Environmental Innovation Challenge 2017

Nova Solar Glazing

Business Summary

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Affordable, practical solar windows. Finally.

The Problem

Modern commercial construction makes extensive use of architectural glass, which often represents most of a building's exposed surface. Architectural glass is typically designed to block the majority of incident sunlight, in order to leviate HVAC loads. A long-held dream of both architects and proponents of sustainable cities alike is to harvest, rather than reflect this solar energy, to produce useful electricity. A way of making solar windows truly practical and affordable had yet to be found. Until now.

The Clear Solution

Our technology transforms industry standard curtain windows into transparent, energy-producing solar windows, that manufacturers can incorporate into their products, allowing their windows to produce solar electricity. We upgrade standard commercial curtain windows using revolutionary, patent-pending luminescent solar concentrator (LSC) technology. Solar windows with our technology can be manufactured, engineered, and installed using current industry practices. For a modest initial increase in window cost, a building's surface is transformed into a source of renewable energy.

Our Vision

We will provide conversion kits to commercial window manufacturers, allowing them to upgrade their windows into solar windows.

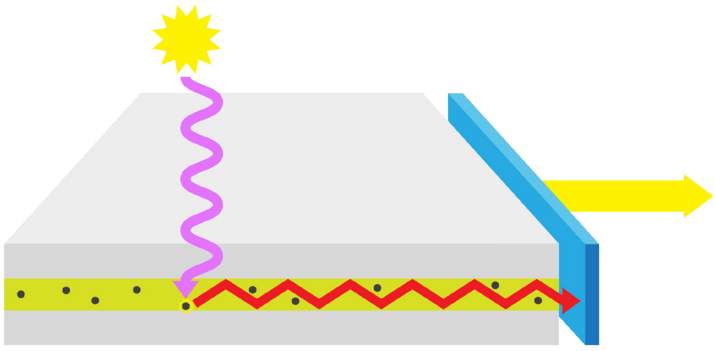
Convert buildings from energy sinks to energy sources

Compatible with industry standard window manufacturing and installation techniques

Provide solar power for use within the building with excess power sent onto the grid

Above: Cities today appear to be made of glass. Our product is positioned to use this surface area as a resource for energy generation.

Left: A typical curtain window. Our product is designed to seamlessly replace curtain windows.



LSC Technology: The central pane of a triple-pane window contains a thin sheet of polymer in which quantum dots are dispersed. UV light excites a quantum dot. The quantum dot downshifts and re-emits the now near-infrared light to photovoltaic cells contained within the frame. The photovoltaic cells convert the light to electricity, using an on-board MPP tracking chip. Adjacent windows snap together, enabling compatibility with existing installation techniques.

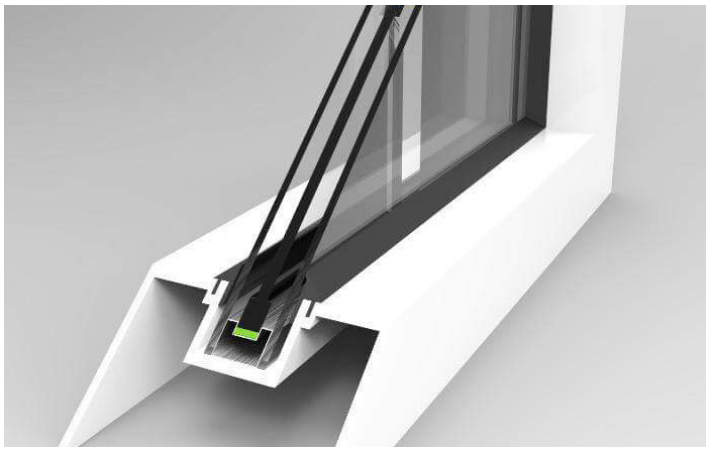
How it Works

Our conversion kit replaces the central pane in a standard triple-pane commercial window with a transparent solar concentrator. A portion of incident sunlight-specified by the architect according to the desired level of tint-is harvested and redirected to the second component, a narrow strip of solar cells in the window frame. Low-cost on-board MPP tracking chips produce low voltage power, with snap-interconnects linking curtain windows together. Upgraded solar windows compatible with current installation techniques, worker skillsets, design practices, and construction permitting requirements.

Arrays of windows feed distributed grid-tie inverters, sending excess electricity to the grid through a building's existing wiring. The entire system is robust against partial shading and individual component failure, and is easily serviced.

Display

To showcase our solution, we will demonstrate a fully functioning prototype. As an interdisciplinary team of chemistry, engineering, industrial design, and business students, we are committed to helping develop fully carbon neutral buildings and communities world wide.



Top: A cutaway view of our window. The LSC pane described above is the middle pane of glass.

Above: Installment of a curtain window. Our window can be installed exactly the same way.

Market Analysis

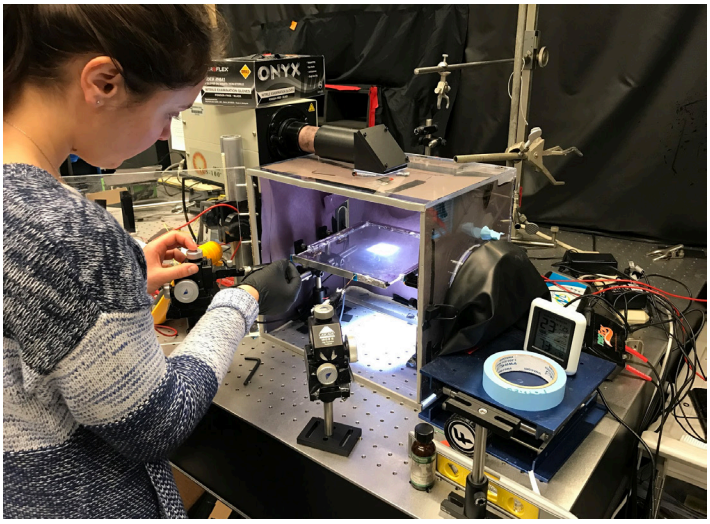
Our product consists of a conversion kit made of a frame insert with solar cells and an MPP tracking chip that replaces the inner pane of a standard, triple-pane curtain window. We will sell our conversion kit directly to window manufacturers who will sell solar windows to architects and developers. This strategy allows us to retain control over our core IP and minimize startup costs.

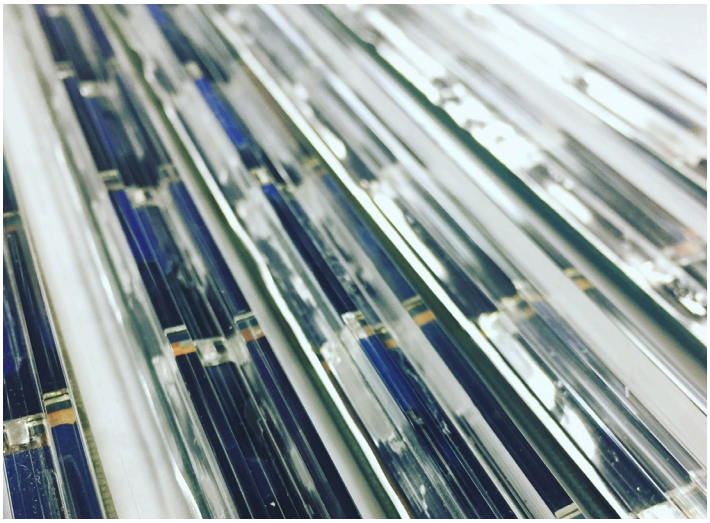
By partnering with window manufacturers, we will enable strong product differentiation in the $12 billion commercial glazing market. Manufacturers will be empowered to satisfy the increasing demand for sustainable building materials and do so without requiring significant changes to current manufacturing, sales, distribution, or installation practices. Our product offers increased value with a low barrier to market entry.

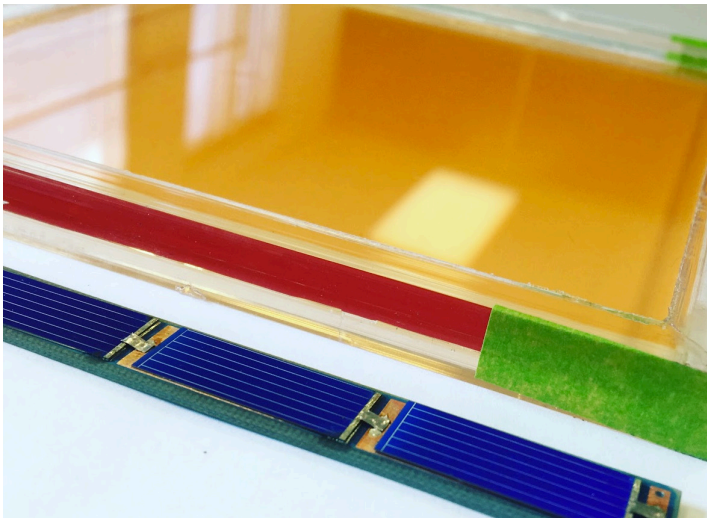
Windows manufactured with Nova Solar Glazing technology can be sold in two markets. In the commercial glazing market, we provide a differentiating strategy. In the sustainable building materials market, we are a brand new product.

Commercial Glazing Market
Estimates by IBISWorld (2016) indicate this sector expects revenues in excess of $12 billion in the US in 2017. Competition in this sector is growing, and firms are focusing on high-value, non-residential construction projects. Our product gives window manufacturers a way to distinguish themselves by generating energy while staisfying the demand for sustainable materials. Nova Solar windows are far superior to current sustainable window options that focus on insulation and energy retention.

Sustainable Building Materials
Consumer demand for sustainable building products has been demonstrated by IBISWorld (2016) market estimate of $53 billion in revenue in the US alone. Increased focus on LEED-certified buildings has spurred much of the growth in this sector. Use of sustainable, responsibly sourced materials is aided by incentives like tax subsidies and savings in operating costs. Government incentives such as tax credits reduce the upfront costs of this kind of construction. Our technology contains no toxic materials and is fully recyclable. Window manufacturers will have a competitive advantage our product allows them respond to these trends and stand out in a growing market.







Top: Testing the efficiency of our LSC-filled pane.
Middle: Photovoltaic cells ready to be coupled to our LSC-filled-panes.
Bottom: A testing sample of our LSC-filled-pane next to a PV string.

Cost Performance of Windows with Nova Solar

Compare the installed cost of windows with Nova Solar Glazing technology to conventional C-SI PV modules. At scale our per watt costs are competitive with conventional, commercial-scale PVs. This is possible because the incremental costs of a structure are spread between the window, a necessary purchase, and our technology, as opposed to a separate installation of PVs.

Consider a typical commercial building measuring 40mx50mx50m where 75% of its surface area is glass. The tables to the right show the installed cost, annual electricity production, and payback time in three electricity markets. The initial scenario is based on 5% energy conversion efficiency. The at-scale scenario is based on 10% efficiency and full maturity of the technology.

At our introductory 5% efficiency, favorable markets already have payback times of three years or less. With further development, our technology becomes favorable in most markets around the world. The pathway is therefore open to truly global-scale impacts.

Installed Cost

Location	initial	at scale
Honolulu	$4.63/W	$1.62/W
Las Vegas	$4.02/W	$1.47/W
Seattle	$4.89/W	$1.69/W

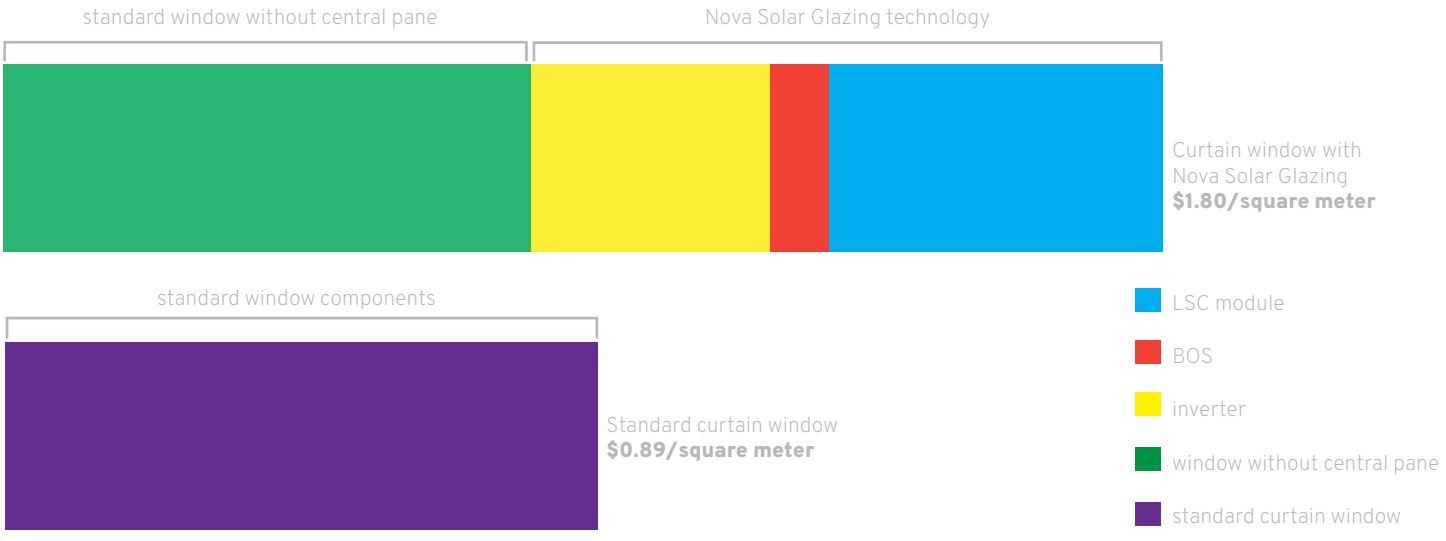
Annual Electricity Savings per Building

Location	initial	at scale
Honolulu	$169,029/yr	$338,057/yr
Las Vegas	$56,790/yr	$113,580/yr
Seattle	$32,817/yr	$65,634/yr

Payback TIme for Capital Outlay in Different Markets

Location	initial	at scale
Honolulu	3 years	2 years
Las Vegas	--	5 years
Seattle	--	10 years

Cost of standard curtain window vs cost of solar window per square meter



Key Assumptions:

We applied a discount rate of 12%. We chose this conservative rate based on the uncertainties surrounding the output of our technology. We also assumed a 10-year lifespan of the window and no degradation in its output. While it is likely our windows will last upwards of 25 years, long term degradation cannot be tested at this point. Inputs to our solar window's production become much cheaper in large amounts, reducing production costs at scale.

We used a 5% efficiency rate as a realistic goal that can be attained though improvements in our manufacturing process. We believe there is an upper limit of around 10% for the technology that could be attained with additional costs in research and process development.

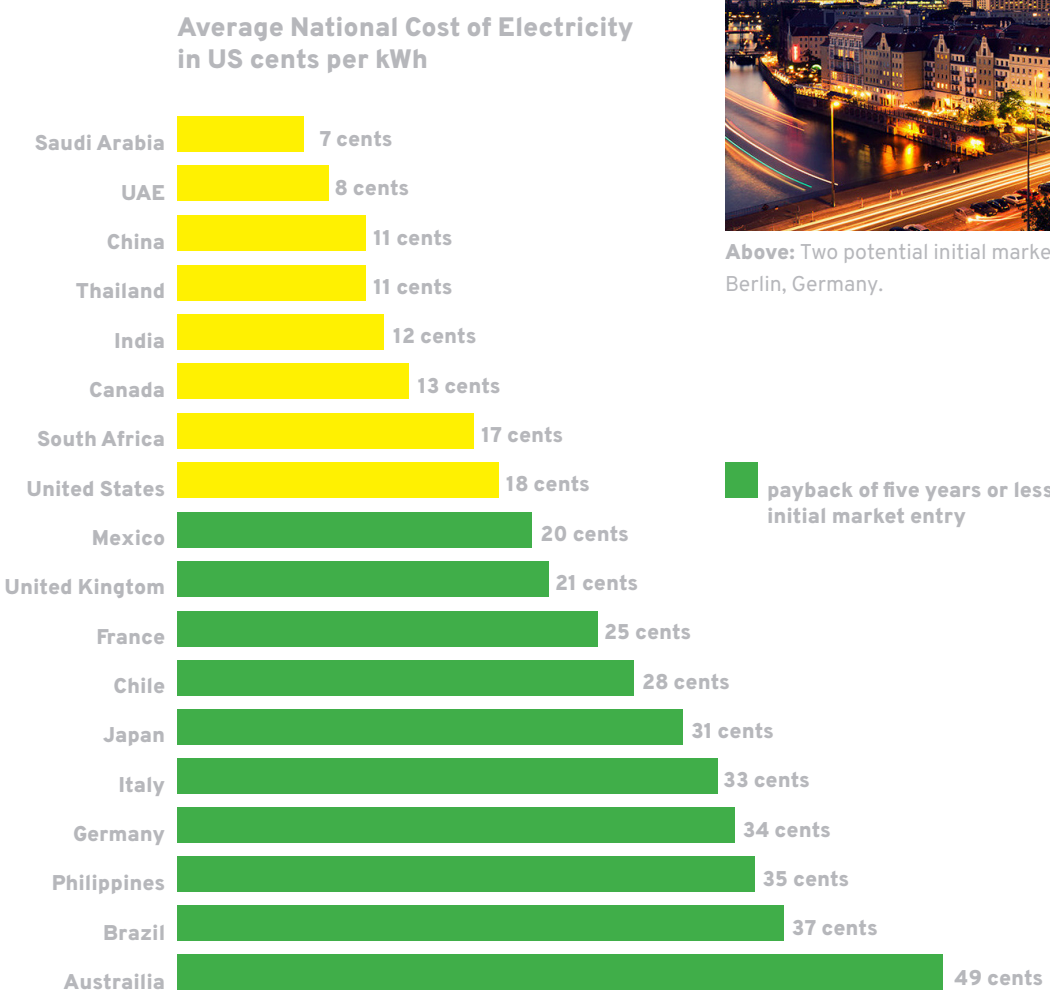
Go to Market Plan

Window manufacturers are a natural partner for our operations. By integrating our technology into their product. We can offer a them differentiated and value-added option to consumers in the commercial construction industry.

At launch, we will offer a solar glazing that achieves 5% power conversion efficiency which provides an attractive value proposition in a number of geographic markets. Revenue on these initial sales will allow us to finance the research and development costs needed to improve efficiency to 10%.

Retail electricity costing more than $0.20 in high solar irradiance markets allow payback periods of under 5 years at 5% efficiency. Many geographic markets are available at this price point including Australia, Italy, Japan, Germany, and some domestic locations like Hawaii. At 10% efficiency almost all markets become accessible.

Above: Two potential initial market entry locations. Tokyo, Japan and Berlin, Germany.



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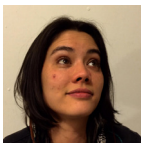
Chemistry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Ed Love is an Associate Professor of Marketing and Department Chair at Western Washington University.


Bill Miller has more than 35 years of operating experience in the software and Internet arena.

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Images

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