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HARVARD ELECTRICITY POLICY GROUP SPECIAL SEMINAR

Reliability, Capacity Requirements and the Obligation to Serve in a More Competitive Market

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. MEETING SUMMARY

There is widespread agreement that system reliability must be maintained in a restructured electricity industry. There is far less agreement about what methods will be employed to preserve reliability, both in reality and in perception. There will be a new balance between regulatory requirements and market forces. The obligation to serve may change to the obligation to deliver, with a corresponding increase in customer choice to select alternative mixes of cost and reliability. New incentives and mechanisms may develop that complement an increased reliance on competition in the generation market. The focus of regulation for reliability may move from the utility supplier to the customer purchaser through pricing, contracts and capacity obligations. Alternative approaches may develop to provide and preserve incentives for investment in generation capacity, transmission networks, and demand options. New challenges will arise to avoid gaming of the rules, unintended cost shifting, or undermining the economics of the energy market. This seminar addressed the options and the policy framework needed for the analysis of reliability issues in a more competitive electricity market.

NERC Reliability Assessment, 1995-2004: Findings and Issues

First Speaker:

NERC has done reliability assessments yearly since about 1970. Reliability, for our purposes, is defined as a combination of security and adequacy. To most of our customers, reliability means that when you flick the switch, the lights go on. Security means that we have protection from uncontrolled cascading tripling of transmission facilities causing large, area-wide blackouts. Adequacy has more to do with planning sufficient generation and transmission capacity to continuously satisfy demand under normal conditions and likely contingencies.

Each year, NERC's reliability assessment seems to have a theme, and this year the theme is, of course, restructuring. During the transition to a new structure, whatever that is, there will be numerous challenges that need to be addressed. What is the obligation to serve? Who has it? Will it

continue? Another challenge is to develop rules for open access that assure reliability. Restructuring must not cause reliability of the bulk electric system to fall below the minimum standards set by NERC and the various regional councils. The potential consequences to the economy and public health and safety are too great.

The main question asked in the report is whether the market will adequately meet the necessary reserve requirements to maintain reliability. We don't mean individual customer reliability, that decision is for utilities and their customers to make. But we can't let those decisions adversely affect others on the bulk electric system. Customer choices and contractual supply arrangements will be extremely important in the future. But they must remain customer issues, and not become regional or national issues because they have had adverse consequences for other utilities or other regions.

The installed capacity margin, if we count only those facilities already existing or under construction, looks to fall below 15% in about four years' time. This is not a magic number of any sort, but most utilities' resource margins stand at around 15-18%. So the future as far as we can see now shows reserve margins getting lower and lower as time goes by.

The good news is that some of the reasons for the decline in capacity margins have to do with the higher availability of existing units. Utilities are doing more with existing generation, and that's reducing the need for reserve margins. Planned units are getting smaller. Several regions are reporting improvements in the coordination of maintenance schedules, which also reduces the need for *a* wide margin. The new combined-cycle units are extremely efficient and economical. And of course, all the uncertainty of the restructuring process is contributing to utilities' delaying the decision to build new generation.

Most people agree on the nature of the security function, in that the operational control should be maintained by a single entity, generally the control area that's in place today. The reliability debate centers more around the issue of adequacy. *Caveat emptor* is probably the word for the day. Buyers must be aware that they're not just buying a resource but also the reliability that goes along with it, and so they must be aware of what they're buying. A new term for it is "resource reality." A lot of power marketers have been buying energy on the spot market hour to hour, lining up multiple supplies of non-firm interruptible resources and then selling them as firm resources to other individuals. This raises a concern in terms of actual operating reliability: what happens if those supplies are curtailed? Interestingly, most of these power marketers now use options to back up these non-firm resources with firm. Unfortunately, where we've seen this done, we've found that while the option was there, the ability to deliver it to the customer in question was not. So clearly we need to keep educating the players in this game. Certain aspects of the way we report firm power can result in counting certain transactions twice. So we need to address problems in the reporting requirements to make sure we're not painting an overly rosy picture with respect to the margin.

The operation of the market is going to be extremely critical. We will be forced to adjust operations in response to changes in the market, which will grow more complex as

transactions increase. The complexity of this system will be limited only by communications technology. Real-time information networks will have to be easily accessible by all users, and the operator will need to be able to communicate with all participants as necessary.

We want to make sure we continue to follow the rules of the road for reliability. We need to formalize definitions and manage contracts for business on the bulk electric system. Control areas will continue to be responsible for reliability on an hourly basis, and they need standardized rules. For example, in the Western region, schedules start changing at ten minutes before the hour and complete the change by ten after the hour. This timing standard is not consistent through the U.S.

Organizational restructuring will have an even more radical impact on transmission. As new types of capacity and energy transactions are developed, we'll need to keep track of them. Transmission margins for emergency support are becoming a hot topic as well, and it will be up to the utilities to define what's available transmission capacity for services to third parties. The FERC's open access rulings will play a central role in this debate. Some western RTGs are starting to address the issue of who is responsible for network adequacy. Determining the amount of transfer capability available for firm and non-firm use is also going to be very important. We have something called special protection or remedial action schemes as a backstop for multiple contingencies; but it's very important that those schemes be reviewed and coordinated within the region.

One of our primary goals in ensuring reliability in a competitive environment is to maintain the reliability standards and guides that have worked fairly well, with a few exceptions, for years. New players need to understand the importance of following the rules of the road, and we have to encourage participation by the new competitive market players in the various NERC committees. Finally, we need to talk a little about contracts or try to require contracts for power and power-related services and include a commitment by those who are operating bilaterally to operate in accordance with the established rules of reliability.

NERC will not let reliability dwindle. Operations will become more complex, but no one is suggesting that we let reliability be degraded in any way. As long as the various parties are willing to coordinate with the NERC councils and follow those rules of the road, I don't think we're really going to have a problem.

Revisiting Reliability Requirements in a More Competitive Electricity Market.

Second Speaker:

I'd like to talk about the concerns that an incumbent in the market might have when facing a residual obligation to serve. My concerns are to some extent addressed by the very fact that we're having this meeting. The vast majority of the debate I've heard has focused on economics, finance, and a bit of public policy, but not much attention has been paid to how the lights will stay on. I'm not assuming that electricity can or cannot be reliable in a competitive environment, but rather that it absolutely must be reliable in whatever environment we operate in.

In the near term of this restructuring process, we will use essentially the same generators, wires and end users as we have now. The change is one of focus, from an engineering- and reliability-driven industry to one that's more customer-focused and market-driven. Our experience is that a customer on interruptible rates will call just Eke anyone else when they get interrupted and want to know what we're doing to improve the system to reduce the number of interruptions. Furthermore, when the power does go out, it is the local distribution company that has to deal with the unhappy retail customer, not the generating company, the transmission company, the grid, or even NERC.

The NERC reliability assessment report outlines the practices and procedures that need to be considered. They fall into three groups or levels. First, there are certain "rules of the road" that are internal to each utility. They may not be discussed at the local PUC or FERC, but they're going to have to be reviewed by each utility as we unbundle. Even the utility-level, internal reliability rules are incredibly complex and have to be reviewed in great detail. But it's not an impossible task; there's no actual impediment to getting it done. You've just got to grind through it.

The second level of rules, that have to do with coordination of the various participants, we've usually handled through reliability councils. They've been based on sharing of resources and information to ensure the common good, whatever that is. In the future these rules will probably have to be more formalized in the future of contracts and tariff provisions, although hopefully they can be developed through regional reliability organizations. Again, it's a matter of working them out one by one.

Finally, the third type of rules, for meeting the future needs of the system, present the largest uncertainty as to how we're going to provide generating and transmission reserve capacity in the future. It's particularly difficult because it requires large capital expenditures to accomplish. I think the responsibility for determining the adequacy of reserves will shift from generators to users and purchasers. It's going to hinge on the amount of contract and supply, spot market availability and so on. To require a specific amount of reliability seems to be contradictory to the competitive market environment. On the other hand, one purchaser's decision to operate with a lesser degree of reliability shouldn't have an impact on the reliability of other customers who may have made different market decisions.

The solution still may be to mandate some reserve requirement level for wholesale purchasers; however, this might be impossible to police in a retail environment. Ideally, we would design some type of penalty for shortfalls that would create new capacity instantly. Otherwise, we'll just be closing the barn door after the horse has escaped. In the final analysis, we will have reliability, because the customers and the public policy will demand it.

Third Speaker:

Any regulator has to acknowledge that we are necessarily focused on the big picture - that while we can try to decide on ideal results we may not be able to prescribe detailed solutions. The previous speaker is right in saying that the process is going to be incredibly time-consuming. I see reliability as an iceberg, where on the surface it appears

that we all agree to maintain a high level of reliability, safety, quality. Underneath all of this lie a host of really thorny issues and some difficult choices.

Many aspects of reliability today did not arise spontaneously but rather were developed over a period of time to reflect particular industry structures, such as vertical integration. Franchises create a different sort of relation between individual utilities than would exist in a completely competitive market. Existing rules for reliability are made possible by the existing industry framework. As these arrangements are altered, it is essential that careful regard be given to each of these issues, and as always, the devil is in the details. Reliability is the kind of iceberg that could sink a lot of restructuring and reforms.

That industry restructuring will proceed is clear; however, how this is to be done remains less obvious. A simple framework suggests what must be done. First we must identify the dimensions of reliability that are important to us and those we serve and represent. Reliability is not a one-dimensional thing; it's a cornucopia of different vegetables. Once they're identified, we can ask the initial critical question: whether or not deregulated, decentralized market solutions can efficiently deliver the levels of reliability that customers want and are willing to pay for. Earlier this year, Irwin Stelzer observed that, if there were a debate over the best way to get peas into cans and onto grocery shelves, that the kind of elegant model we've heard in some of these discussions would inevitably win out over the approach that just lets market forces do their work. This is because to anyone accustomed to a regulatory environment, the solution which states "Let the market decide" seems too vague and risky. In addition, it must be recognized that not all aspects of reliability may be packageable as a can of peas. Adam Smith observed that the lighthouse is the classic public good because you can't exclude the beneficiaries of the lighthouse from receiving its benefits, whether or not they pay for them. A lot of the dimensions of reliability are also public goods -- voltage support, spinning reserves, fuel diversity. For each dimension of reliability, we have to decide whether it's a can of peas or a lighthouse. Finally, for each dimension of reliability, we must consider the most efficient, fair, and administrable structures and locations for addressing that particular concern.

I'm not going to try to identify the many dimensions of reliability that are important to us as customers and citizens. There area lot of different ways to look at that question, and a number of them have been put forward at one or another of these meetings. Let me simply suggest some decision rules to be put into place once we've decided what the dimensions of reliability are. The first one is obvious: Degraded reliability is unacceptable except in very limited and contracted-for circumstances. A minimum level of basic reliability should probably be purchased, like a minimum level of auto insurance, by all players in the market. Second, it's important to decide whether reliability is in fact a can of peas. Third, I'm very cautious about just letting customers live with the consequences of their choices. It's like the motorcycle helmet problem -- we can't force people to wear motorcycle helmets, but we won't refuse to take them to the hospital and pay their hospital bills if they get in trouble. We may want to argue that letting people live with their choices is the way the market works, but I don't think it's politically tenable. Fourth,

actions that degrade system reliability should be charged appropriately. Fifth, mechanisms to address reliability should also address the problem of market power. Sixth, there's a lot to be said for simplicity. Various aspects of system reliability should probably end up being charged to users on a postage-stamp basis, just because trying to do anything else is probably not worth the effort.

Finally, there must be a provider of last resort, who will take on the obligation to serve. We might as well acknowledge that it will be necessary and figure out a way to pay for it. I strongly suspect that this implies new regional mechanisms which will go substantially beyond existing power pool arrangements and new mechanisms for federal/state coordination as we restructure the electricity industry.

Fourth Speaker:

The three questions at the heart of the reliability issue are, first, why is reliability such a big deal in the electricity industry? Second, how do we accomplish it now? And third, how shall we accomplish it in the future?

The answer to the first question lies in the fact that electricity is instantaneous and, essentially, can't be stored. So there's not much forgiveness in the system, and a loss of reliability can be very expensive in terms of both technical and socioeconomic costs. In addition, there area lot of economic and social benefits that have resulted from the high reliability level of the current system.

Today, vertically integrated utilities have an obligation to serve franchise customers, which is something that may well change in the future, either partially or totally. Somebody takes responsibility for firm load, which drives the need for resources, which provide the reliability. NEPOOL is probably a good example of this: rather than a single large utility handling its own reliability issues, we have around ninety utilities in a space around the size of New York State, and we've had to learn to work together to share the responsibility for reliability in the region. These are skills that will probably prove crucial to reliability in a more competitive industry.

Most of us are speculating that the future market will be driven not by franchise responsibility but by economics. For instance, the load aggregator is the person who eventually will take responsibility for the load. In future markets, large customers may take over that role themselves. Or it may fall to the existing utilities, both municipal and investor-owned, to the extent that they are able to hang onto the responsibility for some kind of a contractual arrangement with customers. Generators, marketers and supply aggregators will pull together portfolios of resources in order to contract with people who take responsibility for the load and providers who will work the demand side of the equation.

In a restructured world, not all customers may necessarily want to come out into the competitive market. Some will want the protection of a franchise. We need a system in which every piece of firm load corresponds to a responsible party, either because there's a residual franchise on some of the customers, or because a contractual arrangement exists between a load aggregator and the ultimate customer. The load aggregator has options on that contract, one of which might be varying degrees of firmness and interruptibility that have different price

tags.

How do we ensure reliability under these circumstances? First, we assume that there is an independent system operator taking responsibility for operating the control area and trying to maintain reliable operation. Since the resources necessary for reliable operation are driven by the amount of firm load, the system operator assigns the requirement for resources to the load aggregators who have taken on that responsibility. The aggregators are then responsible for the resources that are necessary to serve that firm load in an acceptable way.

That reliability obligation will take place on several levels. For the long term, we need to ensure a reasonable chance that there will be enough resources in the area. I think we need a long-term price signal or market signal to do this. It can be accomplished by presenting the future need for capacity to the participants in the market as potential future market share, thus encouraging them to build. Such a market signal will let people know what the requirement for future resources will be, not specifying what they should be or who should have them: the market will take care of that.

Fifth Speaker:

My first question has been neatly laid out by the previous speaker. Is the electric utility industry so unique that when it comes to long-term commitment or long-term new resources, we have to have some type of special obligation or will the market in fact deliver the needed resources, taking into account the long lead time and capital needs of the industry? I would say that yes, the market will deliver. In other capital-intensive industries like gas or telecommunications, people make large investments with long lead times. There are, however, essential criteria that have to be met for that market to work.

The first is that barriers to new entrants into the market must be relatively low, or at least low enough that no single player can drive prices up by withholding commitments. Second, price must be allowed to fluctuate and clear the market. Likewise, returns must be allowed to fluctuate, low or high. Finally, there can't be a threat of going back to the old form of regulation. I'm sure there must be other criteria as well, but I think that if those are met, and I believe they generally have been in other deregulated industries, then we will be able to rely on the markets to deliver. It's not something we can do tentatively, and it's not something we can do in steps.

Looking across the range of deregulated industries, there's quite a consistent pattern of results. Demand for the product and service has risen, prices have fallen, but returns have become more volatile. In fact, in the gas industry, returns are fairly weak, at least for those suppliers who supply consistent with long-term commitments. I think we can see a positive result as long as we set the rules up correctly. In the gas industry, barriers to entry have been lowered, making it easier for suppliers to get to customers. Prices have fallen, but with technology, suppliers have found a way to be profitable and keep demand rising while prices stay low. On the production side, a number of sites were drilled in anticipation of both demand and high prices, and so not all of those enterprises have been successful.

Has the market, then, delivered? Even though lead times can run up to five years,

capital has come into the market to meet increasing demand. Deliverability has been able to keep pace with demand. Futures markets show that the market does in fact anticipate demand. In the long term, production continues because new technology enables those enterprises to make money at a lower expected sale price. But there are other issues specific to electricity that might get in the way of capital coming into the market. I'd like to hear what other people think about that.

Discussion:

—: Whoever proposed that there should always be a provider of last resort: Will this be settled on a state-by-state basis, or would we need to have a more regional model? It seems that uniformity is desirable from an efficiency standpoint, but that there could be problems with interstate commerce clauses and individual state jurisdiction.

—: I think it is a state-by-state decision, but I don't see any commerce clause problem. Perhaps a metaphor that works is the mandatory risk pool in insurance, where insurance companies are required to contribute to the provision for those customers who for one reason or another would otherwise fall out of the system. No one is disadvantaged since everyone is contributing equally to the pool, and the existence of the pool makes it possible for all citizens to get some level of service. I think that is preferable to the historically based model, where whoever has the franchise today keeps that obligation to serve unless compensation arrangements are included in that transaction.

The big challenge is to bring together entities with differing cultures: the regulated industry and the unregulated marketplace. Will such an arrangement be acceptable to the industry?

—: I am a little unclear as to who these load aggregators are. How do you separate them from the supply aggregators?

—: There are probably some practical limits on how small you would want one of these load aggregators to be. An industrial customer might decide to act for itself as load aggregator. Some independent professional aggregators may appear and aggregate retail customers into a block of power and then go and arrange supply to cover it. Many existing utilities will try to compete both inside and outside their current physical franchise area to aggregate retail customers into blocks and arrange supply.

—: I find myself wondering whether one will be able to get specific performance or not. How can we ensure that those who contracted for less reliability are in fact those who have their load interrupted when we have to have applied percent load reduction? Hopefully, through future technological and communications advances, we'll be able to have a little more play in interruptibility. That might create the ability to have less of a single reliability standard and in fact let reliability float with the market more. But that's not the first thing that will happen. First we'll see more of a uniform reliability standard and the obligation placed on the loads to do their part.

Buying and Selling Reliability: How and How Much?

Sixth Speaker:

It seems that outlooks on reliability will really depend on the history of the particular institution. As a member of a power pool, I expect to see these issues differently than will a company that represents an individual utility's control area. Another important ingredient is local conditions, traditions, if you will. The organizations active nationally are going to have to learn to move seamlessly between these areas.

Further, we should be careful not to view reliability as a single quality, where if a given system or a given type of generation meets the benchmark, it's reliable, and otherwise it's not. The truth of the matter is that reliability has many aspects. As we move toward a true market system, the marketplace will have to allow the customer to make that choice on the degree of reliability they need. This raises a major issue. If customers are going to make choices, they should also have to face consequences. There can be very severe consequences if they fail to fulfill their end **of** the bargain, inasmuch as that failure has impact on others. So we have to be sure that the customer has an understanding of what the characteristics of reliability are, and the nature of the product for which he is contracting.

There is a lot of difference between reliability that exists at the individual customer distribution level and at the bulk power market level. I'd like to focus on the bulk market. To ensure reliability, you need to look at the availability of both transmission and generation over the long term. These resource commitments are going to be made on some sort of a planned basis: the question remains, what is the nature of that plan? The specific requirements of the system in question have to be taken into consideration: for example, in the Northeast we have to make allowances for unexpected weather conditions in the winter. As for the customer base, we will have to be able to accommodate a fairly divergent set of requirements of customers who should be able **to** have choice. On the other hand, the benefits of resource pooling should also be made available within that retail market, so the planning process will have to be consistent with the nature of the pool. Those entities with the obligation to serve, whether that is a franchise or contract obligation, must be able to assure compliance with their obligations without being undercut by those who do not share similar kinds of commitments.

The first assumption I made is that the transmission services will be available on an economic dispatch basis from the independent system operator. We'll have to provide bilateral transactions and schedule our own generation for a while longer, however. Current load will have two basic options. They can go it alone, that is, not take part in the regional pooling or reserve sharing. This means they will have to ensure that during periods of generation shortage, their loads do not exceed the output of their designated generation. They also have the option to participate in regional pooling agreements whereby they join a power pool arrangement like those we've discussed, agreeing on their reliability objectives collectively, and making a commitment to the planning process.

Seventh Speaker:

We need to be careful when we talk about buying and selling reliability, as it can be misleading. It's also important to recognize that reliability issues will vary slightly in different segments of the industry. It is useful

to make the distinction between security and adequacy. Security has been used to talk about the resiliency of the generation and the transmission systems generally. The distribution system should be included in this assessment as well, since incentives will be put in place which are going to change the way the traditional distribution companies have operated.

Some analogies can be made with the telecommunications industry. It is not unlike the kinds of incentive regulation that we are bringing into the telecom industry, where it turns out that prices have been effectively regulated by incentive regulation, in which a dollar saved is a dollar earned.

An interesting thing happened recently when an unseasonable storm dumped a foot of wet snow on the Denver area. One hundred thousand customers lost electricity. The complaints we heard were not simply, "I didn't have my lights or refrigerator." Instead, we heard, "I couldn't use my PC. I couldn't use my cordless phone. I couldn't get my e-mail from the office." As the uses of electricity increase, the demand for reliability among residential consumers increases as well, and that should make us think twice about lowering reliability standards. At the moment, I can't see consumers taking any interest in bargaining about the degree of reliability. I think the demand is going to be at least as high as it has always been.

What about sharing the costs of reliability? The real issue is whether reliability should be unbundled in some way. Among consumers, we see a strong belief that customers deserve what they have already paid for (to the extent that anyone is suggesting that we go back and rethink the value of reliability and then assess the future cost of that as a value service). I think we will see a lot of resistance to that idea right away, coming out of the notion that there really is an equity issue here. The notion of reliability as a lighthouse, a common good which benefits and is funded by everyone, is probably the best representation of how the public thinks of these things. You might get people interested in a lower price for electricity, but when their power goes out they're still going to want to know why.

This sort of public attitude leads to what might be called the politics of reliability. You can't paper over reductions in reliability. You can't explain it away. Someone once said of the question of reliability in the telecom industry, that when you ask how many outages are acceptable, it is like asking how many babies you can drop in a nursery. The answer is zero. I think we are going to find a similar political governance of what we are doing here.

I am very concerned about the equity issues that are raised by the unbundling of reliability. My conclusions are that the necessary levels of reliability will be maintained if the customer is valued highly. This should not be compromised in the transition.

Eighth Speaker:

For the aluminum industry, electricity has three different aspects. It can be used as fuel for heat or for lighting. It can be used as power for moving our machines. Or we can look at it as a feedstock, since the production of aluminum involves actually taking electrons out of the electricity system and adding them to the metal.

In the first stage of manufacturing, we need steam and power for the large motors that mix the ingredients for turning bauxite into alumina. The second process, smelting, is the electrolytic process I referred to. It uses huge plants that run on 200 to 500 MW of DC electricity. So our capabilities are tremendous, but so are our vulnerabilities. If we lose power for four hours, the molten metal solidifies, and it can take months to recover. From that point, the molten metal goes on to be cast and so on. We've developed an electromagnetic casting process that keeps the aluminum in better condition than the traditional method of pouring water down the walls of the mold. Then the rolling mills take over. One of our plants, for example, has three mills. The first one is a 132-inch mill. It runs on a single 5000 horsepower DC reversible motor, at a rate of about 900 feet per minute, and we try to keep it going continuously. Thus interruptions can be pretty critical there, too. There may be a certain amount of flexibility in areas where gas heaters back up the electric heaters, but then again, the whole operation is computer-controlled. It is largely an electricity-dependent and reliability-dependent system throughout.

The point is that we have so many different uses for electricity in our operations that lapses in reliability would be felt almost immediately throughout the system. While we can do a lot of different things in terms of either protecting or adjusting our operations to deal with reliability problems, we also have some components and some processes that won't allow such adjustments. The key is for us to be clear about how we use the electricity, so that we can determine what its value is and what our needs are.

Price is important as well. Price not only affects our desire to have the electricity and produce a product, but also whether or not we want to pay more for reliability, because there are alternatives that price is related to in the process. Deliverability is critical, since there's not much on-site stockpiling that can be done. However, one can stockpile other components, alternative fuels, for example, or maybe even stockpile part of the finished product, if an electricity shortage is expected. That gets back to the price issue. Alternative suppliers with cheaper electricity are becoming a very important option for us. Reliability for industrials is determined by whether the supply is within spec for quality, contracted volume, on-time delivery, and price performance. We know this requires a reliable transmission system, and, if the system requires anything other than large volume wholesale purchases of electricity, it also requires a very good distribution system.

Every customer has certain precautions they take for reliability's sake. As a residential customer, I have candles, flashlights, a fireplace, surge protectors and automatic back-up features on my computer. Our company has coped with that need through self-generation, which in many cases has proved exceedingly reliable. We will write into our contracts in many instances that there are payments to be made in the event of a reliability problem that's the fault of the generator. In addition, there are a variety of management options for aspects of production over which we have control, such as scheduling of certain units and alternative fuels. Of course, long-term changes can be undertaken in the process or the technology, if it's economically feasible or necessary for the benefit of the company.

We've looked pretty seriously at the risk that retail wheeling and competition in generation poses to reliability. There are some other areas that also need to be looked at. How important, for example, are these risks relative to the existing reliability factors? Where are the opportunities to improve reliability in the industrial sector as we move toward market pricing? I see a real can-do attitude toward the problems of competition, and I compliment the utilities that have taken the lead in solving some of these problems. As we look to the future, let's take the same kind of can-do attitude toward solving problems of reliability.

Ninth Speaker:

Over the past couple of years, the IPP community has changed its perspective on the likely impacts of retail competition on our ability to do business. Our primary focus has been on trying to ensure that we get a fair shake in the competition at the wholesale level. Historically, utility management had principal responsibility for the planning of the system and reliability issues. That was supplanted by IRP in the late eighties and early nineties. Since the passage of the EPAct of 1992, however, we've seen some very dramatic developments. The issuance of the California Blue Book in 1994 hastened things along, and it has forced us to look at retail issues as well as the wholesale market.

We're dealing with a very uncertain climate, where we're up against unwilling customers. The framework in which we all operate poses a very burdensome and inefficient barrier to entry. I don't think that was the original intent. The original intent was not to build any more of those big, ugly, smoking power plants than necessary. If you look at new electricity generation technology, you see that it's clean, efficient, and can be decentralized. Yet barriers to the generation market remain. We think it's time to revisit some of the underlying assumptions that led into the devising of those statutes. We're very keen on moving toward a market structure that brings generators and distributors together as willing buyers and sellers of each others' services.

The past planning process typically included utilities, independents, advocates for various points of view, for energy efficiency, environmental conservation, and low-income customers, a highly politicized and litigious process. We've come to the view that rather than looking to regulation to make decisions in proxy for customers, we need to start thinking about how regulation can empower individual customers to make decisions in their own behalf It's important that all suppliers should deal with customers on the basis of contracts which will be their exclusive means for recovering all costs. Obviously there'll be transition issues in reaching that point, but in the long term we can't afford to have a market that differentiates in its treatment and the legal status of utility generators and non-utility generators. We need a system that treats us all simply as generators. That will require a full and effective unbundling of services and a strict bright line between what are deemed to be competitive services and those that are natural monopolies, with rigorous steps taken to ensure that there's no opportunity for cross-subsidization which could undermine the development of a truly competitive market. The independent system operator will clearly be vital to this process as well.

IRP may not be dead yet, but it is time for us to move on to a new framework, which

I call integrated market development. IRP presented a sort of top-down perspective, whereas this other approach presents a bottom-up perspective. One of the key elements of a true market for power is the opportunity to tap into a force that has really not been utilized before, and that is the price elasticity of demand for electricity. Some speakers assert that there's no evidence for such a phenomenon. On the contrary, electricity customers will adjust their demands in response to accurate price signals. We've seen prices in the bulk power market spiking from one and a half or two cents up to fifteen or even twenty cents during very acute periods of demand. When those prices are made transparent, we'll see a tremendous response in terms of the deployment of control equipment to take advantage of such fluctuations. People are never going to sit in front of their electric meters like their televisions or wake up at two in the morning to turn on their clothes washer, but someone will come up with some clever device that enables the customer to do essentially that in other ways. I cast my vote with the man who said that the peas will get on the shelf if we let the prices do the job.

In terms of the long-term reliability of the system, an independent system operator and equivalent treatment of all generators is essential so that really accurate prices get sent back to the market. That feedback is the key to balancing price spikes and establishing the need for long-term capacity. As long as we can find ways to allow the market to evidence itself, people will adapt and we'll continue to plan for a highly reliable system.

_: Is anybody saying that we can't possibly create a competitive market whereby we can rely on market-determined signals for expanding generating capacity?

_: No, and I don't think the issue should be framed in the sense of whether or not we can, but rather whether that's the best public policy for a period of transition. We are proposing a reliability-based capacity market. Our expectation is that if it becomes irrelevant to the power market, it will merely atrophy and die of its own weight. But as a practical matter, you cannot make the transition overnight without chaos.

Discussion:

_: The way one speaker put it, that the public should live with the consequences of choice, is a pretty strong statement. I think there are certain consequences of certain choices that the public will not allow. For example, if a major employer in a given state is out of power for a sustained period because they contracted with an independent who went belly-up, and no other mechanism existed to deal with those consequences reasonably quickly, I think the public would just turn their backs on this sort of reform. If it were a large residential area that was cut off, this would be even more true. We should anticipate that possibility and create a pool or insurance mechanism to protect against the worst of the risks. Then everyone can go into the new world with some confidence that we will not have the political rug pulled from under us.

_: I'm not as worried about generators going out of business, because in the case of bankruptcy we'll always have the option of going in and taking over the plant. But as an industrial, I want to know what happens if you lose your fuel contract at a critical time. What

happens if you have a ten-year contract and, when it expires, you find yourself in a seller's market instead of a buyer's market, and you can't get power at the price that you'd like to have to continue your operation.

_: The concept of a competitive generation market brings so much more efficiency than the system we've known, but it also brings us to a margin that we don't want to face. That's where I think some public policy oversight wouldn't be out of place.

_: When you proposed the situation of the generator that goes out of business unexpectedly, you assumed that the only fill solution to that gap quickly would be some sort of institutional mechanism. I argue that the market needs to be fluid. Bankruptcies occur all the time in every industry. There will be IPPs that go down here and there, but others will come in and take their place. That's the typical pattern when bankruptcies occur in other industries. The system operates pretty seamlessly. As long as the existence of a fluid secondary market is ensured, price signals will do the rest.

I don't believe that a very high price for energy for a few hours a year is going to get someone to build a new plant. Perhaps you can get better availability of existing resources by letting prices vary widely in the short term. But it's installed capacity that really provides the cornerstone of the market, and that requires a longer-term signal for the market.

_: You can really distinguish a couple of ways to handle the public policy implications of reliability. One is to hold industrial customers who are sophisticated enough to deal with these issues to a standard that says they have to deal with the failed generator themselves. Since residentials will probably be buying from a relatively sophisticated aggregator, it might turn out to be a non-problem.

I wanted to address the comment about siting. The public expects that siting will be intertwined with the planning process itself. That needs to be sorted out so that it's just another industrial facility.

We've talked about reliability as a complex problem; I would add that I think distribution reliability is probably the cause of most outages, and that it should be the focus of our concern. Second, we talk about how good reliability is now, but I think that what we really have is an overcapacity problem masquerading as reliability. Let's consider whether we're doing the best job getting reliability or whether we shouldn't be looking for more flexible resources that will do the job better. And maybe markets can do that better.

As far as the relationship between price signals and capacity investment is concerned, we've learned that you don't build capacity based on the last peak in price. You build it based on what you think long-term demand growth is going to be. You want to be the first one on-line in the good years, for a quick return. It's amazing what you can do to extend old plants if there is a price incentive out there. The right price signals and long-term demand expectations have resulted in a number of plants running today that we thought were dead ten years ago. In fact, we're making a certain amount of money off the technology we developed to revamp old

plants.

_: On a short-term basis, the independent system operator will be charged with maintaining reliability. Therefore, the responsibilities of that position would seem to include making sure there are enough resources to meet the daily short-term requirements, including things like spinning reserve. If that is done and the costs are then passed on to the market, won't we automatically get the kinds of price signals that are required for long-term capacity building?

_: Which comes first, the provision of the resources or the calculation of the price? Prices are going to be out there on an hourly basis, perhaps on a fifteen-minute or less basis. And people will respond accordingly.

In order to maintain reliability, the operator needs to know, at the very least, that the flows that he is moving provide sufficient spinning reserves at appropriate locations.

_: I see no disagreement over this from the two ends of the spectrum on the Poolco/bilateral debate. The ISO is going to need to have control over sufficient resources to keep the market afloat. Now, what proportion of the resources is that going to be? Some proponents of Poolco say it needs to be one hundred percent to minimize dispatch costs. At the other end, people are saying things like two or three percent. I don't know what the answer is. Historically, in NEPOOL, one hundred percent of all resources were scheduled by the pool. We're now moving away from that. How far away can we move before we bump up against safety and reliability constraints? I think we need to move carefully and judiciously, but from a market perspective, let's allow that evolution to occur and figure out the ideal result on the basis of our experience.

_: Listening to this discussion, it's important to realize that it will not be deregulation per se that occurs. Instead, it will be re-regulation. No market functions without a set of rules, and if our concern is the reliability of the system, we'll have to focus on setting up rules that will allow reliability not to be degraded.

Regulation, Incentives and Markets: Approaches to Ensuring Reliability

Tenth Speaker:

I made the mistake of saying the word "reliability" around a representative of some large consumers lately. He said that there was no point talking about reliability, that customers wouldn't stand for anything short of 100% reliability -- end of discussion. I would like to respectfully disagree with that view of this topic. Others have suggested that you only get into discussions of reliability if you're an opponent of customer choice and it's just a ruse for high-cost utilities to slow down the transformation, or perhaps to end it entirely. Again, I think that's an unfair way of approaching a very important subject. I am a proponent of customer choice, but I also recommend a Hippocratic approach: First, do no harm.

As far as I'm concerned, traditional regulation has failed miserably when it comes to pricing and efficiency questions, but it's done a pretty good job of ensuring reliability, even if it's done that by shoveling too much money into the industry. Thus, I'm sympathetic to the idea of setting up a specific reliability standard, through contracts or regulation or some law. One of the questions

we need to focus some attention on is defining reliability. What do we mean by a reliable electric system, anyway? Is there a standard we want to establish, or can we let the market establish our standards?

Reliability is a product of reserve marginal capacity, transmission capability, fuel diversity, shared use of facilities, communication between utilities, data access and information exchange, coordination of maintenance, the power of the operator to call the shots, and the culture of mutual support and cooperation. Competition in this industry has already had an impact on most of those criteria. Reserve marginal capacity, for instance, is declining throughout the U.S.. Maintenance is another area I'm concerned about. As capacity margins decrease, it may be increasingly difficult for utilities to schedule adequate maintenance programs for their aging plants. Many utilities are under significant competitive pressures to limit or reduce expenses wherever possible. Fuel diversity may become a problem in the future if competition favors forms of generation that perhaps have lower capital costs but higher life-cycle costs. We have to be serious about information exchange and working out confidentiality agreements, especially when the data that a system operator may need is proprietary. That is going to depend on the culture of mutual support, which is breaking down as the business gets more competitive.

Thus far this industry has produced reliability largely by letting private and voluntary associations figure out how the system will be reliable. I wonder whether this sort of informal, wholly voluntary, private arrangement can survive in a competitive world. There's certainly a role for government to establish some of the rules of the road, and maybe some of the contractual requirements that would govern reliability in the future.

I fall on the other side of the fence from those who assert that the market will provide sufficient reliability. Too many questions, such as emergency generation prices and so on, need to be thrashed out. I like what I hear about requiring members of pools to meet some installed capacity requirement and other measures designed to protect reliability. I think it's important that we finally take seriously the issue of the culture of the industry changing and what that means for reliability. We've already seen that cooperation can break down. For example, last January 19th Pennsylvania had to institute rolling blackouts and ask the governor to declare a state of emergency. Imagine, then, how far it might break down under competitive pressures on a similar day.

Eleventh Speaker:

I will address the issue of finding adequate incentives to invest when relying on market-based pricing for electric generation. We have two plants under construction in Argentina, predicated solely on revenues from the spot market. So the simple answer to the question of market incentives is yes, there are circumstances in which investors will invest in generation in a spot market-type system. But in another sense the question is a bit circular. As an investor, you can just say, well, tell me what the rules are for these markets, and if the rules support investments, I'll invest. We have to think about what kind of rules we want to establish that will actually bring forth investment.

When I was a consultant working on the restructuring of the U.K. system in 1988,

we debated passionately over this very subject. I took the position that nobody would ever invest without some kind of long-term credit-worthy arrangement that would secure their revenue base. I don't think the debate was ever fully resolved, since to the best of my knowledge all of the plants that have been built in the U.K. have been built with contracts. In Argentina, on the other hand, they had just restructured their industry and installed a spot market in 1992. Anyone over two megawatts was free to shop around, and developers like myself were running around the country trying to organize contracts and so on. At the time, the average wholesale price was about 3.8 cents. We offered someone a fifteen-year contract at an average price of 3.2 cents, and he responded, we would take up your offer, except that we want to maintain the same relationship to the spot market as we start with. We realized that we could build the plant based on spot prices, and came up with some approaches where we thought that even with significant deterioration in spot prices, our plant could not only survive, but make money.

So there are indeed a set of circumstances in which people will build plants in a competitive market. The circumstances in Argentina were idiosyncratic, but not unique: relatively high marginal costs, very low gas prices, and comparatively robust load growth due to previous suppression of demand. I'm not sure that you'd find those conditions in the U.S., but we're also working in Colombia and New Zealand, where marginal costs are very low due to a lot of hydro in the installed base, and while it's not as easy as it was in Argentina, we're working to find a way the plant can work. The lesson is that as long as the rules of the market are set up properly, plants can get built.

_: In Argentina, do you have to dispatch into the grid? What about capacity charges?

: Argentina pays a small capacity payment to all generators who declare themselves able to be dispatched. In fact, there are very stiff penalties if you declare yourself able to be dispatched and then for some reason can't deliver on it. The economics of our plants are not driven by these very small capacity payments, but by the fact that our marginal costs are significantly lower than the average marginal cost of the system.

Twelfth Speaker:

So far today we've talked about reliability in at least two ways. First there's relatively short-term operating reliability, which is to say dealing with the inevitable outages that occur in all systems. Going to a competitive market makes zero change in those protocols. Trees are going to fall on power lines occasionally whether the market is competitive or regulated. The potential difference crops up when we look a day ahead and see what is available and what the system can withstand. The question is whether we will be able to keep the lights on without involuntary curtailments to bring the system within its design parameters. Second, I will assume the existence of a spot market. My thesis is that competition and reliability can go hand in hand, without resorting to involuntary curtailments, as long as our approach to reliability is consistent with the underlying economics.

If you look at a spot market duration curve for a given year, under the current system there will be around 100 hours out of 8,760 in which the price is four cents per kWh or higher. Those are typically extreme

weather conditions or equipment failures. The rest of the time, the price is somewhere around two cents per kWh. No one will build capacity based on a price of eight cents per kWh for only a hundred hours a year. The previous speaker was facing a very different-looking curve for the Argentinean market. Why does ours look like this? We have let combustion turbines cap our price as a consequence of the way we do business. The market goes from 100% of peak to 90% in about 100 hours, and down to 75% in about 500 hours. If you are carrying a reserve margin of plus or minus fifteen percent, it means that ten to fifteen percent of your capacity is designed to serve less than 100 hours a year. Those 100 hours are pretty expensive under the current system. The result is that the value of that 100 hours of load exceeds 50 cents per kWh on average. As a result, no one is going to build at eight cents.

We currently have a regulatory, accounting and pricing system which is designed to shield customers from the fact that electricity is very expensive in the 100-500 highest hours of the year. It asks people to build plants that are only going to run 100 hours per year, and then pays them the average list price. We are going to have to find sources of cheap short-term capacity, and we won't know if we've gotten it right unless we let the market work.

What are some stable systems for maintaining reliability? The key is to send short-term capacity price signals so that we get the prices up in those five hundred highest hours. The U.K. model simply lets the energy price get as high as necessary. The LLOP model is similar in that, in hours where the LLOP is small, you don't get much capacity payment. There are also capacity ticket systems. The point is that all these methods basically provide the market with a short-term capacity signal. If we can do that and allow a full range of competition, then we'll have the right kinds of suppliers and responses to ensure the system operator does not have to resort to voluntary curtailment.

_: It's worth noting that those hundred hours you're talking about are spread out over fifty or more different days per year. That's fifty or so different disruptions a year, and the customer isn't going to be too happy about that.

__:__ What's wrong with paying the cost of the facilities that would serve those hundred hours but just spreading it over all the hours of the year? That's the current practice.

It doesn't send any price signals or other signals to tell you whether you're doing the right thing. It's a central plan, which is inherently unstable.

_: In the U.K. there was a system proposed that established one ticket to go with every megawatt of defined capacity. If you were a licensee, you just had to make sure you had a ticket for every megawatt of load that you were serving.

_: How is the ISO going to take care of spinning reserves and other contingencies?

_: Spinning reserve bids and the like are part and parcel of the dispatch bids the ISO is getting. Under one model he might have to resort to dispatchable demand or involuntary curtailment to run the system within its design criteria. Under an OPCO model, either the bilateral folks have got to provide for themselves, or the ISO is empowered to go

purchase some power.

Thirteenth Speaker:

There are three approaches immediately available for handling reliability issues. It can be a regulated monopoly - that's the lighthouse model. The second possibility is a rebuilt transmission group that would make decisions about building new capacity. like the Western RTGs. The third possibility is to design incentives and let private investment do the job. This is for those of you who think reliability is a can of peas. All three are possible.

The regulated monopoly model is an unsolved problem, because we don't have any way of telling whether a transmission monopoly is doing a good job or not. If we want to consider it as an option, we need to establish performance criteria and develop a system for rewarding or punishing monopolies. The success of the regional transition group depends on the success of group decisions, either by unanimity or by majority rule, and both approaches are problematic. Unanimity is difficult to achieve. Why should one plant have the power to veto a transmission line because it threatens their market share? Majority rule is questionable because everyone gets the same vote on a transmission line that affects different plants differently.

The possibility I'd like to focus on is the third option, that of having incentives for building the capacity necessary for reliability. We would need to find a way of discouraging the construction of common lines that are bad for the network as a whole, and encouraging beneficial lines. The mechanism that will do this is called the transmission congestion contract. It was originally proposed as a way of financing generating plants. The transmission congestion contract can be awarded to the investor who builds a line. If the price difference between the two nodes A and B specified in the contract is positive, you can collect a certain amount of money. The catch is, if you build a bad line, the price difference could be negative. You might find yourself stuck having to pay money to the grid merchants.

These contracts produce a predictable result under certain slightly tricky conditions. First, in order for these TCCs to provide exactly the right incentives to prevent bad lines from being built, you have to have the TCCs distributed among the players in a way that matches their use of the network. If somebody's shipping a lot of power from A to B, he should have a TCC covering that line. The next requirement is that the investment incentive rule for handing out TCCs has to be followed to the letter. If both of these conditions are satisfied, and there's minimal market power in the system, then the TCCs will be completely effective in preventing detrimental lines from being built.

The incentive rule for handing out TCCs is that the investor is given a choice of sets of TCCs. This means that there will be good choices and there will be bad choices as in any other investment. In addition, a certain restriction exists on what the investor can choose, inasmuch as each TCC represents a quantity of dispatch from Node A to Node B. In other words, they can't violate any of the constraints on the network. The total set of TCCs must correspond to a feasible dispatch on the grid. Given these restrictions, the TCC system can cover any sort of modification to the grid.

Unfortunately, I'm not so sure this system is going to work out because of the first requirement I mentioned. Utilities that already have a lot of wires will start out with TCCs for all those wires. We don't know if the market for those TCCs is going to work effectively, to ensure that they are eventually distributed according to people's usage of the wires. It's not without problems, but there's still some real hope that it could result in a truly market-based system.

: How can you hope for the TCCs to be distributed according to usage, if the investor can choose his own TCCs?

_: Because the best way to choose them is to choose the ones that will exactly mimic the power flow of the system.

_: If, as you say, this system allows for bad choices, then how can you be sure that all detrimental investments will be prevented?

_: The real world won't be perfect, of course. What I suggest is that if you get a pretty good match, you can get a correspondingly good result.

Discussion:

_: How do we assure that for the foreseeable future none of these investments that involve, for instance, significant use of land resources, are going to be named without someone overseeing the reasonableness of the land use?

_: And what about jurisdictional issues? Last time I checked, power markets were not respectful of jurisdictional boundaries, except perhaps in the interior of Texas.

: Well, the TCCs reward or punish you according to the benefit or detriment of the lines you build and use. What it really means is that when you look at all the total benefit that the system provides, at every node, you have to find out if the system is worse off or better off. If you have nodal spot prices, it gets worked out by the node price market. Still, you have to study the situation pretty hard to figure out whether your line is a good one or not. This is as it should be because the system is tricky and we don't want people building lines without working out the problems.

— : It worries me that this seems like a huge incentive not to build at all.

— : I think the TCCs will be just like any other investment, where changes in the market could result in changes in the benefits of the contract.

_: How does this actually get paid for?

_: Theoretically, the amount of revenue collected by the ISO in the spot market will always be enough to pay for all of the TCCs, provided the ISO is dispatching optimally.

The speaker who wanted to be sure pricing signals were being sent to the market to take care of the most expensive hundred hours: Is that going to produce either enough demand-side resources or capacity resources in real time, or are we going to have two or three years of shortages that will have to be met before that pricing produces an adequate, reliable system?

__: Frankly, I don't care how those hundred

hours get met, as long as they get met, even if it is from demand-side resources, or priced as high as 50 cents per kWh. My concern is that we should not have involuntary shortages for a couple of years, because that is politically untenable.

_: It strikes me that there is nothing to prevent generators from going out right now and negotiating with their customers a price level at which they would be willing to accept shortages. That information could be used to build a book, a base of sorts to see what is out there before we just jump off a cliff into restructuring. I am taken by some of the comments I heard earlier, that currently it's not unusual for customers to sign on for interruptible rates where they might be cut off for 80 hours in a year, and as soon as it hits ten hours a year they call up saying, why do you keep interrupting me?

_: Yes, and it seems that the customer might be more satisfied to name a price above which they would not be willing to pay for electricity. Then they are in the position of choosing the lesser of two evils rather than feeling like they are being interrupted after they've already paid for power, even though they signed up for interruptions.

_: You are suggesting that in the interim you may ask the ISO to maintain these reserve facilities as a system hedge while you figure out whether in the long run they are, in fact, necessary.

_: That depends on initial conditions. It will be true in systems that are already right up against their reserve; but in systems which still have a bit of leeway left, it's not too soon to go out and start finding out what those cutoff prices might be.

_: These transmission congestion contracts are going to be very important, and we ought to get a better explanation of them so we can make them more intuitive. If someone owns a transmission line and the price at one end is 3 cents and at the other end it's 5 cents, the line owner can sell his capacity for two cents to whoever he wants: or we could have the ISO dispatch the system, collect the two-cent differential for people who are actually moving power over the line and pay the owner two cents. Or we could use a transmission congestion contract. In this sense they are equivalent, and if there were no other complications to the system you could just let the line owner sell his capacity; when you get into a network situation, it gets a little more complicated, with loop flow and whatever making for a whole set of tradeoffs. The spot prices, if they are done with economic dispatch, always adjust in a way that is internally consistent. If someone over here is using the system in such a way that it is preventing our line owner from using his network line, the prices adjust over there in such a way that there is enough money collected so we can pay the owner the equivalent amount that he would be paid if he went through the complication of selling his rights to the line, which would be much more difficult even to define. The fact that they are equivalent makes the whole system much simpler, and provides the revenue adequacy we're looking for.

_: As long as the ISO handles the dispatch and collects the funds properly.

In other words, it is implicitly assumed that the ISO is also processing settlements. If you ask the question, how much transmission capacity is there for actually moving power between locations over the next ten years, the

answer is that it depends on everything we've been talking about today. We'll have to do a lot of simulations under a lot of scenarios in order to make assertions about what might be the range, and then make a judgement as to what the capacity is, which won't be accurate 100% of the time. We'll have to do this every time someone wants to make an investment. This is another reason why the transmission congestion contracts make everything much simpler.

Let's suppose that the network you are analyzing is embedded in a set of networks: how can you deal with just a part of that set?

That's an external network modeling problem. You can set rigid rules about area control, net outflows and inflows and so on, and the result is effectively the same as if the subset were a single network. The problem is created by loop flow, and that's a problem you'll need to deal with regardless.

It seems to me that there area number of intermediate things that one can do to prepare for the transition period without thinking that we are going to have to jump off cliffs. New pricing systems and DSM have already substantially reduced the price of those peak hours. Customers are actually getting used to the kinds of changes we're proposing.

Actually, the idea that voluntary curtailments are more politically tenable than involuntary curtailments isn't necessarily always true.

—: Yet despite all of our rhetoric about paying for the consequences of your decisions, oftentimes it's just not enforceable. We had a situation where organizations such as hospitals just didn't back up their gas supply, and when it went down, they came to the local distributor and said, give us gas. Who was going to deprive a hospital? There's a sense of opportunism that comes into this and so we started considering rewriting the rules to have mandatory backup, but even then how would you police it?

—: The problem is the shock that occurs when people are thrown onto obtaining their energy on the spot market at their locational price. They should be addressed by contract, and then you wouldn't have to worry about the politics.

The point that was made about looking under the water at the rest of the iceberg on this issue of reliability is exactly right. Everyone pays lip service to it, but the challenge is actually to solve the problems. We're dealing with both a lighthouse and a can of peas, and we will have to learn to balance those two ways of looking at different parts of the system. They're not mutually incompatible, and today's discussion has done a lot to look at ways of separating and balancing them.