

Please cite this paper as:

OECD (2008), "Eco-Innovation Policies in the United States", Environment Directorate, OECD.



**Country profiles on policies to support environment-friendly innovation**

# **Eco-Innovation Policies in the United States**

Xavier Leflaive



Environment Directorate

## FOREWORD

The report is part of a series of country profiles on eco-innovation policies developed for eight non-EU OECD members: Australia, Canada, Japan, Korea, Mexico, New Zealand, Turkey and the US. Country profiles are based on extensive desk research and on field missions in selected countries (Canada, Japan, Korea, the US). Country experts have commented earlier drafts of their country profile.

This series complements the eco-innovation roadmaps developed by EU member countries under the Environmental Technology Action Plan. It provides an empirical basis for further investigation on policies to support eco-innovation.

A short introduction presents the background for this series of country profiles, including the methodology, and a brief overview of some of the instruments identified.

The country profiles were drafted by Xavier Leflaive, under the supervision of Brendan Gillespie. Carla Bertuzzi has provided data and information on measurement issues and has drafted selected sections. IEEP was commissioned for the initial desk research and preliminary identification of policy issues. Country experts have provided most valuable inputs, in terms of time, information and policy relevance: Warren Hughes (Department of the Environment, Water, Heritage and the Arts, Australia), Javier A. Gracia-Garza (Environment Canada), Graham Campbell (Natural Resources Canada), Tim Karlsson (Industry Canada), Noriko Kishimoto (Ministry of the Environment, Japan), Kyu-Shik Park (Ministry of Environment, Republic of Korea), Carlos Muñoz Villarreal (Ministry of Environment and Natural Resources, Mexico), Vera Power and Alison Stringer (Ministry for the Environment, New Zealand), David Widawsky (USEPA), Sebahattin Dokmeci (Ministry of Environment and Forestry, Turkey).

**Copyright OECD, 2008.**

**All requests for permission to reproduce or translate all or part of this material should be submitted to [rights@oecd.org](mailto:rights@oecd.org). OECD Publishing, 2, rue André Pascal, 75775 Paris Cedex 16, France.**

## TABLE OF CONTENTS

|  |    |
|--|----|
| FOREWORD .....   | 2  |
| INTRODUCTION.....  | 4  |
| Background.....  | 4  |
| Policy instruments to support eco-innovation .....                 | 4  |
| COUNTRY PROFILE OF THE US .....                                    | 6  |
| Introduction and country definitions of eco-innovation .....       | 6  |
| Policies, Initiatives and instruments – a national inventory ..... | 10 |
| Country Synthesis.....   | 28 |
| Appendices .....   | 32 |

### Figures

|  |    |
|--|----|
| Figure 1. R&D budgets in US, Japan and the EU.....     | 10 |
| Figure 2. Venture capital funding eco-innovation ..... | 34 |

### Boxes

|   |    |
|---|----|
| Box 1. Clean Energy Technology Export in Guatemala..... | 27 |
| Box 2. Institutionalised collaboration.....             | 29 |

## INTRODUCTION

### Background

This report is part of the OECD work programme on eco-innovation policies.

The ambition of this report is to provide an empirical inventory of policies in place in the US to promote eco-innovation. Considering that European countries had developed roadmaps for eco-innovation policies in the context of the European Commission Environmental Technology Action Plan (ETAP), the secretariat prepared an inventory of eco-innovation policies in eight non-EU OECD countries (Australia, Canada, Japan, Korea, Mexico, New Zealand, Turkey and the US). A similar project for China is published separately.

The objective of this work is to complement the knowledge base on eco-innovation policies in OECD countries and to provide empirical material for additional research on policy issues related to eco-innovation. The outline of each country profile is similar to that of ETAP roadmap, to facilitate comparison.

The work was implemented in coordination with country delegations, which have identified experts in each country who could provide additional information and review initial drafts of the country profile of their country.

A consultant (IEEP, Brussels, Belgium) has been commissioned to collect all information publicly available in English on eco-innovation policies in each of the eight non-EU OECD members. Field missions have been organised by the country experts in four countries (Canada, Japan, Korea, the US). During these missions, the secretariat met with the agencies identified and selected by the country expert. Draft country profiles have been developed on the basis of desk research and field missions. They have been reviewed by national experts and revised accordingly. All country profiles present information which was up-to-date at the end of 2007. In most cases, more recent information has been taken into account.

### Policy instruments to support eco-innovation

The country profiles confirm that eco-innovation policies deploy a variety of instruments. They have to adjust to the features of the domestic economy, in particular the knowledge base, the size of domestic markets, and the *vigueur* of the venture capital industry.

In most non-EU OECD countries, public research and development (R&D) remains a major orientation. The US and Japan typically allocate significant public finance to environment-related R&D. However, three trends have emerged: i) some countries are concerned by the competition and trade issues related to such support; ii) public resources are increasingly channelled via Departments not directly in charge of environment policies (Energy, Agriculture, Transport), making inter-agency cooperation even more necessary; iii) the role of research organisations is being redefined, to intensify linkages with the private sector and stimulate the development of marketable outputs; incubators in the

US, or the National Institute of Advanced Industrial Science and Technology's (AIST) Technology Licensing Office in Japan illustrate innovative arrangements in this area.

Attracting private funds to finance environmental R&D is another major policy orientation. The main issue is to reduce risks for private investors investing in environmental R&D projects, while making sure that public money is used effectively and does not crowd out private initiatives. A variety of funds have been established to reduce risks to private investors (e.g. Sustainable Technology Development Canada-SDTC in Canada), or incubators (e.g. The Clean Energy Alliance in the US, Environmental Technology Business Incubator in Korea). Measures are taken to stimulate the venture capital industry and to provide incentives for environment-related projects; e.g. this is the role of the Environmental Venture Fund in Korea.

Environment-related performance standards are being set with the aim of stimulating innovation in goods and services. Such standards are pursued in particular in the field of energy and resource efficiency. However, standards may provide disincentives and can only have a lasting positive effect on innovation if they are timely revised. Schemes such as the Top Runner programme in Japan aim to address this challenge.

Market-based instruments are burgeoning in non-EU OECD Countries. A number of new projects and initiatives have been identified at national or local level. One interesting case is the all-encompassing Emission Trading Scheme envisioned in New Zealand, where equitable sharing of responsibility across sectors and stakeholders is based on the principle of equity across sectors.

There is some evidence that, besides environmental policy instruments and regulation, soft instruments such as voluntary commitments, eco-audits and eco-labels play a role as determinants of innovative behaviour in firms. Voluntary initiatives can become mandatory over time (cf. Stand-by Korea). Industry initiatives abound and, in particular contexts, can change the relationship between the administration in charge of environment policies and the business sector. This is illustrated by Performance Tracks in the US, where the US Environmental Protection Agency (USEPA) and firms enrolled in the programme construct a collaborative relationship. This typifies what can be seen as a new phase in environmental policies which sets out to promote broader sustainability, rather than address one single environmental issue. In that perspective, governments rely less on regulatory tools and endeavour to work with industries, in sectors which use materials and/or energy.

In line with the OECD Council Recommendation on Improving the Environmental Performance of Public Procurement [C(2002)3], green procurement initiatives are burgeoning at local and national levels. Guidelines are supported by websites, green products databases, and *pro forma* requests for tenders. The Green Purchasing Network is an international network active in this area.

Some initiatives set out to promote technologies and products developed by one country. Others try to alleviate barriers to the deployment of environment-friendly technologies and products; shared definitions, standards and labels contribute to a level playing field for the creation and diffusion of environment-friendly technologies, products and life-styles. Such efforts are still plagued by institutional problems related to intellectual property rights and international monetary transfers. Typically, the capacity of a national agency to (financially) support one country's side of a multinational joint venture depends on how countries will share the intellectual property rights. Few cooperation projects reach developing countries (with the exception of East Asia, and China in particular).

## COUNTRY PROFILE OF THE US

### **Introduction and country definitions of eco-innovation**

#### ***Definitions related to eco-innovation used in the Country***

‘Environmental innovation’ or ‘clean technology’ (cleantech) is more often used in the US than ‘eco-innovation’. The Environmental Protection Agency considers that today’s environmental challenges require new approaches. It fosters innovation and collaboration. It approaches environmental innovation as a result-oriented, collaborative endeavour. The emphasis is both on innovation in the *regulatory approaches*, and in *technologies or techniques* for environmental protection.

Innovative regulatory systems include pilot testing flexible air permits, offering regulatory incentives for environmental improvements, innovative ways to regulate small businesses (through an integrated system of compliance assistance, self-certification procedures and statistically based performance measurement). USEPA supports regulatory innovation at State level as well. The Innovation Toolkit for EPA Rulewriters provides a framework for and examples of innovative approaches in the regulatory process; the competitive State Innovation Grant Programme provides funding to help states explore innovative approaches in three areas of mutual interest, namely environmental permitting, environmental management systems and performance-based leadership programmes.

Environmental technology development also benefits from government’s support. Major amendments to the most important environmental laws (Clean Air Act, Clean Water Act, Federal Insecticide Fungicide and Rodenticide Act, etc.) have enhanced and, in some cases, expanded the environmental mandate. Some provisions of these laws provide new tools for achieving environmental results, and some of these new tools rely on technology and market forces.

#### ***Institutions playing a major role on eco innovation***

A number of federal agencies support eco-innovation, often in a collaborative way. States play a crucial part. Some institutions have been created to steer work in particular areas.

#### ***US EPA***

EPA’s strategic plan 2006-2011 entails three principles, or cross-cutting themes. One is innovation and collaboration, with the aim to promote a sense of environmental stewardship and shared responsibility for addressing environmental challenges. Another one is the use of best available science, to anticipate threats and opportunities.

In 2002, EPA released a comprehensive strategy to drive innovation in environmental programs. EPA’s innovation strategy is based on the idea that future environmental protection systems will rely less on technology requirements and more on strategies tailored to address the needs of whole facilities, communities, or industry sectors. The strategy targets a set of priority problems: reducing

greenhouse gases and ozone, restoring water quality and addressing the funding gap for water infrastructure. All types of options are considered (regulations, policy, guidance, voluntary initiatives and compliance assistance). The strategy focuses on developing tools that will expand current capabilities, for example by supporting environmental technology innovation. This entails in particular creating a culture and organisational systems to foster innovation at the Agency.

EPA has established an Innovation Action Council, a senior-level policy forum which develops an innovation work plan, oversees and reports on innovation progress. States participate in the Council.

Efforts to boost innovation are coordinated through the National Center for Environmental Innovation ([NCEI](#)), which describes its role as follows: “NCEI is working to bring about the next generation of environmental protection, one that focuses more on results and less on process; emphasizes environmental protection, not just pollution control; and takes a comprehensive rather than piecemeal approach to problem-solving. This environmental protection system we envision - and are working toward - would use more market-based incentives that link environmental and economic objectives. It would also provide better information and meaningful opportunities for public involvement in decision-making”.

NCEI works at firm, sector, community level; it collaborates with states and tribes as well; it runs a network of 10 regional offices. Partnership with colleagues in the EPA or with other public or private sector organisations is a major feature of NCEI’s strategy, as it fosters leveraging resources and sharing experience.

#### *US Department of Energy*

The [Department of Energy](#) is an important player in the development of energy technologies. In particular, it has initiatives in the field of fossil fuel (carbon sequestration from coal plants), energy efficiency (e.g. it is responsible for developing energy efficiency standards) and renewables.

The DoE presents itself as a holding, with ten programmes focused on technologies. For each programme, its mission is to find ways to develop and commercialise technologies developed in national laboratories so that they become cost competitive. National laboratories administered by DoE are incentivised to actively promote their technologies; for instance, laboratories are allowed to take an equity share in the companies that commercialise the results of their research. Major projects involve demonstration at a production (not pilot) scale.

The Department works with other agencies, universities and venture capital companies (to understand what it would take to lower the risk from an investor’s perspective). It operates a number of instruments with a view to lower the risks for investors: commercialisation funds, loan guarantees (to subsidise the cost of capital for large scale project development), entrepreneurship residence programmes (to create incentives for venture capital firms to come in the laboratories); it showcases best technologies to venture capital firms.

#### *The U.S. Department of Defence*

DoD has a strong action on the field of environment and sustainability in general. This entails buildings, vehicle fuel and energy. Research is involved.

In particular, DoD operates the Strategic Environmental Research and Development Program ([www.serdp.org](http://www.serdp.org)), planned and executed in full partnership with the Department of Energy and the

Environmental Protection Agency, with participation by numerous other federal and non-federal organizations. To address the highest priority issues confronting the Army, Navy, Air Force, and Marines, SERDP focuses on cross-service requirements and pursues high-risk/high-payoff solutions to the Department's most intractable environmental problems. The development and application of innovative environmental technologies support the long-term sustainability of DoD's training and testing ranges as well as significantly reduce current and future environmental liabilities in the US (forts) and abroad.

### *US Department of Agriculture*

USDA plays a major role on eco-innovation for renewables, biofuels and bio-products. It cooperates with other agencies, such as USEPA and more recently with DoE.

At the turn of the century, USDA had initiated work on biomass and energy. The Energy Title of the Farm Bill, in 2002, invited USDA to put more emphasis on energy (solar, wind, biofuels). The issue of rural development is another entry point.

Support to eco-innovation spreads all along the technology continuum; the instruments depend on the maturity of the technologies. Typically, USDA supports basic research on feedstock supplies and on logistical issues (with concerns about scale, etc.); direct public funding and tax rebates are essential instruments at this stage. In the case of anaerobic digestion, the thrust is on demonstrating the technology. For more robust technologies, the priority is market access. The effort is shifting from initial emphasis on R&D to deployment.

### *The National Science Foundation*

The Foundation supports basic science research and education. A wide array of proposers is eligible, including universities and colleges, non-profit, non-academic organisations, for-profit organisations (in particular SMEs), states and local governments. Proposals are assessed on the basis of two merit review criteria: the intellectual merit of the activity, the broader impacts of the activity (in particular in terms of teaching, training and learning, access to underrepresented groups, infrastructure for research and education, dissemination, benefits for the society).

The Foundation has an Environmental Research and Education division which is relevant to eco-innovation (<http://www.nsf.gov/geo/ere/ereweb/about.cfm> ). It is particularly active in nanomaterials and water.

### *States*

States are engaged in environmental innovation and related policy, including through the Environmental Council of the States ([www.ecos.org](http://www.ecos.org) ). They approach eco-innovation either through an environmental or an economic development perspective (e.g. Mississippi considers turning its economy into a biofuel economy, in the aftermath of Katrina). Under certain circumstances, they can act on their own standards.

### ***Policy documents related to eco-innovation***

The Energy Independence and Security Act was signed in December 2007. It consists mainly of provisions designed to increase energy efficiency and the availability of renewable energy. It is consequential for eco-innovation policies in the US. The three key provisions are the Corporate

Average Fuel Economy (CAFE) Standards, the Renewable Fuel Standard (RFS), and the appliance/lighting efficiency standards (see details on [energy.senate.gov](http://energy.senate.gov)):

- Corporate Average Fuel Economy (CAFE) Standards. The law sets a target of 35 miles per gallon for the combined fleet of cars and light trucks by model year 2020. Also, fuel economy programs are established for trucks;
- Renewable Fuel Standard (RFS). The law sets a modified standard that starts at 9.0 billion gallons of renewable fuel in 2008 and rises to 36 billion gallons by 2022. Of the latter total, 21 billion gallons is required to be obtained from advanced biofuels;
- Appliance and Lighting Efficiency Standards. Energy efficiency standards are set for broad categories of lamps. A required target is set for lighting efficiency, and energy efficiency labeling is required for consumer electronic products. Also, efficiency standards are set by law for a number of appliances. Further, Department of Energy is directed to set standards by rulemaking for furnace fans and battery chargers.

Some of the most relevant policy documents for eco-innovation are mentioned below:

- National Center for Environmental Innovation, 2004: report on progress (most recent one issued, at <http://www.epa.gov/innovation/aboutncei.htm>); most of EPA related literature can be found at <http://www.epa.gov/etop/>;
- [A new generation of American Innovation](#): a presidential initiative announced by President Bush on April 26, 2004. Among its aspects are ‘Providing a cleaner more secure energy future through hydrogen fuel technology,’ with funding channelled through the DOE;
- [American Competitiveness Initiative](#): announced by President Bush in his 2006 State of the Union address. Among its goals are: ‘Overcoming technological barriers to efficient and economic use of hydrogen, nuclear, and solar energy through new basic research approaches in materials science (DoE, NSF, NIST);
- The [National Energy Policy Act](#) contains a large number of items relevant to promoting innovative energy;
- The US Department of Energy [Strategic Plan](#).

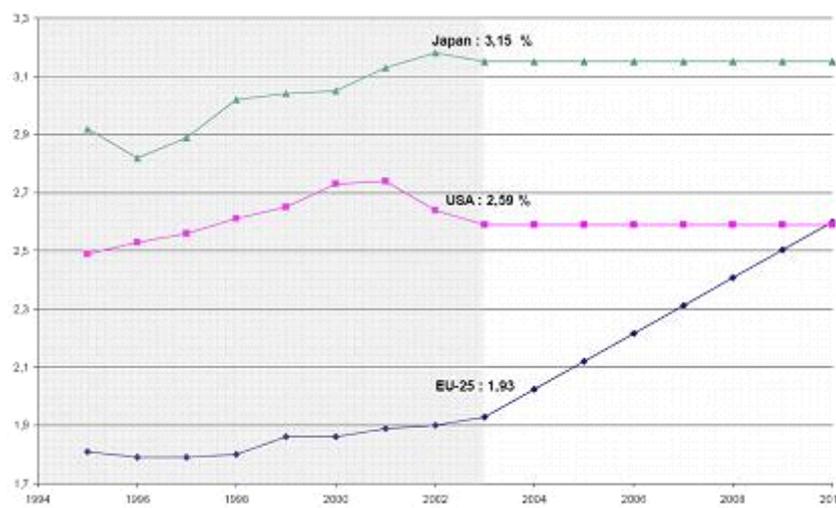
## Policies, Initiatives and instruments – a national inventory

### Research and Development

#### Statistics on R&D in the United States

The overall picture of United States research and development (R&D) budgets (for all types of R&D) is one of high expenditure compared to the EU, but lower than in Japan.

Figure 1. R&D budgets in US, Japan and the EU



Source : <sup>1</sup>

In terms of science and technology budgets, the US is in the lead overall, but if one limits the calculation to non-defence spending, it falls behind the EU.

Specific government R&D expenditure on eco-innovation does not appear to be available in summary form, though the Rand Corporation maintains a database of US R&D funding. It describes the US R&D situation as the following (from [https://radius.rand.org/radius/federal\\_rd.html](https://radius.rand.org/radius/federal_rd.html)):

In recent years, the U.S. Federal Government has spent over \$100 billion annually to support the “conduct of R&D” in government laboratories, colleges and universities, private firms, and other entities. Although this \$100+ billion represents only a small proportion of the total federal budget each year, it comprises approximately 14% of annual federal discretionary spending.

This budget is allotted to 22 federal agencies. Six federal agencies control 95% of these funds: Department of Defense, Department of Health and Human Services, National Aeronautics and Space Administration, Department of Energy, National Science Foundation, Department of Agriculture.

The section below features some of the major initiatives from USEPA, DoE, USDA and from States and local governments.

<sup>1</sup> data after 2004 are projections

### *EPA research programmes*

EPA's research programmes cover the whole technology continuum, from basic research and proof of concept to full-scale commercialisation and utilisation (see [EPA Environmental Technology Research & Development Continuum](#)).

The **intramural research programme** helps to understand the key drivers of environmental systems and provides the fundamental scientific basis for addressing a wide variety of environmental problems. This programme follows multiyear research plans that set out research goals for the next 5-10 years. It is managed by the EPA Office of Research and Development (ORD). ORD states that its mission is to:

- Perform research and development to identify, understand, and solve current and future environmental problems.
- Provide responsive technical support to EPA's mission.
- Integrate the work of ORD's scientific partners (other agencies, nations, private sector organizations, and academia).
- Provide leadership in addressing emerging environmental issues and in advancing the science and technology of risk assessment and risk management.

The ORD has eight priority areas: [Air](#), [Drinking Water](#), [Ecosystem Assessment and Restoration](#), [Global Change](#), [Human Health Protection](#), [Water Quality](#), [Pollution Prevention and New Technologies](#), [Endocrine Disrupting Chemicals](#).

The **Science to Achieve Results (STAR) program** is a competitive grant program that funds research grants and graduate fellowships for extramural research in environmental science and engineering for universities and non-profit organization. It complements intramural R&D and the programmes of those of four federal agency partners.

In addition to ORD, EPA is involved in a number of collaborative R&D programmes with the industry. The **Clean Automotive Technology Programme** is an illustration: EPA conducts innovative research in collaboration with the automotive industry to achieve ultra-low pollution emissions, increase fuel efficiency and reduce greenhouse gases. The programme encourages manufacturers to produce cleaner and more fuel-efficient vehicles.

### *The US Department of Energy initiatives*

The National Laboratory system is under the jurisdiction of the US DoE. An overview of R&D is available at <http://www.osti.gov/EnergyFiles/research.html>.

The following DOE laboratories conduct research and development of energy efficiency and renewable energy technologies (the list is not comprehensive):

- The Albany Research Centre specialises in life-cycle research of metals, alloys and ceramics; it is particularly active in technology transfer and is involved in cooperative research partnerships;
- Ames Research Centre explores the development and use of new materials;

- Argonne National Laboratory has R&D activities on energy resources programs (developing advanced batteries and fuel cells and advanced electric power generation and storage systems), on environmental management. It is actively involved in moving benefits from research to industry;
- Brookhaven National Laboratory has a department focusing on waste technology and working on hazardous materials management problems;
- Idaho National Engineering and Environmental Laboratory is the lead laboratory in environmental management (including managing US nuclear waste). A part from R&D in nuclear energy, INEEL is also involved in research in energy efficiency and renewable energy and fossil energy (developing solutions to the environmental problems of the US petroleum industry);
- National Renewable Energy Laboratory; NREL has an entrepreneurial section in its organisation, which provides resources for technology commercialisation (including a network of incubators, see below); it organises Industry growth Forums, which bring together start-up clean energy companies, venture capitalists and senior business executives to catalyse learning about business growth strategies and facilitate strategic business partnerships;
- Sandia National Laboratories; it has a section devoted to the development of small businesses and runs a number of projects to facilitate development projects.

#### *US Department of Agriculture*

The Department has an R&D programme, sometimes via extension of funding to other agencies. For instance, the Department of Energy has responsibility to make loans but lacks the organisation to manage them. DoE has brought USDA in for the assessment process. Under the Biomass R&D Act, USDA and DoE jointly decide on a set of projects that will be funded.

The Department runs a Cooperative R&D Agreement programme (CREDA), through which it supports public-private partnerships in environmental R&D: the public sector provides equipment and human resources. Under such agreements, the private sector can access outcomes of federal research.

#### *State and Local R&D initiatives*

States support R&D via the universities they support. They also take a number of initiatives, essentially bridging the gap between research and markets, often in collaboration:

- The **California Public Interest Energy Research (PIER) Program** supports research and development (R&D) in energy technologies through direct research grants totalling up to \$62 million annually;
- California's **Innovative Clean Air Technologies (ICAT) funds** are used to help businesses bridge the funding deficit between research and wide-scale deployment. ICAT funds technically solid projects that can demonstrate the commercial utility in California of technical innovations that will improve emission prevention or control;
- **Incubators** are targeted to improving the survival of new companies, and moving products to market. An example is the city of Austin's Clean Energy Incubator, which is a program in

cooperation with the National Renewable Energy Laboratory, the Texas State Energy Conservation Office, and Austin Energy. The **Clean Energy Alliance** is an alliance of leading business incubators dedicated to providing business and financial services tailored to the needs of the clean energy community. It was established in 2000 by the National Renewable Energy Laboratory (NREL), the US primary laboratory for renewable energy and energy efficiency research and development. NREL's mission and strategy are focused on advancing the U.S. Department of Energy goals. It is noteworthy that NREL has forged a focused strategic direction to increase its impact by accelerating the research path from scientific innovations to market-viable alternative energy solutions.

- There is also the **Connecticut Clean Energy Fund (CCEF)**, operational since 2000. It makes equity investments in companies 'whose products and services will accelerate the development of clean energy technologies, including fuel cells, solar, wind, biomass, wave/ocean technologies, and green buildings.' (Stack, 2007).

### ***Verification of technologies***

Verification is the subject of Environmental Technology Verification (ETV) program, a dedicated programme at the EPA (see <http://www.epa.gov/etv/>). The program started in the mid 1990s, and is designed to reduce uncertainty around new technologies and to increase their acceptance, by offering third-party information on technologies so that potential purchasers are not relying on the claims and data of the vendors alone: it provides performance information which is critical to EPA, other government agencies (at federal, state and local levels), and purchasers of innovative environmental technologies.

The EPA's ETV program has been in a pilot phase until 2000. From 2001 it has been in full implementation. Since 1995, and as of May 2008, 403 technologies have been verified and 90 verification protocols have been defined in six areas, each run by a different institution.

Federal funding to ETV is decreasing and more resources have to come from the verifications themselves.

In its [May 2007 report](#), the National Advisory Council on Environmental Policy and Technology encourages EPA to expand technology verification programmes across the world.

### ***Performance Targets***

Performance targets are contained in major regulations like the Clean Air Act and Clean Water Act, governing permissible emissions levels for pollutants, or the Energy Independence and Security Act (which includes a zero net energy initiative to develop technologies, practices and policies to reach the goal of having all commercial buildings use no net energy by 2050). These have been driving environmental innovation. Performance targets in the US include:

- Clean Air act and Clean Water Act
- Corporate Average Fuel Economy (CAFE) regulations
- National Performance Track
- Federal Renewable Fuels Standard
- Minimum standards of energy efficiency
- EnergySTAR
- Natural Gas STAR
- Energy Policy Act of 2005

- Executive Order 13423
- California's Greenhouse Gases Emission Performance Standard Act
- California Low Carbon Fuel Standard (LCFS)
- Renewables Portfolio Standards
- Efficiency standards on household appliances

Other environmental legislation with targets for environmental media (and, hence, technology standards), also include the Resource Conservation and Recovery Act (RCRA), the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the Toxic Substances Control Act (TSCA), and the Safe Drinking Water Act (SDWA).

### *Federal initiatives*

#### Clean Air act and Clean Water Act

Innovation credited to the provisions of the Clear Air Act and its amendments include improved SO<sub>2</sub> control technologies, Selective Catalytic Reduction technology and ultra-low NO<sub>x</sub> burners, mercury control technologies and VOC controls, among others (Saha et al., 2005).

#### Corporate Average Fuel Economy (CAFE) regulations

Another example is the CAFE regulation, which set required limits for fleet fuel usage. Since 2003, the government has finalized two sets of revisions, requiring a combined 15 percent increase in the fuel economy of light trucks.

#### National Performance Track

More recently there are new approaches to targets, focused on *exceeding regulatory requirements through voluntary action*. The main example was the EPA's Project XL: voluntary performance standards, a pilot that led to the [National Environmental Performance Track](#), under the EPA office of Policy, Economics and Innovation. Performance Track recognizes environmental stewardship and drives environmental excellence by encouraging facilities with strong environmental records to go above and beyond their legal requirements.

Facilities applying to Performance Track must meet the following criteria:

- Applicants must have an Environmental Management System in place for at least one complete cycle;
- Performance Track members have a record of compliance with environmental laws and are in compliance with all applicable environmental requirements;
- Applicants must demonstrate past environmental achievements during the current and preceding year. Applicants also commit to four quantitative goals for improving their environmental performance;
- Applicants commit to remain involved and active in their community, sharing their accomplishments with the public and addressing any community concerns.

In return, Performance Track:

- acknowledges member facilities locally and nationally through letters to elected officials, trade journal articles, press releases, case studies, *P-Track News*, member listings on the website, and Performance Track Awards.
- provides networking opportunities through Annual Member Events, regional roundtables, teleseminars, EPA meetings, joint workshops with Performance Track partners, and meetings of the Performance Track Participants' Association.
- works with states and other stakeholders to provide specific regulatory and administrative benefits, such as reduced self-reporting and low-priority status for routine federal inspections.
- encourages Performance Track facilities to take advantage of services such as the Green Suppliers Network Review or the Performance Track Mentoring Program.

Leading financial advisory firms use Performance Track data in their research methods. This practice can benefit top-performing, publicly traded companies, making them more attractive to investors and increasing brand recognition.

EPA claims the programme has helped to transform EPA's relationship with the regulated community, fostering a more collaborative and constructive dynamic. In 2006, 470 facilities had earned membership.

A similar programme is focused on greenhouse gases: [Climate Leaders](#) is an EPA industry-government partnership that works with companies to develop comprehensive climate change strategies. Partner companies commit to reducing their impact on the global environment by completing a corporate-wide inventory of their greenhouse gas emissions based on a quality management system, setting aggressive reduction goals, and annually reporting their progress to EPA. Through program participation, companies create a credible record of their accomplishments and receive EPA recognition as corporate environmental leaders.

#### Federal Renewable Fuels Standard

The federal Renewable Fuels Standard, established by the 2005 Energy Policy Act, requires that U.S. vehicles consume a minimum of 7.5 billion gallons of renewable fuel annually by 2012 – up from about 1.8 billion gallons in 2001.

#### Minimum standards of energy efficiency

Minimum standards of energy efficiency for many major appliances were established by the U.S. Congress in the Energy Policy and Conservation Act (EPCA) of 1975, and had been subsequently amended by succeeding energy legislation, including the Energy Policy Act of 2005 and the Energy Independence and Security Act in 2007.

Two federal programmes recognise equipment and techniques reaching high standards (text from [www.whitehouse.gov/ceq](http://www.whitehouse.gov/ceq)):

- EnergySTAR: in cooperation with more than 8,000 private and public sector organizations, the program identifies and promotes energy-efficient products to reduce greenhouse gas

emissions. The Energy STAR label is now on major appliances, office equipment, lighting, home electronics, and more. EPA has also extended the label to cover new homes and commercial and industrial buildings. For more information visit <http://www.energystar.gov>.

- Natural Gas STAR: this is a flexible, voluntary partnership between EPA and the oil and natural gas industry. Through the Program, EPA works with companies to identify and promote the use of cost-effective technologies and practices to reduce emissions of methane. As of 2005, the companies participating in Natural Gas STAR represent 56 percent of the natural gas industry in the U.S. Today, the program has over 110 partner companies and is endorsed by nearly 20 major industry trade associations. For more information visit <http://www.epa.gov/gasstar>.

The Federal Government is also establishing requirements for performance of its own facilities (see also the procurement section below):

- Energy Policy Act of 2005: it established requirements for Federal agencies to, among other things, decrease energy consumption at Federal facilities by over 2% per year for 10 years ([www.whitehouse.gov/ceq](http://www.whitehouse.gov/ceq)).
- Executive Order 13423, Strengthening Federal Environmental, Energy, and Transportation Management, was signed by the President on January 24, 2007. It establishes total energy reduction goals for every Federal agency, reaching 30% reduction in energy intensity by 2015.

#### *State and local standards and targets*

##### California's Greenhouse Gases Emission Performance Standard Act

The Act (SB1368) effectively prevents the production or import of coal-fired power; although there is almost no coal power in California, there is in neighbouring states and more is planned, largely for export to California – this law means they will have to find cleaner options.

##### California Low Carbon Fuel Standard (LCFS)

It is a requirement to reduce transport related GHG emissions by 10 per cent by 2020.

##### Renewables Portfolio Standards

Renewables Portfolio Standards are an increasingly popular way of promoting renewables in various states around the US:

- *California*: 20% renewable power by 2010
- *Illinois*: 5% by 2010, with a goal of 15% by 2020
- *Nevada*: 20% by 2015
- *New Jersey*: 20% by 2020
- *New Mexico*: 10% by 2011
- *New York*: 25% by 2013
- *Pennsylvania*: 18% by 2020
- *Rhode Island*: 16% by 2019
- *Texas*: 2.15% renewables in 2005, 3% by 2009.

## Efficiency standards on household appliances

Arizona, California, Connecticut, Maryland, New Jersey and New York have imposed efficiency standards on household appliances not covered by national law. The latest is New York, where the Appliance and Equipment Energy

Efficiency Standards Act of 2005 addresses refrigerators, washing machines and other major energy users in the home, as well as standby power.

## ***Mobilisation of Financing***

In this section, major federal initiatives are accounted for (, The Energy Policy Act of 2005, Renewable Electricity Production Credit, Volumetric Ethanol Excise Tax Credit), as well as several state-level initiatives and programmes.

A feature of the US framework conditions to support eco-innovation is the presence of an active venture apital community. EPA has recently investigated how the resources from this community could more systematically be harnessed.

## *Harnessing private finance and the venture capitalists*

Recognizing that EPA's goals can be advanced with more new and effective technologies in the market place, EPA asked NACEPT to seek the investment community's advice on what actions EPA and the investment community could take, and what partnerships they could create, to boost private-sector investment in the commercialization of environmental technologies over the long-term.

In its report, NACEPT urges EPA to consider the following six recommendations:

1. Recognize carbon dioxide, greenhouse gases, and climate change-related pollutants as pollutants that are addressed in Goal 1 of EPA's Strategic Plan (Clean Air and Global Climate Change\*) and take priority measures within EPA's authority to establish standards and long-term regulations for these pollutants.
2. Forge and sustain communications with the early-stage investment community.
3. Strengthen financial support (e.g., loan guarantees, grants, revolving loan funds) and reduce regulatory risks for new technology development during the commercialization period.
4. Take steps to streamline permitting for commercial scale-up of new, innovative environmental technologies.
5. Enforce environmental regulations consistently to clarify needs and avoid uncertainty.
6. Support metrics and monitoring of new technologies.

The report claims that with the strong investment interest today in energy and environmental technology, EPA also can spur development and implementation of needed new technology by helping to provide a more predictable regulatory framework for greenhouse gas emissions.Federal Renewable Energy incentives

## The Energy Policy Act of 2005

The Energy Policy Act authorized \$5 billion over five years in tax incentives to encourage investments in energy efficiency and alternative renewable energy sources. The new energy law provides new performance-based tax credits of up to \$3,400 for the most highly fuel efficient vehicles such as hybrids and clean diesel.

Tax incentives are only one source of incentives. The Department of Energy's Office of Energy Efficiency and Renewable Energy runs grant programs for demonstration projects for energy efficiency and renewable energy ([www.eere.energy.gov](http://www.eere.energy.gov)).

The Energy Independence and Security Act (2007) authorizes state energy grants to address state's energy priorities and adopt emerging renewable energy and energy efficiency technologies through Fiscal Year 2012. It establishes an Energy and Environment Block Grant to be used for seed money for innovative local best practices to fund local initiatives, including building and home energy conservation programs, energy audits, fuel conservation programs, building retrofits to increase energy efficiency, "Smart Growth" planning and zoning, and alternative energy programs ([EnergyPriorities.com](http://EnergyPriorities.com)).

### Renewable Electricity Production Credit (REPC)

EPACT also extended the REPC, which is a per kilowatt-hour tax credit for electricity generated by qualified energy resources. Electricity from wind, closed-loop biomass and geothermal receives a tax credit of 1.9 cents/kWh. Electricity from open-loop biomass, small irrigation hydroelectric, landfill gas, municipal solid waste resources, and hydropower receives 1.0 cent/kWh.

### Volumetric Ethanol Excise Tax Credit (VEETC)

Biofuels are supported by the federal Volumetric Ethanol Excise Tax Credit of \$0.51 per gallon to ethanol producers and \$1 per gallon for renewable biodiesel producers. There is also a \$0.54 per gallon tariff on ethanol imports protecting domestic producers.

### *State and local Initiatives*

There are many programmes at state level to finance research into clean technologies –like California's Public Interest Energy Research (PIER) program and the New York State Energy Research and Development Authority (NYSERDA). These "public benefits" programs are typically financed by tax dollars or surcharges on rate payers.

The California Solar Initiative (CSI) is a \$3.3 billion programme to help offset the cost of installing residential PV through capital grants, with the amount linked to the expected performance of the unit, and a 10% reduction per year, to spur innovation and cost reduction.

Also in California the two largest public pension funds in the country, CalPERS and CalSTERS, along with the state Treasurer's office, have launched the Green Wave Initiative in 2004, setting aside \$450 million of capital to invest in cleantech companies.

Boulder, Colorado has imposed a tax on fossil fuel power for electricity sold in the city. The revenue will be invested by the city in clean energy and transport.

Colorado, Connecticut, the District of Columbia, Illinois, Louisiana, Maine, New Mexico, New York, Oregon, Pennsylvania, South Carolina and Utah offer preferential tax treatment to purchasers and/or users of cleaner vehicles. In South Carolina, the federal credit is supplemented by 20 per cent, and there is a 20 cent per gallon biofuels credit as well.

The California Clean Energy Fund and the Massachusetts Green Energy Fund are two examples of new state-level public-private venture funds.

Many states have renewable energy incentives (Burtis, et al, 2006):

- Iowa: a 1.5 cent production tax credit (PTC) per kWh for residential and commercial renewable energy projects; sales and property tax exemptions on wind and solar energy equipment and materials; interest free loans for analysis and installation of renewable projects;
- Louisiana: Property tax exemption for the value of installed renewable energy equipment, including passive solar and solar PV;
- South Carolina: \$1,000 rebate on installation of solar water heaters;
- Idaho: low-interest loans for energy efficiency projects and for active solar, wind, geothermal, hydropower and biomass energy projects.

Colorado (and other States) also offer tax credits and rebates for renewable energy and energy efficiency. The Database of State Incentives for Renewables and Efficiency (DSIRE) is a comprehensive source of information on state, local, utility, and federal incentives that promote renewable energy and energy efficiency ([www.dsireusa.org](http://www.dsireusa.org)).

***Market-based Instruments***

Market-based initiatives in the US include federal and State initiatives:

Some federal initiatives

- Emissions trading for leaded gasoline and sulphur
- Water Quality Trading Policy
- Review of Harmful Subsidies

A selection of actions taken by States

- Chicago Climate Exchange
- Regional Greenhouse Gas Initiative (RGGI)
- Global Warming Solutions Act of 2006

### *Federal initiatives*

#### Emissions trading for leaded gasoline and sulphur

The United States pioneered emissions trading with trading in reductions of leaded gasoline, and of sulphur emissions. The former was part of an overall requirement to phase out leaded gasoline, with trading coming in a latter period of the process in the mid-1980s. The latter started in 1995 and is still going on, now in its second phase (which began in 2000).

See <http://www.epa.gov/airmarkets/progsregs/arp/s02.html>.

#### Water Quality Trading Policy

In 2003 the EPA announced the ‘Water Quality Trading Policy’ to cut industrial, municipal and agricultural discharges into the nation’s waterways. The trading policy was intended to support and encourage states and tribes in developing and putting in place water quality trading programs that implement the requirements of the Clean Water and federal regulations.

#### Review of Harmful Subsidies

A single national approach to tackling environmentally harmful subsidies is difficult, as decisions are dispersed among numerous different pieces of legislation. A non-profit organisation dedicated to addressing such subsidies is Green Scissors ([www.greenscissors.org](http://www.greenscissors.org)), which has publications outlining the nature, size and effect of US subsidies.

The US government, for its part, has focused subsidy reform efforts on getting countries to reduce subsidies in areas where it feels it is put at a disadvantage, through the WTO for example, where it has tabled proposals on agriculture, fisheries and export subsidies.

### *State and Regional initiatives*

#### Chicago Climate Exchange

Although voluntary, the Chicago Climate Exchange is a US pioneer in climate emissions trading ([www.chicagoclimateex.com](http://www.chicagoclimateex.com)).

#### Regional Greenhouse Gas Initiative (RGGI)

In 2005, the governors of seven states from the Northeast and Mid-Atlantic regions (Connecticut, Delaware, Maine, New Hampshire, New Jersey, New York, and Vermont) established the Regional Greenhouse Gas Initiative (RGGI), the country’s first mandatory (though not yet operational) cap-and-trade program. The goal is to reduce the region’s greenhouse gas emissions by 10 percent by 2019.

Two other regional GHG initiatives have formed in the United States:

- the Western Climate Initiative ([www.westernclimateinitiative.org](http://www.westernclimateinitiative.org)), comprised of Western States;
- the Midwestern Greenhouse Gas Accord, in the Midwest (<http://www.midwesterngovernors.org/govenergynov.htm>).

#### Global Warming Solutions Act of 2006

California's Global Warming Solutions Act of 2006 (AB 32) is a major step forward in US GHG reduction commitments, putting the state at the forefront of climate policy. Among other things, it authorizes emissions trading as one means of reaching reduction objectives.

#### *Procurement*

The Energy Independence and Security Act promotes the purchase of energy efficient products (e.g. to substitute energy-efficient lighting for incandescent bulbs), and procurement of alternative fuels with lower carbon emissions, by federal government. It also requires green building standards for new federal buildings.

Section 203 of EPA Act 2005 requires that, to the extent it is economically feasible and technically practicable, the total amount of renewable electric energy consumed by the federal government during any fiscal year shall not be less than the following: 3% in FY 2007-2009; 5% in FY 2010-2012; 7.5% in FY 2013 thereafter. Section 204 requires the installation of 20,000 solar-energy systems on federal buildings by 2010.

The Federal Electronics Challenge illustrates a collaborative, industry-targeted approach to green public procurement. This is an EPA partnership programme that leverages the 65 billion USD spent annually in the US on electronic equipment and services. Under this challenge, government agencies commit to making electronic purchases that meet certain environmental criteria.

Several examples of green public procurement are given in Stack et al. (2007), though the list is by no means complete, given the myriad local, state and national institutions involved:

- US EPA use of renewable energy in its facilities in nine states;
- Iowa efficiency and renewable energy requirements for state agencies;
- Wisconsin requirements for state government buildings to meet LEED standards<sup>2</sup>;
- Washington, DC passed a law in 2006 requiring all new buildings to meet LEED standards – public buildings from 2007 and private from 2012;
- Minnesota – Environmentally Preferable Purchasing Initiative: requiring state agencies and other public entities to purchase recycled, repairable, and durable goods.

---

<sup>2</sup> Leadership in Energy and Environmental Design: [www.usgbc.org](http://www.usgbc.org): 'The Leadership in Energy and Environmental Design (LEED) Green Building Rating System™ is the nationally accepted benchmark for the design, construction, and operation of high performance green buildings'

- Other governments adopting Environmentally Preferable Purchasing programs include Massachusetts; Vermont; Ohio; King County, Wash.; Austin, Tex.; and many others.
- New Mexico's Alternative Fuel Acquisition Act of 1992 requires that 75% state cars bought in 2003 and after are bi-fuel or alternative fuel vehicles, or hybrids. By 2010, all cabinet-level state agencies, K-12 public schools, and higher education institutions are required to take obtain 15% of their total transportation fuel requirements from renewable fuels
- In New York City, Local Law 6 mandates that 80 percent of new light-duty vehicles and 20 percent of new bus purchases must be powered by alternative fuels.

### *Awareness raising and training*

Awareness raising is central to the National Centre on Environmental Innovation and Performance Track. Environmental education in more general terms is also promoted through other programmes and initiatives. The Energy Independence and Security Act (2007) authorizes a media campaign to educate consumers about efficiency and conservation and to increase energy efficiency and reduce energy consumption.

### *National Centre on Environmental Innovation (NCEI)*

One of NCEI's core missions is to build capacity for innovative problem solving. One of the primary means of doing so is through the work of the Policy and Program Change Division (PPCD), which is intended to 'achieve better environmental results by scaling up pilot projects, issuing new policy directives, changing organizational culture, and rethinking traditional business practices.' Further, the Performance Incentives Division gives public recognition and further encouragement to top performing innovations.

### *Performance Track*

One of the benefits of Performance Track is provision of information resources to prospective and member companies. This is designed to help them set environmental goals, develop approaches for improving performance, learning about best practices, learning about management systems, benchmarking performance and learning about public outreach and performance reporting.

In addition, Performance Track provides participants with public exposure through a range of initiatives, including awards and public information.

### *The Clean Water Act Recognition Awards*

The program is sponsored by EPA's Office of Wastewater Management. The awards recognize municipalities and industries, including Tribal Nations and U.S. military commands for demonstrating outstanding technological achievements or an innovative process, method or device in their waste treatment and pollution abatement programs.

### *Government and non-government initiatives on environmental education*

The Green Jobs Act was voted in June 2007 to help train American workers for jobs in the renewable energy and energy-efficiency industries. It authorizes up to \$125 million in funding to establish national and state job training programs, administered by the U.S. Department of Labour, to help address job shortages that are impairing growth in green industries, such as energy efficient

buildings and construction, renewable electric power, energy efficient vehicles, and biofuels development. The Green Jobs Act would also help identify and track the new jobs and skills needed to grow the renewable energy and energy efficiency industries. Among other things, this effort would link research and development in the green industry to job standards and training curricula.

The Energy Independence and Security Act creates an Energy Efficiency and Renewable Energy Worker Training Program to train for “green collar” jobs.

Regarding environmental education generally, of which eco-innovation will play a part but is not the specific focus, there are several relevant initiatives. The US EPA’s office of environmental education has a range of programmes; substantial detail is available at <http://www.epa.gov/enviroed/index.html> . There are also partnerships with other federal agencies on a range of programmes listed on <http://www.epa.gov/enviroed/iag.html>.

In addition, there are other non-government initiatives, such as the North American Association for Environmental Education ([www.naeee.org](http://www.naeee.org) ).

### ***Acting globally***

International cooperation aims at providing partner governments with tools (not grants) which will strengthen their capacity to design and implement policies to support eco-innovation.

The National Advisory Council on Environmental Policy and Technology has recently encouraged EPA to engage more in international activities, increase awareness of and response to changing international standards and markets, and identify emerging markets for new technologies (see its [May 2007 report](#)).

A number of initiatives/institutions are relevant to stimulate and promote eco-innovation abroad. The Energy Independence and Security Act supports the promotion of U.S. energy exports in clean, efficient technologies to India and China and other developing countries; USAID is authorised to increase funding.

### ***US Agency for International Develop (USAID)***

The primary agent of US development aid, the US Agency for International Develop (USAID) has an environment programme with a range of relevant actions: [http://www.usaid.gov/our\\_work/environment/](http://www.usaid.gov/our_work/environment/). USAID is a major financier with wide-ranging impact on technology globally. Several highlights include:

- The Research programme, which focuses on agriculture.
  - USAID funds the Consultative Group on International Agricultural Research (CGIAR) at the World Bank. It sponsors 16 international research centres distributed throughout the world (13 in developing countries) which cover a wide array of basic food commodities and natural resource issues;
  - Since 1978, USAID has supported research, education, and outreach through the Collaborative Research Support Programs (CRSP). The CRSPs harness the expertise of US universities in low-cost, high-impact programs that contribute knowledge, trained personnel, and technology to agriculture worldwide in the fight against hunger and poverty;

- The Middle East Regional Cooperation (MERC) Program and the US-Israel Cooperative Development Research (CDR) Program both fund competitively reviewed, applied research projects. These research programs are open to nearly all relevant technical topics and have produced advances in saline and arid lands agriculture, enhanced understanding of emerging diseases and other threats to human health, improved water management technology, advances in biological pest management, and improved systems for natural resources and wildlife management.
- USAID’s cleaner production activities have been active for almost a decade and have worked to raise awareness, build capacity, and promote US environmental goods and services. The Agency has set a foundation of strengthening institutions and building technical and government capacity at the local and national levels. This is done through training, the development of case studies, and demonstration projects.
- USAID has funded environmental programs that have reduced growth in greenhouse gas (GHG) emissions while promoting energy efficiency, forest conservation, biodiversity, and other development goals. This “multiple benefits” approach to climate change helps developing and transition countries achieve economic development without sacrificing environmental protection

The US is also involved in a range of global technology and related agreements, some of which were initiated by the US, under leadership of the Council on Environmental Quality (the following is from [www.whitehouse.gov/ceq](http://www.whitehouse.gov/ceq) ).

#### *Asia-Pacific Partnership on Clean Development and Climate*

This US-led Partnership (including China, India, South Korea, Australia, and Japan) ‘will develop, promote, and share cleaner energy technologies to achieve results in the areas of energy efficiency, methane capture and use, rural/village energy systems, clean coal, civilian nuclear power, geothermal, liquefied natural gas, building and home construction, bioenergy, agriculture and forestry, hydropower, wind power, and solar power.’ For more information, visit <http://www.whitehouse.gov/news/releases/2006/01/20060111-8.html>.

#### *Methane to Markets*

Launched in November 2004, the Methane to Markets Partnership focuses on advancing cost-effective, near-term methane recovery and use as a clean energy source from coal beds, natural gas facilities, landfills, and agricultural waste management systems. The Partnership includes 18 countries: Argentina, Australia, Brazil, Canada, China, Colombia, Ecuador, Germany, India, Italy, Japan, Mexico, Nigeria, Republic of Korea, Russia, Ukraine, United Kingdom and United States. For more information visit <http://www.whitehouse.gov/news/releases/2004/07/20040728-2.html>.

#### *Future Gen*

In February 2003, President Bush announced that the United States would sponsor, with international and private-sector partners, the Future Gen Initiative, a \$1 billion, 10-year project to build the world’s first coal-based, zero-emissions electricity and hydrogen power plant. The Future Gen is designed to dramatically reduce air pollution and capture and store greenhouse gas emissions through carbon sequestration. For more information visit <http://www.fossil.energy.gov/programs/powersystems/futuregen/>

### *Global Nuclear Energy Partnership (GNEP)*

The Global Nuclear Energy Partnership (GNEP), announced in February 2006 as part of the Advanced Energy Initiative, seeks to develop worldwide consensus on enabling expanded use of economical, zero-emission nuclear energy to meet growing electricity demand. America will work with nations that have advanced civilian nuclear energy programs, such as France, Japan, and Russia. GNEP will use new technologies that effectively and safely recycle spent nuclear fuel. For more information visit <http://www.gnep.energy.gov/>

### *Renewable Energy and Energy Efficiency Partnership*

The United States participates in the Renewable Energy and Energy Efficiency Partnership (REEEP). REEEP was initiated by the United Kingdom as a WSSD partnership to assist market development of renewable and energy efficiency systems.

### *International Partnership for the Hydrogen Economy (IPHE)*

Recognizing the common interest in hydrogen research, the United States called for an international hydrogen partnership in April 2003. The partnership was launched in Washington, D.C. in November 2003, with representatives from 16 governments; it provides a vehicle to organize, coordinate, and leverage multinational hydrogen research programs that advance the transition to a global hydrogen economy. IPHE will develop common recommendations for internationally-recognized standards and safety protocols to speed market penetration of hydrogen technologies.

### *Carbon Sequestration Leadership Forum (CSLF)*

CSLF is a US initiative that was established formally at a ministerial meeting held in Washington, DC in June 2003. CSLF is a multilateral initiative that provides a framework for international collaboration on sequestration technologies. The Forum's main focus is assisting the development and deployment of technologies to separate, capture, transport, and store carbon dioxide safely over the long term, making carbon sequestration technologies broadly available internationally, and addressing wider issues, such as regulation and policy, relating to carbon capture and storage.

### *Generation IV International Forum (GIF)*

In 2002, nine countries and Euratom joined together with the United States to charter the Generation IV International Forum (GIF), a multilateral collaboration to fulfil the objective of the Generation IV Nuclear Energy Systems Initiative. GIF's goal is to develop a fourth generation of advanced, economical, safe, and proliferation-resistant nuclear systems that can be adopted commercially no later than 2030.

### *International Thermonuclear Experimental Reactor (ITER)*

In January 2003, President Bush announced that the U.S. was joining the negotiations for the construction and operation of the international fusion experiment, International Thermonuclear Experimental Reactor (ITER). ITER will allow scientists to explore the physics of burning plasma at energy densities close to that of a commercial power plant, the critical next step in producing and delivering commercially available electricity from fusion to the grid.

### *Clean Energy Initiative (CEI)*

At the World Summit on Sustainable Development (WSSD) in Johannesburg in 2002, the United States launched a Clean Energy Initiative (CEI). CEI consists of four market-oriented, performance-based partnerships: Global Village Energy Partnership, led by the U.S. Agency for International Development; Partnership for Clean Indoor Air and Partnership for Clean Fuels and Vehicles, led by EPA; and Efficient Energy for Sustainable Development, led by DOE. The mission of CEI is to bring together governments, international organizations, industry and civil society in partnerships to alleviate poverty and spur economic growth in the developing world by expanding access to and modernizing energy services.

### *US-Brazil agreement on ethanol*

President Bush and Brazilian President Luiz Inacio Lula da Silva recently signed an agreement regarding ethanol that will promote technology exchange between the countries and work to develop international biofuels standards.

### *California-Sweden agreement on biogas*

The California Energy Commission and Sweden's Ministry of the Environment signed a joint development agreement for biogas and other alternative fuels. The agreement will promote the exchange of ideas and technologies between the two, enabling California to learn from Sweden's biogas experience (the country has the largest biogas vehicle fleet in the world), while providing Sweden with an opportunity to market its products in California markets.

### *Supporting exports of eco-industries*

Two major initiatives support exports in clean technologies.

The Clean Energy Technology Export (CETE) program is intended to be a public-private partnership that addresses export barriers in global markets. The program does not deal with technology development, but with proven technologies. CETE's activities fall into 3 categories:

- *Outreach.* This effort consists mainly on information sharing and coordination among agencies. One recent example is the launching of a specialized website in March 2007 to "assist US companies in the deployment of clean energy technology in global markets."
- *Tools.* These are programs that are intended to help multiple vendors with multiple projects, and address issues that no one company working alone could resolve.
- *Partnerships.* These efforts serve to strengthen both efforts mentioned above—outreach and tools. The purpose is to institutionalise contacts and foster regular collaboration with the private sector, rather than encourage such arrangements on an *ad hoc* basis. One example of such partnership is the efforts by CETE to promote fora for venture capitalist and new technology companies where they can explore opportunities to create mutual benefits.

A brief example about Guatemala illustrates how the CETE programs work in practice.

The Ex-Im Bank established the Environmental Exports Programme in 1994, to increase support to environmentally beneficial goods and services exports. The programme helps mitigate risks for US environmental companies and also offers competitive financing terms to international buyers for the

purchase of US environmental goods and services. The programme covers renewable energy equipment, wastewater treatment projects, air pollution technologies, waste management services, inter alia.

#### **Box 1. Clean Energy Technology Export in Guatemala**

Because Guatemala presents ideal conditions for the development of small and medium hydro-power plants, some US producers have explored investment possibilities in that market.

To explore the opportunities for US companies, a consultant with local market knowledge is hired to help potential exporters identify the main opportunities for contracts as well as the main barriers to the construction and operation of the hydro-power plants. The expert is hired by the industry with some support from the DoE.

In the case of Guatemala, a critical barrier for the deployment of technologies, according to the US expert, are the off-take practices in place: the country provides “spot” (or present) prices but offers no long-term off-take prices to the provider of clean technology. This uncertainty about future demand and price spills over the company’s financing strategy because the technology providers are unable to guarantee to the investors that electricity will be purchased at a profitable price in the future.

CETE intervenes by establishing a relationship with the Guatemalan government to, inter alia, explore possibilities that guarantee predictable off-take prices in the future. In practice, the governmental decision to intervene or to leave the deployment to market forces is a difficult task.

#### ***Other instruments to support eco-innovation***

##### **Small Business Innovation and Research Program**

SBIR funds technology development through competitive solicitations for small businesses (less than 500 staff) in the initial stages of the technology continuum (before venture capital becomes interested). SBIR focuses on proof of concept (Phase I) and commercial prototype (Phase II). It is a cooperative effort of 11 agencies. The total budget for the program was more than USD 2 billion 2005.

Since the early 1980s, USEPA has been supporting small business innovators in the development of technologies, products and processes that are helping the Agency to achieve its strategic long term goals. Since its inception, USEPA’s SBIR programme has provided some 100 million USD through more than 700 awards to small businesses to translate their ideas into commercial products. Success is monitored technologically (through awards, patents, etc.) and commercially (sales, commercial partnerships, follow-on funding, etc.).

The money is allocated to technology developers through grants. Options are available to share the cost of technology verification and of commercialisation (if a third party is cofounding). Staff from an EPA lab serves as an informal mentor for the vendor.

It is noteworthy that focus is shifting more towards commercialisation and a request to proven environmental benefit.

##### **California Global Warming Solutions Act**

While the United States have been reluctant to enact national level climate change policies which may have ‘market pull’ impact on technology innovation (e.g. a mandatory cap or similar), States are becoming quite vocal in this regard. These policies will stimulate innovation through market pull; the

California Global Warming Solutions Act of 2006 (AB32) is the first mandatory statewide greenhouse gas reduction legislation with non-compliance penalties.

#### EPA's Superfund Innovative Technology Evaluation

SITE is a demonstration programme that offers a mechanism for conducting joint technology demonstration and evaluation projects at hazardous waste sites involving the private sector, EPA, and other state or federal agencies. All participants (SITE programme, site owner, technology vendor) share in the project funding through financial and in-kind contribution (see <http://www.epa.gov/NCEI/directory/index.htm>). SITE illustrates a problem-solving approach, where EPA joins with other players to support the demonstration of innovative technologies.

### **Country Synthesis**

#### *A genuine focus on innovation*

Innovation is explicitly conceived by the United States as the primary response to the contemporary environmental challenges, including climate change and energy security. In this perspective innovation includes, but is not restricted to, technology.

Innovation applies to regulatory practices as well. It is consequential for the way agencies work together and engage nongovernmental actors. It follows that eco-innovation policies are not top-down: they are very much interlocked. Having an open-ended approach to innovation has fostered multiple forms of collaboration within and across agencies, with industry, academia, non-profit organisations and states.

The focus on technology is shifting. R&D still attracts a lot of attention and public money, in particular in the energy sector: at DoE, renewable energy, alternative fuels, and cleaner coal are receiving increased research attention and funding. There is a clear orientation towards problem solving. In a pragmatic approach, innovation may come from a variety of sources (including foreign suppliers). Technological innovation is acknowledged as a collaborative process and a number of initiatives stress that labs should cooperate with the private sector and pay attention to the dissemination/commercialisation of their work. One feature of the US experience is the dynamism of venture capital and the flexibility of instruments designed to harness private capital and to incentivise public entities (in particular laboratories).

#### *Collaborative action*

The US innovation system is uniquely decentralized leading to flexible approaches and a competitive spirit. Several federal agencies and departments manage their own programmes to spur environmental technology innovation. Most federal activities accrue from the Environmental Protection Agency (EPA), the Department of Agriculture (USDA) and the Department of Energy (DOE).

EPA explicitly links innovation and collaboration: leveraging limited resources and sharing expertise are considered key factors of success, in the context of complex challenges and tightening federal budget.

Collaboration is organised at federal level, among agencies. It also involves a number of local and nongovernmental players, including States, venture capital, the private sector and nongovernmental organisations (which play an important role in stimulating policy debates).

States play a particular part, as they take a number of initiatives with or without federal support (half of EPA's budget is granted to States). They have a (limited) capacity to directly finance R&D. Important measures, increasingly in use at local and state level, have to do with performance standards such as requirements for green buildings, or portfolio standards for renewable energy.

Venture capital is also key, when it comes to financing innovation and its deployment. Collaboration with industry is organised at the level of the firm (e.g. the Climate Leaders) or at industry level (with sectors that are committed to reducing emissions, e.g. Smartway Transportation Partnership with the ground freight transportation industry).

Institutions have been set up to facilitate collaboration between federal agencies and other players (see Box 3).

## **Box 2. Institutionalised collaboration**

### **The Biomass R&D Board in the US**

The Board is an inter-agency initiative that grew from a mandate in the 2005 Energy Policy Act (<http://www.biofuelspostureplan.govtools.us>). It is co-chaired by US Department of Agriculture and the Department of Energy. A number of federal agencies sit on the Board: transportation, the national Science Foundation, the White House Office of Science and technology, Department of Commerce, Department of Energy, NOAA, USEPA, National Institute of Standards and Technology (NIST).

The Board promotes a systemic approach because of the interdependencies of a number of dimensions (feedstock, feedstock management, conversion, infrastructures, and end use). In particular, the Board is concerned with issues related to logistics and economics (the Energy Independence and Security Act includes provisions to improve the infrastructure for delivering renewable fuels).

The strategy entails a number of instruments, from direct public funding of specific technologies, to economic incentives (tax credit), regulation (such as the Energy Policy Act in 2005), permitting (it becomes an issue when refineries mushroom all over the country).

Each agency plays a particular part, based on its own expertise and agenda. Typically, the Department of Energy is putting a lot of public R&D on refineries (including biochemical processes). EPA is promoting waste as a source of energy, an item that was not initially considered by the Board.

The Strategy has an international dimension: Canadian companies are involved, as well as European ones which supply technologies that correspond to specific needs.

### **Climate Change Technology Program (CCTP)**

The Climate Change Technology Program (CCTP) is a multi-agency effort that increases the development and use of key technologies aimed at reducing GHG emissions. The intent of this program is to reduce, avoid, or sequester greenhouse gas emissions by stimulating the development and use of renewable, clean coal, fusion, nuclear and other energy technologies and by increasing energy efficiency throughout the U.S. economy.

## *Public funding for R&D*

Public funding accrues to environmental R&D, either via direct financial support or via the increasing use of tax credits to help finance innovative technologies.

Together with Japan, the United States offer among the strongest public support for energy R&D. For example, the combined funding of US and Japanese governments is around 70% of the total

energy R&D expenditure of all IEA member countries reaching USD 6.8 billion in 2004. Measured as percentage of GDP, energy R&D investments in the United States ranks fifth among IEA members while Japan ranks first (OECD, 2006b).

The US government also provides major support for R&D in renewable energy. According to 2002 data from the IEA, the United States allocated a peak of USD 700 million for solar energy, and approximately US\$1 billion for all renewable energies in the early 1980s. Since then funding for solar energy has stabilised at approximately US\$ 100 million per year for the past 20 years.

The DoE is a major provider of funding for basic and applied research for converting biomass resources to biofuels<sup>3</sup>; it finances research, development, and demonstration efforts geared at the development of integrated biorefineries; the Biomass Program is focusing its R&D efforts to ensure that cellulosic ethanol is cost competitive by 2012; US\$ 198 million are appropriated for the Biomass Program in the FY 2008 budget (see <http://www1.eere.energy.gov/biomass/budget.html>). In addition, DoE conducts joint solicitations with the U.S. Department of Agriculture (USDA) as part of the [Biomass Research and Development Initiative](#).

Wind and geothermal energy R&D is supported at a level of approximately USD40 million each year. A 20% tax credit is also available for “incremental” R&D for private companies. Some joint public-private cost sharing programs exist as well ([www.doe.gov](http://www.doe.gov)).

The estimated budget authority for renewable energy programs was nearly US\$ 349 million in 2003 (these programs mostly address R&D). Two income tax preferences, a new technology credit, and exclusion of interest on facility bonds supported renewable energy at an estimated outlay of around US\$ 510 million in 2003 (General Accounting Office, 2005).

#### *More support to commercialise R&D outcomes*

The National Advisory Council on Environmental Policy and Technology has recently reviewed EPA’s role in impacting market demand forces to empower technology development, both within the US and abroad (see its [May 2007 report](#)). NACEPT recommends that, to encourage market demand, USEPA:

- Includes emission credit trading as a component of environmental programs wherever possible; it can stimulate the weak market for many new technologies;
- Allows greater flexibility in permitting at state level, to promote progressive technology development;
- Makes sure enforcement actions authorize the development, piloting, or enhancement of environmental technology where appropriate;
- Provides the environmental marketplace with independent information and quality assured data on the performance of innovative, commercial-ready technologies;
- Expands on the success of the voluntary ENERGY STAR program, creating additional “green” standards for a wide variety of industries and activities;

---

<sup>3</sup> It is noteworthy that efforts in bioenergy were initiated by the National Science Foundation (NSF) and subsequently transferred to DOE in the late 1970s

- Expands and stimulates environmentally preferential purchasing.

*The challenge of an international approach*

It is fair to say that most initiatives are usually open to US technology suppliers only. However, some programmes are increasingly oriented towards problem solving and hence open to inputs from foreign suppliers.

In addition, a variety of initiatives, in the energy and in other fields, attempts to engage foreign governments and international institutions.

Developing countries are the targets of USAID programmes which strive to spread the benefits of US innovations.

## Appendices

### Summary table

| <b>R&amp;D</b>                               |   |
|--|---|
| US EPA Office of Research and Development:   | Various EPA programmes to support technology  |
| US DOE: national laboratories                | DOE administers the laboratory system   |
| State R&D initiatives                        | Technology incubators<br>One example is the city of Austin's clean energy incubator<br>State R&D investment funds<br>Connecticut Clean Energy Fund<br>California Public Interest Energy Research Program  |
| Council on Environmental Quality             | Technology Platforms<br>Climate Change Technology Platform<br>SmartWay transportation partnership<br>Hydrogen Fuel Initiative   |
| <b>Verification of Technologies</b>          |   |
| US EPA                                       | Environmental Technology Verification (ETV) program   |
| <b>Performance Targets</b>                   |   |
| National Regulations                         | Not considered in detail here, reference to major regulations such as the Energy Independence and Security Act, the Clean Air Act and Clean Water Act, the Green Jobs Act, Corporate Average Fuel Economy regulations   |
| US EPA                                       | National Performance Track  |
| EPACT  | Federal Renewable Fuels Standard<br>Extension of minimum standards of energy efficiency of major appliances   |
| Voluntary standards                          | EnergyStar<br>Natural Gas Star  |
| Energy performance in federal facilities     | Energy Policy Act of 2005<br>Executive Order 13423  |
| California standards                         | GHG emissions performance standard act<br>Low Carbon Fuel Standard  |
| RPS in various states                        | California, Illinois, Nevada, New Jersey, New Mexico, New York, Pennsylvania, Rhode Island, Texas.  |
| Efficiency Standards on household appliances | Arizona, California, Connecticut, Maryland, New Jersey and New York   |
| <b>Financing</b>                             |   |
| EPACT  | The Energy Policy Act of 2005<br>Renewable Energy Production Tax Credit   |
| Biofuels                                     | Volumetric Ethanol Excise Tax Credit  |
| State and local level programs               | California's Public Interest Energy Research (PIER)<br>New York State Energy Research and Development Authority (NYSERDA).<br>California Solar Initiative<br>Green Wave initiative<br>Colorado tax on fossil fuel power for electricity<br>Many states' preferential tax treatment for greener vehicles<br>California Clean Energy Fund<br>Massachusetts Green Energy Fund<br>State level renewable energy incentives: Iowa, Louisiana, South Carolina, Idaho |

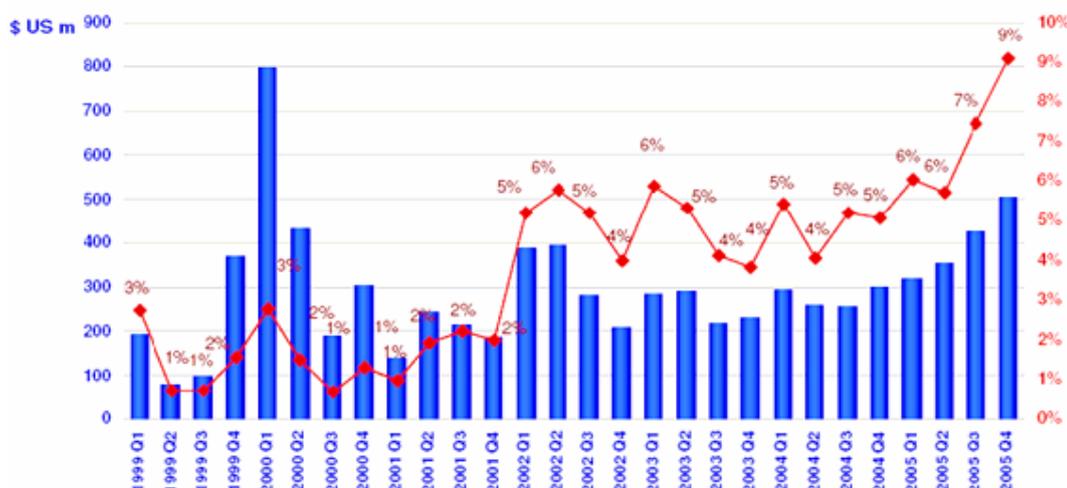
| <b>Market Based Instruments</b>                                     |  |
|---|--|
| Trading Policies - federal  | Emissions trading for leaded gasoline (no longer functioning)<br>Emission trading for sulphur<br>Water Quality Trading Policy'   |
| Subsidies   | Www.greenscissors.org: critical assessment<br>US government involvement in WTO   |
| Emissions Trading – state/regional                                  | RECLAIM (no longer functioning)<br>Illinois VOC trading<br>Chicago Climate Exchange<br>RGGI<br>California's Global Warming Solutions Act of 2006<br>Western Climate Initiative (incl. California – not a national-only initiative hence not mentioned here)  |
| <b>Procurement</b>  |  |
| State programmes  | Several initiatives noted: environmentally responsible purchasing programmes, efficiency and renewable energy requirements, vehicle and fuel standards.  |
| EPACT   | Federal Agency energy consumption decrease targets<br>Increasing renewable energy on federal facilities, and a specific target for solar energy.   |
| <b>Awareness raising and training</b>                               |  |
| Specific for eco-innovation   | National Centre on Environmental Innovation (NCEI)<br>Performance Track (see also ' <i>Performance Targets</i> ')  |
| Environmental Education   | US EPA Office of environmental Education: many programmes<br>North American Association for Environmental Education  |
| <b>Acting Globally</b>  |  |
| State Department - Bureau of Oceans, Environment, and Science (OES) | Coordinates international policy and diplomacy on environment and science  |
| USAID   | Its environment programme gives aid in many relevant programmes internationally  |
| Technology agreements   | Asia-Pacific Partnership<br>Methane to Markets<br>Future Gen<br>Global Nuclear Energy Partnership<br>Renewable Energy and Energy Efficiency Partnership<br>G8<br>International Partnership for the Hydrogen Economy (IPHE)<br>Carbon Sequestration Leadership Forum<br>Generation IV International Forum<br>International Thermonuclear Experimental Reactor<br>Clean Energy Initiative<br>Ethanol agreement with Brazil |
| State programmes  | California biogas agreement with Sweden  |
| <b>Other instruments</b>  |  |
| Global warming caps   | California's AB32 legislation  |

## Green technologies in the US

As the world's largest economy, the United States plays a leading role in many industries and eco-industries are no exception. The 'environment industry' has grown from less than \$20 billion in 1970 to \$245 billion in 2004, and is responsible for 2.1% of GNP and employ 1.3 million people in the United States (Andersson and Widegren, 2006). Importantly, the share of innovation funding dedicated to eco-industries is rising.

**Figure 2. Venture capital funding eco-innovation**

The amount of venture capital investment in clean technologies in amounts (left) and as a percentage of VC investment (right)



Source : Andersson and Widegren, 2006

Clean Technology (cleantech) has moved from the 7th largest venture investment category in 2004, to 5<sup>th</sup> in the last quarter of 2005 – surpassing semiconductors. Venture capital investment in cleantech reached \$1.4 billion in 2005, with around 70% of this going to energy (Andersson and Widegren, 2006).

### ***Reference and data sources***

- Andersson, Åsa and Karin Widegren, 'Driving forces & main fields of competence for environmental technology in Japan and the US' The Royal Academy of Engineering Sciences (IVA), 2006
- Berg, David R., Ferrier, Grant, Meeting the Challenge: U.S. Industry Faces the 21<sup>st</sup> Century, The U.S. Environmental Industry, U.S. Department of Commerce, Office of Technology Policy, September 1998
- Brooks C, Milford, L, Schumacher A Global Clean Energy Market – The Strategic Role of Public Investments and Innovation, Clean Energy Group, May 2004 Burtis, Patrick R. et al Creating the California Cleantech Cluster, Environmental Entrepreneurs and Natural Resources Defense Council, September 2004
- Burtis, Patrick R. et al California's Cleantech Industry: Annual Venture Capital Investment Update 2006, Environmental Entrepreneurs and Cleantech Venture Network, 2006
- Burtis, Patrick R. et al Creating Cleantech Clusters: 2006 Update, E2 Environmental Entrepreneurs and Cleantech Venture Network, May 2006
- Clean Energy Group, The potential For Transatlantic Investment in Clean Technology – An Opportunity Assessment of the Clean Energy Sector, March 2005
- Cogan, Douglas G. (2006) Corporate Governance and Climate Change: Making the Connection, Ceres, March 2006
- EBI - Environmental Business International Inc., Global Environmental Market Data package, data tables, 2006
- EBI - Environmental Business International Inc., The U.S. Environmental Industry Overview – An executive Review, EBI report 2020B, 2005
- Egelston, Anne and Maurie J. Cohen, "[California RECLAIM's market failure: lessons for the Kyoto Protocol](#)", *Climate Policy Volume 4 No.4*, 27/May/2005.
- Environmental Protection Agency (EPA) (2006), EPA Draft Report on the Environment, [www.epa.gov/indicators/roe](http://www.epa.gov/indicators/roe) Export America, Global Environmental Technologies: Trends, Markets, and Prospects, Vol 3 No 11 Nov 2002.
- Galatola, Michele and Andrea Tilche, 'Sustainable Neighbourhood: from Lisbon to Leipzig through Research' Presentation, Leipzig, 8-10 May 2007
- Global Network of Environment & Technology news Center, Clean-Tech Investing Rises Sharply, August 11, 2006
- Goldman D.P., McKenna J.J., Murphy L.M., Financing Projects That Use Clean- Energy Technologies: An Overview of Barriers and Opportunities, National Renewable Energy Laboratory, October 2005
- LoGerfo, James et al, Cleantech Venture Investing: Patterns and Performance, Cleantech venture network, March 2005

Makower Joel, Pernick Ron, Wilder Clint, Clean Energy trends 2006, Clean Edge, March 2006

Makower, Joel, The clean Revolution: Technologies from the Leading Edge, GBV Global Business Network, May 2001

Parker Nicholas, O'Rourke, Anastasia, The Cleantech Venture capital report – 2006, Cleantech Venture Network, January 2006

Saha, Bansari, B. Galef, L. Browning, J. Staudt, 'The Clean Air Act Amendments: Spurring Innovation and Growth while Cleaning the Air,' ICF Consulting, 27 October 2005.