Amato, Robert A (PSC)

From: Geoffrey Young [gyoung4@isp.com]
Sent: Friday, June 17, 2005 10:58 AM
To: karen.easterling@ky.gov
Cc: Bob Amato; Jason Bentley
Subject: Admin Case 2005 00090 Comments plus 3 Word files GYoung

Dear Ms. Easterling,

Please accept this written testimony in Administrative Case No. 2005-00090. There are three attached files in Word. The first two are intended for inclusion in the case record, while the third -- my November 2004 comments to the Commonwealth Energy Policy Task Force – may also be included in the case record if the Commission so desires.

If you are unable to open any of these files or have other questions, please reply to this message or call me at (859) 278-4966.

Thank you,
Geoffrey Young

COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

AN ASSESSMENT OF KENTUCKY'S ELECTRICAL GENERATION, TRANSMISSION, AND DISTRIBUTION NEEDS	)))	ADMINISTRATIVE CASE NO. 2005-00090

Submitted
TESTIMONY

Geoffrey Young
Member, Sierra Club
June 17, 2005

Thank you for the opportunity to provide information relevant to certain aspects of Kentucky's future electrical system.

I worked for 13 years at the Kentucky Division of Energy (KDOE), most of that time as the Assistant Director, before leaving state government last fall. My work there focused on energy policy issues, electric utility issues including demand-side management, energy-efficient building systems, and alternative fuels for vehicles. Demand-side management, or DSM, is defined as programs that a utility company implements to help its customers control or reduce their energy use and save money. From 1994 to 2004 I was KDOE's representative on three DSM collaboratives at the Louisville Gas and Electric Company (LG&E/KU), Kentucky Power Company (AEP), and the Union Light, Heat and Power Company (Cinergy). As the division's lead person in addressing electric industry regulatory

issues before the Public Service Commission, I developed and submitted testimony in ten integrated resource planning (IRP) cases, two general rate cases, and several other PSC proceedings. I am now serving on a volunteer basis as a public spokesperson for the Kentucky Sierra Club (i.e., Cumberland Chapter) in the area of energy efficiency and renewable energy policy.

The scope of this administrative case is very wide-ranging. I would like to highlight and build upon the testimony provided by three of the people who made oral presentations at the public hearing on June 14, 2005. They are Dr. Stephen Roosa, Dr. Don Colliver, and Tom Fitzgerald. All three witnesses made the point that the potential for cost-effective improvements in energy efficiency throughout Kentucky's economy is very large. This is the most important point that has been made in this Administrative Case so far, and I urge you to review their testimony carefully to gain a clear appreciation of the magnitude of this potential resource.

No one benefits from waste. Even the coal industry gains nothing by having its product used up wastefully, thereby depleting the easily-mined reserves faster than necessary and leading to the premature decline of the industry. The Kentucky economy suffers dramatically from energy waste. It reduces the disposable income of residents and makes our goods and services more costly to produce than they would otherwise be. This in turn hinders our ability to compete in national and international markets.

The key point made by Dr. Roosa is that over the past 15 years, improved energy efficiency has been the largest energy "source" for the United States. Efficiency improvements are available throughout all sectors of the economy at a cost of two to three cents per kilowatt-hour saved. Kentucky has not taken as much advantage of this low-cost, pollution-free energy "source" as several other states have done. The potential for improved energy efficiency in Kentucky is still largely untapped. Dr. Roosa listed several available, cost-effective technologies which exist today and simply need to be incorporated by our residents, business owners, industrial firms, and electric utilities: energy-efficient lighting, motors, drives, cogeneration, digital energy management systems, advanced glazing, air sealing, efficient chillers, and small-scale hydropower. In my oral statement, I added the idea of whole-system design, which combines a number of technologies in clever ways to reduce the energy requirements of the system as a whole, whether it be a manufacturing process, a commercial building, or a new home. I recommended the book, *Natural Capitalism*, which provides a readable overview of the exciting possibilities that can be achieved through better design practices. The chapters on design and waste reduction are particularly relevant to this case. (Hawken, Paul, Amory Lovins, and L. Hunter Lovins, Rocky Mountain Institute, Snowmass, Colorado, 1999. The book is available electronically at no cost via the Institute's web site - www.natcap.org They ask only that you don't use excessive paper by printing out the whole book.)

I would like to provide just one example from the book that describes the savings achievable through better design and engineering practices in the industrial sector. A major use of electricity in industry is to operate pumps for moving liquids around. The carpet company, Interface, was planning to build a new factory. One of the factory's production processes required 14 pumps. A leading firm specializing in factory design did a conventional engineering analysis and sized the pumps to total 95 horsepower. An Interface engineer, Jan Schilham, however, took a fresh look and was able to come up with a different design that was not only more efficient but cost *less* to build. The first design change used larger pipes and smaller pumps, greatly reducing frictional losses. Second, Schilham laid out the pipes first and then the equipment, in the reverse order from standard practice, enabling him to use shorter and straighter pipe runs. The combination of these two approaches allowed for a system with only 7 horsepower of pumping capacity – a 92% decrease. The lower capital cost of the smaller pumps, motors, inverters, and associated electrical system more than compensated for the additional cost of larger diameter pipes. The payback period for the higher-efficiency design was instantaneous and its

return on investment was infinite because it was cheaper to build than the inefficient design would have been. However, "optimization" techniques in use throughout the industrial sector routinely ignore systemic effects such as these, focusing only on single-component or partial-system optimization. *Ibid.*, pp.116-117.

Similarly, Dr. Colliver testified that a consortium of organizations that include 145,000 design and engineering professionals is now working on methods to produce buildings which are 30%, 50% and 70% of the way toward using zero net energy. In other words, the buildings are extremely efficient and also include distributed energy generation technologies that produce as much energy as the building uses over the course of a year. One example of such a technology is solar shingles in place of the conventional shingles, but which generate electricity and feed it back into the electric grid during peak periods.

Dr. Roosa concluded that energy efficiency includes much more than the limited DSM programs now in effect in Kentucky to weatherize the homes of a small number of low-income families and to control the duty cycle of air conditioners on hot summer days. Although our existing DSM programs represent a good first step, other states have engendered far more success and consequently enjoy a higher level of statewide energy efficiency than Kentucky. These states have succeeded in part by bringing their energy utilities on board in a partnership to help their customers improve end-use efficiency.

The major obstacle to the formation of such a partnership in Kentucky is the traditional ratemaking formula, which essentially fixes the price per unit of energy. The fundamental regulatory problem is that under the present ratemaking framework, the more electricity or natural gas a utility sells, the more revenue and profit it makes. That means the utility has an extremely strong economic incentive to try to sell more energy at all times. Conversely, utilities have a very powerful economic incentive to oppose efforts to help their customers use energy more efficiently. They may implement a small-scale, token DSM program or a net metering pilot program here or there for reasons of public relations, but if there is a chance that a cogeneration installation or a new DSM program could save large amounts of energy, they will oppose it.

Fortunately, unlike many of the other issues brought up in this Administrative Case, this is one problem for which the solution is relatively simple and painless. It is called "decoupling," and it allows the price of electricity to vary slightly to compensate for changes in the amount that is sold. So, for example, if a utility company launched a campaign to get people to buy more electricity, the decoupling formula would decrease the price of each kilowatt-hour slightly, and the company's profit would remain unchanged. If, on the other hand, the utility implemented effective DSM programs and helped its customers use energy more efficiently, the rates would increase slightly and the company would make the same amount of profit – actually, slightly more to provide a positive financial incentive for them to do it.

In the words of Sheryl Carter, "Rate designs that break the sales-revenue link are not new, nor are they merely theoretical. These mechanisms have been in operation in some form since the California Public Utilities Commission (CPUC) adopted an electric rate adjustment mechanism (ERAM) in 1982. While California has the most extensive experience, Oregon, Washington, New York and Maine have also adopted some form of revenue cap mechanism over the last two decades." ("Breaking the Consumption Habit: Ratemaking for Efficient Resource Decisions," *The Electricity Journal*, December 2001, p.70). This article is provided as Attachment 1. Even Kentucky had decoupling in place, for residential customers of LG&E and ULH&P only, during the period from 1994 to 1998. But there were some disagreements about how it should be implemented, the utility companies proposed that it be cancelled, and the Commissioners at that time didn't feel it was important enough to keep in place.

There is a Federal law that addresses this issue of utility incentives. The relevant law, 16 USC Section 2621(8), as amended by the Energy Policy Act of 1992, states that public service commissions should set rates so that investments in DSM are at least as profitable as investments in new power plants. The Commission held some hearings from 1992 through 1994 in Administrative Case No. 341, which led to some halfway measures such as the enactment of Kentucky's DSM statute, KRS 278.285, but Kentucky still has not solved this critical problem, and has not implemented the intent of 16 USC Section 2621 (8). Investments in power plants are still much more profitable to utilities than investments in improved end-use efficiency, even when the latter yield lower total costs for customers and society as a whole. The DSM cost recovery mechanisms now in effect in Kentucky provide incentives for utilities to operate DSM programs that look good on paper but do not actually save much energy. The strong incentives to boost sales remain in effect.

Because these concepts can be somewhat dry and hard to understand, it may be helpful to translate the messages being sent by the PSC into words. The implicit message that has been sent to utility companies by the traditional ratemaking formula is as follows: "For the past 60 years, one unintended side-effect of our fixed-rate formula has been that if you boost energy sales, we will reward you handsomely; conversely, if you help your customers save significant amounts of energy, we will kick you in the teeth." The implicit message the PSC sent to LG&E and ULH&P in 1994 when it approved a decoupling formula for their residential customers was as follows: "For the next three years, on an experimental pilot basis in the residential customer class only, if you help your customers save energy we will stop kicking you in the teeth; instead, we will give you a small reward. In regard to all of your other customers in the non-residential sectors, if you help them save energy we will continue to kick you in the teeth as we have for the past 60 years." When the PSC approved the elimination of decoupling in 1998, it was saying, in effect, "Our limited, pilot-scale experiment in one customer class was all well and good, but we are now returning to the decades-old system whereby we will reward you for boosting sales to all customer classes and will kick you in the teeth if you help your customers save energy." Although these translations into words may seem dramatic, they clearly express the financial incentives that various ratemaking formulas convey to utility company executives.

Although it might not seem likely at first because co-ops are not-for-profit institutions, similar incentives also apply to the electric co-ops. Like investor-owned utilities (IOUs), co-ops have certain fixed costs, and each additional kWh sold provides additional net revenue to meet operating expenses. A large reduction in energy sales would reduce the co-ops' net revenue to the point where they would need to curtail some of their employees' activities, possibly lay off employees, and come in for rate cases on a more frequent basis. These are significant disincentives that counteract what one might assume would be a co-op's natural tendency to help its owners/members improve their energy efficiency. The result has been that Kentucky's generation and transmission (G&T) and retail co-ops have implemented far fewer energy efficiency programs than have been cost-effective, from the perspective of minimizing the total resource costs for society as a whole.

Decoupling Options

In his report, *"Statistical Recoupling: A New Way To Break the Link Between Electric-Utility Sales and Revenues,"* Eric Hirst described three types of decoupling: recoupling revenues to determinants of fixed costs (e.g., California's Electric Revenue Adjustment Mechanism); recoupling revenues to the growth in the number of customers, also known as revenue-per-customer decoupling; and recoupling revenues to the determinants of electricity sales, also known as statistical recoupling. The type of decoupling that temporarily existed in Kentucky was of the second type, revenue-per-customer decoupling.

Two problems with the first two types of decoupling – ERAM and revenue-per-customer decoupling – are that they may cause relatively large fluctuations in rates under certain conditions, and they also

change the allocation of certain risks between the utility and its customers, most notably the risks relating to weather and economic recessions. If the weather is severe and energy usage increases, during the next period the decoupling formula will lower the rate and require the utility to return some of the revenue to customers. The formula would give rise to a similar refund if there is an economic boom and energy use per customer increases. Conversely, if the weather is mild and energy use falls, during the next period the decoupling formula will raise the rate per kWh and allow the utility to receive additional revenues from its customers. If there is an economic recession and energy use per customer decreases, during the next period the decoupling formula will raise the rate per kWh. In some cases such as in Maine, the rate effects of such factors have dwarfed the effects of energy efficiency programs.

Statistical recoupling (SR) addresses these issues and reduces the size of the rate fluctuations. It does so by recoupling the revenues to the main factors that affect the amount of energy consumed. To develop the SR formula, a regression analysis is performed, using the past 10 or 20 years of data, of energy consumption as a function of variables such as heating degree-days, cooling degree-days, the number of customers, the retail price of electricity, and a measure of economic activity in the region such as industrial output. Hirst's model also includes a first-order autoregressive term solely for the purpose of reducing the standard error in the model's other coefficients. The allowable revenues for subsequent years are determined by using the same formula and coefficients in conjunction with each year's variable data. *Ibid.*, pp. 33-36. The result is that revenues are decoupled from sales – i.e., the PSC stops kicking the utility in the teeth for helping customers save energy – and the year-to-year price fluctuations that can result from other forms of decoupling are moderated. Statistical recoupling appears to be the solution that would be most beneficial to all energy utilities in Kentucky.

Eric Hirst noted a minor issue related to revenue-per-customer decoupling: "With RPC decoupling, it may be necessary to agree on an estimate of per-customer growth in electricity use (expressed in percent per year). Statistical recoupling has no predetermined growth-rate factor that remains constant between rate cases." *Ibid.*, p.53. It should be noted that a disagreement about the proper magnitude of LG&E's growth-rate factor eventually led some of the parties in the LG&E DSM Collaborative to propose the elimination of decoupling.

As Sheryl Carter noted, "Eliminating the disincentive is necessary, but not sufficient."
While decoupling or SR formulas "make utilities neutral to investments that reduce throughput, they do not provide the utilities with incentives to actively promote energy efficiency, distributed resources, or other energy policy goals. Additional incentives or mechanisms are necessary to promote active investment in these areas... Strong performance-based incentives could also be established to deliver cost-effective savings, distribution enhancements, and other least-cost system values." (Op.cit.) In other words, in addition to statistical recoupling, the PSC should include factors in the rate formula that enable utilities to share in the savings that customers obtain – some jurisdictions give utilities a revenue boost equal to 15% of the customers' savings – and to recover prudently-incurred DSM program costs. Over the past 25 years, methods have been developed to estimate customers' savings. The Kentucky Division of Energy and several energy service companies have experience working with the International Performance Measurement and Verification Protocol (IPMVP), which provides a method for verifying energy savings. A brief overview of the IPMVP is provided in Attachment 2. (Satish Kumar, "Measurement and Verification of Energy Savings," *Energy User News,* December 8, 2000.)

Implementing the Necessary Ratemaking Reforms in Kentucky

The most straightforward way to change the ratemaking formulas to implement statistical recoupling, shared savings factors and DSM program cost recovery factors is for the PSC to issue an Order scheduling a series of rate cases for each energy utility in Kentucky – electric and gas – for the sole purpose of changing the rate structures. The Order could specify that the magnitude of the utility's

revenue requirement is not at issue but only the rate structure. This would eliminate almost all of the complex, contentious and time-consuming issues and testimony that typically accompany general rate cases, a phenomenon I have called "dueling accountants." In my view, the PSC would have the authority, under KRS 278.260, to initiate such proceedings on the grounds that the existing rate structure is not fair, just and reasonable because: 1) It unjustly punishes utilities financially for working with their customers to implement cost-effective measures that would significantly reduce energy use; and 2) It is contrary to the intent of 16 USC Section 2621(8), which states that public service commissions should set rates so that investments in DSM are at least as profitable as investments in new power plants. It is clear to me that the Commission has the legal authority to implement regulatory changes in Kentucky's energy utility sector that are called for by Federal law.

To summarize these comments on energy efficiency and utility regulatory reform:

- Improved energy efficiency is the largest, most cost-effective, and most environmentally sound energy "source" for the Commonwealth.
- The potential of DSM in all customer classes extends far beyond the existing limited programs.
- The traditional ratemaking framework rewards utilities for selling more energy and kicks them in the teeth if they help customers use energy more efficiently.
- The best solution is statistical recoupling and shared-savings incentives, which need to be applied to all energy utilities in Kentucky.
- The essential reforms can be implemented unilaterally by the PSC via a series of limited rate cases that deal with rate structure alone.
- All parties can benefit significantly by working together to reduce waste.

The other comments I made at the public hearing on June 14, 2005 related to the need to account for the environmental externalities that accompany various fuels and energy conversion technologies. PSC Chairman Goss asked if it was difficult to establish the value of pollution taxes. I answered that it is difficult and contentious, but if it is not done, Kentucky is implicitly valuing such external costs at zero, which is surely not the correct outcome from the perspective of economic efficiency. What would be advisable would be to invest a certain limited amount of time and effort into making an approximate assessment of the external costs of various fuels and technologies, review the values used in other jurisdictions, and then set some values for Kentucky that could be adjusted in the future if better information becomes available. To be approximately right is a much better policy than to be precisely wrong.

There is some overlap between this testimony and the written testimony I submitted to the Commonwealth Energy Policy Task Force on November 23, 2004. Some of the points included herein are explained in somewhat greater detail in the 11/23/04 document, for example, the issue of environmental externalities. Other comments I made at that time relate to issues that have been brought up by other parties in this administrative case, for example, the effects of international trends on Kentucky's energy sector, and state policies that relate to "clean coal." This should not be surprising

because some of the parties are the same. I am therefore including an electronic version of that file as Attachment 3, which is 19 pages when printed out, with the understanding that the Commission may choose to include it in the record of this case or leave it out, as appropriate.

Respectfully submitted,
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Attached documents:
1. *Electricity Journal* article on decoupling by Sheryl Carter
2. Measurement and verification overview by Satish Kumar
3. Written testimony by Geoffrey Young to the Commonwealth Energy Policy Task Force

Attachment 1

Breaking The Consumption Habit
Ratemaking for Efficient Resource Decisions

This article by NRDC's Sheryl Carter appeared in *The Electricity Journal*, December 2001.

For most distribution companies, most of the time, today's dominant regulatory practices create thoroughly perverse incentives. The result is lost opportunities to reduce energy service costs and improve reliability by introducing a wide variety of efficient and cost-effective alternatives. Among the casualties are effective resources such as targeted energy efficiency, load management, and distributed generation, which can effectively avoid many costly capacity additions and greatly enhance grid reliability. Traditional rate design, which ties utilities' financial health directly to the volume of commodity sales, invites an exclusive focus on more traditional distribution and generation capacity expansions -- often in direct conflict with other important societal objectives. This antiquated design must be changed to reward utilities' for making more economically and environmentally efficient resource decisions. Adoption of these ratemaking reforms is critical to the effective integration of promising alternatives such as distributed resources.

Breaking the link between utilities' commodity sales and revenues is necessary but not sufficient. Additional mechanisms such as performance-based incentives to deliver cost-effective savings, and distribution enhancements, will be needed to align shareholder and customer interests. Some state public utilities commissions applied this concept to their rate designs (variously known as decoupling, revenue cap or revenue-per-customer mechanism, revenue indexing, and statistical recoupling) in the 1980's and 1990's, with generally positive results. Industry changes in the last few years make it more important than ever to re-examine this concept and discard the current antiquated rate design, regardless of how expansive or limited a role one believes a distribution company should have, or whether that distribution company is investor, or consumer-owned. Several utilities in California and Oregon now actively support adoption of a revenue cap mechanism. This is significant for two reasons. First, these utilities account for more than ten percent of U.S. gas and electric revenues. Second, Oregon and California arrived at very different structures for the distribution companies' role.

Weighing All the Options

Utilities have long had the responsibility of delivering least-cost, reliable energy services to customers. Increases in demand have traditionally led to increases in capacity -- of generation, transmission or distribution infrastructures -- regardless of the grid location, time period, permanence or reliability level of that demand. A quick look at the landscape reveals that as customer needs have grown, so have the range and the number of resources available to meet those needs.

The distribution system across the U.S. is under increasing stress for an increasing number of hours each year. There is a growing consensus that we need major new infrastructure investment. The nation is looking at very expensive grid enhancements if we rely solely on traditional solutions such as the construction of new peaking power plants. Targeted energy efficiency or load management, or well-placed distributed generation on either side of the meter, would likely prove much more cost-effective and much less environmentally disruptive.

In some cases, capacity expansion of the generation, transmission, or distribution infrastructure may very well be the most prudent solution to customer needs; in many more cases, the most prudent solution will be a portfolio of the many options. To come to the most economically and

environmentally efficient resource decision, requires balanced consideration of all the options. If both the needs and the resource alternatives available to meet these needs have expanded, why have the utilities not added these new tools to their toolboxes? One answer is that current ratemaking encourages them not to.

Ratemaking for Efficient Resource Decisions

All ratemaking provides utilities with incentives or disincentives to behave in a certain manner. Ideally, utilities should be rewarded based on how well they meet their customers' energy service needs. However, most current rate design instead places the focus on commodity sales, tying a distribution company's recovery of fixed costs directly to its commodity sales.

This system of price cap regulation discourages even the most economical investments if they are likely to reduce throughput. As sales go down, the utility's shareholders or customer-owners lose dollars with every unsold kilowatt-hour. To actively encourage or promote demand- or supply-side resources installed on the customer side of the meter, or any other solutions that might reduce throughput, would undermine the institution's financial health. Under this system, it follows that capacity expansion is the primary response to projected load growth - to the exclusion of investments in energy efficiency and other distributed energy resources. This is economically inefficient, because there is no the incentive to choose the total least-cost option to provide energy service to its customers.

The response to the wholesale market volatility of 2000-01 makes these perverse incentives even worse. Public utilities commissions all over the West are responding with a move toward sharply tiered residential rate structures. (Table 1) Tiered rates are extremely useful in sending price signals to consumers to encourage energy efficiency and conservation; however, this structure also makes more revenues subject to unexpected change since short-term increases or reductions in residential consumption will occur in tiers or blocks that return significantly more revenue per kilowatt-hour to utilities than the relatively flat rates that prevailed until very recently.

Breaking the Sales-Revenue Link

In order to motivate utilities to consider all the options when planning and making resource decisions on how to meet their customers' needs, the sales-revenue link in current rate design must be broken. Breaking that link between the utility's commodity sales and revenues, removes both the incentive to increase electricity sales and the disincentive to run effective energy efficiency programs or invest in other activities that may reduce load. Decision-making then refocuses on making least-cost investments to deliver reliable energy services to customers even when such investments reduce throughput. The result is a better alignment of shareholder and customer interests to provide for more economically and environmentally efficient resource decisions.

As an added benefit, breaking the sales-revenue link streamlines the regulatory process for rate adjustments. Contention over sales forecasts consumes extensive time in every rate case. If the sales-revenue link is broken, these forecasts carry no economic weight, so the incentive to game forecasts of electricity sales is removed and rate cases become less adversarial.

Many works have addressed the different forms that alternatives to the traditional rate design mechanism can take.[1] These alternatives, variously known as decoupling, revenue indexing, revenue cap or revenue-per-customer mechanism, or statistical recoupling, range from the simple to the complicated -- allowing the design to take into account the unique characteristics of different utilities or regions.

Eliminating the Disincentive is Necessary, But Not Sufficient

While revenue cap or revenue-per-customer rate designs make utilities neutral to investments that reduce throughput, they do not provide the utilities with incentives to actively promote energy efficiency, distributed resources, or other energy policy goals. Additional incentives or mechanisms are necessary to promote active investment in these areas. A non-bypassable system benefits surcharge provides a stable level of funding for public good investments in cost-effective energy efficiency, renewables, low income services and RD&D. Strong performance-based incentives could also be established to deliver cost-effective savings, distribution enhancements, and other least-cost system values.

Partial "Fixes" Do Not Get The Job Done

While there are many different ways to break the link between sales and fixed-cost recovery, that link must be broken to allow a more balanced consideration of all resource options. Several alternatives have been proposed to remove the disincentive to reduce throughput; however, decoupling mechanisms are able to do this much more successfully and comprehensively than any of the proposed alternatives which include a shift to more frequent rate cases, fixed customer charges, or lost revenue adjustments.

Frequent Rate Cases

Increasing the frequency of rate cases is neither an efficient nor an effective alternative to decoupling. Under any circumstances, most of life will be lived between rate case decisions. Increased frequency of rate cases could partially address many issues underlying the short-run profitability of incremental sales; however, since the frequency of rate cases directly influences the size and persistence of the disincentives that decoupling seeks to address, annual rate cases, at a minimum, would be necessary. Too much of life would then be lived in rate cases, which are lengthy, litigious, and expensive. Even then, the problem would not be resolved, since the disincentive to reduce sales would still exist, and revenues would still increase with sales between rate case decisions. In addition, frequent rate cases would dampen any cost-cutting incentives that utilities might have between rate cases.

Fixed Charge

Another proposed alternative to decoupling is to shift from volumetric customer charges to fixed charges. In this argument, since distribution costs are independent of consumption in the short run, the charges that recover these costs should not vary with consumption. Proponents of fixed charges contend that when fixed distribution costs are recovered by raising the cost of kilowatt-hours, customers are being overcharged for those kilowatt-hours and socially beneficial electricity use is being suppressed. Their preference is to recover the distribution costs instead as fixed monthly charges that do not vary with consumption. A response at that same lofty theoretical level is that distribution costs are extremely sensitive to consumption over longer periods, with sustained growth periodically requiring costly equipment replacements in order to handle the higher volumes safely. This argues for making customers pay higher distribution costs as their electricity consumption grows. Volumetric rates recognize the variability of distribution costs over time, and promote long run, dynamic economic efficiency.[2]

However one resolves the theoretical debate, it is difficult to contend seriously that society today is suppressing socially beneficial growth in electricity consumption by imposing excessive charges on its use. The opposite seems far more likely, given growing environmental strains and the abundant evidence that pervasive market barriers continue to block energy savings that are much cheaper than additional energy production. We should not make a bad situation worse by reducing customers' rewards for using less electricity, which is precisely what would happen if we raised their fixed charges and cut their usage-based distribution charges by a corresponding

amount. Volumetric, or usage-based, rates provide a very valuable price signal by giving customers power over their own bills.

Lost Revenue Adjustments

Probably the most frequently proposed alternative to decoupling is lost revenue adjustment. Proponents contend that by estimating sales lost, or commodity not consumed due to energy efficiency or load management activities, and reimbursing the utility for those 'lost' sales, the disincentive to reduce throughput will be eliminated. The principal problem with such a system is that it fails to break the link, and it gets utilities' overall incentives very wrong. The most profitable energy efficiency programs under such systems are those that can be made to look good on paper and save nothing in practice. Such programs would leave overall revenues unimpaired (since consumption would not decrease), while yielding utilities a windfall in the form of restored lost revenues that were never in fact lost. Lost-revenue adjustment mechanisms also impose a high administrative burden associated with implementation and produce very complex and controversial measurement and evaluation issues.

Furthermore, lost-revenue adjustments deal only with revenue losses directly attributable to utility energy efficiency and load management activities while leaving the underlying incentive to pursue incremental sales unaffected. Lost-revenue adjustments do nothing to support environmental and efficiency objectives, and do everything to motivate utilities to oppose them. Under this type of mechanism, aggressive efficiency codes and standards would still threaten fixed cost recovery since they result in a reduction in throughput. Since utilities have been instrumental in the development and promotion of stringent standards, loss of their support -- or worse, active opposition -- would be devastating to environmental and efficiency goals.[3]

Learning From Experience

Rate designs that break the sales-revenue link are not new, nor are they merely theoretical. These mechanisms have been in operation in some form since the California Public Utilities Commission (CPUC) adopted an electric rate adjustment mechanism (ERAM) in 1982. While California has the most extensive experience, Oregon, Washington, New York and Maine have also adopted some form of revenue cap mechanism over the last two decades.

Reliance on decoupling mechanisms declined substantially in the mid-to late 1990s. This was due in large part -- at least in California -- to uncertainties related to and the structure imposed by the restructuring transition. The CPUC, however, never abandoned its policy of breaking the sales-revenue linkage (see discussion below), and California's legislature mandated reinstatement of the policy in April 2001.[4] Today, Pacific Gas & Electric (PG&E), Southern California Edison (SCE) and San Diego Gas & Electric (SDG&E) all have either proposed, or have stated their intent to propose, some form of revenue cap mechanism.[5] Oregon is also actively considering revenue-per-customer mechanisms. A proceeding is underway in Oregon to consider adoption of revenue-per-customer mechanisms proposed by Portland General Electric (PGE), and NW Natural Gas. In addition, Pacificorp has stated their intent to propose some form of revenue-per-customer mechanism.[6] Of note is the fact that these utilities account for more than 10 percent of U.S. gas and electric revenues.

California

The California PUC adopted an ERAM for the three major California utilities beginning with PG&E in 1982[7]. SCE and SDG&E followed in 1983 and 1984, respectively. The mechanism applied to all electricity and gas sales for residential and small commercial customers. Not surprisingly, California utilities led the nation in their commitment to energy conservation in the early 1980s. In 1990, the CPUC supplemented decoupling with a system of performance-based financial

incentives for utilities to promote even more cost-effective energy savings. In 1996, the California legislature approved a nonbypassable system benefits surcharge to be collected on bills for investments in cost-effective energy efficiency, renewables, low-income services, and RD&D.[8]

A Lawrence Berkeley Laboratory (LBL) report, *The Theory and Practice of Decoupling*, provides details on the historic impacts of ERAM in California as it examines the first decade of ERAM results.[9] The report concludes that ERAM "has had a negligible effect on rate levels and has, for PG&E, actually reduced rate volatility." In addition, "...the clearing of ERAM balances has accounted for only a small proportion of the total change in revenue requirements between 1983-1993."[10] In its first six years in operation in California, ERAM reduced operating revenues for California's three largest utilities nine times and increased them eight times; the average adjustment was one-fourth of one percent.[11] The LBL report also estimates a decrease in the standard deviation of annual rate changes for two utilities (for PG&E, 9.5% to 7.5%; for SDG&E, 7.9% to 7.4%). Based on these estimates, they conclude that there has been no risk shifting at all for these two California utilities. "The record in California indicates that the risk-shifting accounted for by ERAM is small or non-existent and, in any case, ERAM has contributed far less to rate volatility than have other adjustments to rates, such as the fuel-adjustment clause."[12] On the contrary, ERAM has been accompanied by rate risk reductions to customers and profit risk reductions to utilities. The LBL report also concluded that decoupling did not insulate management from the need to focus on expenses and customers.

Electric industry restructuring in California led the CPUC to suspend the existing ERAM mechanism in 1996, but the CPUC did not officially abandon its policy of breaking the link between utility revenues and kWh sales. Restructuring legislation in California established a competitive transition charge (CTC) meant to recover the utilities' stranded investments over a limited period of time. Since the utilities were not allowed to raise rates under this legislation, CTC collections could only come from excess revenues. The CPUC suspended ERAM, in large part, because of the challenge that the statutory rate freeze posed, under the continuation of ERAM, to the utilities' ability to collect their stranded costs. In Decision No. 96-09-092, the CPUC found that "[w]e do not consider today whether it is desirable or appropriate to apply some form of ERAM solely to the distribution revenue requirement. The details of implementing a distribution ERAM may also be considered in the distribution PBR [performance-based ratemaking] proceedings."[13]

Now that the official restructuring transition period is nearing an end -- the CTC largely expires March 31, 2002 -- all of the major California utilities have either proposed, or are developing, proposals to institute a revenue-per-customer mechanism.

Oregon

As early as 1992, the Public Utilities Commission of Oregon (OPUC) was "persuaded that the connection between profits and sales should be severed."[14]

The OPUC approved Pacificorp's alternative form of regulation (AFOR) in May 1998.[15] The AFOR included a revenue cap for distribution revenues. Rate impacts from this mechanism have been minimal. The affect on total rates on average was -- 0.23%, less than 1%, and 0.78% for 1999, 2000, and 2001, respectively. For those working with Pacificorp, there has been a noticeable shift in its corporate commitment to energy efficiency since the AFOR was established. Energy efficiency activity has increased and budget levels have doubled from pre-AFOR levels.[16]

Portland General Electric (PGE) and NW Natural Gas both recently proposed decoupling mechanisms to the OPUC. In addition, Pacificorp indicated at an August 2, 2001 OPUC workshop on decoupling that they are committed to developing a revenue-per-customer mechanism to replace their recently expired AFOR. NW Natural Gas representatives at that same workshop

indicated that their customer service staff were "very aware" of the conflict in profit motive and were made "very uncomfortable" about providing energy efficiency advice that reduces revenues.

Washington

The Washington Utilities and Transportation Committee (WUTC) acted in April 1991 to sever the link between Puget Sound Energy (Puget) revenues and its kWh sales, thus making Puget's shareholders' interests consistent with the company's least-cost planning objectives. In Docket Nos. UE-901183-T and UE-901184-P, the WUTC adopted an experimental ratemaking mechanism for Puget that decoupled sales from revenues and established a "periodic rate adjustment mechanism" (PRAM). The two years following the institution of a decoupling mechanism in 1991 saw dramatic improvements in energy efficiency performance. In a September 21, 1993, Order (Eleventh Supplemental Order), the WUTC found that "PRAM has achieved its primary goal -- the removal of disincentives to conservation investment. Puget has developed a distinguished reputation because of its conservation programs and is now considered a national leader in this area."[17] This order extended PRAM for another three years.

One of the most telling indicators of the effects of decoupling, though the hardest to measure quantitatively, is the response from utility management. Management's ability to redirect scarce resources toward efficiency objectives depends on assurances that such efforts are consistent with shareholder interests. After all, in any market economy, a firm's performance will be affected by the incentives it receives. As the Testimony of Ralph Cavanagh in May 1993 details,[18]

Puget reported energy savings for 1991 -- 17.6 average MW -- that almost equaled the totals for the three previous years combined; 1992 yielded a further large increase, to almost 28 average MW, while the average cost of savings dropped.[19]

In 1991 alone, Puget's programs accounted for energy savings equivalent to 65% of those reported for the rest of the Pacific Northwest region.[20] Puget delivered more energy savings in that year than the Idaho Power Company, the Montana Power Company, Pacificorp, Portland General Electric, and Washington Water Power combined. In 1992, Puget did even better, and outperformed the entire BPA conservation program -- 27.9 aMW to 27.4 aMW -- although BPA's efficiency budget was more than twice that of Puget.[21]

While this transformation in performance was not entirely the result of decoupling, breaking the link between Puget's revenues and sales was a critical part of the change.

New York

Consolidated Edison in New York had an ERAM-type mechanism in place from 1992 to 1997. Rate impacts from this mechanism were minimal. In 1993, a $148.3 million shortfall (less than 3 percent effect on total rates) was collected from customers; for the next four years, over-collections totaling $155 million (less than 1 percent annual effect on total rates) were returned to customers. This period was also the pinnacle for Consolidated Edison energy efficiency investments, with average annual investments during this period of nearly $74 million. About 75 percent of total DSM investment in New York during this period can be attributed to Consolidated Edison. After 1997, and the elimination of the decoupling mechanism, the company's average annual energy saving investments dropped by nearly half.

Maine

There have been questions about the success of Central Maine Power's (CMP) decoupling mechanism in the early 1990s. A report by Eric Hirst in 1993 concluded that the prolonged Maine recession led to an overestimate of future load growth at the end of CMP's prior rate case.[22] Even

then, the accumulation of CMP's decoupling-related rate adjustments averaged less than 3 percent per year over the mechanism's first two and one-half years, despite the sharp and unexpected economic downturn in Maine.

Hirst explains that "[r]ather than reopen the rate case, the parties agreed to stick with the pre-recession forecast and let decoupling address the ensuing revenue shortfall."[23] In its order terminating the three-year decoupling experiment, the Maine PUC (1993) noted, "a relatively small portion of these [decoupling] accruals was due to DSM efforts. The vast majority was because the recession had reduced sales."[24] Hirst concluded, "when adverse weather and/or a poor economy occur, price changes can be important."[25] But he concludes that even when this happened in Maine, decoupling worked as intended. Establishing a cap on the annual price adjustments, and a balancing account for the deferred refund or collection can mitigate significant fluctuations in collections that might arise from unexpected events such as a recession.

Realizing the Promise of Distributed Resources

As stated earlier, distributed resources are quite often the most cost-effective, but overlooked, resource alternative available to meet customers' energy service needs. The universe of distributed resources includes distributed generation (e.g., internal combustion engines, combustion turbines, wind turbines, photovoltaics and fuel cells), storage technologies, and targeted energy efficiency and load management activities.

An analysis by Amory Lovins and Andre Lehman provides one of the most comprehensive looks at the benefits of distributed resources.[26] The list is still growing and the nature of these benefits is still being discovered. Some of the more significant potential benefits include: reduced or deferred transmission and distribution investments, improved system and customer power reliability, reduced distribution system energy losses as a consequence of proximity to load (which also allows a closer match with customer load), reduced system demand in areas experiencing increasing peak load growth; and insurance against uncertainties in load growth.[27]

Most customers that rely on distributed generation will continue to take advantage of grid services such as load balancing, peak power needs, and sales of excess generation. These benefits and those discussed above illustrate that the real potential for distributed resources lies in grid enhancement, not grid replacement. In addition, regardless of what happens with the generation side of the business, distribution infrastructure balancing, integrating, and planning will continue to be an important role for utilities. It is clear that sponsors of distributed resources must have regulated utilities as motivated partners (or at least not adversaries) for these technologies to reach their full potential.

All of these technologies, however, when placed on the customer side of the meter, reduce throughput. As we have seen, utilities do not have the incentive to promote these technologies under traditional rate design, and in fact may actively discourage their use. The success of distributed resources depends a great deal on removing the utilities' intolerance to reduced throughput.

Conclusion

Recent events make clear that we need planning and investment that incorporates consideration of all available resource options to meet energy service needs at total least cost. This will not happen until today's dominant regulatory practices are changed. Until then, utilities have no incentive to make the most economically and environmentally efficient resource decisions. The solution is a shift from the perverse incentives of today's rate cap mechanisms that tie utilities'

financial health directly to the volume of commodity sales, to a revenue cap mechanism that breaks this link.

Notes

1. See for example: S. Nadel, M. Reid, D. Wolcott, Editors, *Regulatory Incentives for Demand-Side Management,* American Council for an Energy-Efficient Economy, Washington D.C., 1992; J. Eto, S. Soft, T. Belton, *The Theory and Practice of Decoupling*, LBL-34555, Lawrence Berkeley Laboratory, January, 1994; E. Hirst, E. Blank and D. Moskovitz, *Alternative Ways to Decouple Electric utility Revenues from Sales*, Electricity Journal, July/August, 1994.

2. R. Cavanagh, Memo to Pacificorp, August 10, 2001.

3. Utilities have undertaken significant research and technological development that has provided the basis for aggressive standards. In addition, utility energy efficiency programs have often pioneered development and adoption of technologies that became the basis for more stringent standards. Utilities have also funded entities devoted to developing and promoting aggressive building and appliance standards.

4. California Public Utilities Code SEC. 9. Section 739 (3) and SEC. 10. Section 739.10 as amended by Assembly Bill X1 29 (Kehoe) [signed by Governor Davis on April 11, 2001].

5. See *Southern California Edison Company's (U 338-E) Expedited Petition for Modification of D. 96-09-092*, A. 93-12-029, May 4, 2001; *Emergency Application of Pacific Gas & Electric Company to Adopt a Rate Stabilization Plan (U 39 E)*, Chapter 6: Balancing Account Mechanisms and Revenue Requirements, October 3, 2001; and January 31, 2001 letter from San Diego Gas & Electric to the Natural Resources Defense Council stating SDG&E's intent to request a revenue-per-customer indexing mechanism in their 2003 PBR application.

6. See *In the Matter of Portland General Electric's Proposed Tariffs to Decouple Distribution Revenues from Residential and Small Nonresidential Consumers and the kWh Sales (UE 126)*; *In the Matter of the Application of Northwest Natural for Public Purpose Funding and Distribution Margin Normalization (UG 143)*; and oral comments of Bruce Hellebuyck of Pacificorp at the Oregon Public Utility Commission Special Public Meeting, August 2, 2001.

7. CPUC Decision No. 82-12-055.

8. Assembly Bill No. 1890, Chapter 854, Article 7, Section 381 [signed by Governor Wilson on September 23, 1996]. On September 20, 2000, Governor Davis signed Senate Bill 1194 and Assembly Bill 995, which extended the system benefits surcharge through 2011.

9. J. Eto, S. Stoft, and T. Beldon, *The Theory and Practice of Decoupling*, LBL-34555, Lawrence Berkeley Laboratory, 1993, at 46.

10. *Id.*, at 42.

11. R. Cavanagh, Comments of the Natural Resources Defense Council on the State of California's Experience with Regulatory "Decoupling" Options for Electric and Gas Utilities, Natural Resources Defense Council, June 1990.

12. *Supra*, note 9, at xvi.

13. California Public Utilities Commission Decision No. 96-09-092, at 21 September, 1996.

14. Public Utilities Commission of Oregon, Order No. 92-1673, Nov. 23, 1992.

15. Public Utilities Commission of Oregon, Order No. 98-191, May 5, 1998.

16. Scottish Power, *Environmental Report 2000/01*, at 27-28.

17. Washington Utilities and Transportation Commission, Eleventh Supplemental Order, September 21, 1993, at 10.

18. Direct testimony on behalf of Northwest Conservation Act Coalition, WUTC Docket No. UE-921262, May 1993, at 4.

19. Statement of Richard Sonstelie before the California Public Utilities Commission, Full Panel Hearing on Demand-Side Management Policy Issues, Feb. 25, 1993, transcript at 58.

20. Northwest Power Planning Council, The Green Book: Tracking Pacific Northwest Electric Utility Conservation Achievements 1978-1991, Feb. 17, 1993, at 7. In none of the previous three years did that percentage reach even 20%.

21. BPA data are from Bonneville Power Administration, Conservation Resource Energy Data, 1993, at 6.; Puget savings for 1992 are taken from Statement of Richard Sonstelie *supra* note 19, at 58.

22. E. Hirst, *Statistical Recoupling: A New Way to Break the Link Between Electric-Utility Sales and Revenues*, Oak Ridge National Laboratory, September 1993.

23. *Id.*, at 15.

24. Maine Public Utilities Commission 1993, Order Approving Stipulation, Docket Nos. 90-085-A, 90-085-B, and 92-346, Augusta, ME, February 5, at 15-16.

25. *Supra*, note 22.

26. A. Lovins, A. Lehman, *Small is Profitable: The Hidden Economic Benefits of Making Electrical Resources the Right Size*, September, 1999 DRAFT.

27. With the notable exception of renewables, super clean fuels cells, and energy efficiency it is impossible to say that distributed resources are necessarily better or worse for the environmental than the alternative. Many, but not all distributed resource technologies have substantially lower environmental impacts than the generation/transmission/distribution infrastructure that they will offset or replace. These technologies do indeed have the potential to reduce air pollution, but only if states and the federal government adopt the right policy packages. The potential for distributed generation to actually worsen environmental conditions is a real concern. One analysis presents a very instructive comparison of electric generation technologies. See N. Greene, R. Hammerschlag, *Small and Clean is Beautiful: Exploring the Emissions of Distributed Generation and Pollution Prevention Policies*, Electricity Journal, June 2000, at 50-60.

Attachment 2

Posted on: 12/08/2000

Measurement and Verification of Energy Savings

Satish Kumar

M&V provides the proof that an energy savings plan works

The field of measurement and verification (M&V) of energy savings has matured in the last decade; we have learned that there is a big difference between measuring the flow of energy and predicting the reduction in energy savings based on metered data. For this reason, any discussion of monitoring energy savings must address both objective and subjective issues raised in the evaluation of an energy conservation measure (ECM). The recently revised and updated International Performance Measurement and Verification Protocol (IPMVP) provides good information and a method for verifying energy savings.

M&V has two components-cost and precision. Cost includes metering and the analysis required to measure savings. Precision is an issue for the calculations or metered values. Technological advances have reduced the cost of metering building energy systems. However, the complex nature of the performance of some systems requires more than just metering. For instance, the energy use of lighting systems often depends on building occupancy, and heating, ventilating, and air-conditioning (HVAC) systems can be load dominant or weather dependent. These factors, coupled with the day-to-day variation in operation and maintenance of energy systems makes the determination of energy savings difficult.

The need for accurate and cost-effective measurement and verification of energy savings is even greater at a time when energy-efficiency retrofits are increasingly seen as a way to improve building performance by enhancing indoor environmental quality and to reduce greenhouse gas emissions. Lighting levels, setpoint temperatures, and humidity levels not only affect the comfort and productivity of building occupants but also heavily influence energy consumption. Any evaluation of ECMs must include close monitoring of building performance before and after their implementation. With global climate change becoming a major concern, there is significant interest in developing a fair, simple, accurate, and easily applied mechanism to accumulate emissions credits that can be traded at a date under the provisions of the Kyoto Protocols.

These factors and extensive feedback from the users of the IPMVP led to the publication of the revised and updated IPMVP. This document provides an overview of current best practice techniques available for verifying results of energy-efficiency, water-efficiency, and renewable-energy projects.

The IPMVP

The IPMVP has been widely used as the technical basis for determining energy savings in building retrofit projects. Since its introduction in 1994 as the North American Energy Measurement & Verification Protocol (NEMVP), IPMVP has become the industry standard. International use of NEMVP led to development of an international protocol in 1997. Many performance contracting projects now require the use of IPMVP methodology and options to measure and verify energy savings.

The IPMVP determines energy savings by comparing energy or demand before and after the implementation of energy conservation measure (ECM). Energy data are first normalized to ensure that savings are not over- or understated. The revised IPMVP uses the following equation as the basis for determining all types of energy savings (IPMVP 2000):

Energy Savings = Baseline Energy Use - Post-Retrofit Energy Use I Adjustments

Base year energy use is defined as energy consumption or demand during a period of any length before implementation of an ECM. The significance of the "adjustments" in the above equation is crucial. Uniform conditions must be clearly spelled out in the M&V plan, but a number of routine and non-routine adjustments can be made to the plan.

Routine adjustments are allowed for predictable changes in parameters that can be expected to happen throughout the post-retrofit period. These adjustments can be mathematically modeled to represent the relationship between the parameters and the energy use-demand. These changes are often seasonal or cyclical, such as weather or occupancy variations. The IPMVP defines four basic options for making routine adjustments.

Non-routine or baseline adjustments are for changes that cannot be predicted and which will have a significant impact on energy use or demand. These adjustments can be made in two ways. Either the base-year energy use under post-retrofit conditions can be restated, or an agreed fixed set of conditions can be applied. Non-routine adjustments should be based on known and agreed-upon changes to the facility. Disagreements can result if the full implications of the changes are not fully understood by the affected parties. Examples of non-routine adjustments include changes in occupancy schedules or changes in lighting levels and temperature set points.

The revised IPMVP emphasizes the development of a good M&V plan. The M&V plan, apart from helping a project stay within budget, ensures that all data needed for proper savings determination will be available and becomes the basis for resolving disputes between parties. Detailed guidance on developing a good M&V plan can be found in the revised IPMVP.

A good M&V plan starts with an analysis of the proposed ECM, but must also include a choice of one of the IPMVP options to be applied. Selecting an IPMVP option also helps to isolate the variables to be metered along with the duration and frequency of such measurements. These options include:

- Option a, or partially measured retrofit isolation, determines energy use or demand by isolating the energy use of equipment affected by an ECM from the energy use of the rest of the facility. Measurement equipment isolates all the relevant energy flows in the pre-retrofit and post-retrofit periods. Partial measurement means that some but not all parameters may be stipulated, if the total impact of possible stipulation errors is not significant to the resulting savings.
- Option b, or retrofit isolation, does not allow stipulations; full measurement is required. Short-term or continuous metering may be used. Continuous metering provides greater certainty in reported savings and more data about equipment operation. These data can be used to improve or optimize the operation of the equipment on a real-time basis, thereby improving the benefit of the retrofit itself.

  Option b can determine the savings created by most types of ECMs; however, the degree of difficulty and costs associated with verification increases proportionately as metering complexity increases. Option b methods will generally be more difficult and more costly than option a. Option b, however, may produce less uncertain results where load and savings patterns are variable. The additional costs may be justifiable if a contractor is responsible for all aspects of ECM effectiveness.

  For either option, measurement equipment must be used to isolate the energy use of the equipment or system affected by the ECM from the energy use of the rest of the facility. The isolation metering should reflect the boundary between the equipment or system that the ECM affects and the rest of the facility. The presence of any parasitic load can be

found by turning off the known equipment loads and ensuring that the meter reads zero. For example, a lighting load reduction often has a related impact on HVAC system energy use, but the boundary for measurement may be defined to encompass only the lighting electricity.

- Option c, or whole building method, is commonly used in cases where there is a high degree of interaction between installed ECMs or between ECMs and the rest of the building. Whole building metering is also used when the isolation and measurement of individual ECMs is difficult or too costly. Option c uses utility meters or whole building sub-meters to assess the energy performance of the whole building. The whole building approach measures the total effect if more than one ECM affects an energy meter. This option is intended for projects where savings are expected to be large enough to be discernible from the random or unexplained energy variations normally found at the level of the whole facility meter.
- Option d, or calibrated simulation, involves the use of computer simulation software to predict facility energy use for one or both of the energy use terms in Equation 1. Such simulation models must be "calibrated" so that they predict energy use and demand patterns that match utility-supplied consumption and demand data from the base year or a post-retrofit year. This approach is frequently applied in situations where multiple ECMs affect many systems in a building but where no base year data are available.

Metering Concepts

One of the primary challenges of developing an M&V plan is striking a balance between the precision of the estimated energy savings and the cost of metering the key parameters. This depends on the nature and characteristics of the ECMs in question.

Regardless of the metering technique employed, annualization is a common problem when energy savings are determined by extrapolating short-term data to an annual estimate (EPRI 1996). The drawbacks of this technique are evident when evaluating a weather-dependent load, such as some HVAC systems. Even in a lighting retrofit situation, the seasonal and diurnal impacts of daylight availability can influence the operating schedule of a lighting control that uses daylight availability to provide optimum light levels inside a building.

Agreed or Stipulations

The energy quantities in Equation 1 can be "measured" using a variety of techniques. The boundaries of the savings determination, the responsibilities of the parties involved in project implementation, and the significance of possible assumption errors will determine where assumptions can reasonably replace actual measurement. For example, in an ECM involving the installation of lighting equipment (with no change in the lighting schedule), savings can be determined by metering the lighting circuit power draw before and after retrofit while assuming the circuit operates for an agreed period of time.

End Use Metering

Special meters can isolate a retrofit or portion of a facility from the rest of the facility. Measurements may be periodic for short intervals or continuous throughout the post-retrofit period.

Power measurement devices such as the handheld wattmeter are used to spot-meter true power. Sometimes these meters can also display voltage, current, and power factor. This information can reduce the variance between estimated and actual equipment performance.

The value of power measurement readings is enhanced when coupled with run-time data gathered from run-time devices. When it is not practical to deploy enough loggers to monitor all the equipment, statistical sampling is recommended.

Utility KW and KWh Meters

Some utility meters accumulate energy use and record the peak demand. These meters are generally installed by utility technicians and may require power interruption.

Proxy Monitoring

Proxy monitoring techniques do not measure energy consumption directly. Instead, they use alternative metering devices to measure parameters that are then used to estimate another (usually more complicated) parameter (EPRI 1996). An example of a proxy measurement is to measure electric current (in amps) over time for a given voltage and power factor to estimate electrical energy.

Calibrated Computer Simulation

Computerized building energy simulation tools, such as DOE-2, are sometimes useful for estimating energy use when baseline data do not exist. This approach requires considerable skills on the part of the modeler to ensure that the assumptions are valid; the input data must be correct. Results from the modeled data must be calibrated or made to correspond with actual performance data for the system or facility being modeled.<

Summary

Determining energy savings, in most circumstances, is not a precise exercise. It always requires a tradeoff between accuracy and cost. The set of guidelines outlined in the IPMVP can help when developing a cost-effective strategy for determining energy savings for a variety of energy efficiency projects.

Satish Kumar is a scientist at the Lawrence Berkeley National Laboratory and the technical lead in developing and expanding the IPMVP.

http://www.energyusernews.com/CDA/Article_Information/Fundamentals_Item/0,2637,16252,00.html

Commonwealth Energy Policy Task Force

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Note: I would like to receive a copy of the draft report and energy plan for Kentucky when it becomes available please.

November 23, 2004

A. Professional Experience

By way of introduction let me summarize my professional experience, which has focused primarily on energy-related technologies, economics and policies. My degrees are a bachelors in Economics from the Massachusetts Institute of Technology, a masters in Mechanical Engineering from the University of Massachusetts at Amherst, and a masters in Agricultural Economics from the University of Kentucky. Before coming to Kentucky in 1982, I worked as a Staff Engineer at Technology + Economics, Inc., a research consulting firm in Cambridge, Massachusetts, where I analyzed the economic and energy savings resulting from energy-efficient technologies.

From 7/82 to 6/83 I was the Staff Engineer at the Kentucky Small Business Development Center, administered by UK in Lexington. I performed cost-benefit analyses of energy efficiency and renewable energy technologies, provided technical assistance to small businesses, and maintained and updated a manual with descriptions of energy-efficient technologies.

From 4/90 to 9/91 I worked for the Kentucky Division of Waste Management in the Department for Environmental Protection as an Environmental Engineering Technologist Senior. There I performed technical and administrative reviews of applications for hazardous waste facility permits.

From 9/91 to 11/94 I worked as an Environmentalist Principal at the Kentucky Division of Energy (KDOE). My major duty was to manage the Alternate Energy Development Program. I administered federal pass-through grants to demonstrate renewable energy technologies, developed fact sheets and other information for the public, edited a national monthly newsletter on energy efficiency programs in the 50 states, and wrote proposals for grant funding.

I was promoted to assistant director of KDOE in November 1994. In addition to administrative duties and continuing management of the Alternate Energy Development

Program, my work focused on energy policy issues, demand-side management, energy-efficient building systems, and alternative fuels for vehicles. (Demand-side management, or DSM, is defined as programs that a utility company implements to help its customers control or reduce their energy use and save money.) From 1994 to 2004 I was KDOE's representative on three DSM Collaboratives at the Louisville Gas and Electric Company (LG&E/KU), American Electric Power Company (AEP), and the Union Light, Heat and Power Company (Cinergy). As the lead person for the Division in addressing electric industry regulatory issues before the Public Service Commission, I developed and submitted testimony in ten integrated resource planning (IRP) cases, two rate cases, and several other PSC proceedings. I was heavily involved in the work of the previous energy policy task force established by Governor Paul Patton in May 2001.

B. How Not To Develop an Energy Plan

As I mentioned during my public testimony in Lexington on November 12, 2004, the previous planning effort was unable to come up with a final report or comprehensive plan for Kentucky. The reason was not a lack of intelligent, well-informed participants, but rather the way in which the work of the task force was organized and managed.

The person directing the planning effort, Annette duPont-Ewing, established certain "overarching principles" at the outset in a unilateral manner, and also imposed a committee structure on the participants that mirrored Kentucky's energy industries. Thus she established subcommittees for coal, oil/gas, nuclear, energy efficiency/renewables, and utilities. Each subcommittee went off to do its own research, hold its own discussions and draft its own committee report, and each pretty much ignored the "overarching principles" that had been imposed upon them without their input. The principles were not particularly cogent or compelling in any case. When each industry group had presented its work, it proved impossible to combine what were essentially five different energy strategies into a single coherent document. The task force was disbanded without producing a final report. The "draft" report that was released, consisting mainly of the five subcommittees' reports stapled together, was so execrably written that it was downplayed (probably out of embarrassment) and quickly forgotten.

Unfortunately, the present Energy Policy Task Force seems to be in danger of repeating some of the same conceptual and procedural mistakes that doomed the previous effort. It is not yet possible to judge whether the present task force will adopt the industry-specific outline favored by the previous effort, but I would urge the people involved in the drafting to try to avoid that conceptual pitfall. The press release dated 11/5/04 from Governor Fletcher's office indicates that three "central principles" have already been established in a top-down manner:

- Maintain Kentucky's low-cost energy
- Responsibly develop Kentucky's energy resources
- Preserve Kentucky's commitment to environmental quality

I will discuss these principles in more detail in Section D below, but at this point it suffices to observe that they were imposed from above without input from the public or from participating groups. Unfortunately, the task force's announced process does not provide for an opportunity to rewrite or amend these central principles.

C. A Better Way to Develop a Comprehensive Energy Plan

Early in 2002, the Consensus Building Institute (CBI) and the Rocky Mountain Institute (RMI) published a report on a National Energy Policy Initiative (NEPI) that they had facilitated during the previous year. This foundation-supported effort involved a wide range of experts in developing "a set of principles, objectives, and policy proposals" to guide the nation's energy future (From NEPI, Appendix B, the National Energy Issues Assessment, page B1). The initiative was carried out in four stages. The first stage was "an assessment of the views and interests of a wide range of energy leaders on energy policy goals, specific policies, and pending legislation," which was carried out through a series of structured telephone interviews with 75 energy experts and leaders. Out of these interviews the CBI staff produced a briefing document on key goals, policies, and ideas about implementation. The second stage was an "expert workshop" that used the briefing document to develop a set of guiding principles, objectives and specific policy proposals. The two remaining stages involved dissemination of the reports to the U.S. Congress and the public. (Ibid., page B2)

A brief summary of the results of the expert workshop was provided in a news report by the *Glenwood (Colorado) Post Independent* on March 15, 2002 (web site: http://www.nepinitiative.org/gpi15iii02.html). Speaking at the Dirksen Senate Office Building in Washington, DC, Amory Lovins, chief of research for RMI, explained the purpose and importance of NEPI. "The National Energy Policy Initiative reached a challenging conclusion," he said. "The United States' current energy policy has inadvertently created serious threats to the nation's security, prosperity and environment. Yet the initiative also found that a well-integrated set of proven policy innovations can improve security, the economy and the environment simultaneously and without compromise."

According to the NEPI's vision statement, "The United States, and the world, must begin a decades-long transition to an energy system that will not run out, cannot be cut off, supports a vibrant economy and safeguards our health and environment." On the subject of transportation and mobility, the NEPI report warned against continued dependence on foreign oil, while it recommends greater fuel efficiency and the development of new fuel sources and systems. The future of electricity must concentrate less on central generation, costly grids, poorly regulated monopolies and meager environmental regulation and focus more on distributed generation, recycled energy, and combined heat and power generation, the report said. While energy security has always been important, the issue has become especially critical since Sept. 11, 2001. The report points out that the country's heavy dependence on foreign oil and vulnerable energy infrastructure need to be changed.

The issue of global warming is also addressed in the report. The need to reduce the emission of greenhouse gases is crucial, as these gases increase the risk of major climatic change. "Climate change could impose direct economic costs on the United States and could also create global economic and political instability," the report said. "Starting immediately, energy policies need to send clear signals to producers and consumers to reduce carbon emissions." The transition "could be a net benefit to the economy because investments in fuel efficiency and new non-fossil fuel technologies can be profitable," the report stated.

I am not recommending that the Commonwealth Energy Policy Task Force adopt the entire conceptual framework and set of conclusions of the National Energy Policy Initiative and adapt them uncritically to Kentucky. However, both the NEPI process and the information it generated deserve careful consideration by policy-makers here. Some of the national issues, e.g. the vulnerability and instability of the electric transmission and distribution system, carry over to the state level rather precisely. It would be accurate to say that Kentucky's past and current energy policies have inadvertently created serious threats to the Commonwealth's security, prosperity and environment. Many (but not all) of the NEPI recommendations can usefully be carried over to Kentucky.

Members of the present Task Force should become as familiar as possible with the NEPI process and outcomes. It may be worthwhile to bring a member of the Rocky Mountain Institute or the Consensus Building Institute to make a presentation to Task Force members, staff and general public on the NEPI experience.

D. The Conceptual Foundation of the Present Energy Policy Effort Is Unsound

As mentioned above, three "central principles" have been established by Governor Fletcher's office to guide the work of the Commonwealth Energy Policy Task Force:

- Maintain Kentucky's low-cost energy
- Responsibly develop Kentucky's energy resources
- Preserve Kentucky's commitment to environmental quality

The first principle lacks any meaningful content. Kentucky's low-price coal resources are primarily the result of an accident of geography coupled with the normal functioning of a reasonably competitive marketplace for primary fuels. If the thickness of available coal seams continues to decline, as indicated by historical trends and assessments published by the Kentucky Geological Survey, the cost of mining Kentucky coal will increase. If the most easily-mined coal runs out soon, the cost to mine it will increase dramatically in the near future, whereas if the coal industry develops technologies that allow thinner seams to be mined cost-effectively by robots, the cost increase may be postponed for a few years. In either case, market conditions and mining technology will largely determine whether Kentucky's low-cost energy will be maintained or not. This

"principle" is nothing more than a statement to the effect that as long as there is coal to be mined cheaply, Kentucky will continue to mine it as fast as we can. It is not a meaningful contribution to a forward-looking energy strategy worthy of the name.

Moreover, as Patty Draus testified during the 11/12/04 hearing in Lexington, when external health and environmental costs are properly factored into the equation, coal is not actually very cheap. Full-cost accounting would quickly reveal that the Commonwealth pays a high price indeed for its "cheap" energy supplies. The first central principle should be deleted because it is based on the misleading assumption that Kentucky has low-cost energy now, and because it provides no useful guidance for a flexible, robust long-term energy strategy.

The second principle, to "responsibly develop Kentucky's energy resources," likewise has little if any real meaning. It focuses on the energy industry itself rather than the benefits that a well-functioning energy system can deliver to people and the economy. The task force should instead be asking, "What are the proper purposes and functions of an energy system, and what characteristics should it have?" That is the question the NEPI participants started with, and the results were illuminating. Upon investigation, Kentucky may well find that the most beneficial, cost-effective, and sustainable strategy for the public as a whole, including the industrial sector, would be to dramatically improve the efficiency with which we use energy. It would then become clear that the goal of "developing Kentucky's energy resources" is largely beside the point. The second central principle should be deleted because it focuses our attention on the wrong issues.

The third central principle, to "preserve Kentucky's commitment to environmental quality," has some value but could be substantially improved by rephrasing it. Several witnesses spoke during the public hearings about the need to internalize the environmental costs, as well as other external costs, that our energy and utility industries are presently avoiding by dumping them onto the general public. This principle should be replaced by one modeled after the NEPI Issues Assessment document, page B5, as follows: **Laws and regulations governing the production and use of energy in Kentucky should be structured to achieve environmental goals at the lowest economic cost, preferably by ensuring that full environmental costs are internalized in market prices.**

If the task force insists on basing its analysis and recommended strategy on the original central principles set forth in the Governor's press release of 11/5/04, it should at least remain aware of and try to avoid the conceptual pitfalls described above. If not, the energy strategy runs the risk of unimaginatively endorsing business-as-usual and making itself virtually useless in planning for the Commonwealth's dynamic energy future.

E. Review of Some of the Comments Made During the Public Hearing in Lexington

1. Mark Goss, Chair of the Public Service Commission (PSC)

Mr. Goss focused on the low electric rates Kentucky has, and by way of explanation cited our available coal reserves and predictable utility regulation. I would grant that the regulatory policies pursued by the PSC over the past 20 years have had some positive elements, but there have been major shortcomings as well, as I will discuss in subsequent sections.

2. Roy Palk, President and CEO, East Kentucky Power Cooperative

Mr. Palk focused on one of the newer technologies for burning coal more efficiently in central power plants, the circulating fluidized bed technology. He urged the task force to consider encouraging clean coal technology, both research and deployment. It was not clear from his oral statement whether he was proposing that public funds be allocated by the General Assembly to subsidize coal R&D and power plant construction.

3. Greg Ficke, Cinergy Corp. and Union Light, Heat & Power

Mr. Ficke clearly requested public subsidies for clean coal technology. He referred approvingly to a neighboring state (Ohio or Indiana) that recently mandated that utilities using clean coal power plant technologies receive an extra 3 percent return on investment and also recover costs for construction work in progress.

4. Bill Caylor, President, Kentucky Coal Association

In a similar vein, Mr. Caylor approached the task force with both hands outstretched. He asked for public funds to subsidize the training of coal miners, to open new coal mines, solve the coal waste slurry problem, promote the coal industry in the same way that Kentucky promotes tourism, burn more Kentucky coal, and pay utility companies to invest in transmission facilities to enable expanded exports of electricity (also known as "coal-by-wire"). He had a helpful suggestion of where some of this government money might come from: the "windfall" coal severance taxes, which he estimated to be $20 million. Not content with pleading for more corporate welfare, Mr. Caylor also proposed that the permitting of energy facilities be "streamlined" and that localities be stripped of any role in siting new facilities within their jurisdictions because they just slow the process down unnecessarily.

5. William Barr, Kentucky Oil and Gas Association

Mr. Barr cited predictions that the demand for natural gas in North America would increase significantly in coming years.

6. Joe Kelly, Columbia Gas

Mr. Kelly described how the gas industry is regulated in Kentucky.

7. George Siemens and Paul Thompson, LG&E

Mr. Siemens reiterated that "Kentucky can't walk away from coal." He urged the task force to recommend that Kentucky subsidize clean coal technologies.

8. Dr. Wendy Baldwin, Executive Vice President for Research, University of Kentucky

Dr. Baldwin described some of the advanced energy-related research being done at UK. She noted the potential for Kentucky to increase the amount of federal R&D funding that comes into the state.

9. Dr. Nancy Martin, University of Louisville

Dr. Martin made some extremely significant points in the course of her presentation, and they bear emphasizing here. She stated that UofL views energy efficiency as the "most promising" way to meet future gaps between supply and demand. She also reported that the Kentucky Pollution Prevention Center (KPPC) "always identifies savings" when its staff people do their free assessments of energy-using technologies for small and medium-sized industrial plants. This is noteworthy because it indicates that there are large potential energy efficiency improvements still to be harvested in the industrial sector. The KPPC staff consist mostly of retired engineers and engineering student interns. They are not likely to have specialized knowledge about the specific industrial processes that are being used in each particular type of industry that they visit. If these non-specialists are able to find cost-effective opportunities for energy savings in virtually every industrial plant they visit, it could be projected that experts with industry-specific skills and experience would find even more substantial savings.

While some larger corporations may employ their own engineers to identify some energy savings and implement certain efficiency improvements, it has been my experience that the vast majority of firms leave many opportunities untapped. The usual reason is a shortage of trained staff to identify, assess and implement improvements, but in most firms there are other bureaucratic-type barriers as well.

Amory Lovins and the Rocky Mountain Institute have documented numerous cases in which the redesign of industrial systems yields amazing energy savings as well as improved product quality. One such example is cited in the book, *Natural Capitalism*. A major use of electricity in industry is to operate pumps for moving liquids around. A carpet company, Interface, was planning to build a new factory. One of the factory's processes required 14 pumps. A leading firm specializing in factory design sized the pumps to total 95 horsepower. An Interface engineer, Jan Schilham, however, took a fresh look and was able to come up with a design that was not only more efficient but cost *less* to build. The first change used larger pipes and smaller pumps, greatly reducing frictional losses. Second, Schilham laid out the pipes first and then the equipment, in the reverse order from standard practice, enabling him to use shorter and straighter pipe runs. The combination of these two approaches allowed for a system with only 7 horsepower of pumping capacity – a 92% decrease. The lower capital cost of the smaller pumps,

motors, inverters, and associated electrical system more than compensated for the additional cost of larger diameter pipes. The payback period for the higher-efficiency system was instantaneous and its return on investment was infinite because it had a lower up-front investment cost than the inefficient design. However, "optimization" techniques in use throughout the industrial sector routinely ignore systemic effects such as these, focusing only on single-component or partial-system optimization. (*Natural Capitalism,* pp. 116-117)

10. Dr. Lindell Ormsby, Chair, Environmental Quality Commission

Dr. Ormsby spoke about the need to balance economic development with protection of the environment, including policies to slow down global warming.

11. Dennis Howard, Attorney General's Office

Mr. Howard stated that the goal of the Attorney General's activities in the energy and utility sectors is to keep the rates as low as possible. Many people and institutions in Kentucky share this goal. In fact, it is something of a cliché. Unfortunately, however, like many clichés it is somewhat misdirected. If energy users are rational economic actors, they will be less concerned about their utility rates than their total utility *bills*. The bill, after all, is what the customer has to pay every month, not the rate. If an energy consumer's electric rate were to increase by 2%, but the amount of energy they needed to use decreased by 20% (as a result of effective new energy efficiency programs), the customer would clearly be better off. If enough customers were to participate in such programs, society as a whole would be better off. Mr. Howard and the Attorney General's Office would do well to become aware of this arithmetic and keep it in mind as they develop their energy-related policies.

12. John Davies, Director, Kentucky Division of Energy

Mr. Davies proposed that the Governor implement a Utility Savings Initiative to improve the efficiency of State Government, and asked that Kentucky leaders support a proposed Rural Energy Consortium that could accomplish several beneficial tasks in the Commonwealth's rural areas.

13. David Ledford, Rocky Mountain Elk Foundation

Mr. Ledford suggested that with better management of previously-mined land, elk could become a tourist attraction that would benefit Kentucky's economy.

14. Dr. Jim Cobb, State Geologist, Kentucky Geological Survey

Dr. Cobb described some of the research being done to identify underground formations where carbon dioxide from power plants might be sequestered so as to reduce utilities' contribution to global warming.

15. Geoffrey Young, Sierra Club member

The purpose of my remarks was to raise some relevant issues I did not expect other witnesses to address. I described the failure of the Energy Policy Task Force that had been launched during former Governor Patton's administration. I brought up the world oil situation and referred to Hubbert's Peak, the point in history when oil extraction reaches its maximum rate. Hubbert's Peak and the end of cheap oil are either here or will arrive very soon. The Bush administration has made a military lunge to try to seize control of the second largest oil reserves in the world in Iraq, and most other countries in the world strongly disapprove. Every country's economy runs on oil, and few other countries are comfortable with the idea that a violent, aggressive and unpredictable superpower should have military control over the flow of most of the world's oil. Furthermore, Bush has pulled the U.S. out of the Kyoto process to reduce global warming, an environmental issue about which the world is deeply concerned. Even simple, cost-effective actions to improve our transportation efficiency, such as improving nationwide fuel economy standards, have been taken off the table – an example of very short-sighted thinking.

Although no other country or group of countries can challenge the destructive power of America's high-tech military hardware, they do possess powerful economic levers. If at some future time the countries of the world were to get together and decide they have had enough of our government's efforts to dominate the critical substance underpinning the global economy by force of arms, or have had enough of our government's refusal to limit our massive global warming emissions, there are economic actions they could take that would devastate the U.S. economy for many years to come. The most obvious action would be for them to dump their holdings of U.S. Treasury notes, which would lead to the collapse of the dollar and its abandonment as the international reserve currency. Imports, including imported oil, would become completely unaffordable here. A few well-targeted acts of sabotage could then cut off the bulk of oil shipments into the U.S., which in turn would cripple our transportation sector and much of the rest of our economy. Alternatively, the collapse of the dollar could occur as a result of chronic federal deficits and the resulting forces in the international currency market, without the connivance of foreign governments. These governments would then be in a position to tell the U.S. that they would provide economic assistance, but only if the U.S. were to agree to improve our energy efficiency and place severe limits on coal mining and combustion (i.e., they could exert a form of economic blackmail). There is a real possibility of either hyperinflation or another Great Depression in the U.S., or both simultaneously.

Even if the worst-case scenarios described above are somehow avoided, the end of cheap oil will affect Kentucky by bringing to bear intense economic pressure to mine our coal as rapidly as possible to convert it into liquid transportation fuel, regardless of the environmental consequences. At the same time, there will be intense and growing political pressure on the U.S. from the world's other countries to limit the mining and combustion of fossil fuels, especially coal. Regardless of what any of us might wish, Kentucky's coal industry is likely to become the target of tremendous political,

environmental and economic pressures that are in opposition to each other. Kentucky's freedom of action to set its own state-level policies will be severely limited by urgent national and international priorities. The final outcomes cannot be predicted with any certainty at all.

Large-scale considerations such as these make it clear that policy-makers should analyze a wide range of different scenarios about possible future events and how they could affect Kentucky's energy-producing and -consuming sector. A plan that is based only on a single view of how historical trends are likely to play out will probably become obsolete quickly. At the very least, a robust energy strategy needs to provide the Commonwealth with greater flexibility than our historical pattern of near-total dependence on a single, nonrenewable fuel that is becoming ever more costly to extract from the ground.

I concluded my comments on 11/12/04 by emphasizing that environmental externalities need to be fully accounted for and factored into decisions about which fuels and technologies to use.

16. Andy McDonald, Kentucky Solar Partnership

Mr. McDonald urged the task force to make energy efficiency and renewable energy the foundation of Kentucky's energy policy. He noted that improved energy efficiency has been adding more resources to our energy mix than any other source. When Kentucky businesses operate less efficiently than they could, our economic competitiveness suffers. Fossil fuels should be used as transitional fuels to a long-term, sustainable future based on renewable energy sources.

Mr. McDonald's specific recommendations included the following:

- Attract and foster renewable energy (RE) companies to enable Kentucky to become a leader in RE technologies.
- Institute a Renewable Portfolio Standard that would require 20% of our electricity to be generated by RE by the year 2020.
- Establish a Public Benefits Fund to help individuals and companies improve energy efficiency and install RE technologies.
- Expand the newly-passed net metering requirement to other RE technologies in addition to solar electricity.
- Make judicious use of tax credits to encourage energy efficiency and RE.

He concluded by noting that small-scale generation sources distributed throughout the electric grid can improve the system's stability and help prevent blackouts.

17. Tom Fitzgerald, Director, Kentucky Resources Council

Mr. Fitzgerald introduced himself by saying he has spent the past 24 years providing legal representation for people who live downhill, downwind, and downstream of our industries that extract and consume energy. One of his former clients was killed when a coal waste impoundment failed. Mr. Fitzgerald emphasized that improving energy

efficiency is the Commonwealth's most promising strategy and referred to the "Five-Lab Study" on the potential of energy efficiency published a few years ago by the U.S. Department of Energy's national laboratories.

Mr. Fitzgerald recommended that Kentucky strive to become a center for companies developing energy-efficient technologies. He also cautioned against electric utility retail deregulation and the Commonwealth's policy of outlawing environmental regulations that are more stringent than federal ones. He indicated he would submit written comments.

18. Lloyd Cress, Commissioner, Department for Environmental Protection

Mr. Cress described how certain existing laws and regulations affect Kentucky's extractive energy industries.

19. Kip Bowmar, Director, Kentucky Association for Community Action

Mr. Bowmar described how the federal Low-Income Home Energy Assistance Program (LIHEAP) is implemented in Kentucky and urged the task force to ask the Kentucky Congressional delegation to support LIHEAP funding. He also asked for state funds to help low-income customers pay their utility bills.

20. Jeff Boyle, Northern Kentucky Chamber of Commerce

Mr. Boyle made a number of energy-related statements that were unsupported by evidence and can be described as fanciful.

21. Carl Breeding, attorney representing Associated Industries of Kentucky

Mr. Breeding proposed state economic incentives for the complete range of energy technologies, including RE and improved efficiency.

22. Dr. Mark Klan, Greater Louisville Inc.

Dr. Klan discussed the complex and burdensome regulatory framework that has been imposed on industry by the Louisville/ Jefferson County Air Pollution Control District.

23. Katie Yunker, Midwest Independent System Operator (MISO)

Ms. Yunker described the role of MISO in the management of interstate electricity transmission systems.

24. Dave Cooper, member of Sierra Club and Kentuckians for the Commonwealth

Mr. Cooper condemned the practice of blowing up mountaintops and shoving vast quantities of rock into streambeds to get at the coal underneath. He referred to reports

that document the damage to health resulting from the fine particulates and mercury emitted by coal-burning power plants. He recommended improved energy efficiency and RE to reduce and eventually eliminate the need to mine and burn coal.

25. Pete Rutledge, Kentucky Chamber of Commerce

Mr. Rutledge advised the task force to encourage the growth of all aspects of Kentucky's energy industry, including clean coal and ethanol. He did not provide reasons for this recommendation. He also recommended that the regulatory process be "streamlined."

26. Dr. Larry Turner, Director, UK Extension Service

Dr. Turner talked about UK Extension's energy-related activities, including an energy efficiency exhibit used at the State Fair and other venues, his office's successful working relationship with the Kentucky Division of Energy, and the proposed Rural Energy Consortium.

27. David Beck, Kentucky Farm Bureau

Mr. Beck described the Farm Bureau's 90-year history and its 30-year involvement with energy issues.

28. Jack Rivel, consultant on energy-efficient construction

Mr. Rivel criticized the Bush administration's tax credit for large SUVs. He recommended that Kentucky's energy-related building codes be made stronger and enforced more uniformly across the Commonwealth.

29. Patty Draus, Sierra Club member

Ms. Draus, who works as a nurse, focused on the health damage caused by particulates emitted by vehicles and power plants. She concluded that "our energy is not really that cheap" when the costs of health and environmental damage are taken into account. She recommended that new power plants be required to use the most effective available pollution control technologies, including coal gasification, and that the old, more polluting coal plants be phased out. Ms. Draus noted that Kentucky ranks poorly in energy efficiency, but that increased investments in efficiency and RE could generate sustainable employment and economic growth.

30. Don Pratt, Lexington resident

Mr. Pratt observed that if Kentucky continues to increase its energy extraction and consumption, we will destroy the water, soil, air and natural beauty that make our Commonwealth unique. He stated that "Love without power is weak, but power without love is abuse," and that we have been abusing the Earth.

F. Major Policy Recommendations

1. Kentucky needs to recognize the vast potential gains that can be made by improving the energy efficiency of all sectors of our economy.

The Environmental Energy Technologies Division of the Lawrence Berkeley National Laboratory estimates that "If only tune-ups and performance monitoring of existing buildings were performed, average energy use could be reduced by about 20%. If proven efficiency measures were applied when a building is retrofitted (usually about every 15 years), about 50% reduction could be attained. The full range of efficiency measures that can be designed and incorporated into new buildings could bring about an energy reduction of as much as 75%." (Lawrence Berkeley National Laboratory, "Creating High-Performance Commercial Buildings," *EETD News*, Fall 1999, pp. 1-2.) Other estimates (for example, by E Source) are even higher. A long list of market barriers currently prevents Kentuckians from harvesting these cost-effective savings opportunities. A comprehensive set of carefully designed programs and policies, however, can remove the market barriers and lead to dramatic improvements in energy efficiency statewide.

Savings of a similar magnitude are obtainable in the residential sector as well. The U.S. Department of Energy's *Building America* program is applying whole-building design principles to new home construction and is thereby reducing energy use by approximately 50%, at little or no additional cost to production builders in a range of climate zones. http://www.eere.energy.gov/buildings/building_america/

The Rocky Mountain Institute describes a case study of what can be done in the residential sector by a utility company that is seriously interested in exploring the potential energy savings resulting from whole-system design. The Pacific Gas and Electric Company, as part of its Advanced Customer Technology Test (ACT2) program, hired the Davis Energy Group to improve an initial design for a house that already met California's strict Title 24 energy code, which is supposed to include all efficiency measures that are worth buying from a societal perspective. The first step was to eliminate unnecessary corners that had added 23 feet (11%) of length to the outside walls. The designers then put the windows in the right places, used window frames that would transmit less heat, and invented an engineered wall that saved about 74% of the wood, reduced construction costs, and nearly doubled the insulation. A number of small improvements to the building envelope, windows, lights, major appliances, and hot-water system raised the total energy saving to 60% and increased the cost by nearly $1,900. At the same time, however, the thicker insulation and better windows eliminated any need for the $2,050 furnace and its associated ducts and equipment. Instead, on the coldest nights, a small amount of hot water from the 94%-efficient gas-fired water heater could be run through a radiant coil cast into the floor-slab. Finally, the designers eliminated the air conditioner by adding several more efficiency measures that had not previously appeared to have been cost-effective based on a conventional (measure-by-measure) analysis. The report concludes as follows:

> "Factoring out small electrical appliances (one-third of initial electricity usage), which offered many savings opportunities but would be brought along by the buyer rather than installed by the builder, the resulting final design would save about 80% of total energy or 79% for electricity alone: 78% for space heating, 79% for water heating, 80% for refrigeration, 66% for lighting, 100% for space cooling, and 92% for space cooling plus ventilation. If such construction techniques became generally practiced – so-called "mature-market cost" – then those savings would make the house, in a mature market, cost about $1,800 less to build and $1,600 less to maintain.
>
> "The measured savings, adjusted for some last-minute design changes requested by the homebuyer, agreed well with these predictions. The house proved very comfortable even in a severe hot spell. Since by law the Title 24 code is supposed to include all cost-effective measures, the Davis house may mean that this influential state standard has to be rewritten from scratch." (Rocky Mountain Institute, "Designing For Zero Cooling Equipment in a Hot Climate," 1999, www.naturalcapitalism.org/sitepages/pid27.asp)

Using the California design as an example, it should be straightforward to develop marketable house designs for Kentucky that replace the central furnace by a water-heater based system – home builder Perry Bigelow has done so in the Chicago area – and downsize or eliminate the conventional air conditioning system.

Similar examples can be cited in the industrial sector. A case study describing Interface's redesign of a pumping system inside a carpet factory was summarized in section E.9 above.

These examples illustrate an important point about whole-system design: It is frequently more cost-effective to save large amounts of energy than small amounts. It can make sense from a whole-system perspective to make certain components more efficient than a component-by-component "optimization" approach would suggest. This surprising phenomenon, called "tunneling through the cost barrier," results from capital cost reductions (e.g., smaller or no HVAC systems, smaller pumps) that can be added to the energy savings. "Optimizing components in isolation tends to pessimize the whole system." (Hawken et al., *Natural Capitalism*, page 117)

In conclusion, existing market barriers to efficient design in all sectors of the economy – residential, commercial, and industrial – are significant and long-standing. They can, however, be addressed and overcome through well-focused programs that involve a range of participants, including utility companies.

2. Kentucky should eliminate all corporate welfare payments and tax loopholes for mature industries that are capable of performing their own research and development.

In particular, the coal industry should be mature enough to finance the development and installation of new technologies on its own. No public funds should be diverted to subsidize "clean coal" technologies or coal-fired power plant construction. All existing financial incentives for coal and other fossil fuels need to be eliminated from Kentucky's tax code. The gas industry has organized itself to fund the Gas Research Institute, the utility industry funds the Electric Power Research Institute, yet the coal industry would rather come begging to the General Assembly for public assistance than finance its own R&D and capital construction activities, which it is financially capable of doing.

The economic effect of subsidizing the coal industry is clear and unambiguous. Because Kentucky is constitutionally forbidden to run budget deficits and pass the costs of operating the state government on to future generations, doling out public funds to one particular industry entails taking more tax money from other industries or from our households. Any "economic multiplier effect" asserted by coal industry lobbyists is approximately offset by the negative economic multiplier effect resulting from having the same amount of disposable income extracted from other sectors of Kentucky's economy.

The lobbyists will complain loudly that other states are subsidizing their coal industries and that if we do not imitate them we will place Kentucky coal at a competitive disadvantage. That argument should be dismissed as irrelevant. The fact that other states enact policies that misallocate scarce resources, increase economic inefficiency and damage their overall economies is no reason for Kentucky to do the same. While the rate at which Kentucky's nonrenewable coal reserves are being extracted may decline slightly relative to nearby states that have enacted coal industry welfare programs, Kentucky's overall economy will improve faster than those of our short-sighted neighbors, and our coal reserves will last longer than otherwise.

3. In order for all energy options to be able to compete in the marketplace on an equal basis, Kentucky must enact policies that internalize the environmental costs that the mining, processing, and burning of fossil fuels impose on Kentucky's environment and citizens.

The most economically efficient mechanism would be to impose a pollution tax that is proportional to the environmental damage done by coal mining and processing, plus an additional tax on the emissions if the coal is burned in Kentucky. I previously forwarded some references to the task force staff describing how other states have estimated the value of environmental externalities for planning purposes. Pollution taxes are a simple and straightforward market solution that would make it unnecessary to modify Kentucky's integrated resource planning (IRP) process to account for externalities. The after-tax market price of coal would reflect its true cost to society, and coal would finally be competing against energy efficiency and renewable energy on an equal basis.

A pollution tax of the proper magnitude would make the mining technique known as mountaintop removal uneconomical in Kentucky.

Another advantage of pollution taxes is that they could correct a serious flaw in the Clean Air Act (CAA), which established different emissions limits for new and existing power plants. If the tax is made proportional to the amounts and types of pollution that each plant emits in the end, old plants that had been "grandfathered in" at the less stringent emissions level by the CAA will finally start paying their fair share of the external costs they impose on society. This, in turn, would create economic pressure on utility companies to retire these ancient plants sooner and replace them with energy efficiency programs and/or cleaner new generating technologies.

Pollution tax receipts could also become a major source of revenue to fund the state government. Kentucky should follow the example of some Western European countries that have begun a gradual process of shifting taxes away from wages and employment – things they want to encourage – onto pollution and waste, which they want to discourage.

If the idea of pollution taxes is not adopted by this task force, a partial, second-best solution would be to develop environmental cost adjustment factors to be applied to polluting fuels during the IRP process. This would level the playing field somewhat during the process of planning for new investments by utilities.

4. Kentucky's Integrated Resource Plans must be made binding.

The IRP process in this state is virtually unique in that the 15-year resource plans developed by the jurisdictional electric utilities and updated every three years are not binding or approved by the PSC. To my knowledge, no other state that still requires IRPs makes them purely advisory as Kentucky does. The staff of the Kentucky PSC – not the Commissioners – review each utility's plan every three years and write a report that includes recommendations. The utility may observe these recommendations when it updates its plan three years later or it may utterly disregard them without consequences. The PSC has never seen fit to rule that an IRP fails to meet the minimum requirements of 807 KAR 5:058, Kentucky's IRP regulation, even when that is obviously the case. (See, for example, Case No. 2002-00377, The 2002 Integrated Resource Planning Report of Kentucky Power Company d/b/a American Electric Power to the Kentucky Public Service Commission.)

As a result, the IRP process has become a mere exercise in paper shuffling. If Kentucky is serious about planning for its energy future, 807 KAR 5:058 must be amended or superseded by legislation to require the PSC to officially approve, reject or modify the jurisdictional utilities' IRPs. In addition, any new power plant proposed for construction by an electric utility should be consistent with its current IRP or risk the proposal's disapproval by the Commission.

5. The utility's least-cost plan should also be its most profitable plan.

The next critical issue that needs to be addressed has to do with the economic incentives that the PSC has set up for the for-profit utility companies which serve most of Kentucky's population. Under the present regulatory framework, the more electricity a utility sells, the more revenue and profit it makes. That means the utility has an extremely strong economic incentive to try to sell more electricity at all times. I have found out by working with investor-owned utilities over the years that their management and staff people are very strongly motivated by short-term profits. The problem with this is that they therefore have a very powerful incentive to oppose efforts to help their customers use energy more efficiently. They may implement a small-scale, token DSM program or a net metering pilot program here or there for reasons of public relations, but if there is a chance that a new DSM program could save large amounts of energy, they will oppose it. A recent example of the way utilities operate in Kentucky was the many amendments that utility industry lobbyists insisted upon adding to an originally strong net metering bill introduced by Representative Lonnie Napier. For reasons of convenience and short-term profit, they weakened the bill by adding very low limits both on the size of individual net metered systems and on the total capacity of distributed generation systems within their service territories. They also vetoed net metering for any advanced technologies other than solar electricity.

There is a Federal law that addresses the issue of utility incentives. The relevant law, 16 USC Section 2621, as amended by the Energy Policy Act of 1992, states that public service commissions should set rates so that investments in demand-side management (DSM) are at least as profitable as investments in new power plants. The PSC held some hearings from 1992 through 1994 in Administrative Case No. 341, which led to some halfway measures such as the enactment of Kentucky's DSM statute, KRS 278.285, but Kentucky has still not solved this critical problem. Investments in power plants are still much more profitable to utilities in Kentucky than investments in improved energy efficiency, even when the latter yield lower total costs for customers and society as a whole.

Fortunately, there is a relatively painless way to solve this problem of incentives. It is called "decoupling," and it allows the price of electricity to vary slightly to compensate for changes in the amount that is sold. So, for example, if a utility company launched an advertising campaign to get people to buy more electricity, the decoupling formula would decrease the price of each kilowatt-hour slightly, and the company's profit would remain unchanged. If, on the other hand, the utility implemented a DSM program and helped its customers use energy much more efficiently, the rates would increase slightly and the company would make the same amount of profit, or slightly more to provide a positive incentive for them to do it.

Several other states have implemented decoupling over the past two decades, using various formulas, but at the present time only Oregon and California still have decoupling in place. California did away with it temporarily while they were engaged in their

disastrous experiment with deregulation, but now that they have ended retail deregulation, they have brought decoupling back. Other states dropped decoupling when they joined the deregulation bandwagon about ten years ago. Even Kentucky had decoupling in place, for residential customers only, during the period from 1994 to 1998. But there were some disagreements about how it should be implemented, the utility companies proposed that it be cancelled, and the PSC didn't think it was important enough to insist upon keeping in place.

A comprehensive energy strategy for Kentucky must implement the intent of 16 USC Section 2621, as amended by the Energy Policy Act of 1992, to ensure that rates are set in such a way that investments in DSM are at least as profitable to utility companies as investments in new power plants.

6. Kentucky needs to make greater use of cogeneration.

Another major opportunity for Kentucky is our huge untapped potential for cogeneration, also known as combined heat and power. When a company generates power on-site, it can often use the heat for an industrial or commercial process. This is at least twice as efficient as a utility power plant, which has to expel about two-thirds of the energy in the fuel into the environment as waste heat. Cogeneration also reduces the amount of electricity lost in power lines, and it can also be used to provide cooling for buildings. In spite of its higher efficiency, the PSC has done virtually nothing to encourage or require utility companies to help their industrial and commercial customers install cogeneration systems. Utility companies oppose cogeneration strongly, for the reason I cited earlier: It cuts into their profits. Yet very often, cogeneration would be the most cost-effective way to meet energy demands. Kentucky should ensure that utility companies do not erect artificial barriers against cogeneration in the form of high standby power rates or low buy-back rates for the excess electricity that these systems sometimes produce. Other barriers include unnecessarily burdensome interconnection requirements.

In addition to being more energy-efficient, having numerous small cogeneration systems distributed throughout the system reduces the vulnerability of the electric transmission and distribution grid to natural disasters, large-scale blackouts, or attacks by terrorists. As Andy McDonald noted during the public hearing on 11/12/04 in Lexington, distributed generation makes the entire system more stable, less likely to collapse, and faster to recover if there is a blackout.

7. The demand responsiveness of the electric system should be improved.

Another weakness in Kentucky's electric system is that there is very little demand responsiveness in the retail electricity market. What this means is that although the wholesale price of electricity changes hour by hour, most retail customers do not see any price changes and pay the same price per kilowatt-hour regardless of when they use the energy. During periods of high demand, when the wholesale price gets very high,

customers have no economic incentive to reduce their consumption and thereby help ease the shortage. It would be more economically efficient if more customers received real-time pricing information, so they could time some of their energy use to occur during low-cost periods and cut their usage during system peaks.

The electricity grid of the future will be more interactive, and will contain more computer-controlled devices that can react to changes in the electricity market. So, for example, a residential customer could program his or her washing machine to come on at 2:00 am when the electricity price was lowest. Or the air conditioner could be programmed to shut itself off for an hour when the customer wasn't home, in response to a price signal, and earn a small payment from the utility company.

The following points summarize my major recommendations for Kentucky's energy policy:

1. Harvest the huge potential for improved energy efficiency.

2. Stop giving corporate welfare to mature industries such as the coal industry.

3. Internalize the environmental costs of mining and burning fossil fuels. Pollution taxes are the most economically efficient mechanism to accomplish this.

4. Make the integrated resource planning process binding upon utilities.

5. Make each utility's least-cost plan its most profitable plan.

6. Remove the existing barriers to cogeneration.

7. Improve the electric system's demand responsiveness.

8. In addition, the task force should adopt the recommendations about renewable energy made by Andy McDonald of the Kentucky Solar Partnership (see Section E.16 above).