Developing Sustainable Technologies

Dr Damian Kelly
Business Development Director
Enterprise Technology

CRODA

Enterprise Technology

The Science of Innovation

Agenda

- The Croda organisation
- Technology in Croda

CRODA

Enterprise Technology
The Science of Innovation

Ideal business model

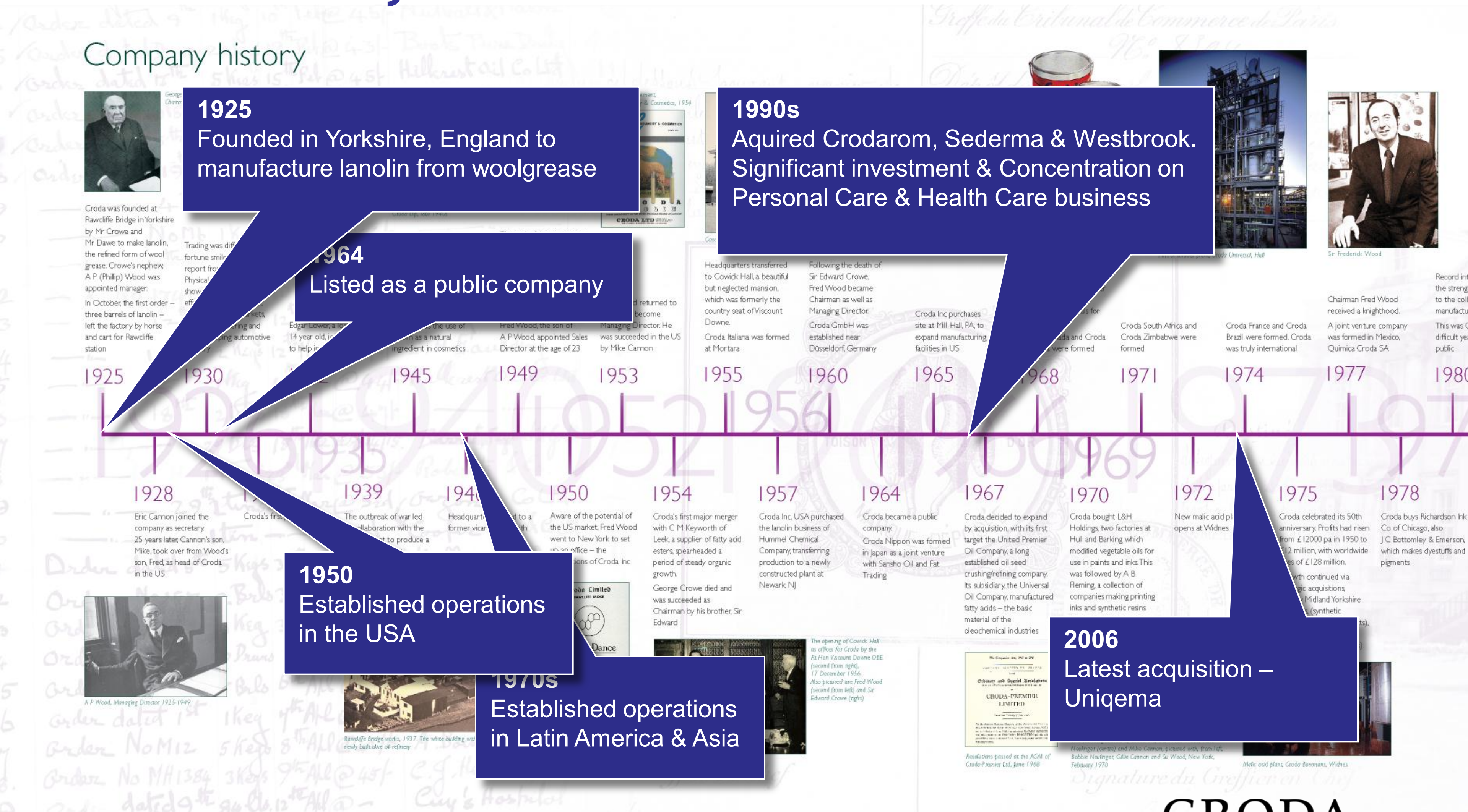
What would the ideal sustainable manufacturing business look like?

- based on nature's raw materials, harvested in a sustainable manner
- raw materials would be converted by carbon neutral processes
- finished products would have unique performance characteristics which were IP protected and for which the customers were prepared to pay a premium
- finished products would be fully biodegradable after use

Croda is as close as any to this model…..

CRODA

Our History…it makes us who we are



1925
Founded in Yorkshire, England to manufacture lanolin from woolgrease

1964
Listed as a public company

1950
Established operations in the USA

1970s
Established operations in Latin America & Asia

1990s
Aquired Crodarom, Sederma & Westbrook. Significant investment & Concentration on Personal Care & Health Care business

2006
Latest acquisition – Uniqema

CRODA

Enterprise Technology

The Science of Innovation

What are we?

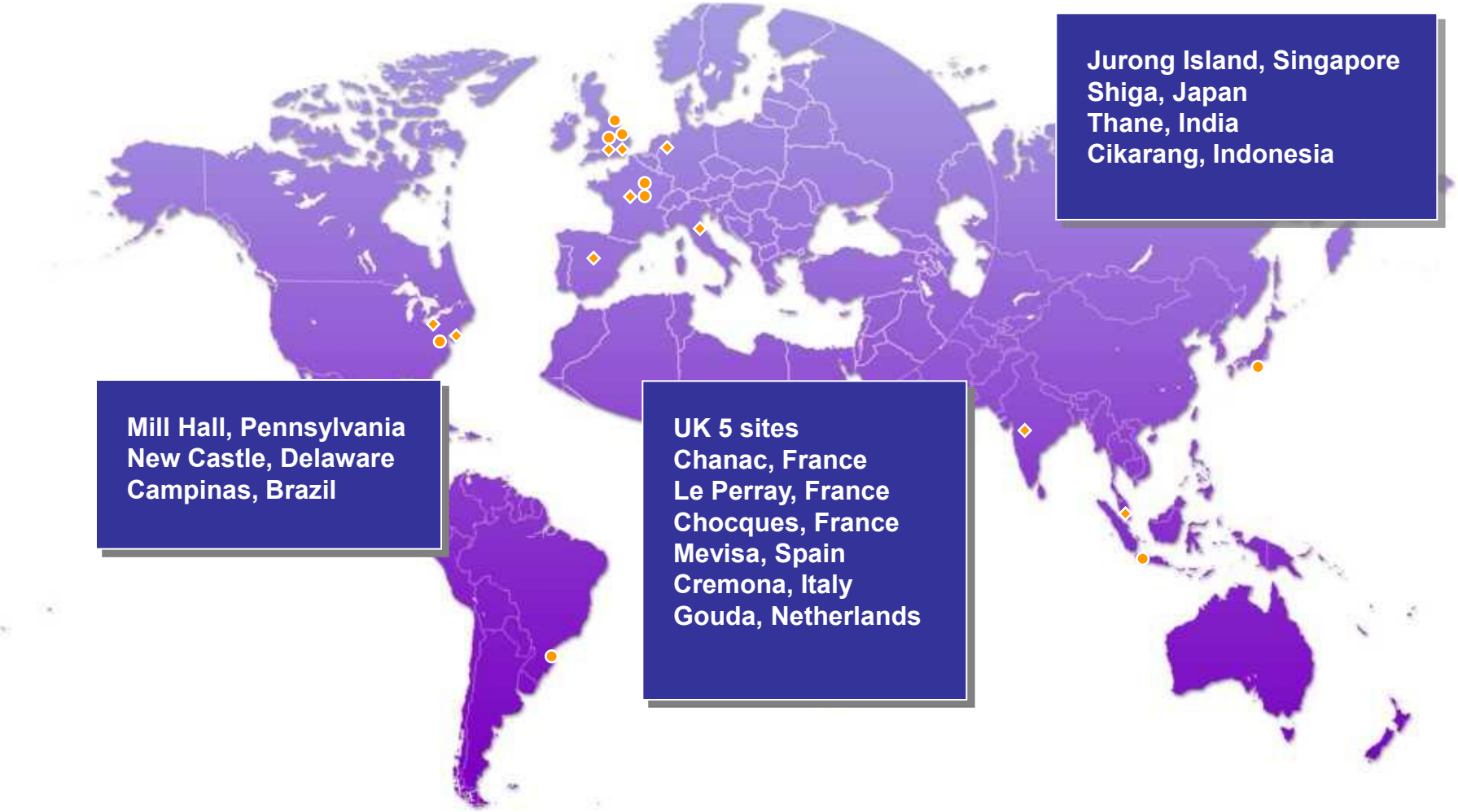
- A leading producer of speciality ingredients for high growth markets
- Majority of feedstocks are naturally derived (69%)
- Sell effects and not chemicals
- Driven by innovation and exploitation of technology

CRODA

Croda – The numbers

	2011	2010	2009	2008	2007	2006	2005
Turnover (£m)	1,068	1,001	916	911	886	519	306
Pbt (£m)	242	192	106	96	67	54	51
Returns (%)	23%	19%	12%	11%	8%	10%	17%
EPS (p)	122	95	53	48	37	29	26
Dividend (p)	55	35	22	20	16	14	13
Employees	3241	3174	3461	3624	3812	4000	1600

Croda's Manufacturing Sites



Jurong Island, Singapore
Shiga, Japan
Thane, India
Cikarang, Indonesia

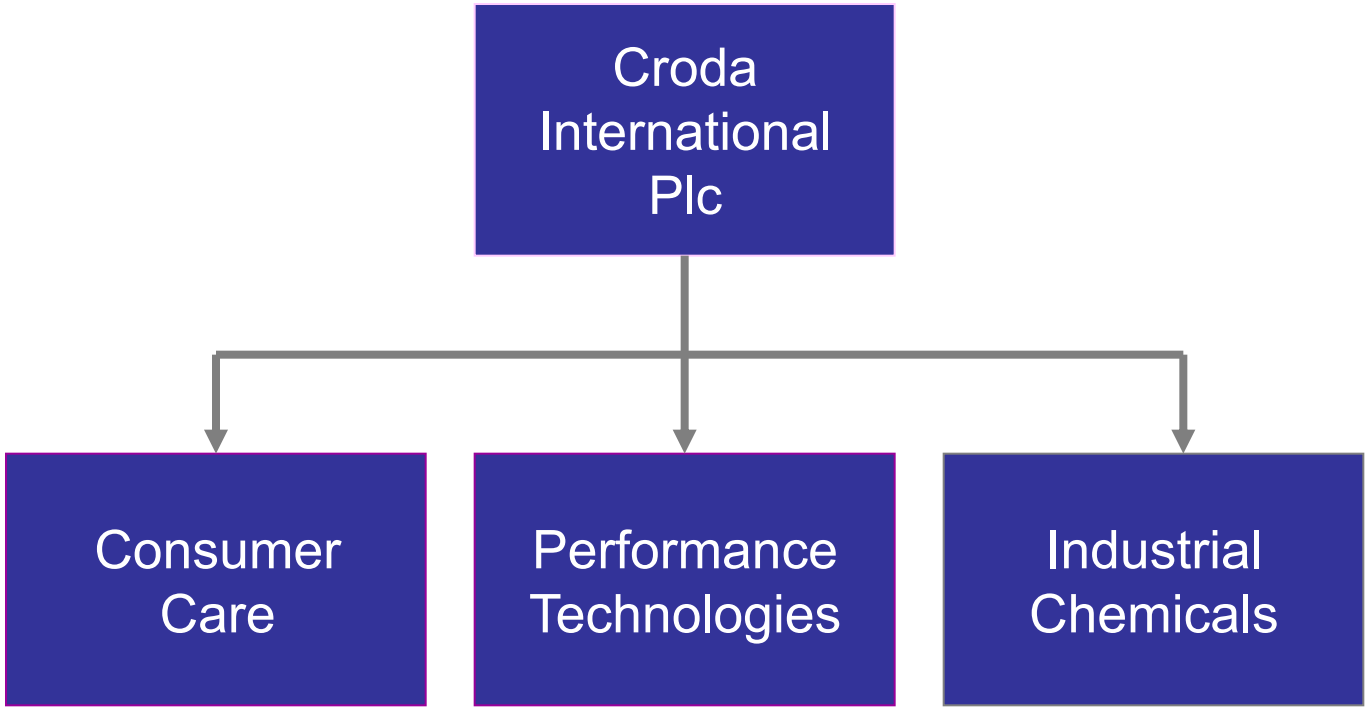
Mill Hall, Pennsylvania
New Castle, Delaware
Campinas, Brazil

UK 5 sites
Chanac, France
Le Perray, France
Chocques, France
Mevisa, Spain
Cremona, Italy
Gouda, Netherlands

Enterprise Technology

The Science of Innovation

Three divisions, different markets, one unified focus...



… to grow through constant innovation

CRODA

Enterprise Technology
The Science of Innovation

Markets Served

Consumer Care

- Personal Care
- Health Care
- Crop Care

Performance Technologies

- Home Care
- Lubricants
- Geo Tech
- Coatings & Polymers
- Polymer Additives

Industrial Chemicals

- Process Additives

CRODA

Enterprise Technology

The Science of Innovation

What are the key drivers in our core markets?

- Performance
- "Green"
  - Natural
  - Renewable
  - Sustainability
  - Low environmental impact
  - Biodegradable

CRODA

Enterprise Technology

The Science of Innovation

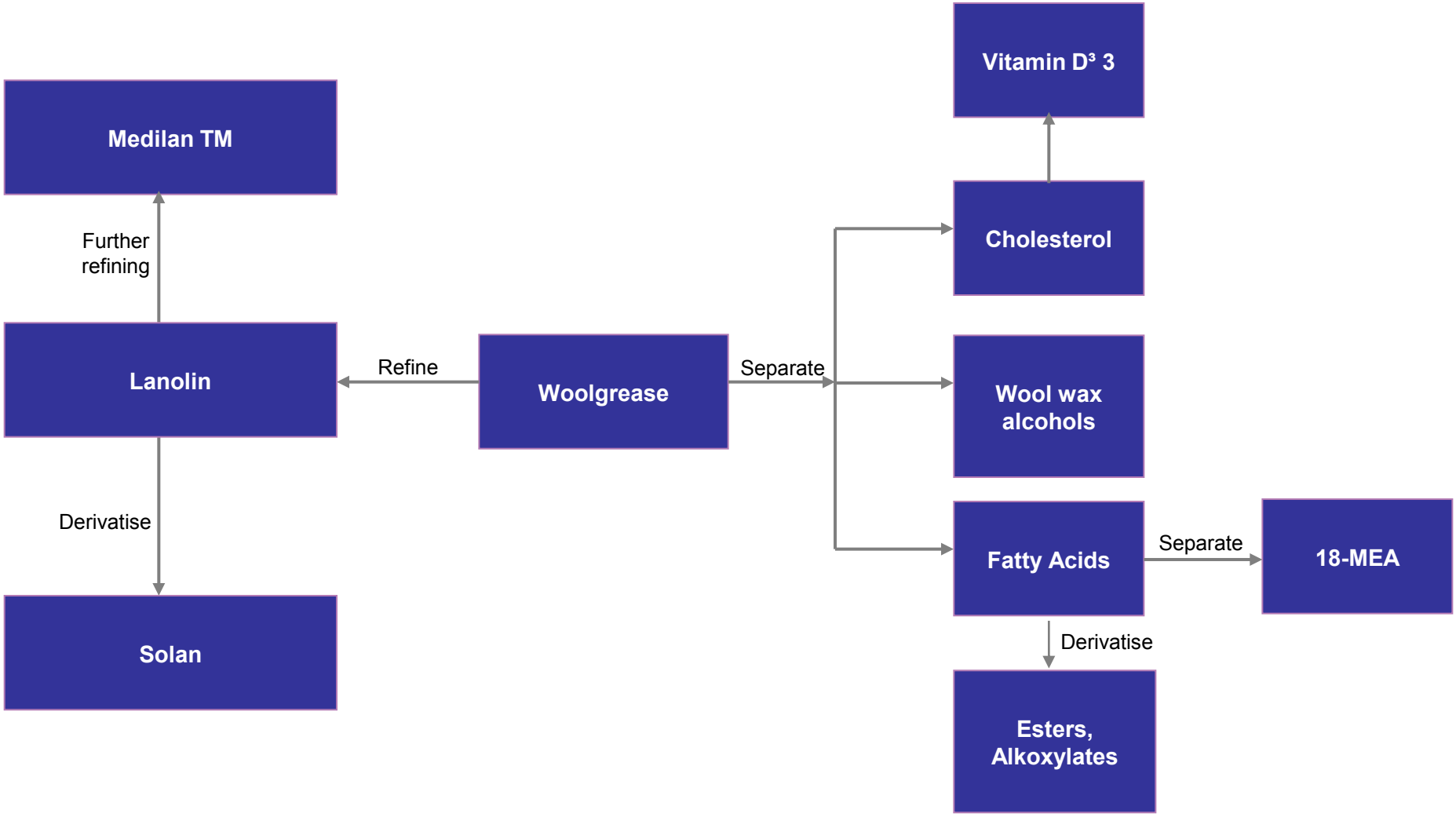
Technology in Croda

- What is Croda all about?
- From a technology perspective:

"Adding value to naturally derived raw materials by purification, separation and derivatisation"

CRODA

Woolgrease


Medilan TM
Further refining
Lanolin
Derivatise
Solan
Refine
Woolgrease
Separate
Vitamin D³ 3
Cholesterol
Wool wax alcohols
Fatty Acids
Separate
18-MEA
Derivatise
Esters, Alkoxylates

Enterprise Technology

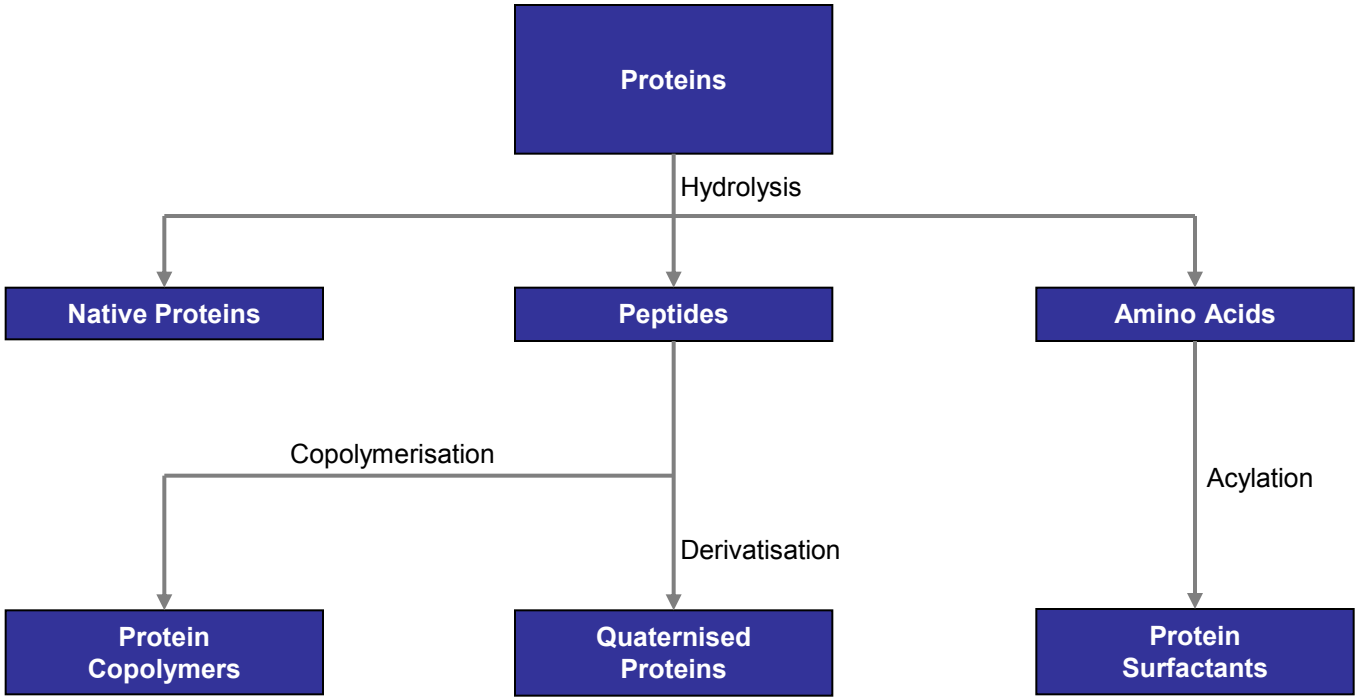
The Science of Innovation

Woolgrease

CRODA

Enterprise Technology
The Science of Innovation

Proteins



Protein sources include Wheat, Soy, Milk, Cashmere, Potato, Silk, Cotton,

CRODA

Enterprise Technology

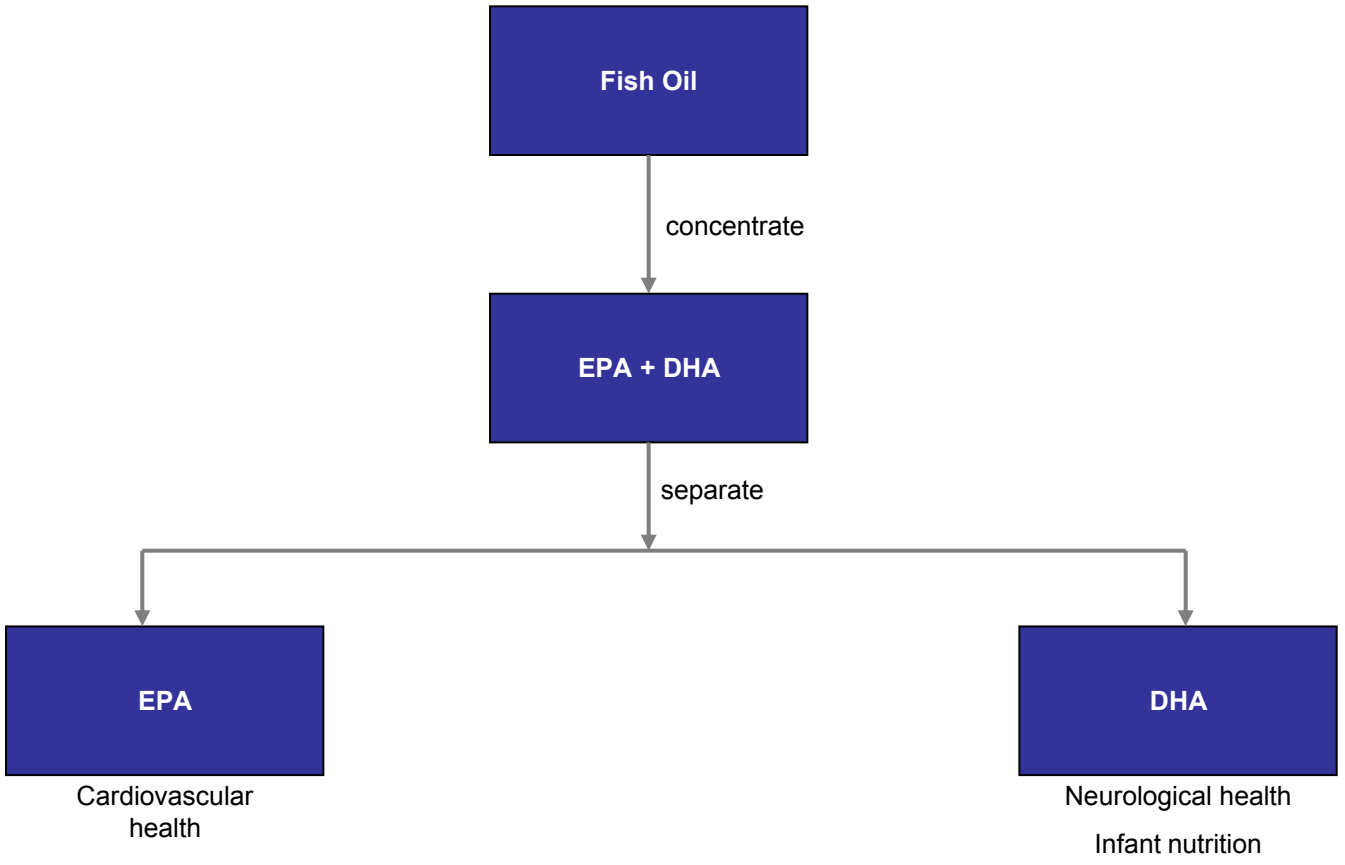
The Science of Innovation

Proteins

CRODA

Enterprise Technology
The Science of Innovation

Fish Oil



CRODA

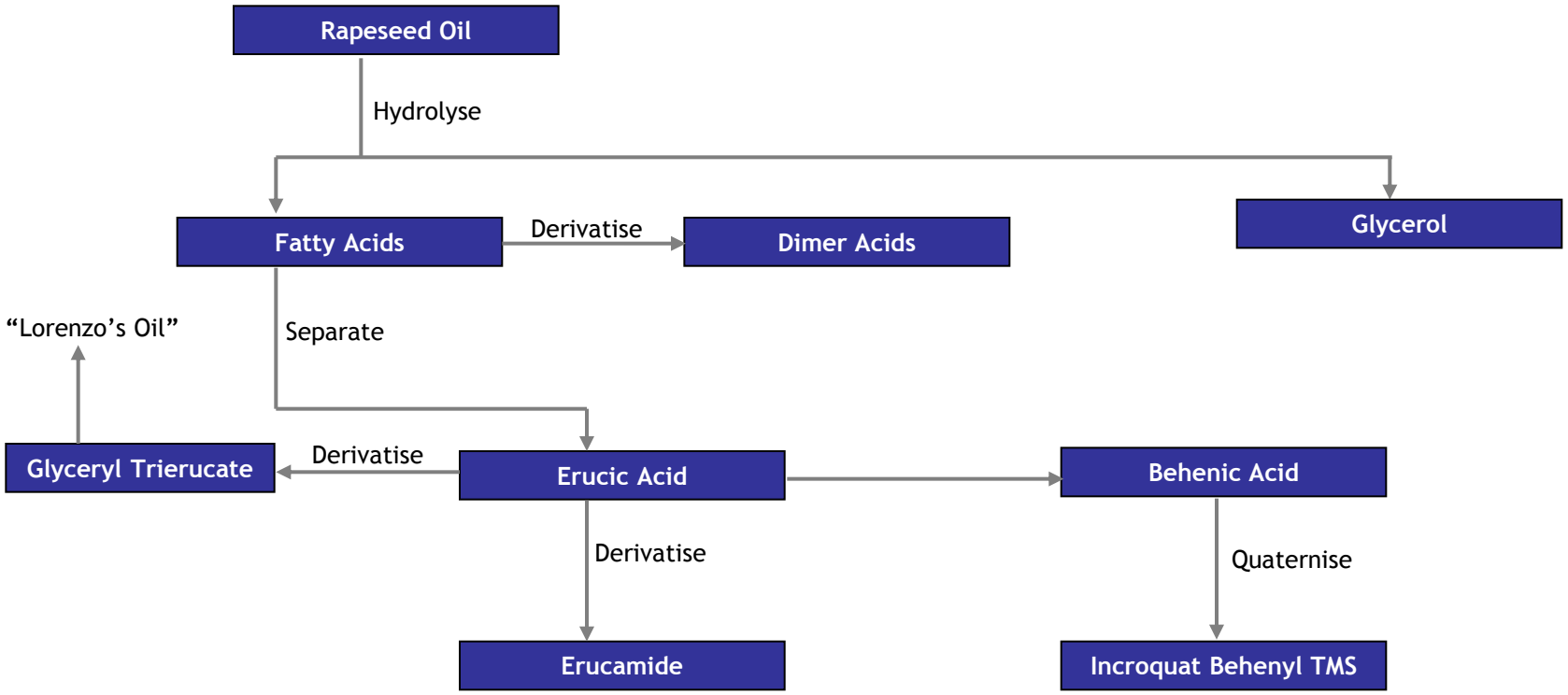
Enterprise Technology

The Science of Innovation

Fish Oil

CRODA

Rapeseed Oil



Enterprise Technology
The Science of Innovation

Adrenoleukodystrophy (ALD)

- Late 1980s approached by Augusto Odone for a source of high purity erucic acid
- Requested to treat his son Lorenzo, who suffered from Adrenoleukodystrophy disease (ALD)
- Croda developed a biologically active derivative

CRODA

Amazonian Oils


Cupuaçu


Castanha do Brazil


Maracujá


Pequi

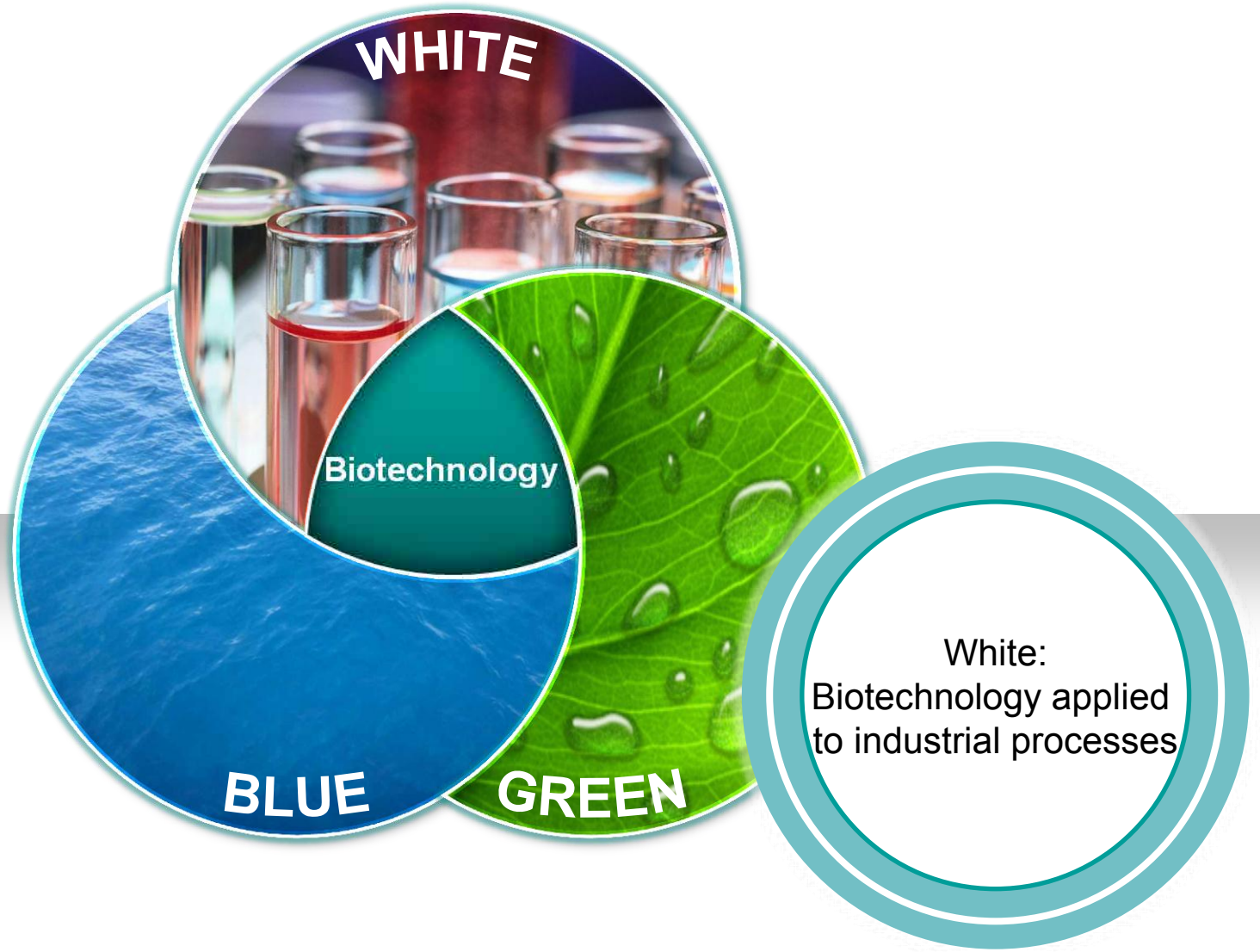

Andiroba


Babassu


Murumuru

Crodamazon Oils
and
Hydramazon Derivatives
for
Cosmetic Applications

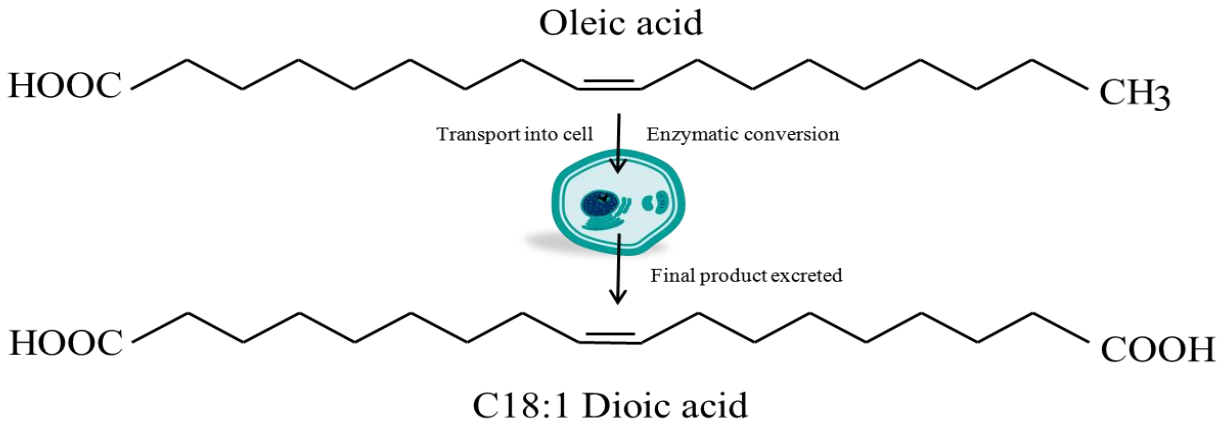
Bio-innovation at Croda



Enterprise Technology
The Science of Innovation

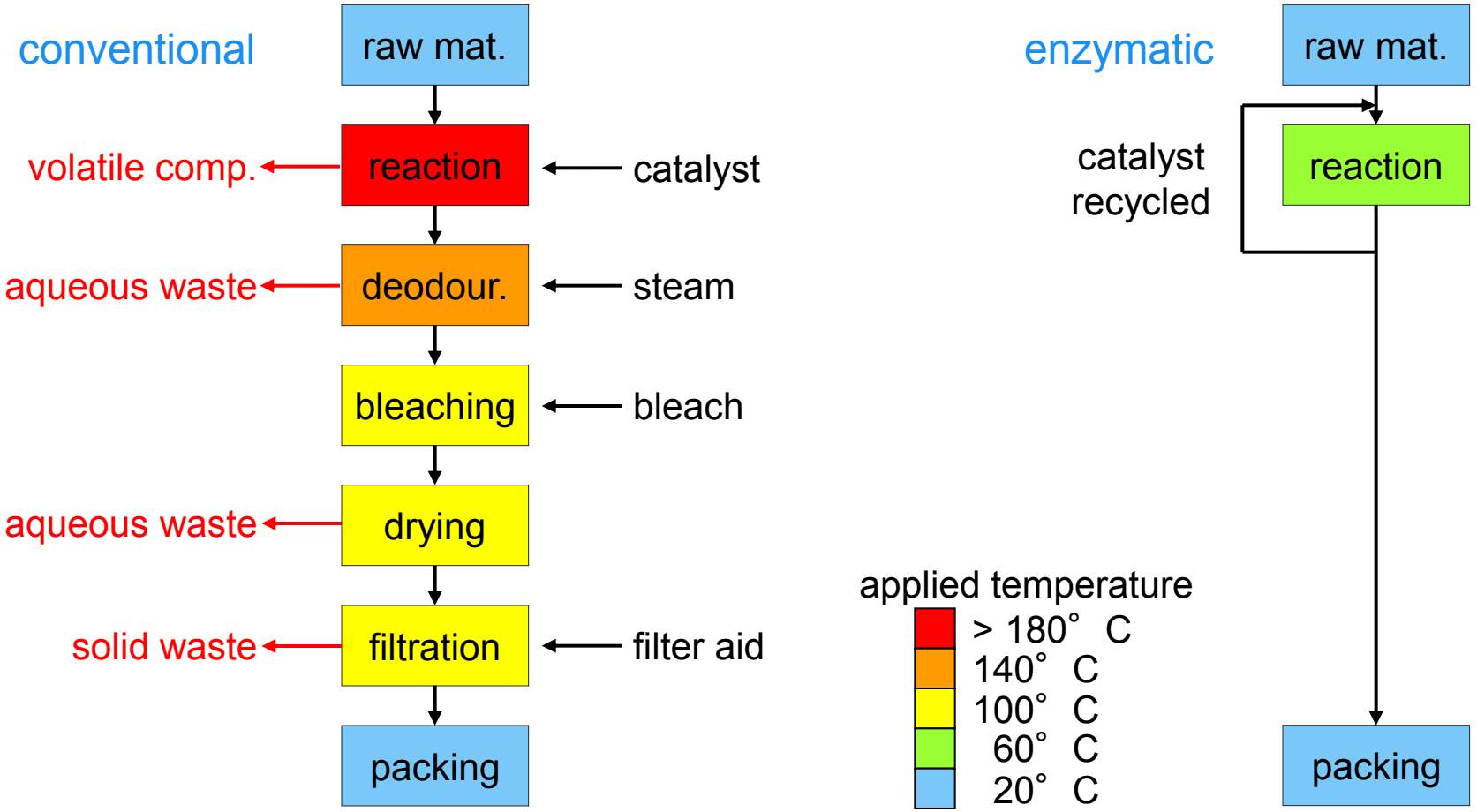
White Biotechnology

- ODA White
  - A skin lightening active marketed by Sederma.
  - Based on oleic acid (C18:1) conversion to ω-dioic acid.
  - An otherwise very difficult chemical conversion.
  - Conversion carried out by yeast biotransformation.



CRODA

White biotechnology - biocatalysis



Enterprise Technology
The Science of Innovation

Why is Biocatalysis of interest?

- Remove need for chemical / metal catalysts
- Lower operating temperatures
  - Less energy consumption – lower CF
  - Less discolouration
  - Reduction / elimination of post-processing
- Higher specificity (fewer side reactions)
  - Higher yield
  - Reduction / elimination of post-processing

CRODA

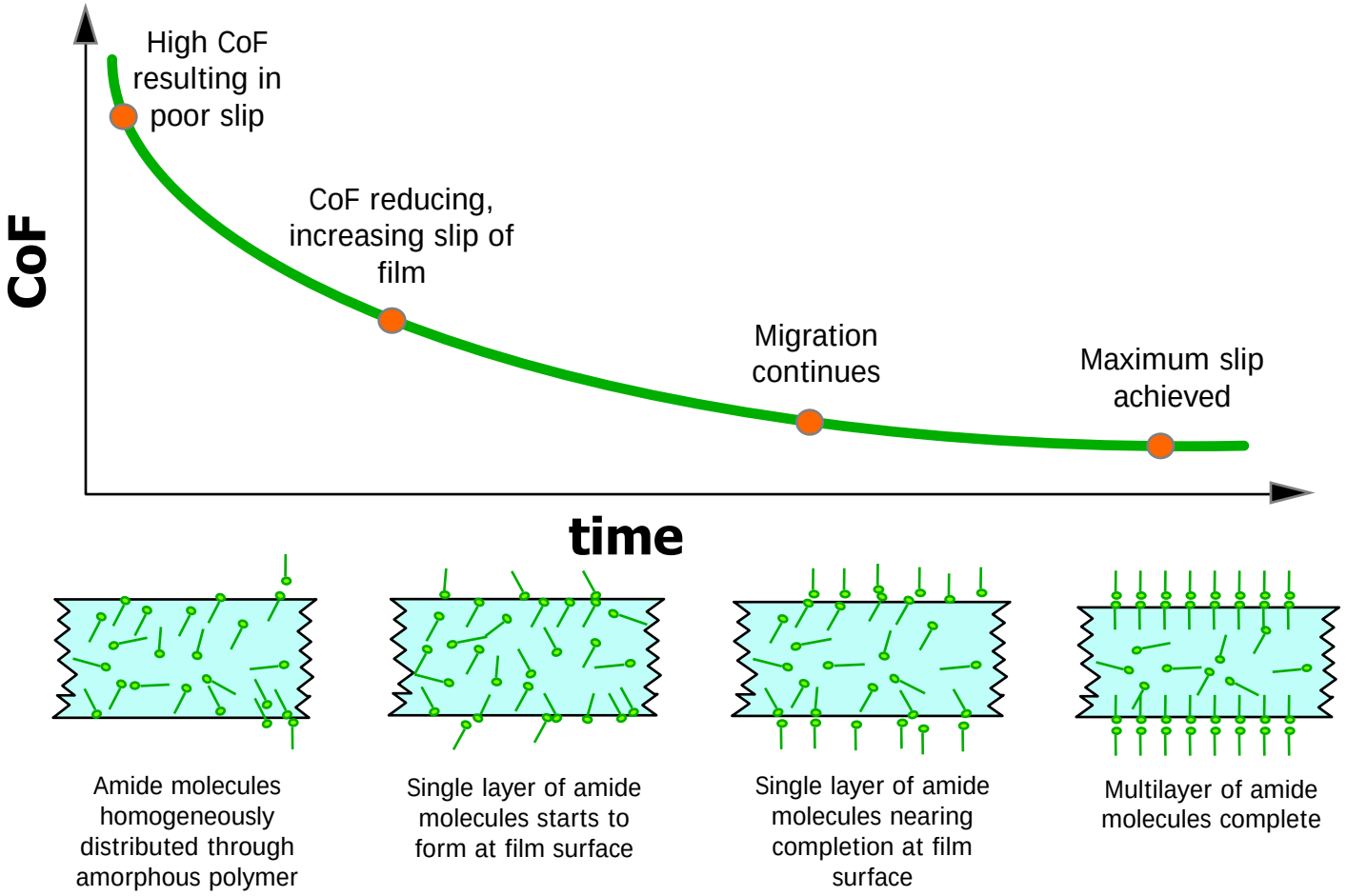
Enterprise Technology
The Science of Innovation

Amides – polymer applications

- Polymer surfaces often exhibit high friction
- High friction can result in difficulties with:
  - Winding of film rolls
  - Bag production
  - Packaging operations
  - Mold release
- Amides offer slip

CRODA

How amides offer slip

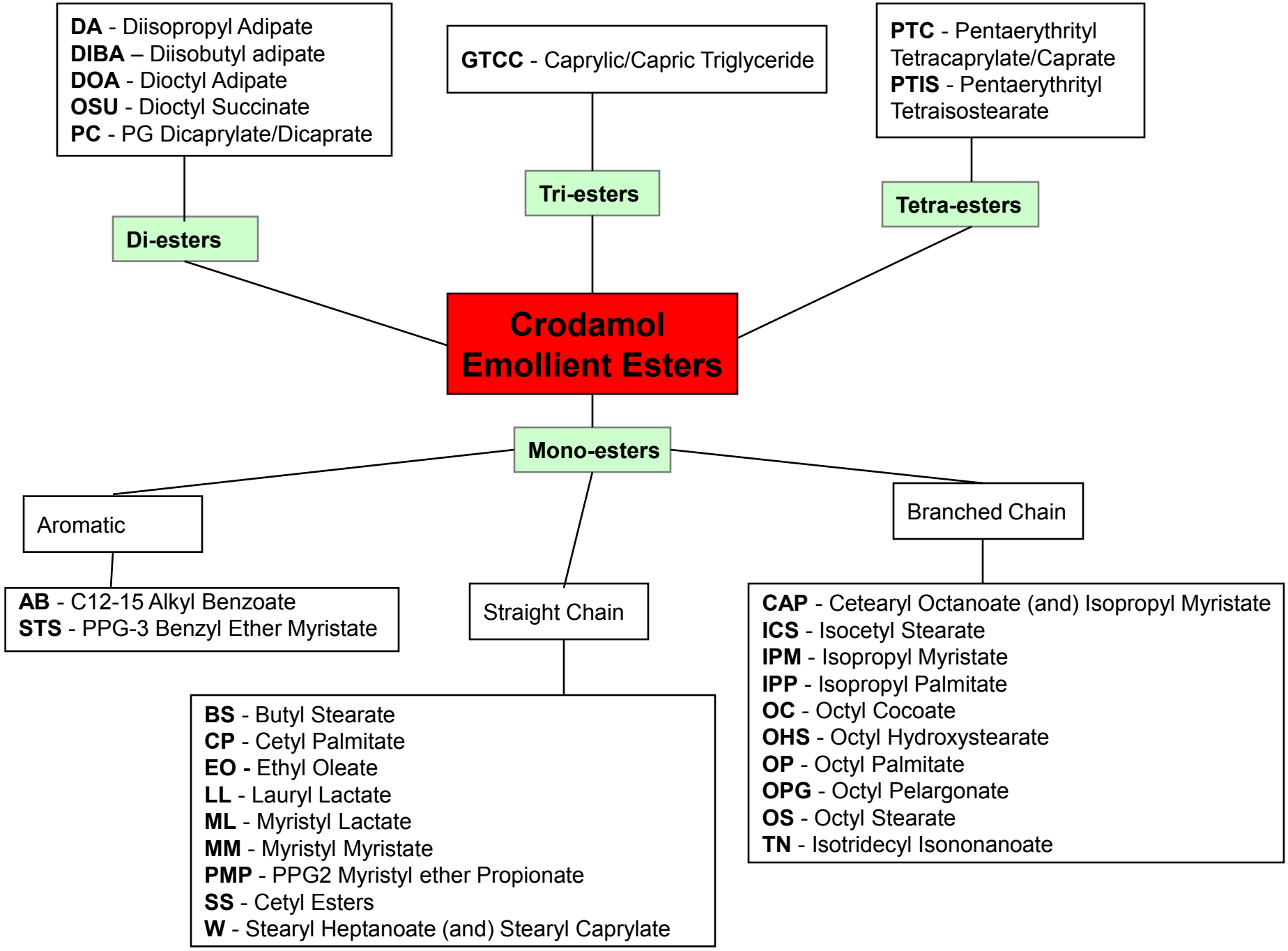


Enterprise Technology
The Science of Innovation

Bioesters

- Customers use esters as emollients
- An emollient is a product that impart softness and/or smoothness to the skin
  - Moisturisation (plumping of the corneocytes)
  - Lubrication (decrease of the rough feel)

CRODA


DA - Diisopropyl Adipate
DIBA – Diisobutyl adipate
DOA - Dioctyl Adipate
OSU - Dioctyl Succinate
PC - PG Dicaprylate/Dicaprate
GTCC - Caprylic/Capric Triglyceride
PTC - Pentaerythrityl Tetracaprylate/Caprate
PTIS - Pentaerythrityl Tetraisostearate
Di-esters
Tri-esters
Tetra-esters
Crodamol Emollient Esters
Mono-esters
Aromatic
Branched Chain
AB - C12-15 Alkyl Benzoate
STS - PPG-3 Benzyl Ether Myristate
Straight Chain
CAP - Cetearyl Octanoate (and) Isopropyl Myristate
ICS - Isocetyl Stearate
IPM - Isopropyl Myristate
IPP - Isopropyl Palmitate
OC - Octyl Cocoate
OHS - Octyl Hydroxystearate
OP - Octyl Palmitate
OPG - Octyl Pelargonate
OS - Octyl Stearate
TN - Isotridecyl Isononanoate
BS - Butyl Stearate
CP - Cetyl Palmitate
EO - Ethyl Oleate
LL - Lauryl Lactate
ML - Myristyl Lactate
MM - Myristyl Myristate
PMP - PPG2 Myristyl ether Propionate
SS - Cetyl Esters
W - Stearyl Heptanoate (and) Stearyl Caprylate

Enterprise Technology

The Science of Innovation

Ester properties

- Molecular weight
- Melting point
- Spreadability
- Skin penetration
- Moisturisation
- Barrier repair
- Smoothening
- Dispersability
- Solubility

CRODA

Enterprise Technology
The Science of Innovation

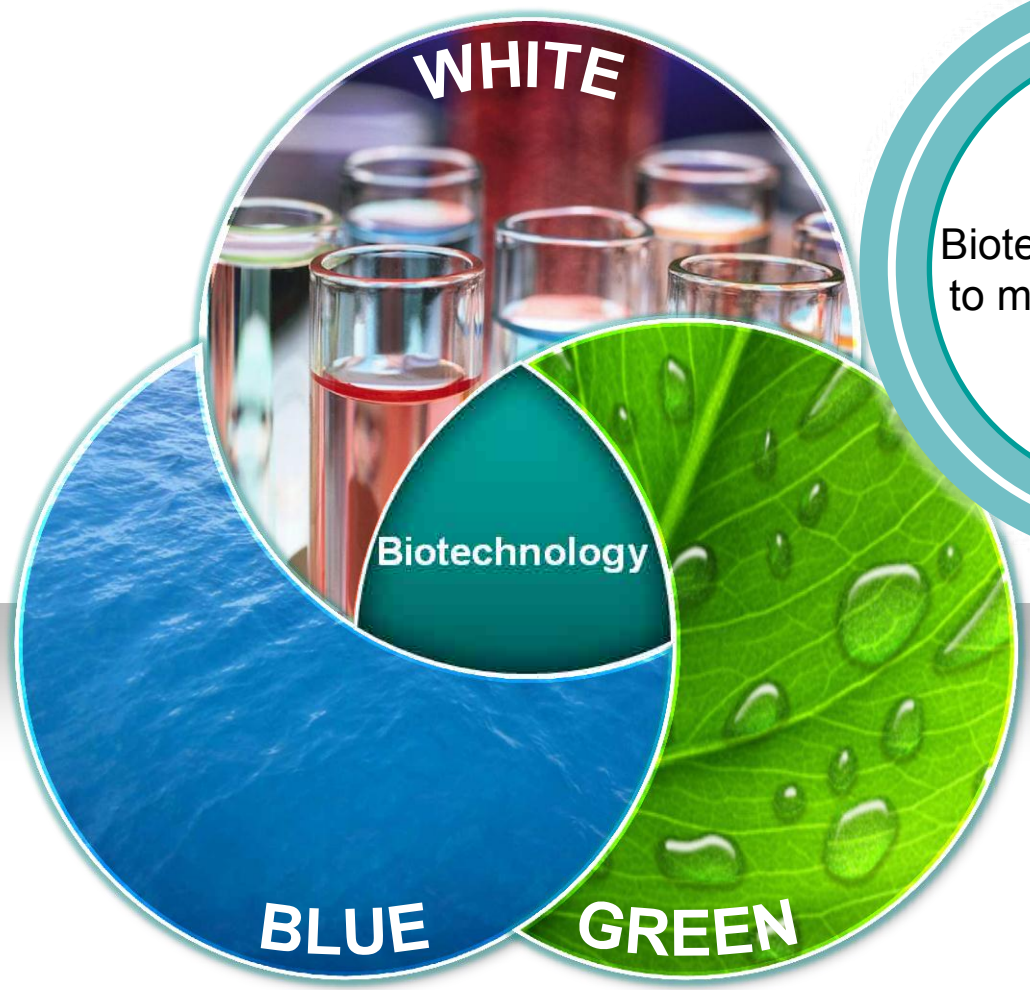
Typical Esterification conditions

$$RCO_2H + R'OH \rightleftharpoons RCO_2R' + H_2O$$

- Equilibrium forced to rhs by removal of water
- Carried out in hot oil reactors
- Batch sizes – 5, 10 & 20 MT
- High reaction temps (>230 C)
- Variety of metal catalysts
- Vacuum & Nitrogen

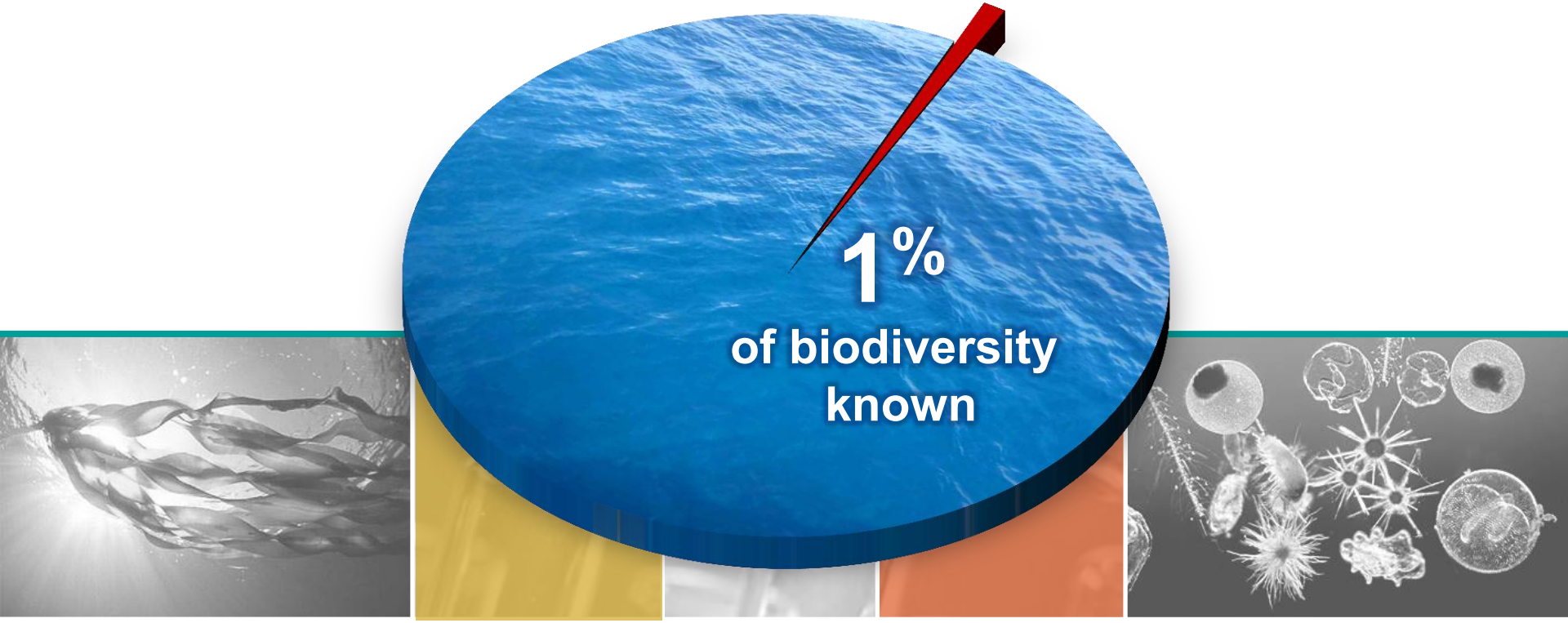
CRODA

Bio-innovation at Croda



Blue:
Biotechnology applied to marine and aquatic applications

Blue Biotechnology

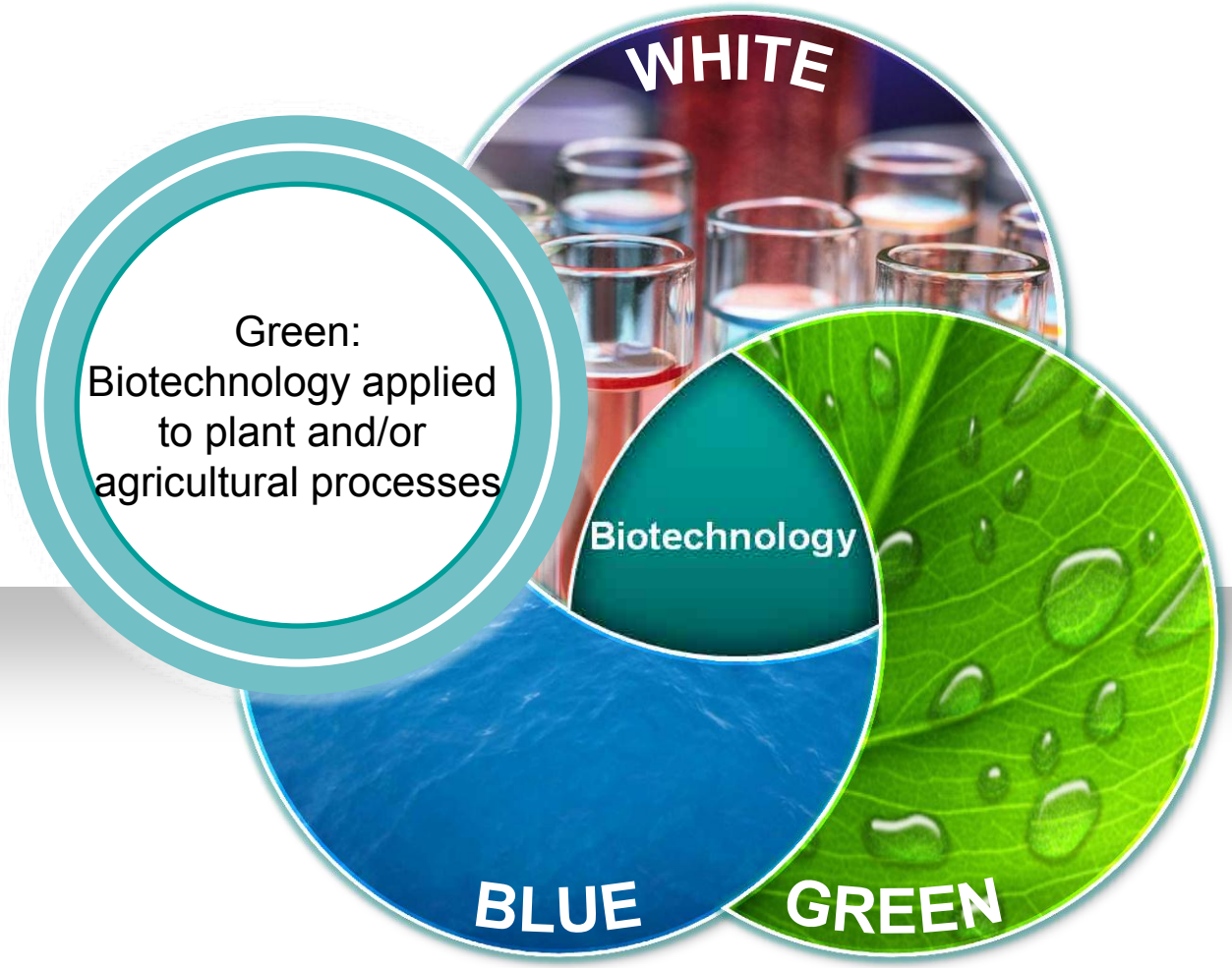


Enterprise Technology
The Science of Innovation

Blue Biotechnology

- Venuceane
- Extract of a deep sea microbe
- Enzyme with multi anti-oxidant activity
- Anti-ageing effects for skin care.

Bio-innovation at Croda

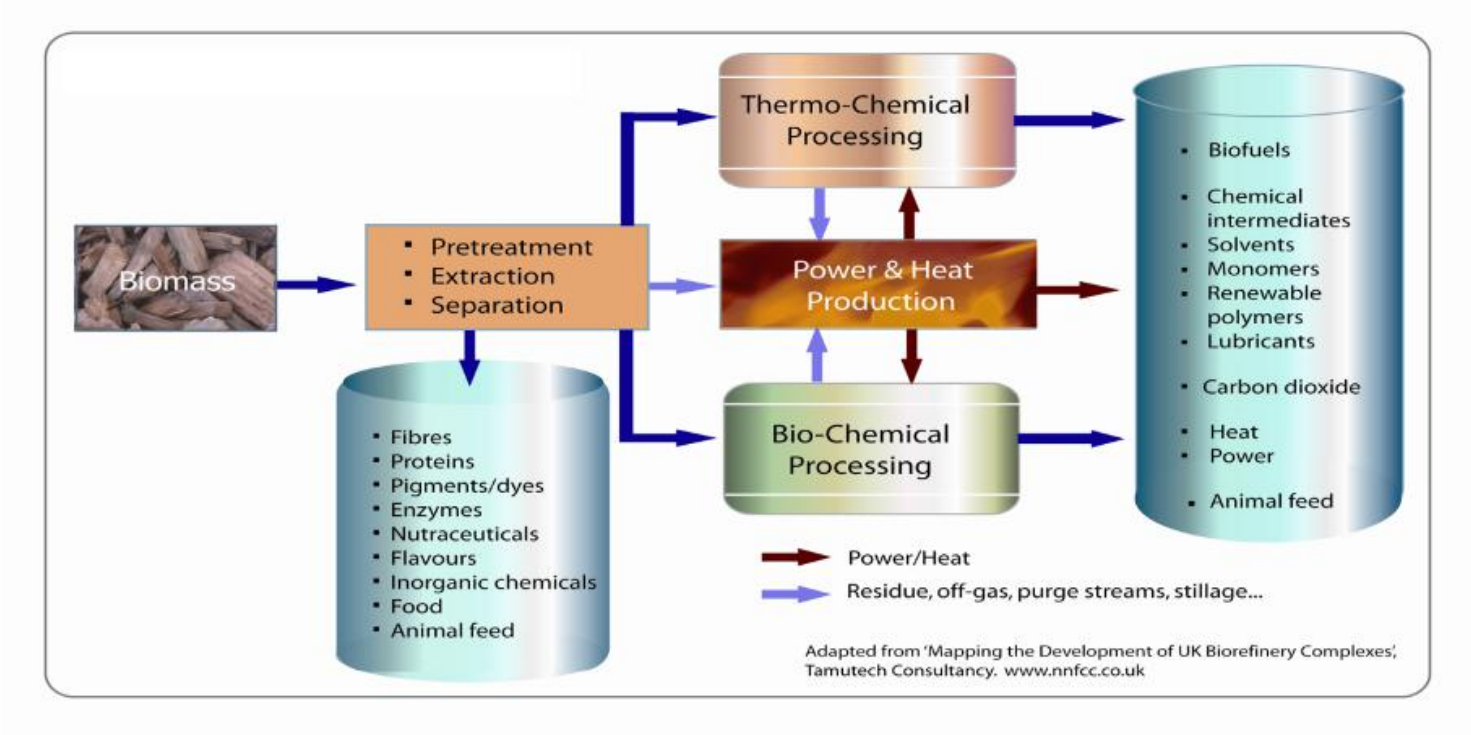


Green Biotechnology

Enterprise Technology
The Science of Innovation

Biorefinery Interests at Croda

- The use of biomass to generate speciality ingredients.
- Supporting the Integrated Biorefinery Technology Initiative (IBTI)



CRODA

Enterprise Technology
The Science of Innovation

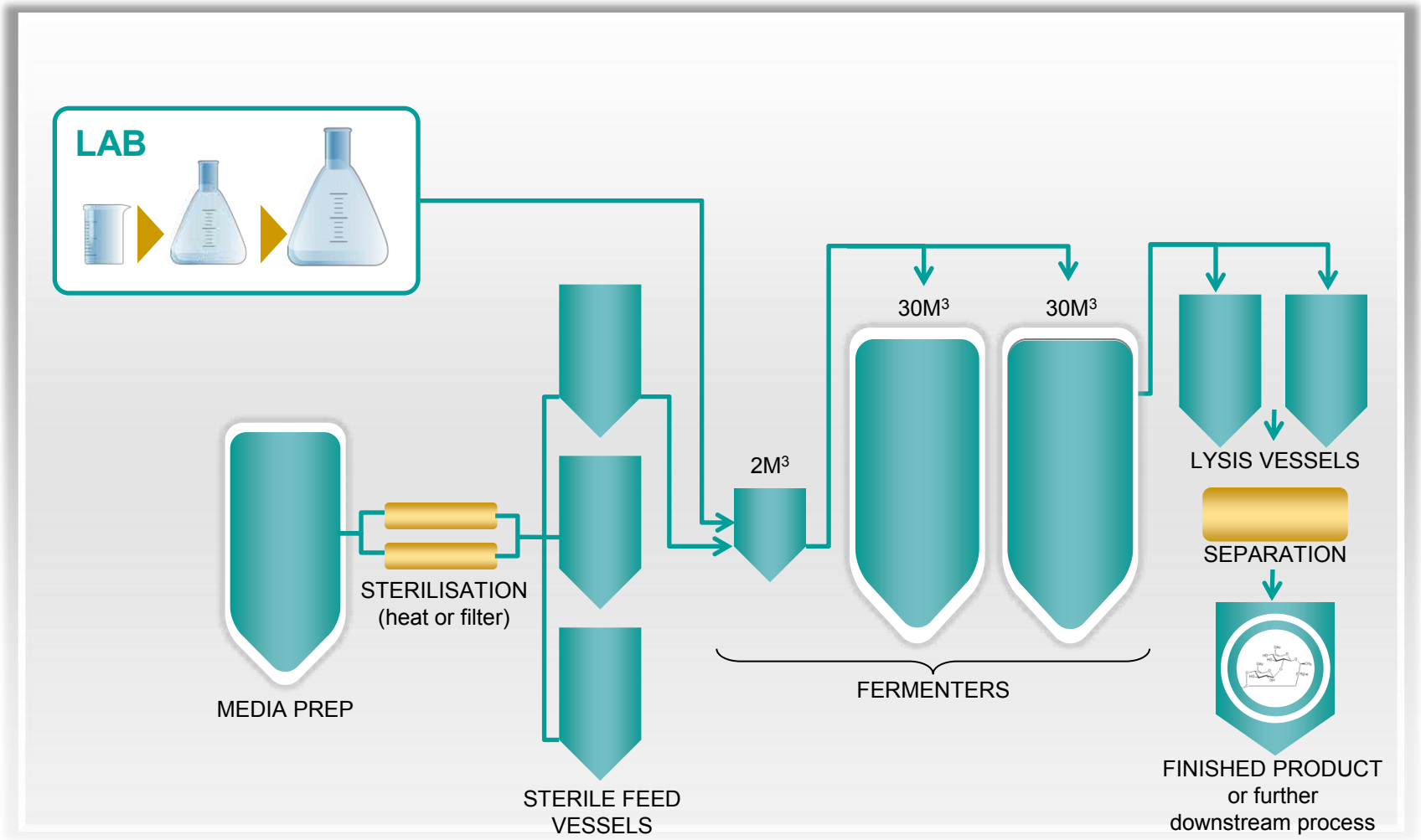
New feedstocks

- Algae
- DDGS
- Cereal crops
- Lignocellulose
- Rape seed meal
- Fruit & Vegetable waste

CRODA

New Bio-Manufacturing Unit

Bio-plant Capability Overview



Enterprise Technology
The Science of Innovation

Ideal business model

What would the ideal sustainable manufacturing business look like?

- based on nature's raw materials, harvested in a sustainable manner
- raw materials would be converted by carbon neutral processes
- finished products would have unique performance characteristics which were IP protected and for which the customers were prepared to pay a premium
- finished products would be fully biodegradable after use

Croda is as close as any to this model…..

CRODA

Developing Sustainable Technologies

Thank you

Dr **Damian Kelly**
Damian.kelly@croda.com

CRODA