ATTACHMENT 11
Commitment and Support Letters

Letter of Commitment/Support # 3 of 6 for Wind Harvest International	
Type of Letter	☐ Commitment ☒ Support
Commitment Letter Subject Matter *(select one or more as appropriate)*	☐ Match Funding ☐ Project Partner ☐ Pilot Test/Demonstration/ Deployment Site
Type of Match Funding *(if applicable)*	☐ Cash in hand ☐ Equipment ☐ Materials ☐ Information technology services ☐ Travel ☐ Subcontractor costs ☐ Contractor/project partner in-kind labor costs ☐ Advanced practice costs
Author of Letter (name and title)	Marius Paraschivoiu, Professor, Concordia University
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Concordia University
Engineering and Computer Science
Department of Mechanical and Industrial Engineering

June 12, 2017

Dear California Energy Commission and grant reviewers,

I am writing to convey support for the research and development project proposed by Wind Harvest International in response to the CEC's grant funding opportunity Improving Performance and Cost Effectiveness of Wind Energy Technologies.

I am a professor at Concordia University as well as a consultant for many wind energy companies such as Iopara Inc. and LML Ltd. My research focuses on developing simulation methodologies and flow analysis with application to Wind Energy and Aerodynamics. I have received a PhD in 1998 from the Massachusetts Institute of Technology (MIT) and an MASc and BEng from École Polytechnique de Montréal. Between June 2006 and May 2016, I had a Concordia University Research Chair Tier II entitled "Simulations for Clean Energy Production and Storage". Between 2008 and 2010, I was also president of the Canadian Society for Mechanical Engineering (CSME) and Director of Concordia Institute of Aerospace Design and Innovation. I have published 40 journal articles and over 50 conference papers in the field of Computational Fluid Dynamics.

As consultant for Iopara Inc., I collaborated with WHI on their prior project, *Modeling Blade Pitch and Solidities in Straight Bladed VAWTs*, funded through the CEC's Energy Innovations Small Grant Program. For that research project, Iopara created an aerodynamic model of WHI's vertical axis wind turbine using data collected from a 3-turbine array located in Palm Springs, CA. Iopara's modeling validated the "coupled vortex effect" and predicted that the physics and wind effects the phenomenon generated by certain configurations of turbines would be able to significantly increase the energy output of lower solidity VAWTs such as WHI's G168. . WHI's proposed Applied Research and Development project will test these predictions, confirming the increase in Capacity Factor that can be realized by the strategic positioning of a VAWT near its neighbor. The project will further build on the findings of the previous study in order to develop a commercially viable strategy for deployment of VAWTs in the understories of existing horizontal axis wind turbines. Although our CEC funded study evaluated two dimensional wakes produced directly behind the VAWT array, our other work on VAWTs indicates that a region of turbulence will develop just above an array of closely spaced turbines. Above that, the increase in wind flowing over the top of the VAWT array will produce a region of wind moving faster than the incoming wind speed at that height. In order to take advantage of the speed-up effect, the VAWT arrays would need to be placed so that the HAWT rotors operate in the higher-speed wind zone without being impacted by the turbulent region.

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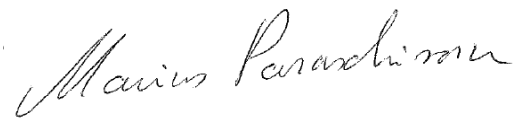
To our knowledge, there is currently no data available from which to predict the extent and intensity of the speed-up effect over VAWT arrays. WHI's research will provide valuable groundwork for further research in this area. By making the data available to the public, WHI will allow other researchers to begin modeling the interactions of various models of turbines and the economic benefits that can be realized by HAWTs and VAWTs working in tandem.

We also would like to note that after the CEC Innovations grant was completed we conducted additional aerodynamic modeling on downwind wakes that showed VAWTs like WHI's G168 will be able to be placed about five rotor diameters downwind of an upwind VAWT array and realize the full wind speed that entered the rotors of the upwind array. Additional field research as described in WHI's new grant application will help validate our modeling predictions.

Please let us know if you have any questions. The research WHI is proposing is ground breaking and will be critical to opening wind farms to VAWTs and to incentivizing HAWT manufacturers to make VAWTs, as traditional HAWTs cannot handle the turbulence in the wind that occurs near the ground.

Best regards,



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