



NREL National Renewable Energy Laboratory
Innovation for Our Energy Future

Financing Non-Residential Photovoltaic (PV) Systems



**LSU Center for Energy Studies
Alternative Energy 2009**

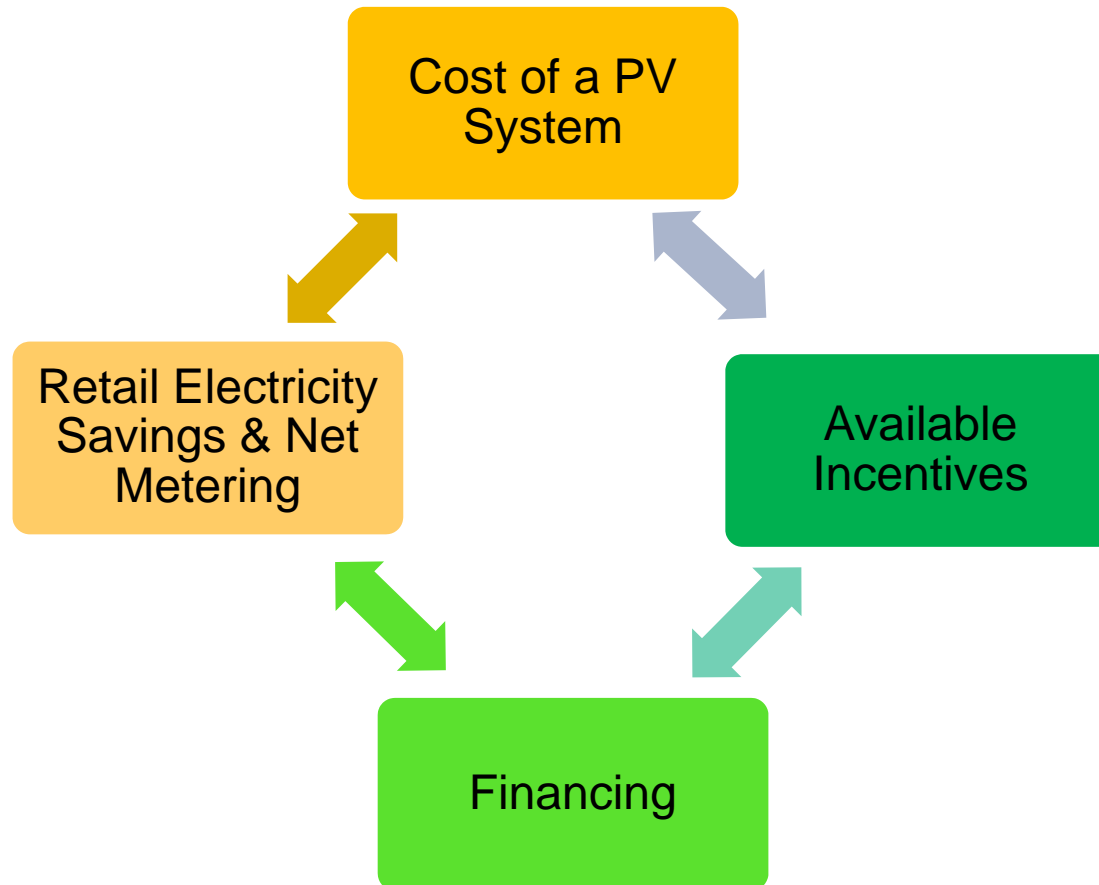
Jason Coughlin

**Baton Rouge, LA
April 22, 2009**

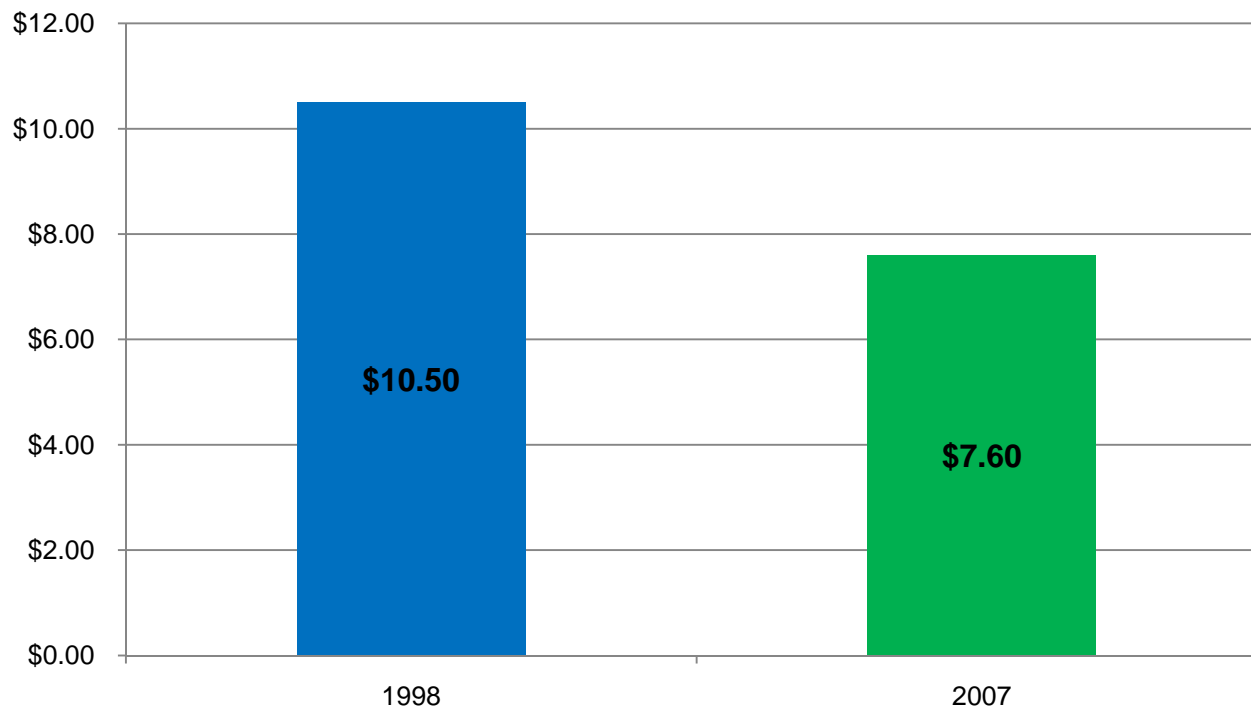
NREL Overview

- **Located in Golden, Colorado**
- **Began in 1977 as the Solar Energy Research Institute (SERI)**
- **Designated a National Lab in 1991 and changed name to NREL**
- **Federally-funded – managed by the Alliance for Sustainable Energy, LLC (Battelle and Midwest Research Institute)**
- **Areas of expertise**
 - **Renewable electricity**
 - **Renewable fuels**
 - **Integrated energy system engineering and testing**
 - **Strategic energy analysis**
 - **Technology Transfer**
- **> 1,200 employees**

The Basic Elements of PV Finance



The Cost of a PV System (per Watt before incentives)

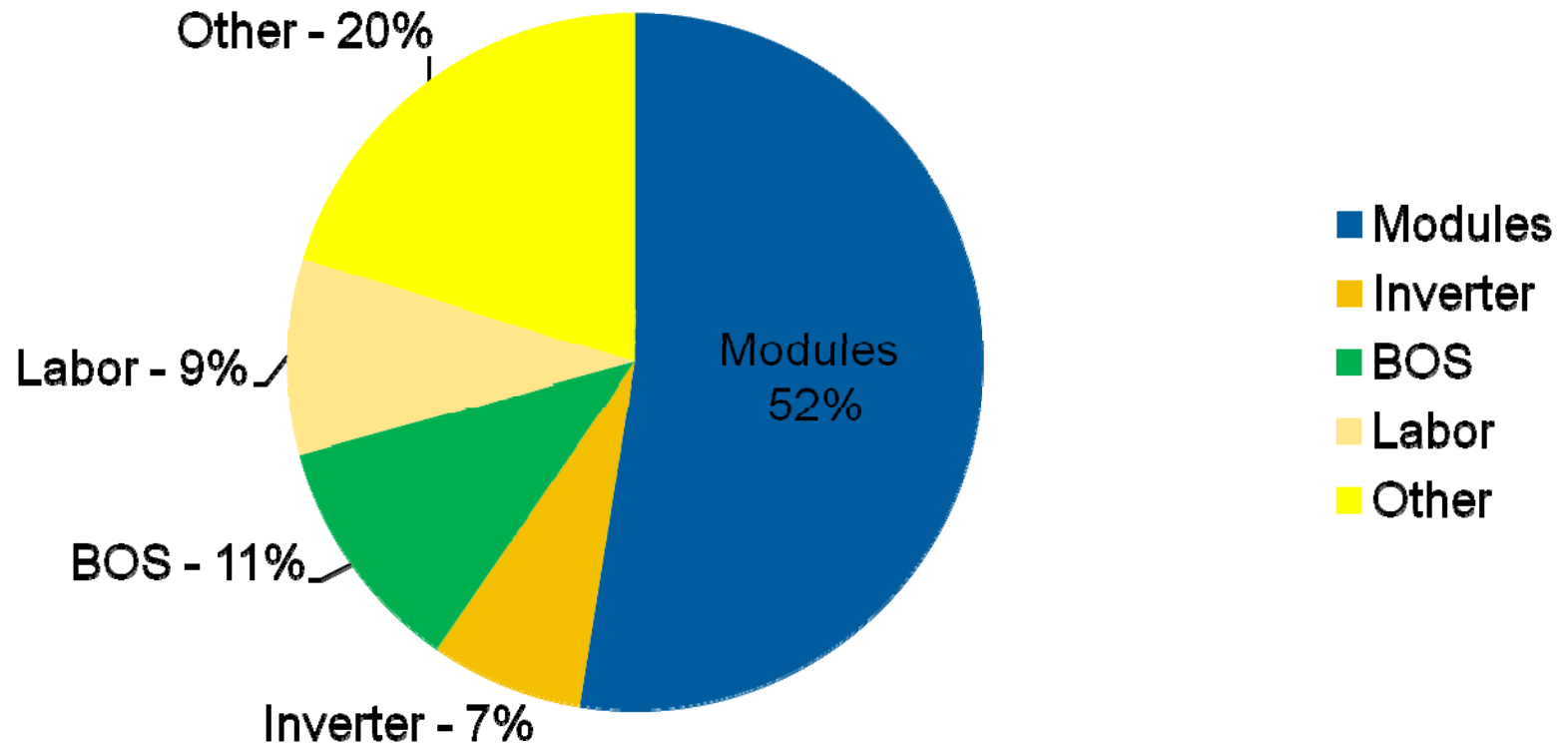


Costs have declined but still expensive

50 kW commercial system = \$380,000

Source: Tracking the Sun: The installed costs of photovoltaics in the US from 1997-2008
Lawrence Berkeley National Laboratory. February 2009.
<http://eetd.lbl.gov/ea/emp/reports/lbnl-1516e-ppt.pdf>

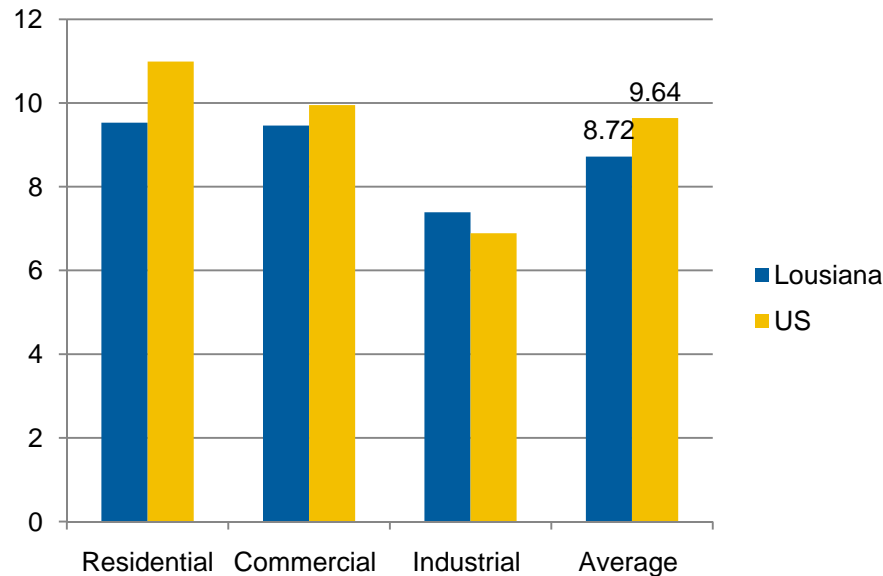
The Cost of a PV System



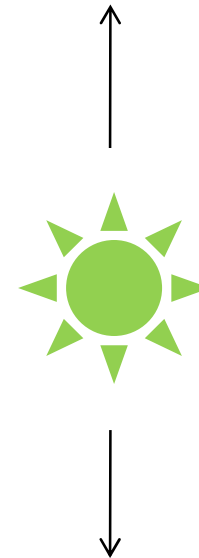
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The Cost of a PV System (cents per kWh)

Traditional electricity prices



Cost of PV (kWh)
Today
18 – 30 cents per kWh



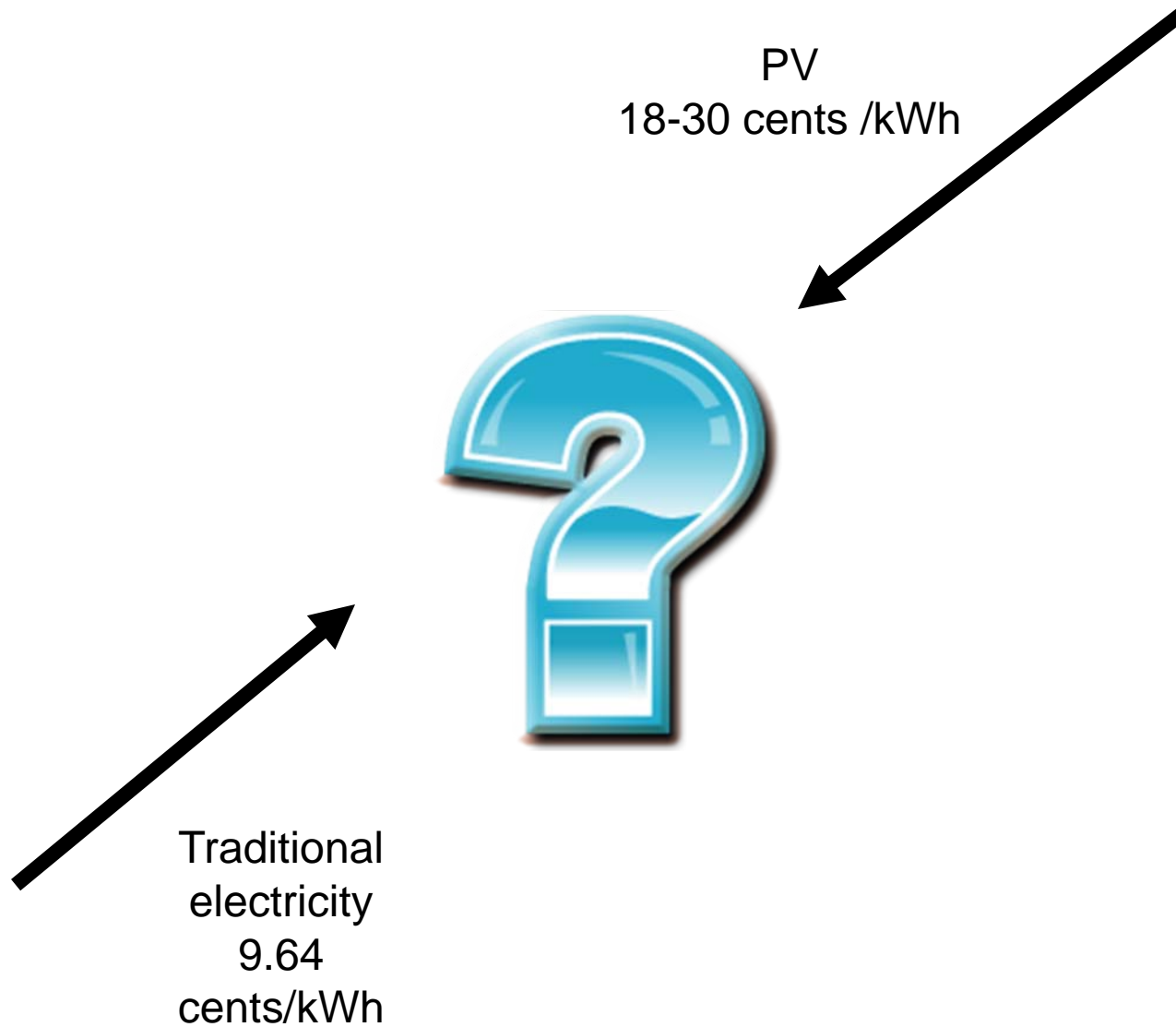
Future
11-18¢/kWh by 2010
5-10 ¢/kWh by 2015
“grid parity”

Source: U.S. Department of Energy, EIA.

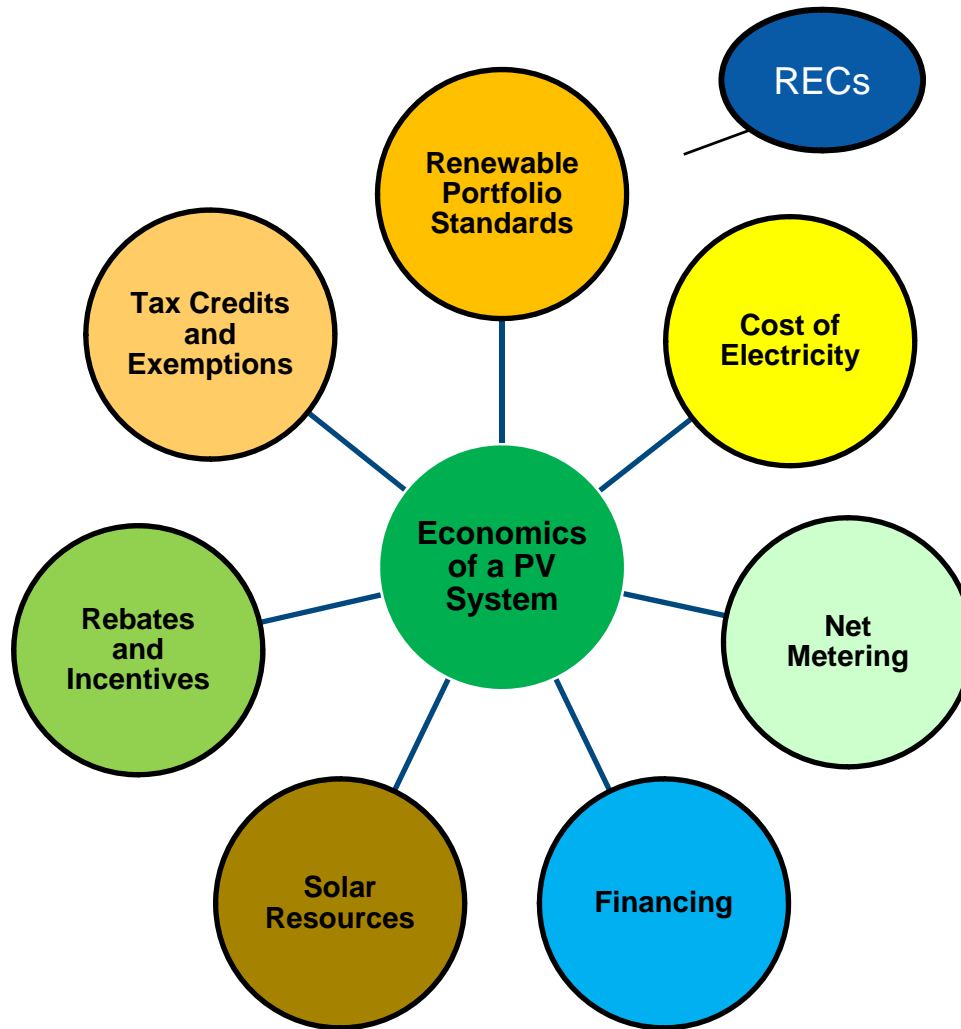
Table 5.6.A. Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, by State, December 2008 and 2007

http://tonto.eia.doe.gov/state/state_energy_profiles.cfm?sid=LA

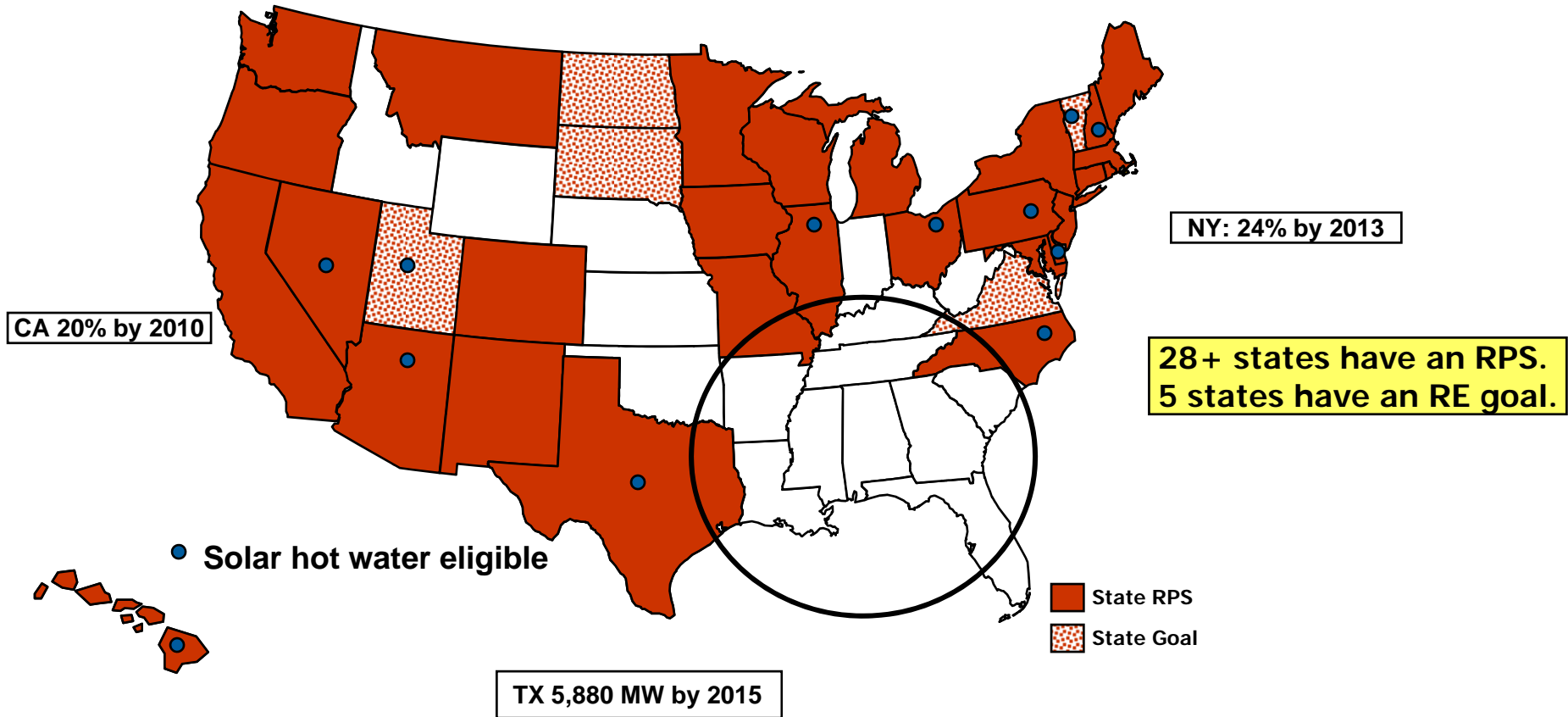
Grid Parity



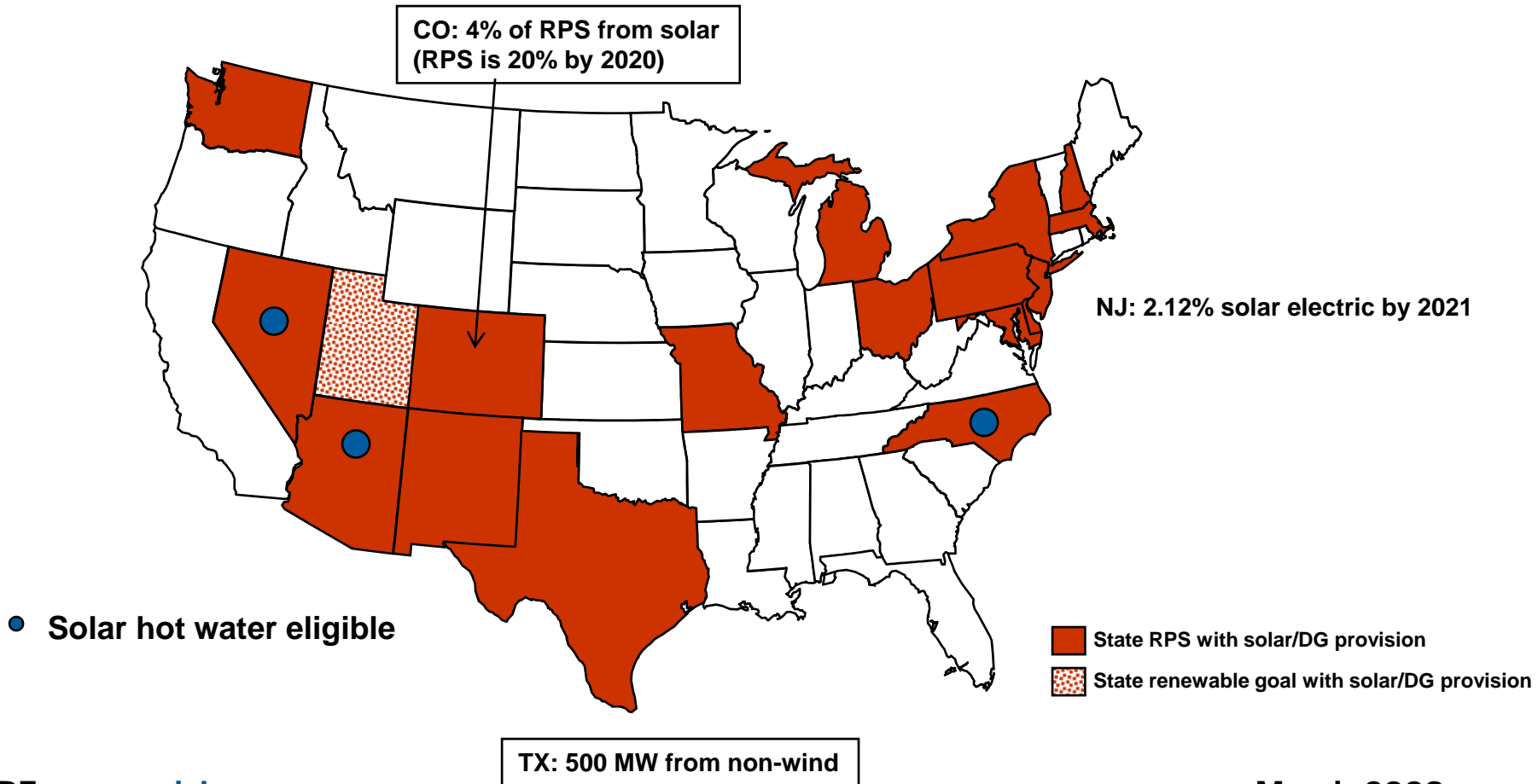
Elements of a PV Project



Renewable Portfolio Standards

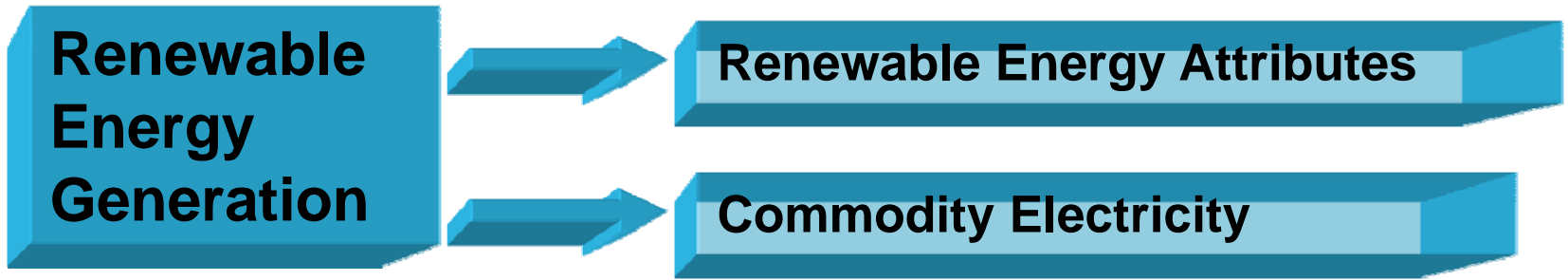


Solar and other Distributed Generation provisions



Renewable Energy Certificates

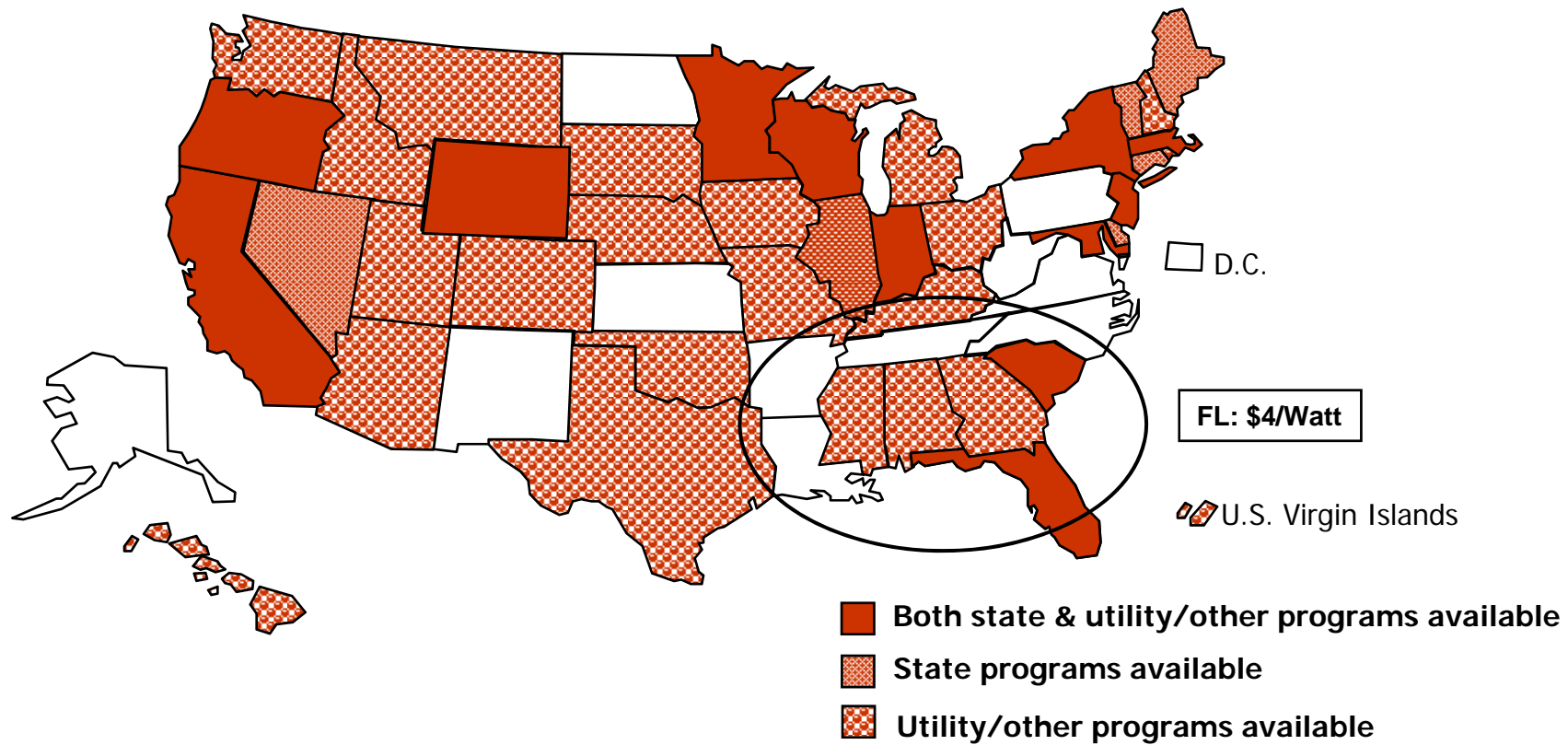
What is a REC?



- 1 REC = 1 MWh of renewable electricity
- Commonly used for RPS compliance
- Solar RECs are critical to getting projects financed in certain markets
 - \$115/MWh in Colorado (10-110 kW systems)
 - \$12,500/year for 75 kW system (estimate)
 - \$250-300/MWh in New Jersey
 - Value often derived from penalty payments (Alternative Compliance Payment)

State and Utility Incentives

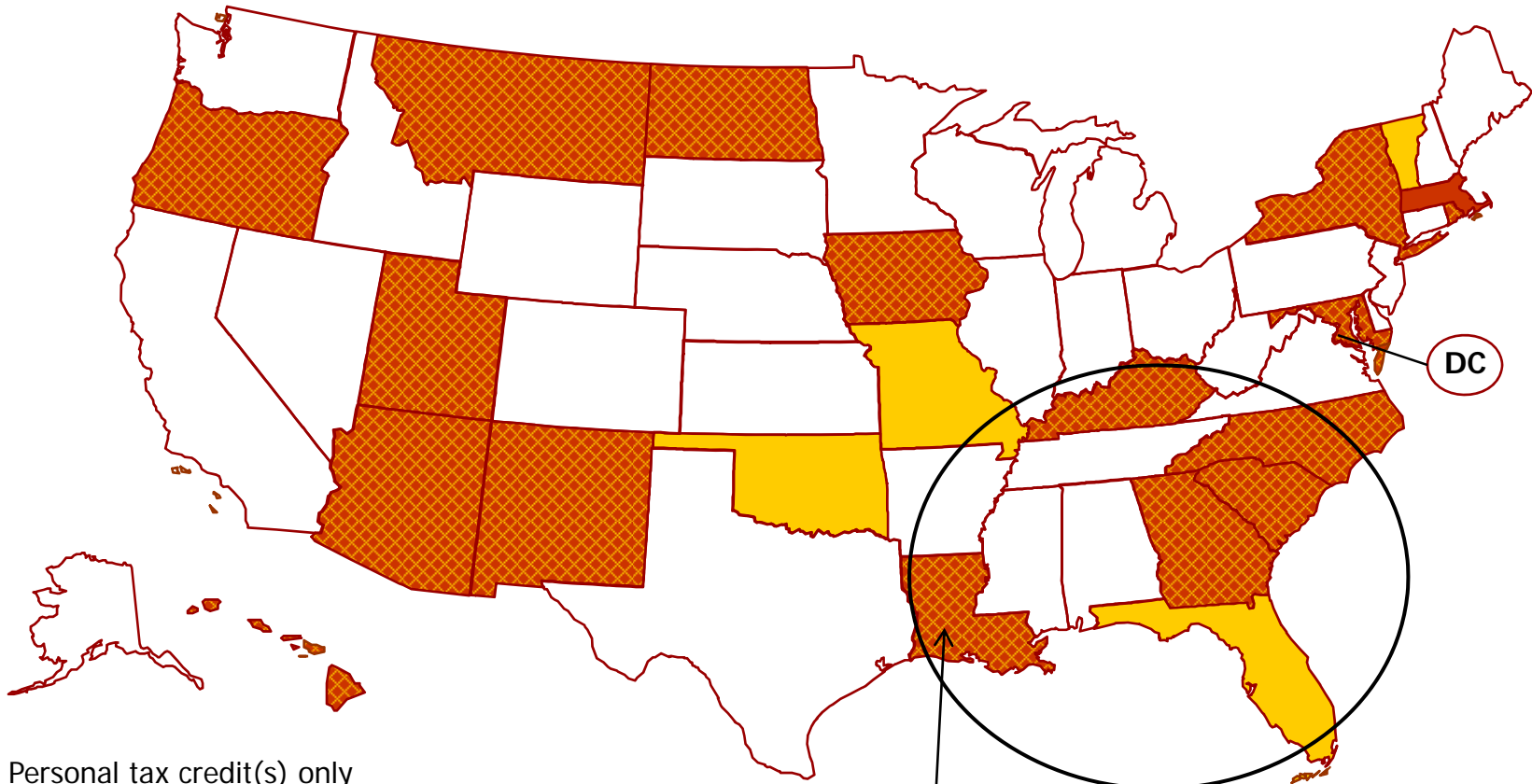
Rebates
and
Incentives






DSIRE: www.dsireusa.org

December 2008

State Tax Credits



-  Personal tax credit(s) only
-  Corporate tax credit(s) only
-  Personal + corporate tax credit(s)

Louisiana State Tax Credit for PV (generous but limited)

Federal Tax Incentives

Federal Tax incentives

- 30% Investment Tax Credit (ITC)
 - Final cost of system = \$20,000
 - Federal tax credit = \$6,000

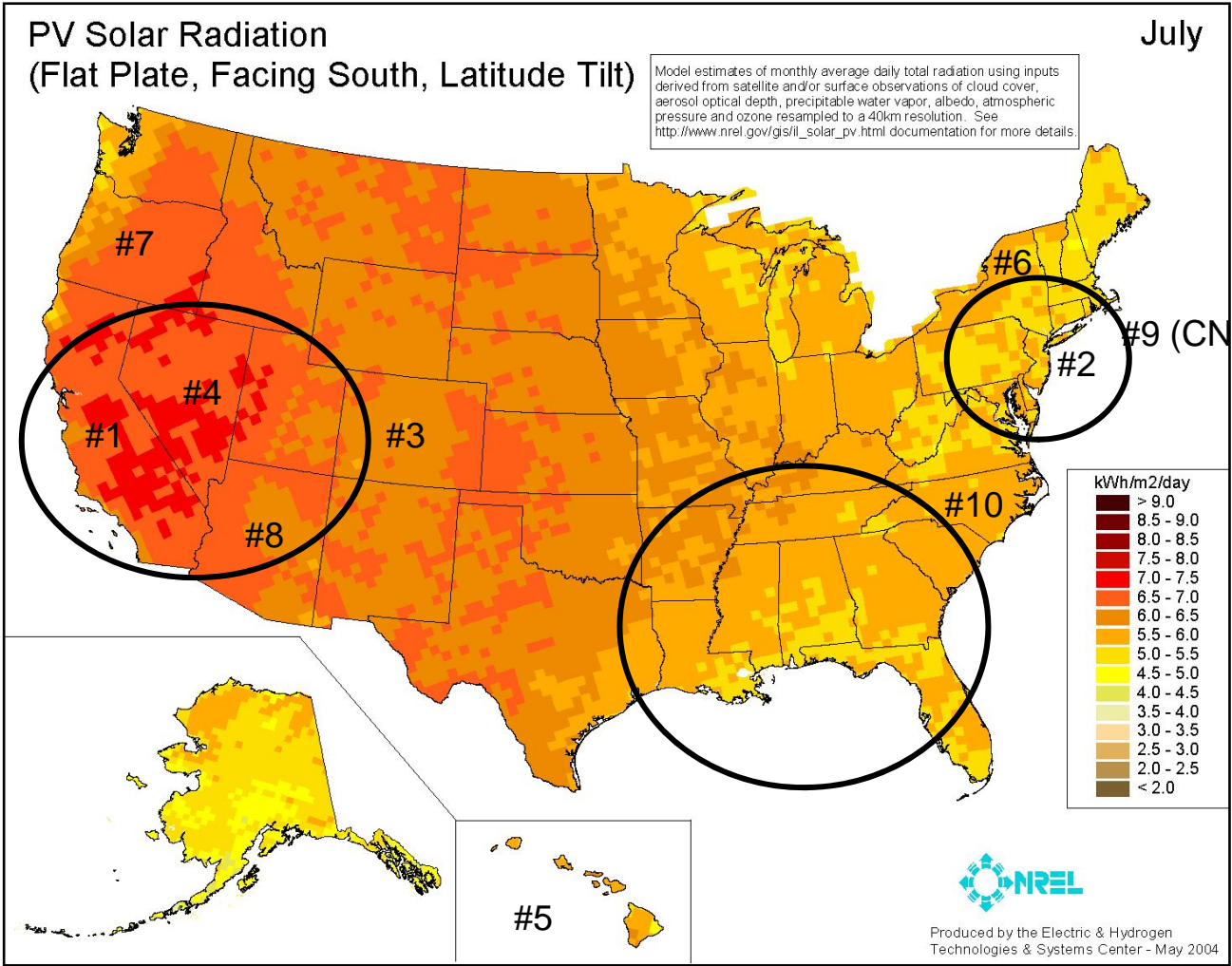
- Accelerated Depreciation (5yr MACRS)
 - Bonus depreciation

ITC + MACRS = 50+% of installed cost

Stimulus Bill: 30% grant instead of tax credit

Source: Database of State Incentives for Renewables and Efficiency (dsireusa.org)

Solar Resource



Top ten ranking for installed capacity as of 2008.
Reference on following slide



Leading States for Solar (MW per year)

<u>State</u>	<u>2006</u>	<u>2007</u>	<u>2008</u>
California	71	87	178.6
New Jersey	18	17	22.5
Colorado	.9	12	21.6
Nevada	2.6	15	13.9
Hawaii	n/a	2.4	11.3
New York	2.7	4.4	7.0
Oregon	.5	1.1	6.6
Arizona	2.1	2.1	6.4
Connecticut	.5	1.8	5.3
North Carolina	n/a	n/a	4.0
Others	1.5	4.4	15.3
Total	102	150	292

Sector Review

- PV and New Construction
- Commercial Sector PV Installations
- Public Sector Installations
- Utility Scale PV

PV and New Construction

SUNTILE®

SOLAR ROOF TILES FOR PRODUCTION HOMEBUILDERS



Source: www.sunpowercorp.com/homebuilders

PV and New Construction

- PV as an option vs. standard vs. mandated
 - Granite countertops or PV system
 - Hawaii and Solar Hot Water
 - Oregon – Solar on Public Buildings (1.5%)
- “PV Ready”
 - Pre-wired
 - Roof pitch and orientation
- Building Integrated PV (BIPV)
- \$0.60/Watt cheaper than an install on an existing home (06-07)*
 - \$30,000 savings on a 50 kW system

* Source: Lawrence Berkeley National Laboratory. February 2009.
<http://eetd.lbl.gov/ea/emp/reports/lbnl-1516e-ppt.pdf>

Solar Communities



**Sacramento Municipal Utility District
SolarSmart new homes**

<http://www.smud.org/en/residential/solarsmart/Pages/index.aspx>

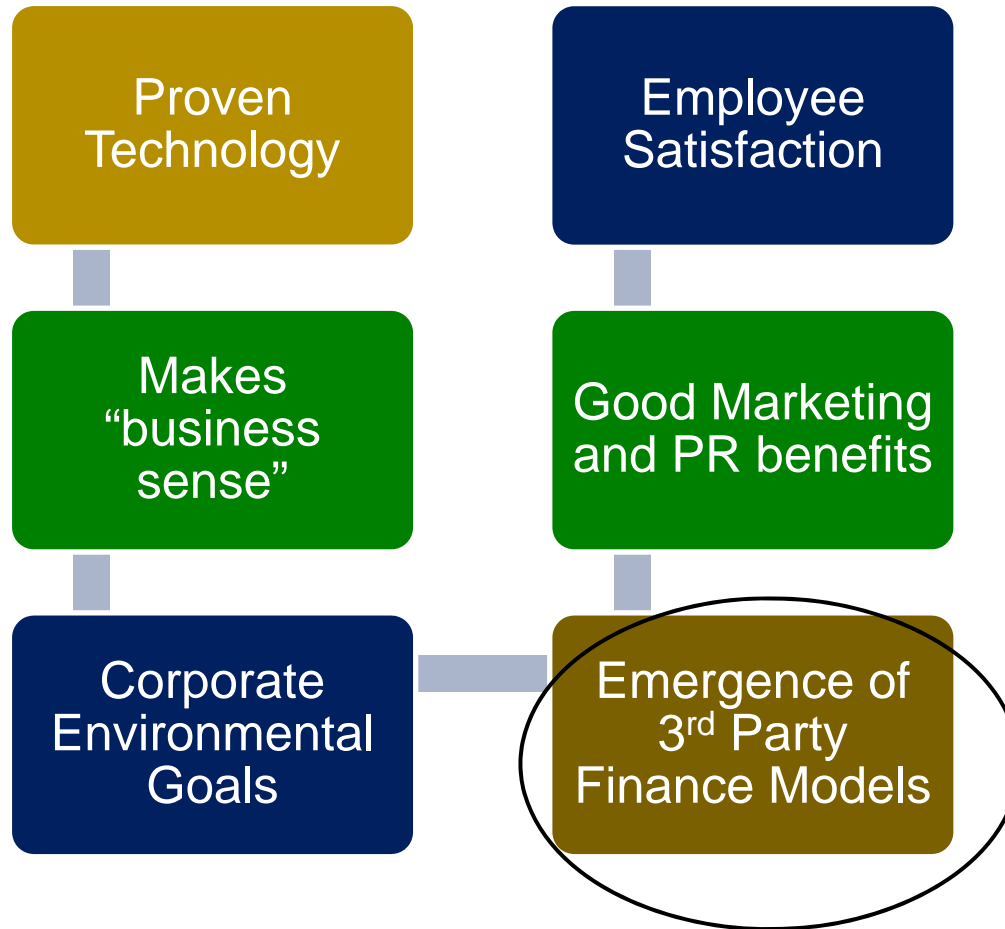
Commercial Sector PV



Source of Picture:

<http://www.environmentalleader.com/2007/04/27/kohls-plans-solar-power-for-64-california-stores/>

Commercial Sector Interest in PV (why)



Two Primary Methods

Purchase
and Own

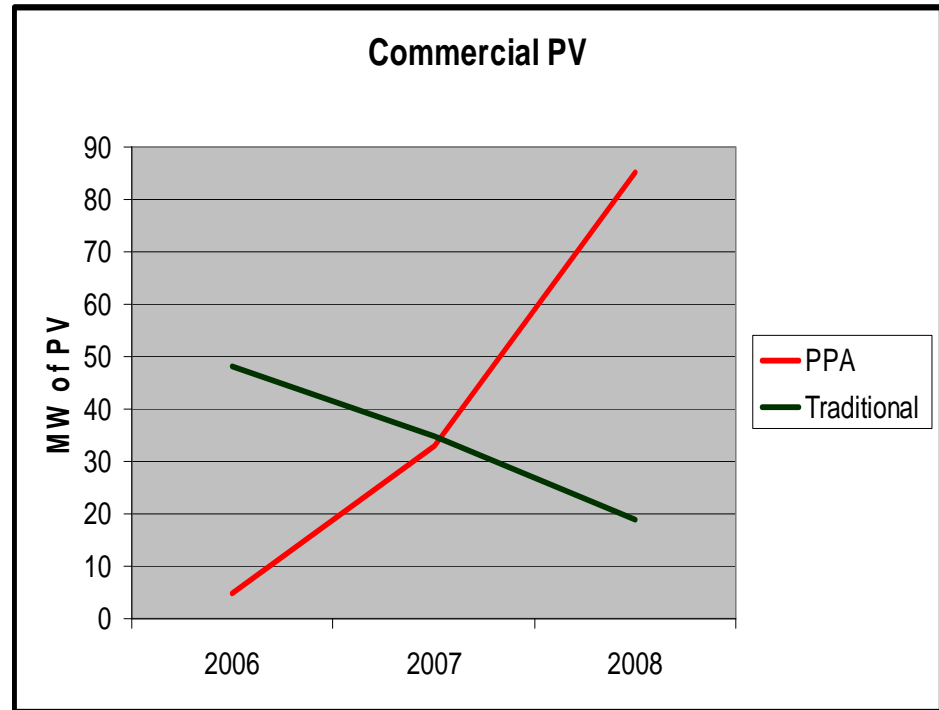
Google
Microsoft
Johnson & Johnson
GE Healthcare

Third
Party
models

Kohl's
GM
Whole Foods
Wal-Mart
Staples
JCPenney

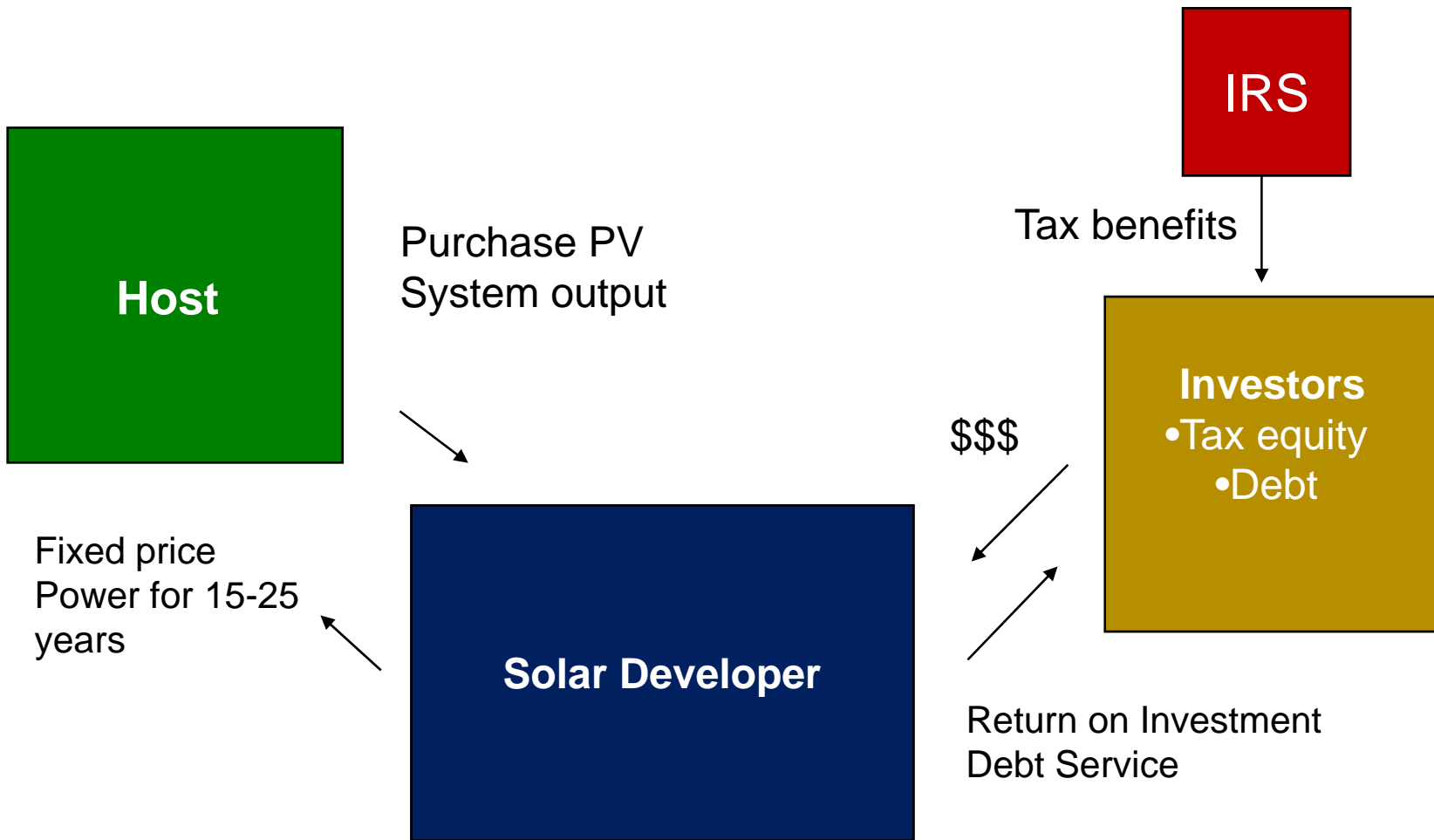
Third Party Ownership

The Power Purchase Agreement (PPA) is becoming the primary method to finance PV in the commercial and institutional markets.



Source: Solar Power Services: How PPAs are changing the PV Value Chain.
Greentech Media. Feb. 2008 Jon Guice & John King

Basics of the Third Party PPA



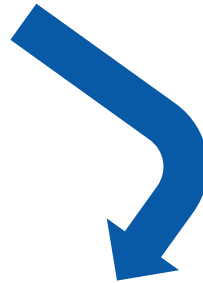
Public Sector PV



Public Sector PV

Primary Issues

- Tax Exempt Financing
 - Inability to benefit from tax incentives
- Budgets are tight
- Available City resources
- Grants, Subsidies and Rebates



New Models and potential funding sources

- Clean Renewable Energy Bonds (CREBS)
- Qualified Energy Conservation Bonds (QECS)
- Stimulus Bill Funding
- Third party PPA model

The Third Party PPA Model in the Public Sector

Benefits of the PPA model

- Allows public agencies to benefit from tax incentives
- No upfront outlay of capital
- No O&M responsibilities
- Path to ownership

Examples of Public Sector PPA projects

- San Diego Water Treatment Facility (1MW)
- Nellis AFB (15 MW)
- NREL (750 kW)
- Denver Int'l Airport (2 MW)
- Many others in the works

UTILITY SCALE PV

Utility Scale PV

- Tax changes: utilities can now take the 30% ITC
 - potential game changer
 - at least, may act as an upper boundary on IPP costs
- Ability to rate base investments
- More control over costs
- Balance between ownership and contracted power

Ownership Structures

Third party
financed
systems
using PPA

Direct
ownership of
PV systems

Utility owned
but
distributed on
leased
rooftops

Utilities and third party ownership

Duke Energy North Carolina

- 16 MW with SunEdison

Progress Energy North Carolina

- 1.2 MW with SunEdison
- 1 MW with SunPower

Nevada Power/Sierra Pacific Power

- 64 MW with Acciona (CSP)



Source: http://thefraserdomain.typepad.com/energy/2007/03/nevada_solar_on.html

15 MW PV System in Colorado

(Xcel and SunEdison)



Source: SunEdison and NREL

Rooftop Leasing Programs

Southern California Edison

- Goal of 250 MW on 150 commercial roofs in 1-2MW systems
- \$875 MM investment proposed
- First Solar Thin Film technology
- May be reduced to 160MW with 90MW for third parties

Duke Energy

- Initial \$100 MM project for 20 MW on homes, schools, and businesses
- Reduced to \$50 MM for 10 MW

Issues*

- Full rate base recovery?
- Anti-competitive concerns (squeezes out IPPs)
- Is it too expensive?

*sources: <http://www.greentechmedia.com/articles/california-puc-mulls-changes-to-socal-edisons-rooftop-project-5943.html>
<http://www.greentechmedia.com/articles/duke-chops-100m-distributed-solar-project-in-half-5052.html>

Utilities owning large solar systems

- Florida Power & Light (FPL)
 - **The DeSoto Next Generation Solar Energy Center**
 - 25 MW
 - One of largest PV plants in the world
 - FPL Property
 - **The Martin Next Generation Solar Energy Center**
 - 75 MW
 - Hybrid system
 - Solar thermal + combined cycle natural gas plant
 - **The Space Coast Next Generation Solar Energy Center**
 - 10 MW

DeSoto Next Generation Solar Energy Center

Artist's Conception



Source: FPL



Martin Solar Thermal Project

Artist's Conception



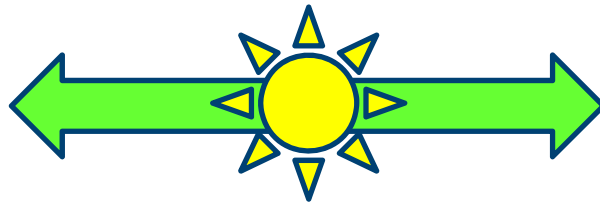
Source: FPL



Sources: FPL News. <http://www.fpl.com/news/2008/062508b.shtml>
FL PSC: <http://www.psc.state.fl.us/home/news/index.aspx?id=419>

Community Solar

Voluntary Green
Power Program



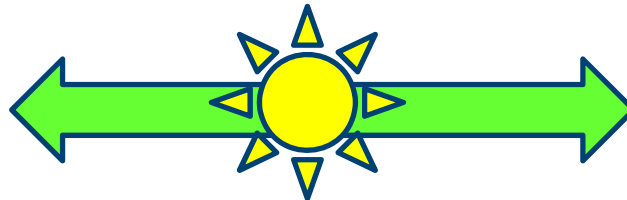
Individual
System Ownership

Property ownership
• renters
• condo owners



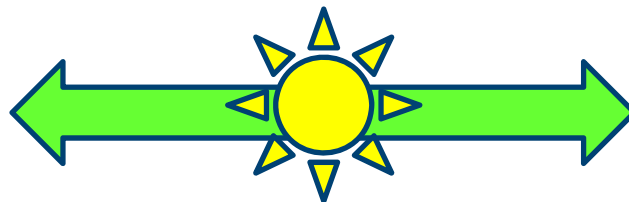
PV system benefits
“Virtual net metering”

Solar access



PV system benefits
“Virtual net metering”

Tax benefits
and incentives



Individual
System Ownership

Economies of Scale

Summary

- Cost of PV are high but falling
- State Policies (RPS) drive installed capacity
- Available Financial incentives
- Tax Credits
- High cost of electricity
- Good net metering laws
- Good (decent) solar resources
 - Germany (a world leader in PV and 8x US levels)
- Third party PPA model is well established
- Utilities expanding their activities
- New financial models continued to be developed

The U.S. Department of Energy's National Renewable Energy Laboratory

www.nrel.gov

Contact Information

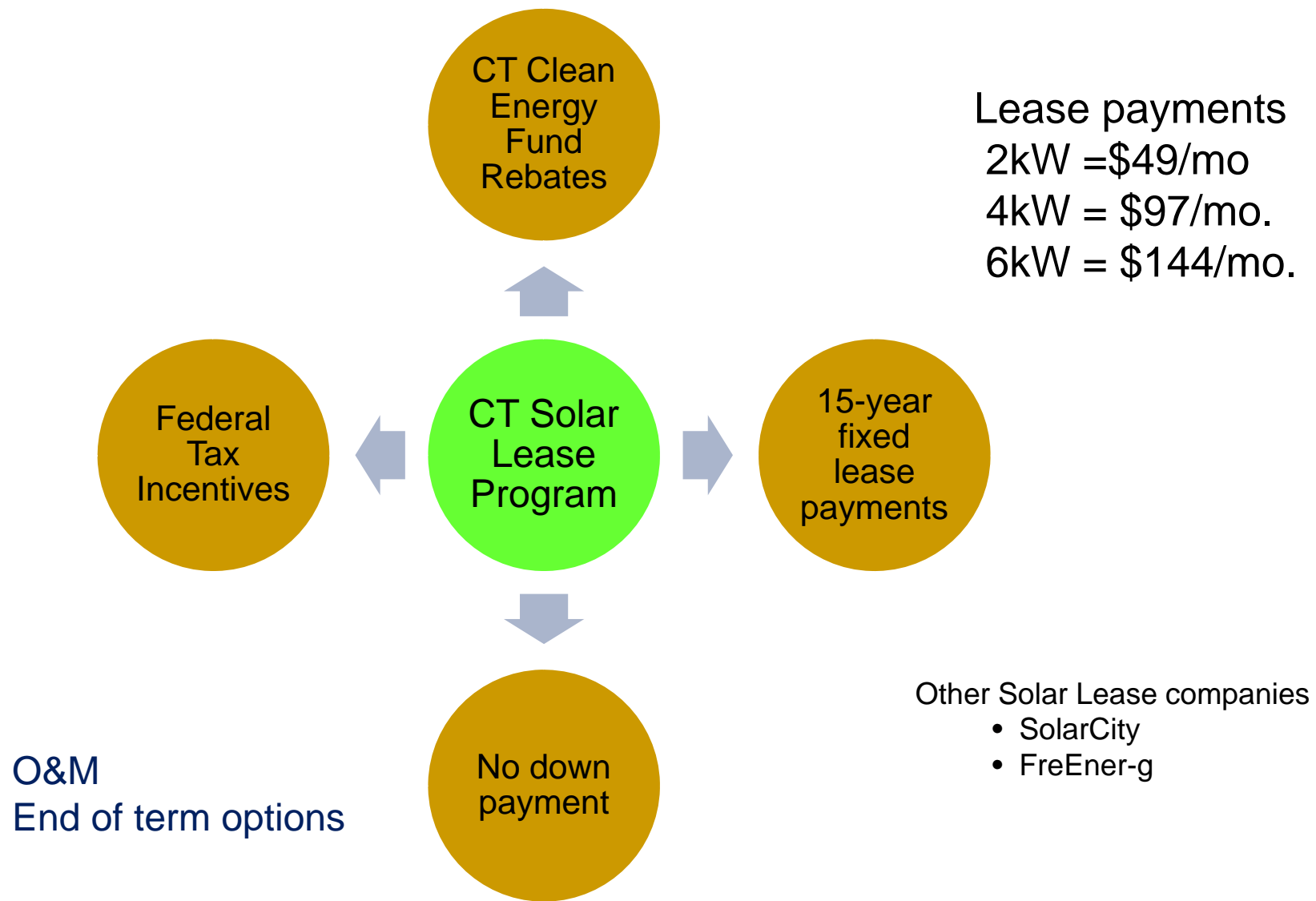
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Golden, Colorado

Extra Slides on Residential PV

Residential Solar Leasing



Property Tax Assessment Model

