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Inside This Issue

It's Official: First U.S. Nuclear Plant Is Sold

As Boston Edison turns over the Pilgrim plant's keys to Entergy, more nuclear plant acquisitions are in the works

New Orleans-based Entergy Corp. last month became the first company to complete a nuclear plant deal in the United States, when it finalized the acquisition of the Pilgrim plant from Boston Edison—the first competitively bid nuclear plant sale in the country.

Entergy will pay $81 million for Pilgrim, its nuclear fuel, and the plant's 1,600-acre site on Cape Cod Bay. Boston Edison will fully fund the decommissioning trust with $471 million.

"Nuclear will continue to play a major role in the overall competitive energy strategy in the nation," said Don Hintz, president of Entergy Corp., shortly after signing the closing documents July 13. "Well-run nuclear plants of a certain size and in a good area can be competitive to any generation that is operating today or any technology that is out there in the foreseeable future."

Entergy, which is eyeing other plant purchases (see Hintz interview, page 3), is not unique in viewing nuclear energy as an attractive business in a competitive market.

So, too, does AmerGen Energy—which has purchase agreements on Three Mile Island in Pennsylvania, Nine Mile Point 1 and 2 in New York, and Clinton in Illinois. AmerGen is a joint venture of Philadelphia-based PECO Energy and British Energy.

Similarly, Virginia Power's President and Chief Nuclear Officer James O'Hanlon said in June that his company expects to buy a nuclear plant by year's end—and eventually could increase its nuclear holdings from four units to as many as 20.

Plant sales—the direct result of the restructuring of the electricity industry to a competitive environment—provide insight into the future landscape of the generation business. "As the electric utility industry transitions to competition, the number of nuclear operators is going to drastically consolidate," Hintz said.

In view of the new competitive environment, where communities and businesses must depend on the vibrancy of the marketplace for power reliability, Tom May, chairman, president and CEO of Boston Edison said: "To have Entergy here is good for the region. It is good to have that strong competitor for all of our businesses that are located here."

MOODY'S SEES BENEFITS IN NUCLEAR PLANT PURCHASES

The attitude in the financial community—specifically, Moody's Investor Services—supports the contention that

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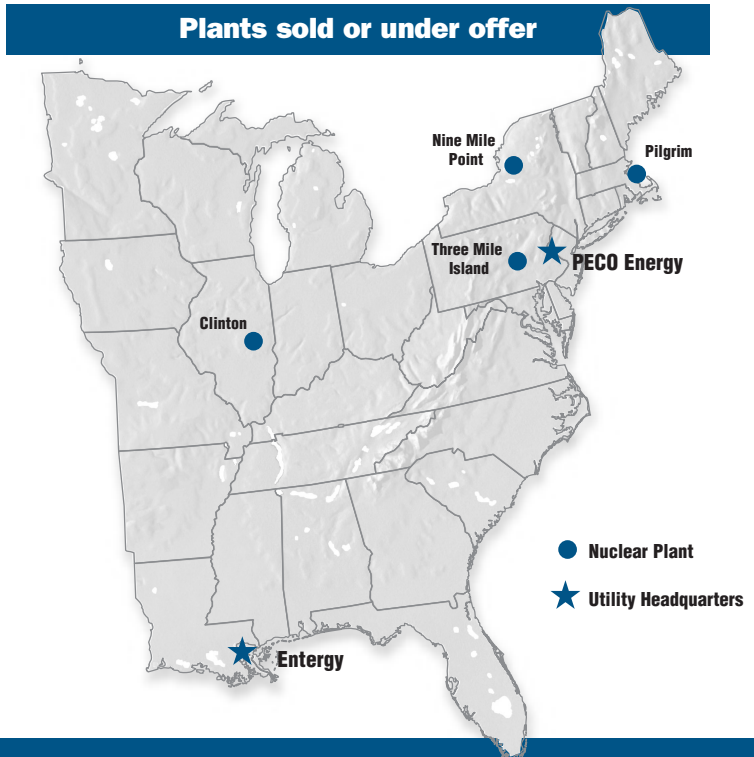
Plants sold or under offer



Entergy's President on Tomorrow's Nuclear Fleet... *see page 3*

competent, experienced operators that purchase nuclear power plants may improve their competitive advantage.

"Utilities that have a highly regarded reputation as nuclear operators will benefit from acquiring efficiently operated nuclear facilities—and even mediocre ones whose efficiencies can be improved upon," according to Moody's July report *Nuclear Update: A Buyer's Market for Nuclear Plants.*

Given that nuclear fuel generally is less expensive than fossil fuels, nuclear plants—when purchased for a relatively modest price—"can be better suited to provide the buyer with a marginal cost advantage over most other types of power plants in a competitive market," Moody's said.

The report forecasts that well-run nuclear units will generate prodigious cash flow: "Highly efficient nuclear facilities will generate more cash flow to the operating utility to cover its non-fuel operating and maintenance costs, since these plants will be dispatched before other higher-cost fossil generating units in the regional power grid." Well-run plants also are likely candidates for license renewal, Moody's adds.

Finally, the report touches on the modest prices—$100-125 per kilowatt—that nuclear power plants have fetched during the past year.

According to Moody's, nuclear plants will continue to sell "at a substantial discount to book value" because of the "specialized skill sets" required to operate them, the unresolved issue of used fuel disposal, concerns over funding decommissioning, the "degree or type" of future regulatory oversight, and the presence of "outmoded regulations." ■

PHOTO COURTESY OF ENTERGY NUCLEAR

Entergy Nuclear welcomes the opportunity to become an involved neighbor in the Plymouth community by continuing to fund a Massachusetts Department of Public Health program that lets science students in high schools near the Pilgrim nuclear plant collect and analyze data on background radiation.

Once Again, Three Mile Island Rewrites Record Book

For the third time since 1991, the Three Mile Island 1 nuclear power plant has broken the world record for continuous operation by a light water reactor.

The Pennsylvania plant bettered its own record—set in June 1997—when it entered its 617th consecutive day of service on July 21. Three Mile island is scheduled to run until September, when it will be taken out of service for refueling. The plant's first continuous-run record came in 1991, after it ran for 479 straight days.

"The performance at TMI 1 reflects not only attention to excellence in daily activities but also unrelenting commitments to safety, reliability and the right work environment by many people over many years," said Gary Broughton, president and CEO of GPU Nuclear. "Today, 25 years after it began operation, TMI 1 is more reliable than ever before."

That's certainly good news for AmerGen Energy—a joint venture between PECO Energy and British Energy—which made TMI 1 the first acquisition in its strategy to become a dominant nuclear operating company. That sale should be completed by the end of the year.

Three Mile Island's performance also is a reflection of the industrywide improvement seen during the 1990s, said Ralph Beedle, NEI senior vice president and chief nuclear officer.

"TMI 1 continues to embody industry improvements in safety and reliability," Beedle said. "It exemplifies the industry's commitment and dedication to help improve society's economic and environmental well-being."

The Department of Energy also recognized Three Mile Island's record-breaking performance.

"This achievement demonstrates how nuclear energy can safely deliver electricity to the nation reliably and efficiently," said William Magwood, who heads DOE's Office of Nuclear Energy, Science and Technology. ■

ONE ON ONE

Entergy Corp.'s Don Hintz Sees Competitive Nuclear Power Plants in America's Energy Future

History was made on July 13, when Entergy Nuclear Inc., headquartered in Jackson, Miss., closed on its purchase of the Pilgrim Station, located in Plymouth, Mass. This was the first successful nuclear power plant sale in the United States and the first sale through a competitive bidding process. Don Hintz, president of Entergy Corp., the parent company, located in New Orleans, spoke with Insight *about the future prospects for nuclear energy—for his company as well as the industry.*

Q. What is the future of nuclear energy in the competitive environment for electricity generation?

A. Nuclear has a bright future in a deregulated competitive environment. A well-run nuclear plant of a certain size, in a good location, can be extremely competitive with any other generation that is available today, or any generation in the foreseeable future. I am talking about the non-fuel operations and maintenance costs, the fuel cost, and whatever new capital is put into the plant.

If you can buy a nuclear plant at a market price—not what was on the books for the plant or what it cost to build the plant—then we believe that these plants can be very successful in a competitive environment.

Q. Why is Entergy buying nuclear power plants?

A. Consolidation of industry ownership, which we believe is going to happen, is going to make nuclear plants even more competitive. They'll be run by operators that must have good operating records. Just as important, you will get economies of scale if you are operating a large number of nuclear plants.

Q. What is Entergy's acquisitions strategy?

A. We are primarily interested in the larger nuclear plants in the Northeast, upper Midwest, and the New York area—places where there is a demand for power.

Q. Do you prefer plants of a certain capacity or age?

A. Since we are primarily interested in the larger plants, that generally means the newer plants, built in the mid-'80s. However, the age of the plant is not a particular concern to us; it's more the size. But even at that, our focus is a combination of factors, including size, operational performance and potential power sales in the region of a particular plant.

It is extremely important for a nuclear plant to operate at very high performance levels to be competitive, and that means very high capacity factors. A plant that operates at 70 percent capacity factor probably could not make it in the competitive environment. You really can't cut enough costs to make these plants economical if you don't perform at high capacity factors. [Capacity factor measures a plant's output compared with the maximum generation possible.]

Q. How many companies do you think will own the nation's 103 nuclear plants, once the industry is restructured?

A. I believe there will be drastic consolidation, and I don't think you are going to see many utilities operating a single nuclear unit. It could be maybe a dozen operators.

Q. Is the expected consolidation of nuclear plant ownership and operation good for the consumer?

A. Yes. There are economies of scale when you can have contracts that go across a number of plants or a number of sites, for instance, in the purchasing of supplies and materials. This will tend to lower the production cost of nuclear, and that will be good for the consumer. Also, there is an advantage to having all the plants operated by operators with good performance records—companies that have a real focus on nuclear.

Q. Through more efficient operations and benchmarking, U.S. plants have been able to reduce production costs in the last decade. Will consolidation help that trend continue?

A. Yes, because you will have more of the plants operated by utilities that have a real focus on nuclear. They'll have more resources to put into operating the plants. In addition, as improved performance increases generation, your cost per kilowatt-hour goes down. I think

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DON HINTZ *from page 3*
you will see a continued reduction in cost.

Q. How important is the decommissioning fund transfer tax issue to the decision to close a transaction and to the eventual economic success of a given acquisition?

A. It's absolutely critical. If the decommissioning fund were taxed upon transfer, many of the plants—particularly the smaller ones—would not be sold, because the value of the plant to the buyer would be less than the taxes paid on the decommissioning fund.

Because the smaller plants are often operated by a utility with one nuclear plant, the economics would probably force the utility to shut the plant down. If the plant were sold, economies of scale would make the plant competitive and keep it operating. So, the resolution of this issue [now before Congress] is in everybody's best interest—the utility that is trying to sell the plant, the utility that is trying to buy the plant and the consumer.

Q. As you know, the Nuclear Regulatory Commission has begun to move away from a very prescriptive form of regulation that has resulted in an inordinate amount of time and money being spent on things with little or no benefit to safety. Why is now the right time for the introduction of safety-focused regulation?

A. There is a lot more credibility with the public and with the regulator regarding the safety of these nuclear units. That has happened over the last 20 years or so because of the great improvement in the performance of the industry.

I think this industry needs a strong regulator. But we need a fair regulator, we need a predictable regulator, for these plants to operate in a competitive environment and for our particular nuclear strategy to be well accepted by the financial community.

I think this new regulatory climate will result in a healthier industry and possibly more plants that will continue to run rather than being shut down.

NOW HEAR THIS...

"[Nuclear plants] are going at a very low price at this point and time, but in the future they'll go up dramatically as people realize their true worth."

—Deutsche Bank Alex. Brown analyst Edward Tirello in* Arkansas Democrat-Gazette, *August 5, 1999

Q. How do you expect plants to respond to this new regulatory approach in terms of their safety efforts?

A. I think the response will be real good. You've got to operate these plants at the very top level of safety. With the new regulatory process, there will be more time and effort spent on issues that truly affect safety and maybe less time spent on things where the safety benefits are very marginal.

Q. Has progress toward more safety-focused regulation had an impact on your decision to pursue plant purchases aggressively?

A. We made the decision about two to three years ago to go ahead with purchasing power plants. I think the decision would have been made even under the previous regulatory environment, but this makes the decision so much easier, and we are more positive about it now.

Q. How do you see the issue of the permanent disposal of used fuel becoming resolved?

A. The disposal of fuel, from a technical standpoint, is not a major issue. But because of political reasons, it's been a very frustrating situation. I believe that fuel will be disposed of at Yucca Mountain, but the process has been much slower than any of us would have liked. And we've spent a lot more money than it should have cost to dispose of the spent fuel.

Still, we are convinced that the high-level waste issue will be resolved.

Q. Do you expect the environmental benefits of nuclear plants to translate into economic benefits?

A. Over time we are going to get more credit for the clean air benefits of nuclear, and I think that will ultimately turn into economic benefits.

Nuclear is clean generation—really the only source of energy that is not going to contribute to some of the environmental problems we have, such as global warming, that can produce a large magnitude of electricity, as compared to wind power or solar.

People increasingly see nuclear as a partial solution to the environmental problems that we have in this country and in the world associated with power generation. At a minimum, people are questioning whether anything is being done to adversely affect these nuclear units such that they ultimately get decommissioned [prematurely], which would compound our environmental situation.

Q. What is your advice to young people considering a career in nuclear energy?

A. Given that we have over 100 units running and we have momentum on life extension, it looks to me that we are going to have a big industry out there for quite some time. And hopefully at the end of the useful life of the current generation of plants, we will be in a position where nuclear again will be a choice of generation for building future plants. ■

Nuclear Energy, Carbon Reductions Go Hand in Hand, Says Business Roundtable

Recognizing "there is no other zero-emissions generation source that could supply as much electricity as nuclear power supplies today," The Business Roundtable is advocating that U.S. climate change policy include license renewal for existing nuclear plants as well as construction of new ones.

Nuclear energy should "continue to play a strong role in reducing all forms of emissions" and contribute to a diverse national energy supply, says *The Role of Technology in Responding to Concerns About Climate Change.* The report was released last month by the environment task force of The Business Roundtable, which bills itself as "an association of CEOs committed to improving public policy."

License renewal is key to nuclear energy's future role, says the report. "Without relicensing, most nuclear units will shut down by 2020, and their substantial electricity supply will have to be replaced"—most likely, with emitting sources of generation.

Another influence on nuclear energy's future role is the status of federal programs to manage nuclear waste, according to the report. "A license renewal and nuclear waste management process that proves to be generic, timely and predictable will encourage a decision to continue the nuclear option." The report urged government and industry to work together to "refine the process" in the upcoming years.

Turning to the Kyoto Protocol, the report noted that the electric utility industry couldn't reduce its greenhouse gas emissions to the target levels with today's electricity generating capacity—and its heavy dependence on coal.

"Future electric supply considerations need to take into account that additional nuclear capacity is neither forecast nor anticipated by most analysts," said the report. "This will create a substantial challenge for other sources (likely natural gas) to provide as much growth in energy supply for the next 20 years as nuclear energy did for the past 20 years."

Looking ahead to new and emerging technologies, the report observed that technology could "bring a new generation of nuclear fission reactors over the long term." New nuclear plant designs are already available, promising ongoing efficiency and cost improvements, added the report. However, renewable technologies, other than hydro, "cannot contribute a major share" of either the growth in supply or the absolute supply of electricity for the next several decades—"even under the most optimistic scenario." ■

Oconee License Renewal Earns Support of Friends and Foes

You must be doing something right when you earn the praise of your opponents.

The Oconee Nuclear Station and its owner, Duke Power, found itself in that enviable position last month during a day-long public hearing on its application to renew the operating license for the three-unit facility in western South Carolina.

"Duke has been a good neighbor and actually runs a pretty good plant," said Buzz Williams, executive director of the Chattooga River Watershed Coalition. The group and four individuals petitioned the Nuclear Regulatory Commission—a petition the agency denied, saying the petitioners had not submitted "admissible contention."

Despite his positive comments, Williams said the NRC needs "to give the public answers they are entitled to over such important issues."

That largely was the purpose of the July 8 public meeting in Clemson, S.C., where the NRC discussed the results of an environmental review of the Oconee Nuclear Station.

The study examined potential environmental impacts from plant operation—such as the plant's interaction with the land, water and air, socioeconomic factors, aquatic species, and threatened or endangered species. It also looked at the impacts of alternative electricity generating sources.

The NRC's overall finding: "The adverse environmental impacts of license renewal [of the plant] are not so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable." Said local resident David Wehmeyer, who lives about two miles from the Oconee plant: "I think the report is showing rather clearly that the generation of electricity through nuclear power is the safest and the environmentally best way to produce it." Another Oconee County resident, Tom Harper, called the plant's relicensing outstanding, adding: "I have a high level of confidence in Duke Power." ■

PHOTO COURTESY OF DUKE POWER

Oconee visitors enjoy nature in the plant's backyard wildlife habitat.

House Slashes Funding for Waste Program

Action jeopardizes safe, responsible disposal program

At $409 million, the Department of Energy's funding request for its high-level waste program is a far cry from the $630 million a year that electricity consumers pay into the Nuclear Waste Fund to finance the program.

At $281 million—the amount approved July 27 by the House of Representatives for high-level waste activities, including the study of Yucca Mountain in Nevada—the effort to build a repository could shrivel up, much like everything else in the desert location contemplated for used fuel disposal.

The $281 million for the agency's nuclear waste program is "so far below DOE's request that it would cause significant schedule delays, if not shut down the project altogether," NEI President and CEO Joe Colvin said in a July 19 letter to House Appropriations Committee Chairman Bill Young (R-Fla.) and its ranking member, Rep. David Obey (D-Wis.). DOE had requested $370 million in new budget authority for the program, plus $39 million from previously appropriated funds.

> ***The delays resulting from this reduction [in DOE's waste program] would significantly jeopardize the planned opening date for the repository and the long term prospects for nuclear power in the United States.***
>
> **— Office of Management and Budget, July 20, 1999**

Earlier in the month, the Appropriations Committee cited "severe budget constraints" as the reason for drawing only $169 million from the Nuclear Waste Fund—established by Congress in 1982 to pay for DOE's high-level nuclear waste program activities. But Colvin pointed out that millions of electricity consumers will pay $630 million in fiscal year 2000 to the fund—four times what the committee voted to appropriate from the fund.

"Nearly half a billion dollars in electricity consumer payments to the Nuclear Waste Fund in FY2000 would be diverted to contribute to a budget surplus instead of to the legislatively mandated purpose of managing used nuclear fuel," Colvin told Young and Obey.

The Clinton administration, too, is alarmed about the waste program cut. In a July 20 letter to Appropriations Committee Chairman Young, the Office of Management and Budget expressed its strong opposition to the reduction, saying: "If the site is found suitable, the delays resulting from this reduction would significantly jeopardize the planned opening date for the repository and the long-term prospects for nuclear power in the United States." ■

Correct Gross Injustice, Urge State Regulators, Union

The nuclear industry and the Clinton administration aren't the only ones concerned about the low level of funding approved by the House last month for the Energy Department's high-level waste management program, including the development of a repository in the Nevada desert.

The National Association of Regulatory Utility Commissioners, in a resolution passed in late July, said that cutting funding to $281 million—from the $409 million requested by DOE for fiscal year 2000—would "cause an indefinite delay" in the agency's ability to make a recommendation to the president about the suitability of Yucca Mountain. DOE's schedule calls for a site suitability determination to be made in 2001.

NARUC's resolution also noted that customers of nuclear-generated electricity "will pay more than $650 million into the Nuclear Waste Fund in fiscal year 2000, nearly three times the amount appropriated by the [committee]…

[C]orrect this gross injustice by appropriating the necessary funding that assures the nuclear waste disposal program proceeds to a site suitability recommendation and license application within the time frame currently advocated by the Department of Energy."

The Nuclear Waste Strategy Coalition—whose members include electric utilities, utility commissioners and state attorneys general—also urged House appropriators "to reconsider and release appropriate funding requested by the DOE to carry out this program to completion as promised and mandated by the 1982 Nuclear Waste Policy Act."

The coalition, in July 19 letters to committee members, noted that diverting payments to the waste fund "to camouflage other federal spending…has been and continues to be an unjust and fraudulent tax on the American electricity consumer."

Elsewhere, the Utility Workers Union's national executive committee, at its annual meeting in late June, adopted a resolution that calls on Congress "to compel the Department of Energy to comply with the requirements of the Nuclear Waste Policy Act by immediately establishing a process to develop an interim storage facility and an integrated used fuel management system.

"It is time to ensure that the government live up to its responsibility—and keep nuclear energy as a vital part of America's mix," the union said. ■

WORLD SCAN

SWITZERLAND CO_2 CUTS REQUIRE NUCLEAR CAPACITY, SAYS ENERGY AGENCY

Recent recommendations by the International Energy Agency are making Swiss cheese of any thoughts Switzerland might have of phasing out its nuclear power plants.

The country's nuclear power plants "are efficiently run and contribute significantly to Swiss electricity supply," says the IEA in a new report. Switzerland's five nuclear units, which produce 40 percent of the country's electricity, had an average availability factor—essentially the same as capability factor—of nearly 92 percent in 1997. In addition, "because nuclear power is carbon-free, it contributes largely to making Switzerland one of the lowest emitters of [carbon dioxide] among developed countries."

For these reasons, the IEA "recommends that Switzerland take great care in setting a timetable for plant closings, taking into account the costs involved, the effect on carbon emissions, and the implications for both supply and demand."

The Swiss federal government decided last October to limit, in principle, the operating lifetimes of the country's five nuclear units. At the same time, the government charged the energy ministry with drafting a new atomic law, which would preserve the option of building new nuclear plants. However, no new plant could be authorized without the option of putting the issue to a nationwide referendum.

The IEA gave Switzerland "high marks" for its efforts to reduce CO_2 emissions in line with the Kyoto Protocol. The agency urged the Swiss government to update its decade-old Energy 2000 Action Plan, which called for increasing the capacity of nuclear power plants. A new action plan is needed, given Switzerland's "ambitious goal" of cutting greenhouse gas emissions by 8 percent between 2008 and 2012, said the energy agency.

PLANS FOR ANOTHER NUCLEAR UNIT PICK UP STEAM IN FINLAND

In Finland, home of the world's first carbon tax, concern over the need to further reduce emissions has the country looking at building a fifth nuclear power plant.

That would be a wise move, says the International Energy Agency, which suggests that Finland assess the role that emission-free nuclear energy can play—"through lifetime extension or nuclear capacity additions" in reducing carbon dioxide and air pollutant emissions, in helping to ensure security of supply, and in diversifying fuels. The agency also suggests that Finland clarify the future role of nuclear energy "based on the economic, environmental and security impacts of all energy resources."

Five years ago, the Finnish parliament voted against the construction of a fifth nuclear unit. Finland's four nuclear units supply 27 percent of the country's electricity. The country's new coalition government, formed in March, is expected to re-examine the nuclear issue.

The national confederation of industry and employers has urged the new government to make a clear commitment to nuclear energy, as a means of increasing generating capacity and curbing greenhouse gas emissions.

NUCLEAR OPTION FOR POLAND?

If Poland is to meet its international commitments to stabilize greenhouse gas emissions, nuclear energy must account for 12 percent of the country's electricity output by 2020. That's the preliminary result of a national long-term energy policy study, says the Polish national committee of the World Energy Council.

The study considered two scenarios for Poland's electricity generating industry—one in which the country makes no effort to limit carbon dioxide emissions and one in which it attempts to reduce CO_2 emissions by 6 percent, in accordance with its Kyoto Protocol commitments.

Under the first scenario, Poland's carbon dioxide emissions from electricity generation would rise from about 130 million metric tons in 1998 to about 170 million metric tons in 2020. Under the second scenario, CO_2 emissions would range between 130 million metric tons and 140 million metric tons. Poland generates nearly all its electricity from coal-fired power plants, many of them in need of costly modernization or replacement.

The Polish government canceled the country's partially built Zarnowiec nuclear power plant in 1990, following a referendum in which Gdansk voters called for a construction halt. The plant had been subjected to stop-and-go construction because of money shortages, labor strife and public protests. However, the government didn't close the door on the nuclear option, noting that nuclear energy should be developed in Poland after the year 2000.

Before the end of this year, the Polish government is due to finalize a document outlining national energy policy up to 2020. The document is expected to address the nuclear option.■

Electricity Transforms Society in EPRI's Roadmap to Future

Access to reliable and affordable electricity is one of the most important factors in a country's economic prosperity—it's what separates the industrialized world from developing and undeveloped nations.

That truth will live on in the 21st century. And unless policymakers rely on electricity to address "an energy policy trilemma," the gulf between the haves and the have nots will widen, says Kurt Yeager, president and CEO of EPRI, a Palo Alto, Calif.-based research institute.

The trilemma, Yeager explains, requires that policymakers manage the interconnected nature of population trends, pollution control and the need to improve economic prosperity.

It's a juggling act that won't be easy. A look at the world 50 years from now demonstrates why. In 2050:

- Earth's population will have soared from six billion to 10 billion people with roughly half of them lacking access to electricity.
- Developing and undeveloped countries will see their populations nearly double, from about five billion people to nearly nine billion. What energy these people do have will be largely supplied by highly polluting fuel sources, such as wood and high-sulfur coal.

> ***EPRI foresees the need for a massive global investment in electric-generating capacity... the equivalent of about 200 large nuclear power plants...each year until 2050.***
>
> **— Kurt Yeager, President and CEO, EPRI**

- Population levels in industrialized nations will remain at about one billion. However, an aging populace in these countries means that a declining number of working-age adults will bear an increasingly large societal burden, including the cost of maintaining and upgrading an aging infrastructure for generating and distributing electricity.

To address the "energy policy trilemma" and still allow sustainable development, Yeager looks to electric power. More than a commodity, "electricity is a solution that transforms society," he says.

In addition to its link to economic prosperity, increased reliance on electricity will reduce air pollution. That's a result of the end-use efficiency of electricity, as well as the fact that it can more readily take advantage of cleaner-burning fuels, including emission-free nuclear energy and renewables, as well as relatively clean natural gas.

If electricity is the means to economic prosperity, what must be done to provide access for the globe's mushrooming population?

EPRI addresses this question in its Electricity Technology Roadmap, which evaluates various technology innovation opportunities and their potential benefits. The roadmap "will produce a comprehensive vision and agenda, establishing direction and guiding priorities, resources and responsibilities" for improving electricity-related science and technology, according to an EPRI Web site discussion <http://www.epri.com>.

Above all, Yeager says, the roadmap is an attempt to look at "the future of the future... the world as it might become in the next several decades."

EPRI foresees the need for a massive global investment in electric-generating capacity. Yeager says an additional 200,000 megawatts of production—the equivalent of about 200 large nuclear power plants—will be needed each year until 2050. Conversely, a "business as usual" approach will result in about four billion or five billion people lacking access to electricity in the middle of the 21st century.

Just as important, Yeager says, will be the discovery and introduction of "limit-breaking technologies," which will require significant—but not unheard of—investments in research and development. Yeager contends that electricity-related R&D needs to increase by about $5 billion a year.

"That's a big number to you and me, but it's only 2 percent of the R&D investment of the United States," he says.

"The technology base to make this happen by 2050 does not exist today," Yeager says. "We have perilously little time to develop it, because it takes years to deploy. It isn't as if we can wait until 2045 and, like magic, get 10 million megawatts dispersed throughout the world in five years. ■

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