The Appraisal of Renewable Energy Facilities and Solar Installations

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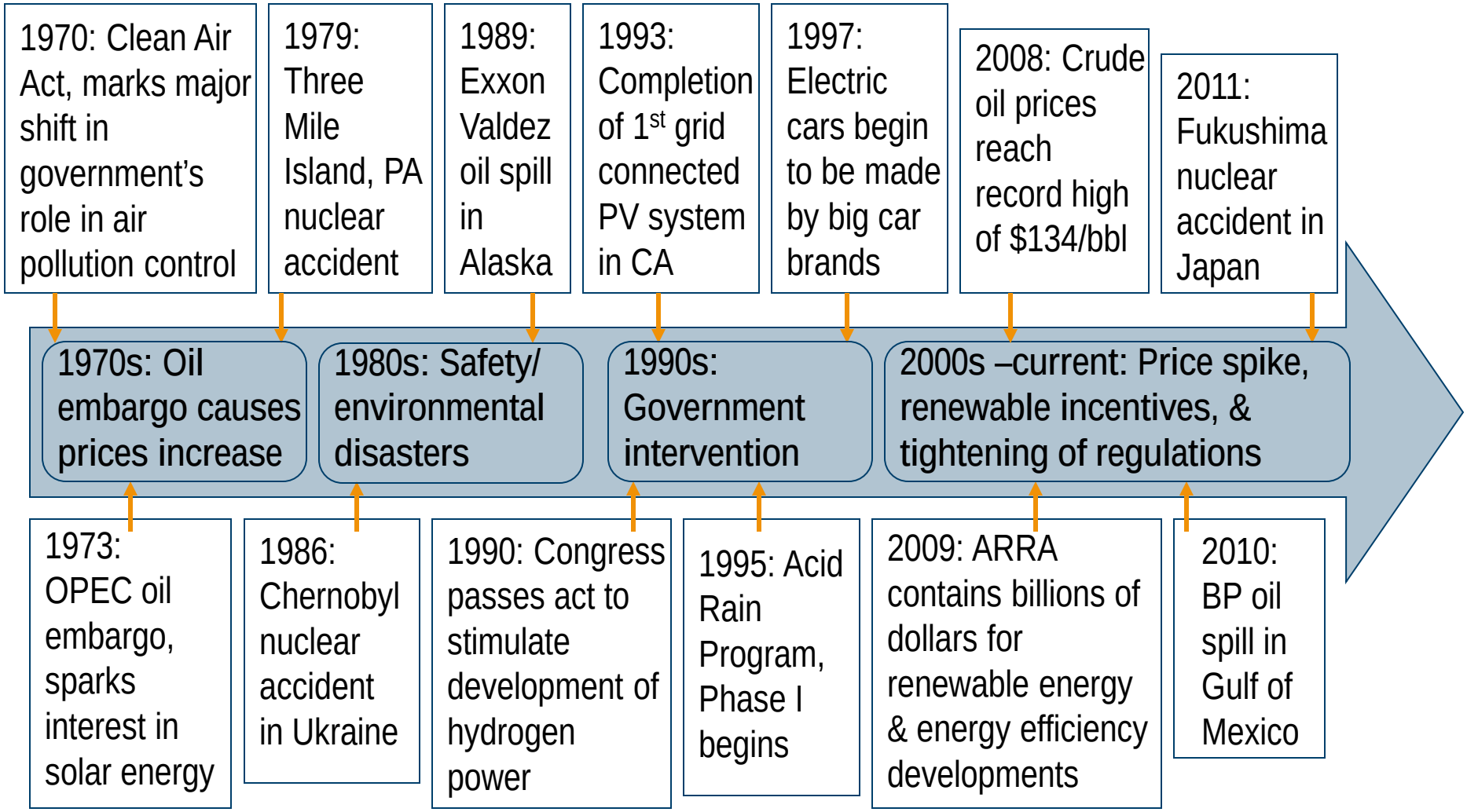
Presentation overview

Technology Mix for U.S. Electric Generating Plants

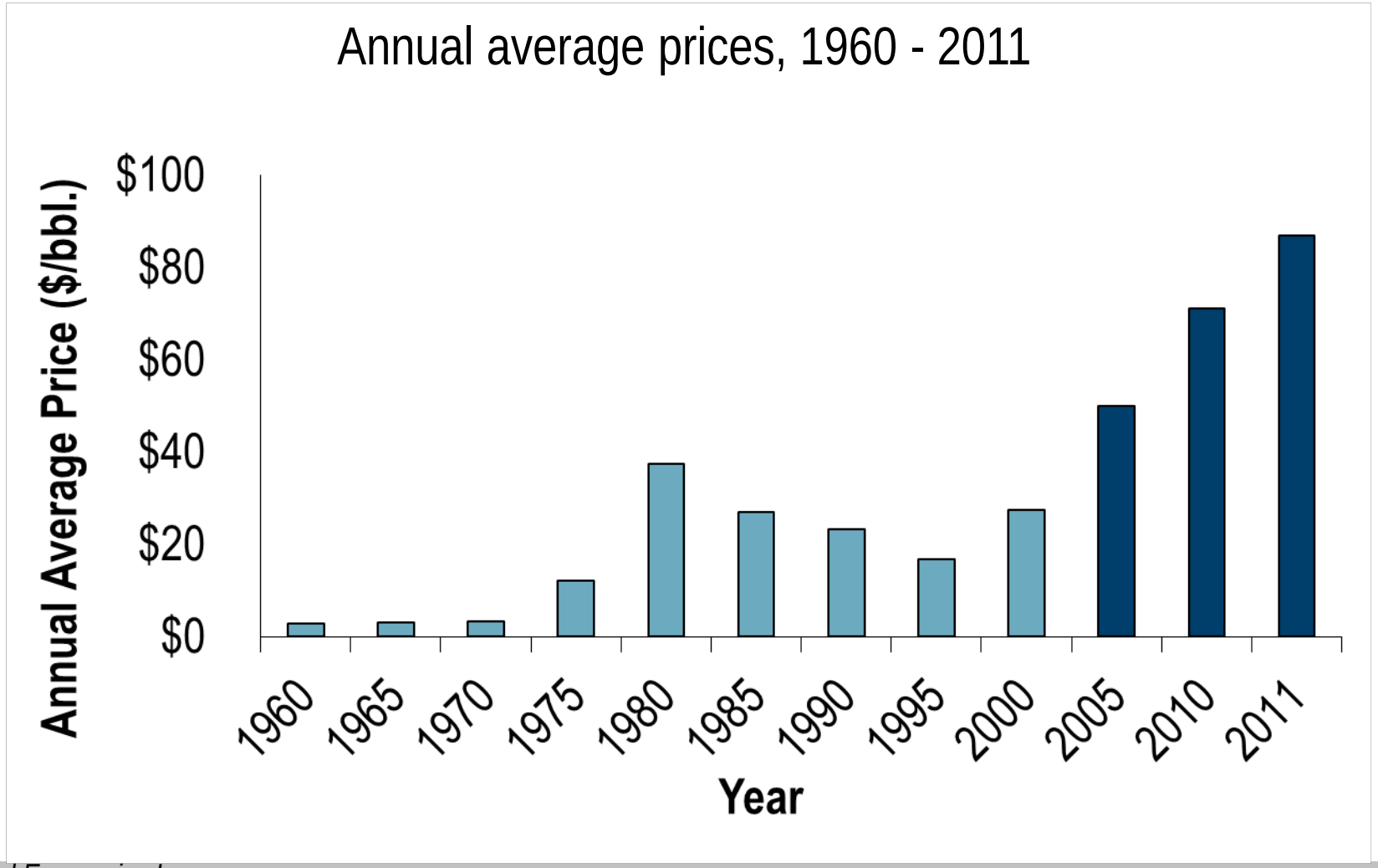
U.S. Solar Energy - Overview and State Incentives

Appraisal of PV Solar Energy System

Events that shaped today's thinking about technology mix for electric power

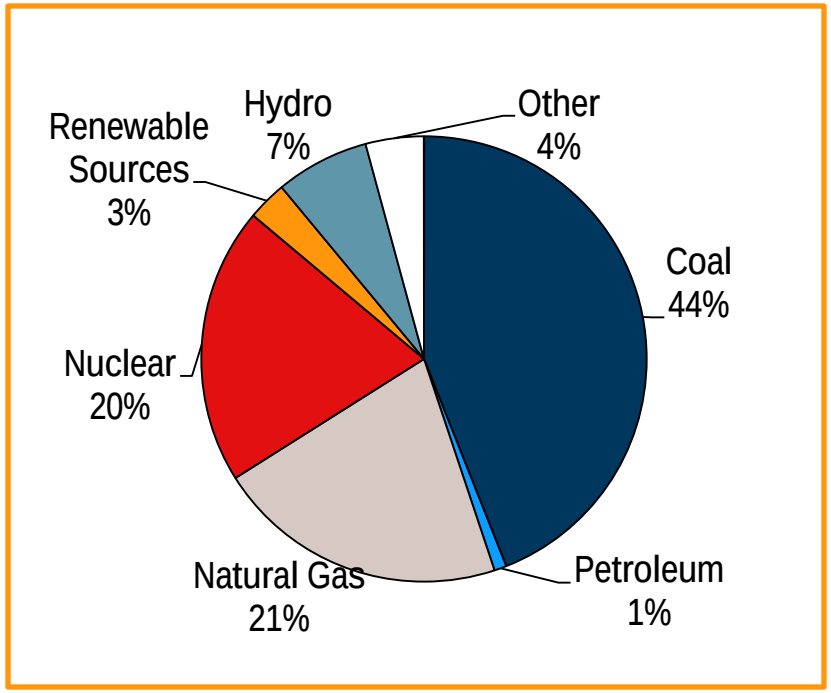


U.S. crude oil prices over the last 50 years

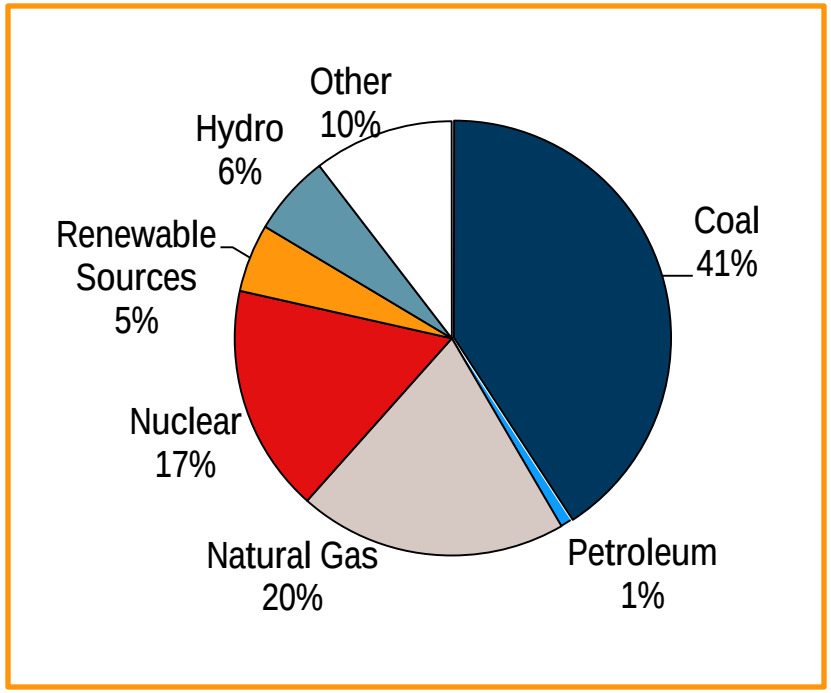


Future reliance on coal remains but will not increase

2009



2035



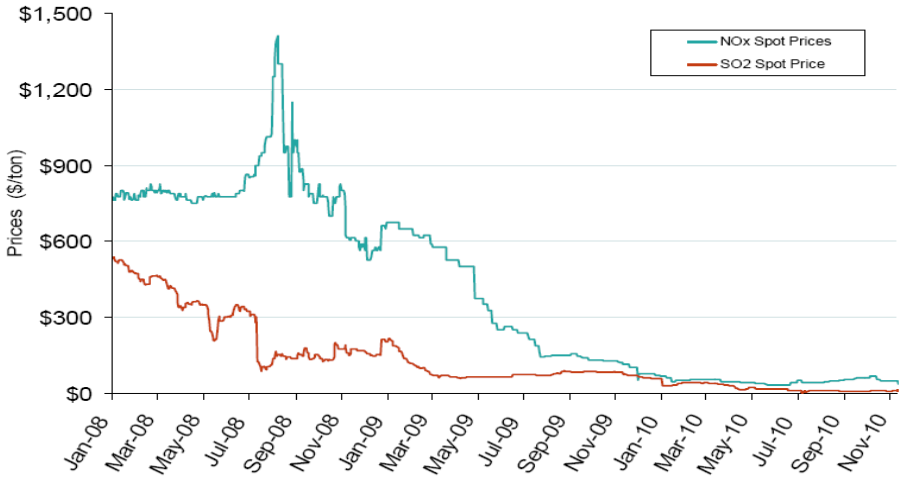
** Other: includes pumped storage, distributed generation, and combined heat and power*

Source: EIA Annual Energy Outlook, 2011

Environmental regulations make coal more expensive

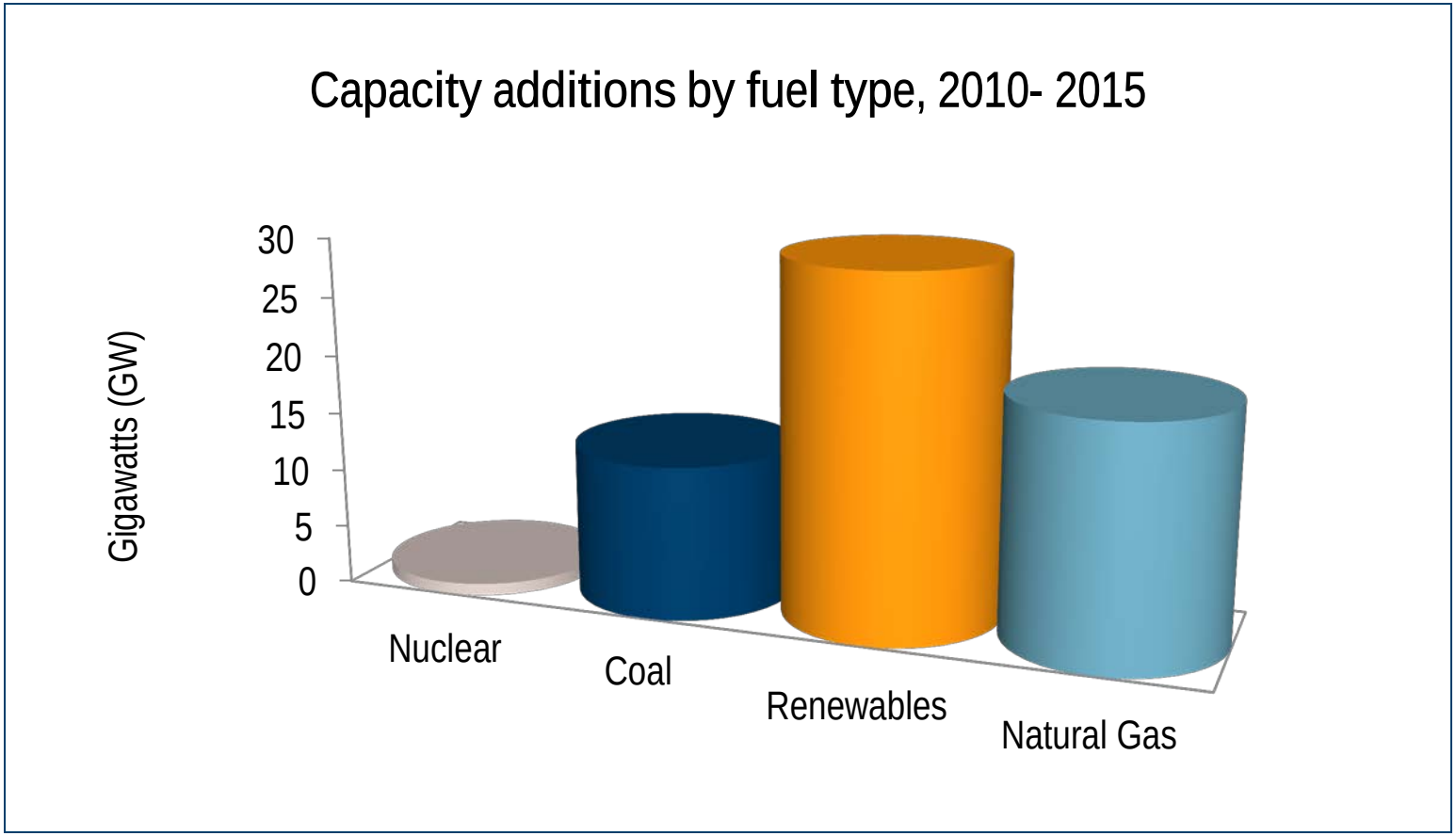
- The U.S. has a cap and trade policy, placing a mandatory cap on emissions such as SO_2 and NOx pollutants
- Polluters can choose to reduce emissions and sell allowances, bank for future use, or continue to emit at high levels and purchase allowances to cover the excess emissions
- CO_2 regulations put on back burner
- In January 2010, there were 22 coal projects either permitted, near construction or under construction, however by year-end, 10 projects had been cancelled

SO_2 and NOx Spot Prices



Source: FERC

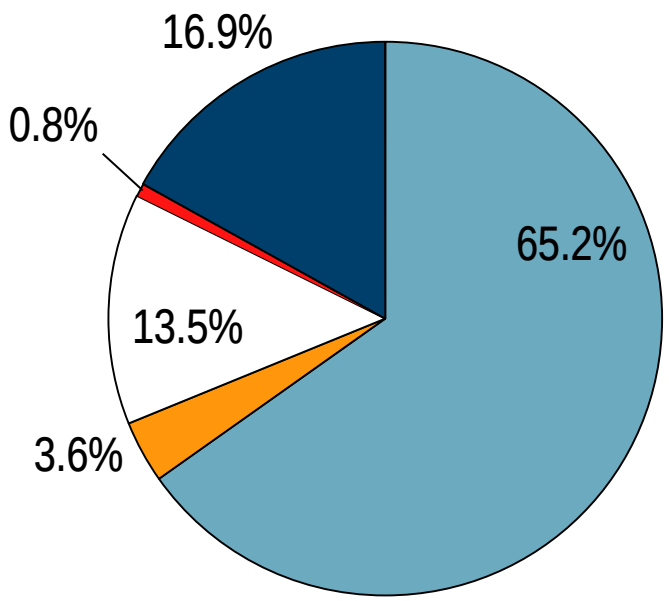
New installations: renewable energy is projected to be a large piece



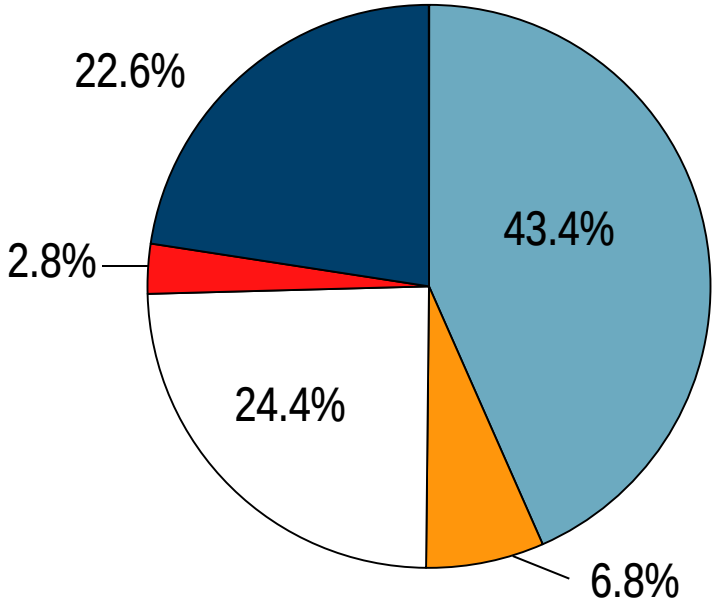
Source: EIA Annual Energy Outlook, 2011, Solarbuzz US Deal Tracker Report

Considerable growth in domestic renewable energy is expected

~420 billion kWh of renewable energy generation in the U.S., 2009



~724 billion kWh of renewable energy generation in the U.S., 2035



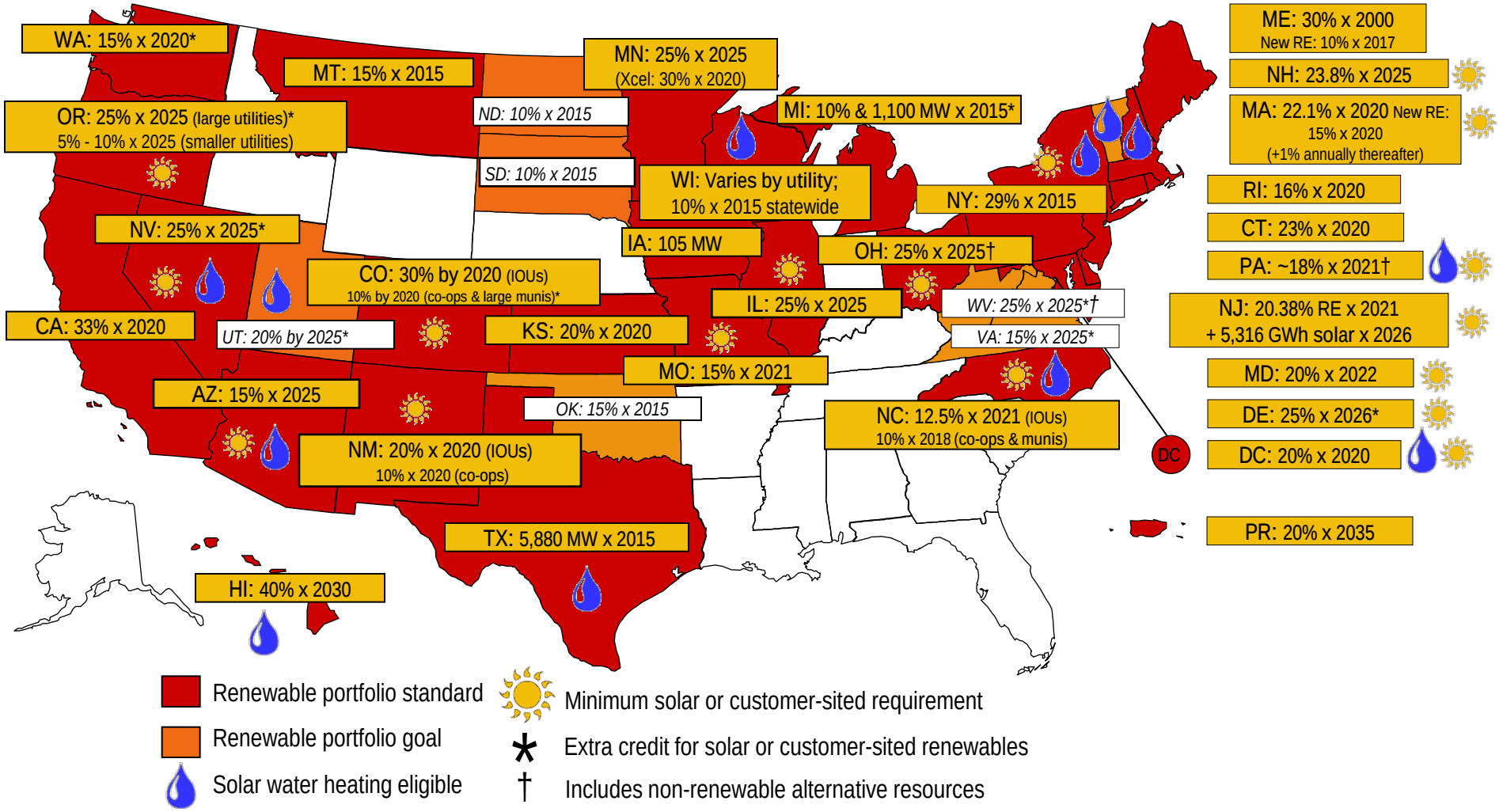
Hydropower Geothermal Biomass Solar Wind

Source: EIA Annual Energy Outlook, 2011

Renewable Portfolio Standard (RPS)

- The 1999-2000 federal government mandate provides states with a mechanism to increase renewable energy generation
- The intent is to stimulate market and technology development so that renewable energy becomes economically competitive with conventional technology
- Goal is to generate about 25% of U.S. electric power from renewable sources by 2025
- State's RPS can ***require*** electric utilities and other retail electric providers to supply electricity from renewable energy sources

29 states have Renewable Portfolio Standards (RPS) in place



Source: www.dsireusa.org, May 2011

Technology eligibility varies under Renewable Portfolio Standards (RPS)

- Under the various state requirements for RPS eligibility, all states include photovoltaics
- Solar thermal (hot water) is included in 30 states
- Biofuels, biomass, hydro, landfill gas, and wind are also all eligible in all states

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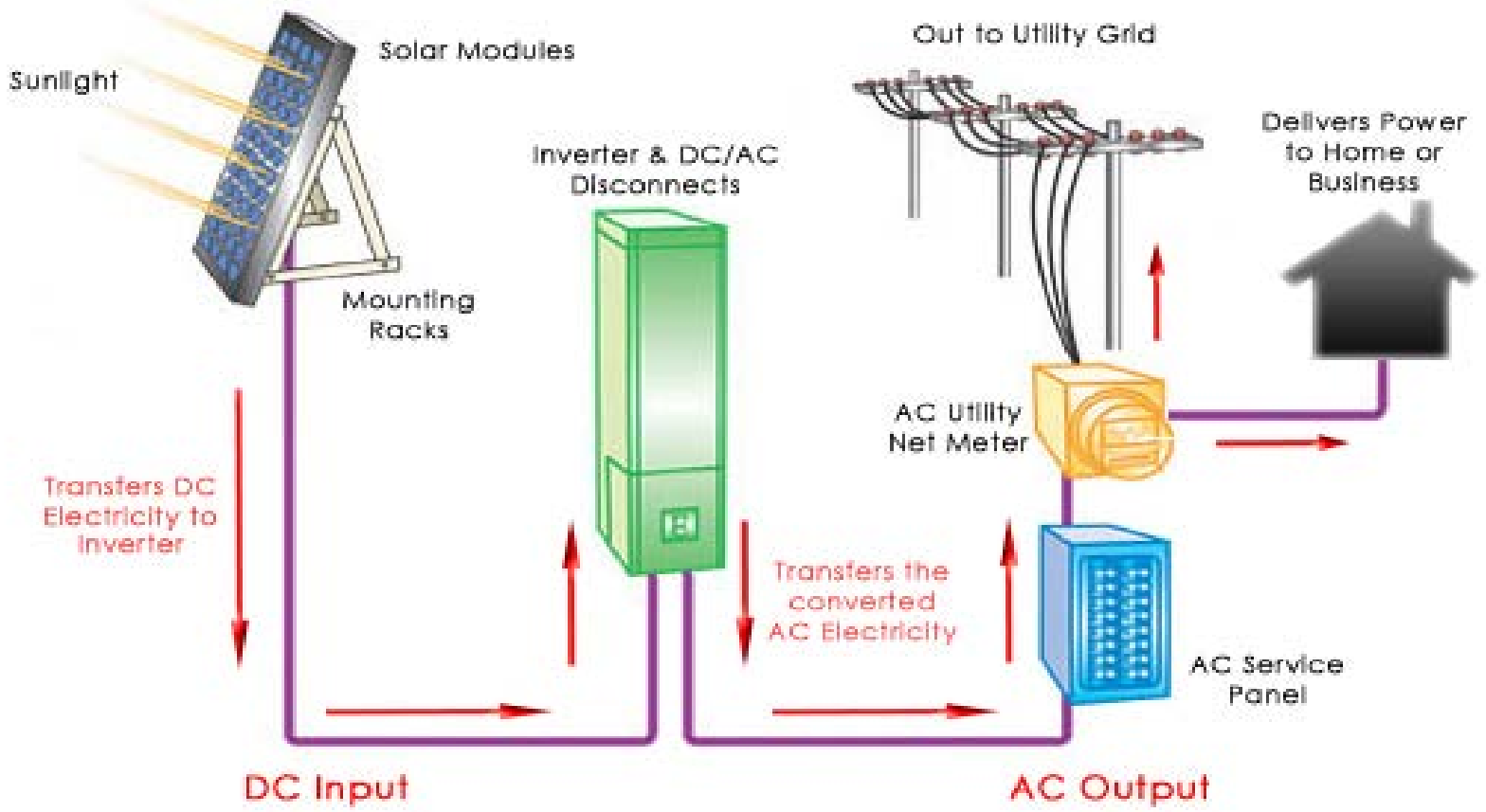
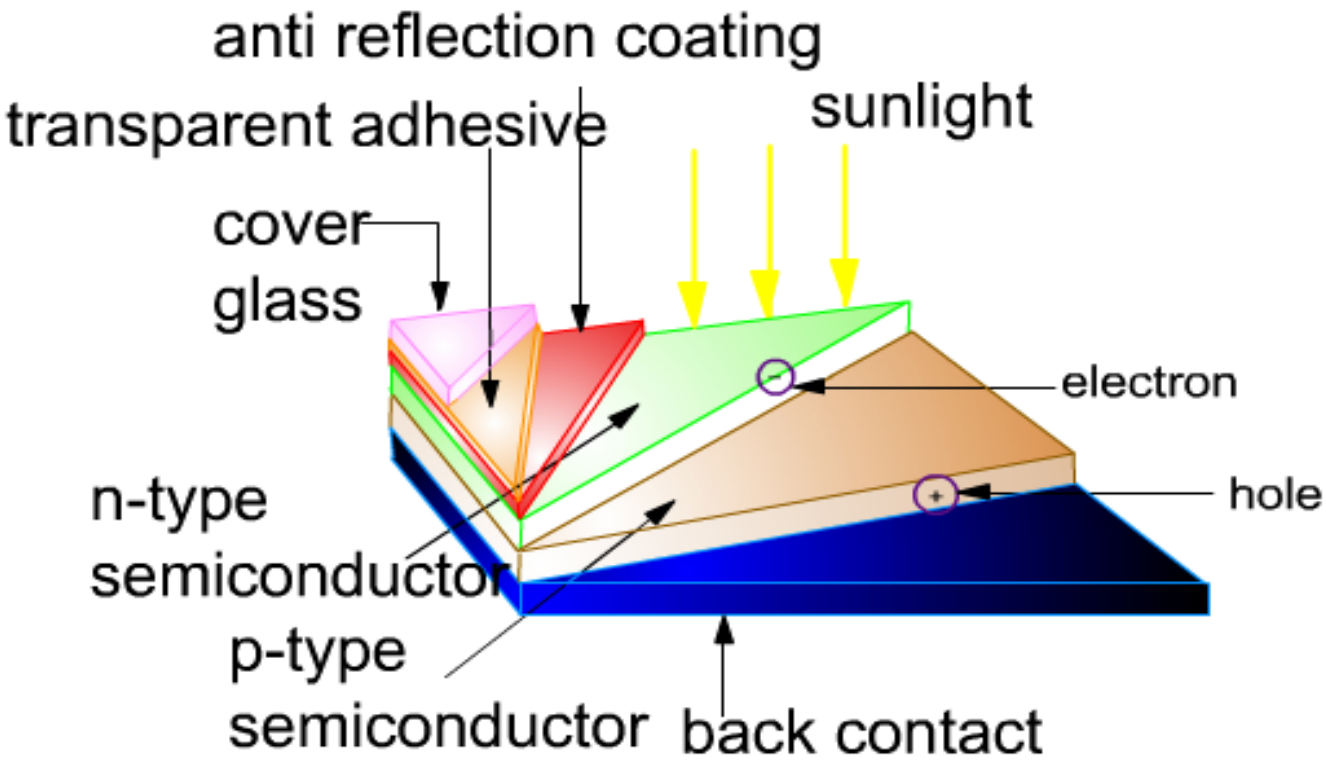
Appraisal of PV Solar Energy System

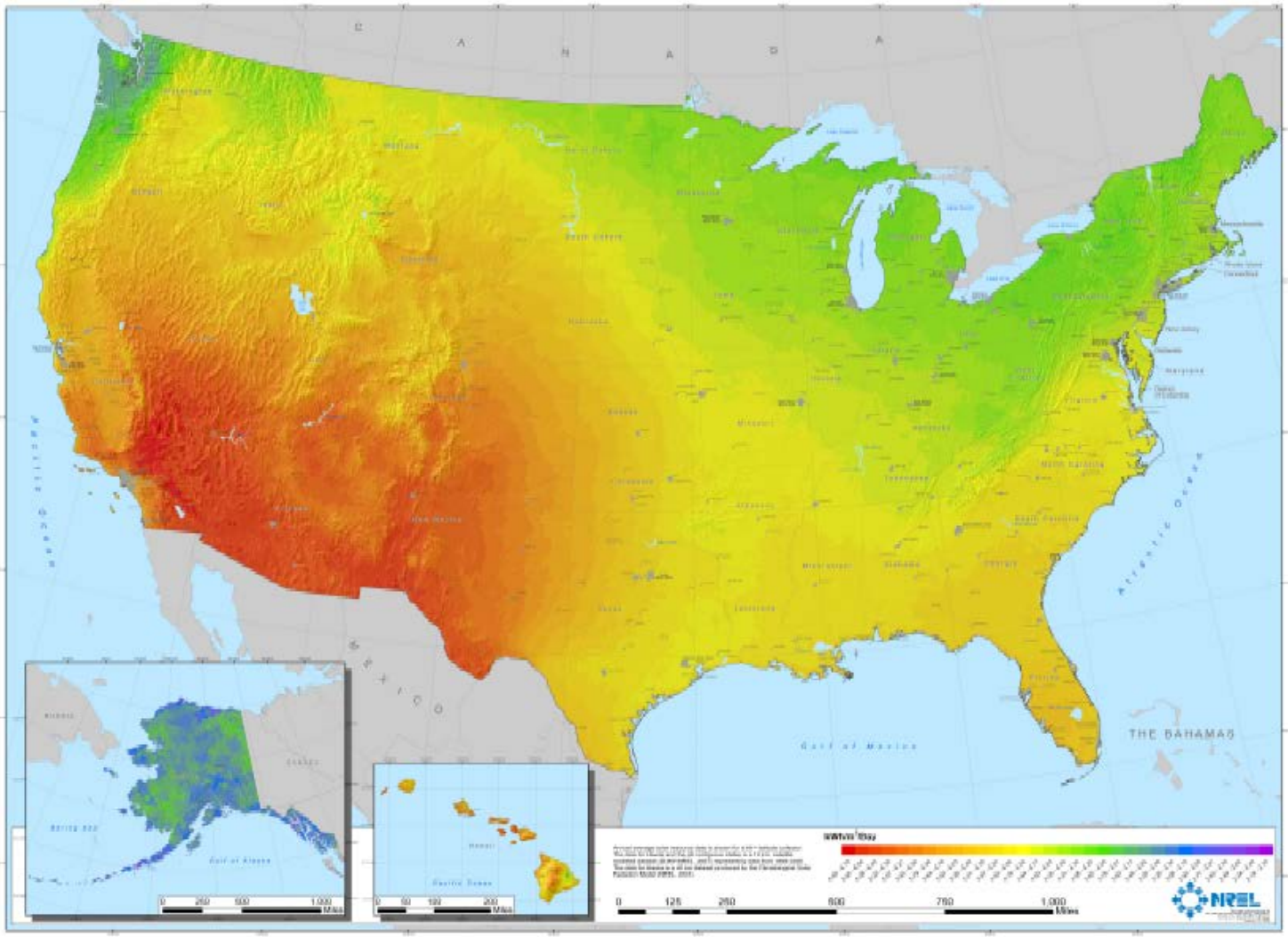
Components of a PV solar system



Layers of a typical solar module



Solar resources in the U.S. are plentiful, especially in the Southwest



Source: NREL

Solar supply and demand is created by government

- **Supply** of solar power driven by significant government incentives for both construction and production
- **Demand** for solar power driven by government regulations *requiring* utilities to supply a portion of their electricity from renewable sources
- As a result, solar generated electricity expected to grow 8-fold from 2.3 billion kWh in 2009 to 16.8 billion kWh in 2035
- 10 MW standalone plant is equivalent to about 5,000 residential roof-top installations

Government incentives have led to new technology and U.S. jobs

- Cost effectiveness of thin-film cells are attractive to solar developers building large scale power plants
- GE plans to build a new plant making 400 MW of thin-film *photovoltaic* solar panels per year
- The solar industry currently has employees in all 50 states
- New commercial solar facilities in Oregon, South Carolina, and Mississippi will create 2,500 jobs with total domestic growth of 24,000 jobs expected in 2011

California and New Jersey lead the country in PV solar installations

- Both states have aggressive policies and incentives in place to encourage renewable energy

2011 Total PV System Installations

	Total Systems Installed	Total MW
California	87,222	880.0
New Jersey	9,566	339.6

- In 2010, PV installations nearly doubled (in terms of MW installed) compared to 2009 across the country

2010 PV System Installations

Top States	MW Installed
CA	258.9
NJ	137.1
NV	61.4
AZ	54.0
CO	53.6
PA	46.8
NM	42.8
FL	35.2
NC	30.7
TX	22.6
Rest of US	135.2
Total	878.3

Source: US Solar Market Insight, 2010 Year in Review

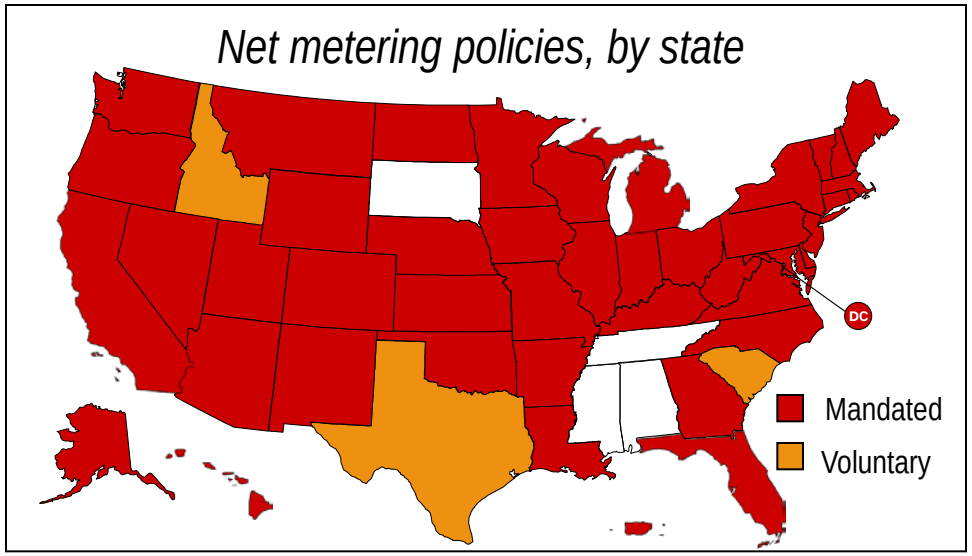
Incentives vary by state and are evolving

- Performance Based Incentives
- Net Metering
- Reduced or No Property Tax
- No Sales Tax on Equipment
- Income Tax Credits
- No Permitting Cost
- Public Benefits Fund and Government sponsored Loan Programs

Incentives encourage solar installations by reducing initial equipment costs and also provide a revenue stream to secure financing

Over 40 states have implemented net metering policies

- Net metering allows electric customers who generate solar energy to "bank" excess electricity on the grid, typically in the form of kWh credits
- These credits offset electricity consumed when the customer's solar energy system is not generating enough electricity to meet its needs
- Usually customers can receive retail rates for electricity sold to the grid, but in some states electricity that flows back to the grid will obtain a rate lower than retail prices



Source: www.dsireusa.org, April 2011

Net metering policies vary, with NJ, TX, PA, & CO being the most favorable

For Example: Net metering in NJ (established in 1999)

- Allows metering for **systems up to 2 MW** for **all customer types**
- **No company limit** on aggregate net metering capacity
- Any **net excess generation** during a billing period is **carried forward** to the customer's next bill as a full kWh credit (**at the utility's retail rate**)
- At the end of a **12-month period**, **the utility purchases remaining excess electricity** at the utility's avoided cost rate
- **Customers own SRECs (solar renewable energy credits)** associated with the electricity they generate
- Go to www.DsireUSA.org for detail on each states current incentive programs

NJ is credited with resetting the bar for solar installation incentives

- Utilities must either produce or purchase a minimum of 2.12% of states demand from solar
- Net metering at retail prices
- For every 1MWH production an SREC is created, valued at about $400
- Rebate program expired

Total installed renewable energy projects from 2001 to May 31, 2011

Technology	# of Projects	Total kW	Total Rebates
Solar	9,566	339,613	$355,380,787
Biomass	18	30,910	14,207,886
Fuel Cell	8	1,505	4,707,312
Wind	39	8,039	5,074,117
Total	9,631	380,067	$379,370,102

Source: www.nicleanenergy.com

Solar Renewable Energy Certificates (SRECs) are a crucial component of NJ's solar incentives

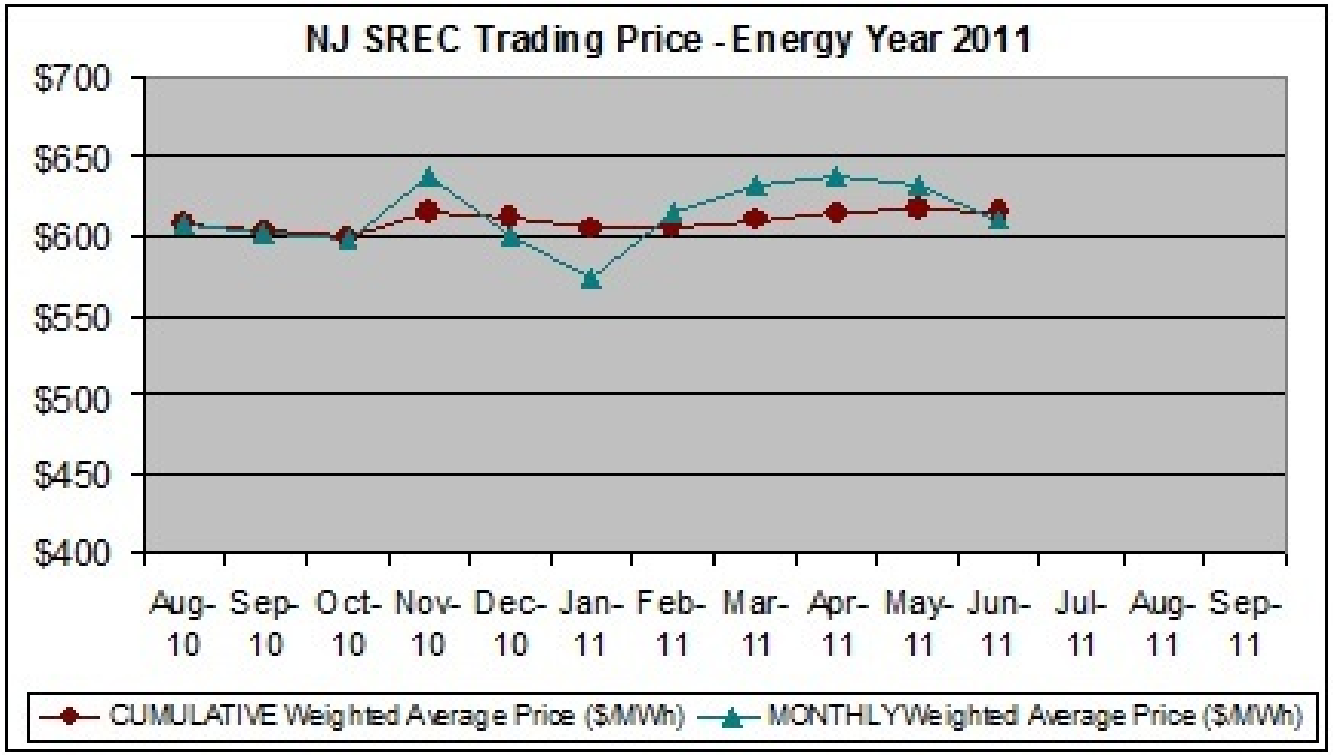
- SREC model provides renewable energy credits that acts as a production subsidy
- SRECs are traded in a competitive market, with prices determined by market forces within each state
- Energy associated with SREC is sold separately and is used by another party
- **Electricity suppliers are the primary purchasers of SRECs** (only receive a certificate, not the electricity generated from the system, to meet state RPS solar requirement)

How do SRECs work?

- Each time a system generates 1,000 kWh of electricity, an SREC is earned and placed in the customer's electronic account
- SRECs are sold on the electronic SREC tracking system, providing revenue for the first 15 years of the system's life

SREC prices are driven by market forces, while SACP prices are fixed by state

- The **Solar Alternative Compliance Payment** (SACP) is the penalty that utilities must pay if they are unable to generate or buy SRECs at mandated yearly amounts
- 2011 SACP price is $658/MWH which is above 2011 SREC of $600/MWH



To receive SRECs, NJ owners must participate in the SREC Registration Program (SRP)

- Registration of project
- Start of construction
- Registration accepted
- Construction completion
- Final paperwork submitted and deemed complete
- Project is issued a New Jersey Certification Number which enables it to generate New Jersey SRECs

- All solar projects in NJ must register at NJCleanEnergy.com
- Registration provides market participants with information about the pipeline of anticipated new solar capacity and insight into future SREC pricing

The NJ SREC tracking system enables account holders to track solar energy system production

- Through the tracking system, SRECs are issued to account holders based on recorded or estimated production of the solar energy system
- After solar system has been installed an SREC tracking system account is established
- SRECs will then be deposited monthly into the owners account based on either estimated or actual reported energy production
- The SREC tracking system also records the sale of SRECs from generators to purchasers

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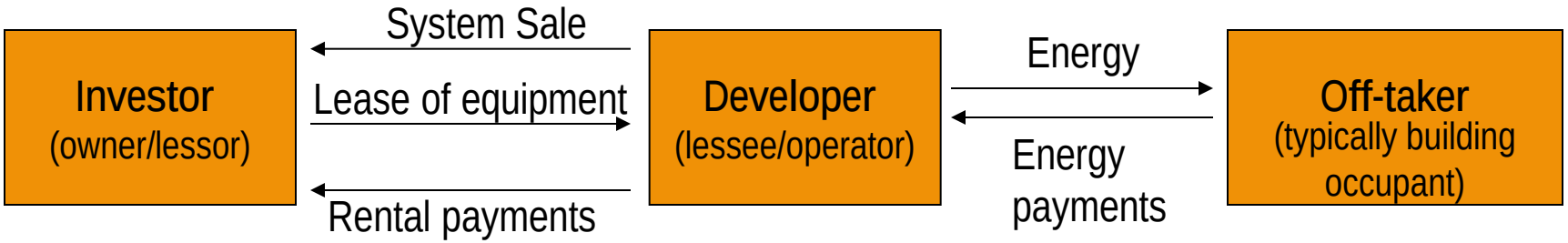
Appraisals are often required for project financing

- Typical leasing scenario is the sale-leaseback: lease length usually equivalent to PPA (PPA between lessee and the Host)
- Bank (Lessor) takes tax credit or cash grant and can claim tax depreciation
- Lessee has option to purchase at the end of the lease term
- The system off-taker receives benefits of reducing reliance on local power grid and use “green” marketing
- Appraisal determines FMV at lease commencement, purchase option date, and residual value at end of lease



Income Approach requires an analysis of the solar system's cash flows throughout its EUL

Approach to value

- Use of a discounted cash flow analysis is recommended
- Direct Cap problematic for new system:
  - Timing of rebates, typically over first few years
  - Other incentives, such as PBIs, are for a specified number of years (usually 5 to 15)
  - PPA may expire prior to end of EUL
  - System efficiency changes over time
  - Accelerated depreciation not uniform

Cash flow considerations

- Estimated yearly generation (kWh)
- PPA terms
- Current and forecasted electricity rates
- Rebates (if applicable)
- SRECs / PBIs
- O&M costs
- Insurance costs
- Inverter replacement costs

A typical solar system will produce cash flows for over 35 years

Key assumptions

System Size (kW)	1,127.5
Total Cost of Equipment ($/kW)	5,000
System Cost ($)	5,637,500
Initial kWH Production	1,720,000
Degradation per year	0.5%

Year 1 rebate

Years 1-5 PBI

Return to market electricity rate upon PPA expiration

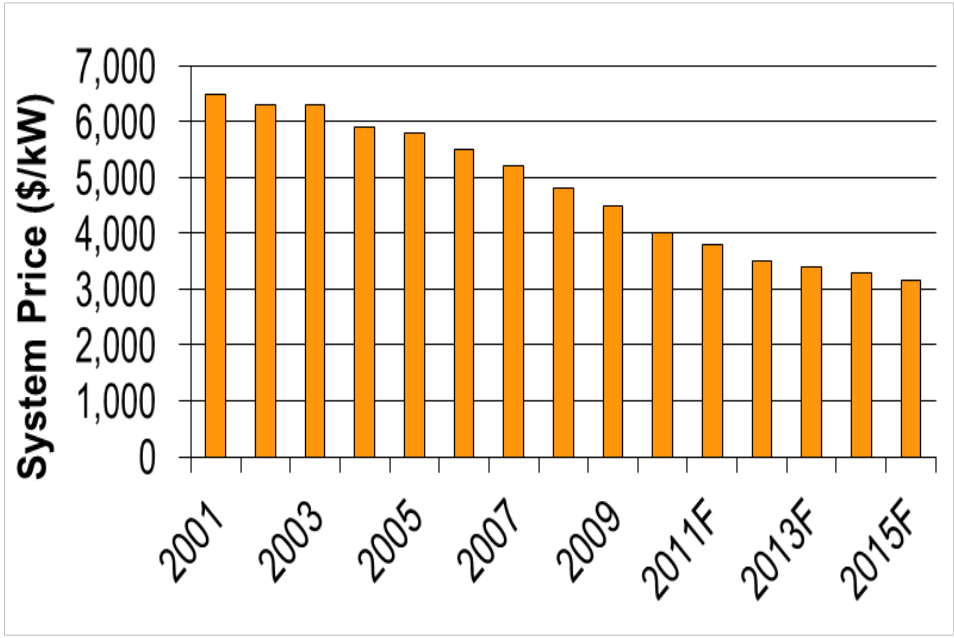
Add'l expense to replace inverter before EUL

	1	2	3	4	5	6	7	8	9	10	11	...
Electricity generation (kWh)	1,720,000	1,711,400	1,702,843	1,694,329	1,685,857	1,677,428	1,669,041	1,660,696	1,652,392	1,644,130	1,635,909	
PPA rate ($/kWh)	0.120	0.124	0.127	0.131	0.135	0.139	0.143	0.148	0.152	0.157	0.200	
PBIs ($/kWh)	0.05	0.05	0.05	0.05	0.05							
SRECs ($/kWh)	0.63	0.58	0.53	0.487	0.469	0.457	0.446	0.432	0.415	0.387	0.36	
Revenues												
Electricity revenues	206,400	211,529	216,786	222,173	227,694	233,352	239,151	245,094	251,184	257,426	327,182	
PBI revenues	86,000	85,570	85,142	84,716	84,293							
SREC revenues	1,083,600	992,612	902,507	825,138	790,667	766,585	744,392	717,420	685,743	636,278	588,927	
Total rebate (cash grant)	1,691,250											
Total revenue	3,067,250	1,289,711	1,204,434	1,132,027	1,102,654	999,936	983,543	962,514	936,927	893,704	916,109	
Expenses												
Inverter Replacement (around year 15)												
O&M	16,913	17,335	17,769	18,213	18,668	19,135	19,613	20,104	20,606	21,121	21,649	
Insurance	22,550	22,550	22,550	22,550	22,550	22,550	22,550	22,550	22,550	22,550	22,550	
Total expenses	39,463	39,885	40,319	40,763	41,218	41,685	42,163	42,654	43,156	43,671	44,199	
EBITDA	3,027,788	1,249,826	1,164,116	1,091,264	1,061,435	958,251	941,379	919,860	893,771	850,033	871,910	

Cost Approach - Total solar system installation costs are forecasted to decrease

- Improved manufacturing techniques and technology
- Current average price to install PV system in the U.S. $4,000 per kW
- Average cost in the U.S. is projected to decline to $3,150 per kW by 2015

U.S. Commercial Solar PV Systems Average Prices, $/kW, 2001- 2015



Source: GlobalData, February 2010

PV modules are the greatest cost component of the overall system

Cost Components	Average Cost Allocation
PV Module	60%
Inverter	10%
Other equipment (mounting structure, wiring, meter, switches)	15%
Installation	15%



Obsolescence factors for solar installations

Physical:

- Unless PV system has solar tracking capability, there are no moving parts
- EUL could be life of roof
- Inverters have limited life

Functional:

- Degradation 0.5% annually
- Today, state-of-art efficiency about 20% compared with 15% 10 years ago
- New technology in future could be 30% efficient

Economic:

- Potentially a big issue as sale of an existing facility will not receive most of the front-loaded government incentives
- Lower demand for electricity from conservation

Cost Approach Calculation

Subject plant:

Install date: 2003

Capacity: 1,500 kW

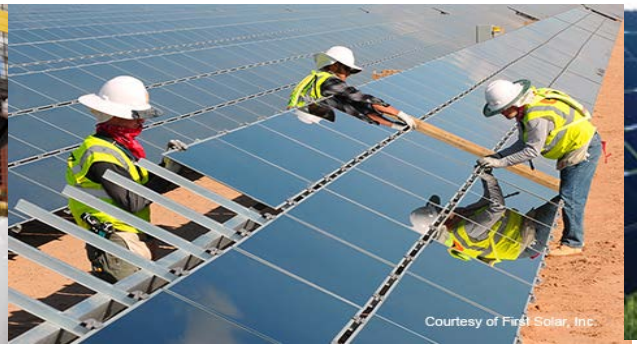
Efficiency: 15.0%

UEL: 35 years

Replacement Cost New	$7,500,000
$5,000/kW x 1,500 kW	
Physical Depreciation	22.9 %
8 years old / 35 years EUL	
RCNLD	$5,782,500
RCN x (1-Phys. Dep.)	
Functional Obsolescence	25 %
(20% eff. - 15% eff.) / 20%	
Fair Market Value	$4,337,000

Thin film technologies and costs improving

- Market share is expanding rapidly
- Advantages: relatively low consumption of raw materials, high automation and production efficiency, ease of building integration and improved appearance
- Disadvantages: lower efficiency, limited experience with lifetime performances
- Manufacturing costs per kW <$1,000



Crystalline silicon PV panel technology is proven and reliable

- 85 to 90% of the market share
- Single and multi-crystalline modules
  - Multi-crystalline are less expensive, but less efficient
- Long lifetime, most manufacturers' warranties are for 25 years
- Technology challenges: reduce materials, improve cell concepts, automate manufacturing
- Efficiency levels are currently16-20%
- Degradation between 0.25% to 0.5% per year
- Single crystalline cell prices $1.14 per watt compared to $1.09 per watt for multi-crystalline

Source: IEA, Venture Beat

Crystalline silicon PV panel efficiency is to reach 25% by 2020 –2030

	2010—2015	2015—2020	2020—2030 / 2050
Efficiency targets (%, commercial modules)	Single crystalline: 21%	Single crystalline: 23%	Single crystalline: 25%
	Multi crystalline: 17%	Multi crystalline: 19%	Multi crystalline: 21%
Industry manufacturing aspects	Si consumption < 5 grams/Watt (g/W)	Si consumption < 3 (g/W)	Si consumption < 2 (g/W)
Selected R&D areas	New silicon materials and processing	Improved device structures	Wafer equivalent technologies
	Cell contacts, emitters, and passivation	Productivity and cost optimization in production	New device structures with novel concepts

Source: IEA PV Roadmap

Thin film efficiencies are also expected to improve in the near future

	2010—2015	2015—2020	2020—2030 / 2050
Efficiency targets (%, commercial modules)	Thin film Si: 10%	Thin film Si: 12%	Thin film Si: 15%
	CIGS: 14%	CIGS: 16%	CIGS: 18%
Industry manufacturing aspects	Roll to roll manufacturing, packaging	Simplified production process, low cost packaging, management of toxic materials	Large high efficiency production units, recycling of modules
Selected R&D areas	Improved substrates and transparent conductive oxides	Improved cell structures	Advanced materials and concepts

Source: IEA PV Roadmap

QUESTIONS?

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