



Southern & Central Arizona Aerospace & Defense Region 2014 Energy Reduction Challenge Grant Competition

SUMMARY AND BACKGROUND

The Arizona Commerce Authority (ACA) is the recipient of an Advanced Manufacturing Jobs and Innovation Accelerator Challenge Grant. This three-year multi-federal agency grant enables the ACA to develop programs to support and grow southern and central Arizona's Aerospace and Defense (A&D) industry and its supply chain.

The intent of this competition is to foster stronger relationships between Small to Medium-Sized Manufacturing Enterprises (SME) and encourage third-party solution providers to develop new tools and technologies to reduce energy consumption and relate those energy consumption improvements to bottom line savings for the A&D machine tool industry.

The problem statement for this competition is that many A&D machining processes utilize older generation CNC machine tool technologies that can result in an inefficient use of resources – energy, time and materials – compared to the latest state-of-the-art CNC machines. The ACA and the US Department of Energy's Advanced Manufacturing Office have teamed to provide the tooling and machining industry with technical assistance and solutions to improve energy efficiency of these older generation machine tools.

In order to advance **emerging technologies towards commercialization**, the ACA will conduct an annual Energy Reduction Challenge Grant competition for one or more of the following topic areas. Companies may respond to multiple topic areas; however, each proposal must address a single topic.

Topic Area 1: Integrated Lean & Green Energy Improvement Tools

Next-gen lean tools and rapid response Kaizen events to help identify integrated productivity and energy use improvement opportunities using data driven tools and methods developed and supplied by a training partner that link proposed improvement ideas to bottom line financial savings and energy use impact.

Topic Area 2: "Bolt-On" CNC Machine Tool Sensing & Control Technologies

Development of "bolt-on" sensing and control technologies and/or software-enabled interfaces for older generation machine tools that make these machines "smarter" and easier to set-up, program, and monitor similar to newer state-of-the-art MTConnect compatible machines/controllers that have recently become available.

Topic Area 3: Simulation-Based Machine Tool Energy Use Optimization

Application of commercial off the shelf (COTS) simulation software such as discrete event simulations and physics-based modeling to baseline "current state" machine tool and manufacturing system performance and guide process innovation strategies similar to how these same tools are currently used to drive product innovation.

This year multiple competitive awards (up to \$75,000 each) totaling \$300,000 will be made. Over the three-year period, it is anticipated that Energy Reduction Challenge Grants totaling \$742,000 will be awarded.

By participating in this grant competition, SMEs will benefit by 1) providing valuable insight into new tools and practices to help them understand and quantify where their biggest energy inefficiencies occur and relate these to bottom-line costs, 2) help develop new technologies that improve the energy efficiency and/or productivity of their manufacturing operations, and 3) leverage the pilots to help identify and drive improvements that result in bottom line savings to their businesses. Third-party solution providers will also benefit by receiving funds to develop new innovative tools and technologies that will allow them to expand their service offerings into new areas that can result in revenue growth.

Specifically, this regional initiative will seek to help companies in a six-county region (Maricopa, Yuma, Pinal, Pima, Cochise and Santa Cruz) create a sustained effort to strengthen and differentiate its existing base of A&D companies and suppliers, grow a more diverse base of companies, position the resulting cluster of companies and suppliers to compete more effectively in global markets, develop and commercialize new technologies, broaden participation in the cluster to include more disadvantaged firms, and broaden the region's talent pool to support additional growth.

WHY SHOULD I PARTICIPATE?

Solution Providers - Consultants, training firms, engineering and technology companies and educational institutions

- This is an opportunity for you to enhance and grow your services, products and research by developing new methodologies, processes and technologies for energy use improvements in manufacturing.
- Awardees will receive seed money to develop and implement new products and services.
- Novel technologies may result in follow-on projects and commercialization assistance i.e. – AZ Fast Grants and/or SBIR/STTR opportunities, etc.

Tooling & Machine Shops

- The projects funded by this grant are beyond changing the light bulbs. The ACA and DOE are providing financial assistance to help you identify production line flow/energy use improvements, as well as new sensing and control technologies/software that help make older machines “smarter” and easier to set-up, program and monitor.
- You can help influence the development of next-generation tools that help solve the most pressing problems along with help from the third party solution providers in linking the proposed improvements to bottom line savings.
- Participating as a pilot site means that you will receive expert third-party technical advice and assistance.

TOPIC AREAS DESCRIPTIONS

The ACA is currently interested in identifying small to medium-sized tooling and machining companies and third party solution providers that have an interest in participating in an Energy Reduction Challenge Grant competition for one or more of the following topic areas. Companies may respond to multiple topic areas; however, each proposal must address a single topic.

Topic Area 1: Integrated Lean & Green Energy Improvement Tools

Next-gen lean tools and rapid response Kaizen events to help identify integrated productivity and energy use improvement opportunities using data driven tools and methods developed and supplied by a training partner that link proposed improvement ideas to bottom line financial savings and energy use impact.

- Maximum per award \$50,000
- Completion: 4 months

Topic Area 2: “Bolt-On” CNC Machine Tool Sensing & Control Technologies

Development of “bolt-on” sensing and control technologies and/or software-enabled interfaces for older generation machine tools that make these machines “smarter” and easier to set-up, program, and monitor similar to newer state-of-the-art MTConnect compatible machines/controllers that have recently become available.

- Maximum per award \$75,000
- Completion: 6 months

Topic Area 3: Simulation-Based Machine Tool Energy Use Optimization

Application of commercial off the shelf (COTS) simulation software such as discrete event simulations and physics-based modeling to baseline “current state” machine tool and manufacturing system performance and guide process innovation strategies similar to how these same tools are currently used to drive product innovation.

- Maximum per award \$75,000
- Completion: 6 months

Specific details and areas of interest for each of the three topics are included at the conclusion of this document.

More information on the application of lean and six sigma approaches to achieve process excellence through energy efficiency and greenhouse gas reductions can be found at EPA’s [Lean Energy and Climate Toolkit](http://www.epa.gov/lean/environment/toolkits/energy/resources/lean-energy-climate-toolkit.pdf).
<http://www.epa.gov/lean/environment/toolkits/energy/resources/lean-energy-climate-toolkit.pdf>

APPLICANT QUALIFICATIONS

- The purpose of this grant is to identify **process improvement methodologies and novel technologies** that can be implemented on a pilot basis **with an industry partner or partners** within three to six months of the award notification.
- Third party solution providers, i.e. – consultants, training firms, engineering and technology companies, and educational institutions, are required to team with small to medium-sized manufacturing enterprises (SME) to develop and submit proposals.
- Each applicant **must identify** a teaming arrangement with one or more tooling and machining shops (Shops) in the six-county region. Preference will be given to proposers teaming with multiple Shops.
- The machine shops must have less than 500 employees in its southern and central Arizona operations and serve aerospace and defense customers.
- Each proposal must address a single topic area.

PROJECT REQUIREMENTS

Applicant and their tooling and machining shop partners are required to leverage the award funds with a partial match of the requested award amount. The chart below details the match requirements for two theoretical awards.

	Example 1	Example 2
Energy Reduction Challenge Grant Award	\$50,000	\$75,000
Applicant Match (50%)	\$25,000	\$37,500
Sub Total	\$75,000	\$112,500
Total of Tooling and Machining Shops Partners' Match (25%)	\$18,750	\$28,125
Total Grant Value	\$93,750	\$140,625

- Solution providers must apply jointly with a SME industry partner or partners.
- Solution providers must demonstrate a minimum 50% match (cash and/or in-kind) of the requested award amount. Preference will be given to applicants with higher cash to in-kind ratio.
- *Arizona Joint Technological Education Districts, higher education institutions and solution providers with gross revenues of \$2 million or less are eligible for a waiver of the cost share requirements.* Applicants should indicate in the Project Summary page if they are requesting a waiver. Note the waiver applies only to the work and budget of the eligible applicant and not to the work and budget of its industry partners.
- Industry partners must provide a total award match of at least 25% (cash and/or in-kind, i.e. – labor, materials, machine time, plant overhead, etc) Preference will be given to proposers with higher in-kind contributions.
- Proposals must include a detailed letter(s) of commitment from each participating Shop and a completed budget sheet. The letter must be from the CEO/Senior Manager on site and identify the company's team members who will be participating in the project.
- Performance milestones are required in the proposal.
- Project results including tool improvement findings are public domain. ACA will be granted unlicensed rights for usage.
- All proprietary data, processes, and tools must be identified in the proposal.

GRANT COMPETITION TIMELINE

- March/April - Competition Opens
- Teleconference # 1 to answer questions
- Teleconference # 2 to answer questions
- Proposals Due – within six weeks of open
- Submit proposals via email to energyreductiongrant@azcommerce.com
- June - July 2014 – After negotiation of award contracts and performance milestones, initial allotment of funds will be released. Remaining payments paid upon milestone achievements
- September 2014 - Mid-project performance reviews
- November - December 2014 - Final reports due
- Remaining project funds released – Upon acceptance of final report to ACA
- Address questions to energyreductiongrant@azcommerce.com

REQUIRED PROJECT DELIVERABLES

- Provide at least four measurements of energy consumption – 1) upon initiation of the project to establish a baseline, 2) conclusion of the project to demonstrate results and two post conclusion measurements taken at 6 and 12 months after the project conclusion.
- Monthly project progress and budget reports
- Final impact report with measurements and data that demonstrate actual versus projected energy consumption reductions and discusses potential commercialization pathway

PROPOSAL CONTENT

The proposal should succinctly address each area outlined in the project requirements. Proposals components **may not exceed the maximum lengths identified below.**

1. **Project Summary - Scope of Work, Timeframe and Deliverables (1 page max)**
2. **Qualifications of the Proposer and Teaming Arrangement (1 page max)**
3. **Proposed Solution Methodology**
 - Topic Area 1: (3 pages max)**
 - Topic Area 2: (4 pages max)**
 - Topic Area 3: (10 pages max)**

- Problem understanding and scope definition for area of interest
- Data collection methodology and current state baseline approach
- Data analysis and Shop impact analysis tools and techniques
- Proposed process/tool/technology development to address gaps
- Pilot implementation and energy use impact analysis validation approach
- Proposed metrics for monitoring and sustaining improvements
- List deliverables and any proprietary tools/data that will not be shared

4. **Key Work Breakdown Structure Tasks & Key Schedule Milestones (1 page max)**
5. **Budget Spreadsheet – Download template at <http://www.azcommerce.com/programs-and-services/energy-reduction-grant/>**
6. **Budget Narrative - Use of all cash and matching funds (1 page max)**

PROPOSAL REVIEW PROCESS

- All proposals will be initially screened for minimum qualifications.
- Qualified proposals will be reviewed by a panel.
- Finalists may be invited to present their proposals before the panel.

PROPOSAL EVALUATION CRITERIA (100 points)

All qualified proposals will be evaluated against the following criteria prior by the review committee for final selection.

The evaluation criteria will focus on:

Technical Approach Feasibility and Deliverables (20 points)

- Does the proposed approach align with the RFP scope and directions?
- Is the proposed technical approach well thought out and achievable?
- Is the approach to validate the energy improvement impact clearly defined?
- Is the schedule both reasonable and viable?
- Is the data collection approach sufficient to establish a baseline?
- Do the deliverables balance public domain vs. proprietary concerns?

Commercialization Potential & Innovativeness of Approach (30 points)

- Is the approach scalable across the industry or solve a niche problem?
- Does the approach address energy improvements in new and novel ways?
- Does the approach link productivity inefficiencies to energy inefficiencies?
- Does the approach help make manufacturing more appealing as a potential career to a younger workforce?
- Does the approach advance the current state-of-the-art of approach?
- Does the project align with the mission and value proposition of the AZ MEP?
- Does the solution provider intend to use the project to develop new services?
- What is the potential of new job creation?
- If it appears that jobs will be created, how many and at what salaries?

Qualifications of the Applicant (20 points)

- Has solution provider teamed with at least one SME machine shop?
- Will the SME CEO/Senior Manager on site be participating?
- Are the Shop's resources actively involved in each WBS task?
- Are multiple (>1) SME pilots planned to validate the concepts?
- Does the team have the needed qualifications/expertise to be successful?
- Does the project equally benefit solution providers and Shops?

Integrated Energy, Flow, and Productivity Improvement Impact (15 points)

- Does the approach help identify energy intensive manufacturing processes?
- Does the approach link typical manufacturing wastes to energy inefficiencies?
- Are energy improvements addressed in a holistic (plant vs. process) manner?
- Will energy, flow, and productivity improvement metrics be integrated and linked?
- Does the approach help identify manufacturing overhead energy improvements?
- Are metrics going to be implemented to track actual vs. projected savings?

Budget and Matching Private Funds (15 points)

- Is the budget reasonable for the proposed scope of work?
- How many shops have teamed with this solutions provider?
- Has the proposer met and/or exceeded the matched funds thresholds?
- What is the ratio of match funds (cash and in-kind) for all parties?

Terms and Conditions

- Any Proposal must contain a written certification by an officer of the Applicant that the information contained therein is true and correct according to the best belief and knowledge of the officer after a reasonable investigation of the facts. If the Proposal contains information that is determined to be materially false, the Applicant is ineligible for an award and, if applicable, is subject to recovery of any prior award amounts based on the false information, plus penalties and interest.
- The ACA is not obligated by law to provide grants to any business. Grants are made in the sole and absolute discretion of the ACA based on the recommendations of its review panel and a variety of factors and no factor or combination of factors ensures grant eligibility. Decisions made by the ACA are final and may not be appealed.
- The awarding of grants is based on criteria determined by the ACA to be consistent with program and ACA goals and objectives.
- An Awardee is required to enter into a written agreement with the ACA. Among other provisions, the agreement requires the Awardee to provide the ACA with periodic updates as directed and sets forth the Awardee's agreement to indemnify and hold harmless the ACA for any and all costs, expenses and obligations incurred by the ACA. Further, under the agreement, the ACA reserves the right to cancel the whole or any part of the agreement due to failure of the Awardee to carry out any term, promise, or condition set forth in the Agreement.
- Awardees are required to submit a Letter of Good Standing from the Arizona Department of Revenue prior to the receipt of any award funds.
- All Awardees, as a condition to an award, authorize the ACA to identify the Applicant and the Applicant's project (along with a description thereof) in ACA news releases and marketing activities.

Topic Area 1: Integrated Lean & Green Energy Improvement Tools

Lean and six sigma techniques are proven industry best practices commonly used to guide productivity improvements by providing a data driven approach to identify sources of manufacturing waste, variation, and bottlenecks that impede flow. This includes rapid response Kaizen events aimed at engaging shop floor workers in the use of six sigma and lean concepts learned in training curriculum to make the changes necessary to improve the flow in the production line and reduce sources of variation. More sophisticated analysis tools such as value stream mapping, activity of the operator and also the product, and process modeling are also routinely used to further optimize the manufacturing operations as companies move further along their lean journey. These same proven techniques and tools can be used to understand plant energy usage and guide efforts aimed at reducing greenhouse gas emissions and energy consumption.

Thus, of particular interest here are the extension of proven six sigma and lean techniques and tools that address flow, productivity, and energy improvements in a holistic “integrated” manner. This includes linking continuous improvement projects to bottom line financial savings including development of metrics that link improvements in flow and/or productivity to energy savings and vice versa. It is common practice for Kaizen events, value stream maps, activity of the operator and product, and process modeling to measure cycle and touch time, scrap and rework, and work in process inventory at each process step and use this data to guide flow and productivity improvements. This topic area is aimed at developing additional criteria and data that can be gathered to help drive integrated productivity and energy improvements.

For this topic area the maximum award amount is \$50,000 with a period of performance of 4 months, with proposals solicited in areas aimed at both developing and piloting Kaizen methodologies and next-gen integrated lean and green tools and validating with Shop data in areas such as but not limited to:

- Development of a “cookbook” Kaizen methodologies to identify both productivity and energy use leverage points and sources of waste including top level ROI calculation methodologies to quantify energy consumption and financial savings impact
- Development of new metrics, measures, and data to help identify and quantify process and shop energy consumption drivers such as machine energy use, material use, chemical use, water use, compressed air use, and hazardous waste generation
- Development of next-gen value stream mapping tools that allow integrated parallel evaluations of cycle time and energy use by capturing key data at each process step that can be used to better understand production line energy consumption and flow
- Holistic approaches to define metrics that track and link manufacturing energy use and greenhouse gas emissions at the process, production line, and factory floor levels and allow current state monthly energy bills to be dissected and analyzed
- Analysis tools and methodologies that help identify and quantify energy use inefficiencies that directly result from production control and scheduling inefficiencies such as non-optimal routing, batch sizes, low machine utilization rates, etc.

- Innovative approaches that help identify and understand the energy loss associated with “hidden factory” mechanisms such as safety stock and inventory holding costs, built in process scrap and rework activities, and machine tool set-up inefficiencies

Specific minimum project deliverables that must come out of this project include:

- Development of a standard recipe for conducting Kaizen events including data collection needs, leverage point identification, and impact analysis calculations
- Development of “current state” and “future state” value stream maps including metrics that link proposed improvement projects to energy and productivity savings targets
- Proposed go-forward plan that will be used by both the solution provider and the Shop(s) to apply the tool to additional production lines and/or scale to other clients

Topic Area 2: “Bolt-On” CNC Machine Tool Sensing & Control Technologies

A large number of CNC machines in small to medium sized manufacturing shops are older generation 1980’s and 1990’s era technologies that were developed when energy usage and greenhouse gas emissions were not a concern. Of particular interest are novel ideas for “bolt-on” sensing and control technologies and/or improved interfaces for these older generation machines that make them smarter, more efficient, and/or improve operator productivity in ways that impact the overall plant energy consumption. The expectation for proposed projects is not to develop new technologies, but rather adapt proven techniques and approaches used in other engineering disciplines to manufacturing environments and develop a working proof of concept prototype as a deliverable to demonstrate the benefits and viability for the technology.

For this topic area, the maximum award amount is \$75,000 with a period of performance of 6 months, with proposals solicited in areas such as but not limited to the development and implementation of digitally enabled sensing and control technologies such as:

- Application of proven vehicle system prognostic, diagnostic, and trend monitoring technologies to enable proactive crash management of machine tools and other components of manufacturing systems exhibiting performance degradations
- Software algorithms combined with real-time sensing and control technologies that make CNC machines “smarter” and provide real-time adaptive control to account for parameters such as tool wear, coolant flow rates, part distortion, etc.
- Software-enabled interface technologies such as touchscreen displays and/or tablet/smartphone apps that streamline operator-machine input for complex time consuming set-up operations that cannot be streamlined by programming changes
- Low cost data collection techniques that interface with CAD/CAM models to allow on-machine probes to be integrated into a multi-spindle machining centers to enable on-machine non-CMM inspection to be performed prior to removing part from fixture

- Neural network and artificial intelligence technologies that monitor sensor load monitoring data and dynamically adjust speed/feed parameters and/or coolant flow rates to maximize cutting tool life and reduce scrap and rework of complex parts

Specific minimum project deliverables that must come out of these “proof of concept” brassboard/breadboard demonstration projects include:

- Working prototype to demonstrate viability of concept along with a proposed plan to secure additional internal/external funding to mature the technology to the next level
- Description of sensing and control hardware and/or software algorithms utilized along with lessons learned and best practices for scaling technology to other areas
- Calculation methodology and assumptions used to estimate anticipated energy impact and financial savings that could be achieved by adoption of the technology

Topic Area 3: Simulation-Based Machine Tool Energy Use Optimization

Modeling and simulation (M&S) based methodologies are routinely used in mechanical system product development activities to understand performance improvement leverage points and to test out improvement strategies prior to making design changes. Examples include simulation tools such as computational fluid dynamics (CFD) to solve and analyze problems involving fluid flow, finite element analyses (FEA) to solve and analyze problems involving structural or thermal distortion and stress, and even discrete event simulations (DES) to solve and analyze problems involving logistics and scheduling of maintenance, repair, and operations (MRO) activities. Of particular interest for this topic area are the application and use of simulation-based technologies such as these to help pinpoint and understand sources of manufacturing inefficiencies and guide machine tool and manufacturing system energy use optimization.

For this topic area, the maximum award amount is \$75,000 with a period of performance of 6 months, with proposals solicited in areas such as but not limited to the development of analytical models and simulation-based approaches for manufacturing such as:

- Use of commercial off the shelf (COTS) DES software to baseline “current state” production line performance characteristics and guide lean cell design/re-design strategies, routing improvements, machine tool uptime improvements, and/or technology upgrades for older machines
- Use of COTS FEA software to baseline “current state” machine tool chip formation characteristics and guide CNC program speeds/feeds, alternative cutting tools, and/or improved fixture designs to reduce machining time and/or minimize scrap and rework
- Use of COTS CFD software to baseline “current state” machine tool coolant nozzle flow characteristics and guide the design of new nozzle geometries, nozzle arrays, coolant flow rates, etc. to reduce machining time and/or minimize scrap and rework

- Development of model based engineering (MBE) approaches and analysis criteria to determine if flexible manufacturing systems (FMS) are being used to their fullest potential and identify needed CNC program changes for cycle time improvements

Specific minimum project deliverables that must come out of these simulation-based manufacturing energy use optimization demonstration projects include:

- Description of modeling approach utilized along with lessons learned and best practices for conducting machine tool and manufacturing system simulations
- Baseline “current state” analysis including assumptions made and the technical approach used to identify and model targeted physical processes on factory floor
- List of targeted process/factory improvement recommendations and a comparison of “future state” vs. “current state” energy use impact for each recommendation
- Calculation methodology and assumptions used to estimate anticipated energy impact and financial savings that could be achieved by implementing improvements

DRAFT