# Synthetic and Vegetable Oils The More Sustainable Future in Lubricant Market

Cargill

## Sustainability
- Key trends
- Cargill approach

## The role of esters

## The future

# Several Manufacturing Sites

## Local and Personalized Supply

# Sustainability

# Sustainability drivers

**Customer “pull” for more sustainable products, regulatory “push” to meet strict targets**

**Regulatory Requirements**
Our customers need to comply with regulations preventing use of toxic substances.

**Mandatory/policy**


**Conscious stakeholders**
Our customers want to reduce the environmental impact of their products in measurable ways

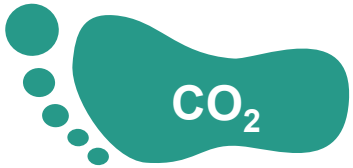
**Voluntary**

# Regulatory drivers

## Global ambition towards a more sustainable future


Source - https://euinasean.eu/eu-green-deal/

# Key themes

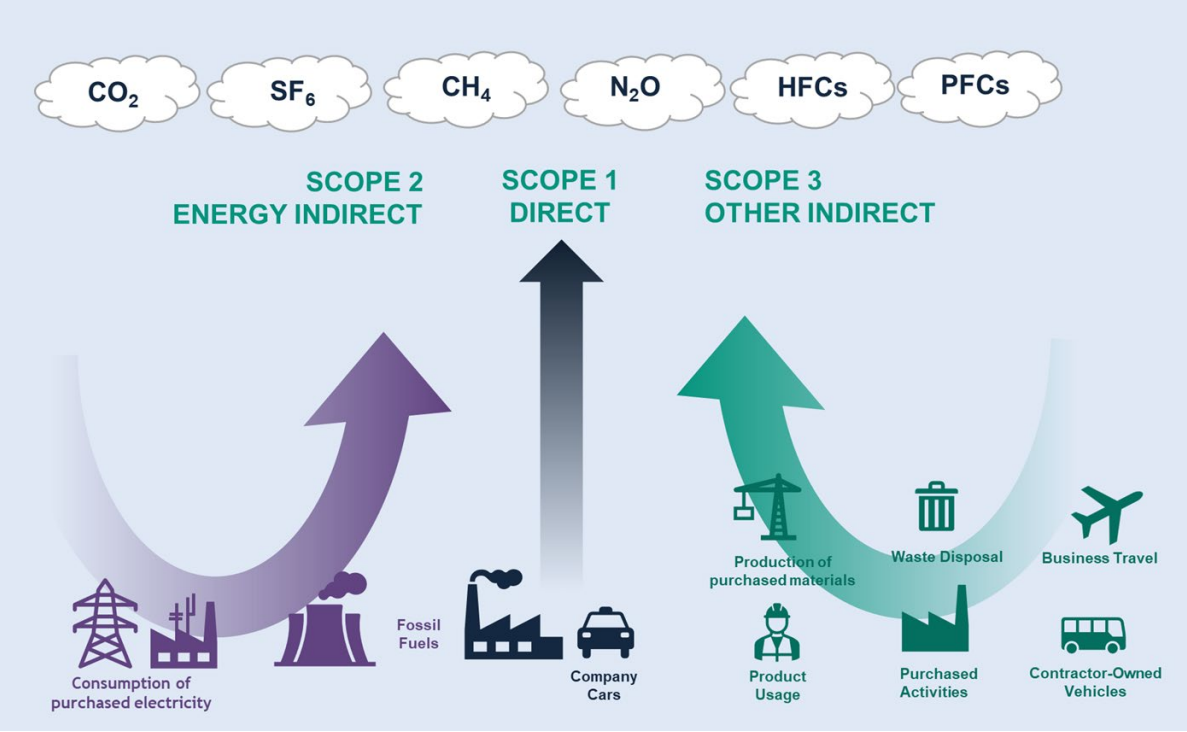



- Decarbonisation
- Reducing carbon emissions
- Carbon footprints

- Responsible sourcing
- Supplier conduct
- Origins

- Circular economy
- Recycling

# Carbon emissions and footprints



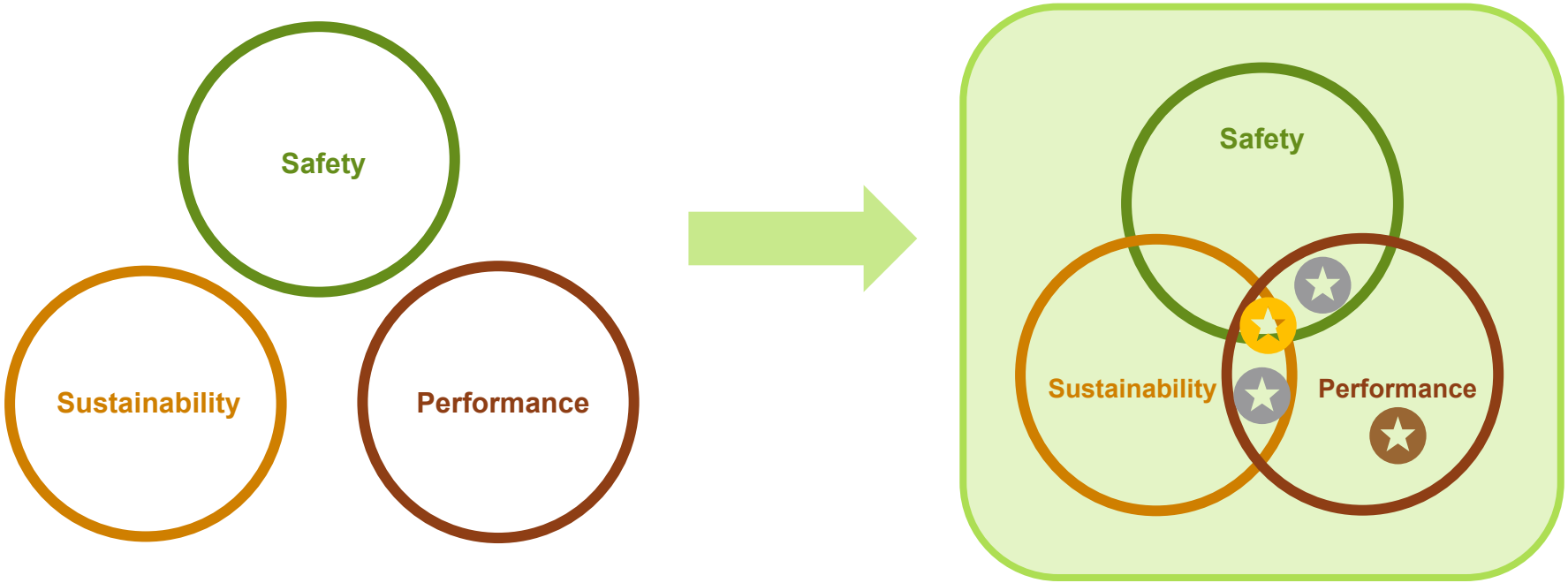

Scope 1 and 2 emissions can be reduced at a corporate level

- Switch to purchasing renewable electricity
- Installing renewable energy on site

Scope 3 emissions are much more challenging to address.

# Sustainability at Cargill – Our approach

## Bringing together safety*, sustainability* and performance*




* Every product would not necessarily have all points

# We strive for use of bio-based raw materials

- **Renewable** or ***bio-based*** feedstocks can help drive down material carbon footprints

- Cultivating crops to produce bio-based feedstocks allows for **carbon sequestration** and mitigates $CO_2$ emissions

**Renewable can be used to describe raw materials and energy**

**Bio-based raw materials are derived from living organisms or "biomass" e.g. crops, wood or algae**

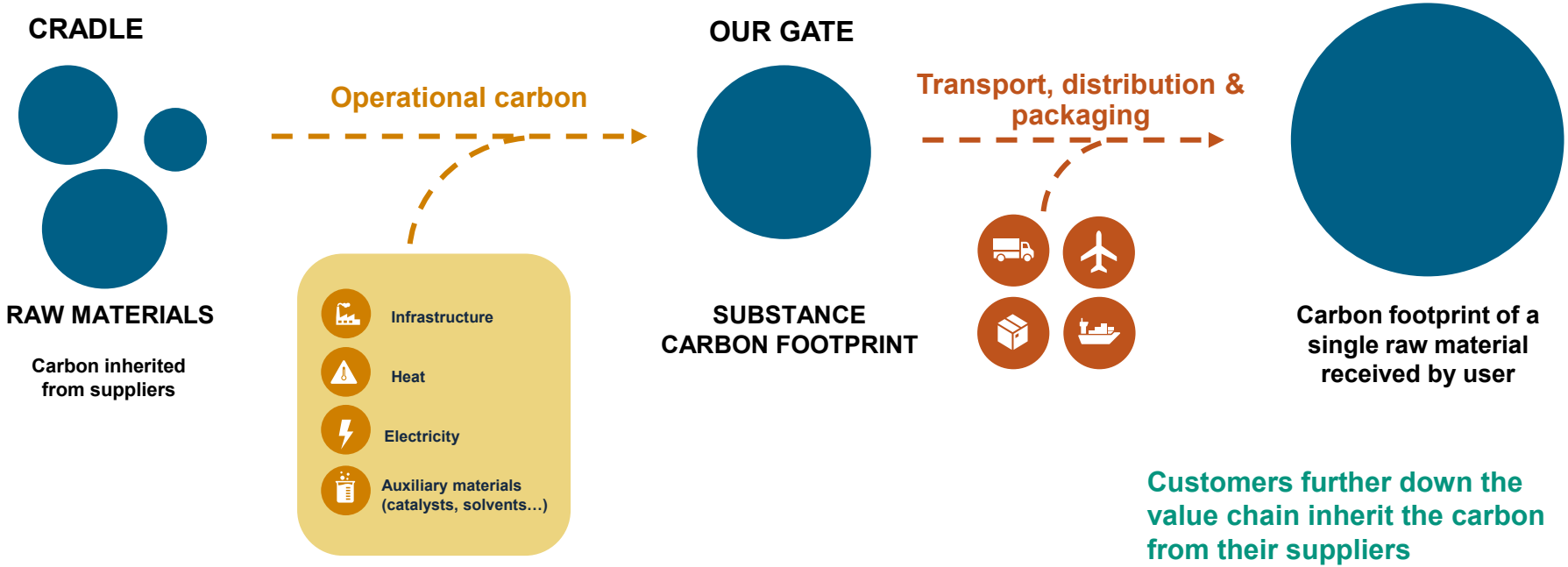
# Measuring bio-based content

**How do we measure the amount of bio-based carbon present in a material?**

| Standard method | What does it calculate? | Notes |
|---|---|---|
| ASTM D6866 | Renewable carbon as a % of organic carbon | Needed for European certifications such as OK Bio-based and for USDA Bio Preferred Program. |
| EN 16640 | Renewable carbon as a % of total (inorganic + organic) carbon | Takes into account inorganic (fossil) ingredients e.g. $CaCO_3$ |
| EN 16785-1 | Renewable C, H, N, O as % or the total mass | Bio-based content, not bio-based carbon content |

# Where does carbon come from?

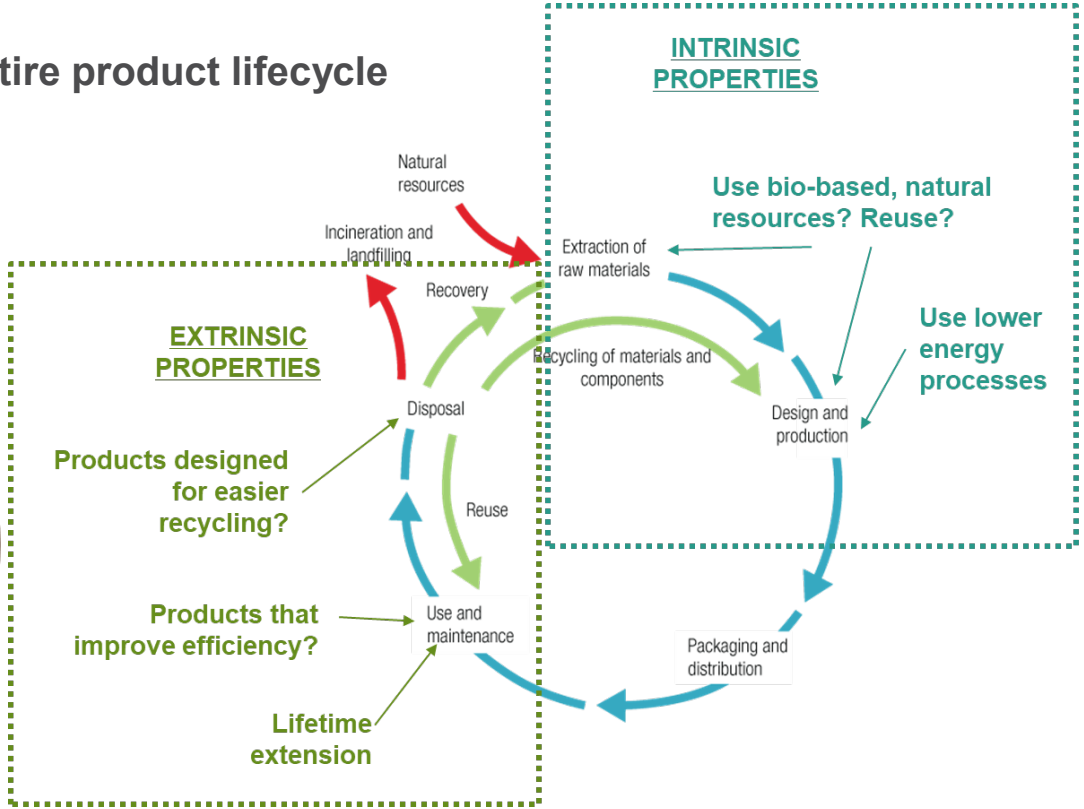
**Consider the manufacture of a bio-based or synthetic lubricant base oil:**




**Customers further down the value chain inherit the carbon from their suppliers**

# But carbon footprint is only one consideration…

**It is important to look at the entire product lifecycle**

# Performance is still key for product success…

## Our products help customer meet their sustainability goals

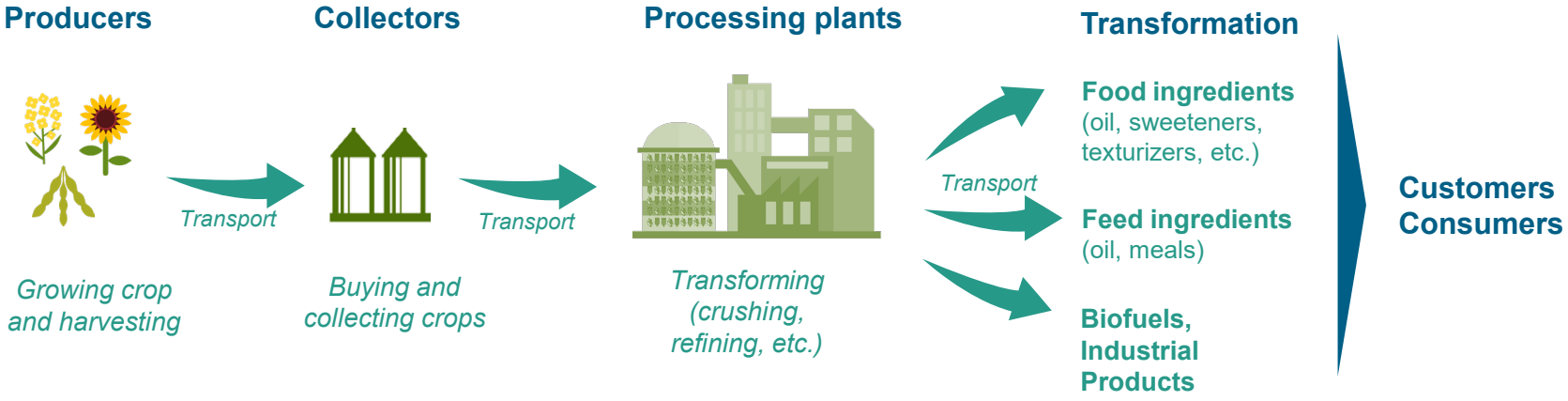




* Every product would not necessarily have all points

# Vegetable Oils

# Vegetable Oils




**Operating sustainable supply chains**

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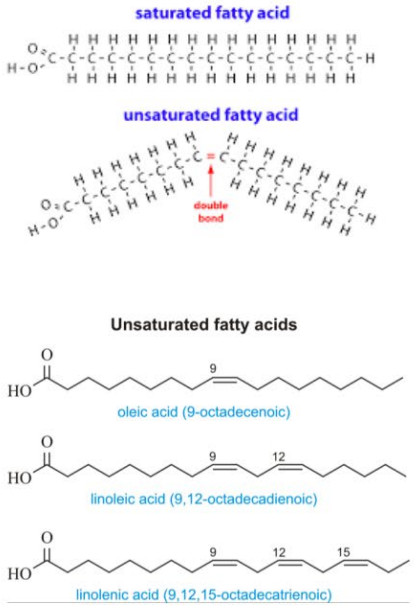
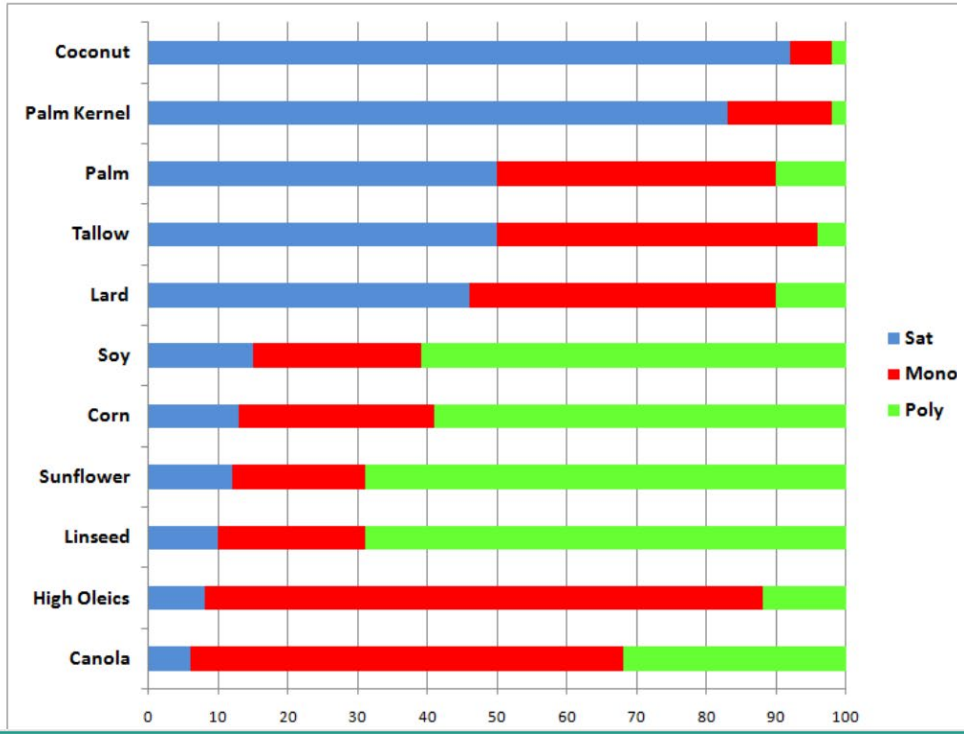
- Promoting responsible agricultural practices
- Respect people and human rights
- Reducing environmental impact
- Ensuring economic viability
- Producing safe and healthy products

# Vegetable Oils

## Types and composition




**Sell into**
**focused categories**

- Paints/Inks/Coatings
- Dielectric Fluids
- Lubricants
- Oilfield Chemicals
- Industrial Chemicals
- Adjuvants
- Consumer Products
- Flexible Foams
- Construction

# The role of esters

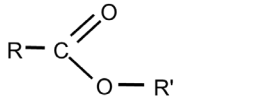
# Esters provide unrivaled formulation flexibility….

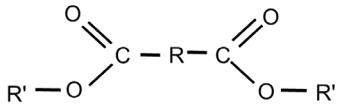
## There are many different types of esters…

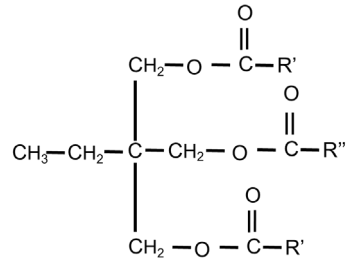
**Natural esters** - oils and fats (rapeseed, sunflower oil, coconut oil, palm oil, tallow, lard etc.)

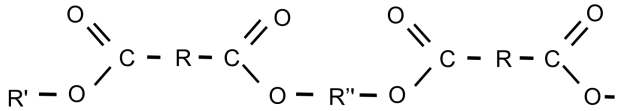
**Synthetic oleochemical esters** (esters completely or partially derived from raw materials from natural raw materials – glycerol trioleate, TMP trioleate)

**Petrochemical esters** (derived only from petrochemical raw materials – di-isotridecyl adipate)



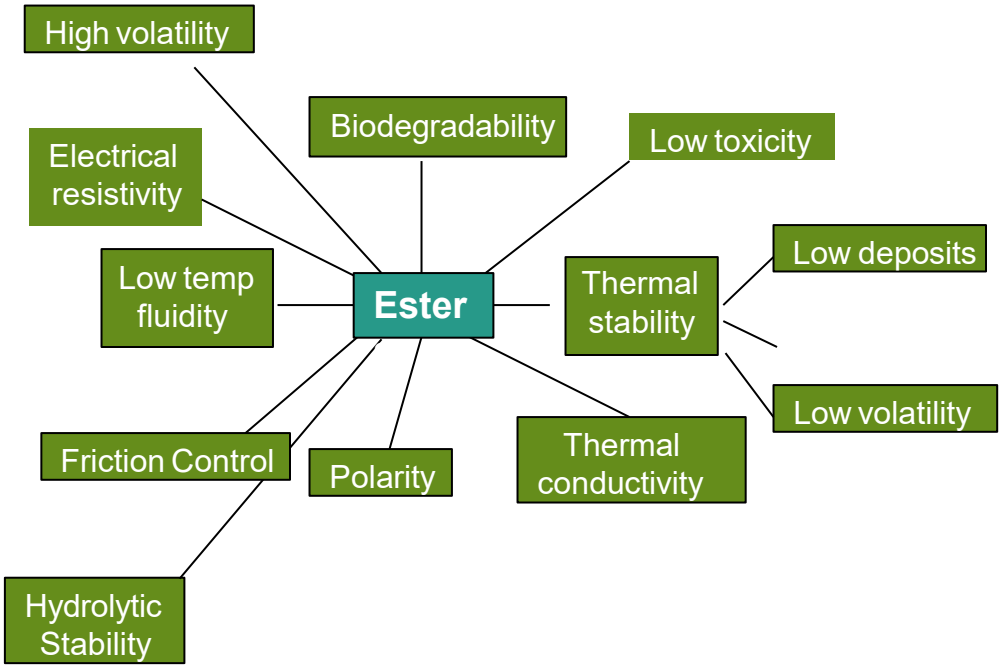






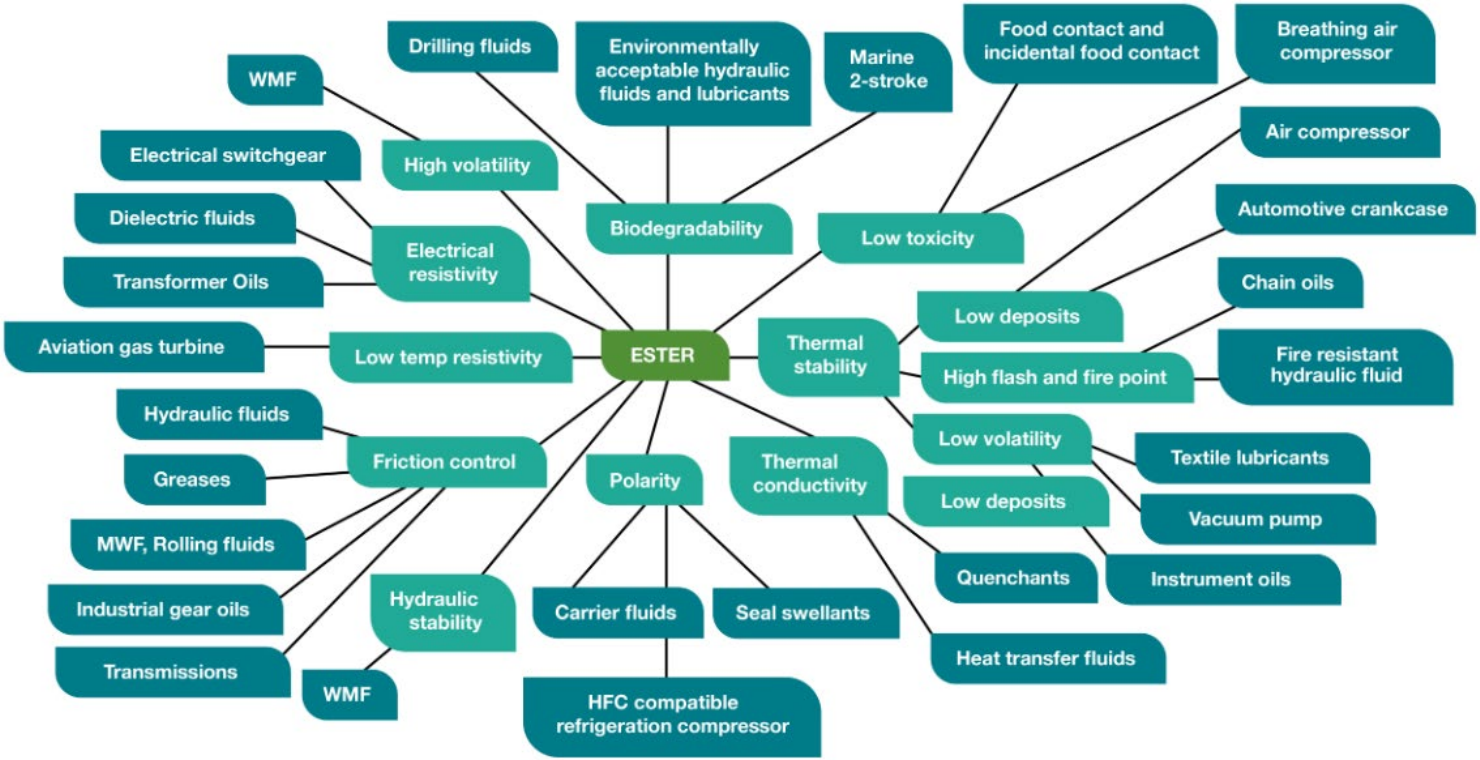
# Esters provide unrivaled formulation flexibility….

## … and are designed to have specific properties!



# Esters provide unrivaled formulation flexibility….

## … aligned to the application.



# Comparison of base oil properties

| | Group I | Group II | Group III | Group IV | Naphthenic | Vegetable Esters | Petro-chemical esters | Synthetic Oleo Esters | PAGs |
|---|---|---|---|---|---|---|---|---|---|
| Viscosity Range (40$^{O}$C) | 10 - 460 | 22 - 100 | 22 – 46 | 5 – 10000 | 9 - 400 | 30 - 50 | 5 - 320 | 2 – 50,000 | 10 - 165000 |
| Viscosity Index | + | ++ | ++ | +++ | ----- | ++++ | ++++ | ++++ | +++++ |
| Noack Volatility | + | ++ | +++ | ++++ | ++ | | +++++ | +++++ | ++ |
| Low Temp Performance | ++ | ++ | +++ | +++++ | + | + | +++++ | ++++ | ++++ |
| Oxidation Stability | ++ | ++ | +++ | ++++ | ++ | ----- | +++++ | + to ++++ | +++ |
| Solvency / Additive Compatibility | ++++ | ++ | --- | --- | +++++ | +++++ | +++++ | +++++ | -- |
| Biodegradability | ----- | ----- | ----- | ---- | ----- | +++++ | +++++ | +++++ | ----- |
| Renewability | ----- | ----- | ----- | ----- | ----- | +++++ | ------ | ++++ | ---- |

# The future of esters