TEC-SMART

Training and Education Center for
Semiconductor Manufacturing and
Alternative and Renewable Technologies

Hudson Valley Community College

New York State Energy Research
and Development Authority
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Executive Summary

**TEC-SMART:** Training and Education Center for Semiconductor Manufacturing and Alternative and Renewable Technologies (TEC-SMART)

**Proposal submitted by:** Hudson Valley Community College and New York Energy Research and Development Authority

**Project funds requested:** $13,022,500

Hudson Valley Community College and the New York State Energy Research and Development Authority (NYSERDA) seek to unite their vision for a successful and thriving future for high-tech and environmentally sound technologies in the Capital Region, and beyond, in the creation of **TEC-SMART**, a resource for training and education for the semiconductor manufacturing and alternative energy technology industries, to be established in the Saratoga Technology and Energy Park (STEP) in Malta, New York. **TEC-SMART** will be a state-of-the-art training facility that includes labs and classrooms with the most up-to-date learning technologies that will be used for semiconductor manufacturing, renewable energy, and energy efficiency training initiatives.

**Goal:**

The **overarching goal** for **TEC-SMART** is to serve the region, state and nation as the premiere resource for training and education for semiconductor manufacturing and alternative energy technologies; and, in so doing, establish New York State as a national leader in meeting the workforce demands for industries that provide products and services integral to our current and future quality of life in the 21st century.

**Objectives:**

**TEC-SMART** will:

1. **Forge strong industry, education, and government partnerships** with entities that have a stake in semiconductor manufacturing, alternative energy systems and “green-build” technology.
2. **Design and deliver expert customized training in semiconductor manufacturing** technology.
3. **Design and deliver expert customized classroom and distance learning training** on the theory, design, and installation of alternative energy technologies as they are developed and become viable, such as solar, solar thermal, micro hydro, wind, biomass, geothermal, and alternative fuels such as hydrogen, biodiesel, cellulosic ethanol, microturbines and fuel cells.
4. **Deliver skilled technicians** ready to meet the growing workforce demands in the semiconductor and alternative energy industries.
5. **Be a showcase facility** that is energy efficient, incorporates “green-build” techniques, and qualifies as a LEED facility (Leadership in Energy and Environmental Design).
6. **Be the first-choice educational resource** for educational institutions and the general public on the various types and applications of semiconductor manufacturing and alternative energy at the residential and commercial consumer levels.

**Outcomes:**

- Economic growth will be accelerated by the infusion of a substantial skilled workforce into the semiconductor manufacturing and alternative energy industries;
- A projected 500 to 600 technicians will be trained during the next five to 10 years to keep pace with industry employment needs throughout the Capital Region;
- National recognition for New York State as a leader in semiconductor manufacturing and alternative energy technologies training;
- There will be increased awareness of the need for and availability of alternative energy sources;
- Understanding of alternative energy and “green build” technologies will grow;
- Increased demand for residential and commercial alternative energy systems;
- **TEC-SMART** will be recognized as a New York State Center for Excellence;
- **TEC-SMART** will become the premiere center for hands-on education and training for semiconductor manufacturing and alternative energy technologies for schools, business, government, and the general public at the regional, statewide, and national levels.
Overview

Since the Albany-Colonie Regional Chamber of Commerce first declared the region to be "Tech Valley" in 1998, the Capital Region has worked diligently to re-tool itself into a community that is attractive to high-tech business, research, and development. As a result, a new “industrial revolution” is taking place. More than 1,000 technology companies in the region employ more than 50,000 people, generating an annual payroll of $2 billion and an annual economic impact of $5 billion. A region that was once dubbed part of the “rust belt” is now experiencing significant growth in the high-tech industries of the 21st century, such as semiconductor manufacturing technology, photovoltaics, alternative fuels such as hydrogen, biodiesel, cellulosic ethanol, microturbines and fuel cells, and other alternative energy technologies. The New York Center for Excellence in Nanoelectronics at the University of Albany, the arrival of International SEMATECH and Toyko Electron, Ltd., and the anticipated future arrival of Advanced Micro Devices represent significant change in the industry landscape of our region.

Further, as global demands for energy continue to swell, and our nation’s reliance on foreign oil becomes more problematic, we are compelled to seek alternative means to address the current and future demands for energy projected by government data and industry trends. Alternative energy sources such as photovoltaic, wind, solar thermal, biofuels, microhydro, and geothermal are now gaining momentum as feasible options to meet these demands.

*Scientific American* has devoted its September 2006 issue to the topic of energy’s future. Daniel M. Kammen, distinguished professor of energy at the University of California, Berkeley, and founding director of the Renewable and Appropriate Energy Laboratory, states in his article beginning on page 84, “The Rise of Renewable Energy,” that:

*Solar cells, wind turbines and biofuels are poised to become major energy sources. New policies could dramatically accelerate that evolution.... We are now in an era where the opportunities for renewable energy are unprecedented, making this the ideal time to advance clean power for decades to come.... Policymakers and ordinary citizens must demand action and challenge one another to hasten the transition.*

New York State has taken a leadership role in cutting oil consumption and improving energy efficiency. Among other measures, 600 state-owned hybrid vehicles will be converted to plug-in hybrids, and a $24-million New York State Alternative Fuel Vehicle Research Laboratory is scheduled to be completed by 2008.

Without question, a major force in New York State’s efforts to curb petroleum consumption and increase energy efficiency is NYSERDA. Established in 1975, NYSERDA funds research into energy supply and efficiency, as well as energy-related environmental issues. NYSERDA has been cited by the U.S. Department of Energy as being among the best government research organizations in North America. The authority is committed to establishing partnerships with businesses, educational institutions and municipalities that work collaboratively to reduce energy costs and meet energy demands.
In July 2006, it was announced that NYSERDA would install two fuel cells and a photovoltaic (PV) awning system at NYSERDA headquarters in Albany, working with two New York companies dealing in alternative energy systems, Plug Power and Solar Energy Systems. In 2004, they began a partnership with Hudson Valley Community College to establish a photovoltaic lab and technical training program at the college.

The partnership between Hudson Valley Community College and NYSERDA speaks to Hudson Valley’s proven expertise in developing and delivering state-of-the-art training in engineering and industrial technologies. Just as NYSERDA has been committed to establishing relationships with other business, government, and educational entities, Hudson Valley Community College also is committed to its many partnerships in training, including partnerships with the New York State Department of Labor and the Capital Region Workforce Investment Board, General Motors Corp., DaimlerChrysler, General Electric, Owens Corning, Association of Builders & Contractors, Capital Region Builders & Remodelers Association Inc., Watervliet Arsenal, and Capital Region BOCES.

Hudson Valley Community College and NYSERDA both maintain excellent working relationships with a great many representatives from among the semiconductor manufacturing and alternative energy industries, government, and colleague educational institutions. These alliances include, but are certainly not limited to:

- DayStar Technologies
- SunPower Corp.
- International Ground Source Heat Pump Association
- SunWize Technologies
- Center for Economic Growth
- Albany, Rensselaer, and Saratoga counties Chambers of Commerce
- Rensselaer Polytechnic Institute
- University at Albany Nanotech Center
- National Renewable Energy Laboratory
- North American Board of Certified Energy Practitioners
- Interstate Renewable Energy Council
- Partnership for Environmental Technology Education
- Capital Region Workforce Investment Board
- New York State Department of Labor
- New York State Department of Environmental Conservation

Additionally, the college and NYSERDA have established an e-mail listserv for energy businesses seeking specialized training to meet their workforce needs through the Web site of NYSERDA’s Saratoga Technology and Energy Park (http://step.nyserda.org/workforce.html).

Today, Hudson Valley Community College and NYSERDA seek a new partnership – one that will have a vital impact on the future of our economy and success of our rapidly growing semiconductor manufacturing and alternative energy industries – not only in the Capital Region, but throughout New York State and beyond. If this region is to be able to meet the high demand for highly skilled semiconductor manufacturing technicians, and if alternative energy delivery systems are to grow in such a way as to lead to their successful commercialization as a viable solution to meet escalating energy demands, a critical central point must be established to foster partnership among these two 21st century industries, education, government, and the consumer. Through education and partnership, these constituencies will be able to work together to provide a highly skilled workforce to ensure high-tech success and promote the rapid integration of alternative energy technology into mainstream energy consumption. To that end, Hudson Valley
Community College and NYSERDA seek to unite their expertise in education, technical training, and semiconductor manufacturing and alternative energy industry resources to propose the creation of TEC-SMART: Training and Education Center for Semiconductor Manufacturing and Alternative and Renewable Technologies to be established in the Saratoga Technology and Energy Park in Malta, New York.

TEC-SMART will be the premiere partner for semiconductor manufacturing and high-tech alternative energy ventures to develop state-of-the-art curricula and training programs to meet the workforce demands of these rapidly growing industries. TEC-SMART will support these high-technology ventures through a collaborative approach among the state, academia, and other private- and public-sector parties. As these industries continue their research and development, with support from NYSERDA and other sponsoring entities, Hudson Valley Community College will serve as the hands-on partner to develop customized training programs for the skilled technicians necessary for these emerging ventures to grow and thrive. Ultimately, TEC-SMART seeks to become a New York State Center of Excellence, serving the region, state and nation as the premiere resource for training and education for the semiconductor manufacturing and alternative energy technology industries.
Goal and Objectives

Goal

The overarching goal for TEC-SMART is to serve the region, state and nation as the premiere resource for training and education for semiconductor manufacturing and alternative energy technologies; and, in so doing, establish New York State as a national leader in meeting the workforce demands for industries that provide products and services integral to our current and future quality of life in the 21st century.

Objectives

TEC-SMART will:

1. **Forge strong industry, education, and government partnerships** with those entities that have a stake in semiconductor manufacturing, alternative energy systems and “green-build” technology.

2. **Design and deliver expert customized training in semiconductor manufacturing** technology.

3. **Design and deliver expert customized classroom and distance learning training** on the theory, design, and installation of alternative energy technologies as they are developed and become viable, such as solar, solar thermal, micro hydro, wind, biomass, geothermal, and alternative fuels such as hydrogen, biodiesel, cellulosic ethanol, microturbines and fuel cells.

4. **Deliver skilled technicians** ready to meet the growing workforce demands in the semiconductor and alternative energy industries.

5. **Be a showcase facility** that is energy efficient, incorporates “green-build” techniques, and qualifies as a LEED facility (Leadership in Energy and Environmental Design).

6. **Be the first-choice educational resource** for educational institutions and the general public on the various types and applications of semiconductor manufacturing and alternative energy at the residential and commercial consumer levels.
Activities

Objective:
1. **Forge strong industry, education, and government partnerships** with those entities that have a stake in semiconductor manufacturing, alternative energy systems and “green-build” technology.

   Based in Malta, New York, at the Saratoga Technology and Energy Park, the Center will provide the ideal central location where trade organizations, non-profit groups, accrediting agencies, for-profit associations and other private institutions can collaborate with manufacturers, educational institutions, businesses, and government agencies to meet the needs of this growing industry.

   Activities:
   
   - Strengthen existing partnerships related to the alternative energy industry.
   - Establish an initial Advisory Board with representatives from among these partnerships to provide guidance on industry trends, workforce skill and training needs, and consumer education.
   - Coordinate educational and training needs for STEP partners.
   - Reach out to newly established and incoming companies, such as AMD, Tokyo Electron, SEMATECH, ASML, to ascertain training needs.
   - Form alliances with educational institutions and other entities conducting research in alternative energy applications, such as Stony Brook University and SUNY College of Environmental Science and Forestry.
   - Create opportunities for new partnerships between business, education, and government entities that will expedite the commercialization of alternative energy systems.

Objective:
2. **Design and deliver expert customized training in semiconductor manufacturing technology.**

   On July 18, 2002, Senator Bruno and other state leaders announced that International SEMATECH (ISMT), the 12-member global consortium of major computer chip manufacturers, would establish a $400-million, next-generation, 300-mm R&D center – named International SEMATECH NORTH – at Albany Nanotech, the University at Albany. In November of that same year, it was announced that Tokyo Electron Ltd. (TEL) would establish a $300 million R&D center at the University at Albany. On June 23 of this year, Senator Bruno, other state leaders and Dr.
Hector Ruiz, chairman and chief executive officer of Advanced Micro Devices announced plans for a multi-billion dollar deal that would enable AMD to build and operate the most advanced semiconductor manufacturing facility in the world at Luther Forest Technology Park in Saratoga County. This facility is projected to create over 1,200 new high-tech jobs, thousands of construction jobs and more than 3,000 indirect jobs. The capability to supply skilled technicians is a critical factor in supporting this industry.

Hudson Valley Community College has in place an A.A.S. degree program in Semiconductor Manufacturing Technology (SMT) through its Electrical Engineering Technology department that was launched Fall 2005 and is anticipating its first graduating class in Spring 2007. The curriculum has been designed to provide education for employment and transfer through competency-based curriculum, integrated with hands-on instruction that supports developments in the semiconductor industry, including present and emerging fields such as semiconductor fabrication, Micro-Electro-Mechanical Systems (MEMS), and nanotechnology. An outline of the SMT curriculum is included as an attachment to this proposal.

Activities:
- Pursue adaptation of theory courses in these curricula to online delivery to reach a wider audience by providing an additional option for access to training and the pursuit of an A.A.S. degree in Semiconductor Manufacturing Technology (SMT).
- Develop and maintain an assessment plan and reporting system for the SMT curriculum consistent with established college procedures for academic assessment and improvement.
- Apply for TAC/ABET (Technology Accreditation Commission/Accreditation Board for Engineering and Technology) accreditation for the Semiconductor Manufacturing Technology degree program.
- Investigate opportunities for additional satellite locations and interactive television (ITV) delivery of training programs that would provide additional access to training, including on-site locations at businesses such as AMD, Tokyo Electron, and IBM.
- Hudson Valley and NYSERDA will collaborate with industry experts to create a standardized platform for the delivery of semiconductor manufacturing training throughout the state.

Objective:
3. **Design and deliver expert customized classroom and distance learning training** on the theory, design, and installation of alternative energy technologies as they are developed and become viable, such as solar, solar thermal, micro hydro, wind, biomass, geothermal, and alternative fuels such as hydrogen, biodiesel, cellulosic ethanol, microturbines and fuel cells.

In November 2006, Hudson Valley is hosting, with NYSERDA as sponsor, a national conference for educators and trainers – The Renewable Energy and Energy Efficiency Workforce Conference – that will
highlight best practices and effective approaches to teaching workforce skills in the energy efficiency and alternative energy trades and industries. The college is well positioned to expedite delivery of these alternative energy programs. Of the five training curricula being proposed for TEC-SMART, the college already has an existing semiconductor manufacturing technology programs, with programs in photovoltaic technology and alternative fuels technology due to be launched in spring 2007.

Activities:

- Develop new credit and non-credit curricula, including distance learning formats as appropriate, for geothermal and wind energy technologies training and other alternative technologies as they become viable.
- Submit and acquire all necessary approvals from internal and external entities including the State University of New York and the New York State Department of Education for the new curricula.
- Design train-the-trainer/teacher programs for alternative energy technologies, including semiconductor manufacturing; photovoltaic; geothermal; wind; and bio-fuel.
- Recruit and train at least four new, full-time faculty members in the new alternative energy technologies curricula.
- Continue to develop and launch new alternative energy programs.
- Pursue adaptation of theory courses in these curricula to online delivery to reach a wider audience by providing an additional option for access to training.
- Develop and maintain an assessment plan and reporting system for the alternative energies curricula consistent with established college procedures for academic assessment and improvement.
- Investigate opportunities for additional satellite locations and interactive television (ITV) delivery of training programs that would provide additional access to training, including on-site locations at individual businesses (examples include Malta/Photovoltaic, Syracuse/Wind, Buffalo/Alternative fuels).
- Hudson Valley and NYSERDA will collaborate with industry experts to create standardized distance learning platforms for the delivery of training throughout the state.

Objective:

4. **Deliver skilled technicians** ready to meet the growing workforce demands in the semiconductor and alternative industries.

As demand for alternative energy systems increases so will the need for qualified installers. TEC-SMART will take a leadership role in growing a workforce to meet the demand, coordinating activities throughout New York State, to ensure that the different types of skill-sets of all types of alternative energy systems are covered. TEC-SMART and Hudson Valley’s Workforce Development Institute will monitor the types of energy systems installed throughout New York State and work with that
geographic location to help meet the workforce needs, whether it’s geothermal, solar, wind, etc. Hudson Valley Community College also will work closely with the semiconductor industry to help ensure that technicians are poised and ready to meet the employment needs of semiconductor companies.

Activities:

- Aggressively market the semiconductor manufacturing and alternative energy technologies programs through media advertising, presentations to business groups, high schools, general public, and contacts in the industry.
- Recruit students through business partners, Capital Region Workforce Investment Board, BOCES, and other sources, including reaching out to displaced workers seeking retraining.
- Recruit businesses to serve as internship training sites and provide training mentors for students to have opportunities for hands-on training in their chosen field of alternative energy technologies.
- Provide academic and student support services, as needed, to ensure student success.
- Regularly assess the relevance and effectiveness of the curricula through Advisory Board, employers, and alumni feedback.
- Prepare students to qualify for application for professional certification from the North American Board of Certified Energy Practitioners.
- Establish a semiconductor manufacturing and alternative energy job opportunities network for employers and job candidates to post job opportunities and submit applications and resumes electronically in order to expedite the hiring process. This system would be accessible through both the college Careers and Employment Web site and the NYSERDA/Hudson Valley Community College/STEP Workforce Initiative Web site.

Objective:

5. **Be a showcase facility** that is energy efficient, incorporates “green build” techniques, and qualifies as a LEED facility (Leadership in Energy and Environmental Design).

Construction has a huge impact on not only the overall environment, but human health and the economy as well. According to the U.S. Department of Energy and Department of Transportation, buildings in the U.S. account for 39 percent of the nation's total annual energy consumption while transportation accounts for only 27 percent. In addition, during a 100-year life span, the average commercial structure will cost 10 times as much to operate as it cost to build. As the environmental and economic impact of buildings become more apparent, the concept of **green building** is attracting interest and gaining acceptance. Green or sustainable building, according to the U.S. Environmental Protection Agency, is the practice of creating healthier and more resource-efficient models of construction, renovation, operation, maintenance, and demolition. While green-build construction methods can be integrated into buildings at any stage of design and
construction, the most significant benefits are gained when an integrated approach is taken from the earliest stages of a building project (see attached preliminary schematic of a PV installation for the TEC-SMART facility).

Activities:

- Design a facility that will meet LEED (Leadership in Energy and Environmental Design) standards.
- Use the facility as a showcase that will serve as an educational platform for industry representatives and consumers.
- Collaborate with NYSERDA on educational programs that focus on “green build” techniques, utilizing TEC-SMART as a model.
- Solicit manufacturers for “green-build” materials for display purposes to raise consumer awareness of green building benefits.
- Provide “green-build” workshops that promote integrated, whole-building design practices.

Objective:

6. **Be the first-choice educational resource** for educational institutions and the general public on the various types and applications of semiconductor manufacturing and alternative energy at the residential and commercial consumer levels.

In addition to its role as the premiere training facility for semiconductor and alternative energy technologies, TEC-SMART also will be a facility that fosters greater community awareness of the environmental and economic concerns surrounding energy sources and delivery systems and will play an active role in long-term, effective solutions to these issues. In partnership with NYSERDA as an educational resource, TEC-SMART will create a forum to disseminate educational information to businesses, the general public, and schools about alternative energy systems and green buildings. If alternative energy sources are to truly become mainstream, educating the public will be imperative.

Activities:

- Establish the NYSERDA Community Education Pavilion – an interactive educational facility that will feature hands-on learning activities for all ages and special programs for school groups, all designed to entertain and educate the public about semiconductor manufacturing, alternative energy, and green-build technologies.
- Provide alternative energy outreach to the community to increase awareness of available alternative energy technologies.
- Provide homeowners with valuable guidance on what types of systems would be best suited for their homes, as well as information on potential government subsidy programs and tax incentives.
• Be a resource center for curriculum development for educators seeking information and lesson/course enhancements concerning the study of alternative energy and green-build technologies.
• Develop and run a series of non-credit hands-on workshops that teach homeowner basics of the operation and maintenance of alternative energy systems.
• Establish and host activities such as an annual Energy Exposition, an Alternative Energies Home Show, and student energy competitions, as part of the educational programming for the general public and include participation from business, government, research, and education.

Outcomes

Hudson Valley Community College and NYSERDA share a common vision for a successful and thriving future for high-tech and environmentally sound technologies in the Capital Region and beyond. As an emerging leader in support of these technologies, the Capital Region and New York State will be recognized as a mecca for these technology-focused initiatives. For its part, as a result of this proposed center of education and training in semiconductor manufacturing and alternative energy technologies, it is projected that the following outcomes will be achieved:

- Economic growth will be accelerated by the infusion of a substantial skilled workforce into the semiconductor manufacturing and alternative energy industries;
- A projected 500-600 technicians will be trained over the next five – ten years to keep pace with industry employment needs throughout the Capital Region;
- National recognition for New York State as a leader in semiconductor manufacturing and alternative energy technologies training;
- There will be increased awareness of the need for alternative energy sources;
- Understanding of alternative energy and “green build” technologies will grow;
- There will be increased demand for residential and commercial alternative energy systems;
- TEC-SMART will be recognized as a New York State Center for Excellence; and
- TEC-SMART will become the premiere center for hands-on education and training for semiconductor manufacturing and alternative energy technologies for schools, business, government, and the general public at the regional, statewide, and national levels.
# TEC-SMART

## Budget Summary

### Facility
- Building: 36,700 sf @ $225/sf  
  $ 8,257,500  
- Parking: 450-space lot  
  $ 900,000  
**Total Construction Costs**  
$ 9,157,500

### Fit-up and Start-up Costs
- Furnishing and fixtures  
  $ 1,000,000  
- Building System Infrastructure  
  950,000  
- IT Equipment: $15,000 each x 10 general classrooms and 6 labs  
  240,000  
- Semiconductor lab/clean room  
  1,000,000  
- Photovoltaic Lab  
  275,000  
- Geothermal Lab  
  300,000  
- Wind Energy/BPI Lab  
  400,000  
- Computer ITV/DL Lab  
  200,000  
**Total Fit-up and Start-up Costs**  
$ 4,365,000

### Total Project Funds
$ 13,522,500

### Offsets
- From HVCC: Equipment for Semiconductor Manufacturing Lab  
  $ 500,000  
**Total Offsets**  
$ 500,000

### Appropriation Request
$ 13,022,500
Attachments

TEC-SMART

Training and Education Center for
Semiconductor Manufacturing and
Alternative and Renewable Technologies

Hudson Valley Community College
New York State Energy Research & Development Authority
TEC-SMART Development Team

Dr. Carolyn Curtis
Vice President for Academic Affairs
Hudson Valley Community College

Joseph Sarubbi
Department Chair – Building Systems Technology
Hudson Valley Community College

Robert Callender
Vice President for Programs
NYSERDA

Sarah Boggess
Vice President for Institutional Advancement, Hudson Valley Community College

Phillip White
Dean, Schools of Business and Engineering and Industrial Technologies
Hudson Valley Community College

Dr. Margaret Geehan
Assistant to the Vice President for Academic Affairs
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Timothy Dennis
Professor
Civil, Construction, Industrial and Mechanical Technology
Hudson Valley Community College

Jill Palmer-Wood
Assistant Professor
Civil, Construction, Industrial and Mechanical Technology
Hudson Valley Community College
## TEC-SMART Timeline

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<th>EVENT</th>
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<td>Fall</td>
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<td>Appointment of TEC-SMART Director</td>
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<td>Recognize Williams 123 &amp; 126 as the Temporary Headquarters for TEC-SMART</td>
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<td>TEC-SMART open and operational</td>
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<td>Outreach to STEP partners, alternative energy industry, government, public</td>
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<td>Completion of curricula for geothermal and wind energy programs</td>
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<td>Hire new faculty for alternative energy programs</td>
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<td>Train-the-trainer programs operational</td>
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<td>Students enrolled in technician programs:</td>
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<td>• Semiconductor Manufacturing</td>
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<td>• Photovoltaic</td>
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<td>Technicians graduate w/AAS degrees</td>
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<td>Homeowner workshops</td>
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<td>Career opportunities web network is operational</td>
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<td>TEC-SMART offers K-12 educational programming</td>
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<td>Annual Alternative Energy Expo is held</td>
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<td>Satellite sites identified for program expansion</td>
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TEC-SMART Organizational Overview

NYSERDA

ADVISORY BOARD

President
Hudson Valley Community College
Andrew J. Matonak, Ed.D.

Vice President, Academic Affairs
Hudson Valley Community College
Carolyn Curtis, Ph.D.

Director, TEC-SMART
Hudson Valley Community College
Joseph Sarubbi

Administrative Assistant, HVCC
Tricia King

Support Staff

Faculty
Faculty
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Faculty
# SEMICONDUCTOR MANUFACTURING TECHNOLOGY (SMT)
## CURRICULUM

<table>
<thead>
<tr>
<th>Fall (First) Semester</th>
<th>Credits</th>
<th>Spring (Second) Semester</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>FORM 101 College Forum</td>
<td>1</td>
<td>ELET 101 Electricity II</td>
<td>4</td>
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<tr>
<td>ELET 100 Electricity I</td>
<td>4</td>
<td>ELET 105 Electronics I</td>
<td>4</td>
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<tr>
<td>ELET 120 Introduction to Computer Technology</td>
<td>3</td>
<td>ENGL 102 Composition II</td>
<td>3</td>
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<tr>
<td>ENGL 101 English Composition I</td>
<td>3</td>
<td>MATH 151 Analytic Geometry &amp; Basic</td>
<td>4</td>
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<tr>
<td>MATH 150 College Algebra and Trigonometry</td>
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<td>Humanities or Social Science Elective</td>
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<td><strong>TOTAL SEMESTER CREDITS</strong></td>
<td><strong>15</strong></td>
<td><strong>TOTAL SEMESTER CREDITS</strong></td>
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<thead>
<tr>
<th>Fall (Third) Semester</th>
<th>Credits</th>
<th>Spring (Fourth) Semester</th>
<th>Credits</th>
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<tbody>
<tr>
<td>ELET 261 Semiconductor &amp; Nanotechnology Overview (new course)</td>
<td>1</td>
<td>ELET 255 Semiconductor &amp; Nanotechnology Fabrication Processes (revised course)</td>
<td>4</td>
</tr>
<tr>
<td>ELET 250 Vacuum &amp; Thin Film Technology (revised course)</td>
<td>4</td>
<td>ELET 285 Semiconductor Metrology &amp; Process Control (new course)</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 105 Introductory Chemistry I</td>
<td>4</td>
<td>ELET 115 C/C++ for Technologies</td>
<td>4</td>
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<tr>
<td>PHYS 135 Technical Physics I</td>
<td>4</td>
<td>ELET 225 Electro-mechanical Devices &amp; Systems</td>
<td>4</td>
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<td>ELET 210 Digital Electronics</td>
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<td><strong>Total Semester Credits</strong></td>
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<td><strong>Total Semester Credits</strong></td>
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<td><strong>Total Program Credits</strong></td>
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### Selected Course Descriptions:

**ELET 261: Semiconductor & Nanotechnology Overview**

This course introduces the student to employment opportunities in the microchip fabrication, nanotechnology and electronics industries. The course provides an overview of the semiconductor industry and nanotechnology fields as well as modules on the protocols and safety procedures required in semiconductor facilities, industry skill requirements and an introduction to Materials Chemistry processing fundamentals. Additional modules are included on the basics of silicon manufacture, backend chip processing, integration into electronics and high technology applications. The course will include tours of actual semiconductor & electronics manufacturing facilities industry as well as thin film & materials laboratories at local universities.

**ELET 250: Vacuum & Thin Film Technology**

The study of vacuum and plasma generation techniques utilized in microelectronic, thin film and nanotechnology applications. The vacuum areas of study include gas flow, pressure regimes, gas laws, outgassing, high vacuum production, leak & contamination detection and residual gas analysis (RGA) techniques. The thin film area of study will cover RF power supplies (radio frequency generation, amplification, conductors), DC power supplies and other thin film deposition technologies. In addition, content will emphasize safety concerns involved in the installation, maintenance and operation of vacuum and thin film equipment.

**ELET 265: Materials Chemistry for Semiconductors and Nanotechnology**

The course provides an understanding of the chemicals and materials used in nanotechnology intensive industries such as in semiconductor fabrication and research. The student will be introduced to process-structure-property relationships relevant to the semiconductor industry and nanotechnology fields. Additional modules are included on the basics of atomic bonding, acids, bases, solvents, reactions, and gas laws.
ELET 255: Semiconductor Manufacturing & Nanofabrication Processes

This course is designed to train the student in the practical and theoretical aspects of the semiconductor and nano device manufacturing processes.

ELET 285: Semiconductor Metrology & Process Control

This course introduces the student to concepts employed in industries in the analysis of semiconductor materials, products, processes and systems. The course provides modules on process flow charting, process parameters, semiconductor metrology instruments, interpreting measurement data, statistical analysis of process data, design of experiments, and applying team troubleshooting skills in solving process problems. The course will allow the student to develop an understanding of physical measurement in conjunction with the statistical data analysis and process experiment design.

ELET 280: Semiconductor / Nanotechnology Practicum

Students will apply knowledge and skills in designated areas of microchip fabrication, nanotechnology and electronics industries through hand-on experience with different phases of production process. The practicum will allow the student to utilize the safety procedures, teamwork, and communication skills that are necessary in industrial and research facilities. Students will acquire work-based experience assisting industrial or university personnel in the research process, design process, prototyping, manufacturing, trouble-shooting, repair, documentation, and/or customer service aspects of the semiconductor, nanotechnology or electronics industry.
TEC-SMART Preliminary PV Installation Schematic