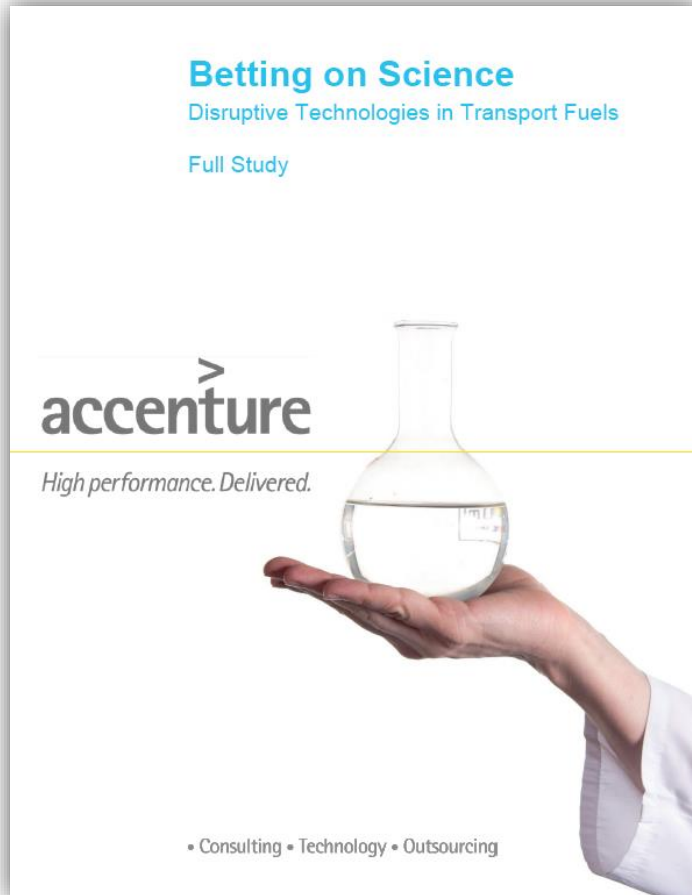




**Production of *Licella* bio-crude oil as
a platform for bio-chemicals, marine
& aviation fuels**





2009

Describes Licella's technology as "potentially "Revolutionary and disruptive" due to its capacity to:create fungible fuels, enabling the use of the existing distribution infrastructure. These technologies would remove the distribution infrastructure constraints.

Why does bio-crude make so much sense?

Paris climate change agreement enters into force



- Where will low carbon, high energy density liquid fuels and chemical feedstocks come from?



- Lignocellulose represents the largest basket of sustainable biomass available and the only source of volumes comparable with fossil deposits

Biomass challenges

Challenges

- Nature has:
 - Aggregated feedstock for free
 - Converted feedstock to crude for free
- Multinationals/Governments have invested trillions of \$ in refining infrastructure
- Biomass has:
 - High oxygen content
 - High water content
- Customers want:
 - Price parity – or cheaper
 - Sustainable production
- Electric & Fuel Cell vehicles being deployed

Biomass opportunities

Challenges

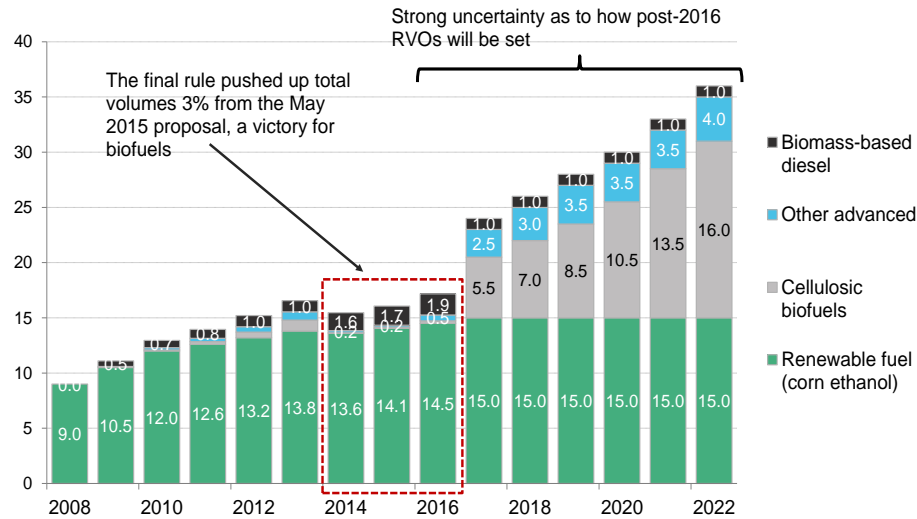
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 - Price parity – or cheaper
 - Sustainable production
- Electric & Fuel Cell vehicles being deployed

Opportunities

- Energy security
- Customers:
 - Using “Bio” as competitive advantage
- Biomass typically low in sulphur
- Aviation still requires high density fuels
- Paris:
 - Carbon pricing is coming & with it national schemes to reduce GHG's
- Biomass processing industries looking to expand into fuels & Chemicals

Revised Mandates Under the RFS2

Finalised RFS2 schedule in November 2015, 2008-2022 (bn gallons per year)



Source: Bloomberg New Energy Finance, Nawitka

- The original RVO for Cellulosic Biofuel in 2017 is 5.5 bn gallons. However, we expect the EPA will reduce this amount to better reflect the installed capacity.



What is the Value of the RFS2 and California LCFS to Investors?

Ensyn Case Study:

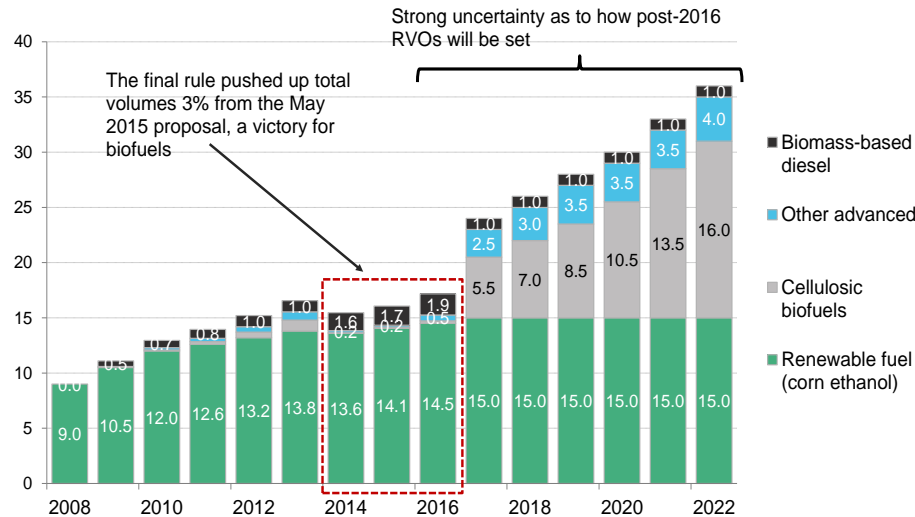
- Ensyn is one of the few companies to have its bio-fuel qualify under both the RFS2 and California regimes.
 - ✓ A challenging process.
 - ✓ Worthwhile for investors?
- Given a \$30/barrel market price of oil and estimated Carbon Intensity of ~ 0.20 gCO₂/MJ, the implied value of qualifying under the California/RFS2 regimes is estimated to be \$143/barrel.
 - ✓ Fuel Value = \$30 barrel;
 - ✓ RFS2 = \$79/barrel;
 - ✓ California LCFS = \$28/barrel;
 - ✓ California Cap & Trade Credit = \$6/barrel
- Should we look closer at adopting the RFS2 and California/BC LCFS across Canada?



Source Nawitka Capital

Revised Mandates Under the RFS2

Finalised RFS2 schedule in November 2015, 2008-2022 (bn gallons per year)



Source: Bloomberg New Energy Finance, Nawitka

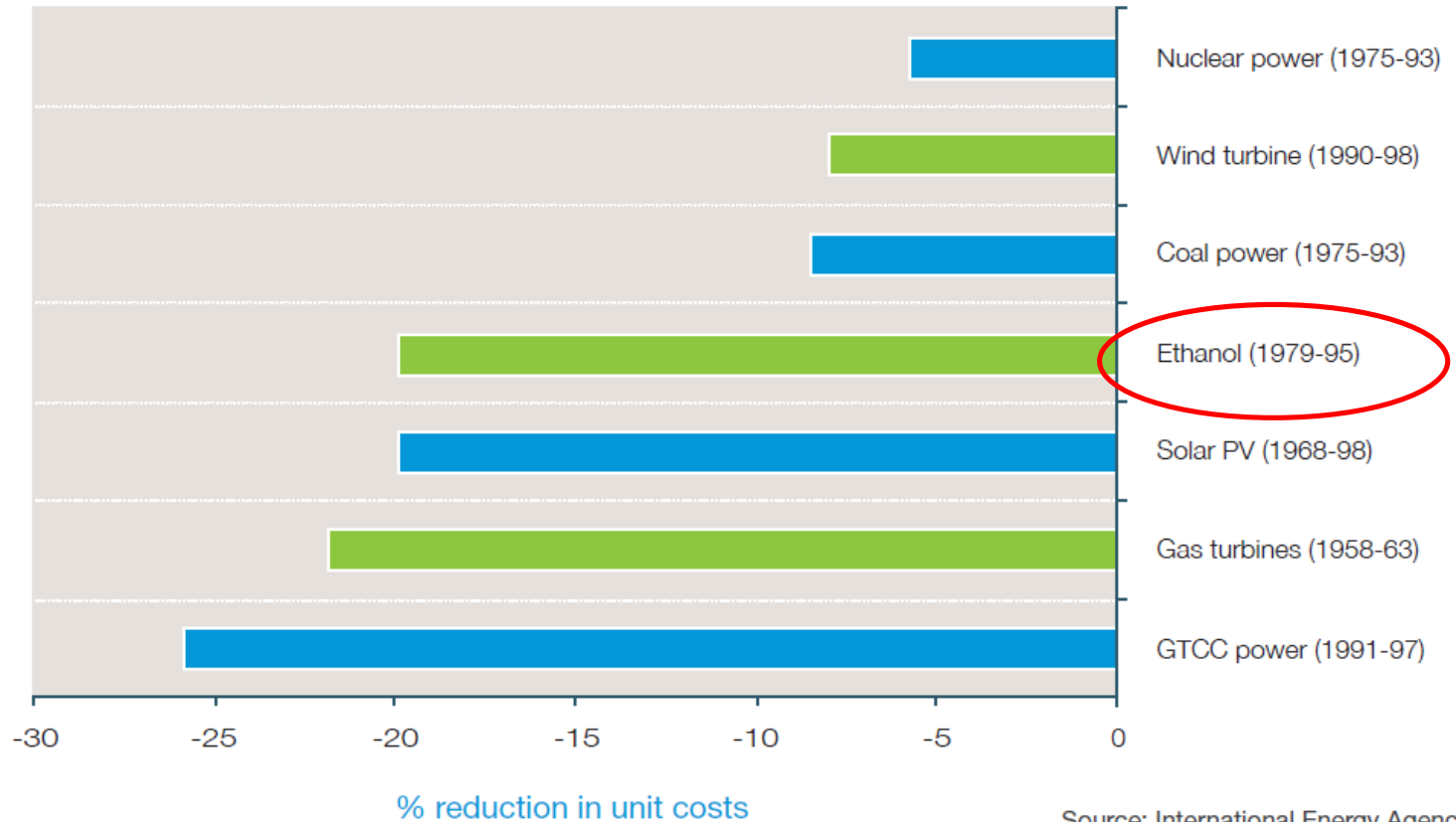
- In late 2015 the EPA slashed the Cellulosic Biofuel mandate for 2016 from 4.2 bn to 0.2 bn gallons – a **95% reduction due to the lack of supply.**

- The original RVO for Cellulosic Biofuel in 2017 is 5.5 bn gallons. However, we expect the EPA will reduce this amount to better reflect the installed capacity.

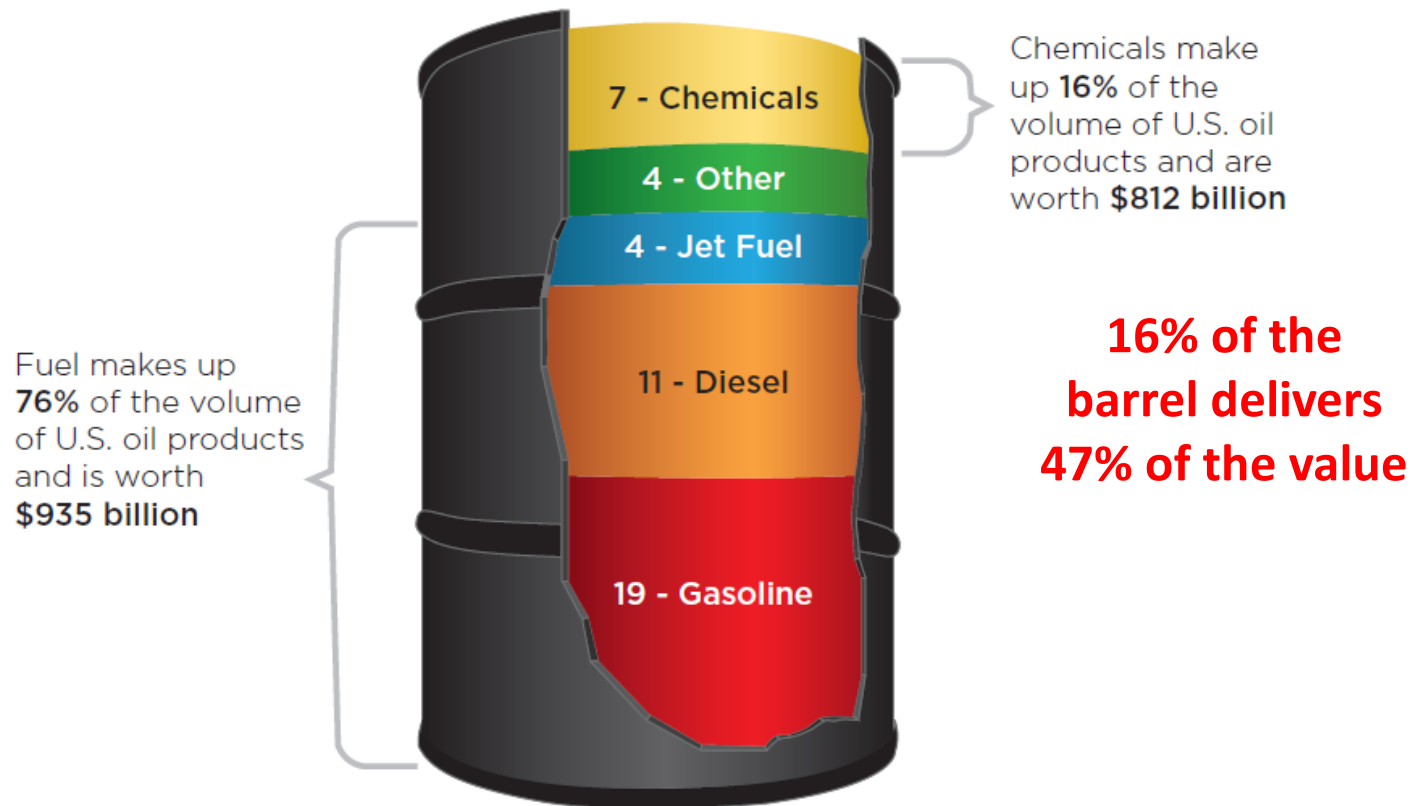


Costs of production will reduce, but it will take time

Reduction in production costs with every doubling in capacity



Critical to capture the full value



Source Bloomberg New Energy Finance, US EIA, American Chemical Council

What we do



Biomass e.g. Wood residues
~17 MJ/kg dry ~40% Oxygen

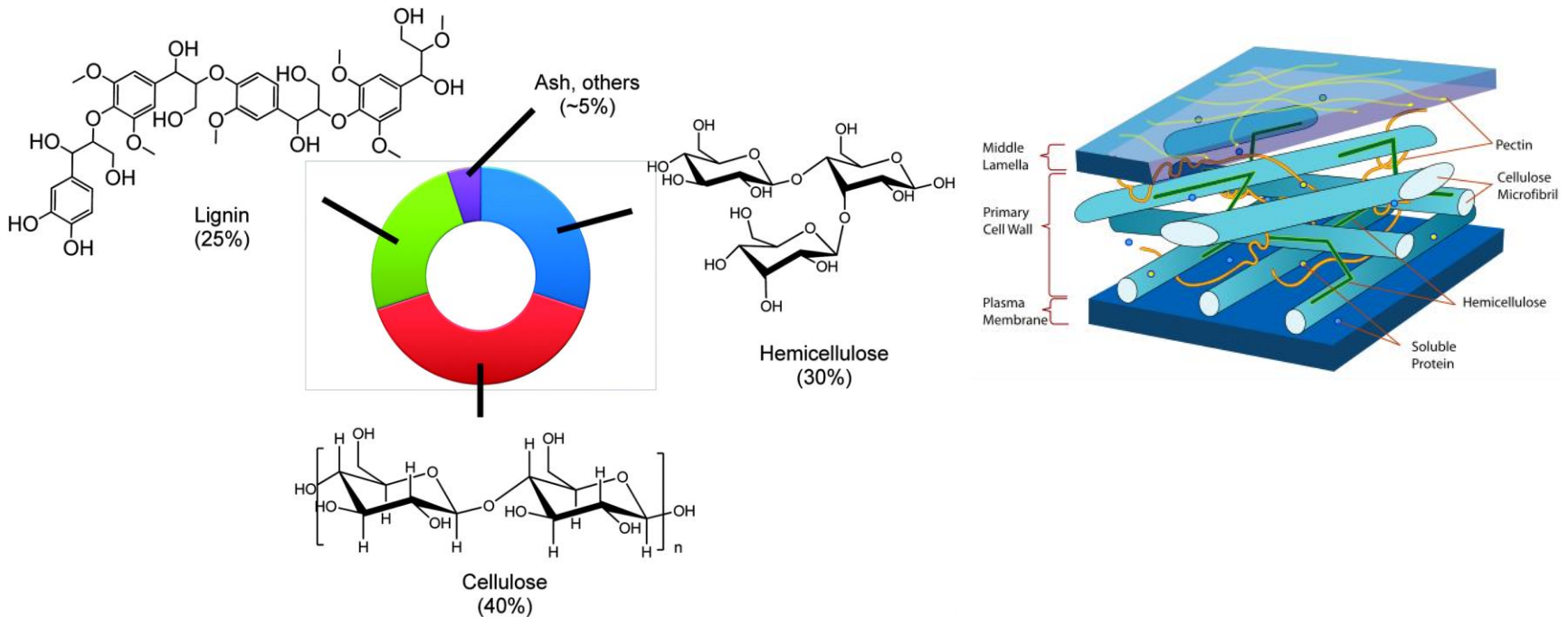


Licella Biocrude
~35 MJ/kg
~13 % Oxygen



Lignocellulosic Biomass

- Use all the resource
- Significant quantities of wood residues e.g. sawmill residue, hog fuel, can be aggregated:
 - Low in sulphur, ash and metals
 - High moisture content (10-60%)
 - Low bulk density and energy density
 - Complex biopolymers plus fatty acids and resins
- Also bagasse, stover, energy grasses, macroalgae, microalgae ...



Technology Scale Up

Gen 1



Gen 2



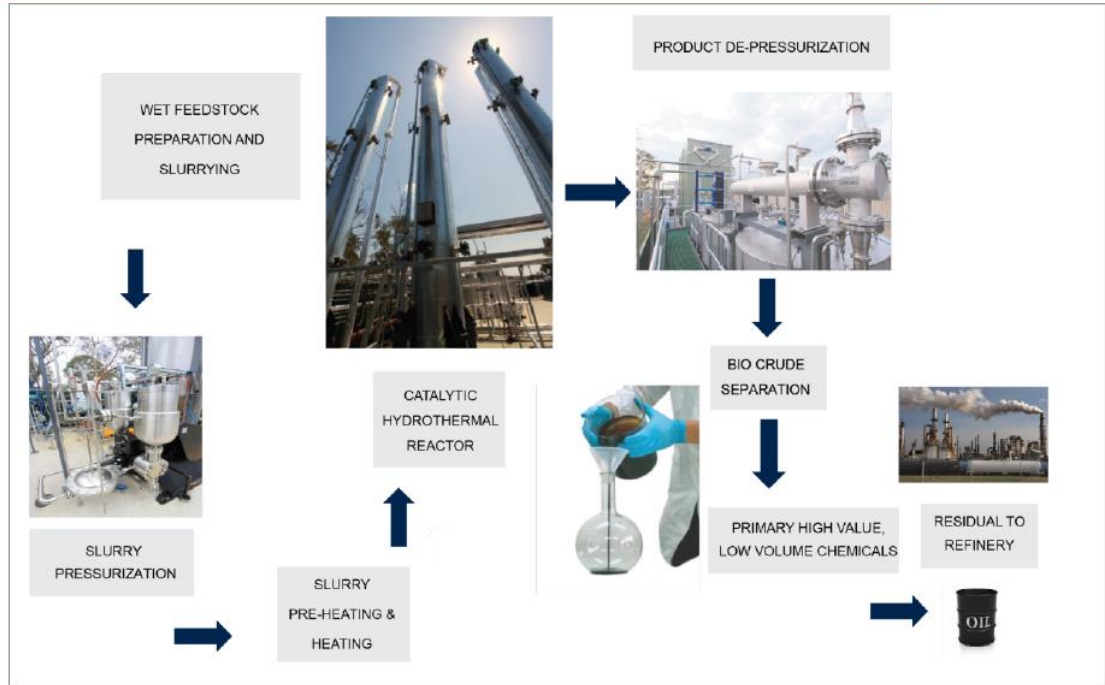
Gen 3



Reactor Progression	Plant	Construction	Reactor diameter scale up	Capacity scale up
1st Generation	Small Pilot	2009	-	-
2nd Generation	Large Pilot	2011	x 2	x10
3rd Generation	Large Pilot	2013	x 3	x100

Licella's Cat-HTR

Simplified Process



CANFOR PULP – “NATURALLY REFINED”

Examples of feedstocks tested

Wood waste

Pine/ Eucalypt



Agricultural waste

Wheat Straw



Palm Waste

Palm Bunches



Algae



Sugar Waste

Bagasse



Energy Crops

Bana Grass

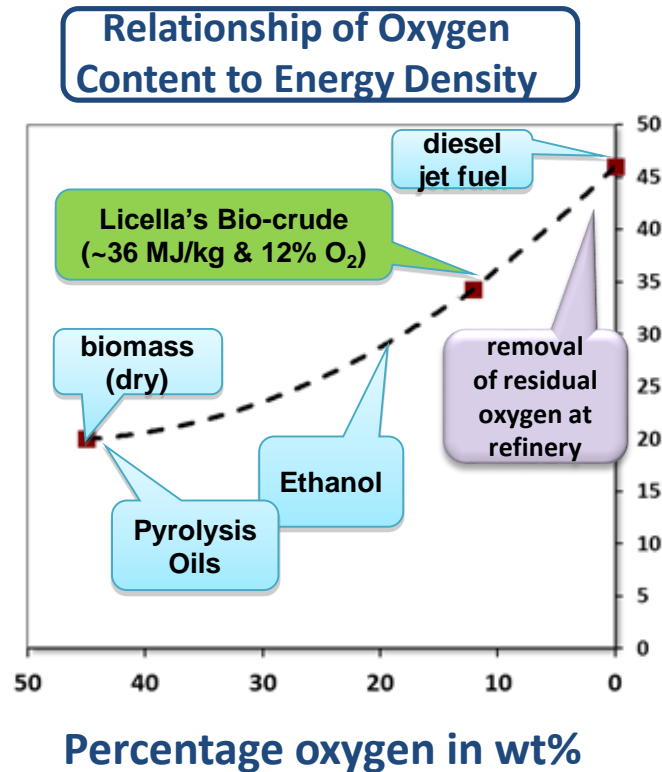


Licella Biocrude overview

- Low sulphur
- Renewable
- Distillable
- Much more stable than pyrolysis oils
- Oxygen content comparable to plant oils
~11-14%
- Made by a process instead of extracted –
many parameters can be altered or
varied



It's all about the Oxygen...and Hydrogen!



More Oxygen =
Less Energy

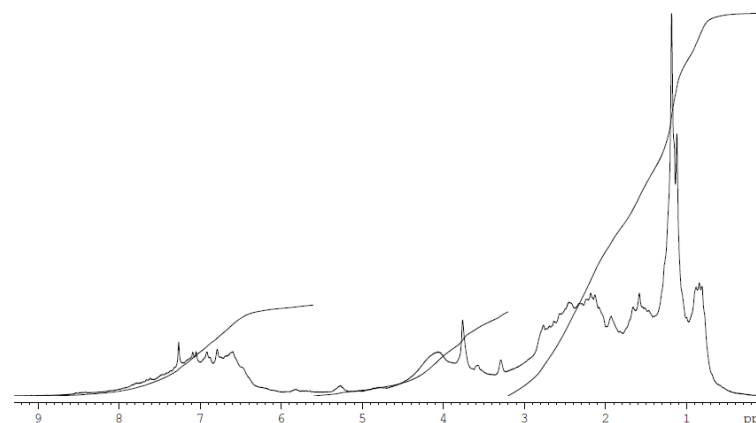
Removal of oxygen
with hydrogen is
expensive

Less hydrogen =
cheaper process

Typical Properties of Radiata Pine Biocrude (dry basis)

Property	
Gross Calorific Value (MJ/Kg)	34-36
Oxygen (mass %)	10-14
Carbon (mass %)	79-82
Hydrogen (mass %)	6-8
Sulphur (mass %)	0.01
Nitrogen (mass %)	0.1-0.2

- Water-insoluble, soluble in many organic solvents
- Can be distilled
- Denser than water at ambient temperatures



- 1H nmr suggests *minimum* aromatic:aliphatic proton ratio about 1:5, so aromatic:aliphatic carbon ratio about 1:2.5



Avelino Corma

Contact

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Special news



Professor Avelino Corma is the Royal Society of Chemistry Spiers Memorial Award winner for 2016

05/09/2016 Professor Avelino Corma from Instituto de Tecnología Química UPV-CSIC is the Royal Society of Chemistry Spiers Memorial Award winner for 2016.

A prolific author and researcher, who has published over 900 papers and holds more than 150 patents, Professor Corma works on the design of solid catalysts – materials that accelerate chemical reactions and direct the formation of the desired product. His research aims to design catalysts for specific reactions, by attempting to unravel how the reactants and the surface of the catalyst interact at the molecular level.



BP Amoco

TOTAL

ConocoPhillips



Shell



Licella

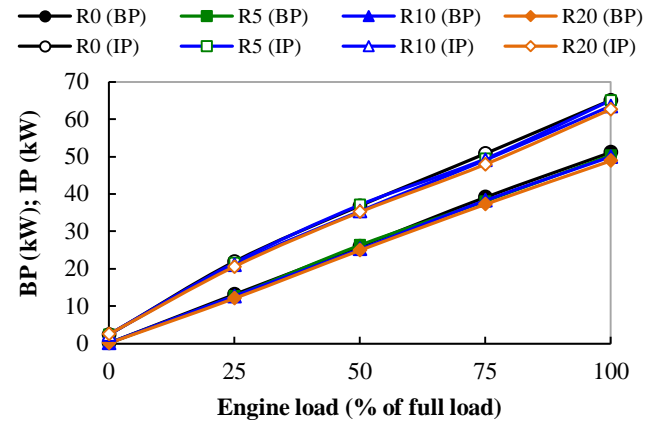
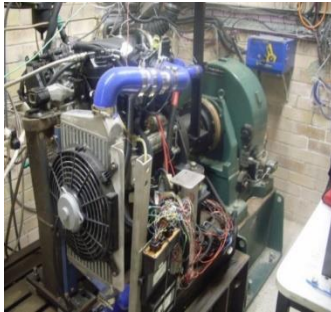
ExxonMobil



Licella

Using Biocrudes without Further Upgrading

- 20% Blend of non hydrotreated biocrude (diesel fraction) showed no significant changes in brake power and indicated power, compared to diesel alone in modern automotive engine



- Results very promising for use of biocrudes in stationary and marine engines **without** upgrading in refinery

Nabi, Rahman, Islam, Hossain, Brooks, Rowlands, Tulloch, Ristovski & Brown, 'Fuel characterisation, engine performance, combustion and exhaust emissions with a new renewable Licella biofuel,' *Energy Conversion and Management*, **96**, 588–598 (2015).

Licella's Bio-Crude Oil

Highest possible yields

Higher yields
We use all the biomass 30 – 40% yield
2+ bbls per odt feedstock

Don't create a char

Lowest possible Opex

No drying required
Able to use wet feedstocks

No pre-treatment required

No specialty catalysts required



Ability to Maximise Revenue

High Energy Content (34-36MJ/Kg) = Less Hydrogen
12-14% Oxygen

Fuels Low in Sulphur

Chemicals as well as fuels

>70% reduction in GHG

Lowest possible Capex

“drops in” to existing petroleum infrastructure

Brownfield sites

Aviation Fuels – “Green Diesel” very prospective



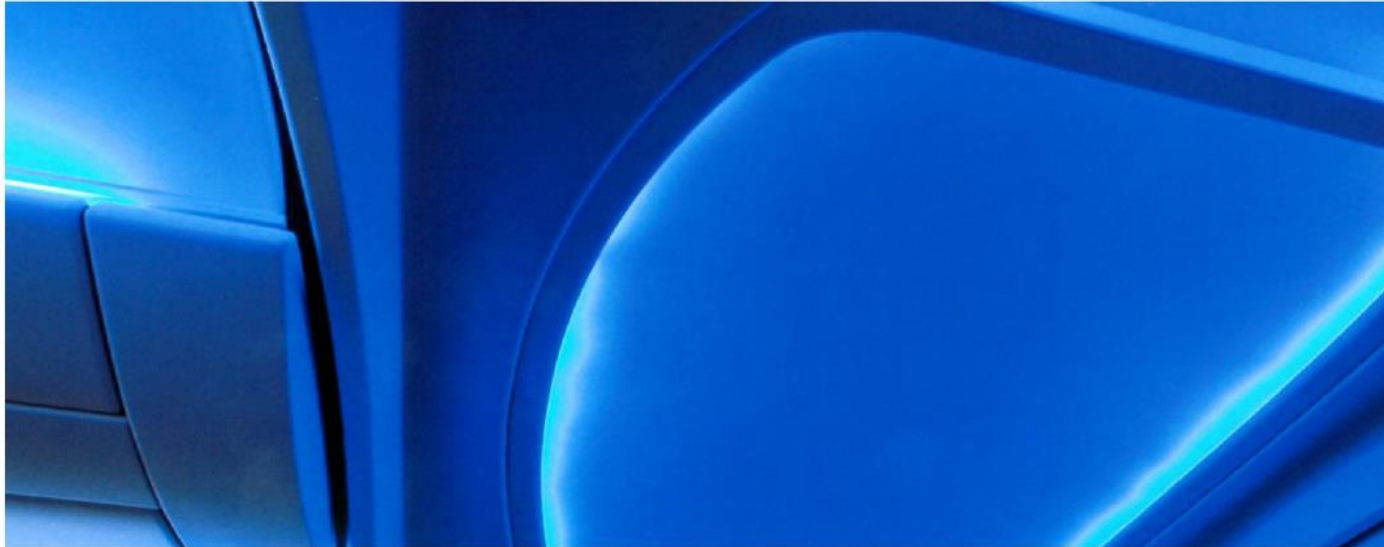
Commercial

Defense

Space

Innovation

100



BOEING MEDIA NEWS RELEASES/STATEMENTS

Boeing Finds Significant Potential in
"Green Diesel" as a Sustainable Jet
Fuel



Meet Errol







- Sustainable Aviation Fuel must be:
 - A “drop-in” replacement that meets the same technical standards as fossil derived fuel
 - Fulfill internationally recognised sustainability criteria
 - Competitively priced compared with fossil Jet-A

Why would you make Jet?

Hamilton, Vic									
	HCU Yield %	Market	Wholesale price at market (cpl)	less Excise (cpl)	less GST (cpl)	Less freight to market(cpl)	Plus CFG (cpl)	Net value to Licella (cpl)	Net value to Licella (US\$/bbl)
Gasoline*	13.5%	Sale	144.14	38.14	12.90			93.1	\$ 132.76
Kero/jet	18.3%	Melbourne	115.37	9.84	10.49	2.20		92.8	\$ 132.41
Gasoil/diesel	34.0%	Sale	150.44	38.14	13.48		38.14	137.0	\$ 195.32
Residue	34.3%	Local Burning	54.53	0.00	4.96			49.6	\$ 70.70
							Average	93.0	\$ 132.67
* includes 91 and 98 RON combined								= Brent +	\$ 16.59

Emerald, Qld									
	HCU Yield %	Market	Wholesale price at market (cpl)	less Excise (cpl)	less GST (cpl)	Less freight to market(cpl)	Plus CFG (cpl)	Net value to Licella (cpl)	Net value to Licella (US\$/bbl)
Gasoline*	13.5%	Emerald	148.74	38.14	13.30			97.3	\$ 138.75
Kero/jet	18.3%	Brisbane	115.37	9.84	10.49	2.40		92.6	\$ 132.12
Gasoil/diesel	34.0%	Emerald	153.94	38.14	13.78		38.14	140.2	\$ 199.88
Residue	34.3%	Local Burning	54.53	0.00	4.96			49.6	\$ 70.70
							Average	94.6	\$ 134.97
* includes 91 and 98 RON combined								= Brent +	\$ 18.89

51% more for selling product that's easier/cheaper to make



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ICAO Assembly achieves historic consensus on sustainable future for global civil aviation



More than 2,200 delegates from 185 Members States, non-Member States and 56 observer delegations to ICAO's 39th Assembly achieved 30% more work than at any previous event of its kind, including an historic agreement on a new global market-based measure (GMBM) for international flight emissions.

Montréal, 6 October 2016 – ICAO's Member States concluded the UN aviation agency's landmark 39th Assembly today, delivering an historic agreement on a new global market-based measure (GMBM) to offset CO₂ emissions from international flights and a comprehensive roadmap for the sustainable future of international aviation.

What are all the existing airline taxes for ?

Receipt And Tax Invoice Details

Fare	AUD 220.23
Taxes/Fees/Carrier-Imposed Charges	AUD 15.64 QRB (Head Tax) AUD 14.82 QRS (Head Tax) AUD 7.50 WG1 (Domestic Safety And Security Charge - Departures) AUD 25.81 UO2 (Taxes)
Fare Calculation Line	SYD VA BNE85.57SZDA VA SYD134.66VZDA AUD220.23END
Endorsement / Restrictions	RESTRICTIONS APPLY/NONEND/PENALTIES APPLY
Form of Payment	Credit Card - Mastercard : XXXXXXXXXXXXX 0043
Total Fare*	AUD 284.00

Other Charges

CARBON OFFSET # 7958205139595 (SYD- BNE / QTY 1, BNE-SYD / QTY 1)	AUD 1.36
GST	AUD 0.14
BOOKING SERVICE FEE # 7958205139594	AUD 7.00
GST	AUD 0.70
Total	AUD 9.20
Total Fare and Other Charges	AUD 293.20
GST included in this transaction	AUD 26.65

Marine Opportunities

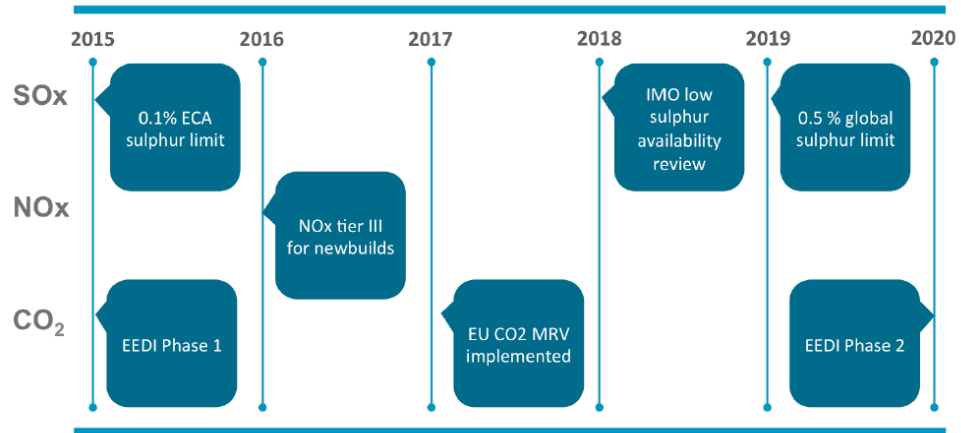
2015 SOx regulation: 0.1% Sulphur in Emission Control Areas (ECA)



Slide no. 5



Significant changes happening with Marine fuel requirements



Source: IMO & EC



NEWS: Maersk, Cargill, and 49 Others From Industry Call on International Maritime Organization to Set Ambitious Emissions Objective

By Carbon War Room | October 19, 2016

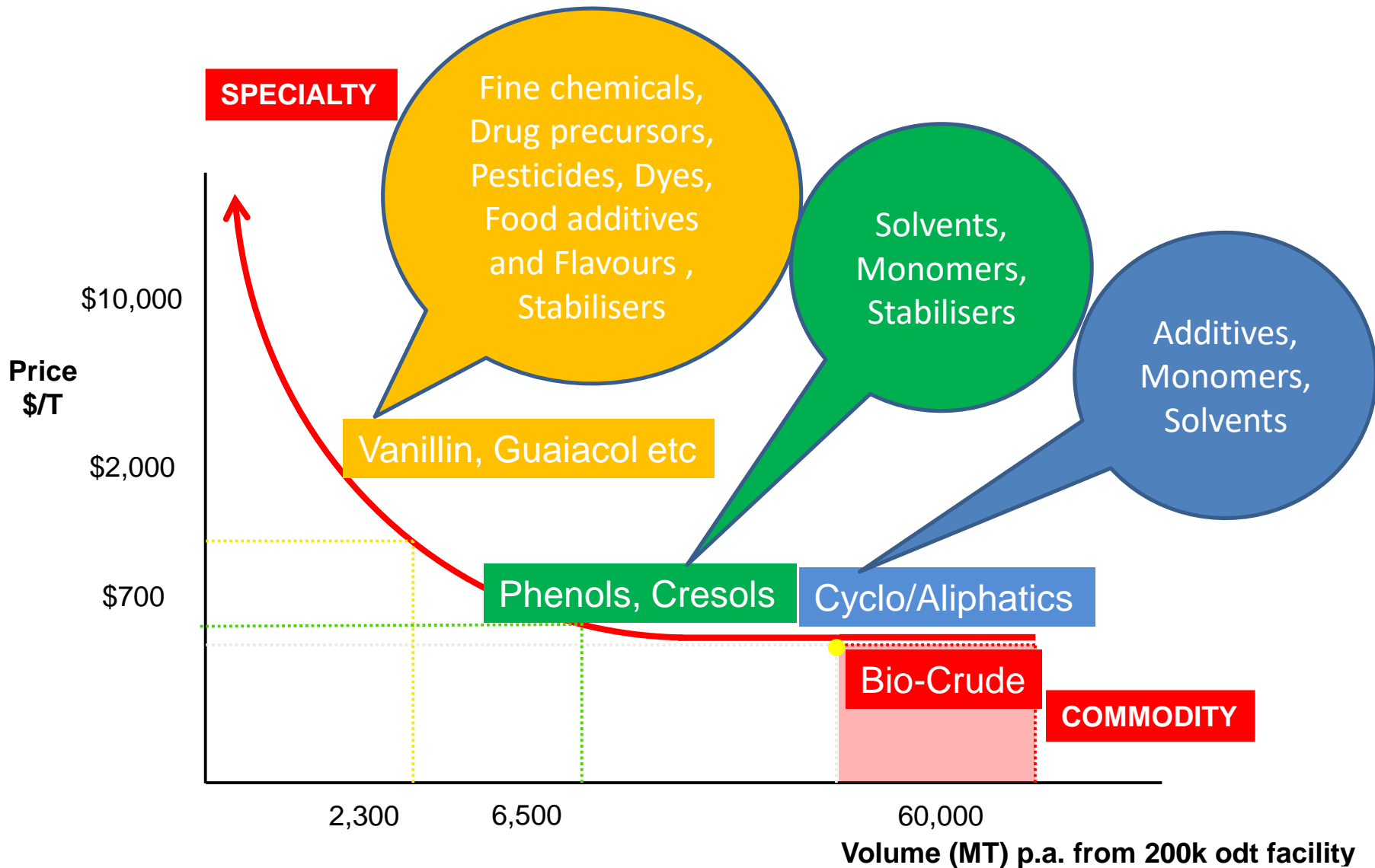
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Category | 2016
Tags | IMO

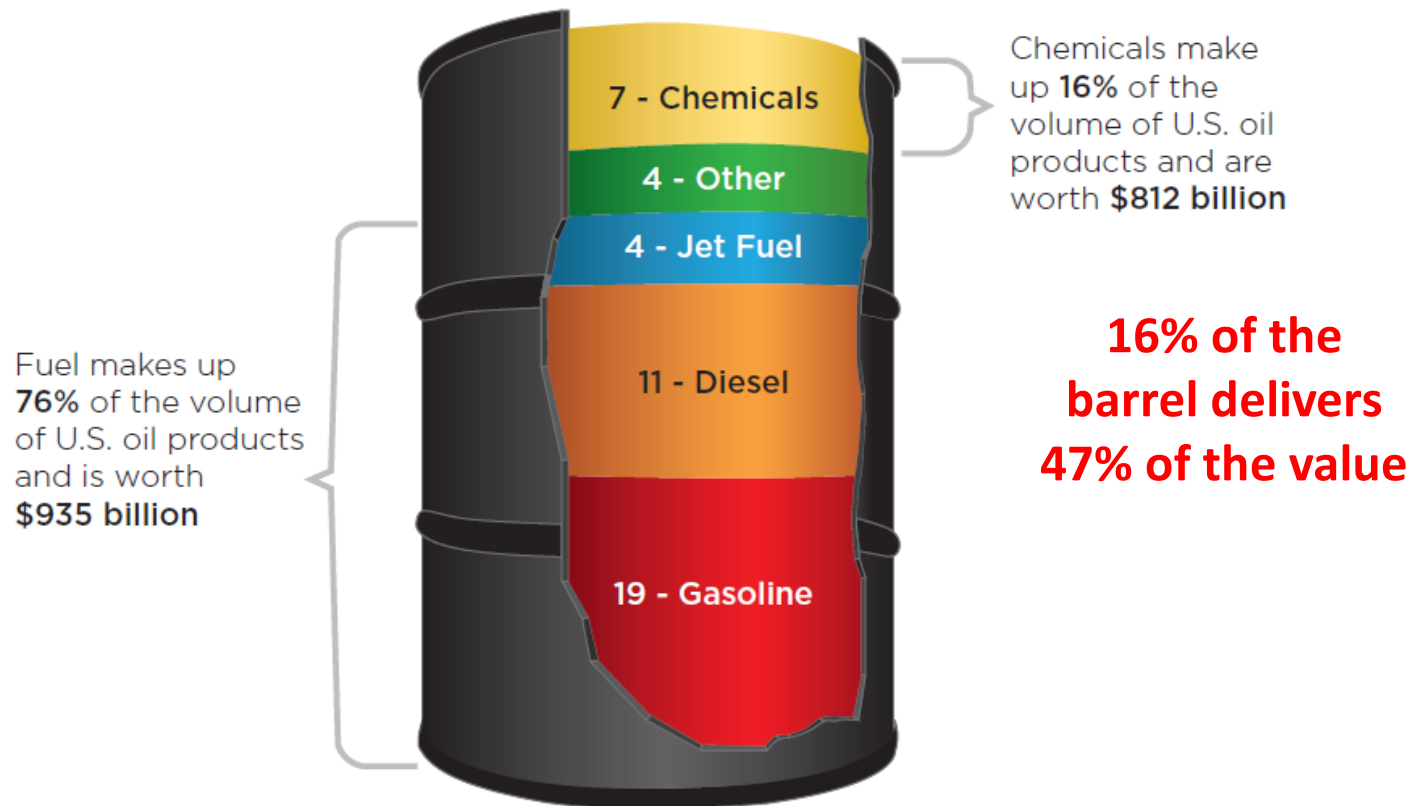
Share



Licella – Biochemicals



Critical to capture the full value



Source Bloomberg New Energy Finance, US EIA, American Chemical Council

Policy certainty required



The Coalition's Plan to Abolish the Carbon Tax.

As soon as an election is called, the Coalition will take immediate and concrete steps to repeal the Carbon Tax.

Repealing the Carbon Tax will ease cost of living pressures on families, help small business and restore confidence to the economy.

On the day the election is called, I will write to the Secretary of the Department of Prime Minister and Cabinet to make it clear that, if elected, the first priority of a Coalition Government will be the repeal of the Carbon Tax.

Within the spirit of the Caretaker conventions, I will also formally request the Clean Energy Finance Corporation to desist from making any further determinations in relation to grants, funds or financing.

If elected, the Coalition will take immediate steps to implement our plan to abolish the Carbon Tax.

On day one, I will instruct the Department of Prime Minister and Cabinet to draft legislation that repeals the Carbon Tax and to have the legislation ready within one month.

On day one, the Finance Minister will notify the Clean Energy Finance Corporation that it should suspend its operations and instruct the Department of Finance to prepare legislation to permanently shut-down the Corporation.

On day one, the Environment Minister will instruct the Department to commence the implementation of the Coalition's Direct Action Plan on climate change and carbon emissions.

ARENA future in doubt – not helping investment in Australian renewable industry

ARENA Funding Cut “Foolish, Short-sighted”

🕒 August 18, 2016 Energy Matters

Reports the Turnbull Government intends to proceed in ripping \$1 billion from the Australian Renewable Energy Agency (ARENA) have again been met with strong opposition.

It appears the Government will take action soon after Parliament returns on Monday.

The plan was originally hatched in March, with the announcement of a “new” \$1 billion [Clean Energy Innovation Fund](#) (CEIF) to be run by the Clean Energy Finance Corporation (CEFC) and ARENA. However, the \$1 billion wasn't new money – it was to come from ARENA's kitty.

At the time, the Clean Energy Council (CEC) suggested the Turnbull Government was giving with one hand while taking from the other and the nature of the change would leave little in the coffers for ARENA to provide capital grants for innovative new clean energy projects. The plan was met with other [similar criticism](#).

The attempt to strip ARENA of funds potentially soon going ahead has again stirred up a hornet's nest.

Calling such a plan reckless, foolish and short-sighted, Solar Citizens says ARENA plays a crucial role in Australia's energy transition.

“It is hard to believe that, yet again, the very organisations that will drive our future prosperity are in the crosshairs of this Government,” [said](#) Claire O'Rourke, National Director of Solar Citizens.

“Slashing and burning ARENA will see Australia miss out on its rightful share of the \$800b global renewable energy investment boom, and we will miss out on all of the accompanying jobs, growth and investment.”





CANFOR PULP INNOVATION (CPI)



Natural Resources Canada

Ressources naturelles Canada



Search and Apply
NOT
Research and
Development



INNVENTIA



“NATURALLY REFINED SOLUTION”

“THE WONDER from DOWN UNDER”

Jim Lane – Biofuels Digest

Biofuels-Bio Chemicals Joint Venture Established

- Global Application to Kraft, Mechanical Pulp mills and Extracted Lignin
- The Worlds Largest Bio-Refinery Base Integrated into Canfor Pulp’s Kraft Mill in Prince George, British Columbia, Canada
- Initial Project – 400,000 - 500,000 bbls of Biocrude Per Annum
- Advanced Biofuel Product Which Meets Highest Standards in Low Carbon Fuel Standards
- The Process will Enhance Existing Pulp Industry Value Proposition

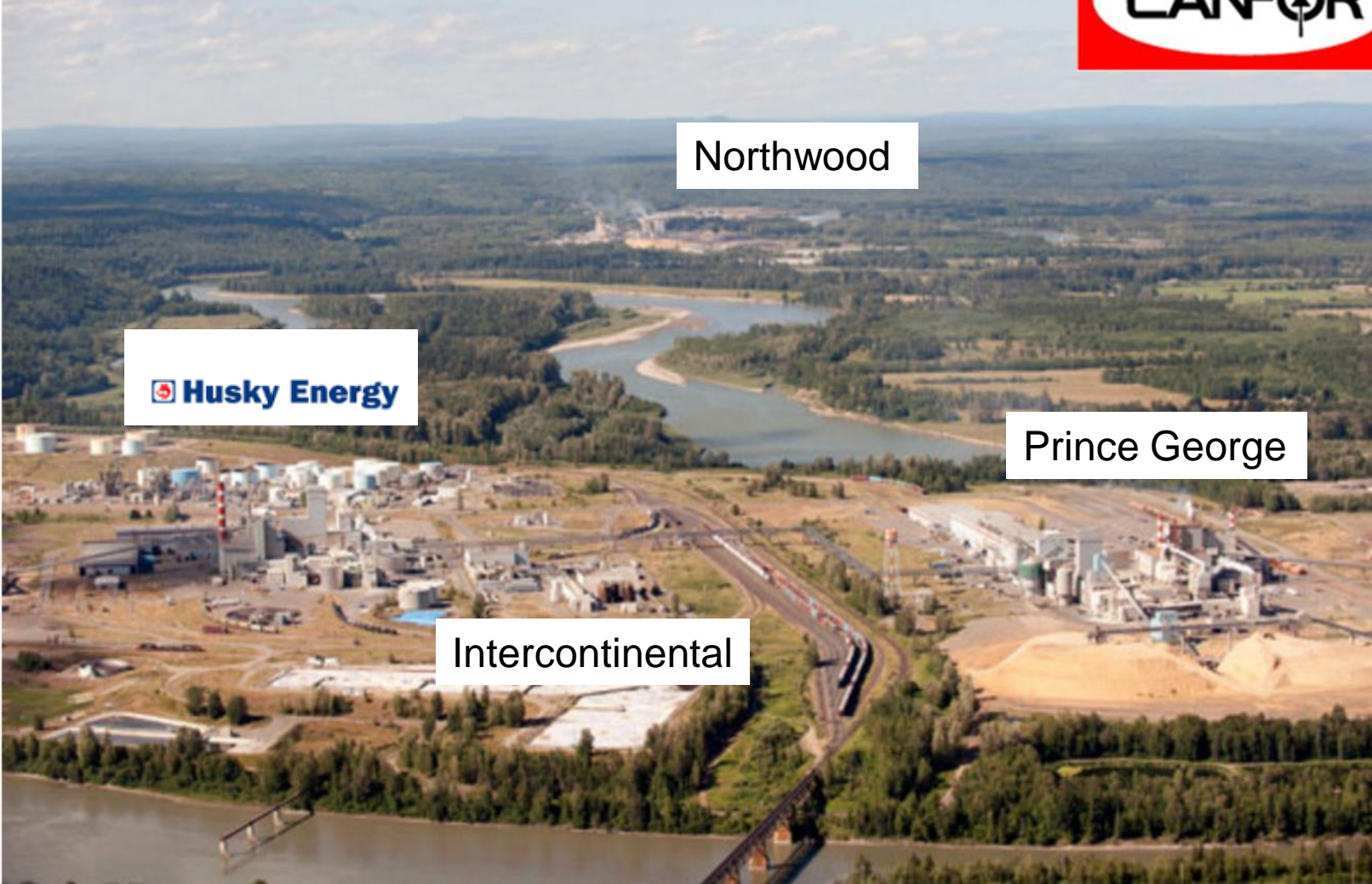


CANFOR PULP

LICELLA KRAFT

“NATURALLY REFINED SOLUTION”





Northwood



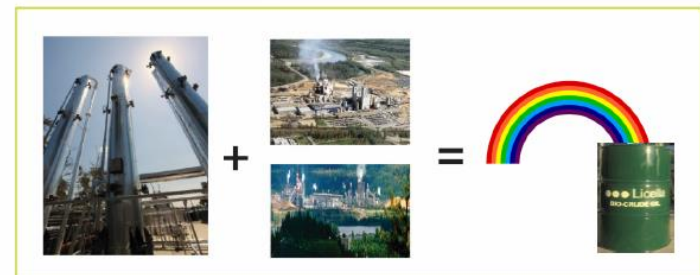
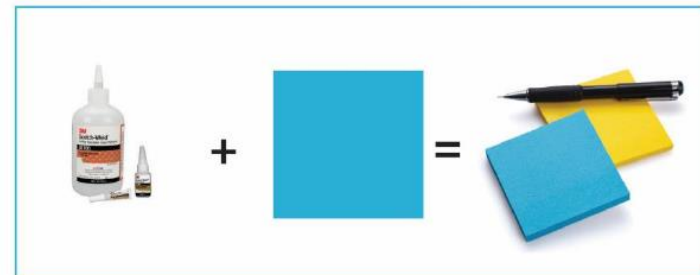
Prince George

Intercontinental

An aerial shot of Canfor's three pulp mills (clockwise from far top): the Northwood, Prince George, and Intercontinental mills.

“Perfect Fit”

- Innovation happens when complimentary factors converge
- Licella’s Cat-HTR is a natural extension of the existing pulp process
- Infrastructure and existing feed streams available are ideal
- Technology enhances existing core pulp business
- Most importantly.... **“CULTURAL FIT!”**



CANFOR PULP – “NATURALLY REFINED”

Summary

Licella's Bio-crude is a true replacement producing fuels and chemicals

Simple Process

Importance of long term, stable, bipartisan policy

Importance of having significant strategic partners with shared vision

This is a long journey but will deliver significant rewards

Not for wimps!

Acknowledgments

ARENA



Australian Government
Australian Renewable
Energy Agency

Licella would like to thank the Australian Government particularly ARENA and Accelerating Commercialisation for their support

Thank you for listening

Questions

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