THE RISING TIDE OF
State-Supported Renewable Energy Projects

Project Deployment Results from the CESA Database, 1998–2011

OCTOBER 2012

Prepared by
Clean Energy States Alliance
& Peregrine Energy Group

Clean Energy States Alliance (CESA) is a national nonprofit organization that works with state leaders, federal agencies, industry players, and other stakeholders to advance renewable energy and energy efficiency. CESA's mission is to support state and local leadership to promote the use of existing and emerging clean energy technologies.

www.cleanenergystates.org

This report was prepared for CESA by the Peregrine Energy Group, an energy consulting firm based in Boston, Massachusetts. Founded in 1992, Peregrine provides strategic and technical services to private and public organizations on a broad range of energy supply and demand issues. Services include strategic planning and policy development; project management; market research; regulatory analysis and advocacy; energy program design and administration; and energy information management and performance benchmarking.

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Introduction

State clean energy funds are a major driver of renewable energy projects across the United States, funding the full range of renewable energy technologies, including wind, solar, biomass, and hydro.

To understand some of the cumulative impacts of the state funds, Clean Energy States Alliance (CESA) compiles a national database of state-fund-supported renewable energy projects.

CESA is a nonprofit organization that works with state, regional and municipal officials, federal agencies, non-governmental organizations, and other stakeholders to advance clean energy. At CESA's core is a national network of public agencies that are individually and collectively working to implement renewable energy and other clean energy technologies. These agencies administer funds for clean energy deployment, business expansion, and research and development. Most CESA members are state agencies or quasi-state agencies, but there are also two municipal utilities. CESA members include many of the most innovative, successful, and influential public clean energy agencies in the country.[1]

CESA was formed in 2002 as an organization to assist state and sub-federal efforts related to renewable energy technologies and markets. CESA is dedicated to helping states implement effective clean energy programs and policies. To that end, CESA facilitates multi-state collaborations, real-time learning, and strategic public-private partnerships, market expansion, and finance initiatives. Put simply, CESA is dedicated to supporting government leadership, activities, and innovation in the clean energy sector.

The CESA National Renewable Energy Project Database contains nearly 130,000 projects that have been installed and commenced operation with state fund support. This report summarizes key findings from that database for projects installed from 1998 to 2011.[2] Since the last installment of this report was released in 2009, direct CESA member funding has been augmented by American Recovery and Reinvestment Act (ARRA) funds in some states, and we document the use of ARRA funds in this report as well.

Solar panels on the roof of Kroon Hall, Yale School of Forestry & Environmental Studies, New Haven, CT

This year's results show continuing trends and some new trends compared to the 2009 CESA database. First, the number of state-supported projects has continued to grow year after year. Second, there has been a shift towards more small, distributed generation projects and away from large, central generation projects. Also, states have taken advantage of falling solar photovoltaic (PV) prices by cutting incentive levels, enabling the states to acquire more capacity for each dollar invested. In addition, with the emergence of innovative solar PV financing models, there has been an increase in third-party ownership of PV systems. Finally, ARRA funds have had a noticeable impact in many states.

1 Current and former members of CESA include: The Alaska Energy Authority; Arizona Department of Commerce – Energy Office; California Energy Commission; Colorado Governor's Energy Office; Connecticut Clean Energy Fund (now CEFIA); District Department of the Environment, Energy Administration; Energy Trust of Oregon; Illinois Clean Energy Community Foundation; Long Island Power Authority; Maryland Energy Administration; Massachusetts Clean Energy Center; Metropolitan Edison Company – Sustainable Energy Fund of The Berks County Community Foundation (PA); New Hampshire Public Utilities – Sustainable Energy Division; New Jersey BPU – Clean Energy Program; New Mexico Energy Conservation and Management Division; New York State Energy Research and Development Authority; Ohio Department of Development – Office of Energy; PA Electric Company – Sustainable Energy Fund of the Community Foundation of the Alleghenies; Rhode Island Renewable Energy Fund; Puerto Rico Energy Affairs Administration; Sacramento Municipal Utility District; Sustainable Energy Fund of Central Eastern Pennsylvania; TRF-Sustainable Development Fund (PA); Vermont Clean Energy Development Fund; West Penn Power Sustainable Energy Fund; Wisconsin Focus on Energy; and Xcel Energy Renewable Development Fund (MN).

2 Because the database focuses on new electricity-generating projects that have been completed and are operational, it does not capture all of the funds' activity. First, it does not include projects that are still in development. Those projects will not be added to the database until they come online. Second, it includes only new projects, and thus does not reflect the funds' substantial support for existing renewable energy projects. The support for older projects has been essential to keeping several gigawatts of pre-1998 renewable energy generating capacity operating. Third, it does not include project outputs other than electricity. Finally, it does not capture the many other activities of the funds, including education, training, clean energy business development, and research and development.

A 10 kW small-wind turbine at a residence in Ellenburg Depot (Franklin County) New York.

Photo courtesy of NYSERDA

Context

CESA members that contributed to the database are mostly state-based public agencies, but also include the District of Columbia, the Commonwealth of Puerto Rico, and the Long Island Power Authority, a municipal utility. In all cases, the members have a mission to advance clean energy. They employ multi-faceted integrated strategies that seek to overcome barriers to greater market penetration for technologies that produce clean energy while also stimulating clean energy job growth. Some of the CESA members' programs result in near-term clean energy installations, and those funded projects are captured in this database report. But it is important to keep in mind that the number of installations and quantity of electricity generated are only two measures of the CESA members' impact. CESA members are laying the foundation for much greater clean energy use in the future by training clean energy technology professionals, establishing consumer standards for specific technologies, supporting technology innovations, aiding early-stage clean energy businesses, and educating the public.

Methodology

CESA and its contractor, Peregrine Energy Group, collected data for almost 130,000 clean energy projects from the following CESA members:[3]

- AK: Alaska Energy Authority
- CA: California Public Utilities Commission; California Energy Commission
- CT: Clean Energy Finance and Investment Authority
- DC: District of Columbia Dept. of the Environment—Energy Administration
- IL: Illinois Dept. of Commerce and Economic Activity; Illinois Clean Energy Community Foundation
- MA: Massachusetts Clean Energy Center
- MD: Maryland Energy Administration
- MN: Xcel Energy Renewable Development Fund, Minnesota State Energy Office
- NH: New Hampshire Public Utilities Commission
- NJ: New Jersey Board of Public Utilities—Clean Energy Program
- NM: New Mexico Energy, Minerals, and Natural Resources Deptartment
- NY: New York State Energy Research and Development Authority[4] (NYSERDA); Long Island Power Authority
- OH: Ohio Department of Development, Office of Energy
- OR: Energy Trust of Oregon
- PR: Puerto Rico Energy Affairs Administration
- VT: Vermont Clean Energy Development Fund
- WI: Wisconsin Focus on Energy

The data collected include:

- Technology type
- Completion/approval date
- Capacity (for electric projects)
- Annual energy production (for electric projects)
- Location
- Incentive amount
- Customer type (residential or non-residential)
- Total cost.

Once collected, we standardized and incorporated the data into a single database to enable analysis and reporting. Note that values such as total cost and energy production were not available for some projects so we estimated these values where necessary (estimation methods are explained in the relevant sections). Also note that, although some projects produced thermal outputs that were used for building and water heating and cooling, we did not collect thermal output values for those projects because of difficulties in collecting and standardizing the values.

3 The list of agencies that contributed to the database includes current and past CESA members.

4 NYSERDA is unique among CESA member states because it selects which projects receive support through its state's Renewable Portfolio Standard. For this reason, NYSERDA RPS projects are included in the CESA database.

Key Findings about State-Supported Projects

1. 2011 saw the most state-funded renewable energy projects installed in a single year.

CESA members supported 32,734 clean energy projects in 2011.[5] This represents an increase of 18% over the number of projects installed in 2010 and is almost double the number of projects installed in 2009. The 2011 installations bring the total number of projects supported by the funds to 129,420 for the years 1998 through 2011. These projects total 4,777 megawatts (MW) of electric generation capacity. (See Figures 1 and 2.)

Figure 1: **CESA Member Projects Installed by Year**

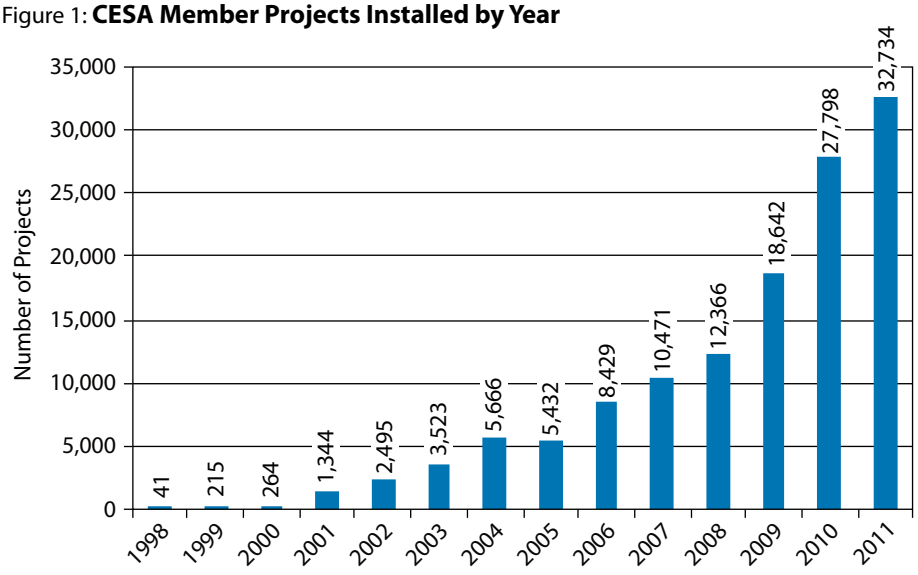
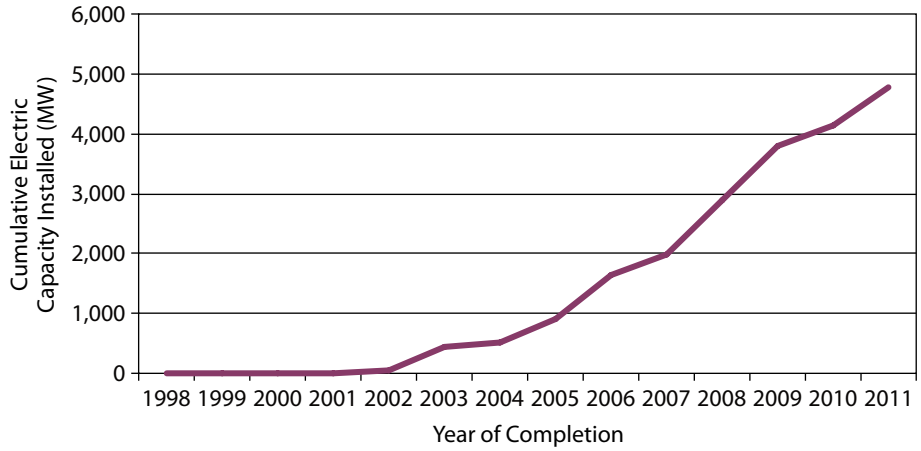


Figure 2: **Cumulative Capacity Installed**



Alaska's Unalakleet Wind Project

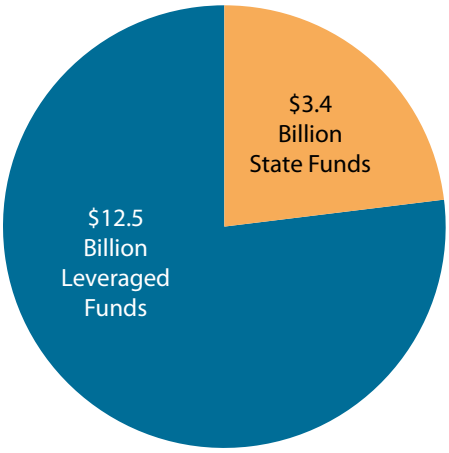
Deborah Mercy, Alaska Sea Grant Marine Advisory Program

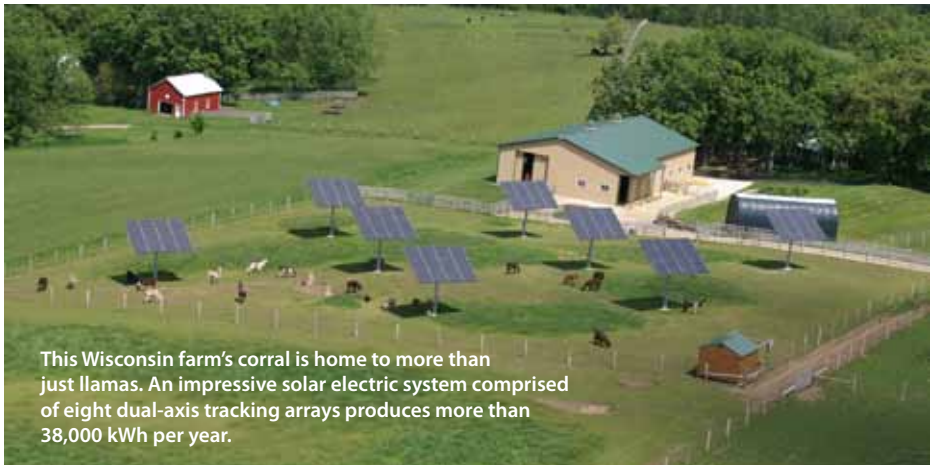
5 Projects funded by the American Recovery and Reinvestment Act (ARRA) are covered in a separate section of the report and are not included in these figures.

2. From 1998 to 2011, states invested $3.4 billion of public funds in renewable energy projects and leveraged an additional $12.5 billion.[6]

For every $1 of state funds invested, other funding sources provided $3.42 of additional capital. As a result, the funds' $3.4 billion public investment in clean energy projects leveraged approximately $12.5 billion, bringing the total investment to $15.9 billion.[7] Additional funding resources consist largely of private investment but also comprise a small amount of foundation and municipal funding. (See Figure 3.)

Figure 3: **Program Funds and Leveraged Funds from 1998–2011**





This Wisconsin farm's corral is home to more than just llamas. An impressive solar electric system comprised of eight dual-axis tracking arrays produces more than 38,000 kWh per year.

3. Projects supported by CESA member funds are avoiding significant greenhouse gas emissions.

The projects installed in 2011 will generate 1.1 million megawatt-hours (MWh) of electricity annually and avoid more than 800 million tons of carbon dioxide (CO_2). This is equivalent to taking 150,000 cars off the road.[8]

Since 1998, state funds have supported the installation of almost 4.8 gigawatts (GW) of clean energy generation capacity. Each year, these projects generate 10.7 million MWh of energy and avoid 8.1 million tons of CO_2, the equivalent of taking 1.4 million cars off the road or the annual electric use of over 900,000 homes. (See Table 1.)

Table 1: **Projects, Capacity, and Investments by Technology in 2011**[9]

Technology Type	Number of Projects	Electric Capacity Installed (kW)	Annual Electric Generation (MWh)	State Incentive Amount
Biomass/ Biofuels	64	5,734	37,209	$10,823,597
Fuel Cell	20	1,380	9,957	$4,459,476
Geothermal	319	0	0	$2,857,580
Hydro	23	112,565	251,525	$41,193,917
Landfill Gas	14	95,182	161,714	$31,737,592
PV	31,311	367,003	497,950	$354,038,848
Solar Thermal	724	243	260	$2,951,719
Wind	259	66,765	156,544	$29,383,204
Grand Total	**32,734**	**648,872**	**1,115,157**	**$477,445,933**

6 These numbers aren't comparable to previous years' reports because the states included in the database have changed slightly from year to year, and also because of discrepancies in past years' results regarding what were considered completed projects.

7 Because 5% of the projects in our database were missing total cost and incentive values, we estimated total incentives and leveraged fund values by scaling up the data. We first estimated the total state incentive amount by scaling up, by technology, the number of projects with state incentive values (99.3% of projects) by the total number of projects in our database. We then estimated the total costs by technology by multiplying this estimated total state incentive value by each technology's total cost to state incentive ratio from projects where states provided both values. For example, assume there are 200 PV projects in our database, and 180 had state incentive values totaling $100 million while 150 had both state incentive and total cost values totaling $80 million and $320 million, respectively. We first scale the $100 million in state incentives by 1.11 (200 divided by 180 projects) to estimate total state incentives as $111 million. We then multiply this amount by the ratio of total cost/state incentive for PV projects ($320M/$80M = 4) to estimate a total cost value of $444 million.

8 The EPA *(http://www.epa.gov/cleanenergy/energy-resources/calculator.html)* estimates that 1 MWh is equivalent to 0.76 Tons of CO_2 equivalent, and that 1 MWh is equivalent to annual greenhouse gas emissions from 0.135 passenger cars and from the annual electricity use of 0.086 homes.

9 All geothermal projects installed in 2011 had no associated electric output, only thermal output.

4. Over time, states have emphasized supporting smaller capacity projects, particularly solar PV projects.

From 2003–2008, large wind installations comprised the majority of annual installed capacity, but from 2009 onwards state funds have supported the installation of more distributed PV than large wind capacity each year. This follows a general shift within CESA member agencies towards supporting smaller, distributed generation projects and away from large-scale projects. We see a related shift towards residential projects from 2006 onwards; the emphasis was on non-residential projects prior to 2006. (See Figures 4a and 4b.)

Figure 4a: **Number of Projects Installed by Technology**

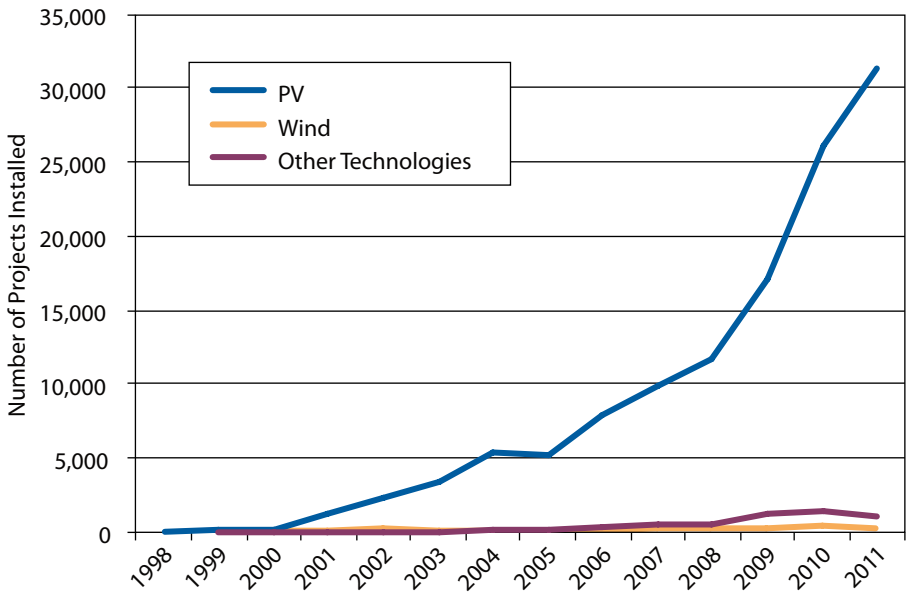
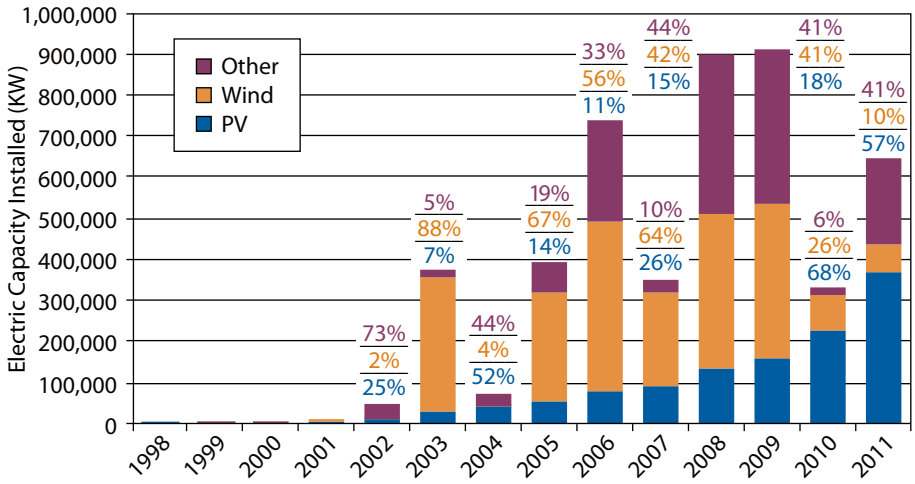


Figure 4b: **Renewable Electrical Capacity Installed**



Solar PV trackers installed at GWR Engineering Office in Charlotte, Vermont

GWR Engineering, PC

Rich Stromberg, Alaska Energy Authority

Eva Creek Wind Farm, Alaska

This strategy makes sense because most states also have Renewable Portfolio Standard (RPS) policies to support the installation of large-scale renewable energy projects. RPSs require electricity suppliers to procure a certain percentage of the electricity they sell from specified clean energy generation technologies. State funds, in contrast, concentrate mainly on smaller projects and distributed generation. Distributed generation provides such societal benefits as increased energy security, decreased demand on central power stations during peak periods, and decreased power network congestion. (See Figures 5 and 6.)

Figure 5: **Number of Projects Installed by Customer Type**

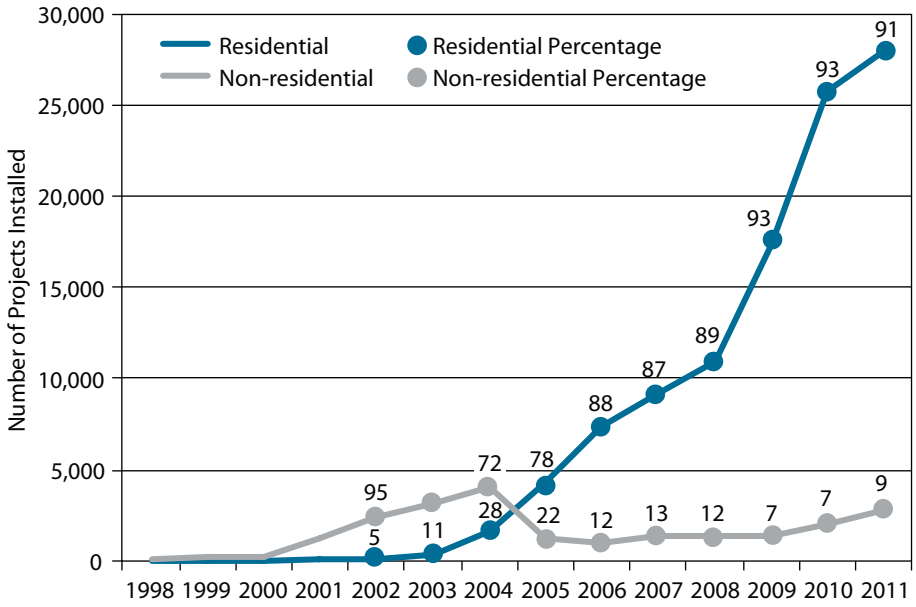
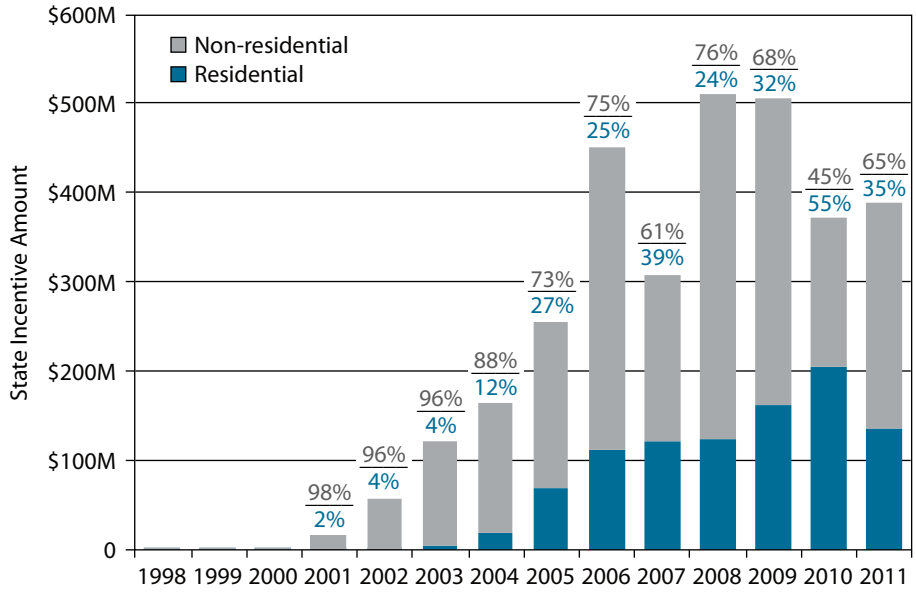


Figure 6: **State Incentives by Customer Type**



5. State funds have taken advantage of declining PV prices to lower incentive levels sharply, acquiring more capacity and leveraging more money for each dollar invested.

Since 2007, the average total cost per kW of PV projects supported by state funds has fallen by 24%, from $8,488 per kW to $6,458. During that time, in response to lower project costs, states have dropped incentive levels by 60% from an average of $2,966 per kW to $1,119 per kW. As a result, the state share of total costs has declined from 35% to just 17% with the rest of the funding coming from other sources. These additional sources mostly consist of private funds but may also include some foundation and municipal funds. (See Figures 7a and 7b.)

Figure 7a: **Contributions of State Support and Outside Funding to Total Solar PV Costs per kW**

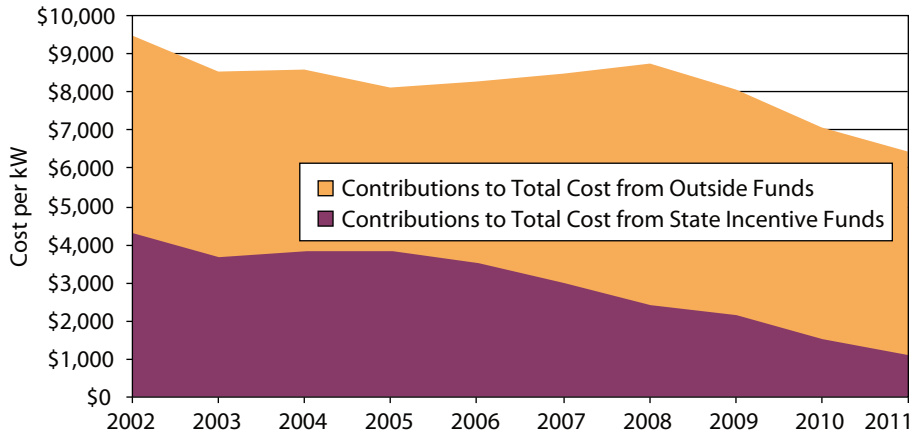
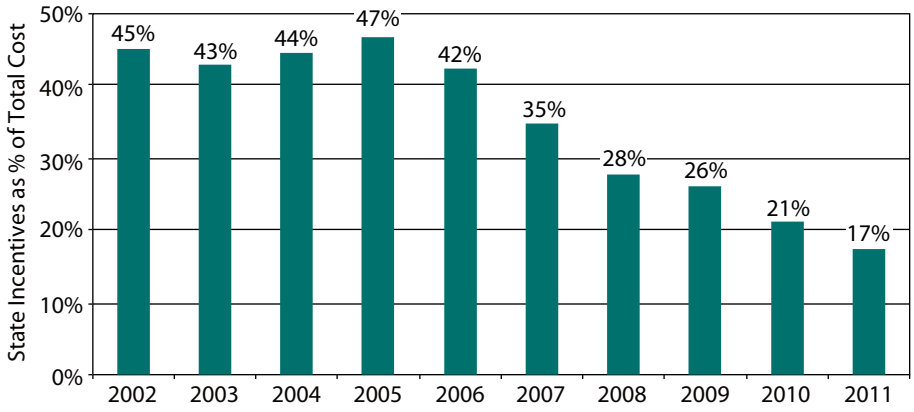


Figure 7b: **State Incentives Contributions per kW as Percentage of Total Cost**



Residential PV project supported by the Energy Trust of Oregon

Photo courtesy of Energy Trust of Oregon

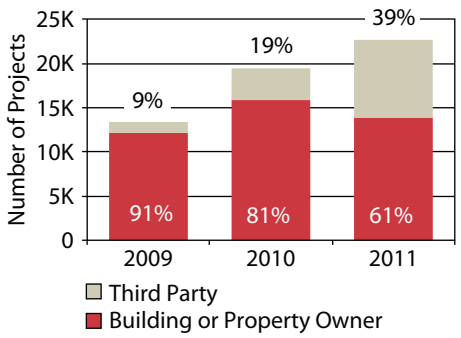
Solar PV installation on a residence in Acton, Massachusetts with funding support from MassCEC

Photo courtesy of David Gerratt/NonprofitDesign.com

6. The share of third-party-owned renewable energy projects has increased over time in the residential sector

Looking at states that provided ownership data—California, Maryland, Minnesota, and Oregon—we found that the number and generation capacity of residential renewable energy projects owned by third parties rather than the project hosts has steadily increased from 2009 to 2011. (See Figure 8.) The vast majority of these projects were PV. This fits the national pattern of innovative renewable energy business models emerging that reduce upfront costs for building owners.

Figure 8: **Residential Projects Installed and Percent of Total Each Year by Owner Type**



Residential Solar PV Business Models[10]

Traditionally, residential solar PV installations were owned by the building owner. But decreasing PV costs and the rise of net energy metering policies in most states—which mandate that system owners be reimbursed at retail rates for electricity they send to the grid—have led to the rise of third-party ownership business models. Some key players in the residential third-party PV market include Borrego Solar, OneRoof, SolarCity, and SunRun. In a different approach, the Clean Energy Finance and Investment Authority in Connecticut offers a solar lease program.

PV Business Model	Description	Trends
System owned by end user (building owner)	Building owner pays for installation of PV system and manages installation, permitting, operation, and maintenance, or hires a third party to manage these.	Traditionally the dominant business model. Has been steadily giving way to the third-party ownership model.
System owned by third party	Third party assumes all or most of upfront PV installation cost. Customers pay for the solar electricity the system produces at prices below utility rates. Third party sells any excess energy produced back to the grid at the retail price. Third parties or their partners manage permitting, installation, operation, and maintenance.	On the rise because upfront cost to building owner is dramatically reduced.

10 See Greentech Media *(http://www.greentechmedia.com/articles/read/who-owns-solar/* and NREL *(http://www.nrel.gov/news/features/feature_detail.cfm/feature_id=1816)* and *(http://www.nrel.gov/docs/fy08osti/42304.pdf)*.

7. The largest amounts of state-supported renewable electric generation capacity installed since 1998 have been in California, the Mid-Atlantic, and the West regions. Different regions[11] have selected different technology portfolios to achieve their clean energy goals.

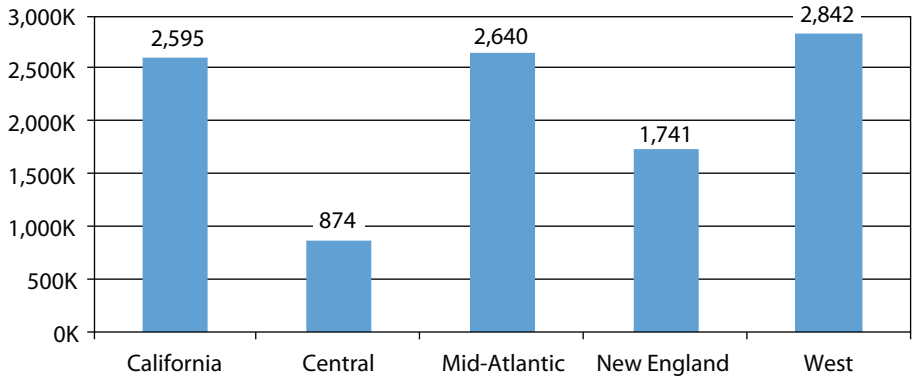
Different geographic regions used different renewable energy portfolios to achieve their electric generation goals. California and New England have focused on solar PV installations, while the Central and West regions have focused on wind energy resources. The Mid-Atlantic region has focused on wind and hydroelectric energy. (See Table 2 and Figure 9.)

11 West region states include AK, NM, and OR. New England states include CT, MA, NH, NJ, and VT. Mid-Atlantic states include DC, MD, and NY. Central states include IL, MN, OH, and WI. PR did not have any commonwealth-supported electric projects prior to 2012. Note that these region classifications differ slightly from the 2009 CESA report's definitions.

Table 2: **Percent of Total kW Capacity by Technology per Region**

	Region				
	California	**Central**	**Mid-Atlantic**	**New England**	**West**
Biomass/Biofuels	2.1%	7.1%	5.7%	22.3%	0.7%
Fuel Cell	0.7%	0.2%	0.1%	1.6%	
Geothermal	5.1%				0.1%
Hydro	2.7%	10.5%	44.3%	4.8%	1.2%
Landfill Gas	3.4%	6.8%	5.3%	8.1%	
PV	55.3%	14.1%	5.1%	52.2%	17.1%
Wind	30.7%	61.3%	39.6%	10.9%	80.9%

Figure 9: **Annual Electric Generation from State-Funded Clean Energy Projects by Region**



Courtesy of Clean Energy Finance and Investment Authority

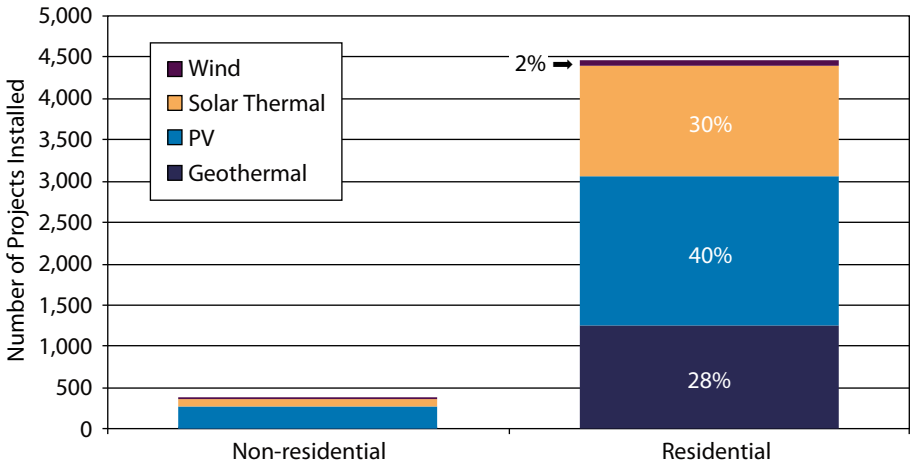
Connecticut Science Center, Hartford. This 200-kilowatt fuel cell at the new Connecticut Science Center will generate almost 100% of the electricity used at the science center annually.

Findings about ARRA-Funded Projects Administered by CESA States

8. On the residential side, CESA states used ARRA funds to support a mix of geothermal, solar thermal, solar PV, and wind projects. On the non-residential side CESA states focused ARRA funds on solar projects.

Some states have also used ARRA funds to support clean energy projects. In the residential sector, states used ARRA funding to support a wide mix of technologies, including geothermal, solar thermal, and PV projects along with a small number of wind projects. In the non-residential sector, states focused on solar projects (PV and solar thermal). (See Figure 10.)

Figure 10: **ARRA-Supported Projects by Technology, and Percent of Total by Year from 2009-2011**



OH Dept. of Development–Office of Energy

ARRA-funded project at Lincoln Electric Headquarters, 2.5MW wind turbine, Euclid, OH. The cost of the turbine and installation is about $5.9 million. Lincoln Electric is paying $4.55 million. The company also borrowed about $350,000 from the county and received a $1 million federal stimulus grant.

Dawn O'Brien

A "Solarbration" at St. Philips the Apostle school caps off the successful completion of a 1 kW educational PV system installation as part of the Illinois Clean Energy Community Foundation's Solar Schools Program.

Conclusion

Between 1998 and 2011, CESA member clean energy funds supported nearly 130,000 renewable energy projects and leveraged $12.5 billion in outside investment for clean energy. These projects total nearly 4.8 GW of generation capacity and each year generate enough electricity to serve over 900,000 homes. In recent years, we've seen states shift funds towards more small, distributed projects. Also, they have taken advantage of falling technology prices to cut incentive levels and acquire more generating capacity for each dollar invested. In the years since the 2009 CESA database report, we've seen the use of ARRA funds for clean energy projects as well as the rise of new ownership models for PV systems that encourage greater private investment. Continued tracking of state efforts to drive the development of renewable energy will continue to hold important lessons at the national, state, and local level for addressing our energy challenges in all parts of the country. It is clear that state and local investments and leadership in renewable energy are helping the U.S. to reach its potential to become a world leader in clean energy technologies as well as to achieve the additional benefits of economic development and energy security. It is also clear that continued public-private partnerships for clean energy deployment are essential for the continued growth of clean energy markets.

State Leadership in Clean Energy

About CESA

Clean Energy States Alliance (CESA) is a national nonprofit organization that works with state leaders, federal agencies, industry players, and other stakeholders to promote renewable energy and energy efficiency. CESA's mission is to support state and sub-federal leadership, policies, and innovation in the clean energy sector.

At CESA's core is a national network of public agencies that are individually and collectively working to advance clean energy. Most of CESA's members are state agencies, but there are also independent nonprofits and municipal utilities. These organizations administer funds for clean energy deployment, business expansion, and research and development. CESA members include many of the most innovative, successful, and influential public clean energy funders in the country.

CESA Strategies

CESA works to advance programs and policies that effectively address financing challenges, drive technological innovation, grow green jobs and industry development, and raise public support and demand for clean energy. Among its many activities, CESA:

- provides up-to-date information about clean energy programs and developments to its members and other audiences.
- creates forums for the exchange of information and best practices among state policymakers and other clean energy stakeholders.
- pursues numerous multi-state initiatives and projects designed to improve the overall effectiveness of individual programs, as well as to advance the interests of clean energy programs as a whole.
- frames and addresses key issues facing clean energy market development by working with federal agencies, regulators, and industry participants.
- provides technical support to its members (and to non-members, by request), assisting with program development and assessment.
- represents the interests of state and municipal clean energy programs in federal and industry forums.

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