Michigan Academy for Green Mobility Alliance

Advanced Compression Ignition Engineering Certificate

Education and Training Provider
Request for Proposals
BACKGROUND

Michigan is moving rapidly toward renewable energy and other sustainable technologies to remain economically viable and protect our environment. In response to the rapid growth in this sector, the Michigan Department of Energy, Labor & Economic Growth (DELEG) has partnered with automotive manufacturing industry employers to establish the Michigan Academy for Green Mobility Alliance (MAGMA). The purpose of MAGMA is to ensure the automotive industry has the trained workers it needs to grow and prosper in the emerging green economy. Driven by the needs of the employers, the Academy is administered by a governing board made up of employers, education and training providers, the workforce development system, and state government. It is the role of the governing board to make decisions on behalf of the Academy.

MAGMA delivers rapid skill growth in green technology solutions for advanced mobility to meet industry needs. Its objective is to prepare individuals for emerging technologies in vehicle propulsion, component design, manufacturing, and maintenance. The skill development and training requested in this Request for Proposals (RFP) is in direct response to specific knowledge and skill demands of employers in the automotive manufacturing industry as they diversify into advanced technologies that support Michigan’s green economy.

As Michigan’s automotive industry transitions toward green mobility, there is an increasing demand for individuals with the knowledge, skills, and experience necessary to work on emerging vehicle technologies. There is a need for training to help prepare individuals to move quickly from jobs working on traditional gasoline-based vehicles to advanced propulsion vehicles that use green technologies and applications. DELEG works with automotive manufacturing employers, education and training providers, industry associations, and the workforce system to develop a mechanism for providing that training.

The mission of the Academy is to:

Provide rapid skill growth in green technology solutions for advanced mobility to meet industry needs.
The mission of the Academy drives the following objectives:

- Prepare individuals for emerging technologies in vehicle propulsion and vehicle component design, manufacturing, and maintenance
- Encourage and support rapid/accelerated training and re-training
- Train individuals for green mobility jobs including:
  - Incumbent and displaced engineers
  - Engineering students
  - Incumbent and displaced technicians
  - Technician program students

MAGMA endorses education and training based on the occupations, skills, and knowledge required by employers to design, develop and manufacture the next generation vehicles. The focus is on efficiently and effectively up-skilling the Michigan workforce to prepare them for new jobs in green mobility and retain existing jobs affected by the drive for improved fuel economy and less environmental impact. Education and training institutions provide learning opportunities that are short-term, targeted, innovative, flexible, and have a strong focus on hands-on practical experience. MAGMA endorsed education and training meets or exceeds employer defined skill and competency needs, positioning individuals to excel in green mobility jobs.

Partnerships are critical to make the most efficient use of established curriculums, facilities, laboratories, and equipment to provide the automotive industry with the talent necessary to succeed. Collaboration is necessary to create the right mix of theoretical knowledge with practical experience, and build on the strengths of individual organizations in order to provide the highest quality training available in this emerging field.

REQUIREMENTS

The following outlines the Education and Training Requirements for the RFP.

Applicants are encouraged to create innovative partnerships to make the most efficient use of established curriculum, resources, and expertise. Applications that combine coursework and lab experiences from multiple education providers are preferred.

The purpose of this Education and Training Provider Request for Proposals is to develop and implement a Masters Level Engineering Certificate Program delivered by one or more provider(s) in the area of Advanced Compression Ignition Engineering. The Certificate Program should consist of a menu of courses (nominally equivalent to 12-18 university semester hours) that provide students with the knowledge and practical experience necessary to work with Advanced Compression Ignition (CI) technologies. The selected training provider(s) will work with MAGMA to carry out its mission.
It is desirable that the courses selected for the subject Certificate Program be compatible with module concentration building within conventional master's level engineering degrees. Thus upon completion of the Certificate Program, it is anticipated that the provider(s) would make available executable options that permit the Certificate Program courses to be used as building blocks within their conventional masters level engineering degrees. While the primary short term objective of this Certificate Program is to provide incumbent and displaced engineers basic overall knowledge of CI technologies in an automotive system, it is anticipated that these initial Certificate Program courses will also form the “launching” platform for more advanced, in-depth courses in advanced diesel technologies which are compatible with advanced academic study in the area.

The Academy will assist in identifying students for this program. This RFP does not obligate the State of Michigan for the costs associated with the development or delivery of the solicited education and training program. This RFP does not address the future costs associated with the education and training program.

Training Requested:

- Advanced Compression Ignition Engineering Certificate

Target Audience:

- Incumbent and displaced engineers transitioning from traditional vehicle design and manufacturing to advanced Compression Ignition projects that may include hybrid electric vehicle (HEV), plug in hybrid electric vehicle (PHEV) and common rail diesel applications. Education and training for the Advanced Compression Ignition Engineering Certificate program should be structured for bachelor or master degreed engineers entering Advanced Compression Ignition engineering and component design and manufacturing.

Prerequisites:

- Bachelor Degree in Engineering

Learning Objectives and Outcomes:

- The Advanced Compression Ignition Engineering Certificate should expose engineers to a broad range of CI skill areas. The certificate should include a set of core coursework that provides the base knowledge necessary for working on CI technologies as well as opportunities to obtain more in-depth knowledge and experience in specific skill areas. The Advanced Compression Ignition Engineering Certificate program should include courses that cover all or a subset of the following key skill areas defined by employer needs:
O COMPRESSION IGNITION ARCHITECTURES
  ▪ Review of current Light Duty, Medium Duty, and Heavy Duty designs
  ▪ Implications of down size, down speed and up boost
  ▪ Future technologies pipeline: Homogeneous Charge Compression Ignition, Camless, Variable Compression Ratio, Air-hybrid, et al.
  ▪ Engine system simulation resources
  ▪ Overview of Key Diesel enablers: Fuel Injection (FI), Air handling, Exhaust treatment, et al.
  ▪ Impact of Legislation

O FUEL INJECTION TECHNOLOGIES
  ▪ History of FI
  ▪ Legacy Pump-Line-Nozzle systems
  ▪ Electronic Unit Injector and Electronic Unit Pump systems
  ▪ Common Rail Systems: remote pump, distributed unit pump
  ▪ Nozzle Technology
  ▪ System simulation using AMESim
  ▪ Control strategies
  ▪ Alternate fuels and fuel effects
  ▪ Low pressure feed systems
  ▪ System application considerations
  ▪ Laboratory: Hands-on with system test machines

O BOOSTING TECHNOLOGY
  ▪ Review of past and current boosting options
  ▪ Mechanical boosting system options: Roots, screw, centrifugal, piston, et al.
  ▪ Turbocharging system options: Centrifugal, axial, mixed flow, waste gate, multi-stage, Variable Geometry Turbo, et al.
  ▪ System Architectures: Single Stage, Multi-stage
  ▪ Intercooling and thermal management
  ▪ Integration with Exhaust Gas Recirculation (EGR) and aftertreatment
  ▪ System simulation
COMPRESSION IGNITION COMBUSTION
- Review fundamental types of combustion: flame front, diffusion, premixed
- Review of combustion chamber options: Bowl-in-piston on axis vs. side injection
- Thermodynamics: Diffusion and premixed
- Injection Strategies: Single, multiple, partially premixed, fully premixed
- Simulation Options: Computational Fluid Dynamics, KIVA, Chemkin
- Combustion Optimization: Emissions, noise, Specific Fuel Consumption tradeoffs
- Laboratory: Single Cylinder combustion research engine

EXHAUST GAS AFTER TREATMENT
- Global Emission standards for diesels: On highway, Off highway, Not to Exceed, On Board Diagnostics (OBD), et al.
- Emissions and measurement
- Diluents and system integration: EGR, water, et al.
- Oxidation catalysts
- Diesel particulate filters
- NOx remediation: Lean NOx Trap systems, Selective Catalytic Reduction systems
- Exhaust system architectures
- Emerging technologies

CONTROL SYSTEMS
- Fundamentals of control theory
- Control system architectures
- Sensor and actuator types and signal requirements
- Common Rail Injector drives: solenoid, piezo, et al.
- Engine Control Unit Architectures
- Control Strategies: fuel, boost, EGR, Exhaust Gas Analysis, engine protection
- Software design, layers, coding, and validation
- Data link communications protocols and requirements
- Hardware in the Loop testing
- Electro Magnetic Compatibility (EMC) testing
- On Board Diagnostics 2 (OBD2), Heavy Duty OBD system design, test and validation

○ APPLICATIONS ENGINEERING
  - Calibration to meet vehicle/customer requirements: Performance, drivability, emissions, fuel sensitivity, hot/cold start, altitude, Noise Vibration Harshness, transmission match, hybrid system integration
  - Vehicle emissions system optimization: Diesel Particulate Filter regeneration, SCR system functionality, OBD functionality
  - Use of data-logging and diagnostic tools
  - Maintainability and serviceability
  - Durability testing: Reliability growth and Weibull analysis
  - Certification and homologation issues

- MAGMA recognizes that all topics may not be covered by a single education provider or a single certificate program. Proposals should indicate which skill areas are met by each of the courses included in the proposed certificate program. Partnership with other institutions is encouraged to provide a comprehensive certificate program.

Applicants are encouraged to be innovative in their program design and delivery to meet the employer driven needs. Individual courses may focus on one or multiple skill areas and course design is at the discretion of the applicant.
Training Delivery:

- **Method of Delivery:**
  - Training should include at least one hour of lab/practical experience for every three hours of classroom style learning. (as applicable)
  - Training should include team-based, hands on learning opportunities.

- **Delivery Timeframe:**
  - Program delivery outside of normal business hours (Monday through Friday, 8 a.m. – 5 p.m.) is preferred.
  - No more than half of the training should be conducted during normal business hours. (Monday through Friday, 8 a.m. – 5 p.m.)

Student Assessment:

- Students should be evaluated through a combination of tests and practical projects.

Credit:

- Education and training resulting in graduate level credits is required.

- The Advanced Compression Ignition Engineering Certificate should consist of 12 – 18 credit hours (approximately half the credit hours required for a master’s degree).

- All credits earned through the Advanced Compression Ignition Engineering Certificate should be accepted toward a master’s degree program.

- Proposed Advanced Compression Ignition Engineering Certificate programs should accept transfer credits from other MAGMA endorsed courses. A minimum of 20 percent of the proposed program’s credit hours is preferred.
  - Partnerships that combine coursework and lab experiences from multiple education providers are preferred.
  - Example: University A (applicant) offers a certificate program that includes three courses from University A, two courses from University B, and lab experiences at Community College C. Credits are articulated across all partners involved and a certificate is conferred by University A.
APPLICATION REQUIREMENTS

Eligibility:

- Eligible applicants are education and training providers with a significant presence in the State of Michigan including but not limited to universities, community colleges, private training providers, and industry associations.

- Proposals may be submitted by a single institution or in partnership with multiple institutions. Cross-institutional partnerships are encouraged to create the right mix of theoretical knowledge with practical experience and make the most efficient use of established curriculums, facilities, laboratories, and equipment. If the proposal is submitted in partnership, a lead agency must be identified to serve as the applicant.

Pre-Bid Webinar:

A Pre-Bid Webinar will be held to answer questions related to the RFP. The Webinar is scheduled for May 5, 2011. We request questions be submitted in writing to MiSA@michigan.gov prior to the Webinar for responses to be provided during the Webinar. Please visit the Michigan Skills Alliances Web site at www.michigan.gov/rsa for information regarding this Webinar.

All PowerPoints, questions, and answers are posted to the Michigan Skills Alliances Web site at www.michigan.gov/rsa by within three business days after the webinar, or May 11, 2011.

Proposals:

Proposals must be filled out electronically using ATTACHMENT A: Michigan Academy for Green Mobility Alliance Application. Proposals received in other formats will not be considered.

This RFP does not require proposals to be submitted by a specific deadline. DELEG will accept proposals and MAGMA will endorse training providers throughout the year. Submit proposals electronically to Mr. Richard Fisher at fisherr2@michigan.gov. Hard copies may also be sent to:

Department of Energy, Labor & Economic Growth  
Bureau of Workforce Transformation  
Regional & Sectoral Strategies Division  
Mr. Richard Fisher, Workforce Development Specialist  
Victor Office Center  
201 North Washington Square, 3rd Floor  
Lansing, Michigan 48913
Review Process:

Proposals received by DELEG are evaluated by a committee consisting of MAGMA employers and workforce development representatives. The committee reviews proposals and recommends endorsement of education and training programs that most closely meet the needs identified by industry employers using the following criteria:

To be considered, the proposal must:
   a. Align with the vision and objectives of MAGMA
   b. Confer credits (through either the applicant or a partner organization)

Evaluation:

- Certificate Program/Course Content: 40 Points
  - Weighted toward alignment with industry needs
- Certificate Program/Course Delivery: 25 Points
- Student Assessment: 10 Points
- Partnerships: 10 Points
- Reciprocity of Credits: 15 Points
  - Provisional endorsement may be given while reciprocity agreements are in process

All proposals are considered and must be open to negotiation and/or modification. The review committee has the option to recommend changes to applicant’s proposals prior to recommending endorsement. The MAGMA Governing Board has final approval of all education and training endorsed by the Academy.

Notification:

Successful applicants are notified of MAGMA endorsement within 60 days of proposal submission. This information will also be posted on the Michigan Regional Skills Alliances Website at [www.michigan.gov/rsa](http://www.michigan.gov/rsa).
**Reporting Requirements:**

Upon completion of the program, the selected education and training provider(s) must report the following information to the MAGMA Governing Board:

- Number of students enrolled
- Education level of enrolled students
- Engineering discipline of enrolled students
- Demographic information of enrolled students (in aggregate)
- Number of students completing the program
- Education level of students completing the program
- Engineering discipline of students completing the program
- Student assessment results including practical project results