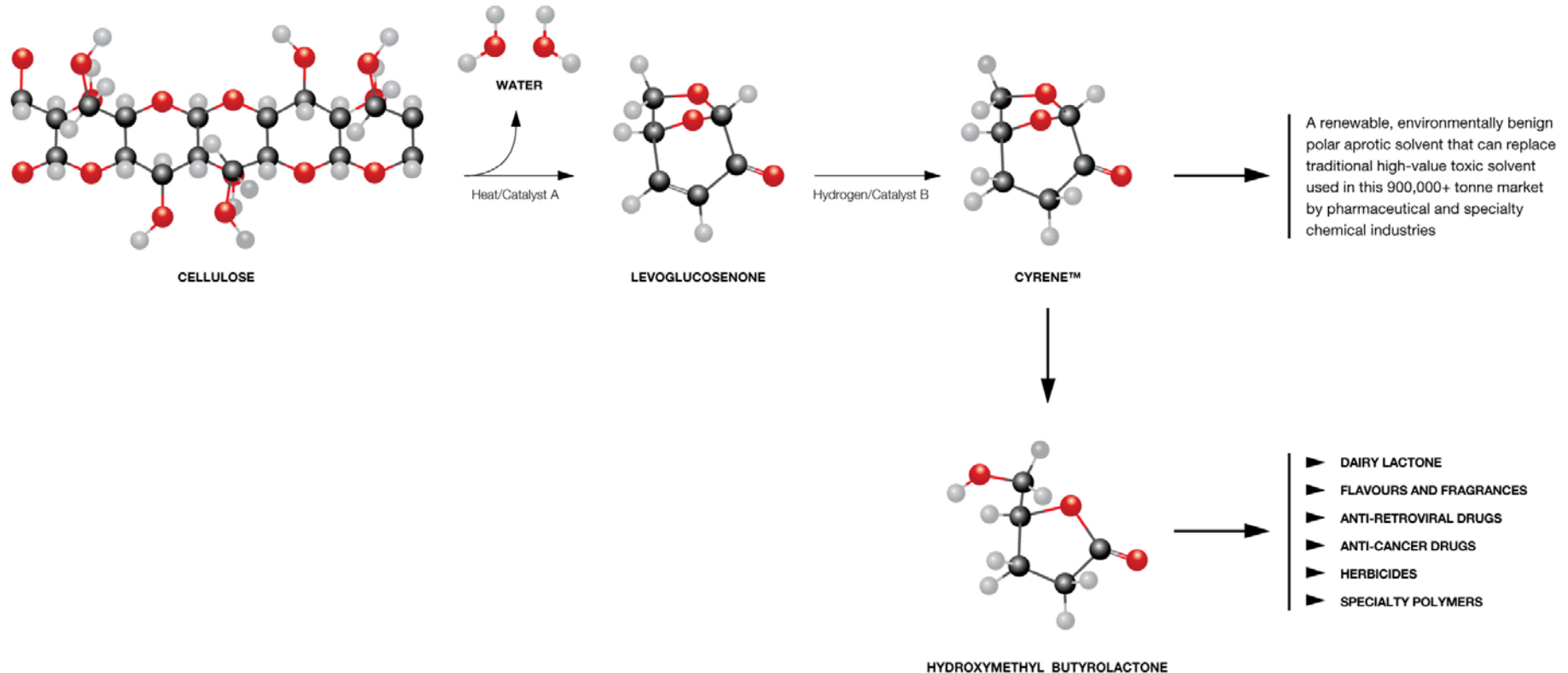




(The path is made by walking)

Tony Duncan CEO
Circa Group
20 November 2015

Circa's business is built on extracting value from waste cellulose....



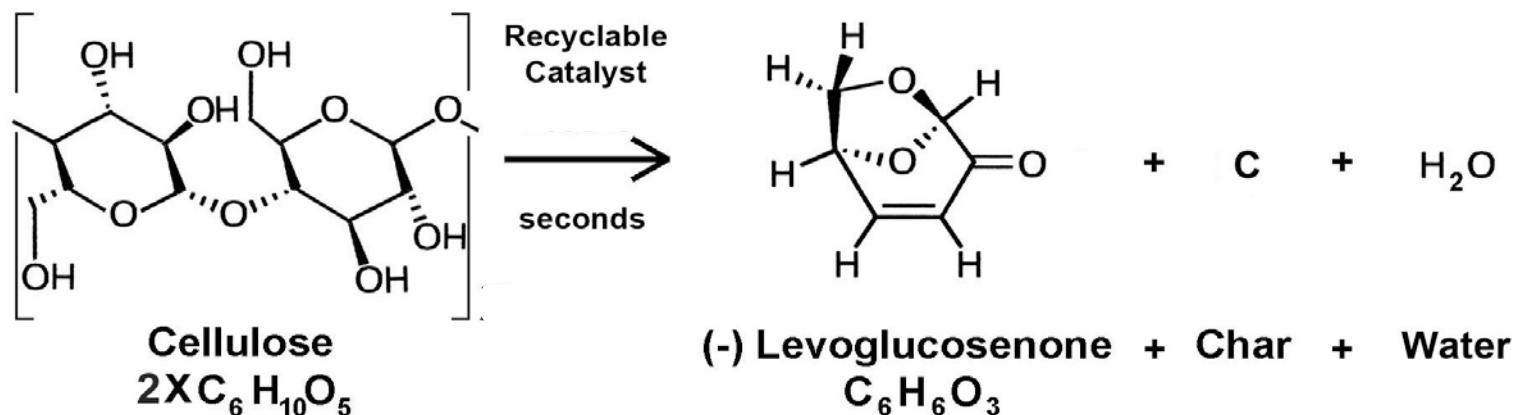
Circa overview:

- > 6 years developing continuous process for manufacture of Levoglucosenone
- > Patent underway – first international approvals
 - China, New Zealand, Australia, Japan
- > Privately funded
- > Co-founders ex pulp and paper industry
- > Circa Sustainable Chemicals Ltd

(registered UK May 2014)

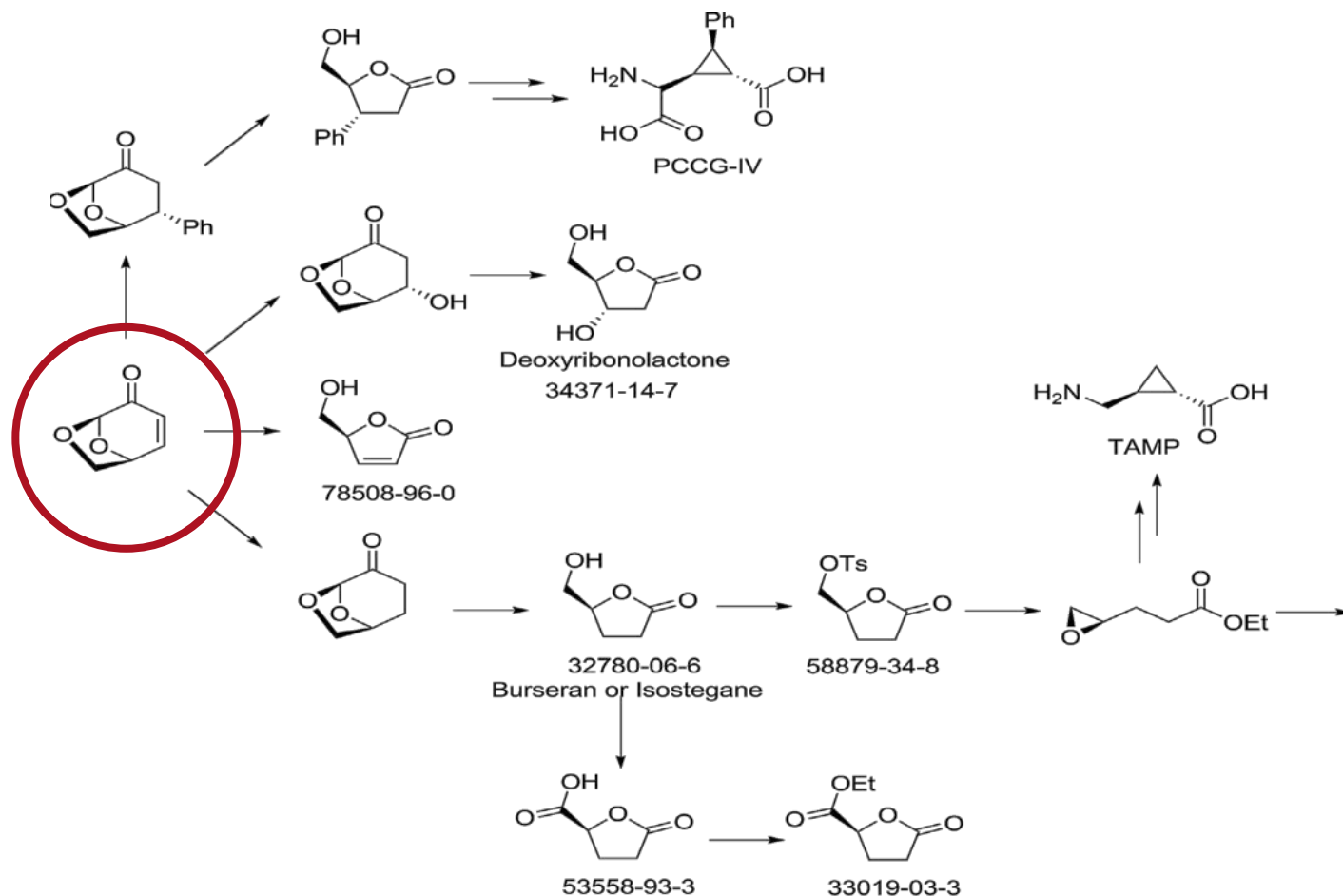
Circa's proprietary **Furacell™** process is sustainable and commercially viable:

- > The only continuous process for **levoglucosenone** production
- > Cellulose feedstock tolerant
- > Energy neutral
- > Operated near atmospheric pressure
- > Scalable
- > Environmentally benign



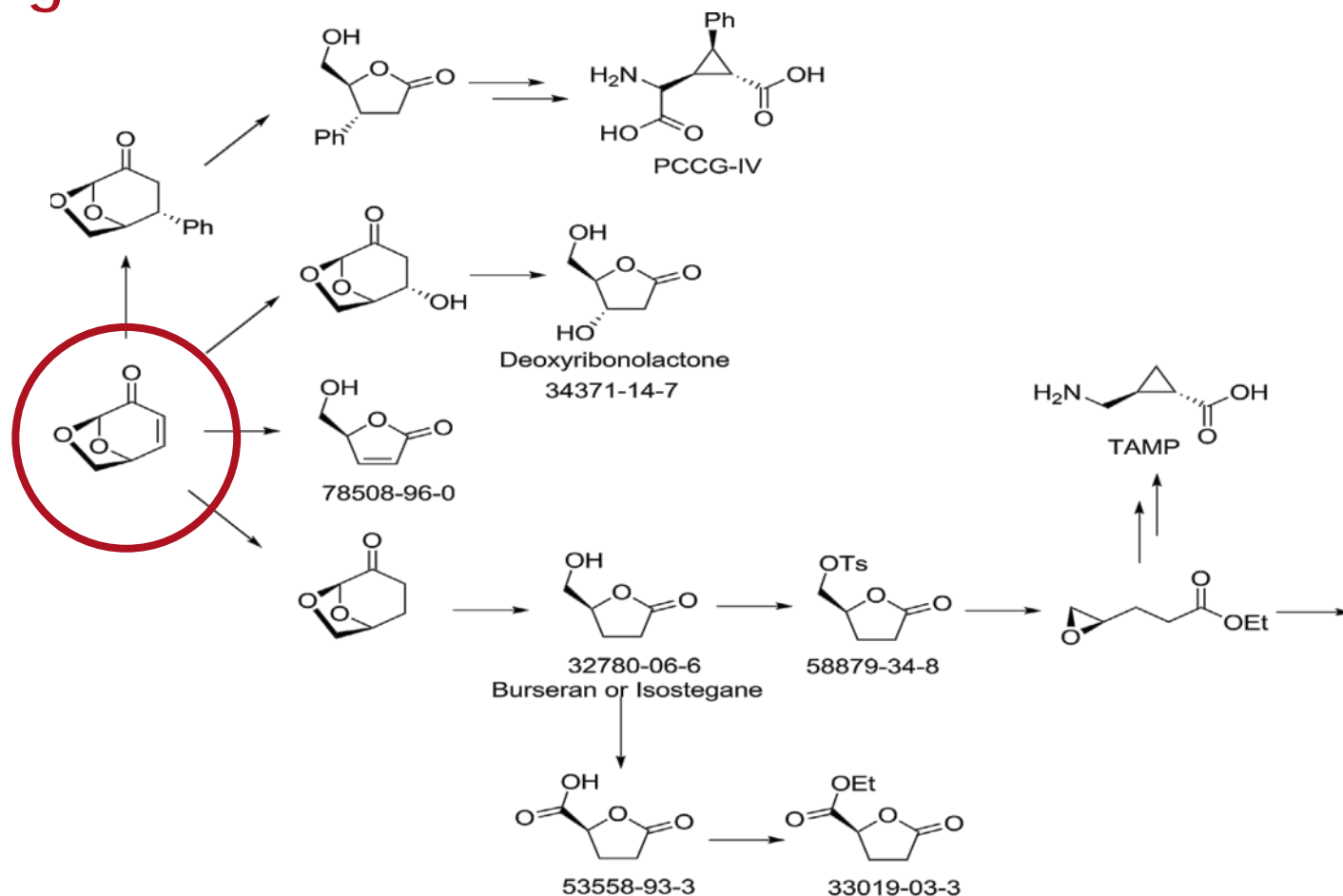
Levoglucosenone commercialisation (1)

\$50 per 1 gm



Levoglucosenone commercialisation (3)

\$50 per 1000 gm

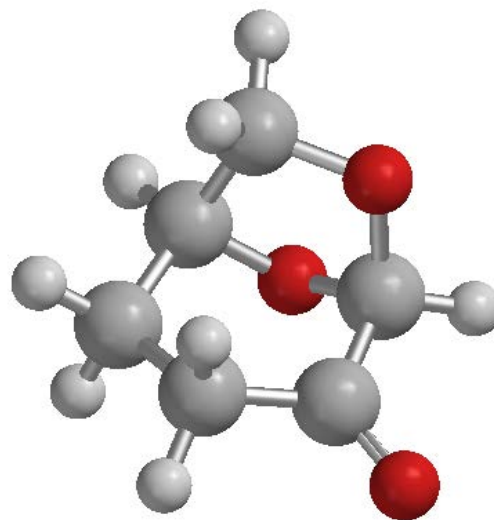




an example

A new polar aprotic solvent
made from renewable cellulose

cyrene 



 **circa**

CYRENE™

Dihydrolevoglucosenone

[(1S,5R)-6,8-dioxabicyclo[3.2.1]octan-4-one]

$C_8H_8O_3$

CAS 53716-82-8

Mol. Wt.: 128.13

LABORATORY REAGENT GRADE:

99.6% pure (GC)

Batch Number: QA150218_DC

Contents: 1,000g

www.circa-group.com.au



**Green
Chemistry**
Centre of Excellence



circa

9.1 Information on basic physical and chemical properties

Form	clear liquid
Density	1.25 g/cm ³ (20.0°C; OECD No.109)
Solubility	500 g/l, water (20.0°C)
Partition coefficient	log P _{ow} - 1.52 (octano/water 22.0°C) (Shake Flask Method, OECD No. 107)
Melting temperature	< - (20.0°C; OECD No.102)
Boiling temperature	227°C (100.7 kPa) (OECD No.103)
Vapour pressure	28 Pa (25°C) (OECD No. 104)
Flash point (liquid)	108°C (A.9. EG method)
Ignition point (liquid)	296°C (A.15. EG method)

9.2 Other Information

Note	no oxidising potential (Expert Statement)
Surface tension	72.5 mN/m (22.0°C) (OECD No. 115, *Surface Tension of Aqueous Solutions*)

11.1 Information on toxicological effects

Acute toxicity	LD ₅₀ > 2.000 mg/kg (oral, rat) (OECD No. 423 (Acute Toxic Class Method))
Local effects	eye: irritant (In Vitro: OECD No. 437: BCOP Test) skin: non-irritant (rabbit: OECD No. 404)
Sensitization	not skin sensitizing (mouse) (OECD No. 429, LLNA (Local Lymph Node Assay))
Mutagenicity	negative, both with and without metabolic activation (OECD No. 471 (Salmonella typhimurium) not mutagenic (OECD No. 487 (In vitro Mammalian Cell Micronucleus Test))

SECTION 12: ECOLOGICAL INFORMATION

12.1 Toxicity

Ecotoxicity	barely toxic for algae (Pseudokirchneriella subcapitata) ErC ₅₀ (72 h) > 100mg/l (nominal concentration) EyC ₅₀ (72 h) > 100mg/l (nominal concentration) NOEC (72 h) 100mg/l (nominal concentration) (OECD No.201) barely toxic for planktonic crustaceans (Daphnia magna) ErC ₅₀ (48 h) > 100mg/l (nominal concentration) NOEC (48 h) > 100mg/l (nominal concentration) (OECD No.202) barely inhibitory on aerobic bacterial reproduction (activated sludge) (activated sludge) ErC ₅₀ (3 h) > 1000mg/l NOEC (3 h) 500mg/l (Activated Sludge Respir. Inhib. Test, OECD NO. 209)
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12.2 Persistence and degradability

Ready biodegradability	readily biodegradable 99%, 14d (DOC Die-Away Test, OECD No. 301A)
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Identification of High Performance Bio-Based Solvents for the Sustainable Processing of Graphene

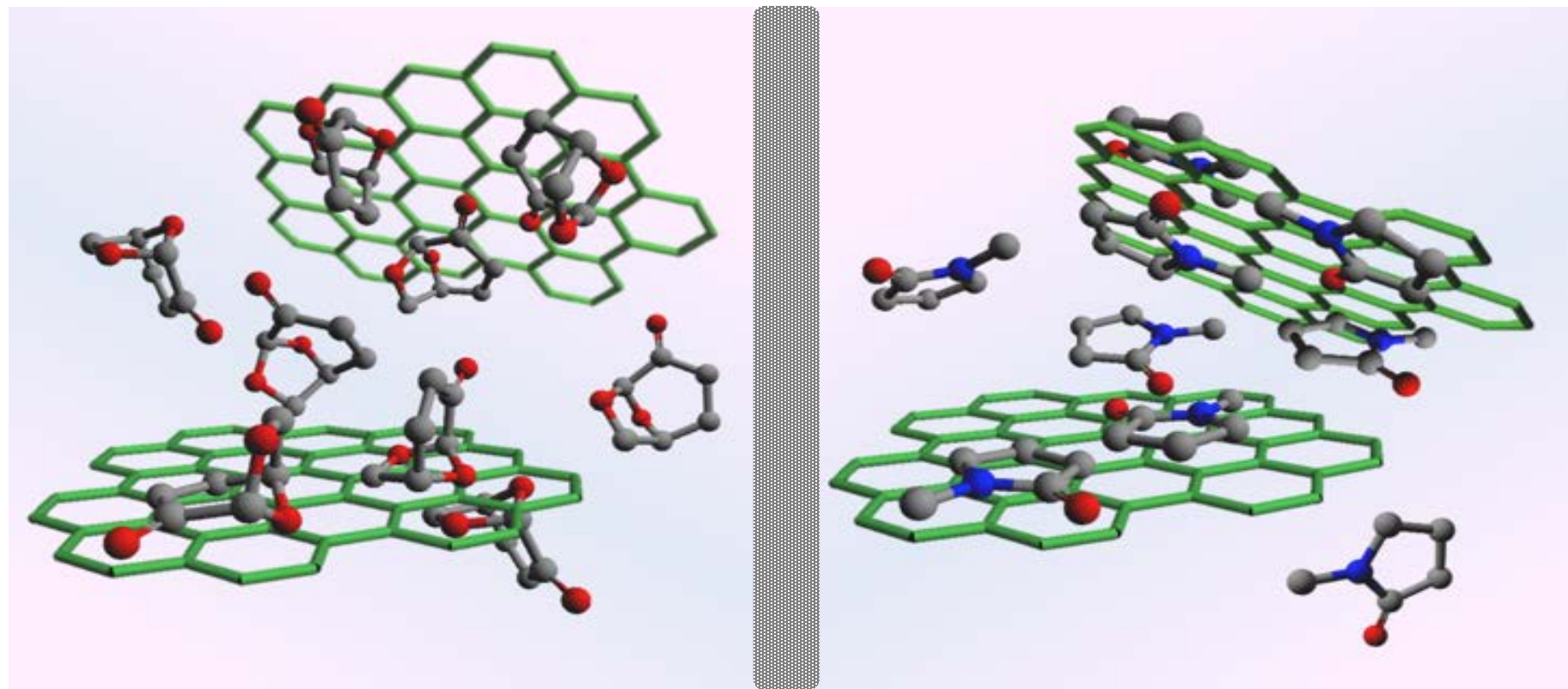
Horacio J. Salavagione¹, James Sherwood², Mario De bruyn², Vitaliy L. Budarin ², Gary Ellis¹, James H. Clark^{2*}, Peter S. Shuttleworth^{1*}

¹ Departamento de Física de Polímeros, Elastómeros y Aplicaciones Energéticas, Instituto de Ciencia y Tecnología de Polímeros, CSIC, c/ Juan de la Cierva, 3, 28006, Madrid (Spain).

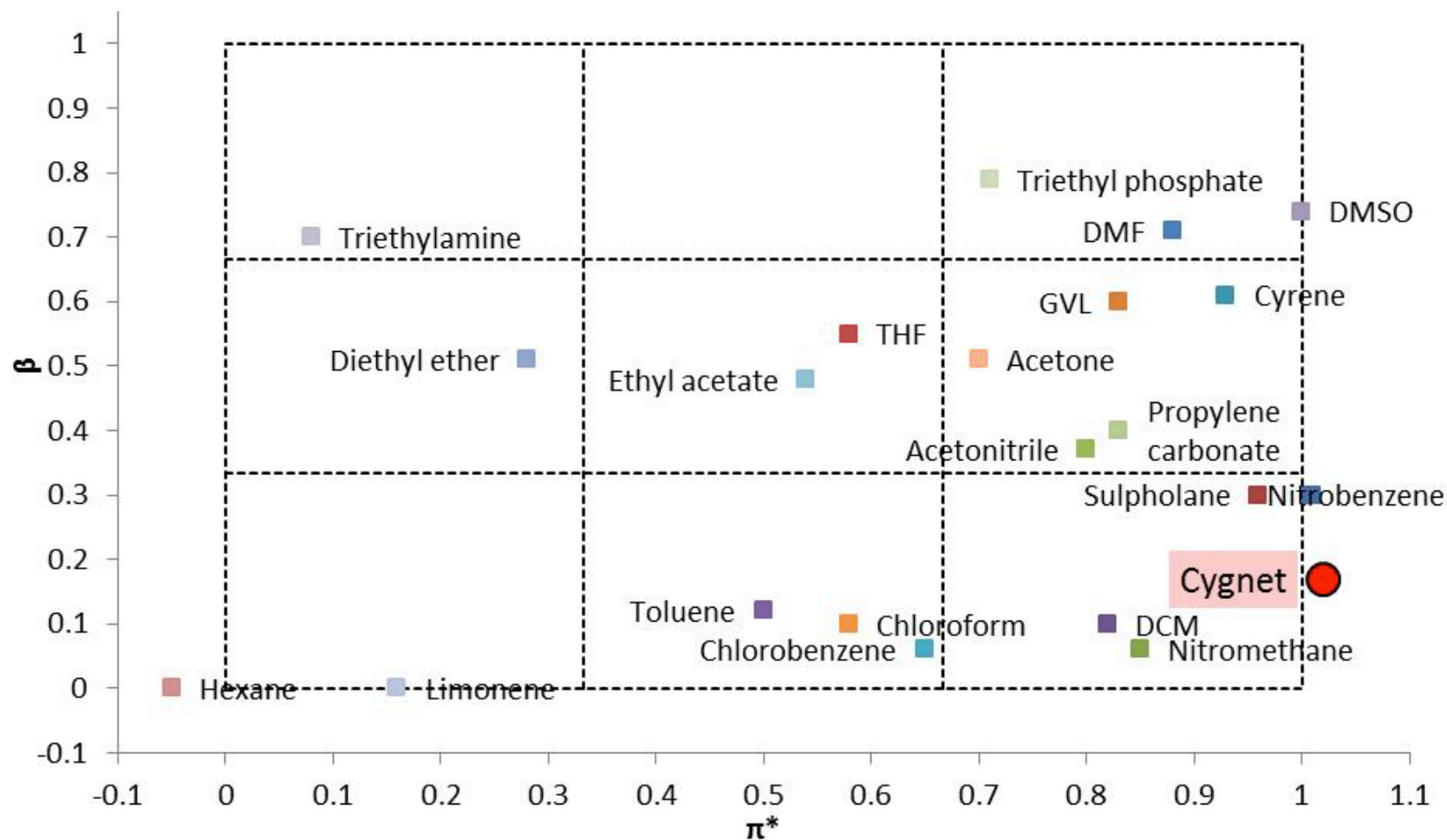
² Green Chemistry Centre of Excellence, University of York, Heslington, York, Yorkshire, YO10 5DD (UK)

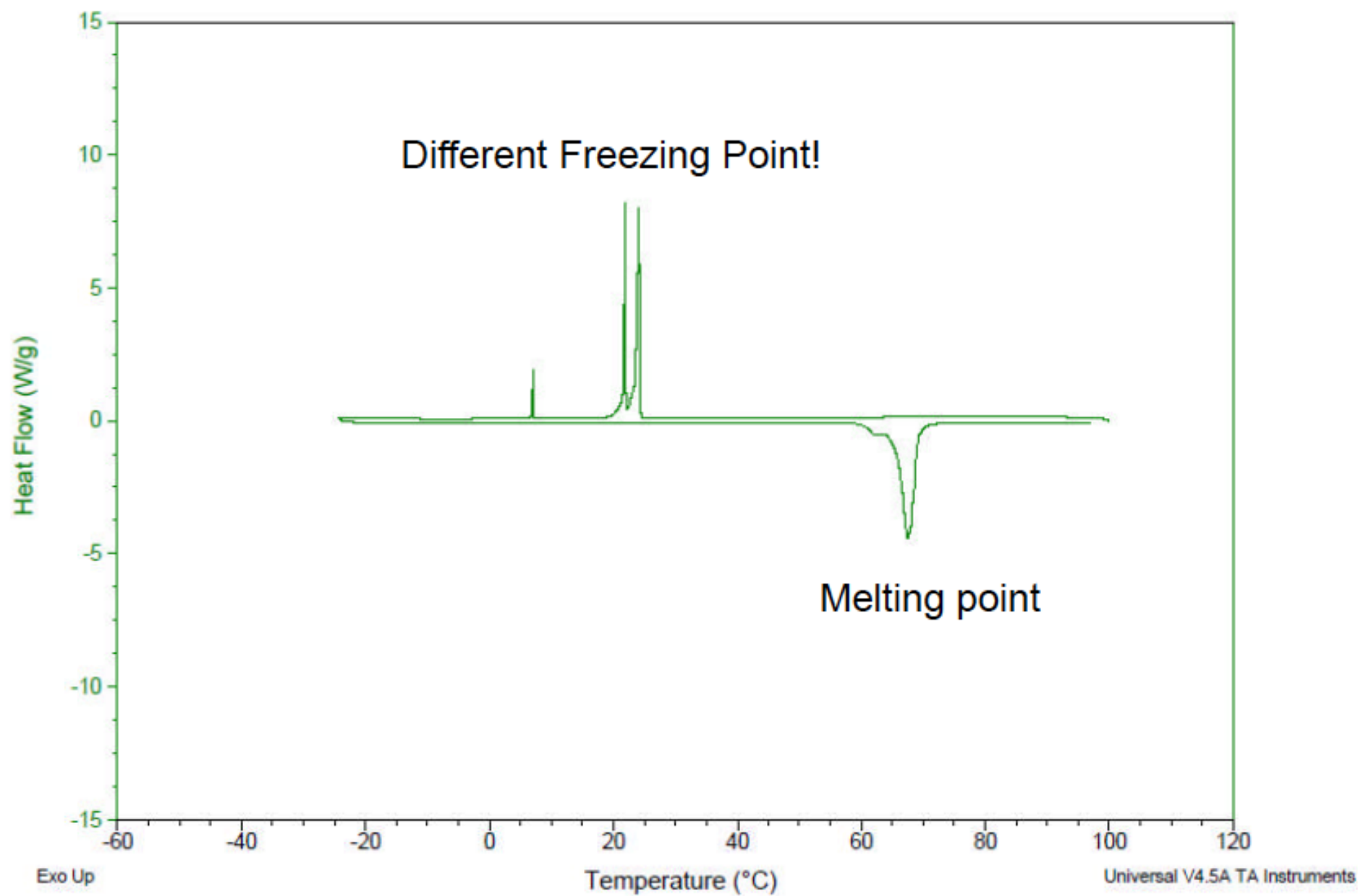
*.....graphene dispersions in the renewable solvent
Cyrene were an order of magnitude (0.24 mg ml^{-1})
more concentrated than what could be achieved in
N-methylpyrrolidinone.....*

Cyrene: chirality & structure = unique property set
(solvent / chiral auxiliary / racemate resolution...)

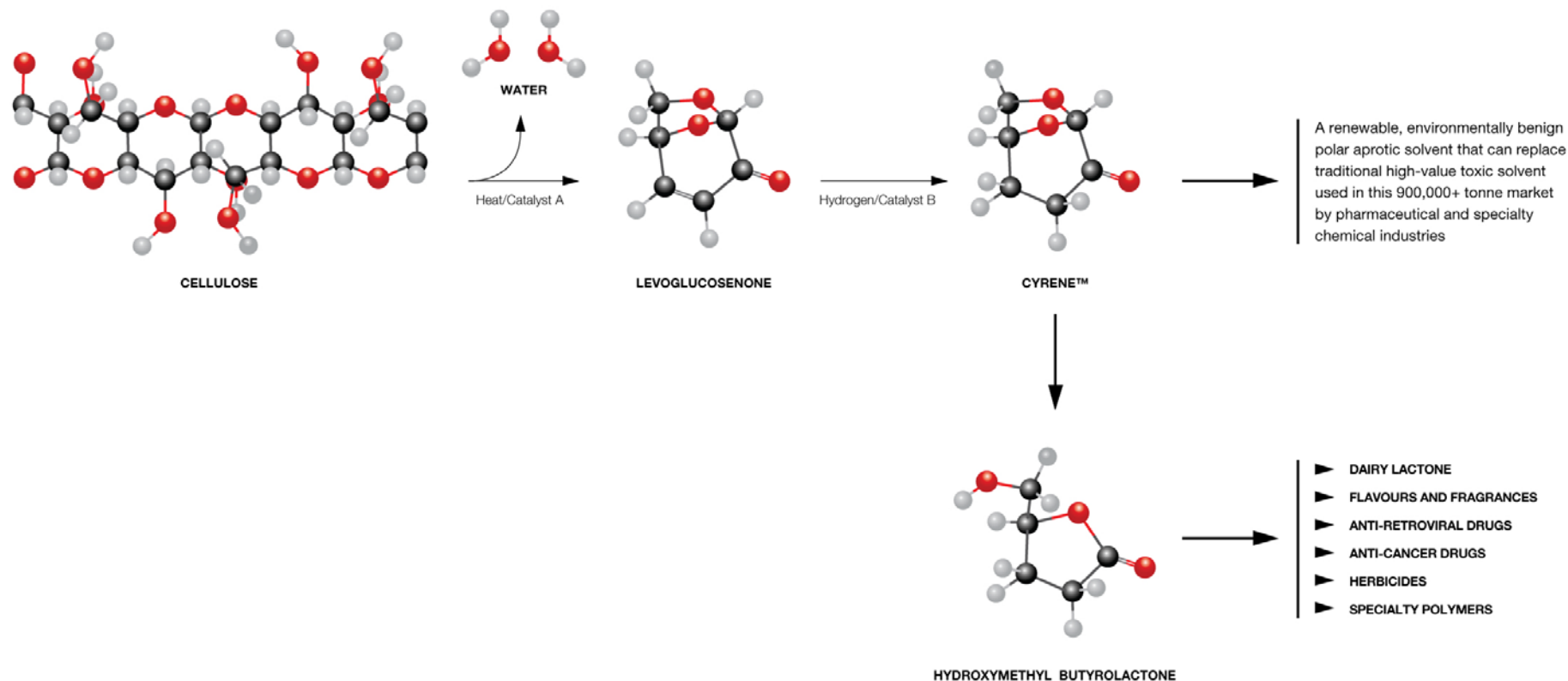


Aprotic solvent properties.....?



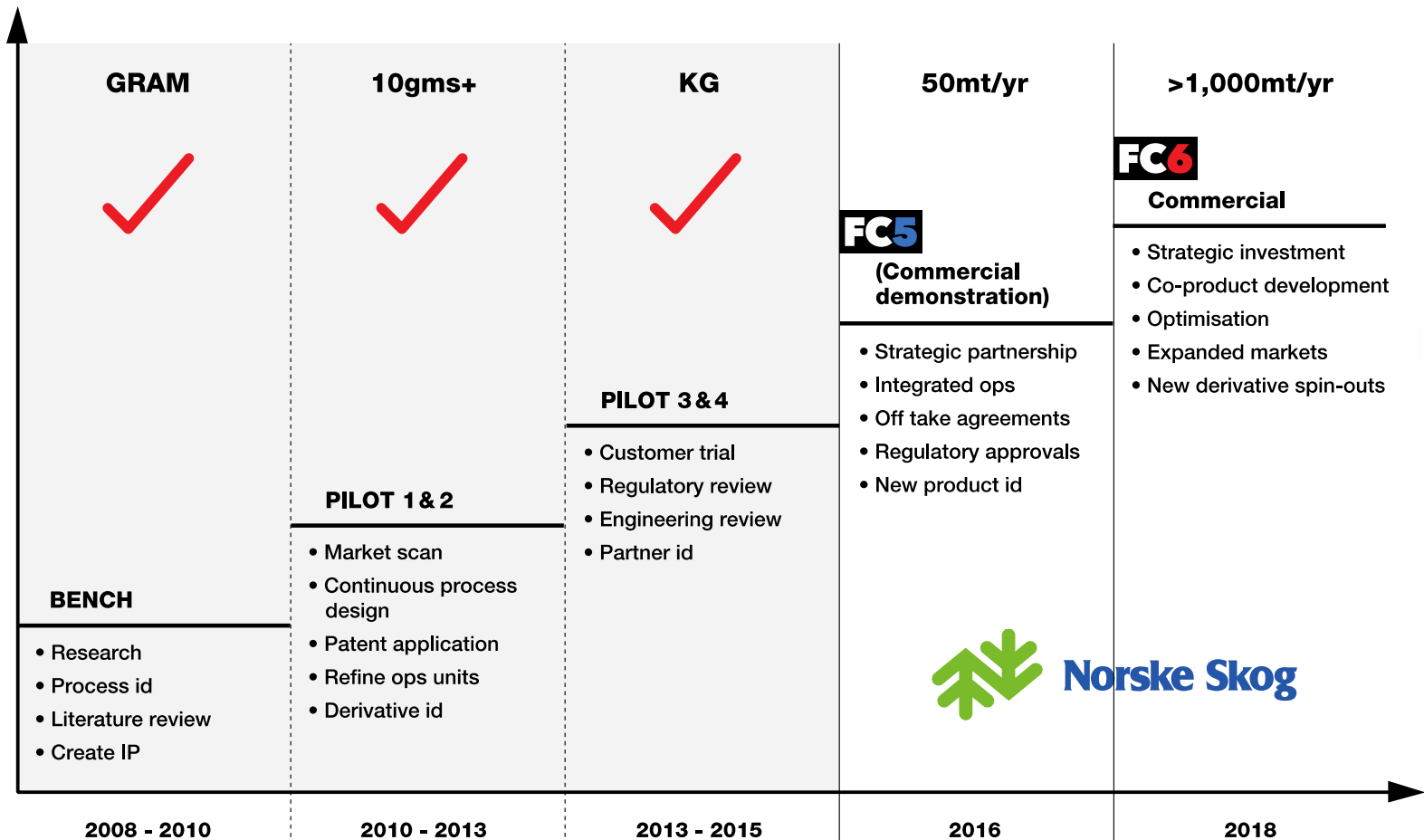


But the opportunity goes way beyond solvents.....



It's taken 6+ years....

and we have a clear vision to build a valuable, global business



And many thanks are due
to some fine collaborators.....



PHOTOS:
LSDMEL
BOURNE



Traveller, there is no path
The path is made by walking

By walking you make a path
and turning, you look back
at a way you will never tread again

Antonio Machado

(Thank you)

