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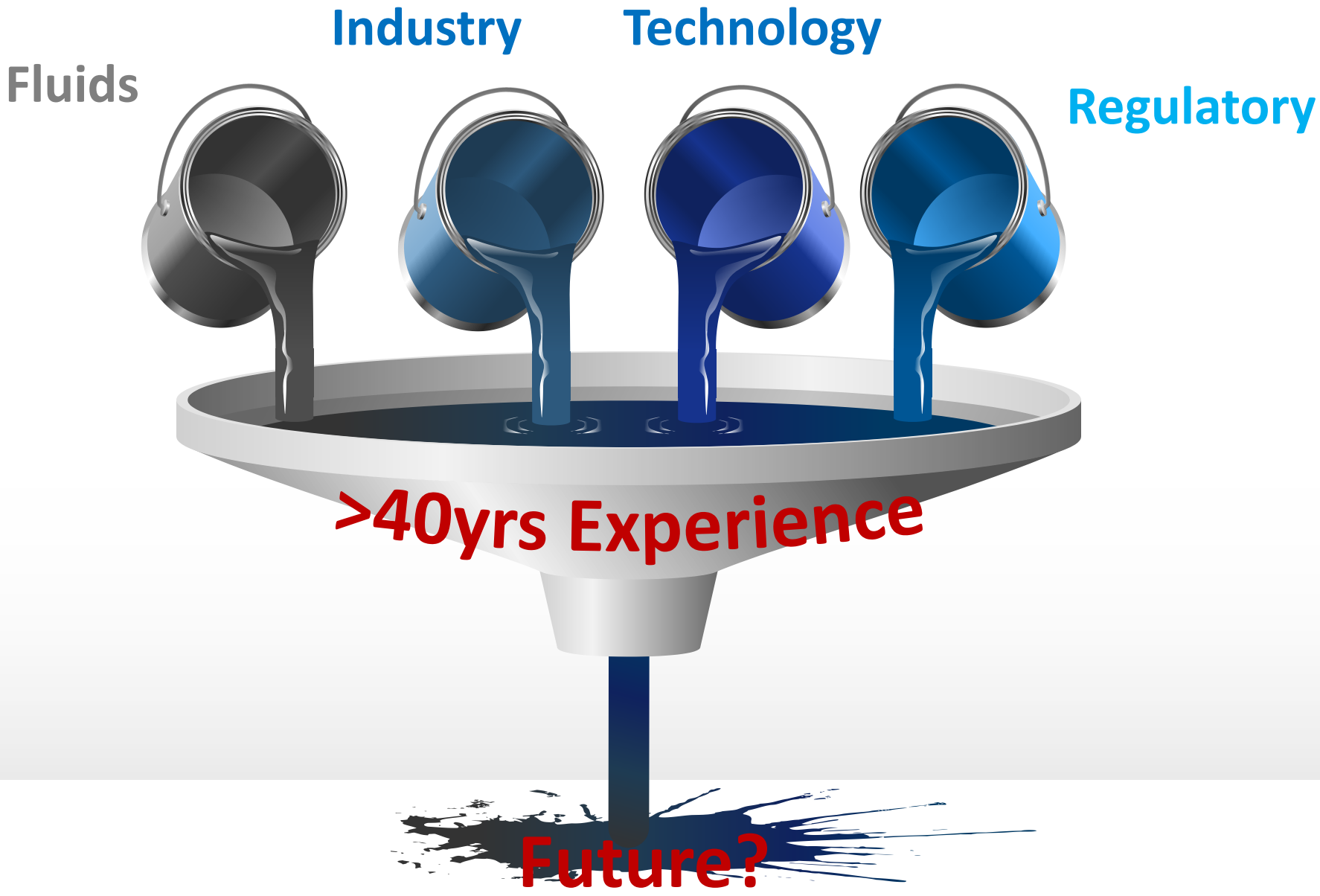
OFFSHORE SOLUTIONS

SUBSEA PRODUCTION CONTROL FLUIDS – PAST, PRESENT & FUTURE

SUT
Society for Underwater Technology

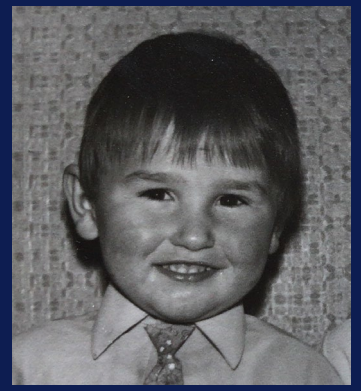
SUBSEA CONTROLS DOWN UNDER 2024

Subsea Production Control Fluids - Past, Present & Future



INFORMAL DISCLAIMER!

PAST



MacDermid Offshore Solutions has been developing and supplying Subsea Production Control Fluid since the 1970s

Dates & details are as accurate as records and recollection allows!

PRESENT

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OVERVIEW

Industry Trends

Case Study: HIGH WATER 500

Lessons Learnt

Today’s Challenges

Future Hopes

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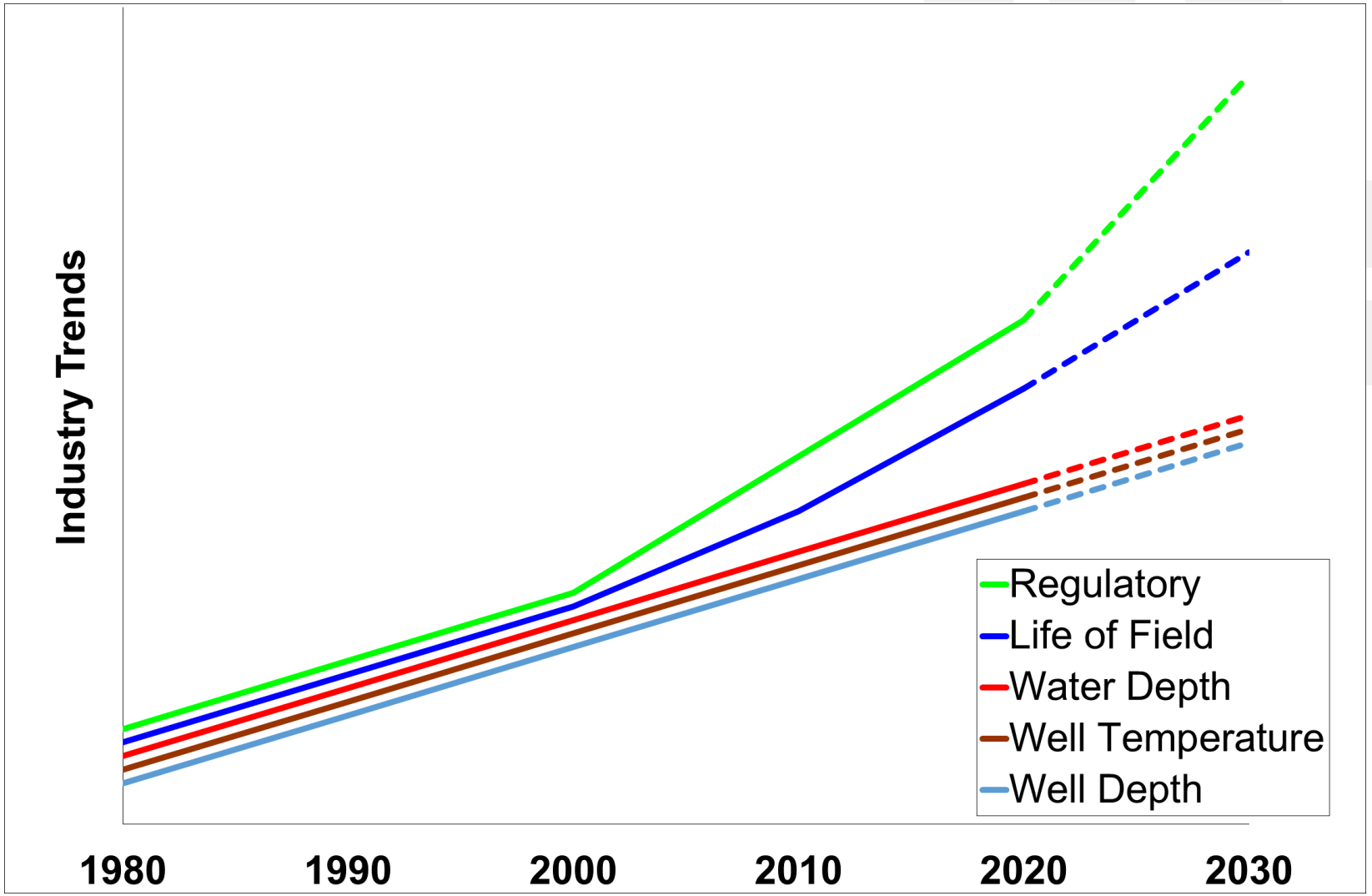
INDUSTRY TRENDS



Artist's impression,
Not to scale!

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REGULATORY - ENVIRONMENTAL

- **Hydraulic fluid impact on marine ecosystem**
  - Depletion of dissolved oxygen in ocean

- **Hydraulic fluid impact on marine life**
  - Ability of species to biodegrade chemicals
  - Potential of chemicals to bioaccumulate in species
  - Toxicity of chemicals to marine life

Minimise discharge during operations

Use more environmentally acceptable chemicals

REGULATORY - CHEMICALS

- **REACH Regulations**
  - Protection of human health and the environment from the risks that can be posed by chemicals
  - Registration, Evaluation, Authorisation & Restriction of Chemicals

Downgrading of Chemicals & Removal from market

LIFE OF FIELD

- **PAST (1970 – 2000s)**
  - 10 to 20 years
  - Frequent maintenance & repair
  - Assets beyond anticipated service life

Pioneering times
Technology development and improvement.
Accidents and lessons learnt

- **PRESENT (2010-2020s)**
  - 25 to 40 years
  - Planned maintenance & repair
  - Management of Ageing / Late-Life Operations
  - Repurposing (CCUS) & Decommissioning

Mature Industry
Reliability and Asset integrity improved. Legislative framework for Duty Holder

- **FUTURE (2030 onwards)**
  - > 40 years
  - Leaner system design with reliability
  - Less frequent maintenance & repair

Mature/declining Industry
Dwindling resources?
Challenging locations & environments?

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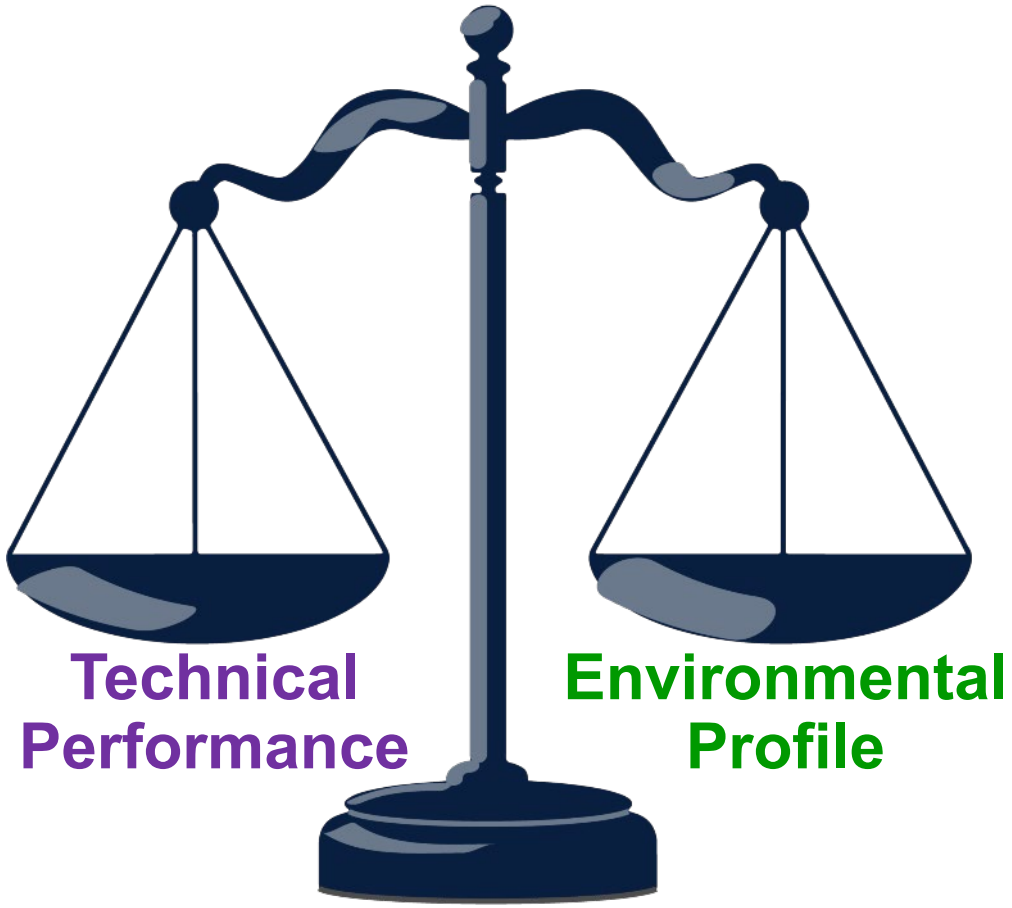
WATER / WELL DEPTH & TEMPERATURE

- **NORTH SEA**
  - Water Depth: Average 90m, maximum 700m
  - Well Depth: Up to 3000 m
  - Reservoir Temperature: 70-120°C (Captain, Alba…). Some HP/HT> 150°C
- **GULF OF MEXICO**
  - Water Depth: Average 1600m, maximum >5000m
  - Well Depth: 1000m
  - Reservoir Temperature: wide range. Some HP/HT> 150°C
- **AUSTRALIA**
  - Water Depth: Shelf <200m, otherwise >1000m
  - Well Depth: 3000m & more
  - Well Temperature: wide range. HP/HT> 150°C

INDUSTRY CHALLENGES AND DRIVERS



- **Environmental Regulations**: Minimize amount and impact of chemicals discharged to the marine environment.
- **Operational Temperature Range**: Favoured fluids challenged by widening operational range.
- **Equipment Reliability & Compatibility**: Fluids used in modern and legacy open and closed loop subsea control systems. Longer field life desired

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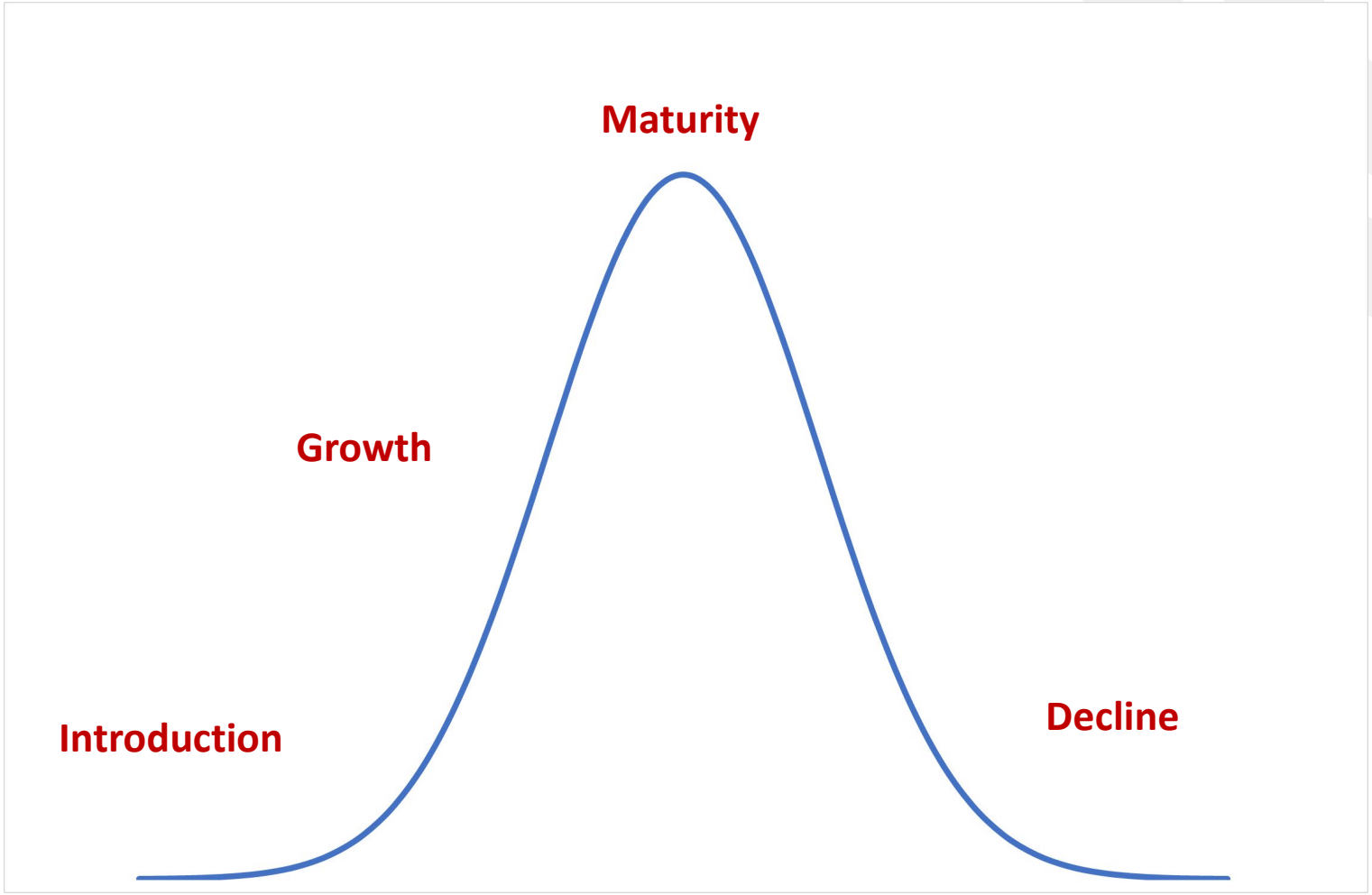
TEXTBOOK PRODUCT LIFECYCLE….



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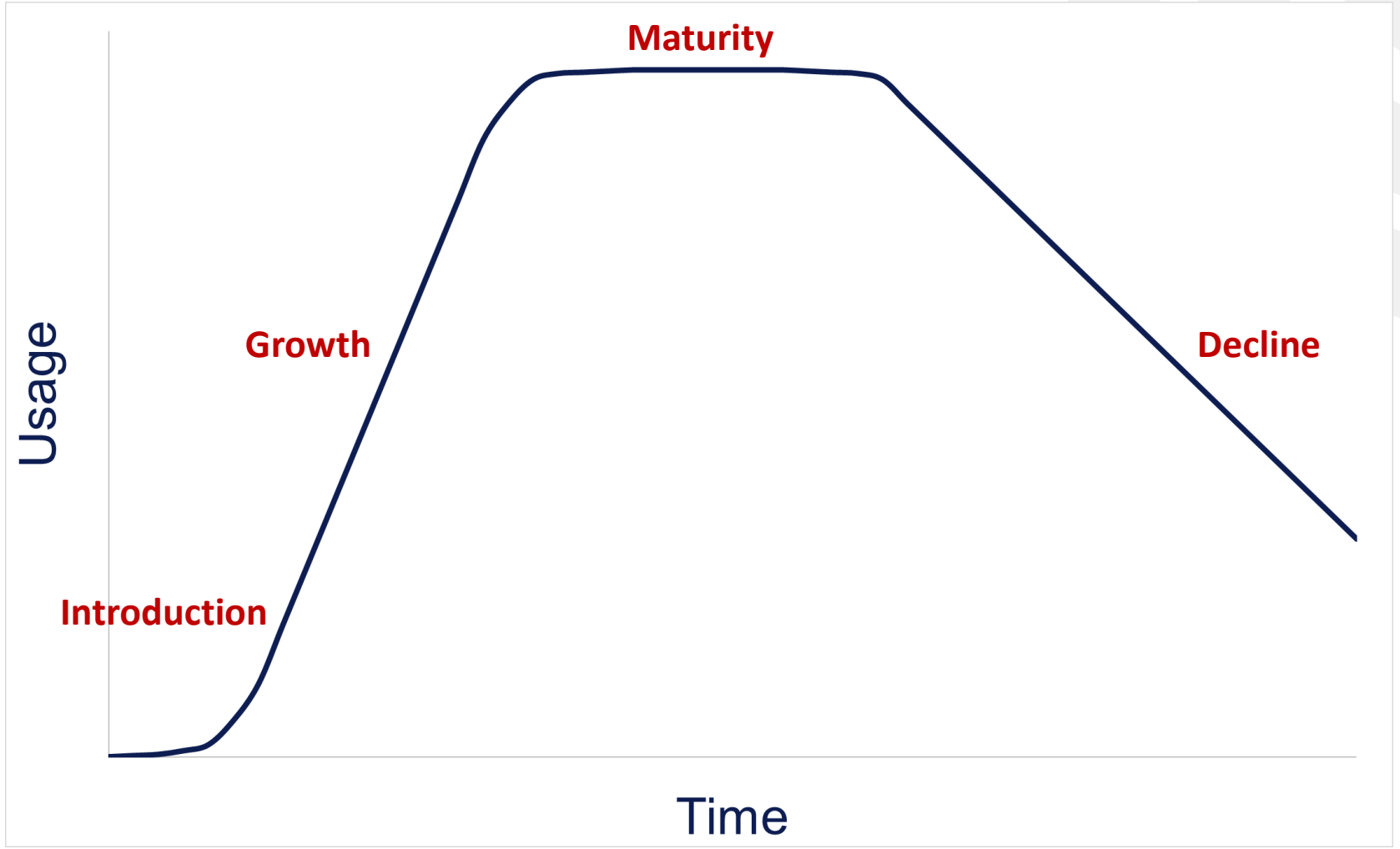
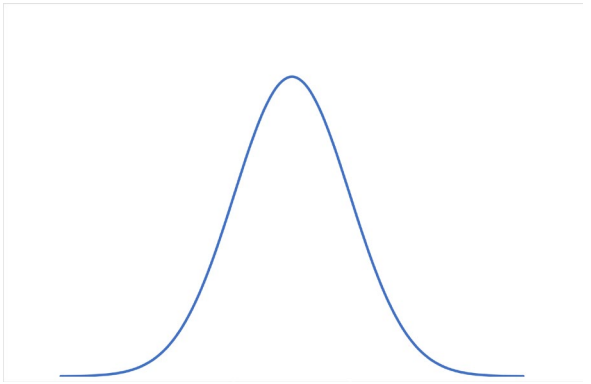
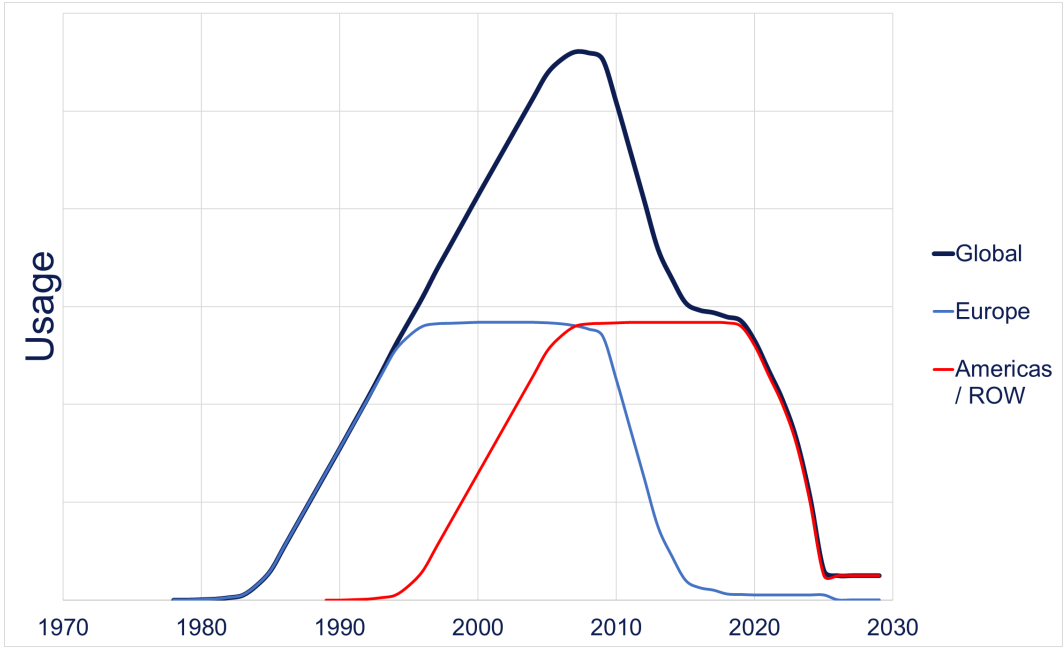
CONTROL FLUID LIFECYCLE….





CASE STUDY – HIGH WATER 500

- Introduction: Europe late-1970s, Americas/ROW mid-1980s
- Growth: > 300 projects world-wide in 2000
- Maturity: Market leading product from 1990 to 2010
- Decline: Europe from 2000, Americas/ROW mid-2010s
- Phase out : 2025 onwards



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CASE STUDY – HIGH WATER 500

- Growth & Maturity:
  - Best product available in a growing market
  - Exceeded Technical performance requirements.
  - Met Environmental regulations
  - Preferred fluids of OEMs & operators
- Decline:
  - Overtaken by Environmental regulations
  - New chemical regulations impacting raw material availability
  - Not suitable for high temperature operations

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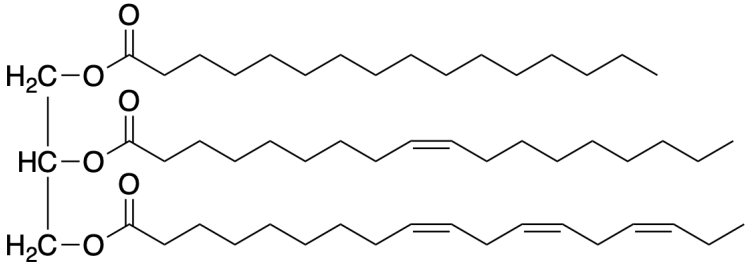
LESSONS LEARNT

- Goal posts will move!

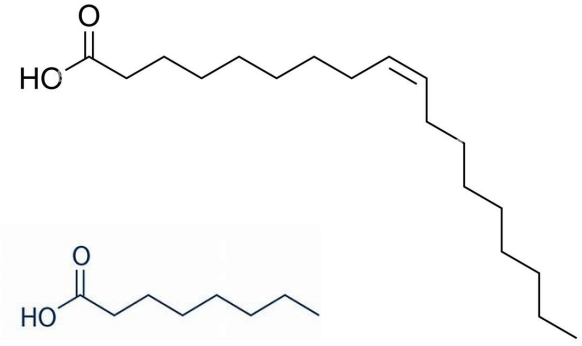
- Today's fluids may not meet tomorrow's requirements:
  - Technical performance (stability, compatibility, thermal limits…)
  - Regulatory (chemical & environmental)
  - Availability (raw materials…)

CHALLENGES

- Using chemicals from natural, renewable and sustainable sources is favoured
- Chemicals assessed based on aquatic toxicity, biodegradation and bioaccumulation potential
- Natural products are available for metabolic processes (i.e., food) but this can be considered as bioaccumulation (i.e., given sub warnings)



Fat - Triglyceride



Fatty Acid

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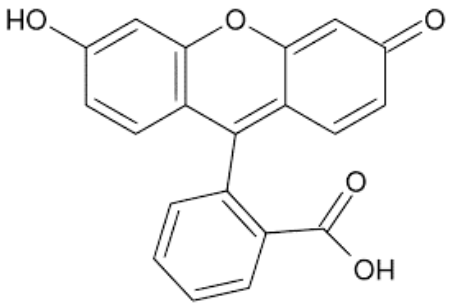
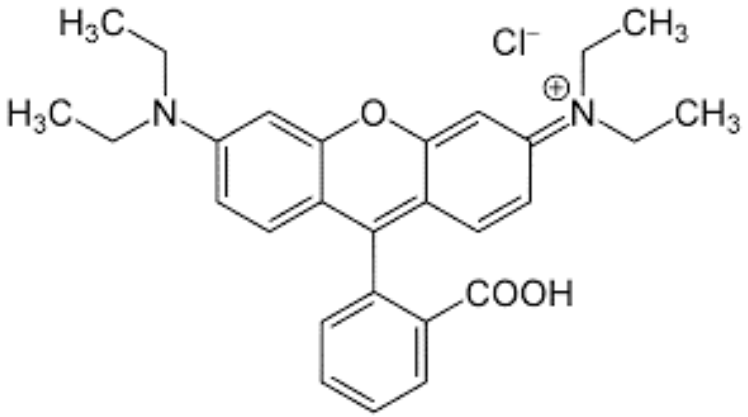
CHALLENGES

- Dyes & Environmental Acceptance?
- Poor Biodegradation & Substitution warnings

Yellow Dye

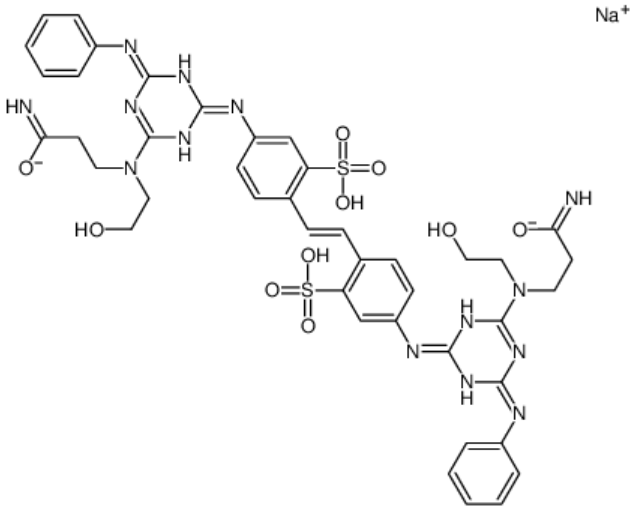


Red Dye



Na+

Clear Dye



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FUTURE HOPES

- Environmental Regulations catch up
- Environmental Compliance (Low Toxicity and High Biodegradability)
- Chemical regulations don’t restrict commercial availability/cost
- Control Fluids for high temperature operation (>150°C)
- Control Fluids exceed field life predictions

NEW ENVIRONMENTAL CONTROL FLUIDS

- Chemicals from natural/renewable/sustainable sources favoured
- High biodegradability to meet Norwegian preferences
- Stable up to 190°C / 374°F
- Operational temperature range:<-30°C to 180°C (-22°F to 356°F)
- Accepted/Qualified by OEMs
- Available with different levels of glycol for freeze protection & hydrate resistance
- Available with or without dye for identification & leak tracing

UV lamp

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