Utility-Industry Restructuring and the Future of State Energy Research and Technology Transfer Institutions

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ABSTRACT

State energy research and technology transfer institutions (SERTTI) are state and regional organizations that have historically filled in gaps when a state need was not met[1]. SERTTI build on research of the federal government and universities and focus on technologies with potential for timely commercialization. They have made valuable contributions to the energy balance, economic development, and environment of their states and the nation.

SERTTI prospects are uncertain given their dependency on funding from oil-overcharges and utilities in an era of utility restructuring, oil-overcharge fund depletion, and general declines in energy research and development (R&D). SERTTI are likely to continue following restructuring, with funding from traditional sources or systems benefits charges[2], however, the R&D mix and SERTTI activities will probably change. Unless provisions are made, utility investments in public-benefit R&D are likely to fall precipitously, reducing benefits and diminishing state-level R&D efforts because there will be less utility funding for SERTTI to leverage.

Many R&D issues emerge that all states will need to address as they make restructuring decisions: What is *public-benefit* R&D, how can it be more effective, how much funding should be provided, who should administer funds, how should funds be allocated? Is a dedicated R&D fund needed? Is there a role for SERTTI to be involved in technology transfer? This paper looks at the current situation of state-level R&D in regard to restructuring and suggests answers to these questions.

Introduction

State energy research and technology transfer institutions have made valuable contributions to the energy balance, economic development, and environmental integrity of their states and the nation. They have helped companies develop and introduce new products and manufacturing techniques that protect the environment, enhance business revenues, create jobs, and save consumers hundreds of millions of dollars annually through lower energy bills. Despite their success, future prospects are uncertain given the dependency of many programs on oil-overcharge funding or utility contributions or surcharges in an era of utility restructuring, steady depletion of oil-overcharge funds, and broad-based declines in energy R&D in the private, utility, and public sectors.

The paper summarizes case studies on a dozen of the more successful state R&D programs, discusses relevant restructuring issues, recommends the role of SERTTI in a more competitive utility environment, and profiles 16 members of the Association of State Energy Research and Technology

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[1] SERTTI vary in type, including state-run, university-run, and independent non-profit institutions, but do not include utility programs.

[2] Systems benefits charges are small non-bypassable charges added to the price per kilowatt hour of energy, used to fund public-benefit purposes.

Transfer Institutions (ASERTTI). A more detailed version of this paper, *Energy Technology Innovation at the State Level: Review of State Energy Research, Development, and Demonstration Programs* (Pye and Nadel 1997), is available from ACEEE.

The Association of State Energy Research and Technology Transfer Institutions (ASERTTI)

In 1990, several state energy research and technology transfer institutions established ASERTTI in response to the increasing need for state initiatives in energy R&D, and technology transfer. ASERTTI is a confederation of state and regional organizations focused on enhancing energy research and technology transfer on a statewide and regional basis to promote collaboration and eliminate duplication. As of June 1998, ASERTTI had 21 members (see Figure 1):

> *Mission: "To increase the effectiveness of energy research efforts in contributing to energy security, environmental quality, and economic growth."*

ASERTTI Members

California Energy Commission (CEC)
California Institute for Energy Efficiency (CIEE)
Connecticut Office of Policy & Management
Energy Center of Wisconsin (ECW)
Energy Systems and Resources Program, University of Missouri
Florida Solar Energy Center (FSEC)
Hawaii Department of Business, Economic Development, and Tourism (DBEDT)
Iowa Energy Center (IEC)
Kansas Electric Utilities Research Program (KEURP)
Massachusetts Division of Energy Resources (Mass DOER)
Minnesota Building Research Center (MnBRC)
Missouri Environmental Improvement and Energy Resources Authority (EIERA)
Nebraska Energy Office
New York State Energy Research and Development Authority (NYSERDA)
Northeast Energy Efficiency Partnership (NEEP)
North Carolina Advanced Energy Corporation
Oregon Department of Energy
Pennsylvania Office of Pollution Prevention and Compliance
South Carolina Energy Research and Development Center
Virgin Islands Energy Office (VIEO)
Washington State University Energy Program

These institutions develop and promote energy efficiency and renewable energy technologies. ASERTTI members vary significantly in terms of type, funding and co-funding levels, and funding sources. Table 1 summarizes the most current data available ('96/'97) for 16 ASERTTI members for which data were available (in many cases pre-restructuring). Their situations, however, are changing rapidly with restructuring. For example, California Energy Commission's funding increased from $7.6 million (utility mandatory surcharge) in FY 96/97 to approximately $65 million (non-bypassable distribution charge) in

FY 97/98. Similarly, in 1998, NYSERDA is getting approximately $7 million in additional funding from systems benefits charges.

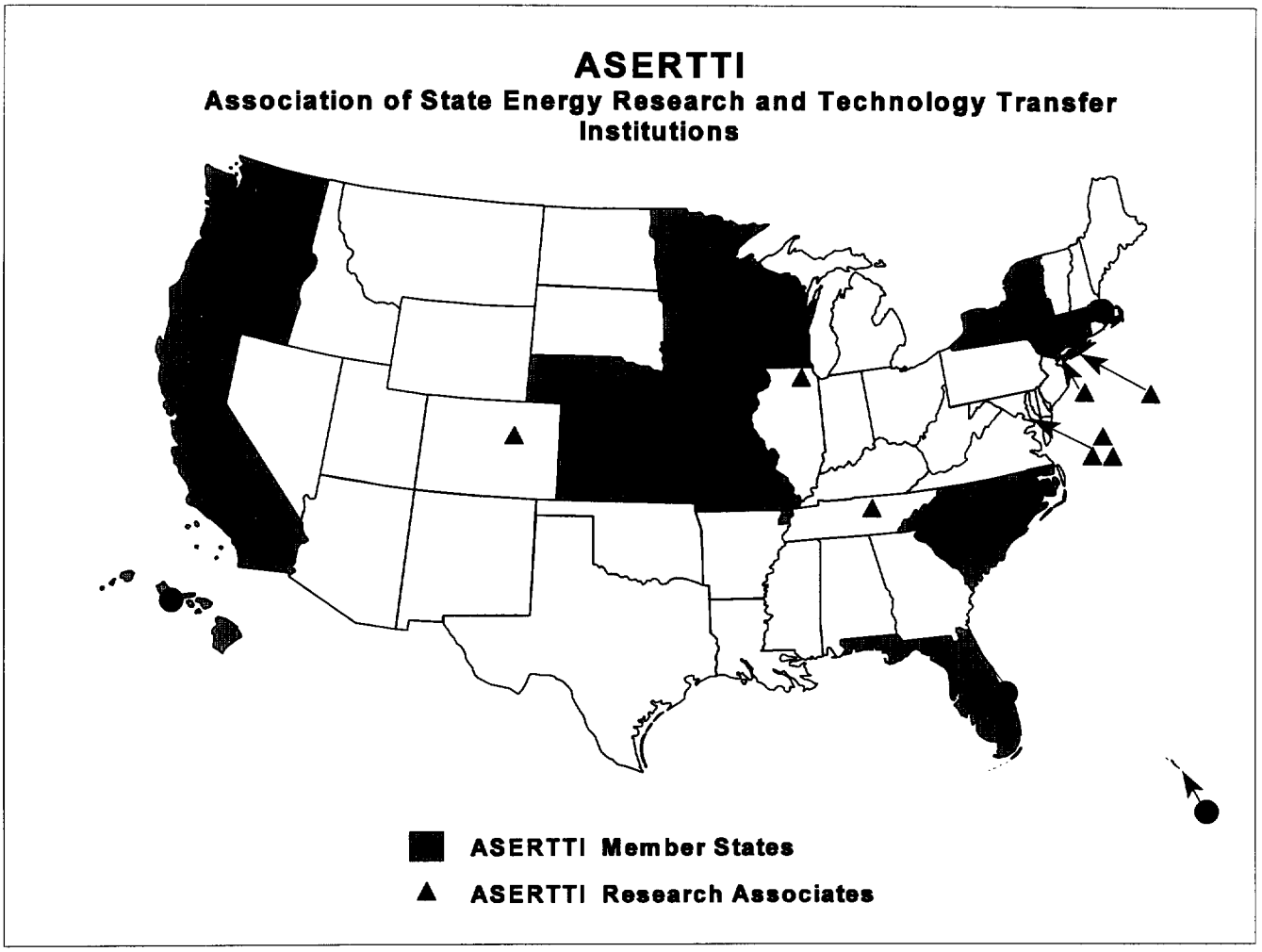

Figure 1. Location of ASERTTI Members

ASERTTI members managed more than $180 million in 1996/97 for energy research. This amount includes a $64 million SERTTI budget and $118 million[3] in project co-funding from public and private research partners (e.g., DOE, EPA, local businesses). Compared to efforts of utilities, the federal government, Electric Power Research Institute (EPRI), the Gas Research Institute (GRI), and the private sector, who together spent approximately a billion dollars on energy-related R&D in 1996 (Dooley 1996), SERTTI R&D efforts are small. Despite relatively small funding levels, SERTTI have sponsored public-benefit programs that have had nation-wide impact, and have been particularly effective in addressing state and local priorities.

[3] These figures are for the ASERTTI members who provided funding data.

Table 1. ASERTTI-Member Summary

Organization	State	Year Est'd.	Type	R&D Funding Level ($mil/yr) 1996/97	1998 Primary Source of Funds	Matching Funding ($mil/yr) 1996/97	Program Focus/ Use of Funds	Majority of Research Contracted Out/ In-house
California Energy Commission	CA	1975	state	7.6*	systems benefit charge	23.0**	renewable/conservation tech. grants/loans	Contracted out
CA Institute for Energy Efficiency	CA	1988	univ.	3.0	California Energy Commission	2.3	elec./gas end-use effic., RD&D & tech. transfer	Contracted out
Office of Policy & Management	CT	1994	state	0.1	oil overcharge	-	en. effic., renewables, RD&D, tech. transfer	Contracted out
Energy Center of Wisconsin	WI	1989	non-profit	4.7	utility voluntary contribution	>10.0	en effic. RD&D, tech. transfer, customer-side of meter	Contracted out
Florida Solar Energy Center	FL	1974	univ.	8.4	state, contracts	-	renewables, en. effic.	In-house
Dept. of Business, Econ. Dev. & Tourism	HI	1981	state	0.7	oil overcharge	1.5	renewables, en. effic.	Contracted out
Iowa Energy Center	IA	1990	univ.	4.6	utility mandatory surcharge	6.5	en. effic. & renewable R&D, tech. transfer	Contracted out
Kansas Electric Utiities Research Program	KS	1981	non-profit	0.7	utility voluntary contribution	5.0	renewables, elec. vehicles, power quality, elec./magnetic field issues	Contracted out
Massachusetts Dept. of Energy Resources	MA		state	N/A		-	en. effic., renewables, transportation	Contracted out
Minnesota Buildings Research Center	MN	1987	univ	N/A		-	buildings	Contracted out
MO Env. Improvement & Energy R&D Authority	MO	1972	quasi-govt.	2.5	financing and tipping fees	5.0	en. effic., education, renewables	Contracted out
Nebraska Energy Office	NE	1973	state	1.3**	oil overcharge	-	financing, load mgt., alternative fuels	Contracted out
NY State Energy R&D Authority (NYSERDA)	NY	1975	public-benefit state corp.	15.9	systems benefit charge	64.0	buildings, industry, transportation energy resources/renewables, environmental research	Contracted out
Advanced Energy	NC	1980	non-profit	4.5	utility voluntary contribution	-	en. effic, RD&D, building science, motors & drives	In-house
South Carolina Energy R&D Center	SC	1981	univ./ state	5.0	US DOE & EPA	0.2	tech. transfer, land-based gas turbines, muni. solid waste, buildings	Contracted out
Virgin Islands State Energy Office	VI	1974	state	4.8**	oil overcharge	-	end-use effic., renewables, energy resources, environmental quality, econ. development	Contracted out
Total for Members with Available Data				**63.8**		**117.5**		

*1997/98 funding level is approximately $65 million (not including co-funding).

**Estimate

Achievements and Lessons Learned from State Energy R&D Case Studies

Table 2 summarizes 12 of the more successful and innovative ASERTTI-collaborative and ASERTTI-member projects, reflecting approaches that integrate technology development and deployment to advance state-of-the-art technical knowledge to address real-world needs and opportunities. These projects are not confined to a single piece of hardware; instead, they define technology more broadly to include energy systems and services.

SERTTI have historically built on research by others and filled in gaps when a significant state need was not being met. The SERTTI build on the more basic research capabilities of the federal government and university systems and focus on technologies and services with potential for timely commercialization and use. Many ASERTTI members have worked collaboratively with utilities to plan and manage programs. Most ASERTTI members work extensively with energy end-users and technology developers in their respective states. The SERTTI have developed many successful approaches to make public-interest R&D efforts more effective:

- *Collaborating with a variety of partners* brings a diverse range of expertise to their projects, stretches research dollars, makes the technologies developed more marketable, and creates closer contacts with constituents.
- *Getting stakeholder input from the beginning of the process* allows for agreement on project design.
- *Building strong partnerships* is part of what places SERTTI in a unique position to involve a wide range of partners.
- Approaching projects as *objective service providers* strengthens their credibility.
- Taking *marketing and technology transfer* into account in initial project stages shapes research to accommodate commercialization and maximize effectiveness.
- *Understanding customers and marketplace dynamics* is key to successful marketing of new products or services.
- *Focusing efforts* is important and can be facilitated by structuring requests for proposals (RFPs) so that they solicit multiple complementary projects that address a topic area that has been identified as "ripe for action."
- *Being flexible* allows organizations to act quickly to pick up "hot" projects, and fosters project expansion by being open to identifying opportunities throughout the entire project.
- *Being patient* is required because it often takes time to get the attention of manufacturers, develop a productive relationship with them, conduct R&D, and get to the commercialization phase.

SERTTI have evolved over the years, learning lessons such as these not only from successes, but also from failures. Emphasizing project evaluation would further strengthen credibility, as most projects are not well-evaluated. Evaluation criteria should be identified early in the planning stage. Certain institutions have struggled with cumbersome administrative bureaucracies. Others are still working on maximizing the number of the "public" who can benefit from their public-benefit R&D (i.e., doing good work *and* getting the message out—through marketing, publications, workshops, etc.). Marketing their "product" could only be enhanced by further evaluation of their programs, so the public can better understand the magnitude of the return on the investment in energy efficiency and their contribution toward public-benefit R&D.

Table 2. ASERTTI Case Study Highlights

Residential Thermal Distribution Systems—develops and commercializes residential duct technologies.

- Savings potential for California consumers: $300-600 million per year. Reduces costs for sealing ducts in existing homes by half (CIEE).

National Lighting Product Information Program (NLPIP)—publishes and distributes publications on innovative lighting products and subjects.

- Over 160,000 publications distributed to date.
- Country's primary source of *objective* information on efficient lighting.
- Serves as model for IEC's HVAC program (ASERTTI).

Hybrid Electric Vehicle (HEV) Program—develops and demonstrates HEV technologies.

- Developed the first hybrid electric bus, and facilitated business partnership to produce 100 of these buses (NYSERDA).

Residential and Commercial Heating Program—provides funding to heating-equipment manufacturers to develop innovative products:

- Pulse-combustion space-heating boiler saves 20 percent of energy and halves emissions.
- Condensing, gas-fired boiler cost effectively achieves 20 percent energy savings (NYSERDA).

Low-Income Housing and Weatherization—develops and demonstrates technologies, processes, and strategies to save energy in low-income households.

- Targeted Investment Protocol System (TIPS) has helped low-income households cut energy bills more than 25 percent on average.
- Model for other states (NYSERDA).

Energy-Efficient Wastewater Treatment and Sludge Management Technologies—provides co-funding for municipalities and businesses to test, demonstrate, and implement technologies that save or produce energy.

- Savings for 6 recent projects: 19-65 percent energy savings; 18-86 percent cost savings.
- Non-energy benefits: reduction in residue disposal saves landfill space (NYSERDA).

Biopulping—new technology that reduces energy and cost of making high-quality paper.

- Savings: 30 percent reduction in pulp grinder's electricity consumption.
- Non-energy benefits: increases throughput and produces stronger paper (ECW).

Responsible Power Management (RPM) High-Efficiency Motors Program—provides information and tools to motor distributors.

- Increased share of energy-efficient motors sold in Wisconsin to 37 percent in 1996.
- Coordinated utility programs and simplified rebate process across state.
- Serves as model for nationwide program (ECW).

Performance Optimization Service—uses *systems* approach to optimize entire motor system.

- Energy savings: 20-50 percent for systems identified as good candidates for POS.
- Average project payback: less than 2 years (ECW).

Reducing Cooling Loads and Smog Through Urban Heat Islands Control—measured energy savings of shade trees and light-colored roofs.

- Energy savings: approximately 30 percent (air-conditioning savings) from either strategically planted shade trees or reflective roofs.
- Doubling albedo of roofs and pavements decreases ozone levels by as much as 11 percent during peak afternoon hours (CIEE).

California Building Code Project for Electric Vehicle Chargers—developed, adopted and trained building officials on building codes that ensure safe, effective installation of electric vehicle charging systems.

- Coordinated wide range of stakeholders with disparate agendas.
- Serves as model for other states (CEC).

Low-Cost Water-Heating Systems—promotes use of cost-effective, solar water heating.

- 460,000 solar water-heating systems installed in Florida, saving consumers $83 million/yr (FSEC).

State Energy Research and Technology Transfer Institutions as Providers of Public-Benefit R&D

Public-benefit R&D involves goods and services that benefit society, but for which private interests cannot capture enough revenues to recover the cost (plus a profit) of providing the goods and services (e.g., space exploration). In addition to providing a variety of services to promote the creation, development, and commercialization of new technologies for energy efficiency, public-benefit R&D can address myriad market failures that persist in the energy services marketplace.

Public-benefit R&D performed by SERTTI is gaining in importance because fewer organizations are providing it as a result of electric utility industry restructuring, decreasing federal budgets, and businesses focusing more on near-term profits. Public-benefit R&D that reduces energy use and pollution can also enhance business competitiveness by reducing the energy and waste content of their products.

In order for a market to function, good information is needed and SERTTI have proven their ability to disseminate information well. By supporting development of renewable energy sources by local businesses, SERTTI can diversify the states' energy resource mix.

SERTTI can also reduce the economic and environmental costs of predicted growth in transportation energy demand, and help fiscally stressed municipalities meet environmental requirements.

While substantial and useful R&D can be included in broader public-benefit programs, a valuable role exists for statewide, dedicated R&D. The benefits of working at a statewide level, compared to federal R&D, include:

- Focus on state and regional needs and opportunities provides R&D that is not addressed by national programs (e.g., ECW's work with the paper industry and FSEC's promotion of solar water heaters);
- Closer ties with local industries and consumers make R&D more "customer driven" (e.g., NYSERDA's work with New York businesses and CEC's work on building codes for electric vehicle chargers); and
- Closer ties with state and local R&D expertise enriches the value of the R&D (e.g., CIEE and University of California and LBNL).

Benefits also accrue from working at the statewide level as compared to individual company R&D:

- Greater resources can be brought to bear and more coordination is possible than if individual companies and utilities operate their own public-benefit R&D programs. For this reason, many utilities have voluntarily chosen in the past to channel a portion of their R&D funds through statewide organizations (e.g., NC Advanced Energy Corporation and ECW);
- A dedicated statewide R&D fund has greater visibility than more dispersed efforts; and
- State institutions are in a better position to leverage federal resources.

SERTTI effectively fill a need for R&D that can focus on state and local needs and coordinate a range of resources from across the state. The biggest issue currently on the minds of SERTTI is the uncertainty of future funding sources as the electric utility industry restructures.

Electric Utility-Industry Restructuring and the Future of State Energy Research and Technology Transfer Institutions

Utility restructuring will probably alter the mix of R&D and may add new functions to SERTTI's activities. In all six states that have ASERTTI members and where some final or preliminary restructuring decisions have been made, it appears that the R&D institutions will continue, some with their traditional funding sources, and some with funding from a small charge on distribution service.

In some cases, the roles of SERTTI will expand. For example, restructuring legislation in California delegated administration of public-benefit funds for R&D and renewable energy to the California Energy Commission (CEC), and a public service commission decision in New York delegated administration of public-benefit funds to the New York State Energy Research and Development Authority (NYSERDA). In February 1998, the CEC issued its first RFP seeking proposals for R&D projects to fund. A future role is not ensured in the case of California Institute for Energy Efficiency (CIEE), although given CIEE's expertise and experience, it is likely that it will partner with the CEC in planning, funding, and managing a major component of the public-benefit R&D program. In Massachusetts, restructuring legislation has established a significant new R&D and promotion effort for renewable energy to be administered by Massachusetts Technology Park Corp., a quasi-government agency with directors appointed by the Governor. In other states that have made restructuring decisions, some are continuing R&D activities as part of broader energy efficiency and renewable energy efforts and a few have thus far ignored R&D and other public-benefit programs.

While SERTTI are likely to continue in many states following restructuring, this is only part of the picture. Utility R&D funding historically exceeded ASERTTI R&D funding by more than a factor of five. Even in states with large state R&D organizations such as New York, California and Florida, utility R&D funding historically exceeded state R&D organization funding to a substantial degree. ASERTTI members often work closely with local utilities to fund projects jointly, thereby leveraging ASERTTI members' funds. While some utility R&D funding will continue following restructuring, unless specific provisions are made by policy-makers, utility investments in public-benefit R&D are likely to fall precipitously. Such funding cuts will directly reduce benefits from these investments, and can also adversely affect state R&D efforts because there will be less utility funding for SERTTI to leverage.

From our review of restructuring in California and other states, a number of R&D issues emerge that all states will need to grapple with as they make decisions on restructuring. Among these questions are the following:

- What is *public-benefit* R&D, versus R&D that can and should be funded by private entrepreneurs or regulated distribution companies?
- Is a dedicated R&D fund needed, versus funding R&D out of designated funds for such public purposes as energy efficiency and renewable energy?
- To what purposes should public-benefit R&D be focused—energy efficiency, renewable energy, environmental research, environmentally preferred advanced generation, system reliability, others?
- Who should administer public-benefit R&D funds—state agencies, utilities, non-profit institutions?
- How much funding should be provided?
- How should funds be allocated?
- To what extent should strategic planning guide decisions about allocation of public-benefit R&D funds?

- Should R&D programs stop at the point of demonstration, or is there a useful and appropriate technology transfer role for R&D institutions including commercialization and promotion of new technologies in the marketplace?
- How can public-benefit R&D be made more effective?
- How should R&D programs be coordinated with other public benefit programs and with privately funded R&D efforts?

Suggested answers to these questions are discussed in the Recommendations section of the full report. Briefly, we conclude:

- There is an important role for public-benefit R&D—not all good and socially beneficial ideas will be developed by the private market. Given past cutbacks in federal and private R&D[4] that will be difficult to reverse, it is very important that steps be taken to minimize reductions in state and utility public-benefit spending.
- At least a portion of these funds should be in dedicated, statewide or regional R&D funds to permit a statewide or regional approach to R&D, rather than having to coordinate multiple utility-based efforts. Also, state institutions are probably in a better position to leverage federal resources than individual utilities.
- The R&D organization responsible for administering programs must be not only a good administrator, but also technically competent and widely perceived as objective. The administrator should have a strategic vision of what it seeks to accomplish and have good ties with private companies and other researchers throughout the state and region. Administrators need the contacts and ability to involve other stakeholders in their planning, prioritization, and funding processes. The administrator also needs to be flexible and independent.
- State public-benefit R&D, including both statewide and utility-supported funds, is currently funded at approximately $2 per capita annually in the states that are leaders in energy innovation. This funding level may be a reasonable level for other states to consider for their public benefit R&D efforts.
- Priority areas should be established to guide the allocation of funds, so that efforts are focused rather than scattered. For example, priorities can be established and used as the basis for a series of RFPs, one or more for each priority area.
- R&D institutions should be broad in scope, with the ability to pursue technology transfer and deployment efforts to the extent other players are not adequately addressing these needs. R&D institutions should plan for and be involved in commercialization activities, with the role of the R&D institution gradually lessening as deployment proceeds.
- Work by R&D institutions should be well-coordinated with other public benefit programs, particularly programs that will help advance the deployment of new technologies developed through R&D efforts. Likewise, state R&D institutions should work closely with the private sector, such as by conducting cooperative research projects, seeking private sector co-funding, and subcontracting some work to the private sector, because ultimately it will be the private sector that will commercialize and market new technologies.

[4] Between 1985 and 1994, federal energy R&D spending (in real dollars) was cut ten percent and private sector energy R&D spending was cut 42 percent (in real dollars) (Dooley 1997).

Conclusion

State-sponsored R&D emphasizing energy efficiency and renewable energy sources is a forward-looking investment that can pay off substantially in the long run given national and global challenges such as climate change, urban air pollution, and global economic competition. The states that nurture local production of technologies such as fuel cells, PV systems, hybrid electric vehicles, and super-efficient appliances, etc. *today* are likely to be the states that will be major suppliers of these key technologies of the 21st century.

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