

TECHNOLOGY ROAD MAPPING FOR CARBON SEQUESTRATION

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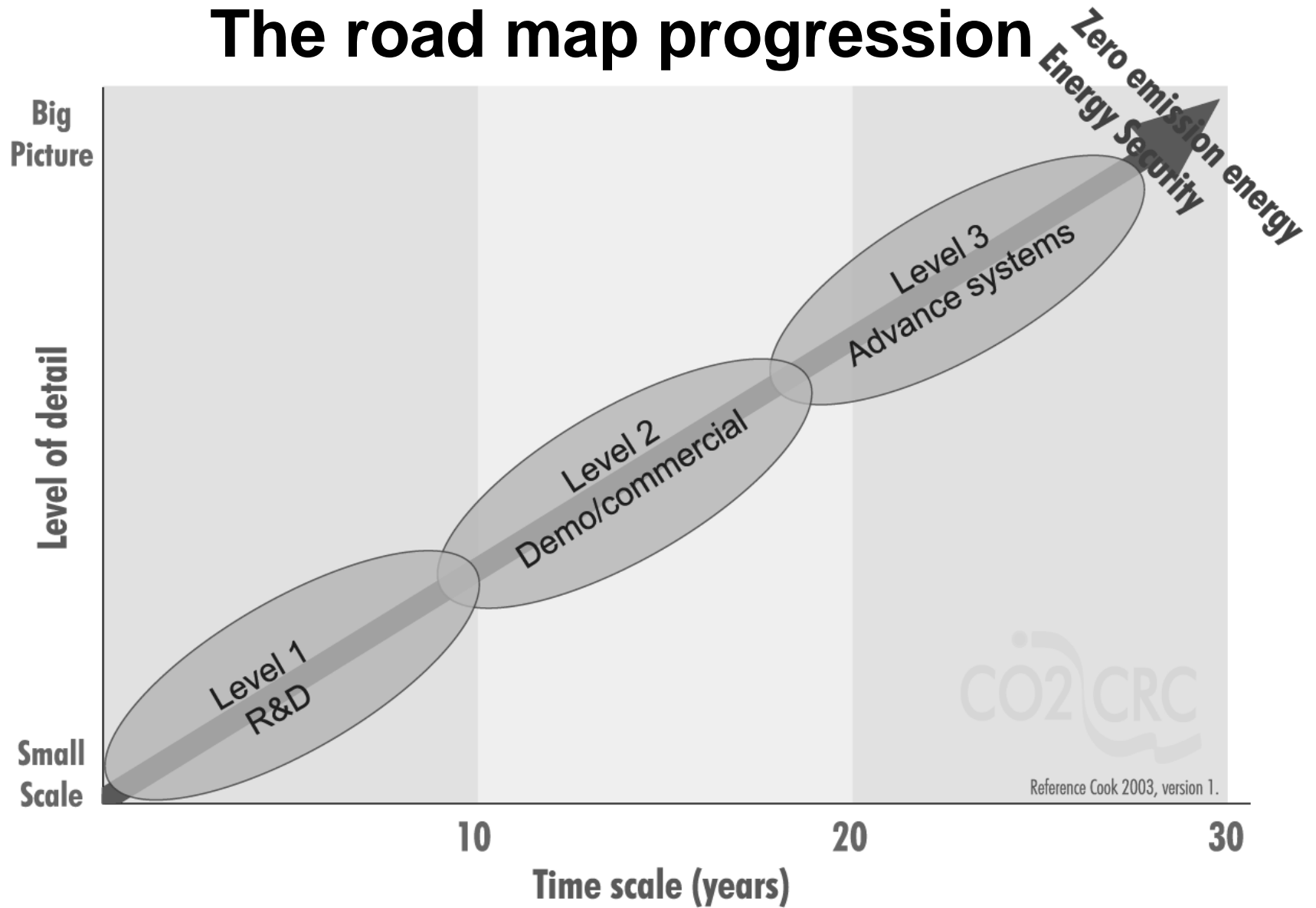
**Cooperative Research Centre
for Greenhouse Gas Technologies**

(CO2CRC)

Australia

www.co2crc.com.au

The road map progression



Functional Analysis System Technique (FAST)

Based on the concept of establishing boundaries for “value engineering”. Evaluates opportunities and puts a dollar cost and value on them.

This technique was used by Chevron Texaco staff to facilitate the capture and storage workshops.

Provides a visual map of the functional steps in the road mapping process.

Level 1 road mapping

Purpose: To clarify and consolidate the Australian position on carbon capture and storage techniques.

Stakeholders: 0 – 90 people from industry, government and the research community, representing a multi-disciplinary/interdisciplinary team.

Took whole of industry approach encompassing a range of CO₂ emitters.

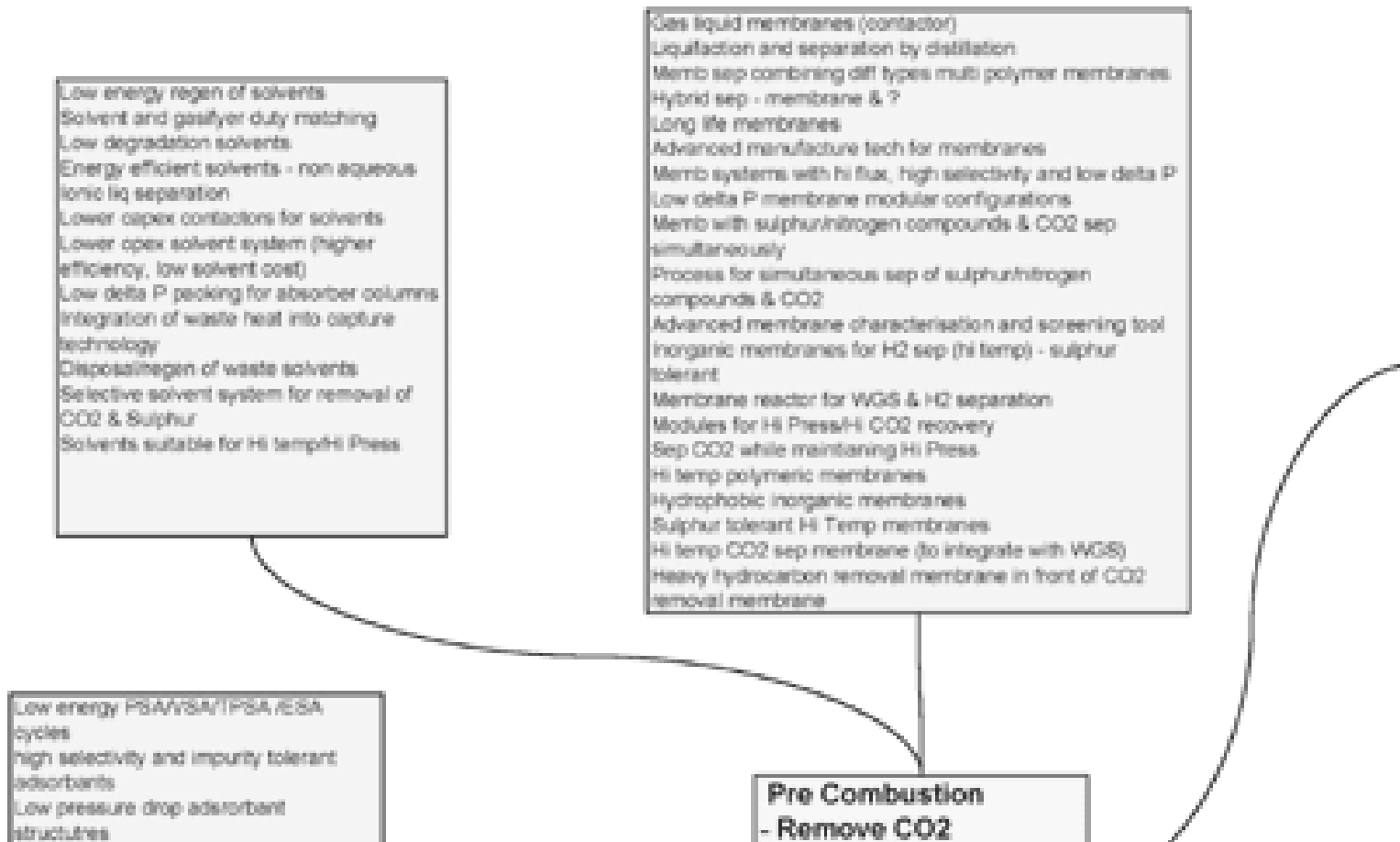
Strategy:

- **Work with international team to maximise technology transfer and research leverage.**
- **Focus on identification, development and application of cost effective systems.**
- **Don't ignore niche opportunities.**
- **Develop regional, national and international options.**

Level 1 road maps

- 1. Review of other road mapping excercises**
- 2. Brain storm on issues, technologies, problems, interesting things to do**
- 3. Identify the important ideas**
- 4. Compile and draw together key headings and topics**
- 5. Prioritise topics and identify where the expertise lies**
 - Is it within capability?**
 - Is it important?**
- 6. Confirm who does what**
- 7. Detailed road map**

Level 1 road mapping



- **Low energy PSA/VSA/TPSA /ESA cycles**
- **high selectivity and impurity tolerant adsorbants**
- **Low pressure drop adsorbant structures**
- **Circulating/moving solid bed adsorbant system**
- **Hi temp adsorbants**
- **Multi stage PSA for H₂ & CO₂ sep**
- **Energy recovery from PSA blow down gas stream**
- **PSR reactors for WGS - adsorb CO₂**

Level 1 road maps

Technology assessment for CO₂ capture:

Relative importance

- Now?
- Future?

Competitive impact

Competitive position

Maturity

Level 1 road mapping

Technology	Relative Importance		Competitive Impact	Competitive Position	Maturity
	Now	Future			
Novel absorbent solvents	Low	Med	Emerging	Favourable	Growth
Improved solvents	Med	Low	Key	Favourable	Mature
Improved solvent-gas contactor systems	Low	Med	Base	Tenable	Mature
Optimised solvent system integration (heat transfer)	Low	Med	Key-Pacing	Favourable-Strong	Mature
Gas-liquid membrane systems	Med	Med-High	Pacing	Strong	Growth
Novel membrane polymers / manufacturing / fabrication	Med	Med	Emerging	Strong	Growth
Novel inorganic membrane materials / manufacturing	Med	Med	Emerging	Favourable-Strong	Embryonic
Ion transport based CO2 separation / reactor systems (similar to fuel cells)	??	??	Emerging	Tenable	Embryonic
Improvements to existing membrane materials	Med	Med	Key	Strong	Growth
Improved membrane module design	Med	Med	Key	Strong	Growth
Optimised system integration - membranes/hybrids	Low	Med	Emerging	Favourable	Growth
Membrane based reactors	Med	High	Emerging	Favourable-Strong	Embryonic
Facilitated transport systems	Low	Med	Emerging	Favourable-Strong	Embryonic
Gas adsorbant contacting systems	Low	Med	Emerging	Strong	Embryonic
Novel adsorbants (low temperature mesoporous adsorbants)	Low	Med	Emerging	Strong	Embryonic
Novel adsorbants (high temperature applications)	Low	Med	Emerging	Tenable	Embryonic
Optimised process cycles for adsorption/regeneration	Low	Med	Pacing	Strong	Growth
Combined adsorption/reaction (PSR)	Low	Med	Emerging	Tenable	Embryonic
Chemical looping concepts	Med	Med	Emerging	Weak	Embryonic
Low temperature / cryogenic CO2 separation	Med	Med	Key	Favourable-Strong	Growth
Hydrate formation/separation	Med	Med	Emerging	Tenable?	Embryonic

Level 2 technology building blocks to be put in place. (COAL21/TAG)

- **Technologies that enable significantly higher efficiency and hence inherently lower CO₂ emissions in coal-based power generation.**
- **Technologies that enable a future transition to hydrogen based energy systems.**
- **Technologies that enable economic CO₂ capture – the path to near zero emissions.**
- **Technologies that enable the safe and reliable storage (geosequestration) of CO₂.**

Level 2 road maps Demonstration projects

IGCC for black coal *

IGCC for brown coal *

Oxyfuel combustion *

Ultra Clean Coal IUCC *

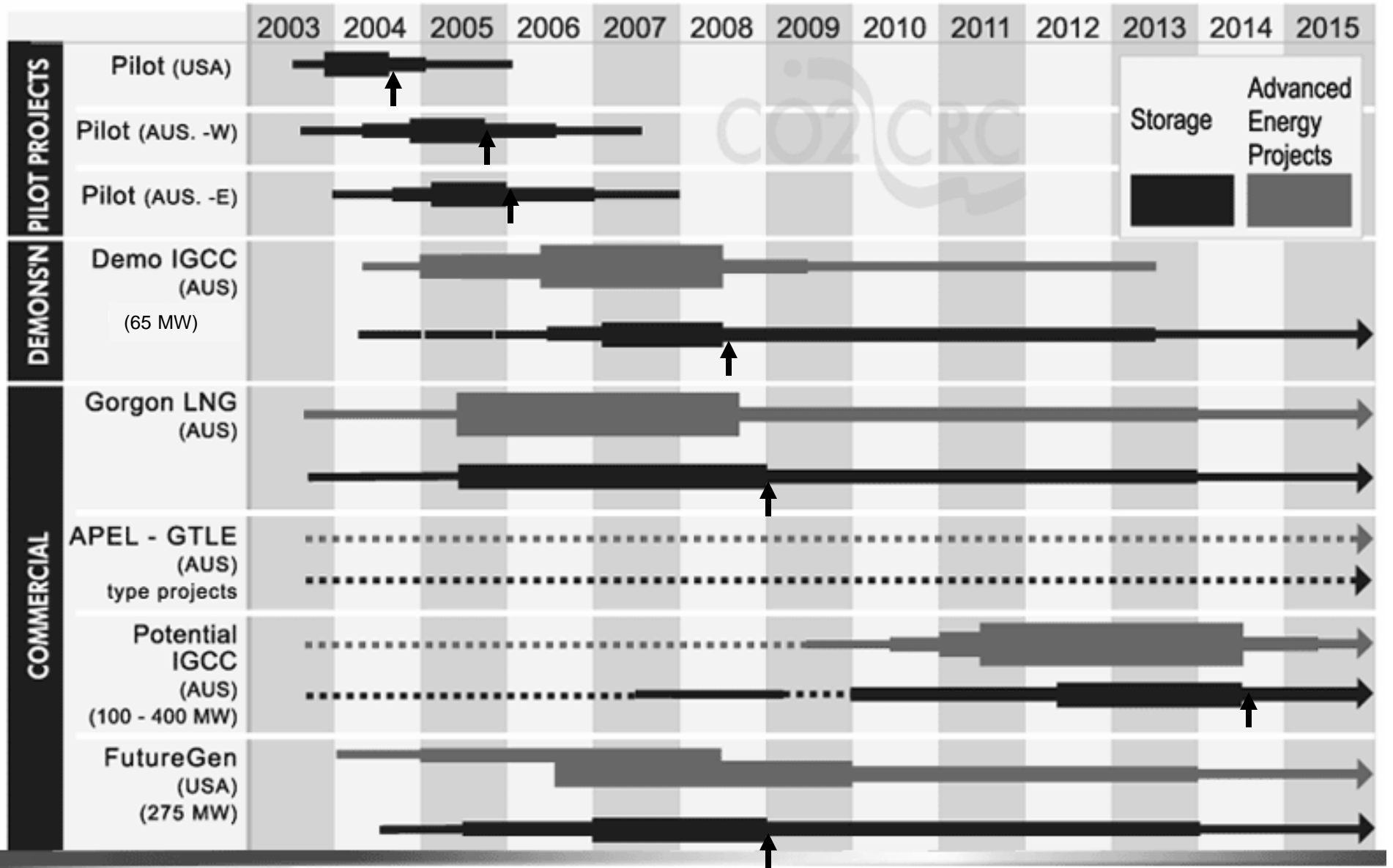
Lignite dewatering and drying

Carbon capture and storage

*** Together with geosequestration
as an essential component of ZET.**

The Level 2 roadmap provides topics, timing and costings.

SCHEDULING OF SOME POTENTIAL ENERGY AND CO₂ CAPTURE & STORAGE PROJECTS IN AUSTRALIA AND THE USA



Level 3

Towards the hydrogen economy

- 1. Application of CO₂ capture and storage technologies**
- 2. Zero emissions electricity generation from fossil fuels**
- 3. Production of commercial quantities of H₂ from fossil fuels**
- 4. Development of H₂ infrastructure**
- 5. Wide scale application of H₂ as an energy carrier for power and transport**
- 6. Production of commercial quantities of H₂ from renewable energy**

Progress towards the hydrogen economy

