

ALL-ENERGY AUSTRALIA 2009



CLEAN COAL - THE SOLUTIONS

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7 October 2009

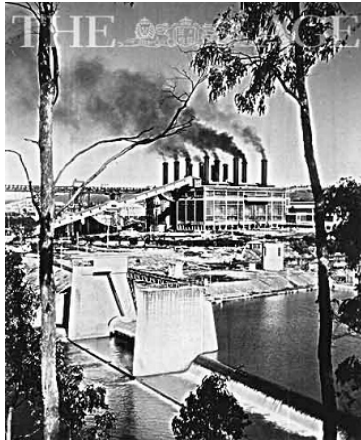
VICTORIAN BROWN COAL



- Globally 150 Billion tonnes (Bt) known reserves
- Australia: 37Bt, ~90% in the Gippsland Region
- Energy Reserves ~400% of Australia's Natural Gas
- Market Potential – Carbon / Oil / Chemical / Fertilizer

BROWN COAL TECHNOLOGIES

1940's



Yallourn
100MW Units
~19% HHV so

1980's



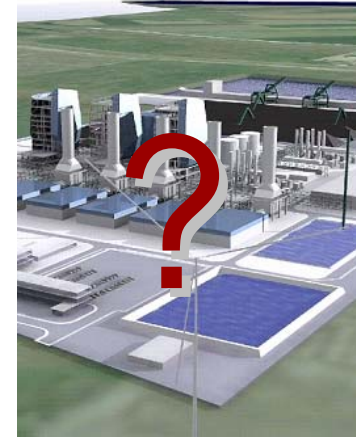
Loy Yang
500MW Units
~28% HHV so

2000's



Niederaussem K
1,000MW Units
~35% HHV so*

2020's



Future ASC - IGCC
750MW - 400MW
~40% HHV so*

Community expectations always met over time!

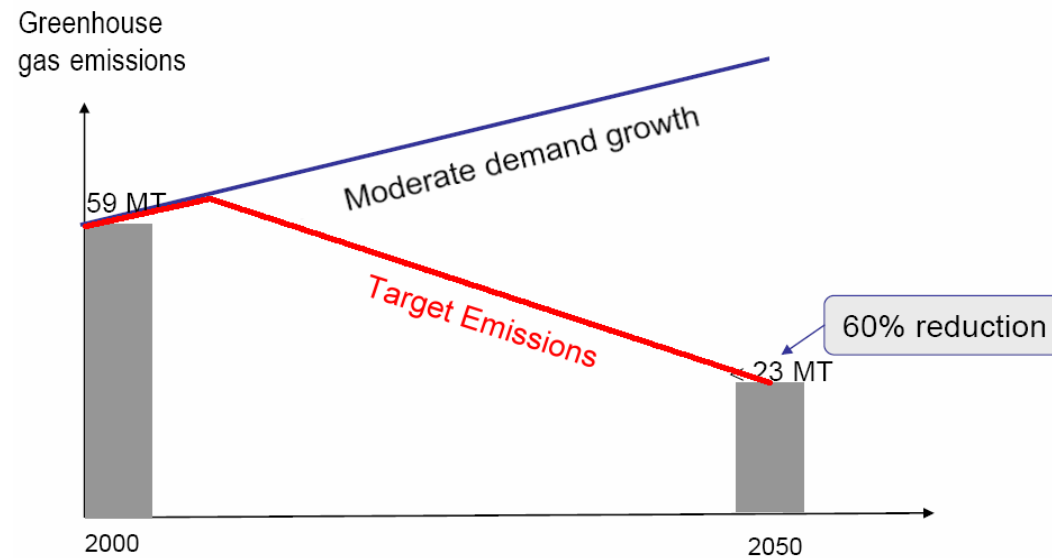
** On Loy Yang Coal @61% MC*





GOVERNMENT SCENE SETTING

VICTORIAN GOVERNMENT VISION FOR 2050



“Given Victoria’s opposition to nuclear power, deep cuts can only be achieved with coal and CCS” – Peter Batchelor

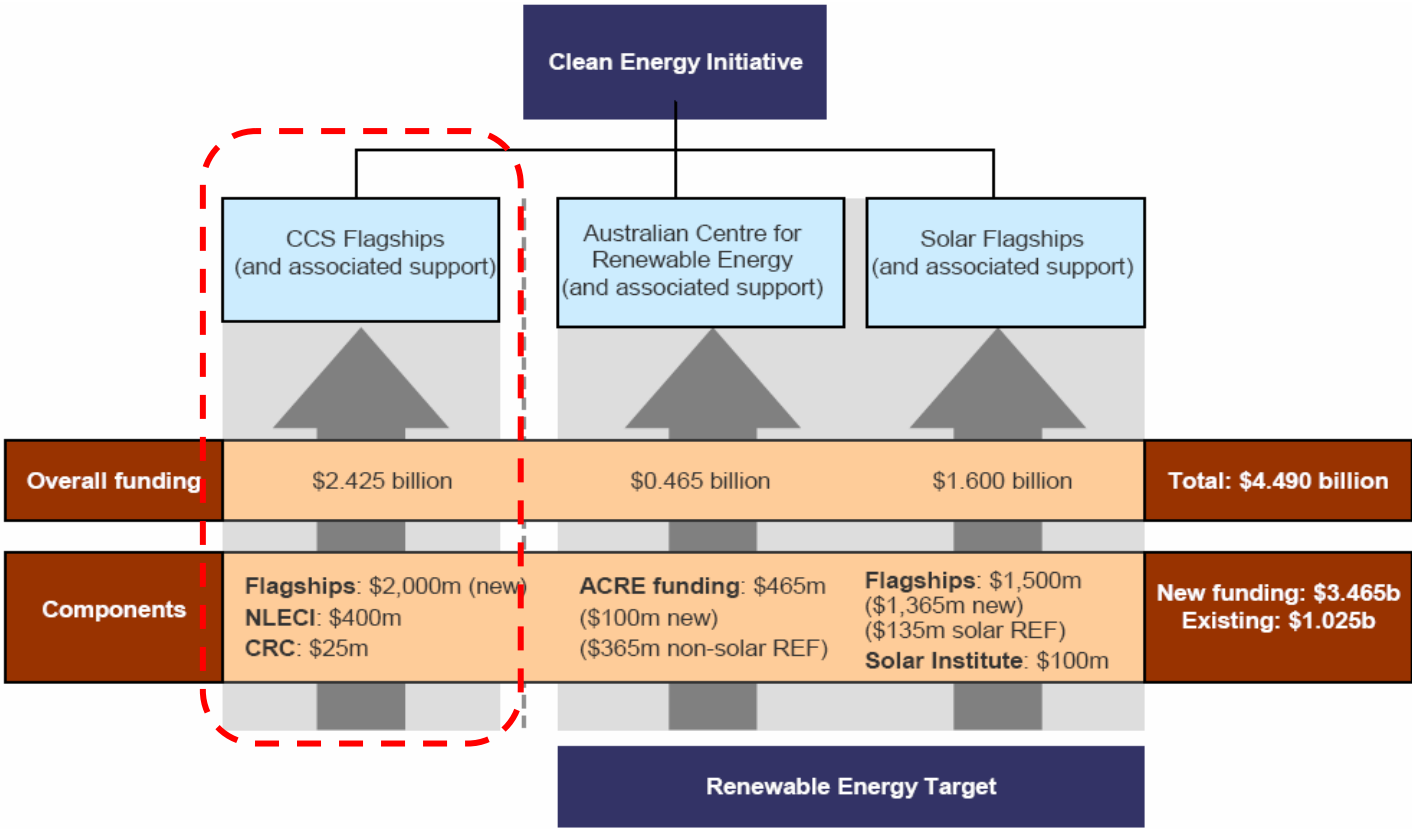


GOVERNMENT/S and CCS

- Leading the charge for CCS
- Consider CCS as a prime climate response measure
- Have established:
 - Pricing Mechanism for carbon
 - CCS Technology Development Funding programmes
- Looking to energy sector to play key role in development
- Understand challenges of Industry funding



COMMONWEALTH FUNDING

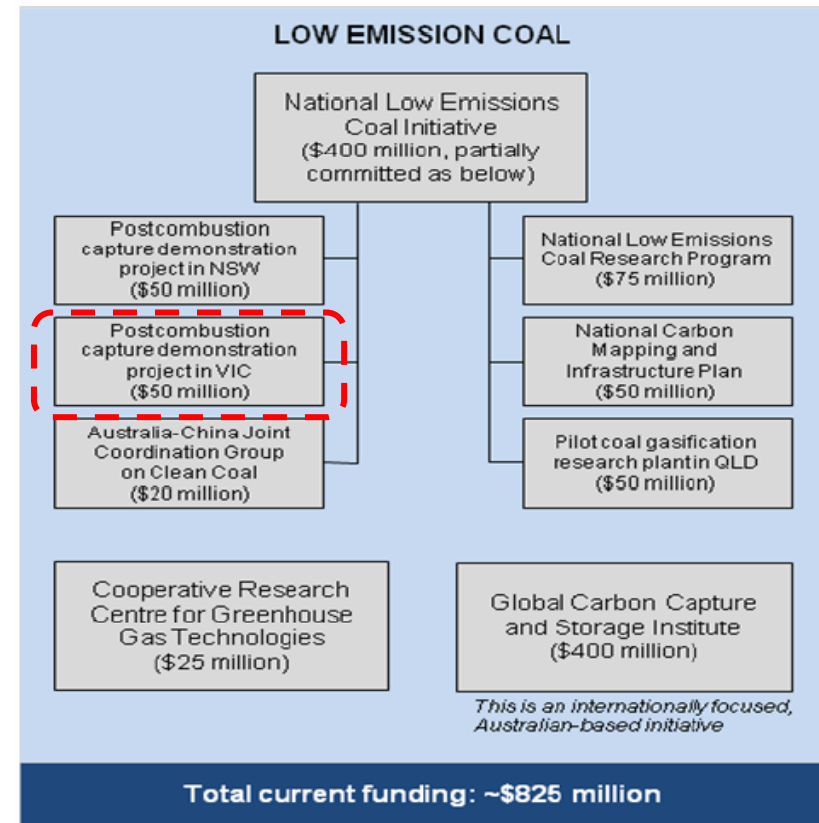


ETIS FUNDING ALIGNMENT



Victoria's Energy Technology Innovation Strategy

Your energy future lies in Victoria



LOY YANG POWER OVERVIEW

Generation



- Capacity: 2,200 MW
- Electricity: 33% of Victoria's needs
- Greenhouse: Lowest emission rate for brown coal plant
- Coal usage: 60,000 tonnes/day

- Australia's largest Open-Cut Coal Mine:
 - 30 Million tonnes/annum
 - 90,000 tonnes/day
- Electricity: 50% Victoria's needs
- Site Area: 5,640 hectares

Coal Mine





POSITIONING FOR THE FUTURE

CARBON MANAGEMENT

A mission critical and multi-dimensional issue:

- Brown Coal Leadership
- Financial & Energy Security
- Emissions Trading Preparation
- Research & Development
- Technology Demonstration
- Plant Enhancements
- Stakeholder Engagement
- Collaboration / Cooperation



EMISSION REDUCTION OPTIONS

Pre-Combustion

- Coal Pre-Drying
- Coal Pre-Treatment
- Selective Mining
- Biomass/Hybrid Fuel

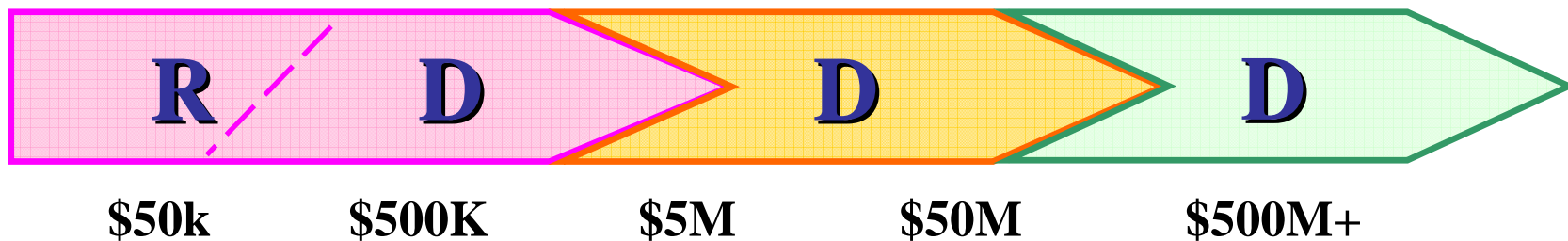
Combustion

- Turbine Upgrades
- Condenser Upgrades
- Efficiency Upgrades
- Steam Cycle Upgrade
- Waste Heat Recovery
- Operational Changes

Post-Combustion

Capture & Storage:

- Geo-sequestration
- Bio-sequestration
- Chemical/Physical Sequestration



* Research, Development, Demonstration and Deployment



CLEAN COAL TECHNOLOGIES

MTE COAL DEWATERING



POST COMBUSTION CAPTURE





NEW TECHNOLOGY EMISSIONS

Stage 1: Efficiency Improvements & Coal Drying (CO₂ 5-20% ↓)

Stage 2: Advanced technologies & Coal Drying (CO₂ ~30% ↓)

- Advanced Supercritical PF (ASC) with coal drying
- Integrated Gasification Combined Cycle (IGCC) with coal drying
- Integrated Drying Gasification Combined Cycle (IDGCC)

Stage 3: Stage 2 & CCS (CO₂ ~90% ↓)

- Advanced Super Critical (ASC), coal drying and PCC
- Oxy-combustion, coal drying, ASC and FG liquefaction
- IGCC with coal drying and pre-combustion capture
- Hydrocarbon co-production incorporating coal drying



CCS DEMONSTRATION PROJECTS

- PCC & Geo-sequestration
- PCC & Bio-sequestration
- PCC & Chemical / Physical Sequestration



INDICATIVE EMISSIONS PATHWAY

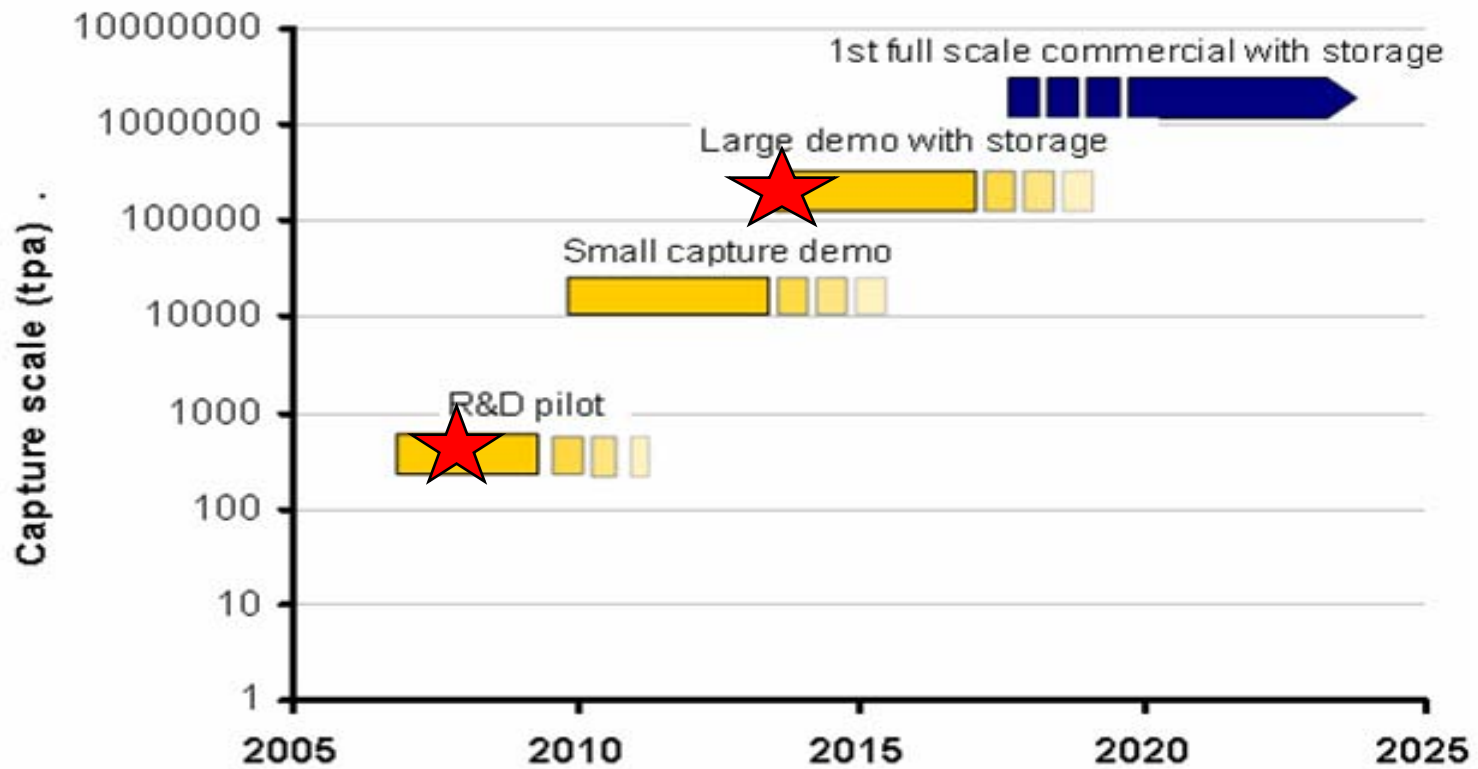
LOY YANG POWER STATION			
Base Assumptions	2,200 MW, 4 x 550MW Units		
CO ₂ Emissions:	19,000,000 tonnes		
Targets	2010 LSDP	2030 Commercial Application	2050 Target
CCS Scale - Unit basis	500 tpd	3,000 tpd - 5,000 tpd	8,250 tpd
CCS Scale - Plant basis	500 tpd	12,000 tpd - 20,000 tpd	33,000 tpd
CO ₂ Annual Reduction	173,375 t	4,161,000 t - 6,935,000 t	11,442,750 t
% Reduction	1%	22% - 37%	60%

Without CCS - Generation Reduction to achieve CO ₂ Equivalent Reduction			
Year	2010	2030	2050
Generation	2200 MW	1718 MW - 1397 MW	880 MW
Generation Reduction	0 MW	482 MW - 803 MW	1320 MW





CCS DEVELOPMENT TIMEFRAME



Courtesy of

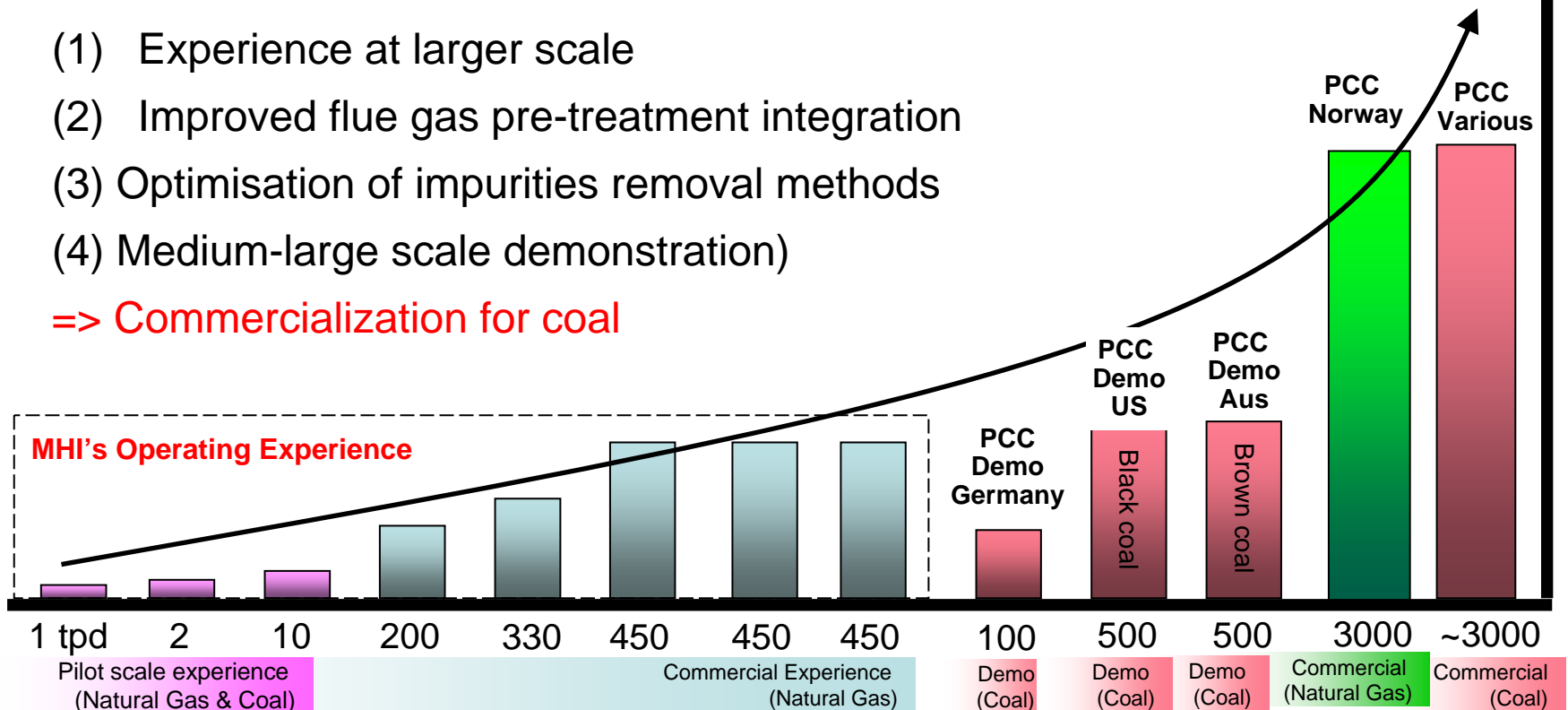


MHI - PCC COMMERCIALISATION

Roadmap for coal fired boilers

- (1) Experience at larger scale
- (2) Improved flue gas pre-treatment integration
- (3) Optimisation of impurities removal methods
- (4) Medium-large scale demonstration)

=> Commercialization for coal





LSDP PROJECT - PCC

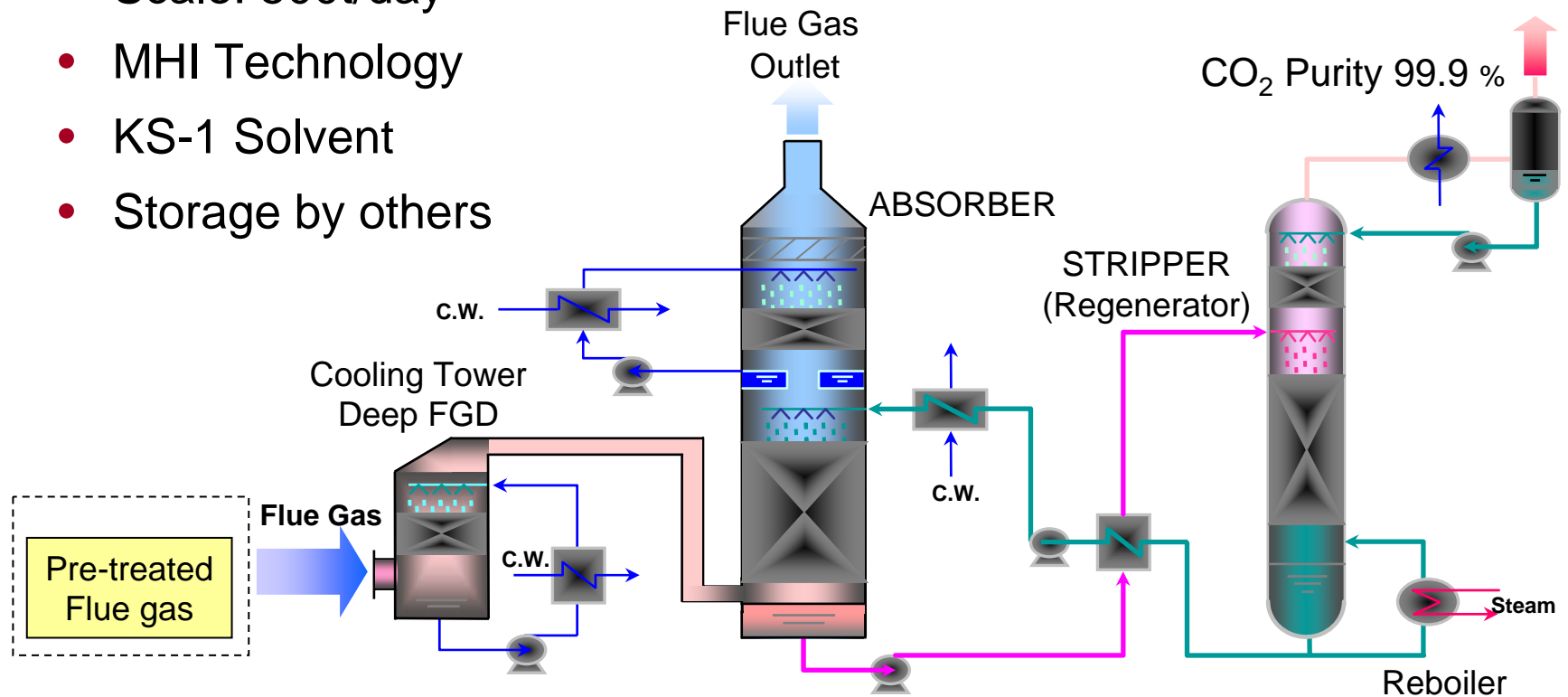
- ETIS II PCC project at Loy Yang
- Loy Yang Power and TRUenergy as joint proponents
- Industry collaboration has proven to be an effective approach to R&D
- Project Jointly supported by:
 - Mitsubishi Corporation (Australia) Limited
 - Mitsubishi Heavy Industries (Technology Provider)
 - Worley Parsons (EPCm services)





POST COMBUSTION CAPTURE

- Scale: 500t/day
- MHI Technology
- KS-1 Solvent
- Storage by others



POST COMBUSTION CAPTURE

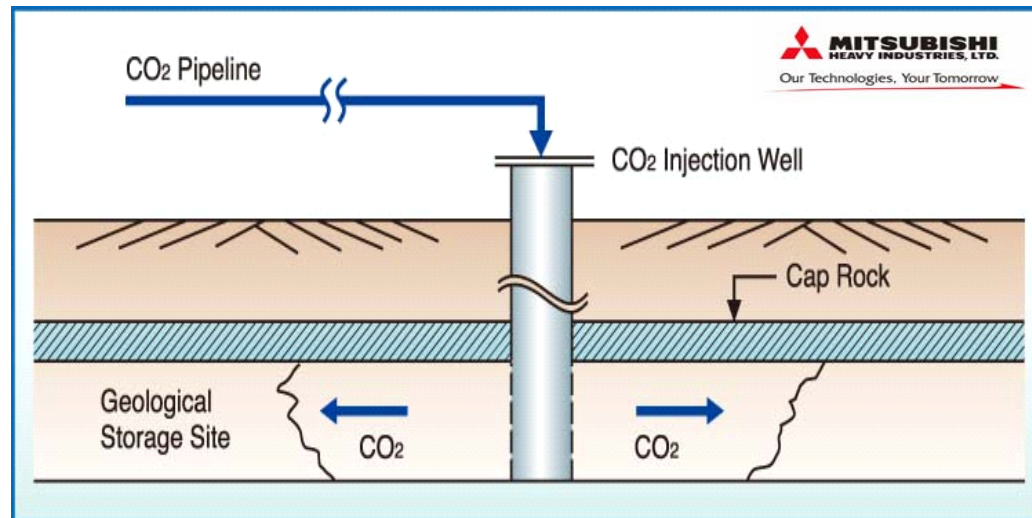
Key participation principles:

- Hosting to support the advancement of CCS technologies for commercial deployment when economically viable.
- State and Federal Government funding for Large Scale Demonstration Project (LSDP) essential (Capex and Opex)



CO₂ TRANSPORT & STORAGE

- CO₂ Transport and Storage outside the scope of PCC Project
- Working with specialists to facilitate the early realisation of suitable CO₂ storage sites
- Regulatory certainty and mutual support required to advance CCS - End to End



BIO-SEQUESTRATION

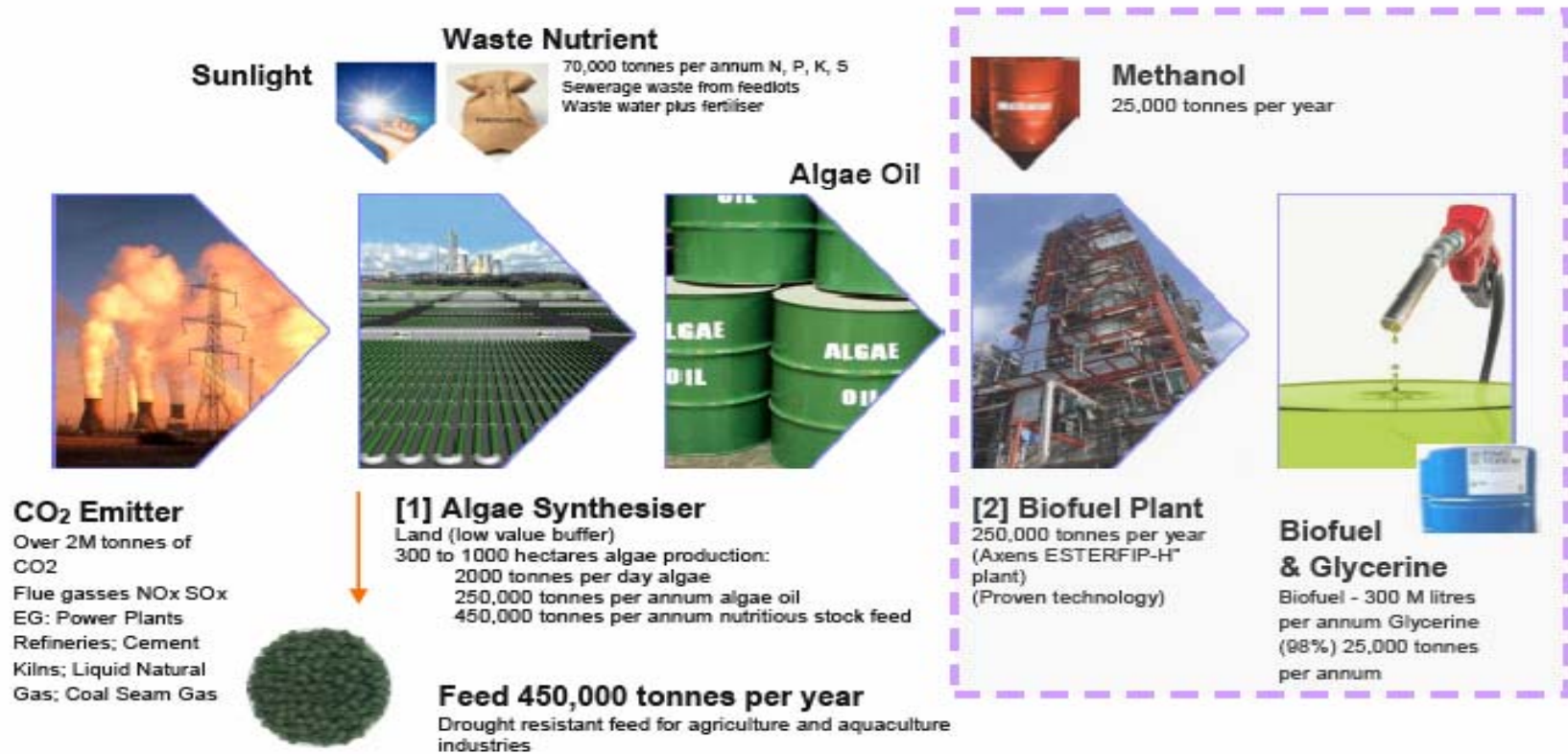
LYP partnering with MBD Energy to advance algae processes to capture flue gasses (CO₂), and recycle with waste water.



- James Cook University
- Bio-sequestration able to produce valuable commodities:
 - Algae oil: bio-diesel & bio-plastic
 - Algae meal: Protein Rich livestock feed
- Potential sustainable and affordable carbon abatement



MBD ENERGY BUSINESS MODEL





MINERAL CARBONATION

- Processes to capture flue gasses and recycle with saline waste water and fly-ash.
- Capable of producing valuable commodities such as:
 - Cement
 - Supplementary Cementitious Materials
 - Synthetic Aggregate
- Potential sustainable and affordable carbon abatement for coal fired generation
- LYP listed as supporter for a technology vendor (ETIS II)



CCS CHALLENGES

- Balancing expectations of all stakeholders
- Appropriate Partnerships and Robust Project options
- Funding and Financing
- Resourcing / Skill Match
- Development Fundamentals:
 - Parasitic Load / Loss of Energy to Market
 - Siting / Area
 - Technology Adaption to Brown Coal
 - Transport & Storage (Technical & Regulatory)
 - Knowledge Development
 - Lead Time



SUMMING UP

- Brown coal - an energy resource of national significance;
- Ongoing energy security / economic viability is a key factor
- Strong push and financial support from Government for industry to invest in new clean coal technologies
- Need to build CCS related capability:
 - Availability for retrofit if applicable and economic
 - Positioning for the next generation of technology
- New coal technologies can potentially meet both environmental and market needs – not at zero cost
- Scale of investment and lead time requirements significant
- Project Options / Partnerships / Business Environment - Key

THANK-YOU

QUESTIONS

