scholarships, and union apprenticeship programs that focus on preparing workers for everything from low skill, entry-level jobs that help Americans climb the ladder of opportunity all the way up to high-skill, high-wage jobs at the leading edge of technical innovation”³

² Pollin, Robert, Heidi Garrett-Peltier, James Heintz, & Helen Scharber. Green Recovery: A Program to Create Good Jobs and Start Building a Low-Carbon Economy. Center for American Progress and Political Economy Research Institute, September 2008.

³ Apollo Alliance website: <http://apolloalliance.org/apollo-14/the-full-report/>



NACFAM agrees that we need to prepare our workers. We also must help manufacturing companies understand the benefits of these training programs and make sure that they are designed in a manner that is useful for manufacturing companies. Again, we emphasize the need for inclusion of all stakeholders in this process so we can help many Americans take advantage of the coming opportunities from entry-level jobs in manufacturing to high-skill, high wage jobs in innovation and product design. It is imperative that the training programs fit the needs of workers, the needs of manufacturers, and the needs of the sustainable manufacturing paradigm.

Finally, as the Department of Labor’s Employment and Training Administration (ETA) points out in the report entitled *Why America Needs an Educated and Prepared Workforce*, “the jobs of today and tomorrow demand advanced skill levels.”⁴ The following table is modeled after an ETA table in this same report. This table compares October 2008 and October 2007 seasonally adjusted Bureau of Labor Statistics numbers for employment status of the civilian population 25 years and over by educational attainment.

Table 1: Employment Growth, Changes in Average Weekly Earnings, and Unemployment rates from October 2007 to October 2008

	Less than High School	High School Graduates	Some College or Associate’s Degree	Bachelor’s Degree and Higher
Employment Growth	-120,000 (-1.07%)	-810,000 (-2.2%)	-142,000 (-0.4%)	+868,000 (+2.0%)
Growth in Unemployment	+378,000 (+42.2%)	+652,000 (+336.5%)	+643,000 (+50.3%)	+472,000 (+50.3%)
Unemployment Rate	10.3%	6.3%	5.2%	3.1%
Change in Unemployment Rate	+39.2%	+37.0%	+48.6%	+47.6%

The Need for Defining Green Jobs in the Context of Different Industries and Industry Sectors

Many studies have shown the positive impacts a low-carbon economy can have on the creation of new “Green” jobs. Studies have illustrated that there could be 2 million to 5 million new “Green” jobs and have documented the component manufacturers that exist in many states identifying some of the skill sets needed for that portion of the supply chain. These studies have shown that there is a potential for increase in manufacturing jobs in industries that create “green” products (e.g., renewable energy and energy efficiency products). Some state studies on component manufacturers have also been used to attract renewable energy original equipment manufacturers (OEMs). These studies are important to understanding the economic and policy implications of applying some of the policy proposals that will help create a low-carbon economy. In addition, there are many jobs in manufacturing that could incorporate sustainability perspectives in order to make all existing manufacturers greener. Similar to the ability for the manufacturing and use of “green” products, moving towards sustainable manufacturing of all products has the potential to create “green” jobs in regional economies based on closing supply chain loops and increasing resource efficiency.

⁴ Employment and Training Administration, Department of Labor. *Why America Needs an Educated and Prepared Workforce*.



This illustrates that there are many ideas about what “green” jobs are. It also illustrates the need to define many different “shades of green” (as referred to by the UNEP report⁵). NACFAM aims to facilitate this process. Further, NACFAM will build the collaboration needed to drill down to develop and implement a strategy for making these “Green” jobs come to fruition. Below, we lay out a preliminary strategy for making this happen on the ground and explain why NACFAM is uniquely positioned to be a driving force and partner in this process.

The Definition of Green Jobs

NACFAM has developed a strategy for defining “Green Jobs” in manufacturing, determining the skills needed for different categories of “Green Jobs”, developing “Green” workforce development training, and connecting people with “Green Jobs”. We will accomplish this by collaborating with all of the appropriate stakeholders including labor, industry, education, government, communities, and more. While we have listed existing definitions for “Green Jobs” and have defined categories of “Green Jobs” in manufacturing here, the definition will likely morph over time with input from all of the stakeholders and partners.

One definition of “Green Jobs” is from the report *Green Jobs: Towards decent work in a sustainable, low-carbon world*. This report was commissioned by the United Nations Environmental Programme (UNEP) as part of the Green Jobs Initiative of the UNEP, the International Labour Organization (ILO), the International Organization of Employers (IOE) and the International Trade Union Confederation (ITUC).

This report defines “Green Jobs” as:

Positions in agriculture, manufacturing, construction, installation, and maintenance, as well as scientific and technical, administrative, and service-related activities, that contribute substantially to preserving or restoring environmental quality. Specifically, but not exclusively, this includes jobs that help to protect and restore ecosystems and biodiversity; reduce energy, materials, and water consumption through high-efficiency and avoidance strategies; de-carbonize the economy; and minimize or altogether avoid generation of all forms of waste and pollution. But green jobs, as we argue below, also need to be good jobs that meet longstanding demands and goals of the labor movement, i.e., adequate wages, safe working conditions, and worker rights, including the right to organize labor unions.⁶

“Green Jobs” can occur at all levels in the global economy and can provide opportunities for people from all socioeconomic levels, ethnicities, backgrounds, races, genders, and social groups. “Green Jobs” provide an opportunity for everyone. There has been a lot of discussion about “green-collar jobs” and how they have the promise to help everyone in our current struggling economy.

Van Jones, Founder and President of Green For All, defines a “green-collar” job as:

- Blue-collar employment that has been upgraded to better respect the environment

⁵ Green Jobs: Towards decent work in a sustainable, low-carbon world. Produced by Worldwatch Institute with technical assistance by Cornell University Global Labor Institute. Commissioned and funded by the United Nations Environment Programme (UNEP) as part of the joint UNEP, ILO, IOE, ITUC Green Jobs Initiative.

⁶ Green Jobs: Towards decent work in a sustainable, low-carbon world. Produced by Worldwatch Institute with technical assistance by Cornell University Global Labor Institute. Commissioned and funded by the United Nations Environment Programme (UNEP) as part of the joint UNEP, ILO, IOE, ITUC Green Jobs Initiative.



- Family-supporting, career-track, vocational, or trade-level employment in environmentally-friendly fields⁷

In fact, Green For All's Green Jobs Pledge states that:

- Provide pathways to prosperity for all workers;
- Offer competitive salaries and lead to a lasting career track, thereby strengthening the U.S. middle class;
- Emphasize community-based investments that cannot be outsourced; and
- Contribute directly to preserving or enhancing environmental quality⁸

Defining “Green Jobs” in Manufacturing

NACFAM agrees with the UNEP report that there are different “shades of green” when it comes to “Green Jobs”. We are applying that in our definitions addressing “Green Jobs”. Borrowing from the UNEP report, the overarching definition is that “Green Jobs” in manufacturing are jobs that contribute substantially to preserving or restoring environmental quality.⁹ However, in its application to manufacturing there are several general “shades of green” or categories that NACFAM is concentrating on.

1. Greening existing manufacturing jobs. These jobs can help make manufacturing facilities more efficient. Jobs in this category cover many efficiency-related topics including, but not limited to, the following:
 - a. Energy efficiency and renewable energy
 - b. Resource efficiency
 - c. Waste efficiency
 - d. Water efficiency
2. Jobs manufacturing “green” or “sustainable” products. Some examples of these types of products include:
 - a. Photovoltaic panels
 - b. Wind turbines
 - c. Energy efficient products
 - d. Products containing recycled or remanufactured components
 - e. Products to facilitate more efficient means of transportation
 - f. Many more products and product categories
3. Jobs in the economy that are enabled through sustainable manufacturing (see NACFAM's sustainable manufacturing strategy). Some examples can include:
 - a. Collection centers & materials recovery
 - b. Reuse
 - c. Recycling
 - d. Remanufacturing
 - e. Efficient transportation between points

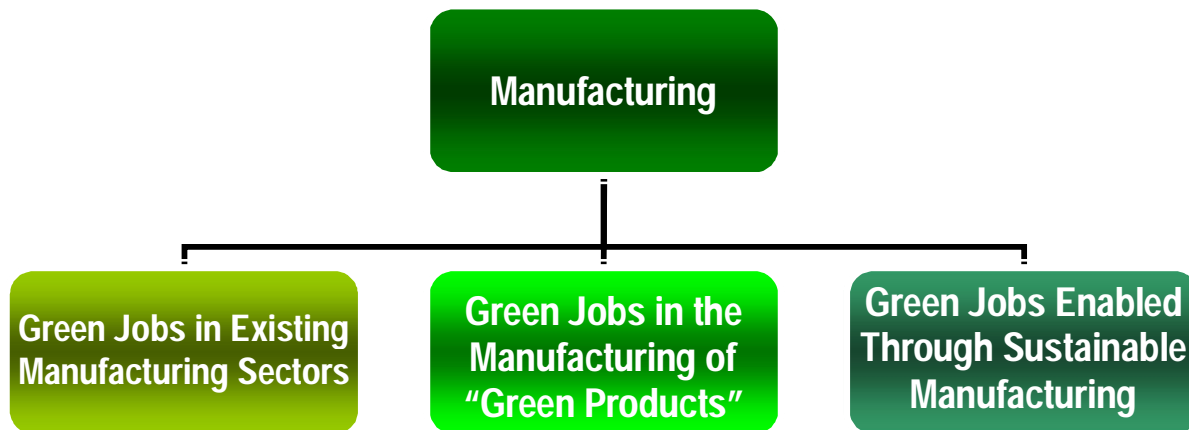
⁷ Van Jones, *The Green-Collar Economy: How One Solution Can Fix Our Two Biggest Problems*, Harper One, 2008

⁸ Green For All website: www.greenforall.org/

⁹ Green Jobs: Towards decent work in a sustainable, low-carbon world. Produced by Worldwatch Institute with technical assistance by Cornell University Global Labor Institute. Commissioned and funded by the United Nations Environment Programme (UNEP) as part of the joint UNEP, ILO, IOE, ITUC Green Jobs Initiative.



f. Entrepreneurial opportunities



It is imperative that we build flexibility and progression into our definitions of jobs that are considered “Green Jobs”. For example, as energy efficiency capabilities improve and become more affordable the “Green Jobs” related to the manufacturing of the applicable products will change accordingly. NACFAM believes we must build in the ability for our definitions and categorizations of “Green Jobs” to change morph over time in order to stay up to date and push progress. If we do not build in that flexibility, it could be a detriment to sustainable manufacturing and effectively quash or hold back innovation. Therefore, the definition should include continuous improvement.

Identification of Applicable Jobs within the “Shades of Green”

NACFAM has received input and engaged stakeholders in discussing the types of jobs that this strategy should address. This is where the “shades of green” must be applied to help categorize job growth in sustainable manufacturing, the manufacturing of “sustainable” products, and other green economy jobs enabled by sustainable manufacturing. NACFAM is beginning to collect and catalog jobs within each shade. These jobs will span manufacturing organizations including product development, product design, supply chain management, manufacturing technicians, environmental health and safety, research and development, management, and more. A comprehensive effort will build off the great work started by many great organizations and partners in our journey towards, to borrow Van Jones’ words, *The Green Collar Economy*. In addition to Van Jones’ book some other sources have already begun categorizing green jobs (by no means is this a complete list):

- The Center on Globalization, Governance & Competitiveness (Duke University) prepared a report¹⁰ that identifies examples of the associated jobs within 5 industries including:
 - LED lighting
 - high-performance windows
 - auxiliary power units for trucks
 - concentrating solar power.
- The UNEP report¹¹ notes some manufacturing jobs within its report

¹⁰ Gereffi, Gary, Kristen Dubay, & Marcy Lowe. Manufacturing Climate Solutions: Carbon-Reducing Technologies and U.S. Jobs. Center on Globalization, Governance & Competitiveness at Duke University, November 2008



- more efficient transportation (e.g. more efficient vehicles & rail car manufacturing)
- scrap-based manufacturing
- renewable energy and energy-efficiency related manufacturing
- remanufacturing
- pollution control products
- energy and materials efficiency
- clean production techniques (toxics avoidance)
- closed loop systems (McDonough and Braungart's concept of cradle-to-cradle)
- and more
- The Renewable Energy Policy Project¹² has created numerous technical reports for States determining the opportunity and capacity for renewable energy component manufacturing jobs supporting:
 - Wind
 - Solar
 - Geothermal
 - Biomass
- The Apollo Alliance has produced a report and policy proposal entitled *The New Apollo Program*.¹³ This report refers to the creation of more jobs in manufacturing related to
 - transportation including the manufacturing of more fuel-efficient vehicles
 - renewable energy
 - more energy efficient products for buildings
 - more efficient factories
 - and more
- *The Blue Green Alliance*¹⁴ has participated in and provides a number of reports concerning the road to energy independence and sectors involved in providing green products and services (transportation, green building, and renewable energy)
 - These reports have been produced for a number of States
 - They look into the types of jobs and supporting industries in the respective states
 - They look into local economic development opportunities based on these findings
- The Center for American Progress and The Political Economy Research Institute¹⁵ list categorizations that include manufacturing. Their examples cover:
 - direct effects of renewable energy and energy efficiency investment (e.g. jobs created through manufacturing of wind turbines),
 - indirect effects (e.g., manufacturing of intermediate goods for building retrofits, solar or wind turbine manufacturing such as steel production), and
 - induced effects (which are “retail and wholesale jobs created by workers in these ... manufacturing ... industries when they spend the money they earn on other products in the economy

¹¹ Green Jobs: Towards decent work in a sustainable, low-carbon world. Produced by Worldwatch Institute with technical assistance by Cornell University Global Labor Institute. Commissioned and funded by the United Nations Environment Programme (UNEP) as part of the joint UNEP, ILO, IOE, ITUC Green Jobs Initiative.

¹² The Renewable Energy Policy Project website: www.repp.org

¹³ Apollo Alliance website: <http://apolloalliance.org/apollo-14/the-full-report/>

¹⁴ Blue Green Alliance website: www.bluegreenalliance.org

¹⁵ Pollin, Robert, Heidi Garrett-Peltier, James Heintz, & Helen Scharber. Green Recovery: A Program to Create Good Jobs and Start Building a Low-Carbon Economy. Center for American Progress and Political Economy Research Institute, September 2008.



Benefits for Industry

The benefits for workers have already been addressed and these benefits are a main focus of this “Green Jobs in Manufacturing” strategy. However, it is important to point out the benefits for industry and manufacturing companies as well. The main benefits to manufacturers of such a program include positive bottom-line impacts in the short-term and positive strategic impacts in the long-term.

- 1) Secure Pipeline of sustainable manufacturing qualified workers for manufacturers
 - a. If people at the entry-level have the understanding of sustainability, the skills needed for sustainable manufacturing, and the knowledge for how to apply manufacturing skills in the context of sustainability
 - b. Manufacturers will be able to save on the costs of training development for sustainable manufacturing if these programs and/or curriculum already exist
- 2) Entry-level workers with the knowledge of how to apply manufacturing skills in a sustainability context (energy and resource efficiency with direct and profitable impacts on the bottom-line) and skills unique to sustainable manufacturing
- 3) Entry-level workers that can provide long-term strategic advantage when their knowledge is tapped for overall operational process and product improvements
- 4) Workers at all levels with knowledge and understanding of sustainable manufacturing through the upward mobility of existing and new workers as well as the expansion of this program to cover all levels of employment within a manufacturing company.

Where Do We Start?

NACFAM’s strategy will concentrate on front-line workers, manufacturing managers, supply chain managers, product design, and product development. General management and corporate level training will not be addressed at this point. Corporate strategy for moving towards sustainable manufacturing will be addressed by the activities of NACFAM’s Sustainable Manufacturing Council. We will concentrate first on how to keep jobs, create jobs, enhance existing jobs, and create pathways for upward mobility and career development. The initial efforts will focus on front-line manufacturing. We will move into the other professions and levels of manufacturing as we develop upward mobility tracks and pathways.

The strategy will be to develop national skill standards that can then be used to train anybody throughout the country, all communities and all sectors of manufacturing. Skill standards will cover (illustrated in the chart below as well):

- Sustainability concepts,
- How to apply existing manufacturing skills (defined by previous standards) within a sustainability context,
- Standards for sustainability skills that can be used throughout “green” product manufacturing sectors (e.g. all renewable energy manufacturing sectors),
- Standards for skills that are unique to certain industry sectors (e.g. heavy equipment or solar vs. wind), and
- Standards unique to certain aspects of sustainable manufacturing; e.g., designing for closed loop systems, waste minimization and related revenue generating opportunities, energy efficiency, etc.

Many of the skills may already exist and some may not. NACFAM’s strategy is to collaborate with other stakeholders to collect all of the applicable skills in one place, develop necessary new skill standards and then combine it all into an organized, nation-wide standard for training. The goal is to have a virtual (in



some cases, real) bookshelf of green workforce development training for many potential industries available to all people. It needs to be well-organized to minimize confusion and maximize training productivity.

Sustainability Related Skills				
	Crosscutting Skills	Industry-Specific	Industry Sector-Specific	Product or Material Specific
Application of Existing Skills in a Sustainability Context				
Modified Skills or Applications of Skills and new KSAs that Can Be Trained in a Short Amount of Time				
New Skills and KSAs that Require Specialized Training				

This matrix would be used to categorize everything from broad core competencies to specialized skills for critical work functions, as well as sustainability-specific KSAs related to the critical work functions

Then, we will collaborate with partners to develop a train-the-trainer program and determine the most effective channels for dissemination in order to increase access to workforce development for the green economy for all people. These channels can include, but are not limited to, the following:

- Pre-K through 12 education
- Community and technical colleges
- Other local workforce training programs
- Universities
- Internet
- Re-introduction programs
- Public Housing Agencies/Authorities
- Department of Housing and Urban Development Programs

The role of institutions (educational, workforce development, etc.) must be clearly defined to make this effort successful. That is another focus of a successful “Green Jobs in Manufacturing” strategy.

Further, our strategy will aim to determine how we can apply existing education and workforce models to organize this effort so we can leverage work that has already been done and avoid “reinventing the wheel.” We want to maximize the efficiency and effectiveness of this “Green Jobs in Manufacturing” program so we can get opportunity to all people as quickly and effectively as possible. In many cases, we may be implementing strategies on the ground before skill standards and standardized training is fully developed and certified. For this we will develop pilot programs to help get people jobs first and then learn from that process to better inform standards, training and channel development.



Examples of programs or models that can be considered for application to this issue are the Manufacturing Career Cluster Pathway and the Advanced Manufacturing Competency Model. Another example is America's 21st Century Learning System, developed by NACFAM. We will discuss these three examples in some detail below. There are others, of course, that will be analyzed and included in the development process. This program aims at maximizing the benefits of including more foundational skill standards like those by the Manufacturing Skill Standards Council (MSSC) as well as occupational and specialty skill standards (e.g., skill standards for welding).

Manufacturing Career Cluster Pathway

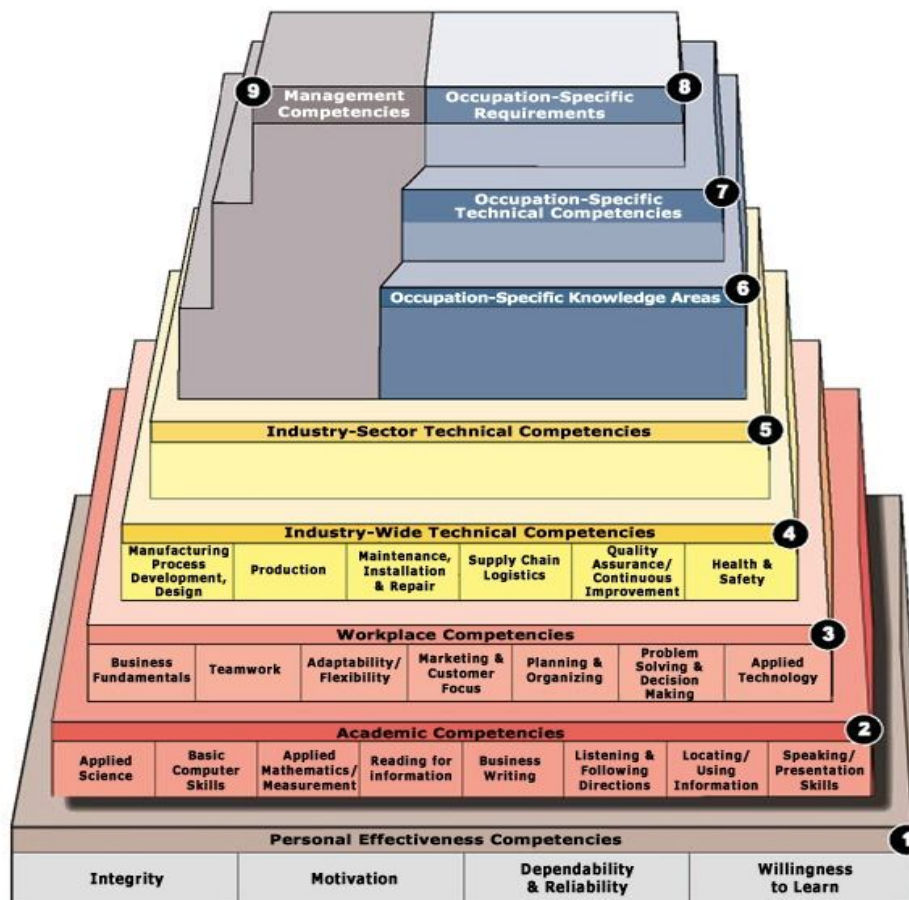
In 2006, the National Council for Advanced Manufacturing (NACFAM) was named the Cluster Leader for manufacturing and formed the Manufacturing National Advisory Council (MNAC). During 2007, NACFAM began working with the U.S. Department of Labor Employment and Training Administration to more closely align their Advanced Manufacturing Competency Framework initiative, a project in which NACFAM has been a lead, with the Manufacturing Career Pathway Plans of Study. The expected outcome is a more clearly defined message about both initiatives and their complimentary aspects. Both are based on the Manufacturing Skill Standards Council (MSSC) skill standards-based certification system for manufacturing production technicians. The MSSC work to develop such a system, through rigorous research involving small, medium and large companies from all industry sectors, laid a solid foundation for identifying much of the underlying content in the Manufacturing Pathway Plans of Study. See Appendix for sample career specialties/occupations, pathways and cluster knowledge & skills for Manufacturing.

Advanced Manufacturing Competency Model

We will determine how we might be able to utilize the Employment and Training Administration's (of the Department of Labor) Advanced Manufacturing Competency Model,¹⁶ which NACFAM helped develop and has helped promote the effective use of this model and its resources in business. This model might be used to facilitate a general framework for where sustainability skills and education fit into the overarching framework for industry-wide competencies. Industry competency models were identified as a workforce solution through industry forums as part of the High Growth Job Training Initiative. The Advanced Manufacturing Competency Model serves as a dynamic, industry-driven framework for foundational competencies that are necessary for entry level workers across all manufacturing sectors. Such a model framework would allow for consistency across industries, customization within sectors, and easy updating to accommodate changing technology and business practices.

Sustainability and its related topics can actually be inserted at every point in this model. However, NACFAM will work with its partners to identify where the best points are to promote job growth, the greening of existing jobs, and developing job skills that will help companies employ sustainable manufacturing processes on the frontlines. The initial efforts might concentrate on level 3 of the competency model, the workplace competencies, because they will have the most immediate impact and are the most needed by those looking to enter the workforce and those in the existing workforce that would benefit from developing their skills further in this arena. Overlapping with this, we should simultaneously work to incorporate an overarching sustainability aspect for application of academic competencies by inserting sustainability into America's 21st Century Learning System described next.

¹⁶ Employment and Training Administration, Department of Labor. Advanced Manufacturing Competency Model website: <http://www.careeronestop.org/competencymodel/pyramid.aspx?hg=Y>



America's 21st Century Learning System

These recommendations were developed by NACFAM's Workforce Education & Training Advisory Council at its spring Policy Conference and refined over several months since that event. 32 national manufacturing trade associations and professional societies have agreed to support these recommendations. Tony Girifalco, Executive Vice President of the Delaware Valley Industrial Resource Center in Philadelphia and chair of NACFAM's Workforce Education & Training Advisory Council, stated that "The policy statement establishes the major **principles** of a Pre K – 16 **learning roadmap** that indicate what must be done at the federal, regional, state and local levels to improve and enhance the knowledge and skills students and workers need over the next generation in all sectors including the manufacturing sector, but especially in the STEM disciplines."

NACFAM's CEO, Eric Mittelstadt added that, "As businesses continue to think innovatively, they require production workers with state of the art skills and ingenuity. Along with *academic competencies* such as reading, writing, math, science, listening and speaking, workforce members must have *workplace competencies* in computerized manufacturing systems, gathering and analyzing data from these systems, making decisions and judgments to optimize their work, analyzing and solving technical problems, working on teams, and adapting to changes in workplace conditions," said Mittelstadt.

This is a general framework that we feel should be followed when preparing our children, our workforce, and those entering the workforce for careers in sustainable manufacturing and the manufacturing of "sustainable" products.



Key **Learning System** recommendations announced by NACFAM include:

- Validated and rigorous world-class learning standards, assessments and curricula for grades Pre K – 16.
- Applied learning in grades Pre K – 12 to help students better understand the relationship between what they learn in the classroom and what they do with this knowledge in postsecondary schools and their jobs or careers.
- Demonstrated mastery of academic *and* workplace competencies before high school seniors can receive their diplomas.
- Strengthened career counseling for students in grades 7-12 to help ensure that graduates gain access to postsecondary schools or productive employment.
- Support of life-long learning and continuous skill enhancement for all Americans from Pre K through retirement.
- Periodically review the learning paradigms to ensure the principles are achieved.

These recommendations should also be followed when we are developing and implementing skill standards, training, and workforce development programs for Green Jobs in Manufacturing.

Developing Skill Standards

NACFAM will utilize its expertise in developing skill standards and brokering intense collaboration among stakeholders to develop skill standards applicable to greening existing manufacturing jobs and the creation of new “Green Jobs”. We will use the Manufacturing Skill Standards Council (MSSC) as our model and utilize aspects that have already been created through that process. Sustainability in manufacturing can become a cross-cutting production module within the MSSC system.

The Vision for Sustainable Manufacturing Skill Standards

The future we see has a skill standards system that is responsive to the needs of the market and its specific customers among employees, employers, educators, and communities. This skill standards system will include skill standards for sustainable product design, sustainable manufacturing processes and skills, the application of general engineering skills in a sustainability paradigm, and sustainable supply chain management. There will not be just one list of skill standards for everything sustainable, and all of the skill standards will not be unique to sustainable manufacturing. However, we do envision an easy to use set of skill standards to be applied in a flexible manner throughout industries including general skill standards that will apply to all manufacturing operations to make them more sustainable. “Green Jobs in Manufacturing” skill standards will be used widely across the country as the foundation for education and training for both incumbent and entry-level workers. Confidence in standards will grow because they follow a common nomenclature, they are developed through similar processes by organizations competent in the particular industry and in sustainability to assure quality, they are continuously updated and improved as sustainability standards and capabilities improve, and they are readily available to ALL people regardless of socioeconomic condition, disability status, social status, race, ethnicity, gender, sexual orientation, or any other characteristic.

We see a future where all of the applicable stakeholders have integrated sustainable manufacturing skill standards into their work because the skill standards have proven to be highly beneficial to achieving each stakeholder’s respective goals. Stakeholders have been able to see the positive feedback and positive bottom-line impacts. Specifically, through a system built on continuous performance improvement, the use of skill standards will have the following results:



- Increased number of high-skill, high-wage jobs
- Increased opportunity for pathways to high-skill, high-wage jobs for everyone
- Increased productivity growth rates within a sustainable manufacturing paradigm
- Increased sustainability/viability of manufacturing companies, resulting in increased employment security for workers and opportunities for all
- Demonstrated effectiveness of various education and training providers ensuring that workers and students achieve levels of performance set by standards
- Increased capital investment
- Increased labor mobility and portability

NACFAM would like to see sustainable manufacturing skill standards provide a powerful and useful tool for companies to create high performance workplaces that are better able to compete with the low wages and other advantages of global competitors. These high performance and more sustainable workplaces will lead to:

- Heightened productivity
- Creation of more high skill jobs
- Development of more accessible pathways to high skill jobs
- Raised incomes for workers
- Fewer low-skill dead-end jobs
- Clearer and sounder career paths
- Accelerated progress towards sustainable manufacturing and a green economy

In this environment both entry-level and retrained workers will have the skills needed to adjust successfully to technological change and changes in the economic base in the U.S., to improve their job security, and enhance their opportunities for advancement.

We would like to see skill standards combined with curriculum, training, and appropriate channels to create more jobs through a framework based on moving towards sustainable manufacturing. We want these standards to help make recruitment more efficient for both companies and workers. Ideally, companies, in cooperation with workers, will use skill standards to clarify career ladders and provide the opportunity and encouragement for workers to increase their security and income. NACFAM wants to see the skill standards and associated career ladders communicated and provided through the appropriate channels to reach the people who need them, whether they are existing workers in a company or unemployed in the community. Finally, we would like to see the perception of manufacturing improve due to more emphasis on sustainability, innovation, professionalism, opportunity, and career advancement.

The accompaniment of career ladders based on skill standards is imperative to successful career development and opportunity. The education and training system will enhance portability for workers across industry sectors and clusters. Individuals will be in a stronger position to manage their own career development because they have a clear picture of what manufacturers will require of them (including both core competencies and more specialized skills) as manufacturers can use a standardized skills- and knowledge-based system to communicate job requirements and career ladder opportunities. This clear picture and the availability of training will help students, unemployed, and currently employed workers to learn new skills to advance their careers in sustainable manufacturing and the manufacturing of “sustainable” products.



Elements of a Nationwide System

To create and implement a nationwide system for skill standards several components need to be developed and integrated.

Component Development

Using established guidelines and criteria, this partnership would develop components that will help build and form an integral part of the nationwide system. These will include, at a minimum, the following:

- Skill standards for the critical work functions ranging from the very broad core competencies to specialized skills for particular sectors or processes as they relate to the practical needs of the manufacturing cluster
- Tools and methods used and trusted by employers and workers to document, against the standards, the skills and knowledge of an individual
- Systems and processes that will lead to the assessment and certification of individuals reaching the standards
- Quality assurance processes and criteria for the development and implementation of standards

The resulting system and quality criteria will include components and processes that ensure the following:

- The standards development process will identify and draw upon existing skill standards work
- The standards follow a common nomenclature
- The standards encompass the academic, employability, occupational and specialty skills and knowledge needed for the workplace
- The standards adhere to statutory, regulatory and policy requirements
- The system processes and standards are consistent with civil rights law
- The standards meet the highest comparable applicable standards used in the U.S.
- The standards are benchmarked against international standards
- The standards setting process provides for continuous updating and improvement
- Identification of best practices examples, both national and global, that stakeholders can use as a reference point in applying skill standards to their own programs

Designing Training Programs and Resources That Work

It is imperative that we design training and workforce development programs to get knowledge and opportunity to all people. We must apply the concept of eco-equity, from Van Jones' book *The Green Collar Economy*.¹⁷ He defines eco-equity as "equal protection and equal opportunity in an economy that respects the Earth."

Under the concept of eco-equity the following organizations must be engaged in training for "Green Jobs" and "green" workforce development.

- Community and Technical Colleges
- High Schools
- Social justice institutions

¹⁷ Van Jones, *The Green-Collar Economy: How One Solution Can Fix Our Two Biggest Problems*, Harper One, 2008



- Workforce development training programs
- Re-entry programs for the formerly incarcerated
- And any other programs related to helping ALL people enter the workforce successfully (including people with disabilities, underserved populations, etc.)

Once skill standards are developed, NACFAM will work with partners, members and other stakeholders to develop the proper training for making the workforce greener. Then, we will collaborate to develop programs that train the trainer in each of the types of organizations that will provide training for people entering and/or already in the workforce.

In addition to training programs with applicable coursework, we will need to partner to develop standardized guidebooks, diagnostic tools for employers, self-diagnostic tools for existing and potential employees, and internet resources. We believe these guide books and resources must be easily available to all people. We must take into consideration how people in different communities access information and determine how best to educate them on the opportunities available and get them the resources they need. This will facilitate functional learning and preparation at all levels. Finally, we will need to develop performance measurement techniques so we can determine whether this is working. Performance measurement will help us improve the program as we move along.

Certification

Certification will be addressed after skill standards and training programs are developed. However, it is important that we carefully determine in collaboration with all of our partners the best way to incorporate certification. Accreditation/certification of training programs and trainers is definitely necessary in order to make sure that the training programs provide consistent training so all of the applicable skills training are available to ALL people. Providing certification for individual workers must be discussed and addressed carefully so that certification does not become a barrier to any groups of potential or existing workers. Certification must not knowingly or unknowingly discriminate against different populations.

Why is NACFAM the right organization to spearhead these efforts?

NACFAM has a unique set of skills and experiences necessary for successfully designing, developing and implementing a “Green Jobs in Manufacturing” strategy. NACFAM has successful experience in developing skill standards, developing workforce development programs and has a progressive sustainable manufacturing program. Federally funded projects from the U.S. Departments of Education and Labor have enabled NACFAM to play a leadership role in the development of occupational skill standards for industrial workers for the last 16 years. NACFAM began work in 1992 on two U.S. Department of Education projects to develop occupational skill standards for computer-aided drafting and design (CADD) technicians and for advanced manufacturing workers.

In 1997, NACFAM and the AFL-CIO Working for America Institute were awarded a grant from the U.S. Department of Labor to develop the first *comprehensive skill standards system* for manufacturing workers, known as the Manufacturing Skill Standards Council (MSSC). NACFAM co-led the development of the MSSC standards, assessment and certification program, which today operates as its own 501(c)(3) organization. With these grants, NACFAM has demonstrated effective leadership working with companies, labor organizations, workers, educators and trainers, associations, government agencies and NGOs in identifying the skills that are needed by workers to succeed in high performance workplaces of today and tomorrow. Working with national partners, regional economic development groups, and



local public and private organizations, NACFAM continues to broker relationships and promote the strengthening of the U.S. manufacturing sector.

Here is a summary of many of the workforce development programs NACFAM has worked on:

- **National Skill Standards for Computer-aided Drafting & Design** – Standards sold to over 5,000 CADD teachers and trainers. 1992-present.
- **National Skill Standards for Advanced Manufacturing** – Standards now integrated within multiple state and community skills programs. 1993-1997.
- **Science, Technology, Engineering, and Mathematics (STEM)** –
 - NACFAM partnered with the Delaware Valley Industrial Resource Center in conducting a STEM Talent Development Forum to build a regional collaborative to enhance STEM education.
 - NACFAM partnered with the Massachusetts MEP for its STEM Talent Development Regional Conference
- **Nanofabrication Skill Standards** – NACFAM is beginning to work on the Penn State University nanofabrication skill standards, NSF-funded project, for which NACFAM helped on the definition phase and proposal
- **Career Clusters** – NACFAM is the leader of the Advanced Manufacturing Career Cluster Career Path & Curriculum Effort (Department of Education, DoEd)
- **Advanced Manufacturing Competency Model (AMCM)** –
 - NACFAM helped the Department of Labor Education and Training Administration (ETA) develop the AMCM
 - NACFAM has also completed an outreach contract with ETA to accelerate acceptance of the AMCM.
- **America's 21st Century Learning System** – NACFAM has built broad-based support for *America's 21st Century Learning System* recommendations developed by NACFAM's Workforce Education & Training Advisory Council at NACFAM's April Policy Conference. So far 32 trade associations and professional societies are signatories to our Learning System recommendations.
- NACFAM is one of several associations asked by the National Association of Manufacturers' Manufacturing Institute to oversee their development of a comprehensive certification system for manufacturing worker competencies.



Manufacturing



Appendix

Planning, managing, and performing the processing of materials into intermediate or final products and related professional and technical support activities such as production planning and control, maintenance and manufacturing/process engineering.

Sample Career Specialties/Occupations	<ul style="list-style-type: none"> Assembler Automated Manufacturing Technician Calibration Technician Electrical Installer and Repairer Electromechanical Equipment Assembler Extruding and Drawing Machine Setter/Set-Up Operator Extrusion Machine Operator Foundry Worker Grinding, Lapping, and Buffing Machine Operator Hand Packers and Packager Hoist and Winch Operator Instrument Maker Machine Operator Machine Setter and Set-Up Operator Manager, Supervisor Medical Appliance Maker Milling Machine Setter, Set-Up Operator Operator, Tender, Cutter/Brazer, Solderer, Machine Operator Painter Pattern & Model Maker Precision Layout Worker Precision Optical Goods Worker Production Associate Sheet Metal Worker Solderer and Brazer Tool and Die Maker Welder 	<ul style="list-style-type: none"> Design Engineer Electrical and Electronics Technician and Technologist Electronics Engineer Engineering and Related Technician and Technologist Engineering Technician Industrial Engineer Labor Relations Manager Manufacturing Engineer Manufacturing Technician Nanofabrication Technician Power Generating and Reactor Plant Operator Precision Inspector, Tester, and Grader Process Improvement Technician Production Manager Purchasing Agent Supervisor 	<ul style="list-style-type: none"> Biomedical Equipment Technician Boilermaker Communication System Installer/Repairer Computer Installer/Repairer Computer Maintenance Technician Electrical Equipment Installer/Repairer Energy Audit Technician Facility Electrician Industrial Electronic Installer/Repairer Industrial Facilities Manager Industrial Machinery Mechanic Industrial Maintenance Electrician Industrial Maintenance Mechanic Industrial Maintenance Technician Instrument Calibration and Repairer Instrument Control Technician Job/Fixture Designer Laser Systems Technician Maintenance Repairer/Technician Major Appliance Repairer Meter Installer/Repairer Millwright Plumber, Pipefitter and Steamfitter Power Generating and HVAC Operator Security System Installer/Repairer 	<ul style="list-style-type: none"> Calibration Technician Inspector Lab Technician Process Control Technician Quality Assurance Technician Quality Control Technician Quality Engineer SPC Coordinator 	<ul style="list-style-type: none"> Communications, Transportation and Utilities Manager Dispatcher Freight, Stock, and Material Mover Industrial Truck and Tractor Operator Logistical Engineer Logistician Material Associate Material Handler Material Mover Process Improvement Technician Quality Control Technician Traffic Manager Traffic, Shipping, and Receiving Clerk 	<ul style="list-style-type: none"> Environmental Engineer Environmental Specialist Health and Safety Representative Safety Coordinator Safety Engineer Safety Team Leader Safety Technician
	Production	Manufacturing Production Process Development	Facility, Maintenance, Installation & Repair	Quality Assurance	Logistics & Inventory Control	Health, Safety and Environmental Assurance
Cluster K & S	Cluster Knowledge and Skills <ul style="list-style-type: none"> Academic Foundations ♦ Communications ♦ Problem Solving and Critical Thinking ♦ Information Technology Applications ♦ Systems Safety, Health and Environment ♦ Leadership and Teamwork ♦ Ethics and Legal Responsibilities Employability and Career Development ♦ Technical Skills 					