MACROECONOMICS: INTERINDUSTRY AND REGIONAL MODULE PANEL

February 1, 1993 - 1:00 pm

PANELISTS:

Gerald E. Peabody, Moderator
Mark E. Rodekohr, Presenter
Paul Holtberg, Reviewer
Terry Morlan, Reviewer

AUDIENCE PARTICIPANTS:

Jim McMahon
Dr. Gale Boyd
Hugh Knox
Clair Asklund
Keith Laughlin
Bernard Gelb

PROCEEDINGS

MR. PEABODY: Welcome to our second panel on the Macroeconomic Activity Module in NEMS. We've got several changes from the listing of the speakers. Ron Earley, who was going to give the presentation, was spending the weekend doing analyses of energy taxes, and he's been called to go do some more work on that. Also Peter Blair is not going to be able to be here today because of illness.

So we're going to relax a little bit and take the pressure off the speakers to conform to the time limits and give them a little bit more time and also encourage you to talk a little bit more.

The speaker today presenting the discussion of the regional and the interindustry submodules of the macroeconomic modules is Mark Rodekohr. Mark is the Director of the Energy Demand and Integration Division. We have basically two divisions working on NEMS, the supply side and the demand side, and Mark is head of the demand side, which also includes macroeconomics and international.

Then our speakers commenting on the modeling system will be Paul Holtberg from the Gas Research Institute, who is the executive economist in the Strategic Planning and Analysis Division. He's been at GRI for a number of years, and he's been working with the NEMS working group since we started it. So he's been involved with the NEMS for a while also.

Then we also have Terry Morlan from the Northwest Power Planning Council, who's manager of the demand forecasting for them, and he was also at EIA a number of years ago working with us on demand systems then. So he has wide-ranging experience in this area.

So we'll start with Mark Rodekohr.

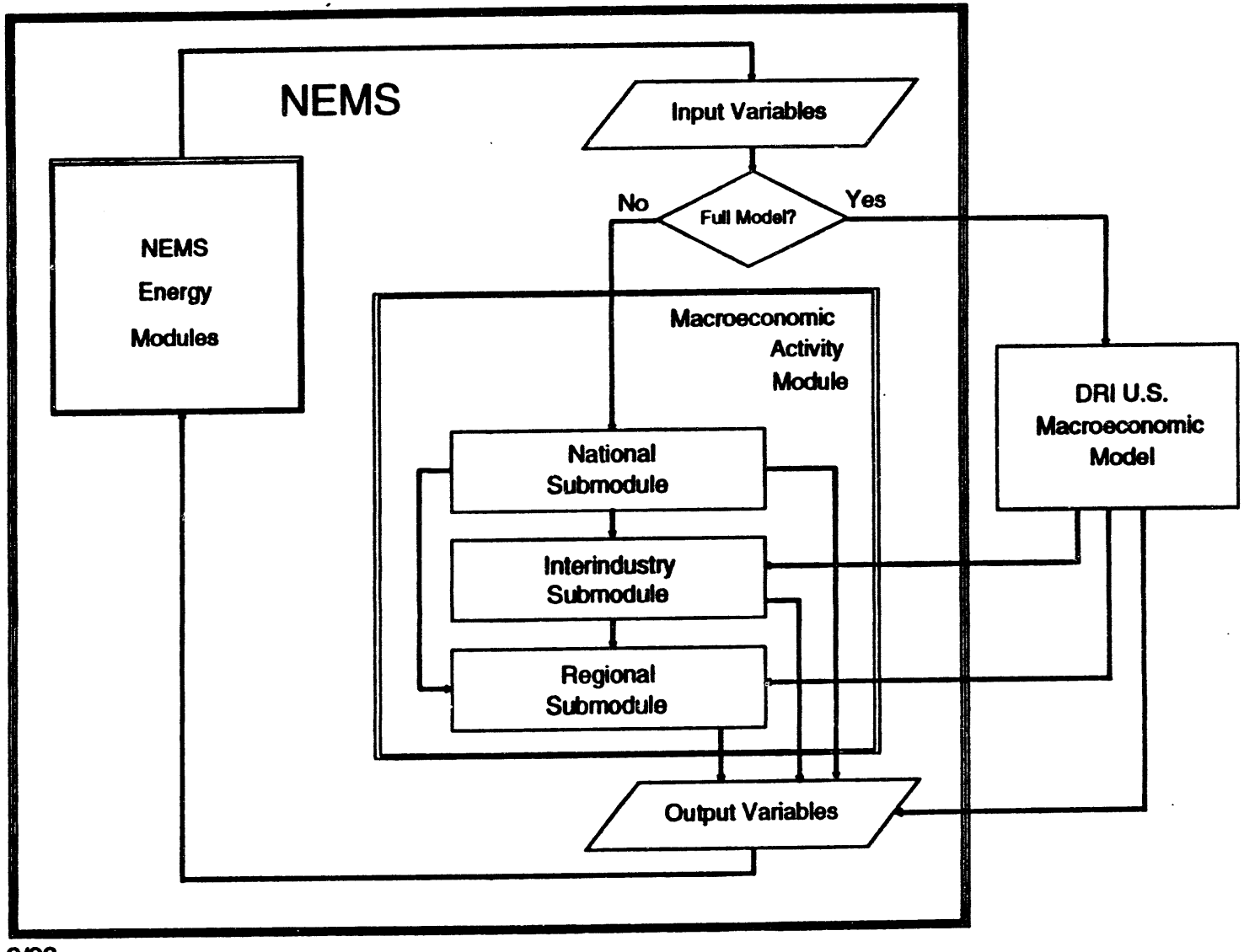
MR. RODEKOHR: This morning you heard about the macroeconomic, the national submodule of the three macromodules we use. We employ a top-down approach.

We employ a top-down approach by starting off with the National Submodule, which is a Keynesian-like model. It produces final demands and other macrovariables. The final demands go to the interindustry component shown there, and that, in turn, produces estimates of industrial production to meet these final demands.

Then we go to the regional subcomponent, which shares the outputs among the nine regions, which then, along with other variables, are fed back into the NEMS energy module. It is a closed system. The energy modules then solve and their outputs are part of the input variables back into the macromodels, and we just keep going around until we reach that magic equilibrium we're always looking for.

The first part of my talk will be based upon the Interindustry Submodule. As I said earlier, the National Submodule, given certain inputs from the energy sector, population, deficit and other factors, computes a set of final demand components.

Macroeconomic Activity Module



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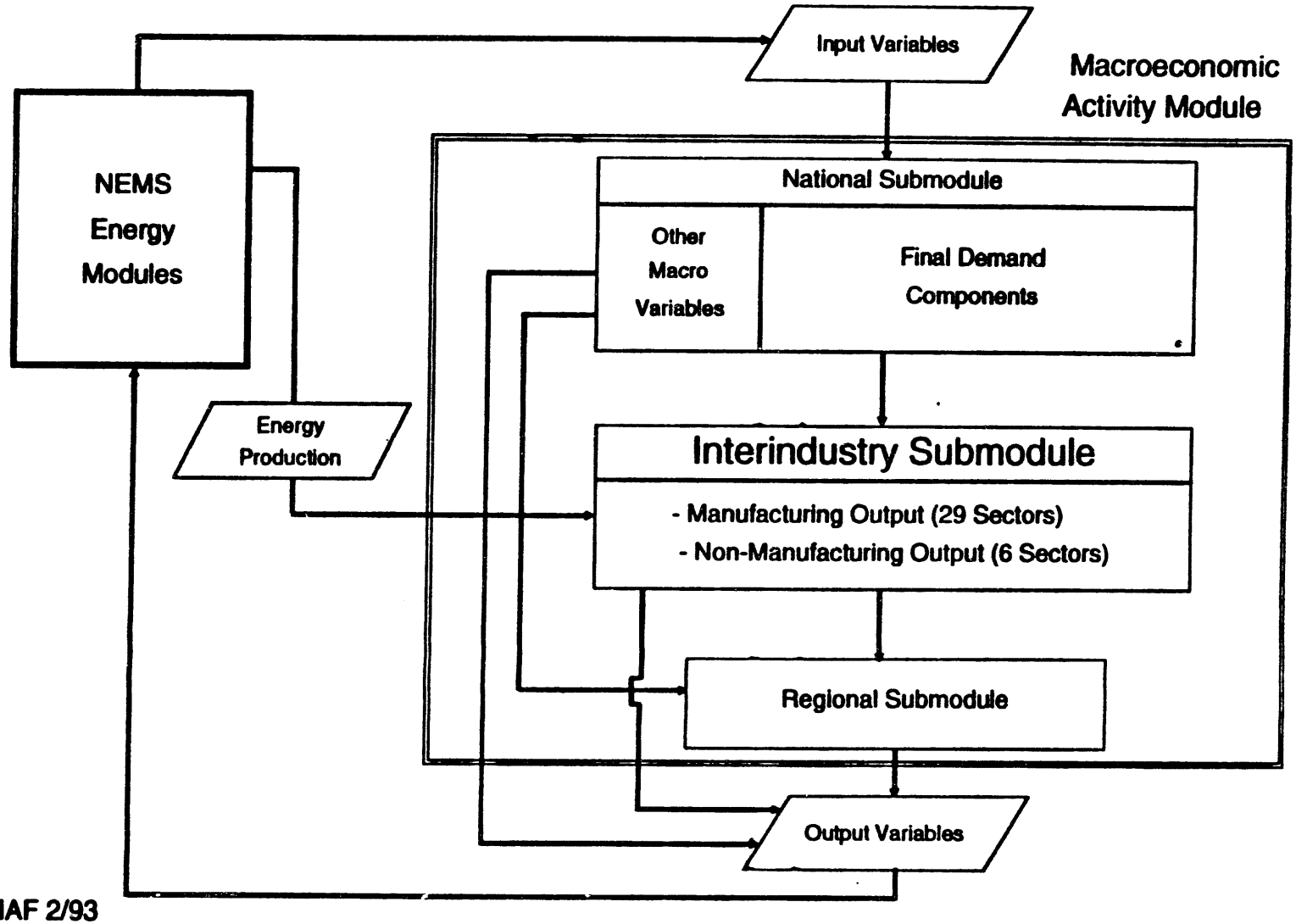
Position of Interindustry Submodule within NEMS



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The Interindustry Submodule is a classic input-output model, and its goal is to meet those final demand components in the most efficient form possible. It has 29 sectors of manufacturing output, six of nonmanufacturing output, and out of the 29, there's really -- for energy purposes, there's about five that really make a difference.

The NEMS systems have certain requirements, and we took a look at the energy using characteristics of the industrial sector and determined that breaking the sector down into about 35 groups would give us the best representation of the energy using characteristics, and that's what we did.

We supply the production activity to the industrial demand modules for the 35 sectors, and we also supply shipping activity for the transportation module because it needs to know how much freight is going to be moved around the country, and that's very important in determining diesel fuel use.

This is the impact assessment. Why are we doing this? What are we interested in these figures for?

Well, Ron and I and some of the other people in this room spent most of this weekend looking at this part of the picture with respect to a series of six energy taxes, analyzing the effect on GDP.

Then they wanted to know, well, now that you've done GDP, what about inflation; what about employment; and I imagine over the next few weeks, we'll start looking at other impacts, too. Interindustry, perhaps we'll be looking at that, as well.

We use or developed in conjunction with DRI a smaller scale representation of their interindustry model. We call this the PCIO, personal computer input-output model, from which we have derived a response surface PCIO. We can use the response surface PCIO either with the response surface version of the DRI national submodule or with the full DRI national module should we decide we need it.

The response surface PCIO model calculates the changes in the interindustry activity necessary to satisfy those changes in final demands that we got from the full DRI model or the response surface version of that model.

It's a standard input-output model. It gives the level of interindustry activity necessary to satisfy the final demands. Importantly, the technical coefficients of the model change over time, and that is important. This is not a static version of how the economy meetings its final demands, but it's ones that incorporates some idea of technological change over time.

We've been asked, "Can you use this model to look at the issue of technological change and relate it to, say, R&D funding in energy activities?" We didn't think we could really do that, and I'll be interested to hear from the audience if anybody has any ways of doing that.

The response surface PCIO model has an approach in structure that's compatible with the national submodule, and it's maintained for base line and ad hoc analyses.

Inputs to Interindustry Submodule

- Changes to Final Demands from National Submodule

- Incremental Investment Incorporated Through the Effect on Final Demands within the National Submodule

- Refining and Mining Activity Altered to Reflect Resource Extraction and Conversion from NEMS Modules

Outputs from Interindustry Submodule

- Interindustry Activity at the National Level
- 29 Manufacturing Sectors, 2-Digit SIC, Except:
  - SIC 28 Chemicals & Allied Products (5)
  - SIC 29 Petroleum & Coal Products (2)
  - SIC 32 Stone, Clay & Glass (3)
  - SIC 33 Primary Metals Industries (3)
- 6 Non-Manufacturing Sectors
- Flexibility In Interindustry Aggregation
- Passed to Regional Submodule, Integrating Module

Improvements Over Existing System

- Interindustry Activity More Disaggregated (35 versus 11 Sectors)

- Time Horizon Extended (2015 versus 2010)

- Will Incorporate a More Recent Snapshot of Activity (1987 versus 1977 Input-Output Table)

System Requirements

- Provide Baseline Interindustry Activity Drivers for 35 Industry Groups:
  - Production Activity for Industrial Demand Module
  - Shipping Activity for Transportation Demand Module

Impact Assessment

- National Submodule Determines Impacts on Components of Consumption, Investment, Government, and Trade

- Interindustry Submodule Evaluates How These Final Demand Impacts Affect Industrial Production Requirements

- In-Depth Industrial Assessment Requires Offline Evaluation

As I said before, the inputs essentially are the changes in final demands. We are hoping that we can also incorporate incremental investment activity, and by that I mean investment activity over and above that associated with the base case, into our analyses.

We can identify the investment activities in the refining sector and in the electric utility sector quite well because they are routinely calculated. The other sectors it's not so easy. So we're still exploring how we're going to do this or if we're going to do this at all.

A last point. It's worth noting we don't use the refining sector that is in the PCIO model because it would be inconsistent with our own refining modules. So we essentially replace that area of demand with that calculated from our own refining module elsewhere in NEMS.

As I talked about, we have 29 manufacturing sectors: 16 sectors at the two-digit SIC level and 13 sectors broken out in finer detail -- chemicals and allied products are really broken down into five; petroleum and coal is further disaggregated into two; stone, clay, glass, three; and primary metals, three.

This is to get at the very heavy energy users, and subcomponents of these two-digit SICs are very intense energy using industries. So we feel we have to model them on a more detailed basis.

Then six nonmanufacturing sectors. This is flexible though. We could decide three years from now that we want to change our aggregation of industries, and we can go back in and do it. It would take a fair amount of work, but it can be done.

I think the ultimate -- the IO model we're basing it on is about 110 sectors. So it can be disaggregated to any groupings of those sectors.

What are the improvements to the existing system? Well, we essentially have a lot more industries, 35 versus 11 in the old model. The time horizon has been extended. This last point is very important, and it's part of the frustration of working with input-output models. They're so dated, but we are finally going to be able to update to 1987, where we were using 1977 before.

If you're sitting in 1992 using a 1977 snapshot, it doesn't leave you with that sort of warm and fuzzy feeling. Especially if policy-makers never get around to asking you, but when they do and you say that, they just get this blank look on their face, you know.

I'm now going to change the discussion to the Regional Submodule. This is the last one. Early on in our efforts to develop a new modeling system, the subject of regionality kept being brought up. We've decided that in terms of the overall structure of NEMS, we will focus it on the nine Census divisions.

Different fuel components though will focus on different regions, but they will talk to each other in terms of the nine, and we will publish results in terms of the nine Census divisions.

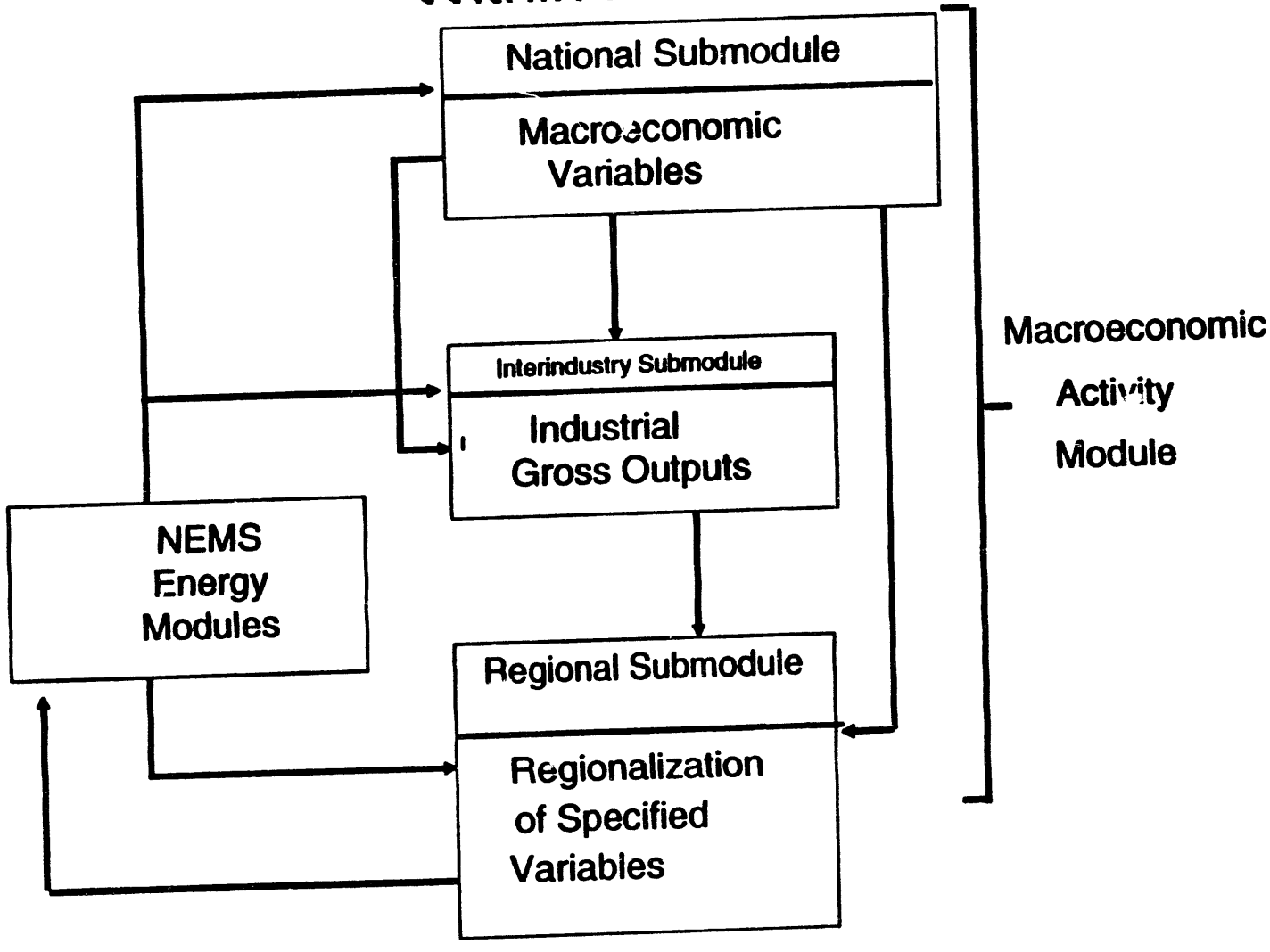
Interindustry Submodule of NEMS

- Response Surface Representation of PCIO
- Used with Either Response Surface National Submodule or DRI U.S. Model
- Calculates Changes in Interindustry Activity Necessary to Satisfy Changes in Final Demand

DRI's PCIO

- Standard Input-Output Model (Top-Down Approach)
- Determines Interindustry Activity Necessary to Satisfy Given Level of Final Demand
- Technical Coefficients of the Model Change Over Time
- Approach and Structure Compatible with National Submodule, and DRI Quarterly Model
- Model Maintained for Baseline Generation, Ad Hoc Analyses

Position of Regional Submodule Within NEMS



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System Requirements for the Regional Submodule

- Industrial output by 9 Census Divisions
- Employment
- Commercial floor space
- Income
- Housing starts and stocks

So the Regional Submodule will give the industrial output by the nine divisions, as well as employment, commercial floor space, income and housing starts.

On the commercial floor space side, we're also a little concerned. We currently have a link to employment, and we're looking into doing it a little bit differently because it is an area where it might not be growing quite that smoothly, and you certainly have some history with banks around here. They could tell you all about that, I'm sure.

The regional model is based upon an economic base or export theory. Each region will have an export sector where it will make products for other regions other than itself, and it'll have a domestic sector. It will always satisfy its domestic demands where it can and then export, and it will also import from other regions and other countries.

We have five blocks: output, employment, income, housing, and population, and like the other models, it's going to be a response surface module.

Now, in order to capture some of the unique relationships amongst regions, we're going to use the regional energy prices that we get from NEMS and production. So if you have a lot more oil production in Texas, for example, that region will reflect that energy activity.

In addition, if you've got a rapid change in energy prices in one region like, say, in the Northeast where it makes cost of production go up and you might think its output might fall because of that, that'll be reflected in there as well. So it works both ways.

It takes the gross outputs from the Interindustry Submodule and any macroeconomic variables it needs from the National Submodule.

Turning now to the outputs, there'll be the 35 industry groups we talked about for the nine Census regions. Employment, corresponding to those manufacturing sectors; income; housing starts at the regional level. This says population is an output, but it's also an input, too. So it's shown both ways, and then at present commercial floor space depends on employment in nonmanufacturing industries, and as I said, we're looking into doing something a little bit more with that.

Improvements over the existing system. It gives you a lot more regions. It incorporates changes in labor and energy costs by region, and it gives you great regional specification of the macroeconomic variables, and most importantly, it uses the NEMS energy prices in production and reflects the changes in those.

And that's really it. So I'm hoping our reviewers will show us how to do it the right way now that I've described it to you.

Thank you.

MR. PEABODY: The first reviewer will be Paul Holtberg from the Gas Research Institute.

Regional Model Description

- Based on an economic base (or export) theory
- Consists of an export sector and domestic sector.
- Five Blocks
  - Output
  - Employment
  - Income
  - Housing
  - Population
- Response surface version of full regional model

Inputs to the Regional Submodule

- Regional energy prices and production from NEMS.
- Industrial gross outputs from Interindustry Submodule.
- Macroeconomic variables from the National Submodule.

Outputs of the Regional Submodule

- Industrial Output corresponding to the 35 Industry Groups
- Employment by 2-Digit SIC classification for manufacturing industries; 1-Digit SIC for non-manufacturing industries.
- Income--disposable and personal, adjusted for inflation
- Housing starts and housing stock
- Population
- Commercial floor space--depends on employment in non-manufacturing industries

Improvements over Existing System

- Produces different regional results
- Incorporates changes in labor and energy costs.
- Provides greater regional specification of macroeconomic variables--78 concepts compared to one.
- Uses NEMS regional energy prices and production.

MR. HOLTBERG: As a first point, I just want to really applaud the effort that's been put in here. From looking through the component of these IO reports, not just for macroeconomics, but overall, it's a tremendous amount of work that's been put in, and I think it's very important and going to be useful once it's completed.

That's me being nice. Now I'll go into criticism.

First off, you need to understand the perspective I'm coming from in terms of even looking at this. I'm more of an energy modeler than a macroeconomic modeler. Most of my time is spent looking at energy models and running them and using macroeconomic inputs. I'm a user of macroeconomic inputs.

My feeling is in terms of what things are important from the perspective of an energy model, what things aren't there in current macroeconomic models, (in fact, I use the DRI model extensively), what things should be there, and what we need for answering future questions, future issues, etc.

That's the perspective I'm coming from in reviewing either of these two component designs.

First off, I want to set the stage a little bit in terms of a little broader concept, in terms of focusing on these two particular Component Design Reports. I think everybody recognizes that energy industries are a particularly small part of total economic activity. We're only talking about, well, depending on the estimates you use, some place it between six and maybe ten percent, and that's about it.

We're a very small component of the total macroeconomic activity in the country. It is that very macroeconomic activity that drives energy demand and supply. I realize this is EIA and the focus is on energy, but we spend far too much time focusing on the energy models and not enough time focusing on the economic aspects, which are the basic drivers behind those energy demand and supply numbers we look at.

We need a better balance in that effort, and to some degree this represents a step in that direction, but I don't think it goes nearly far enough, we've seen clear evidence of that. If you just look at the shifts we've seen in the underlying economic activity and the results it's had on energy over the last 20 years, it's hard to deny that the economic activity is what really drives things.

The decline in heavy industry, the shifts in production outside the U.S., the growth in the commercial and service sectors, the rapid changes in productivity have all had tremendous impacts on what energy demand and supply look like, and we just simply aren't focusing on that to the degree we should.

Third, the government needs to lead in that modeling effort. I think that there are too many statements in all the Component Design Reports which downplay or talk about the difficulty of doing something, which basically means, "Let's ignore that and go on."

REVIEW OF INTERINDUSTRY AND REGIONAL SUBMODULES OF THE MACROECONOMIC MODEL

OVERVIEW

- ENERGY INDUSTRIES ARE A SMALL PART OF TOTAL ECONOMY
- MACROECONOMIC ACTIVITY DRIVES ENERGY DEMAND AND SUPPLY
- GOVERNMENT NEEDS TO LEAD IN MODELING EFFORT

Despite the constraints that may exist, the federal government has more resources than any single private company I am aware of and has more ability to deal with some of those difficult problems than I do or anybody else in this room does. I'd like to see the modeling effort here take advantage of that advantage, of having more resources, of having more data available to it, of having more dollars available to it, to try to deal with those harder projects.

You might relate it to the concept of, a far stretch, of defense where the private citizen can't take on defense by himself, but I'd like you to take on the hard modeling problems that the private person or the private company can't take on themselves, and we tend to be ignoring a lot of those in terms of the way we're approaching this. We're just pushing them aside and using the existing structures.

Now, really only two broad goals were approached in this whole effort. One is obviously a need to do methodological updates and improvements on the modeling structures as they existed before. Nobody can argue with that. If you know you've got a problem, you want to try to fix it within the structures.

The other thing which is probably the most important broad goal that you're trying to do here is that you're trying to develop a model which is capable of answering tomorrow's questions, not today's questions, but tomorrow's questions. You've got a model here which is showing a picture through 20 years. Presumably it's going to be in use for more than one year. I want to be able to answer tomorrow's questions.

Now, the first thing you need to do in looking at any of these models is say: "What are tomorrow's questions and what do they mean in terms of what I need from that model?"

Some obvious ones, as I've listed here: issues dealing with the environment. That is a question today -- I don't think it's going to go away tomorrow. From a macroeconomic perspective, it has major impacts in terms of capital costs.

The cost of capital is not just interest rates. It's the cost of the capital itself in terms of manufacturing.

There are potentially big regional variations. I don't think anybody from California is going to argue with that relative to a lot of other regions in the U.S.

Another issue is revenue raising or expenditure cutting. I don't know how we're going to deal with the deficit on a federal level or a state level, but it has major implications for macroeconomic projection both in terms of federal, state, and local taxes, regional variations in terms of the strengths or weakness, levels of disposable income. You may have an absolute decline in disposable income. Inflation rates, interest rates, et cetera, which all need to be dealt with.

There's technology change, which was mentioned, and I'll get into that more later as we look at the specific models. Obviously that has implications for output shifts, material requirements, dollars, quality of goods issues, etc. All impact on the macroeconomic side and eventually on the energy side.

BROAD GOALS FOR EFFORT

- METHODOLOGICAL UPDATES/IMPROVEMENTS
- DEVELOP MODEL CAPABLE OF ANSWERING TOMORROW'S QUESTIONS

POTENTIAL QUESTIONS WHICH COULD IMPACT ENERGY

- ENVIRONMENT
- REVENUE RAISING/EXPENDITURE CUTTING
- TECHNOLOGY CHANGE
- GENERAL WELFARE ISSUES
- INTERNATIONALIZATION OF WORLD ECONOMY

General welfare issues, medical costs, inner city reconstruction, infrastructure issues. They all change the relationships between macroeconomic activity and energy activity.

Obviously international issues. Now, I recognize there's a need to choose which issues you want to deal with when you set up a model. But what we've done up to this point is we've compromised too much in the current set-up of the models. I think we're avoiding dealing with a lot of issues which need to be dealt with, which we need to try to find hard answers for, and you need to be able to clearly understand those issues to even try to deal with them.

As modelers, we do too much of patching of model structures when the question comes up in two or three years, as opposed to trying to anticipate the question and plug something to deal with it into the model structure as we build the thing.

Now, the key attributes to try to deal with that looking forward aspect of things is done to some degree within these models, and I've heard a lot of people mention the words. It's like one of those types of things that you can't ever say you don't like, you know, like flexibility, modularity. Coverages I've got up here; ease of structural change.

But those are real things that you have to make sure are incorporated into the model. The structures here, the interindustry and the regional, are taking a move in that direction, but you really need to think whether it's gone far enough to incorporate enough information to try to deal with the questions that you've got to deal with in the future.

Let me turn to the models themselves. I'll tell you what. The only thing I really want to point out in this slide because we've already heard an overview of the models, there's really only two changes being made here. You're extending the time horizon, and you're increasing the industrial coverage.

From what I've said already it's obvious that I think that's the right direction to go in. I think you probably need to do more. Let's go on to the next one.

Let's take a look at the problems at least as I focus on them from this structure. The first problem which was alluded to in the presentation is the handling of technology itself. It wasn't alluded to as a problem. The coefficients on the IO are not static. They're dynamic, but the dynamism of them is due to changes that take place in the energy modules in the national macroeconomic submodule. At least that's what I'm reading from the Component Design Report. In other words, they're being adjusted as they're fed down into the structure.

So the technology seems to be handled from a national perspective. What that misses, even with the level of detail you have here, is sub-interindustry technology changes. What I'm implying is even at 35 industries, you're still too aggregate.

A lot of the change which has taken place over the last ten or 15 years on a regional basis or an interindustry basis has to do with change in the mix of the industry at a three and four digit level of SIC code, and we need to focus on that a little bit better if we're going to get a reasonable projection using these model structures.

KEY ATTRIBUTES IN MODEL STRUCTURE WHICH ARE NECESSARY WHEN LOOKING FORWARD

- FLEXIBILITY
- COVERAGE
- EASE OF STRUCTURAL CHANGE

Obvious factors that the technology might impact would be things like productivity, the employment mix, and of course, the output mix.

Along the same line, there are other factors that we're missing at a sub-interindustry level, going below the 35 industries we've had here. Changes in capital mix, changes in output mix, process changes which have a big impact both in terms of requirements for capital and also in the way they feed through to the energy models.

Some of this crosses over and starts to deal with both the energy module and economic module, but there's a need to coordinate those and probably take a more detailed look.

There's an old problem which is imbedded in all of these structures, and that's a reliance on dollars as a measure of output. Most people are familiar with that, but what I'm talking about is an issue of the quality of the products themselves.

A dollar today is not the same thing as a dollar in the year 2000 or 2010 both in terms of what it implies for the absolute physical level of output or what it implies in terms of the requirements for inputs to the process of production or in terms of what it requires in terms of energy.

There's a real need to look at a quality issue in terms of the production we're talking about, and all of these models, particularly the economic models, are relying on dollars as a measure of output and as an absolute change which takes place over time, and you miss a lot by doing that.

You're also creating a problem by picking up the extraction industry data from the energy modules. The way I read the Component Design Report, and I'll quote here, is that the "physical quantities" -- and that's from the energy model -- "will be used to calculate growth rates. Those growth rates will then be applied to the base year constant dollar output levels." That's for oil production, gas production, etc., coal production, if I'm correct.

What that should suggest to you is if I'm doing it that way, it implies constant energy prices implicitly by that equation. Of course, you're not assuming constant energy prices, which means you're missing the dollar value of the extraction industry by a factor of whatever your energy prices change by. Automatically you're imbedding an error within the model by doing that.

That's not an appropriate way to pick up the output of the extraction industries. It doesn't work.

Let me turn to the regional submodel, and again let me skip some slides. I didn't want to run through, again, the characterization of the model. Obviously we've heard that already. We don't need to do it again.

The only reason I'm putting this up is because despite all the changes and what I would call rhetoric to say that we're doing something different, the regional model here is essentially

INTERINDUSTRY SUBMODULE

- WHAT IT DOES
- STRUCTURE EXISTS TODAY
- TWO AREAS OF CHANGE:
    1. EXTENDING TIME HORIZON
    2. INCREASING INDUSTRY COVERAGE

INTERINDUSTRY SUBMODULE
ISSUES/PROBLEMS

- HANDLING OF TECHNOLOGY CHANGE OVER TIME
- MISSING SUBINDUSTRY CHANGE
- RELIANCE OF DOLLARS AS MEASURE OF OUTPUT
- USE OF EXTRACTION INDUSTRY DATA FROM ENERGY MODELS

still just a sharing model structure. You're sharing out the national level outputs to a regional level of detail.

There are equations which deal with certain aspects of it, industrial output, income, employment, housing, except that the bottom line is, when you get regional totals for these variables, specifically the variables underlying the modules, you add them up. If they don't match the U.S. macrolevel total, you basically adjust them. You proportionately adjust them so that they match the national level total.

In any other words, that's a sharing model. And in fact, it's even worse than that because depending on how you adjust them, whether it's proportional or not proportional, you are creating a level of problem. You're ignoring the information you just got from your regional models. You're saying your national model is correct, and you're basically just throwing it out, and there may be some real information there that you're just chucking out the window.

Right now it's just simply a sharing model. Again, I would say from that perspective it's not aggressive enough. It's being too conservative. I'm not necessarily suggesting that you use a complete bottom-up approach to modeling here on a regional basis, but I am suggesting that you have some valuable information in those regional numbers, and by just proportionally adjusting it down to the national total is throwing it out.

But you need to try to figure out a way to use that information if you think it's valid. If you don't think it's valid, you don't need to go through all of this. You could share it out a lot easier.

Now, the problems that I'm going to cite from the perspective of the regional model are as I see them in the Component Design Report as they are written, and I understand the regional model right now is being developed. So some of these problems, I think, are being solved. Some of them are ones that you're trying not to deal with. You're just throwing them out the window altogether. Some of them are probably real.

First off, I'm not sure if you're dealing with shifts within a region. By using this trade model, you're dealing with shifts between regions in terms of activity, but I don't think you're dealing with shifts within the region. In other words, you're developing national output levels for certain products, and then you're sharing it down to the regions, and you're assuming that those shares are based on some historical measure of share by region.

But we've seen over the last 10 years severe shifts within regions in terms of the products and between regions. A good example would be the west-south-central region where, because of the energy problems during the 1980's we've seen a strong impetus to try to push that region into more technology type production. So, the balance of production even within that region has changed aggressively over the last ten years or so. And the model, the way it's currently set up, is going to miss that.

There's no regional variation in capital cost, and I'm not just talking about interest rates here. There is simply just no variation due to environmental regulation, due to all sorts of types of regulation on a regional basis.

REGIONAL SUBMODULE

- WHAT IT DOES
- NEW MODEL STRUCTURE

IMPORTANCE OF REGIONAL SUBMODULE

- NEED FOR REGIONAL ANSWERS
- SUBSTANTIAL REGIONAL VARIATION EXISTS

REGIONAL SUBMODULE CHARACTERISTICS

- FIVE PARTS TO SUBMODULE:
  1. INDUSTRIAL OUTPUT
  2. INCOME
  3. EMPLOYMENT
  4. HOUSING
  5. POPULATION
- BASICALLY STILL SHARING MODEL
- NOT AGGRESSIVE ENOUGH, TOO MANY COMPROMISES

It's hard to ignore the fact that there is a lot of state regulation which changes relative capital costs between regions. You just can't ignore that.

You're using historical share elasticities for industrial output. You're basically saying the future is going to look like the past, like we all do in a lot of these models. Unfortunately the future doesn't usually look like the past.

You need to take a look at the factors that have impacted the relative shares of output by region to determine if they're reasonable things to assume about the future. You need to take a little time to do a little more studying than just using historical data in this particular case.

I would venture to guess that you'll find that the historical share elasticities and what comprise those shares are not going to be very valid in many regions for the future because they dealt with specific things that happened, where maybe a region was more energy intensive than another region or maybe it was more labor intensive in terms of its production, etc., which will adjust those in the future.

There's also some capital availability variation by region. The model doesn't limit capital availability by region. I think when you deal with issues of S&Ls failing, assortment of banks, just general issues of what's going on in that region, I think there is a need to take a look at capital availability by region, and that's not as big an issue as some of the others.

The Component Design Reports make a real clear statement that they're going to ignore regional taxes. Regional taxes vary substantially by region. I'm sorry. That's just something you can't ignore. It's there. It's real.

Even if you only take the variation in taxes which exist today, it should be at least input into the model. You shouldn't just basically assume it away. You can't do that.

There's also an issue of technology introduction, which also varies by region to some degree. The sensitivities here are more related to the energy models, at least from my thinking. We're talking about, for example, the types of heating systems which vary by region, as do the capital costs associated with them. In many cases, the types of production may vary by region depending on the resources available in that region versus another region.

The technology introduction does vary by region. In fact, technologies are targeted for sale in certain regions around the country. They're not always targeted on a national basis.

One thing that bothered me a lot was the CDR seemed to suggest that regional energy consequences are going to be addressed through the energy supply and demand models, and that the regional macroeconomic models only address secondary impacts. That's almost the wording that was in there.

In my thinking, that's circular reasoning. The basis of those regional energy consequences in many cases is the macroeconomic variables and what the underlying activity is, as I said earlier. You need to look at those first in terms of the drivers going into the energy.

REGIONAL SUBMODULE
ISSUES/PROBLEMS

- SHIFTS WITHIN REGIONS OVER TIME
- NO REGIONAL VARIATION IN CAPITAL COSTS
- HISTORICAL SHARE ELASTICITY FOR INDUSTRIAL OUTPUT
- CAPITAL AVAILABILITY DOES NOT VARY BY REGION

REGIONAL SUBMODULE ISSUES/PROBLEMS (CONTINUED)

- NO REGIONAL VARIATION IN TAXES
- TECHNOLOGY INTRODUCTION
- REGIONAL SUBMODULE ONLY ADDRESSES SECONDARY IMPACTS OF ENERGY CHANGES

REGIONAL SUBMODULE
ISSUES/PROBLEMS
(CONTINUED)

- HISTORICAL SHARE ELASTICITIES FOR EXPORTS
- HANDLING OF REGIONAL EMPLOYMENT
- COMMERCIAL BUILDING STOCK

I'm not sure what the point was being made there, but I don't think it makes a lot of sense. I think it's a case of the tail wagging the dog as opposed to the dog wagging the tail.

Similar to the issue of the share elasticities for output, historical share elasticities are being used with exports. Again, there needs to be an evaluation of the determinants behind those shares in the past, and it needs to be reviewed from the perspective of it doesn't make sense to apply those historical relationships as you move out into the future. In a lot of cases it doesn't between the regions of the U.S.

Regional employment was made a function of national output, national output per worker and regional output. That implies simply there are no regional productivity differences, which doesn't make any sense.

If you believe that education raises productivity and if you have different education levels in different regions of the country, you'd better hope there are differences in productivity by region. Either that or you're telling me that education has no impact on productivity at all, in which case we can stop investing a lot in education.

Commercial building stock, I'm glad to hear it was mentioned before because if you read the CDRs, it's mentioned as an afterthought on one line. I applaud the concept of taking a look at something more than just employment in the regions because obviously that's not sufficient.

The bottom line is you're simply assuming away too many variables. There are too many variables which are important on a regional basis which you need to consider in a long-term forecast. Water availability, regional capital availability, regional productivity differences, etc. Those are very, very important.

In conclusion, I think I've been relatively critical of both structures. That's part of my job. Again, I want to applaud the effort, but I think there are a couple of points.

As I said earlier, you need to be more aggressive in terms of developing the model structure. You need a much clearer concept of what questions you're answering in the future. You should be doing that first, then building the model second.

You need to take more time to explore the issues. I know everybody's got schedules, but schedules sometimes make you do things that aren't correct just to get by. You should view this as a research product and not just an ends to a means.

And last, as I said earlier, I think the macroeconomic modeling needs to receive a lot greater emphasis than it's being given currently, even if it is from EIA.

Thank you.

MR. PEABODY: And our next speaker is Terry Morlan from the Northwest Power Council.

MR. MORLAN: Hello.

CONCLUSIONS

- BE MORE AGGRESSIVE
- HAVE A CLEARER CONCEPT OF FUTURE QUESTIONS TO BE ANSWERED
- TAKE TIME TO EXPLORE KEY ISSUES
- NEED GREATER EMPHASIS ON MACROECONOMIC MODELING

Jerry announced that having more time as if it's a good thing. I don't know how he feels about speaking in public, but having more time is not necessarily such a great deal as far as I'm concerned, especially since a good bit of what I was going to say has already been said either in the macro session this morning or just now by Paul.

I, too, would like to congratulate EIA on the progress they've made in the NEMS design so far. It's quite an accomplishment even for a group of people as experienced in modeling the national energy picture as EIA staff are, and I was at EIA during the '70's when there was a lot of exciting work going on. It was kind of a fun place to work, and I was also there in 1980 and 1981 when it wasn't such a fun place to work, and I hope that working on the NEMS has restored a little bit of the excitement and fun of working at EIA for the EIA staff.

I basically agree with the general balance that has been struck here between analytical capability, on the one hand, and pragmatism, on the other. I'm pretty much a pragmatic economist, and I think there's been a balance there, although I really mourn some of the capability that's been left on the cutting room floor, so to speak.

There are four areas that I would like to comment on in general and the things within these areas slop over on each other a little bit, but one is the nature of the energy feedbacks to the economy, and these have really been mentioned by previous speakers.

The second is balance in the treatment of various sectors in the economy and in the energy picture. A third one is the treatment of uncertainty in the model. And, finally, some comments on the regional forecasting specifically.

Let me start with the energy feedbacks. I guess my feeling is that the feedbacks to the economy, as the model is designed, and particularly in the response surface model are quite limited. There was quite a bit of discussion of response surface models in the macroeconomic session. I assume that a lot of you were there, but there was a good analogy to a reduced form model given in that panel, and that was G.S. Maddala's reduced form speech. He said, "Basically, you've got an elephant here, and you've got a work horse, and you want to make the elephant into a work horse, and that's really all I have to say." That was a reduced form speech. He took the essence of what he had to say and said it pretty quickly.

In terms of the feedback, first of all, as I understand it, the energy price feedback into the economic model takes place in the form of an aggregated wholesale price index of fuel and power. If that's the only energy price feedback you've got into the response surface model, then it seems to me all you're likely to be capturing is general inflationary effects of energy prices.

And the effects of changing energy prices are really much richer than that, and part of the problem here is that there is no way in the structure of the models as designed now for relative prices to feed into the economic structure of the economy. This is partly because the -- well, first, because if you aggregate the prices, you won't get the relative prices, but secondly, you can't -- the way the model is structured now, the input-output coefficients are fixed essentially. They've been described as varying over time, but what's really going on there, is that they're being calibrated to a series of historical years, and then you put some sort of a trend

Review of the NEMS Interindustry and Regional Economics Sub-modules

Terry H. Morlan

Northwest Power Planning Council

AREAS OF COMMENT

- Energy feedbacks to the economy.
- Balance: Sectors that get too little attention.
- Treatment of uncertainty.
- Regional forecasting.

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FEEDBACKS TO ECONOMY

- **Response surface models of limited use.**
- **Macroeconomic feedback.**
  - **Price feedbacks primarily limited to general inflationary effects.**
- **Interindustry feedback.**
  - **Unbalanced energy model overrides.**
  - **Demand-side feedbacks do not exist.**
  - **Fixed I-O coefficients and bridge matrices.**

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on them.

They aren't endogenously responding to changes in relative prices or changes in demand factors, for example. The bridge matrix that goes from aggregate final demand categories down to input-output categories is a fixed scaling of the demands, as well, and it seems to me that there's an awful lot of the response of the industry, of the economy in general to energy prices and energy policies that have a lot to do with the structure of the economy.

If you look at the studies of changing energy, GNP ratios, for example, and most all of those types of studies find that about half of the effect of the energy price changes or about half of the effect in reduced energy GNP ratios has been due to structural shifts within the economy among the importance of various industries and so on rather than direct elasticities of some sort at the individual industry level.

So those kinds of structural changes, it seems to me, are quite important.

I think that there were real practical reasons for not picking some of the models that have more dynamic input-output coefficients, but I wonder if there's not some way to take advantage of those types of models that can respond in an economic structure to change in prices and policies over time and try to maybe -- try to derive some trends in the coefficients from those types of models that could be plugged into the NEMS system.

It might be a compromise between the two that could be achieved that way.

In terms of response surface models briefly, I think it's -- I'm really glad to hear that the coupling between the full-scale DRI and the input-output models is being changed because response surface models -- you have to design them specifically for the kinds of questions you want to answer, and my experience has been, anyway, that we're really not much better at forecasting what kinds of questions we need to answer in the future than we are forecasting anything else in the future.

Let's move on to some questions of balance. It's stated in the Component Design Reports that there's some direct feedbacks or overrides from the energy sectors in NEMS to the macroeconomic and interindustry models, and in particular, that the results from oil, natural gas, coal and refineries override the o· tput results of the interindustry model.

I guess my question is: what about electric utilities? Why are we not trying to get some of the results from the electric utility model directly integrated and overridden in the macro and interindustry results, as well?

And, secondly, what about demand side resources? That's part of the problem of the fixed coefficients, again, that if you do demand side investments, and I think NEMS is making a real effort to try to incorporate demand side investments in an integral way into the system, although I'm not sure very many of you have seen that. A Component Design Report just came out a few weeks ago that deals with that, and I was really encouraged to see that.

BALANCE

- **Among energy supply sectors**
  - Electric utility treatment
- **Between demand and supply side resources**
  - Effects of demand side energy investments ignored.
  - Broader problem with NEMS.
- **The service or commercial sector.**
- **The international sector.**

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My comment, you see, said that the broader problem with NEMS on the demand feedbacks, and if that new demand side load and demand side management system works as advertised, that's going to be a real advance in that area for the modeling, and I'm glad to see it.

It may be that the reason we don't have electric utilities feeding back into the system is indicative of a little bit broader problem that has to do with the service industries and the economy in general. I'm not sure what it is about economic modeling. Maybe it's the economic base model or maybe it's that manufacturing industries are sexier than service industries for some reason or maybe it's the old arguments about taking each other's laundry in, but in general, it seems to me that the service sector receives far too little attention in our thinking about the economy.

You think about the service sector a minute and what it means. Actually about 80 percent of non-agricultural employment is in the service sector. About half of the output is in the service industries, and if you look at the energy consumption side, the commercial sector, which is mainly service industries related, it's about 16 percent of energy consumption in the economy. It's not a small industry by any means.

And if you look at energy intensity and think about what's happened to the service sector over time, it's been a growing sector of the economy, and yet that growing sector of the economy is not nearly as energy intensive as the manufacturing sector.

Now, the manufacturing sector, for example, uses about eight times the amount of energy per employee as the service sector and about three times as much energy per dollar of output as the service sector. So when you're shifting from one of those sectors to the service sector, it really can have a fairly significant effect on the energy demand.

So I think it deserves a little bit more attention than it's getting.

And another factor in that regard is that it's hard to find the service sector detail sometimes in the design report, but it appears to be at the one digit SIC-level, and in my experience of the types of models we use, that's not enough detail to drive a typical commercial sector end use demand model like NEMS is supposedly going to incorporate.

And in the housing area, as well, you don't see a mention of breaking down housing stocks into single family, multi-family, and manufactured housing, and those kinds of details are really needed to drive the demand models in NEMS.

It seems to me that those kinds of breakdowns should be done in the macroeconomic or interindustry regional models because they're basically a function of demographic and economic factors and not done at the demand model level probably.

One final area in terms of balance is that there's really not much discussion of international in the design report, and I'm not sure what is really intended to be there, but in terms of thinking about what things from the NEMS supply modules and so on could be input directly into the economic forecasts, international sector has certainly got some candidates in

terms of petroleum imports and exports, imports of gas from Canada, and so on.

Let's move to uncertainty for a minute. It's been my experience in dealing with uncertainty and the risk that that entails in terms of energy planning and so on that when you look at the bands of uncertainty on various factors, that the economic inputs pretty much dominate all the other uncertainties in terms of your results.

And one concern I have about what discussion did take place on the uncertainty in NEMS was that it appeared that the uncertainty was focused on macroeconomic national level uncertainty, and with an economic potential model of the type we're talking about, the uncertainty at the national level in terms of long-term growth is really not all that big.

You pretty much know where the labor force is going to go based on existing people and fairly close trends on labor force participation rates, and you've got some idea of what kind of productivity gains are likely to occur, and so when you try to generate a wide band of uncertainty from a national forecast, you have trouble generating one with most models.

And yet if you go down to the regional level for a regional economy, uncertainty is much wider than it is at the national level. In and out migration play a much larger role in a regional economy, and similarly, if you start to break down aggregate economic activity into industry level activity, the uncertainties become much larger.

I mean it's just a fact of life. I don't know whether it's the law of large numbers or what it is, but whenever we're doing forecasts and we're comparing them to actuals, compensating errors always save us, you know. In the aggregate it looks pretty good, and you start to look in a little more detail and you find out that things are a lot worse when you get down to the detail, but they do tend to offset one another.

So it bothers me a little bit knowing that economic uncertainty tends to dominate in this analysis and that the only economic uncertainty that apparently is being talked about here is aggregate macroeconomic uncertainty so that changing industry mix or uncertainty about industry mix, for example, which may be quite larger and can have very serious impacts on energy use are not really being built into the uncertainty structure is a bit of a problem.

What our goal really should be in planning is to minimize the expected value of energy costs in the economy or something on that nature, not ignoring variance. You ought to be looking at the variations and what kinds of energy policies really can help you reduce the risk due to uncertainty in the future.

What kind of energy policies would reduce the adaption costs following a large change in energy prices or some kind of disruption in energy prices? What's the optimal size of the petroleum reserve?

These kinds of questions require an integral approach to uncertainty that I don't see existing right now in NEMS.

Finally, let's turn to regional things. There's a lot of additional detail being added to the

UNCERTAINTY

- **Aggregate economic uncertainty understates energy and regional uncertainty.**
  - **More uncertainty at lower levels of detail.**
  - **Differing impacts on energy.**
- **Goal of planning should be lowest expected value of energy service costs.**
- **Can NEMS identify risk averse energy policies?**
  - **For example:**
    - **What energy policies minimize the economic disruption of future energy price changes?**
    - **What is the value and optimal size of strategic reserves?**

regional modeling capability in NEMS, and I think that's good. I won't try to talk about what all that includes, but basically increasing the number of regions from four to nine helps, providing outputs as well as employment, income, population and housing, those are all important drivers if you're going to have demand forecasting inputs at the regional level.

I think like Paul though, and maybe for different reasons, I have the feeling that this regional model is going to end up essentially being a sharing model, and maybe that's the best we can do. I hope I'm proven wrong, but let me give you an idea of some of the things that worry me.

First of all, the economic base models, I don't want to evaluate economic base models here, but it seems to me that the longer period of time you try to apply an economic base model over, or the larger a region you try to apply it to, the less applicable it becomes, and Charles Dubois at one point said that if you follow the economic base model, then the only way the world economy could grow and prosper would be if we export to celestial economies.

The other thing is maybe the economic base strategy is the reason we don't pay much attention to the service sector. After all, it implies it's just a trailer. It's an afterthought, and it's really driven by the industrial sector.

So in my opinion, at least, the level of aggregation that we're talking about here is too big to apply an economic base model, and I feel like the time period is way too long to apply an economic base model in spite of the real gut level attractiveness of the economic base systems to most people.

It's advertised in the CDR that the economics sharing will be able to change over time based on regional employment and energy prices, and one of the reasons that those particular variables aren't going to help very much and you'll end up essentially with a sharing model is that when you aggregate to something as large as the Census Divisions, meaningful differences in electricity prices and wages are probably going to be aggregated out, and you'll have a very difficult time getting a reliable and significant result when you estimate these equations econometrically.

Again, I'd be happy to be proven wrong on that, but my experience has indicated that's real tough to do.

One comment. I was a little bit confused. Paul mentioned something about the employment equation. I guess he looked at a different employment equation than I did. I saw an employment equation for the regional model that had in it a variable which was the aggregate employment for a specific industry in the region as a function of the aggregate employment over all industries in that region or function of aggregate wages -- excuse me -- in all industries in that region.

When you think about what that variable is going to capture and whether it will really help you explain changes in regional shares or not, when you think about it, the theory put out there was that if you've got higher wages, that would tend to detract from regional growth. But what is that variable really likely to be measuring?

REGIONAL FORECASTING

- Additional detail is good.
- Economic base theory becomes less attractive as region size grows.
- Size of regions likely to hide differences in wages and energy costs.
- Aggregate relative wage may be a weak variable in industry employment equations.
- Role of international exports can be very important in some regions.

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Well, it might be measuring just industry mix. You know, maybe the region has got a larger share of high wage industries, and so then what you get is that high wage industries, a regional of the mix of high wage industries would tend to not grow as fast as other regions because the wages are high? It doesn't necessarily follow.

The other interpretation, or maybe it's both, would be that the high wages in that region reflect the quality of the local labor force, its productivity in general, the education levels, which should be attractive to regional growth in the general thinking about things, and if that's the case, then, you know, what sign do you expect on that variable?

And in fact, probably again you may have trouble getting a significant sign on such a variable because it's got one direction on the demand side and another on the supply side.

And just to link it back to economic base, I think that the latter interpretation of the thing, which is quality and the supply of local labor force, that's one of those supply side determinants of economic growth that's not accounted for in economic base systems. So there may be a connection there.

Finally, there doesn't seem to be any role in the regional model for international trade. It may have just not been mentioned, but there wasn't any mention of it that I could see, and there are some regions where international trade is a much more significant part of the local economy than is true for the nation as a whole, and probably need to reflect that in some of the regional models.

Well, finally, although my comments, I guess, were focused on the scraps on the cutting room floor, going back to the earlier analogy, I really have been impressed with what's been accomplished so far in a relatively short time, and I hope that after a period of testing NEMS will become the primary analytical tool for the national energy policy development.

I had a chance to be involved with the National Research Council committee that worked on the NEMS recommendations, and it seems to me that EIA has really made a good quality and sincere effort to try to follow the recommendations and incorporate the kind of factors that were in that committee report, and I'm really glad to see that.

MR. PEABODY: We're going to have a couple of rejoinders. Mark is going to say something, but I also want to put the staff who are doing this on notice that if you would like to say something, start thinking about it.

Kay Smith is sitting here. She's been involved in the regional model. Brian Unruh is over here. He's involved in the interindustry, and then Jason Altman sitting beside Brian has been involved in various aspects of the NEMS implementation.

Mark.

MR. RODEKOHR: Well, first of all, I did think the comments were very good, and I thought there were some very good suggestions for looking at some differences, new things to

explore in the future.

I guess maybe some of my comments are just to clear up misunderstandings. Others will be a little more argumentative.

On the regional variation in taxes, you're quite right in that the macro part of that isn't captured, but the energy part of that is captured. The various supply conversions' submodules do have different tax structures depending upon the region in question.

Terry's talk, the use of a dynamic IO is something worth looking into, and it certainly adds a level of complexity to what we have, but certainly something that's worth considering, too.

Why we don't use electric utilities like we do refineries? Well, we'll have to explore that. I'm not sure where that lands in the IO calculations, but you're probably right, and we probably ought to, and we'll do that.

And as far as one of the other questions you asked, what about the value and the size of the SPR, NEMS doesn't need to know that. We've already done that study. It's under 750 million barrels.

Thank you.

MR. PEABODY: Additional comments, questions?

MR. McMAHON: I'm Jim McMahon from Lawrence Berkeley Lab. I have a question for the two panelists.

The gist of both of your comments, part of it seems to be at the level of disaggregation, geographic disaggregation, and I'm wondering if there are models that are at the state level. You make specific recommendations about what level of detail you think would be adequate and identify any models that exist at a greater level of detail.

MR. MORLAN: I guess that I would hesitate to jump from what I said to the conclusion that I want more detail. I think what I would say is that at the level of detail they're working at, probably some fairly simple sharing scheme is about all you can expect to use pragmatically, and that maybe it's worth trying to get to something a little more dynamic, but it would be very difficult at that aggregate level.

There was a comment in the macro session, something about creating a market for the new equations. I don't know if any of you heard that. It's akin to offsets for CO_2 or SO_2, and that if you add more equations you ought to have to get rid of some somewhere else before you can do it.

I guess I subscribe to that. It's a good idea, and for that reason I guess, although there may be some state level models that are available, I'm not sure that it's that important for NEMS to try to go to that level of detail.

MR. HOLTBERG: There was a point made by Jay Edmonds earlier this morning in which he said that, you know, in looking at the DRI model, its focus largely is realized GDP, and from that perspective in terms of using a macroeconomic model for energy modeling, maybe there's a need to build a new macroeconomic model, and I think his real point was that most of the macroeconomic structures that are built today were not designed for use in an energy model specifically. So they don't always address the right aspects of what you want to deal with.

My comment is really not so much that you need to go to a much greater level of detail; it is that maybe what you need to do is focus a little better on the things that are important from a regional model or from an interindustry model in terms of the energy output or the energy model itself, and structure it a little bit more in that way.

And what I'm suggesting is there's a lot of things missing, and that's more what I'm saying as opposed to going to just simply a greater level of detail without respect to what you're putting in that detail.

DR. BOYD: My name is Gale Boyd from Argonne National Laboratory.

Paul referred specifically to issues of regional variation and capital costs and capital availability. Were you talking -- I understood the point that was made about how regulation places specific capital requirements on the firm and that raises their cost of capital because they have to invest in those kinds of equipment, but you seemed to also hint at the notion that there may actually be something akin to capital rationing going on in terms of the cost of capital that firms use.

Is that part of your comment on capital availability or are you talking about simply, well, there's not a bank down the street to lend it to us?

MR. HOLTBERG: I think it's a combination of the two, and what I'm really suggesting there is that maybe you want to address it by taking a look at what data's available, to look at issues such as maybe possibly rationing by region, issues of limited capital availability, for example, in inner cities due to bank rationing where they basically say, "I'm not going to lend here, period."

You may have some biases which are created in the regions. You may not. I mean the bottom line may be that that may simply not exist because the regions are so darn big that it washes out in the issue of the size that you're dealing with.

It may not though. I don't know. I was raising it as an issue that maybe you want to take a look at.

The other side of it, as you mentioned, in terms of cost of capital, there's just an out-and-out statement in the CDR that says, "Hey, we're going to assume cost of capital is the same everywhere." I mean I just don't think that's a reasonable statement that's in the CDR.

MR. PEABODY: Anyone else?

MR. KNOX: I'm Hugh Knox from the Bureau of Economic Analysis, another alumnus of EIA.

I thought the comments by the reviewers were excellent, and I wanted to highlight especially a need to focus as much as possible on some bottom-up analysis. I've been beating Ron over the head with that idea for the last two or three years, and I'm sorry he's not here to get beat on again.

I think that other niceties aside about the modeling process and how the world works, the bottom-up is especially important if you're going to be serious about doing longer term policy studies. You can respond to Congress with a top-down sharing scheme if you're just looking at the short term response, if you have enough information to use your sharing in top-down schemes.

Where the problem comes is where you're talking about policies on emissions, oil import fees, things that have major geographic incidence that you need to have a way to build in not trickling down from some off-line macroadjustment, but actually deal with real regional data. That's the major flaw that I've seen in the presentation this afternoon.

MR. PEABODY: Other comments?

MR. ASKLUND: I'm Clair Asklund from DRI. So here I am.

It was mentioned that there is work being done on the model. To defend me and the company, there are a couple of dynamic properties of the model that I should mention that are capabilities. I'm not here to try to oversell it because the model was designed to address just energy issues and to try to get some dynamic properties into the model in order to explain how a changing, basically top-down kind of national impact would share out to activities in regions.

Using the phrase "sharing down" or "top-down" is a fair enough characterization of the model as built. There are variations in regional tax rates in the model. What the model doesn't purport to do is to forecast how those rates will change. So as a share of cost, they vary by region.

The main properties in the model are really linked to two different kinds of regionally varying levers, if you will, in the model that include a cost variable that does have labor and energy price detail, and since the CDR that has been expanded to include oil, gas, coal, refined petroleum products, electric utility and gas utility prices by regions.

So there's considerably more regional price levers within this cost term. The cost term does effect the elasticity of output by region. So it's not just shared down. To the extent there's a different cost structure in different regions of the country, that will change directly the production level in the key industry.

There are also interindustry linked potential demand variables in the model that to the extent a major end market of an existing industry grows, other industries within that region grow. So there are some reasons for activity to expand and increase beyond just a simple share-

down of national behavior.

At the same time I don't want to oversell the fact that it is addressed mainly for doing energy policy simulations. It doesn't address questions about, say, education and the role of that in changing the skills of the work force, and there are points about, you know, the appropriate level of demands to put on the model that are very fairly addressed. So I'm not really criticizing the comments made. I'm just suggesting a perspective.

Since we're in the market for selling equations, it has 800 estimated equations. When you put in identities, we're well over 1,000 equations now. So it grows very quickly.

MR. PEABODY: Thanks.

MR. LAUGHLIN: Hi. I'm Keith Laughlin from the House Science Committee.

I looked into the modeling that went into the National Energy Strategy pretty closely, and it was my opinion that it was a very Rube Goldberg kind of process. There was a lot of patching over to try to address problems as they came up.

And I'm not saying there's anything necessarily wrong with that, except that in my opinion it was, to use the term of the gentleman from DRI, I think it was oversold. The problems in that were really minimized, and it was portrayed as being relatively flawless, when it was pretty flawed.

I guess I had a two-part question for both sides of the panel. I'd like for our reviewers, I'd like to know how you think how NEMS compares with the modeling, the FOSSIL2 modeling which was done for the NES, and I'd like the EIA perspective on how you would make sure that this is not oversold.

I think that a lot of their criticisms that they made are probably valid, but you probably have very good reasons why you can't address all of the concerns they made. So I would like to know how you are going -- what steps you are going to take to make sure that when Congress looks at this material, that we understand that this is not flawless.

MR. MORLAN: I guess it's kind of hard to do much. I don't know that much about FOSSIL2. I know it's a systems dynamics model, and I know what the opinions of people that work in the industry are of systems dynamics models, but it's really hard for me to get a handle on quite why.

There's a tendency to caricature them as being something that can answer any question you want. You just build it into the model, and it's a very flexible system that way, but it ends up giving the reputation that it's not very scientifically based or valid somehow.

And I'm not sure, you know, to what degree that caricature is right, but nevertheless that opinion is out there, and it probably affected the response to the use of that model in the national energy plan.

That's about as much as I can say about it.

MR. LAUGHLIN: Is it an improvement?

MR. MORLAN: I think, yes. Theoretically this is an improvement. First of all, if nothing else happened, the process that we're going through right here today is a big contribution to that.

When you get right down to it, you can make any model do whatever you want pretty much. It's up to the modeler. What is important is how much credibility does the model have. How much exposure does it have? How much is the general structure of the model and its inputs and uses, how much have they been exposed to the public and reviewed? That's a lot of it right there.

So just from that point of view, it's probably a real step forward here. But I guess my conclusion would be that in general this would be a step forward, although it's certainly going to complicate the analysis, make it a much more laborious analysis. You know, all of that credibility and detail doesn't come free, as I'm sure these guys will tell you.

MR. RODEKOHR: I certainly could never say anything against the FOSSIL2 model because I have to work with these people, after all. It does, however, focus on an area and an issue that the NEMS model that we've been talking about today doesn't focus on as much, and that's the long term, and that, of course, we've put off our long-term modeling until next year.

But you're much more susceptible to the kinds of patches and problems that you discussed in that area because let's face it -- what do I know about a technology in the year 2020? Well, really I don't know anything, and it's one of the reasons I don't like to do long-term modeling because it can be anything you want it to be.

And, in fact, in part of the NES, part of the process that was going on was that everybody was rolling out their favorite technology and saying, "Oh, I'm going to be the cheapest," and the next guy would say, "Well, no, I'm going to be cheaper." And, you know, it was liar's poker going on here, and that's just the nature of the process.

It's one of the reasons if we do do anything in the long term, it's going to be very simple, and it's going to be very transparent because I don't enjoy playing those kinds of games.

As to overselling what we're doing -- and Terry talked about the process -- we've designed a process that we think will keep that from happening. We started by asking the National Research Council where do you think we should be going relative to where we are, and they did a big study, and we're following that study.

Part of what they also said or suggested was that you need to get a lot of input from different people, and we've designed a process to do that, and this is part of that process.

I hope it happens that we don't oversell the model. Also it leaves you susceptible, however, since everybody has their favorite thing that they think is the most important thing in

the world and your model needs to have it in. We have to use a little bit of our own, I hope, good judgment to embrace the good ideas and just politely step back from the bad ideas.

Thank you.

MR. PEABODY: Other questions, comments?

MR. GELB: Bernard Gelb with the Congressional Research Service.

Really kind of a technical question. Based upon my little, small understanding and failure to read the detailed report as to the interindustry model, and there was conversation here about output being measured in dollars, and I'm aware that BEA is wrestling now with their revisions of gross output by industry, and it seems to me that there's a correspondence there and that you may well have had a similar problem in allocating.

Basically it amounts to deciding how important one industry is relative to another, and you have problems of productivity change over time and prices and so on and so forth which relate to some extent, to things which Mr. Holtberg said.

I was wondering to what extent that problem is a problem for you or has been a problem or perhaps isn't.

MR. RODEKOHR: Well, if I understand the question, measuring output in terms of dollars is a problem, and quality is a problem, and I don't think they've discovered a way for all of it to go away quite yet.

Let me give you an example. A P-38 and an F-15, they're both airplanes. They both fly in the sky, but they're two different things, and a P-38 might cost $100,000 and an F-15 $40 million. Well, is your $40 million plane that much better than your P-38?

That's the kind of quality issue people wrestle with, and I don't think they've really found an answer to that yet.

Measuring output in terms of dollars is really the only thing I think we can do right now. You've got a few commodities you could measure in physical terms and not be too badly off. You could talk about tons of crude steel or barrels of oil, for example. You can talk about numbers of vehicles, but a vehicle, you know, ranges from an Escort to a Cadillac, and they're two different things. So I guess that's the best I can tell you.

MR. GELB: I didn't phrase my question very well obviously. What I mean to say is that if you've got an IO table at a particular point in time and it's so many dollars of input for Sector 1 to produce the output of Sector 3, etc., etc., this is based on a certain point in time, and at some other point in time not only do the coefficients change, but the rates of change in productivity change as well, and you have dollars in one period and dollars in another period, and so it seems to me that the kind of problem that BEA is wrestling with in relative importance of different industries in the economy would be a problem for the NEMS model as well.

MR. RODEKOHR: It is. However, in the IO table, the coefficients do change over time based upon trends and the expert judgment of the people at DRI, and there are increases in productivity. I mean that's one of the big factors that drives overall economic growth, is increases in productivity.

Do we do it right? I don't know about that. We at least try.

MR. SPARROW: I'm Tom Sparrow from Purdue. Hi, Terry.

MR. MORLAN: Hi.

MR. SPARROW: I think one of the things that Terry said that interests me most was the issue of uncertainty, and I don't think we've discussed that.

Maybe it was discussed this morning, but how does the model treat uncertainty in demand and equilibrating between the demand and supply side? Do you simply take three scenarios and develop knife edge responses to each one of those scenarios, or do you attempt to look at a -- give a supply side option which is fairly good under all scenarios, but not necessarily best under any one, to come forth and in fact be chosen as the correct response to uncertainty?

Do you use over-under type models where you explicitly look into the cost of having too much supply or the cost of not having enough supply and the asymmetry in those costs to decide upon your supply side scenario?

MR. RODEKOHR: The issue of uncertainty, in general, we have usually treated by either scenarios or by slightly more sophisticated technique and that is taking the sum squares of several scenarios and calling that uncertainty.

In other words, we haven't spent a huge amount of time on it as of yet, just like most other forecasters don't. You know, you have a reasonable range for some of your inputs, and you take a look at the range of your outputs, and you say, "Yep, I've done uncertainty," and you move on.

We are going to be doing more than that. It's a little bit unclear as to how much more than that. We do have one advantage over many other modelers, one advantage and one disadvantage, and that is that we've been forecasting long enough that we can develop a track record, and I was talking about this morning -- I see Jim's not here -- there's a group of physicists out somewhere in the Midwest who took our forecasting results, and using some clever statistics, developed confidence ranges for a lot of our variables based upon this track record, and this is one approach we're looking into.

We've had suggestions. Believe me we've had a lot of suggestions in this area. Other people thought, well, if the people who build models of nuclear power plant accidents can run their model, you know, 500,000 times, why can't you run your model 500,000 times?

So we've gotten a lot of varied comments on that. We're trying to sort through them

now and trying to pick something that's doable that's an improvement over what we're using now to characterize uncertainty.

It's a problem with the way I believe everybody presents their results, however. We're not unique in that area.

MR. PEABODY: Further questions?

MR. BELZER: Hi. I'm Dave Belzer from Pacific Northwest Laboratory.

Initially there was a comment that was made that there was a linkage between the supply modules in terms of the initial investment or reduced investment from different scenarios brought into the interindustry framework. I just was trying to get a better indication of whether there was a clear plan or method by which that was also going to be done at the end use sector level in which at least in the building sector there'd be menus of technologies with different capital requirements. I expect the same case to be true in the industrial sector, and whether that's going to be -- if there's any timetable for that mapping to take place from those end use modules over to the IO and regional module.

MR. RODEKOHR: You want a clear plan, huh? Well, we have a clear plan that we don't know how we're going to deal with that issue yet, and the reason we have that problem is there's a good accounting structure developed in electric utilities, in refining industries that allows you to see their capital requirements. There's also a clear accounting structure in the macromodel for those sectors.

That's not true in the other sectors. Let's take the residential sector for a while. You invest in an energy efficiency improvement to your house. That's going to end up in one macrosector. If you do it in an appliance, it ends up somewhere else, and it just varies all over the map. So there's no clear accounting from the other demand sectors back into the macromodel that I'm aware of, let alone the problem of figuring out how much investment is already assumed in the macroprojections.

That's what I'm having all the problem with. I can't see that clear accounting structure. So that's where we stand right now.

MR. PEABODY: Someone else? Comments, questions?

MR. LAUGHLIN: I'd like to return briefly to the issue of measurement of output and the business of measuring it in terms of dollars or measuring it in terms of physical units where those things are well defined, and it does relate to this issue of price indices and quality that the BEA has been wrestling with a lot, but I think that that issue that they're dealing with of price and quality and the example you gave of the airplane may not be that relevant to what the goal here is, and the goal here -- whereas there was a good point made that macro and regional drivers are what drive energy demand. The point of this modeling is to get at something that is good at driving energy demand.

And so there may be cases where the issue of the price index -- you have to then look

at the energy implications in terms of modeling energy demand in the energy sectors, not just the issue of the valuation in and of itself.

The problem with the valuation and the trends in, say, whether or not that plane you gave the example of shows the output of that industry growing very fast is that if it used the same amount of energy to make that plane, we might mistake that as an energy conservation improvement when, in fact, it's purely an issue of valuation.

And so when we're thinking about that problem of valuation, it's not just a macro and measurement issue. One has to look at it in the context of how that information is used to drive the energy sector, and I won't purport to have an answer to that, but that's the context at which it has to be looked at.

MR. RICHARDS: Gordon Richards, National Association of Manufacturers.

I wanted also to address the issue of using physical output measures to substitute for dollar based or deflated dollar based output measures. That is, the Federal Reserve does, in fact, use physical output measures to compile its index of industrial production, but one of the key problems associated with that index is that for certain kinds of output, it has proved impossible to actually generate indices based on physical units because the units differ from each other too much.

So what the Fed. actually does is very often to count physical output based on energy use, and here, of course, you have exactly the problem that was just brought up visually by one of the participants, and that is that you're getting into circular causality for measuring physical output in terms of energy use and then deriving energy demand from that measure of physical output. Clearly you've got circular causation.

MR. PEABODY: Anybody else? We thank you all very much for coming, and particularly I want to thank our reviewers, Paul Holtberg and Terry Morlan, for giving us their time.