

**BUILDING-INTEGRATED PHOTOVOLTAICS (BI-PV)
FOR PRIMARY ENERGY PRODUCERS IN THE UNITED STATES OF AMERICA**

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INTRODUCTION

In 1896, Thomas Edison was giving away light-bulbs in West Orange New York to encourage customers to utilize the new technology of electricity. In one hundred short years, the earth's humanity has become significantly dependent on electricity for a variety of needs from lights to appliances to the modern scribe's stone -the computer. Patterns of large-scale dependency on electricity are, today, being established in 3rd World Nations.¹

Fossil, nuclear and hydro are the three primary fuels used at this time to produce electricity. In 1994, the *Big Three* represented 99.5% of electricity consumption in America.² Various types of pollution, hazardous waste and environmental erosion are significant global problems created by the increased and long-term use of these depleting fuels for our newly developed tools of *electricity* and *mobility*.

Humanity has not begun to comprehensively document or understand the related importance of the role of oil, natural gas and coal in the earth's evolution. 989 Billion Barrels of Crude Oil are slated for extraction.³ In a forum at the *59th American Power Conference*, the question was raised as when the Holy Lands will subside into the earth with 75% of global oil removal in the Middle East. Many consumers question the ethics and risk of this unnecessary environmental damage. We suggested a mandatory global schedule to phase-out fossil fuel removal while accelerating alternative technology deployment.

US electricity consumption from all forms other than the *Big Three* fuels including all sustainable fuels increased only 0.1% in the last twenty years while US coal consumption doubled amid continued warnings about CO2 emissions. *Building-integrated photovoltaics (BI-PV)* slowly emerged as the most viable electricity source in the world. This sustainable semiconductor *demand-site consumer* electricity generation reduced in cost from \$500 watt to \$5 watt in 1990.⁴ Chicago is approximately 52 square miles. 12.5 watts per SF PV surface on 1% of the total area of Chicago will produce how much electricity in one 4 sun-hour day? With 200 sun days a year, what is a yearly yield?

Figure 1: Earthrise Over Moon Apollo 11⁵ - Contemplation of the Earth's Moments of Inertia

Proceedings of the 60th American Power Conference Eileen M. Smith © 1998 All Rights Reserved

A New Pallet for the Scribe of Humanity

From the time of cave dwellers to the construction of massive marble skyscrapers, humanity has evolved shelter with the natural elements of the earth. Historically, architecture has served the dual purpose of shelter as well as communications from the drawings of cave dwellers on stone walls depicting ancient civilizations to stone carvings and paintings of religious stories in western architecture.

The art of communications in architecture has evolved over many centuries while the complex science of architecture in communications technology has evolved over several decades. Today, architects are building a new bridge to the future as we realize the dream of sustainable electricity through a new role for building envelopes as solar generators. The fact that BI-PV will provide sustainable clean electricity is only an immediate promise of semi-conductor building materials. Imagine that if you will!

Contemplation of the Economics of Strategy

The **Solar Development Cooperative** was founded in 1992 to assure timely domestic and global mainstream deployment of grid-connected ***building-integrated photovoltaics (BI-PV)***. In 1997, President Clinton endorsed a ***Million Solar Rooftops In USA 1997-2010 Program***.⁶

This program will be most successful if used to organize a domestic and global BI-PV industry assuring ready access to products and quality service. The price of BI-PV will be resolved through volume just as Ford's mass production made automobiles affordable to a greater public. The ***Utility Photovoltaics Group (UPVG)*** claim that when PV reduces in price to \$3 watt, a 9,000 MW market will appear.⁷ Their primary focus is ***remote-site photovoltaics*** which does not exploit the natural benefits and dual-use characteristics of this technology maximized by ***demand-site consumer electricity*** produced with ***building-integrated photovoltaics (BI-PV)***.

Figure 2 Solar Rooftop - Georgetown University Intercultural Center 300 kWp Installed 1984⁸

ECONOMICS I: Real Functions of Capital⁹

According to Henry George in his book **Progress and Poverty**, capital is not required in a healthy business for payment of wages.

Capital is used to increase labor productivity:

- (1) *Capital enables labor to become effective.*
- (2) *Capital expands nature's renewable forces:*
 - a. *Technology is used to sow corn more efficiently to further nutrition.*
 - b. *Mass producing BI-PV surface reduces cost to convert sun's light to electricity.*
- (3) *Capital allows division of labor, and thereby increases efficiency by effectively utilizing the diversity of talent, training, climate, land mass and situation to obtain the **highest and best use of resources**.*

Appropriate ethical and effective use of capital is naturally directed to improve the human condition. Capital expenditures only to create wealth commonly produce crime and poverty.

To say capital may limit the form and productivity of industry is a different thing from saying that capital does limit the evolution of industry. Only in the case of unusual situations like war, natural disaster and new community is industry limited by the want of capital. The real limitation, in many cases of modern commerce is not capital, but the want of proper use and distribution of capital due to ignorance, custom or other conditions that hinder a progressive use of capital.

"To simply give a circular saw to a Tera del Fuegan or locomotives to a Bedoin Arab or a sewing machine to a Flathead squaw would not add to the efficiency of their labor."

*The ineffective introduction of technology and products into diverse cultures was poignantly illustrated in the movie "**Have the Gods Gone Crazy!**". In one scene, a bushman is seen praying to a coke bottle dropped from a plane.*

ECONOMICS II: The Theory of Reflexivity¹⁰

In *The Alchemy of Finance -Reading the Mind of the Market*, George Soros sheds some light on how market decisions are often dictated by influential preference, not the commonly assumed price or consumer supply and demand issues expressed in classical economic theories based on equilibrium models.

*"I believe market prices are always wrong in the sense that they present a biased view of the future. But distortion works in both directions: not only do market participants operate with a bias, but their bias can also influence the course of events. This may create the impression that markets anticipate future developments accurately, but in fact, it is not present expectations that correspond to future events, but future events that are shaped by present expectations. Participants' perceptions are inherently flawed, and there is a two-way connection between flawed perceptions and the actual course of events which results in the lack of correspondence between the two. I call this two-way connection "**reflexivity**". . . .truth is, successful investing is a kind of alchemy. . . .The shape of the supply and demand curves cannot be taken as independently given, because both of them incorporate the participants' expectations about events that are shaped by their own expectations. . . .market participants adjust to market prices, but they may be adjusting to a constantly moving target. In that case, . . .equilibrium theory becomes irrelevant to the real world."*

It is my belief that, today, BI-PV is very cost-effective. Participant behavior and perceptions in decision-making have in many cases a significant though often unspoken influence on decision-based criteria of demand and supply, proper use of capital, pricing and related industry services.

DEMAND-SITE CONSUMERS

Considering the dual-use characteristics and many environmental benefits of grid-connected BI-PV, this *product-driven commodity* is extremely cost-effective, today, even at less than .001% of United States electricity consumption. Defining market services and establishing a quality industry ethic in product development as well as service will bring the confidence needed for mainstream use and deployment of BI-PV.

A Native American Wanted Solar

Last year while in Washington, DC I met an elder from an Indian tribe in Arizona. We discussed the possibility of using photovoltaics for their new community center. While she thought it was a wonderful idea and strongly believes in the technology, she was hesitant to explore it. Six years ago someone sold her a PV system for her home on the reservation. Within a month after they installed it, the system stopped working completely, and never worked, again. She finally got through to the people who sold her the PV system. They said they could not fix it and refused to return her money.

BI-PV Deployment Needed In Malaysia

A business man from Malaysia relayed to me a similar story. The system he was sold took six months to break-down. He expressed a strong interest in opening a regional BI-PV installation training and service center with the eventual plans to open a BI-PV manufacturing plant to expand the use of photovoltaics in their nation and assure a quality service ethic. He indicated sufficient funding is available for renewable energy deployment in Malaysia if he could find investors to fund the pre-development costs to write a business plan and prepare applications.

Does lack of receptivity and cooperation only occur in 3rd World Nations and reservations?

In February of this year, in addition to the organizing of BI-PV public education activities for Orange County, California where I live and market BI-PV systems, I conducted BI-PV consumer research to determine what my clients need to do to connect their BI-PV system.

First, I called the general customer service line for electricity hook-up to request information on hooking up a BI-PV system and contracting for net metering. After three days of being put on hold, being transferred around, asked numerous questions and being told to call long-distance numbers, I still have not to-date found one person at Edison who knows how a consumer hooks up a BI-PV system and gets credit for net metering. I took the time to explain these terms to nearly every person I talked to. They all sounded relieved and grateful to know about them. During the second day, someone tried to get me to call Solar II in the Mojave Desert to find out how to hook up a BI-PV system in Irvine and Corona del Mar. The service planners sent me to Earth Source. They suggested I call the CEO's office and ask for the Vice President of Energy Efficiency. I asked him where I could get a guidebook explaining requirements for the 50% Buydown being offered by the California Energy Commission (CEC) as part of \$540 million *Renewable Technology Program*¹¹ with Assembly Bill 1890 and Senate Bill 90. He indicated he was not aware of the renewables program for BI-PV consumers and as far as he knew BI-PV grid connect at SCE was only available if a program was initiated, internally.

BI-PV consumers - my clients - would have given up the first day. Restructuring information refers only to generators and merchandisers as ***Energy Service Providers***. The Solar Development Cooperative is in the process of formally establishing a third category of ***Energy Service Provider (ESP)*** referred to as ***demand-site consumers***. The law in California requires service to all consumers that connect to the grid including a ***BI-PV demand-site system***.

1-800 #s For Demand-Site Consumers

Remote-site electricity consumers have their electricity hooked up with 1-800 numbers and orders are processed in ten to twenty minutes. An important goal is to assure *demand-site consumers* are provided 1-800 service, too and that BI-PV system hook-up is as easy as hooking up regular electricity or your phone. Distribution services are regulated and must be non-prejudicial toward all types of consumers. *Demand-site consumer electricity* will in fact be the fastest growing segments of the competitive energy industry over the next fifty years.

Registration criteria for *demand-site consumer technology and service providers* need to be formally established and issued to the public by the **Public Utilities Commission (PUC)**. The lack of criteria for registration of commercial-scale power generation and merchandising has turned into a serious problem revealing fraud.¹² **Primary Energy Producers in the USA** know more than anyone in the world how very much the world needs clean sustainable fuels for *electricity and mobility*. Consumers have time and again shown their confidence in BI-PV only to be discouraged by the lack of service. During restructuring in deregulation is an ideal time to strengthen the BI-PV markets through defining and organizing related facets of the industry.

Market research finds solar energy is the energy of choice for Americans. Consumers expect ready access to aesthetic fully-integrated solar electric building materials with a reliable service industry to support their changing needs. Markets for electricity and the need for renewed sources of production will grow at least as rapidly as the BI-PV industry. The *second-hand smoke* of the *Big Three* is dangerous to the health and safety of humanity. Cigarette litigation sets precedent for anti-trust and consumer protection suits against *Primary Energy Producers*. Cooperative alliances using BI-PV may improve a company's public image.

BI-PV for Primary Energy Producers in USA

With limitless financial and technical support resulting in complete success in meeting our fifteen-year \$2 billion dollar business plan, multiplied by ten companies with comparative success, the BI-PV industry will hardly be more than a grain of sand in the economic ocean of global electricity generation by 2010. However, the *return on investment* will be far-reaching as we establish a down-payment only experience can provide¹³ to develop the needed technology expertise and strong foundation for mainstream deployment of BI-PV throughout the next century and far into the new millennium. To secure the future of this nation and a global posterity assuring the promise of economic, clean, autonomous, dual-use, renewable and sustainable electricity technology, we must take the initiative to utilize BI-PV, today.

Alliances and projects realized with this program will provide important feedback to develop BI-PV consumer protection policies and grid-connect services for *demand-site consumers*. Benefits **BI-PV PEP USA** may evolve:

- (1) Courage to become technologically literate.
- (2) Know and appreciate sustainable technology.
- (3) Actively be environmentally protective.
- (4) Demonstrate economic responsible behavior.
- (5) Alleviate fear and set a cooperative example.
- (6) Encourage consumer investments in BI-PV.
- (7) Accumulate knowledge to solve problems.
- (8) Establish wealth through good investments.
- (9) Actually evolve a new peace in the world.

Americans ---and especially registered *Energy Service Providers* cannot ethically claim we are assisting nations around the world to establish democracy and free enterprise if we do not practice them ourselves. Beyond environmental and safety issues, the only entity ethically endowed with the authority to determine what energy consumers can *afford* to purchase is the consumer. Distribution must serve every choice.

MOMENTS OF INERTIA FOR BI-PV

California Energy Commission \$540 Million Renewables Program 50% Buydown Jan '98

**Million Solar Roofs In USA 1997-2010¹⁴
Solar Energy Industries Association Apr '97
Endorsed by President Clinton June 1997**

1000 PV Rooftops German States 1993-95

**SOLAR DEVELOPMENT COOPERATIVE
Advent of Headrick Solar-Voltaic Dome™
100 By 2000 In USA - EC - Japan Oct '95¹⁵
1000 By 2010 Globally Program April '94**

SOLAR DEVELOPMENT COOPERATIVE¹⁶

**BI-PV Design Studios® w/Showroom '96
Electri-City® Solar Electric Bldg. Materials
Electri-City® Educational Toys '96**

Sustainable Village® Developments '96

- Solar Electric Car Rental Facility
- Solar Electric Building Materials Factory

**PV for your TV® '95
Healthfood For Our Electronic Pets**

ECO TECHE® Featuring Science City & the Solar Solution™ KC's Union Station 1992¹⁷

| TOP FIVE NICHE MARKETS (>\$4/Wp) | | | | | | | | |
|---|------|----------|----------|-----------|-------------------|---------------|------------|-----------|
| State-By-State Study Showing Best Markets & Incentives For Grid-Connected Photovoltaic Systems In The United States | | | | | | | | |
| STATE | Rank | Res Rate | Com Rate | NET METER | Res Tax Incentive | Com Incentive | Cap Factor | Com ELCC* |
| Hawaii | 1 | 15.2V | 12.0V | Pend | 2a | 2b | 22.5% | 50% |
| California | 2 | 13.1V | 10.3V | Yes | 0 | 0 | 20.9% | 64% |
| Arizona | 3 | 9.6V | 8.6V | Yes | 1 | 0 | 22.8% | 65% |
| New York | 4 | 14.5V | 11.2V | Pend | 0 | 0 | 17.1% | 60% |
| Massachusetts | 5 | 12.6V | 9.3V | Yes | 4a | 4b | 17.3% | 49% |

*ELCC = Effective Load-Carrying Capacity

Figure 3. Source Niche Markets for Grid-Connected Photovoltaics May 1996¹⁸

¹ Wu Naitao, *Energy Sector Seeks More Foreign Cooperation*, Beijing Review; Vol.38 No.17 Apr 24, '95

² *Sustainable Energy Strategy Clean & Secure Energy - Competitive Economy*, 1995 US Energy Pol. Plan;p13

³ Ibid 2, pg 43

⁴ *Solar Energy: Energy Coming of Age At Last?* State Legislators' Newsletter Feb '96

⁵ NASA Image AS11-44-6550:<http://ceps.nasm.edu>

⁶ *A Look Inside Million Solar Roofs Prog, Working W/ Industry, Perfect Climate for PV*, NREL PV, DOE '97 <http://www.eren.doe.gov/millionroofs/solarbuild.html>

⁷ Ibid 4

⁸ Berger, John; "Pretty Poly" *Charging Ahead*, Jan '97

⁹ George, Henry; *Progress and Poverty* 1879-1979, p80

¹⁰ Soros, George; *The Alchemy of Financing*, 1986

¹¹ *Renewable Tech Prog* Jan'98 Cal Energy Commission

¹² *Fraud Threatens Energy Deregulation In California Orange County Register*, Front Page, Feb 13, '97

¹³ "1000 Roofs" *Programme*, Fraunhofer Institute, 1995

¹⁴ Ibid 6

¹⁵ www.geocities.com/Eureka/1905/100BY2000.html

¹⁶ SDC Website:www.geocities.com/Eureka/1905

¹⁷ Susan Ferguson, *An Alternative View -A Women's (Architect) Vision for Union Station Includes Development of Solar Power Station*, The Wednesday Magazine, Kansas City, Missouri USA, Sept. 6, '95

¹⁸ *Customer-sited Photovoltaics; Focusing on Markets That Really Shine; A Study Highlighting The Best Markets In the United States For Grid-Connected Photovoltaic Systems*, Guiding U.S. Commercialization Christy Herig, *National Renewable Energy Laboratory, United States Department of Energy*; March 1997