



Member Initiated Projects Round #4
Request for Proposals
Approved by the Member Advisory Committee
June 23, 2021

The PowerAmerica Member Initiated Projects (MIP) program is a valuable benefit of the Institute that is focused on critical needs of the WBG community. The specific purpose of establishing MIPs is to provide a mechanism for Institute members to collectively identify the priority projects that are needed to advance WBG commercialization and to direct resources to address those challenges. As the name implies, these projects are funded by member dues and other revenue generating activities the Institute may perform (without DOE funds).

The topics included in this Request for Proposals have been developed by PowerAmerica members based on the PowerAmerica Technology Roadmap. Each topic addresses a technical challenge faced by producers and/or users of SiC and GaN semiconductor technology in a range of applications, semiconductor device design, fabrication and reliability, energy efficient motor drives, electric vehicles, renewable generation and battery storage integration, and reliability of the power grid, among others.

Successful projects are expected to strengthen the SiC and GaN semiconductor ecosystem and help accelerate the adoption of SiC and GaN power electronics. In doing so, PowerAmerica's efforts contribute to energy savings, new job creation and strengthening U.S. manufacturing and critical infrastructure.

This request for proposals is issued as a result of action taken by the PowerAmerica Member Advisory Committee (MAC) on June 23, 2021. Round 4 includes five proposal topics found at Attachment 1 to this document. PowerAmerica is soliciting proposals according to these topics and the information provided in this Request for Proposals.

MIP Round #4 Proposal Process

Proposals must address the specifications and information provided in one of the topics listed in Attachment 1. All PowerAmerica members (industry, university, and labs) are encouraged to participate on at least one team. Industry and university members can participate on more than one team, but each proposing team must have at least one university and one industry member. The quality and makeup of the team relative to the proposal topic and the role of each team member described in the proposal is a consideration in scoring proposals. Each team must have a principal investigator who is responsible for the project.

Please note the time frames and funding levels for projects differ among topics. These differences are related to differences in the nature of the topics.

Proposals must be made according to Attachment 2 to this document, including a Statement of Project Objectives (SOPO) and budget. The budget should indicate funding required from PowerAmerica, not to exceed the limit specified for each topic, plus a cost match.

Approximately \$1 million of PowerAmerica funding is designated for MIP Round #4.

The deadline for proposals is Tuesday, September 7, 2021 at 11:59 p.m. EDT. Proposals received after this date will not be considered. Proposals must be submitted to <https://ncsu.infoready4.com/> and will be reviewed and scored by a working group consisting of PowerAmerica members not participating on any proposal. The working group will recommend proposals to the Membership Advisory Committee for funding with the goal of having projects under contract and started in the fourth calendar quarter of 2021. Questions about any aspect of this solicitation should NOT be directed to this email address but instead to the PowerAmerica website at: <https://poweramericainstitute.org/member-initiated-projects/>

MIP Round #4 Project Topics

1. Define optimal SiC device characteristics for specific grid applications other than PV, wind and EV infrastructure. Interest includes but is not limited to: power flow control, power transformers, protection devices (breakers, switches, network protectors, reclosers, sectionalizers, alternatives to fuses), power conditioners, reactive power support, auto-transfer switches / load transfer, fault current limiters, unbalanced three-phase compensators, and solid-state substations.

It is anticipated this will be a four to six-month paper project capturing the landscape of opportunities for power electronics at 5 kV– 25 kV for MVAC power distribution that identifies current market technologies (likely using Si chips) and the requirements for SiC technology to be competitive (price targets, technical requirements, etc.) It is expected the study would identify with justification the best opportunities for SiC technology for follow up modelling/design/prototyping. Funding is limited to \$100,000 of PowerAmerica funds not including cost match.

2. Design and simulate high-volume-production compatible process integration to achieve SiC MOSFET devices (such as trench and advanced planar MOSFETs) with higher transconductance and reliability/robustness needed for lower voltage devices (e.g., 650V). Characterize and demonstrate improved performance including high and low field mobility, mobility variation vs temperature, interface charge/trap density (Dit, NIOT, etc.), and Vth shift under negative and positive bias (NBTI and PBTI).

This project is expected to be up to 12-months in duration limited to \$250,000 of PowerAmerica funds not including cost match with deliverables including test data from the improved oxide interfaces. The deliverables should also include designs, simulations and materials related to the fabrication of MOSFET's with experimental and control gate dielectric structures and characterization of threshold voltage shifting. Although proposals for full device fabrication are not sought at this time, the proposals should define the full process integration of MOSFETs using the improved oxide interface.

3. As referenced below, silicon and wide bandgap devices exhibit a poorly understood mechanism that can contribute significantly to switching losses at very high frequency (e.g., >1 MHz, soft switching conditions). This project supports efforts to help quantify the practical impact and causes of these switching losses. The scope includes evaluation

and investigation of losses seen in SiC and GaN devices (including comparison to Si SJ FETS) and also their materials, circuit topology (and device configuration, etc.), impact on operation, and possible problem resolution. Proposals should consider building on and extending the work of Grayson Zulauf and others at Stanford, including: https://superlab.stanford.edu/poster/JESTPE2019_paper_Zikang.pdf (see also relevant references there).

This is expected to be a four to six-month paper project with funding limited to \$100,000 of PowerAmerica funds, not including cost match. Projects can focus on SiC, GaN or both.

4. Design and demonstrate novel, SiC and/or GaN optimized motor drives for electric motors addressing:

- Fast switching (dv/dt)
- Power electronics integration in electric motor
- Techniques to minimize stress on motor insulation
- Motor loss as a function of frequency

Results should conform to NEMA standards, including standards for maximum dv/dt to avoid damaging the motors, with >98.5% efficiency. New motor drive topologies and control methods resulting from this project should address this issue to enable to exploit the full benefits of WBG devices for motor drive applications. The applicable NEMA standards and their description for motor operation and testing must be referenced in the proposal. This is expected to be up to 12 months in duration limited to \$250,000 of PowerAmerica funds not including cost match.

5. Design and demonstrate novel circuits for paralleling SiC or GaN modules (air-cooled preferred) for high current (> 400 A per SiC module at $\geq 1200V$; > 150 A per GaN module $\geq 650V$) for EV, UPS, battery and other applications. The project should address cost-effective and reliable passive or active gate driver techniques and demonstrate acceptable static and dynamic current sharing between modules. The number of modules in parallel will be a criterion in proposal evaluation. At least three parallel modules should be demonstrated.

- Junction temperature difference between parallel modules to less than 5 C
- Current sharing guaranteed within nominal rated current ($I < I_n$)
- Current sharing guaranteed during short time overloads depending on selected application ($I > I_n$)

This project is expected to be up to 12-months in duration limited to \$250,000 of PowerAmerica funds not including cost match.

Note: Topics 2, 4, and 5 are considered “hardware projects.”

Member Initiated Project Round #4 Requirements

Project Proposals

- a. Projects should be pre-competitive in nature, the results of which should benefit members broadly. Project output, results and IP will be shared with all members.
- b. Expected project duration is indicated in the topics in Attachment 1.
- c. Cost match is encouraged but not required, but cost match is considered when scoring proposals. The previous MIP projects funded by PowerAmerica have cost matching of approximately 30 percent on average. Equipment cannot be used in calculating the cost match.
- d. Projects can be proposed and carried out by teams consisting of PowerAmerica members in good standing (e.g., current on member dues payments), and prospective members. Prospective members are required to join PowerAmerica if their team's project is selected for funding. Past members and those not current on dues are required to become current on dues in order to participate on a proposing team.
- e. Although pre-competitive in nature, it is expected the project will contribute to the PowerAmerica mission of realizing manufacturing jobs creation and energy savings through accelerated large-scale adoption of WBG semiconductor devices in power electronics systems, consistent with PowerAmerica's SiC or GaN technology roadmaps.
- f. Team collaboration between members is required, either formally with compensation or as informal advisors on the project. All participants, formal or informal, must be named in the proposal. All proposals must include at least one PowerAmerica university and industry member on the team with the aim of increasing the likelihood of commercial relevance and rapid commercialization of the project's results. Additional, uncompensated team members can be added after the project begins.
- g. No MIP funds can be provided to or used by non-members (except for materials, supplies, justified contracted services, etc.) Projects must be performed in the United States.
- h. The award of an MIP will not affect any member's project activity or funding on a previously funded, on-going project.
- i. The funding mechanism will be a cost-reimbursable assistance subaward. The subaward template available upon request.
- j. All proposers must certify as part of their proposal that they have read and understand the provisions of PowerAmerica's Bylaws (revised April 23, 2019) that apply to MIP, including the intellectual property provisions of the Bylaws. In addition, any background intellectual property that may be used in the project, including in the project proposal, must be identified and described in the proposal. Since PowerAmerica members expect to have unencumbered use of the results of the project and designs submitted with the proposal, any restrictions on the use of background technology or other restrictions that may apply to the proposal or use of the results of the project must be fully disclosed. This includes but is not limited to the use of technical data and patented technology. Such restrictions are likely to result in a lower

score on the proposal or disqualification of the proposal. Proposals selected for funding will require this certification by the appropriate intellectual property authority in each organization to be funded in addition to the principal investigator.

- k. No member organization serving as a lead on a proposal may offer more than one proposal for MIP Round #4.

Proposal Review Process

1. A MIP Working Group of the Member Advisory Committee (MAC) will review, score, and recommend projects to the MAC for the MAC's vote on the projects that will be funded.
2. PowerAmerica will post announcements related to MIP project solicitation, selection and funding through its website.
3. Expertise from outside the MIP Working Group may be employed as needed as part of the review.
4. Criteria that will be used in evaluating and scoring proposals are:
 - a. Significance: The extent to which the project, if successfully carried out, will make an important and/or original contribution in a one or more ways that accelerate the adoption of SiC or GaN devices and SiC- or GaN-based products and technology in the marketplace. The project should be pre-competitive in nature but advance the state of the art and broadly benefit the membership and a range of applications. Incremental advances are not of interest. The number, qualifications and role(s) of team members participating on the project, paid or unpaid, to help guide the project to increase the likelihood of project success and rapid commercialization of the results will be taken into account, especially team members who may be eventual manufacturers or customers of the project's results. (35% weight)
 - b. Approach: The extent to which the concept, design, methods, analyses, and technologies are properly developed, well-integrated, and appropriate to the aims of the project, and result in an outcome that meet the stated objectives. Evidence of scalability and potential manufacturing will also be considered. Any limitations on the use of background technology required to implement the project's results by PowerAmerica members will be taken into account, and if onerous, may disqualify the proposal. (35% weight)
 - c. Feasibility: The likelihood that the proposed work can be accomplished within the proposed budget and within the specified timeframe by the investigators and technical staff, given their expertise, past performance and results specific to the technology that is the focus of the project, available resources, institutional/organizational commitment, and (if appropriate) access to technologies. The amount of cost match will be taken into account and the quality of any prior performance on a PowerAmerica project. (20% weight)

- d. Time to implementation: The speed with which the project output can be put into commercial practice. (10% weight)
5. Once proposals are selected for an award, subsequent meetings may be organized with the member working group to shape and refine the project plans prior to project start. The working group has the latitude to negotiate with the proposers to modify projects and budgets and negotiate the combination of similar proposals received from more than one entity.
6. PowerAmerica will issue the award to the project recipient(s).
7. Project reporting will be quarterly, plus a final report, submitted to the Member Advisory Committee.

Proposal Preparation -- General Provisions

- No proprietary information should be included in proposals.
- Documents must adhere to the following:
 - Page size – 8 1/2 x 11 inches
 - Margins – 1 inch
 - Spacing – single Font – Times New Roman 12 point

Proposal Format

- A. Cover page (1 page)
 - Project title and abstract
 - Applicant organization
 - Point of contact name and full contact information
 - Team members
 - Funds requested and cost match (encouraged, but not required) to be provided
- B. Technical project description and Statement of Project Objectives (SOPO) (7 pages maximum)
 - Describe the technical challenges addressed by the project, and how PowerAmerica members will benefit from the results of the work.
 - Describe the technical approach to be followed including but not limited to designs, drawings, schematics, testing, simulations, data including reliability data, etc. developed previously that will be used by the project, and that which is expected to be developed during the project, described as specifically as possible so as to give confidence that the technical targets can be

- met. Provide a justification for the technical approach. Describe the facilities and equipment to be used and personnel needed.
- Describe the current technical state of the art relevant to the work proposed, and the team's previous, relevant work. For "hardware projects," describe the technology readiness level (TRL) and how the state of the art will be advanced and the expected TRL at project completion.
 - Describe the current commercial or industrial state of the market relevant to the work proposed, the ways the results can be commercialized by PowerAmerica members generally, and the non-proprietary details of the commercial path anticipated by specific team members in commercializing the results. The plausibility of the commercial path is considered in scoring proposals.
 - For "hardware projects," describe technical and other risks and describe risk mitigation approaches. Include a bill of materials, and a description of required equipment, facilities, and personnel. It is expected that the cost and leads times for each item on the bill of materials will be determined and confirmed as part of the proposal.
 - Describe the primary tasks, milestones and deliverable(s) in SOPO format (attached) and how the deliverables advance PowerAmerica's objectives.
- C. Identification and description of any background intellectual property that may be used in the project, and any restrictions on its use that may be encountered by PowerAmerica members in using the project's results. Per item j. in "Project Proposals" above, a certification is also required that the proposers have read and understand the provisions of PowerAmerica's Bylaws (revised April 23, 2019) that apply to Member Initiated Projects, including the intellectual property provisions of the Bylaws. (1/2 page)
- D. Teaming arrangement, description of roles, and list of key personnel including any informal, uncompensated advisors. (1/2 page)
- E. Gantt chart or timeline showing monthly progress and quarterly milestones. (1/2 page)
- F. Budget estimate: See sample format given below; provide figures for each organization if more than one organization is being compensated and the cost match, if any, for each line item. For any team member other than the lead team member that is proposed to be compensated, a pro-forma contract or purchase order, as well as a budget, must be included with the MIP Round #4 proposal, not subject to the page limit. It is expected that key terms and conditions will be negotiated by the proposing team member and any other compensated team members prior to proposal submission so as to avoid delay the start of the project if selected for funding.

PowerAmerica will not pay for work by any team member in advance of work being completed. (1 page)

Budget Sample Format

| | PowerAmerica Funds | Applicant Cost Match |
|----------------------|--------------------|----------------------|
| Personnel | | |
| Equipment (>\$5,000) | | |
| Supplies & Materials | | |
| Travel | | |
| Indirect Costs | | |
| Total | | |

Statement of Project Objectives (SOPO) Template

Project Title

Task Summary:

Narrative description of your technical approach, planned accomplishments, team member roles, notable equipment or supply issues, risks and plan for mitigation, etc. Include appropriate graphics, tables of engineering parameters, and other descriptive information as needed. Up to ½ page in length. Note that milestone time frames below are illustrations only; actual project duration is specified in each topic in Attachment 1.

Subtask 1: Title of your first subtask

Subtask summary: Narrative description of your subtask. Up to ¼ page.

Milestone 1.1 Description of your measurable, quantifiable milestone with due date. (Month 3)

Milestone 1.2 Description of your measurable, quantifiable milestone with due date. (Month 6)

Subtask 2: Title of your second subtask

Subtask summary: Narrative description of your subtask. Up to ¼ page.

Milestone 2.1 Description of your measurable, quantifiable milestone with due date. (Month 9)

Milestone 2.2 Description of your measurable, quantifiable milestone with due date. (Month 12)

Create a Milestone Summary table and include all milestones described in the body of the SOPO.

Milestone Summary Table

| Milestone No. | Brief Description | Verification Method | Month of Completion |
|---------------|-------------------|---------------------|---------------------|
| X.XX.1.1 | Lorem Ipsum | | 3 |
| X.XX.1.2 | Lorem Ipsum | | 6 |
| X.X.X.2.1 | Lorem Ipsum | | 9 |
| X.X.X.2.2 | Lorem Ipsum | | 12 |

Deliverables:

List all the project deliverables and when they will be provided.

1: Lorem Ipsum (Month X)

2: Lorem Ipsum (Month X)