POWER SECTOR DEVELOPMENT AND SOUTH GOBI DEVELOPMENT

William Derbyshire

Ulaanbaatar, 30 October 2008

ECONOMIC CONSULTING ASSOCIATES LIMITED
41 LONSDALE ROAD LONDON NW6 6RA UK
TEL +44 (0)20 7604 4545 / FAX +44 (0)20 7604 4547
www.eca-uk.com

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

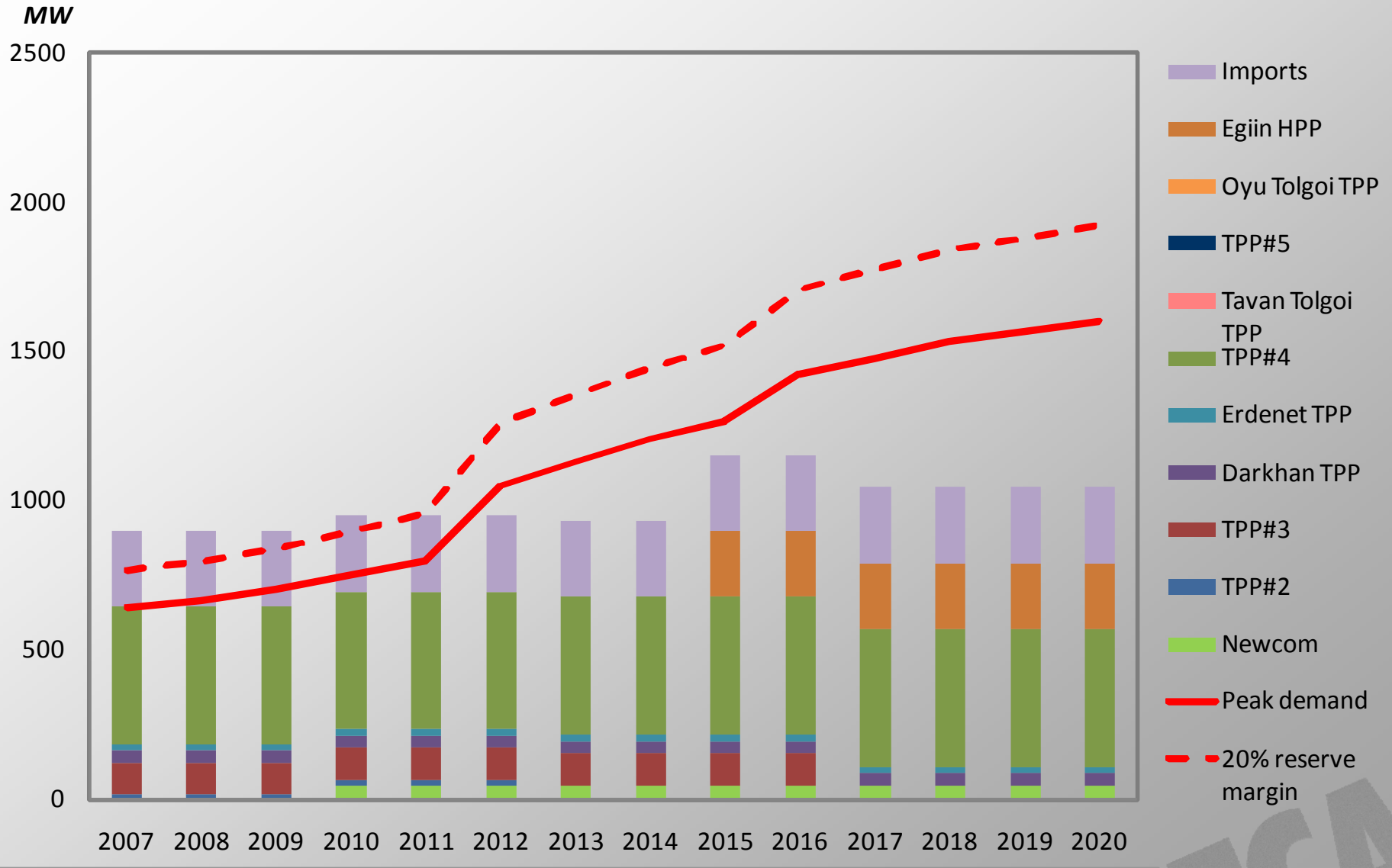
CES – SOUTH GOBI INTER-CONNECTION

- 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 Baganuur**
  - **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

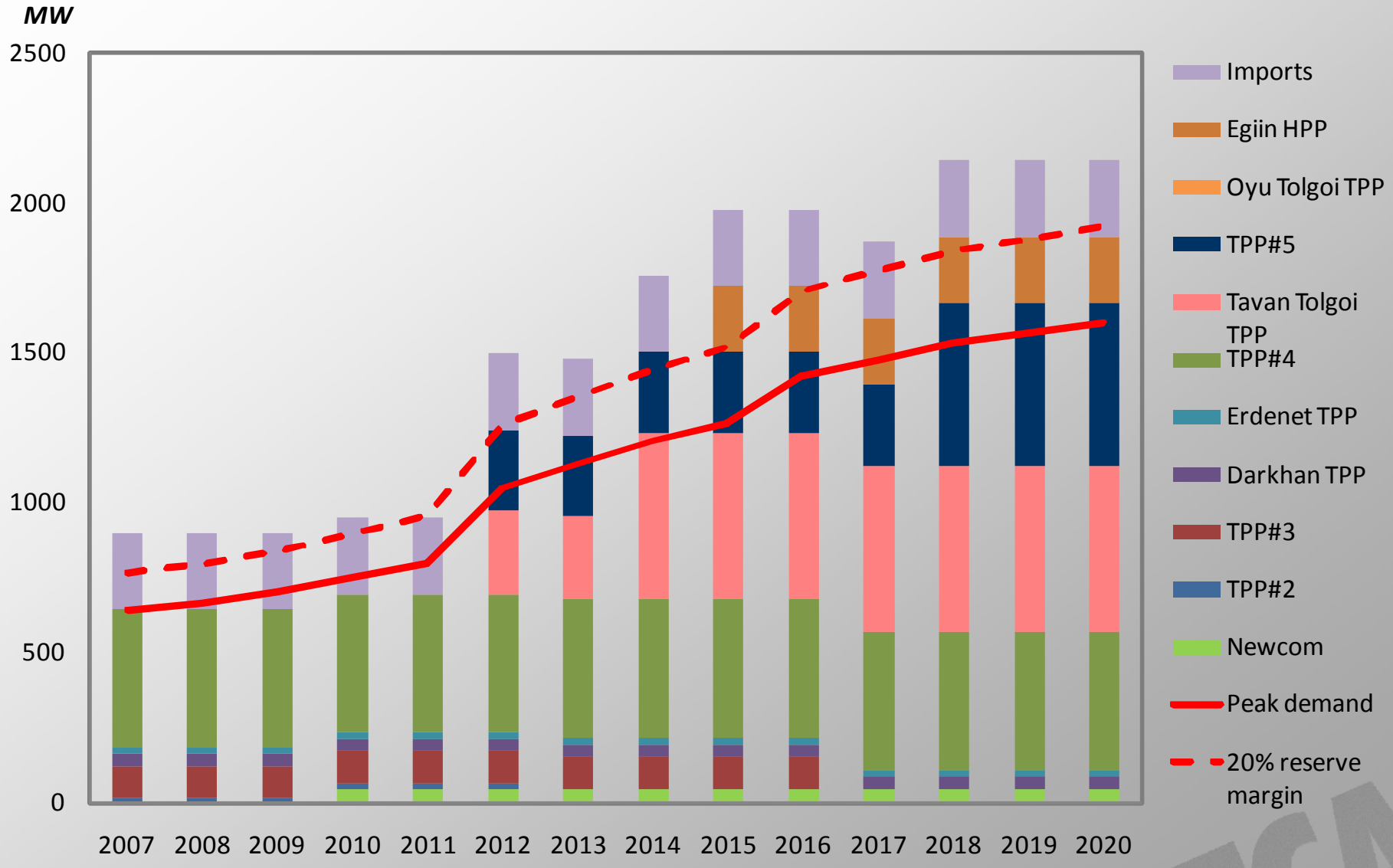
- We have estimated the present value (at a 10% discount rate) of total generation costs under three alternative expansion scenarios
- Scenario 1: Develop TPP#5 and Tavan Tolgoi TPP simultaneously
- Scenario 2: Develop Tavan Tolgoi TPP followed by TPP#5
- Scenario 3: Develop Oyu Tolgoi TPP followed by 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

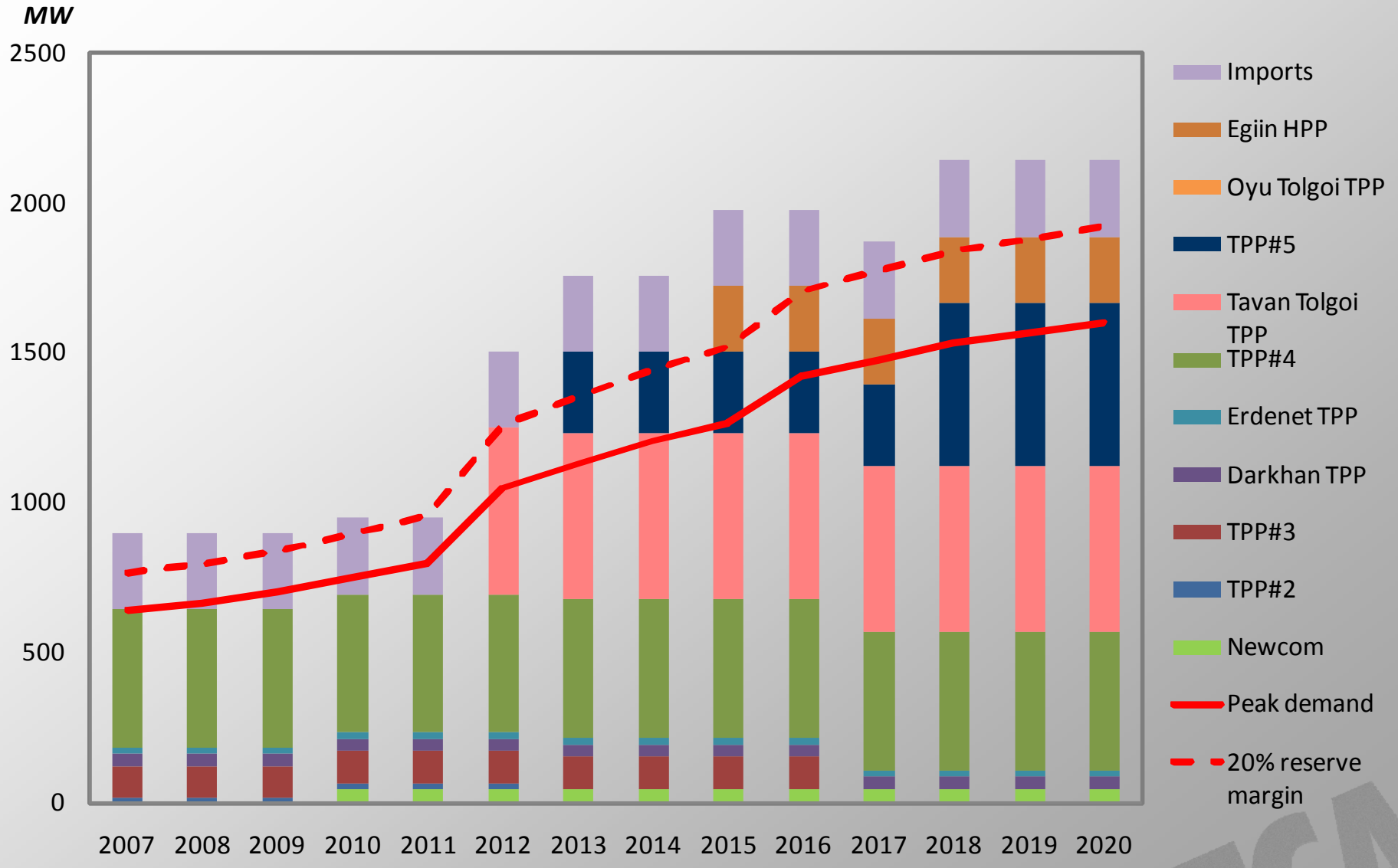
Scenario		Entry dates					PV costs (@10% discount rate)			
	First plant commissioned	TPP#5		Tavan Tolgoi TPP		Oyu Tolgoi TPP	Tavan Tolgoi coal price			
		Unit 1	Unit 2	Unit 1	Unit 2	Units 1-3	$20/t		$0/t	
1	TPP#5 + Tavan Tolgoi	2012	2018	2012	2014	n/a	2,184	0%	2,029	0%
2	Tavan Tolgoi	2013	2018	2012	2012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

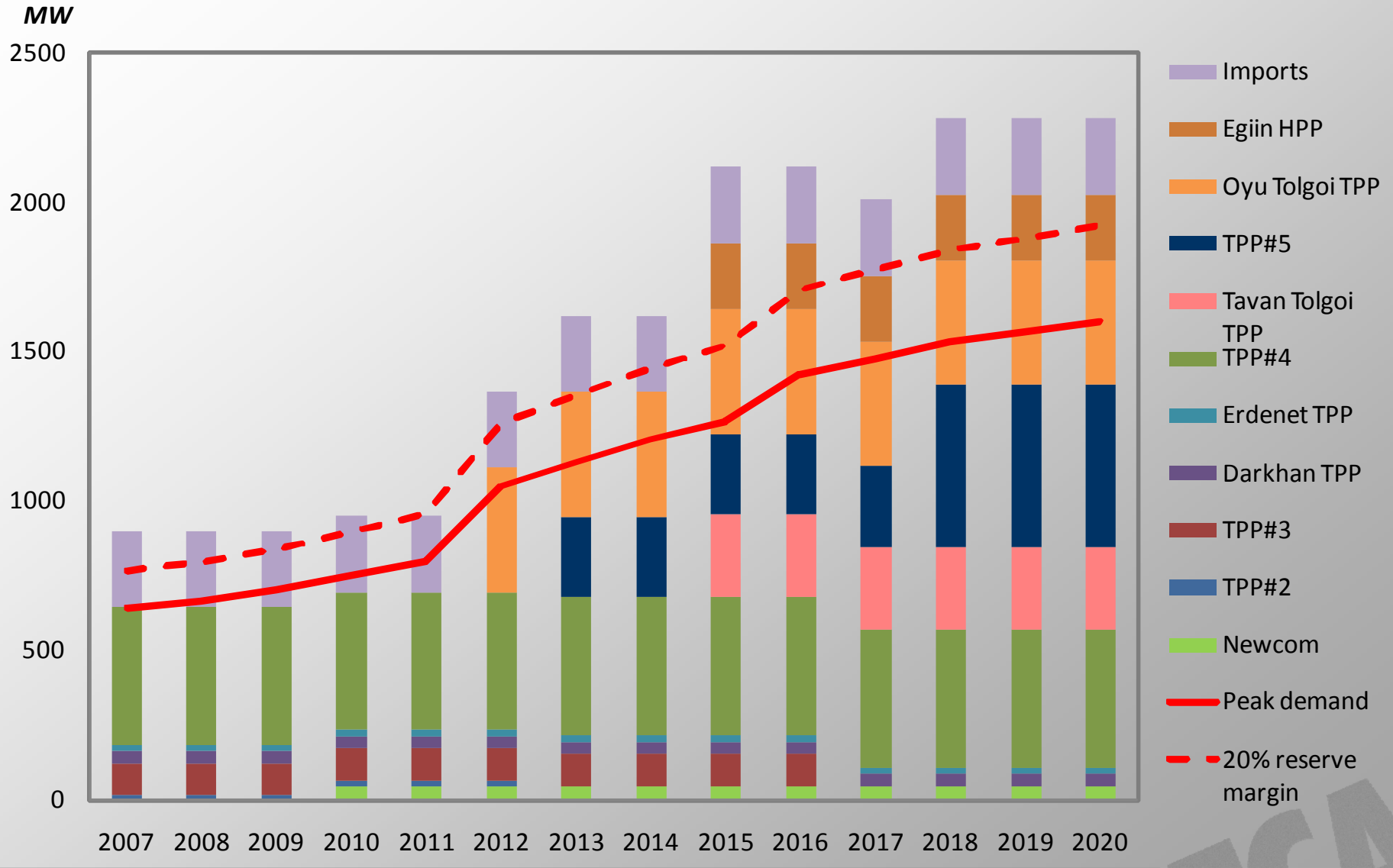
LEAST-COST EXPANSION PLAN – SCENARIO 1



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)			
	First plant commissioned	TPP#5		Tavan Tolgoi TPP		Oyu Tolgoi TPP	Assumes Tavan Tolgoi coal price of $20/t			
		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%

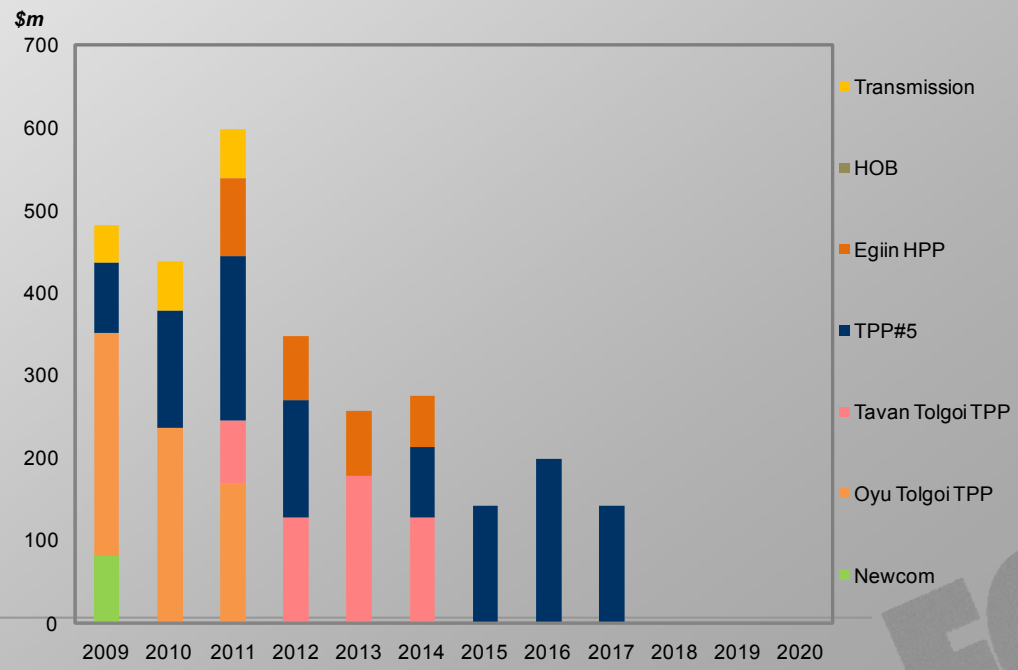
- **It is clear that delays would greatly increase the costs of scenarios 1 and 2**
- **The cost of the resulting unserved energy outweighs the minor savings relative to scenario 3**

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