RESUMED **[12.06 pm]**

COMMISSIONER: Welcome back. I apologise for the delay. There were some technical problems. I welcome Ernst and Young for the computational general equilibrium model assessment briefing. Mr Jacobi.

MR JACOBI: Computational general equilibrium modelling assessments will be undertaken to determine the economy-wide effects of labour, capital and primary resource flows, both interstate and intrastate, which would result from a possible investment in any part of the nuclear fuel cycle in South Australia. To explain those assessments, Mr Craig Mickle and Dr Jyothi Gali.

COMMISSIONER: Welcome. Please start.

MR MICKLE: So we're going to quickly run through just the objectives of the CGE analysis work that we've been asked to undertake, provide a high-level description of the model and the approach that has been undertaken that underpins that work, talk about the scenarios that we've been asked to use to look at different potential outcomes in respect of investment in different parts of the nuclear fuel cycle, discuss quickly some of the key inputs and the key assumptions that underpin the modelling approach we're developing as we speak and then, most importantly, obviously talk to you about some of what the key outputs will likely be in terms of the variables that we'll be able to comment on which will complete the brief as you outlined.

So obviously the key task here from our part of this job is to assess the potential economic merits for the South Australian economy of greater involvement in any part of the nuclear fuel cycle. I think you've heard a few parties talk about the business cases this morning. They covered the three elements of the fuel cycle we're not involved in Australia as it stands today but our work will also cover, obviously, the mining and

extraction part of the fuel cycle. Really, what it's about is what does it mean for GDP, employment, jobs, investment, particularly in South Australia but ultimately for the whole Australian economy if indeed we were to move into other parts of the fuel cycle or expand our involvement in the mining and extracting sector.

Really it's about determining those key outputs that you've referred to previously and looking at the in-train state flows. This is just a really simple schematic of how the CGE modelling fits – not very simple, I imagine – into the process. So on the right-hand side we have our little graphic of the nuclear fuel cycle which I'm sure you are very well across as we speak, probably in more detail than we are, which really describes, obviously, the four key stages although there's more diagrams in those boxes, the four key stages of the fuel cycle that we're particularly interested in looking at from the terms of this analysis right the way through from mining and extraction to waste disposal and storage, ultimately.

In between the scenarios that we'll be adopting we're looking at those fuel cycle business cases and saying, well, what are the underpinning scenarios that may or may not drive further investment in each case. Obviously there's a BIS, which is a business as usual, and then there's two alternative scenarios which will have different assumptions in respect of the level of market involvement and/or government support that might assist in various parts of the fuel cycle, investment in various parts of the fuel cycle. At the bottom of the diagram is our electricity market model and essentially that will feed in to the work we do in two important respects. Obviously electricity prices are an important part of the fuel cycle generally and an important part of CG analysis generally but in particular, that work will feed in to the nuclear generation business case that you are talking about because clearly one of the things that an investment in nuclear generation will impact is Australian electricity prices. Those then flow through in to the model.

And on the left hand side is a very high-level schematic of how the CG modelling works. Now in essence, computer (indistinct) model really does two things that typical more narrow modelling doesn't do, it's dynamic and it takes in to account substitution effect. So what I mean by that is that the model is set up in such a way that if we see further investment in one part of the fuel cycle, in the nuclear fuel cycle, let's assume it's mining for the sake of argument, that by definition affects other parts – the factors of production in the economy generally. So enough resources, labour and capital are taking you to the nuclear sector then by definition some less resources or higher prices for the remaining resources may be required to provide those resources in another sector. What CG modelling does is an economy wide look at that to say if indeed more resources are taken in to nuclear as opposed to something else, there will be some counter balancing impacts on the economy. And the purposes of CG modelling is to take into account all those counter balancing factors and then produce an outcome that says, okay in total what does this mean for – in the case of South Australia, GDP growth and what have you.

So it's really an economy wide view of what we'll be testing in each of those scenarios

in terms of what's happening in a nuclear fuel cycle in particular. So that is it in essence what it seeks to do and so that you can get confidence that when – if a particular policy initiative is embraced, you will have some confidence of what it will mean for the economy as a whole and what it will certainly mean for parts of the economy in South Australia like regional for example if mining activity occurred in a certain region, it would be able to pick that up and illustrate what that might mean. So that's just at a very high level. Jyothi's going to then take you through a little bit more detail in relation to how the CG modelling will work and the inputs and outputs it will use.

MS GALI: Thank you, Craig. The conception framework is a good interaction to our methodology of assessing the cost (indistinct) of the nuclear fuel cycle activities in South Australia. As part of our approach we have used – we have been using the Victoria University regional general equilibrium model. There are a number of general equilibrium model exist and available for the policy analysis but clearly we chose this model because it has a number of advantages and most suitable to this project focuses. But clearly this is widely documented and it has a very recent database and it has a more than 80 sectors and also the energy accounts and emission accounts are well articulated in this particular CG model. This model is (indistinct) the Victoria University model by centre of (indistinct) Victoria University and this model has been used by the commonwealth government departments, particularly the productivity Commission and also the commonwealth treasury. It is also widely used by the state governments and also the private sector but clearly for the tax policy issues, economic contribution impact (indistinct) and also due diligence reports for the private commercial purposes.

As I said – as Greg said, it is a dynamic model implying that construction and operation activities of nuclear fuel cycle activities can be tracked on annual basis. The model has a very specific state (indistinct) economic information in terms of the South Australian industries, structures and labour market. So for example, the model can show what is the economic impact of expansion of the Olympic Dam on the South Australian jobs and also the incomes. Not only we have used computer general equilibrium model but also by taking in to advantage of having (indistinct) electricity model we (indistinct) the general equilibrium model with the EY electricity model. EY has a considerable experience in powered market modelling over number of 20 years. It provided a number of energy policy issues to the Australian government and also the private clients. And particularly in this exercise, electricity model plays an important role in terms of the competitiveness of the nuclear powered generation in the energy mix in Australian energy market.

This model previously known as the (indistinct) model, it provides the future evolution of the structure of the supply side of the electricity market and based on the dynamic programming (indistinct) cost optimisation approach, what it basically means, given the fuel technologies fuel cost, given demand how the technology shapes in the electricity market changes. So we created this model with the general equilibrium model to get the demand and supply balances so that they are in equilibrium condition in the long run. In terms of the iteration process, the iteration starts with the CG model. CG model based on the macro economic and demographic assumptions produces electricity

demand by fuel (indistinct) by end users in the economy, complete by states and industries. But a given demand, the electricity model produces the optimum combination of technologies and also resource cost and prices for sale and retail electricity prices. But in turn, those outputs produced by the (indistinct) model is (indistinct) input in to the CG model. We iterate few times to get the equilibrium achieved between these two models. Because the CG model do not have the supply side details, very details supply side aspects, that is one of the reason we are using two models to get the optimum solution for this study.

To summarise, our computational general equilibrium modelling assessment of nuclear fuel cycle activities in South Australia consists of two main parts. The first part is about changing the methodology and model calibration to suit the purpose and the second one is (indistinct) scenarios. As a complete nuclear fuel cycle activity does not currently exist in Australia, we need first to modify the model to suit this particular purpose. This involves a degree of data sources, calibration of the model parameters and also taking the information from the business cases. The second part is developing scenarios. The Commission has requested three core scenarios to assess, the economy by (indistinct) in any part of the nuclear fuel cycle on intra and interstate flows of labour, capital, primary resources. Scenario one is a business as usual on base line investment scenario which is mainly characterised by no policy shift, leading to low investment in any new parts of the nuclear fuel cycle in South Australia. The investment scenario two or IS2 is characterised by nuclear fuel cycle business cases that could be possibly driven by the market with commercial opportunities in the expansion of the new parts of the nuclear fuel cycle in South Australia. Investment scenario three or IS3 is mainly characterised by some form of the public subsidies or private capital on any part of the nuclear fuel cycle, including expansion of the uranium exploration, mining and also for the (indistinct) of the (indistinct) higher value and commodities.

For modelling perspective it is important to (indistinct) which key features of these scenarios to assess the economic impact of each scenario relate to the base line. The model (indistinct) series 2009 and 10 include (indistinct) with tables of the Australian economy. Simulation of the base line investment scenario is between 2010 and 2050. All the variables coming from this model are represented 2014, 15 prices. The simulation for two investment scenarios starts with the 2016-17 financial year and ends with the year of 2040-50 financial year. Those are the nuclear activities in the nuclear fuel cycle goes beyond 2050. As I said before, all these three scenarios require very detailed inputs but the business investment scenario resourced all the inputs from the official projections, consistent with the official growth path of the state economies and also the national economy. Under the featured listing which is three scenarios is the potential activities undertaken in each scenario. Say, for example, in the business investment scenario there is a possibility that existing uranium extraction and mining activities continually operate in Australia, may benefit from the global expansion of the nuclear sector.

In the investment scenario there is a possibility that the market potential exists for waste disposal in South Australia. This has to be determined based on the business case for

waste disposal commissioned for this study and also the removing of some barriers also helps the market. In the investment scenario three potential opportunities will be considered for all parts of the nuclear fuel cycle both front and back end nuclear fuel cycle activities from uranium exploration, mining, conversion, fabrication, enrichment and nuclear power generation and nuclear waste disposal.

To continue on characteristics of scenarios, global climate change is very high on the agenda of many government policymakers. A number of governments made commitments to curb greenhouse emissions and submitted their pledges to Paris 2015. As you already know, the energy sector, the major source of greenhouse gas emissions, has a key role to play in alleviating the risk of global warming. To model the potential cost and benefits of nuclear fuel cycle activities in South Australia, in all three scenarios we have assumed stringent global mitigation policy measures consistent with the atmospheric targets of stabilising the concentration of greenhouse gases at 450 parts per million carbon dioxide emissions by 2100.

In the baseline scenario we have assumed the global economy will act to mitigate the greenhouse gases, consistent with the Paris commitments. There is no explicit carbon price in the Australian economy. For the two investment scenarios there will be a carbon price in the Australian economy. It is also important to consider Australia's role in burden sharing of the global climate change mitigation task. For the purpose of this study, based on the discussions with the Commission, slightly (indistinct) burden sharing rules are assumed for the investment scenario two and a more aggressive level of burden sharing rules are assumed for investment scenario three. These differences in the burden sharing rules allow the Australian (indistinct) to source more emission permits either from overseas or use the domestic mitigation technologies to curb the emissions domestically.

The assumed carbon price underlining these scenarios will be sourced from the published sources, mainly from the Commonwealth government, and it will adjusted to take into consideration the current global traded market, that is European Union Market. To develop these scenarios requires detailed information and inputs from various sources. The baseline investment scenario in developing the growth path of the Australian economy and South Australian economy, we sourced the inputs from the published sources, mainly from the South Australian treasury, Commonwealth treasury and Intergenerational Report. The framework we have used is similar to the Intergenerational Report, the IGR report, that is the population, productivity and participation approach. Because the model is based on state economies we need to develop this three-piece approach for each (indistinct) state.

The productivity participation and population framework approach gives us the statistic growth path of the economy in the business investment scenario. Only the difference in the scenario is the world countries have policies to mitigate the pollution but not Australia. That is the baseline under which we are going to assess the investment scenarios two and three.

For the investment scenarios the major inputs are mainly sourced from the business cases. Business cases provide the inputs, both operational expenditure and capital expenditure, on an annual basis in very detailed labour, capital and intermittent inputs and energy use. We take those inputs and in the model we construct the production and concentration functions for these three nuclear fuel cycle activities. These three new industries are not existing at the moment in the economy. We need to create in the economy based on the business case studies.

After considering all the inputs and development scenarios the model gives us a number of key outputs, both in the baseline investment scenario and policy investment scenarios. The outputs include around two or four thousand very small variables from price variables to the macro aggregates. In terms of this presentation we have provided key macro variables in terms of the extenuating parts currently on balance and gross national income, gross domestic product and labour market, including the employment, real wages and industry variables, industry gross value-added, industry turnover and investment, exports, imports and tax receipts and the contribution of the electricity sector and also the emissions by user.

At the end the key outcomes from this study is quantification of both micro and macro economic benefits of investing in parts of the nuclear fuel cycle in South Australia measured as deviations from the baseline investment scenario. These deviations either could be positive or could be negative, depending upon how the resources are reallocated in the economy because of this investment. Thank you.

COMMISSIONER: Any questions? I have one. We've heard this morning of modelling supply and demand in the electricity market and we've also heard that you're going to use your electricity model. That's a price model?

MR MICKLE: That's right. Well, there's two components. There's what's called a planning model that looks forward and says, given the cost structures in different parts of generation, what are the least cost additions to the fuel mix. So there's two components. That's the first component. So it comes up with a view about the future generation mix and then there's an optimisation model that actually produces both very short-term and long-term forecasts of prices.

COMMISSIONER: Our modelling will also provide some future generation mix. So we'll need to make sure that there is - - -

MR MICKLE: Absolutely. We've already had this conversation with your electricity modellers. So that will all be harmonised and we're ultimately relying on inputs for them. It's just that we have a model that – it needs to be done in a slightly different way to fit into the electricity model. So there's a bit of alignment to achieve but we're already making sure that occurs.

COMMISSIONER: Those key words of harmonisation make me happy.

MR MICKLE: Yes. Well, that's what we're seeking.

COMMISSIONER: Thank you very much for your presentations. We'll now adjourn.

MATTER ADJOURNED AT 12.29 PM UNTIL WEDNESDAY, 7 OCTOBER 2015