THE NEMS CONFERENCE

REFINERIES AND PETROLEUM MARKETS PANEL

February 2, 1993 - 8:30 am

PANELISTS:

James M. Kendell, Moderator
Bruce Bawks, Presenter
Dr. Timothy J. Considine, Reviewer
Jerrold L. Levine, Reviewer
Joe Marcinek, Reviewer

AUDIENCE PARTICIPANTS:

Chuck Boudrye
David Woodruff
David DiAngelo
Martin Tallett
Bernard Gelb
Stan Kaplan
Joel Mumford

EIA

PROCEEDINGS

MR. KENDELL: Good morning. I'd like to welcome you to the panel on refineries and petroleum markets. Now that we've got all of our reviewers here, we're ready to start.

The module that we're reviewing this morning is called the Petroleum Market Module, and unlike some of the modules that we've talked about yesterday, it is a single module. It is not a collection of submodules.

We're going to do this panel in a little different format than what you saw yesterday. We're going to have three separate, brief, mini-sessions. Bruce Bawks is going to make the presentation. Then the reviewers are going to respond.

The first section will be on the purpose and approaches of Petroleum Market Module. The second will be on the classification of the various products, crude oils, and regions, and the third will be on the methodology.

My name is Jim Kendell. I'm the Chief of the Oil and Gas Analysis Branch, and the person giving the presentation this morning is Bruce Bawks. Bruce is an operations research analyst on the petroleum markets team. He was responsible for writing the component design report that the Petroleum Market Module is being written to. He, as such, is responsible for modeling and analysis in the area of refining and petroleum marketing.

Much of Bruce's work in EIA has been in the price area. He was involved in EIA's response to the December 1989 heating oil crisis, as well as EIA's response to the Iraqi invasion of Kuwait.

Bruce.

MR. BAWKS: Good morning. I want to thank each of you for coming out this morning. We will have a question and answer time at the end, and I want to encourage you to ask questions and provide comments. We want your input.

One of the few predictions I can make with confidence is that this model will not make everyone happy, but we will try and incorporate as many of your comments as we can and answer your questions as best we can.

If you don't get a chance today, then you could call me later or write your comments down and send them to me. We do appreciate your input in this type of endeavor.

I'm going to be talking about the Petroleum Market Module this morning, which I'll be referring to as the PMM. The PMM is that part of NEMS that represents petroleum refining and marketing.

One of our goals in building this model was to have a model that could be used not only for midterm forecasting, but could also answer a wide range of analytical questions and respond to various analytical issues, and that played an important role in our choice of modeling

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approach.

But before we get into the type of approach, I want to give some specifics on the role of PMM in NEMS. Given petroleum product demands, a world oil price and various supply curves, PMM produces end-use petroleum product prices. PMM will also compute refinery inputs, crude and product import numbers, and other supply components, assuring that petroleum supply equals demand.

PMM also will calculate capacity expansion and capital expenditures, refinery emissions, and refinery fuel consumption.

We've made several enhancements to the PMM compared to the predecessor model, the predecessor being the Oil Market Module which is currently used in the AEO process, and these enhancements are both to improve the analytical and the forecasting capability.

The choice between importing crude oil and refining it or importing finished petroleum products is now going to be explicitly represented in the PMM. This is being done in conjunction with the oil and gas supply module and the international module which will be supplying us with production functions and supply curves.

Previously, imports were a balancing item that simply balanced supply with demand.

We are going to have five types of crude oil represented in the PMM, characterized by API gravity and sulfur content. The OMM had only one type of crude oil with no quality characteristics. This will enable us to deal with issues such as declining crude oil quality over the forecast period. I'll talk a little bit more about this in the second section today.

As a result of the Clean Air Act Amendments, we have added several new products, new specifications, and new processing units to the PMM. We have several types of gasoline, and I'll talk more about that, as well, in the second part today. We've also added low-sulfur on-highway diesel as a separate product.

We've added a number of specifications in order to define the different types of gasoline, including oxygen content, benzene and total aromatics content, sulfur and olefin content, and distillation characteristics to enable us to do specifications such as T-90 or T-50. These are in addition to octane and RVP, which were part of the previous model.

As far as new processing units, we've added ether production capability. We have the ability to represent MTBE, TAME, and ETBE processing units. We will be adding representation for merchant MTBE units, as well.

We are also planning to add gas plant and olefin plant representation. We foresee a lot more interaction between the refining industry and the petrochemical industry as a result of the Clean Air Act, and we plan to capture some of that in our representation.

We'll be measuring refinery emissions of carbon monoxide, carbon dioxide, volatile organic compounds, sulfur oxides, and nitrogen oxides. These are refinery emissions only.

Purpose of PMM

- Model petroleum refining and marketing
- Provide analytic structure
- Estimate petroleum product prices
- Compute petroleum supply balance
- Calculate capacity expansion, capital expenditures
- Measure refinery emissions
- Determine refinery fuel consumption

Enhancements

- Choice between crude oil and product imports
- Five types of crude oil
- New products
- Specifications
- New processing units
- Emissions
- Capacity expansion represented
- Regional refinery representation

Tailpipe emissions and other emissions associated with gasoline will be handled in the transportation module.

Capacity expansion is represented endogenously. Previously capacity expansion was done off-line and was fixed across all scenarios. I'll talk briefly about this in the third section today.

Finally, PMM will now have regional refinery representation. The OMM was national as far as the refinery representation, and we've decided to use a regional approach with PMM. We'll look at that in a little more detail on the next slide, as well as in the second section.

PMM receives many more inputs from other modules, and produces many more outputs than the Oil Market Module. This, along with the desire to perform analysis, contributed heavily to our choice of modeling approach. After considering several options, we decided on a linear programming approach.

For PADD III, which is the Gulf Coast region, we have what we're calling an enhanced refinery model. This is a linear programming model with 418 rows, 1,254 columns, and 30 processes. We chose PADD III to have the most detail because it has the greatest refining capacity, and it provides a lot of products that go to the other PADD's, especially PADD's I and II.

The other four PADD's will have what we are calling compact refinery models. These also are linear programming models. They will have about 25 percent fewer rows and columns, and around 24 processes. We are doing the compacting by combining or eliminating some of the processing units, combining intermediate streams that are similar, and using recipe rather than specification blends for some of the products.

The main reason for doing this is to speed the solution time. Throughout the development process, we've had to balance the size, structure, and analytical capability of the model with execution time. We feel that this approach gives us the strongest model for performing analysis while maintaining an acceptable solution time in the NEMS integrated environment.

And that's it for part one of mine.

MR. KENDELL: We're going to take our reviewers in the reverse order from what you see in the program this morning. So first we're going to have Jerry Levine. Jerry is the Director of Corporate Studies for Amoco Oil Company, where he's been involved in business development and planning. He's the past Chairman of the American Petroleum Institute's Motor Gasoline Committee, and he represented the API on the recent regulation negotiation with the EPA and many other parties under the Clean Air Act.

MR. LEVINE: Thank you.

I'm going to present our comments on the first part of the PMM. Generally, in fact, more than generally, very specifically we believe it's a good idea to build a computer model like you're doing. It's a difficult task.

Methodology

PADD III	Enhanced refinery model - 418 rows - 1,254 columns - 30 processes	LP
PADD's I, II, IV, V	Compact refinery model - 25% fewer rows, columns - 24 processes	LP

GENERAL COMMENTS

Good Idea to Build Model

Amoco Supports EIA

Future Forecasting Difficult

Best Use is Differences Between Cases

We support the EIA. In fact, one of our people, Ed Flom, has been a member of the committee of the National Energy Modeling System, and he's told me that unless I support it, he's going to break my kneecaps when I come home, which is maybe one of the more difficult things about working in Chicago relative to other places in the country.

At any rate, also we really appreciate the fact that we do have the opportunity to put in comments, in fact, not only we in the oil industry, but this whole broad spectrum of commenters that we've seen in the last couple of days.

I put out the same caveat that a lot of people mentioned yesterday, that forecasting the future is very difficult. I'm always reminded of one of Yogi Berra's many, many famous statements. He says he never makes forecasts and especially about the future.

The problem is that there are so many unknown, unanticipated events that it gets to be very difficult. The best use of the models in the end is just to look at the differences between cases rather than trying to figure out what the price is going to be 20 years from now or the supply. If you take a given set of assumptions and look and see what kind of result you get and then take a variation on those sets of assumptions and get another result, and then look at the differential between the two sets of answers, that gives you better guidance on how you might want to set policy or gives you some guidance within the constraints that something down the road is going to happen that you don't even anticipate.

While I may not look that old, I was at a meeting of some city planners about 100 years ago in the 1890's, and at that meeting, they concluded that they were looking at growth of vehicle miles traveled, the same thing that we're looking at today, and they concluded that they had a major, major problem. They couldn't draft enough people to shovel up all the horse manure from the vehicles. That is part of the problem you have here. They never heard of Henry Ford. You look too far in the future and obviously things change that just absolutely cause a great variance from what you anticipate.

We support the concept of an LP model. We believe it gives the best results. A lot was made in the handouts that I received about solving time being important, but it's not critical. Any analysis that anybody does of the runs is going to take several days. If it takes an extra hour, two, or three hours even to make a run with more detail, we're still going to spend several days analyzing that output. So the quality of an answer is a whole lot better than solving time.

Another comment is that it may be difficult to integrate what you're doing here with an LP with the nonlinear complex model that EPA is putting together for the Clean Air Act on reformulated gasoline.

Also, a minor comment is that in lumping an entire PADD together for a refining area, it assumes then you have a perfect transfer of intermediate streams between refineries within a PADD. Obviously you don't, and so what you need to do is maybe reduce the existing refining capacity by some percentage to reflect those inefficiencies between the refineries.

However, as the industry always seems to do no matter how much we complain about not being able to do something, when the smart engineers sit down and figure out how to do it,

SUPPORT LP MODEL

Gives Best Results

Solving Time Important, But Not Crucial

May be Difficult to Integrate with EPA Non-Linear CAA Complex Model

Reduce Existing Capacity to Reflect Inefficiencies Between Refineries

Recognize Inter-PADD (or Area) Transfers we always come out a lot closer to optimistic or to an optimum than we anticipate.

And likewise, the model ought to recognize inter-PADD transfers just for the same reason, that the refining system can transfer intermediate stocks between PADD's if the economics are good.

A few detailed comments. Canadian crude inputs should be allowed into PADD II. It wasn't clear as I read the information that they allowed imports to PADD II. PADD I and III obviously had imports.

We should use 13 to 15 percent for cost of capital. I think there was a lower number in the report. What you have to appreciate is that a company, all companies have limited funds, and what you end up with inside a corporation is competition for funds. Unless you have a project that can show a 13 or 15 percent return on investment, you're going to lose that money to somebody else who's going to drill a well out in the North Sea or build a new chemical plant somewhere. So even though the going interest rate might be much lower, you still have to achieve a hurdle rate usually in the 13 to 15 percent range.

Also, you should recognize -- and I think you've mentioned that -- the refining industry is going to make a considerable number of environmental investments that will provide no capacity increase or no change in the amount of product produced.

Low-sulfur diesel is required starting this fall. The report talked about different storage options and different complications with storage, but one thing that you ought to recognize is just the option to drop out of the on-highway diesel business. I think several people are considering doing that. At least if they have a multi-refinery system, they are certainly considering dropping out in a couple of refineries, and some people are just getting out of the business altogether.

An option that should be allowed is to trade to get low-sulfur and give high-sulfur in a given market.

And one other comment is to allow for alternate computer solver routines. Some of us think our own better proprietary solver routines are better than some of these. They may or may not be any better but at least it's invented in-house, and so the computer people like them better.

A couple of other minor comments. You mentioned that revenue was the best indicator of refinery health. I think percentage utilization of the refining industry is a much better indicator of industry health. Margins are always fairly thin in spite of what the press and others and our shareholders would like to believe; our margins ought to be better. As an example, in the early '80's prices were very high, so revenues were relatively high. By and large, during that time frame though the utilization rates were low. They were in the low 80's, and profits were essentially zero in the refining industry. In fact, during that time period maybe 100 refineries shut down.

So that's why I say percent utilization is maybe a little better indicator of industry health.

DETAILED COMMENTS

Allow Canadian Crude to PAD II

Use 13-15% for Cost of Capital

Recognize Refining Environmental Investments that Provide No Capacity or Product

Include Option to Drop Out of On-Highway Diesel

Allow for Alternate Solver Subroutines

And one final comment. It's a question really. How are we going to handle the breakdown between large and small refiners in the same PADD as far as accounting for the sulfur subsidy for the small refiners?

So I'll stop at that point.

MR. KENDELL: Thank you, Jerry.

Next we're going to hear from Joe Marcinek. Joe has been with Mobil Oil for 28 years. He's currently involved in manufacturing, planning, crude supply and the regulatory end of fuels issues. He's been involved with the oxygenated gasoline issues and recent Clean Air Act issues.

Joe.

MR. MARCINEK: Thank you.

I don't have slides, and I'm going to offer my major comments basically off the cuff from the notes that I've taken.

First of all, it seems obvious that the only way to fly in solving this problem is with an LP. I don't believe that can be challenged.

However, as you proceed to do that, I certainly believe that there's a great opportunity here to become overly involved in details, and several of the comments that I'll offer have to do with ways that maybe you can minimize the burden of the matrix that you would otherwise build.

An example might be as you aggregate what is represented by the refineries in a PADD, you certainly are going to run into some units that you might say are de minimis, and basically the message is it's just not going to be worth representing for the importance that it'll mean to your solution.

So this is just an example of not getting overly involved in details that will help you with reducing the size of the matrix and your execution time.

One of my greatest fears in reading about this is that it will become overly large, difficult to maintain, and the execution time might literally eat your lunch. It will have an opportunity to grow and grow and grow, and I think that with a wonderful tool and an opportunity to build such a good tool, you can't let that opportunity get away from you.

So you're going to have to restrict yourself somewhat, and go about setting up the matrix in an intelligent way.

I believe Jerry made an excellent point when he said whenever attempting to forecast what is going to happen, don't get hung up on trying to forecast the absolute. Doing the relative is much easier to do. When you're looking down the road, let's face it, it's really difficult to forecast what's going to happen next month, let alone next year or in 5 years.

However, on a relative basis, this fuel versus that fuel, or this type of energy versus that type of energy, if you set something as a base and say what's going to happen relative to some fixed base, that's much easier to deal with, and that kind of pricing strategy is definitely encouraged.

With regard to the ability to calculate capacity expansion, and capital expenditures that spin off thereof, I would encourage the ability to unload that portion of the matrix. In other words, make a decision up front. Am I studying the industry the way it is, which I would guess would involve an awful lot of the studies. If the answer is yes, you don't want the burden of the matrix that is representing the ability to build units and the capital that will carry, not only because of the size of the matrix, but because you would introduce some economic error in such an analysis.

For example, once you've built the unit, then that's water under the bridge, and the only thing that counts from there on is how you use that unit on an incremental basis. In other words, once the unit is built, the capital is behind you. The amortization is important, but that really shouldn't get involved in future decision-making.

The time to consider how capital is going to impact you is before you build the unit, not after. So I make that point about having that ability to unload the section of the matrix that pertains to capital expansion.

And then, finally, after you've built the model, I highly encourage model validation. It's going to have to be tested versus things that have happened, and more than a couple of points, just to make sure that it's tuned properly. That is certainly going to be an important step that occurs near the end of the construction process.

I have no other comments.

MR. KENDELL: Thank you, Joe.

Our final reviewer is Tim Considine. Tim is an associate professor of mineral economics at Penn State, and Tim was heavily involved in the construction of the current model that we're using called the Oil Market Model. The Petroleum Market Module is going to replace it in NEMS.

Tim.

DR. CONSIDINE: I also do not have any overheads, and I just want to make some general comments.

First of all, my general comments can be divided into two sections: one, those related to the model report, and secondly, I'd also like to raise an issue on the appropriate methodology.

First of all, I think it was a good, well written report, but there were several documentation issues that should be addressed. The previous gentlemen who were speaking pointed to a number of these. I have three questions that came up in my mind as I read the report.

First, how are the technical coefficients actually derived? What are the aggregation assumptions and other assumptions embedded in the off-line calculations for the technical coefficients? This is a difficult task to document, especially for a large LP, but I think it should be attempted.

Secondly, what are the alternative technologies for producing reformulated fuels? Exactly what are we talking about? It seems to me that refiners would have a choice of a range of technologies to meet these EPA standards that are coming up over the next 5 years.

And then third, exactly how will the model be verified? Are we going to compare the estimated marginal cost for products with actual data, etc.? Over what time period? Lay out the experiment. Develop some measures of forecasting performance, mean squared error, tile statistics, and so on.

The previous reviewers raised the issue about the scale of the modeling, and one question I have is: are there diseconomies of scope in modeling? Are we trying to do too much in this model? Are we really more concerned with forecasting or policy analysis, and can we really do both in one model?

For instance, one point that raised my eyebrow in the report was towards the end of the report, where it mentioned that there's a detailed refinery model that could be used to examine environmental issues. Well, if that can be used to examine environmental issues, why do we need this LP model, which is a reduced form of that detailed refinery model?

In this context, in the discussion of the background research, the authors did a very nice job of laying out the alternative models that exist, pointing out the problems of pseudodata. I think it's a good idea to avoid the pseudodata approach and build a specific -- well, an LP model as they're proposing.

I think there's more discussion needed of econometric approaches. I've done a lot of research in this area, and you can, indeed, get reasonable econometric representations of these markets. Whether you go econometric or LP, I think it really revolves on this question: do you want to really focus on forecasting, or policy analysis?

And people use econometric models to analyze environmental issues. Analytically I think it comes down to whether the marginal cost schedules are uniformly shifting in response to the environmental regulation or do they radically change. I would guess in the case of refining that the shape as well as the level would change, and therefore, an LP may be reasonable.

But I think some mention of alternative econometric approaches is needed in the report. The basic criticism against these models is that multi-colinearity is a problem, but when you're using the data that EIA has been publishing over the past 10 years on a regional basis, either monthly or even weekly, there's a great deal of variation in that data, and I have found that colinearity is not a serious problem.

Also, the assumption is made that inventories are not important for the annual model. Well, that may be a reasonable approximation, but is it really a realistic representation of how petroleum markets operate?

If we look at the month-to-month changes, inventories are very important, and even when you aggregate the pluses and the minuses over the months of the year, those inventory changes at the annual level are fairly sizable. So perhaps there's something to examine on the inventory question.

I have more detailed comments when we proceed. Thank you.

MR. KENDELL: I'm going to ask Bruce to hold his response until after we've completed all three sections.

In the next section, Bruce is going to present the crudes, the products, and the regions.

MR. BAWKS: This first slide in this section shows the refining regions that we've chosen for the PMM. We will be using the Petroleum Administration for Defense Districts or PADD regions that many in the industry are familiar with. We chose PADD's primarily because they are used extensively in the industry, and much of the published data is at a PADD level.

The demand regions that are used in NEMS and will be used by PMM are the nine U.S. Census divisions. PMM will have transportation structure in the LP that will represent the movement of products from the five PADD refining regions to the nine Census division demand regions. The end use product prices that PMM develops will also be at a Census division level.

This slide shows the types of crude oil that we'll be using in the PMM. API gravity is on the X axis and sulfur content is on the Y axis. Despite some of the gaps that you see, the white areas, all of the crude streams that EIA has information on do fall into one of these categories.

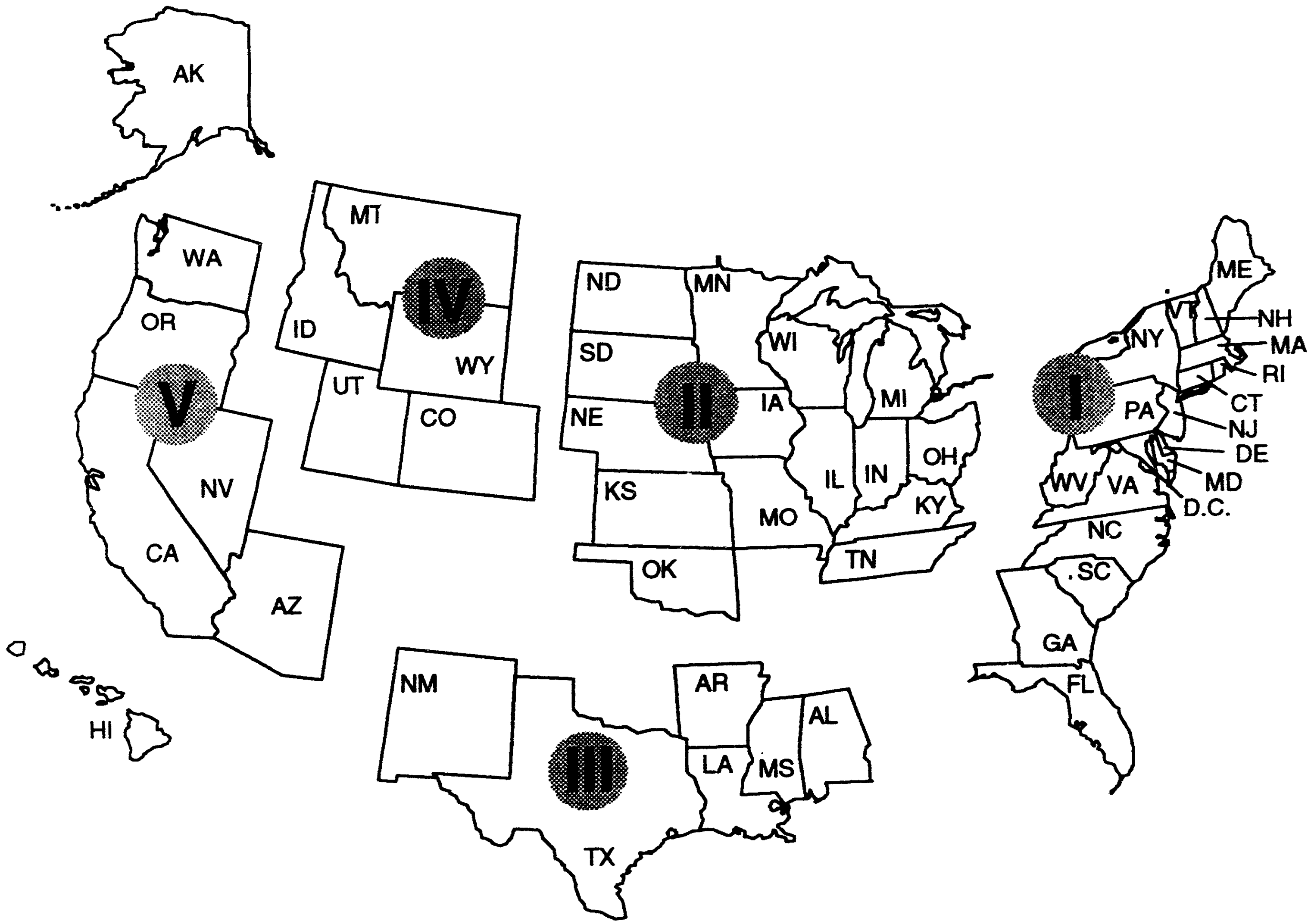
The yield of heavy fuel oil from these crude streams was also a factor in determining which category they would fall into, and that's the reason for some of the shapes that you see for these categories.

Foreign and domestic crude oil will have the same definitions. However, the composite yields will differ. For example, the low-sulfur, light, domestic crude oil will have a different composite yield than the low-sulfur, light, foreign crude oil, and the reason for that is that different streams make up this composite. The composite will be a weighted average of the streams that fall into that category.

So in reality, we will have five foreign crude oils and five domestic crude oils. We've also given some consideration to keeping Alaskan North Slope crude as a separate type, as well.

This slide shows the end use product categories for PMM. We will be developing prices for each of these products, except for the "other" category. We have several types of gasoline,

Petroleum Administration for Defense Districts



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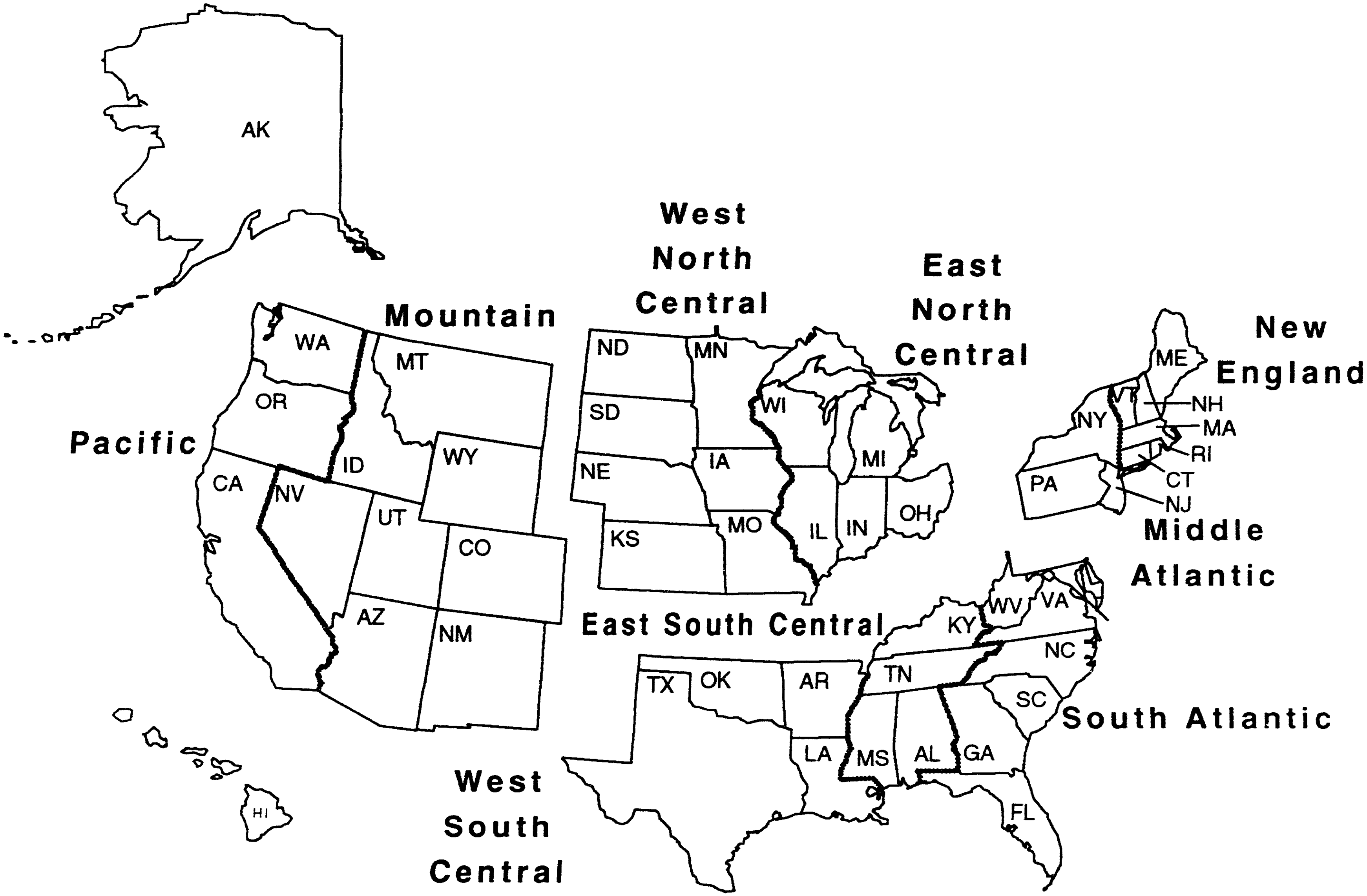
U.S. Census Regions and Divisions



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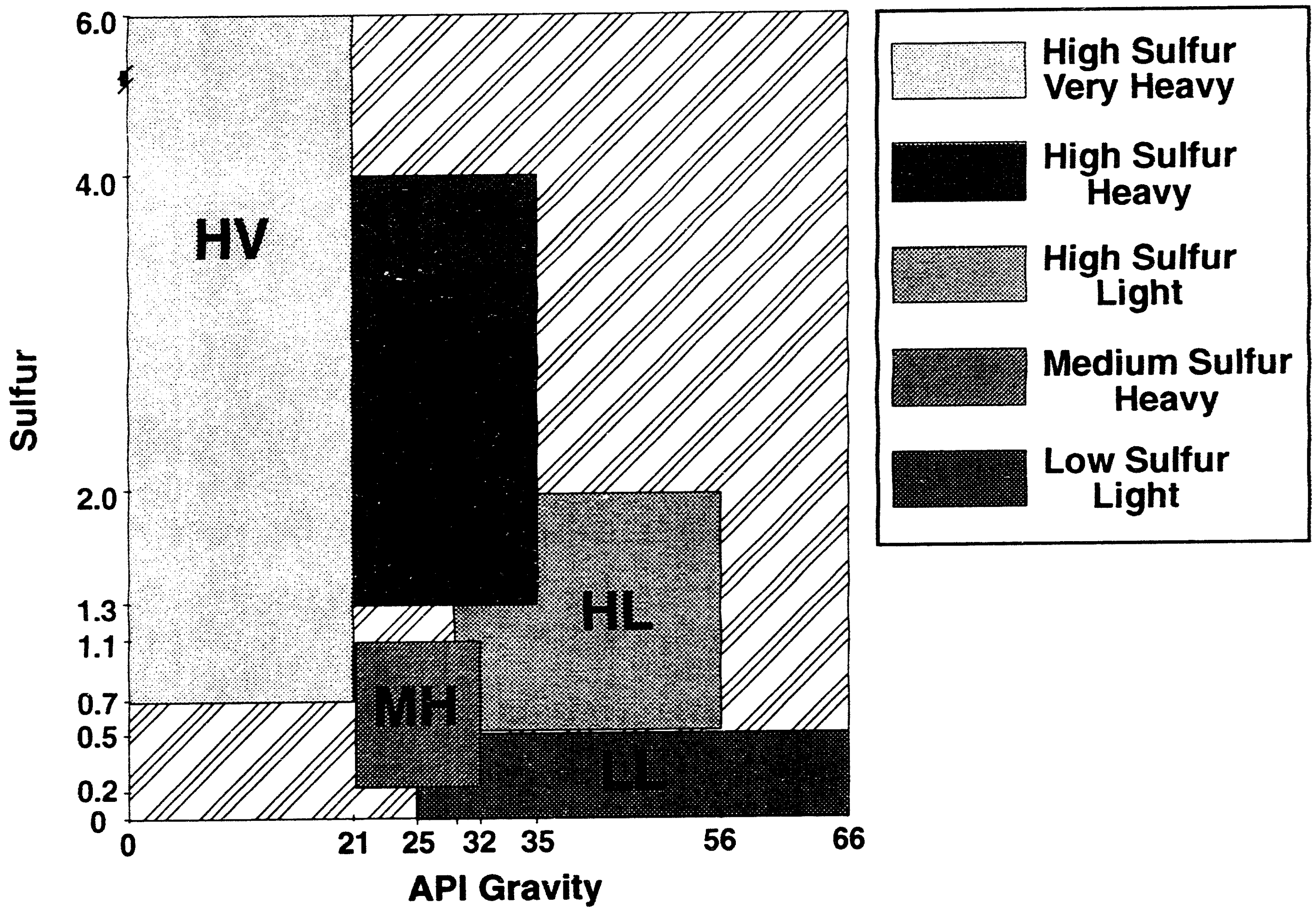
Crude Oil Classification in NEMS



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Product Categories

Gasoline

Distillate

Jet Fuel

Residual Fuel

Petrochemical Feedstocks

Asphalt and Road Oil

Kerosene

LPG

Other

and I'll talk about that in the next slide.

We have two types of distillate. We're going to have the low-sulfur on-highway diesel and then "other" distillate. We'll also have less than or equal to one percent sulfur residual fuel and greater than one percent sulfur resid.

Altogether we're going to have about 12 products that we'll be developing prices for in the PMM.

This slide shows the various gasoline types that we're going to be modeling. This has resulted from the Clean Air Act Amendments. In 1993 and '94, we're going to have conventional gasoline and oxygenated gasoline, oxygenated having 2.7 percent oxygen content by weight.

In PADD V, California, they have their own restrictions on oxygen content. So we will be restricting that to just 2 percent oxygen content for PADD V.

In 1995, the reformulated gasoline program comes into effect, and we will have conventional gasoline as well as reformulated gasoline, which will have 2 percent oxygen content, and then a high-oxygen reformulated gasoline which will have 2.7 percent oxygen content.

The high-oxygen reformulated gasoline is for those areas that are out of attainment for both ozone and carbon monoxide. Note that in PADD V we do not have the high-oxygen reformulated. Again, that's because of the restrictions in California to limit the oxygen content to two percent.

In addition, we do not have oxygenated gasoline, oxygenated being conventional gasoline with 2.7 percent oxygen content. The reason for that is our analysis has shown that oxygenated will have less than 5 percent of the market share once the reformulated gasoline program takes effect.

In 1996, for PADD's I through IV, the gasoline types stay the same as in 1995. California, once again, has their own program for reformulated gasoline. They have more severe specifications than the federal program. So we will be modeling California reformulated as our PADD V gasoline.

So we have six types of gasoline in all. However, we have no more than three types in any particular region or forecast year.

The complex model was mentioned earlier, and that comes into play in 1997. I haven't seen that yet, and that could affect our gasoline types, but that's something we have yet to deal with.

MR. KENDELL: Mr. Levine and Mr. Marcinek will comment on this section of Bruce's talk.

Gasoline Types

PADD	1993-94	1995	1996
I-IV	Conventional	Conventional	Conventional
	Oxygenated	Reformulated	Reformulated
		High-Oxygen Reformulated	High-Oxygen Reformulated
V	Conventional	Conventional	Conventional
	California Oxygenated	Reformulated	California Reformulated

MR. LEVINE: The first comment I have is that it might be useful to use the nine Census regions that you have for demand for refining also. All nine aren't necessary. In the Midwest you have a break in PADD II, for example, between the eastern part of PADD II and the western part. They are separate refining, as well as market areas, but you get some of that in other parts of the country, too. PADD I and PADD III, you could break up, and we thought it would be more useful.

Overall, we didn't think it would increase the time to solve the problem, but we thought we'd get a much better answer.

Bruce just mentioned, and we thought you ought to add 2.7 percent oxygenated gasoline beyond 1994. A couple of major markets, Minneapolis and Denver, fit that category. While your comment that oxygenated gasoline that is not reformulated, which is just one of the requirements we'll have, is only 5 percent of the national market, in PADD IV, it's going to be 50 percent of the gasoline. The other 50 percent would pretty much be conventional, except for Salt Lake where it would be both oxygenated and reformulated.

At any rate, the next point is not a big point. I was trying to line up just some major crudes in the boxes, and you can make them fit, and I think your crude system is fine. Forget about the next comment.

We thought maybe you ought to put crude oil transportation options in the model instead of the fixed allocations. Again, we thought this could be increased with only a slight increase in size, and this lets various areas compete for crudes, which is closer to the real world as long as you have an LP.

I have mixed feelings because, as Joe points out, you don't want the thing to be too big, and you always feel like you've got to add to it. At the same time you feel like you want to get better answers, and somehow you have to make a draw between all of that.

One thing to help minimize the size of the LP is that you could consider just two grades of gasoline, premium and regular, and a blend to make a mid-grade. Again, it's not a big deal.

The next comment, on page 27 of the December 16th document, you ought to add T-90 to the specs. In fact, that was mentioned earlier, too, and that's just to make good quality gasoline. Besides all the environmental requirements that were going to make us look at T-50 and T-90, we'd look at something like T-10 just to make good quality gasoline, which is something that anymore gets lost in all the environmental requirements.

And, finally, you've indicated that you would use an annual average volatility. If you look at the South, however, where you're going to have a 7.1 RVP average or California with a 7.0 RVP max, to make those levels you're probably going to end up taking pentanes out of the gasoline. This is a much larger volume removal than just using the assumption of an annual average, which would put you around 9 or 10 RVP average for a year, and that'll change overall gasoline yields by a few percent.

Thank you.

PERIOD 2 COMMENTS

Use the 9 Census Regions for Refining
NPC Used 13

Add 2.7% Oxygenated Gasoline Beyond 1994

Question Arab Light, West Texas Sour Crude
Class

Crude Transporation Options Should be in
Model Instead of Fixed Allocations

MR. MARCINEK: I guess with regard to PADD's and the Census regions and divisions I have no comments other than to say I would support what they plan to do, and I don't see any overwhelming reason to change.

Jerry did make some good points, but I'm not sure if that's reason enough to cause a change. I guess I'd need to know more about where they stand in order to dig into that further.

With regard to crude oil, I believe what you have here is a reasonable compromise between what you plan to do for the LP and the real world. I've seen people just drive themselves nuts, you know, worrying about this crude or that crude, and that's a never ending battle, and I think with what you have here, you can make a reasonable stab at just about anything since you have the ability of blending these together.

It's a definite improvement versus the prior model that had, as I understand it, basically one crude representation.

In the write-up, one of the important byproducts that's never mentioned is sulfur, and I just make note that it's a very important byproduct, and as time goes on, there's going to be more and more of it.

Tim Considine mentioned inventory representation, and I really hadn't given that an awful lot of thought, but after he mentioned it, it really started me thinking. I look at inventory as something maybe you would be interested in in a day-to-day refinery operation, but for what DOE-EIA is doing, considering the considerable addition to the matrix that that would entail, I would strongly discourage an inventory representation for many reasons that I don't think are necessary to get into. If anybody wants to entertain it later and debate that, I'd be happy to.

Gasoline types. Again, I'm somewhat handicapped in that I haven't been working with the government to help construct their model. Therefore, I don't really know what the guts of it really looks like, but in reading over the text, I sense that there's probably opportunity to simplify the gasoline representation in this way.

Think of there being two types of gasoline. You have conventional; you have reformulated. You can oxygenate either of those. So if you're in 1993-1994, for example, where reformulated doesn't yet exist, you have conventional gasoline. For a portion of the year, you may have to oxygenate it. That can be represented adequately with a single representation of conventional gasoline.

If you go ahead with the gasoline representation, especially when you get into reformulated, the structure is huge. In other words, you're into gasoline representation and worrying about all the different cuts and all the different properties. That is a very large addition to the matrix. So you want to minimize the occasions that you have to represent that.

Finally, not knowing how you plan to represent the intermediate grade, I just urge you to represent it as a blend of your regular and premium grade. Don't attempt to represent the intermediate grade per se with all of the structure that the other two grades have, and again, that will reduce the size of your matrix.

That's all I have.

MR. KENDELL: The final section of Bruce's talk this morning is going to concentrate on the methodology that we use in the PMM. He went over that briefly in the first section, but he's going to go into some more detail now.

MR. BAWKS: This first slide shows the linear programming solution in the PMM. The objective function is to maximize profits, profits being revenue minus cost. Revenues are derived from the sale of petroleum products, both domestically and in foreign markets. Costs are incurred through the purchase of raw materials, the transformation of those raw materials into finished petroleum products and the movement of those products to the demand sectors.

These activities are constrained by material balance and specification requirements, and capacity limitations.

I mentioned earlier that capacity expansion would be endogenous in the PMM. Expansion will occur if the incremental revenue is greater than the incremental operating plus investment costs. The incremental revenue occurs as the result of the sale of additional products that are produced from the expansion.

The investment costs are currently being determined off-line. We are taking into account not only the plant and equipment costs, but also costs associated with utilities, environmental regulations, off-sites, land, working capital, and inventory. Taxes and depreciation are also taken into account.

Some of the basic assumptions we used in deriving these costs are a 20-percent return on investment; an actual life of 20 years; and a depreciation life of 10 years. We may want to talk later about the difference between return on investment and cost of capital.

Currently all units are allowed to expand in the model. We may restrict that to certain major units if we run into execution time constraints.

I mentioned earlier we had approximately 12 end use products, including the different types of gasoline, distillate and resid. We'll be developing prices for those products in the nine Census divisions by each of the relevant end-use sectors. The end-use sectors are residential, commercial, industrial, transportation, and utility.

That multiplies out to a fairly large number of prices that we produce. These end-use prices will equal the wholesale price from the linear program, plus a mark-up. That mark-up will be product and sector specific, and it will be equal to the average historical retail minus wholesale mark-up for each region.

Product supplies have to equal product demand. The supplies will include crude, NGL, and other non-crude inputs to refineries. Those non-crude inputs will include the imports of unfinished oils, alcohols that are purchased for ether production at the refinery, and ethers that are purchased from outside the refinery.

Linear Programming Solution

Objective Function:	Maximize (Revenue - Cost) (Million $/Day)
Revenues:	Domestic Product Sales and Exports
Costs:	Raw Materials, Production and Transportation of Products
Constraints:	Material Balances, Specifications, Capacities

Capacity Expansion

Expansion Occurs If:

Incremental Revenue is Greater Than
Incremental Operating Plus
Investment Costs

End-Use Prices

End-Use Prices: LP Wholesale Prices Plus Markup

Markup: Average Historical Markup (Retail - Wholesale)

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In addition, supplies will include the volumetric gain that results from some of the refining processes, net imports of products, and non-refinery inputs. Non-refinery inputs include fuel ethanol which is splash blended downstream, LPG's and natural gasoline that are produced at NGL plants and sent directly into the market, and crude oil product supplied. We also have a discrepancy number up there, and we hope that that will be a very small number.

Last and certainly not least are oxygenates. This schematic shows how we're going to deal with oxygenates in NEMS. The Transportation Module will provide demands for M-85 and E-85, M-85 being 85 percent methanol, 15 percent gasoline, and E-85 being 85 percent ethanol and 15 percent gasoline.

The International Module will provide supply curves for methanol and MTBE, and this will be for imports of those components. The Renewable Fuels Module will provide us with ethanol supply curves.

Based on these supply curves and the known demands for methanol and ethanol, the PMM will determine the market clearing prices and quantities of ethanol, MTBE, and other oxygenates.

MR. KENDELL: We'll take one final round of our reviewers' comments here, going again in reverse order, Mr. Levine first.

MR. LEVINE: The first comment, I think we realize that an LP doesn't solve for both prices and quantities, as such, but you input one and you get the other. For a given production that you put into an LP, it solves for the incremental or marginal cost or vice versa. If you put in a price, then you get an optimal production level. It's not a big deal. It's something that I think we recognize.

The next one is a major find, probably a typo. On page 44 in the present value calculation, the exponent should be negative in the evaluation of the nominal total plant and equipment costs during the construction period. In fact, it's done in an incremental three-year calculation, and it might be better just to use continuous discounting, which you do anyway on the next page for getting the present value of the entire investment. Not a big deal of a comment. I assume it's probably programmed right, and it's more a typo in the report.

And a final question that we have and I'm sure a lot of people are asking: what are the results? How soon will we see output? Because that's when you really can understand what kind of product you're getting.

We're really enthused about it, and a lot of people are looking forward to it.

Thanks.

MR. KENDELL: We're going to have some results, but we're not going to let the model out until about the 1st of October. We're going to spend the summer testing it and integrating it with the system, and then we hope by the beginning of October to begin letting other people use it.

Petroleum Supply Balance

Crude Input to Refineries

Processing Gain

Net Imports

NGL Inputs

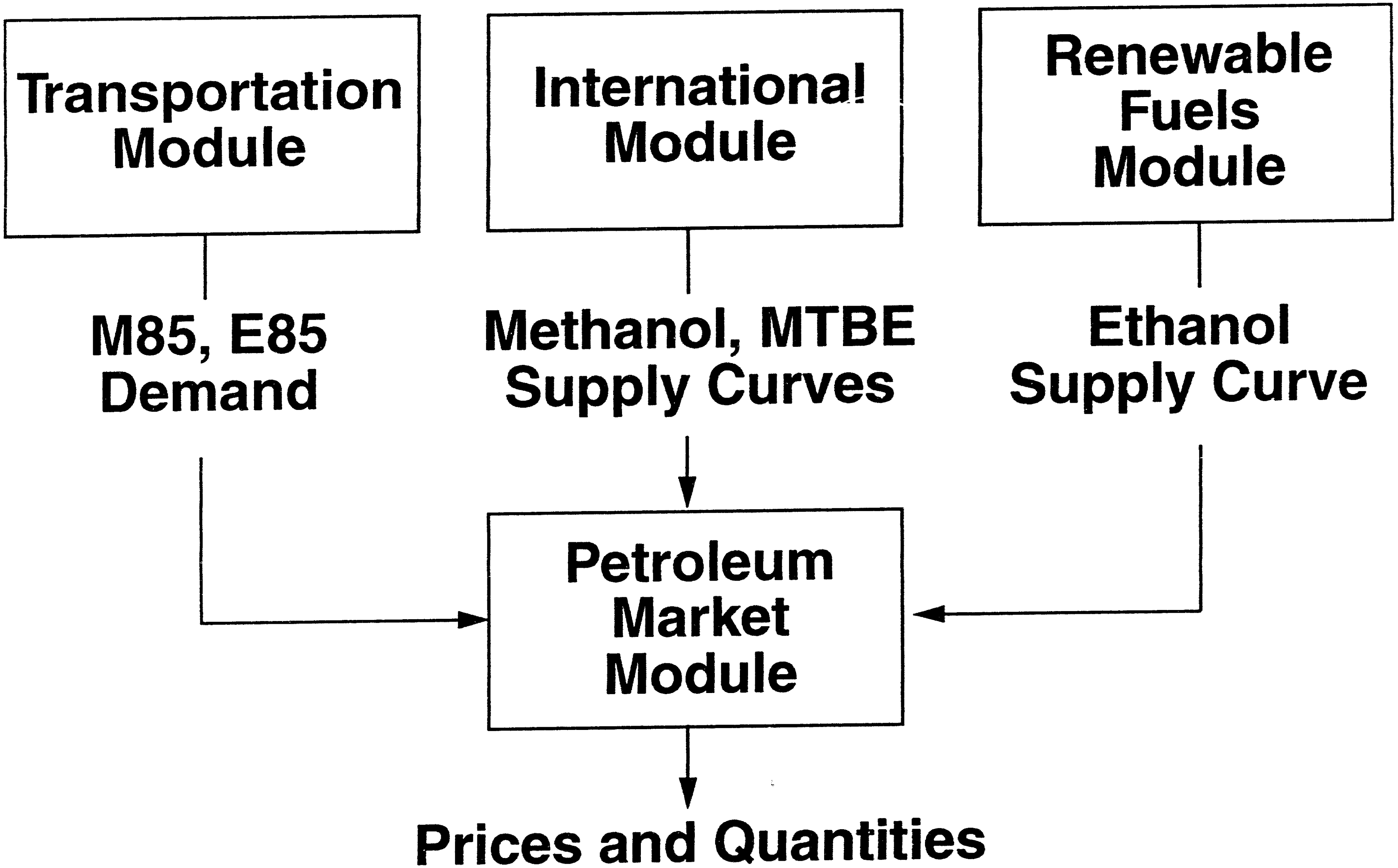
Other Non-Crude Inputs

Non-Refinery Inputs

Discrepancy

Product Demand

Oxygenates



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PERIOD 3 COMMENTS

Prices and Quantities

Input one or the other, ie:
Given production get incremental cost
Given price get optimal production level

What Results Are There Now?

Our next reviewer is Joe Marcinek.

MR. MARCINEK: I guess my first comment on this section has to do with what was shown as the capacity expansion slide, and my comment here somewhat relates to what I previously said. Only I think I should elaborate a bit more.

Remember when you require construction in a refinery, you're talking about up to 4 years in order to complete it, and you can't be rebuilding refineries every day or every week or in every year.

If you think about what has happened with regard to reformulated gasoline, we're expecting about next September to have the rules finalized, and at that point we'll know what we have to begin doing, with the mandated use of the complex model in 1997.

In other words, we were expecting 4 years from the time that's finalized until you have to use the complex model, and again, the reason for the 4 years is the time that it takes in order to build process units in a refinery.

So getting back to NEMS and the problem at hand, I guess I am wondering how often will you be looking at a model, a problem, if you will, whereby it's a policy decision that won't necessarily cause you to get into refinery construction. To whatever extent that represents a percentage of the questions that NEMS might be asked, those are situations where you don't want the flexibility to construct units to interfere with your solution.

On the other hand, if you're looking at something like reformulated gasoline, there's a new and different kind of problem with construction. You can't represent it until you know what you're doing.

So I guess the point I'm making is when you get right down to the usefulness of the capacity expansion portion of the model, you have to be careful with it.

A comment was made about return on capital. I would recommend that they use 15 percent.

Those are the only comments I have on this section.

DR. CONSIDINE: First of all, when you read the equations, basically they're indexed for one region, but really the plans are to put all the regions together in one big LP. When you read the report, it's difficult to follow whether that is, indeed, the objective.

For instance, PADD III has a lot more activities than the other PADD's, and would this affect the objective function in some way? I guess that's something they'll get to as they actually construct the model.

I had a couple of comments in support of the previous gentleman's comments on the capacity expansion module. It seems to me that there are two issues: expansion of capacity in light of demand and also refinery upgrades to meet environmental regulations. It's not clear in the report what exactly is going on there.

Also another practical issue for the LP: should there be limits on investment spending in line with historical spending patterns or expected expenditures? Perhaps there should be an additional constraint in the model for that.

Another constraint perhaps should be included for balancing supply and demand by product. There was a material balance in that constraint that was just discussed, and that's between the amount that goes in, crude and liquids, and total product demand. But, should there be also constraints across each product, such as gasoline demand versus where it's coming from? That is, production plus imports less exports?

That may be just a minor sort of housekeeping matter to take care of, but it could be important for the solution of the model.

Also, this was brought up as well. Will the interregional flows between the detailed refinery model in PADD III be compatible with those in the other PADD's? I'm not quite sure of that. You know, when you've got an imbalance between activities, that would require careful consideration.

Also, unit costs. As you all know, most of the costs of producing product is crude, but are there other costs included here, like labor, maintenance, and so on? It may be only 5 percent or so, but if that data is available, it may be worthwhile to incorporate.

They also had a section on uncertainty, and there are some interesting techniques for dealing with uncertainty with math programming models. There's a method called stochastic sensitivity analysis where you select key parameters that have perhaps a probability distribution around them, and you generate some probability distribution on the outcomes of the model. For instance, capital costs may be uncertain, especially in these environmental projects that are required, and perhaps it may be worthwhile once the model is constructed to conduct a stochastic sensitivity analysis and generate some probability distributions on the results.

And that would give us some feel for what the shape of the distribution looks like and perhaps give us more of an intuitive feel for the forecasting capability of the model rather than just, as someone mentioned earlier, relying on point forecasts.

That's about the gist of my comments. I'd just like to make one point about the National Energy Modeling System. It seems to me that much of this is a collection of linked models that iterate -- for instance, the refinery supply model predicts prices, and those go into demands, and if there is a big gap between the two, the models are iterated. At least that's the plan. There have been a lot of advances in computable general equilibrium models that may be worth investigating in this effort.

Thank you.

MR. KENDELL: I'd like to thank our reviewers. I think we've gotten a lot of ideas this morning. I've heard some new things, and I've been paying a lot of attention to this over the last year.

I was pleased with the format. We got some exchange between the reviewers we didn't get with some of the other panels, and I was also pleased to hear the tension between reviewers wanting more detail and those wanting less. It's something we've been struggling with for a long time, the tension between a larger matrix and a smaller matrix and a longer execution time and a slower execution time.

I want to open up to questions in a few minutes, but before we do that, I'd like to give Bruce a chance to respond to some of the questions that the reviewers raised.

When I call for questions, I'd like you to identify yourselves and your affiliation so that the recorder can get that.

MR. BAWKS: It's much easier to prepare a presentation ahead of time than to have to respond spontaneously to some of these comments. I do appreciate the many comments we've gotten from the reviewers. There are a lot of good ideas and things that we need to consider.

I'm going to try to respond to some of the issues that came up.

About Canadian imports into PADD II, we are going to be accounting for imports into PADD's II and IV. That wasn't in the CDR but we are going to add it. The international module will be providing us with supply curves for all five PADD's.

We will account for environmental investments. As for expansion, we are going to have expansion not just for crude distillation, but also for the downstream units as well. Several of the ether producing units and other capacity additions will be for meeting the environmental regulations. We also are incorporating the costs of adding equipment to the refinery to reduce refinery emissions. They'll be treated like a fixed cost.

As far as sulfur allowances are concerned, we're going to deal with those off-line, and we're looking at that mainly at a U.S. level. We haven't broken it down to the regional level. We are taking into account the percentage of small refiners and low-sulfur diesel output and using that to come up with an algorithm. But that is being handled off-line currently.

We do have the ability to restrict capacity expansion, not only the level of investments, but also to turn it off completely. Eventually we may get to the point where we run capacity expansion one time with each iteration and add that capacity into the base capacity for the following forecast year.

We are going to be validating the model against historical years. We haven't set up the test procedures yet, but we probably will run it against several historical years. We plan to do a variety of other tests as well, looking at issues such as the tradeoff between ethanol and MTBE and investigating how the model will respond under various conditions.

A detailed refinery model was mentioned. We do have a detailed refinery model that is not going to be part of the integrated NEMS environment. It will be used for handling issues that deal only with the petroleum industry.

PMM will be used for those issues that require demand side feedbacks or interaction with the International Module, where we're interacting with other sectors or other modules.

We decided not to include inventories in this model, since it is an annual model. Inventory change is very important for short-term analysis or short-term forecasting. We felt, however, that in the long term the market can't live off of inventories and can't build inventories forever. We felt that it would be easier just to let inventory change be zero for the forecast years.

We did estimate that oxygenated gasoline is going to be less than 5 percent at the National level. However, if it is 50 percent of, say, PADD IV, then we will incorporate oxygenated gasoline in PADD IV. We will have to look at that on a regional basis and see if that changes the decisions that we've made.

Crude transportation will be built into the model. The fixed coefficients that are in the CDR are just for Phase 1. We are going to be adding a crude transportation structure that will move crude oil from the oil and gas supply regions to the PADD refining regions.

Currently we're only modeling one grade of gasoline. We haven't even broken it into premium and regular. We felt it was more important to represent conventional, oxygenated, and reformulated gasolines than to have the different grades of gasoline. If solution time allows, we would like to break out premium and regular. That's something that we haven't dealt with yet.

We are planning to have the capability to use T-90 as one of our specifications. That's something that's not in the model right now, but we are planning to add it.

As far as the annual average RVP, that is something we're going to look at. We're going to test the summer regulations versus the winter regulations, and see what impact that has on price and some of the other variables. That may give us some insight into the appropriate annual average RVP to use. It probably isn't just a simple average between summer and winter. It is an area where we are going to do some testing.

Sulfur is part of the model. We don't output any information on it currently, but it is carried within the refinery units. We do keep track of sulfur.

The present value calculation in the CDR should have a negative coefficient. So that's another change that we will make in the CDR.

We will take another look at the objective function. We spent quite a bit of time debugging the notation for the objective function and the balance equations that are in the CDR but we'll have to take another look and see if it really does represent what we're trying to do. But Tim was correct in that we are going to have one general matrix, and it's not going to be by region.

We do need to take another look at the balance between supply and demand by product.

I'm certain that the suppy and demand for individual products does balance.

Uncertainty is being dealt with. I'm not really familiar with exactly what has been done so far on the uncertainty issues, but that is something that is being dealt with at the overall NEMS level so that each module will be handling uncertainty in a consistent manner.

I think that's all I have. I may have missed a few things. I'll ask if Chuck Boudrye may have some comments as well. Chuck, by the way, is from SAIC, Science Applications International, and he has been doing a lot of the linear programming work for us.

MR. BOUDRYE: I have a couple of comments. One, on the capacity expansion, the NEMS system runs over a period of 29 years, by year. So events happening 5 years down the road when they're making a particular iteration are not known in advance. So representing capacity expansion becomes quite a challenge.

Expansion will be adjusted using some of the switches that Bruce was referring to. The approach we've taken so far is, recognizing what you said about the time for refinery building of about 4 years, off-line we have taken projections of demand to the year 2015 for the United States and have made runs with the PMM looking for how much investment occurs, where is it happening to meet those demands that we have, say, in the business as usual case.

What we intend to do is to use that information, in effect, as an upper limit on the amount of capacity based on 5 year look-aheads, and then within any given year in NEMS, we will allow only a portion of that capacity to be built.

If you don't do that in this kind of environment, the model says, "Oh, I want a million barrels a day more capacity in PADD III. I've got it." Well, that is not something that's going to be very easy to accomplish.

So the capacity expansion is one area that's giving us a great deal of difficulty because of the way that NEMS operates.

I thought your suggestions were very good. I hope Jim remembers this, that when we don't have to look at capacity expansion, let's just drop it out of the matrix.

Bruce covered most of the changes to the CDR that you looked at. It has been updated. Crude transportation is in. I might add that on the foreign import side, the international model provides us with supply steps for foreign crude oil for the five PADD's: East Coast in PADD I, PADD III, the West Coast, and then coming in to PADD's II and IV from Canada.

From the Gulf Coast in PADD III, foreign imports move up the crude oil pipelines to reach PADD II. So we have the crude oil pipeline transportation network in the U.S. represented, as well as the product transportation network.

I also thought your comments were well taken on the regionality in terms of the Census divisions. It was a tradeoff that we had. We wanted to have fewer refining regions. So we said, "Look. We'll stay with the PADD's."

But we try to do the best we can. It's sometimes a sharing out process, but the approach we took was to designate what I call a home Census region for each PADD. PADD II is a good example of this. The products that are made in PADD II refineries go to the nearby Census regions at a fairly nominal cost. So that way you get a good flow which you expect to happen. This is the local tributary area.

But it is a problem any time you have these different regions.

MR. KENDELL: The Component Design Report that we've been referring to is in the back of the room. We do have a few copies if people would like to pick that up or you can just order it and have it sent so you don't have to carry it home.

This is the time for your questions. If you have any questions of the reviewers or Bruce, we'd be glad to hear them, or if you have comments on what you think the model ought to do.

MR. WOODRUFF: Hi. I'm David Woodruff with Pennsylvania Power and Light Company.

I have a question related to the product categories. There was a lot of discussion about different gasoline types but from a utility standpoint, it was mentioned that there are only two divisions in residual fuel, less or equal to one percent, and greater than one percent. As you move to Clean Air Act compliance the difference between one percent or 0.3 percent resid can be as much as $3 and might even be more as you get more into Clean Air Act compliance usage.

Is there any consideration to breaking that down into different categories, 0.3, 0.7, instead of lumping them all together as "less than or equal to one" because you don't know? Is it an average of the three categories or is it more heavily weighted towards the lower sulfur? We don't know what you have if you just lump it all together like that.

MR. KENDELL: I don't know what Bruce has thought about that, but that's something we could certainly do. That's one of the advantages of the LP, that we have that flexibility to redefine products, and I think we also have the data. We collect a lot of data in EIA by those sulfur categories. So that's something that is conceivably possible.

MR. BAWKS: I think if the electric utility people feel that they need that, it is something we could consider. The reason we've come up with many of those product types, it's the result of what the demand side people want, what kind of prices they feel that they need. If they feel that it's necessary to have a 0.3 or 0.7 percent sulfur, it is something we could probably provide.

MR. DiANGELO: David DiAngelo, the same company as Dave.

As an efficient way, perhaps, of polling the industry, there is a fuel oil users group within EPRI, and you might just simply ask them.

MR. BAWKS: Thank you.

MR. KENDELL: Martin.

MR. TALLETT: Martin Tallett, ENSYS Energy and Systems.

We supply the International Energy Module and the Detailed Refinery Model that are adjunct models to the NEMS system.

One comment that I would raise is about data and data consistency. I used to work for Amoco in a European office in London years ago, and we had a lot of arguments with Chicago about supply planning results. The reason was, we eventually found out, that we were actually arguing about the data coefficients buried deep in the LP models that we were each using.

Here you have a situation where there are three or four refinery LP matrices. You've got the International Model. You've got the Detailed Refinery Model. You've got really two matrices within the Petroleum Market Module itself, and as time goes on, there is the risk of these matrices becoming inconsistent not in terms of so much the outside, visible assumptions, but in terms of the coefficients that are buried in the matrices.

I really feel that maintaining that data consistency is essential. For instance, if the data are not consistent, you're likely to get inconsistent supply curves coming out from the International Energy Module to be put into the PMM.

Another point on the situation about the environmental regulations, particularly on gasoline: these really are making life complicated. I mean the EPA is changing the rules. No longer is gasoline being controlled in the traditional way by individual product, physical property qualities, but by equations that control overall emissions of VOC, toxics, and NO_x.

Not only that; these equations over the long term will apply to both reformulated and the conventional gasoline, at least conventional gasolines. NO_x and critically the toxics will be controlled using complex modeling equations.

The experience that we've had to date, and this involves integrated modeling, and we have linearized these equations and put them into our models, is that unless in this case the PMM has a representation of these equations in there, it will be difficult to arrive at conclusions on different issues analyses, policies analyses, where you can be confident of the results.

The reason for that is that if you just put in the recipe-type specifications, percentage of olefins, aromatics, and so on, that you feel reflect the emissions levels, they're likely to limit in ways that are really inconsistent with the spirit of the equations. The idea of the equations is to give refiners flexibility, and so putting in individual specifications can cause misleading answers, in our view.

We're already finding our own results very sensitive to this. It's unfortunate at the moment, but it complicates the modeling challenge that, as Joe Marcinek said, we're entering into a period of considerable uncertainty. Maybe five years down the road when the whole gasoline reformulation issue has been resolved and people are used to knowing what they're dealing with, it'll be possible to take some shortcut methods in modeling; but at the moment one almost has to consider all of the possibilities, including all of the processing options, because you're not quite sure which way all of these regulations are going to turn out.

The only comment I have on the set of crudes is a slight nervousness, which one of the reviewers reflected, on whether it's appropriate to have such a range of medium sour crudes that you have, say, Mayan crude oil and Saudi light crude oil in the same group. From a processing and economic point of view, those types of crudes are significantly different.

The question of small refiners came up. We've done analyses before where we've broken down a PADD like PADD III into different groups by size or complexity. We find that you don't get quite the same answer if you look at the composite PADD versus looking at the PADD in its subgroups, but maybe the Detailed Refinery Model is the place to look at that.

Thank you.

MR. KENDELL: That's a good point about keeping the technical coefficients consistent between the international and the domestic model. We had the benefit of our Office of Statistical Standards in EIA getting Alan Manne, who is now retired from Stanford, as an independent expert reviewer. In his last review, he made quite a pitch that we needed to keep the international and the domestic modules consistent.

So as a result, one of the things we've done is initiated a series of ongoing meetings between the international and the domestic teams. We had quite a bit of interaction when we were designing this a year ago or thinking about it, and we decided that it's important to keep that up.

MR. BOUDRYE: Don't be misled by that crude oil chart. Arab light is not in the same category as Mayan crude. Mayan is in the HV category, and Arab light's in the heavy, but low sulfur.

MR. MARCINEK: I wanted to make a few comments to the gentleman that spoke before last, back there somewhere.

MR. KENDELL: Martin.

MR. MARCINEK: Martin, okay.

First of all, you alluded to buried coefficients, and I really don't know much about the LP that you people are using to develop your NEMS. I presume that it's an OMNI type or a MAGEN type where you have data tables, and the data is readily readable, and how you grind up the data from the data tables into what becomes the coefficient later on, that's readily readable.

So I would say that gone are the days, or at least they should be gone, where you literally were developing coefficients by hand and burying them, and as time went on the true meaning of that coefficient got lost. That's a benefit of the way LPs are generated today. And I guess that's my reaction to what I heard.

With regard to the complex model representation, and I'm going to shoot from the hip on this. I'll say that to date nobody has represented the complex model per se. Now, let me explain.

You mentioned, first of all, one thing that you don't want to do is prejudge a slate of properties that will satisfy VOC, NO_x and toxics, all the requirements, because the danger in doing that is you might cause a representation that's higher cost than optimum.

Then, on the other extreme is what I say nobody has done yet, representation of a complex model. I don't know how close any of you are to what EPA has proposed so far, but you could literally be at a point with a set of data and no matter which direction you go from there, it's all of the same sign, which should be impossible. In other words, you're in a saddle. If you're in the saddle and you try to get out of there, you go in this direction. The number gets smaller. You go in the opposite direction. The number gets smaller, and you say, "My God, this doesn't make sense."

You're right. It doesn't make sense, but that's really the kind of battle we're currently fighting with the current representation of the complex model as put forth by EPA, and we're struggling with that sort of thing.

You need to have a rather regular shape in order to represent it, and if it's nonlinear, then you can break it down into linear segments. When you hear of people representing the complex model -- I'll use Turner Mason as an example -- really what they're doing is they're picking a single linear segment out of an equation and saying, "All right. I'm going to prejudge that my solution's going to be in this area," and then they check it and make sure that it is, and then if it is, you've hit the right section.

So, in other words, you don't have a complete representation, no matter what the solution is, that it's right and consistent with a complex model. We're not quite there yet.

MR. KENDELL: A response from Martin.

MR. TALLETT: Two very good points. First the one about the hidden data coefficients. You're absolutely right. Every data coefficient in all of these models is there in a table.

I think the problem that I was alluding to, and it's one that I've discussed with Chuck before, is that when you get hold of these models, often the tendency of the user is to focus on the particular subset of tables that are concerned with the case assumptions. For instance, we supplied a version of the World Model tables to EIA recently. Those are what Chuck was using to develop these reduced matrices.

That's fine, but we changed the tables since then. We looked, for instance, at some of our runs, and we realized we're getting too much investment in one or two units, like solvent de-asphalting and vis-breaking. We thought, "Well, what's going on here?"

We checked into the coefficients and realized that there wasn't a particularly good weight and sulfur balance on some vectors on those units. So we went back, and we have changed those coefficients in the World Model. They have not been changed in the Petroleum Market Module.

Another instance relates to oxygenates. Oxygenates are clearly key. We ran some of our earlier cases and we found that refineries were taking up a lot of higher oxygenates, such as TAME, THME, and the world, as it were, was not investing so much in merchant capacity for MTBE production.

Then we looked again at our cost coefficients, and we realized we were not fully reflecting the fact that when you produce TAME and THME in a refinery versus MTBE that there are extra costs associated with fractionating out the feedstocks.

When we reflected those extra costs, even though it was an approximate reflection, the result shifted. You had a more balanced set of results where there were some that had higher oxygenate but more global merchant MTBE production. So here is a case in point where, again, there's an ongoing process of refining and improving the data over time. My main point was that the stewardship of the data coefficients needs to be coordinated between these various models.

The other question concerned the EPA complex models. Bear in mind that there's a simple model and there's a complex model. The simple model is now a law, but that only applies really in the medium term, '95-'96. The complex model is what will really determine the long-term future, and EPA is making different attempts at that, different interpretations of the science, if you will, which are also the subject of negotiation with the oil industry.

The EPA came up with an initial set of complex equations. They came up with a revised set of equations last October, and they're expected to come up with yet a further set, which hopefully will be the final-final set, some time later this year.

So nobody at the moment knows exactly what the form of the complex equations is going to be. There are problems, as Mr. Marcinek said, about inconsistencies, saddles, and so on, in the form of the equations. They're also quite complicated. They could possibly be simplified, and in addition, their design of experiment does not at the moment cover the full range of gasolines. In other words, the equations were developed looking more at reformulated gasolines, but EPA is now saying, "Well, we're going to apply these for conventional gasoline as well."

If you do that, you've got to have equations that are developed that cover the range of properties, including high enough aromatics, olefins, and so on, contents for them to be valid for conventional as well as reformulated gasoline.

And in terms of what I was saying or claiming, the method that you were talking about is not the method that we've taken. We've taken a different method involving statistical analysis and correlation, and we've found good correlation with the simple equations, with the original complex equations, and with the Auto/oil equations in the sense that we have been able to come up with linearized values that work within realistic error ranges over a range of cases.

That said, again, the accuracy can be improved, and this is critical, by doing something that people do when they model gasoline octane blending, namely, to establish different sets of gasoline pools like conventional, moderately reformulated, severely reformulated, and generating different sets of emissions coefficients for those pools.

Our own view is that this is something that we will be able to achieve, that can be done, and that we would certainly intend to build into the detailed models to help EIA-DOE undertake issues analysis.

MR. MARCINEK: I'm curious. Is this a single linear representation or is it a segmented curved technique where you've broken it up into more than one line?

MR. TALLETT: No, it's not a segmented curve technique. It's a single linear representation where you use a set of coefficients.

MR. GELB: Bernard Gelb, Congressional Research Service.

I have a question about the equilibration of supply and demand at end use. I assume that demand is exogenous to the PMM from outside, elsewhere in NEMS, but yet you're deriving end use prices by essentially adding to refining cost a mark-up based on some historical relationship. So the end-use price isn't going to be the end-use price unless it meets exactly that demand, and they haven't been derived by using the same relationship and inputs.

So I was wondering if you could address that, and second, because there are shifts in who's doing U.S. petroleum marketing at retail these days, I was wondering if you had looked into that and if that has any effect on your expected mark-up 10 years from now.

MR. BAWKS: As far as the mark-up, we are keeping the mark-up fixed over time, and it is a consideration to look at how the mark-ups may change in the future. Historically, we found that even though the mark-ups move around, the trend tends to be flat. So we elected just to keep them constant.

We do receive product demands from the demand modules, and they are fixed. The PMM's responsibility is to meet that demand and then to determine the price which equals the cost of meeting that demand.

To get equilibrium, the PMM produces a price which is passed on to the demand modules, and they use that price to determine a level of demand; then, that demand level is passed back to the PMM, and the iteration process continues until equilibrium is reached.

MR. KAPLAN: Stan Kaplan, Koch Refining.

I'd like to echo a comment of Jerry's. Somehow, we need to address seasonality. Averages don't work in refining, especially if you take a look at PADD II, PADD IV, and parts of PADD I. Capacity is not the same summer and winter, as refineries go into turn-around. Specifications that we put on gasoline are different and they don't average up. In fact, demand is seasonal.

So somehow I think those things need to be addressed, and then I have a question. I imagine we're going to be wanting to study some of the things in terms of policy issues or rationalization. When we're dealing with an aggregate or an average refinery, how are we going to represent refinery shutdown and refinery rationalization?

MR. BAWKS: We are considering, as far as expansion, to also have a retirement of certain refining capacity. We haven't really dealt with the issue of refineries shutting down as a result of the Clean Air Act. It's something that we're aware of, but we're going to have to deal with that off-line. We don't have any way currently of building that into the model.

As for seasonality, this model is for mid and long term. It's not a short-term model, and seasonality is very important in the short term. As part of our testing, we are going to look at how the model would react to summer demand and specifications versus how the model will react to winter demand and specifications, and try to come up with annual specifications and information that will give us what we feel are accurate prices. Beyond that we really aren't dealing with seasonality per se.

DR. CONSIDINE: I had a couple of comments. One, on the mark-up question, that's a really good question because the model doesn't really have any theoretical structure behind the mark-ups. It's purely ad hoc, but you could argue that that difference between the wholesale price and the retail price reflects transport costs, and that's a really tough problem or tough measure to estimate.

On your question about entry and exit under the Clean Air Act, perhaps you're selling yourself short on the model. You know, the model could be changed in a way to represent that process. Refiners may have the choice of either importing product or investing in new capacity to meet the regulations, and maybe a lot of that information is already there.

That's an important question for the refining industry -- what is capacity? And that's why I asked that question: what are the technological recipes available in the model for meeting the Clean Air Act? Is it just a matter of blending different product or do you have to really embark upon a wholesale reinvestment program?

And that would be related to the import question, whether these products could be made elsewhere at lower costs.

MR. MUMFORD: Joel Mumford with Southern California Gas Company.

The first part of this question was just answered by a previous question, but my question was: is there seasonality in refining markets, and if so, can the model be modified to look at alternatives to additional refining capacity?

MR. KENDELL: I think seasonality is something that we could conceivably tackle. I don't know if I'd really want to do it in NEMS without some experimentation.

As I've said before, we've always got to make these trade-offs between more detail and less detail, faster running time, slower running time. And with seasonality, we all recognize the turnarounds. Turnarounds happen every year, there's maintenance that needs to be done, and there are definite seasonal patterns. I just don't know that it's something that we can really cover in this kind of a model. Perhaps in a more short-term representation, but I'm not sure it's really appropriate here.

MR. MUMFORD: Yes, I had a second question.

One of the reviewers mentioned that capacity expansion is different than refinery upgrades to meet environmental regulations. Related to this, can this model address a policy analysis where the nation follows California or stricter standards, and can it then determine the capital investment required to change the environmental standards and the resulting end-use prices?

MR. KENDELL: In a word, yes. That's one of the advantages of the LP. We could restrict gasoline to a certain recipe. We could say it's all California reformulated, and just force all the regions to run with that, and one of the features of the PMM that we didn't have in the previous model is that we are going to put out capital expenditures to the macroeconomic models, and we will be able to see that hopefully in this model. So that's something we're looking forward to.

MR. MARCINEK: Many of these questions send me off thinking, and pertaining to the last question, I'm wondering just how far a California regulation might be factored into this. If you're talking about something that might require a change to the waste water treatment plant, I dare say that there's no way that an LP's going to comprehend that or low NO_x burners, for example.

So my point is there are things that an LP's going to comprehend, and those things are basically process unit oriented, and there are things that LP-type refinery models are unlikely to comprehend. Today in our industry roughly 50 percent of our capital is being spent on environmental items, and a big chunk of that really doesn't lend itself to LP-type refinery representation. It's not a magic box. There are certain things that it does very well, and there are some things that you have to keep track of off to the side.

MR. KENDELL: That's very true. That's one of the things I wanted to ask the panelists about before they leave. We've got Stacy MacIntyre in the back of the room working on that very question and trying to figure out what some of those environmental costs are going to be. That is very important right now for the refinery industry.

We're almost at the end of our time. Do we have any last questions?

If not, I'd like to thank you for coming. I think we've gotten a lot of good questions today, a lot of good input, and I want to once again thank the reviewers.