

*Development of  
High Efficiency Coal Gasification  
Technology and  
Its Application to Low Rank Coal*

March 2011

**Brown Coal Business Research Australia Pty Limited**

# Contents

Key Points

Background of Low Rank Coal Utilisation

NSEC's Coal Gasification Technology (ECOPRO \*)<sup>1</sup>

Pre-feasibility Study of ECOPRO \*<sup>1</sup>Demonstration Project

Future Development

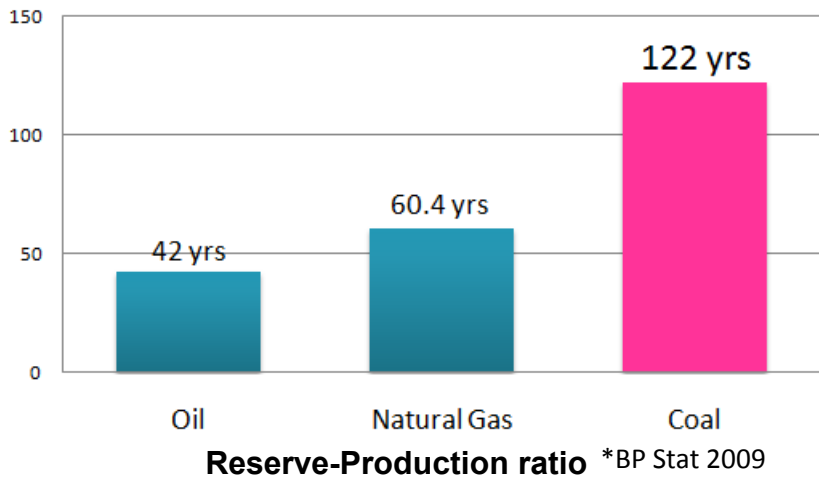
\*<sup>1</sup> (Efficient **Co**-Production with Coal Flash Partial Hydro-**Pyro**lysis Technology)

- 1) Value add of Under Utilised Low Rank Coal
- 2) High Efficiency Gasification
- 3) New Business Model and  
Supporting Infrastructure

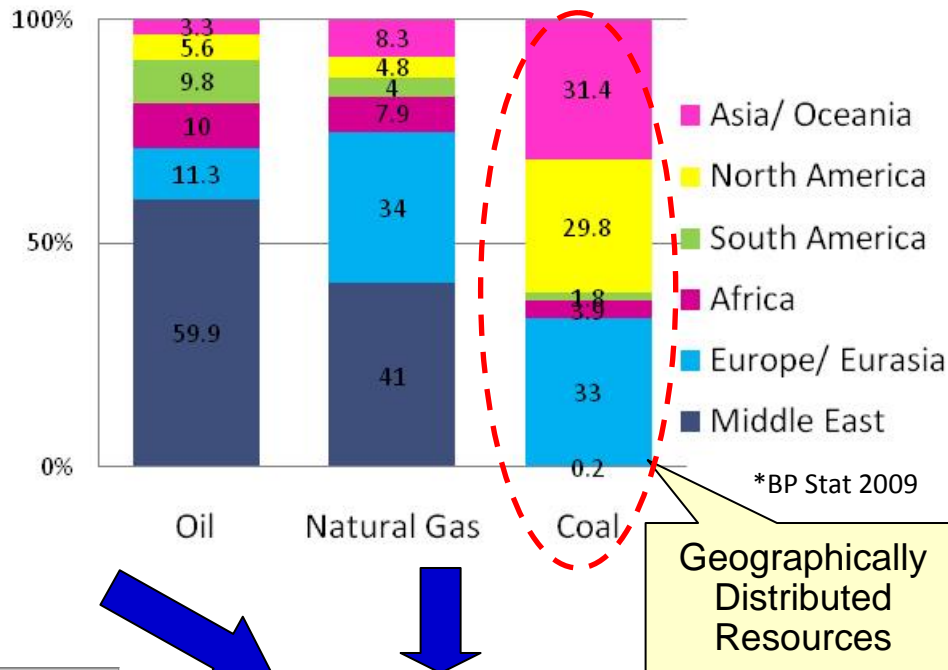
## 2. Background of Low Rank Coal Utilisation

# 2.1 Needs for Utilisation of Low Rank Coal

## Coal: High reserve-production ratio

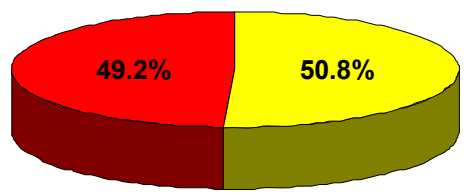


## Coal: Evenly distributed in the world

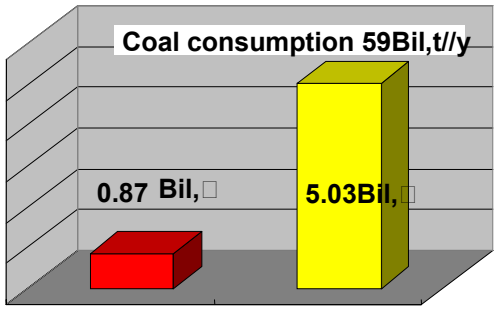


## Low Rank Coal: Not Fully Exploited

Recoverable reserves;  
Approximately 900 Billion tons



**Coal Reserves by categories**



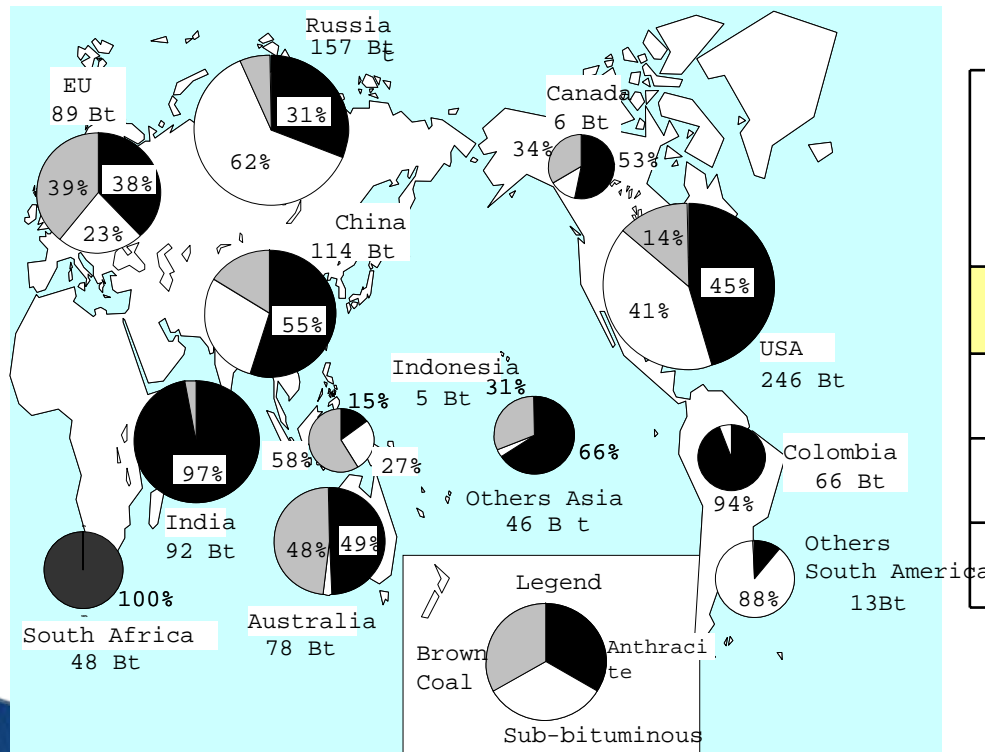
**Coal consumption by categories**

**Higher Demand for Coal Resources, Especially underutilised Low Rank Coal**

# 2.2 Status of Low Rank Coal in Asia-Pacific Region

The utilisation ratio is generally low in comparison with the reserves  
 Proven reserves = 160 bil. Ton (18% in Total): Production = Approximately 0.4Bili. ton/year (8% in Total)

The present use is essentially limited to low value Power generation at mine mouth.



Coal Reserves & Production of Coal Mining Countries in Asia

	Reserves*(Bill. Ton)		Production**(Bill./y)	
	Total	Brown Coal Reserves Ratio	Total	Brown Coal Production Ratio
World	905	<b>161 (18%)</b>	5	<b>0.4 (8%)</b>
Australia	78	37 (48%)	0.3	0.04 (12%)
Indonesia	5	2 (58%)	1	0.0001 (0.1%)
China	114	20 (18%)	1	0.07 (4%)

\*WEC2004, \*\*IEA-OECD statistics (2005)

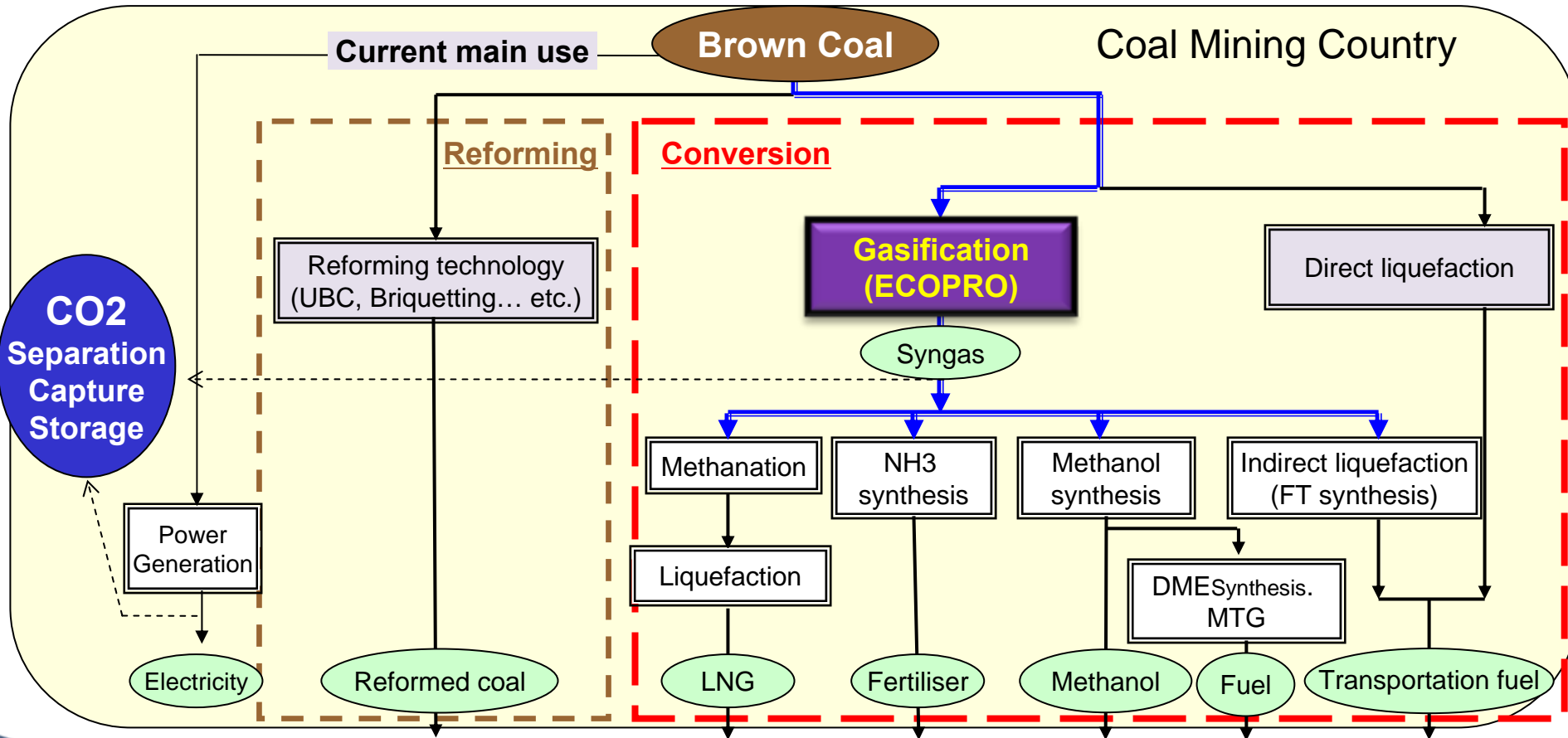
Coal reserves by category in the world (WEC2004)

# 2.3 Role of Gasification for Brown Coal Utilisation

Promotion of brown coal utilisation

(1) Reforming  $\Rightarrow$  Alternative to steam coal (2) Conversion  $\Rightarrow$  Liquid fuel, SNG\*

\*SNG Substitute Natural Gas



## Multiple uses

- ✓ Power generation and Production of export products in coal producing countries.
- ✓ Diversification and stabilisation of energy resources in energy import countries

Single use

### 3. NSEC's Coal Gasification Technology ECOPRO<sup>\*1</sup>

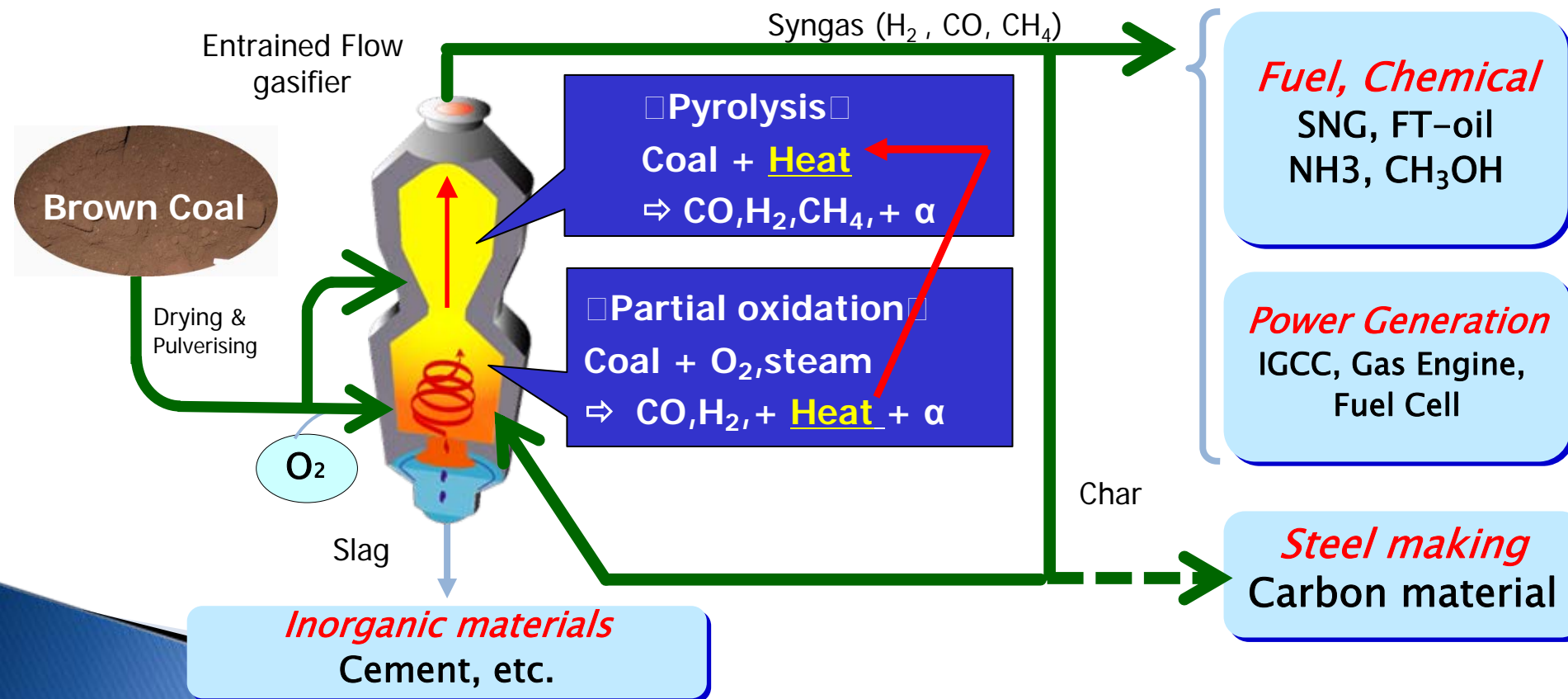
\*<sup>1</sup> (Efficient Co-Production with Coal Flash Partial  
Hydro-Pyrolysis Technology)



# 3.1 Unique Features of ECOPRO Technology

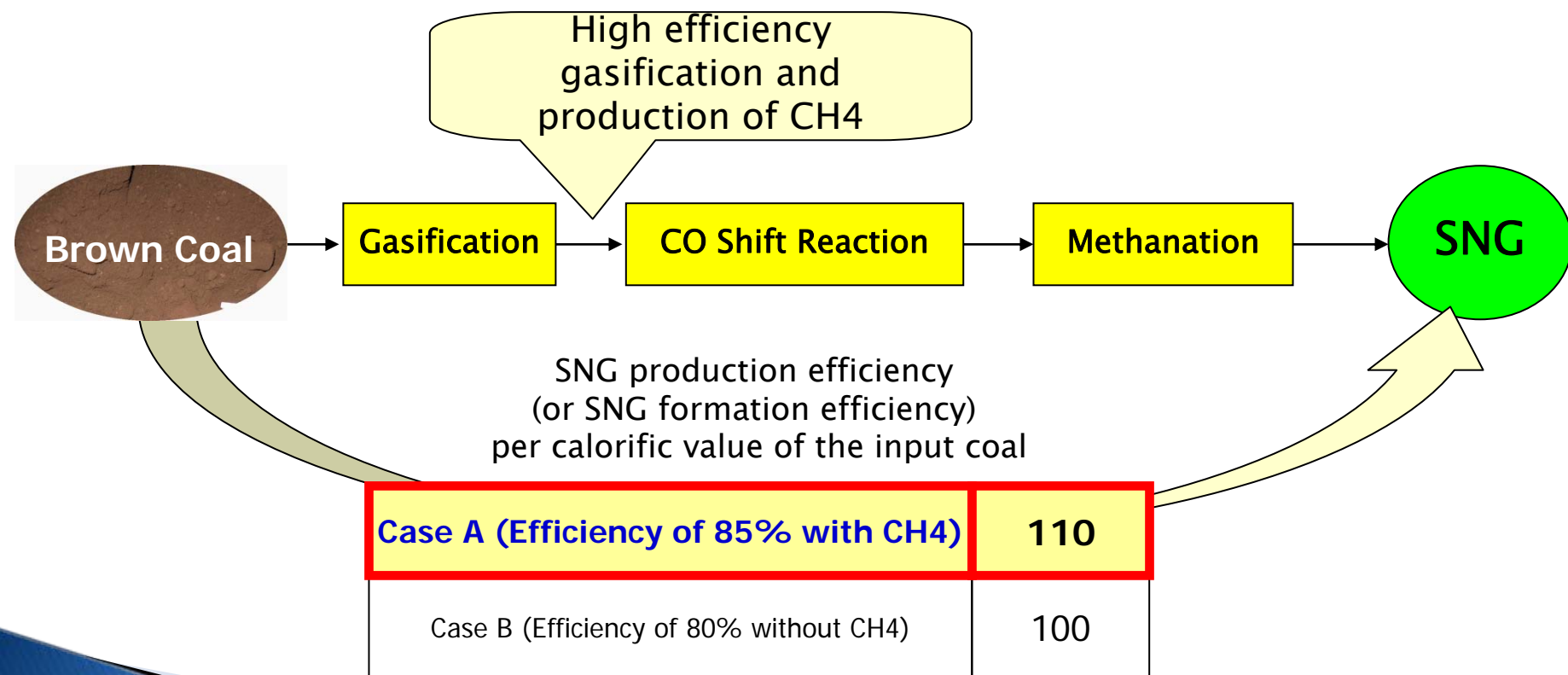
Pyrolysis reaction in upper chamber utilising the sensible heat from lower chamber.

- ⇒ High efficiency (85% at commercial plant) for coal to syngas conversion.
- ⇒ High Methane content in Syngas
- ⇒ Applicable to low rank coal.



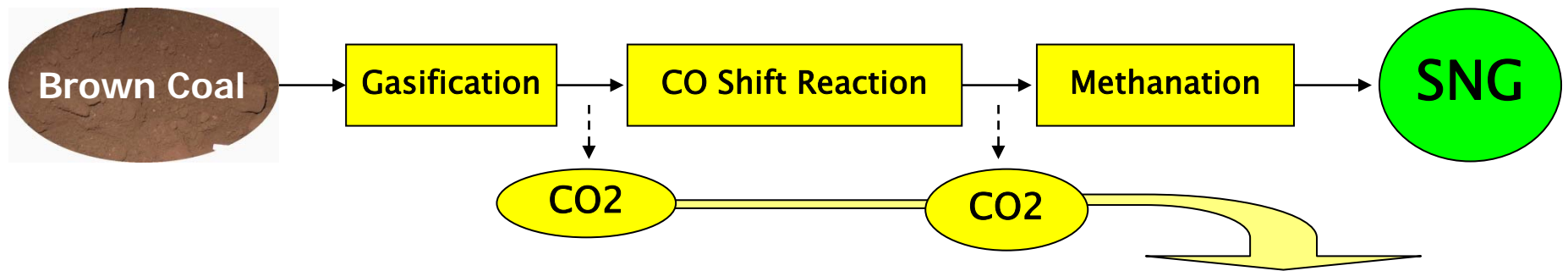
## High efficiency SNG production

**ECOPRO produces 10% more SNG** owing to the high efficiency synthetic gas production and high content of CH<sub>4</sub> in the produced gas.



# 3.3 Characteristics of ECOPRO 2: Low Emission of CO2

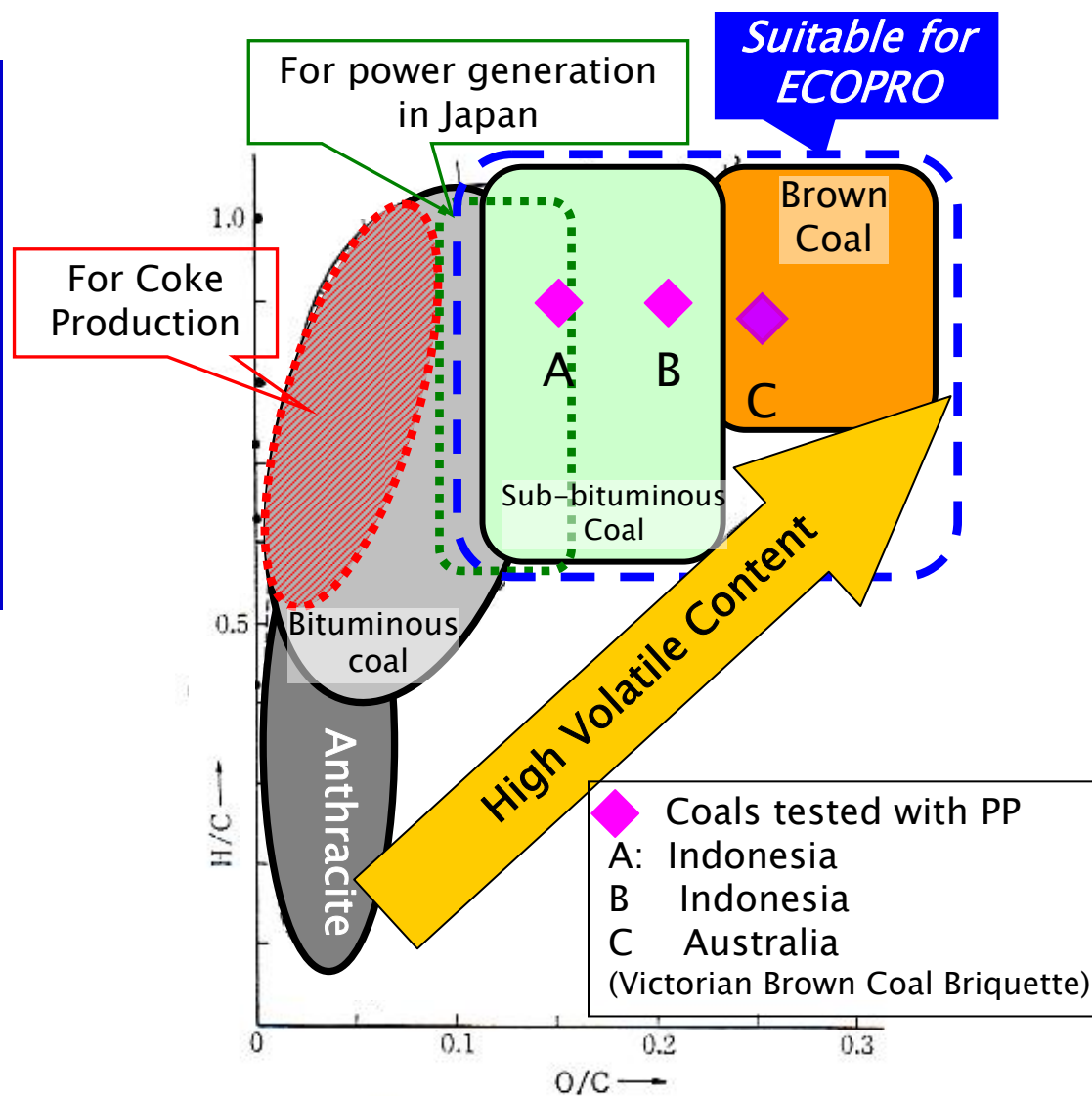
CO2 Reduction: 33% from high efficiency gasification, 6% from CO shift reaction with 9% overall reduction



	Gasification	CO shift reaction	Total
<b>ECOPRO with 85% efficiency</b>	<b>10</b>	<b>81</b>	<b>91</b>
Other gasifier with 80% efficiency	14	86	100

## Applicability of Brown Coal

Coal containing high volatile components such as sub-bituminous or brown coal are suitable for ECOPRO due to high reactivity to Pyrolysis



-Figure- Classification of Coals with regard to contents of H and O

# 3.5 ECOPRO Pilot Plant Project



Capacity: 20 t/day

Supported by Japanese  
Government (METI),  
through JCOAL

Project Period: 2003 ~ 2009



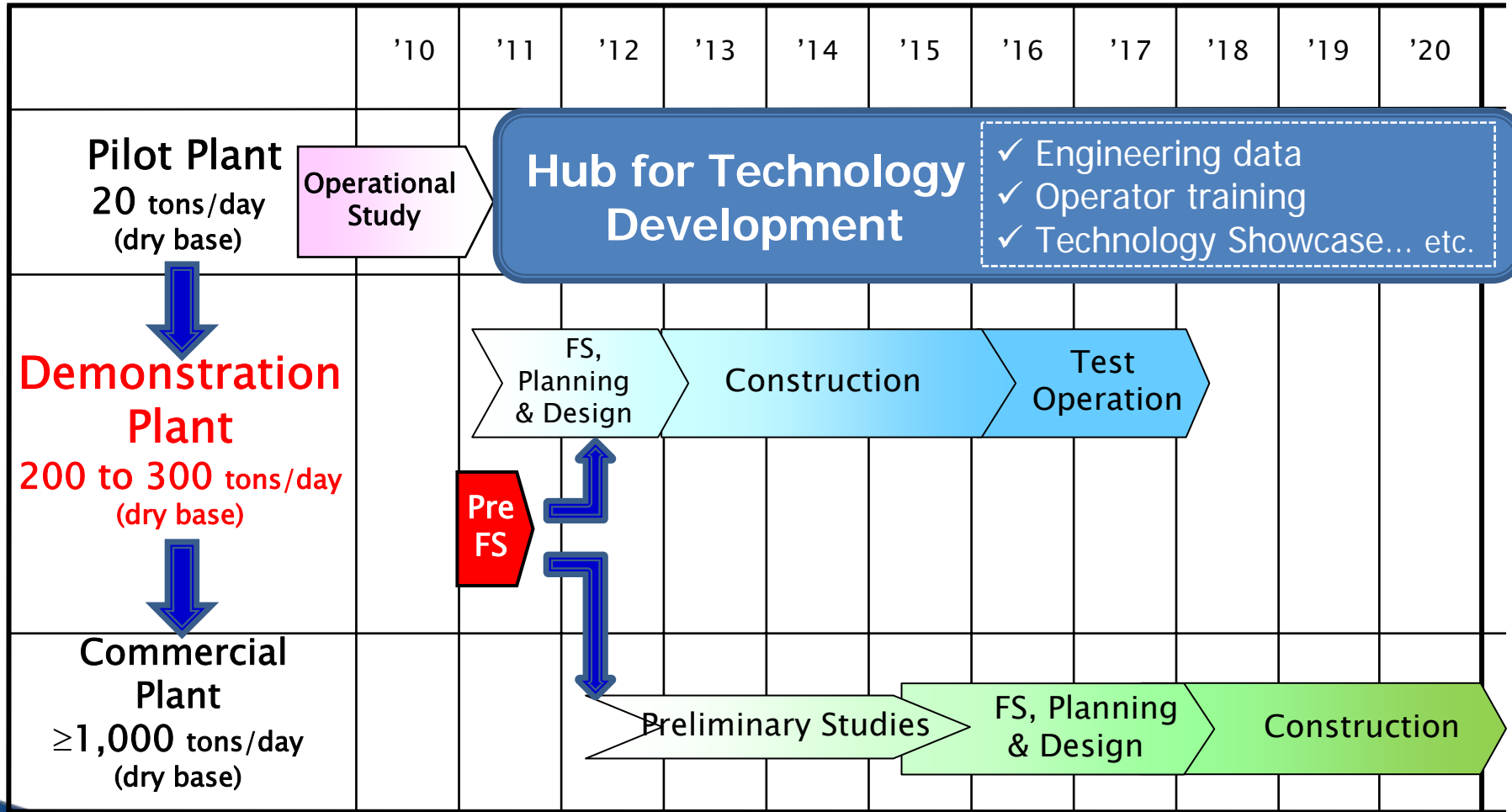
## 3.6 Achievements of ECOPRO Pilot Plant Test

No.	Item	Achievement	Note
1	Energy Efficiency*	85 %	The highest level efficiency in the world (estimated for commercial scale)
2	Process Stability	908 hrs <i>Continuous operation</i>	Original target: 200 hr Total operation time : 3100 hrs
3	Applicability to Low Rank Coal	15 runs(2658 hrs) for sub-bituminous coal 3 runs (443 hrs) for brown coal	18 runs in total

\*Energy efficiency

= Calorific value of Products / Calorific value of coal

# 3.7 Next Step: Demonstration & Commercialisation



. Pre-Feasibility Study of ECOPRO  
Demonstration Project  
(Utilisation of Victoria Brown Coal through  
Gasification)

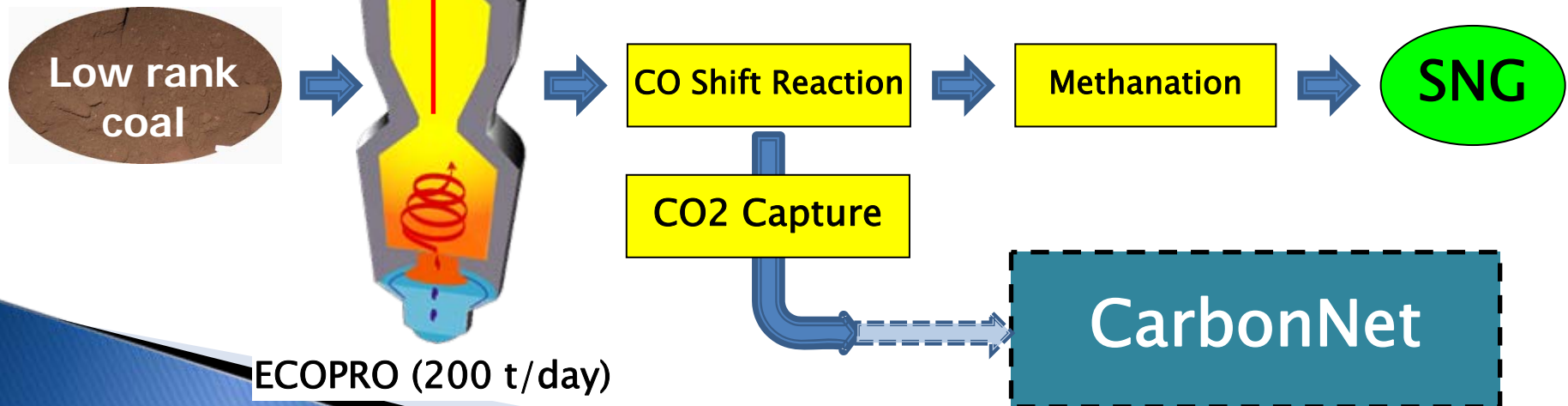


# 4.1 Objectives and Concept for Pre-FS

## Objectives

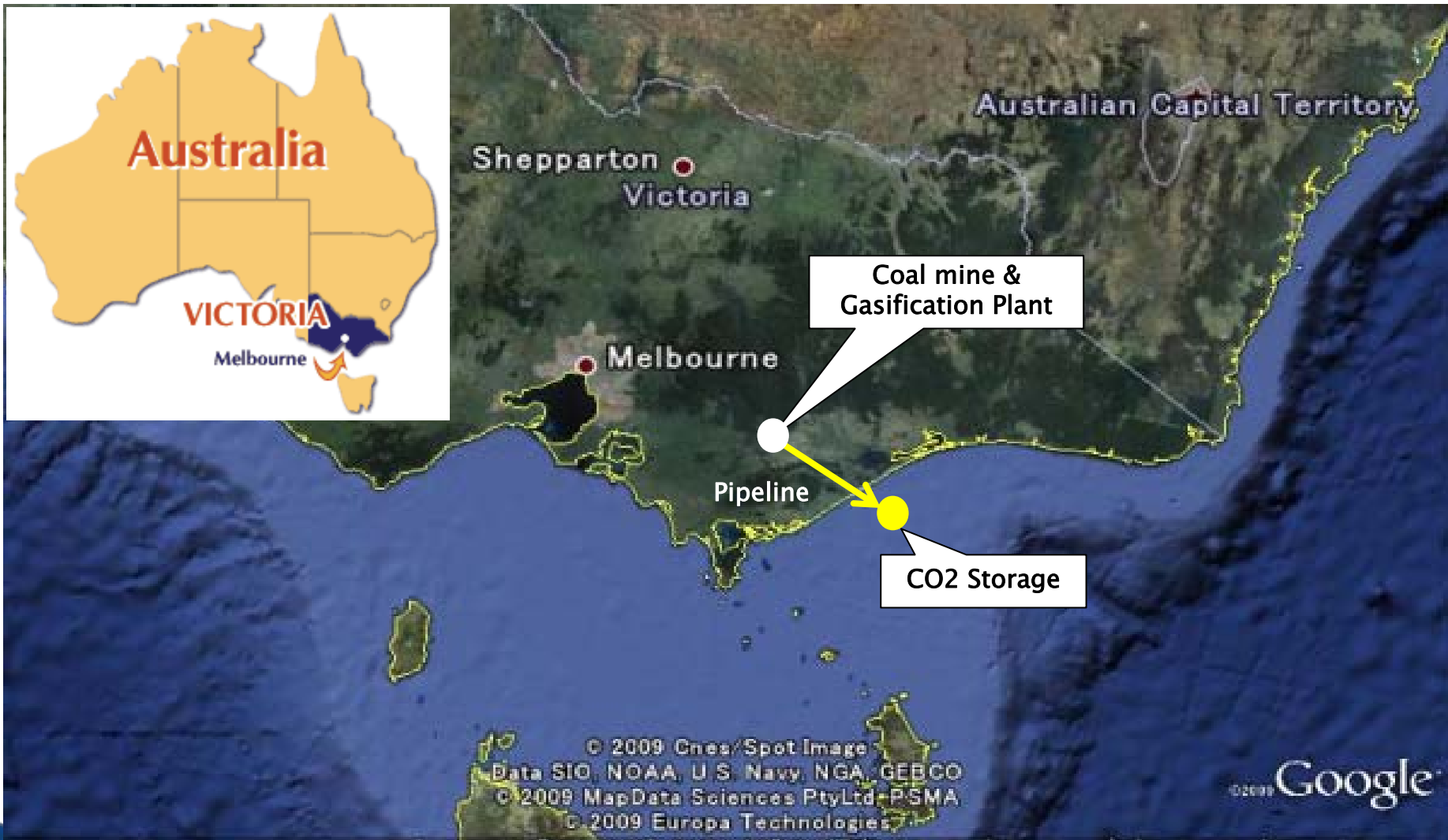
- Large Scale Demonstration Project of ECOPRO technology is defined.
- Technology and business development concept is examined from various points of view including;
  - ✓ future commercialisation strategy,
  - ✓ utilisation of demonstration facility,
  - ✓ integration with CCS infrastructures, and
- Based on the results of Pre-Feasibility study, funding support for demonstration project will be explored with all project participants

Demonstration project scope



ECOPRO (200 t/day)

# 4.2 Planned Demonstration Plant Location



# 4.3 Contents of Pre-Feasibility Study

## Study -1 Commercialisation Strategy

### Establish commercialisation strategy for ECOPRO gasification technology

- Market definition
- Corresponding plant capacity and plant specification
- Plant location and transportation infrastructure for product transportation
- Integration with CCS network (CarbonNet)
- Cost of raw materials and price of the products

## Study-2 Utilisation of Demonstration Plant

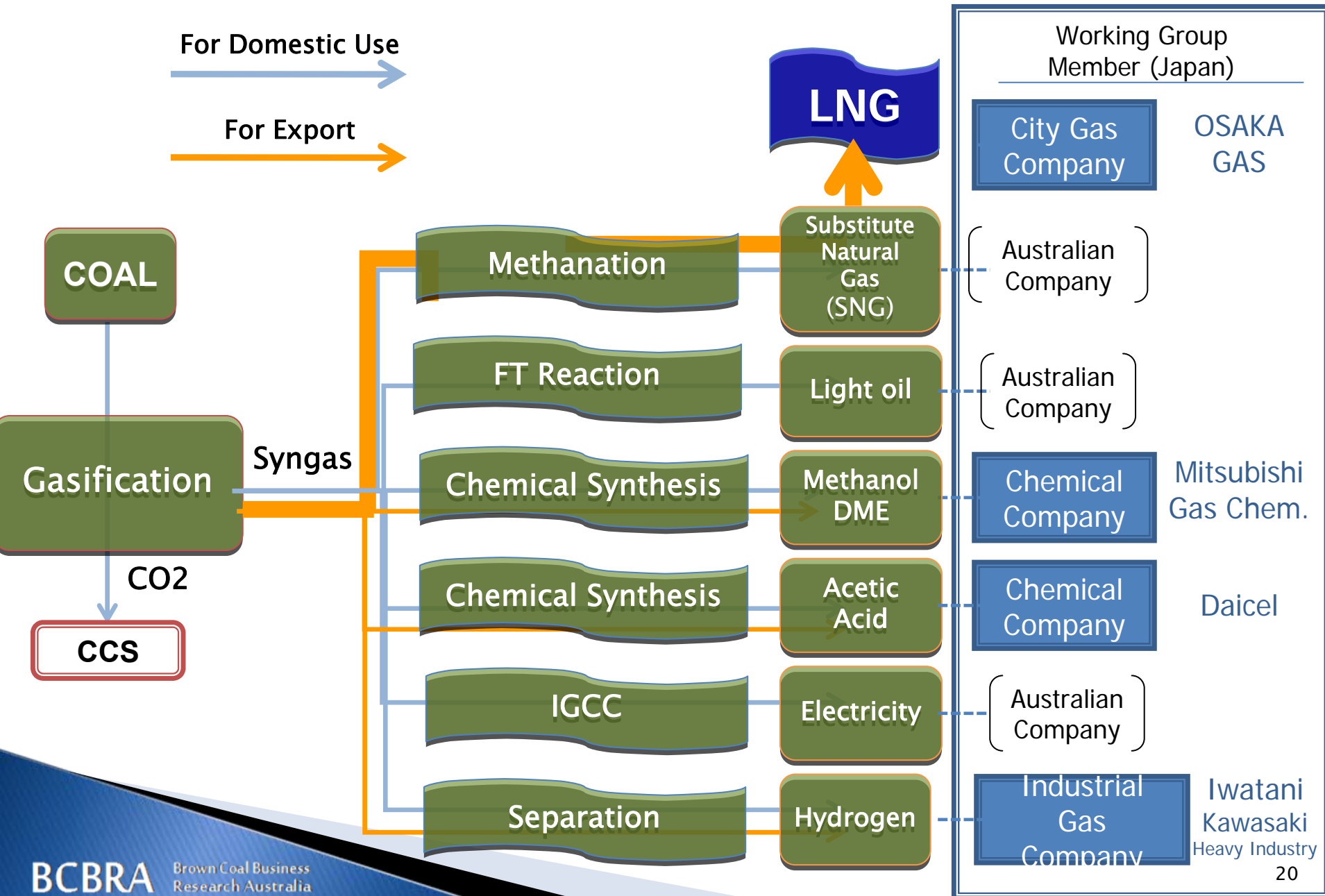
### Explore possibility of utilising Demonstration Plant after technology demonstration.

- Investigating the nearby industries as possible users of the product from this plant.
- Study of the facilities required for supplying the product to such users.
- Integration with CCS network (CarbonNet)

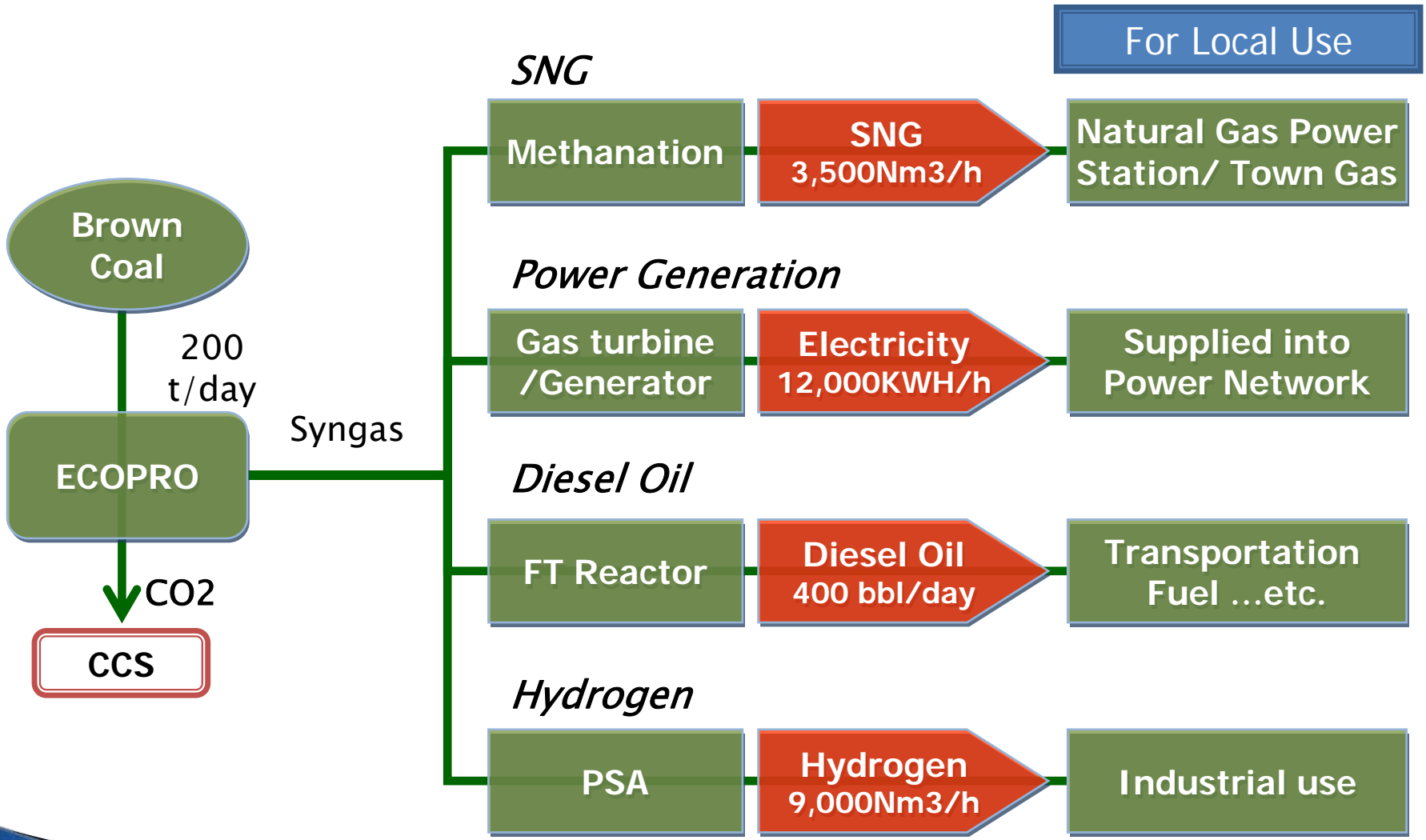
## Other studies Definition of Demonstration Project and Others

- Plant Design Engineering
- Siting Study
- Utilities Study
- Water & Waste Management Plan
- HAZOP Study,
- Green House Gas Emission Assessment
- Construction, O&M Plan
- Cost Estimate
- ... etc.

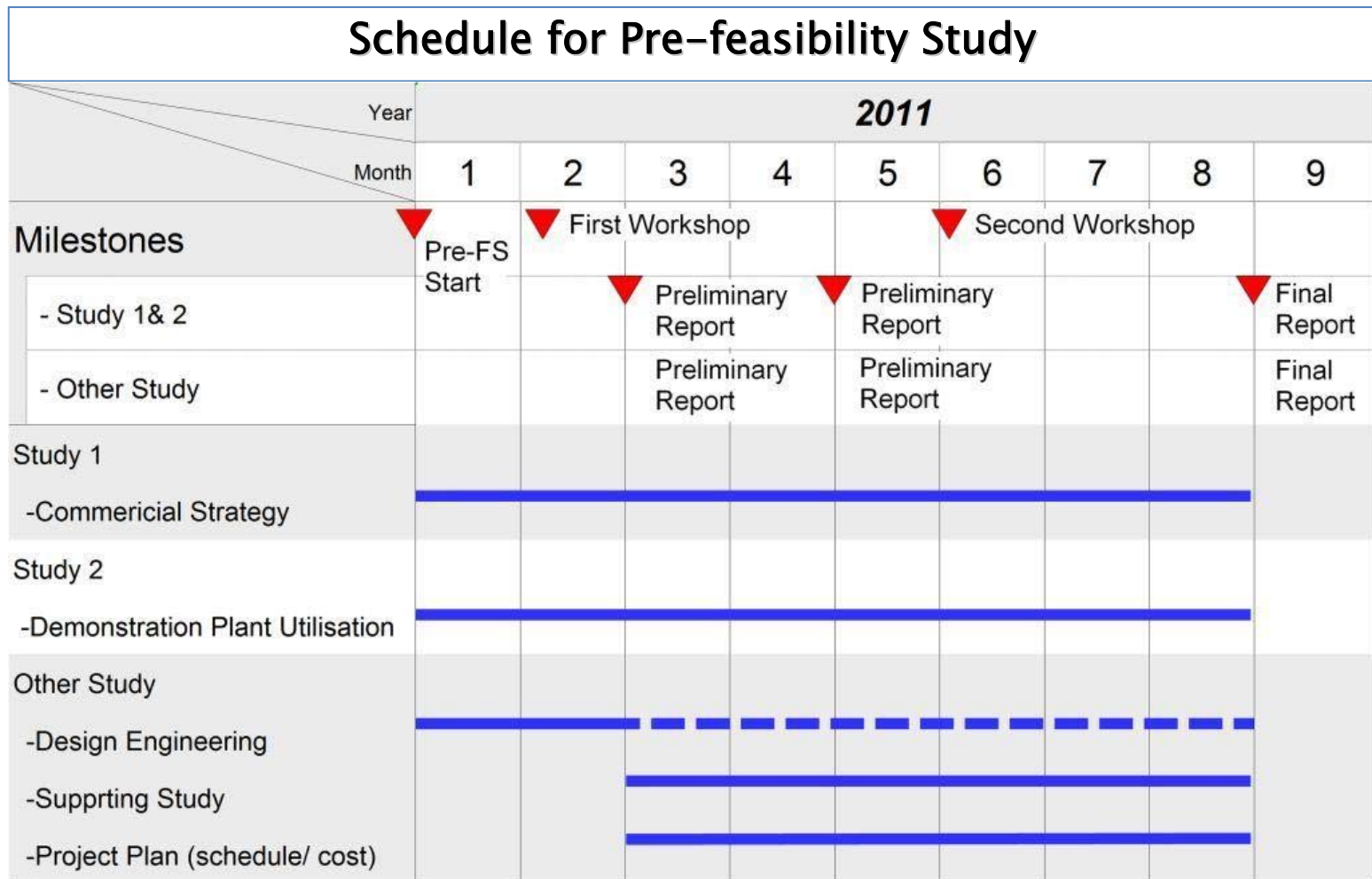
# 4.4 Commercialisation Strategy



# 4.5 Utilisation of Demonstration Plant



# 4.6 Pre-FS Schedule

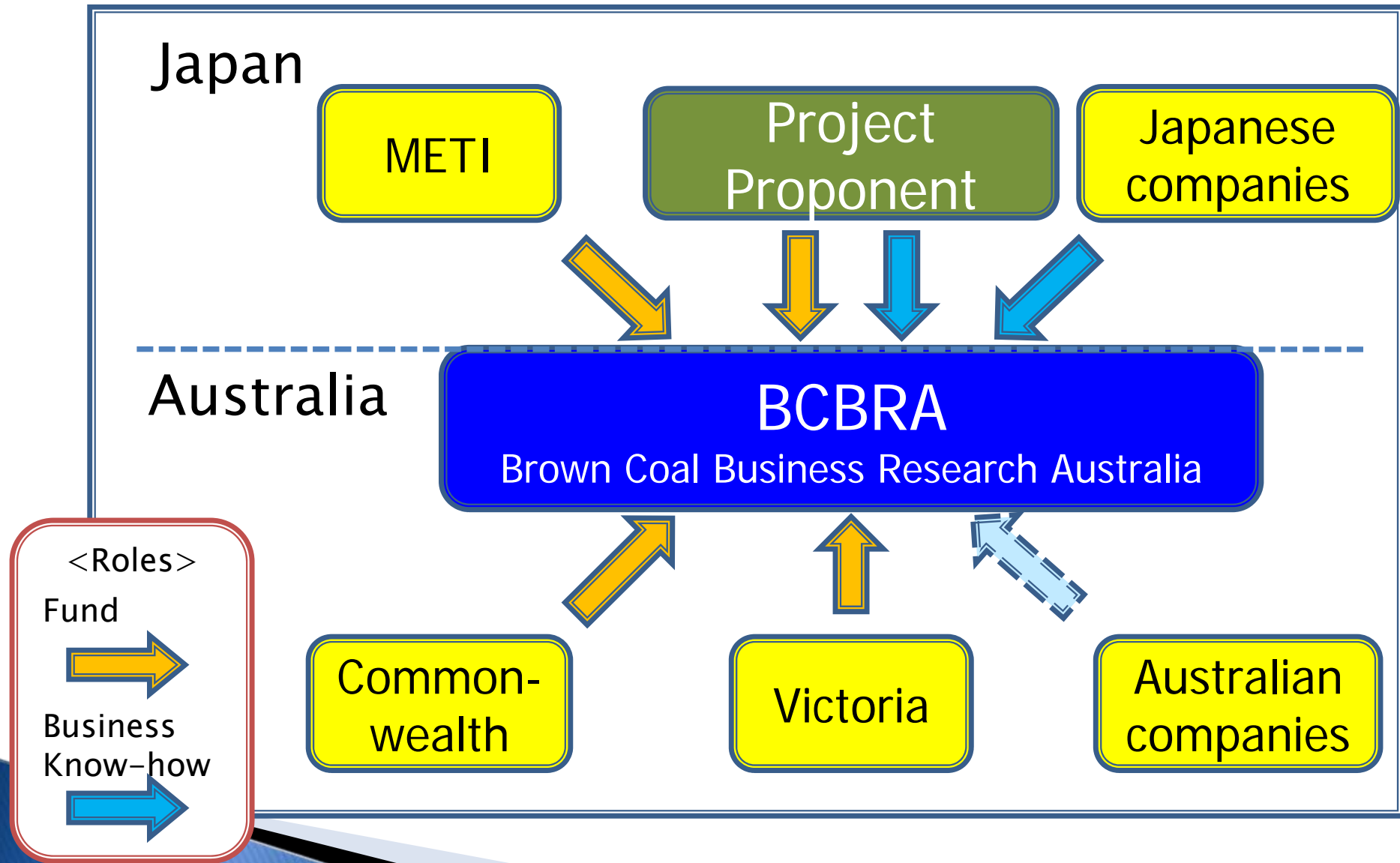


# 4.7 The First Workshop

- ▶ Date: 9<sup>th</sup> ~ 10<sup>th</sup> February 2011
- ▶ Place: Melbourne
- ▶ Presentation and Discussion:
- ▶ Pre-feasibility Study Plan
- ▶ Preliminary findings of Pre-feasibility Study
- ▶ Participants

<i>Australia</i>		Commonwealth (DRET), State of Victoria (DPI, DBI), Latrobe City etc.
<i>J a p a n</i>	(Proponents)	Nippon Steel Engineering (NSEC) Chiyoda Corporation (CYD) Japan Coal Energy Center (JCOAL)
	(Academics)	Kyushu University Kyoto University The Institute of Applied Energy
	(Industries)	Osaka Gas, Mitsubishi Gas Chemical, Daicel, Iwatani Corporation, Kawasaki Heavy Industry, Kyushu Electricity

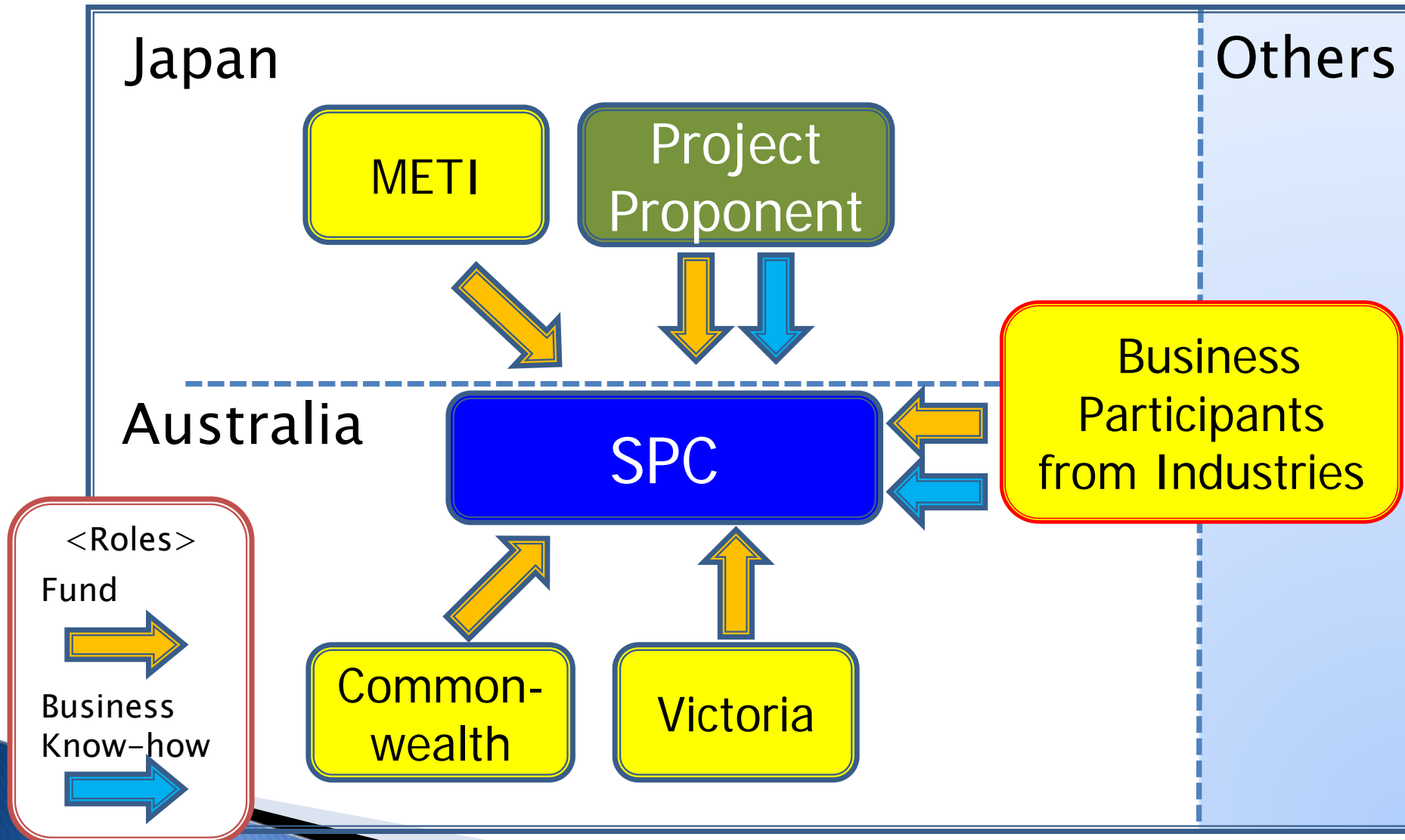
# 4.8 Organisation of Pre-Feasibility Study





# . Future Development

# 5.1 Organisation of Demonstration Project execution (expected)



# 5.2 Establishment of New Coal Business Scheme, Integrated Value Chain

## Current Scheme

Coal mining

Company A



Coal utilisation

Company B



## New Scheme

Coal mining

Company A



Syngas  
Producing  
Synthesis  
Process



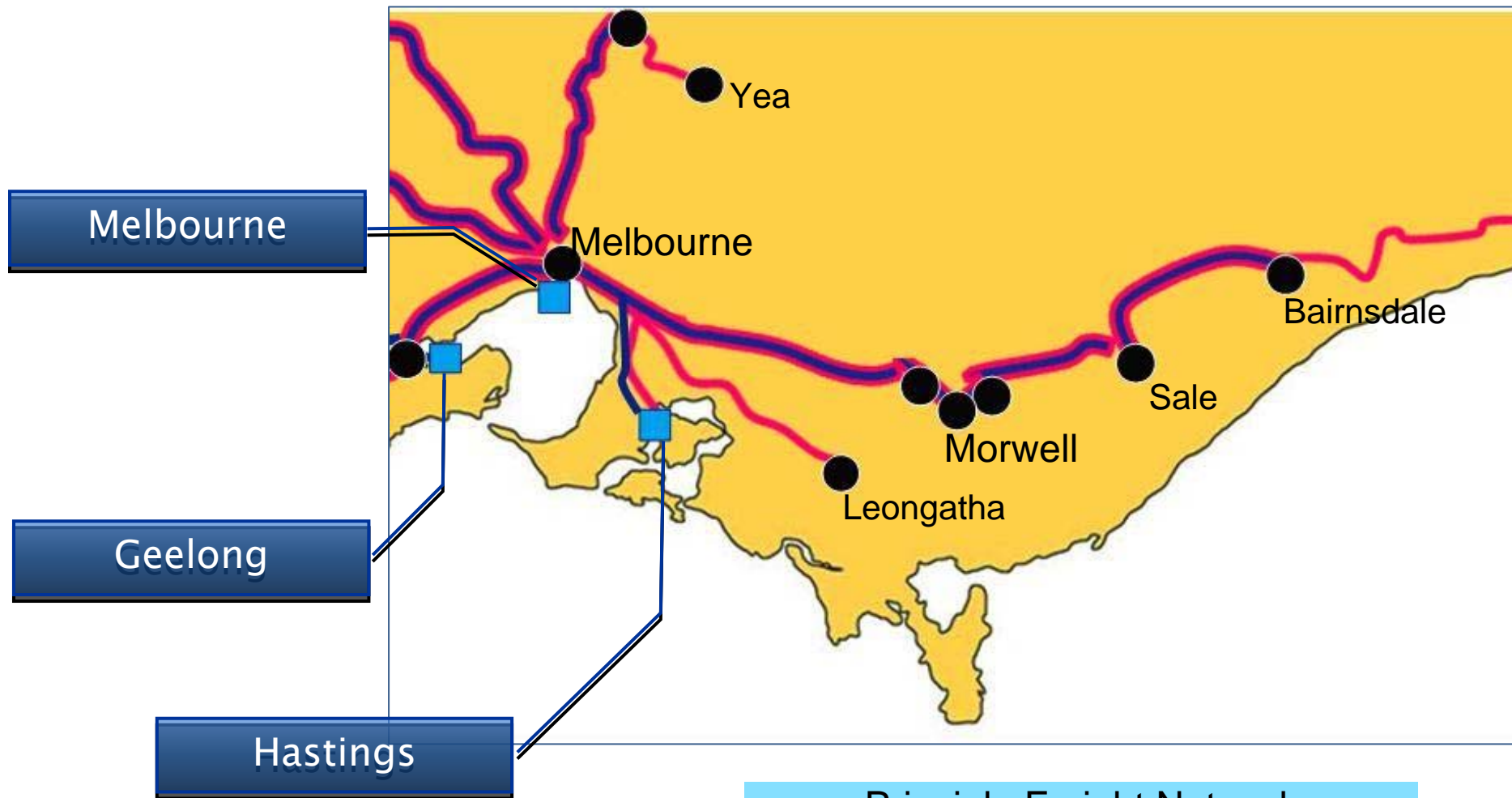
Chemical  
Product user

Company C

Integration



# 5.3 Principle Transportation Infrastructures in Victoria



Principle Freight Network

- Port
- Road and Rail
- Rail
- Road

## Low Rank Coal Utilisation for Sustainable Energy Security

1. Industrial Development (Energy & resources user industries)
2. Infrastructure Improvements (Transportation infrastructure)
3. Building new business schemes. (Integrated value chains from mine through gasification to product off-take.)
4. Collaboration between Australian and Japanese businesses.
5. Orchestrated support from both Australian and Japanese governments.

ECOPRO will realise the high efficiency conversion process from low rank coal to valuable SNG or chemical products. It has the potential to bring significant benefits to Australia through high value utilisation of low rank coal. We seek an opportunity for the technology demonstration in Australia and believe it will contribute to closer relationship between Australia and Japan.

# *Thank You For Your Attention*

## Acknowledgment



**Australian Government**  

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**Department of Resources, Energy and Tourism**



State Government  
**Victoria** Department of  
Primary Industries

This project received funding from the Australian Government as part of the National Low Emissions Coal Initiative.

It also received support from the Victorian State Government through the Department of Primary Industries as part of the Energy Technology Innovation Strategy: Carbon Capture and Storage Large Scale Demonstration Program. In particular, it received financial assistance from Regional Development Victoria towards the pre-feasibility study.