



natcoretechnology
advancing solar science



Solar Power still doesn't work . . .
without the benefit of substantial government
subsidies



There are two ways to make solar energy cost-competitive:

- Double the efficiency
- Halve the cost



**Natcore has technologies
that we feel will do both**



Market Bigger than Companies or Governments

- 1960s - Exchange Controls
- 1970s - Hunt Brothers / Silver Market
- 1980s - United States / Interest Rate Control



Effect on Solar Industry

- Reduced capacity
- Technological improvements will fill this void left by lost government support



Intellectual Property

Currently Natcore owns and controls:

18 granted patents

39 pending patents



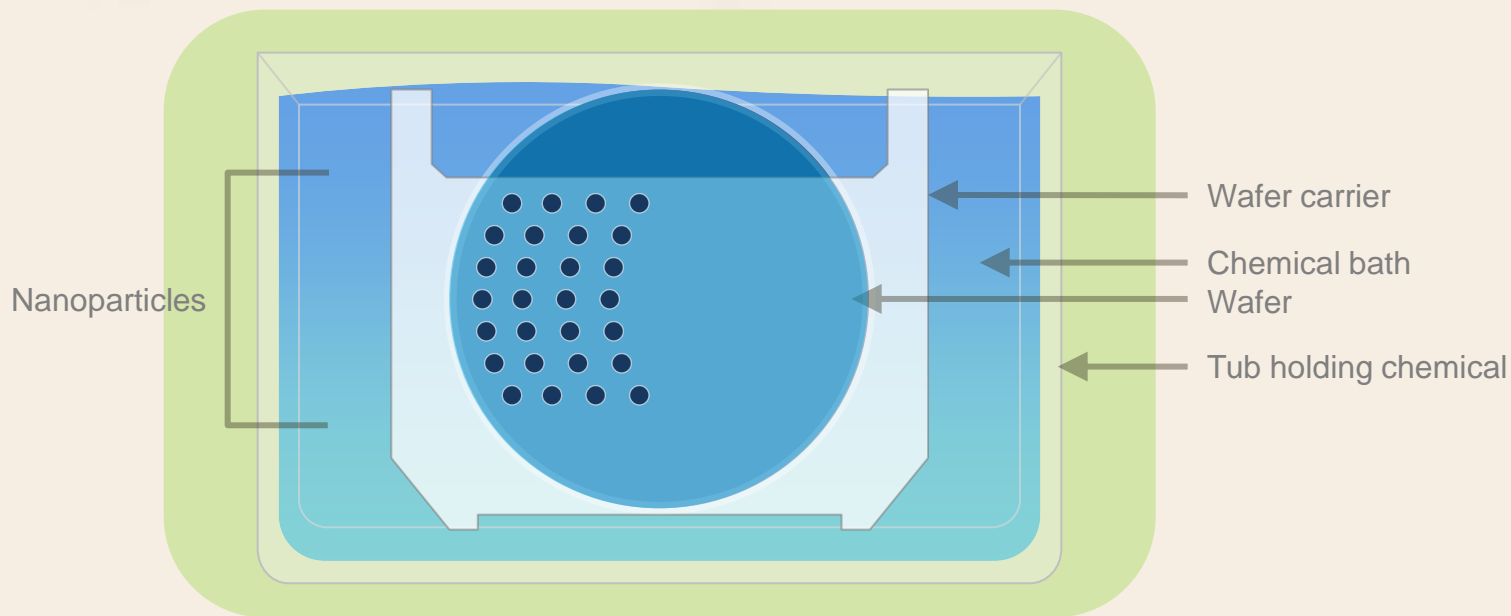
What is Natcore's technology?



Liquid Phase Deposition (LPD)



- 1 Wafers are inserted into wafer carrier
- 2 Wafer is inserted into chemical bath
- 3 Chemicals in the bath react to grow a film that bonds to the wafers

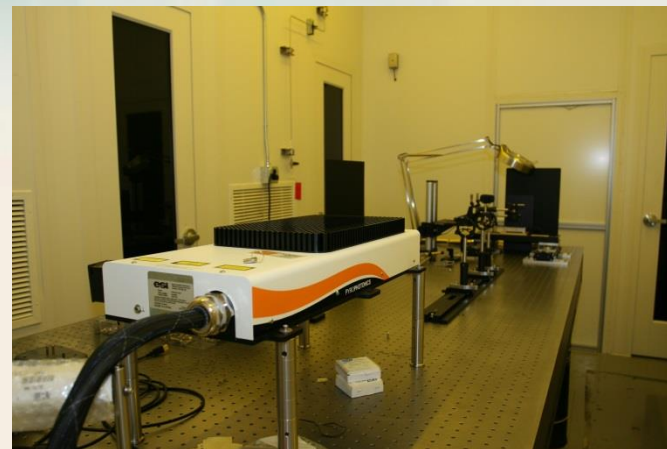
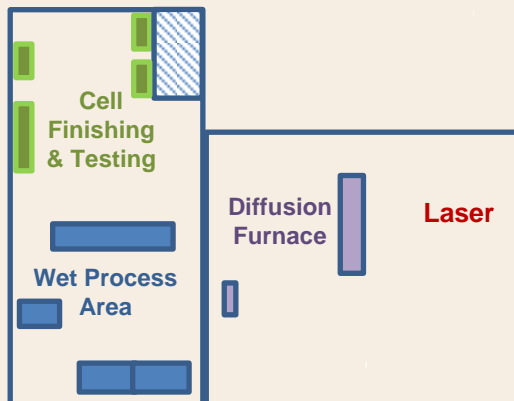


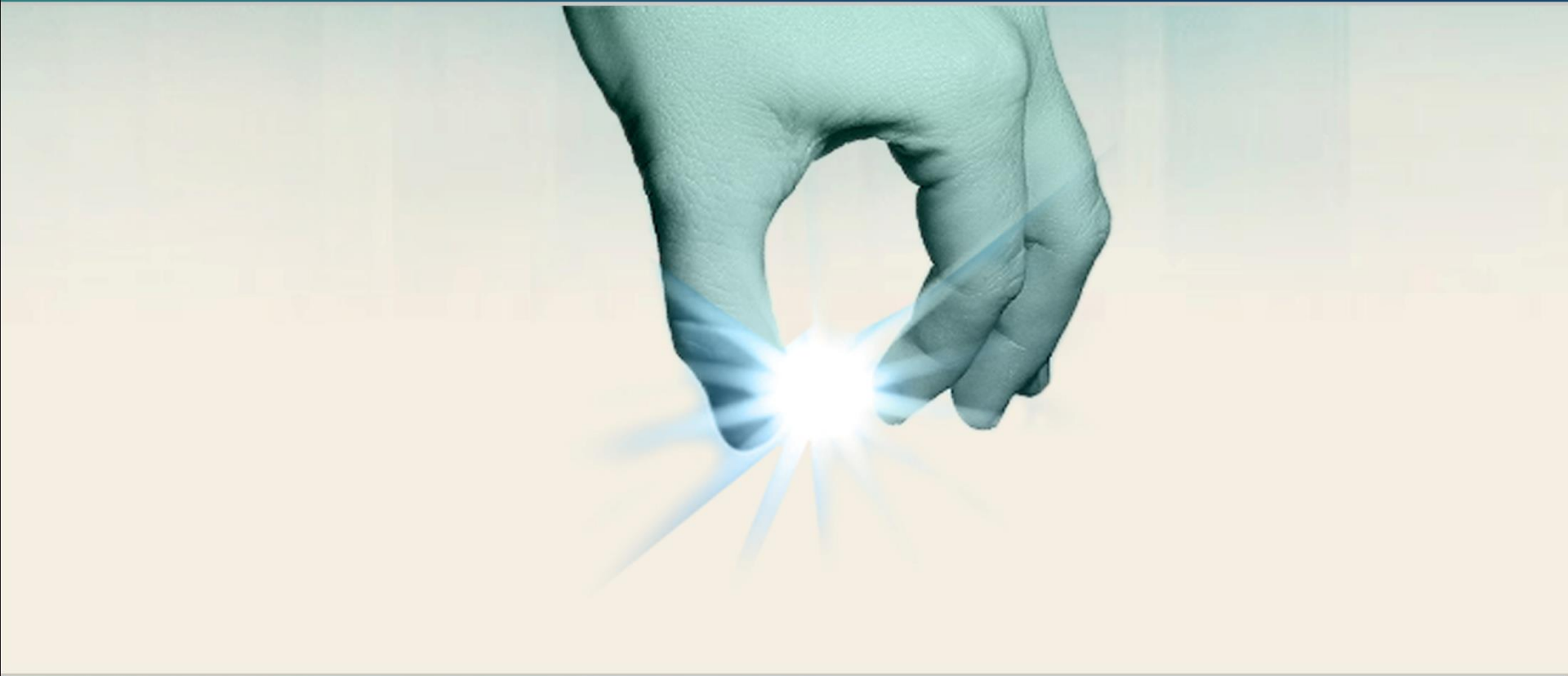


The Natcore Facility and Capabilities



- 19,000 ft² facility / 8,000 ft² of Class 10,000 clean room
- Full solar cell process (bare silicon wafer to working cells)





Road To Commercialization







Natcore's Applications to Commercialization

- Black Silicon
- Laser Back-side Contacts
- Tandem Quantum Dot Solar Cell



- Research report from Shyam Mehta, senior analyst at GTM Research, “Technology not materials to drive down solar costs”
- China trying to save 1¢ per watt over next two years, Natcore can save 3-4 ¢ per watt now



- **Black Silicon: Cost Reduction**
- Laser Back-side Contacts
- Tandem Quantum Dot Solar Cells



➤ Reflection

- Silicon is very reflective → wastes light
- Industry currently uses a costly process to reduce reflection
 - Texturing of the surface (chemical waste) plus...
 - PECVD silicon nitride (vacuum process, dangerous chemicals)

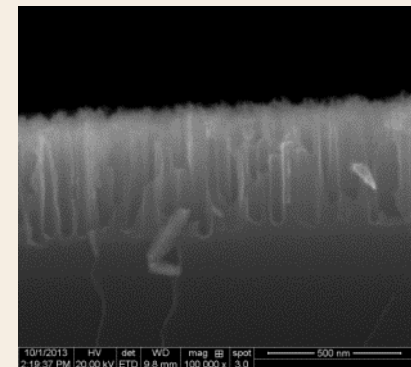
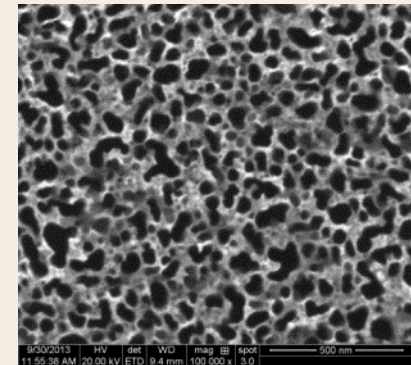
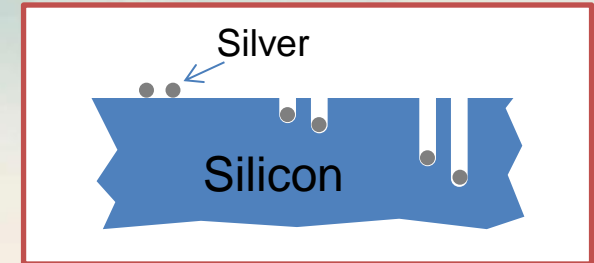
➤ Black silicon

- Simple chemical treatment → Low cost
- Silver nanoparticles drill holes into the silicon surface
- Reflectance below 1% achievable
- Process times: in the minutes

➤ Objectives

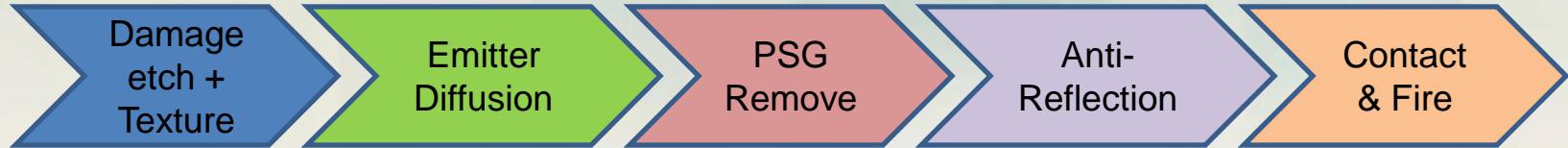
- Perfect black process (and demonstrate)
- Establish cost advantage

Silver nanoparticles creating Black Silicon





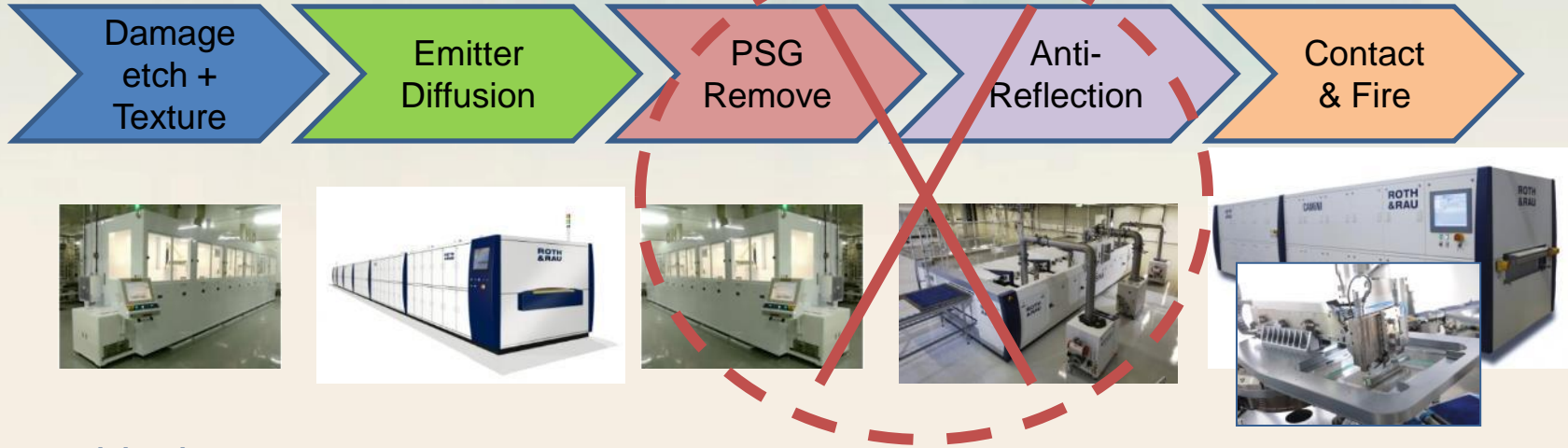
Standard Process



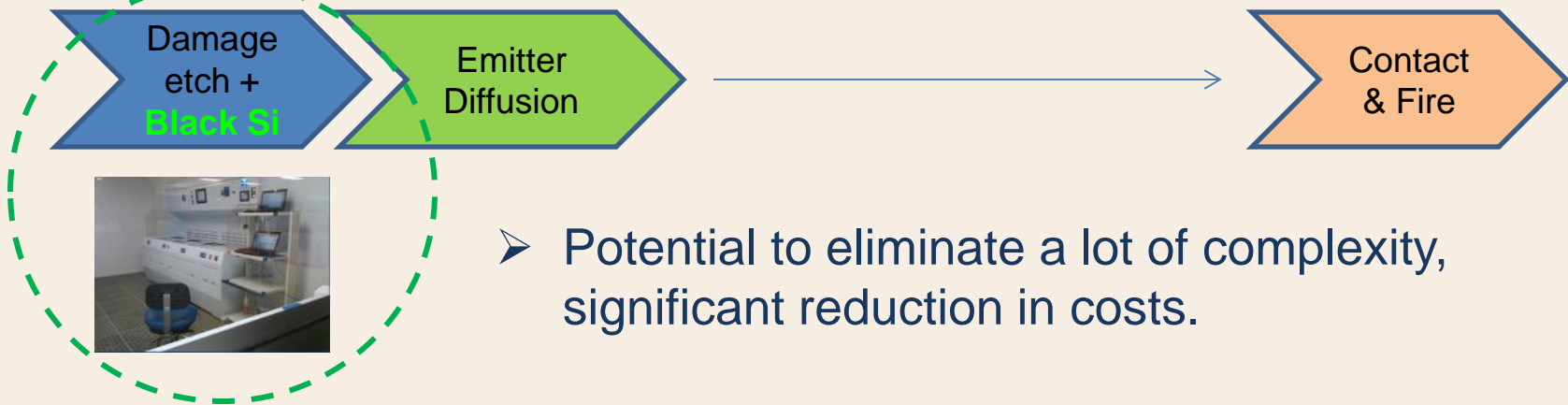
Simplification of solar cell manufacture



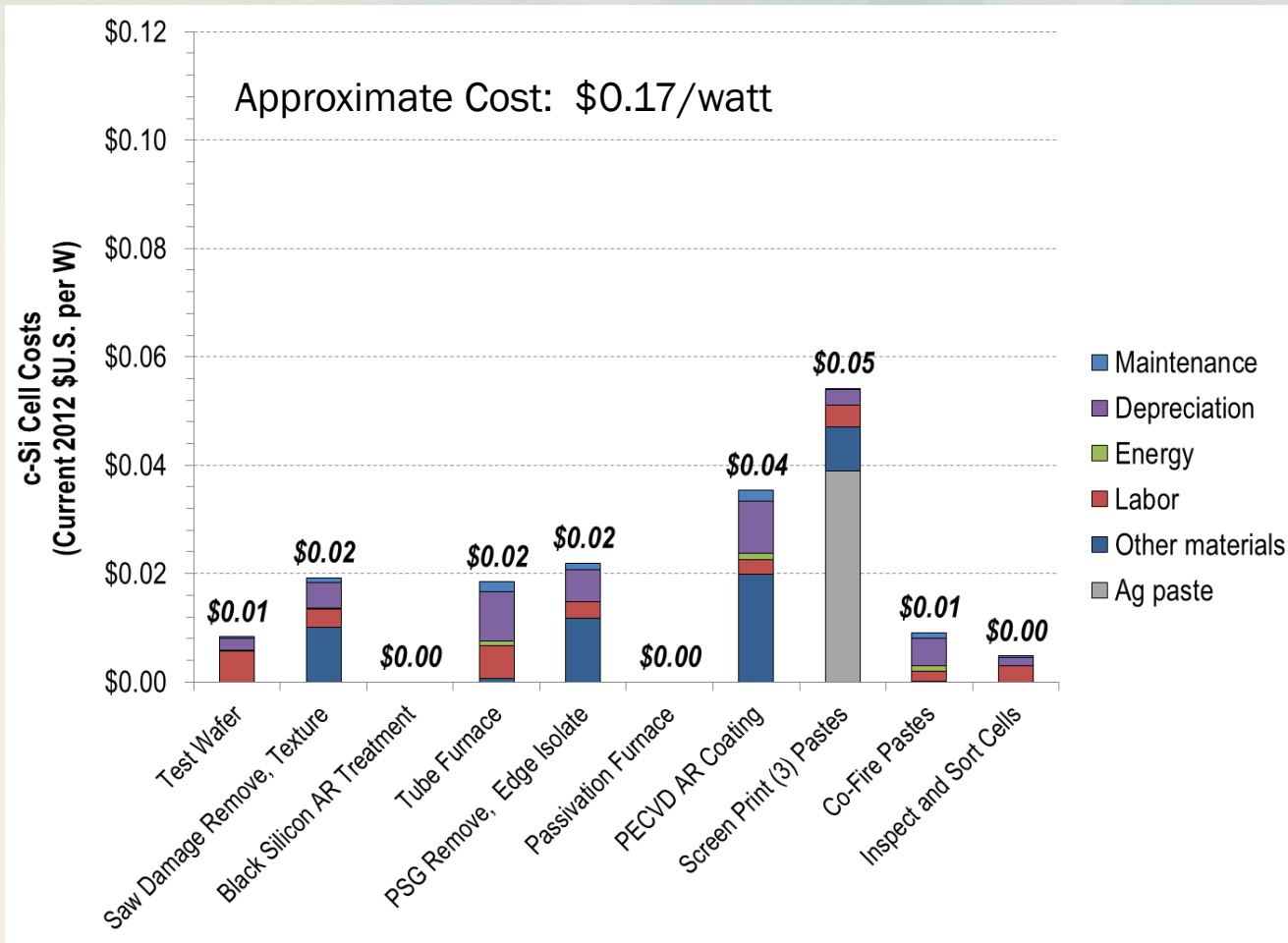
Standard Process

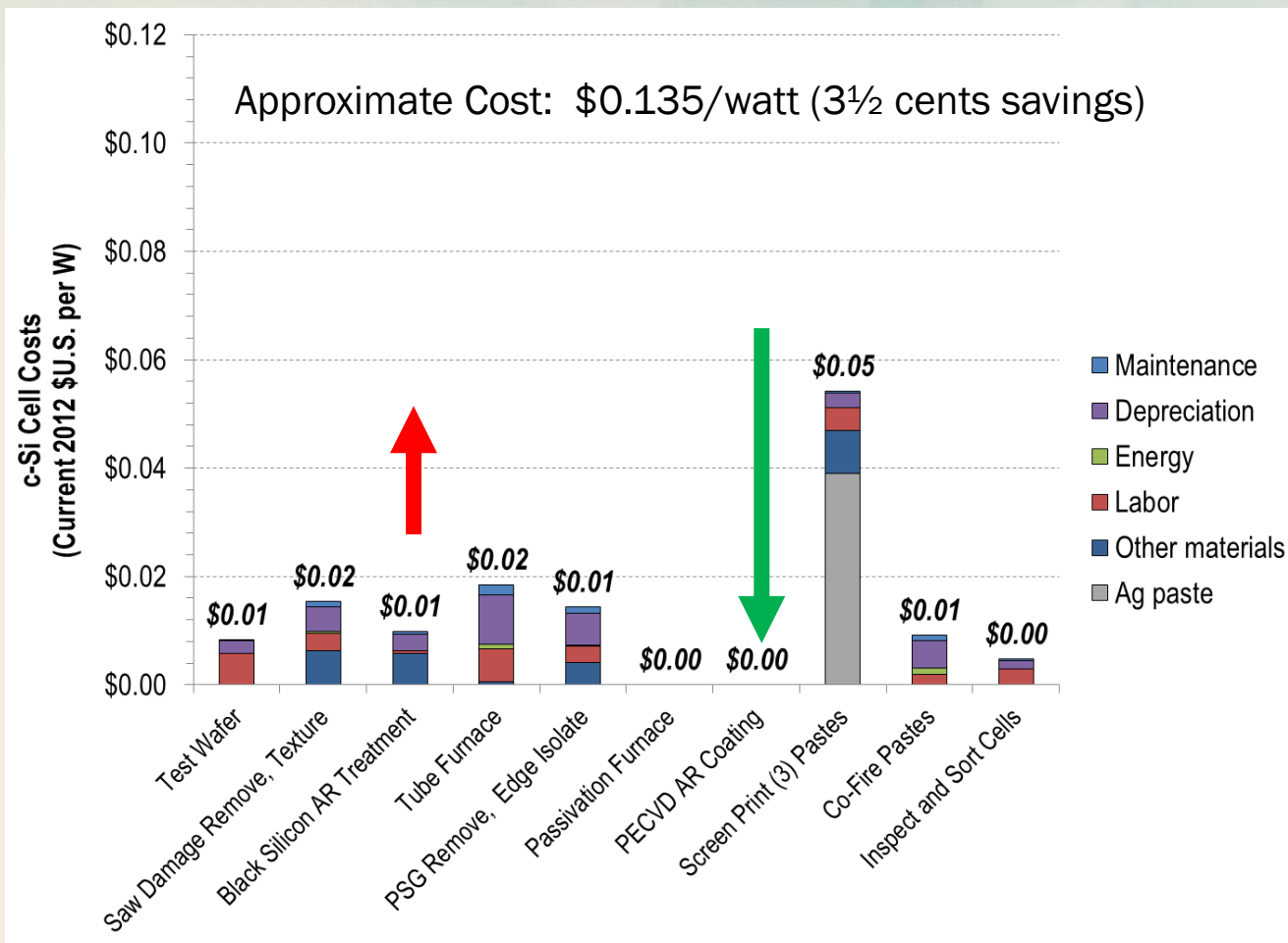


Natcore black process



Conventional Cell Cost



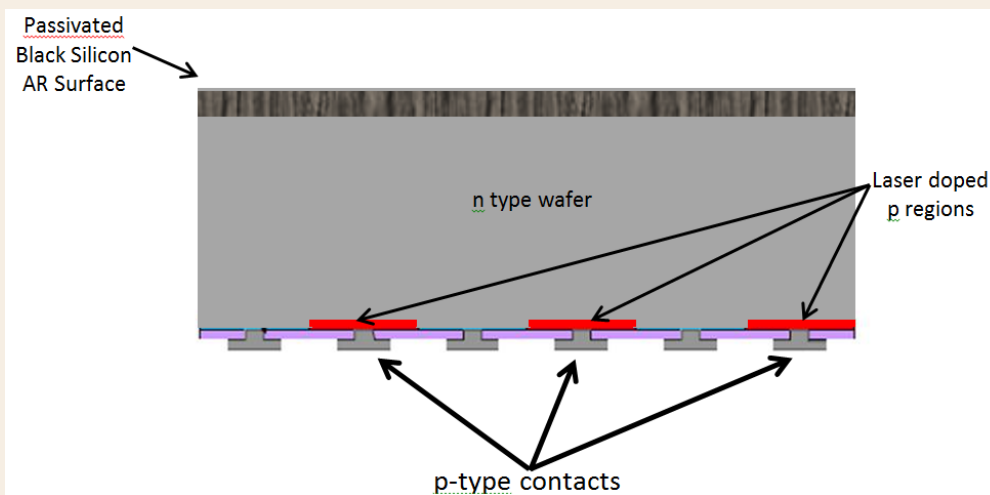




- Black Silicon: Cost Reduction
- **Laser Back-side Contacts**
- Tandem Quantum Dot Solar Cells



- Joint research agreement with a leading university to combine Natcore's black silicon with a laser-processed, all back contact solar cell.
- The laser processing will allow all solar cell processing to take place at room temperature
 - With localized heating for drive-in diffusion of the p-regions on the wafer back side and for contact formation.
- Dramatically lower the cost of silicon solar cell production
- Pushing commercial cell efficiencies into the low 20+% range



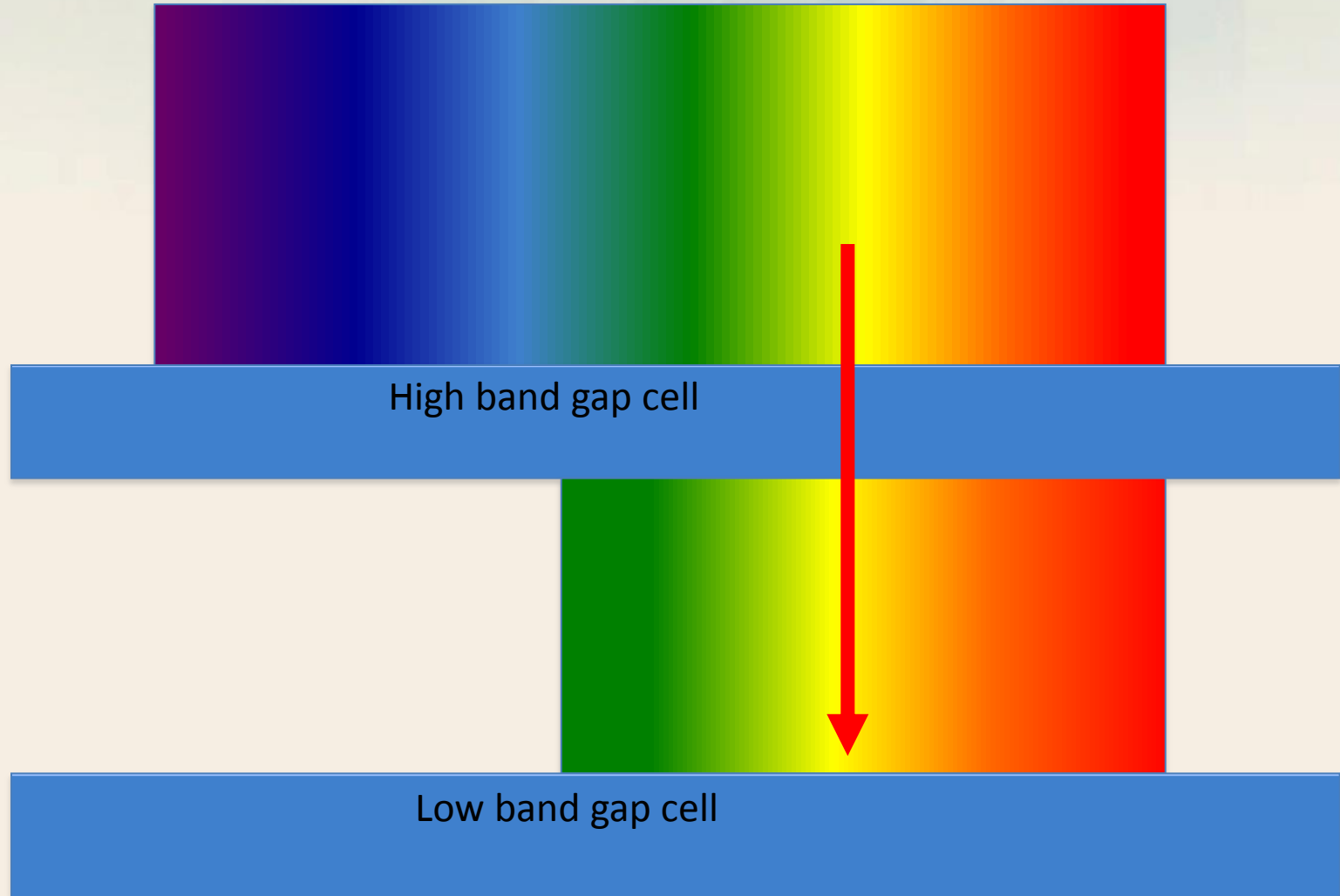
Schematic of n-type all back contact solar cell with passivated black silicon top surface antireflection control.



- Black Silicon: Cost Reduction
- Laser Back-side Contacts
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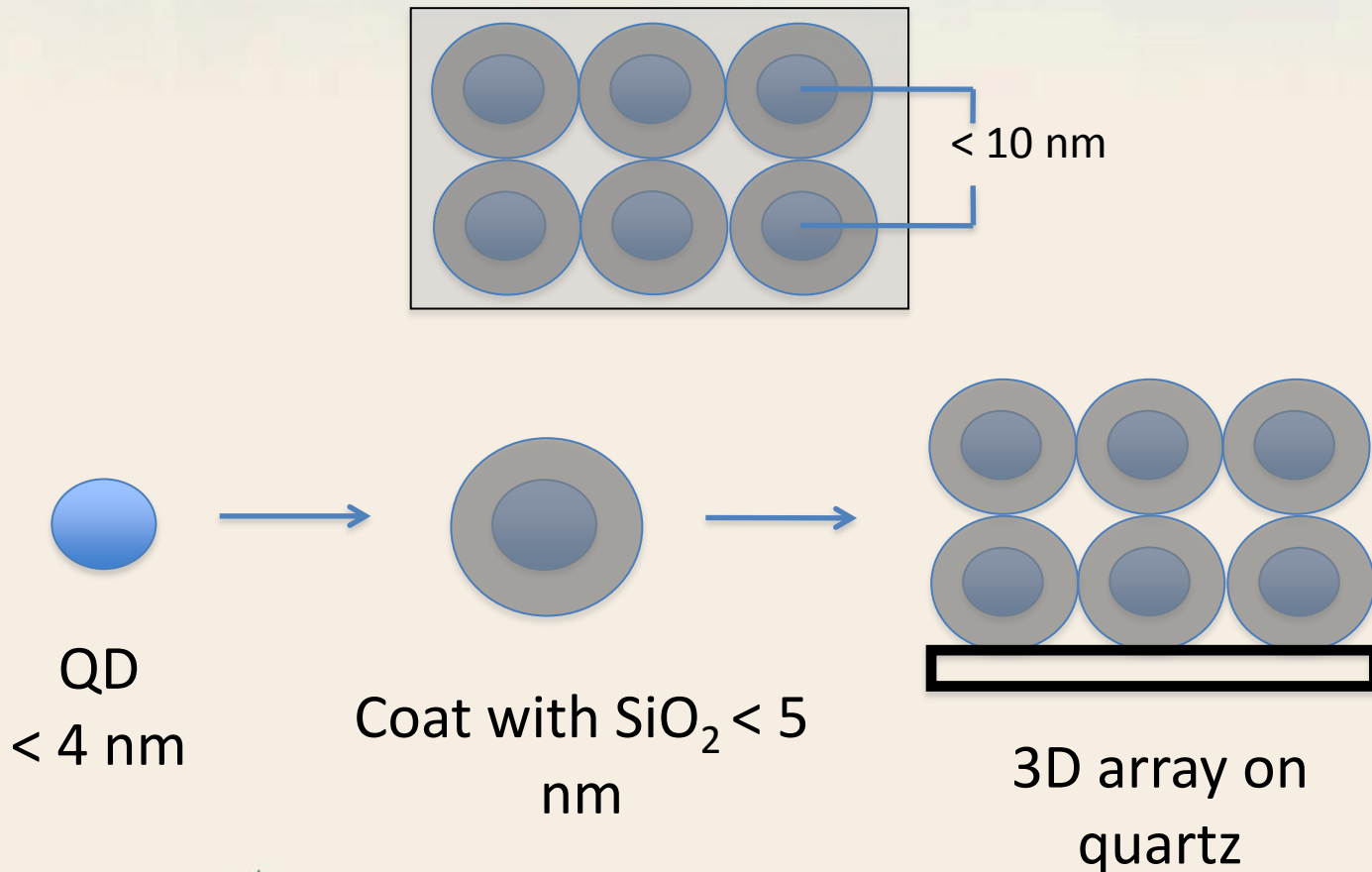


Why a Tandem Cell?





Natcore's Approach to a QD Solar Cell





Media



ABC Television, "World News with Diane Sawyer"



Fox News Network, "Fox and Friends"



ABC News.com





The New York Times INTERNATIONAL Herald Tribune

Clean Energy Entrepreneurs Face More Obstacles in U.S.

By KEITH BRADSHER
Published: September 8, 2010

With erect posture and clear gray eyes, Chuck Provine still looks like the Marine who graduated from the Naval Academy in 1969 and was repeatedly decorated for bravery in Vietnam.



Chuck Provine, chief executive of Natcore Technology in Red Bank, N.J.

He fumes at strangers who call him a traitor for agreeing to manufacture in Zhuzhou, China, a new solar panel production device that his company developed in the United States.

"I love my country," said Mr. Provine, chief executive of 10-employee Nat Bank, N.J. "It makes me crazy that I do things with us, but not here."

Mr. Provine acknowledges that the technology, which involves the manufacture of solar panels, is a complex process. But his experience highlights the challenges of doing business in the United States — and the opportunities that await in the United States — and the opportunities that await in the United States.

American venture capitalists are the main source of money because most commercial banks are leery of lending to venture capitalists are reluctant to make long-term financing and want clear timetables for when they can get their money back.

"They want to come in, make a killing and get out," Mr. Provine said on Wall Street, including as president of Ladenburg Thiel & Co.

He said he spoke with a Congressional aide and was seeking advice on government assistance. But the aide and were hard to find and apply for, Mr. Provine said for its own research and help finding joint-venture partners.

Investors in Brazil, Taiwan and particularly in China. Dr. Andrew Barros, a Natcore co-founder, said he had been in China for several years.

The New York Times

China Drawing High-Tech Research From U.S.



Shiho Fukada for The New York Times
An Applied Materials research lab in Xi'an, China. The Santa Clara, Calif., company is the largest supplier of the equipment used to make semiconductors, solar panels and flat-panel displays. More Photos »

By KEITH BRADSHER
Published: March 17, 2010

XI'AN, China — For years, many of China's best and brightest left for the United States, where high-tech industry was more cutting-edge. But Mark R. Pinto is moving in the opposite direction.



Slide Show
China's Role in Clean Energy

Mr. Pinto is the first chief technology officer of a major American tech company to move to China. The Silicon Valley's most prominent firms, it supplied equipment used to perfect the world's biggest supplier of the equipment used to make semiconductors, solar panels and flat-panel displays.

In addition to moving Mr. Pinto and his family to Beijing in January, Applied Materials, whose headquarters are in Santa Clara, Calif., has just built its newest and largest research labs here. Last week, it even held its annual shareholders' meeting in Xi'an.

It is hardly alone. Companies — and their engineers — are being drawn here more and more as China develops a high-tech economy that increasingly competes directly with the United States.

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The New York Times
International Herald Tribune



Reuters News, Times Square, New York



White House Invitation





DesignNews

Montalbano, Elizabeth. “[Artificial Retina Is Solar Powered](#)” (9/26/13)



“[Natcore Technology appoints prominent Italian solar scientist to head new advisory board](#)” (1/18/13)

pv magazine

PHOTOVOLTAIC MARKETS & TECHNOLOGY

Miller, Amanda H. “[Natcore developing selective emitter for solar cells](#)” (4/14/13)

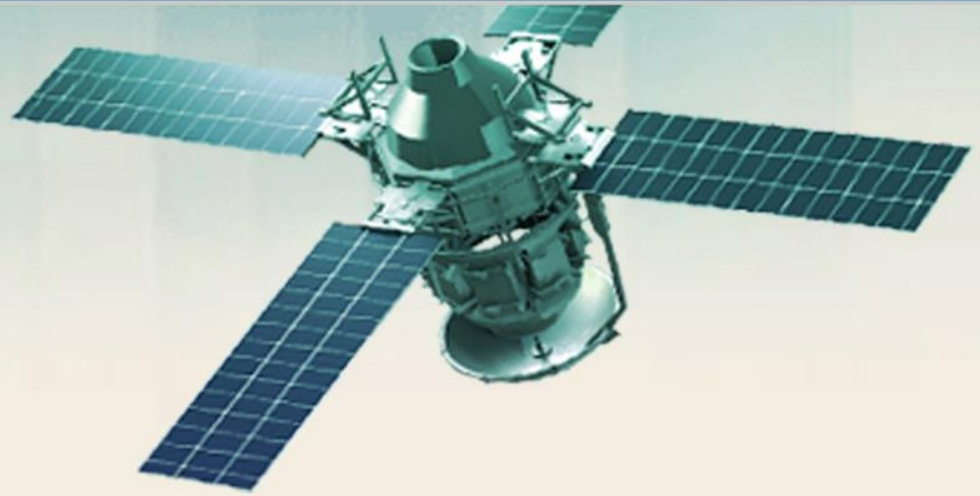
Solar Power World

Bushong, Steven. “[NREL Expands Natcore License To Develop “Black Silicon” Cells](#)” (8/2/12)



- Toxic waste the bankrupt solar companies left behind
 - “The state records show the 17 companies, which had 44 manufacturing facilities in California, produced 46.5 million pounds of polluted sludge and contaminated water from 2007 through the first half of 2011”. Associated Press, Jason Dearen, February 10, 2013
- Hazardous Silane gas
 - Extremely flammable, explosive and unpredictable
 - Natcore’s proprietary black silicon process eliminates all silane





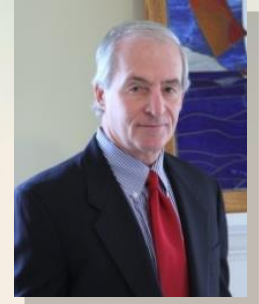
Our management team combines a unique blend of business and scientific experience and consistency.



Management

- **Charles “Chuck” Provini, President and CEO**

- President of Ladenburg Thalmann Asset Management
- Director of Ladenburg Thalmann, Inc.
- President of Rodman & Renshaw’s Advisory Services
- President of LaSalle Street Corporation



- **Brien F. Lundin, Chairman and Director**

- Co-Founder of Natcore
- President and CEO of Jefferson Financial, Inc.
- New Orleans Investment Conference



- **John Calhoun, Director**

- Co-Founder of Natcore
- Managing Director of Fort Hill Resources, LLC
- Director and organizer of FNBC Bank
- Managing Director of Shadows Bend Court and Oak Grove Senior Living
- Managing Director of LEAP Entertainment





Science

- **Professor Andrew R. Barron**

- Co-Founder & Chief Science Advisor
- The Charles W Duncan, Jr. – Welch Endowed Chair of Chemistry
- Professor of Materials Science at Rice University
- Published author of over 350 peer-reviewed scientific papers
- Faculty member for the Smalley Institute for Nanotechnology
- Co-Founder Gallia, Inc.



- **Dr. Dennis J. Flood**

- Chief Technology Officer & Co-Founder of Natcore
- Chief of the Photovoltaic and Space Environments Branch at the NASA Glenn Research Center
- Chair of the Institute of Electrical and Electronics Engineers (IEEE) Photovoltaic Devices Technical Committee
- Serves on the International Advisory Committees of the European, the U.S. and Japan/Asia
- Serves on the organizing committees for World Photovoltaic Conference

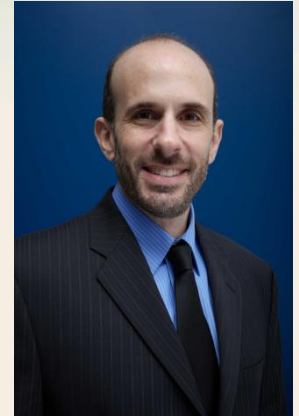




Science

- **Dr. David H. Levy**

- Director of Research & Technology
- Received PhD in Chemical Engineering, with minor in Electrical Engineering, from MIT
- BSE in Chemical Engineering from the University of Pennsylvania.
- Invented the atmospheric Spatial Atomic Layer Deposition process (SALD), which is being intensively studied for many applications including the passivation of solar cells
- 20 years of industrial R&D experience with vapor/vacuum coating, nanoparticle synthesis and dispersions, liquid coating, circuits and electronic devices at Eastman Kodak Company
- Holds 64 patents
- Invited presenter at meetings of the Materials Research Society and the American Vacuum Society

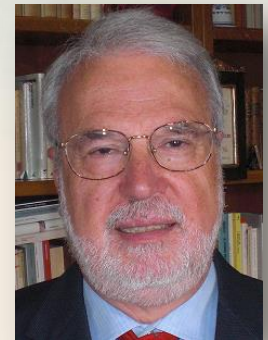




Advisor

- **Dr. Daniele Margadonna**

- Doctorate in Radiochemistry, University of Rome, Laurea degree in Physical Chemistry
- National Secretary of the Italian Crystal Growth Association
- Managing Director of E.T.AE, sas, a consulting company focused on photovoltaic technologies for companies in Italy, Sweden, Norway, Africa and India
- Consultancy specializing in: silicon wafer production, PV module production, silicon feedstock, solar cell production, manufacturing solar cells and PV modules, thin wafer production
- MXGroup SpA CTO, focusing on crystalline silicon technology
- Received Philip Morris Prize for Scientific and Technological Innovation
- Author and co-author 40+ scientific publications
- Holds 6 patents in the PV sector

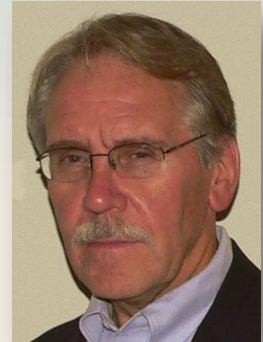




Advisor

- **Dr. David E. Carlson**

- Ph.D. in Physics from Rutgers University, B.S. degree in Physics from Rensselaer Polytechnic Institute
- U.S.Army Nuclear Effects Laboratory, R&D Physicist
- RCA Laboratories, Photovoltaic Device Research, Group Head
- Invented the amorphous silicon solar cell
- Solorex Corporation Vice President, Chief Technologist, General Manager, Deputy General Manager and Director of Research Thin Film Division
- BP Solar Chief Scientist for Future Technology programs and Intellectual Property System
- Received the Morris N. Liebmann Award (IEEE) for crucial contributions to the use of amorphous silicon in low-cost, high performance photovoltaic solar cells
- Awarded the Walton Clark Medal by the Franklin Institute for innovations in the use of hydrogenated amorphous silicon for solar energy conversion
- Received the William R. Cherry Award for advancement of photovoltaic science and technology
- Received the Karl W. Boer Medal from the International Solar Energy Society and the University of Delaware for outstanding contributions to the field of solar energy
- IEEE Fellow and a member of American Physical Society, the American Vacuum Society and Sigma Xi
- Holds 26 patents, 8 pending, published 150+ technical papers, listed in Who's Who in America



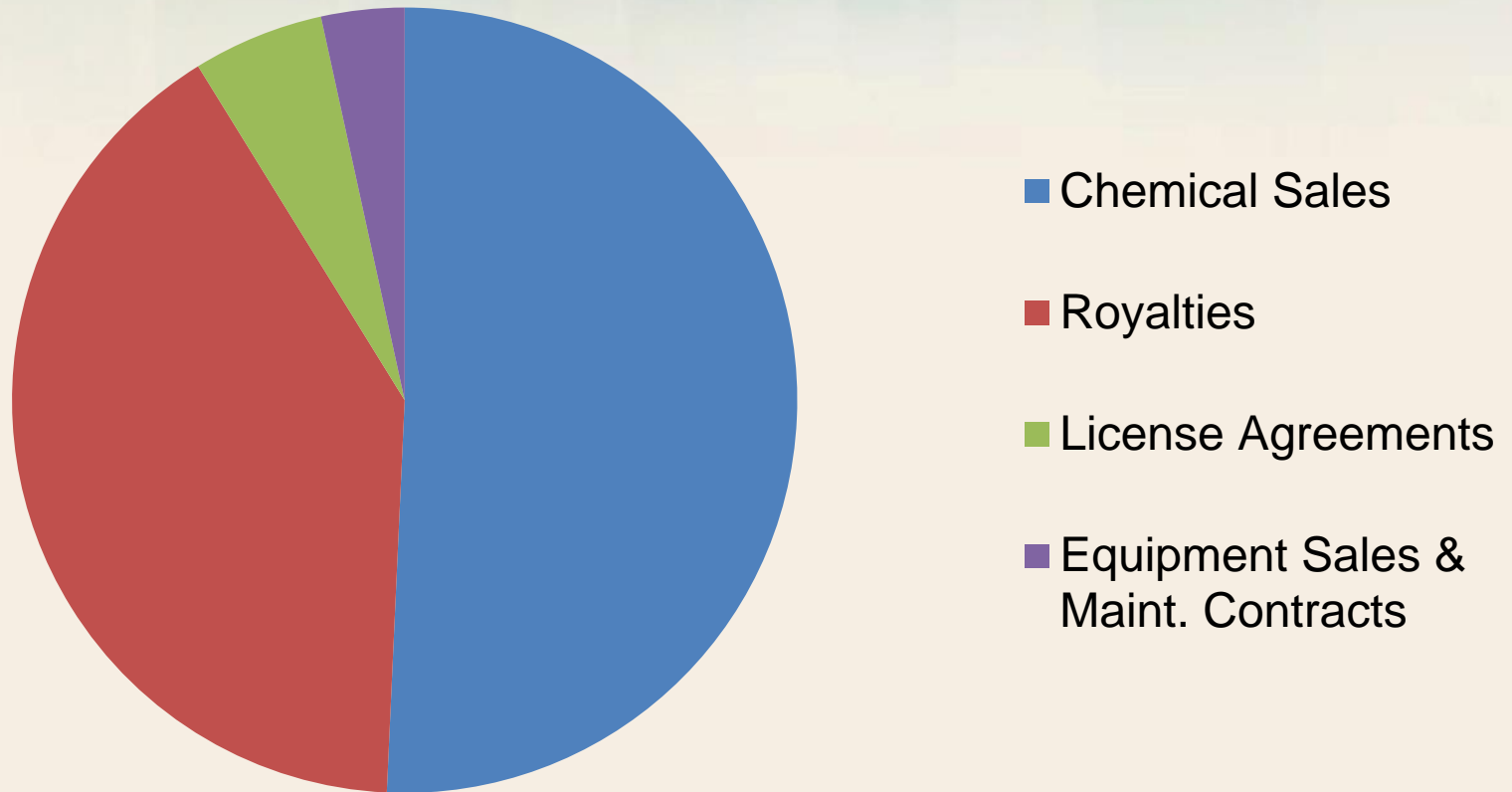


Anticipated Sources of Revenue

- License agreements
- Royalties
- Machine sales
- Chemical sales



Revenue Sources





Black Silicon

Pro Forma Gross Profit

Yearly Worldwide Solar Production	15,300	MW/year
Natcore Market Share	25%	
Cost of a Cell	\$1.50	
Profit Margin per Cell	20%	
Profit Margin per Cell	\$0.30	
Gross Profit per Year (Million)	\$425	



Laser

Pro Forma Gross Profit

Yearly Worldwide Solar Production	15,300	MW/year
Natcore Market Share	20%	
Cost of a Cell	\$1.575	
Profit Margin per Cell	20%	
Profit Margin per Cell	\$0.315	
Gross Profit per Year (Million)	\$292	



Tandem Quantum Dot Solar Cell Pro Forma Gross Profit

Yearly Worldwide Solar Production	140 Million Panels/Year
Natcore Market Share	20%
Cost of a Panel	\$250
Panel Selling Price	\$325
Profit Margin per Panel	\$75.00
Gross Profit per Year (Million)	\$2,100



**If you own the technology,
you will own the industry**



Natcore Owns the Technology



natcoretechnology
advancing solar science