

Commercial Outlook for Solar Power Generation  
International Conference on Alternative Energy 2010  
March 27, 2010 – Karachi Expo Center

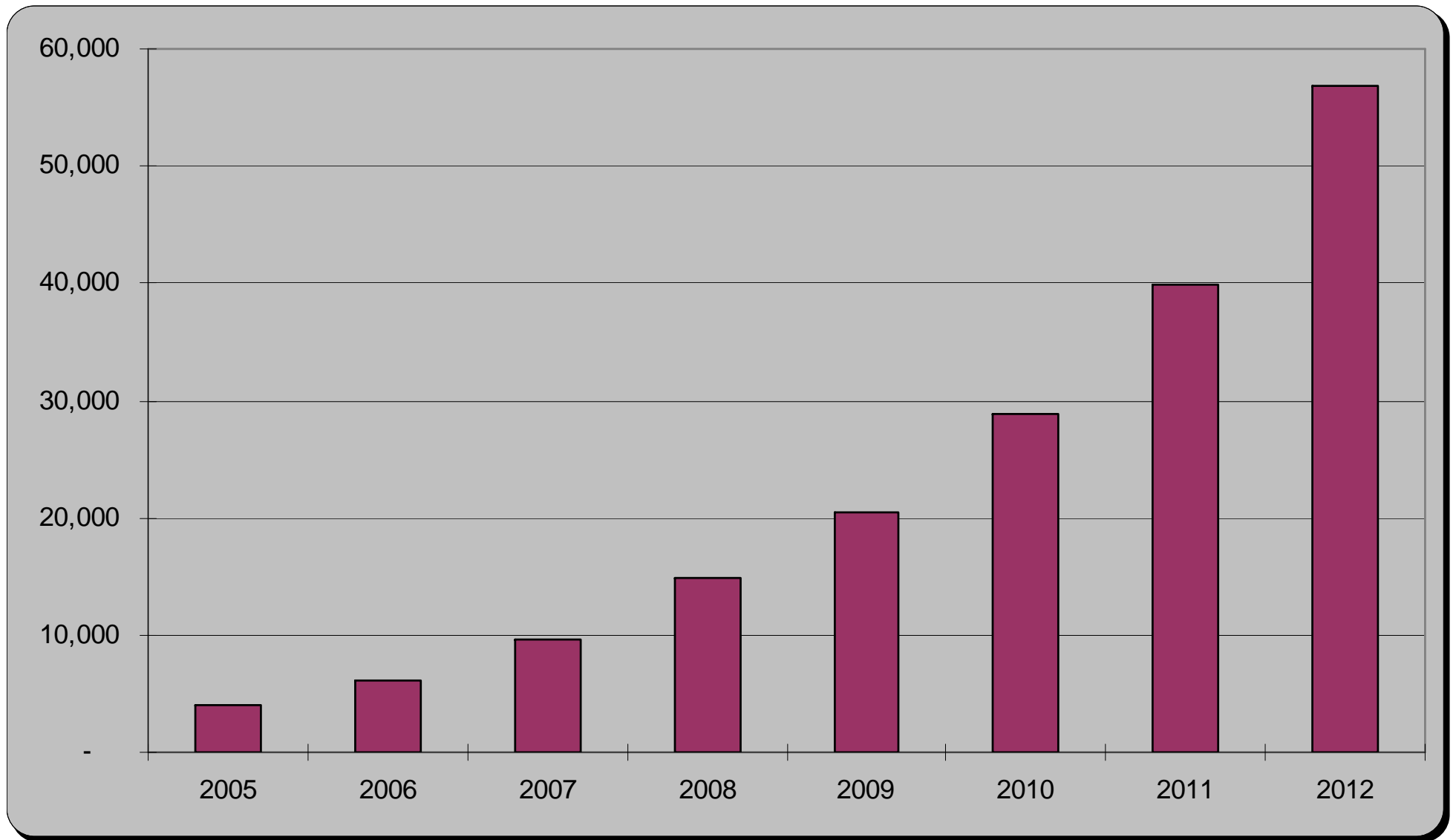
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Energy Potential Inc.

# Topics

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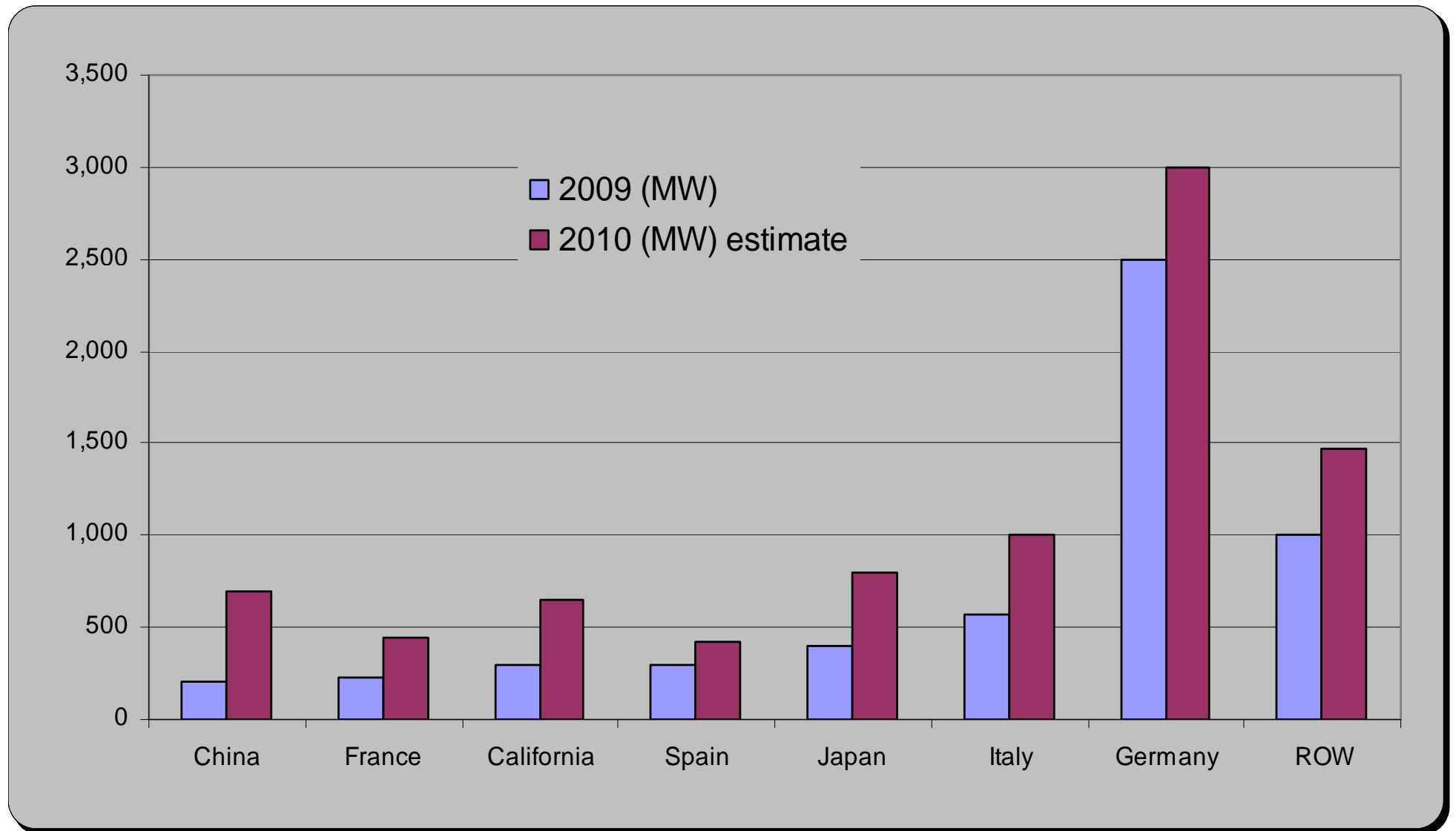
1. Market Scenario – Window of Opportunity
2. Worldwide Incentives
3. Large Open Field PV Power Plants
4. Energy Yield of a 1MW PV System on Karachi Expo Center Roof
5. Energy Yield of a 3KW Residential Roof System in Karachi
6. Summary and Recommendations

# Worldwide PV Installations (MW) - Cumulative



2010-2012 are projections

# Country/State PV Installations – Year 2009



# Incentives Do Wonders!

City	Latitude (degrees)	Radiation (KWh/m2/year)	Country / State	Cumulative PV Installations (MW)	Incentives
Munich	48.13N	1145	Germany	7,500	FIT Euro 0.32-0.43/KWh
Madrid	40.45N	1663	Spain	3,500	FIT
Tokyo	35.34N	1275	Japan	2,500	Rebate
Los Angeles	33.93N	1818	California	1,500	Rebate \$2.5/W or \$0.39/KWh
Rome	42.11N	1549	Italy	1,000	FIT
Karachi	25.03N	1835	Pakistan	-	-
Lahore	31.41N	1720	Pakistan	-	-

# Incentives

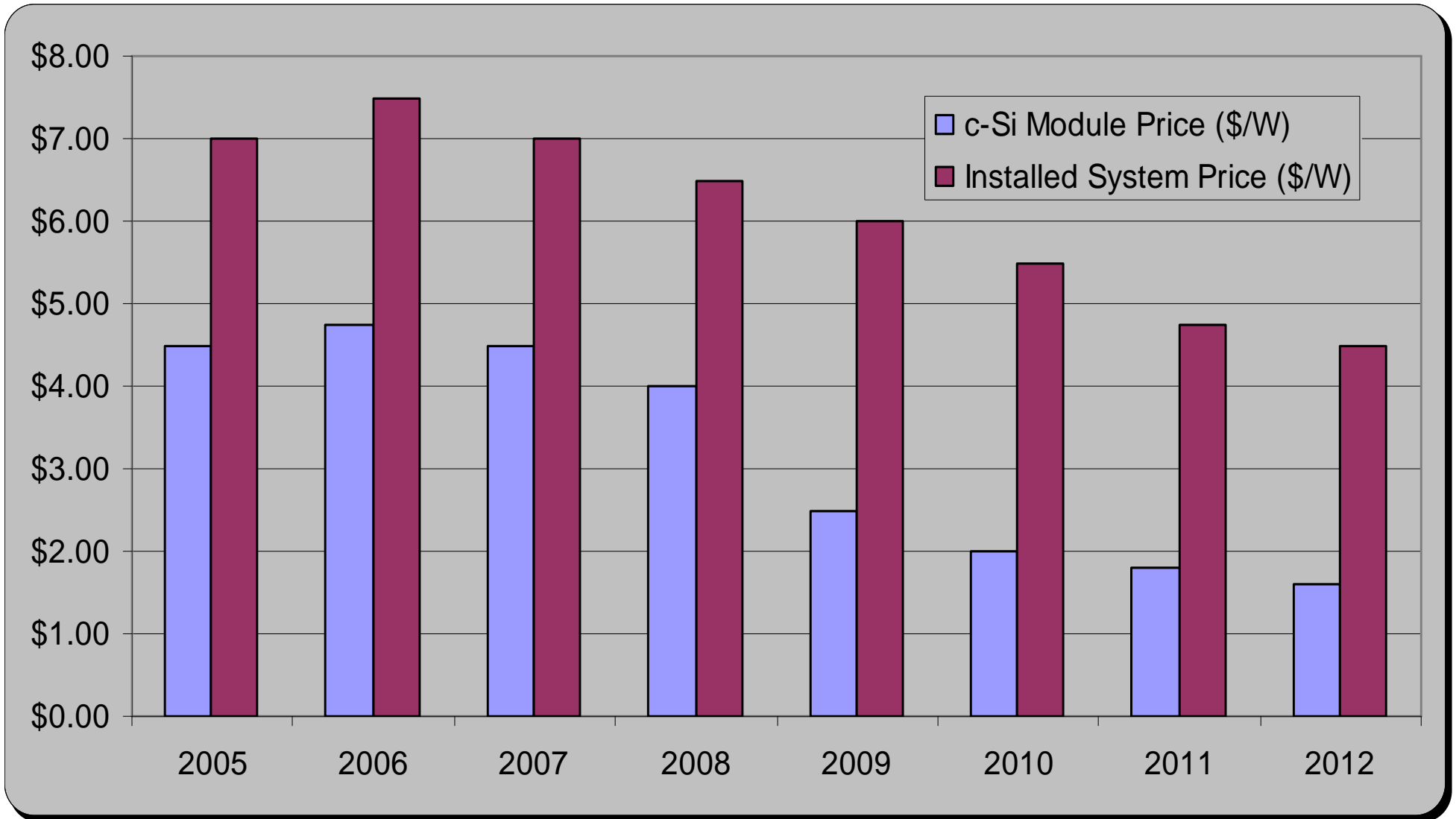
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— Feed-in Tariff (FIT) Example – Germany:

System Type	System Size	2009 FIT/KWh
Residential Roofs	<30KW	Euro 0.430
Commercial Roofs	<100KW	Euro 0.409
Commercial Roofs	<1MW	Euro 0.396
Commercial Roofs	>1MW	Euro 0.330
Ground Mounted	-	Euro 0.319

# Module and System Pricing Trend

2008-2009: Financial Crisis, FIT Changes, Enormous Silicon Supply



2010-2012 are projections

# Demand and Supply Scenario

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Year	Installations (MW)	Growth	Module Production (MW)	Market Situation
2005	1,500	-	-	-
2006	2,200	47%	-	Constrained
2007	3,500	59%	-	Constrained
2008	5,200	49%	6,500	Oversupply
2009	5,500	6%	8,500	Oversupply
2010 (est.)	8,500	55%	14,500	Oversupply
2011 (est.)	11,000	29%	17,000	Oversupply
2012 (est.)	17,000	55%	19,000	Balance
2013 (est.)	28,000	65%	21,000	Constrained

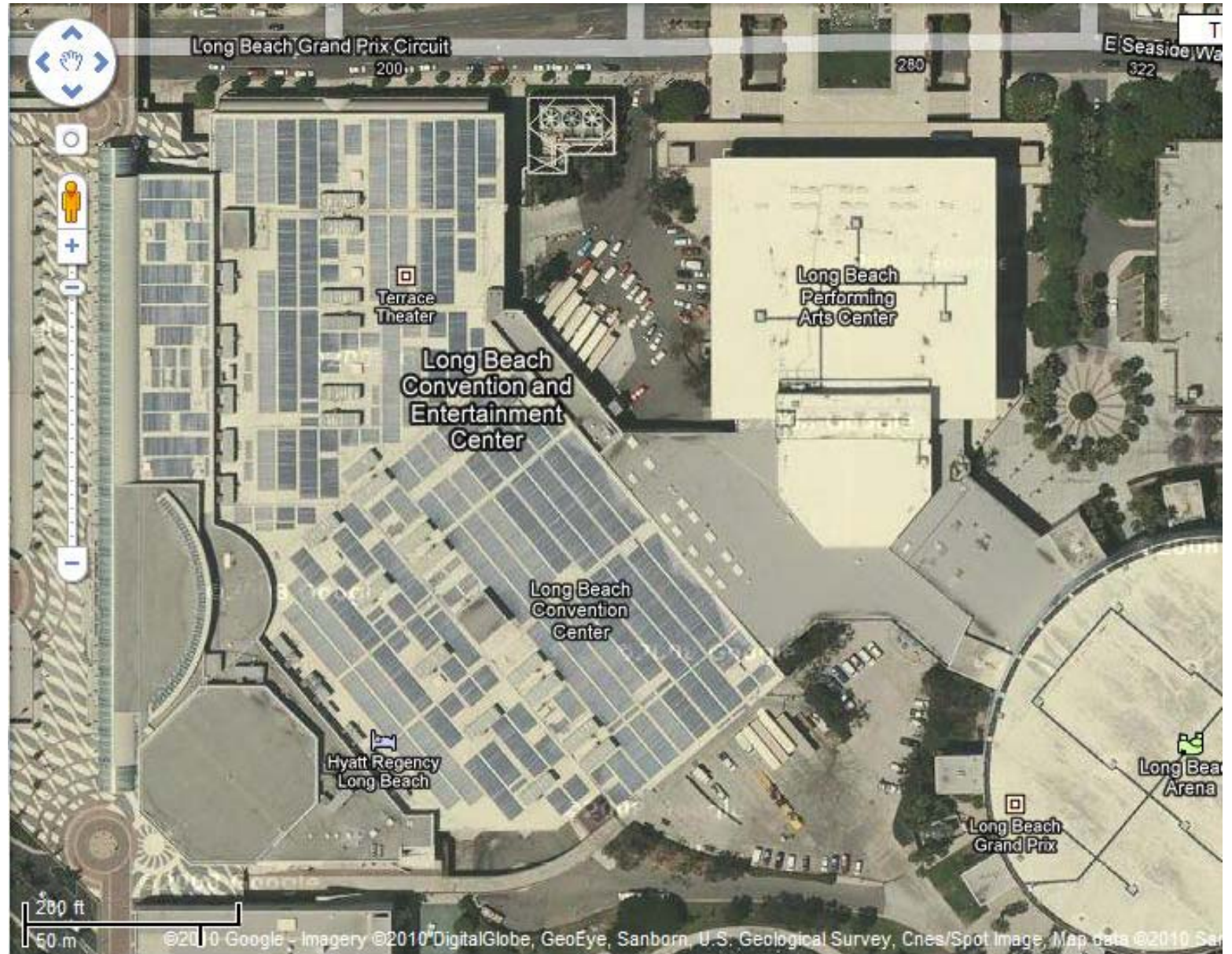
# Open Field Systems - 40MW PV Power Plant (~\$200M)

- 40M KWh/year
- First Solar Panels
- 400,000m<sup>2</sup> (40 Hectare)
- 2008
- Saxony, Germany
- Former military air field (courtesy Juwi)



# Commercial Roof Top Systems (~\$5.5M)

- 750KW
- 5819 panels
- 2006
- >1M kWh/year
- Convention Center
- Long Beach, California



- Area shown:  
120,000 m<sup>2</sup>

# Karachi Expo Center

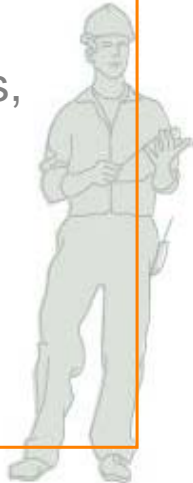
- Similar Solar Resource
- Solar Possibilities?



- Area shown:  
120,000 m<sup>2</sup>

# 1MW System (~\$5.5M)

- 220W Solar Panels:
  - 29V, 7.6A
  - Up to 14% efficient
  - 1.6x1.0m, 18Kg
  - 7280m<sup>2</sup>
- 1MW Inverter:
  - DC Input: 420-815V, 2500A max
  - AC Output: 220V, 50Hz, 3 phase
  - Up to 97.5% efficient
  - <3% THD
  - 2.3x3.5x1.8m
  - 5400Kg
- Panel mounting, combiner boxes, circuit breakers, cables etc.



x4550



x1



# 1MW System – Modeling Example

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## Set Up:

- Location: Karachi
- Latitude: 25N
- Tilt: 22°
- 5,267x 190W panels
- 7727 m<sup>2</sup>
- 1MW Grid-Tied Inverter
- Batteries: None

## Input:

- Radiation on Panels:  
1,967KWh/m<sup>2</sup>

## Yield:

- **1,482,000 KWh/Year**
- 121,808 KWh/Month

# 3KW Residential Roof Top System (~\$18K)

## Set Up:

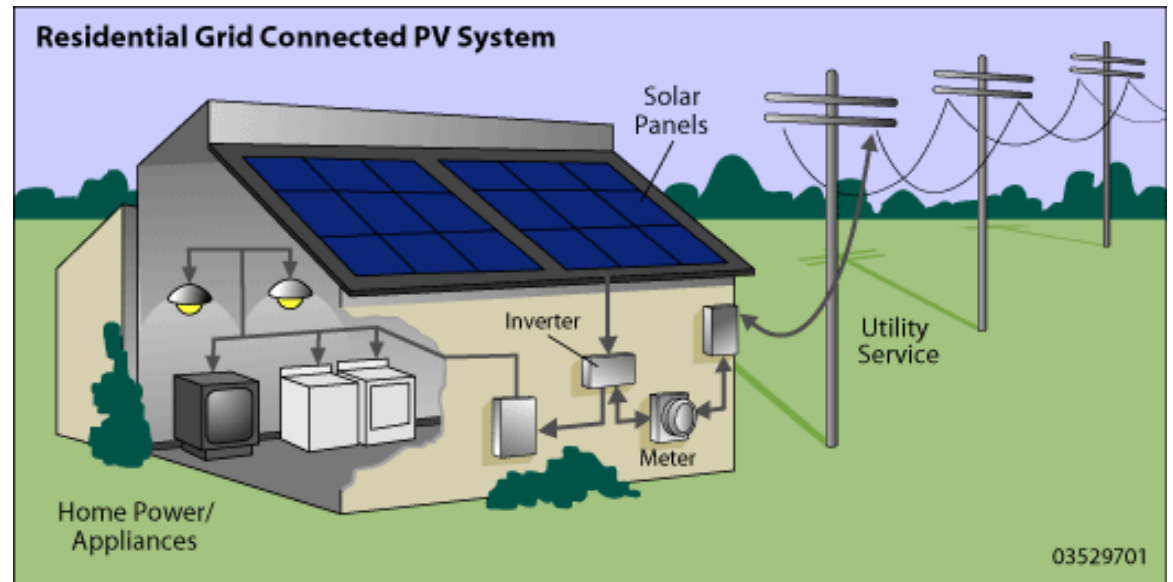
- Location: Karachi
- Latitude: 25N
- Tilt: 22°
- 3KW
- 13x 220W panels, 22m<sup>2</sup>
- Inverter with smart controls for unreliable grid, batteries, and optional conventional generator
- Sealed Batteries

## Input:

- Radiation on Panels: 1,967KWh/m<sup>2</sup>

## Yield:

- 4,107 KWh/Year
- 337 KWh/Month



Batteries not shown

# Summary and Recommendations

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- Great window of opportunity to start PV
  - Low prices
  - Can't perfectly time the market
- Be prepared for uncertain market conditions
  - Supply / Demand changes
  - FIT changes
- Incentives:
  - Remove disincentives
  - Grid Connectivity Standard for Small and Medium Scale Systems
  - Enable Net metering
- Good practices
  - Policy – have one and disclose it fully on your web site (Clear, Concise, and Consistent with start and end dates)
- China is the factory of the world. Use it!
- Have system design, site selection, project feasibility ready. Install it when you find best module pricing
- Large commercial roof tops present a great opportunity in the cities
- When doing ROI analysis, factor in subsidies on conventional power production

# Data Sources / Credits

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- iSuppli Reports and Forecasts
- Navigant Consulting Reports
- Photon International Publications
- SolarBuzz Information
- International Energy Agency – PV Power Systems Data

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Thank You!