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The Business Council Review

October 1996
Volume 4, Number 3

*A publication of the
Business Council for
Sustainable Energy*

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CHAIRMAN'S LETTER

Recent Budget Gains Underscore Breadth of Support for Clean Energy

Robert B. Catell, Chairman and President

When the final gavel sounded on the 104th Congress, members of the House and Senate had completed action on the FY 1997 budget for the Department of Energy. Reviewing the budget, one finds that clean energy programs did well considering the shrinking pool of federal energy research and development dollars. Funding for energy efficiency and end-use natural gas programs -- found in the Interior Appropriations bill, which also includes programs for public lands as well as the Indian Health Service -- stood at \$569.0 million, \$16 million higher than FY 1996. Funding for renewable energy programs, included in the Energy & Water Appropriations Bill along with Army Corps of Engineers waterway improvement projects and nuclear weapons activities at the Department of Energy, stood at \$270.0 million, only \$5 million below FY 1996. In the final accounting, this strong funding for clean energy, combined with cuts in more traditional energy programs, translates to a \$30 million shift in federal funding towards sustainable energy.

I believe it is important to consider how this funding shift occurred. On the renewables front, shortly after the House and Senate took up the FY 1997 energy budgets proposed by their respective Appropriations Committees, Members of Congress began offering a flurry of amendments. For renewables, the House side, Reps. Schaefer (R-CO) and Klug (R-WI) sponsored a successful amendment to restore \$42.1 million in funds for the renewables account. In the Senate, Senator Jeffords (R-VT) spurred action to boost renewables funding by \$23 million. Natural gas programs

(Continued on Page 3)

COUNCIL MEMBERS GREET OUTCOME OF CLIMATE CONFERENCE

U.S. Call for Action Spurs Progress

The Second Conference of the Parties to the Climate Convention closed on July 19 with a renewed commitment by the United States to take a more active approach on global climate change issues. Recharging what had previously been a deadlocked debate, Undersecretary of State Timothy Wirth, head of the U.S. delegation to the negotiations, captured headlines around the world by declaring that the United States would press for a legally binding agreement for controlling global greenhouse gas emissions. Previously, the U.S. had resisted a legally binding approach, and instead advocated voluntary measures.

Once again, Council members were in the vanguard of industry voices urging a proactive approach to dealing with the threat of global climate change. Members of the Council delegation to the negotiations organized a seminar on the market viability of clean energy technologies, held a press conference urging action on climate change with the Council's European counterpart, and made a floor statement during the negotiations in which Council members reminded negotiators that the clean energy industry stands ready to help resolve the threat of global warming. The Council delegation included Jim Wolf (American Standard), Terry Thorn (Enron), Jim Caldwell (American Standard), Jared Blum (PIMA), George Phelps (NAIMA), John Palmisano (Enron), Barbara Levin (Energy Conversion Devices), Griffin Thompson (US/ECRE), Ann McKinney (US/ECRE), Michael Weise (Trane), and Michael Marvin and Kirk Brown (BCSE).

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CHAIRMAN'S LETTER

NEW NAME, NEW FACE BRING NEW ENERGY TO THE BUSINESS COUNCIL

by Robert B. Catell, Chairman and President

As the Business Council enters its fifth year of existence, our message has gotten clearer. Put simply, this unique alliance of energy efficiency, electric utility, renewable energy and natural gas companies offers technological solutions to the nation's and the world's environmental problems.

The Council enters this new era with a new enthusiasm. Michael Marvin, who formerly headed the legislative and communications efforts of the U.S. wind energy industry, joined the association in April as Executive Director. Michael will provide excellent leadership and direction to the Council.

I am also encouraged by the Business Council's newest board member, Honeywell, Inc. Honeywell has been an active member of the energy efficiency community and a world leader in developing energy efficiency and control technology. Through its representative Jim Wolf, Honeywell's participation on the board will strengthen an already impressive ensemble of companies leading the Council.

I would like to thank the members who participated and contributed to a well-attended and successful Board meeting in May. The meeting was another sign of the Council's rebirth of interest among its members. There has also been heightened interest from potential members that are beginning to see how membership in the Council can benefit them directly.

(continued on pg. 2)

COUNCIL MOBILIZES SUPPORT FOR CLEAN ENERGY PROGRAMS

*COMPANIES ACROSS NATION INVITED TO SIGN
CLEAN ENERGY "STATEMENT OF PRINCIPLES"*

In 1995, the Business Council collected industry signatories from across the country for a letter in defense of the Department of Energy's (DOE) clean energy programs. Circulated to members of the House and Senate Appropriations Committees, the effort was a massive success -- in addition to the entire membership of the Business Council, over 250 companies from across the country signed the letter. The show of strength helped galvanize industry support for clean energy programs at a time when proposals to abolish the Department of Energy were gathering steam in both the House and the Senate.

This year, the Business Council is again spearheading an industry effort to support clean energy programs, this time with an industry "Statement of Principles." In cooperation with the DC-based Sustainable Energy Budget Coalition, a targeted group of companies is being asked to sign the Statement. To date, over 300 signatories have been collected for the Statement. The Statement will be used before a variety of audiences -- including Members of Congress and editorial boards of major newspapers -- to illustrate the broad support enjoyed by clean energy development efforts in the business community and the population as a whole. Business Council members interested in receiving a copy of the Statement should contact the Council's offices.

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CHAIRMAN'S LETTER

ELECTRIC UTILITY RESTRUCTURING BRINGS OPPORTUNITIES FOR SUSTAINABILITY

Robert B. Catell, Chairman and President

As 1996 draws to a close, The Business Council for Sustainable Energy will have been in existence for five years. From the last year of the Bush Administration into the second term of President Bill Clinton, The Council has worked to present a message of the importance of sustainable energy to the economy.

The coming year promises to be an important one for energy policy and for the Council as an alliance. Before we look forward, I want to take a brief look back from the perspective of an original Council member, and its Chairman and President for more than a year.

Over the years, I have seen the Council work its way through a number of complex and controversial issues. It's

clear that not all members see all issues from the same perspective. The Council has done a superb job of focusing on the one issue in which we find common ground--sustainable economic development. Moreover, the diversity of the Council membership, with the different perspectives, has been a benefit.

One of the Council's newest issues is one that presents perhaps the greatest challenge of finding common ground--electric utility restructuring. There is general agreement that restructuring the electric markets will be the largest energy issue facing our industries over the next several years, or longer. Electric utility restructuring is one of the more complex issues to come before Congress in many years.

(Continued on Page 3)

CONSULTATION BRINGS PRIVATE SECTOR TO THE WORLD BANK

On November 1, the Council's International Finance Task Force hosted a private sector consultation with the World Bank on its energy/environmental policies. Participants included Bank staff from the Energy and Environment Departments, Council members, and a broad cross-section of other private sector representatives. The consultation was one of only six held by the Bank worldwide in its effort to garner input on a new policy directive on sustainable development the Bank expects to issue in the middle of next year.

During the consultation, Council members aired a wide variety of views on the Bank's evolving role in international finance and project development. Under the direction of its president James Wolfhenson, the Bank is seeking to become more responsive to its clients and various stakeholder groups while improving the environmental track-record of Bank-financed projects. Private sector participants in the consultation voiced their support for Wolfhenson's efforts and urged the Bank to quickly adopt policies to "operationalize" past Bank pronouncements on sustainable energy.

In a meeting prior to the consultation, Council members developed a series of five proposals that the Bank could adopt to operationalize its energy/environment policies:

- ESTABLISH "CLEAN ENERGY TASK MANAGERS" IN THE BANK'S OPERATIONAL REGIONS. Currently, clean energy projects lack a constituency at the project level within the Bank.

(Continued on Page 3)

ECONOMISTS' STATEMENT ON CLIMATE CHANGE

*Endorsed by Over 2000 Economists
including six Nobel Laureates*

I. The review conducted by a distinguished international panel of scientists under the auspices of the Intergovernmental Panel on Climate Change has determined that "the balance of evidence suggests a discernible human influence on global climate." As economists, we believe that global climate change carries with it significant environmental, economic, social, and geopolitical risks, and that preventive steps are justified.

II. Economic studies have found that there are many potential policies to reduce greenhouse-gas emissions for which the total benefits outweigh the total costs. For the United States in particular, sound economic analysis shows that there are policy options that would slow climate change without harming American living standards, and these measures may in fact improve U.S. productivity in the longer run.

III. The most efficient approach to slowing climate change is through market-based policies. In order for the world to achieve its climatic objectives at minimum cost, a cooperative approach among nations is required—such as an international emissions trading agreement. The United States and other nations can most efficiently implement their climate policies through market mechanisms, such as carbon taxes or the auction of emissions permits. The revenues generated from such policies can effectively be used to reduce the deficit or to lower existing taxes.

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Economists Urge Reduced U.S. Emissions

Reuter

Friday, February 14 1997; Page A03
The Washington Post

More than 2,000 economists said in a statement yesterday that the United States would be able to reduce its industrial emissions to slow global climate change without damaging its economy.

Prepared by five leading economists, the statement said well-designed policies relying on market mechanisms "may in fact improve U.S. productivity in the longer run."

Spokesmen for industries that depend largely on fossil fuels such as oil and coal have argued that the threat of climate change from heat-trapping industrial emissions is overblown, and countries should wait for more scientific proof of global warming before implementing policies to slash emissions.

But the economists, who released the statement at a news conference, said climate change "carries with it significant environmental, economic, social and geopolitical risk," and that "preventive steps are justified."

They endorsed a system of "market mechanisms, such as carbon taxes or trading of marketable emissions permits among countries."

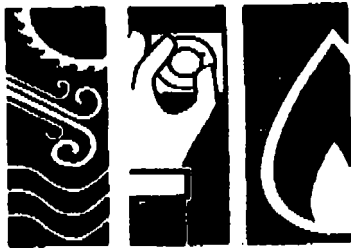
Revenues from carbon taxes or emissions credits could be used to reduce budget deficits or lower taxes to benefit the economy, said the statement drafted by Nobel laureates Kenneth Arrow and Robert Solow, as well as Dale Jorgenson of Harvard University, Paul Krugman of the Massachusetts Institute of Technology, and William Nordhaus of Yale University.

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EUROPEAN
BUSINESS COUNCIL
FOR A SUSTAINABLE
ENERGY FUTURE



**The
Business Council
for
Sustainable
Energy**

STATEMENT

Statement before the Ad Hoc Group on The Berlin Mandate, sixth session, Bonn, March 5, 1997, on behalf of The United States Business Council for Sustainable Energy and the European Business Council for a Sustainable Energy Future - e5.
Presented by Dr. Paul E. Metz, Executive Director of e5.

Mr. Chairman and distinguished delegates, on behalf of The United States and the European Business Councils for Sustainable Energy, thank you for the opportunity to present a statement at this conference. We represent a growing number of energy-related companies and business associations. Our members have interests in energy efficiency, co-generation and renewable energy sources. They agree with much of the business community on many issues, but not on climate change and energy policy. We advocate an early approach to climate policy to protect the environment while embracing important sustainable economic development objectives. We will be happy to make available brochures of our organizations which list our members.

Our members believe that significant energy can be saved and greenhouse gas emissions reduced through the expanded use of a wide range of existing, cost-effective technologies and services. The IPCC estimates that these offer a potential to reduce between 10 and 30% of the present CO2 emissions. We believe that expanded use of these "no-regrets" measures will create profitable business opportunities, save fuel costs, generate revenues and create jobs. We believe that governments should stimulate these investments by developing a responsive and responsible treaty on greenhouse gas mitigation.

In developing the Kyoto agreement, the two Business Councils urge that it contain legally binding targets to prod early action on climate change by Parties to the Convention. We believe this will accelerate a gradual transformation of our present energy structure, increase the economic efficiency and reduce the carbon emissions intensity of societies worldwide.

We propose the following priorities for policy makers:

-2-

1. Set clear near-term targets and time-frames for greenhouse gas emissions levels, beginning with Annex I countries. Climate policy should avoid economic shocks associated with inefficient capital displacement and encourage broader acceptance of climate benign technologies by encouraging gradual, predictable implementation of the climate treaty.

2. Use market-based tools to account for 'the external costs' of energy. Each party should select the best options in accordance with its legal and economic systems. For international markets such as transport, coordination of policies is necessary. Market-based policy responses are proven to be the most cost-effective, efficient approach to reduce emissions levels. This point was recently underscored in a statement signed by more than 2000 economists.

3. In addition to the liberalization of energy markets, institutional barriers, such as subsidies and tax exemptions for greenhouse gas emitting technologies, should be reduced and, to the extent possible, eliminated.

We believe the introduction of targets and the creation of market-based instruments to mitigate climate change will not cause economic or social disruption, but will promote economically beneficial technological innovation.

There are at least four sound reasons to start early in addressing climate change:

- It will reduce the risks and the costs of climate change,
- It prepares for the future scarcity of fossil and nuclear fuels,
- It will create employment and net economic benefits; and
- It will promote the creation of technologies and trade mechanisms that protect scarce environmental resources.

Thank you for the opportunity to share our views and for your continued openness to dialog with the business community on cooperative efforts in climate protection.

Bonn, 1997
USBCSE
e5

An Alternative Energy Future

A Joint Industry Study by:

**The Alliance to Save Energy
American Gas Association
Solar Energy Industries Association**

Peer Reviewers:

**Center for Global Climate Change at the University of Maryland
Environmental and Energy Study Institute
Global Climate Change Division of the U.S. Environmental Protection Agency
Natural Resources Defense Council
Worldwatch Institute**

Alternative Energy Future

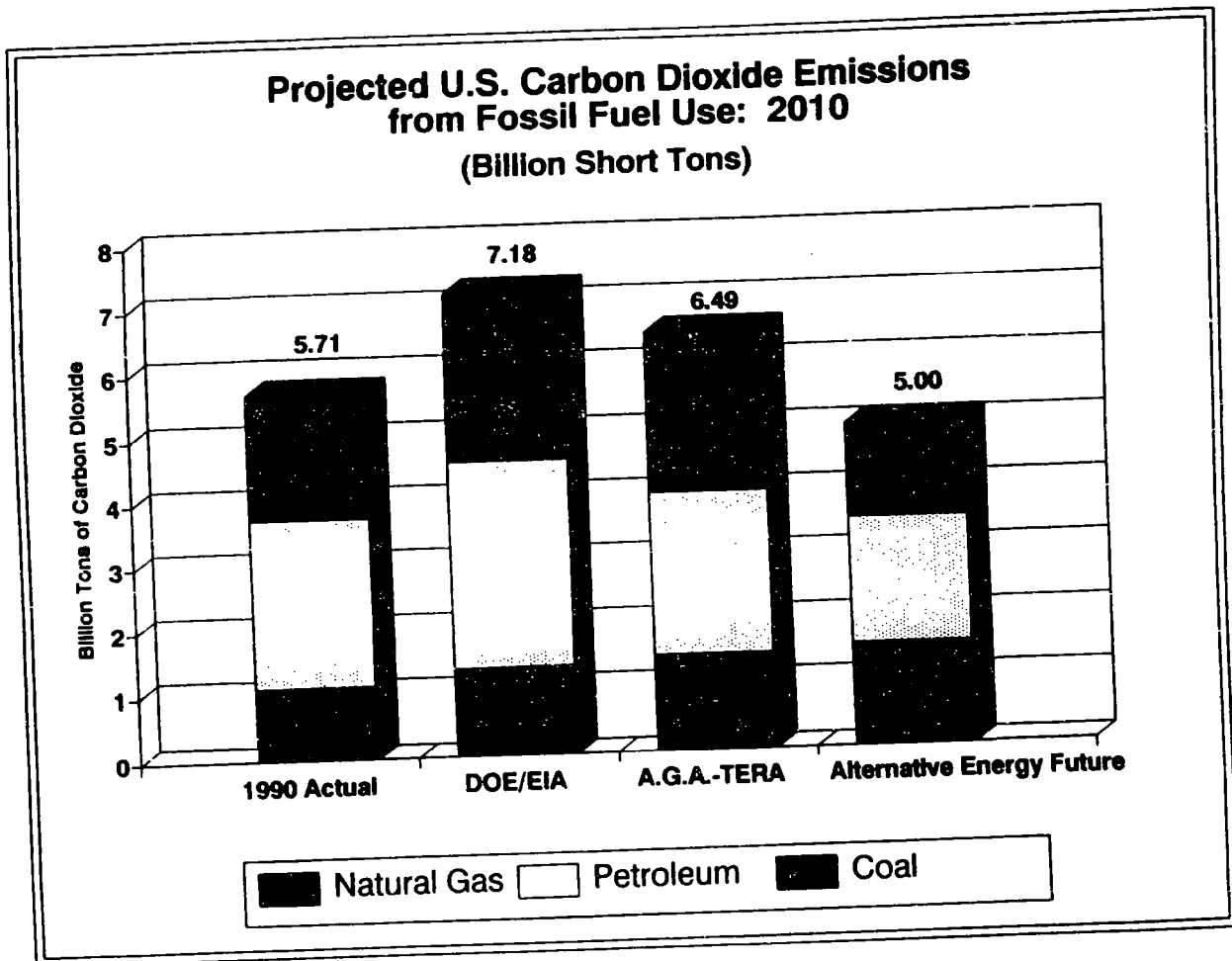
EXECUTIVE SUMMARY

Under the Alternative Energy Future analyzed in this study, substantial environmental benefits would be achieved with little net direct effect on economic health and employment in the energy industries. Emissions of greenhouse gases would decline significantly from current levels and criteria air pollutant emissions would be considerably below conventional projections. This is possible through economically and technologically feasible measures that increase efficiencies in the production and consumption of energy, and the adoption of conservation measures across end-use sectors.

Greenhouse Gas Emissions

Exhibit 1.5 shows the Alternative Energy Future scenario's projected level of carbon dioxide emissions by fuel type through 2010 compared with the 1992 American Gas Association's Total Energy Resource Analysis (A.G.A.-TERA) model Base Case and the 1992 Department of Energy's Energy Information Administration's (DOE/EIA) Reference Case, two more conventional energy forecasts. Throughout this report, except where noted, all references to the Base Case are to the 1992 A.G.A.-TERA Base Case.

Exhibit 1.5



Typically, conventional energy forecasts project increasing levels of carbon dioxide emissions from fossil fuel use over the projection period. For example, increases in CO₂ emissions range from 14 to 26 percent over 1990 levels under the Base Case and the DOE/EIA Reference Case, respectively. U.S. carbon dioxide emissions from fossil fuel use would decrease to 5.0 billion short tons by 2010 under the Alternative Energy Future scenario. This would represent over a 12 percent **decline from 1990 carbon dioxide emissions levels.**

Although not quantitatively estimated in this study, fossil fuel-related methane and nitrous oxide emissions under the Alternative Energy Future scenario are expected to decrease, perhaps significantly. Any potential increases in methane due to increased natural gas consumption are expected to be more than offset by significant decreases in petroleum and coal consumption. Fossil fuel-related nitrous oxide emissions are also projected to decline as a result of increased natural gas consumption coupled with substantial declines in coal and petroleum products consumption.

Criteria Air Pollutant Emissions

The aggregate emission reduction in the year 2010 of criteria air pollutants, specifically sulfur dioxide, nitrogen oxides, non-methane hydrocarbons, carbon monoxide and total suspended particulates, of the Alternative Energy Future scenario relative to the Base Case scenario would be over 10.2 million tons for the five air pollutants analyzed. Reductions of each of the individual pollutants range from 1.1 to 3.5 million tons per year by the end of the forecast period. (See Table 1.2)

- Nitrogen oxide (NO_x) emissions of the Alternative Case would be 24 percent lower (3.4 million tons per year) than in the Base Case. About 80 percent of the NO_x reduction is attributable to coal-fired electricity generating plants: both from the reduced utilization of these units due to reduced electricity demand, as well as the substitution of lower NO_x-emitting gas-fired combined-cycle plants for coal-fired plants.
- Sulfur dioxide (SO₂) emissions of the Alternative Case would be 1.1 million tons less than the Base Case in 2010 -- a reduction of roughly 8 percent. Approximately 60 percent of the SO₂ reduction is attributable to conversions to natural gas or conservation in oil-fired plants. No incremental reduction is projected for coal-fired electric utility plants -- SO₂ emissions of these plants are projected to drop from 15.6 million tons per year to 8.1 million tons per year as a result of the acid rain provisions of the Clean Air Act Amendments, regardless of the scenario employed. However, the reductions may be achieved in a more economic fashion under the Alternative Energy Future scenario which relies more on fuel switching and conservation than capital-intensive scrubbers.
- An additional reduction in non-methane hydrocarbon (NMHC) emissions of 1.2 million tons per year is achievable via the Alternative Case. This incremental

Alternative Energy Future

7 percent reduction is attributable to the substitution of natural gas, electric and other alternative-fuel vehicles for gasoline vehicles. Despite the fact that nearly half of all NMHC emissions come from stationary sources, most future reductions will come from vehicles, as stationary sources are already tightly controlled, and further control of these sources would be very costly.

- Carbon monoxide (CO) emissions will drop sharply over the forecast period due to tighter vehicular emission standards, enhanced inspection and maintenance programs, the use of oxygenated fuels and the expanded use of natural gas and other alternative-fuel vehicles. Alternative Energy Case CO emissions drop from the current level of 66.1 million tons per year to 39.8 million by 2010 -- 3.5 million tons below the projected Base Case level.
- Total suspended particulate (TSP) emissions of the Alternative Energy Case are projected to fall by 1 million tons more -- over 50 percent more -- than the Base Case reduction for the forecast period. This 1 million ton reduction is equally attributable to conservation and switching to natural gas in coal-fired boilers and to vehicular conversions from gasoline to clean alternative fuels.

Table 1.2

Potential Emission Reductions of Alternative Energy Future Scenario
(Thousands of Tons Per Year)

	SO ₂	NO _x	TSP	CO	NMHC
1995	200	834	157	1073	186
2000	440	1713	378	1938	266
2005	760	2443	692	2379	1012
2010	1095	3433	1017	3464	1237

Economic Impact Results

As a result of the increased marketshare for natural gas and the increased penetration of conservation technology, all sectors would experience reductions in the cost of purchasing energy in the Alternative Energy Future scenario compared with the Base Case. The magnitude of the savings would increase over time as overall energy prices increased and conservation saved additional energy. **The following comparisons of energy expenditures are made between scenarios, not in terms of the change from 1992 levels.**

- In the year 2010, total energy expenditures would be nearly 19 percent lower in the Alternative Energy Future scenario than in the Base Case. Total energy expenditures, projected to be \$736.2 billion (1992 dollars) in the Base Case, would fall to \$599.2 billion (1992 dollars) in the Alternative Energy Future scenario. Energy users would save \$137.0 billion (1992 dollars) in energy bills as a result. (See Table 1.3)
- In the Alternative Energy Future scenario, residential energy bills would decline from the Base Case level by \$41.2 billion (1992 dollars) or 24 percent in 2010.
- Commercial sector energy costs in 2010 would decline by 19 percent from the projected Base Case level thereby saving commercial establishments \$29.0 billion (1992 dollars) in energy expenditures.
- The cost of energy purchased by industrial customers compared with the Base Case projection would also decline in the Alternative Energy Future scenario by 19 percent. As a result, U.S. industry would reduce its energy expenditures by \$28.8 billion (1992 dollars).
- Transportation energy costs are projected to decline by 14 percent from the Base Case level thereby saving \$38 billion (1992 dollars) in expenditures.

The Alternative Energy Future scenario would improve the U.S. merchandise trade deficit relative to the Base Case. The primary source of this improvement would be the reduction in the dependence on foreign oil. As noted in subsequent chapters, the Alternative Energy Future scenario not only constrains the growth of petroleum product demand but also projects a smaller decline in domestic production of oil than in the Base Case due to increased drilling activity and improved productivity.

- As a result of increased reliance on foreign oil and increases in the world oil price, the Base Case projects that the cost of net oil imports (expressed in constant 1992 dollars) would grow from \$45.5 billion in 1991 to \$123.3 billion in 2010. The growth represents a 171 percent increase (in real terms) in this major drag on the U.S. economy.
- The net imports of oil in the Base Case are projected to grow from 6.6 million barrels per day in 1991 to nearly 11.3 million barrels per day in 2010.
- By comparison, the Alternative Energy Future scenario projects that the net expenditures for crude oil and petroleum products imports would increase by a still alarming 78 percent from \$45.5 billion in 1991 to \$80.9 billion in 2010 expressed in constant 1992 dollars. Nonetheless, by 2010 the Alternative Energy Future scenario projects a \$42.4 billion (1992 dollar) improvement in the

Alternative Energy Future

petroleum component of the merchandise trade deficit compared with the Base Case.

- The net imports of oil projected in the Alternative Energy Future scenario are stabilized at less than 8 million barrels per day. The growth in the petroleum merchandise trade deficit is a function of the projected increase in world oil prices.
- In addition, the development of energy conservation and renewable energy technologies should allow U.S. industry to compete more effectively for the growing world market for energy development and energy conservation services. Estimates developed by the U.S. Agency for International Development project a world market of between \$8 billion to \$17 billion annually for energy efficiency technologies and services alone. The majority of U.S.-manufactured renewable energy products and services are currently exported, at levels exceeding \$150 million each year, with a market potential of several billion dollars.

Table 1.3

**Projected Consumer Energy Expenditures and Savings
(Energy Bills Only)
(Billions of 1992 Dollars)**

	<u>2000</u>	<u>2000</u>	<u>2000</u>
	<u>Base Case</u>	<u>Alternative Energy Future</u>	<u>Consumer Energy Savings</u>
Residential	\$143.2	\$126.0	\$17.2
Commercial	110.0	99.7	10.3
Industrial	111.6	101.0	10.6
Transportation	214.3	184.4	29.9
TOTAL	\$579.1	\$511.1	\$68.0
	<u>2010</u>	<u>2010</u>	<u>2010</u>
Residential	\$169.0	\$127.8	\$41.2
Commercial	149.9	120.9	27.9
Industrial	152.8	124.0	28.8
Transportation	264.5	226.5	38.0
TOTAL	\$736.2	\$599.2	\$137

The Alternative Energy Future scenario implies a significant restructuring of the nation's energy industry. When the incremental conservation and renewable investment expenditures are combined with the restructured domestic energy production revenues, the total annual revenues received by domestic companies for energy and energy services is reduced but not by as much as consumer energy expenditures.

- In the Base Case in 2010, consumers are projected to pay \$602.9 billion (1992 dollars) for domestically-produced energy.
 - Total energy bills are projected to be \$736.2 billion, which includes \$123.3 billion for imported oil and \$10 billion for imported natural gas.
- In the Alternative Energy Future scenario in 2010, consumers are projected to pay \$518.3 billion for domestic energy. But in order to achieve the conservation improvements embedded in the scenario, consumers are projected to invest nearly \$43 billion on incremental conservation and renewable technologies in 2010.
- As a result, the total revenue received by domestic energy producers, including producers of "conservation energy" and renewable energy, is projected to be \$551.4 billion. This represents a decline of \$51.5 billion or less than 9 percent of the domestic energy industry revenues projected in the Base Case.

Because of the labor-intensive nature of energy conservation and renewable energy, total employment in energy production and service industries in the United States may actually increase.

- Total energy sector employment in the Alternative Energy Future scenario is projected to increase by more than 82,000 jobs in 2000.
 - Domestic natural gas and oil production jobs are projected to increase by over 15,000 jobs above Base Case levels.
 - Coal production jobs are projected to decline by 24,000 compared with the Base Case.
 - Over 90,000 new jobs in the conservation and renewable energy sector are projected to be created.
- By 2010, the rate of job growth is projected to accelerate. The Alternative Energy Future scenario projects a net increase of more than 175,000 jobs in the energy sector above the Base Case level.

Alternative Energy Future

- Natural gas and oil production employment is projected to increase by more than 25,000 jobs.
- Coal production employment would continue to decline, losing more than 44,000 jobs compared with the Base Case.
- Energy conservation services and renewable energy are projected to become major employers in the U.S. economy by 2010, with more than 190,000 jobs created above the Base Case levels.

The Washington Post

AN INDEPENDENT NEWSPAPER

Staying Cool

WE NOW KNOW that the old saying attributed to Mark Twain—"We all grumble about the weather but nothing is *done* about it"—is not quite true. By virtue of the coal we burn and the gasoline we use and in a thousand other ways, we all have a great effect on the weather. The earth has grown warmer by about one degree, on average, during the last century, and scientists believe the process is accelerating. If nothing is done to slow global warming, the consequences in the next century are likely to be dire. Much turns on decisions the government must take this year.

After years of debate, few now dispute that the burning of fossil fuels releases gases into the atmosphere which then trap more of the sun's warmth than the planet would otherwise retain. The effects of this are more complex than the term "global warming" suggests. Some parts of the earth are likely to become colder, others drier; monsoon and hurricane paths may shift; storms may become more extreme; sea levels will rise. Many small islands and low-lying coastal areas, such as Maryland's Eastern Shore, are at risk. Relatively small temperature changes could have a dramatic impact on agriculture and even the spread of disease.

At the 1992 Earth Summit in Rio de Janeiro, the United States—which produces something like one-quarter of the world's greenhouse-gas emissions—vowed to reduce them to 1990 levels by the year 2000. It seemed a modest goal, but it won't be met. So last year the

administration accepted, in principle, the notion of binding targets. Now nations are negotiating those targets—amounts and dates—hoping to reach agreement at yet another conference in Kyoto in December.

Opponents of meaningful action, led by parts of the energy and utilities industries, have shifted their strategy from attacking the scientists to warning of dire economic consequences. But last week more than 2,000 economists signed a statement challenging the industry claims. The broad array of economists, led by Nobel-Prize winners Kenneth J. Arrow and Robert M. Solow, said that measures to reduce greenhouse-gas emissions need not harm the economy—and "may in fact improve U.S. productivity in the longer run." That's because there are many innovative and energy-efficient technologies just awaiting the right financial incentives to enter the market. In many such fields, U.S. industry leads the way.

The key, then, is for the United States to set a goal that's not pushed off to some distant date like 2020 or beyond. A near-term date would send the signal industry needs to begin seriously investing in more efficient technologies, and the commercialization of such technologies would offer an alternative path for development to giants like China and India. Their economies are sure to grow in coming decades; and if they follow the U.S. path to prosperity, we will all be doing more than just grumbling about the weather.



The Business Council for Sustainable Energy

POSITION STATEMENT -- GLOBAL CLIMATE CHANGE

1997

PREMISE

CLIMATE POLICY SHOULD PROMOTE **ECONOMIC EFFICIENCY AND TECHNOLOGY INNOVATION**

Climate change policy should be developed based on principles of economic efficiency and promoting "climate friendly" product and process acceptance. Policies should be designed to achieve a series of clearly articulated targets designed to first stabilize, and then reduce, global greenhouse gas emissions.

POSITION 1 — Promoting economic efficiency and expanding market receptiveness for efficient and clean technologies and services require that the climate Protocol contain a **NEAR-TERM TARGET...**

The marketplace requires a near-term signal to foster investment in efficient and clean technologies. A target for measuring progress in controlling global greenhouse gas emissions should be set for 2005. **KEY CONCEPT:** the 2005 target could first be stabilization of emissions. Once the near-term target is met, Parties to the Convention should begin making progress towards a series of incremental emissions control goals. To allow clear measurements of progress, a series of goals should be set that ultimately will achieve an agreed upon long-term emissions concentration objective (e.g., a series of five percent reductions every five years — five percent reduction by 2010; 10 percent reduction by 2015; 15 percent reduction by 2020, etc., leading to an acceptable long-term emissions concentration goal.)

POSITION 2 — Developing countries should accept emissions control responsibilities once the developed countries have demonstrated progress on controlling their emissions...

Developed countries should demonstrate leadership by taking serious action to combat global warming and then the developing countries should accept further commitments to limit their emissions growth. A year 2005 emissions stabilization goal achieved by Annex I parties could serve as a trigger for expanding existing commitments of the developing countries. They would then assume obligations to limit emissions growth.

< < OVER > >

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POSITION STATEMENT -- GLOBAL CLIMATE CHANGE (CONT'D)

1997

POSITION 3 — A credible, verifiable emissions credit trading system will ensure an efficient reduction in emissions utilizing climate-friendly technologies...

Emissions credit trading should be allowed between Parties with emissions reduction obligations under the Protocol or other legal instrument. Other market-based tools such as joint implementation should be allowed between Parties with obligations under the protocol, but only for clearly verifiable and quantifiable emissions REDUCTION projects.

POSITION 4 — Long-term emissions averaging will make tracking progress on reducing emissions difficult and will dampen climate-friendly investments and technological innovation...

Using averages to track emissions over long time periods (e.g., ten years) will not be as effective as clear year-specific signals for spurring action to reduce greenhouse gas emissions. Instead, a series of targets could be used: for instance, Annex 1 stabilization by 2005, preliminary Annex 1 cuts by 2010, deeper Annex 1 cuts and developing country stabilization by 2015, and still deeper cuts on the part of both Annex 1 and developing countries by the year 2020 and in later years. If emissions averages are to be used to track progress towards meeting these goals, they should be based on a short time-period (e.g., two to five years).

POSITION 5 — Emissions banking could be allowed but emissions borrowing should be **REJECTED WHOLESALE**...

Emissions borrowing reduces the incentive to take action TODAY to combat global greenhouse gas emissions.

* * * * *

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is comprised of business leaders from the energy efficiency,
renewable energy, natural gas and utilities industries. Members
of the Council work with senior officials from major environmental
organizations to support energy-related policies and programs which
will enable the United States to achieve a sustainable pattern of
energy production and use that simultaneously contributes to
global economic, environmental and security goals.*

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Southern California Gas Company
Southern California Edison Co.
SYCOM Enterprises
Union of Concerned Scientists
United Solar Systems Corp.
United Technologies
U.S. Clean Air Network
U.S. Export Council for Renewable Energy
Worldwatch Institute
York International
Zond Systems



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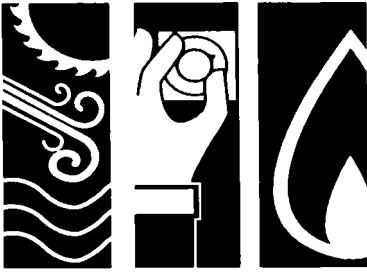
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Randall Swisher, American Wind Energy Association

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List of Attendees for the April 16 Meeting

Michael Marvin
Business Council for Sustainable Energy

✓ Kirk Brown
Business Council for Sustainable Energy

\ Murray Liebman
American Gas Association

James Wolf
American Standard

Michael Bergey
Bergey Windpower Co.

Mark Stanga
York International Corporation

Jennifer Schafer
Engelhard/ICC

Charlie Fritts
American Gas Association

Cynthia Sandherr
Enron Corp.

Don Forester

4/2/07

CHARACTERISTICS OF A COMPREHENSIVE DISLOCATED WORKER PROGRAM

Introduction. This paper offers a general framework for developing a comprehensive program of assistance for workers likely to be adversely affected as a result of limitations on greenhouse gas emissions. The design is one based on experiences of publicly funded workforce programs responding to adjustment needs caused by such factors as trade liberalization, reduced defense expenditures, and restrictions on natural resource extraction.

This paper neither provides nor has the advantage of information on the number of individuals who may be affected by this event. The suggestions offered herein would likely require fine-tuning as estimates of economic impact become available.

Contextual Framework. The design of an adjustment program will typically be based primarily on five factors:

- o the *characteristics of the individuals* served
- o the *employment opportunities* available in the labor market
- o the *interventions necessary* to bridge any gaps between the skills needed by local employers and those resident in the affected workforce
- o the financial and institutional *resources available* to support the needed interventions
- o the *specific goal(s)* of the program

Basic Principles. An effective design would be based on the following principles:

- **Equity.** Any worker dislocated as a result of the Treaty should be eligible for assistance, regardless of the cause of the dislocation.
- **Early intervention.** Workers should be enrolled as early as possible to reduce the period of unemployment and facilitate early return to appropriate employment.
 - To the maximum extent possible, early identification of affected industries and firms should allow targeting of services on affected workers prior to dislocation.
- **Broad range of services.** An array of quality adjustment services should be available that can be tailored to individual needs.

- ▶ *Customer-driven choice* in the selection of service providers.
- ▶ *Flexibility* for local planning and oversight, with employer participation.

Governing Structure and Funding. As indicated, experience shows that flexibility and choice are critical components of a responsive adjustment system. The following are also important features:

- ▶ *Accountability for results* amongst all levels of the governing structure, and the participating individuals.
- ▶ *Appropriately structured levels of authority* which:
 - focus responsibility for key design decisions and basic program operations on a local administrative and management structure;
 - establish State responsibilities for infrastructure support, coordination and other activities to achieve program goals; and
 - provide for a Federal role including technical assistance, demonstration programs, and other discretionary activities carried out by the Secretary.
- ▶ *Adequate funding.* Earmarked funding through a trust fund or another similar vehicle to ensure adequate financial resources; flexibility in using existing program funds such as those available through the unemployment trust fund.

Services. Amongst the broad range of services offered by effective worker adjustment programs are:

- ▶ *Early planning and intervention* through a combined worker/employer assistance initiative (see below) and other forms of rapid response assistance
- ▶ *Basic readjustment services* to assess the needs of affected workers and direct them to the most appropriate service response
- ▶ *Retraining* to provide workers with the new skills needed to become productively reemployed
- ▶ *Remedial and basic skill training* for individuals who are not adequately prepared in those areas
- ▶ *Supportive services* to allow participation in training. These needs may include health insurance and transportation assistance.

- *Income support* to allow the full participation of individuals who require services that will extend beyond their unemployment compensation period.

The Need for a Comprehensive Strategy. The principles identified above are effective only when they are applied in a setting that takes maximum advantage of the information and opportunities that exist. In this case, the following are among the factors that could prove critical in developing a comprehensive strategy to address the impact of greenhouse emission reductions on workers, employers and communities:

1. **Early Warning.** If it is possible to provide identification of likely impact (on workers, firms and geographical areas) well in advance of the actual effect, interventions can be designed to mitigate the effects of the emission reductions. Workers and firms in affected industries can be offered services designed to avoid layoffs and economic loss. States and communities likely to suffer serious impact can be provided assistance in developing comprehensive strategic plans to respond to the impact. **Early warning also maximizes the opportunity to merge resources available through a range of public and private sources in order to meet the many and varied needs of workers, firms and communities.**
2. **Employer-based assistance.** To the extent that comprehensive approaches to adjustment require consideration of worker, employer and community needs, publicly-funded assistance aimed at helping affected employers adjust to the effects of the emission limitations could be made available. The goals of this assistance would be conversion of the employer to alternative fuel production or use and retention of employment.
3. **Trust Fund.** Some or all of the proceeds from the auction of emission rights could be used to fund adjustment services for communities, workers and firms.
4. **Job creation.** Because much of the impact would occur in areas offering few alternative employment opportunities, Federal funds may be required to support the creation of new jobs. One option is the designation of high-impact areas as Empowerment Zones to provide a range of incentives for skill training and job creation activities.
5. **Community service employment.** One employment option for areas and populations with special needs is community service employment in the public and not-for-profit sectors. Projects like the Civilian Conservation Corps could serve as models for this type of intervention.

Policy Consideration. Experience with dislocated worker programs underscores the difficulties inherent in a public policy that provides superior levels of service for individuals whose job loss is tied to a specific event. Need for specific services or support is the most appropriate determinant of public assistance. Equity of treatment among all dislocated workers argues for responding to these dislocations through the publicly funded workforce development system.

November 1996



**Business Council For
Sustainable Energy**



Changing Tide: Tomorrow's Clean Energy—Today

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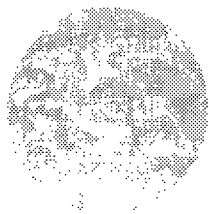
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Changing Tide: Tomorrow's Clean Energy - Today

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Changing Tide: Tomorrow's Clean Energy - Today

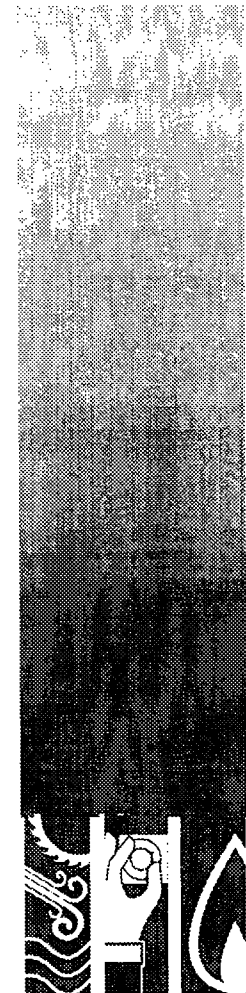


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AMERICAN FLYWHEEL SYSTEMS, INC.

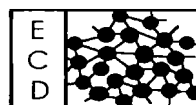
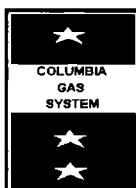


Changing Tide: Tomorrow's Clean Energy - Today

No activities have a greater effect on the global environment than do the production and use of energy. It was this fact that helped lead to the creation of the Business Council for Sustainable Energy and this important document.

Formed in 1992, the Council is comprised of leading companies in the energy efficiency, natural gas, renewable energy and electric utility industries that share a common concern for developing sustainable energy policies.

The Council and its members offer more than policy options. We bring technological solutions to environmental problems. Technologies are available and being used today that reduce the environmental impacts of energy production and use while simultaneously promoting vigorous economic growth. Technologies such as photovoltaics, fuel cells, natural gas combined-cycle, cogeneration, and wind turbines can make our energy system more environmentally sustainable. Products such as heat pumps, high efficiency appliances, natural gas cooling, insulation, and a host of others can reduce the amount of energy we require.





PROVEN ALTERNATIVES

The desire to protect the environment while providing for economic growth transcends political ideology and geography. The energy choices highlighted here show that cost-effective, environmentally friendly technologies provide benefits in the global marketplace today. These technologies can power the nation's economic engine while providing the quality of life that comes with a cleaner environment.



The Council would like to thank the Energy Foundation for its support in developing *Changing Tide: Tomorrow's Clean Energy - Today* and for the leading role the Foundation has played in increasing awareness of the importance of crafting sound energy policy in the United States and abroad. I also want to recognize the role that Kirk Brown, the Council's Policy Director, and Katheleen Freeman, an intern with the Council, played in creating this document.



Robert B. Catell
Chairman and President
Business Council for Sustainable Energy





Energy For the Twenty-First Century

Energy efficiency, natural gas, and renewable energy are the three pillars of a more secure and sustainable energy strategy that will help strengthen the U.S. economy and clean up the environment.

It has been exactly a century since the last great energy revolution occurred. In fact, much of the energy system in place today was created in an explosion of invention between 1890 and 1910. During that short period, many cities were dramatically transformed, with horse-drawn carriages replaced by automobiles, and gas lamps by electric lights. Carriages and gas lamps had prevailed for centuries, but once the conditions for rapid change were in place, the old technologies suddenly became obsolete.

Today, we may be at a similar turning point, as revolutionary new energy technologies emerge at the same time that consumers demand a cleaner environment and more flexible, less costly ways of meeting their energy needs. Energy efficiency, natural gas, and renewable energy are the three pillars of a more secure and sustainable energy strategy that will help strengthen the U.S. economy and clean up the environment.

Around the world, advanced electronics, new kinds of synthetic materials, and the techniques of mass production are allowing engineers to substitute clever technologies for brute force. The result is a variety of new, modular, mass-produced energy systems that may soon be more economical than the ones we rely on today. Just as personal computers allowed the development of networks of distributed computers, so may our currently centralized energy system be transformed.

Already, the market for the new energy systems is booming. Worldwide sales of solar cells rose 75 percent between 1990 and 1995, while sales of wind turbines rose 500 percent. Meanwhile, a new generation of highly efficient home appliances, light bulbs, and window glazing have also proven popular with consumers.



Leadership in the energy technologies of the future will help revitalize the U.S. economy, reduce our growing dependence on imported oil, and create millions of jobs—many of them in export industries. Indeed, the largest market for these new technologies will be in the developing world, where 2 billion-3 billion people are poised to acquire televisions, refrigerators, automobiles, and other energy-using equipment, driving energy needs upward. In developing Asia alone, energy use has grown 30 percent just since 1990.

These new energy technologies will also allow the world to reduce its environmental problems. Lung disease, forest damage, and toxic pollution are among the legacies of today's energy systems—and in rapidly growing developing countries, they are reaching epidemic proportions. Combustion of traditional fuels is also pumping over 25 billion tons of carbon dioxide into the atmosphere each year. The Intergovernmental Panel on Climate Change (IPCC), comprised of 2,500 scientists, concluded last year that human-induced climate change may already be affecting climate patterns. Only a highly efficient energy system running on cleaner fuels can solve such problems.

Just as the automobile and electric power industries were engines of economic growth at the turn of the last century, so can a new generation of sustainable energy technologies help power the global economy into the twenty-first century. These technologies, together with other modern marvels such as gas turbines, fuel cells, and a new generation of electronic controls, offer the prospect of a strong and powerful economy that no longer causes damaging air pollution or contributes to the heating of the atmosphere.

Leadership in the energy technologies of the future will help revitalize the U.S. economy, reduce our growing dependence on imported oil, and create millions of jobs.

Energy Supply . . .
Tomorrow's Clean Energy—Today



Solar Power . . .

Technology Description

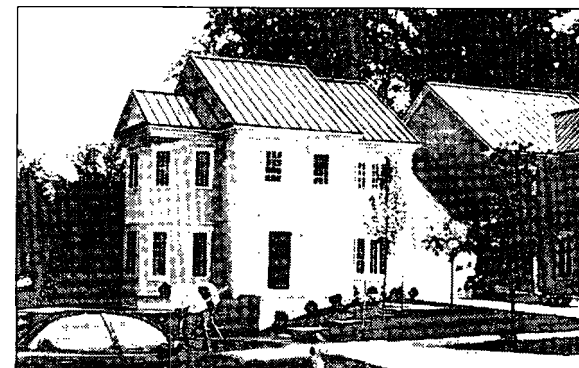
Solar technologies include photovoltaics — the direct conversion of sunlight into electricity — and solar thermal, which uses heat from the sun either directly in heating applications or to drive a turbine to convert heat into electricity. The existing photovoltaic (PV) module market is relatively small (just over 70 megawatts per year worldwide in 1994), but is growing as demand for solar power both off- and on-grid continues to increase. More than 80 percent of PV modules are installed in remote applications where traditional power generation sources would be impossible or would require very expensive transmission line extensions. These applications include telecommunications, cathodic protection, battery charging, water pumping, refrigeration, and lighting. In addition to these remote applications, solar water heaters, already a cost-effective option, are installed on 1.5 million buildings across the U.S.

ENTER THE "UNI-KIT"

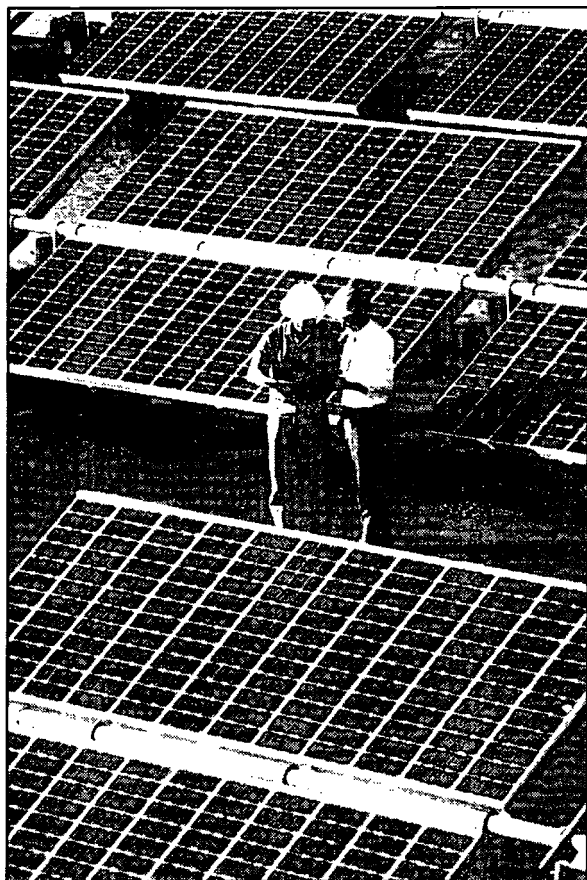
Energy Conversion Devices, Inc. (ECD) and its U.S. manufacturing joint venture, United Solar Systems Corp. (United Solar), have developed numerous products to address "distributed power" markets, a major trend in energy supply. As the standard of living in developing areas of the world improves, off-grid markets will continue to grow very rapidly. A lightweight, conveniently packaged PV lighting system, the Uni-Solar "Uni-Kit," produced by United Solar, can be taken to any remote area and installed with a minimum of technical training to provide lighting and other small scale electrical requirements. For more substantial electrical energy systems, ECD and United Solar have developed unique solar shingles and metal roofing products that emulate conventional roofing materials in form, construction, function, and installation. These roofing products can be installed by roofing contractors on residences, commercial buildings, and industrial facilities to provide energy in addition to fulfilling normal roofing functions. In high volume production, these materials will be competitive with electricity generated by conventional fuels and can be used to supplement or replace grid-supplied power.

Benefits

- Pollution Reduction.
- Increased Energy Independence.
- Massive Worldwide Export Potential.
- Reduced Transmission and Distribution Costs.
- High Energy and Capacity Value.

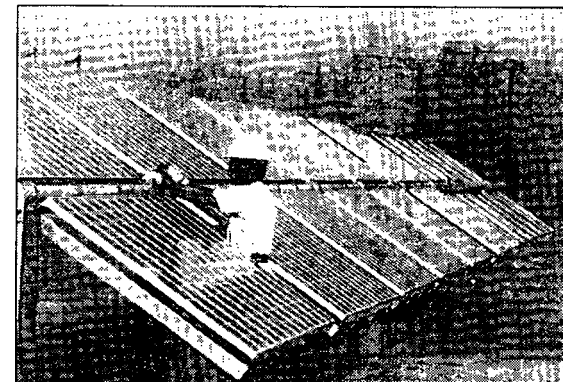
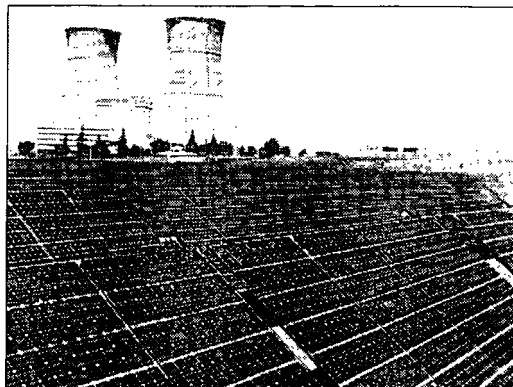


*Model of standing seam photovoltaic roofing modules.
Installed at the National Association of Home
Builders (NAHB), Upper Marlboro, Maryland.*



BRINGING PV POWER TO MARKET

In January 1995, two US energy companies, Amoco and Enron, joined to form Amoco/Enron Solar, to manufacture and sell photovoltaic modules and to develop solar-powered electric generation facilities for the world market. This joint venture signals the beginning of a new era in solar energy. The companies will jointly fund construction of the manufacturing facility for a new thin-film amorphous silicon solar technology at a scale that will allow solar energy to compete with traditional fuels in the bulk electric market. Based on this technology and manufacturing scale, Amoco/Enron Solar proposed to sell power to the U.S. Department of Energy, among others, under a long-term power purchase agreement at 5.5¢ per kWh, escalating at three percent per year for 30 years, from a 100-megawatt solar generation facility to be built, owned and operated by Amoco/Enron Solar in the proposed Nevada Solar Enterprise Zone. While this offer was conditioned upon receipt of tax-exempt industrial bond financing, it does illustrate the near-term competitiveness of this particular technology when commercialized on a large scale by leading companies in photovoltaics and power project development.



Current and Future Markets

World shipments of photovoltaic cells have been rising steadily since they first appeared in commercial markets in the early 1970s. At the same time, costs have dropped dramatically. The United States, buoyed by healthy increases in domestic and export demand, leads world production in PVs. Japan and Western Europe also have developed strong markets for PVs. Improvements in manufacturing technology and electric conversion efficiency combined with economies of scale have made it possible in the near term for thin film photovoltaic technologies to compete in the grid-connected power market, at least in areas with good solar resources.



Wind Power . . .

Technology Description

Wind power technology accommodates two distinctly different customers. First, and perhaps more widely thought of, is the large-scale power producing systems. In 1995, six billion kWh of electricity were generated by large-scale wind power systems. The state of California produced three billion of those kilowatt-hours by using three windy mountain passes for wind "power plants." That is enough electricity to meet the residential needs of a city the size of San Francisco or Washington, D.C. These systems are designed to compete with conventional power plants connected to the utility grid system.

A second wind technology is a smaller-scale power producing system designed for small villages in developing countries, farms, or other sites where connecting to a power grid is not feasible due to location or costs. These systems are comprised of a small number of wind machines providing power on-site for electricity, water pumping for agriculture, or even powering oil wells. These systems are relatively low in cost when maintenance, fuel supply, efficiency and reliability are considered.

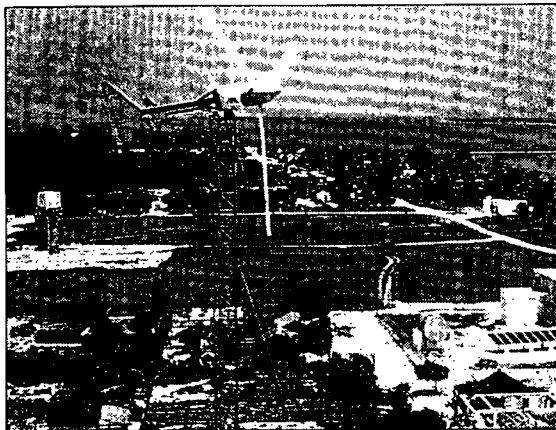


Benefits

- Modularity - units can be added to the system at a low cost and without major system overhaul.
- Minimal future costs subject to inflation (no changing fuel prices).
- Low operating and maintenance costs.
- Each one million megawatt-hours of electricity produced from wind translates into avoidance of 1.1 million metric tons of CO₂ emitted into the atmosphere by a coal-fired power plant.
- Newer turbines are available for use over 95 percent of the time.
- Provides jobs because wind technology is labor intensive, not natural resource intensive.

THE VICTORY GARDEN

In 1981, the Victory Garden Windpower Station, designed by Zond Systems, Inc., and located on ridgelines bordering the Mojave Desert, became the first commercial wind facility to deliver power to Southern California Edison. The generating station was developed in increments and with advancing wind turbine technology as it evolved throughout the decade. "Build-out" was reached in 1990 totaling 1,338 turbines with an aggregate rated generating capacity of 120 megawatts. The facility now covers 900 acres. The station's turbines are arrayed along a four-mile ridgeline at an elevation of 5,000 feet. In order to harness the most wind energy along the ridgeline, Zond developed the "wind-wall" array, consisting of several tower heights in each row. Electricity generated by the turbines is collected through a system of underground power lines that connect at substations for delivery of power to the utility grid. Each of the facility's largest machines (225-kilowatt) generates enough electricity to meet the ongoing power needs of over 100 homes. Zond has recently deployed a 550-kw machine and is in the final testing stages of a 750-kw turbine.



POWERING A MEXICAN FISHING VILLAGE

Xcalac, a fishing village on the eastern coast of Mexico, in the province of Quintana Roo, has had access to electrical power from diesel systems for a number of years. But the diesel systems required frequent maintenance and were hindered by the lack of a reliable fuel supply. As a result, the village was often without power. Electrification by extension of the utility grid was economically and logistically infeasible, and would not have happened in a timely manner. The Quintana Roo government hired Condumex S.A. of Mexico City to study the feasibility of providing the village with reliable electric power using a renewable energy system. The new power system was completed less than a year later using Bergey Windpower turbines, Siemens solar modules and the existing diesel generator. Electricity demand was estimated at 160 kilowatt-hours per day. The new system was designed to provide 400 residents with power for residential lighting, street lighting, and other residential uses. Additionally, because of the system's modularity, capacity may be added as need arises. The average daily demand once the system was in place was 300 kilowatt-hours per day, nearly twice the design value. Average wind speed was higher as well, enabling the system to keep up with increased demands. During the first year the system was 100 percent available. The total cost (including shipping, tariffs and installation) was about \$450,000 compared to \$3.2 million estimated for the alternative (grid extension). The residents are pleased with the new system and have been adding loads such as refrigerators at a faster rate than anticipated. Additionally, a tourist hotel is under development and expects to tap into the electrical system. The power system may be expanded soon to meet growing energy needs.

Current and Future Markets

The cost of generating energy from wind is constantly decreasing as technology advances. The worldwide market for wind power is large and growing, having reached \$1.5 billion worth of new installations in 1995. Wind projects are currently being planned in the U.S., Europe, Asia and Latin America to meet and sustain energy requirements in a reliable and clean manner. It is now possible to economically produce 20 percent of U.S. electrical needs on just 0.6 percent of the U.S. land mass — of this amount, only five percent of the land actually would be used for turbines or other equipment. Denmark expects to produce 10 percent of its electricity via wind power by 2005. Over 20 percent of Europe's electrical needs could be met by wind machine systems and at least 20 subtropical islands have nearly constant trade winds that could meet an even greater portion of their electric needs. Wind turbines have earned a place in the world of clean and sustainable energy production.



Natural Gas: Combustion . . .

Natural Gas

Natural gas is one of the leading fuels consumed throughout the world. It is used mainly for industrial process steam and heat production, for residential and commercial space heating, and for electric power generation. Natural gas consists of a high percentage of methane and varying amounts of ethane, propane, and butane. Gas processing plants are required for the recovery of liquefiable constituents and removal of hydrogen sulfide before the gas is used.

Current and Future Markets

In the U.S., 15 percent of the new power plant capacity added in 1994 by U.S. investor owned electric utilities were natural gas-fired combined-cycle units. According to the North American Electric Reliability Council, electric utilities had nearly 10 Gigawatts (1 GW = 1,000 MW) of natural gas-fired combined-cycle systems operating in 1994 and project to add another 13 GWs through 2004. According to the Gas Research Institute's 1995 Industrial Cogeneration Forecast, 7.9 GW of industrial cogeneration capacity utilizing combined-cycle configurations were on-line in 1992 in the U.S. Of the total 24.3 GW of industrial cogeneration capacity projected to come on-line between now and 2010, an estimated 17 GW (71 percent) will be new gas-fired facilities.

Emissions from Natural Gas Combustion

Natural gas is a relatively clean-burning fuel, but some emissions can result from combustion. Improper operating conditions may produce carbon monoxide and certain organic emissions. Some sulfur oxides will be produced in combustion due to sulfur-containing mercaptan which is added to natural gas to permit leak detection. Nitrogen oxide (NO_x) emissions are a greater concern when burning natural gas. Nitrogen oxide emission levels vary with the type of combustor and with operating conditions.

Natural gas is a preferred fuel from an environmental perspective. A study by ICF Resources provides the following comparison between a 500 MW power plant fired by coal and one fired by natural gas.

Pollutant (tons per year)	Natural Gas	Coal	Natural Gas Benefit
Sulfur Dioxide	7	8,043	↓ 100 %
Nitrogen Oxides	971	5,056	↓ 81 %
Carbon Dioxide	1,241,292	2,942,375	↓ 58 %
Ash	0	125,000	↓ 100 %
Sludge	0	350,000	↓ 100 %
Particulates	21	428	↓ 95 %

Emission Control Technologies

Low NO_x burners and flue gas recirculation are the two most prevalent control techniques. Additionally, two post-combustion technologies that may be applied to reduce emissions are noncatalytic reduction and selective catalytic reduction. These systems inject ammonia into combustion flue gases to reduce inlet NO_x emission rates by 40 to 70 percent.

Natural Gas: Combined-Cycle . . .

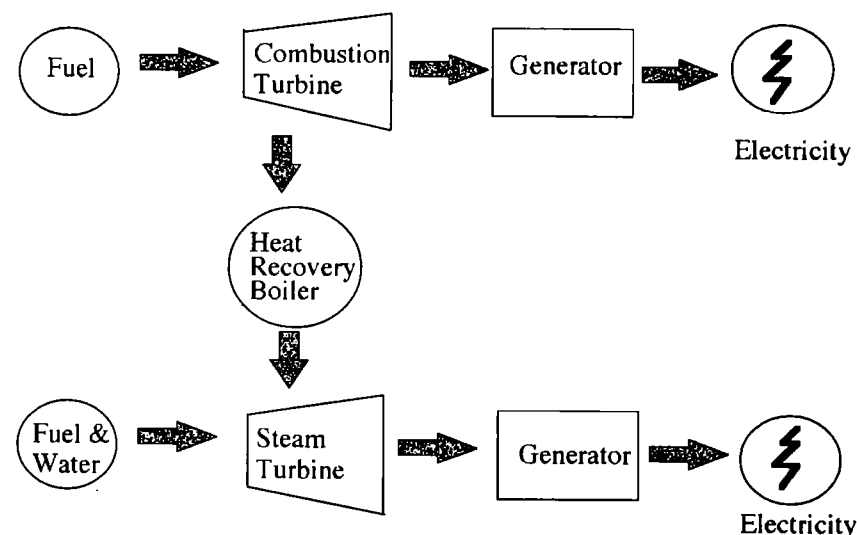
Technology Description

Combined-cycle systems are a combination of combustion turbine and boiler/steam turbine technologies. These systems generate electricity first; exhaust gases are then recovered via a heat recovery steam generator. Combined-cycle cogeneration systems are designed to generate a substantial amount of power relative to process steam.

Technology Advances

Since the early 1970s, gas-turbine based combined-cycle systems have made significant technology advances in terms of unit efficiency, higher specific power output, and lower air emissions. Natural gas combined-cycle power plants have increased efficiencies from 42 percent in 1980 to 60 percent currently. A single percent gain in efficiency can reduce power plant operating costs by \$15 million to \$20 million over the life of a typical 400 to 500 MW power plant.

Schematic of a Combined-Cycle System



Benefits

- Gas turbine combined-cycle power plants can be built in phases and can be built in a fraction of the time needed to site and build a coal-fired power plant.
- Modular gas turbines can be installed first to operate the simple-cycle modes as soon as possible. Heat recovery steam generators, steam turbines and other equipment can be added later to convert a facility into a high-efficiency, base-load plant.
- Combined-cycle plants have operating flexibility that is ideal for peaking or emergency/backup service. It takes them only five to ten minutes to switch from no-load to full-load, creating a clean, natural partnership with intermittent renewable energy technologies such as wind and solar energy.

NATURAL GAS IN THE UK

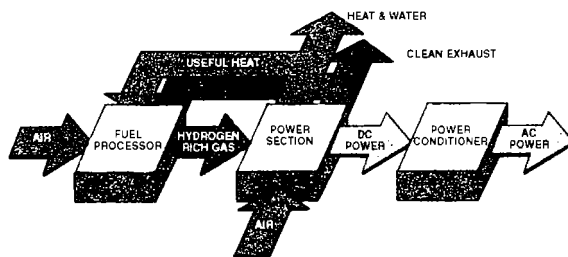
Enron built the largest gas-fired combined-cycle cogeneration plant in the world in Teeside, United Kingdom. Completed in March 1993, the 1,875 MW plant supplies approximately four percent of the U.K.'s average daily power requirements. Teeside, one of the largest plants of the world, cost \$1.2 billion and was constructed in only 29 months. Teeside consists of eight gas turbines and two steam turbines, and provides up to 1.5 million pounds of processed steam per hour to an adjacent petrochemical complex.

Fuel Cells . . .

SIR WILLIAM GROVE

Over 150 years ago, Sir William Grove discovered how to create energy using an electrochemical process rather than combustion. In a series of experiments, Grove produced electricity, heat, and water by combining hydrogen with oxygen in the presence of certain materials. Today's fuel cell is the ultimate product of Grove's breakthrough.

FUEL CELL POWER SYSTEM



Technology Description

Fuel cells typically are boxlike devices that can range in size from a small backpack to a large power plant. A single anode-cathode cell by itself does not produce a great deal of electricity or very high voltage, but by connecting many cells together a fuel cell can produce a few kilowatts to many megawatts of electricity at a usable voltage. Hydrogen-oxygen fuel cells suitable for space craft or underwater use comprise the fuel cell stack itself, plus auxiliary gas supply and heat and water management components; fuel cells for commercial application with hydrocarbon fuels also include a fuel processor to convert fuel into hydrogen and a component to convert the power from DC to AC. Fuel cell applications range from supplying on-board power for vehicles to grid-connected electric power generation. Today, the market niche of the fuel cell is most apparent as a provider of on-site electric power and hot water to hospitals, public buildings, and other large facilities — particularly those which require stable, uninterruptable electricity.

THE FUEL CELL COMES TO MARKET

Based in South Windsor, Conn., International Fuel Cells (IFC) is a pioneer in bringing fuel cell technology to commercial acceptance. IFC's subsidiary, ONSI corporation, has manufactured the world's only commercially viable on-site fuel cell system: the ONSI PC-25™. The PC-25 is a 200-kW phosphoric acid system ideally suited for use by facilities that require reliable power and have a need for the hot water produced by a fuel cell. The fuel cell is ideal for many utilities faced with constraints associated with transmission and distribution of power. Several utilities have sponsored demonstration projects that have validated the real world performance of fuel cells.

Benefits

Fuel cells have sparked the interest of corporate energy users and environmentalists alike. Fuel cells produce practically no pollution, are quiet, highly efficient, and require little maintenance. These attributes and their adaptable size make it possible to locate fuel cells close to the final consumers of the energy they produce. Thus, energy produced by fuel cells is efficiently used rather than being lost in transmission from a distant production site. Fuel cells produce both electricity and heat, making them attractive for cogeneration and distributed generation applications.

Current and Future Markets

Phosphoric Acid Fuel Cells (PAFCs) are currently the only commercial fuel cell. PAFCs produce high quality electric power and usable hot water (140° F to 250° F). When the electric power and hot water produced are used together, PAFCs can achieve an overall energy efficiency of 80 to 90 percent — making PAFCs ideally suited for office buildings that require reliable power and hot water. PAFCs can stand alone or they can be connected to a utility's electrical grid, and can be added incrementally as energy needs change. PAFCs require little maintenance. Over 60 PAFC fuel cells produced by the ONSI corporation are in use worldwide. PAFCs are expected to become competitive with traditional power generation technologies once economies of scale from larger production quantities are realized.

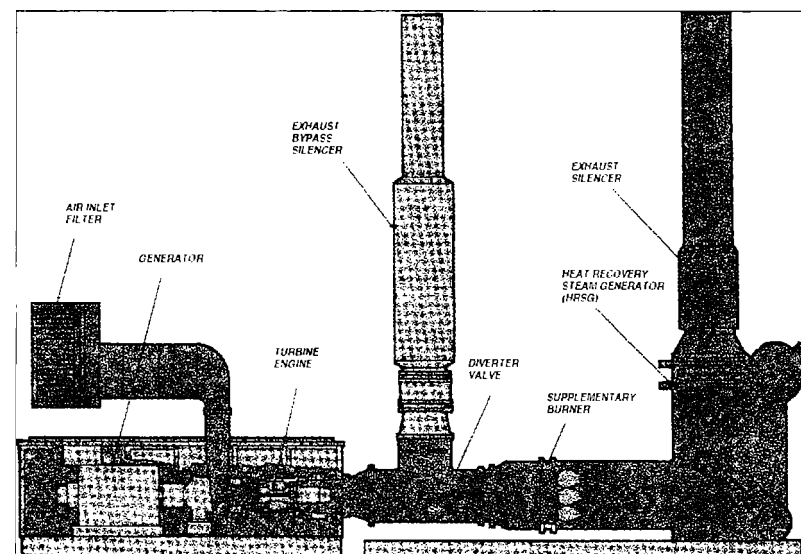
Proton Exchange Membrane Fuel Cells (PEMs) are characterized by high energy density and low operating temperature (80° F). A small PEM fuel cell can produce relatively large amounts of electricity. For that reason, PEMs are regarded as a possible transportation power option if fueled with hydrogen or methyl alcohol (which can be readily transformed to produce hydrogen).

Molten Carbonate Fuel Cells (MCFCs) and Sulfur Oxide Fuel Cells (SOFCs) operate at higher temperatures (1200° F and 1800° F, respectively). This allows MCFCs to convert a fuel like natural gas to hydrogen without the additional equipment required by other fuel cells. MCFCs are being evaluated for power generation applications distributed at various sites along an electric grid and for operation using landfill gases for fuel. They are suitable for many industrial applications. SOFCs could potentially be used in large stationary power applications to displace coal-powered facilities or for large-scale transportation purposes, such as trains and large trucks.

Cogeneration . . .

Technology Description

Cogeneration is the simultaneous production of electricity or mechanical power and usable energy (e.g., steam or hot air). Cogeneration systems use less fuel to deliver the same amounts of power and heat as systems that individually provide either one or the other of these services. A typical cogeneration system is a natural gas turbine-driven generator set equipped with a heat recovery boiler that captures thermal energy from the gas turbine's hot exhaust and uses it to make steam for industrial purposes. The gas turbine consists of an air-inlet section, air compressor, combustor, turbine assembly and exhaust system. As the compressor rotates, fuel is combusted, resulting in high-energy hot gases expanding through the turbine section. The turbine section extracts energy to drive the air compressor and the power output shaft. The hot exhaust gases are used as thermal energy. Cogenerating electricity and thermal energy can produce net system efficiencies from 70 percent to 90 percent compared to the 33 percent average efficiency of typical older, baseload plants. Cogeneration is an excellent investment for facilities requiring large quantities of power and heat while minimizing environmental impact.



Benefits

- Reduced fuel usage and cleaner exhaust streams leading to low emissions.
- Improved energy economics; reduced expenses.

Current and Future Markets

Turbine technology in cogeneration systems has been in use at least four decades. Solar Turbines (of San Diego, Calif.) installed its first gas turbine generator sets in 1960 at a natural gas processing plant; those turbines are still in operation today. Cogeneration capacity increased from 10,476 megawatts in 1979 to 22,310 megawatts in 1987. By 1994 more than 68,000 megawatts of capacity were registered with the Federal Energy Regulatory Commission. Cogeneration systems are used in an array of industries including hospitals, district heating, dairies, universities, textile plants and breweries. Its ability to reduce energy use and emissions while providing the same level and quality of energy services makes cogeneration an invaluable technology.

THE CASE FOR COGENERATION - A COMPARISON

WITHOUT COGENERATION

	Energy Requirement	Input MW	Output MW	Efficiency Percentage	NO _x Tons/Year
Process Steam	23,000 lb/hr	9.7	6.7	70	19.2
Electricity	3,700 kW	10.7	3.7	35	83.8
Total	-	20.4	10.4	51	103.0

WITH COGENERATION

Process Steam	23,000 lb/yr	-	6.7	-	-
Electricity	3,700 kW	-	3.7	-	43.0
Total	-	13.7	10.4	76	43.0

Results: 33 percent Less Energy Consumed, 60 percent Lower Emissions with Cogeneration

End-Use-Energy
Rising Tide: Tomorrow's Clean Energy—Today



End-Use-Energy.....

Rising Tide: Tomorrow's Clean Energy—Today

Energy Performance Contracting . . .

Technology Description

Energy saving performance contracts are the most popular approach to instituting a comprehensive energy management program for a building without making financial commitments up front. Performance contracting includes the installation, retrofit or upgrade of a lighting system; building automation and control systems; temperature control systems; and heating, ventilation and cooling (HVAC) systems. Services included in a performance contract optimize building performance while improving both the interior and exterior work environment.

A building automation and control system, the ultimate management tool installed under many performance contracts, can be as simple or complex as the needs of the building or facility. It may entail only a single-zone control module, or enable the customer to control separate systems in different parts of a facility through a computer graphic of the facility layout.

The customer is guaranteed financial savings over time because the performance contractor takes a “systems approach” to reducing the energy use and the operating cost of the building. The contracting company conducts an initial audit of the building, then determines and engineers the required retrofits. Once the contract has been executed, product procurement and project management are undertaken by the performance contractor. Follow-on services, such as systems maintenance, are performed by the performance contractor over the life of the contract.

Under a performance contract, the overall energy use reduction means the customer always saves at least the guaranteed amount — usually the financed cost of the improvements. This approach often produces energy and operational savings so significant that even problems otherwise costly to solve are corrected.

Benefits

Environmental Benefits

- Reduces additional emissions of CO₂, SO_x, NO_x, and particulates into the atmosphere.
- Helps slow global climate change.
- Conserves energy resources such as natural gas, coal and oil.
- CFC refrigerant or total chiller replacement reduces harm to the ozone layer.
- Lighting upgrades and better air quality improve indoor working environment.

Financial Benefits

- Operating costs reduced often thousands of dollars per month.
- Customer saves energy and dollars without up-front investment.
- Savings beyond the guaranteed amount can be applied to customer's programs.
- Customers continue to save energy and dollars after the performance contract ends.
- If savings fall short the contractor pays the customer the difference — guaranteed.



PERFORMANCE CONTRACTING MEETS MUNICIPAL INTERESTS

Honeywell, a global controls company, is a leader in energy management and performance contracting. In 1990, Honeywell entered a seven-year performance contract with the city of Seattle, Wash., to reduce the operating cost of its Municipal Building and to improve the environment inside and outside the building. In the first two years the indoor work environment improved while building energy use decreased by 62 percent. Those savings also prevented the release of tons of CO₂ in the atmosphere. By the end of 1994, the city was saving over \$300,000 annually.

Indoor air quality was improved by installing a high efficiency air filtration system to keep traffic exhaust out of the building. Additionally, 180 new fan coil units and almost 100 Variable Air Volume boxes were installed to circulate air in the building. An automation and controls system has enabled the city to use only as much energy as is necessary to support activity in different parts of the building at different times. High-efficiency lighting fixtures replaced old lighting. Automated centralized lighting controls and occupancy sensors reduced energy used for lighting from 400 kWh to 224 kWh.

Current and Future Markets

Performance contracting is widespread in the U.S., with public and private institutions such as schools, hospitals, industries, and state, federal and local governments taking advantage of the benefits. In April 1995, the U.S. EPA reported that commercial building owners in the U.S. alone could save \$35.5 billion in energy costs if they employed appropriate technologies.

Hagler-Bailly Consulting released a report the same month indicating that the world market for commercial building technologies they targeted is close to \$9.5 billion per year. Performance contracting is an excellent vehicle for reducing pollution caused by the burning of fossil fuels in Eastern Europe and other developing or transitional economies, but appropriate financing is more difficult to arrange internationally than in the U.S. In many non-US markets, performance contracting is a new concept for financiers and customers alike. In certain countries, the concept conflicts with real property laws. However, many energy efficiency companies and energy service companies (ESCOs) with a global interest are experiencing greater acceptance of guaranteed energy savings.

More financing options must exist if performance contracting is to be as widely utilized in developing and transitional countries as it is in the United States. There is much discussion of innovative financing mechanisms for energy projects in transitional and developing countries, but many projects are too small to qualify for traditional multilateral bank funding. Studies to determine the best financing options for performance contracts are on-going.

District Heating Controls . . .

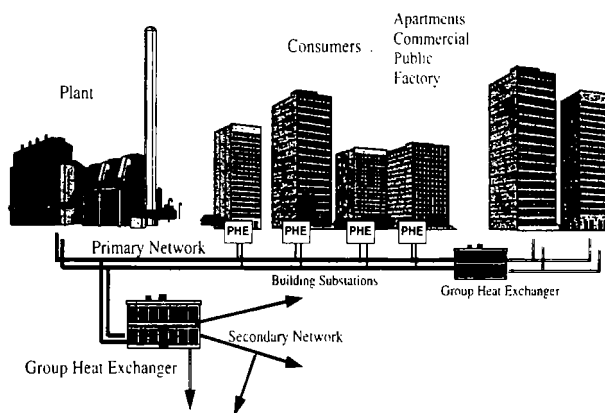
Technology Description

District heating is a centralized system under which all heat is provided to industrial, commercial and residential buildings from a main boiler house and pumping station. In a large city, local network systems connected to a main system may serve separate neighborhoods. Cities such as Berlin have networks whose branches stretch over 1000 kilometers.

In district heating systems, coal or natural gas is typically burned in the boiler house or in the combined heat and power (CHP) plant. In a boiler house it is converted directly to hot water; in a CHP plant it is converted to steam that runs turbines to produce electricity and, through condensation, hot water. The hot water is pumped through the system to buildings where it is used for heating and domestic purposes or, via the primary heat exchange (PHE), used in secondary hydraulic systems.

Systems lacking controls on the production plants, in the distribution networks, and on the demand side can be extremely energy inefficient, sometimes using up to 50 percent more energy than is necessary. Loss of energy can be attributed to four parts of the system: inefficient process control in the boiler house; leaks in transmission pipelines; heat exchanger and distribution losses; and overheating of individual buildings and apartments. Application of controls to these elements of district heating systems reduces energy use (and the resulting pollution) dramatically.

By applying a Supervisory Control and Data Acquisition system (SCADA) to the heat production process, one can achieve full boiler optimization, water treatment control, boiler sequencing and load control, and monitoring of major building energy use for demand side management. Control of the motors at the pumping stations increases pump efficiency, and upgrading and controlling of heat exchangers improve the efficiency of secondary loops. Installation of thermostatic radiator valves in buildings and apartments allows owners to control temperature, avoiding costly overheating.



Benefits

Environmental Benefits

- Controlling the burning process in boilers decreases boiler emissions of SO_x, NO_x, CO₂ and particulates that remain near ground level.
- Control of the system on the production end and the demand side results in decreased energy requirements — some boilers may be shut down altogether and their emissions eliminated.
- Temperature control in buildings and apartments improves comfort and health.

Financial Benefits

- Lower energy subsidies required by central governments and, in those locations that have adopted market pricing, reduced energy costs for consumers.
- Reduced maintenance cost and extended life-cycle of equipment.
- Local jobs and technology transfer.
- Excess energy that is created by the system can be sold.

Current and Future Markets

Use of district heating is widespread in Europe and China, and, to a lesser extent, in the United States. The size of the world market for controls on district heating systems is estimated at \$12 billion. District heating accounts for close to 50 percent of the space heating in residential, commercial and public buildings in Eastern Europe. Heating systems can benefit significantly from the installation of controls. Many of these systems are supplied by boilers with stacks low to the ground, keeping pollution where it affects the health of people and the integrity of the city's physical environment.

The unnecessary costs to energy consumers and pollution caused by energy inefficiency make Central and Eastern Europe and Asia the prime markets for controls on district heating systems. The lack of financing for transitional economies in Europe and the low priority placed on energy productivity in parts of Asia have resulted in significant untapped potential for district heating efficiency.

DISTRICT HEATING IN OLD EUROPE

Krakow, is the former royal capital of Poland and a cultural treasure. Air pollution in Krakow has been so concentrated that SO₂ and CO have slowly eroded the city's centuries-old monuments and degraded the health of its inhabitants. To reduce pollution from power generation, the U.S. Department of Energy and U.S. Agency for International Development funded a demonstration of energy efficient technologies and their value in Krakow's district heating system. In the boiler house control room, a Honeywell SCAN 3000 SCADA system was installed to monitor and supervise the overall network. It gathers data and controls all major building substations. Advanced boiler controls will also be integrated and connected to the SCADA system to complete the "brains" of the system. The interconnection of controls allows demand information to be conveyed to the boiler controls, resulting in optimization of energy supply. This means steam will also be produced using less fuel, and efficiency at the plant will be improved 15 to 20 percent. The comprehensive controls system limits air emissions by reducing both the amount of hot water needed and the quantity of fuel needed to produce the required heat. Heat loss in the distribution system was a major factor in causing the plant to produce more energy than necessary. Fifty "hydro-elevators" connected to the plant are being replaced with compact plate heat exchangers. Group heat exchangers are being upgraded for more effective heat transfer. Thermostatic radiator valves will be installed in the buildings for occupants to control heat levels for comfort. If the project was replicated for the entire Krakow district heating system, the amount of coal needed to operate the system would be reduced by 30 percent.



Fiber Glass, Rock Wool & Slag Wool Insulation . . .

Technology Description

Fiber glass, rock wool and slag wool insulation materials are energy saving products used in homes, businesses and industrial facilities. These materials increase energy conservation, reduce pollution, and help preserve the environment.

Fiber glass, rock wool and slag wool have historically been termed man-made mineral fibers; however, a more appropriate name is man-made vitreous fibers, reflecting their glass, non-crystalline nature. Glass fibers are made from molten sand and other inorganic materials. The mineral wool form was developed by melting slag (blast furnace residue) and "spinning" it into insulation. The term "mineral wool" encompasses rock wool and slag wool, though raw materials are different. Rock wool is made from natural minerals and slag wool is made from iron ore blast furnace slag.

Products made from fiber glass, rock wool and slag wool are non-combustible and mildew-, mold- and bacteria-resistant. Rock and slag wool fibers are stable and have high tensile strength. These materials absorb sound, help control heat loss and gain, and help control condensation. Fiber glass products can also remove impurities from liquids and gases and reinforce other materials.





An important application of these materials is as insulation to control temperature and sound in homes, commercial buildings and industrial operations. These materials also are used as sound insulation in air ducts, pipes, roofs, walls, floors, automobiles, mobile homes, aircraft, appliances, and a wide variety of other applications. Because of their non-combustible nature and high melting temperatures, these materials are used in buildings to prevent the spread of fire.

Benefits of Fiber Glass, Rock Wool and Slag Wool Insulation

Fiber glass, rock wool and slag wool insulation products reduce energy use in homes, businesses, and manufacturing plants. According to the Alliance to Save Energy, if all new homes were built to the Council of American Building Officials' Model Energy Code (MEC) requirements in states with energy code standards below those of MEC, those homes would realize savings equivalent to 498 million kilowatt-hours of electricity, or 739,830 gallons of oil. Insulation saves enough energy each year to supply the total energy requirements of Florida for four years. From an environmental perspective, installed insulation is responsible for the avoidance of over 600 million tons of CO₂ annually.

Finally, the insulation industry makes good use of recycled materials. In 1994, insulation manufacturers used over 1.6 billion pounds of recycled glass and slag in the production of thermal insulation as compared to 1.5 billion pounds in 1993. Fiber glass insulation manufacturers average 30 percent recycled content in the production of insulation products. Approximately 897 million pounds of recycled glass were used in the production of residential, commercial and industrial fiber glass insulation, while an additional 720 million pounds of recycled blast furnace slag were used in the production of all types of slag wool insulation. Using recycled materials lowers production costs and saves landfill space. In 1994, the insulation industry saved over 33 million cubic feet of space in landfills.

Polyisocyanurate Insulation . . .

Technology Description

Developed in the late 1970s, polyisocyanurate insulation ("polyiso") has evolved into one of the most energy-efficient and cost-effective insulation applications available in construction. Rigid foams were originally developed for military and aerospace application; however, cost-saving mechanical and safety improvements have made polyiso a highly attractive application in the building industry. These factors, and the oil embargoes of the 1970s, caused a high demand for energy-conserving technology, resulting in polyiso's success in the marketplace.

Benefits

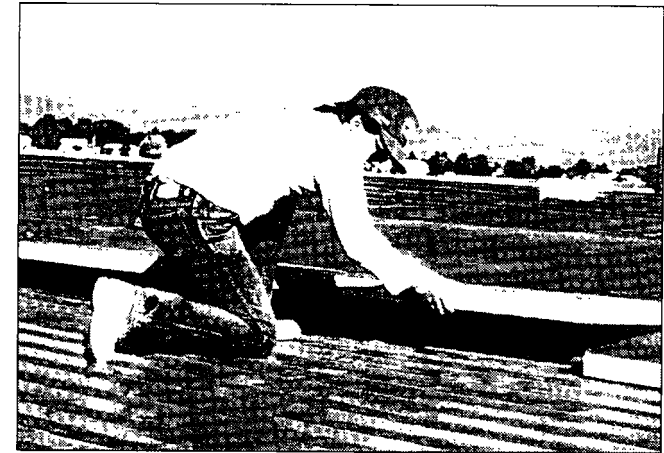
Polyiso has unique energy-conserving qualities. It has a high R-Value, a measure of thermal resistance used to describe an insulating material's effectiveness. Because of this, higher insulating value can be achieved with polyiso than with the same thickness of other material. As a result, less polyiso is needed to insulate and maintain a desired R-Value. The compact nature of polyiso results in:

- Thinner walls and roofs with shorter fasteners.
- Less change in building dimensions to meet a determined R-Value.
- Immediate cost savings caused by a reduction in materials and labor.

Because polyiso is a fire-retardant material, it can be installed directly on a steel deck and built-up roofing can be installed directly on the polyiso.

The R-Value of polyiso increases with thickness because of the unique structure of the boards. With more polyiso insulation used, seasonal heat loss or gain decreases. Buildings containing polyiso have lower heating and cooling costs, which could lead to downsizing of mechanical equipment, depending upon the amount of insulation used. Polyiso's unique physical properties mean that it:

- Is stable over a large temperature range (-100° F to +250° F) and can be used as a component in roof systems that use hot asphalt.

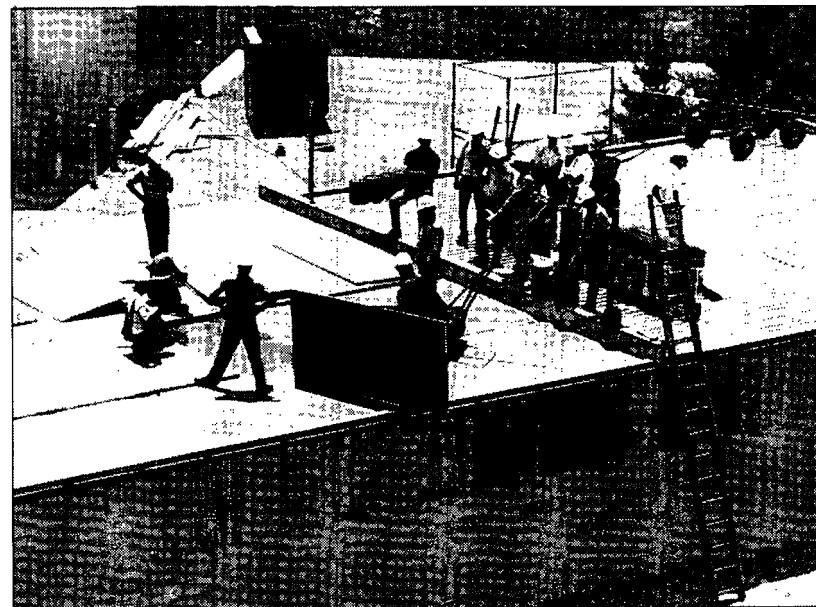


- Has low density, good adhesion to facers, low water absorption and low vapor transmission.
- Provides an effective moisture barrier when used with laminated aluminum foil facers.
- Is not affected by oil-based waterproofing compounds, insecticides or fertilizers.

Polyiso is good for the environment -- polyiso meets Federal procurement regulations for buying recycled material and it uses EPA-accepted alternative blowing agents. All polyiso manufacturers met the pollution reduction provisions of the Clean Air Act well in advance of the January 1, 1996 compliance date. Polyiso also meets all model codes and federal specifications.

Current and Future Markets

Polyiso is used in at least half of all new commercial construction and a large percentage of new residential construction. As its widespread use continues to grow, the industry trade group Polyisocyanurate Insulation Manufacturers Association (PIMA) meets the challenge for technical information about the product.





High Efficiency Clothes Washers . . .

Technology Description

New washers are being designed to wash and spin on the horizontal axis. Because they require less energy and water than today's conventional machines, these models are called high-efficiency washers. Unlike conventional washers, high-efficiency washers do not have an agitator; rather, they operate with a tumbling motion like that of a dryer. Instead of agitating clothes in a full tub of water, the washer tumbles clothes in and out of a shallower pool of water.

Current & Future Markets

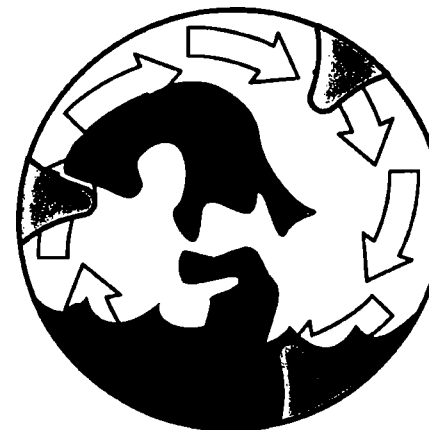
For decades, the top-loading, vertical-axis washer has been the mainstay of the North American laundry industry, representing well over 90 percent of the seven million washers sold annually. High-efficiency washers, on the other hand, have long been the choice of European consumers. Consequently, while high-efficiency washers have begun to appear in the North American market, they have not yet been widely accepted by consumers for various reasons. First, American and Canadian consumers clearly perceive their familiar vertical-axis washers to be larger and easier to use. Second, high-efficiency washers have been far more expensive than conventional washers. Acceptance also has been limited because available models resemble European versions and lack many features popular with American and Canadian consumers—like large capacity, easy access and short wash cycles. However, the purchase will likely become more attractive to informed consumers, as Maytag, the Iowa-based appliance manufacturer, develops a high-efficiency washer with these features.

While consumers may not yet be demanding a high-efficiency washer, other groups are urging its development. Many utilities and energy consortia, for example, will offer rebates to encourage sales of high-efficiency appliances. And because the U.S. Department of Energy proposes to enact more stringent energy standards on appliances, the issue may well reemerge. Further, it is possible that individual states—particularly those subject to water restrictions and strict conservation measures—may legislate their own standards, effectively mandating high-efficiency washers.

To help meet anticipated national requirements for energy and water conservation, Maytag is committing substantial resources to the development of a high-efficiency washer that will meet or exceed potential DOE energy mandates, as well as potential water conservation requirements.

Benefits

In addition to superior cleaning results, high-efficiency washers also are gentler on clothes. When one considers that the value of a load of clothes often can exceed the value of the washer itself, a wash process that helps clothes last longer takes on added importance. High-efficiency washers provide a substantial reduction in energy usage since heating the water accounts for 85 to 90 percent of energy costs in operating a conventional washer. High-efficiency washers spin faster than traditional North American models, removing more water from the clothes, thus speeding drying times and reducing dryer energy usage. While high-efficiency washers may cost more initially, their reduced energy and water costs provide a net savings to consumers over the life of the product.



The increased demand for water has already caused water rates to skyrocket in many communities. The mounting costs of eliminating and purifying wastewater have further aggravated the problem. In fact, a national water and wastewater rate survey conducted by Ernst & Young shows that, during the 1990s, average water and waste water rates were increasing much more dramatically than the rate of inflation. As water and wastewater costs rise, becoming a more noticeable part of customers' bills, consumers will look toward utilities to give incentives to "buy back" water, which utilities say is much cheaper than building new supply and treatment facilities.

Water is not the only resource causing concern, however. Prudent use and management of energy have taken on new importance, considering that electricity is expected to remain the fastest growing form of energy used worldwide. According to the International Energy Outlook, a government publication, electricity consumption is expected to grow by two percent annually between now and 2010. Anticipated population growth and world dependence on electricity will stimulate additional usage and regulatory issues.

With water and energy conservation becoming crucial, the savings provided by high-efficiency washers is significant — 30 to 48 percent of the water and 58 to 70 percent of the energy. Tests by manufacturers and laboratories confirm that switching to a high-efficiency washer can save from 3,500 to 6,000 gallons of water per household annually. If the estimated 12 million households in California were to cut back by 5,000 gallons of water each, the state could eliminate the need for as much as 60 billion gallons of water per year — about the yield of a major new reservoir.

Natural Gas Cooling . . .

Technology Description

Natural gas cooling includes three different types of technologies — absorption, engine driven, and desiccant-based (see next section for a description of desiccant-based technologies).

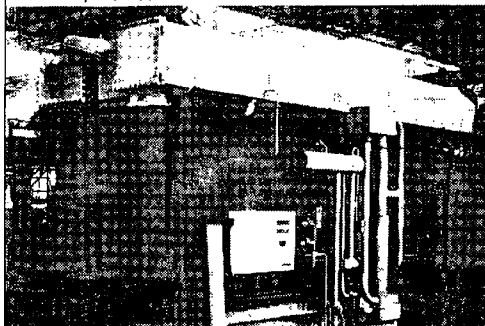
Absorption cooling is similar to the regular vapor compression cycle utilized in other types of cooling applications, which rely on a cycle of condensation and evaporation to produce cooling. Absorption technologies are driven by a heat source, however, rather than a mechanical compressor. Absorption systems are available as chillers or chiller/heaters and are currently being produced as single-effect generator configurations and the more efficient double-effect designs. Triple-effect systems are under development. Absorption systems have very few moving parts and provide for quiet, vibration-free and low-maintenance operation.

Engine-driven systems employ a mechanical process similar to electric cooling but differ in that a high-efficiency natural gas-fired engine drives the reciprocating, rotary screw, or centrifugal compressors. Engine and exhaust heat can be recovered to efficiently generate high-temperature domestic hot water or process steam. Engine-driven systems are available in a wide range of sizes that are suitable for very large buildings as well as home and small business applications.

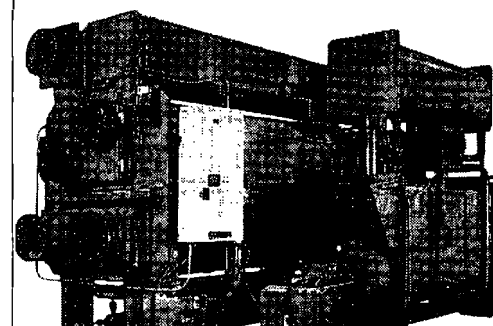
Benefits

- Natural gas-fired cooling can be less expensive to operate than electric alternatives because of lower gas prices, especially during summer months.
- Lower costs to consumer by avoiding paying peak demand electric utility charges in the summer.
- Pollution reduction (including ozone-depleting chlorofluorocarbons in most conventional air conditioning systems).
- Natural gas cooling is more labor intensive than other electric counterparts; thus, increased use of this technology could create jobs.

Direct-Fired Double-Effect Absorption Chiller/Heater



Direct-Fired Double-Effect Steam Absorption



Current and Future Markets

Natural gas cooling was available in the American marketplace as early as the 1950s. However, the moratorium on residential natural gas use in the 1970s forced many U.S. firms to license their technologies overseas, and research into energy efficient natural gas cooling technologies was effectively halted in the U.S. The early 1980s saw a resurgence of interest in natural gas-fired cooling. Research continues to lead to more efficient and cost-effective gas options.

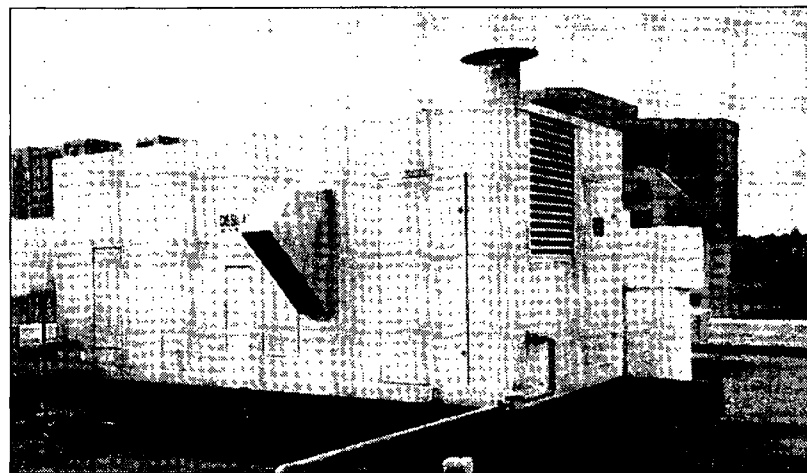
Because the U.S. is fully "electrified" many of the best opportunities for natural gas cooling exist elsewhere in the world, particularly in the Far East and South America. A recent study by Oak Ridge National Laboratory estimated the overseas market for gas cooling at \$5 billion. The market in the U.S. is expanding, especially with recent concern over the use of CFCs, and reliance on imported and environmentally harmful fossil fuels. All of the major U.S. heating, cooling and ventilation companies are looking to advanced natural gas cooling as a critical part of their future markets.

Desiccant-based Technologies . . .

Technology Description

Desiccant-based technologies remove moisture from the air, which allows heating or cooling with minimum energy usage. Desiccant technologies rely on a dehumidification agent such as silica gel to remove moisture from the air. As humid air passes through the desiccant material, humidity is removed, leaving dry air. Next, supplemental heating and cooling can be applied using much less energy. The desiccant material is regenerated using a drying technique.

Current desiccant technologies are primarily natural gas-fired. They can be used to supplement existing heating and cooling equipment or can function alone (Engelhard/ICC has a technology package that will heat, cool, and dehumidify). The application of the desiccant for drying purposes eliminates the need to supercool, which is the method other air conditioning systems use to operate. The ability to remove humidity first means less energy is expended and there is no longer the need to reduce temperatures to a point where the moisture "falls out" and then reheating is applied.



Benefits

- Improved energy efficiency and corresponding financial savings. Adding desiccant to a facility can reduce energy costs as much as 50 percent.
- Desiccants improve air quality. Desiccant material reduces airborne particulates and airborne diseases such as tuberculosis. The moisture-reducing properties of desiccants mean that fewer molds, mildews and other allergens are introduced to indoor environments.
- Desiccants can even out the temperature across the entire facility in buildings with wide temperature differentiations.

Current and Future Markets

Desiccant technologies are employed primarily in high humidity areas. Units installed to date are dehumidification technologies only and do not achieve heating and cooling in the same package. These units are installed primarily in supermarkets where temperature differentiations from the cold cases and humidity in the air can destroy building structures.

The future holds a very significant market for desiccant technologies. Increasingly, they are being considered in places where mold and mildew pose a serious problem. The Swann Hotel in Disneyland recently incorporated a desiccant technology and has corrected a compelling moisture problem that previously resulted in millions of dollars in renovations.

New regulations requiring 300 percent more outdoor air circulation in public buildings may lead to a surge in office building applications. Laboratories, computer installations, hospitals, and other applications that require pure environments will also take advantage of desiccant technologies.

Desiccant technologies that heat, cool, and dehumidify will make headway in the marketplace. Home-size desiccant technologies are coming into the market, so the residential market is expected to expand significantly. Overseas markets also exist, especially those in hot, humid climates and those that are currently increasing the use of air conditioning in general.

Water Source Heat Pump . . .



Technology Description

Water-source and geothermal “heat pumps” and air conditioners use water-to-refrigerant heat exchangers as heat sinks in the cooling mode and as heat sources in the heating mode. This is in contrast to using ambient air as the heat sink for cooling and the heat source for heating. The water generally comes from one of three sources: a cooling tower; a ground heat-exchange loop; or nearby surface water.

The water for the units is provided by a network of piping throughout buildings. This may be a dedicated piping system, or the system may share the piping with sprinklers. Either configuration permits the system to move heat from one part of the building to another.

Benefits

- Reduced peak electric demand because the water used as a heat source/sink is usually more temperate than the extremes of ambient air.
- Lower outdoor noise levels due to the absence of the outdoor fan dominant in HVAC systems.
- Aesthetically pleasing because there is no equipment installed on outside walls.
- Greater flexibility of room and building design and operation than traditional systems due to a wide range of sizes and configurations.
- Significant reductions in utility costs due to decreased electricity demand.

Current and Future Markets

The market for water source and geothermal heat pumps spans the range from individual homes or apartments to the largest commercial buildings. The units are made in a range of capacities from one-half-ton to more than 25 tons (1 ton = 12,000 BTUs per hour = 3,516 Watt-hours).

Water-source heat pumps and air conditioners have been in the market for decades and have proven their value to tens of thousands of customers. Many units over 20 years old are still in service. The market for water-source heat pumps and air conditioners has continued to grow over the last decade, driven largely by school construction and applications to the residential market using ground loops. This has been particularly attractive to rural electric co-ops which pay demand charges to their suppliers but do not pass these on directly to their members.

The U.S. market for water source heat pumps was 130,000 units in 1995 and is expected to grow even more rapidly in the future as the benefits of heat pumps become more widely recognized.

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Transportation . . .

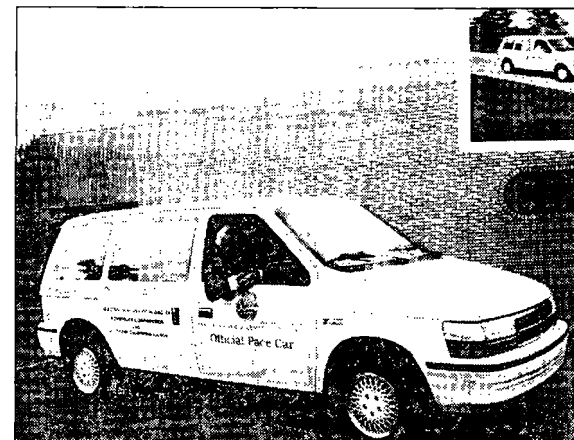
Electric Vehicles . . .

Technology Description

In many parts of the world, air pollution from vehicle exhaust emissions has created severe environmental and health hazards. Many countries are promoting the use of electric vehicles (EVs) as a means of drastically reducing their air pollution.

EVs replace the internal combustion engine and its supporting exhaust, fuel, and cooling systems with electric-driven motors powered by on-board batteries and controlled by steady state electronics. A charge controller controls the flow of energy to the motors, and, in some cases, the flow of energy recovered by regenerative braking systems back to the batteries. The vehicles usually carry an on-board charger. Most can be recharged using a conventional residential power outlet. For faster charges, a higher power source is required.

While current generation EVs need to be recharged more frequently than conventional vehicles need to be refueled, they can be conveniently recharged at home or in the workplace when not in use, thereby reducing range requirements for most users. Since there is no need to change the oil, spark plugs, distributor cap, transmission fluid, engine coolant, clutch pads, or muffler, or to qualify for smog certification, there is less need to go to the traditional "service station" for either fuel or maintenance.



ELECTRIC BATTERIES TURN THE CORNER

Until recently, the greatest limitation on the performance of EVs has been the battery. Lead acid batteries have low energy density and limited cycle life. Ovonic Battery Company, a subsidiary of Energy Conversion Devices, developed an advanced nickel metal hydride (NiMH) battery technology which, with financial assistance from the United States Advanced Battery Consortium, it has further developed for EV applications. Ovonic NiMH batteries have two to three times the energy density of lead acid batteries, will last the lifetime of the vehicle, have excellent power, are maintenance free and fully recyclable, and operate at ambient temperatures. They have already powered numerous vehicles over 230 miles between charges, and further technology advances will increase the range to match that of conventional vehicles.

Successful demonstrations of the battery's capabilities have resulted in numerous commercial developments: Several companies have taken licenses to manufacture the Ovonic battery for vehicles of all sizes. General Motors has entered into a joint venture with Ovonic (GM Ovonic) to manufacture the batteries for larger vehicles for sale worldwide; Honda and Toyota have announced that their new electric vehicles will be introduced with NiMH batteries, and other companies have indicated that they will offer them as an option in early models and use them more in later models.

Current and Future Markets

EVs are being introduced in all parts of the world. With conventional batteries and their limited range, EVs are well suited for fleets and use as “neighborhood vehicles.” When advanced batteries provide greater range and faster recharging times, and high volume production brings down costs, they will be fully competitive with traditional vehicles.

Many small companies have been producing EVs for some years. General Motors, Ford, Chrysler, Honda, Toyota, Nissan, Peugeot, BMW, Mercedes, Hyundai and Daewoo are among the auto companies that have announced they will produce EVs. Many of these large and small companies are introducing new “ground up” electric vehicles, and moving away from conversions of conventional vehicles. The vehicles being introduced include small sport cars, pickup trucks, sedans and small “neighborhood” vehicles. Electric buses are also being demonstrated in several US cities.

There is also a great deal of activity in Europe, where higher gasoline prices add additional incentive for EVs. In Asia, there is a strong movement to produce electric scooters, bicycles and other two- and three-wheeled vehicles to ease air pollution problems in large cities. Electric bicycles are seen as a huge market in Asia and Europe, where they can provide enhanced personal transportation without increasing either air pollution problems or traffic congestion. The markets for all two- and three-wheeled EVs are very large due to the large populations of the newly developing countries and their rapid economic growth.

Benefits

Environmental Benefits

- Greatly enhanced urban air quality.
- Reduced noise pollution.
- Improved fuel efficiency over conventional vehicles.
- No fuel used when standing still in traffic.
- Substantial reduction of most air pollutants and greenhouse gases, even when taking into account smokestack emissions from electric generating plants.
- Totally non-polluting energy system possible with use of renewable energy sources such as solar and wind to provide electricity.
- Reduced risks to ecosystems from accidental gasoline spills, routine wash-out of oil from roadways into estuaries, rivers, and oceans, and illegal dumping of used oil into storm drains and gutters.

Financial Benefits

- Electricity costs per mile substantially less than gasoline.
- Low maintenance further reduces operating costs.
- Reduced reliance on imported oil, thereby easing balance of trade deficits and improving national energy security.
- New technological developments will have substantial spin-offs in other areas.



Natural Gas Vehicles . . .

Technology Description

In the United States, over 100 million people breathe polluted air that threatens their health. The U.S. Environmental Protection Agency estimates that half of the nation's air pollution is caused by the exhaust from traditional vehicles — cars, trucks, buses fueled by gasoline and diesel fuel. City smog irritates the eyes, nose, and lungs, and can cause cardiac and respiratory disease. In addition, the United States imports over half the oil it requires, effectively exporting thousands of domestic jobs. Congress enacted the Clean Air Act Amendments of 1990 and the Energy Policy Act of 1992 to help address these health, environmental, and economic security concerns. These two pieces of landmark legislation have helped provide the framework for the development of vehicles that use cleaner-burning, domestically available natural gas.

Natural Gas Vehicles (NGVs) do not require risky oil supplies from unstable regions of the world. The natural gas that powers NGVs comes almost entirely from North America. Increasing our use of domestic energy resources becomes imperative if one considers that, today, the United States imports over half its oil. Further, current trends have us on track to be importing almost two-thirds of our oil by early next century. Importing oil means the United States is exporting jobs. By investing in products developed here, we keep jobs in the United States.

The only major difference between a gasoline vehicle and a natural gas vehicle is the fuel system. Natural gas is compressed to 3,000 pounds per square inch and is stored on board the vehicle in cylinders installed in the rear, undercarriage, or atop the vehicle. When natural gas is required by the engine, it leaves the cylinders, passes through a master manual shut-off valve and travels through a high pressure fuel regulator located in the engine compartment. The natural gas is injected at atmospheric pressure through a specially designed natural gas mixer, where it is properly mixed with air. Natural gas then flows into the engine's combustion chamber and is ignited, creating the power required to drive the vehicle. Special valves prevent the natural gas from entering the engine when it is shut off.

The NGV market is developing because of the health, environmental, and economic benefits provided. Over the past few years, a broad coalition — including the natural gas industry, trade associations, fuel suppliers, original equipment manufacturers, and other NGV industry players — have been working to develop the NGV market. Natural gas utilities are using NGVs in their own fleets and providing marketing programs to assist public and private fleets to convert their vehicles to natural gas. Gas utilities are also working with fuel suppliers, such as Mobil and Hess, to construct public NGV fueling facilities. Utilities have also installed a number of fueling stations at their own facilities.

Current and Future Markets

NGVs are well-suited for a wide variety of fleet vehicle applications. NGVs are particularly suitable in medium to heavy duty high-fuel-use applications, such as transit buses and sanitation trucks, where the fleet is centrally fueled.

The automakers have begun building vehicles powered only by natural gas (known as “dedicated” vehicles). For example, Ford offers natural gas-powered Crown Victorias, pick-up trucks, and vans. Various school bus manufacturers offer dedicated vehicles. Transit bus manufacturers are also producing natural gas transit buses in what is an expanding market. Existing gasoline-powered vehicles can also be converted to operate on natural gas. Existing gasoline powered vehicles can also be converted to operate on natural gas. The Natural Gas Vehicle Coalition, a national organization for companies interested in NGVs, provides members of the growing NGV industry with marketing, legislative, and regulatory support.

Benefits

- NGVs pollute substantially less than gasoline vehicles. For example, they produce 98 percent less carbon monoxide emissions, 85 percent less reactive hydrocarbon emissions, 65 percent less nitrogen oxide emissions, and no sulfur dioxide or evaporative emissions. By drastically reducing this pollution, NGVs are good for the environment and human health.
- The NGV industry creates economic growth and jobs in the U.S. In the state of New York alone, utilities have invested more than \$50 million in NGVs and NGV infrastructure.
- NGVs can be more economical to operate than gasoline-powered vehicles. Federal and state incentives are available to encourage their use.



THE BUSINESS COUNCIL FOR SUSTAINABLE ENERGY

The Business Council for Sustainable Energy was formed to bring a new and sharpened focus to one of our most critical global issues — the question of choices regarding our energy future. In December 1992, a group of business leaders from the renewable energy, natural gas, energy efficiency and utilities industries, along with senior officials from major environmental organizations, came together with the aim of helping develop a new energy strategy for the United States.

The overall mission of the Council is to support energy related policies and programs that will enable the United States to achieve a sustainable pattern of energy production and use that simultaneously contributes to the nation's economic, environmental and national security goals. These policies and programs will specifically promote greater reliance on energy efficiency, natural gas and renewable forms of energy.

The Council is comprised of over thirty member companies and organizations. All businesses and organizations committed to the development of a sustainable energy future are eligible for membership in the Council. Organizations interested in learning more about the Business Council for Sustainable Energy and its activities should contact:

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