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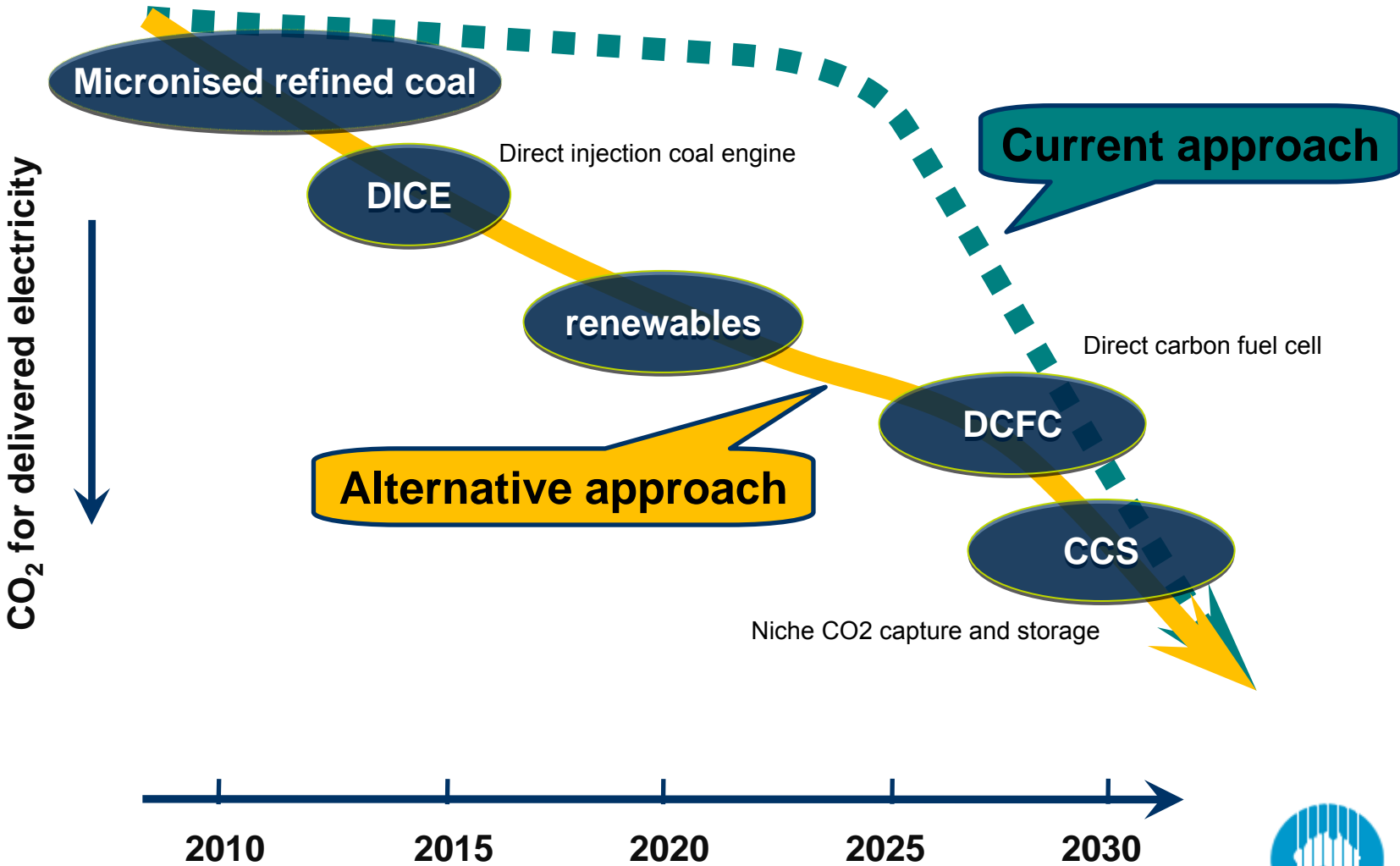
# Production of micronised refined coal

Australia-India Energy and Minerals Forum, Perth 6-9 June 2010

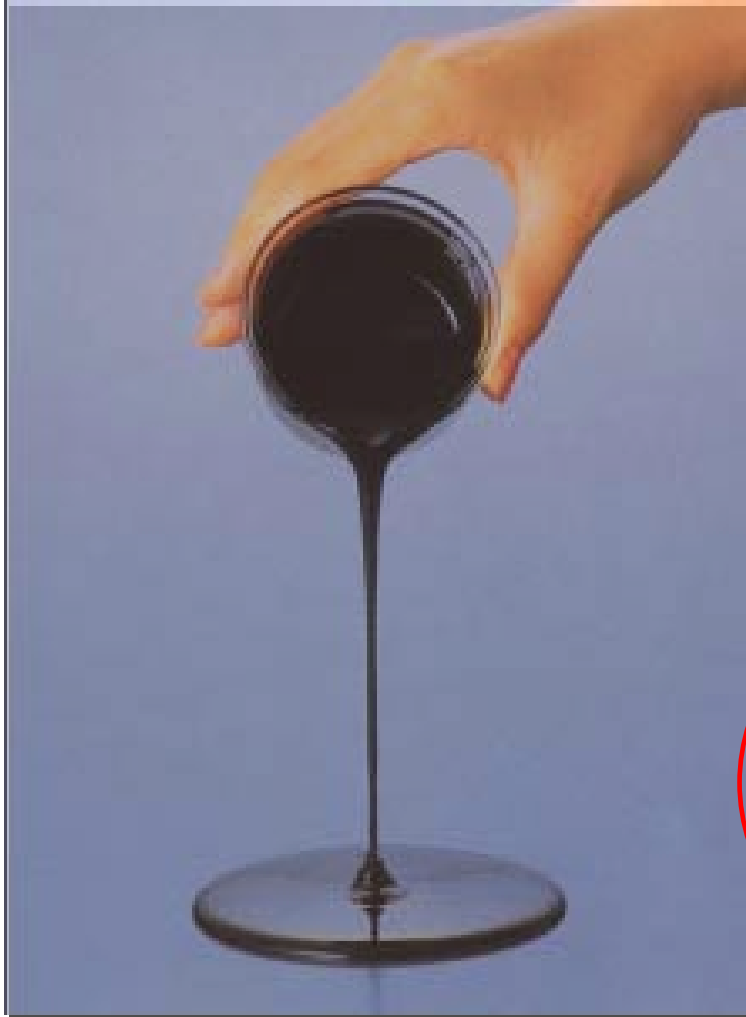
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# Alternative pathway based on micronised refined coal



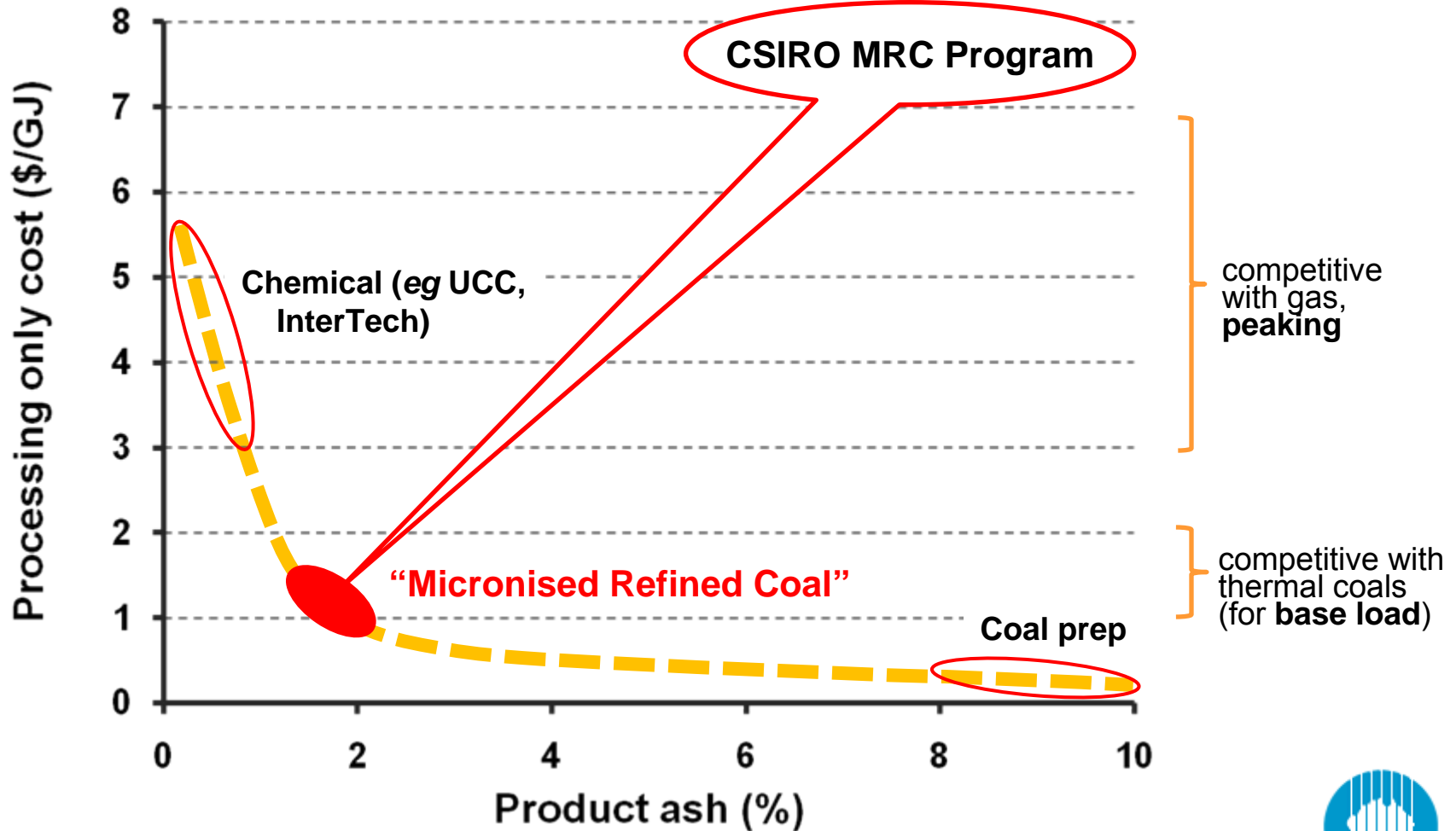
# Coal water fuels



JGC Corp

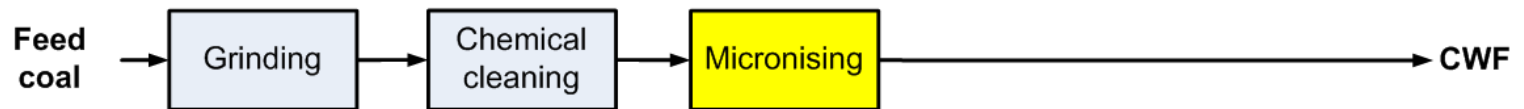
- >35 Mtpa globally for boiler fuel
  - typically 30% water
  - highly stable, with 12-24 months storage possible in unstirred tanks
  - Bingham viscosity - paste when stationary, but thins rapidly with shear
  - readily pumpable
- ... but conventional CWF are too viscous, too high in ash, and too coarse for DICE
  - needs <20 $\mu$ m, <2-3% ash, at least 45% solids, and <500mPa.s
  - very low production cost needed for baseload

# Processing costs vs product ash

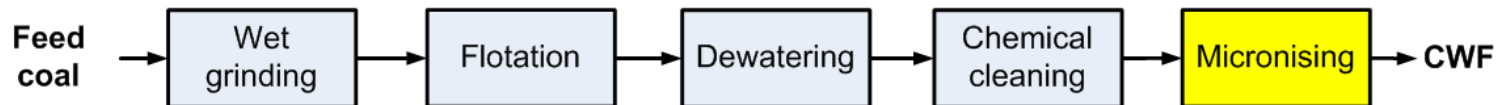


# Routes to ultra low ash coal water fuel

## a) Chemical cleaning (eg AMAX, UCC, Intertech)



## b) Combined physical and chemical cleaning (eg AMAX)



## c) Physical cleaning of micronised coal



Micronised Refined Coal

Different flotation behaviour

Trim dewatering only

# Micronised Refined Coal – excellent early results

- Lab tests with existing ultra fine coal technology has given excellent results
  - ultra fine coal milling using an Isamill (D99 <30 $\mu$ m)
  - ultra fine flotation (J-Cell or Concorde Cell)
  - 2-3% ash at a combustibles recovery of 85-93%
  - processing cost ~\$0.7/GJ
  - Qld, NSW and Collie coals
- Commercial equipment



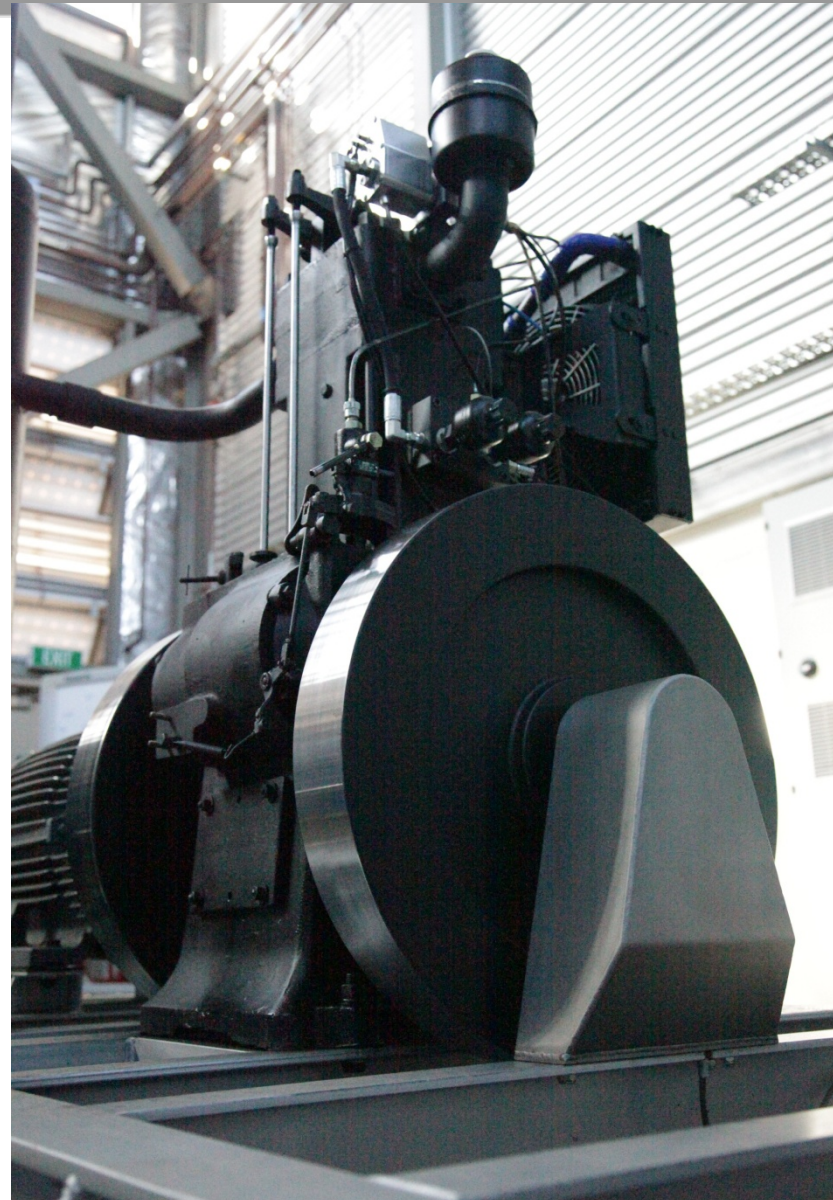
# Excellent early results

- Preliminary tests by CSIRO with Xstrata Technology, TCC and the University of Newcastle
- Ultra fine coal milling (d95 30 $\mu$ m) using an Isamill, followed by ultra fine flotation using Denver, J-cell and Concorde cells
- Results for a range of NSW and Qld coals and tailings
  - Coal A (27% ash ROM) 94% recovery\* @ 1.8% ash
  - Coal B (13% washed) 90% recovery \* @ <3.0% ash
  - Coal C (14% washed), 91% recovery\* @ 2.6% ash
  - Coal D (26% silica doped), 89% recovery\* @ 2.3% ash
  - Coal E (54% tailings), 84% recovery\* @ 3% ash
  - Coal F (6%, sub-bit), 78% recovery \* @ 3% ash \*\*
  - very low collector rates, and cell productivity comparable with conventional fine coal cleaning (over 4 t/m<sup>2</sup>/h)
- Residual ash mostly ultra fine clay
- 25 tpd pilot plant being planned (with 10 MW engine)

\* recovery of combustibles \*\* early results, expect improvement

# Coal-engine interactions

- Low speed (200-600rpm) direct injected single
- Successful operation on coal water fuel from black and brown coal – at diesel efficiency
- CSIRO electronic fuel injection system – multi-shot injection of coal water fuel at up to 150MPa
  - better ignition achieved
- Fuel preparation laboratory and 20 MPa atomisation/combustion simulator
  - fundamental research into slurry rheology and atomisation/ignition
  - burnout and wear particles
  - effect of coal characteristics





# Summary

- Micronised refined coal is being developed for use in high efficiency internal combustion engines and fuel cells
- Produced by micronising coal to increase mineral liberation then ultra fine coal flotation and trim dewatering
  - 2-3% ash
  - low processing cost (\$0.6-0.9 /GJ)
  - high coal recovery (around 90%)
- Concept proven for a wide range of Australian coals, including coal washery tailings (54% ash)
  - residual mineral matter is mostly very fine clay material which is (unlikely to cause wear issues in engines)
- Several demonstration projects under consideration
  - coupled with a 10-12MW coal fueled diesel engine
  - commercially available technology (Xstrata Technology's Isamill and J-cell)
  - potential for testing other coals

**CSIRO Coal Technology**

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Thank you

