

NET-ZERO WITH SOLAR ALONE™

Cogenerate Solar is a climate change reversing company. A solar technology company that combines photovoltaic and thermal energy production to deliver low-cost electricity and heat generation for the commercial and residential and utility markets.

Executive Summary



Who We Are

Cogenerate Solar is a climate change reversing company and a game changer for the solar and sustainability markets. A photovoltaic and thermal energy cogeneration technology company, specializing in the development of products for both the distributed generation (commercial and residential) and industrial/utility scale markets.

Our Mission

Cogenerate Solar is driven by a mission to live in equilibrium with the environment, through balancing what we consume with what we naturally harvest - and that includes clean energy.

Our team works to attain this mission through continuously innovating and challenging the conventional, to ultimately reach complete neutrality.

Introduction

A game changer for the solar industry. With 2.5 times the energy production and half the space utilization, Cogenerate Solar captures 4 to 6 times more solar energy from the same rooftop compared to flat PV panels.

Cogenerate Solar combines its patented low profile dual-axis micro-tracking and concentration technologies together with terrestrial cells to harvest 85% of the sun's energy (35% PV + 50% Thermal), making NET-ZERO achievable for both existing and new buildings.

Our systems simultaneously deliver electricity and high-grade heat (boiling temperature) critical for heating, cooling and industrial applications. Combined with thermal storage and thermoelectric generator, Cogenerate Solar provides cost effective solar power 24 hours a day.

Cogenerate Solar has an additional niche in addressing hot climate markets, where flat PV panels significantly underperform due to overheating. We also address the industrial/utility scale with our cogeneration solar panel.

Cogenerate Solar requires 1/10th of the manufacturing CAPEX compared to PV panels and offers a lower combined LCOE (levelized cost of energy) than grid electricity and natural gas.

With three lines of products, Cogenerate Solar addresses all three market verticals, the residential, commercial and industrial/utility worldwide.

The Problem

For most commercial and residential buildings, NET-ZERO is not achievable with flat PV panels alone, due to low energy generation.

According to the Treasury Board of Canada, natural gas makes 40% of GHG emissions in all Government of Canada buildings.



One example is The Joyce Centre for Partnership & Innovation, the latest NET-ZERO building at Mohawk College in Hamilton, where the following was done to achieve NET-ZERO.

- 1) Build a special structure on top of the building to achieve a south facing tilt for solar panels.
- 2) Install additional panels on 2 additional buildings.
- 3) Install 6,000 meters of geothermal pipes and
- 4) Install a special building skin.

Cogenerate Solar delivers NET-ZERO to new and existing buildings with solar alone.

The Cogenerate Solar Solution

Cogenerate Solar is a photovoltaic and thermal energy cogeneration technology company, developing products for both the distributed generation (commercial and residential) and industrial/utility scale markets. Utilizing 44% efficient terrestrial solar cells, together with our patented solar receiver, optics and dual-axis tracking technologies, our systems deliver 2.5 times the energy production utilizing half the space, thus capturing 4 to 6 times more energy compared to flat panels.

For the residential and commercial rooftop market NET-ZERO can be achieved by the following:

- **Increased Energy Density:** Cogenerate Solar patented technology captures 4 to 6 times more solar energy from the same rooftop compared to using standard flat panels, by capturing 2.5 times the energy production (PV + thermal) per kWp using half the space.
- **Reduced System Size:** Using the thermal energy captured for cooling (air conditioning), cuts the demand for electricity by 30% (in Ontario) to 65% (in Arizona), and thus enabling the use of smaller system size. For example, a 7 kWh Cogenerate Solar system will suffice compared to a 10 kW flat panel.
- **Half Space Utilization:** With double the PV efficiency (35% vs 18%), the system requires only half the space required by a flat panel.
- **Multiple Usages:** Electric power for on or off grid installation. The thermal yield for a) cooling using off-the-shelf absorption/adsorption chillers in the summer, b) space heating in the winter and c) water heating all year round. According to the Treasury Board of Canada, natural gas makes 40% of GHG emissions in all Government of Canada buildings.
- **Cold Climates Suitability:** No snow accumulation due to ability to tilt. No ice accumulation by reversing heat back into the system.
- **Hot Climates Suitability:** No efficiency degradation due to heat.

Market Size

Analytica Advisors valued the global cleantech market at more than \$1.15 trillion a year. The world's NET-ZERO energy market for both commercial and residential projects is expected to grow to \$1.4 trillion by 2035, according to a Navigant Research report.

The North American NET-ZERO building industry is also expected to skyrocket, with an anticipated annual increase of 38.4% between 2014 and 2035, pushing its value beyond \$127 billion.

Navigant said the growth of NET-ZERO projects is partly attributable to the technology that now makes almost any building — commercial or residential — a good candidate for the energy efficiency method. In addition, the research firm said NET-ZERO's adoption into state and national building codes, as well as the enactment of strict energy-saving requirements in several states, will boost its growth, according to Building Design + Construction.

Case & Point

Slanted Rooftop (Residential): Comparison between Cogenenerate Solar iPyramid and a Flush Mount Panels:

A 2 storey 3000 ft² home in the USA consumes 20MWh per year (electricity & heat) requires 20kWe of PV panels to achieve NET-ZERO, will require only 8kWe (includes 12kWt) Cogenenerate Solar iPyramid 1-5 system. A 20kW PV panel system requires 192m² (2066 ft²) of roof space, while the 8kWe iPyramid system uses only 50m² (538 ft²). A typical home doesn't have 192m² of roof space to install a 20kWe PV panel system, even when including east, west and south facing sides. However, most homes have 50m² of south facing roof space required to install the 8kWe iPyramid-2 system. A south facing installation generates 25% more energy than an east/west installation.

This translates to \$10K in savings for the homeowner and a lower \$/kWh and the ability to achieve NET-ZERO.

Flat Rooftop (Commercial): Comparison between Cogenenerate Solar iPyramid and a Flat Rooftop Panel Installation at 10°:

Using a real life example, a 3 storey residential building with 16,000 ft² of usable flat rooftop space in Ottawa consumes 467MWh per year of electricity and 409MWh of thermal energy (876MWh combined). To achieve NET-ZERO the building will need 760MW of PV panels, requiring 56,000 ft². The same building will require only 383kWe (producing an additional 547kWt) Cogenenerate Solar iPyramid-1 system requiring only 15,890 ft². Assuming there is enough space for the 760kWe PV panel system, this translates to \$180K in savings for the owner and a lower \$/kWh and the ability to achieve NET-ZERO.

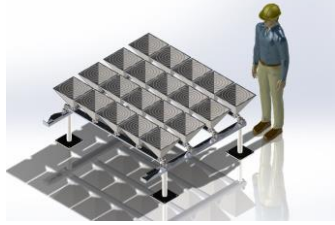
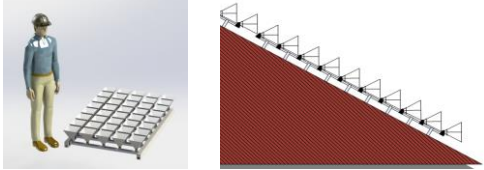
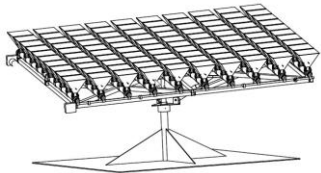

Business Advantages

- **Patented micro-tracking** technology, brings CPV to the rooftop,
- **Patented Tracking Mechanism (not Conversion):** Means market protection does not depend on the alterable conversion methodology as for flat panel technology, but rather on a unalterable mechanical methodology.
- **Hot Climates Suitability:** See hot climate positioning section below.
- **Low Manufacturing CAPEX:** one tenth (1/10) the cost for silicon technology based solar panels.

Technical Advantages

- **Patented Dual Axis Micro-Tracking** brings CPV to the rooftop
- **Patented Active Cooling/Thermal Capture**
- **Patented Secondary Optic with Higher Acceptance Angle:** 2.6° compared to standard 1°.

Product Lines

<p>iPyramid 1 (Commercial): 843 We + 1,264 Wt</p> <p>A cogeneration solar system with dual-axis micro-tracking technology for the commercial flat rooftop market. Unit Size (L x W x H) (168 x 157 x 45 cm)</p>	
<p>iPyramid 2 (Residential): 499 We + 635 Wt</p> <p>A cogeneration solar system with dual-axis micro-tracking technology for the residential rooftop market. Unit Size (L x W x H) (168 x 105 x 22 cm).</p>	
<p>iPyramid 3 (C&I): 4.2 kWe + 6.3 kWt (10.5 kWe+t)</p> <p>A low profile 30 degree tilt cogeneration system tracking, providing 180 degree dual-axis tracking for industrial rooftops and ground mounts.</p>	
<p>Ground Mount (Utility Scale): 10kWe to 50 kWe</p> <p>cogeneration solar panel system for industrial/utility scale installations.</p>	

Hot Climate Positioning

Flat panel technology degrades by 30% to 50% (an average of 0.5% per degree of back cell temperature), compared to no degradation for [Cogenerate Solar](#). In addition to no heat degradation, in hot climates, power consumption increases by 3 times that of winter due to air conditioning, making impossible to size a standard solar system by oversizing for winter months and under sizing for the summer. Converting the thermal energy to cooling addresses this critical problem and open new markets.

Competition

	PV	PVT	Solarus	Cogenra	iPyramid-1.0	iPyramid-2.0
Technology	Poly/Mono	PVT	LC-PVT	LC-PVT	HCPVT	HCPVT
PV Efficiency	18%	18%	10.5%	11.5%	35%	35%
Thermal Efficiency	NA	50%	50%	50%	50%	50%
Heat Grade	NA	Very Low	Low	Medium	High	High
Thermal Transfer Temp (summer) (30° C ambient)	NA	40° C	60° C	65° C	100° C	100° C
Thermal Transfer Temp (winter) (-5° C ambient)	NA	0° C	0° C	20° C	75° C	75° C
Efficiency Per Installed Surface Area	100%	150%	200%	205%	440%	580%

Cogenerate Solar uses high sun concentration levels (1000 x) capturing high grade thermal energy in both summer and winter months, which is required for cooling and heating. A cooling chiller requires a minimum of 75° C to operate.

TECHNOLOGY STATUS

Cogenerate Solar product development has achieved the following:

- 1) Single Cell development has been completed including primary and secondary optics using own component and third party tracker.
- 2) Single cell third validation: The PV efficiency has been validated by Spectranova Inc. using 40% efficient cell to be at 31.2%. The thermal receiver has been validated by Ottawa University SunLab to have over 90% efficiency.
- 3) Patents: 2 granted patents covering a) dual-axis micro-tracking mechanism, b) active cooling and thermal capture, c) optical design including own secondary optic.
- 4) Mechanical Design: the mechanical design has achieved a high level of readiness
- 5) Complete financial analysis of system cost and feasibility including project 5 year financial plan.

BUSINESS MODEL

Cogenerate Solar is a manufacturer and solar technology development company.

Our 3 lines of products covering the residential, commercial and utility scale markets demand different business models to reaching the different target audience.

Early Commercialisation

Commercial & Utility Markets: The company will utilize the direct B2B business model to reach its sales targets in the commercial and utility scale markets, identifying key market player with keenness on reducing the GHG footprint and achieving NET-ZERO for their properties and operations.

- Malls
- Retail Warehouses
- Public Buildings
- Island Resorts & Hotel chains
- Commercial / Residential REITs

Residential Market:

- Direct B2B: Residential REITs, Community Housing, Residential Compounds.
- Direct B2C: through an online ordering model targeting key market player with keenness on reducing the GHG footprint and achieving NET-ZERO for their properties and operations.
- Indirect B2C: HVAC companies and solar distributors.

Full Commercialisation

Commercial & Utility Markets:

Distribution Channels, Commercial HVAC, large direct orders, PPA/IPP model.

Residential Market:

- Direct B2B: Residential REITs, Community Housing, Residential Compounds.
- Indirect B2C: HVAC companies and solar distributors.

Market Traction

Cogenerate Solar has received support from National Research Council (NRC) Canada – IRAP program and a winner of Sunlife Sustainable Innovation Lab Award - 2019.

- Sun Life Financial: Award & sale of a 4 commercial unit pilot for a commercial building located at 100 Murray Street, Ottawa. The combined value award and sale is CAD\$125K.
- Ottawa Community Housing (OCH): Letter of Intent (LOI) for 300kW system for a multi-tenant mid-rise residential building located in Ottawa for CAD\$1.8M
- Windmill Developments: Letter of Intent (LOI) for 600kW system for a multi-tenant mixed use building (residential & commercial) located in Ottawa and London for CAD\$3.6M.
- EPCOR Utilities: Letter of Intent (LOI) for a 1 to 2 MW utility scale ground mount system located in Alberta for CAD\$5M.

International Activity

Cogenerate Solar commences discussions with multiple overseas

- Petroleum Development of Oman (PDO): Requested the installation of 5MW pilot, with the potential for 250MW installation.
- MOU with Bharathi Cement of India for a 5MW pilot leading to 100 to 150 MW installation.
- Agreement with King Abdullah University for Science and Technology (KAUST) for hot climate testing.
- Discussion with Institut de Recherche en Energie Solaire et Energies Nouvelles (IRESEN) in Morocco for hot climate testing.

Team

- **Ra'ed Arab, B.Eng., President & CEO**

Mr. Arab is the founder of **Cogenerate Solar** with over 20 years of senior executive experience in management and engineering. He served as CEO of Quadra Systems Corporation, a software technologies company, for the past 7 years. He also founded 4ads Inc., an online marketplace, in 2000. Ra'ed also worked in lead positions at CGI, Sympatico, SHL System House, Nortel and Lockheed. Mr. Arab holds a degree in Electrical Engineering from Carleton University.

- **Bruno Rocha, PhD, CTO**

More than 20 years of experience in industry, in design, production, management, R&D, and teaching. Bruno has worked in the automotive and anti-corrosion industries, and has managed companies, business units and projects, while managing teams of more than 200 members in different locations. He was a researcher for the NRC and NASA and has participated in several worldwide renowned scientific projects, scientific groups, committees and institutions (such as NATO). Bruno has more than 50 publications. He currently teaches at Algonquin College, having taught previously at the University of Victoria. Bruno holds a Ph.D. and a B.Sc. in Aerospace Engineering.

- **Simon Fafard, PhD, Principle Scientist CPV**

Dr. Simon Fafard, Ph.D, founded Cyrium Technologies Inc. in 2002 and serves as Chief Technology Officer and Director. Dr. Fafard has 20 years of Optoelectronics experience. He holds a Ph.D in Physics from University of Ottawa. He published over 115 articles in the scientific literature.

- **Hanna Taher, VP of Marketing**

Hanna Taher is a branding and marketing expert with over 15 years of experience. In addition to marketing strategy, she directs media relations, content, branding, video production, advertising and web development. Her extensive marketing experience, paired with a design background and software development skills, allow for in-depth knowledge of what constitutes an effective online presence and a strong brand image. Having worked with brands like Mercedes-Benz, LCBO, Siemens and others, she has exposure to various aspects of brand communication and positioning. Hanna leads teams of marketers and developers through strategy, campaign development and execution. She holds a degree in Fine Arts from York University.

- **Colin Parry, VP of Manufacturing & Logistics**

Mr. Parry is a dynamic executive with over 20 years experience in senior-level management positions. He served as VP Global Manufacturing & Logistics at Alcatel/Newbridge, Spotwave Wireless and Curtiss Wright Corporation.

- **Khaled Kaddoura, VP of Projects**

Mr. Kaddoura is a co-founder of Quadra Power, a solar EPC company. He is a certified Project Manager, with 14+ years of hands on experience managing multiple EPC grid-tied ground mount commercial PV systems. Mr. Kaddoura has lead the due-diligence process, constructed and commissioned over 200MW AC with a total value of over \$400M. Mr. Kaddoura holds a bachelor's degree in Integrated Science with a focus on Physics/Renewable & Sustainable Energy from Carleton University.

Advisory Board

- **Claude Haw, P.Eng., ICD.D**

Claude is President of Venture Coaches, an investment and management consulting firm, and Executive Leader, Strategy & Governance at Business Sherpa Group. He serves on the Boards of VigilantCS, Portia International, Mindtrust and PSHSA. He has more than 40 years in a variety of technical, general management and investment roles in the technology and not-for-profit sectors. Claude holds a Bachelor of Electrical Engineering from Lakehead University. He completed the Canadian Securities Course and is a member of Professional Engineers of Ontario. He has the Directors Education Program at the Rotman School of Management at University of Toronto and holds ICD.D certification from Institute of Corporate Directors.

- **Jonathan Westeinde**

Jonathan is the founder of Windmill and brings a great deal of experience in corporate strategy, finance and business development as it relates to green development practices. Jonathan has spearheaded a new national consortium that is focused entirely on green building retrofits as part of Ledcor Construction. Prior to founding Windmill, Jonathan was a founding partner of Venbridge, a venture capital services division of Gowlings, one of Canada's leading law firms. To date, Jonathan has been responsible for the complete oversight of four LEED Platinum mixed-use projects totaling +/- \$500M.

- **Pamela Heneault**

Pamela Heneault is the Executive Director of Public Affairs at Rockport Networks. Pamela Heneault brings over 30 years of experience in social policy, innovation policy and programs.

Operating Plan

Phase 1: Short Term (3 to 9 months):

- Raise US\$1M seed equity investment
- Obtain CAD\$800K to CAD\$1M in non-dilutive funding
- Build product prototypes.

Phase 2: Medium Term (6 to 24 months):

- Convert LOIs on hand to signed contracts:
 - CAD\$1.8M for 300kW flat rooftop system (Ottawa)
 - CAD\$3.6M for 600kW flat rooftop system (London, Ontario)
 - CAD\$100K for 3 x 5kW residential slanted rooftop system (Ottawa)
 - CAD\$5M for a 1 to 2 MW ground mount pilot (Alberta)
- Raise US\$9M equity investment
- Ongoing access to non-dilutive funding.
- Perform accelerated life testing & certifications (CSA, UL & EU)
- Deliver the installations
- International patent applications

Phase 3: Medium-Long Term (2 to 3 years) (Commercialization in Canada/North America):

- 50 MW of commercial rooftop orders (100 x 500kW installations)
- Establish sales channels through distribution. utilities (like Enbridge), and home builders.
- 100 MW of industrial / utility scale ground mount installations (1 cement factory)

Phase 4: Long Term (2 to 5 years) (Commercialization Worldwide):

- Debt financing for assembly plant.
- Initiate public offering
- Target 200MW to 500MW of utility scale ground mount installations (1 to 5 cement factories or similar)
- Establish Partner Network of existing HVAC and Solar Installation companies.

Investment Required

The total investment being sought is US\$20.5M (US\$5.5M + US\$7M + US\$8M). Non- dilutive funding programs are expected to be levered. Finally, a projected \$50M debt round for manufacturing scaleup.

Stage	Use of Funds	Funds Required	Duration
<u>1. Product(s), Demonstration, Completion & Certification</u>	a) Produce iPyramid 1 solar cogeneration system for commercial rooftops. b) Complete iPyramid 2 solar cogeneration system for residential rooftops. c) Produce cogeneration panel	US\$5.5M Equity Investment	12 to 18 months

	for ground mount. d) Product Trials & certification of iPyramid rooftop solution. e) Product Trials & certification of Cogenerate Solar panel solution. a) Obtain \$15M in government grant funding b) Grow revenues to \$100M c) Build out management team from founder and CTO d) Expand geographically to USA market		
PRE-COMMERCIALIZATION			
2. <u>Deploy Pilots</u>	a) 1 MW rooftop projects b) 1 MW industrial scale pilot c) Product Monitoring	US\$15M Equity Investment	18 months
COMMERCIALIZATION			
3. Commercialization & Full-Scale Manufacturing	a) Full Marketing & Sales b) Secure 100 to 200 MW pipeline c) 100 MW Assembly Plant Setup	US\$50M debt/loan (repayable over 3 years)	9 to 12 months

Use of Funds

Cogenerate Solar is raising the first two rounds to • buy 18 months of runway • leverage investment to obtain CAD\$15M in government grant funding • grow revenues to \$50M • build out team • strengthen IP • launch residential product, and • expand geographically to the US and internationally.

Exit

It is expected that the payback period will be approximately 11 operating quarters. Positive cash flows are planned for Q1 of Year-3. **Cogenerate Solar** plans to initiate IPO upon reaching the \$150M revenue and \$50M profit mark.

Summary

- The company can generate high profitability and strong growth in the NET-ZERO market
- Government support is projected for demonstrators in Canada
- Patented technology includes unique cogeneration and micro-tracking
- Hot and cold climate suitability allows the company to capture current market opportunities

NET-ZERO WITH SOLAR ALONE™

COMPANY BACKGROUND

Cogenerate Solar, headquartered in Ottawa, Ontario, Canada, cogenerates solar photovoltaic and thermal energy to deliver low cost electricity and heat while reducing green house gases.

Please contact us if you would like to learn more.



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