Blair Mukanik: My name is Blair Mukanik and I am leading technical collaboration for the Integrated Resource Plan (IRP). Our plan for today is to highlight some of the final results of scenario and sensitivity modelling and analysis that we distributed to you ahead of this session. If you did not participate in Round three, engagement on initial results, it may be helpful after this session to review links near the beginning of the handout distributed for additional background. We'll provide time for questions at the end of this section.

When we last spoke with you in December 2022, we summarized what was learned through the IRP's initial modelling and analysis in four high level summary observations. These were supported by many more detailed observations from the initial analysis of the scenarios. The first is that electric needs will increase and the increase is directly related to electrification of transportation and space heating. Second, increasing winter peak demand will drive the need for new capacity resources, which also triggers needs for transmission and distribution systems. Third, to make decisions on what future resources will supply energy, there will be trade-offs between cost emissions and other factors. This IRP focused on understanding potential future options rather than on selecting a specific development plan, and so, in the future, we'll continue to explore these trade-offs further. Lastly, in the future, the gas system could play a critical role in avoiding significant build out of the electric system. For example, dispatchable gas generation can support integration of variable renewable resources such as wind or solar. Dual fuel programs could be used for space heating or renewable fuels could be used as available.

Since we were last together in December 2022, we've continued to refine and complete the modelling and analysis on the four scenarios and additional sensitivities incorporating your feedback. We also completed new sensitivity analysis. As a refresher, we previously provided modelling and analysis results for four scenarios intended to represent a range of uncertainty in the future, and these were based upon five key inputs. In sensitivity analysis, we change an assumption or input in a scenario to understand how it might affect the results of the modelling and analysis. The analysis being conducted is broad and includes both the electric and natural gas systems and all components thereof, including both supply and delivery considerations.

The modelling approach used identifies lowest cost options to meet future energy needs. This is consistent with our mission to provide reliable energy at the lowest possible cost. We recognize that there are other ways of comparing options to meet future energy needs, such as emissions impact, which we do provide analysis on, and these will come up again later in this session when we get to the draft road map. Again, this IRP is not making decisions about specific future new resources, rather, modelling and analysis is informing the development of a road map to prepare for the future.

We'll start by providing an updated summary of energy and capacity supply mix based on lowest cost for the four scenarios. What we see is the same resources as were shown in the initial results back in December are still showing up with minor changes in the proportion of each resource type. As a reminder, the scenarios primarily reflect increasing rates of decarbonization from scenario one through scenario four and with scenario four, notably including transition of natural gas space heating to all electric resistance. The capacity graph on the right can be thought of as the amount of each resource we can count on to meet peak demand, whereas the graph at left represents how energy needs are met cumulatively over the course of an entire year.

Starting with energy, we see that in 2042, as was shown in the initial results, the existing hydro system continues to provide a significant proportion of total energy needs into the future. Added to this is energy efficiency measures noted as DSM on the charts, wind, thermal, as well as imported energy. At right, we see the existing system's contribution toward meeting capacity needs in gray with new resources stacked on top, including energy efficiency measures, wind, thermal, hydrogen and batteries.

Since updating and finalizing assumptions for the four scenarios, we've found that there haven't been significant changes to the observations we discussed in December. We are still finding the same resources that are low-cost. Those include wind primarily as a source of energy and natural gas combustion turbines run infrequently to support peak demand. We also still see imported energy as an important source of low-cost energy, while solar and new hydropower are still not determined to be as cost-effective as other options. In the additional work we've done, we see that some energy efficiency measures are cost-effective when compared to other resource options, and those that reduce electricity demand during winter peak in particular provide value to the electricity system. Additional work is planned with Efficiency Manitoba to better understand the potential role of energy efficiency measures.

Observations regarding cost and emissions have not changed. Financial investment will be needed to support future energy needs within Manitoba, decarbonization through electrification and the corresponding need for new capacity resources drive cost. Emissions are anticipated to drop under all scenarios, primarily due to electric vehicle adoption forecasts. Measured increases in emissions from electricity generation can facilitate larger emission reductions in other sectors such as transportation. One new observation that informs the draft road map is that renewable fuels may play a role in decarbonization. The use of renewable fuels could leverage the existing natural gas system, and further investigation of this is required.

As we discussed in December 2022, we note that there are still energy related emissions at the end of our study in 2042, and even in scenario four. These emissions may be further reduced through additional uptake in electric vehicles, alternative electric generation options, the use of alternative space heating methods or the use of renewable fuels as examples.

The charts shown here are used to illustrate pace of change and the relationship between the capability of existing supply resources shown by the red lines and the dependable energy in winter capacity needs in each of the scenarios. A similar chart was presented in initial results. However, specific values have now been added to the axis. Starting with dependable energy at left, we see that for scenarios one and two, the existing system is able to meet needs to 2032, whereas it is sufficient for scenario three up to 2030. And in scenario four, it is only sufficient to 2026.

If future demand were to reflect what is shown for scenario four, new energy resources would be needed by 2026. Looking now at winter capacity, we see that for scenarios one, two, and three existing resources are sufficient between 2030 and 2033, whereas under scenario four, new capacity resources would be required in 2024. This chart shows that the amount of potential surplus winter capacity is limited over the next 10 years with only up to a few hundred megawatts of surplus with varying duration depending on the scenario, and this surplus could quickly be overtaken by demand depending on pace of change. These charts underscore the importance of the work involved in Integrated Resource Planning and the impact of decisions around energy use. Ultimately, any number of combinations of factors could lead to an outcome between scenario one and scenario four. And the road map, we'll discuss further how it is that we plan to prepare for uncertainty in when future new resources will be needed.

Observations regarding pace of change have been refined. Investment will be needed in all scenarios, and to this observation, we've added that investment is both to support growth, as well as to maintain and modernize existing assets. Customer demand in early years of scenarios one, two, and three is largely met by the existing system. Meeting customer demand in early years of scenario four, however, will be a challenge, which we've changed from may be challenging to will be challenging.

These tables outline the sensitivities for which results were covered in the handout. Today, we are going to focus on the highlighted ones. We've chosen these specific sensitivities to discuss as they support the draft road map that will be presented later in the session. The modelling and analysis we've completed was done with the best currently available information. The use of scenarios and sensitivities was intentional in helping to understand the future within a broad range. Going forward, we'll continue to update analysis based upon changes in the evolving energy landscape and refine analysis approaches as we move towards specific decisions. We'll discuss these activities further within the road map.

The first sensitivity we'll cover, investigates the impact of only non-emitting electricity being used. To do this, we remove the option of using any new natural gas for electric generation. You can see the sensitivity illustrated on the far right of the chart. It shows significantly increased annual costs, which include all costs for electric and natural gas supply and delivery. This cost increase is a result of more expensive resources being required, which include hydrogen fueled combustion turbines, biomass, small modular reactors, as well as new hydro development. We do see emissions from the electricity sector reduce in this sensitivity. The bulk of remaining emissions still come from transportation and stationary combustion sectors including space heating.

We'll now discuss the sensitivity on demand response. The purpose of demand response programs is to influence electricity usage so that less is used during the parts of the day where demand is highest. Examples of demand response can include different pricing or rate programs, controlling loads like electric vehicle chargers or programmable thermostats or water heaters. It can also include subscribing large industrial customers to reduce energy when the system would benefit from doing so.

This analysis used information on market potential and cost provided by a consultant. Demand response programs were found to be a cost-effective alternative to building new capacity resources. Demand response programs may also be able to be implemented faster than building certain new resources, representing another potential benefit. Ultimately, the potential of demand response is limited and found through research to be approximately 250 megawatts. This is because once the demand peaks are reduced to the point that it is flat throughout the day, additional demand response doesn't provide further value. These programs cannot fully meet the growing need for capacity, however, demand response may play an important role. Further study is needed to better understand how to implement these types of programs including technology requirements.

We'll now discuss the sensitivity on dual fuel. Dual fuel for heating involves using an electric air source heat pump, to heat and cool above a certain temperature, a natural gas to heat below that temperature. This heating method provides the opportunity to reduce emissions by reducing natural gas usage while avoiding increasing winter peak electricity demand caused by electric resistance heating. In December 2022, some data was provided showing the cost and emissions impacts of conventional air source heat pumps at a -10°C switchover, which showed potential to significantly reduce costs while also supporting decarbonization.

Since then, more analysis was done with cold climate heat pumps with an assumption of a minus -20°C switchover, and it was found that there is some additional opportunity to reduce emissions, but at an increased cost. The data provided in the chart shows how cost and emissions compare in the present system in scenario four and in both the -10°C and -20°C dual fuel sensitivities. These last two at right incorporate the cost of air source heat pumps, which were not included in round three initial results. Again, while there is some additional opportunity to reduce emissions using cold climate heat pumps, it comes in at an increased cost.

There were several suggestions in Round three engagement to consider further analysis of ground source heat pumps. This included considering significant adoption of this technology as well as district heating. A district heating system provides heat from a central location to a network of connected buildings through a grid of insulated pipes. Benefits of ground source heat pumps raised in Round three included reducing emissions without significant increase to electric demand. Using information from Efficiency Manitoba, a sensitivity analysis was conducted to determine if ground source heat pumps are cost-effective relative to other resource options and energy efficiency measures. Findings indicate based upon performance and cost, typical ground source heat pumps are not cost-effective on average, however, in certain situations, they may provide benefit in being able to be deployed more quickly than other options. Performance and cost can vary widely, and further study in the future is required to refine assumptions. At this time, we do not yet have sufficient data to accurately model district geothermal heating, so this analysis will be deferred to the future.

Let's now discuss the topic of solar. Though solar does provide energy, it does not reduce the need to build other resources for meeting winter peak demand impacting its economics relative to other options. The graph illustrates how solar produces energy in hours when the sun is shining, but the average daily peaks in electricity demand for January happen outside of those hours in the dark, cold, winter, mornings and evenings. Of all the scenarios and sensitivities that have been analyzed, none have identified utility scale or distributed solar as a low-cost option to meet energy needs. Even when a sensitivity looked at pricing solar at 20% below wind, as well as just above the average annual import market price, it was not selected. By comparison, wind generation is typically more even throughout the day and a proportion of its output can be relied on to meet electricity needs during the winter hours when it is most needed.

Customer-owned solar may provide benefit to individual owners, however, it is not the most economic option for the system as a whole. In the future, battery technology may impact the value of solar and this will continue to be a topic of study. The last sensitivity we'll discuss is on energy efficiency. The purpose of energy efficiency measures is to reduce total electricity or natural gas use. We worked with Efficiency Manitoba and a consultant to model potential energy efficiency measures. The first bar at left in this chart contains market potential for savings in scenario four, in which savings from heat pumps and solar are broken out separately. We've shown here the maximized potential which reflects high incentive levels to achieve these savings.

The second bar contains an extrapolation of Efficiency Manitoba's current plan. Along with additional energy efficiency measures, found to be economic based upon incentive levels corresponding to the maximized potential, and this is relative to alternative resource options. The third bar represents a sensitivity in which all energy efficiency measures were allowed to be selected by the model based on economics without a minimum amount assumed. Here, we see the total amount of energy efficiency measures is less than the potential. Also, of note, no additional solar was selected and ground source heat pumps were only selected early in the time horizon before other less costly resources could be built.

We'll present some additional information on relative cost of resource options in the next slide to help explain this result. We continue to engage with Efficiency Manitoba to better understand the potential value of energy efficiency measures.

The last slide as part of this modelling and analysis section is a general one to illustrate the relative cost difference between resource options and how that is impacting which resources are being selected and which are not. The costs shown are a range which reflect differences in timing and in the case of energy efficiency, the range of cost for specific measures. They result from taking all resource costs and spreading them over all energy that is generated or all capacity that is provided over the lifespan of the resource. The two charts reflect two separate and independent metrics that allow for comparison of costs on a unit basis in either dollars per megawatt hour or dollars per kilowatt year.

Looking to the energy chart on the left, we see wind and utility scale solar as being low-cost energy resources that are comparable to the low-cost energy efficiency measures. It was previously mentioned that dual fuel may provide a lot of value as a strategy to decarbonize, so though air source heat pumps look expensive to provide energy, they are a relatively less expensive way to decarbonize when paired with natural gas as opposed through using all electric resistance heating. Looking to the capacity chart at right, we see demand response, as well as enhancements to existing hydro facilities and natural gas fueled combustion turbines as low-cost capacity options. We also see that some energy efficiency measures have a cost of capacity that is only a bit more expensive.

The charts illustrate that ground source heat pumps are a relatively expensive option compared to others. It should be noted that only so much information can be taken from these charts. For example, the fact that solar doesn't provide any winter capacity reduces its overall value and is why solar does not show up in the capacity chart. The chart also doesn't indicate the total amount of each resource that could be developed. For example, only so much load can be shifted or reduced through energy efficiency or demand response, and so those resources would have less potential than, for example, a hydrogen-fueled combustion turbine.

To summarize observations from the sensitivities presented, not allowing any new natural gas generation significantly increases cost and reliance on technologies that are less mature. Demand response is cost-effective for delaying the need for new capacity resources. Energy efficiency requires additional analysis to understand the cost-effectiveness of specific programming. Dual fuel programs have the potential to reduce emissions at a lower overall cost than full electrification. Ground source heat pumps have a range of performance and typically a high upfront cost, more analysis needs to be done in the future on these. And lastly, solar was found to be not as cost-effective as other resource options under a range of scenarios and sensitivities.