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**RICHARD DE
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Hi. It's me again-- Richard de Neufville. And I'm happy to talk with you again. And I'm going to be talking some more about this notion of the forecast being "always wrong, where "always" is in quote marks to give the general idea that we can't count on it being right.

But of course, sometimes, we make a forecast. And what actually happens is exactly what's forecast, although the general rule is, it is not. I showed you some slides previously about how our cost estimate of creating projects was uncertain. But now, let's look at predictions of project demand.

So this is another class of possibilities, where we can deviate from what's actually happening. This one is one of the many predictions of the price of oils in a particular timeline between here now-- 2004 and 10 years later on. And what we have here is an official projection, which is this line that's green.

And that's the low one. And then, there's the red one, which is a high. And the best forecast is that blue one, where it's supposed to be around \$40 a barrel, as predicted in 2004.

The big line up here at the top is what was actually happening. And you can see that the line, the prediction, was not only not within the range of what was originally predicted, but it was about twice as much. And it went up to over \$100 a barrel in that period, which is only 6 years ahead.

So the expert agency that had been doing that was saying, well, it's going to be in this range. It's a reasonably tight range of \$40 to \$60, perhaps. And in fact, what actually happens was terrifically different from what occurred.

Now, I've just shown you this one particular graph. But the fact is that oil price predictions are notorious for being different than what actually happens. And you can appreciate why, because first of all, there have been wars in this area, in the Middle East and elsewhere, which change things. There have been huge economic developments-- the rise of China.

Its appetite for oil has raised the prices enormously. And then, not yet shown on this graph, but you will know it, which is the development of fracking, which has really reduced the prices of oil considerably. So in general, the forecasts of what will happen to the price of oil have not been correct-- systematically lobbied correct, not just by the average person on the street, but by the International agencies and national agencies charged with projecting the price of oil. It doesn't happen the way they say it will.

And I'm not blaming them. They're doing the best they can. But there are things that happen around them that change the possibilities.

Here's a different one. Here is a projection for, in the United States, the production of wind energy installations. So the blue line was a forecast. And it seemed perfectly reasonable.

It showed an active growth. And that was considered to be fairly aggressive at that time. And then, what happened? Actually, the red bars show the actual amount that was installed in those years.

And it got to be easily twice what happened in most of the years except the last one. What happened here? Well, what I believe happened is, the explanation was that somewhere in the government, they passed regulations-- or in state governments, they passed regulations encouraging the use of wind energy.

So people responded. This was unexpected by the people who made the forecast originally, but it happened. This is the kind of thing that does occur.

Sometimes, it leads to an increase. Sometimes, it leads to a decrease. But the thing is that there are changes.

Let me go to another one. This time, it's for water use in a sector of England called Anglia done by the Anglia water people. And the line in the middle here, the black line going straight up, is the projected demand. And they said, well, we're not sure about this.

So let's go basically plus or minus 10%. Gives us a reasonable range. Some other people earlier had a more aggressive line going up.

But basically, it was continued use associated with more people and more washing machines, and whatever you have. But it was a growth pattern. Now, remarkably, what actually happened was, the water use decreased.

And then, at some point, it increased a little bit-- or up to what was expected. And then, it went down again. It was different.

Now, it's just another example of how the forecast and the actuality is different. What happened here? It wasn't they stopped washing or things like that. But what I believe happened was that the water company decided to raise the prices to finance new facilities-- good thing.

But people said, ah, if I'm paying more, I'm going to pay attention to my leaks. And in fact, in many water supply systems, about 1/3 of the actual use of water goes into leaks, because faucets drip because the mains were built 50, 100 years ago, and they leak, and because people don't bother to save water by installing low-flush toilets or what have you.

So it's in fact, quite easy for them to decrease the water that they use, or the water that goes through their households, or their industries if they have the right incentive to do it. Same thing happened in Boston when they built a large sewage protection unit in Boston Harbor. They spent about \$6 billion for it.

They raised the prices. My prices went up from about \$50 a year to about \$500 a year. And like other people, I installed all kinds of water savings devices in my house, and the water usage in Boston went down also.

But that wasn't anticipated by the engineering experts, by the experts that were thinking about it. They're making the projection as the water system was being developed. So again, you have a situation where the forecast and the actuality don't match.

You might ask, how do I get these kinds of graphs? And this gives you an exercise you can do for yourself. I ask my students to choose any topic they want to, to look for a series of forecasts for the future, and to compare them with what happened.

And this particular one was done by one student. The others were done by other students. But you can test my supposition, my argument that the demands are not as predicted by choosing a topic that you want yourself-- the sales of the Ford pickups, the introduction of electric vehicles, whatever you might be interested in.

You could see what forecasts were done 5, 10 years ago, what has now been happening, and make the comparison yourself. Sometimes, the forecast will be a good indicator of what actually happened. But in general, these are the kind of results that my students bring up to me when I give them that exercise. These are the kind of graphs, pictures, diagrams that you can have for yourselves, create for yourselves.

So why is it that the expert forecasts are often wrong? What is happening? The general answer is because things happen. What things?

Well, there might be technological advances that you don't need to do things the way you did them before. Or there's fracking, which made the price of oil cheaper, for example. There are weather patterns that account, maybe, for some of the increase and variability in the use of water in England in that particular example.

There are economic crises-- the economic situation isn't so good, and people don't buy as much. And things are cheaper or more difficult. Things happen. That is the lesson from today. Thank you very much.