



SolarACM
Systems Corporation

Executive Summary

SolarACM Systems Corporation (SolarACM) is seeking an investment from the government of Canada to help localize manufacturing of its Canadian-designed technology, establish its research and development (R&D) lab site, and expand its existing R&D team in Ottawa. With a government partnership, SolarACM's manufacturing and product development capabilities have the potential to create high-valued jobs, economic prosperity and increase Canada's competitiveness in the fast-paced growing green technology industry.

SolarACM is an Ottawa based solar energy technology company, that provides intelligent automation solutions for improving the efficiency of operations and maintenance (O&M) of large-scale solar power plants. Simply put, SolarACM's products inspect and collect important sensing data of the solar panels while performing automatic cleaning on the solar panels. SolarACM's flagship product is the Kolchar S2 solar panel cleaning and inspection robot, which is **water-free** and **self-powered** with a rechargeable battery. SolarACM's autonomous smart solar panel cleaning and maintenance system can improve the effective lifespan of solar panels while increasing their energy output by up to 35%. The company's operations in Ottawa, Ontario is home to research and development of new products, marketing, sales and service of company's products.

SolarACM is pleased to participate in the 2018 pre-budget consultation process and appreciates the opportunity to share with the members of the House of Commons Standing Committee on Finance, our priorities for the 2018 federal budget.

SolarACM's success will facilitate economic productivity because its own story is one of innovation, resourcefulness, and impact. Additionally, SolarACM takes pride in exporting Canada's passion for green technology and green energy by helping to make a difference around the world. Domestically, SolarACM appreciates the direct benefits created through green innovation, including prosperity and competitiveness.

Through a partnership with government, SolarACM could expedite and scale its technology, create both high-value and manufacturing jobs in Canada's capital region.

This submission addresses the key themes the committee is focusing on: productivity and competitiveness. SolarACM is confident its recommendation will help the Finance Committee and Government of Canada reach their objectives in preparation of Budget 2018.

SolarACM's 2018 Budget recommendation is:

- 1. That the government of Canada contributes \$3 million in funding to help SolarACM re-locate manufacturing from overseas to Canada's capital region and to expand its R&D lab, leading to both manufacturing jobs and high-value jobs focused on innovative green technology.**



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Considerations

Worldwide, solar energy is playing an essential role in providing clean and sustainable energy. In fact, as of 2014, there are about 178 gigawatt (GW) solar power plants in operation globally. In the United States, the US Solar Energy Industries Association (SEIA) estimated that the total solar power plants will reach 40 GW by the end of 2017. Another report from International Energy Agency (IEA) shows that there will be 900 GW solar power plants in operation globally before 2030, 2000 GW before 2040, and 3000GW before 2050.

With the rapid development of large-scale solar power plants, solutions that can effectively lower the O&M cost and improve the solar system performance become more and more important in this industry. Particularly, there is a strong and rapidly growing demand for autonomous solar panel cleaning and maintenance system, which aims to significantly reduce labor cost for solar panel cleaning and in the meantime detect defects or potential risks in a timely manner. Such system offers great benefits for solar power plant owners/operators, such as system performance improvement (up to 35% in certain locations); lifetime extension of solar panels; reduction of operation costs; and maximization of the return on investment (RoI) of solar projects. Assuming 50% of the above-mentioned solar power plants are of large scale, i.e., MW capacity or above, and 30% of them need autonomous solar panel cleaning and maintenance system, based on the typical revenue of 0.02 USD/Watt for such system nowadays, the market value will be 2.7 billion before 2030 and 9 billion before 2050.

Problem Analysis

All large-scale solar power plants are facing the following two major challenges in their daily operation and maintenance:

1. Soiling losses: soiling on a solar panel, such as snow, bird droppings, lichen growth, dust clouds, and dirt buildup can cause significant power loss.
2. Solar cell defects: defects in solar cells, such as micro-cracks, hot spots, and uneven soldering pose a frequent and complicated challenge for efficient operations and maintenance and are one of the main sources of malfunctioning or even inactive cells.

Since large-scale solar power plants usually have a massive geographical coverage, the cost for solar panel cleaning and inspection is quite significant.

Our Solution

SolarACM has developed a world-leading smart robotic solar panel cleaning and monitoring system that improves solar panel performance by up to 35%, extends the lifetime of solar panels, reduces operations and maintenance costs, and maximizes the productivity of solar power plants.



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Motivated by the observed significant gap between existing products and market demand, SolarACM has developed its autonomous smart solar panel cleaning and maintenance system. SolarACM's robotic cleaning and monitoring system consists of three subsystems:

1. **Solar panel cleaning and inspection robot (Kolchar S2):** The Kolchar S2 cleaning and inspection robot is equipped with its own power source (solar panel and rechargeable battery) for fully autonomous operation. It can effectively clean solar panels and improve efficiency. Additionally, the Kolchar S2 can perform smart scans to detect hot spots on solar panels, which significantly reduces the very time consuming and labour intense manual inspection and related O&M costs while extending the lifespan of solar panels. The sensing data is transmitted and stored in the cloud server for convenient access anytime and anywhere.
2. **Wireless remote control and monitoring network system:** In our system, the secure and reliable transmission of sensing and control data is achieved by using the innovative TCP/IP over wireless sensor network technology. Robots are distributed across solar power plants and can be used as relay nodes for implementing reliable long range wireless communications. Kolchar S2 has the capability to work with real-time soiling detection and weather monitoring system to optimize its cleaning strategy and achieve superior cleaning efficiency at minimal costs.
3. **Data storage/analysis and software management system:** The sensing and inspection data collected by Kolchar S2 robot can be transmitted and stored and is easily accessible. This allows for data analysis and encourages science-based decision making for all solar panel maintenance decisions.

The robot, equipped with multiple sensors and our in-house developed wireless control and sensor network communication modules, moves back and forth along each row of the solar panel and performs cleaning and inspection duties according to maintenance schedule or direct control commands from operators if needed.



SolarACM's Kolchar S2 slides along a track to clean solar panels.

The smart robot transfer vehicular system transfers robot between solar panel rows and is able to adapt to installation differences between rows by intelligently adjusting the height and orientation angle as needed. This feature is essential for single axis tracker system.

The wireless remote control and monitoring network system provides secure and reliable communications among robots, transportation vehicles, and the control centre. The sensing/monitoring data is stored in our database in the cloud server so as to provide convenient data access to plant owners or management staffs anytime and anywhere. The software management system includes monitoring system software, mobile client software, and backend expert system for analyzing monitoring data, providing statistics or assisting decision- making.



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System Advantages

Fully Automated: The Kolchar S2 solar panel cleaning and inspection robot is water-free and equipped with rechargeable battery and solar panel for achieving self-sustaining solar panel cleaning and inspection.

Remote Control and Monitoring: The state-of-the-art Internet-of-Things technology is applied in the smart robotic cleaning and monitoring systems for implementing a convenient, economic, low power consumption communication network for remote control and monitoring. Kolchar S2 robots can serve as

sensing/monitoring nodes which inspect the abnormalities of solar panels while performing the cleaning tasks. Robots can also be controlled by management staffs to perform on-demand cleaning or inspection.

Flexible and Adaptable: The dual-drive system of Kolchar S2 robot separates the cleaning brush drive from the robot drive so that the brush rotation speed and the robot moving speed can be adjusted independently, allowing more precise control of cleaning operation according to different levels or types of soiling.

Data Management and Expert System: Kolchar S2 is equipped with a variety of sensors for solar panel maintenance inspection and the sensing data can be transmitted to the server hosted on local machine or cloud-based machine for analysis and fault detection.

Reliable: Kolchar S2 robot is equipped with a simple but effective dual motor drivetrain, the well balanced weight and power output distribution improve the capability of the robot in terms of slope climbing and small obstacle crossing, and eliminate the driving wheel deadlock problem.

Customizable Solution: While the provided smart cleaning and monitoring solution can be suited for the needs of most solar power plants, SolarACM realizes there could be different O&M requirements from different power plant operators due to the different power station layout and implementation. Our solution can be flexibly customized to satisfy customized requirements.

Moving Forward

SolarACM has a high quality team of professionals, with broad knowledge and extensive experience in business management, product R&D, marketing and sales. Particularly, our R&D department has a group of experts with proven capability in innovative product design, research and development, encompassing hardware, firmware, software, mobile applications, communication technologies, and security.

SolarACM's existing R&D team has been effective in mechanical design, robotics, wireless communications and networking, hardware design and development, and firmware and software development. In order to scale and truly export our Canadian technology around the globe to improve the performance of solar panels, SolarACM needs to increase its R&D team. SolarACM is currently a world-leader, thanks in large part to our Canadian researchers. It is important to maintain this global position by increasing our researchers, our productivity, and competitiveness.



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SolarACM also has long-term collaborations with the University of Ottawa and the University of Montreal in new technology R&D. As a green technology/communications technology company, SolarACM has established collaboration with the Broadband Wireless and Internetworking Research Laboratory at the University of Ottawa. The partnership is focused on wireless communications techniques and networking. SolarACM has also collaborated with the University of Montreal's Network Research Lab, Department of Computer Science and Operational Research. SolarACM recognizes the benefit of working with Canada's next generation of technology leaders and will seek opportunities to provide high-skill jobs to these students.

With its strong technical strength and outstanding innovation capability, SolarACM has designed and developed an industry-leading autonomous smart solar panel cleaning and monitoring system, as well as its management system fuelled by wireless sensing/monitoring network and advanced data analysis system.

With investment from the government of Canada, SolarACM will be better positioned to increase prosperity and competitiveness and export our knowledge across the globe and meet the challenges faced by large-scale solar power plants.