Green Investments to Secure Our Nation's Future:

Converting Liabilities into Assets

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Overview…

1. **Requirements:** *Secure AND Sustainable*
2. **Conventional Approach:** *"Separate Solutions"*
3. **Proposed Approach:** *"Integrated Solutions"*
4. **Benefits:** *Secure & Sustainable, plus Affordable*
5. **Example Opportunity**
6. **Conclusions & Next Steps**

Requirements:

1. Security: Health & Safety of People & Facilities

- Many upgrades needed in Post-911 World…
  - Proximity Barriers
  - Ballistic Shielding
  - Biohazard Defense
  - Surveillance & Identification

2. Sustainability: Health of Environment

- Ecological Challenges (esp. GHG reduction)
- "Resource Sovereignty" [tm]
  - Energy Independence (Water & Food, too…)

Requirements (continued):

3. Asset Functionality:

- Post-upgrade, Must Still Fully Support Intended Mission
- Opportunity to enhance Functionality / Expand Mission

4. Human Factors / Aesthetics

- Safety and Comfort of Personnel… "We Care"
- Catalyze Performance, Boost Morale & Retention
- Convert Aesthetic Liabilities into Exemplary Assets

5. Affordability

- Opportunity to Convert Financial Liabilities into Assets

Conventional Approach

- **Separate Solutions for each Requirement**
  - Security needs well known for millennia
  - Sustainability needs only known much more recently
  - Thus… separate development timelines

- **Understandable… but More Effort & Cost:**
  - 2 independent sets of requirements (compatible?)
  - 2 procurement cycles (bid/contract/delivery/audit)
  - 2 asset life cycles to manage
  - 2 budget items
  - 2 groups of personnel *(also a Security Symposium!)*

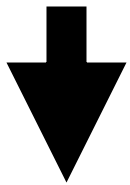
Proposed Approach

- **Integrated Solutions for all Requirements**
  - Combine latest Security and Sustainability needs into a single multi-function system, where beneficial

- **Evolution of Design → Less Effort & Cost:**
  - Only 1 set of requirements (compatible + synergistic)
  - Only 1 procurement cycle (bid/contract/delivery/audit)
  - Only 1 asset life cycle to manage
  - Only 1 budget (generally less than sum of parts)
  - Only 1 group of cognizant personnel

Opportunity via Paradigm Shift

- **Old Paradigm: *Separate Solutions***
  - Accidental Synergies (if any)
  - Conflicting Functional Outcome possible (if not likely)
  - Multiple separate competing budget items



- **New Paradigm: *Integrated Solutions***
  - Intentional Synergies
  - Complementary Functional Objectives
  - Single Budget with Lower Overall Cost**
  - **Opportunity for Second Item to “Pay for” First Item!

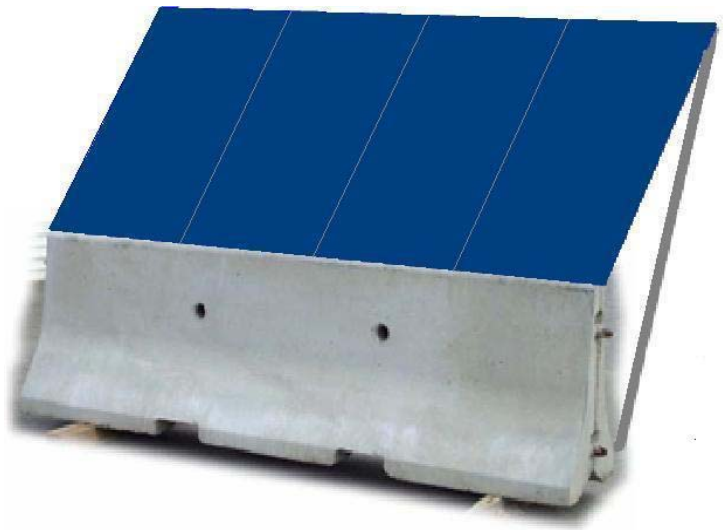
Example #1: Solar Barrier

<u>Conventional</u>:
(Separate Systems)

Massive Security Barrier

Ground-Mounted Solar Array
(PV and/or Thermal)

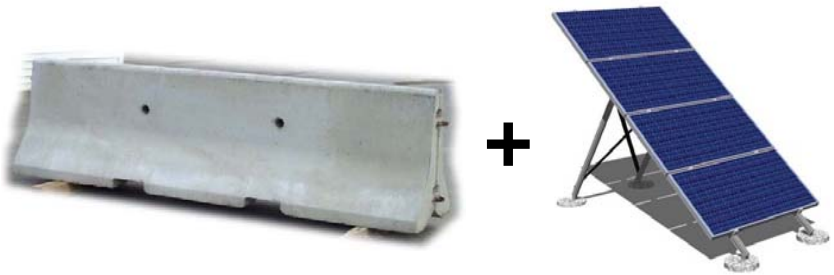
<u>Proposed</u>:
(Integrated Systems)



Massive Security Barrier with Integrally-Mounted Solar Array
(PV and/or Thermal)

Example #1: Solar Barrier

Conventional:
(Separate Systems)



- Redundant Load-Bearing Structures (solar mount high $)
- Slow Installation (solar mount)
- Fixed Placement of Solar
- More Land Used
- **More Costly, Less Versatile!**

Proposed:
(Integrated Systems)

- Common Load-Bearing Structure (use low-cost barrier)
- Very Rapid Installation
- Flexible/Movable Solar System
- Less Land Used
- Extra Functions (e.g., Fence)
- **Less Costly, More Versatile!**

Typical Ground-Mounted Solar

- **Ground-Mounted PV Solar Array Consumes Large Land Area**
- **Substantial Installation Effort (Concrete, Aluminum Framing, etc.)**

Basic Costs of Solar (PV)

Cost of PV Panel per Peak Watt	($ per watt)	**3.75**
Cost of Inverter and Electrics	($ per watt)	**2.00**
Cost of Ground-Mounting System	($ per watt)	**1.50**
Cost of Installation Labor	($ per watt)	**2.25**
Total Installed Cost	($ per watt)	**9.00**
Utility Rebates & Incentives	($ per watt)	**4.50**
System Maintenance per 20-year life	($ per watt)	**1.80**

Analysis of Solar (PV) Barrier

Area of Solar Panel per meter of Barrier	(m^2)	1.50
Nominal Peak Solar Insolation	(Kilowatts per m^2)	1.000
Net System PV Efficiency	(%)	15.0
Peak power per Linear Meter of Barrier	(Kilowatts)	**0.225**
Daily Insolation: D.C. annual average	(KWH/m^2/day)	4.80
Net Energy per meter of Barrier per day	(KWH)	1.08
Net Energy per meter of Barrier per year	(KWH)	394.2
Price of Electricity	($ per KWH)	0.15
Energy Savings per year per meter of Barrier	($)	59.13

Economics of Solar (PV) Barrier

Electricity Price = $0.15

Cost Elements:	**Massive Barrier**	**Ground Solar Array**	**Separate Barrier & Array**	**Integrated Barrier & Array**
Load-Bearing Structure per m	200	225	425	275
Solar Collector Panels	0	844	844	844
Inverters, Electrical elements	0	450	450	450
Installation	100	506	606	353
Maintenance	0	405	405	405
Total Acquisition Cost	300	2430	2730	2327
Solar Rebates	0	1013	1013	1013
Net Acquisition Cost	300	1418	1718	1314
Maintenance	0	0	0	0
Energy Savings	**0**	**1183**	**1183**	**1183**
Net System Cash Outflow	**300**	**235**	**535**	**132**

Economics of Solar (PV) Barrier

Electricity Price = $0.20

Cost Elements:	**Massive Barrier**	**Ground Solar Array**	**Separate Barrier & Array**	**Integrated Barrier & Array**
Load-Bearing Structure per m	200	225	425	275
Solar Collector Panels	0	844	844	844
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Installation	100	506	606	353
Maintenance	0	405	405	405
Total Acquisition Cost	300	2430	2730	2327
Solar Rebates	0	1013	1013	1013
Net Acquisition Cost	300	1418	1718	1314
Maintenance	0	0	0	0
Energy Savings	**0**	**1585**	**1585**	**1585**
Net System Cash Outflow	**300**	**-167**	**133**	**-270**

Conclusions & Next Steps

- **Conclusions**
  1. Integrating Security & Sustainability Saves Money
  2. Combined Systems enable quicker deployment
  3. Economics Sensitive to Solar Insolation, Energy Prices, Equipment Costs, Utility Rebates.
  4. Cost Effectiveness Improving as Equipment Costs decrease and Energy Prices increase

- **Next Steps:**
  1. Need to evaluate systems at other Geo-locations
  2. Demonstration Projects required to verify costs.
  3. “Solar Barrier” is Just one of Many Opportunities…

Thank you!

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