Collie Synfuels Pty Ltd

Small private company, has not traded, “Go-to-market” Start-up

Modular, smaller-scale, Coal-to-Hydrogen + Diesel technology with CCS

> US$ 2.5 million has been invested over the past 4 years in technology and project development, pilot plant work, process design and feasibility studies

presented by: C.M. (Costa) Tsesmelis
Project Director / Managing Director

A new energy source for Australia and the World
Collie Synfuels’ Coal-to-Hydrogen + Diesel technology is based on a “once through” Fischer Tropsch (FT) implementation, without recycle of tailgas.

Technology includes two innovation patents - for Zero Discharge design and a single liquid product Diesel Maximisation design.

Process is CO2 Capture Ready - contains significant Australian IP with proven end-to-end technologies: a commercial breakthrough in “Coal-Value-Add”.

Genuine Low Emissions Technology - also enables commercialisation of CO2 storage sites across Australia leading to potential future Industrial CO2 Free Zones.

Syngas Clean-up technologies ensure contaminants from Coal Gasification not listed in the current SAE / ISO standards for PEM fuel cells are removed to very low PPB levels - for certification/acceptance by Fuel Cell Vehicle manufacturers and OEMs.

Flagship Projects for WA, Victoria & Queensland will each produce 240 ML/Year of High Quality Diesel meeting the EN 15940 Euro Standard for Paraffinic Diesel with up to 50 MW of dispatchable baseload power from low BTU tail gas.

Collie Synfuels low cost catalyst from raw millscale or hematite iron ore creates a new domestic catalyst manufacturing industry to supply the Flagship projects.
Flagship Projects

- **Collie Project**: Ideal site available next to mine-head at the approved Heavy Industrial Shotts Industrial Park, located 7 kms east of the town of Collie, in the South West of Western Australia. Supply agreement in place for sub-bituminous coal with excellent gasification properties available from Ewington mine next to Shotts.

- **Latrobe Project**: Abundant low cost Victorian lignite available, suitable feedstock for dry feed entrained flow gasifier. Lignite located in the Latrobe Valley, 150 kms south east of Melbourne. It is the second largest lignite deposit in the world, estimated to total 430 billion tonnes, with an estimated potential economic resource of 33 billion tonnes. Industrial sites readily available.

- **Potential 3rd Flagship in Surat basin**, Queensland. COAL21 recently announced additional funding of $255 million to support the fund’s objectives of building confidence in CCS technology and demonstrating CO2 storage capacity in Australia. Surat Basin CO2 storage projects will receive particular support because of the abundant coal reserves in that region.
Collie Synfuels - enabler of CO2 Storage Hubs

The Collie Synfuels Flagships are linked with the South West Hub and CarbonNet projects which are advanced Australian CCS projects funded as national CCS projects to well over $100m to date, together with the National Geosequestration Lab in Perth. A future 3rd Flagship is linked to the Surat Basin CO2 storage sites at feasibility stage.

CO2 pipeline from our plants to the nearby CO2 storage sites (SW Hub near Collie & CarbonNet near Morwell) - are 60-70 kilometers in length costing about $60-70 million to build each pipeline. Both CO2 storage sites are low cost storage locations, with $15/tonne of CO2 covering cost of pipeline, re-injection & monitoring at site.
Project Partnerships

Boston Petroleum Research
London, UK
Specialist Consultancy - models simulate regional oil exploration and production, global oil supply, demand and price.

FLUOR Australia
and San Diego
Gasification Technology Centre-of-Excellence

Clean Coal
Technology (CCT)
South Africa Pty Ltd
Technology Licensors

MAN Diesel & Turbo Germany
Fixed-bed Tubular Reactors Supply

Protos Consulting
International Pty Ltd
Project Director - Perth WA Owner’s Management Team

Golden Nest / CCT
Pilot Plant Facilities at Baoji, Shaanxi Province, PRC

China Tianchen
Engineering Corporation (TCC)
Main Engineering and Procurement Contractor

CSIRO Energy, Brisbane
Gasification Research Group

Monash University
Lignite Gasification Consultants

Boston Petroleum Research
London, UK
Specialist Consultancy - models simulate regional oil exploration and production, global oil supply, demand and price.
Collie Synfuels Technology Partner is CCT South Africa

**Lower Capex / Opex  Coal-to-Hydrogen + Diesel**

Collie Synfuels Technology is a Flagship Project at the Global Sustainable Tire Conference in Colorado Springs on 17th October 2017.

**SASOL & SHELL - Large Scale - FT Process with recycle**

- **Air Separation**
  - High Purity O2
- **Gasification**
- **Gas Cleanup**
- **CO2 & Sulphur Removal**
- **Reforming**
- **Cold Gas Plant**
- **CO2 Removal**
- **Gas Products unconverted CO and H2**
- **Liquid Products**

**Conventional Large-Scale Fischer Tropsch Implementation**

**CSF partner: CCT South Africa - Fixed-Bed FT process - smaller scale - robust, simpler operation**

- **Air Separation**
  - High Purity O2
- **Gasification**
- **Gas Cleanup**
- **H2 Off-take**
- **FT Synthesis**
- **Flexible H2 Supply to Fuel Cell Vehicles**
- **Electricity Generation**
  - Clean Low BTU Tail Gas
- **Low Emissions Paraffinic Diesel**

**CSF Technology: Zero CO2 Hydrogen + Diesel with CCS Implementation**

SASOL & SHELL - Large Scale - FT Process with recycle

- **Air Separation**
  - High Purity O2
- **Gasification**
- **Gas Cleanup**
- **FT Synthesis**
- **CO2 Removal**
- **Gas Products unconverted CO and H2**
- **Liquid Products**

**Conventional Large-Scale Fischer Tropsch Implementation**

**CSF partner: CCT South Africa - Fixed-Bed FT process - smaller scale - robust, simpler operation**

- **Air Separation**
  - High Purity O2
- **Gasification**
- **Gas Cleanup**
- **H2 Off-take**
- **FT Synthesis**
- **Flexible H2 Supply to Fuel Cell Vehicles**
- **Electricity Generation**
  - Clean Low BTU Tail Gas
- **Low Emissions Paraffinic Diesel**

**CSF Technology: Zero CO2 Hydrogen + Diesel with CCS Implementation**
Environmental Benefits - Innovative Australian IP

Flagship flowscheme - “Green” H2 - High Quality Diesel - Zero discharge liquids - No toxic emissions

PLANT INPUTS

- Environmental Benefits
- Innovative Australian IP
- Flagship flowscheme - “Green” H2 - High Quality Diesel - Zero discharge liquids - No toxic emissions

Dry Feed Coal Gasification

Coal Feedstock dried to a water content of about 10%

Oxygen supply from ASU

Water saturated steam at gasifier pressure

Solvent Wash Acid Gas Removal

Other plant water streams (from coal drier, gas quench etc) to treatment

CCT Syngas Clean-up Technology

FT - reaction water production to treatment and re-use

Multiple Stage CCT-FT Reactors

Boiler feed water and Cooling Tower make-up

Product Make-up and Electricity Production

Tail Gas is highly pure residual CO and H2 from CCT Syngas Clean-up

High Quality Paraffinic Diesel Tail Gas to power generation

PLANT OUTPUTS

- Molten ash (slag) quenched to environmentally benign glassy frit
- CO2 to Sequestration Sulphur recovery
- Hydrogen supply to Fuel Cell Vehicles

PLANT WATER TREATMENT AND STEAM SYSTEMS

Boiler feed water and Coolig Tower make-up

Raw Water make-up is minimised can include treated mine waste water

Zero Discharge Design

- Oligomerisation for Diesel Max
- Tail Gas to power generation

Collie Synfuels - Flagship Projects - Presentation

- GSTC Conference - Colorado Springs - 17th October 2017
Collie Synfuels Technology - “enables” Near/Mid-term H2 from Coal

Contaminants not listed are not considered to be benign for PEM fuel cells

Collie Synfuels Coal-to-Hydrogen + Diesel technology “enables” Near/Mid-Term FCV H2 from Coal Gasification with CCS

Estimated Plant Capacity (kg/day)

- 50,000
- 100,000
- ≥ 500,000

(Diagram courtesy US DOE – Fuel Cell Facilitation Office)
Coal Gasification with CCS is a low cost bulk H2 supply source for Fuel Cell Vehicles - however - the synthesis gas produced from coal gasification contains a number of potential contaminants that are not listed in the current SAE J2719 / ISO 14687-2 Hydrogen Fuel Quality standard for PEM Fuel Cell Vehicles.

Pre-FEED studies by Collie Synfuels confirm that our FCV Hydrogen from the Flagship design can meet the requirements of the current SAE / ISO Hydrogen standard, and that potential contaminants produced from Coal Gasification not listed in the current standard can also be removed by the Collie Synfuels design.

Collie Synfuels has a Fuel Cell Vehicle H2 Pilot Plant “built-in” to its Flagship design. The novelty of our approach is that we don’t need to build a separate, stand alone, Coal Gasification and H2 Pilot Plant to confirm our ability to produce acceptable FCV Hydrogen for PEM Fuel Cell manufacturers.

We can “flexibly” produce a “slipstream” of purified syngas that can be tested and certified - after the commercial Flagship is built and producing High Quality Diesel and Baseload Power for sales. Once the new H2 source has been approved, we can then expand our “flexible” production of FCV Hydrogen as needed, since all our Syngas Clean-up technologies are skid-mounted and modular.

This innovation is at the heart of Collie Synfuels design for “flexible” Hydrogen supply. It combines commercially proven technologies to allow a Purified Syngas “slipstream” to be fed to the Fuel Cell Hydrogen Recovery unit for H2 production on an “as required” basis.

The Collie Synfuels Syngas Clean-up technologies flowscheme - is highlighted on the following slide.
“Flexible” H2 production - Built-in FCV H2 Pilot Plant
Highlights of Collie Synfuels “flexible” H2 production

- The Collie Synfuels Flagship design employs high temperature, state-of-the-art, dry feed Entrained Flow Gasification technology which produces Raw Syngas with minimal impurities. CCT’s Deep Fine Hydrolysis, Deep Fine Desulphurisation and Contaminant Removal technologies after the Solvent Wash provide the deep purification needed to lower contaminants to extremely low ppb levels. Purified Syngas is fed to the CCT Fischer Tropsch reactor train.

- A Purified Syngas “slipstream” is available as feed to the Fuel Cell Hydrogen Recovery unit which consists of molecular sieves for removal of trace levels of H2O and CO2, residual HC traces, together with custom PSA units designed for N2 and Argon removal, and Ultra CO removal to meet the limiting spec of 0.2 ppm Carbon Monoxide.

- The extremely low level of CO required by the current standard is achieved by accepting a lower Hydrogen recovery in the PSA units with resulting increased levels of Hydrogen in the PSA unit regeneration gas. A low Hydrogen recovery is acceptable with the Collie Synfuels Flagship design. H2 recovered in the Plant FG system is used for the Plant Hydrogen stream for hydrotreatment and co-production of High Quality Diesel - with residual Plant FG combusted with ultra-clean Tail Gas for surplus power export to the grid.

- Collie Synfuels are engaged with industry consultants, standards organisations, government agencies and PEM Fuel Cell Vehicle manufacturers, to assess the potential contaminants of concern and to define acceptable levels for the Flagship H2 Pilot Plant tests.

- Acceptable levels of contaminants from Coal Gasification are also being studied in Japan, as part of Japan’s “Hydrogen Economy Program” and the design of the stand-alone 2 t/d H2 Pilot Plant, being built in the Latrobe Valley Australia by a Japanese consortium - co-funded by the Victorian and Commonwealth Governments - as part of the Hydrogen Supply Chain Project (HSCP).
Hydrogen Supply Chain Project (HSCP) - Lignite to Liquid H2

**Australian Portion**

KHI, U-POWER, Iwatani

**HySTRA**
Hydrogen Energy Supply Chain Technology Research Association

Established in February 2016

**HEA**
Hydrogen Engineering Australia

HEA will:
- Engage with government and non-government stakeholders as part of delivering the project
- Enter into contractual and governance arrangements with the two Australian governments
- Enter into commercial arrangements with suppliers and vendors for services

**Timeline**

- **August 2017**
  - Front End Engineering Design (FEED) study for Australian portion
- **2018-2019**
  - Commence construction of pilot facilities in Australia
- **2021-2030s**
  - Planning, construction and commissioning of the commercial plant

**Key Dates**

- **June 2017**
  - Pilot phase funding commitment by Commonwealth and Victorian Government
- **2017**
  - Regulatory approvals completed and Final Investment Decision (FID) for pilot plant
- **Around 2020**
  - Pilot Operations and delivery of hydrogen to Japan
- **2030s**
  - Full commercial operations

**Process Flow**

**Latrobe Valley - Australia**

- SCE1 A - Brown coal gasification (1 Mt/yr test facility)
  - SCE2 - Gas Refining
  - SCE5 - Liquid hydrogen carrier
  - SCE6 - Liquid hydrogen unloading base

**Japan**

SCE7 - LNG

- SCE8 - CCS (10Mt CO2)

**Port of Hastings - Australia**

- SCE3 - Transport
  - SCE4 - Hydrogen liquefaction and loading base
  - SCE6 - Liquid hydrogen carrier
  - SCE7 - Liquid hydrogen unloading base

HSCP slides COURTESY of Marubeni Corporation
HSCP is part of Japan’s Hydrogen Economy Program

Codes, Standards, and Regulations

Standard
- METI

Regulation
- MLIT

Domestic
- JARI: FCEV Technical Committee
- ENNA
- JEMA

International Harmonization
- ISO/TC197: Hydrogen
- IEC/TC105: Fuel Cell
- SAE: Society of Automotive Engineers
- UN-ECE/WP29: World Forum for Harmonization of Vehicle Regulations
- GRPE: Group of Experts on Pollution and Energy
- EIHP: European Integrated Hydrogen Project

SAE: Society of Automotive Engineers
UN: United Nations
ECE: Economic Commission for Europe
WP29: World Forum for Harmonization of Vehicle Regulations
GRPE: Group of Experts on Pollution and Energy
EIHP: European Integrated Hydrogen Project
Oil Pricing - Highlights

- Synfuel projects and the oil industry at large are currently plagued by a widely held view that oil is now available in unlimited quantities - due to US Shale and OPEC’s push for market share - with oil available at prompt notice and low cost continuing into the future. With the decline in fossil fuel use and peak oil demand, oil prices are forecast to remain low and never approach $100 / bbl again.

- Collie Synfuels and our partners Boston Petroleum Research (BPR) have a different view with our Oil Price scenarios and forecasts based on BPR’s World Oil-Supply-Demand-Price model.

- The BPR model is a unique simulation of real-world processes at very granular scales, with Oil & Gas fields and projects modeled on the supply side, and individual country demand and GDP modeled on the demand side.

- With less oil production to offset the increasing decline in conventional oil field production - the Supply-Demand balance over the next 20 years is favourable for higher oil prices.
In both of our Base Case Pricing Scenarios, oil prices in real terms (US$ 2017) reach levels of $130/bbl in 2030 dropping to levels averaging $90/bbl during periods of increased volatility, following peak global demand around 2028-2030. (Our peak oil demand forecast is similar to Shell’s in their recent market update).

Record cuts in upstream oil investments in 2015 & 2016, with further cuts in 2017, will impact future supplies of oil. Less oil production to offset production declines to meet future oil demand inevitably results in higher oil prices and the Supply-Demand balance in the 2020-2030 timeframe is favourable for higher prices.
Another widely held view that challenges the economic viability of Synfuels Projects is that green energy for Zero Emission Vehicles (ZEVs) - and the ZEVs themselves - particularly Battery Electric Vehicles (BEVs) - can be promptly made available on industrial scale within the next few years. Collie Synfuels considers this to be overly optimistic.

Even the IEA in their most optimistic “2DS scenario” for Light Duty Vehicles only show significant ZEV annual sales in the period 2030 - 2035. Rising demand for transport from rapidly expanding middle classes in China, India and parts of Africa will have to be met by gasoline and diesel, although at some point, ZEVs will undoubtedly begin to displace conventional fuels in transport.

The race to expand ZEV production and deliver sufficient “green” Electricity and “green” Hydrogen supply and infrastructure - will play out in the late 2020s and 2030s. Our Flagships are designed so that Diesel and Hydrogen production volumes can be varied with output timings optimised over the entire operational life of the plant - to match future market demands and evolving transport and industrial developments.

High Quality Diesel can be significantly reduced and H2 production increased, with FT reactors shut-down. The potential timing for this extreme case is taken about 12 years from start-up around 2034. This operational case corresponds to a “switch” to maximum H2 production should FCV demand increase much faster than anticipated, or if zero emissions tailpipe standards are imposed with the banning of the Internal Combustion Engine (ICE).

“Flexible” H2 supply means H2 refuellers can be installed incrementally with commercial roll-outs of FCVs - as “clusters” of refuellers are built to match FCV and H2 demand. By co-producing Diesel and Power together with “green” FCV Hydrogen, and with the option to maximise H2 at the expense of Diesel, significant risk mitigation is “built-in” to Collie Synfuels Technology.
Up to 50 MW Power off-take sales present the benefits of an infrastructure type investment.

Flexible “green” Hydrogen supply for Fuel Cell Vehicle roll-outs overcomes the “chicken and egg” dilemma faced by FCV manufacturers and H2 suppliers producing their H2 from methane or electrolysis.

Car/bus and truck FCV manufacturers will only invest in commercial roll-outs of their Fuel Cell Vehicles if there is H2 refuelling available. H2 suppliers from their side cannot cost-effectively invest & deliver H2 in small increments. Collie Synfuels Technology can however provide flexible “Delivered Gas” to H2 refuellers installed at petrol stations in Perth, Melbourne and regional Australia. The Syngas Clean-up technologies are modular, skid-mounted units, as are the custom PSA units designed for Ultra CO removal.

With appropriate pre-investment in plot plan allocation & tie-ins, additional modules can be readily added in the future as H2 demand increases. Flexible supply of 1,500 kg/day to 10 tonnes/day or more, meets the logistical needs of a growing network of H2 refuellers.

The Collie Synfuels Flagship Projects realise an acceptable rate-of-return with an average oil price in real terms of around $90 / bbl (2017 US dollars) in the 2020-2030 timeframe. This corresponds to a Low Oil Price scenario of $80 / bbl in 2020. BPR’s World Oil Supply-Demand-Price model and service enables owners to forecast quarterly market behaviour and successfully hedge production against downside price risks, following start-up of operations.

Capex including Owners’ Costs for each Flagship Project is estimated at US$ 735 million with production in 2022. With Hydrogen sales at petrol equivalent value the Low Oil Price scenario IRR is approx 18% with an NPV of US$ 1.8 Billion. For an approved Bankable Study meeting Chinese Bank requirements, up to 85% Debt Finance is available.
Collie Synfuels Pty Ltd is the “go-to-market” implementation company with title to Collie Synfuels Technology and Intellectual Property and 100% ownership of the Collie Synfuels Flagship Projects. The company now wishes to engage with a JV Partner and/or Strategic Investor to progress STAGE 2. 51% Majority ownership is offered on favourable terms.

Collie Synfuels have submitted proposals to the WA and Victorian Governments and the Commonwealth Department of Industry for grants to assist the Flagship Project developments. The Latrobe Project is “cloned” from the base Collie Flagship design completed over the past 4 years. The only difference for Latrobe is the technology employed for Lignite feedstock drying & handling.

Collie Synfuels to progress the Partnership Agreement with China Tianchen Engineering Corporation (TCC) as the Main Engineering and Procurement Contractor for all Collie Synfuels Flagship Projects in Australia. The Letter of Intent agreement includes TCC Project Financing initiatives on Collie Synfuels’ behalf with SINOSURE (the China Export-Credit Insurance Corporation) & the China Ex-Im Bank.

A +/- 25% Pre-FEED Capex estimate of US$ 650m for the Flagship Projects has been determined at STAGE 1. Subject to a Bankable Study meeting Chinese Bank and SINOSURE requirements, Project Financing up to 85% Debt Finance is available from the China Ex-Im Bank. Owners’ costs at $ 85m are included based on Western engineering firm estimate - likely to be only a fraction of this cost with our Chinese engineering partner. The $85m estimate includes $20m at STAGE 4 to complete Construction, Commissioning & Start-up of the Flagship plant.
For further information and investment opportunities please contact:

Costa Tsesmelis - Project Director / Managing Director
Collie Synfuels, c/o Mining Corporate, Level 11, London House, 216 St Georges Tce, Perth WA 6000

tel: +61 (0)8 9446-9057
mob: +61 (0)409-288-458

Cmt@protosconsult.com  www.protosconsult.com  www.collie-synfuels.com