

POWER SECTOR DEVELOPMENT AND SOUTH GOBI DEVELOPMENT

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BACKGROUND

- **ECA has been asked to review the least-cost means of meeting electricity demand in the South Gobi region, taking into account the needs of the Central Energy System (CES)**
- **This presentation sets out**
 - **our base assumptions on demand growth**
 - **the expansion plans considered**
 - **our analysis of the costs of these plans and preliminary findings**
 - **our estimate of the financing requirements**

DEMAND – SOUTH GOBI

- **We expect electricity demand in the South Gobi to rise to around 600MW by 2020**
- **We project that:**
 - **open-pit operations at Oyu Tolgoi starting in 2012 will have a demand of 200MW, increasing to 300MW by 2016 with expansion and a shift to underground mining -operations**
 - **demand from Tavan Tolgoi (ERC) will reach 100MW by 2014**
- **To this, we have added**
 - **assumed demand growth of 100MW by 2016 and 200MW by 2018 from additional Tavan Tolgoi developments**
- **Demand from townships is subsumed into these projections**

DEMAND - CES

- **Electricity distributed on the CES grew at an annual average of 3.4% from 1997-2007 and 6.1% from 2002-2007. Peak demand reached 640MW in 2007**
- **Over the period to 2020, we project average electricity demand growth of 3.5% annually**
 - **large tariff increases (up to 60%) can be expected to reduce demand growth**
 - **ongoing work to improve distribution efficiency can be expected to reduce losses**
- **Heat demand in Ulaanbaatar grew at an annual average of 2.5% from 1997-2007 and 1.7% from 2002-2007**
- **Over the period to 2020 we project average heat demand growth of up to 3% annually**

SUPPLY ASSUMPTIONS

- **Current installed capacity on the CES is 774MW. Net available capacity is estimated at 647MW. Up to 255MW of Russian imports are available.**
- **Of the existing power plants, we assume that**
 - **TPP#2 will be retired after 2012**
 - **TPP#3 will be retired after 2016**
- **We assume that the Newcom wind farm project, of 50MW, will commission by 2010**
- **We also assume that a large hydro generator (most likely Egiin) will be commissioned by 2015. A generator of this type is needed for system balancing purposes**

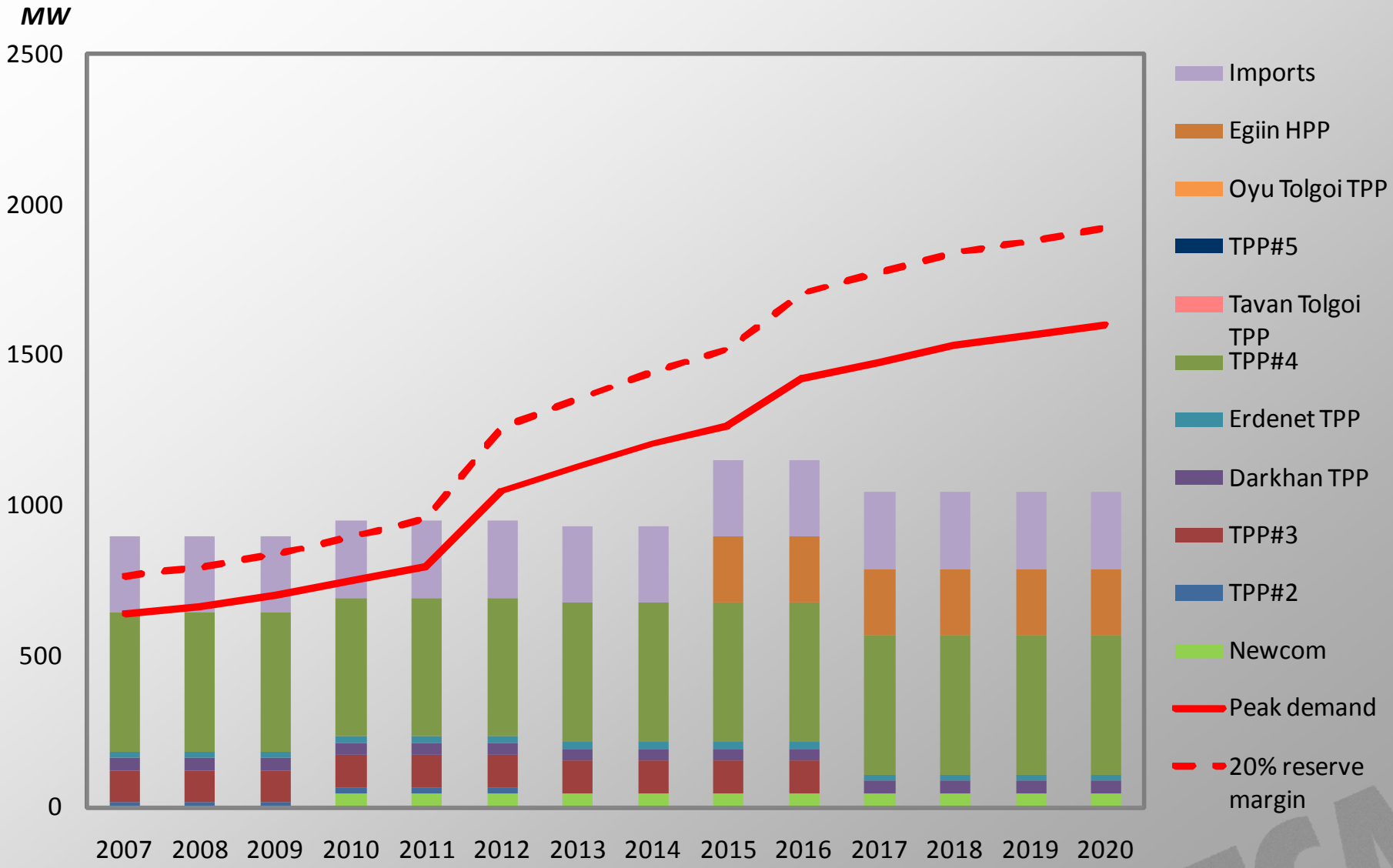
CES – SOUTH GOBI INTER- CONNECTION

- **The Mandalgovi – Tavan Tolgoi transmission line, interconnecting the CES and South Gobi region, is assumed to commission by 2010 and the CES – Mandalgovi line by 2012**
- **This a 640km 220kV double-circuit line. Assumed reliable capacity is around 150MW. Sustained power transfers in excess of this will require new transmission investments**
- **Losses on a line of this length will be significant – up to 15% at full reliable capacity**

SUPPLY- DEMAND BALANCE

- **We expect electricity demand to exceed supply by 2012, assuming no new generating capacity is commissioned**
- **This assumes that the full potential Russian import capacity of 255MW is utilised**
- **These assumptions are conservative – they assume a relatively low rate of electricity demand growth on the CES**

ELECTRICITY BALANCE – CES AND SOUTH GOBI



INVESTMENT OPTIONS

- **A number of possible options for new baseload power plants exist**
 - **TPP#5 at Ulaanbaatar**
 - **a new thermal power plant at Oyu Tolgoi**
 - **a new minemouth thermal power plant at Tavan Tolgoi**
 - **a new power plant associated with a CTL export project at Baganaur**
 - **a new export-oriented thermal power plant at Shivee Ovoo**
- **The last two of these are both dependent on exports, and their development is outside the control of the Government of Mongolia. We do not, therefore, review them further**

OVERVIEW OF INVESTMENT OPTIONS

- **TPP#5**
 - **CHP using coal from Baganuur mine**
 - **unit size of 300MW and 700Gcal/hour**
 - **investment cost of \$1,240/kW**
 - **thermal efficiency of 36%**
- **Tavan Tolgoi TPP**
 - **air-cooled sub-critical coal plant**
 - **unit size of 300MW**
 - **investment cost of \$1,110/kW**
 - **thermal efficiency of 33%**
- **Oyu Tolgoi TPP**
 - **air-cooled sub-critical coal plant**
 - **unit size of 150MW**
 - **investment cost of \$1,500/kW**
 - **thermal efficiency of 32%**

TAVAN TOLGOI COAL COSTS

- **The 1995 JICA Coal Master Plan estimated the cost of production at Tavan Tolgoi at around US\$20/t (at 2008 prices)**
- **Other estimates of production costs provided to us are around US\$10-12/t**
- **There is also the potential for a new coal plant to use ‘middlings’ from the coal washing process**
 - **the opportunity cost of using middlings for power generation is zero or even negative**
 - **the 1995 Master Plan estimated the proportion of middlings in total production at around 9%**
 - **on annual production of up to 30Mt, this would represent sufficient coal for 600-750MW of baseload generating capacity**
- **To represent this possible range of costs, we use an assumed coal price of \$20/t and a sensitivity of \$0/t**

COMPARING EXPANSION SCENARIOS

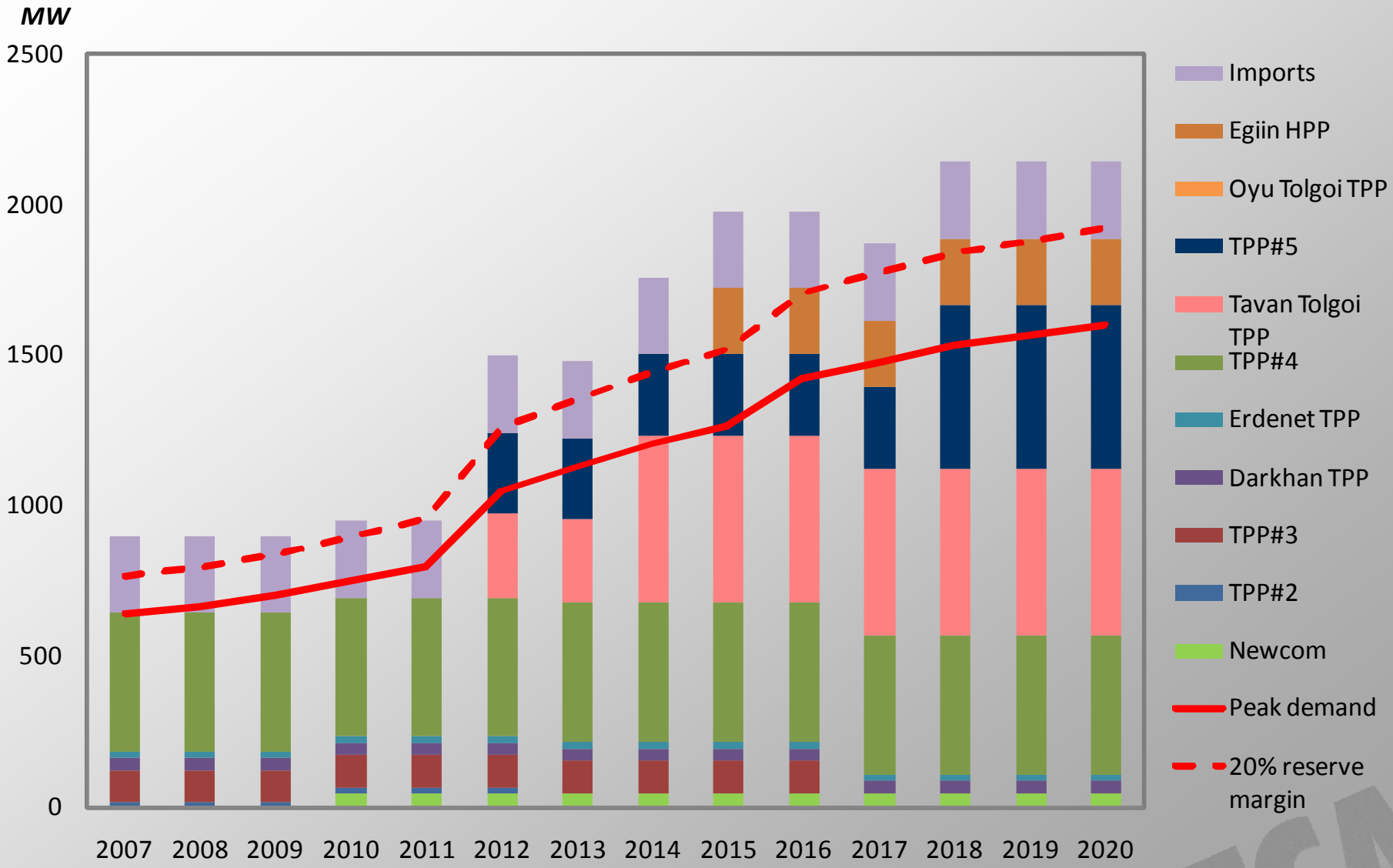
- **We have estimated the present value (at a 10% discount rate) of total generation costs under three alternative expansion scenarios**
- **Scenario 1: Develop TPP#5 and Tavan Tolgoi TPP simultaneously**
- **Scenario 2: Develop Tavan Tolgoi TPP followed by TPP#5**
- **Scenario 3: Develop Oyu Tolgoi TPP followed by TPP#5 and Tavan Tolgoi TOO**
- **Our analysis takes account of**
 - **the need for minimum levels of generation from CHP plants to meet heating demand in the CES**
 - **constraints on the transmission of power between the CES and South Gobi region**

EXPANSION PLANS COMPARED

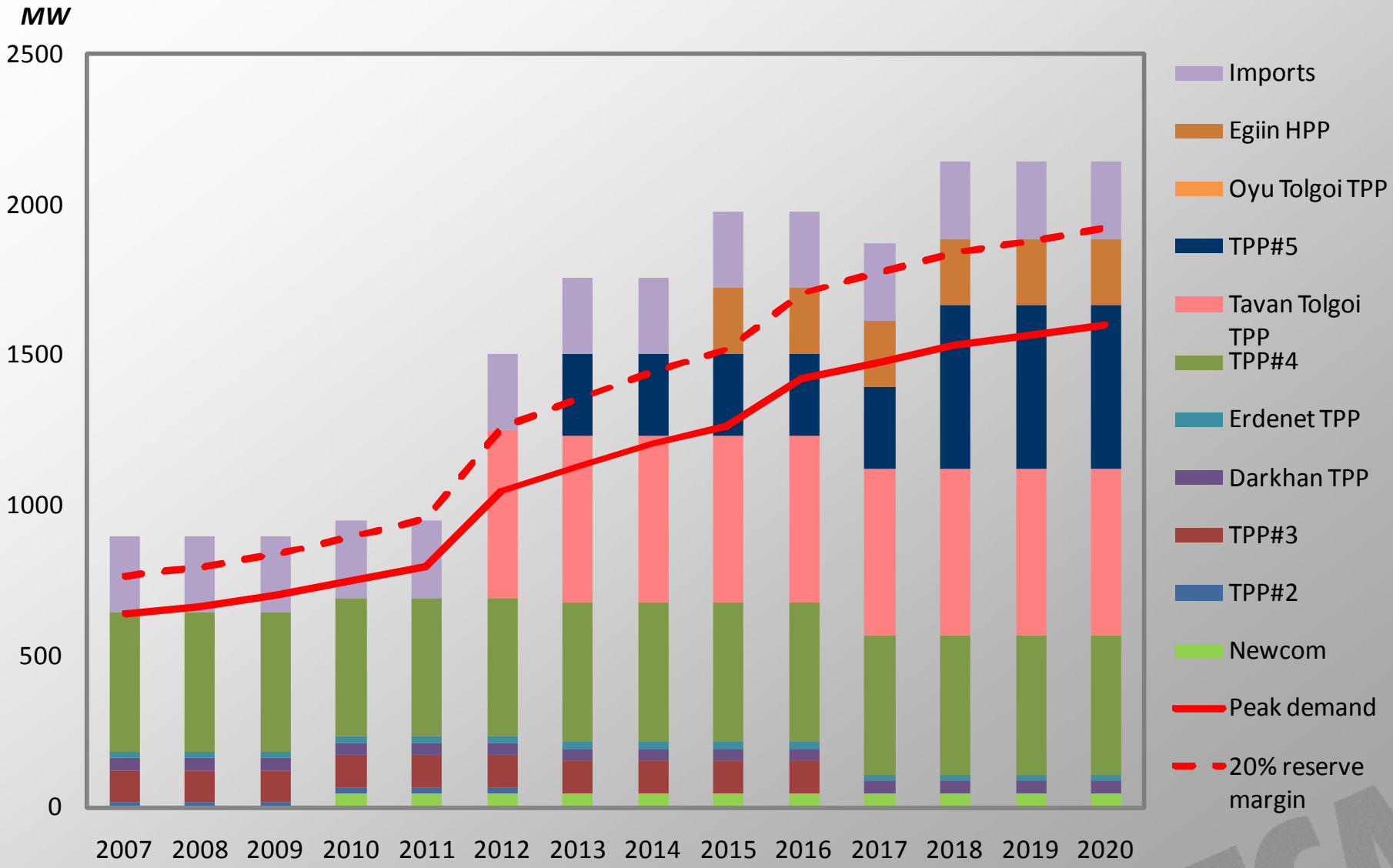
Scenario		Entry dates					PV costs (@10% discount rate)			
		TPP#5		Tavan Tolgoi TPP		Oyu Tolgoi TPP	Tavan Tolgoi coal price			
First plant commissioned		Unit 1	Unit 2	Unit 1	Unit 2	Units 1-3	\$20/t		\$0/t	
1	TPP#5 + Tavan Tolgoi	2012	2018	2012	2014	n/a	2,184	0%	2,029	0%
2	Tavan Tolgoi	2013	2018	2012	2012	n/a	2,223	2%	2,050	1%
3	Oyu Tolgoi	2013	2018	2015	n/a	2012	2,202	1%	2,150	6%

- **The least-cost expansion plan is to develop TPP#5 and Tavan Tolgoi TPP together, with the first units commissioning in 2012**
- **However, the cost differences between the alternative expansion plans are minor (1-2%)**

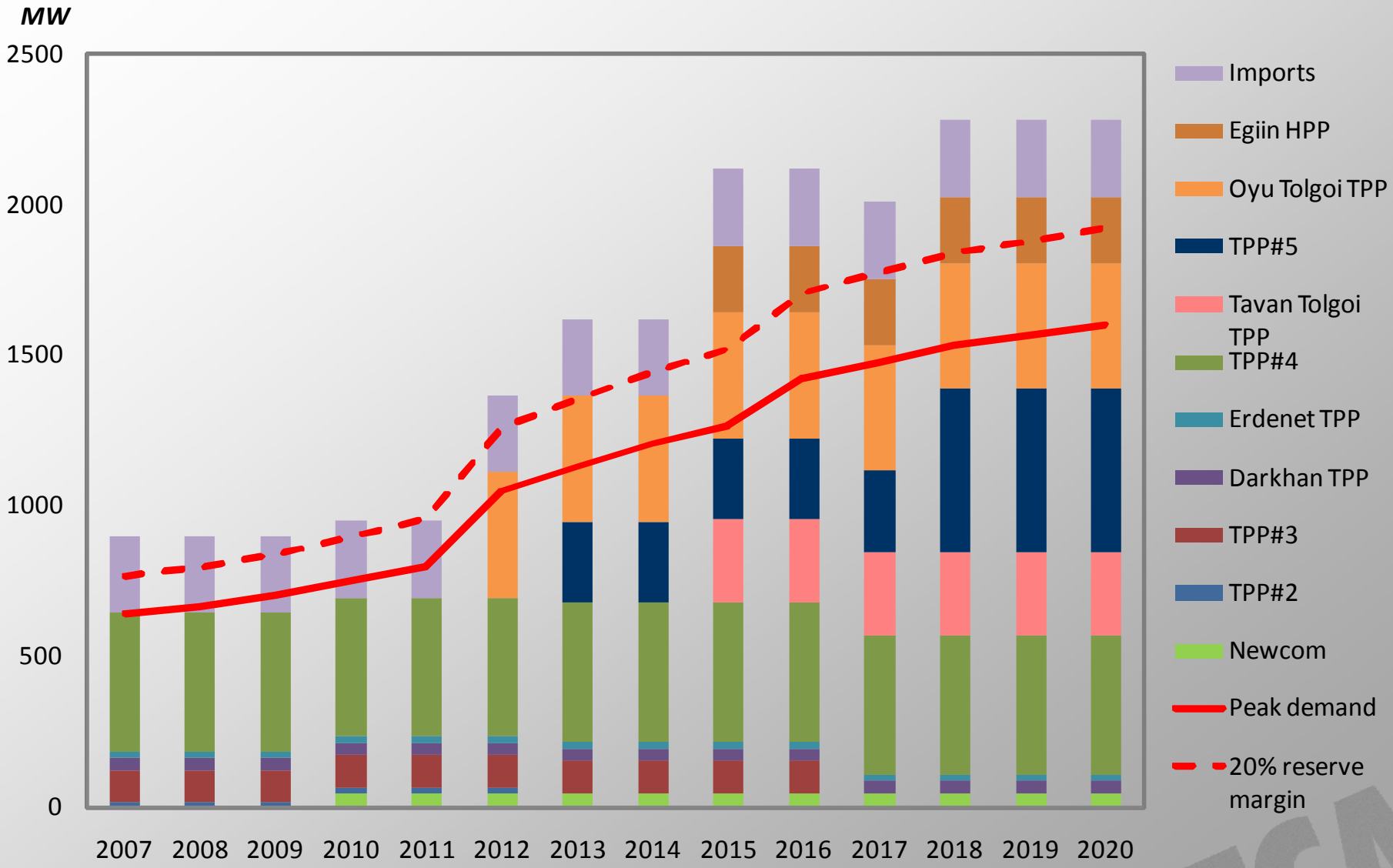
LEAST-COST EXPANSION PLAN – SCENARIO 1



LEAST-COST EXPANSION PLAN – SCENARIO 2



LEAST-COST EXPANSION PLAN – SCENARIO 3



OTHER CONSIDERA- TIONS

- **As well as cost, the selection of the appropriate expansion plan needs to consider risks to the plan. Of these, the most important is the risk of delays in plant commissioning**
- **We do not consider there are other significant differences between the alternative expansion plans**
 - **all the plans involve the development of generating capacity in both Ulaanbaatar and South Gobi**
 - **impacts on air pollution and export potential are therefore similar across the plans**

STATUS OF PROJECT DEVELOPMENT

- **TPP#5**
 - a tendering round is underway
 - there may be delays in evaluating submissions and negotiating final agreements due to the invitation to bidders to propose their own financing and contractual arrangements
- **Tavan Tolgoi TPP**
 - limited development activities undertaken to date
- **Oyu Tolgoi TPP**
 - the mine developers (Rio Tinto and Ivanhoe Mines) have completed design work and much of the permitting requirements
 - estimated time to completion is 30 months

ESTIMATING THE COSTS OF DELAY

- **It is reasonable to assume that Oyu Tolgoi TPP can be commissioned by 2012**
- **There appear to be moderate risks of delays to TPP#5 and significant risks of delays to Tavan Tolgoi TPP**
- **We have estimated the costs of delays in commissioning to Mongolia, assuming that**
 - **the first date that TPP#5 can be commissioned is 2013, and that Tavan Tolgoi TPP can be commissioned is 2014**
 - **delays in commissioning power generation capacity result in reduced output from the Oyu Tolgoi mine**
 - **the value of Oyu Tolgoi's production to Mongolia is \$0.525/lb of copper (assuming a copper price of \$1.5/lb with 35% royalties and taxation)**
 - **this is equivalent to \$380/MWh of unmet demand**

COSTS OF DELAY

Scenario	Entry dates (with delay)					PV costs (@10% discount rate)				
	TPP#5		Tavan Tolgoi TPP		Oyu Tolgoi TPP	Assumes Tavan Tolgoi coal price of \$20/				
	Unit 1	Unit 2	Unit 1	Unit 2	Units 1-3	With no delay		With delay		
1 TPP#5 + Tavan Tolgoi	2013	2018	2014	2014	n/a	2,184	0%	2,734	25%	
2 Tavan Tolgoi	2013	2018	2014	2014	n/a	2,223	2%	2,734	25%	
3 Oyu Tolgoi	2013	2018	2015	n/a	2012	2,202	1%	2,202	1%	

- It is clear that delays would greatly increase the costs of scenarios 1 and 2
- The cost of the resulting unserved energy outweighs the minor savings relative to scenario 3

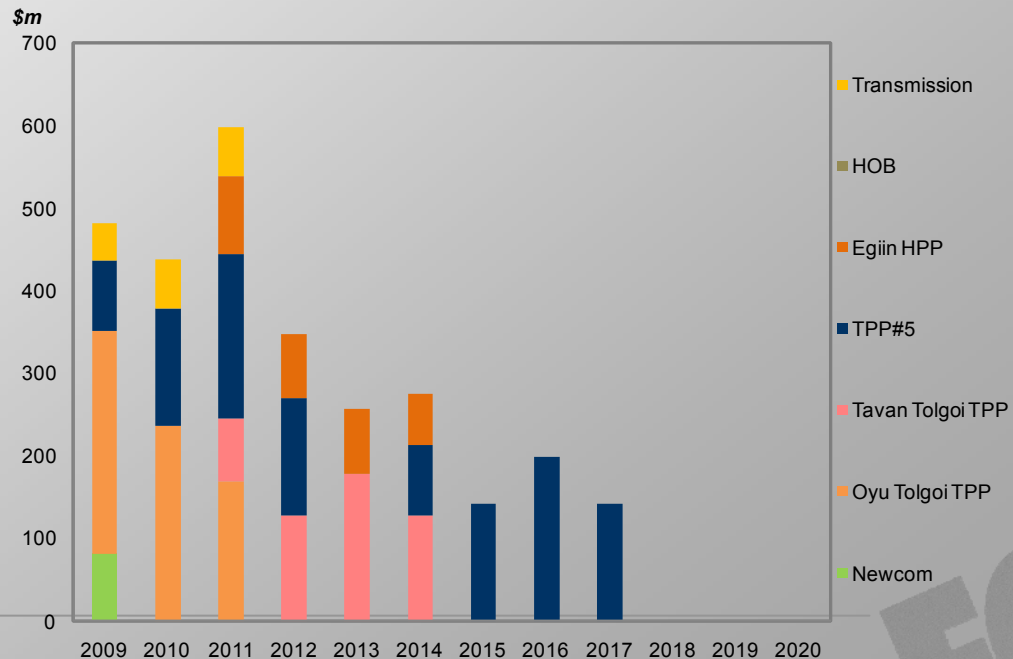
POSSIBLE EXPANSION PLAN

- **These preliminary findings suggest scenario 3 should be adopted**
 - **Newcom is commissioned in 2010**
 - **Oyu Tolgoi TPP is commissioned in 2012**
 - **TPP#5 Unit 1 is commissioned in 2013 and Unit 2 in 2018**
 - **Tavan Tolgoi Unit 1 is commissioned in 2015**
 - **Egiin HPP is commissioned in 2015**

- **Although this plan is slightly higher-cost than scenario 1, it is considerably less risky**
 - **under scenarios 1 and 2 any delay in commissioning either TPP#5 or Tavan Tolgoi TPP beyond 2012 would result in high costs to Mongolia**
 - **the risks of such delays appear high, given the current status of development of these two projects**

FINANCING REQUIREMENTS

- Annual investment needs under the Scenario 3 expansion plan average \$500m from 2009-11, of which \$250m would be financed by Ivanhoe / Rio Tinto and Newcom
- Annual investment needs from 2012-17 average \$225m
- This excludes transmission and distribution investments, other than the CES – Tavan Tolgoi interconnector



PROCUREMENT OF NEW CAPACITY

- **Financing the required generating capacity within the necessary timescale is unlikely to be possible, except on a BOT basis**
- **Best practice needs to be followed to minimise the lead-times required to procure new capacity as BOTs**
 - **TPP#5 will need to commission within 4-5 years**
 - **Tavan Tolgoi TPP will need to commission within 6 years**
- **This is discussed in the next session**