Technology with innovation

TECHNICAL PRESENTATION
ON
VALUE ADDITION TO BY-PRODUCTS GENERATED IN OIL REFINING BY PRODUCING OLEOCHEMICALS

By

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DVC PROCESS TECHNOLOGISTS

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INTRODUCTION

- **DVC Process Technologists** headquartered at Pune is a Technology & Innovation driven company that offers comprehensive processing solution for Edible Oil and Fats, Oleo chemicals & Biodiesel industries.
- Company established with the drive to update the inefficient processing plants on Technological & energy efficiency front. Own **ISO Certified manufacturing facility with CE certification.**
- Provides turnkey solutions for establishing new green field projects as well as upgradation of existing processing facilities
- Competent team for handling the tasks related to new projects as well as upgradation and services.
- 260+ references world over including 60 green field projects with byproducts processing lecithin & soap stock acidulation.
- Successfully executed and running multi-feed stock Biodiesel plant

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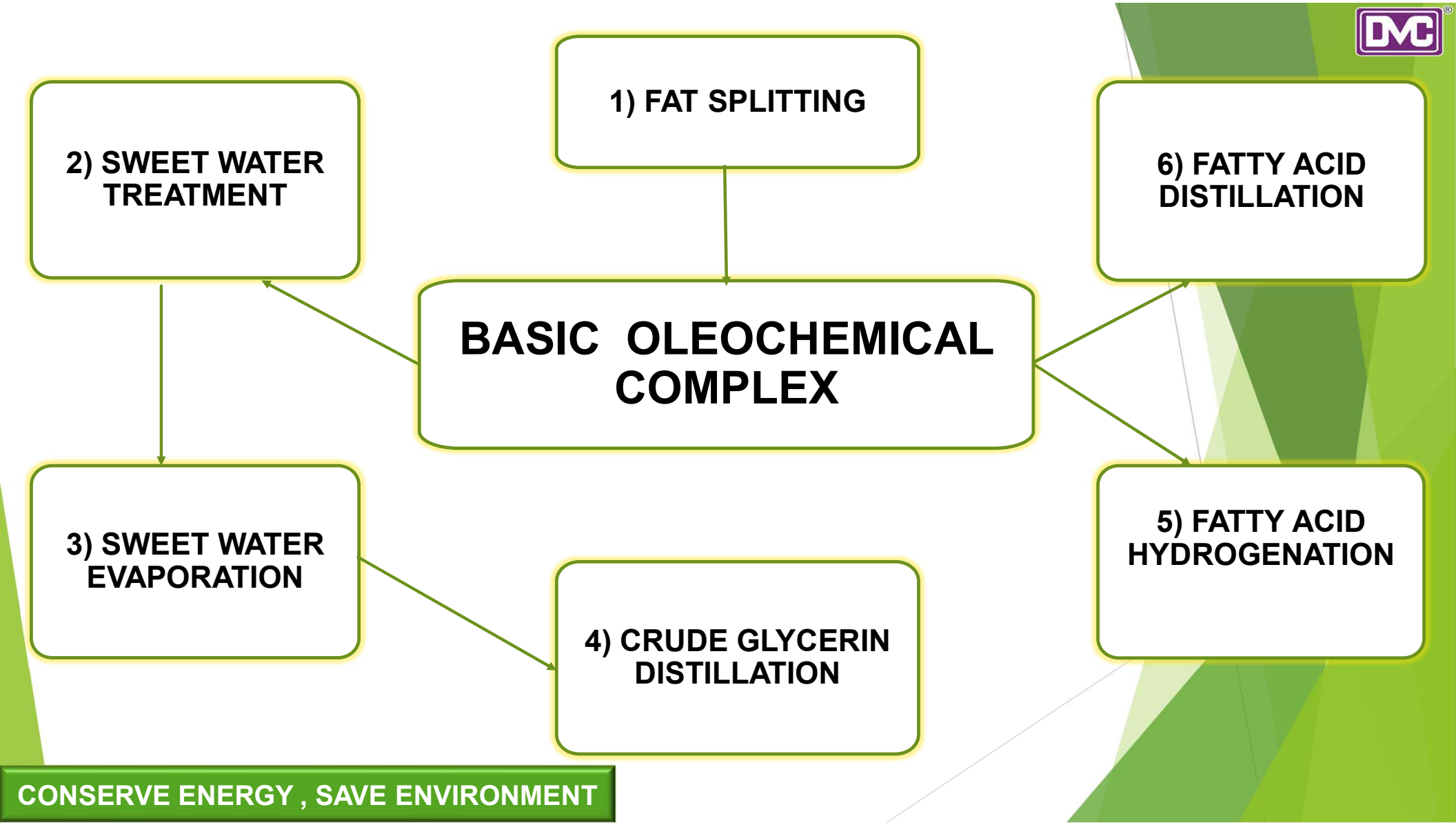
WHAT ARE OLEOCHEMICALS?

- Oleo chemicals are industrial chemicals derived from natural oils , fats and its by products .They are renewable, bio-based alternatives to petrochemicals



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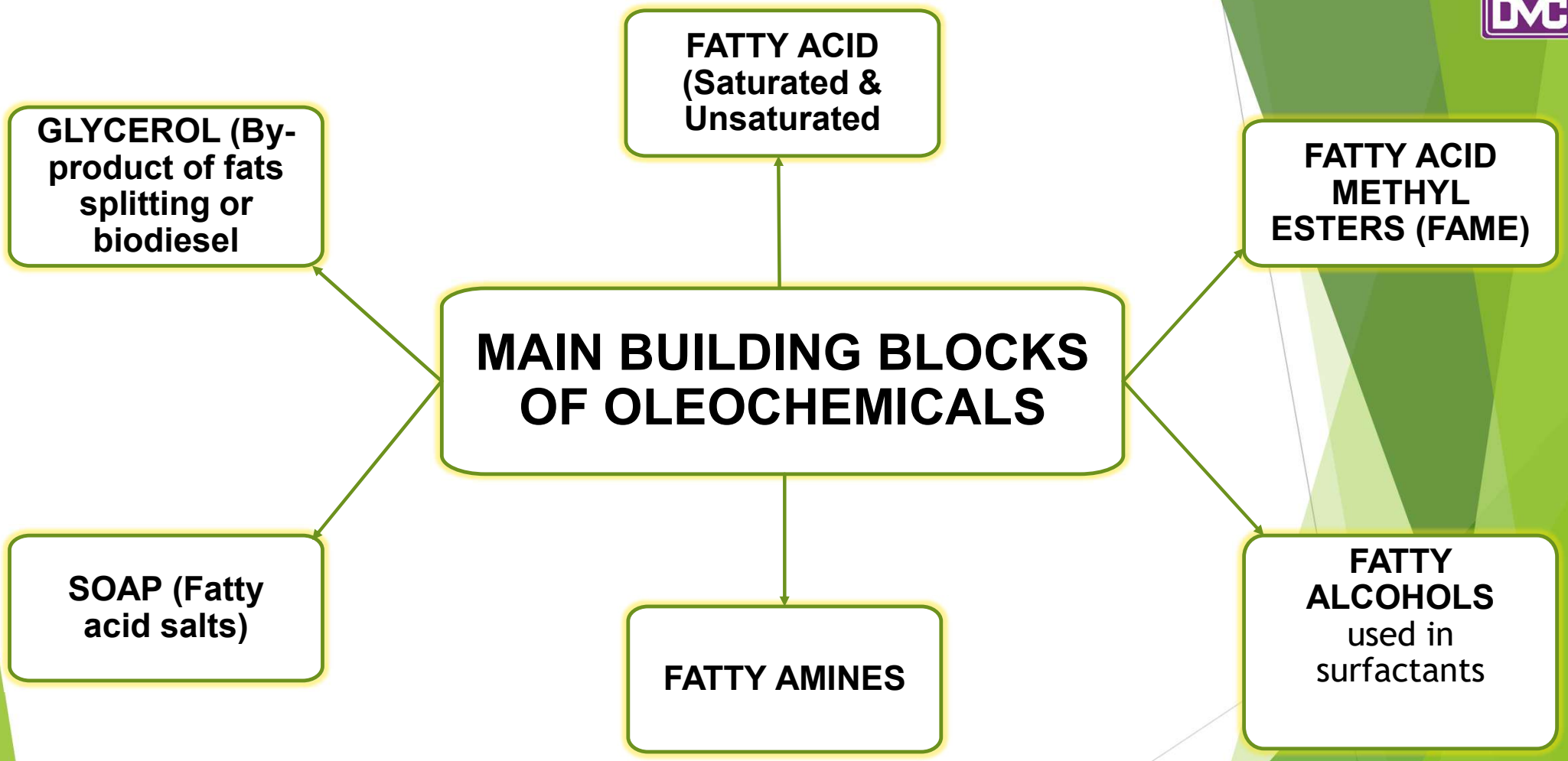

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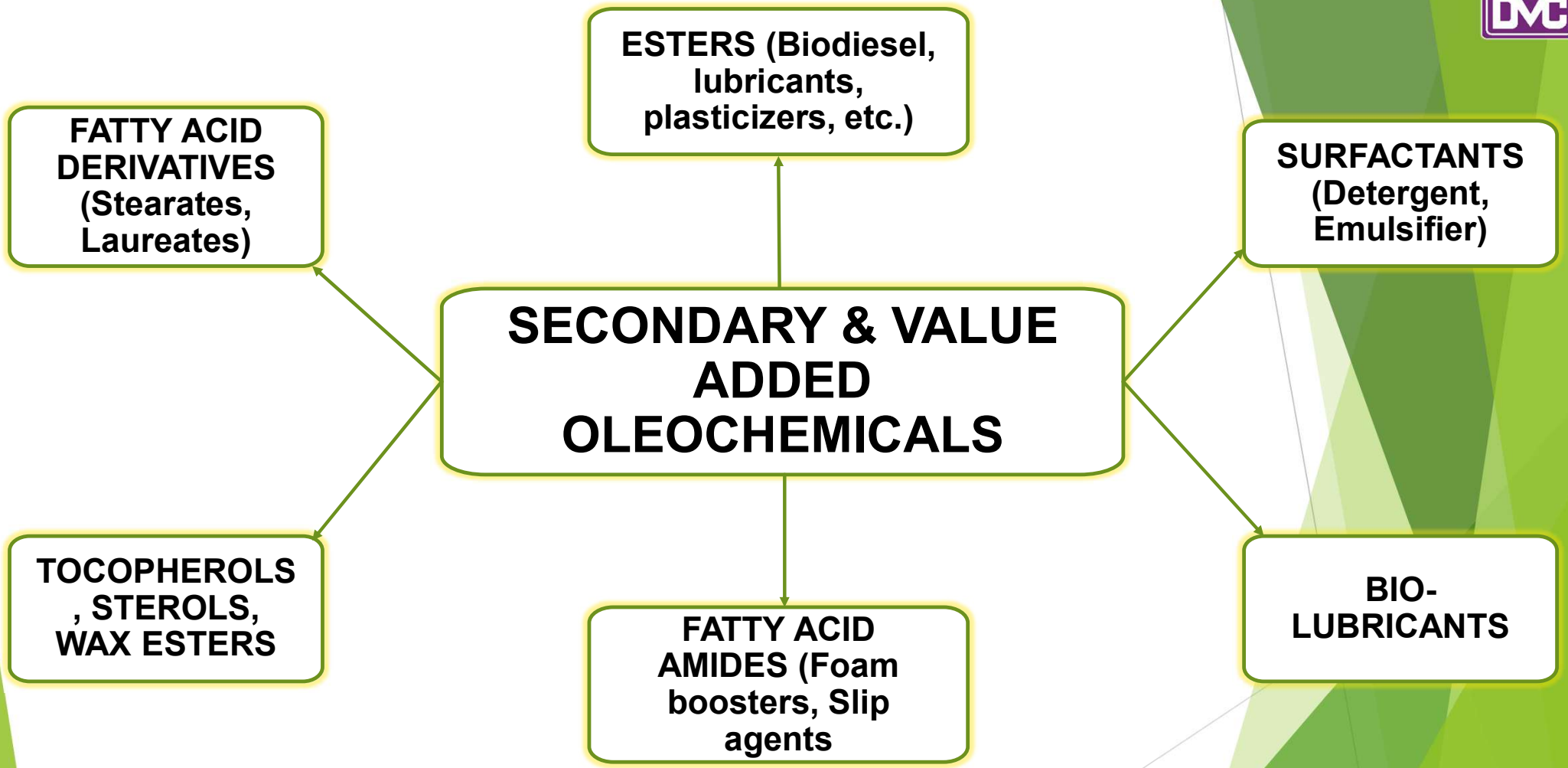

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INDUSTRIAL APPLICATIONS

- Home & Personal Care: soaps, shampoos, cosmetics, detergents.
- Food & Nutrition: emulsifiers, food additives
- Pharmaceuticals: excipients, ointments, capsules
- Plastics & Polymers: plasticizers, stabilizers, coatings
- Lubricants & Fuels: biodiesel, hydraulic fluids, greases
- Agrochemicals: adjuvants, surfactants for pesticides formulations

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ADVANTAGES OF OLEOCHEMICALS

- Renewable , Biodegradable and Sustainable Feedstocks
- Market Demand and Regulatory Support
- Lower carbon footprint compared to petrochemicals
- Wide range of molecular structures and applications
- Non-toxic and environmentally friendly
- **Value addition** to agricultural and waste feedstocks (e.g., UCO, acid oil

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FEEDSTOCKS FOR OLEOCHEMICAL INDUSTRIES

1. VEGETABLE OILS	Palm oil, Palm kernel oil, Coconut oil, Soybean oil, Rapeseed (Canola) oil, Sunflower oil, Castor oil (specialty, ricinoleic acid), Jatropha, Neem, Mahua, Pongamia oils (non-edible) Linseed, Cottonseed, Corn, Rice bran oil, Emerging oils: Camelina, Algae oils
2. ANIMAL FATS	Beef tallow, Mutton tallow, Lard (pig fat), Poultry fat, Fish oils (sardine, tuna, menhaden), Butterfat residues
3. BY-PRODUCT & WASTE STREAMS	Acid oil (from refining), Deodorizer distillates (tocopherols, sterols), Spent bleaching earth oil, Used cooking oil (UCO), Fatty acid distillates (PFAD, SFAD), Distillation residues & pitch

FEEDSTOCKS FOR OLEOCHEMICAL INDUSTRIES

4. SPECIAL NATURAL WAXES & FATS	Beeswax, Carnauba wax, Sunflower wax, Rice bran wax, Lanolin (wool wax), Jojoba oil (liquid wax esters)
5. EMERGING & ALTERNATIVE FEEDSTOCK	Algae oils (DHA, EPA, biodiesel precursors), Microbial oils (Single Cell Oils - SCO), Engineered/synthetic oils (fermentation-derived), Tall oil (Kraft pulping by-product), Moringa, Camelina, Cuphea oils
6. CARBOHYDRATE DERIVED FEEDSTOCK	Glucose, sucrose, starch hydro lysates, Fermentation to bio surfactants, polyols, fatty alcohols, Glycerol (biodiesel by-product): epichlorohydrin, PDO, esters

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KEY OLEOCHEMICAL PROCESS

1. FAT SPLITTING

2. TRANS-ESTERIFICATION

3. ESTERIFICATION

4. FATTY ALCOHOL PRODUCTION

5. HYDROGENATION

6. DERIVATIVES

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1. FAT SPLITTING (HYDROLYSIS)

- Reaction: $C_3H_5(OOCR)_3 + 3H_2O \rightarrow 3RCOOH + C_3H_5(OH)_3$
- Conditions: 200–260 °C, 40–60 bar, water/oil ratio 0.8:1 weight basis
- Catalyst: Non-catalytic (high pressure) or enzymatic
- Equipment: High-pressure fat splitting column
- Products: Crude Fatty Acids + Glycerol as Sweet water

PROCESS PRINCIPLE

- Hydrolysis reaction:

  Triglyceride + 3 H_2O → 3 Fatty Acids + Glycerol

- Continuous counter-current splitting

- Endothermic Reaction

  High pressure + temperature ensure complete hydrolysis

OPERATING CONDITIONS

- Temperature: 220–260 °C
- Pressure: 45–60 bar
- Residence time: 4–6 hours
- Water to oil ratio: 0.8: 1 by weight
- Conversion: 95–99%

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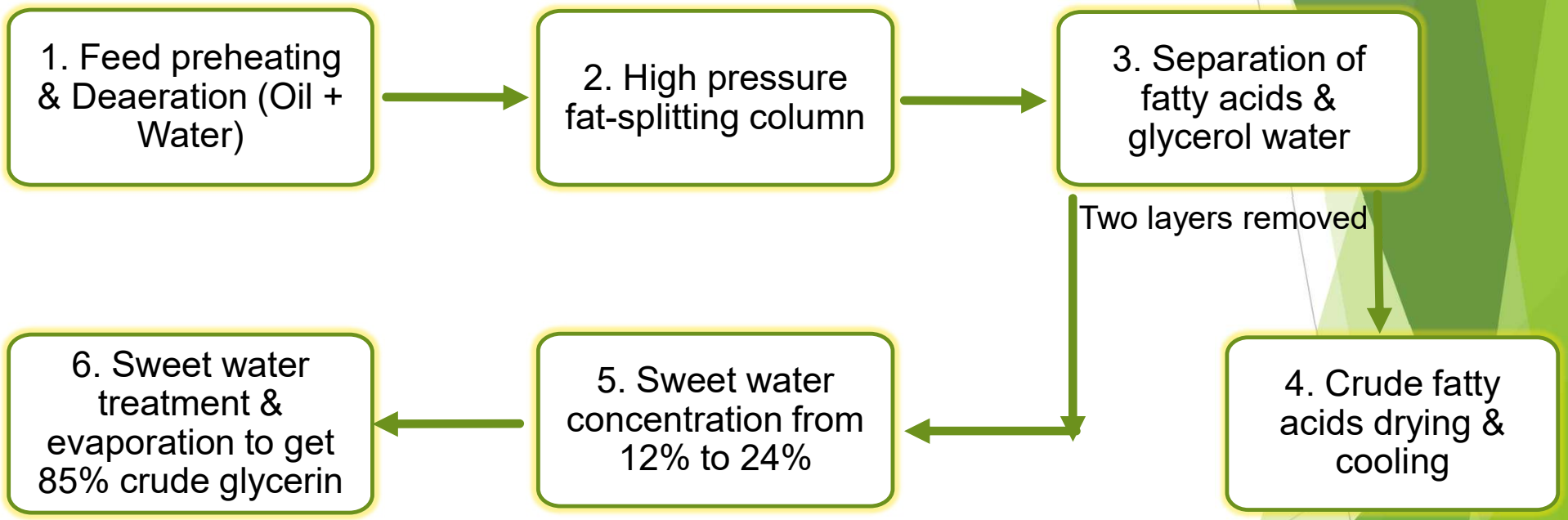
PROCESS FLOW



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2. TRANSESTERIFICATION (BIODIESEL PRODUCTION)

- Reaction: Triglyceride + 3MeOH → 3 FAME + Glycerol
- Catalyst: KOH/NaOH (alkali), heterogeneous, or enzymatic
- Conditions: 60–65 °C, 1–5 bar
- Products: Biodiesel (FAME) + Glycerol
- Application: Renewable fuel, oleochemical feedstock

3. ESTERIFICATION (BIODIESEL PRODUCTION)

- Reaction: FA + MeOH → FAME + Water
- Catalyst: enzymatic
- Conditions: 40–42 °C or below
- Batch time:- 20 to 25 Hrs
- Products: Biodiesel (FAME)
- Application: Renewable fuel, oleochemical feedstock

RAW MATERIAL & PROCESSING OF RAW MATERIAL

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RAW MATERIALS

1. Sun – Soya Distilled Fatty Acids (DFA) From Acid Oil

2. Production Of Distilled Tocopherol And Distilled Sterols From Soybean Deodorizer Distillate (SBD)

3. Used Cooking Oil (UCO)

4. Crude Glycerin / Glycerin

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1. SUN – SOYA DISTILLED FATTY ACIDS (DFA) FROM ACID OIL

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FEEDSTOCK – TYPICAL ACID OIL (EXAMPLE)

- Assumed composition (example): FFA 65.0% (650 kg), Glycerides 30.0% (320 kg), Water/Gums/USM &others 5.0% (50 kg)
- Moisture >=1%, insoluble (gums & others) ~4% depending on upstream processing
- Acid oils (soy & sunflower) contain high FFA (30–70%), phosphorus (500/600 PPM), soaps, pigments, trace metals
- Mineral acidity : more than 200 PPM

PROCESS FLOW

1. Presplitting (Enzymatic hydrolysis) — Reducing gums by convert glycerides to FFA + glycerol+ free gums

2. Bleaching — adsorbents (bleaching earth) remove color & impurities

3. High-Pressure Splitting — Remaining (TG, Mono &Di) converting to FFA + glycerol+ free gums under high steam/pressure (30 bar and 220 degrees temp)

4. Fractional Distillation (Two column) — obtain 130 IV fraction

By-products:
Glycerol, spent earth, heavy-end fatty acids, light volatiles and Residue

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CONVENTIONAL PRE-TREATMENT

Steps:

1. Phosphoric Acid Degumming (0.05–0.2%) – converts NHP to hydratable
2. Water Washing – removes gums & Mineral acidity
3. Bleaching with Earth/Clay (0.5–2%) – removes pigments, residual P, metals

Challenges:

- No much reduction in P content (20 to 25% reduction)
- Mineral acidity (zero not possible)
- High oil losses in gums (2–4%)
- Emulsion problems
- High effluent load (P-rich wastewater)
- Limited efficiency with stubborn non-hydratable phospholipids

KEY NOTES

- Conventional – Simple , but higher losses & wastewater
- P content not reduced in noticeable
- Enzymatic – lower phosphorus, better yields, sustainable, but higher OPEX
- Choice depends on final product spec & economics

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3. USED COOKING OIL (UCO)

Pretreatment Bleaching ,Deacidification, Transesterification with methanol ,Transesterification with **pentaerythritol/ Trimethylolpropane** and Purification ,Blending

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INTRODUCTION

- Feedstock: Collected Used Cooking Oil (UCO)
- Process route used: Pretreatment → FFA reduction → Transesterification (to FAME) → Double transesterification with **TMP/PE(Trimethylolpropane / pentaerythritol)**
- PE esters generally offer better high-temperature performance and stability compared to TMP ester

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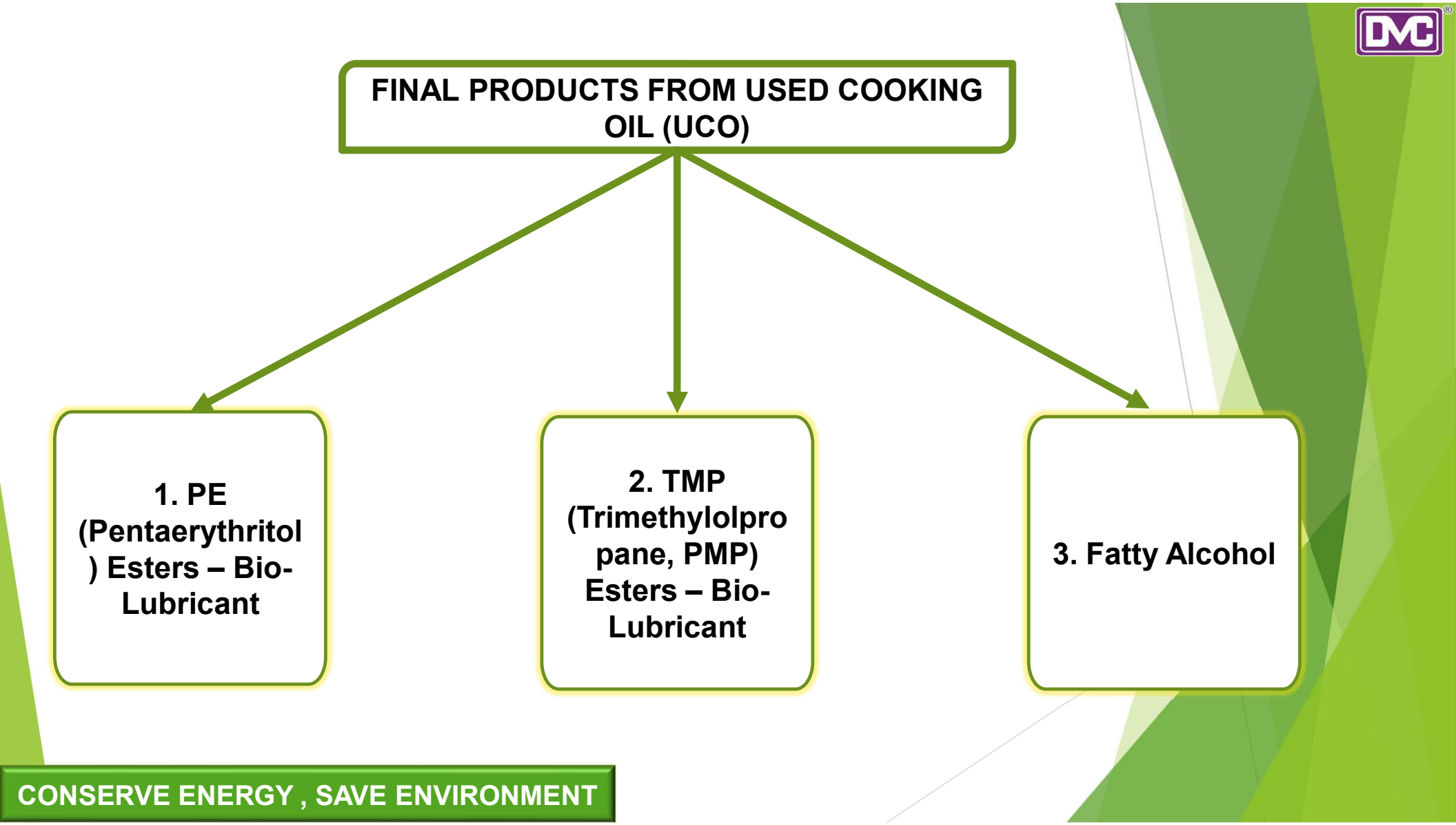

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PRESENT & FUTURE OPPORTUNITIES IN THE OLEOCHEMICAL INDUSTRY

Trends, Challenges & Strategic Avenues

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AGENDA

1. MARKET SIZE & GROWTH

2. KEY DRIVERS & TRENDS

3. PRESENT OPPORTUNITIES

4. FUTURE OPPORTUNITIES

1. MARKET SIZE & GROWTH

- Current market: USD ~27-30 billion (2025)
- Global market projected > USD 50 Billion by 2034
- CAGR ~7–8%
- Fastest growth: Asia-Pacific (India, China, SE Asia) (feedstock advantage)
- Major segments: fatty acids, glycerol esters, FAME
- Demand sectors: Personal care, detergents, Bio lubricants, food & pharma

2. KEY DRIVERS & TRENDS

- Sustainability & environmental regulations
- Natural / bio-based product demand
- Technological advances: enzymatic processes, bio catalysis
- Alternative feedstocks: waste oils, microbial lipids
- Regulatory & policy support for bio-based chemicals
- Regulatory push (ban on toxic petrochemicals)
- Surplus glycerol → need for value-added conversion.
- **1,3-Propanediol (PDO)** → bio polyesters, plastics cosmetics, solvents.
- **Epichlorohydrin (ECH)** → epoxy resins, coatings, adhesives.

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3. PRESENT OPPORTUNITIES

- Demand for natural & sustainable products
- Specialty/products: high-purity fatty acids, bio-lubricants,Fatty acid amides, Tocopherols
- Expansion in Asia-Pacific & India
- Biodiesel (FAME) as renewable energy
- Green surfactants & biodegradable detergents
- Natural personal care & cosmetics

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4. FUTURE OPPORTUNITIES

- Bio-based polymers & biodegradable plastics
- Enzyme innovations to cut costs
- Advanced biofuels (aviation, marine)
- Specialty oleochemicals (tocopherols, sterols)
- Feedstocks: algae, waste cooking oil, non-edible oils
- Pharmaceuticals & cosmetics (high purity glycerin, emollients)
- Circular economy: by-product valorization
- Traceability & ESG compliance
- Digitalization / Industry 4.0 smart manufacturing

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CONCLUSION

- Oleo chemical industry poised for strong growth
- Driven by a global shift toward sustainable, biodegradable, and renewable products, increasing demand from various sectors like personal care and food, and stricter regulations on petroleum-based alternatives
- Sustainability , feedstock diversification and Technology innovation are key drivers
- Opportunities in specialty products, green surfactants, bio-lubricants
- Circular economy and digitalization will shape the future
- Strategic investments essential for competitiveness

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THANK YOU !

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