

GOAL 1

Clean Air and Global Climate Change

Strategic Planning Futures Workshop
28 February, 2006
Summary Report

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Purpose Statement

Explore how EPA might encourage more productive technology investment that improves both economic competitiveness and environmental quality. If EPA can identify some new, additional niches/opportunities to encourage even a modest improvement in more productive technology, the result could be significant energy and carbon savings as well as reductions in environmental impacts. However, the ideas generated here were the results of informal discussions and brainstorming and are not meant to represent official policies or commitments to new activities.

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Background

This workshop was designed to promote a forward looking approach into the strategic planning process. A list of emerging issues was assembled from several sources, including the EPA Innovation Action Council, a consultation with members for the Environmental Council of the States, the symposium entitled, "*Forecasting Environmental Change*," held by the National Council for Science and the Environment, and through other sources including the new book edited by Robert Olson & David Rejeski, *Environmentalism and the Technologies of Tomorrow*.

The EPA Goal 1 planning team chose to examine the \$2 trillion/year (and growing rapidly) domestic investments in infrastructure to maintain the economy. This is a total amount that includes investments in roads, buildings, and manufacturing plants as well new capital needed for our energy infrastructure. If EPA can identify some new, additional niches/opportunities to encourage even a modest improvement in more productive technology, the result could be significant energy and carbon savings as well as reduced other environmental impacts. Thus, the workshop was an opportunity to take an afternoon off from the daily routine to think differently about some of these issues. And if successful to generate ideas to use, and to potentially invest time and resources differently.

The Program is aiming to start an ongoing dialogue; the 2 trillion dollar investment is intriguing – any marginal impact could mean significant air quality benefits. Energy Star, green power, carbon sequestration...futuristic technologies are already on the scene at EPA...still, can we do more to work with private sector to impact investments in new technologies to achieve EPA's air quality goals?

Speakers

Marilyn Brown

Environmental Science and Technology Division
Oak Ridge National Laboratory

Scientific Pathways to Extreme Energy Efficiency

Using energy more efficiently allows energy supplies to stretch further enhances energy security and reliability, strengthens the economy, and protects public health and the global environment. The key question is: How big a role can energy efficiency play?

It can – and must – play a major role. If we continue to grow our energy use by the current rate of 1.5% annually, it would require a pace of investment and resource expansion that is hard to imagine being feasible: a 35% increase by 2025 and a 400% increase by 2100. Improving energy efficiency to cut the growth of energy use in half – or more – would result in a much more viable pace of resource expansion.

We are far from exhausting the potential for cost-effective energy efficiency improvements. The most dramatic opportunities are emerging through *new approaches to systems integration*. For example, **plug-in hybrids** (PHEVs) can bridge between the transportation and power sectors. They will have more powerful electric motors and

batteries than today's hybrids and run on both electricity (with off-peak charging) and biofuels. Even full sized PHEVs should be able to get well over 100 miles per gallon. In time, two-way "Vehicle-to-Grid" (V2G) connections can allow hybrids with advanced controllers to both recharge their batteries and announce their identity, location and storage capacity to the grid. The utility can then juggle small amounts of power back and forth to the cars' large battery packs, helping the utility level its power from moment-to-moment and ultimately providing backup and storage for very large-scale renewable energy sources such as wind power. Another example of systems integration is **biorefineries** that produce biofuels but at the same time produce a wide variety of other materials, bridging between energy and manufacturing.

Beyond such opportunities for systems integration, emerging developments in nano-info-bio-technology are leading to a wide range of specific, highly efficient technologies. Some examples:

- **Super-strong lightweight materials** – Magnesium alloys and carbon fiber matrix composites incorporating nano-sized particles for vehicle bodies stronger than steel but 50% lighter
- **Solid state lighting** – Lighting using semi-conductor diodes that uses 1/10th the energy of incandescent lighting
- **Smart roofs** – Nano-based optical structures and temperature-sensitive polymers that change the reflectance of roof materials to reflect solar radiation in summer absorb it in winter
- **Self-optimizing sensor systems** – Micro-sensors for more flexible control and optimization of everything from small electric motors to large buildings and industrial energy systems
- **Superconductors** – High-temperature superconductors that increase the capacity of electric transmission cables by 3-5X
- **Energy-efficient distillation through supercomputing** – Advanced modeling and simulation of distillation hydrodynamics and other complex industrial processes to improve their design and operation
- **Energy efficient membrane separations** – Nanoporous materials to improve the efficiency of separation processes in industry
- **Molecular-level control of catalytic materials** – Nanomaterial catalysts that increase the efficiency of catalytic processes, saving energy, cutting waste, and reducing the use of precious metal catalysts

Emerging technologies will also be important for developing clean energy supplies. Plant genomics to boost production and engineered bacterial "protein machines" to dismantle plant cell walls are the key to large-scale production of cellulosic ethanol (ethanol made from fibrous or woody plant material like switchgrass, which can be harvested twice per year without plowing or using pesticides). With steady but unremarkable progress to

reduce costs and improve yields, and with a doubling of fleet fuel efficiency, half of the U.S. passenger fleet could be fueled with cellulosic ethanol from just 30 million acres of energy crops. This means that there does not have to be a tradeoff between food and fuel.

A key challenge for EPA is to find ways to help speed the development and utilization of these environmentally superior technologies, while continuing and improving its regulation of 'dirtier' technologies. The key problem is that all energy technologies involve various agencies with different missions. Much more intergovernmental coordination is needed on energy, which is difficult to achieve, but worth the effort.

Hank Habicht

Global Environment & Technology Foundation
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EPA: Creating the "Valley of Life"

- **The Energy Policy Stalemate**

Energy policy has been stalled and stalemated for a generation:

- 20 years of growth in the gap between oil demand and domestic supply
- "All or nothing" nature of the climate change debate (either too uncertain to act on or demanding of extreme measures)
- Nearly 30 years since the last U.S. nuclear power plant was ordered; problems in siting many energy facilities
- 20 years since material fleet improvements in vehicle fuel economy
- 20 years since a real increase in energy R&D
- Interminable battles over power plant emissions
- The piecemeal approach to energy policy

- **A New Energy Context: the Security-Environment-Economy Triad**

Now, however, a new context is emerging that may make it easier to deal with energy issues and to make progress on environmental issues at the same time:

- People care about the threat to long-term US economic leadership posed by China and India; this is more real than the threat from Japan in '70s; the large and growing competition for energy resources threatens US leadership
- People care about energy security
- Awareness of climate change and its connection to fossil fuel burning is increasing
- Even though the environment is not a top public concern, it's increasingly possible to take advantage of security and economic concerns to promote the environment

- Cost curves are crossing – the prices of alternatives are coming down as oil prices rise or stay high
- Investment dollars are ready to flood in
 - but Wall Street has a concern that producers may yet be able to bring oil prices back down to \$25/barrel for just long enough to kill alternatives
- **A Consensus Green Policy May Finally Emerge**

Many of the basics are now agreed upon and States and businesses are developing strategies and business cases. Developing the business case is imperative for success in a future based on greening, so business has a chance to shape solutions. Large corporations are buying into green products, for example, the CEO of GE has made enormous commitments with the Eco-Imagination program.

- **Beyond Stalemate – Growing Areas of Agreement**

There is growing agreement on some of the steps we need to take:

- Reduce oil dependency through more efficient vehicles
 - Expand the domestic portfolio of petroleum alternatives including cellulosic ethanol and biodiesel
 - Expand low-carbon options in the electricity sector with renewables, clean coal (IGCC) and carbon capture and sequestration as a centerpiece (and perhaps even nuclear)
 - Increase international cooperation and focus on massive developing markets where the absence of an existing energy infrastructure creates the potential to leapfrog technology
 - Collaborate with the oil and gas companies in promoting change
- **Defining a 21st Century EPA Agenda**

There are many steps EPA can take to position itself for the changes that need to occur. For example:

- Build and promote a positive vision of environmentally sound economic growth
- Define EPA's added value as an expert source of hard, reliable information
- Avoid turf wars...be a champion of integrated approaches with other agencies and develop a host of cooperative initiatives
- Make maximum use of the many "carrots" EPA has to offer (for example, giving SIP credit for various efforts for energy efficiency and renewables)
- Capitalize on EPA's credibility and its reputation as the premier environmental institution in world to foster greater international cooperation
- Encourage the private sector to more strongly embrace voluntary programs by demonstrating that EPA is staying on top of art of the possible, and encouraging rather than blocking technological progress
- Overcome the hesitancy among some sectors to engage by developing and selling a positive vision of what's possible

There are several areas where events are moving fast and EPA can play a helpful role:

- Ethanol, biofuels, biodiesel...this is a juggernaut. But, Wall Street concerned about a potential drop in oil price now that they've already started investing in oil alternatives. How can EPA promote more investment in alternatives and sooth fears?
 - Carbon sequestration – there's lots of political support and many options to be evaluated
 - Plug-in hybrids – integration between the electric grid and the transportation system can create huge benefits across sectors
 - The undercurrent of concern about economic leadership creates an opportunity to promote U.S. leadership in advanced, clean energy technologies - a multi-trillion dollar global market
- **New Modes of Thinking – to do things differently**

To play new roles, EPA needs to cultivate new modes of thinking:

- Integration across sectors and institutions/regions/communities must become a central theme of EPA's operations
- Cross-functional integration needs to be emphasized – for example, links between energy/water
- New communities of interest need to be cultivated – for example, multilateral development banks' policies to encourage environmentally sound development in developing economies like China and India
- Better foresight and long-term planning – the level of sophistication in economic planning at the regional level is on the rise
- Develop a new focus on siting issues for alternative energy production (all kinds)
- Focus more effort on being a catalyst to private sector (Cleantech Partner) private equity money could quadruple in the next few years

Discussion of the Presentations: Key Emerging Implications for EPA

- We have to take advantage of the 3 highest drivers for energy – national security, moral imperative, promise of innovative technology to generate economic growth
- If we don't pay attention to energy investments...may lock out ability to do anything about climate due to lack of financial resources;
- EPA should look deeply into moving consumer behavior
- Focus on options for efficiency in buildings as well as transportation;
 - Consider efficiency in designing whole communities, i.e. elimination of HVAC, mortgage breaks for people living in smaller houses and closer to work, green building codes as part of SIP planning process.
- Need analysis of not-so-clean technologies with significant influence behind them (oil shale, tar sand)
- EPA can be more bold, and systematically develop reliable base of information that looks at whole value chain and life cycle impacts
 - With closing gap in price, can close gap further with good information on full impacts;

- EPA is a credible source and needs to act as such. Oil industry information on ethanol net energy balance is imprecise. EPA can provide accurate information.
- Natural gas issue - apparent near term spike in interest in generation of gas from multiple sources;
 - Analysis of potential for more generation thru gasification and waste

Brainstorming Exercise

After the speakers' presentations and related discussion, workshop participants participated in a brainstorming exercise. Based on these ideas and the overall theme of the workshop, participants wrote down their ideas for new activities or for activities that needed more emphasis. The ideas were organized by sector and are written up in the table in the appendix. EPA recognizes the need to identify valuable technologies and to provide unbiased information their environmental and economic merits. EPA can work to reduce barriers to the use of new technologies, but is not in the business of selecting "winners." It is also critical to understand that this was just a brainstorming exercise, and the good ideas in the table are not commitments to new work, and would need further elaboration and evaluation.

Glossary

BACT - Best Available Control Technology
EE/RE/DG - Energy Efficiency/Renewable Energy/Distributed Generation
IGCC -Integrated Gasification Combined Cycle
PHEVs - Plug-In Hybrid Electric Vehicles
PUC – Public Utility Commission
V2G - Vehicle-to-Grid

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Appendix. Ideas Generated During Brainstorming Exercise

Category Selected by Participant	Comment
Supplier - General Facility Emissions	Gasification technologies - ID/evaluate/promote the economic/environmental "winners"
Supplier - Electric Utilities - Efficiencies	Develop a "green utility" initiative to work with FGRC/State PUCs on renewable energy disincentives
	Utilities - with computer technology and wireless, change pricing model--peak load, etc
	Examination of likely mega-droughts in the west on energy supply, possible repercussions for adjustment in the energy system and impacts on air quality. This may also affect cooling towers, etc. Not just hydro-electricity
	Help change energy resource planning so EE/RE/DG on equal footing with traditional generation/transmission investments
	Help demonstrate IGCC/carbon capture and storage
	Address barriers limiting utility investment in energy efficiency
Supplier - Nuclear/Renewables	Analysis of short-term medium and long-term economy-wide cost impacts of greater reliance on EE/RE/Nuclear on energy commodity prices
Supplier - Renewables	Demonstrate life cycle analysis, future alternative energy scenarios in SIP process
	Promote reuse of raw materials into products as mode to conserve energy
	<ul style="list-style-type: none"> - Programmatic EISs to streamline NEPA - Compliance flexibility for users of renewable energy - Regional revolving fund - SEPs that incorporate Renewables - Environmental regulatory/licensing guidance for developers
	Work with Wall St. on promoting national market for RECs
	Supplier - Biofuels
Identify barriers/needs of biofuels sector; map life cycle impacts and work with 25 X 25 initiative	
Develop 20 year (plus) strategy on biofuels that includes: 1) partnerships with states, autos, energy companies to educate consumers on renewable fuels (ethanol, biodiesel) and build infrastructure (shorter-term) 2) leverage renewable fuel standard to develop post 2012 strategy 3) fill data gaps, provide consistent information within and outside EPA on GHG and emissions impacts of renewable fuels	
Develop generic permits for biofuel facilities	

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	<p>More exhaustive research into the environmental benefits and costs of ethanol fuels</p> <p>Publish definitive study on life cycle environmental impacts of different biofuels</p>
Supplier - Waste to Energy	<p>Promote cogeneration of power from "new" raw materials (agriculture and coal) with waste</p> <p>Product branding for renewables similar to Energy Star</p> <p>Help ORD/OSW/Regions identify biomass conversion technologies capable of using disaster debris and waste materials</p> <p>Support and work with the Office of Solid Waste and the Environmental Technology Council's "Waste to Energy" Team to inventory technologies and reduce permitting barriers for these conversion technologies</p> <p>Improve characterization and separation/purification of waste gases</p>
Users - Transportation Efficiencies	<p>Develop/build economic and emissions models that have capacity to integrate vehicle technology choices and fuels for short and long-term emissions and cost projections</p> <p>Convene auto industry, marketing types and perhaps consumer groups for a one-day or longer session on how to increase demand and supply of efficient autos in the near term</p> <p>Cost models for car ownership...e.g. insurance based upon VMT, tax on VMT, etc.</p> <p>Build a workshop on the net environmental impact of PHEVs on transportation and power sector emissions</p> <p>"Vehicles to Grid" - PHEVs, a demonstration? Same systems modeling?</p>
Users - Roads	<p>Smart materials with air quality sensors, thermoelectric energy generation, water, filtration , etc.</p> <p>Look at (nano) weight of materials in power (energy) sources trucking nuclear waste safely across the country is heavy and energy intensive</p> <p>Reduce materials weights of industrial materials air scrubbers, engines focus on Rad source materials heavy lead shielding</p> <p>Create new materials bricks made of waste ash from coal fired plants that are lighter</p> <p>Encourage builders to focus first on local materials (lower transportation costs)</p>
Users - Industry/Manufacturing Efficiency	<p>Convene interagency roundtables on a sector basis and engage private sector in a futures discussion. Fund joint research/assessment</p> <p>Biological feedstocks instead of hydrocarbon feedstocks to the chemical industry</p> <p>More biofuels used in chemistry instead of petro fuels</p> <p>Improved corporate energy management tools for industry</p> <p>Providing SIP credit for green buildings, plug-in hybrids, industrial efficiency</p>
	<p>Performance based green building ratings</p>

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Users - Enhancing the Built Environment	
	Engineered urban form - analysis of the potential benefits of limiting sprawl, a demonstration somewhere? Competition to identify the municipality?
	Build housing designed without HVAC system. Keep at 70 degrees without HVAC. This has been done in Europe
	Use sensors, smart houses
	Develop consumer behavior research program
	SIP credit for green building codes
	Smart communities - smart growth, energy efficient materials, mass transit, green roofs/parks/water sources that help reduce heat island effect
OTHER	
Other	Provide better information to public to help the understand how their consumption choices affect the environment
	Work with other EPA programs on product stewardship
	Invest in plans for sustainable redevelopment after natural disasters.
	Incentives (block grants, etc) for communities to do long-term master planning, whole system community design -- buildings, transportation, landscape, architecture, etc
	Use location-efficient mortgage concept for home design--houses with small footprint (less sq. ft) better energy conservation get lower mortgages
	Nanomaterial regulation--study health/environment impacts of materials, regulate to guarantee some industry stability, promote investment and innovation
	Create EPA GPRA goal that gives credit for working across media - across air, water, etc to maximize energy, water, air quality gains - multiple credits - right now can only be in one goal
	Revolving loan fund for gasification (IGCC) to partner with industry
	Consolidate energy conservation and generation activities under a single GPRA goal
	Presidential national security initiative to promote domestic clean energy technologies and energy efficiency while minimizing greenhouse gas emissions
	Greater linkages between planning in climate, air quality, and transportation planning
	Establish working group, with other federal agencies (DOE, DOJ, DOD, State) in long-term planning - build relationships and decrease turf battles
	Characterization of uncertain changes in circulation patterns and other weather patterns with climate change and implications for inter-state and transboundary pollution and exceedances of standards including diffusion of technology
	Full fuel cycle characterization of environmental implications of new energy technologies and abatement options

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	Better analysis of how policy tools affect rates and types of technological change in the private sector
	In the spirit of integration, look at energy/air interface with goal 2 - water infrastructure/water efficiency, with goal 3 - land use for biofuels, global material flow, implications of potential emerging technologies, with goal 4 - ?, with goal 5 - regulatory compliance options
	Change focus to working with the public on their choices. Note that none of the categories listed include and aspect of personal behavior
	Advertise the fact that conservation is the number 1 source of energy (savings) in America
	Enlist the future generation: 50-year bonds to develop and deploy new technologies with payments made tomorrow from the benefits or savings that emerge with the new technology and infrastructure taxes
	Work with faith-based groups to help create "early adopters" for new energy saving technologies
	The standard reference case of future energy use is already changing dramatically from EPA projections. EPA might support an alternative view of emerging energy and investment patterns
	Develop alternative to emergency diesel generators. Solar, hydrogen fuel cells. Need to be easy to buy at hardware stores
	Find alternatives quickly for emergency diesel generators
	Following Kenneth Boulding's comment: "Images of the future are critical to choice-oriented behavior" EPA might provide a richer set of market and technology images.
	Convene National dialogue on siting of energy infrastructure - petroleum refineries, ethanol, IGCC/power plants, LNG, wind (on and off shore) with industry, NGOs, Federal agencies, local government, states, etc
	<ul style="list-style-type: none"> - EPA Energy Coordinator - Energy project tracking - Harmonize standards and monitoring in energy corridors - Regional energy strategies
Other - Life-Cycle Analysis	Work with ORD to prioritize ORD investment in life-cycle analysis for emerging and existing conventional and renewable fuel/energy technologies
	Work with ORD/others on life-cycle assessment of economic costs, net energy balance, a and environmental impacts of alternative energy options
	Develop better life-cycle models
	Develop tools for life-cycle analysis and net energy gains to compare energy sources

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