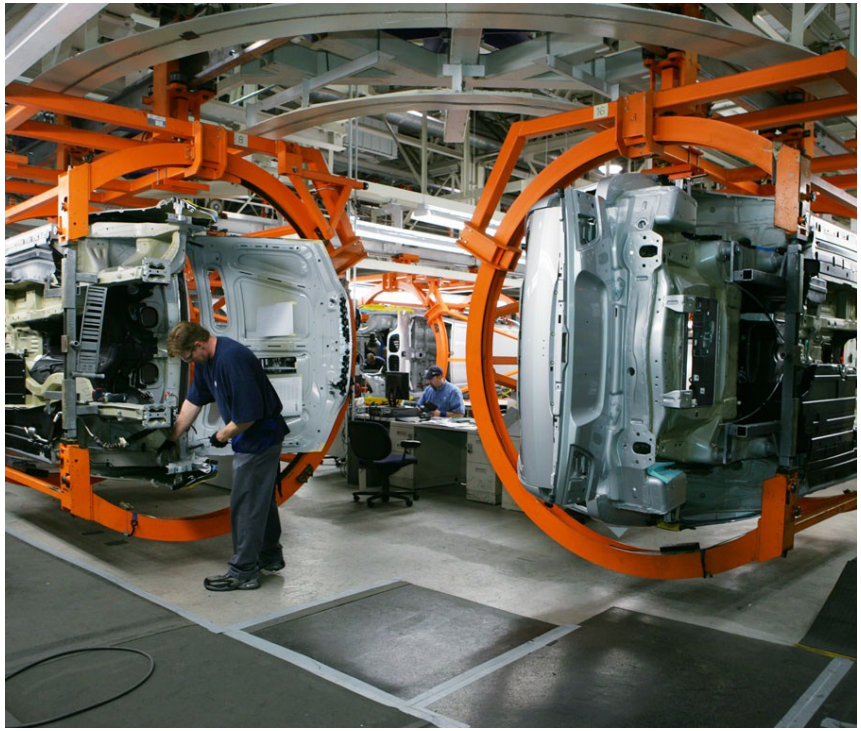
Advanced Manufacturing Strategic Plan

Titusville, Florida

Final | August 2012



Advanced Manufacturing Strategic Plan (2012)

Prepared for
The Space Coast Economic Development Commission
The City of Titusville, Florida
Clean Footprint, LLC

Prepared by
Urban Networks, LLC

ACKNOWLEDGMENTS

Thank you to all City departments, residents, business owners, and stakeholders that helped in the preparation of the 2012 Advanced Manufacturing Strategic Plan.

The Space Coast Economic Development Commission

Clean Footprint, LLC

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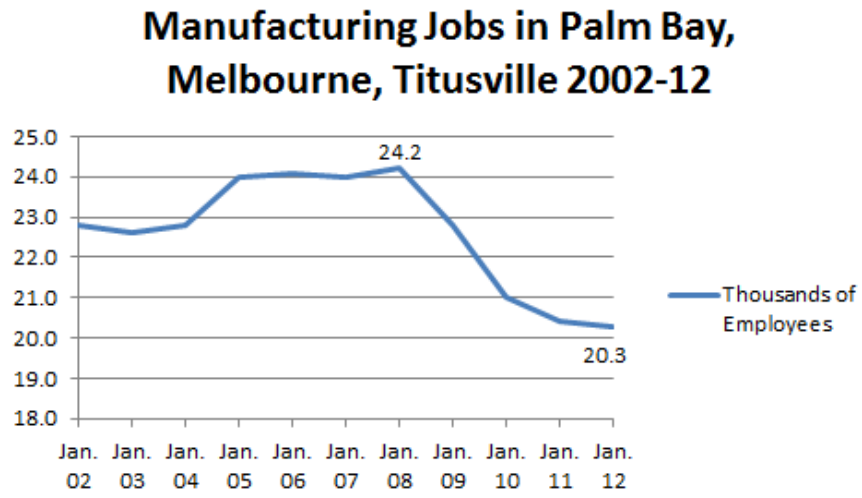
Chapter 1: Historic Overview

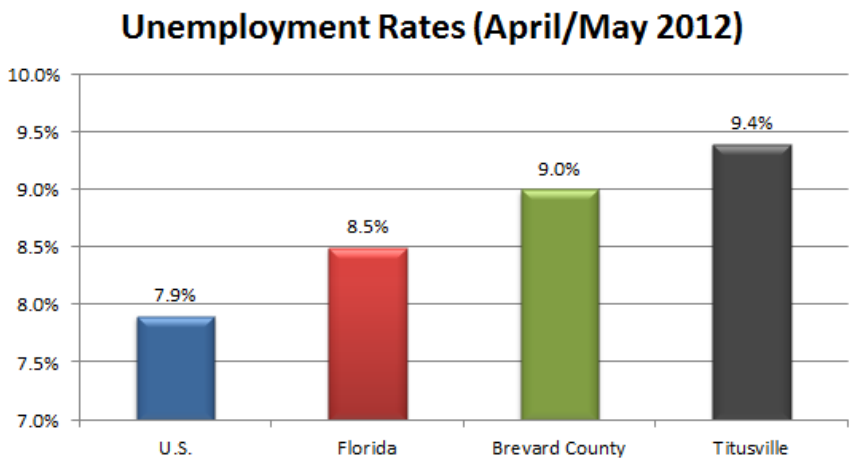
Background

The current economic landscape requires nations to compete in global markets for goods and services. Historically, manufacturing in the United States was the foundation for economic stability securing our position as leaders in the global economy. In recent years that foundation has started to erode. While manufacturing jobs have been placed offshore in low-wage nations, crises in the Middle East also threaten U.S. energy security causing expenditure on a larger more capable military. This shift in corporate investment coupled with the allocation of federal funds in support of energy security and the military effects the economy presenting a challenge for U.S. manufacturing. Investment in advanced manufacturing systems, research, development and commercial deployment provides a real opportunity to reverse this trend and re-establish American manufacturing as the leader in a global economy.

The retirement of NASA's Space Shuttle program in 2011 resulted in the loss of thousands of jobs in Brevard County and an unemployment rate significantly above the national average. According to news releases, the retirement of the shuttle resulted in direct and indirect job losses totaling between 7,000 and 15,000 employees on the Space Coast. The highest percentage of job losses occurred in North Brevard totaling an estimated loss of $100 million in annual income. At the same time, 1 in 10 jobs in Brevard County are in the manufacturing sector with the Brevard metro area having the 2nd highest concentration of high-tech manufacturing with the 10th highest average manufacturing wage in the U.S.[1] Unfortunately over the past four years, Brevard County has seen a drastic decrease in employment in this vital sector.



"Manufacturing is vital to the strength of the economy."



Background

Titusville, in particular, was considerably affected by the shuttle's retirement as it lost an exceptionally talented workforce of highly trained engineers, technicians and scientists. Titusville also suffers from a declining manufacturing industry. By retaining and utilizing the talent and intellectual capital represented by the prior NASA workforce, Titusville has the opportunity to develop and strengthen the local economy.

Manufacturing, based on new technologies including high-precision tools and advanced materials, provides the opportunity for high-quality/wage jobs for the highly skilled workforce already located in the Titusville area. A strong manufacturing sector that adapts to and develops new technologies is vital to ensure ongoing leadership in innovation. Titusville, due to its history as the cradle of manned space flight, is uniquely positioned to fully utilize local assets and establish itself as a major player in advanced manufacturing. The City's long-term ability to innovate and compete in the global economy is greatly strengthened from the location of manufacturing and manufacturing-related R&D activities in North Brevard County. The further loss of these activities will undermine Titusville's capacity to invent, innovate, and compete in global markets, therefore it is imperative that the community devise strategies in support of advanced manufacturing.

Recognizing the need to implement policies and plans that increase economic opportunity in the area, the Space Coast Economic Development Commission and Clean Footprint, LLC requested that Urban Networks, LLC undertake this strategic planning initiative to provide a course of action to secure development of the advanced manufacturing industry in Titusville.

Above and Below: Atlantis crew and onlookers standing before the orbiter following its last landing.

"This planning initiative is designed to position Titusville for success in a global economy through the establishment of an advanced manufacturing demonstration facility."

Project Purpose and Approach

The intent of this study is to introduce advanced manufacturing concepts to community leaders including an overview of key enabling technologies. It acknowledges the fact that both public and private sector interests have a role in the promulgation of advanced manufacturing and stand to benefit considerably. Numerous businesses in the area have been identified as potential benefactors of an advanced manufacturing hub, however for purposes of this study three industry sectors have been selected for analysis: Biosciences, Aerospace/Department of Defense (DoD), and Energy. The future ability of Titusville to innovate and invent new products for these three industries greatly depends upon how well the area can support innovation and the development and use of advanced technologies for its manufacturing sector. Therefore, businesses, institutions, government agencies and other organizations from each of the three industry sectors were identified in an attempt to define how existing relationships and potential linkages can be made to increase economic opportunity on the Space Coast. The study goes on to describe opportunities for workforce training in support of advanced manufacturing. The study then defines regional dynamics that support future industry development and examines various aspects of the physical development of facilities. This includes land characteristics, existing facilities and siting opportunities as well as geographic, and infrastructure related elements. Finally the planning initiative includes specific implementation strategies defining organizational roles and relationships and an overview of economic incentives and potential funding sources.

The result of the study is designed to generate sufficient information to present to community leaders, key individuals and organizations resulting in a consensus for action. The result will be an appropriate strategy that positions Titusville in the center of a globally competitive region through the establishment of an advanced manufacturing hub.

Above: Buhler's Liquidmetal Die Casting machine is considered to be one of the most advanced machines in the world. Apple has struck a deal with Liquidmetal for use of its advanced injection-molding machines allowing it to produce advanced iPhone antennas and holographic metal gadget cases.

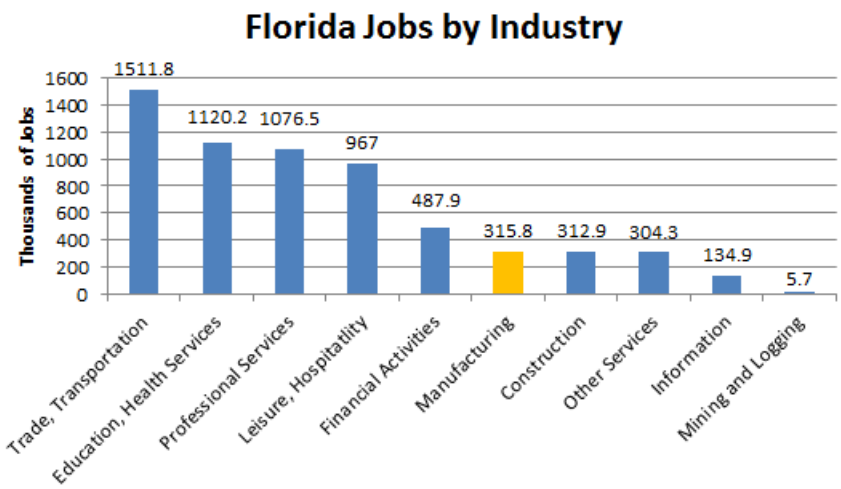
"Titusville is uniquely positioned to develop an advanced manufacturing demonstration facility."

Chapter 2: Advanced Manufacturing

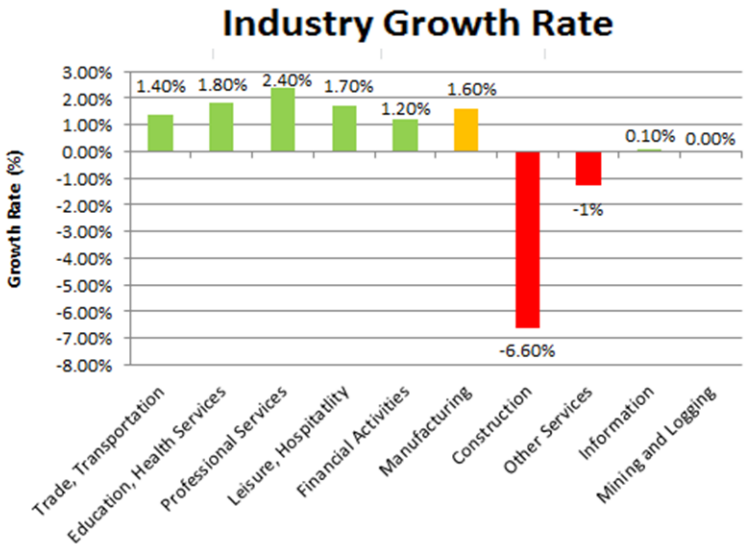
Advanced Manufacturing

Considering the loss of the space shuttle program, a stagnant construction industry and lagging tourism, many Floridians are unsure if the state's economy can return to its pre-recession levels. Many have looked to manufacturing, a previously overlooked industry in a state known more for its natural beauty, agriculture and theme parks as a potential solution. Manufacturing already plays a key role in Florida's economy, but the focus must be on growing this specific industry in our state. The intent of this initiative is to create employment opportunities in the advanced manufacturing field which will move the City of Titusville towards its economic development goals.

Currently, manufacturing is the sixth-largest "non-farm, non-government" industry in Florida. The average annual wages paid to manufacturing employees are higher than the state average in the private sector[1]. Moreover, manufacturing employees enjoy much better stability in their employment than workers in other private industries. Despite the economic recession, employees in the manufacturing industry have enjoyed wage increases each year since 2001. Manufacturing jobs provide lifeblood to surrounding communities and support many peripheral industries such as shipping, service and real estate. At the same time, Florida has the lowest per-capita capital expenditures on manufacturing among the 12 Southern states[2], lagging behind our neighbors in our supply of a trained manufacturing workforce and incentives to attract new advanced manufacturers. To provide increased economic activity and return the economy back to pre-recession levels of employment, increased investment in advanced manufacturing is necessary.



"Manufacturing jobs provide the lifeblood to surrounding communities and support many peripheral industries."



Advanced Manufacturing Defined

Paul Fowler of the National Association of Advanced Manufacturing defined the advanced manufacturing entity as one that "makes extensive use of computer, high precision, and information technologies integrated with a high performance workforce in a production system capable of furnishing a heterogeneous mix of products in small or large volumes with both the efficiency of mass production and the flexibility of custom manufacturing in order to respond quickly to customer demands[3]."

Broadly viewed, the term "advanced manufacturing" refers to many developments in the manufacturing field that occurred during the late 20th and early 21st centuries. These developments include high tech products and processes such as lean, green, and flexible manufacturing. Advanced manufacturing is defined as a "family of activities that (a) depends on the use and coordination of information, automation, computation, software, sensing, and networking, and/or (b) makes use of cutting-edge materials and emerging capabilities enabled by the physical and biological sciences, for example nanotechnology, chemistry, and biology. This involves both new ways to manufacture existing products, and especially the manufacture of new products emerging from new advanced technologies[4]." Thus, advanced manufacturing involves the use of innovative technology to improve products and/or processes. One way to develop advanced manufacturing in the Titusville area is through investments that support the establishment of a Manufacturing Demonstration Facility (MDF).

Above: Inside of the Advanced Manufacturing and Software Technology Center (AMSTC) in Grand Rapids, Minnesota where an advanced high pressure coating technology is applied to turbine blades making them stronger and more durable.

"Advanced manufacturing involves the use of innovative technology to improve products and/or processes."

Manufacturing Demonstration Facilities

A MDF is a collaborative, shared research, development and demonstration (RD&D) infrastructure focused on a targeted technical area of manufacturing[5]. The facility hosts centralized and openly available manufacturing capabilities needed to support advances in manufacturing. MDFs allow U.S. manufacturers access to energy efficient, rapid, flexible manufacturing technologies. These include physical and virtual tools as well as expertise for prototyping new technologies and optimizing critical manufacturing processes that are otherwise cost prohibitive or inaccessible to the manufacturing community. By its nature, the MDF reduces the technical risks associated with promising innovations and increases the ability of small and medium sized enterprises to expand operations due to increased access to resources. The reduction in risk and capital expenditures allows manufacturing firms to develop, demonstrate, and evaluate product and process technology leading to innovation and business growth. Furthermore, the open structure of the MDF allows for the exchange of information between manufacturers including design tools, processing tools, qualification and certification approaches and costing methods. This will also support the education, training, and development of the existing and future workforce.

Through the provision of resources to small and medium sized enterprises that are capable of growth, a MDF, and advanced manufacturing in general, provides a path forward to revitalizing Titusville's leadership in manufacturing. Titusville's long-term ability to innovate and compete in the global economy greatly benefits from the co-location of manufacturing and manufacturing-related R&D activities in the area. The loss of these activities will undermine the capacity to invent, innovate, and compete in global markets.

"MDFs reduce the technical risk associated with promising innovations by increasing access to manufacturing resources."

The purpose of this study is to compile information concerning available resources to support the concept of developing an advanced manufacturing hub in Titusville. These resources pertain to organizations and institutions that are in the business of advanced manufacturing as well as research and development of new technologies and workforce training. The study then examines existing facilities that may be available to support this effort and potential sites for locating new facilities. Finally recommendations concerning implementation strategies and funding are presented.

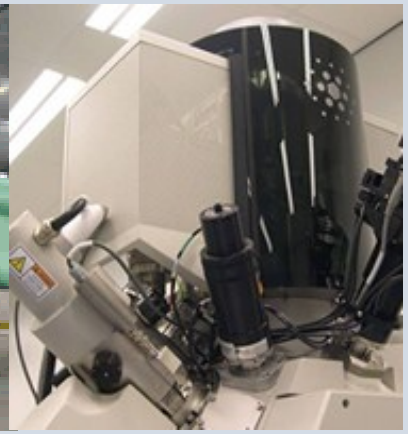
Manufacturing Demonstration Facilities

GE's Advanced Manufacturing and Software Technology Center

In 2010, General Electric expanded its operations in Michigan and developed its Advanced Manufacturing and Software Technology Center. It is expected this Center will create nearly 1,600 new jobs in the state by 2013 with 90% of those positions being filled by Michigan citizens. Aided by aggressive tax incentives, the center utilizes engineers that remain in the area after the restructuring of the automobile industry.

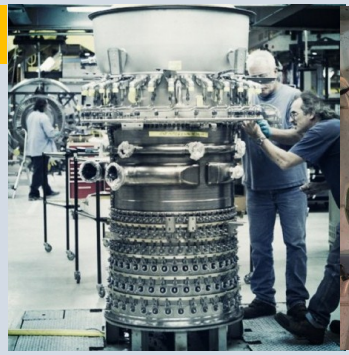
Missouri S&T's Center for Aerospace Manufacturing Technologies

The Center for Aerospace Manufacturing Technologies at the University of Missouri S&T is a university based center of excellence in aerospace manufacturing technologies. As a research and development center, the primary role is to develop advanced and emerging technologies and to transfer those technologies to aerospace manufactures and their suppliers. Functional areas of the center include direct digital manufacturing, composites manufacturing, and electronic materials processing. Members include Boeing, Rolls-Royce, Siemens, and GKN Aerospace among others.



Ohio's Advanced Energy Manufacturing Center

The 20,000 square foot Advanced Energy Manufacturing Center in Lima, Ohio houses flexible fabrication and robotic assembly demonstration projects. Focused on design and development, sustainable energy, advanced materials, and additive manufacturing, the center is intended to create new, high tech manufacturing jobs in Ohio.



Organizational Resources

1

Manufacturing Association of Florida (MAF)

- The MAF is an advocacy organization that serves to improve the business climate for manufactures in Florida
- Website: www.mafmfg.com

2

Advanced Manufacturing Association of North Central Florida (AMANCF)

- The AMANCF encourages the success of local manufacturers through the promotion, support, and expansion of manufacturing efforts.
- Website: www.amancf.org

3

Manufactures Association of Central Florida (MACF)

- The MACF is a not-for-profit organization that works to elevate the image of Central Florida's manufacturing sector and provide tangible resources to local manufactures
- Website: www.macf.biz/

4

National Aeronautics and Space Administration (NASA)

- NASA is responsible for the nation's civilian space program and for aeronautics and aerospace research.
- Website: www.nasa.gov/

5

Space Coast Technical Network (STN)

- The STN is a dynamic network of highly motivated, experienced, and innovative skilled professionals with broad industry expertise.
- Website: www.spacecoasttechnicalnetwork.com

Chapter 3: Key Enabling Technologies

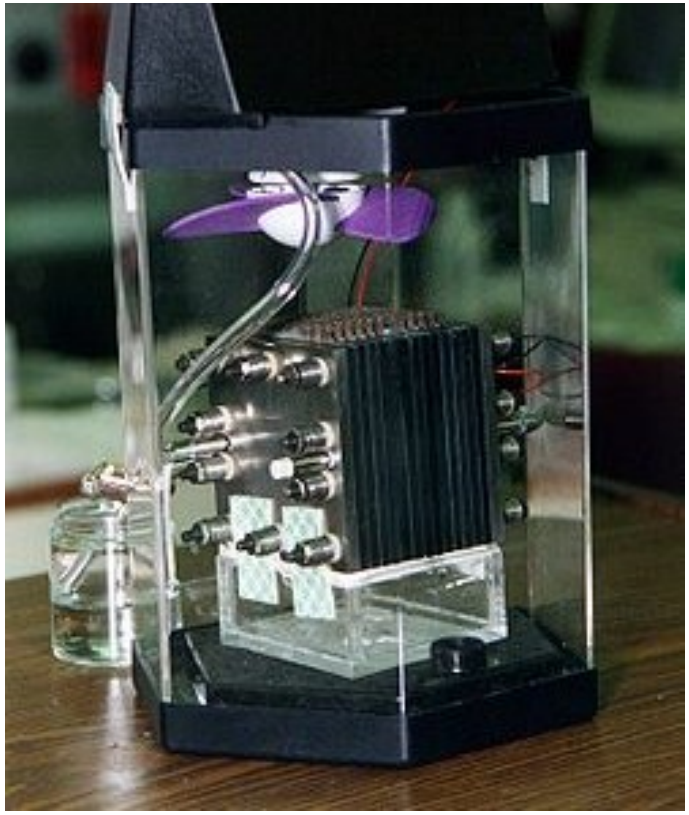
Overview

Advanced manufacturing plays a significant role in the development of five key enabling technologies (KETs): nanotechnology, biotechnology, micro/nanoelectronics, advanced materials, and photonics. These technologies are cutting-edge and will lead to innovations in many sectors of the economy. While some of these technologies are still currently being researched, they form the foundation on which future products will be made. Further development will create opportunities in a variety of industries typically including energy, transportation, medicine, information and communication. These technologies enable a reduction in costs by increasing efficiency and decreasing waste in the manufacturing process. KETs, aided by advanced manufacturing systems, will help build more productive, energy- and resource-efficient products that bear high economic value and contribute to a healthier and safer environment[1].

General applications of KETs by industry include:

- Energy: renewable energy, new biofuel production processes, solar PV module production, advanced fuel cells, smart-grid, energy storage
- Transportation: Development of lighter, safer, and energy efficient transport vehicles
- Information and Communication: Micro-controllers for secure communication, banking and commerce
- Environment: Sensors for environmental monitoring
- Medicine: Gene therapy, genetic testing
- Consumer Goods: cell phones, LEDs, LCDs

This portion of the Advanced Manufacturing Strategic Plan provides a brief overview of the five key enabling technologies and a



Above: Demonstration model of a direct-methanol fuel cell.

"Developments in the Key Enabling Technologies will significantly impact a variety of industries."

Nanotechnology

Developments in the field of nanotechnology will significantly alter the way in which products are manufactured. Today, raw materials are machined down to their functional level in a subtractive manufacturing process. This traditional way of manufacturing will be changed with the introduction of nanotechnology.

Simply defined, nanotechnology involves the engineering of functional systems at the molecular level[2]. Compared to subtractive manufacturing processes, nanotechnology enables manufactures to build products up from the molecular level to make complete and high performing products. This will enable rapid prototyping and low cost manufacturing.

Nanomaterials by definition are chemical substances or materials that are manufactured and used at a scale between 1 and 100 nanometers[2]. For illustration purposes, a nanometer is 10,000 times smaller than the diameter of a human hair. At this size, these chemical substances exhibit novel characteristics including increased strength, chemical reactivity or conductivity compared to the same material not at nanoscale. Nanomaterials have been created in laboratories worldwide with numerous applications in batteries, automobiles, electronics, foods and health supplies among others.

Currently, nanomaterials and nanotechnology are largely based in research laboratories due to the lack of infrastructure and processes needed to achieve scale. Manufacturing techniques have been adapted to function with nanomaterials but new process technology must be created to fully harness their potential. To achieve the goals of cost reduction and increased manufacturing capabilities, material producers, academic institutions, and system integrators must collaborate to establish the necessary value chain to scale nanotechnology.

Above: Sheets of carbon nanotubes glued together with an industrial adhesive could be used to produce lighter aircraft and more resilient space probes.
Below: The wind tunnel at GE's nanotechnology lab where nano-inspired airplane wing coatings are tested.

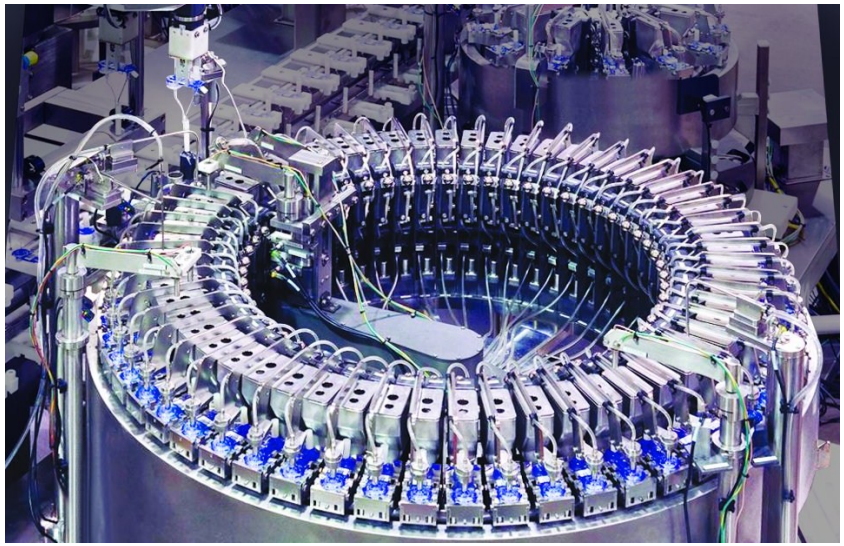
Biotechnology

Biotechnology involves the use of cellular and biomolecular processes to develop technologies and products. This includes genetic engineering, cell and tissue culture technologies and other biological science processes that result in applications for commercial products[3].

While the most widespread application may be in medicine with uses in drug production, pharmacogenomics, and gene therapy, biotechnology is not limited to the medical field. Biotechnology is used heavily in agriculture to ensure high crop yield and resilience to pests. Advances in this field have yielded biodegradable plastics, new process technology to create biofuels, and is the foundation of bioremediation. While intellectual property rights associated with biotechnology and questions about the health effects of genetically modified organisms has brought ethical questions forward, responsible practices in biotechnology will yield breakthrough products in years to come.

There are an increasing number of chemicals, materials, and products that are being produced using some form of biotechnology. As applications for biotechnology continue to grow, it will become necessary to improve production processes to more efficiently create these biomaterials. Advanced manufacturing systems provide the foundation on which biotechnology can be produced and scaled cost effectively. The further development of biotechnology will enable industry to manufacture products that are economically and environmentally sustainable through the eco-efficient use of renewable resources as raw materials[4].

Above: Inside of a biotechnology company producing cancer treatments. Below: An advanced manufacturing system is used to produce the dosage form of a new pulmonary drug delivery system.

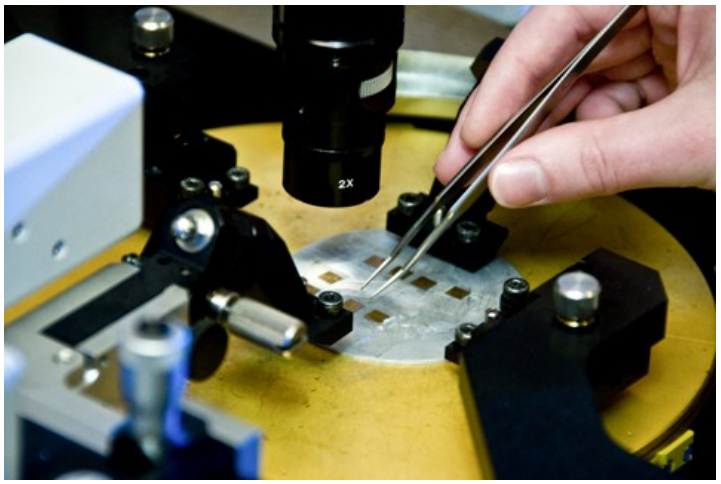


Micro/Nanoelectronics

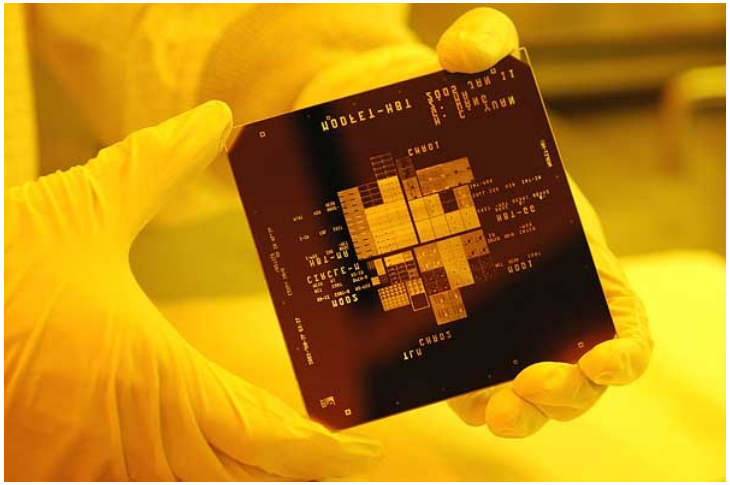
In the world of electronics, size is everything. As the industry continuously innovates the production processes to reduce the size of its products, it is limited by the size of the functional component parts. Integrated Circuits (ICs) are at the heart of this battle. ICs are in everything from computers and communication systems to any expanding number of general consumer goods with the most important component products being microprocessors and memories. The pace of innovation drives size reduction of these component parts enabling the same functionality on a smaller structure.

With increases in technology, ICs have evolved into Photonic ICs that are capable of manipulating photons. This development is similar to those that are occurring for transistors and microprocessors. This is increasing the speed of electronics even as their component parts decrease in size. Through advanced manufacturing techniques the state of the industry can move towards Silicon Photonic chip manufacturing in the short run with optic computing being the goal in the long run. This will drastically reduce the number of fiber interconnections necessary for computing capabilities while utilizing less costly raw materials. In addition, developments in computer chip production will allow for greater functionality and increased uses in industry applications.

Advanced manufacturing systems applied to micro and nanoelectronics allow the continual shrinking of the ICs physical structure where total size can be between 40 and 300 nanometers[5]. This will result in a significant reduction in the amount of silicon used during production thus decreasing costs. With advanced production technology, larger production volumes can be realized with a lower defect rate also leading to reduced costs. The reduction of defects through the implementation of advanced manufacturing technologies will reduce the costs associated with electricity, water, and waste. Combined, this reduces the environmental footprint of the production facility.



Above: Nanoscale computer chips are arranged under a microscope. Below: Fabricated patterned-photo resisits of nanoscale semi-conductors and laser diodes at the Wisconsin Center for Applied Microelectronics.



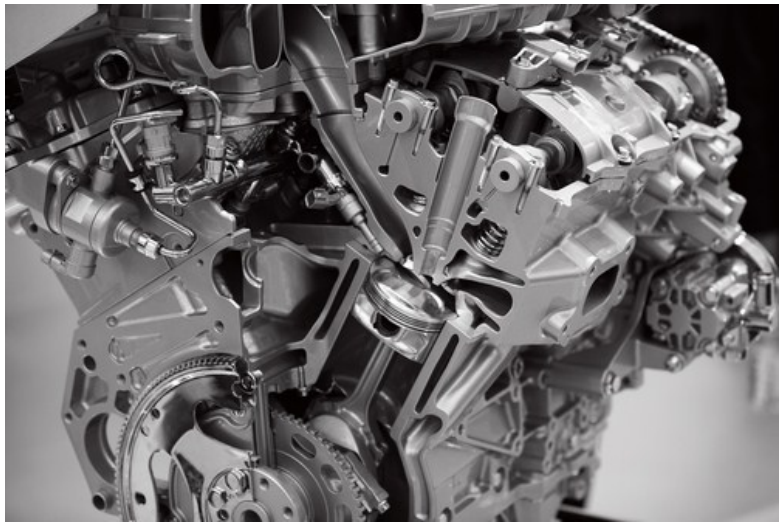
Advanced Materials

The term "materials" is inclusive of many physical products and, generally, is an umbrella term for five subgroups: metals, polymers, ceramics, glasses, and composites. These materials in their traditional sense have been used for hundreds or even thousands of years in a variety of applications. Through advances in our understanding of how these materials behave in different environments and in different applications, modifications have been made to obtain superior performance in one or more of their characteristics compared to their traditional counterparts. Some examples are:

- **Advanced Metals:** advanced stainless steel, super-alloys, and intermetallics
- **Advanced Polymers:** synthetic engineering-nonconducting polymers, engineered plastics, organic-electronic materials OPEs, and nanofibers
- **Advanced Ceramics and Superconductors:** nanoceramics, piezoelectric ceramics, and nanocrystals,
- **Novel Composites:** polymer composites, continuous fiber ceramic composites, metal matrix composites, metal fullerenes and nanotubes
- **Advanced Biomaterials:** bioengineered materials, biosynthetics, and catalysts

Many advanced materials are simply products of developments in material technology and manufacturing processes that create "new" materials through novel process techniques. Thus, advanced manufacturing systems for advanced materials must be applied to earlier stages in the value chain that include the manufacturing of the material itself before that material is then processed into its final form[1].

Above: At Georgia Tech a student and professor examine hydrogel matrices used to form vasculature. Below: an engine is coated with a super-alloy to increase resistance to elevated temperatures and corrosion.

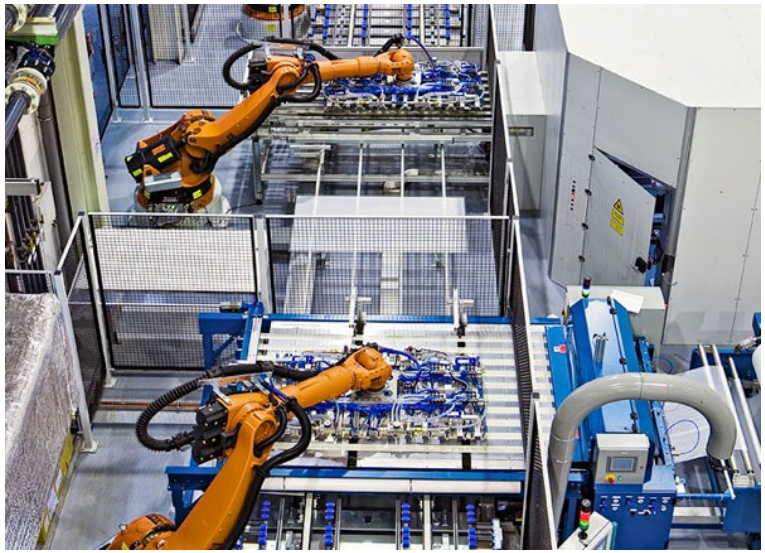


Photonics

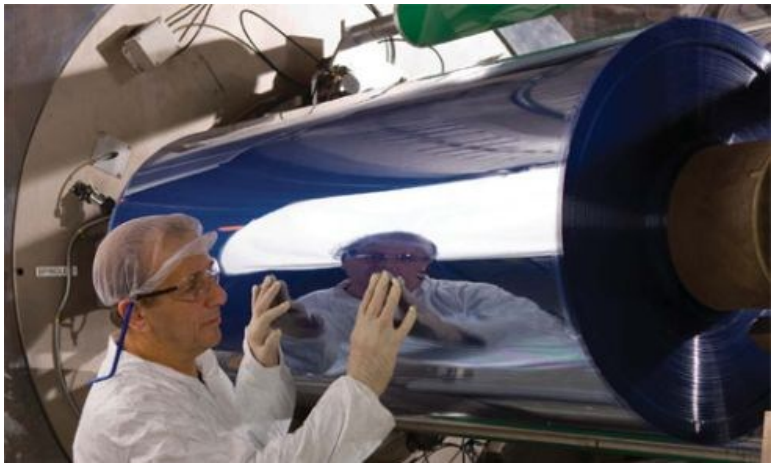
Photonics are integral to the energy industry and include products that contribute to the generation, consumption, and manipulation of electricity. Categorized as either light-in or light-out products, photonics range from solar photovoltaic cells to displays, solid state lighting including LEDs and organic LEDs and also include light-manipulation devices such as fibers, photonic chips, and sensors. Each one of these technologies will be significantly altered with the introduction of advanced manufacturing systems.

LEDs: Over the past decade, Light Emitting Diodes have begun to replace the light bulb due to extended useful life and a resulting decrease in energy consumption. Advanced manufacturing will improve the efficiency of LED wafer production and LED packaging resulting in a reduction in price. Increased capabilities of LEDs including fully recyclable LEDs and complete light management systems with functional LED sensors can be achieved through advanced manufacturing systems.

Solar PV: Current solar photovoltaic technology requires solar cells which are produced sheet-to-sheet to be encapsulated in a support frame to make a solar module. This process requires a significant amount of silicon. With advanced manufacturing technology, solar cells can be printed from roll-to-roll using thin-film technology drastically reducing the amount of silicon and utilizing less costly materials. In addition, advanced manufacturing systems could enable organic photovoltaics to become cost competitive with other solar technologies. This will further reduce the use of rare earth metals.



Above: Fully automated production of CIGS solar modules. Below: Roll-to-roll production of thin film.nanosolar.

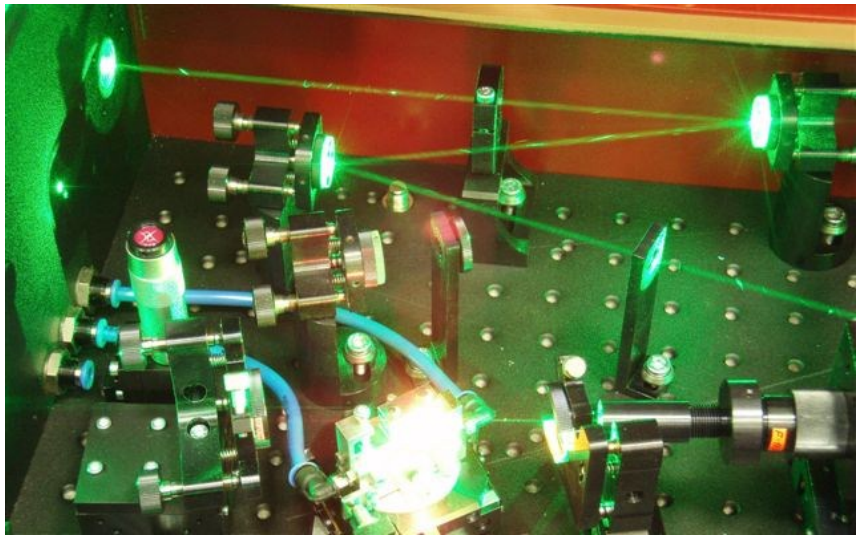


Photonics

Photonic Components: Photonic components include laser sources, fibers, and mirrors that are used in photonic devices. These components have applications in medical and scientific equipment as well as in certain industries. Optic instrumentation is also a key component used in photonic devices that will continue to grow in demand as more powerful products are developed. Through advanced manufacturing and application of other key enabling technologies old technologies will be enhanced and new photonic devices will be developed. The application of nanotechnologies including carbon nanotubes, photonic crystals, and grapheme will significantly change the manufacturing process and potential of photonic components.

While applied to photonics, advanced manufacturing systems will reduce cost, decrease waste and enhance economic value. It is typical to see front-end and back-end manufacturing facilities in the photonic value chain. The front-end production involves the manufacturing of the component parts necessary to produce the final product. For LEDs, front-end manufacturing involves the production of a 2-4'' wafer while the back-end production is where this wafer is then manufactured into the LED device or lamp. The application of advanced manufacturing systems holds the potential to merge these two processes into one fabrication plant resulting in cost savings and waste reduction[6].

Above: Advanced manufacturing processes create solar photovoltaic cells with less waste and minimal impact on the environment. Below: Femtosecond lasers are used to inactivate viruses.



Advanced Manufacturing Systems

Manufacturing technologies are the foundation on which products are produced. The five key enabling technologies hold the potential to revolutionize the products currently available in the marketplace. The next generation of products that utilize these innovative technologies must be produced with advanced manufacturing systems to ensure that the products can be brought to market at a competitive price. Once such advanced manufacturing system is additive manufacturing.

According to the American Society for Testing Materials (ASTM), "additive manufacturing is an advanced manufacturing process that involves the joining of materials to make objects from three dimensional (3D) model data, usually layer upon layer as compared to subtractive manufacturing methodologies[7]." This process minimizes waste and eliminates the need to maintain large inventories of component parts. The products produced using additive manufacturing can achieve significant strength while remaining light weight. There are numerous applications in the aerospace and automobile industry as well as in consumer goods. Additive manufacturing machines commonly referred to as "3D printers" are able to manufacture a variety of products without needing to be retooled.

Recently, the University of Central Florida (UCF) submitted a proposal to locate the headquarters for the National Institute for Additive Manufacturing (NIAM) in Brevard County. The facility would be located in Palm Bay, Florida but, under the grant, there is an opportunity to develop a test bed facility in Titusville. A task force was formed to garner local support for the proposal. In a very short period of time the task force generated over thirty-five letters of support from local government, economic development agencies, area businesses, and entrepreneurs. The majority of these businesses functioned in the manufacturing field in research and development, production or as end users of additive or advanced manufactured products.

Excepts from the National Institute for Additive Manufacturing Letters of Support:

"The NIAM project is consistent with the objectives of our economic development program and will serve as a catalyst for future growth in the high tech industry for North Brevard County." Robin L. Fisher, Brevard County Commissioner

"The proposed consortium with its manufacturing facilities and expertise will be helpful in allowing us to develop new products and more effective manufacturing processes to further our research with new materials and processes." Andy Tran, President of Minting Mill LLC

"We believe the proposed consortium with its manufacturing facilities and expertise will be an invaluable asset to our clients, empowering them to innovate new products, develop effective manufacturing processes and compete on a global scale." Neil Bourgeois Vice President of The SolidExperts

Advanced Manufacturing Systems

Advanced manufacturing systems are built around lean practices that promote continuous enhancement of resource efficiency. With decreasing natural resources such as fresh water, increasing prices of commodities, and worries about climate change it has become imperative that industrial production must rely on more efficient processes. Advanced manufacturing systems that utilize advanced materials including nanomaterials could result in cradle-to-cradle production of goods. In this setting, raw materials used for initial production of products can be efficiently extracted after the product's useful life and reused as new input materials.

Advanced manufacturing systems are vital to the success of the key enabling technologies. To ensure future competitiveness in the global marketplace, Titusville must develop the capabilities to meet the demands of the future market. The processes must be resource and energy efficient and flexible enough to respond to sudden changes in commodity prices while contributing to high value products. This can be achieved by focusing on technologies that are capable of manufacturing at the micro and nano level. This level of precision can only be achieved through the acquisition of the most precise advanced manufacturing technology.

In some fields, industries use key enabling technologies that can be transferred to other industries. The only way for these technologies to cross industry boundaries is for coordination and communication between different and diverse industry players. This type of collaborative environment can be achieve through a manufacturing hub.

While numerous businesses in the area have been identified as either existing users of advanced manufacturing systems and their key enabling technologies or potential benefactors, for purposes of this study three industry sectors have been selected for further analysis: Biosciences, Aerospace/DoD, and Energy. Organizations from each of the three industry sectors were identified and analyzed. The future ability of Titusville to innovate and invent new products for these three industries greatly depends upon how well the area can support innovation and the development and use of advanced technologies for its manufacturing sector.

Above: A light crane system is used to increase flexibility at a Siemens advance manufacturing plant producing power transmission components.

"Advanced manufacturing systems are vital to the success of the Key Enabling Technologies."

Chapter 4: Biological Sciences

Overview

The term "biological sciences" (biosciences) is used to refer to many different controlled biological processes. Adam Arkin, a Professor of Bioengineering at the University of California and Director of the Physical Biosciences Division of Lawrence Berkeley National Laboratory defines the biological sciences as a "field that tries to build a large toolbox of biological techniques and technologies to truly understand biological systems…in order to manufacture products[1]." The main driver behind advances in the biosciences is the capability to manipulate biological systems that enable organisms to produce or repeat desired traits. Thus, organisms are engineered to exhibit precise and predictable outcomes.

Modern advances in the biosciences emerged from the 1980 Supreme Court Case that ruled genetically modified organisms (GMO) could be patented. In this case, the GMO in question was a bacterium developed by General Electric that could break down crude oil for use in oil spills. This opened the door for organizations such as Monsanto to patent crop strains that exhibited desired characteristics such as hardiness or resistance to pests. Other companies have followed suit resulting in a wide variety of applications for genetically modified organisms. Countless other companies utilized GMO products as inputs into their production processes totaling billions of dollars of investment. Further advances in the biosciences will fundamentally affect agriculture, health care, and result in a variety of industry applications.

Left: Student at Virginia Tech inoculates tomato plants with a bacteria. Below: Dr. John Nelson conducts DNA research for the Human Genome Project

Agriculture

By 2030, world population is predicted to reach 8.3 billion drastically compounding the need for a secure food supply[3]. This increase in population coupled with decreases in arable land requires new agricultural techniques that will increase crop yield and reduced susceptibility to unfavorable climates. An increased understanding of the biological processes utilized by food crops will undoubtedly affect the current agricultural system and help meet the nutritional needs of future generations.

It is estimated that by 2015 roughly half of all global food, feed, and industrial feedstock crops will come from plant varieties developed using biotechnology[2]. This biotechnology includes genetically modified organisms, intergenerics, gene shuffling, and marker assisted selection. These are processes that result in either increased yield, resistance to stresses such as drought and salinity, pests, or the expression of desirable traits such as skin thickness, kernel size and higher nutritional value. By selecting for and encouraging the expression of these desirable traits, farmers will be able to produce a higher yield on less arable land resulting in cost savings.

Above and Below: Fields plants with Monsanto's Roundup Ready corn and soybeans are more resistant to pests and produce increased yields.

Case Study: Corn Rootworm

A recent report by the National Research Council estimated that through the use of biotechnology-enabled control of corn rootworm, 10 million acres of farmland produced $231 million in additional annual revenue from crop yield gains, reduced insecticide use by 5.5 million pounds annually, and eliminated 5.5 million gallons of water annually from the farming process[3].

"Advances in the Biological Sciences coupled with advanced manufacturing systems will help us meet the challenges associated with increased population."

Health Care

Health care will be drastically affected by advances in the biological sciences. In the past, the treatment of diseases has relied primarily on pharmaceuticals derived from traditional chemical synthesis along with devices and procedures that were designed to treat symptoms rather than the underlying causes[2]. With an increased understanding of the biological sciences, treatments will be developed that will specifically address the underlying cause of the disease. Already, advances in treatments for anemia, heart attacks, strokes, and cancer have been realized by an increased understanding of the biological systems associated with both the disease and its treatment.

It is believed that by 2015 biotechnology will play a role in the development of all therapies. This will influence pharmaceutical development, clinical trials, and prescribing practices. At this time, treatments are becoming more specialized. Currently, health care is experiencing the emergence of personalized medicine enabled by the ability to identify specific genetic information about the patient and pair that with personalized treatments[3]. This will make treatments more effective while decreasing unwanted side effects.

Working closely with Parish Medical Center, the City of Titusville can capitalize on the growing market of personalized medicine and medical device manufacturing. Share advanced manufacturing assets will expand opportunities for the suppliers of Parish Medical Center and act as a catalyst to develop new programs and facilities.

"By 2015, biotechnology will play a role in the development of all therapies."

Above: Inside of research firm Cambashi's medical device manufacturing facility.

Case Study: Pandora Genomics

Pandora Genomics is an Orlando, Florida based company established in 2011 that has developed the PGxSolution, a technology that helps ensure patients are prescribed the right medication in the right dose based on their genetic composition. While still in the R&D phase, Pandora Genomics could greatly benefit from advanced manufacturing assets. Supplies to companies like Pandora Genomics could also benefit greatly as their reduced capital expenditure could translate to lower per unit costs leading to increased demand for their products.

Industry Applications

Currently, many goods are derived from existing raw materials that undergo chemical or manufacturing processes that result in a market ready product. Advances in the biological sciences will result in improved micro-organisms that can produce goods directly for market or drastically reduce the need for intermediary processing. For example, sugars and lipids created by plants during photosynthesis are often extracted and used as feedstock for biofuel and bioplastic production.

The current process technology is costly and inefficient. Altering the genetic composition of the plants could enable them to produce and store these sugars and oils more efficiently decreasing the costs associated with extraction. Alternatively, some forms of genetically modified algae can convert sugars directly into ethanol during photosynthesis eliminating mechanical processing altogether.

Breakthroughs in the biosciences will result in increased capabilities of biosensors which allow for real-time monitoring of environmental pollutants and hazardous chemicals. In addition, genetically modified organisms specifically engineered to dispose of harmful chemicals can significantly contribute to bioremediation efforts.

The biosciences will lead to further developments in material production. For example, roughly 33% of all plant matter is cellulose. This cellulose can be converted into biopolymers which, in some cases, are compostable. Increased understanding of biopolymers produced from plant cellulose will lead to the next generation of compostable packaging. Through genetic modification, plants can be engineered so that the cellulose is more easily extracted and processed.

Case Study: Spider Silk

Spider silk is uniquely strong. Genetically altering the proteins in spider silk can improve its biocompatibility, stability, and flexibility making it attractive to engineers as an advanced biomaterial.

Case Study: Algenol Biofuels

Based in Bonita Spring, Florida, Algenol is a global, industrial biotechnology firm that has patented a DIRECT TO ETHANOL® technology that enables the production of ethanol from algae for less than $1.00 per gallon. Above: Scientist inspecting tubes of algae at the Algenol plant.

Advanced Manufacturing in the Biological Sciences

New manufacturing processes must be developed to ensure maximum impact of advances in the biological sciences. Advanced manufacturing processes aim to enhance the safety, quality, and consistency of products created through biosciences. By creating new tools for process optimization, control, and improvement, more cost effective production methods can be realized[4] further increasing the scale of the technology. But, in order for advances in the biological sciences to impact each industry, tools must be created to facilitate this change. Currently processes such as genetic engineering and metabolic engineering will continue to be used but advances in these processes are required to produce the next generation of biomaterials. In the short term (5-10 years) tools will be developed that are capable of manipulating biological systems. This will enable the commercial production of fine chemicals, pharmaceuticals, and biofuels directly from biological processes.

In order for these tools to be developed and the advances in biosciences to spread throughout industries, collaboration must exist between industry participants. This level of collaboration can only be realized in the type of environment that an advanced manufacturing hub would create. This type of collaboration has been seen in the agricultural industry. Currently, there is increased sharing of genetic information leading to the enhancement of U.S. competitiveness for food, energy, and chemical production. Similar examples of regional collaboration have been seen locally. The Lake Nona Medical City is a health and life science cluster composed of a variety of participants including the University of Central Florida's Health Science Campus, Sanford-Burnham Medical Research Institute, VA Medical Center, and the University of Florida's Academic & Research Center, among others. Parish Medical Center in Titusville, Florida, along with other hospitals nationwide, stands to benefit from the advances that will be seen at the Lake Nona Medical City. The establishment of an advanced manufacturing hub will allow Titusville to emerge as a central player in the development of advanced material production through advances in the biosciences Through collaborations between industry stakeholders, advances in the biological sciences will have a large impact on a variety of industries including agriculture, health care, as well as commercial applications.

Case Study: Space Florida Life Science Lab

Space Florida has partnered with NASA for the construction of the $29 million Space Life Science Lab (SLSL-Pictured on right). The SLSL resulted in the retention of over 100 high-tech and research jobs focused on biotechnology, microgravity, space agriculture, biomedicine, conservation biology, and microbial ecology. Currently, researchers are studying astronaut bone density loss, Alzheimer's disease, 'closed environments' for human and plant space travel, and LED lighting systems for plant growth among other biological studies[5].

Organizational Resources

1

Parrish Medical Center

- Parrish Medical Center is a public, not-for-profit acute care healing hospital with 210 beds.
- Website: www.parrishmed.com

2

BioFlorida

- BioFlorida is Florida's bioscience industry association with the mission to represent and advocate for the state's biotechnology, pharmaceutical and medical device industries.
- Website: www.bioflorida.com/

3

Astrogenetix

- Astrogenetix is the first commercial biotechnology company utilizing a microgravity environment of space to develop novel therapeutic products.
- Website: www.astrogenetix.com/

4

Pharmco Laboratories

- Pharmco Laboratories is a developer of specialized skin care products using the most efficient and effective ingredients known to the industry.
- Website: www.pharmcolabs.com/

5

Pfizer Inc.

- Pfizer Inc is a world leader in the discovery, development, and manufacture of innovative vaccines and medications for humans and animals.
- Website: www.pfizer.com

Chapter 5: Aerospace and Department of Defense

Overview

The aerospace industry is defined by those firms that design and build vehicles capable of flying through our atmosphere and outer space. The industry as a whole is one of the largest manufacturing industries in the world in terms of the number of people employed and the value of the output. In addition to its size, the industry demands a significant amount of funding for research and development leading to innovation in component technologies and developments in manufacturing, materials, and managerial techniques. Innovations in the industry drive lighter and stronger materials, more powerful propulsion systems, and increased capabilities of aircraft. The technology developed for aerospace applications permeates other industries including travel and tourism, telecommunications, and electronics. This industry supports regional economies and is intimately linked to the Federal government specifically through the Department of Defense[1].

The aerospace and defense industries include a wide range of manufacturing and service subsectors that contribute to the size of the industry as a whole. These subsectors consist of firms that develop, produce, and maintain commercial and military aerospace products including aircraft, helicopters, aero-engines, simulators, electronics, aviation-security products, and associated equipment along with space systems such as satellites, space-based communication systems, and advanced aircraft. Each one of these subsectors requires continued research and development and contributes to national income and prestige. The continued strength of the aerospace and defense industries depend largely on the ability to capture a growing share of the world aerospace and defense market. Growth in these sectors is linked to the cost, reliability, capability, and longevity of the products supplied to national and international markets. Advanced manufacturing techniques utilizing advanced materials will ensure the continued success and economic impact of the aerospace industry[2].

Above and Below: The next generation of advance manufactured fuel and resource efficient airplane engines.

Advanced Manufacturing Technologies

Advanced manufacturing technologies lead to significant advances in product manufacturing and resource processing. Utilizing these techniques and associated technologies, aerospace firms can more rapidly produce higher-quality, less-costly products with enhanced features for defense and commercial applications. This enables manufacturing plants to become more agile, flexible, and efficient as they implement enhanced design, scheduling, production, storage, and distribution activities[2]. The tools developed for advanced manufacturing include advanced machine tools, computer-controlled machinery, machine vision systems, robotics, automated production and processing systems, process sensors, among other instrumentation, production, and control systems. Additive manufacturing, referred to as 3-Dimensional (3-D) printing is one advanced manufacturing process that will directly impact the aerospace and defense industries.

Additive manufacturing as a prototyping and production process is decades old and has experienced fast growth due to advances in material science and the constant downward pressure on unit price. While additive manufacturing possesses the capability to revolutionize a variety of industries, aerospace firms stand to benefit greatly although high quality demands and strict certification rules has limited the number of applications to date[3]. Currently, additive manufacturing is used for tooling component parts, visual aids, prototypes as well as functional models. With the introduction of advanced materials, development in microelectronics and nanotechnology final products from additive manufacturing processes will be fully functional. The capability to rapidly manufacture parts for the aerospace industry will result in decreased unit costs and allow the flexibility to manufacture designs that were previously impossible or impractical to manufacture. Thus, products produced using additive manufacturing will become cost competitive with traditional processes in the near future.

Case Study: Rocket Crafters

On July 10th, 2012 Rocket Crafters announced that it has selected Titusville, Florida as the location for its manufacturing campus. Rocket Crafters is a manufacturer of lightweight, efficient, dual propulsion flight vehicles for transport of passengers and priority goods to the space shuttle and destinations worldwide in one sixth the time of current aircrafts. The company utilizes advanced materials, robotics, and additive manufacturing techniques to overcome the deficiencies of traditional manufacturing processes. Rocket Crafters is expected to bring about $96 million to North Brevard County in payroll and an overall economic impact of $48 million. Companies like Rocket Crafters stand to significantly benefit from the establishment of an advanced manufacturing hub.

Below: CTO Ron Jones at the Rocket Crafters announcement ceremony.

Additive Manufacturing

A variety of aerospace firms are experimenting with additive manufacturing processes and finding niche applications. United Technologies Corporation's Pratt & Whitney aircraft-engine division is using additive manufacturing in the construction of blades and vanes in compressors inside jet engines. In addition, Honeywell's aerospace unit is able to build heat exchanges and metal brackets while Boeing makes roughly 300 different smaller aircraft parts using 3-D printing. Boeing, in particular, has experienced a decrease in per unit costs through additive manufacturing compared to traditional techniques[4].

Additive manufacturing provides the benefit of integrating multifunctional devices for aerospace applications that are difficult or even impossible to make with conventional techniques. For example, microelectronics can be manufactured directly into composite materials reducing the time associated with production. The continued miniaturization of components requires new, high-precision manufacturing techniques. These techniques will enhance capabilities, reduce assembly costs, and improve quality and reliability by utilizing lean construction, eliminating fixtures and tooling, building in complex and/or advanced electronic components, and increasing manufacturing repeatability[5].

NASA has been experimenting with additive manufacturing for use on the International Space Station. The nature of additive manufacturing allows the customized production of spacecraft components including replacement parts and new tools directly from CAD drawings. NASA believes that in the near future broken parts may provide feedstock for fabrication of replacement parts on board of future space flights. While still in the future, this type of cradle-to-cradle production of component parts will drastically reduce waste and virtually eliminate the need to carry hundreds of space parts into space[8].

Above: Example of a 3-D printer for home and office applications. Below: Metal exhaust pipe printed using additive manufacturing for aerospace and motor sport applications.

Department of Defense Applications

The Department of Defense has been experimenting with advanced robotics including the development of a fully anthropomorphic android. While robotic technology has progressed to the point where this is feasible, current machining capabilities cannot produce the complex parts required to achieve full mobility. Additive manufacturing provides a solution by integrating sensors and microelectronics directly into composite materials. Advanced manufacturing technologies such as additive manufacturing will contribute to the development, demonstration, and deployment of materials and processes that address current and future needs of the Department of Defense.

Advances in the material sciences and the introduction of nanotechnology will also impact the Department of Defense. Florida scientists at Draper Laboratory in St. Petersburg and Tampa are experimenting with devices for the Department of Defense that will aid guidance and navigational systems in a variety of applications for the war fighter. Called "vanishingly small systems" these nanoelectronics are 25-50 nanometers or roughly 100,000 times smaller than a human hair. Due to their small size, these nanoelectronics require less energy while optimizing performance.

Above: Inside of an aerospace manufacturing firm.
Below: Artist rendering of a 3-D printed F-35 jet aircraft

Case Study: Knight's Armament Company (KAC)

KAC is a firearms and firearms parts manufacturer based in Titusville, Florida. KAC supplies a variety of weapons including the M-110, M203, the SR line of semi and automatic rifles, as well as light machine guns and personal defense weapons to the United States military and armed forces. Constantly seeking cost reductions and the ability to utilize new, lighter, and stronger materials, KAC stands to benefit from the product development opportunities that would emerge from an advanced manufacturing demonstration facility.

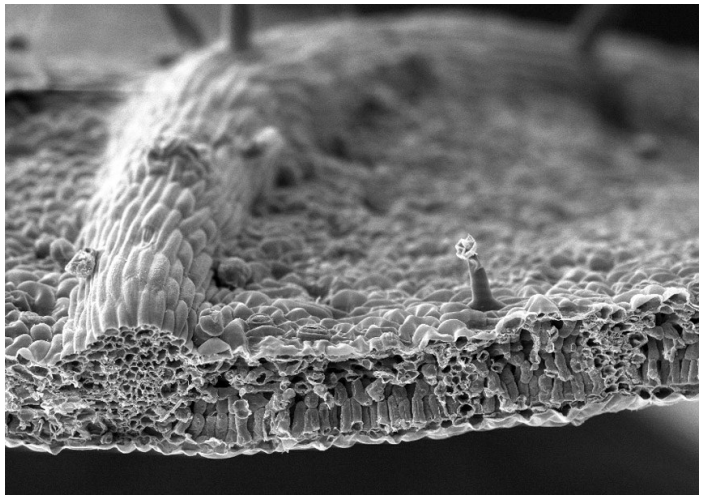
Novel Materials and Techniques

Advanced manufacturing in general along with additive manufacturing has been significantly impacted by the creation of tools such as the scanning electron microscope that allow precision at the nano level. This has allowed the development and application of advanced materials directly to aerospace and defense products. For example, carbon based composites including carbon fiber are becoming more important in the composition of the aircraft. Slade Gardner from Lockheed Martin stated that F-35 fighter jet is composed of 30% advanced composite materials by weight. This percentage is expected to continue to increase in the future[6].

Breakthroughs are being seen in advanced alloys as well. New processing techniques enable the use of new materials by driving costs down and adding new capabilities. For manufactures, the cost of the raw materials is only a fraction of the price of the final product. Manufacturing costs including labor, tooling, and inspection are the main drivers of the final costs for advanced products. A reduction in these manufacturing costs will drastically affect the final price of a product made with advanced materials allowing it to reach the market faster leading to the rapid scale of the technology.

Advanced processing techniques are also being developed that that make manufacturing processes more efficient and effective. Technologies such as laser, electron beam, linear friction and friction stir welding are being developed and refined enabling the joining of metal alloys. In addition, cladding technologies are creating stronger and more heat resistant materials for use in jet engines or in other high stress applications. Increased automation of production processes has improved the use of composite fabrication and joining while robotics and intelligent manufacturing systems create opportunities for the aerospace industry to apply advanced materials that facilitate the production of high-complexity parts at lower cost and with improved performance[7].

Above: Scanning Electron Microscope
Below: Detailed, nanoscale image of a leaf from a Walnut tree taken using a Scanning Electron Microscope.



Titusville and Local Stakeholders

Building domestic manufacturing capabilities in the aerospace industry is critical to national security. By applying advanced materials to aerospace products through advanced manufacturing techniques the industry can reduce the time and cost needed to develop and deploy the next generation of aircraft. Thus, advanced materials and advanced manufacturing technologies will address challenges the aerospace and defense industries currently face.

Titusville is in need of economic development activities that expand and diversify domestic and international opportunities. To drive towards the goal, Titusville must continue to support the industry by attracting, retaining, and expanding aerospace and related supply chain businesses in the area. The resulting economic impact will positively affect a variety of local industries and further expand opportunities in the region. This will lead to talent development, enhanced infrastructure, and support governments and organizations in improving the City's competitive business climate.

Titusville will continue to play an integral role in arranging financial incentives for aerospace and defense firms by providing start up and relocation support as well as connections with consulting services, relocation and venture development, and infrastructure development. An advanced manufacturing hub will act as a central location where these firms will be able to access the necessary equipment to expand and diversify their product offering or reduce costs associated with production making the firms more readily adaptable to changes in the marketplace. The development of an advanced research and manufacturing facility would attract an increase number of high technology companies to the Space Coast in turn creating a large number of high paying jobs. In conclusion, the development of an advanced manufacturing hub complete with assets that could be fully utilized by the industry will accelerate companies like Rocket Crafters to meet their product development goals while attracting other high technology companies to the area resulting in a large economic impact in the area.

Case Study: Craig Technologies

Craig Technologies is a nationwide technology firm that delivers engineering and technical solutions to commercial and government clients. Through a competitive RFI process, Craig Technologies was awarded full use of the equipment at the 160,000 sq. ft. NASA Shuttle Logistics Depot. Craig Technologies must operate, maintain, and store the equipment within a fifty (50) mile radius of the Kennedy Space Center. While on loan, Craig Technologies along with other aerospace businesses can use this equipment for commercial applications. This equipment could be fully utilized by the industry if housed in the open architecture of an advanced manufacturing hub.

Below: Milling machine at Craig Technologies.

Organizational Resources

1

Patrick Air Force Base

- Patrick Air Force Base is home to the 45th Space Wing.
- Website: www.patrick.af.mil

2

Space Florida

- Space Florida is an Independent Special District created with the purpose to foster the growth and development of the space industry in Florida.
- Website: www.spaceflorida.gov

3

Knight's Armaments

- Knight's Armament is a leading producer of quality firearms for military applications.
- Website: www.knigharmco.com

4

Banner Center for Homeland Security

- The Banner Center provides citizens and with education, training, and information on homeland security, terrorism, and emergency response.
- Website: www.homelandsecuritybannercenter.com

5

Boeing Company

- Boeing is the world's largest aerospace company and leading manufacturer of commercial jetliners and defense, space, and security systems.
- Website: www.boeing.com

6

Lockheed Martin

- Lockheed Martin is a global security and aerospace company engaged in the research, design, development, and manufacture of advanced technology systems, products, and services.
- Website: www.lockheedmartin.com

Organizational Resources

7

Rocket Crafters

- Rocket Crafters was founded to develop and commercialize a family of synergistic and interrelated aerospace products.
- Website: www.rocketcrafters.com

8

E'Prime Aerospace

- E'Prime is committed to providing innovative, reliable, and cost-effective launch services to government and commercial entities
- Website: www.eprimeaerospace.com

9

Astrotech Corporation

- Astrotech Corporation is a commercial aerospace company that provides spacecraft payload processing and government services.
- Website: www.astrotechcorp.com

10

Professional Aircraft Accessories

- Professional Aircraft Accessories offers a variety of component capabilities on numerous aircraft.
- Website: www.gopaa.com

11

SpaceX

- Space Exploration Technologies designs, manufactures and launches the world's most advanced rockets and spacecraft.
- Website: www.spacex.com

Chapter 6: Energy

Overview

The manufacturing industry is central to our economy as it produces 11% of U.S. gross domestic product (GDP) and generates 57% of U.S. export value[1]. This value does come at a staggering cost. Roughly one-third of all energy produced in the United States is consumed in manufacturing. Critical to national security and economic vitality is energy availability. Currently, there are opportunities to increase efficiency of manufacturing facilities and to utilize renewable sources of energy leading to reduced dependence on foreign nations for our supply of energy. Advanced manufacturing processes will build upon current energy technologies and expand opportunities for manufacturers. The implementation of these energy technologies will result in significant cost savings for manufactures while the production of renewable energy products offers an opportunity to enter the expanding market for advanced energy technologies.

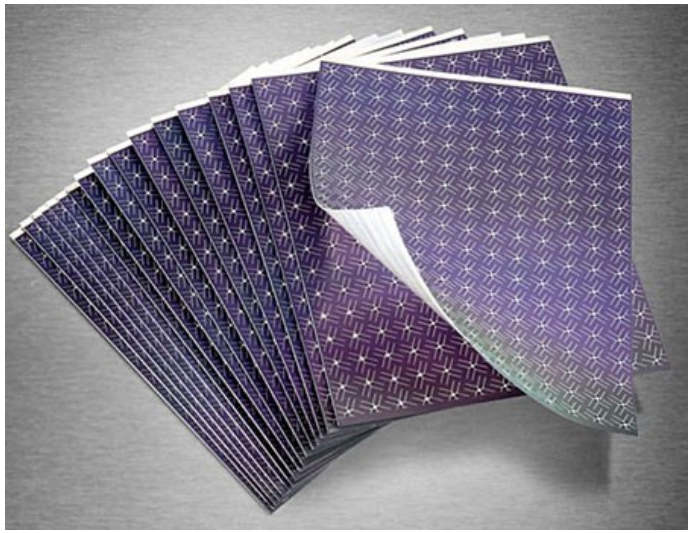
Many firms in Florida have answered this call to action by creating new manufacturing techniques that minimize energy consumption. In addition, companies are focusing their product development efforts on market opportunities in the energy industry. Throughout Florida's High Tech Corridor, many companies are utilizing transformative manufacturing technologies for market penetration and rapid scale-up of energy related product lines.

Energy and related processing technologies are capable through a select group of materials which possess the necessary traits to ensure production, distribution, and consumption of energy. Today the energy sector is experiencing a period of increased global demand and price instability. To curb the effects of these market trends, the capabilities of energy technologies must expand to include a variety of pathways to a sustainable energy future. This energy future is composed of energy efficient production processes, the use and manufacture of energy generation technologies, energy storage, and smart grid products.

Case Study: The U.S. Department of Energy

In partnership with the Savannah River National Laboratory and the University of Florida, the DoE is developing anti-reflection coatings for solar cell technology that can reduce reflective losses and increase the efficiency of silicon-based photovoltaics. This research aims to enable economically feasible and more efficient silicon-based photovoltaic technology with improved conversion efficiency and material stability[3].

Below: PowerSheet solar cells produced by Nanosolar, Inc.



Energy Efficiency and Conservation Technologies

Implementing advanced manufacturing technologies will result in more productive and profitable manufacturing processes by reducing losses in time, materials, and energy. Cutting edge computational tools and techniques along with the next generation of energy materials will provide a competitive edge to manufactures competing in both domestic and international markets. Materials that improve the efficiency of the final energy product as well as the manufacturing process will result in a competitive advantage and stable throughput. Thus, production innovations do not only result in more efficient solar cells or longer range car batteries but also lead to the increased productivity and profitability of manufacturers by enabling them to capture lost sources of energy and reduce wear on equipment and processing infrastructure[2].

The best use of capital resources is in the adoption of energy conservation and energy efficiency products. The focus on conservation and efficiency will jumpstart the development and growth of new supporting industries while having widespread applications in a host of other sectors. The implementation of energy efficient technologies including highly efficient HVAC systems, insulation, lighting, and reflective roof and window coatings will reduce the energy demand of facilities resulting in decreased costs while improving the condition of the facilities.

Alone, energy efficiency and conservation technologies are not enough. To truly overcome dependence on finite resources, a diverse energy portfolio must be constructed composed of all available and emerging energy sources within the spectrum of energy generation and storage technologies. Future energy procurement must be from multiple sources serving site specific needs. In order to achieve this goal, advanced manufacturing processes must be utilized to increase the efficiency of alternative energy technologies while decreasing the price of production. Clean energy generation includes a variety of renewable energy systems and component products including solar technology, wind turbine systems, and fuel efficient automobiles. Each one of these technology platforms stand to benefit from advanced manufacturing systems.

Case Study: PPG Industries, Inc.

PPG integrated an advanced combustion system on an oxy-fuel furnace into the Winter Park, Florida glass manufacturing facility. The high-luminosity burners provide high heat transfer to the glass resulting in lower fuel consumption and reduced emissions. This translates into a substantial decrease in operational costs while providing more uniform temperature distributions leading to longer furnace life[3]. Below: inside of a glass manufacturing facility.

Solar Photovoltaic Technology

Combined with energy efficient building technologies, solar photovoltaic energy generation can supply the energy needs of facilities while powering electric vehicles for short range use. Solar photovoltaic technology could experience significant efficiency gains through the application of advanced manufacturing processes. Through these processes, the absorption range and conversion efficiency of solar materials will increase resulting in a decrease in the cost per kilowatt produced. In turn, this will result in solar contributing to a greater percentage of domestic electricity production in the near future.

While solar and other renewable generation technologies are needed to diversify our energy portfolio leading to increase energy independence, the distribution infrastructure must be upgraded. New, "smart-grid" technologies will enable two way communication using the grid. Currently, centralized energy producers distribute energy on the grid without an in depth understanding of where the energy is headed and its specific use. Smart-grid technology will lead to increased efficiency, reliability, and sustainability of the production and distribution of electricity.

A major component leading to the expansion of renewable generation technologies in a smart-grid system is grid-scale energy storage. Many technologies currently exist including pumped hydro storage, lithium-ion batteries, and ultracapacitors but each technology has its limitations and can only be used in niche applications. The most promising technologies are the result of advanced materials. For example, the advanced material graphene used in conjunction with copper creates a capacitor with 10 time the charge density of current capacitors. While still being tested, these breakthroughs will make the smart-grid and grid-scale storage a reality.

Case Study: HelioVolt

HelioVolt has developed an advanced manufacturing process for producing thin-film Copper Indium Gallium Selenide (CIGS) solar modules. The proprietary technology and manufacturing process allows HelioVolt to lead in the production of practical and economical solar modules aimed at the fastest growing commercial roof top and ground mount solar application markets. Thin film modules compare to mono- or polysilicon use a fraction of the expensive semiconductor material resulting in a drastic decrease in cost. The automated and fully integrated manufacturing process from semiconductor deposition to final modules assembly and test allows HelioVolt to reach high manufacturing efficiencies and low costs more rapidly than other competing technologies[4].

Wind Power Technology

Manufacturing processes are susceptible to corrosion and wear on metallic surface resulting in deterioration that can reduce plant efficiency and result in equipment failures. Advances in material sciences have led to protective coatings that reduce wear in harsh environments. For example, wear-resistant coatings are ideal for use with wind system components that operate in high-friction situations or in unfavorable environments.

In addition, the use of stronger and lighter weight composites will increase wind turbine blade length making the turbine a more efficient producer of electricity. Surface treatments applied to turbine blades can extend the life of the turbine while decreasing downtime due to repair. As with solar modules, increase efficiency of wind turbines results in a decrease in the cost of electricity produced. These composites will also improve performance of both the blades and the tower allowing both components to withstand increased stress[2].

"Increased efficiency of wind and solar products results in a decrease in the cost of electricity produced."

Case Study: Advanced Magnet Lab, Inc.

(AML) AML, based in Palm Bay, Florida, was one of six companies awarded a grant from the U.S. Department of Energy for the advancement of the next generation of wind turbine technology. AML has developed a proprietary innovative turbine generator which enables the development of the first fully superconducting direct-drive generator for large offshore wind turbines. These generators are up to 75% lighter, 50% smaller, more efficient and more reliable than systems in use today. Successful development and deployment of this new technology will help position the United States and the region as a global leader in wind energy technologies, reduce the cost of wind energy, and support thousands of new manufacturing, construction and planning jobs in the renewable energy market[5].

Below: Offshore wind power farm off the coast of Spain.

Automotive Applications

The integration of advanced materials in the automobile industry will result in increased efficiency of cars, trucks, and other means of transportation. This involves the use of lighter component parts made from composite materials that out preform metals in some applications reducing the weight of the vehicle and improving fuel efficiency. From a manufacturing standpoint, these materials require more efficient processes with fewer steps and less energy input translating into cost savings[2].

Net-shape processing refers to a manufacturing method that produces components very close to the final shape, reducing material waste and often eliminating the need for costly secondary processing and finish machining[2]. This translates not only into time and cost reductions but net-shape processes also offer an avenue for tremendous energy savings by eliminating or combining energy-intensive processing steps. This approach has been found to be particularly effective in the manufacture of hard-to-form materials, such as high-performance, lightweight metals and composites, producing components with improved materials properties, and offering downstream savings opportunities in final transportation.

Advanced joining processes where different materials are fused together for specific applications will enable more seamless construction of vehicle structures while permitting the use of lighter weight materials in more demanding operating environments such as the high temperatures near the engine[2]. This directly applies to the next-generation of metallic materials. More fuel efficient automobile engines and advanced energy systems will only be possible when they are constructed from advanced metallic materials that can retain their strength and stability under the most challenging of conditions. There have been a number of thermal stability improvements in certain chromium alloys over the years and advanced manufacturing processes will build upon these successes.

The advanced automotive manufacturing facility (above) will lead to the next generation of vehicles includes lighter, more fuel efficient armored vehicles (below).

Automotive Applications

Reducing the weight of vehicles will drastically improve fuel efficiency but coupling lighter materials with advanced biofuels will create an even more efficient automobile. Drop-in biofuels are currently being used in unmodified plane, ship, and land vehicle engines with decreased greenhouse gas emissions compared to traditional fuels. Florida is uniquely positioned for the procurement of biofuels due to the prolonged growing season, access to water, and favorable soil. Coupled with advances in the biosciences, new advanced strains of feedstock will produce a greater yield of lipids which can be produced into biofuels at a fraction of today's cost.

The production and refining of biofuel feedstocks will ensure a reliable and affordable supply of energy. Advanced manufacturing technologies can bring biofuels to market at or below the price of petroleum fuels resulting in a tangible benefit for local stakeholders. As new regulations go into effect by 2015 mandating the use of more environmentally friendly fuels, Port Canaveral is well positioned to expand cargo services of biofuels and alternative energy products. The $150 million infrastructure investment at Seaport Canaveral allows for the receipt and distribution of biodiesel at its terminal to meet growing market demand.

Case Study: Rivian Automotive

Rivian is a Rockledge, Florida based automobile manufacturer. Rivian automobiles are designed and manufactured to provide extreme fuel efficiency and performance at an affordable price. Once in production, the first Rivian automobile is expected to get over 60 miles per gallon and sell for less that $30,000. In addition, Rivian has taken steps to reduce the waste in the manufacturing process resulting in increased efficiency and reduced environmental impact. Right: Founder of Rivian with first prototype vehicle.

Titusville and Local Stakeholders

Titusville is well-positioned to encourage future developments by leveraging the strength of its current industrial base, proximity to research universities, and national laboratories such as the Florida Solar Energy Center (FSEC). Local stakeholders stand to benefit from continued deployment of energy technologies. Each branch of the military has set specific goals concerning the reduction of energy consumption both on their bases and in the field. The Base Closure and Realignment (BRAC) selection criteria specify mission, condition of facilities, flexibility, and the cost of operations as the four main contributing factors to the military value of the base. Alternative energy technologies developed through advanced manufacturing techniques implemented in military bases in Florida will move the military towards their energy goals while fulfilling three BRAC value criteria: increased condition of base facilities, increased flexibility to future base demand, and reduced cost of base operations.

The technologies mentioned in this section are diverse in their manufacturing processes but their development and deployment can be accomplished quickly and cost-effectively through advanced approaches to manufacturing and materials. The scale of renewable energy products such as solar, wind, and automobile technologies along with affordable and effective efficiency and conservation measures are made possible through the application of advances in materials and material processing techniques. Material science and engineering breakthroughs will reduce the weight of final products and increase efficiency translating into cost savings in production and shipping. Meanwhile, transformational innovations hold promise to revolutionize the way the nation produces, transports, and consumes energy in the long term. However, many companies are slow to incorporate new materials or material processing techniques into their production processes due to the significant investment required. To fully resolve this issue, manufactures must have access to advanced manufacturing technologies for research and development purposes.

Above and Below: Solar panel testing facility at the Florida Solar Energy Center.

Titusville and Local Stakeholders

An advanced manufacturing facility would allow firms to access such technology without requiring a large capital outlay. By pursuing a balanced approach to advanced materials and manufacturing, Titusville can help companies deliver near-term improvements in the energy sector while laying the foundation for radical advances in the longer term. To this end, an innovative manufacturing economy is only possible with the support and investment of manufacturing stakeholders in the community. This requires a coherent and integrated approach that engages all facets of the manufacturing spectrum from the laboratory research to the end user.

The Space Coast Energy Consortium located in Cape Canaveral has engaged local energy and manufacturing companies interested in developing an advanced manufacturing hub. Through workshops, the Consortium has received feedback and suggestions while garnering support for the establishment of a hub. Currently, the Consortium consists of 16 member organizations including Craig Technologies, Mainstream Engineering Corp., and Rapid Prototyping Systems. In addition, the Consortium has 35 partner organizations including Space Florida, Technological Research and Development Authority, and the University of Central Florida among other local economic development agencies and universities. The level of community engagement, communication, and collaboration used by the Consortium should act as a model to ensure project support and success.

Case Study: Going Green

Titusville can drastically reduce its annual energy consumption resulting in significant cost savings for the City. Energy audits of municipal buildings will provide insight into the types of technologies that should be deployed to maximize savings. By utilizing present technologies in power generation, water, lighting, and building envelopes to meet the specific needs of each building, Titusville can work towards becoming a "net zero" city.

Below: the net zero National Renewable Energy Laboratory campus.

"Titusville can become one of the first net zero cities."

Organizational Resources

1

Space Coast Energy Consortium

- A group of business and community leaders who are dedicated to driving energy-related economic development in the Space Coast and Central Florida.
- Website: www.spacecoastenergy.org

2

Florida Solar Energy Center (FSEC)

- FSEC researches and develops energy technologies that enhance Florida's and the nation's economy and environment.
- Website: www.fsec.ucf.edu

3

Advanced Magnet Lab (AML)

- AML provides revolutionary technology for the design and manufacture of advanced coils, magnets, and magnet systems.
- Website: www.magnetlab.com

4

Clean Footprint

- Clean Footprint is a renewable energy company engaged in the retrofit of municipal, commercial, and residential buildings in Central Florida.
- Website: www.clean-footprint.com

5

Rivian Automotive

- Rivian Automotive is developing a highly flexible vehicle platform for a range of ultra-efficient, safe, fun-to-drive, affordably-priced cars
- Website: www.rivian,com

6

Gasoline Equipment Systems (GES)

- GES provides petroleum. Ethanol, compressed natural gas, and alternative fuel maintenance to convenience stores, fleets, marinas, and airports.
- Website: www.gasequipsys.com

Organizational Resources

7

Structural Composites

- Structural Composites provides engineering, scientific, testing and research and development support to government and industry.
- Website: www.structuralcomposites.com

8

Mainstream Engineering Corp.

- Mainstream Engineering offers world-class engineering services to the government.
- Website: www.mainstream-engr.com

Chapter 7: Workforce Training

Workforce Training

In order to compete with low-wage countries, manufacturers must implement advanced technologies to drive prices down while improving efficiency and quality. This improved level of production resulting from advances in manufacturing technology is the benefit of advance manufacturing systems. While manufactures stand to benefit greatly from its adoption, they must ensure that the workforce is properly trained to operate such machinery.

Despite high national unemployment levels, many manufacturing jobs remain unfilled as employers seek a skilled workforce with a solid understanding of advanced math, science, and technology. In the United States, the manufacturing industry employs 12 million people with pay and benefits well above the national average[1]. At this time, the manufacturing industry is contracting and an estimated 300,000 to 600,000 jobs are currently vacant[2]. In the global economy, these jobs are being lost to other countries that are able to educate their workforce to the level demanded by the industry.

A study completed by the National Association of Manufacturers showed that 80 percent of manufacturers cite "finding qualified workers" as a top concern[2]. The largest shortages are in skilled production jobs including machinists, CNC (computer numerically controlled) operators/programmers, craft workers, distributors, and technicians resulting in manufacturers' decreased ability to expand operations, drive innovation, and improve productivity[2]. Advanced manufactures are also looking for employees with competencies in micromechanical systems, computer technologies and applications for drafting/design, simulation and analysis, high-precision machining, robotics and other intelligent production systems, knowledge of composite materials, and the ability to custom-manufacture.

Above: A CNC machinist.
Below: A robotic operator.

Workforce Training

In Florida, many manufacturers are seeking skilled workers with industry credentials. The office of the governor estimates that Florida demands approximately 120,000 new workers in STEM (Science, Technology, Engineering, and Mathematics) fields through 2018[3]. The purpose of STEM education is to transform the classroom experience to one driven by problem-solving, discovery, and exploratory learning[4]. A study released by Georgetown University's Center on Education and Workforce stated, "The disproportionate influence of STEM raises a persistent concern that we are not producing enough STEM workers to compete successfully in the global economy[5]." Furthermore, the study found that while manufacturing jobs increase economic growth and productivity, businesses are struggling to find skilled workers capable of filling positions in advanced manufacturing. At this time, there is increased demand by industry for a workforce that completed training beyond high school including industry certifications, associate's degrees, as well as bachelor's and graduate degrees. The same Georgetown University study found that in just four years 92 percent of traditional STEM jobs will require this advanced level of training.

Eric A. Roe, director of the Banner Center for Advanced Manufacturing in Winter Haven, Florida stated, "We have surveyed our employers and their workforce issue mirrors the national picture — that even in these times of high unemployment, finding the skilled workforce is a critical challenge[2]." Roe believes the skill gap that is occurring is a product of the low-skill jobs leaving, mid-skill jobs staying steady, while high-skill occupations are increasing. Local manufacturing firms that either have or plan to adopt advanced manufacturing technologies must take into consideration the skill level of their current workforce.

Above: A winch technician
Below: A student works on a radio transmitter in a STEM education program

Workforce Training

While locating a viable workforce is an industry wide problem, this presents an opportunity for Titusville. Titusville currently has a strong STEM program in both of its high schools while Brevard Community College (BCC), Florida Institute of Technology (FIT), and the University of Central Florida (UCF) have strong training programs that meet the requirements of the industry. BCC in collaboration with UCF offers a four-year engineering program that spans both campuses. Professors as well as undergraduate and graduate students at FIT are consistently recognized for their research in a wide variety of engineering disciplines.

Due to the retirement of the shuttle program, the Space Coast has an abundance of highly skilled and capable scientists, engineers, and technicians. In 2011, Brevard Workforce completed a series of Aerospace Transition Workshops that assisted Brevard County aerospace workers transition into a variety of fields follow the end of the Shuttle program. This workforce is currently an underutilized asset that can be leverage to attract advanced manufacturing firms to Titusville. Unlike other regions, the Space Coast is perfectly positioned to transition this existing workforce into high wage advanced manufacturing jobs.

In addition to the highly skilled former NASA employees, Central Florida has a significant and sophisticated military workforce that will be returning from the wars in the Middle East. The job opportunities that will become available in an advanced manufacturing hub are consistent with their training.

"Titusville has an abundance of highly skilled and capable scientists, engineers, and technicians."

A recent study by the Boston Consulting Group reported that twenty-one percent of North American manufacturers transitioned production into, or closer to, North America in the past three months. This is up from twelve percent in first quarter of 2011. Even more exciting is that thirty-eight percent planned to research such a move in the next three months[6]. One of the main considerations of these companies is the level of skill of the workforce in potential locations. Companies will be attracted to those areas that currently have strengths in manufacturing with educational institutions that stress math, science, and engineering curriculum. Titusville and the Space Coast is one such area. Steps must be taken to promote this distinctive competency.

According to Andrew Liveris the CEO of Dow Chemical and Co-Chair of the Advanced Manufacturing Partnership, "every new manufacturing job on average creates five additional jobs[6]." Thus, a well-established and growing advanced manufacturing sector will result in meaningful long-term employment in a variety of industry sectors contributing to the economic health of the region as a whole. To meet this goal, our academic institutions, secondary and post-secondary, must change the way they teach and emphasize STEM subjects as well as incorporate the needs of the industry into the classroom. To this end, public and private sectors must collaborate to develop policies and programs that educate the workforce to the necessary level required by industry. An advanced manufacturing hub would allow the level of collaboration between public educational institutions and private industry participants that is needed to fully educate the workforce to the level necessary to be competitive in a global marketplace.

Organizational Resources

1

Workforce Florida

- Workforce Florida is charged with overseeing the state's workforce system.
- Website: www.workforceflorida.com

2

Brevard Workforce

- Brevard Workforce acts as a link between Brevard County employers and residents seeking employment.
- Website: www.brevardworkforce.com

3

University of Central Florida (UCF)

- UCF is the nation's second-largest university serving over 58,000 students.
- Website: www.ucf.edu

4

Brevard Community College (BCC)

- BCC has four campuses in Brevard County: Cocoa, Melbourne, Palm Bay, and Titusville.
- Website: www.brevardcc.edu

5

Titusville High School

- Titusville High School focuses heavily on STEM education
- Website: www.titusville.brevard.k12.fl.us

6

Florida Manufacturing Extension Partnership (MEP)

- The MEP provides resources and solutions to the growing concerns of manufactures in Florida.
- Website: www.floridamep.org

Organizational Resources

7

Employ Florida

- Employ Florida is an award-winning, statewide, industry-driven initiative focused on workforce education and training.
- Website: www.employflorida.com

8

Florida Sterling Council

- The Council recognizes organizations for their Performance Excellence with the Governor's Sterling Award.
- Website: www.floridasterling.com

9

Banner Center for Advanced Manufacturing

- Provides curriculum, training, and certification resources for developing and sustaining Florida's manufacturing production workforce.
- Website: www.banner-mfg.org

Chapter 8: Regional Context

Overview

Following the retirement of the Space Shuttle Program, Titusville has experienced an increase in the unemployment rate. At the same time, manufacturing jobs have been on the decline nationally as well as locally. While the offshoring of jobs is becoming a major concern, even more troubling is the general lack of skilled workers needed to fill domestic positions in manufacturing. The object of this study is to reverse this trend and create economic opportunity through the development of an advanced manufacturing hub. By bringing together educational institutions, local governments, and private industries, Titusville has the opportunity to strengthen its manufacturing base. To this end, the development of an advanced manufacturing hub must be envisioned through a regional perspective as it will attract a large, diverse group of stakeholders each invested in its success.

To help combat the loss of employment, The North Brevard Economic Development Zone was established with tax increment funding to allow the North Brevard area to formulate and focus on a strategy for economic development and job creation. An advanced manufacturing hub is one such strategy that could lead to drastic economic expansion and employment opportunities in high wage manufacturing jobs. To achieve this goal, North Brevard County must clearly define itself as a major player in the Florida High Tech Corridor.

Above and Below: Insides of advanced manufacturing facilities.

"By bringing together educational institutions, local governments, and private industries, Titusville has the opportunity to strengthen its manufacturing base."

Florida's High Tech Corridor

Titusville and Brevard County is the eastern anchor of the Central Florida High Tech corridor. The Florida High Tech Corridor is an emerging high tech cluster including 23 counties and three research universities: the University of Central Florida, University of South Florida and University of Florida. In the Corridor there are 21,454 companies employing 263,000 high tech employees equating to roughly 70 percent of Florida's high tech employment. These companies are focused on 10 key technology sectors[1]:

Agritechnology: With nearly 44,000 commercial farmers using the latest technology to deliver a dependable and safe food supply, Agritechnology is a thriving and growing industry in the Florida High Tech Corridor.

Aviation & Aerospace: With the presence of NASA, Kennedy Space Center and some of the world's largest aviation and aerospace companies including Lockheed Martin, Boeing and Eaton Corporation, Aviation & Aerospace is a high technology manufacturing cluster that serves both public and private sectors.

Digital Media/Interactive Entertainment: With the presence of Electronic Arts Tiburon, the world's largest video game developer, and the Florida Interactive Entertainment Academy (FIEA) at the University of Central Florida, the digital media/interactive entertainment industry is rapidly expanding.

Financial Services: With the presence of financial services powerhouses such as Citicorp, Chase Manhattan, Salomon Brothers and Raymond James Financial, employment in domestic financial services in the Tampa Bay area ranks 20th in the nation.

Information Technology: The Florida High Tech Corridor hosts 4,691 information technology companies, the largest being banking software provider Fiserv and TECO Energy Data and Computer Generated Solutions. The average payroll for IT employees in the Corridor is $72,300.

Florida's High Tech Corridor

Life Sciences/Medical Technologies: This industry includes biotechnology, pharmaceuticals and electromedical and device manufacturers. Some of the largest sector companies include Bausch & Lomb Pharmaceuticals, Florida Oncology Pharmacy in Tampa/St. Petersburg and Tyco Healthcare in DeLand. The Corridor is also home to the University of South Florida's, University of Florida's, and University of Central Florida's Colleges of Medicine.

Microelectronics/Nanotechnologies: Pinellas and Brevard County are home to 43 percent of all employees in this sector. The cluster includes specialized support companies such as contract manufacturers and assembly houses, as well as circuit design and research and engineering companies. Intersil and Jabil Circuit Manufacturing are some of the largest companies in this area.

Modeling, Simulation and Training: This is the High Tech Corridor's second largest technology sector. The modeling, simulation and training industry refers to the process of developing software that is used for a variety of training purposes, such as flight training simulators. Advanced simulation techniques are now widely used for military training, entertainment, testing and evaluation, education, analysis and product design, and are rapidly gaining new applications as the underlying technology advances.

Optics & Photonics: The Florida High Tech Corridor hosts more than 89 photonics technology companies, the largest include Smiths Aerospace in Clearwater, Teleflex Marine, a supplier to the boating industry, and AMETEK, a global provider of electronic instruments.

Sustainable Energy: Currently, the Florida Solar Energy Center at the University of Central Florida and Alternate Energy Technologies and Thermal Conversion Technologies of Gainesville are key elements in the industry's growth within the Corridor[1].

Above and Below: Aircraft simulation programs used by fighter pilots.

Florida's High Tech Corridor

The Corridor supports business success through the provision of State incentives and facilitates the commercial development of scientific discoveries through the Florida High Tech Corridor Council's Matching Grants Research Program. The Corridor, along with university support, has invested millions of dollars into promising scientific developments. Over the past 10 years, the Council has invested $48 million in 715 university research projects involving more than 250 companies. Those companies matched the Council's investment with $103 million, bringing the program's total investment in these technologies to more than $150 million[1]. At the same time, the three universities in the Corridor have $1 billion in combined research funding. Significant advances are being achieved in these research universities opening the doors for private companies to commercialize and scale this technology.

Public Private Partnerships (PPPs) have enabled public university scientists to partner with industry leaders in the evaluation of applied research projects and have accelerated their development. Centers of Excellence have been created to enable state universities and their research partners to leverage public and private dollars to build infrastructure, support emerging research and development projects, and help drive innovations from the lab to the marketplace[1]. To meet the goal of commercializing technology, there are a variety of tax and training incentives for businesses including the Qualified Target Industry Tax Refund which provides pre-approved applicants with a $3,000 tax refund (or $6,000 refund in an Enterprise Zone or rural county) for each new full-time equivalent job created. In addition, the Quick Response Training Incentives assists new and existing Florida businesses with necessary training for expansion[1]. Together, these collaboration structures, the hospitable business climate of Central Florida, and ability to reach a large and diverse market attract high technology companies to the region.

Above: Researchers at the Florida Photonics Center of Excellence at UCF.

"A diversity of high-tech manufacturing firms will find thriving clusters, networks and collaborations in the 23-counties that make up the Florida High Tech Corridor." - Business Xpansion Magazine

Intermodal Transportation System

Titusville is strategically located within the Central Florida region as it has direct access to four modes of transportation: air, land, sea, and space. The multimodal transportation system in Central Florida includes ports, airports, rail, private trucking and warehouse distribution facilities. In addition, Titusville has direct access to a space port servicing the needs of the International Space Station.

The two major consumption areas in Central Florida are located in Orlando and the Tampa Bay region. All major national truck carriers serve this region. At this time, the majority of freight headed to these areas consists of consumer goods, automobiles, food and concrete based products and is considered short-haul as it travels less than 300 miles. To reach these markets, goods must travel along one of Florida's major arterials including I-75, I-95, SR 70, SR 50, SR 528, US 27 and I-4. The region's major east/west arterials are the I-4 corridor stretching between Tampa and Orlando and SR 528 between Orlando and Port Canaveral[2]. Titusville has direct access to SR 50 and SR 528 through US 1 and I-95 granting it access to the Orlando, Tampa, and Miami markets. The close proximity and ability to immediately access the largest markets in Florida is a strategic advantage for Titusville. While long and short-haul truck comprises 65% of the total goods transported to, from, and within the region, railroad transportation makes up the remaining 35%[2].

The two freight railroads that serve the region are the Florida Central Railroad (FCEN) and CSX Transportation (CSXT). The FCEN operates 68 miles of track and directly serves industries in Orlando, Toronto, Plymouth, Zellwood, Mt. Dora, Tavares, Eustis, Umatilla, Ocoee, and Winter Garden. It is a local carrier that mainly transports lumber, foodstuffs, and specialty chemicals. The FCEN connects with CSXT at Taft Yard in Orlando. CSXT provides direct rail service between Central Florida and the eastern United States. Between the two railroads, freight can be transported within the Central Florida region as well as to other states in the country.

Above: FCEN Rail Line

"Titusville is strategically located within the Central Florida region as it has direct access to four modes of transportation: air, land, sea, and space."

Intermodal Transportation System

The Florida East Coast Railway (FEC) operates 351 miles of mailing track along the east coast of Florida with direct access to South Florida's ports including Port Miami, Port Everglades, Port of Palm Beach, as well as Port Canaveral. In addition, FEC serves five intermodal terminals with connections to CSX and Norfolk Southern in Jacksonville allowing access to markets in Georgia and along the east coast of the United States.

While the FEC is the existing rail line between the City of Titusville and Port Canaveral running along U.S. 1, this rail line requires upgrading and security hurdles must be overcome to ensure access to federal land. Working with the DoD and NASA, the FEC can overcome these security hurdles and Titusville can secure its position as a prime location for the establishment of an inland port.

There are numerous distribution terminals located within the Tampa/Orlando/Port Canaveral east/west corridor. These distribution centers are positioned to serve consumption centers further south at Fort Lauderdale and Miami as well as to prepare international cargo to be shipped throughout the United States[2]. There are several pockets of distribution centers located in Central Florida such as the Sand Lake Road area in Orange County. Unfortunately, these distribution facilities are not situated with any general regional design, an area that needs improvement to ensure faster and more reliable freight transportation in years to come[2].

Above: FEC Rail Line.
Below: Rail yard at an inland port in China.

Major Roadways in Titusville

Intermodal Transportation System

Port Canaveral is Florida's second largest cruise port in terms of annual passenger volume. A 2010 study found that, "the port as a whole generates more than 13,000 jobs from its cruise, cargo, marina, and real estate activities. The port has almost $650 million of direct, induced, and indirect wages, salaries and local consumption expenditures, $1.1 billion in revenue for businesses providing services at the Port, and $48 million state and local taxes generated at Port

Canaveral[3]." While cruise activity is the major contributor to direct job creation and income for the Port, cargo is the second largest which offers an opportunity to expand cargo services. Port Canaveral is closer to more major Florida markets than any other port and also has the ability to service ports worldwide. Currently, cargo vessels import petroleum products, cement, citrus concentrate, and salt while exports are limited to scrap steel, fresh citrus, and vehicles[4]. The Port is directly accessible by road including nonstop direct highway access to Orlando.

Urban Networds looked at the possible development of an inland port and concluded that it is feasible but rail connection is necessary. Currently, rail access is close to the port but would require intermediate truck transportation. In addition, currently there is not an east/west rail line connecting the Space Coast to the Orlando market. Establishing an east/west rail line that extends to the port will have significant impact on the ability to import and transport cargo enhancing the port as a center for commerce.

The Orlando International Airport (MCO) is Florida's second largest international airport and is located 35 miles from Port Canaveral. Compared to other south Florida airports, MCO is four hours closer to the rest of the U.S. making cargo air freight from MCO cheaper than shipments from other airports. Currently, 26 cargo companies operate out of MCO including UPS, DHL, and FedEx[6].

Melbourne International Airport (MLB) located in Brevard County includes three runways, eight gates, seven jetways, and a 200,000-square-foot terminal. The facility can accommodate 2 million travelers annually and is also home to a thriving industrial park comprised of aerospace and aviation technology companies, including three aircraft manufacturers[3].

The Titusville-Cocoa Airport Authority governs the operations of the Space Coast Regional Airport, Arthur Dunn Airpark and the Merritt Island Airport. The three airports include expert aircraft maintenance and repair facilities and this system of airports allows for convenient access to I-95, SR 528, U.S. 1, SR 3, Port Canaveral and railway facilities. The Space Coast Regional Airport is the closest airport to the Kennedy Space Center which has allowed it to play an important role in the transportation of NASA personnel and equipment[7] .

"Bringing rail to the port is so important to make Canaveral not only a tourism center but also a commercial center[5]," John Mica, U.S. Representative for Florida

Intermodal Transportation System

The John F. Kennedy Space Center (KSC) is the NASA installation that has been the launch site for every United States human space flight. As the world's only launch site for the space shuttle, KSC handled shuttle ground processing, launch, landing and recovery. Since the ending of the shuttle program there are no longer any active US space flights planned. Today, KSC continues to manage and operate unmanned rocket launch facilities for the civilian space program from the Cape Canaveral Air Force Station. Currently, the Center is undergoing a transition to a government launch complex that allows commercial and government launches, instead of just limiting it to a particular government launch program[3].

Titusville has the opportunity to leverage its existing, educated workforce and strategic position in the High Tech Corridor and further development advanced technology capabilities in the City. Investment opportunities include the development of facilities as well as recruiting, training, and the placement of advanced technology companies in Titusville. Through the development of an advanced manufacturing hub, Titusville can engage industry clusters through the provision of centralized and shared assets that develop and deploy advanced technologies with aerospace, DoD, bioscience, and energy applications.

Establishing an advanced manufacturing hub in Titusville will increase employment opportunities, strengthen the housing market, and support the community's redevelopment goals specifically the renovation of the U.S.1 corridor, downtown and the resurrection of Miracle City Mall and Sears Town Mall. The City will have the regulatory role through planning and zoning approvals and can participate by preparing for an expedited plan review and permitting process.

Case Study: NAAMREI

In Texas, the North American Advanced Manufacturing Research & Education Initiative (NAAMREI) is currently developing an advanced manufacturing cluster. NAAMREI is using the expertise of more than 60 partners in business, education, economic development, industry, finance, and government to attract manufacturers to its region. Key partners include three universities and four community colleges with advanced manufacturing courses. Over the past two years six North American corporate headquarters have been established in the area and plans are now under way to construct a research and education park on 400 acres near the McAllen Foreign-Trade Zone[2]. Titusville has the opportunity to establish a similar advanced manufacturing hub that brings educational institutes and industry players together.

Below: Layout of NAAMREI

Organizational Resources

1

Florida Economic Development Council (FEDC)

- The FEDC purpose is to educate, advocate, and connect professionals
- Website: www.fedc.net

2

Enterprise Florida, Inc.

- Enterprise Florida, Inc. helps innovative, high growth businesses start up, locate, or expand in Florida.
- Website: www.eflorida.com

3

Virtual Entrepreneur Center

- The Virtual Entrepreneur Center provides entrepreneurs with resources in their local area.
- Website: www.flvec.com

4

Florida High Tech Corridor

- The Florida High Tech Corridor is a cluster of diverse advanced manufacturing companies
- Website: www.floridahightech.com

5

Port Canaveral

- Port Canaveral supports cruise, business, leisure, and cargo activities.
- Website: www.portcanaveral.com

6

Titusville-Cocoa Airport Authority

- The Airport Authority oversees three aviation facilities on the Space Coast.
- Website: www.flairport.com

Chapter 9: Vision Statement

Vision Statement

Previous chapters of the Plan have established a clear understanding of the principles of advanced manufacturing and their application to primary business sectors, including the challenges associated with workforce training and the provision of adequate infrastructure. With that basis of understanding, we can now craft a "Vision Statement" that succinctly describes the concept, and intent, of further developing advanced manufacturing capabilities in the City of Titusville. The Vision is expressed from the reasonable perspective that Titusville is one component of a more significant network of regional businesses and institutions that constitute the Central Florida High Tech Corridor. It is also presented with the understanding that to compete effectively the City must simultaneously address the physical and economic conditions in the community to provide a lifestyle and amenities that attract new residents and businesses.

"The Vision for Advanced Manufacturing in Titusville consists of a series of campuses designed to facilitate research & development, testing, training and commercial production of goods through the use of advanced manufacturing materials, technologies and processes. The facilities will contain additive manufacturing equipment, house the university business incubator and serve as an advanced manufacturing demonstration facility."

Left: Artist rendering of the new cleantech business incubator in Los Angeles, California.

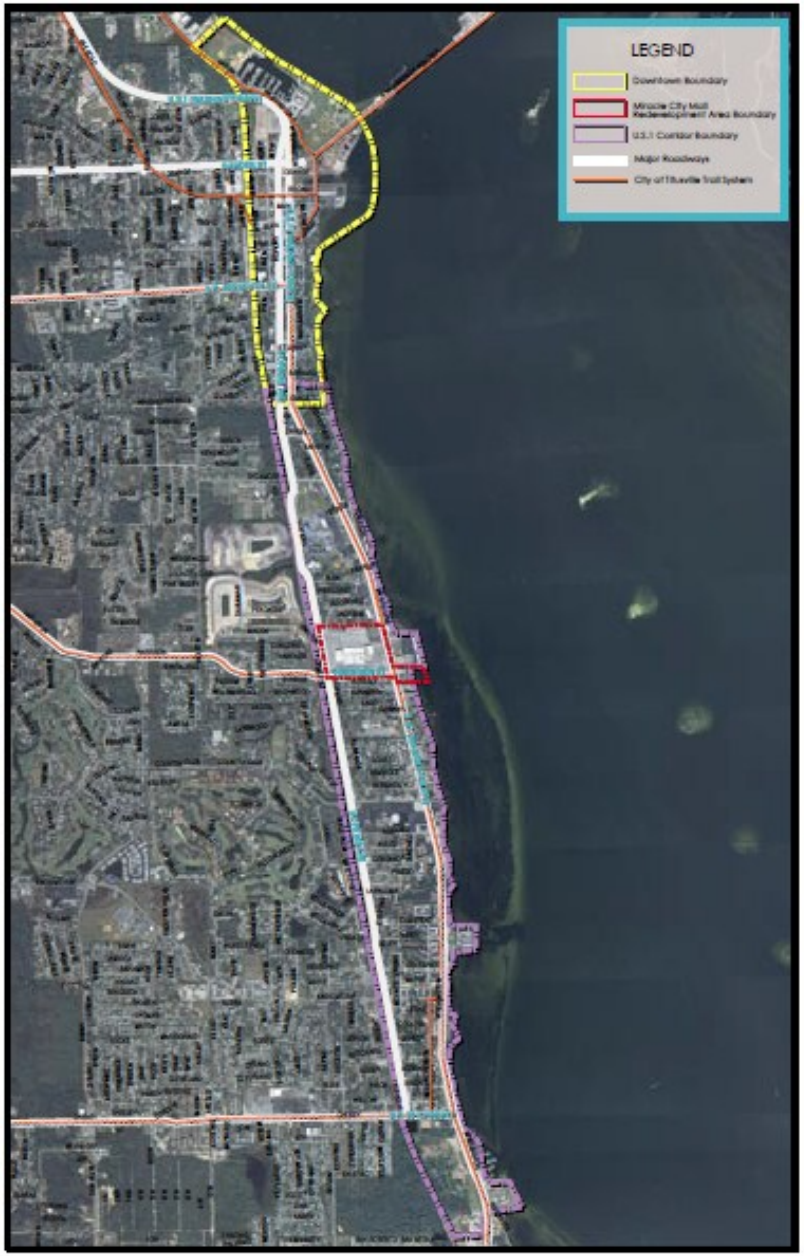
Chapter 10: Advanced Manufacturing Development Opportunities

Inventory of Land Characteristics

With an adequate understanding of the principles of advanced manufacturing and a clear vision of the intent and desired outcome of developing advanced manufacturing facilities in Titusville, the strategic plan now focuses on potential development opportunities. To accomplish this it is important to first establish an understanding of the characteristics of the land considered for development purposes.

The study area boundaries extend north from Kings Highway to SR 50 and west from U.S. Hwy 1 to I-95. Study area analysis also includes land contained in the Vector Space Industrial Park and Space Florida's Exploration Park. Although not included in the land use analysis, NASA land and facilities are implicitly included when considering future development of advanced manufacturing facilities.

The development potential of a project is often dependent on the property ownership patterns. The overriding objective of the advanced manufacturing development proposal is to increase the value of the tax base to provide revenue for public participation in the project and to simultaneously address improvements for the City of Titusville. Therefore, when possible, public lands should be contributed to the project as an economic development incentive and placed back on the tax role to generate revenue for public improvements. Public property owners include the City of Titusville, Brevard County, State of Florida, TICO Airport Authority, NASA and the Florida Space Port.



Above: Aerial view of Titusville area.

Ownership and Uses

Industrial: There is a sufficient amount of vacant industrial to satisfy the development requirements for proposed advanced manufacturing facilities. The majority of the industrial uses are contained in planned industrial parks at the Space Coast Regional Airport, Vector Space and Exploration Park.

Commercial: Most of the commercial development within the planning area is concentrated along U.S. Hwy. 1 and SR 50. Commercial development along these primary corridors consists of a range of uses, and are predominantly of a relatively large scale. Future development along major corridors within the City of Titusville must avoid becoming the traditional sprawling strip development pattern.

Environmental Lands: Environmental lands within the study area consist of wetlands and scrub jay habitat. There are parcels of property designated as environmentally sensitive consuming multiple acres of property. These lands are located predominantly in the southwest quadrant of the study area. Any future development for advanced manufacturing should avoid environmental land because of the complexity and time consuming process of environmental permitting and mitigation.

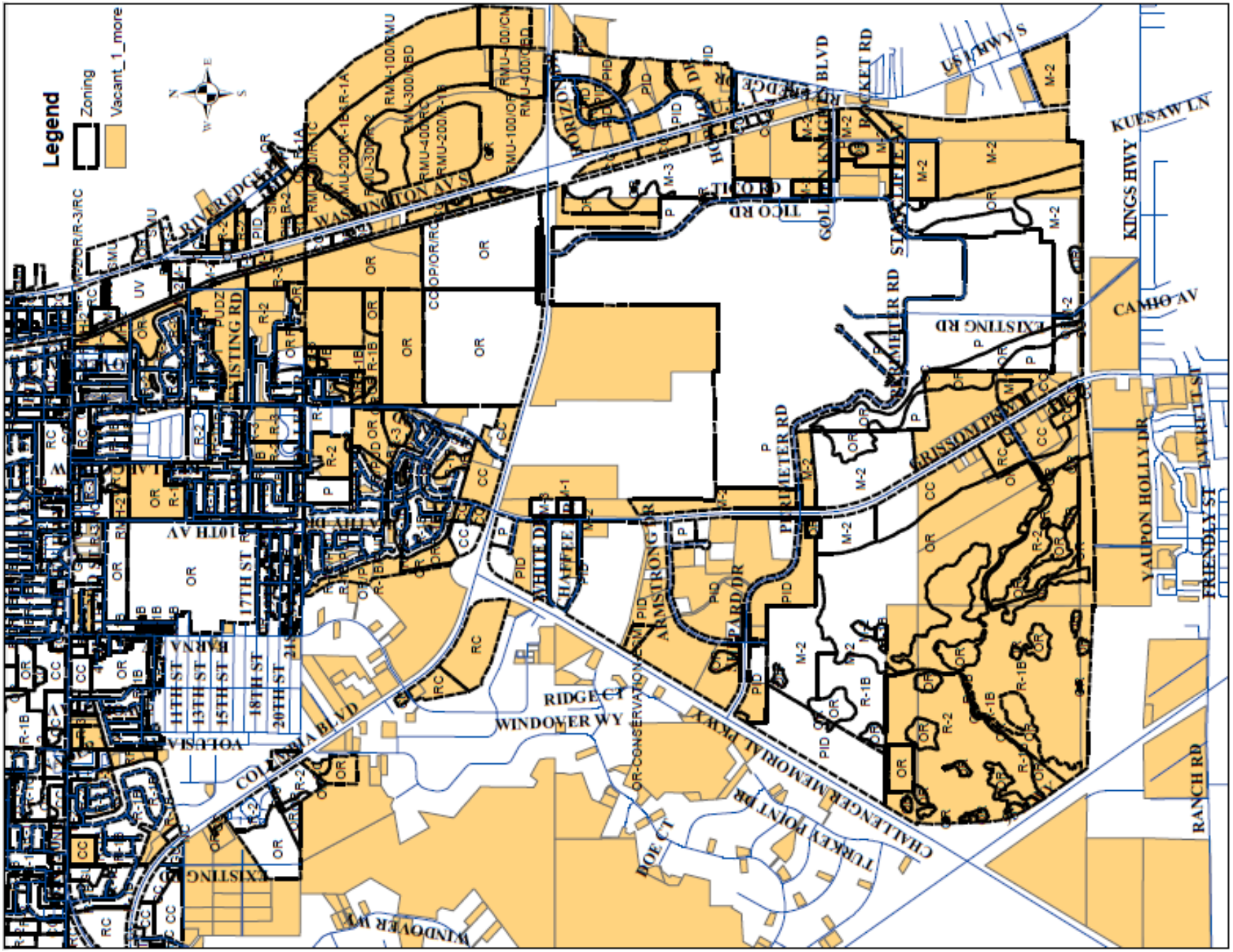
Vacant Lands: There is an abundance of vacant land available for industrial development. The map on page 72 shows the distribution of vacant lands within the study area boundaries.

Residential: There are residential lands located in the northwest quadrant of the study area. Residential areas would preclude industrial development and will require adequate buffering between these incompatible uses.

Parcel Size: The size of parcels has a significant impact on the development potential for any proposed property. Parcels must be large enough to ensure conformance with current zoning regulations and to accommodate regional storm water treatment, roads and other necessary infrastructure improvements. Larger parcels are also desired to avoid the complexities of property assemblage, which is often costly and can become time consuming. Contemporary development trends favor larger sites for development and will be required for the campus style development envisioned for the advanced manufacturing facilities. Parcel size should not be a deterrent to future development in the study area.

Zoning: The City of Titusville has jurisdictional control of zoning regulations for most of the study area. Only a few parcels of property along the southern boundary of the study area remain under the jurisdiction of Brevard County. It is recommended that these properties be annexed into the City to maintain continuity of regulatory control providing consistency in the permitting and review process and therefore stability in the eyes of the developer.

The overriding objective of advanced manufacturing development is to increase the value of the tax base to provide revenue for public participation in the project and to simultaneously address improvements for the City of Titusville.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TURKEY POINT DR
DOE CT
COLUMBIA BLVD
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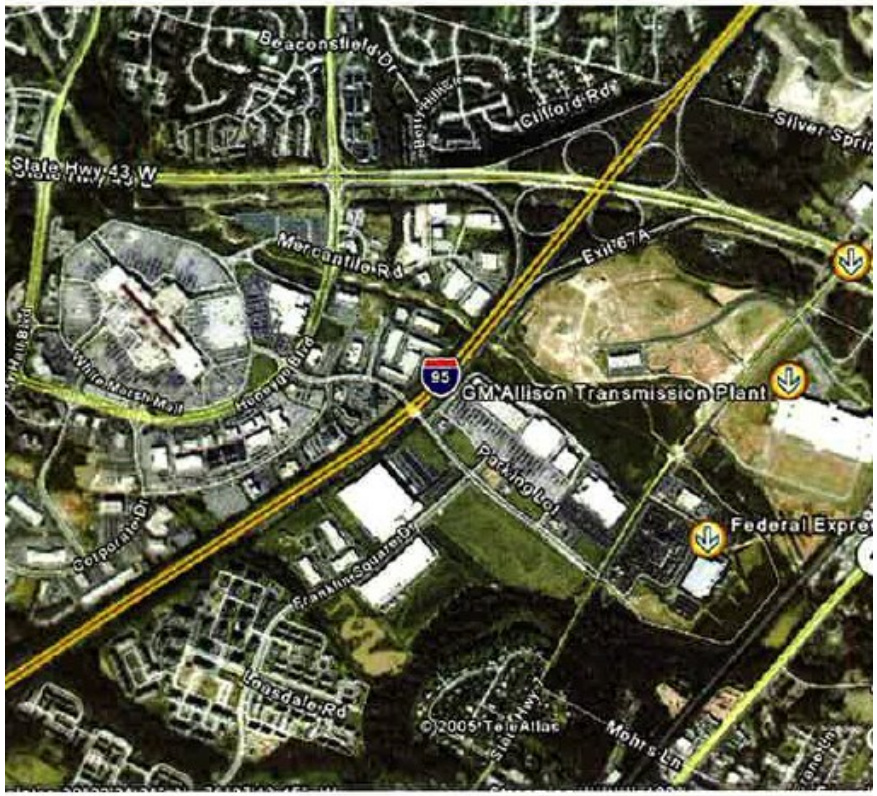
RIVEREDGE DR
OR-CONSERVATION

Zoning

Potential Development Sites

The following advanced manufacturing development opportunity sites are presented geographically from south to north, there are no assumptions as to priority opportunities presented at this point in the plan. Furthermore, there are additional opportunity sites located outside the study area boundary including the previously mentioned NASA facilities as well as downtown Titusville and the Miracle City Mall redevelopment site.



Above: Before and After photos of a 196 acre brownfield remediation project completed by Jacoby Development Inc. in Whitemarsh, Maryland.

Potential Development Site: Old OUC Energy Plant

Project Description: This site contains the old coal powered Orlando Utility Commission (OUC) energy plant. In addition to the power plant, the vacant facilities include two large smoke stacks, a transfer station, four petroleum storage tanks and direct rail access. The property is located in unincorporated Brevard County and should be annexed into the City of Titusville. The City should seek brownfield designation for the property, demolish the plant and smoke stacks and conduct environmental remediation on the land. The site could be renovated to become the energy plant for all of the advanced manufacturing campuses using alternative energy sources including solar, biofuels and possibly energy produced from municipal solid waste.

Potential Development Site: Potential Inland Port

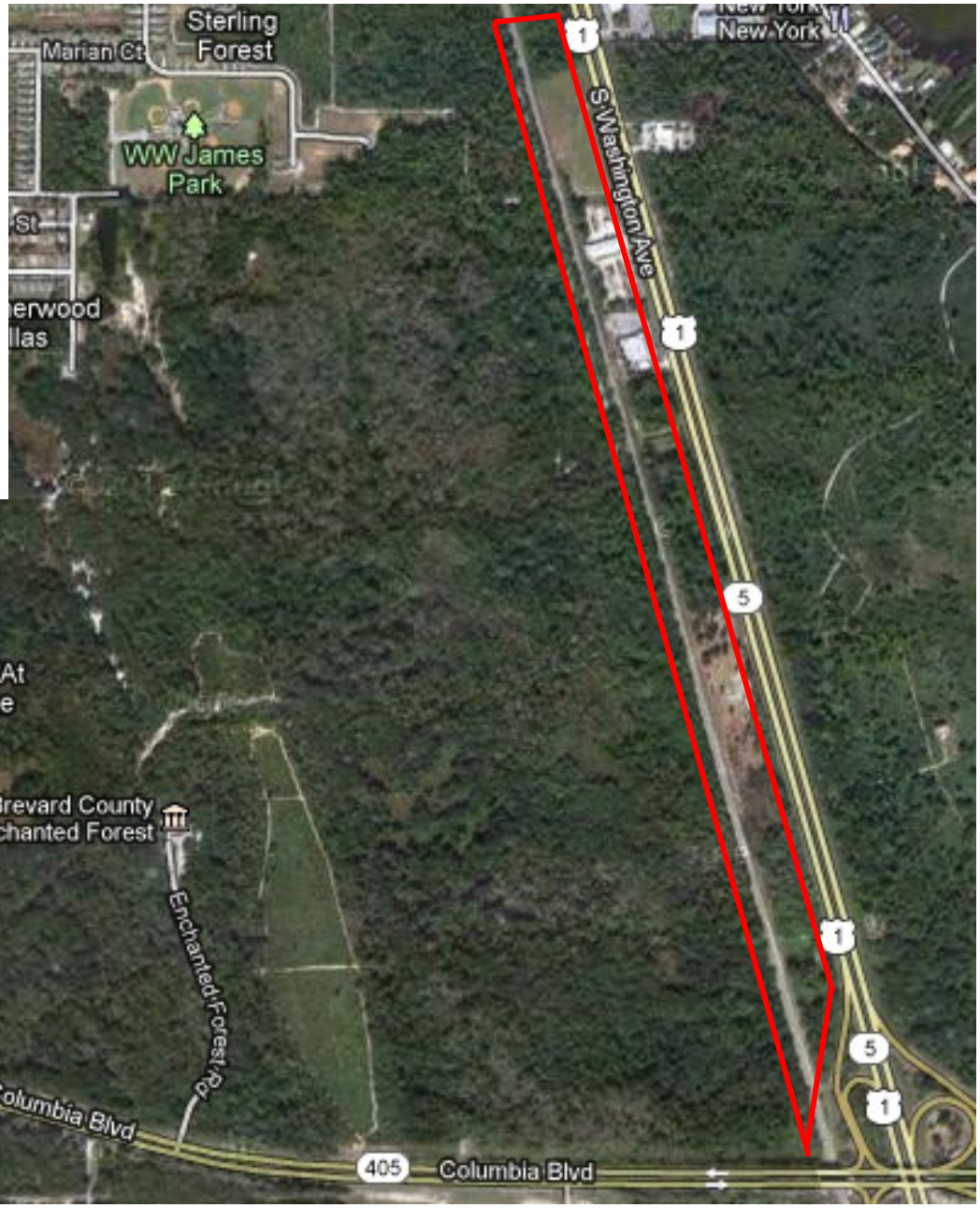
Project Description: Located north of the OUC site, this property presently has rail access and serves as a distribution center for cargo containers. This site could be expanded to the north toward SR 405 and utilized as an inland port for cargo distribution for both imports and exports. Depending on land area requirements, inland port facilities could also be developed to the south in conjunction with development of the OUC property, which also has rail access. The key for this potential opportunity will be Port Canaveral's ability to obtain direct rail access to the Port. The local Congressional representative is attempting to obtain funding for this purpose in the House Transportation Bill.

Potential Development Site: Space Coast Regional Airport

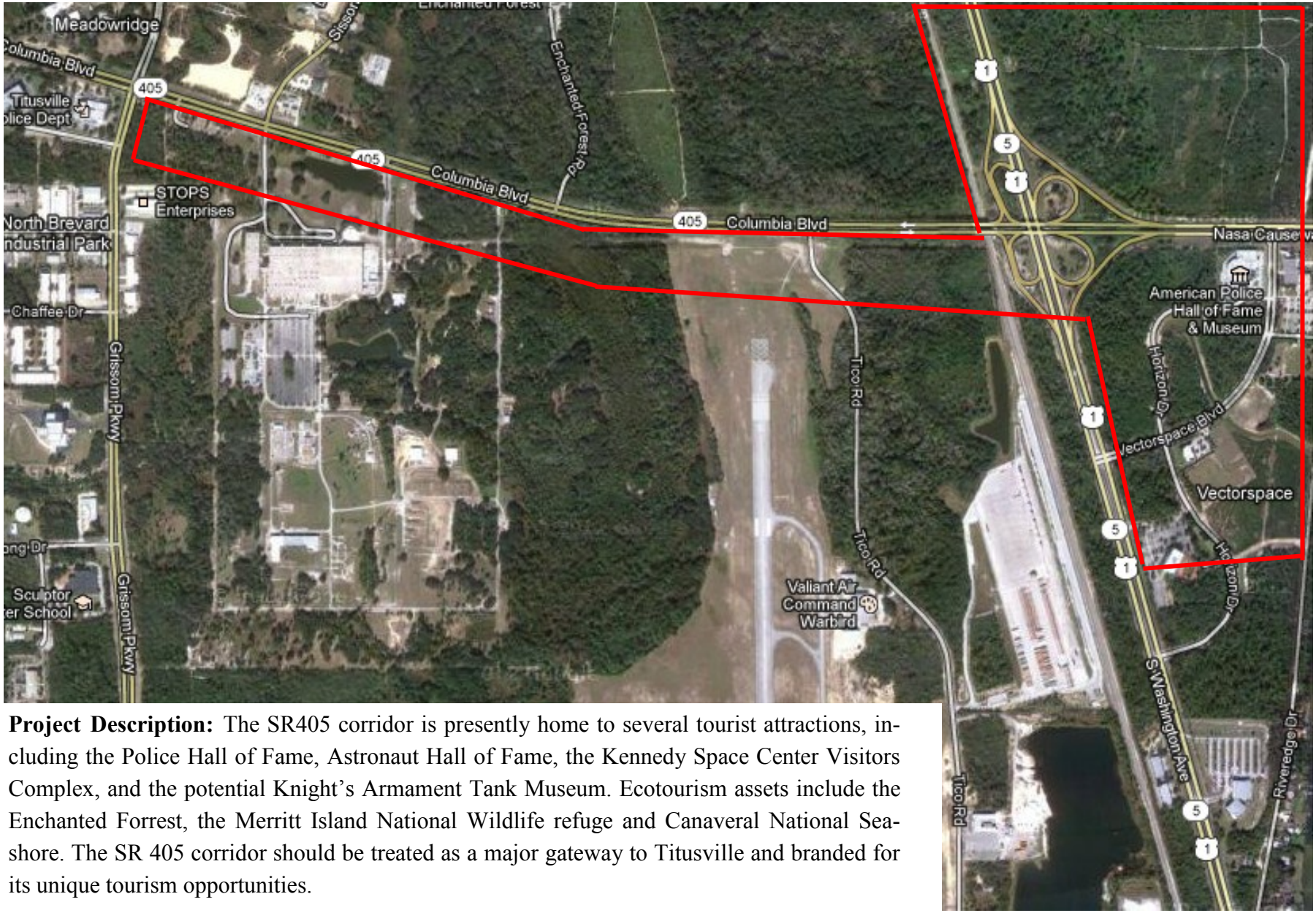
Project Description: Building on the recent announcement that Rocket Crafters will be developing their manufacturing facilities in Titusville, it is recommended that the Space Coast Regional Airport be the primary site for the Main Advanced Manufacturing Campus. The campus would contain the Advanced Manufacturing Demonstration Facility and additive manufacturing equipment in support of future growth in the aerospace and defense industries.

Potential Development Site: East FEC Rail ROW Property

Project Description: Land located east of the FEC Railroad right of way along U.S. Hwy. 1 can be used for development of solar energy fields generating clean energy, providing income for property owners and adding value to the tax base. This use of land would also deter strip commercial development and could provide an opportunity for the co-development of a linear park and trail system connecting the advanced manufacturing campus to the downtown area.



Potential Development Site: SR 405 Corridor/Vector Space/KSC



Project Description: The SR405 corridor is presently home to several tourist attractions, including the Police Hall of Fame, Astronaut Hall of Fame, the Kennedy Space Center Visitors Complex, and the potential Knight's Armament Tank Museum. Ecotourism assets include the Enchanted Forrest, the Merritt Island National Wildlife refuge and Canaveral National Seashore. The SR 405 corridor should be treated as a major gateway to Titusville and branded for its unique tourism opportunities.

Potential Development Site: Exploration Park

Project Description: Exploration Park is a planned industrial park being developed by Space Florida. The Life Sciences facility is currently under construction at this location and infrastructure for the Park is already constructed. While Exploration Park is well positioned for new development it is not recommended that this federally held land be considered as a priority for advanced manufacturing within the context of this study since ad valorem tax revenues are not generated on public land and therefore not contributed to the North Brevard Economic Development Zone.

Potential Development Site: Miracle City Mall

Project Description: Miracle City Mall is the City's highest redevelopment priority. Working closely with Parrish Hospital the City is preparing plans to redevelop the property to include a medical complex as one component of a combination of uses. Bio medical advanced manufacturing would be a logical adjunct use at this location which could add to the feasibility of the project proforma. The added value in tax increment revenues generated from this project could be used to address regional stormwater management issues while providing upgrades to the physical condition of the U.S. Hwy 1 corridor and other local streets in the vicinity of the site.

Potential Development Site: Downtown Titusville

Project Description: Reinvigorating the historic downtown area is another of Titusville's priorities. A vibrant downtown will be one of the amenities expected to attract new residents and businesses. The downtown area would be a logical location for new office development that could house businesses in software engineering, photonics and other advanced manufacturing technologies.

Chapter 11: Implementation Strategies

Leadership

This chapter identifies the roles and relationships of the organizations that will be involved in various aspects of developing advanced manufacturing facilities in Titusville. A network of relationships must be established and nurtured to provide focus on the advanced manufacturing and redevelopment efforts to maximize the use of available resources and avoid duplication of responsibilities enabling effective program implementation. Through partnering with institutions the City can leverage more commitment for projects and create a cumulative impact in the area. Implementation of the Advanced Manufacturing Plan will require the coordinated efforts of the City, the SEDC, Brevard County, the NBEDZ and other government agencies, local business organizations, property owners, and the private sector. These efforts will be coupled with various organizational, legal, funding and promotional techniques to successfully implement the program. Commitment and expediency are absolutely required to ensure success and development of the advanced manufacturing campus must be pursued simultaneously with the redevelopment of the City. This section of the Plan sets forth a process to realize the economic development, planning and design objectives that have been devised for advanced manufacturing in the City of Titusville.

Successful implementation hinges upon close cooperation and coordination between private and public groups and agencies requiring strong and determined leadership. While leadership is a highly intangible quality, it is the single most important factor for successful implementation of the plan. The leadership of the Mayor, City Council, City Manager and staff has been outstanding thus far. Perseverance will be required when deliberating future policy decisions related to the implementation of the Strategic Plan.

Leaders of the program must assume this role with vitality and enthusiasm. City leaders and staff members must support the program's activities and provide a well-devised management system to carry out the Plan. They will be responsible for establishing the administrative, financial and programmatic mechanisms necessary to achieve the goals and objectives of the Advanced Manufacturing Strategic Plan. They should establish policies that support the principles described in this Plan and concentrate on the actions described in this chapter throughout the implementation process.

Above: Artist's rendering of potential downtown landscape from the Miracle City Mall Redevelopment Plan.

Development of Advanced Manufacturing Facilities

Public/Private Partnerships:

As a public/private partnership the City must first attract investment from private developers selecting a master developer to undertake the project. The City will target strategic development projects, solicit developers, and negotiate a public/private development agreement. The agreement sets forth terms and conditions involving the disposition of land, the nature of the prospective development, City/Agency contributions and other conditions pertaining to the project. Following are fundamental components in this process:

- Formulate policies and procedures for developer solicitation and form basic public/private development agreements to enable strategic development on selected projects. The City should work with property owners in the unincorporated areas to negotiate voluntary annexation into the City.
- Contact affected property owners to determine their level of interest in participating in proposed redevelopment activities.
- The City should work with developers to prepare a Master Plan for the advanced manufacturing facilities. These plans can then be used to illustrate the community's intention for the proposed development and set forth public and private contributions to the project.

Above and Below: Example of potential intersection redevelopment

Development of Advanced Manufacturing Facilities

The City and County should identify properties appropriate for development of facilities. Since increasing the tax base is a fundamental goal, the contribution of publicly held lands should be considered a priority. This will not only improve project feasibility but will increase taxable values and revenues for various projects and programs.

If possible the City should find ways to streamline the development review process. A review of zoning, development regulations and the comprehensive plan should be completed to ensure consistency prior to development. If possible preapprovals should be obtained. The City could also work with the permitting agencies to seek preliminary approvals prior to project inception.

Recent court decisions and legislative actions have eliminated the use of eminent domain for site assembly for the purposes of redevelopment. Therefore all land acquisition must be through cooperative sales. The NBEDZ can facilitate land cost write downs if land acquisition expenses by the private sector become too exorbitant.

The City must also plan and coordinate other revitalization activities such as public improvement projects and public infrastructure improvements. Development of advanced manufacturing facilities will also support the City's community redevelopment efforts along U.S. 1, downtown, and other primary redevelopment sites.

Above and Below: Conceptual renderings of redeveloped buildings and street ways.

Clean Energy Sustainable Community

Recent research on the impacts of peak oil demand and climate change have brought to the forefront the importance of integrating concepts of "green" practices, "energy efficiency" and "sustainability" in planning policy and efforts. The clean energy initiative for Titusville is two-fold, first, development of all proposed new facilities should incorporate state of the art energy efficiency and environmental design principles and should be powered completely with renewable energy sources. In fact, the advanced manufacturing facilities should support research and development, testing and commercial production of these alternatives. Secondly, Titusville should become a world leader in the clean energy economy.

The City can target the Downtown Titusville CRA district for housing and commercial building energy retrofits that will save on energy consumption and energy costs. The CRA can use tax increment revenues to stimulate access and use of the program by paying for energy audits for residents and local businesses. The CRA could also package the energy retrofit improvements with additional funding through their existing Façade Improvement Grants to stimulate substantial investment in building renovations. Such improvements will increase property values improving the functional and aesthetic qualities of the community which will then stimulate further investment. These activities will generate local job growth, especially in the construction industry which has been the sector of the economy hardest hit by the recession. Forging partnerships with multiple agencies will be crucial in developing a coordinated approach that prioritizes sustainability through increased public investment in green infrastructure and the creation of incentives for green buildings and infrastructure.

Above: Artist Rendering of a sustainable city. Below: Rooftop solar.

Clean Energy Sustainable Community

Promoting a local green economy will lead to job growth and ensure that Downtown Titusville strengthens its position in addressing regional sustainability goals.

It is recommended that the City of Titusville prepare a Multi Year Municipal Clean Energy Plan. As demand for energy increases along with its cost, many communities are seeking ways to meet this demand with clean, safe, reliable energy from renewable sources that are available on the market today. Representatives of local governments who understand and prepare for policy and market changes can optimally position their communities in the emerging renewable energy economy. The Multi-year Clean Energy Plan is designed to reduce electric consumption, fuel consumption, and carbon emissions while creating an economic impact for local governments. The Intent of this scope of services is to define the process for developing a strategic multi year clean energy plan that focuses on methods to reduce energy consumption and generate cost savings for future operations. The study utilizes a comprehensive approach to energy efficiency and conservation to develop a plan that supports your objectives of reducing energy costs for government facilities while providing an opportunity for residents and businesses to retrofit facilities and receive the benefit of reduced energy costs.

Development of a Multi-Year Clean Energy plan consists of goals and objectives that will achieve long-term environmental, economic and societal benefits through resource conservation, waste reduction and pollution prevention. The Multi-Year Clean Energy Plan will identify programs to deliver net energy savings, peak demand savings and greenhouse gas reductions through the implementation of energy efficiency activities in local government operations.

Above: Ceremony marking the completion of a community solar project in Seattle, Washington. Below: Solar powered LED streetlights.

Clean Energy Sustainable Community

The Multi-Year Clean Energy Plan addresses the following components:

Improve Current and New Infrastructure: This component will identify opportunities to increase the energy efficiency of current and new facilities, vehicles, and equipment. Technologies currently exist that will drastically improve the energy efficiency of local government operations.

Expand the use of Renewable Energy: Provide the evaluation of on-site energy generation capabilities through renewable sources offers the potential for local government to generate a clean energy portfolio that will reduce dependence on the existing grid.

Land Use and Development Opportunities: This component will evaluate areas in which your local government is already achieving energy goals and identifies future opportunities for support of existing Comprehensive and Economic Development Plans and policies.

Education & Outreach: Provides recommendations for a campaign to educate City employees, and the public on initiatives to increase energy efficiency, promote the use of renewable energy, promote energy savings, and reduce greenhouse gas emissions.

Integrating a Multi Year Clean Energy Plan into local planning efforts affirms a community's commitment to renewable energy, promotes strategic long-term thinking, and can help secure resources and political will to accomplish renewable energy goals.

The adoption of a Multi Year Clean Energy Plan helps your local government build credibility as you work with citizens and local businesses on renewable energy programs. In particular, investing in Clean Energy epitomizes responsible government stewardship of tax dollars.

Above: The Florida Solar Energy Center was constructed using energy efficient building materials. Below: The new Amway Center in Orlando is LEED certified.

Economic Development

Several economic development organizations must work together to target new businesses to locate in the proposed advanced manufacturing facilities in Titusville. The SEDC should take the lead in coordinating efforts for business attraction, retention, expansion and development. Organizations that will be involved in this effort include the NBEDZ, TICO Airport Authority, Space Florida, The Economic Development Commission of Space Coast Florida, NASA, Space Coast Energy Consortium, and the University of Central Florida.

Technical Support: Economic Development efforts, especially those targeting advanced manufacturing businesses, will require technical support. The role of the Florida High Tech Corridor Council cannot be over emphasized in this regard. The City, SEDC and other organizations cited here should join the Council and become fully integrated into their programs.

Tourism Development: The City of Titusville has an opportunity to take advantage of substantial tourist related assets as part of the transformation of the City. The SR 405 corridor is home to the Police Hall of fame, Astronaut Hall of fame and the Kennedy Space Center Visitors Complex. Ecotourism assets include the Enchanted Forrest, the Merritt Island National Wildlife refuge and Canaveral National Seashore. As an element of the proposed corridor master plans, the SR 405 corridor should be treated as a major gateway to Titusville and branded for its unique tourism opportunities.

Above: The Astronaut Hall of Fame. Below: The Police Hall of Fame and Museum.

Economic Development

The community should plan to develop facilities in support of tourism. A hotel/ resort with conference facilities should be developed in the vicinity of the SR 405 corridor. Conference facilities can support new business meetings, symposiums and conferences associated with advanced manufacturing. The City should work with the Space Coast Office of Tourism to market, promote and develop tourism.

Inland Port: Working together, Brevard County, the City of Titusville and Port Canaveral are well positioned to support development of an inland port. Combined, these jurisdictions have the assets and resources necessary to pursue such an endeavor including:

- Political fortitude and public support for economic development and job creation with an institutional framework that has the capacity to finance major infrastructure improvements.
- A well educated and highly trained workforce.
- A well integrated transportation system with 5 modes of transport including highways, rail, air, water and space.
- Sufficient industrial land with sites located within close proximity to the Port, Including Space Coast Commerce Park and KSC.
- Infrastructure capacity through Port Canaveral's investment in expanding north end cargo facilities, existing rail lines and spurs, relatively unencumbered highway access for trucking on SR528 providing direct access to Orlando International airport and direct access to Space Coast Regional Airport.
- Opportunities to support new manufacturing to establish a better balance of trade maximizing efficient use of facilities by introducing the export of new manufactured products.

Above: Ariel photo of Port Canaveral. Below: Diagram showing the layout of Port Canaveral.

Economic Development

While this preliminary and cursory assessment concerning project viability seems favorable, the following course of action is recommended to confirm market feasibility and pursue activities for the eventual development of an inland port:

1. Port Canaveral should commission a thorough market and logistics study to determine actual market feasibility.

2. Consider solicitation of master developer for planning and design of a future development physical master plan.

3. Brevard County and the City of Titusville should continue to work closely with the recently established North Brevard Economic Development Zone Board to complete the Economic Development Plan required by Florida Statute to capture tax increment revenue for financing port development opportunities. The Plan also documents economic development incentives available in support of the effort.

4. Community leaders must foster partnerships between various public sector agencies. The following list of public entities and institutions may have a role in supporting future development of the inland port.

    - Canaveral Port Authority
    - Florida East Coast Railroad
    - Brevard County Commission
    - City of Titusville
    - North Brevard Economic Development Zone
    - Space Coast Economic Development Commission

Above: Aerial photo of an inland port. Below: Photo of the cranes and barges at an inland port in Italy.

Economic Development

- East Central Florida Regional Planning Council
- Orlando International Airport
- Orange County Expressway Authority
- Governor's Office
- State Legislature
- Florida Seaport Transportation and Economic Development Council
- Florida Department of Transportation
- Florida Economic Development Commission
- Cape Canaveral Air Force Station
- Orlando Utility Commission

5. The Port, working with Brevard County, City of Titusville, TICO Airport Authority and the North Brevard Economic Development Zone Board, should lead in preparing a detailed Capital Improvement Program identifying capital projects including specific costs and funding sources to facilitate development of an inland port.

Workforce Training: Work Force Brevard should take the lead in working with the many organizations involved in workforce training in support of advanced manufacturing in Titusville. It is recommended that an Advanced Manufacturing Jobs Council be established which membership would include, but not be limited to, representatives from the following organizations.

- Work Force Brevard
- Work Force Florida
- Brevard County School Board
- Brevard Community College

Above: A trainee learns how to operate equipment at a PGT Industries plant in southwest Florida.

"Work Force Brevard should take the lead in establishing an Advanced Manufacturing Jobs Council."

Economic Development

- University of Central Florida
- The Banner Institutes for Advanced Manufacturing and Energy
- Brevard County Office of Veterans Affairs

The objective of the Council would be to develop a comprehensive strategy for long-term education, training, funding and placement of an advanced manufacturing workforce in Central Florida, more specifically for Titusville.

Project Funding: The North Brevard Economic Development Zone (NBEDZ) has the greatest capacity for funding infrastructure improvements and economic incentives for businesses in advanced manufacturing through the use of tax increment revenues generated by new construction. However, tax increment revenues will not be received until 2014, therefore it will be necessary to obtain short term financing. The NBEDZ should obtain approximately $1M to support project activities including design, engineering and permitting for capital improvements and other costs associated with development and business assistance in compliance with their charter. Funding would be in the form of a short term loan (1-3 years) in anticipation of the issuance of long term revenue bond. Possible sources include:

- A loan from the $10M Legislative grant
- Internal fund transfer from Brevard County reserves
- State revolving loan funds
- Commercial Line of credit

Grants: Tax increment revenues should be leveraged to the greatest extent possible particularly as a matching source for grants. State and federal grants are a source of funds for advanced manufacturing, economic development, public improvements, workforce training, and environmental restoration projects. The City of Titusville and NBEDZ should undertake a Grant Stacking Plan using proceeds from the short term financing. A Grant Stacking Plan provides a detailed review of Federal, State and Local grant opportunities defining the purpose of the grant and submittal requirements, maximum awards, matching requirements and opportunities for grant on grant matches and deadlines for applications. The following Chapter contains an inventory of potential grant sources and other economic incentives available for program implementation.

"The North Brevard Economic Development Zone has the greatest capacity for funding infrastructure improvements and economic incentives for businesses in advanced manufacturing."

Chapter 12: Funding Opportunities and Economic Incentives

Federal Funding Opportunities and Economic Incentives

Funding Source	Program	Program Description
Internal Revenue Service	Biodiesel Income Tax Credit	Companies that use biodiesel in their vehicles are eligible for a tax credit of $1.00 per gallon.
Internal Revenue Service	Builders & Manufacturers Incentives	Credits are available to manufactures of high-efficiency refrigerators, clothes washers, and dishwashers.
Internal Revenue Service	Business Tax Incentive	A tax deduction of up to $1.80 per square foot is available to owners of tenants of new or existing commercial buildings that are constructed or reconstructed to save at least 50% of the heating, cooling, ventilation, water heating, and interiors lighting energy cost.
Internal Revenue Service	Combined Heat and Power (CHP)	A 10% investment tax credit for CHP property, applicable to only the first 15 megawatts of CHP property.
Internal Revenue Service	Commercial Solar Tax Credit	The credit covers 30% of the total cost of the system. It expires December 31, 2016.
Internal Revenue Service	Corporate Tax Credit	A non-residential manager can receive a tax credit of 30$ for geothermal energy, micro turbines, and fuel cells.
Internal Revenue Service	Fuel Cells and Micro Turbines Tax Incentive	Tax credits up to $3,000 per kWh are available for the purchase of fuel cells and up to $200 per kWh are available for micro turbines.
Internal Revenue Service	On-Site Renewable Tax Incentive	Businesses are eligible for tax credits for qualified solar water heating and photovoltaic systems.

Federal Funding Opportunities and Economic Incentives

Funding Source	Program	Program Description
Internal Revenue Service	Renewable Energy Generation Tax Credit	Non-residential managers can receive a 10-year tax credit if they help create renewable energy from wind, biomass, geothermal, solar, municipal solid waste, and refined coal.
Internal Revenue Service	Small Ethanol Producer Tax Credit	A small ethanol producer may be eligible for a tax incentive in the amount of $0.10 per gallon.
U.S. Department of Agriculture	Bio-based Products and Bioenergy Program	Loans are available to help rural industry generate electricity from biobased sources.
U.S. Department of Agriculture	Bioenergy Program for Advanced Biofuels	This program was created to ensure an expanding production of advanced biofuels by providing payments to eligible advanced biofuel producers in rural areas. Payments will be made to eligible advanced biofuel producers for the production of fuel derived from renewable biomass, other than corn kernel starch.
U.S. Department of Agriculture	Bio-refinery Assistance Loan Guarantee	Loans are available to help bio-refineries conserve and use energy more effectively. Loan guarantees are available up to $250 million.
U.S. Department of Agriculture	Business and Industry Guaranteed Loans	Loans of up to $10 million are available to rural industrial manufacturers to improve the economic and environmental climate in their communities.
U.S. Department of Agriculture	Energy Efficiency Improvements Loan	Loans are available for the purchase of renewable energy generating systems by small rural businesses or agricultural producers.

Federal Funding Opportunities and Economic Incentives

Funding Source	Program	Program Description
U.S. Department of Agriculture	Repowering Assistance Program	This program offers incentives for bio-refineries to switch to renewable biomass energy production.
U.S. Department of Agriculture	Rural Energy for America Program Guaranteed Loan Program (REAP LOAN)	The REAP Guaranteed Loan Program encourages the commercial financing of renewable energy (bioenergy, geothermal, hydrogen, solar, wind and hydro power) and energy efficiency projects. Under the program, project developers will work with local lenders, who in turn can apply to USDA Rural Development for a loan guarantee up to 85% of the loan amount.
U.S. Department of Agriculture	USDA Renewable Energy Systems and Energy Efficiency Improvements Program	This program provides grants and loans to small businesses in rural communities that are interested in making their buildings more energy efficient.
U.S. Department of Energy	Loan Guarantee Program	DOE offers loans to projects that "avoid, reduce, or sequester air pollutants or anthropogenic emissions of greenhouse gases." Loans are available for biomass, hydrogen, wind, solar, hydropower, advanced fossil energy coal, carbon, electricity delivery and reliability, alternative fuel vehicles, pollution control equipment, and industrial energy efficiency projects.
U.S. Department of Energy	Renewable Energy Production Incentive (REPI)	REPI provides financial incentives of $0.015/kWh of electricity generated from renewable sources. This incentive is issued for the first decade of operation.
U.S. Department of Energy	U.S. Department of Energy State Energy Program	The State Energy Program (SEP) provides grants to states and directs funding to state energy offices from technology programs in DOE's Office of Energy Efficiency and Renewable Energy. States use grants to address their energy priorities and program funding to adopt emerging renewable energy and energy efficiency technologies.

Federal Funding Opportunities and Economic Incentives

Funding Source	Program	Program Description
U.S. Department of Energy	Unsolicited EERE Proposals	Unsolicited proposals may be selected if they are novel and do not reflect a current solicitation or existing work.
U.S. Department of the Treasury	American Reinvestment and Recovery Act Tax Credits and Grants	Tax credits and grants are available from select state energy offices to help promote renewable energy generation and/or energy efficiency.
U.S. Department of the Treasury	Production Tax Credit (PTC)	Through the 2009 American Recovery and Reinvestment Act, Congress acted to provide a three-year extension of the PTC through December 31, 2012. Additionally, wind project developers can choose to receive a 30% investment tax credit (ITC) in place of the PTC for facilities placed in service in 2009 and 2010, and also for facilities placed in service before 2013 if construction begins before the end of 2010. The ITC then qualifies to be converted to a grant from the Department of Treasury. The Treasury Department must pay the grant within 60 days of an application being submitted.
U.S. Environmental Protection Agency	Clean Construction USA Loans	EPA offers loans to companies to help finance projects that reduce diesel emissions from construction equipment and vehicles.
U.S. Environmental Protection Agency	Combined Heat and Power (CHP) Partnerships	Combined Heat and Power (CHP) systems are an efficient, clean and reliable approach to generating power and thermal energy from a single fuel source. Incentives on CHP systems are available through the EPA.
Small Business Administration	Low Interest Loans for Equipment	Manufacturers can take advantage of historically low rates through the SBA 10-year equipment loan. The interest rate is 4.15% for financing up to $4 million. These loans are paired with private sector commercial loans to support manufacturing projects of up to $20 million.

Federal Funding Opportunities and Economic Incentives

Funding Source	Program	Program Description	Amount
NIST	Metrology Infrastructure and Standards to Support Biomanufacturing	Working closely with industry, the Food and Drug Administration, and standards organizations, NIST will develop the measurement infrastructure needed to gain detailed understanding of biomanufacturing processes and design superior methods that yield higher-quality protein therapeutic products. Continuous improvements will enable manufacturing processes that are sufficiently agile—or adaptable—to accommodate manufacture of next-generation treatments.	$10 Million
NIST	Measurement Science and Standards to Support Nanomanufacturing	NIST will develop measurement methods to help companies overcome technical barriers to cost-effective, high-volume manufacturing of materials, devices, and systems that exploit the exceptional properties exhibited at nanoscale levels. This initiative includes $2 million for nanotechnology related environmental, health, and safety research to address potential risks of nanotechnology-based products.	$10 Million
NIST	Measurement Science and Standards to Speed Development and Industrial Applications of Advanced Materials	This work will accelerate NIST efforts in support of the national Materials Genome Initiative, an interagency program with the goal of significantly reducing the time from discovery to commercial deployment of new materials. NIST will focus on standard reference databases, data assessment and validation, standards development and implementation, and modeling and simulation tools.	$10 Million

Federal Funding Opportunities and Economic Incentives

Funding Source	Program	Program Description	Amount
NIST	Measurement Science and Standards to Support Smart Manufacturing	Smart manufacturing exploits advances in sensors, data analytics, modeling, and simulation and integrates these technologies to improve manufacturing performance at all levels, from equipment to factory to supply chain. NIST will develop measurement capabilities and standards for automated in-process quality monitoring and control for factory-level production systems. NIST will also build a testbed to help industry, university, and government collaborators develop an open standards platform for facilitating the simultaneous engineering of the physical and virtual components of manufacturing systems.	$10 Million
NIST	NIST Manufacturing Fellowships Program	This program provides opportunities for engineers and scientists to work with NIST staff on the measurement and standards required to create cutting-edge tools for manufacturers. Fellowships will be available to qualified researchers from companies and non-profit organizations, as well as to recent recipients of bachelor's or master's degrees in relevant fields.	$5 Million
NIST	Advanced Manufacturing Technology Consortia Program	The AMTech program will provide cost-shared funding to industry-led consortia that are focused on developing advanced technologies to address major technical problems that inhibit development and widespread adoption of advanced manufacturing capabilities in the United States. By convening key organizations across the entire innovation lifecycle, AMTech will help to create the infrastructure necessary for more efficient technology transfer. These consortia will identify and conduct precompetitive research to address long-range basic R&D relevant to manufacturing, currently a weak link in the U.S. innovation ecosystem.	$21 Million

State of Florida Funding Opportunities and Economic Incentives

Program	Program Description	Amount
Local Discretionary Sales Surtaxes	Eight separate levies can be imposed by county governments or school districts to fund a variety of local infrastructure, public health, or public safety needs depending on the particular levy.	Total tax rate varies by county from 1.5% to 3.5%
Jobs for the Unemployed Tax Credit	Provides a $1,000 tax credit to a target industry business for each regular, full-time employee who works for at least 12 months; was unemployed for at least 30 days at the time of hiring; was hired on or after July 1, 2010. The credit may be carried forward for one year.	Capped at $5M for FY 2012/13
Enterprise Zone Tax Credit.	Allows a tax credit to a business located in an enterprise zone that increases the total number of full-time jobs over 12 months. The credit is 20% of the actual monthly wages paid to each new employee hired into a newly-created job. The percentage of the actual monthly wages paid could be greater than 20%, depending on certain circumstances. The credit may be carried forward for five years.	Capped at $7M for FY 2012/13
Enterprise Zone Property Tax Credit.	The credit is available to a corporation that does one of the following in an enterprise zone: creates a new business with five or more new jobs; expands an existing business and creates five or more new jobs; rebuilds an existing business that suffered damage in an emergency. The credit is computed on 96% of ad valorem taxes levied for operating purposes, not including debt service. The credit may be carried forward for five years.	Capped at $2.3M for FY 2012/13
New Markets Tax Credit	Provides a credit equal to 39% of the purchase price of a qualified investment as defined in s. 288.9913(9), F.S. A partner, member, or shareholder of a partnership, limited liability company, subchapter S corporation, or other pass-through entity may claim the credit under an agreement among the partners, members, or shareholders. The credit may be carried forward for five years.	

State of Florida Funding Opportunities and Economic Incentives

Program	Program Description	Amount
Capital Investment Tax Credit	The credit is available to businesses in a designated high-impact sector (e.g., silicon technology, transportation industries, or solar panel manufacturing facilities) and must establish a qualified project which results in a cumulative capital investment of at least $25 million. An annual credit may be claimed for up to 20 years in an amount equal to 5% of the eligible capital costs generated by a qualifying project.	Capped at $14.3M for FY 2012/13
Contaminated Site Rehabilitation Tax Credit	Provides a credit to taxpayers that voluntarily rehabilitate brownfield sites or sites contaminated with dry-cleaning solvent. The credit is for 50% of rehabilitation costs, up to $500,000 per site per year. The credit may be carried forward for five years.	Capped at $2.3M for FY 2012/13
Sales Tax Exemptions.	New or expanding business are eligible and it applies to property that has depreciable life of 3 years or more. Machinery for a new business must be ordered before the start of productive operations and received within 12 months. Expanding businesses must show a minimum 10% increase in productive output (Not required for spaceport businesses).	
Manufacturing and Spaceport Investment Incentive Program	Provides a refund on eligible equipment purchases used in the manufacturing, processing, compounding, or production of tangible personal property for sale or for exclusive use in spaceport activities.	$50,000 in state sales and use tax in a single year.
Enterprise Zone Jobs Credit	Businesses that increased the number of full-time employees from the average of the previous 12 months, or added at least five new full-time employees, are eligible for the credit. Credit is allowed for up to 24 consecutive months. Credit is limited to the amount due on each return. No refund or carry-forward is allowed. Amount of credit depends on employee category and the percentage of full-time employees who are residents of a Florida enterprise zone. A business cannot claim the credit against sales and use tax if it has already claimed it for corporate income tax.	

State of Florida Funding Opportunities and Economic Incentives

Program	Program Description	Amount
Business Property Used in an Enterprise Zone (Refund)	Eligible property includes office and warehouse equipment, and some industrial machinery and equipment. Property must be used only in an enterprise zone for at least 3 years. Refund is subject to a minimum and maximum dollar amount.	
Electrical Energy Used in an Enterprise Zone (Exemption)	Exemption for municipal utility taxes for up to 5 years. Percentage of exemption may be increased from 50% to 100% based on the percentage of full-time employees who are residents of a Florida enterprise zone.	
Building Materials Used in the Rehabilitation of Real Property Located in an Enterprise Zone (Refund)	Eligible recipient may be one of the following: owner, lessee, lessor, nonprofit community-based organization, city, county or other governmental organization. Amount of refund is subject to a minimum and maximum dollar amount. Maximum refund amount may be increased based on the percentage of permanent, full-time employees who are residents of a Florida enterprise zone. Only one refund is allowed for each parcel of real property.	
Qualified Target Industry Tax Refund Program	Available for companies that create high wage jobs in targeted high value-added industries. This incentive includes refunds on corporate income, sales, ad valorem, intangible personal property, insurance premium, and certain other taxes from an appropriated amount set aside for this purpose. Pre-approved applicants who create jobs in Florida receive "tax refunds" of $3,000 per net new Florida full-time equivalent job created; $6,000 in an Enterprise Zone or Rural Community	Capped at $5M per single qualified applicant in all years, and no more than 25% of the total refund approved may be taken in any single fiscal year

Potential Local Funding Opportunities and Economic Incentives

Program	Program Description	Amount
Direct Incentives	Monetary assistance can be provided to one or more businesses or through an organization authorized by the local government. Direct incentives include grants, loans, equity investments, loan insurance and guarantees, and training subsidies.	
Indirect Incentives	Includes grants or loans provided to businesses or community organizations that provide support to businesses or promote business investment or development.	
Fee-based or Tax-based Incentives	Tax or fee credits, refunds, exemptions, or property tax abatement or assessment reductions.	
Below Market Rate Leases or Deeds for Real Property	Can be provided to businesses from the local government.	
Development Incentives	Adopt development incentives to promote high-quality private development. This may include streamlining the development review process to minimize the time involved in the approval process, providing zoning incentives, site and architectural design guidelines, providing additional public facilities and coordinating capital improvement programs.	
Capital Improvements	These can include major infrastructure items including street improvement, storm water management systems and upgrading utilities. Also, capital improvements can include a variety of revitalization items such as facade improvements, landscaping, and streetscaping as well as new parking development. In the case of downtown Titusville, the principal requirements appear to be additional parking, general landscape and streetscape treatments throughout the entire downtown, utility upgrading and site assembly.	
Reserves	Reserves are those surplus funds in a local government coffer that are either intentionally built up for a “rainy day” or accrue because the budget requirements were less than the revenues collected. By having sufficient reserves, a municipality does not have to try to sell bonds or borrow capital improvement funds. Reserves are difficult to project.	

Potential Local Funding Opportunities and Economic Incentives

Program	Program Description	Amount
Debt Financing	This method essentially requires a community to sell bonds or otherwise borrow money to be repaid from an annual automatic lien on the general fund. Or a community can pay for its infrastructure in the same way a person borrows money to purchase a home. In both instances, the capital need is immediate and high, the equity appreciation reasonably assured, and the monthly or annual principal and interest payments generally fixed. Like all forms of infrastructure financing, there are some disadvantages and risks.	
Challenge Strategy	The challenge strategy involves the guaranteed construction of public improvements, but only after private revitalization actively reaches a certain point. This provides incentive for the developer while ensuring both parties, the City and the developer, that desired private development will take place along with public improvements. A recognizable schedule of funding can be determined with this strategy and can be selectively implemented, usually on a block-by-block or project-by project basis.	
Private Investment	If successful revitalization is to occur, private investment usually must exceed public funding by three to four fold. Such funding takes the form of equity investment and conventional real estate loans.	
Project Equity Position	When the Redevelopment Agency takes an equity position in a project, the Agency contributes cash or land to the project with a return in the form of profit sharing. This Agency participation has the effect of reducing developer costs.	
Leasing	City-owned land, buildings, and equipment can be leased to developers for projects. For the developer, this eliminates the need for capital investment in land, buildings, etc. or debt service on money borrowed to finance the purchase of these assets. The city receives lease payments which are deductible from the developer's income tax. The lease may also constitute a purchase option.	

Potential Local Funding Opportunities and Economic Incentives

Program	Program Description	Amount
Public Improvements in Conjunction with Private Sector Development	The Redevelopment Agency can offer public improvement activities such as street improvements, parking development, open space development, and utility hook-ups as a way of stimulating or responding to private investment. These improvements are usually funded through the City's Capital Improvement Plan or program, using sources such as property assessments, general funds and tax increment finances.	
Land Write-Downs	Land write-down by the Redevelopment Agency is a method whereby the fair value of land is determined for uses that the City is interested in seeing developed on that land. The land use may not be the most profitable use, but may be the most desirable by the City on an overall basis (e.g., development of retail facilities in the downtown area, and parking structure developments). Land write down reduces development costs, the need for equity and fixed-interest costs, and it improves the developer's cash flow, net income and risk position. It often requires a considerable city investment with no significant financial return to the city, however, there is a potential for making an otherwise infeasible project attractive when combined with a package of other incentives.	
Joint Ventures	In real estate syndication ventures, the Redevelopment Agency can contribute equity capital to a project. This has the effect of reducing equity requirements from the developer and/or reducing the amount which must be debt serviced. Through equity syndication, tax subsidy benefits can be passed on to investors in the form of depreciation, investment tax credits, deferral of taxes and capital gains.	
Mortgage Write-Downs	Mortgage write downs are used to encourage residential development and home ownership in the downtown area. Funds from the Agency are offered to qualified potential home buyers to increase their down payment, thereby decreasing mortgage payments. The Agency usually takes an ownership interest in the dwelling for a predetermined period of time to guarantee against misuse of the funds.	

Potential Local Funding Opportunities and Economic Incentives

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Tax Credits	Corporate income tax credits provide a desirable economic incentive that quite often enables development proposals to become feasible. The following chapter provides a list of all tax credit programs available for energy and advanced manufacturing.	

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