A journey towards...

Planet F&F : perspectives on size, feedstocks, renewability

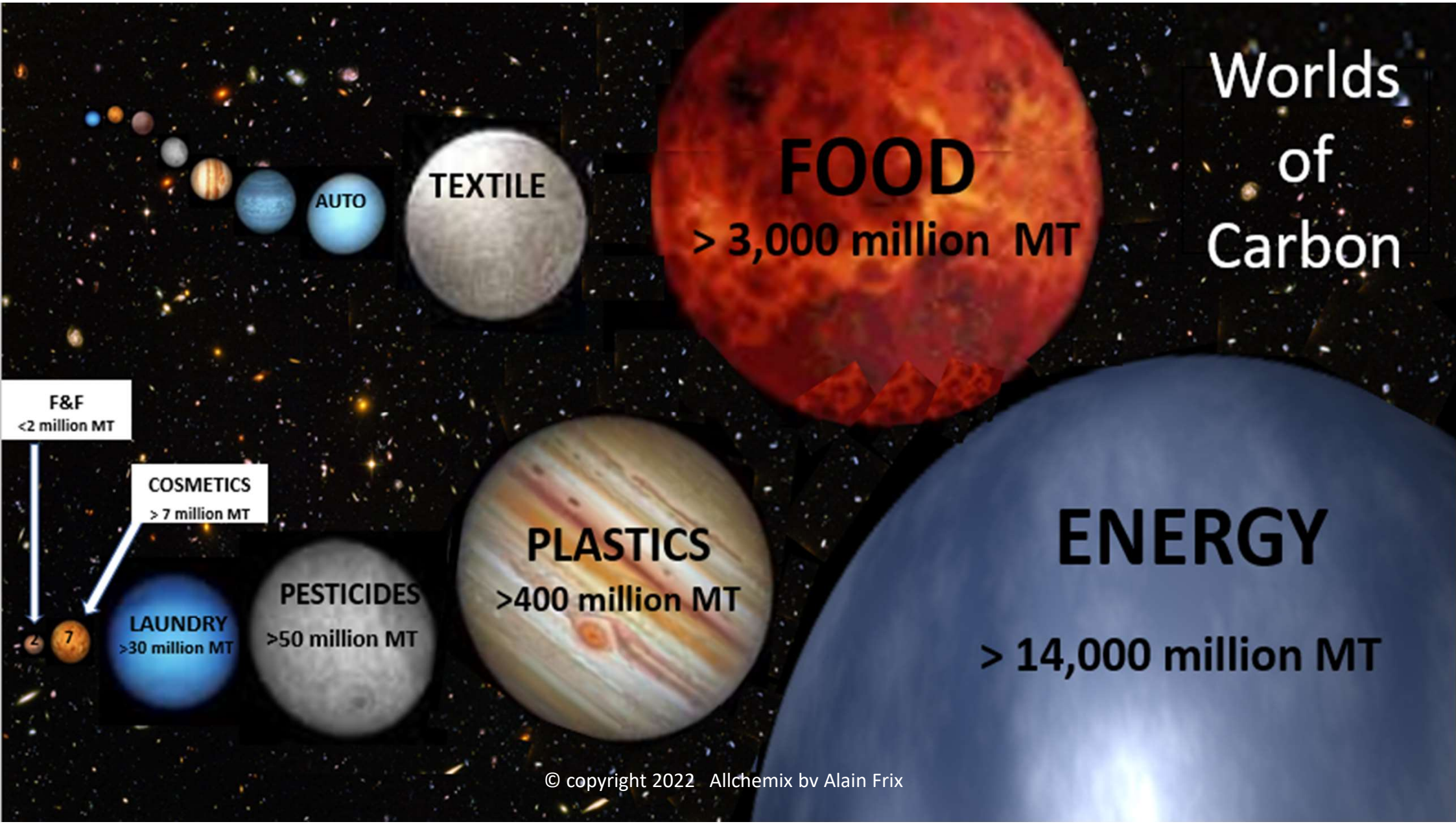
The following slides are part of a presentation given by Alain Frix at IFEAT 2022 Conference in Vancouver, Canada, on October 10th 2022

Alain Frix, Allchemix Consultancy

www.allchemix.com

Whether synthetics or naturals,
F&F feedstocks are mostly relatively tiny hydrocarbon molecules

Let's do some magic and put together the carbon requirements from various industries, and see how they compare.


Worlds of Carbon
FOOD
> 3,000 million MT
TEXTILE
AUTO
F&F
<2 million MT
COSMETICS
> 7 million MT
LAUNDRY
>30 million MT
PESTICIDES
>50 million MT
PLASTICS
>400 million MT
ENERGY
> 14,000 million MT
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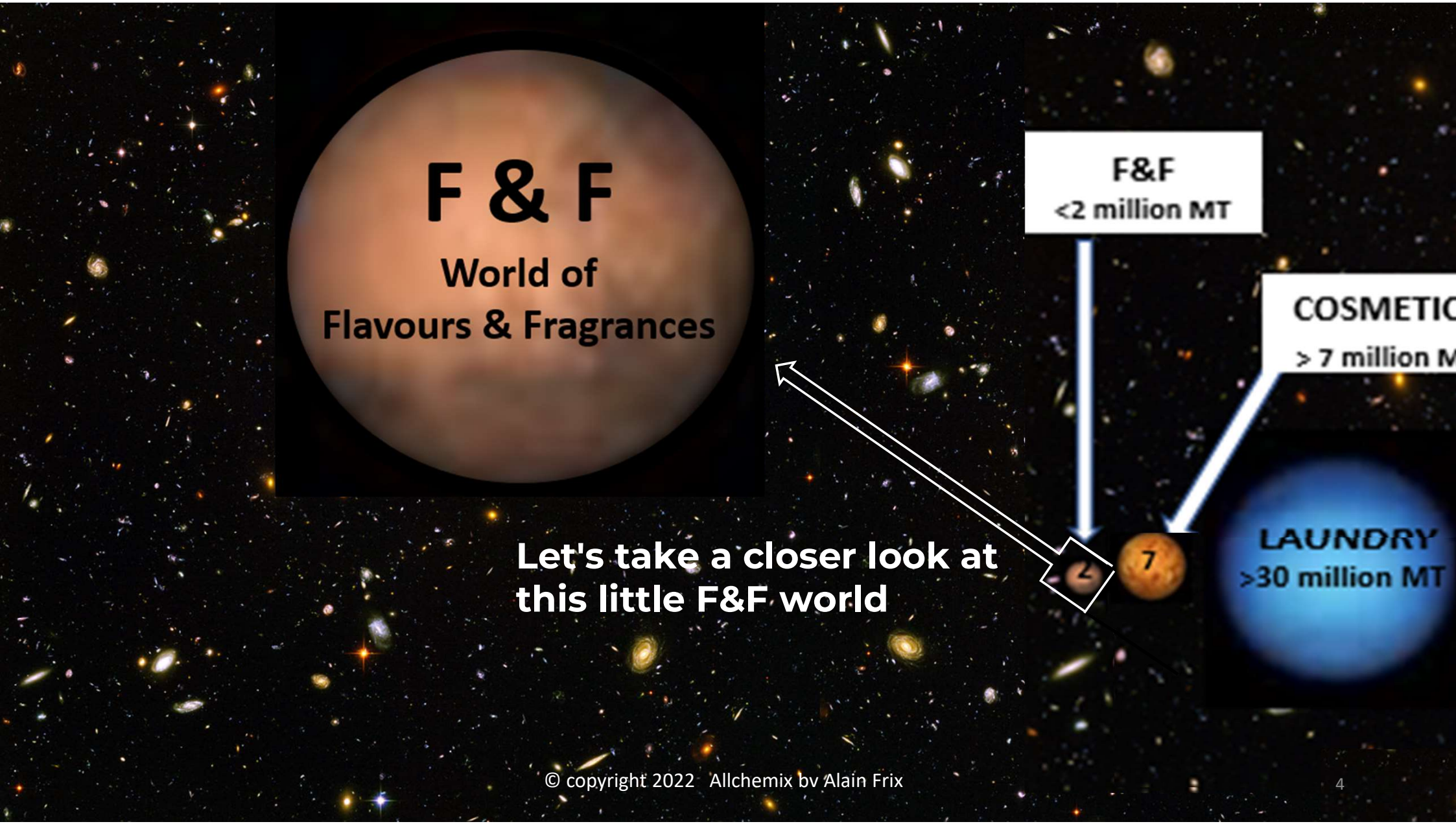


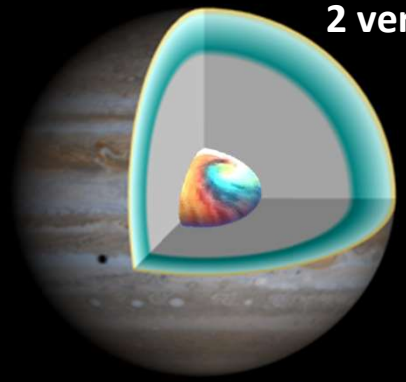
F & F

World of Flavours & Fragrances

< 2 million MT

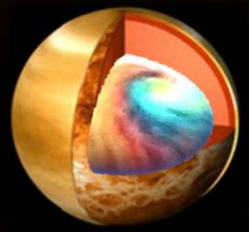
33 billion USD

The F&F planet is made out of 2 very different worlds



Flavours

&



Fragrances

F&F
<2 million MT

COSMETIC
> 7 million M

LAUNDRY
>30 million MT

F & F

World of
Flavours & Fragrances

< 2 million MT
33 billion USD

2 very different worlds

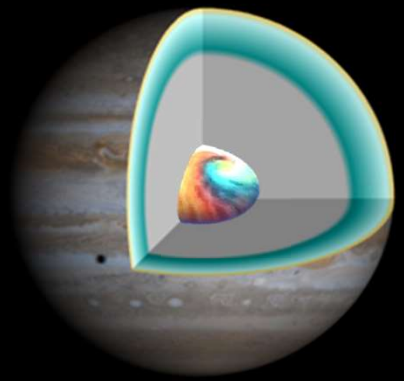
Flavours

19 billion USD

Local, tradition

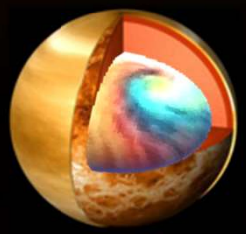
No REACH

Many # of ingredients, small volumes



Flavours

&



Fragrances

Fragrances

14 billion USD

Global, lifestyle

REACH etc

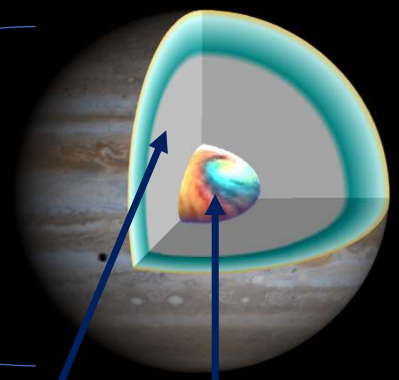
Fewer # of ingredients, big volumes

Flavours

Fragrances

Flavour Ingredients

1,100,000 MT of ingredients



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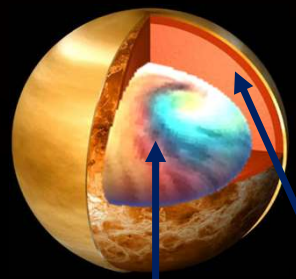


Fragrance Ingredients

800,000 MT of ingredients

Flavours "filler" ~ 940,000 MT =

- Fillers (Maltodextrine,Proteines) 200,000 MT
- Acid & salts & alcohol additives 140,000 MT
- Solvents 120,000 MT
- Sugars 80,000 MT
- Milk cream dairy 80,000 MT
- Vegetable oils & fats 70,000 MT
- Colors 50,000 MT
- Others 200,000 **MT**

Flavour "core" = Aroma chemicals, Essential oils / natural extracts **160,000 MT**

Flavours

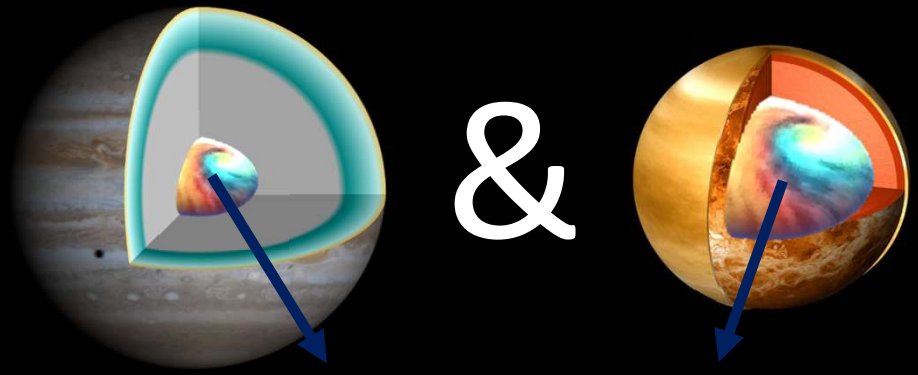
Fragrance "core" = Aroma chemicals, Essential oils / natural extracts **580,000 MT**

Fragrances

Fragrance "filler" ~ 220,000 MT =

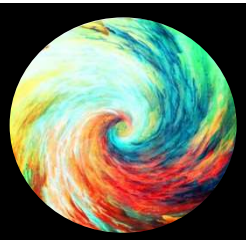
- Solvents 100,000 MT
- Alcohol / additives 75,000 MT
- Others / fillers 45,000 MT

Let's focus on the core of our industry :
All naturals and all synthetic ingredients that have a <u>smell or taste</u>



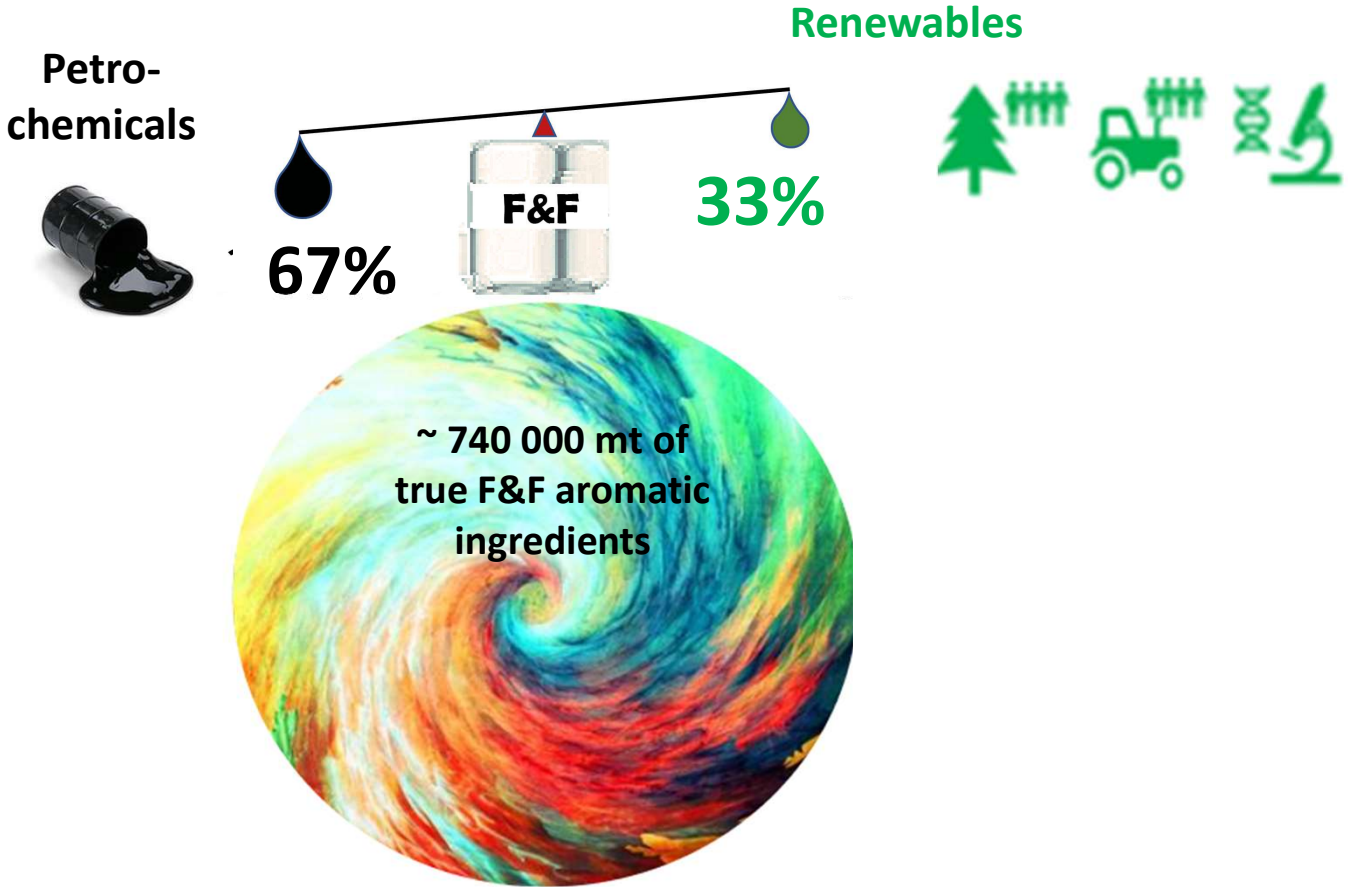
160,000 MT **580,000 MT**

740,000 MT
of key feedstocks



Global odoriferous substances for F&F

Where are these key aromatic feedstocks coming from ?
How do they compare to each other ?
How are they likely to evolve ?



Petro-chemicals

~ 490 000 mt for F&F

Weight of aromatic ingredients for F&F

~ 250 000 mt for F&F

Not Renewable

NON RENEWABLE

Petrochemical derivatives
~ 490 000 MT

Most of perfumery materials are heavily depending on petrochemical raw materials.
Lots of petrochemical materials face increasing price and availability challenges, due to global consolidation and capacity constraints at producers.

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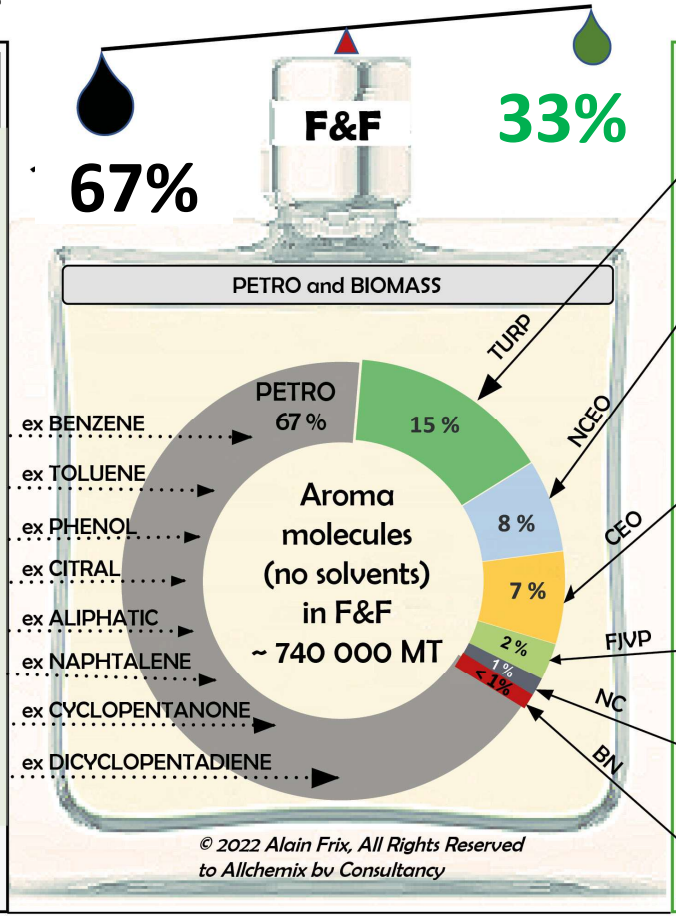


Renewable

Pine Terpene derivatives (TURP)
~ 115 000 MT

Non-citrus Essential Oils (NCEO)
~ 55 000 MT

~ 105 000 MT Essential oils to F&F

Citrus Essential Oils (NCEO)
~ 50 000 MT

Fruit Juices, Veg Puree & other extracts (FJVP)
~ 20 000 MT

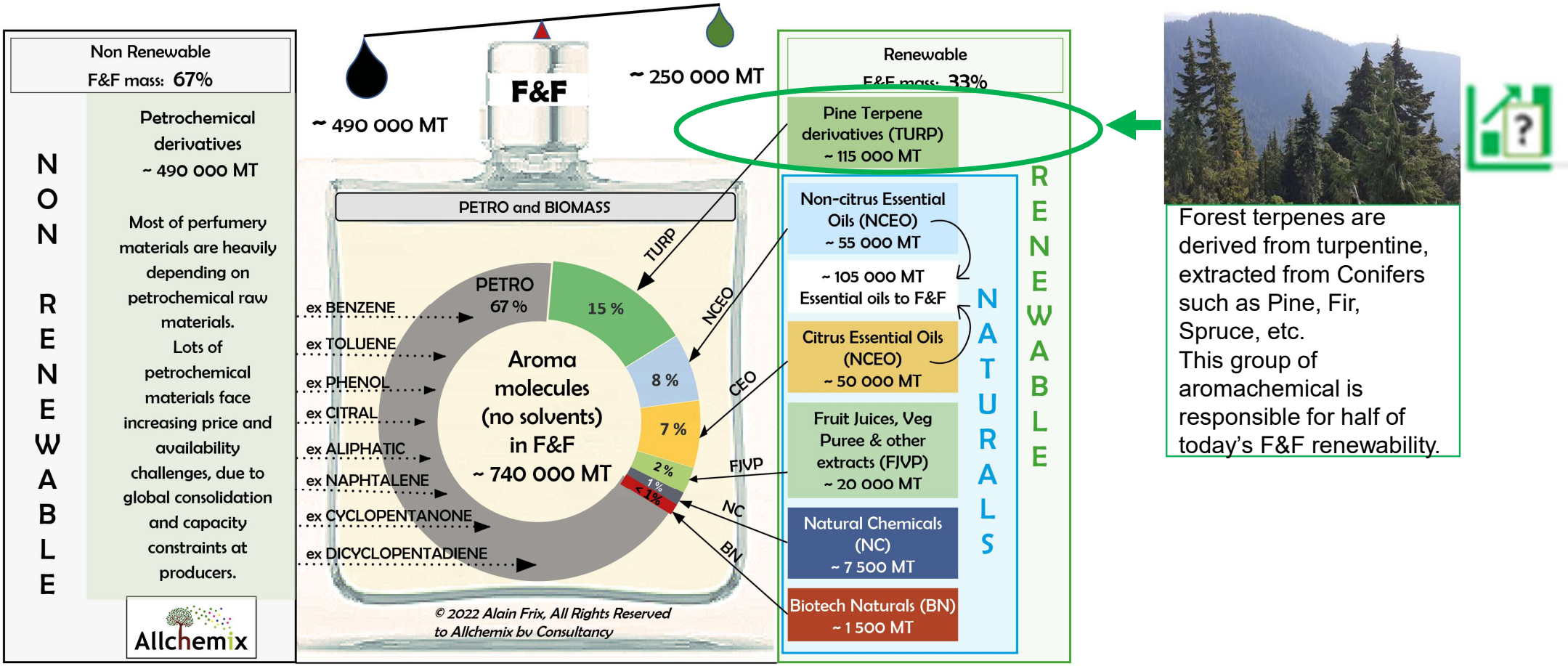
Natural Chemicals (NC)
~ 7 500 MT

Biotech Naturals (BN)
~ 1 500 MT

NATURALS

RENEWABLE

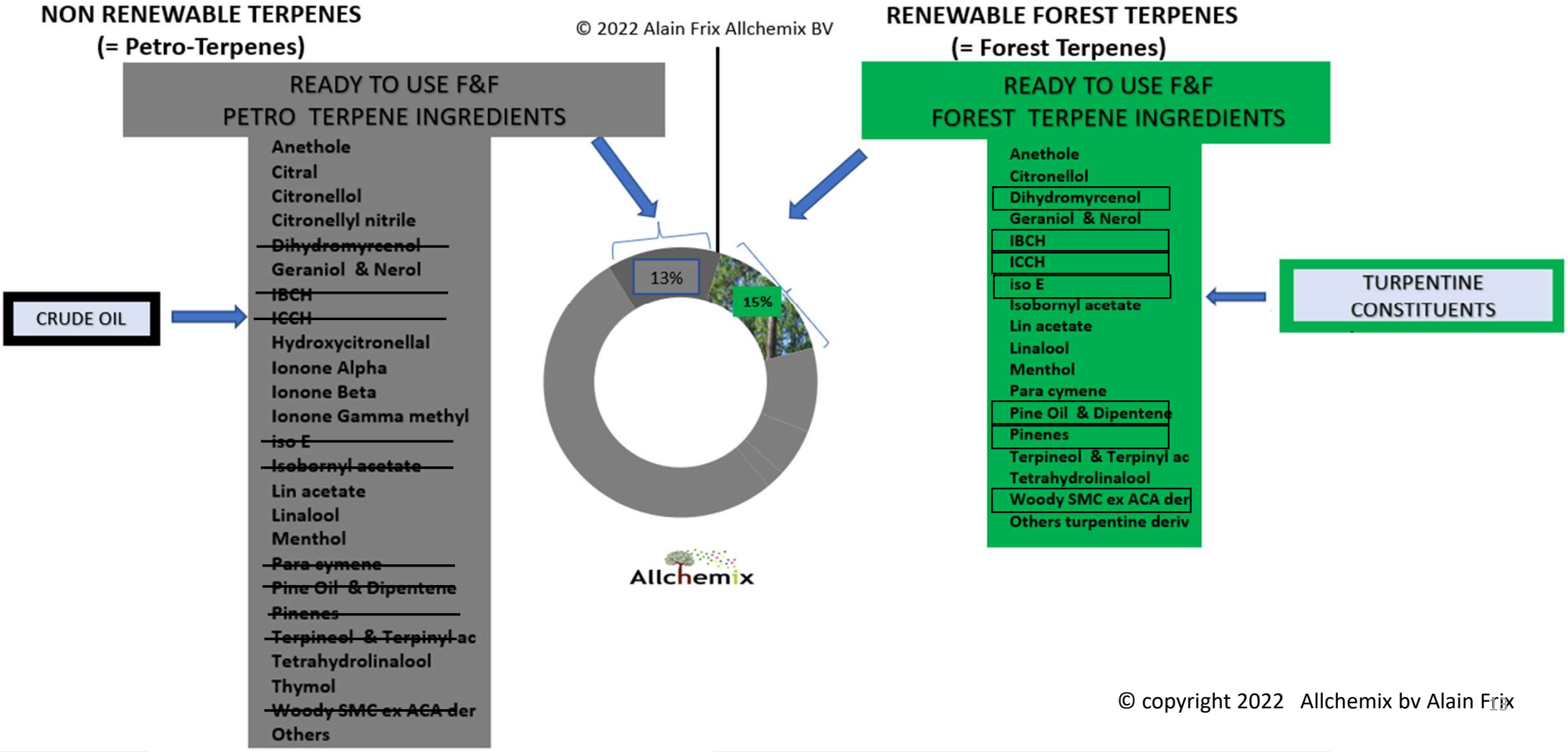
Often, synthetic and naturals complement each other, as they are not similar



Forest terpenes are derived from turpentine, extracted from Conifers such as Pine, Fir, Spruce, etc.
This group of aromachemical is responsible for half of today's F&F renewability.

Fragrance & Flavour Ingredients : Terpenes

F&F Forest terpenes (= F&F terpene ingredients derived from forest Turpentine)
and F&F Petro terpenes (= F&F terpene ingredients derived from Fossile fuels or fossile natural gas)



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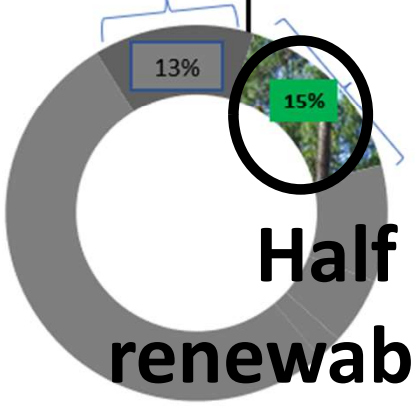
NON RENEWABLE TERPENES
(= Petro-Terpenes)

READY TO USE F&F
PETRO TERPENE INGREDIENTS

- Anethole
- Citral
- Citronellol
- Citronellyl nitrile
- Dihydromyrcenol
- Geraniol & Nerol
- IBCH
- ICCH
- Hydroxycitronellal
- Ionone Alpha
- Ionone Beta
- Ionone Gamma methyl
- iso E
- Isobornyl acetate
- Lin acetate
- Linalool
- Menthol
- Para cymene
- Pine Oil & Dipentene
- Pinenes
- Terpineol & Terpinyl ac
- Tetrahydrolinalool
- Thymol
- Woody SMC ex ACA der
- Others

CRUDE OIL



Half renewability

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RENEWABLE FOREST TERPENES
(= Forest Terpenes)

READY TO USE F&F
FOREST TERPENE INGREDIENTS

- Anethole
- Citronellol
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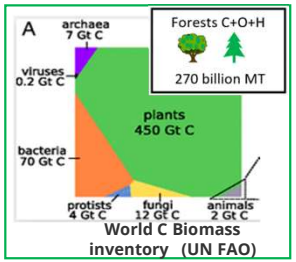
- Others turpentine deriv

Turpentine

Pine Spruce Fir forests biomass

What's behind the drop ?

GLOBAL SOFTWOOD BIOMASS FLOW TO MARKETS



Hardwood forests = 180 billion MT

Softwood forests = 90 billion MT

CUTTING TAPPING

Tapping : access 260,000,000 MT biomass trees alive, only resin collected

Tapping is somehow sustainable

collect < 900,000 MT oleoresin, avg yield 4 Kg per tree times year

Distillation

10% water

~17% GT Natural "gum" Turpentine 150 000 mt

~70% Gum Rosins (90% resin acid) 650 000 MT

Pine Resins 1,120,000 mt (Adhesives,inkt,tires, coatings, sealants,sizing...)

Soap Detergents emulsifiers, mining,adhesives surfactants

480,000 mt TOR rOsins

Biodiesel >500,000 MT

Bio chemicals

Biorefinery ????

?

Conifers dry biomass (average green biomass : 100% moisture content = 50% of weight is water)
42% cellulose (glucose long polymers) 3 xlonger than hardwoods
27% hemicelluloses net (crossed polymers various sugars)
28% lignin rigidity (polymers of phenylpropane units)
70% softwood VOC are terpenes, then hexanal..

> 1,000,0000,000 MT

Softwood Fuel Cutting : >200 000 000 MT (wet)

Softwood Non Fuel Cutting : > 800 000 000 MT (wet) trees cut to feed saw mills & pulp mills

Cut timber, let dry 6 months

-20% water

Barky logs BL

68.8 % biomass

285,000,000 MT

360 million MT

Saw mills

Barks (~11% of BL)

de-bark logs

320,000,000 MT

40,000,000 MT waste bark

Drying wood

42 % yield

Lumber

Saw-chips 170,000,000 MT

80 million MT of chips

Sawdust & shavings 10,000,000 MT

Panels

-20% water

~30% dead biomass stay in forest, decay→ microorganisms→animal CO^2

Stumps & roots 17.2 % biomass

Needles foliage 2.8 % biomass

Branches & tops 11.2% biomass

Fuel wood 165,000,000 MT

F&F <100 mt

Cosmetics <500 mt

Softwood Lumber 150,000,000 MT (construction, furnitures)

Softwood Panel (OSB, Plywood, PB, FB) 80,000,000 MT (construction, furnitures)

170,000 MT of stumps

Stump collection : dead wood stumps removed from forest land

Pulp mills

Barks waste bark 35 million MT

65 million MT

23% Other Pulp mills

MECHANICAL PULP MILLS Rearrangement of fibers, no extraction of components

SEMI-MECHANICAL Chemo-Thermo MILLS CTMP Rearrangement of fibers, no extraction of components

ORGANOSOLV Cleaner tech, to be improved, Good cellulose and sulfur-free lignin separation

PULP 30,000,000 MT

25 million MT

7% Sulfite Pulp mills

SULFITE MILL More for Spruce, less for Pine, weaker fibers, 41% yield, lignin separation, but sulfur

Na2SO3 impregnation Cooking

Separation of lignin from cellulose evaporating

acidic digestion

BROWN LIQUOR

Washing Bleaching

Ligno-sulfonates 3,000,000 mt

PULP 10,000,000 MT

100,000 mt biofuel ?

240 million MT debarked wood

70% KRAFT Pulp mills

KRAFT PULP MILL Cheapest,yield 43%, stronger fibers, but sulfur

NaOH + Na2S impregnation Cooking

Separation of lignin from cellulose evaporating

Washing Bleaching

alkaline digestion

PULP strong cellulose 100,000,000 MT

50,000 mt to biofuel

100,000 MT Pitch to boiler

Recovery of inorganics, **+ lignin is burned**

HVO 400 000 MT

60 % yield

30 %

CRUDE TALL OIL (1) (40 Kg/mt of pulp) 1,800 000 MT (40% rosin acids,35% fatty acids, incl hydroxycarboxylic acids)

Soap skimming +H2SO4 220503BD

2 000 000 MT Organics

60 000 000 MT lignin to furnace

BLACK LIQUOR 62 000 000 MT ORGANICS

$SO^2 + H^2S$

35% Tall Oil Rosins 500 000 MT (2) (600 ppm sulfur)

CST 20 000 mt

32% Tall Oil Fatty Acids (linoleic ,oleic, palmitic)500 000 MT

5% Tall Oil Distilled (35% light resin acids, 65% heavy fatty acids) 75,000 MT

14% Tall Oil Heads 200,000 MT

14% Tall Oil Pitch bioEnergy 200 000 MT

Phytosterols 5 000 MT

<0.3 % (of pulp) **CST** Crude Sulfate Turpentine 180 000 mt

CST 200 000 mt

Methanol < 700,000 mt

Acetic acid < 150,000 mt

Waste slugde 2% hexose <5,000,000 mt

Ethanol < 700,000 mt

fermentation

Animal feed (pellet binders, Ca Na electrolytes, gut agents)

Pulp =Cellulose Soft wood Paper 140 000 000 MT

Construction (concrete) Agrochem (dispersing agent)

Methylcellulose 100,000 MT

Pharma (laxatives)

Food (filler, vanillin)

Asphalt & construction

Inks, Emulsifiers, Tackifiers

Paints, Cleaners, Linoleum

F&F, Camphor, Polyterp, Solvents

Food-CG 10,000 mt

<2000 mt WT Natural "wood" Turpentine 50% alpha 5% beta

Distillation

Solvent extraction

30% dark phenolic rosin >3,000 MT

70% Wood Rosin >7,000 MT

Spent wood

bioEnergy

Glycerol Ester of Abietic acid ~2000 MT

Other esters wood Resin >5,000 MT

= Business driver

= By-product

= Chemical reaction

= Bioenergy

(1) Some hydroxycarboxylic acids found in CTO : α- and β-glucoisosaccharinic, xylosaccharinic, lactic, 3,4-dideoxypentonic, 2-hydroxybutanoic, and glycolic acids

(2)Resin acids :

- Abietic (35-52%)
- Dehydroabietic (4-27%)
- Palustric (10-12%)
- Isopimaric (1-12%)
- Neoabietic (4-10%)
- Pimaric (1-7%)
- Sandrarcopimaric (0-3%)

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Biomass to F&F Ingredients
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Fragrance & Flavour Ingredients

FLOW FROM PINE FORESTS

CONIFEROUS FORESTS DRIVERS :

SAW MILLS : 350,000,000 MT of wood → 230,000,000 MT of lumber and panels → CONSTRUCTION & FURNITURE

PULP MILLS : 280,000,000 MT of wood → 140,000,000 MT of cellulose → PAPER AND CARDBOARD

+ > 6,000,000 MT of by-products → Various Industries

PINE TAPPING: 1,000,000 MT of oleoresin through tapping tree alive → 650,000 MT Pine Rosins → RESINS

Lumber / Panels / Furnitures

Paper / Cardboard

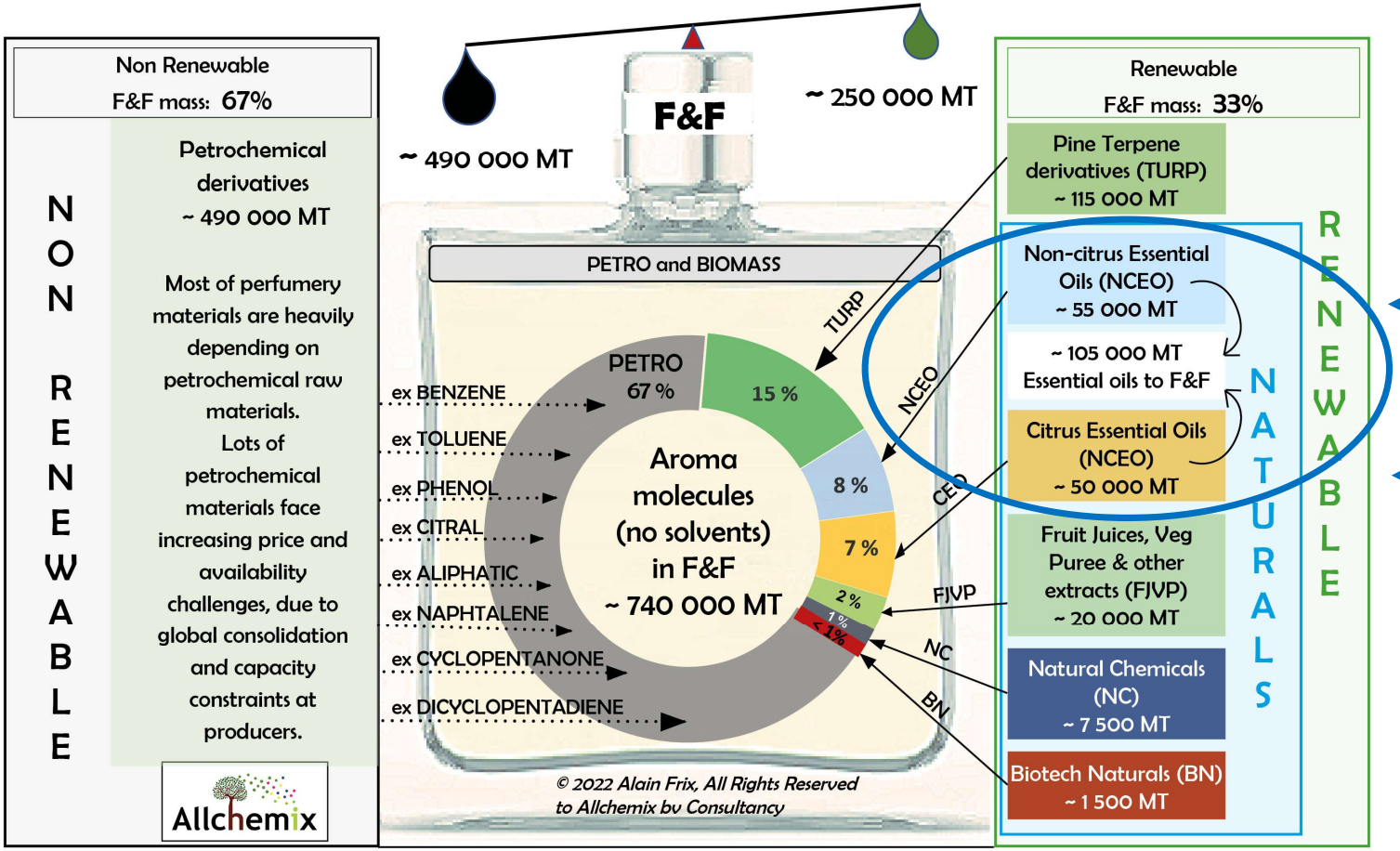
Pine Resins

Turpentine
350,000 MT

Turpentine is one of smallest side streams in whole biomass chain, but with a wide range of applications

- Perfumes
- Camphor
- Terpene Resins
- Agronomy
- Solvents

Fragrance & Flavour Ingredients



ESSENTIAL OILS

The other half of today's F&F renewability mainly comes from Essential oils.

Fragrance & Flavour Ingredients

>227 COMMERCIAL ESSENTIAL OILS IN WORLD

-2	AAA All Essential Oil, concretes, absolutes, MD, & oleoresins	Countries	*Species*	Abs	Concret	Oil	AT	F&F	FL	FRA	Others	ve pri
-1	aaaa total		aaaa total	6,353	7	156,922	6,923	138,760			17,753	
1	Dill seed, Indian	India	*Anethum sowa Roxb. ex Fl*	-		9	-	9			-	
1	Dill weed	USA, Russia, Egypt	*Anethum graveolens L.*	-		20	-	20			-	
1	*Elecampane*		*Inula helenium L.*	-		5	-	5			-	
1	Elémi resin Oil	India, Philippines	*Canarium luzonicum*	-		-	-	-			-	0
1	*Ereocephalus*		*Ereocephalus punctulatus L*	-		50	-	50			-	
1	Eucalyptus cineol-type	China, India, Australia, and some specific places in Africa	*Eucalyptus globulus Labill.,*	-		11,000	300	7,000			3,700	
		South A Congo B		-							- 25	
		lia (WA),		-							-	
		lia, Sout gdong, G		-							-	
		urope, Eg		-							-	
		nia, Egyp		-							-	

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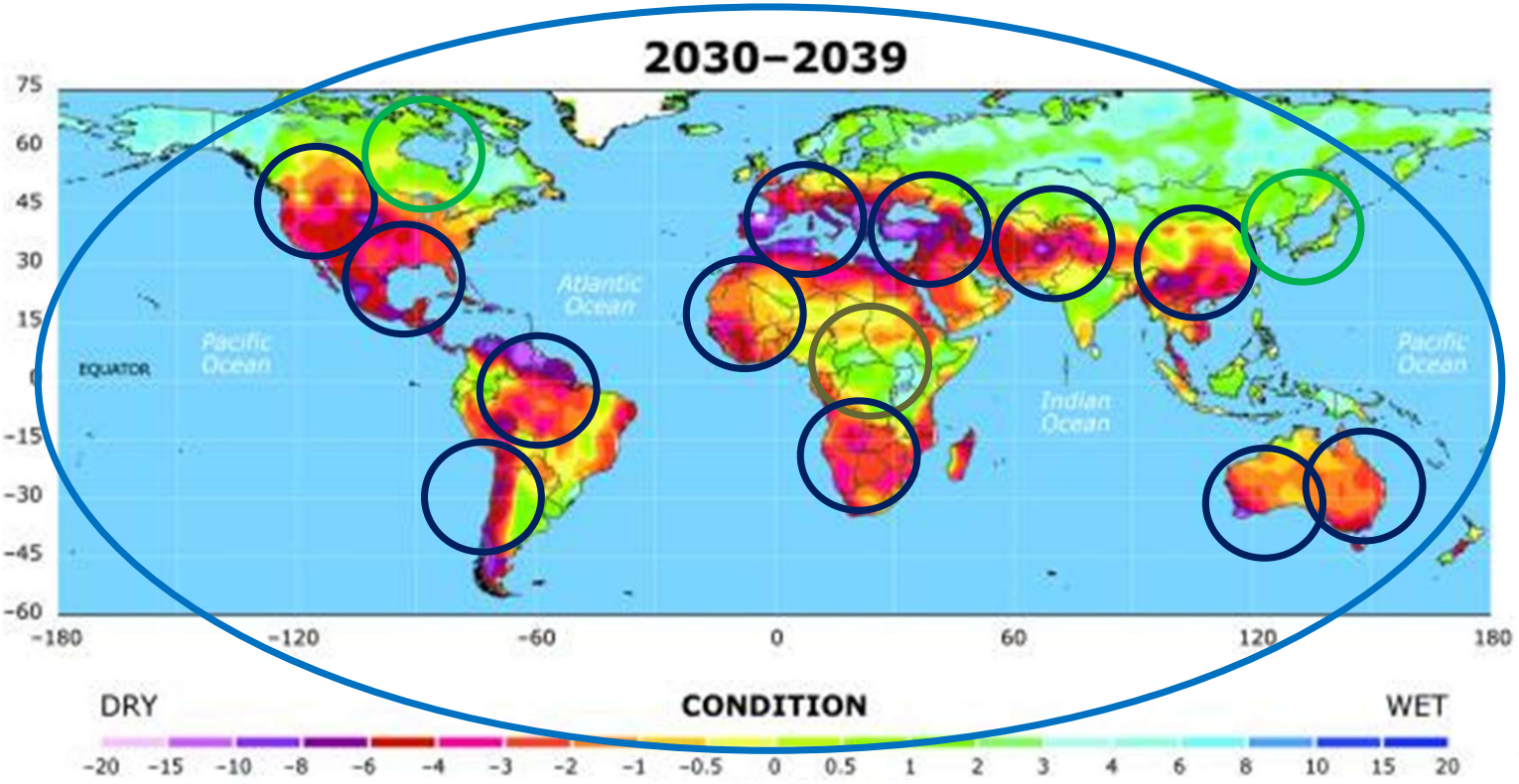
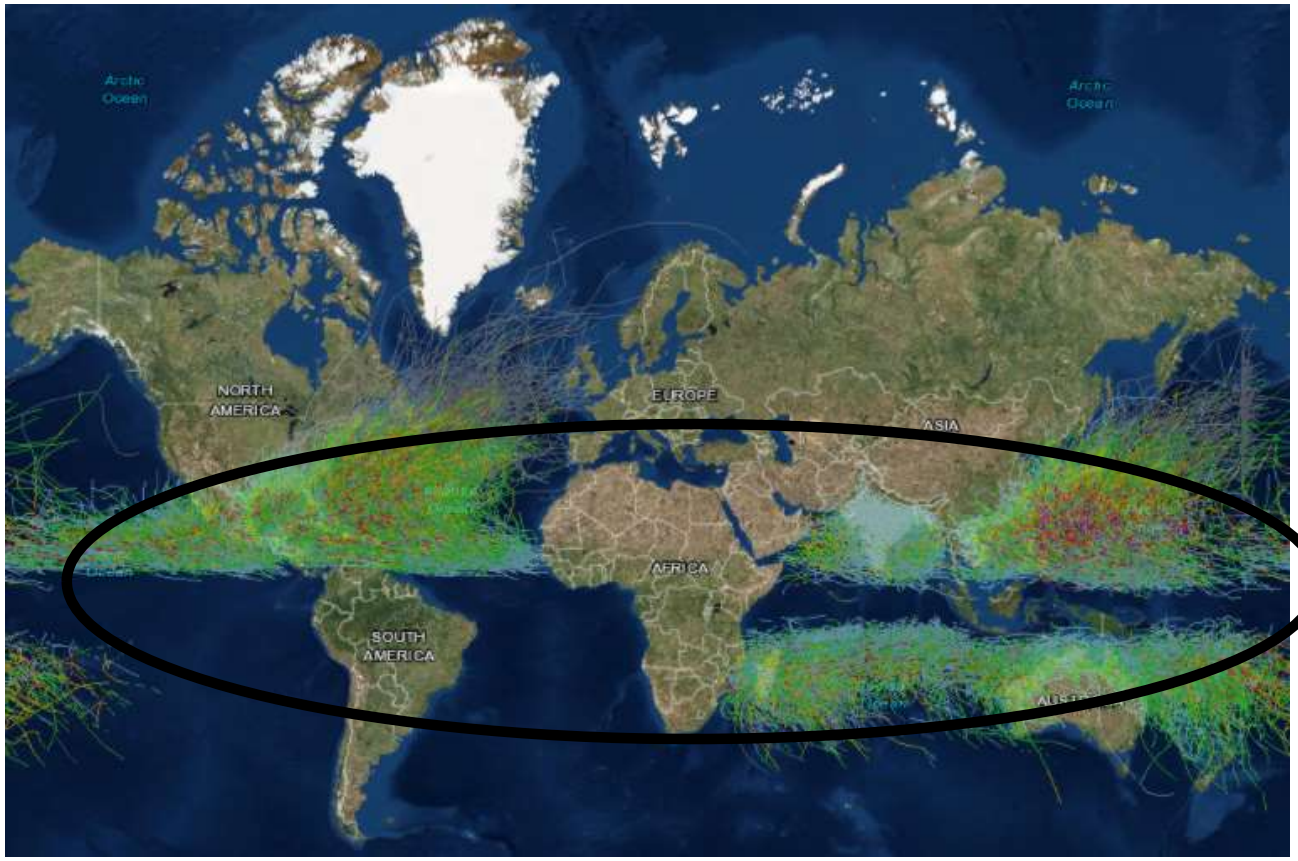
Climate



Various areas are expected to suffer from structural water shortages. Impact on EO yield and composition are yet limited.

This map illustrates the potential for drought by 2039, based on current projections of future greenhouse gas emissions. The map uses the Palmer Drought Severity Index, which assigns positive numbers when conditions are unusually wet, and negative numbers when conditions are unusually dry. A reading of -4 or below is considered extreme drought. Blue or green regions will likely be at lower risk, while those in the red and purple spectrum could face more unusually extreme drought. Courtesy Wiley Interdisciplinary Reviews, redrawn by UCAR

Disruptive corridors of hurricanes, cyclones and typhoons.



Hurricane, cyclones, tyfoons : impact routes of 6000 events over past 150 years

Routes of 6000 Hurricanes, cyclone and typhoon over last 150 years

Especially concerning for areas surrounded by sea surfaces

But also great achievements : example from arid savannah to plantations

20 years of

Patience

Dedication

Investment

Kununurra, Australia

Positive socio-economic impact

Ethical responsibility for <u>all</u> stakeholders including CGC

Sustainability & Regulatory burden on farmers

Farmer …or sherpa ?

- Vegan
- Organic
- Traceability
- ISO
- COSMOS
- RSC
- ECOCERT
- FSC
- REACH
- NATRUE

Key drivers of Sustainability : 3 diverging pillars

Most initiatives aligned to UN's SDG 17 (Sustainable Development Goals 17)
They refer to the need for cross sector and cross country collaboration in pursuit of all the goals by the year 2030

Economical aspects

R&D for more efficient products (C20→C20) - ***increased yields*** - ***energy savings*** - *improved extraction techniques - responsible use of raw materials and finished products- reconsideration of current quality standards — increase reliability of naturals - short-distance value chain (local) economy - access to demand for sustainable products – legal (CITES)*

Environmental aspects

carbon footprint (CO^2+CH4) - ***Renewable materials²*** - ***waste reduction*** - ***environmental toxic³*** – ***biodegradability³*** - ***water*** - ***reforestation*** - ***soil preservation*** - ***pesticides*** - *biodiversity preservation - renewable energy - renewable irrigation - biodiversity preservation - fertilizers - climate change*

OFTEN FORGOTTEN

Social aspects

Employment impact - ***profit sharing (Nagoya)*** - ***women empowerment / equal opportunities*** - ***rural populations*** - *health and safety - local traditions / cultural heritage - extended support of basic needs - access to genetic resources (Nagoya) - human rights*

Often... ***Perfect sustainability is a myth***

...a very good carbon footprint comes at the cost of a reduced social support....

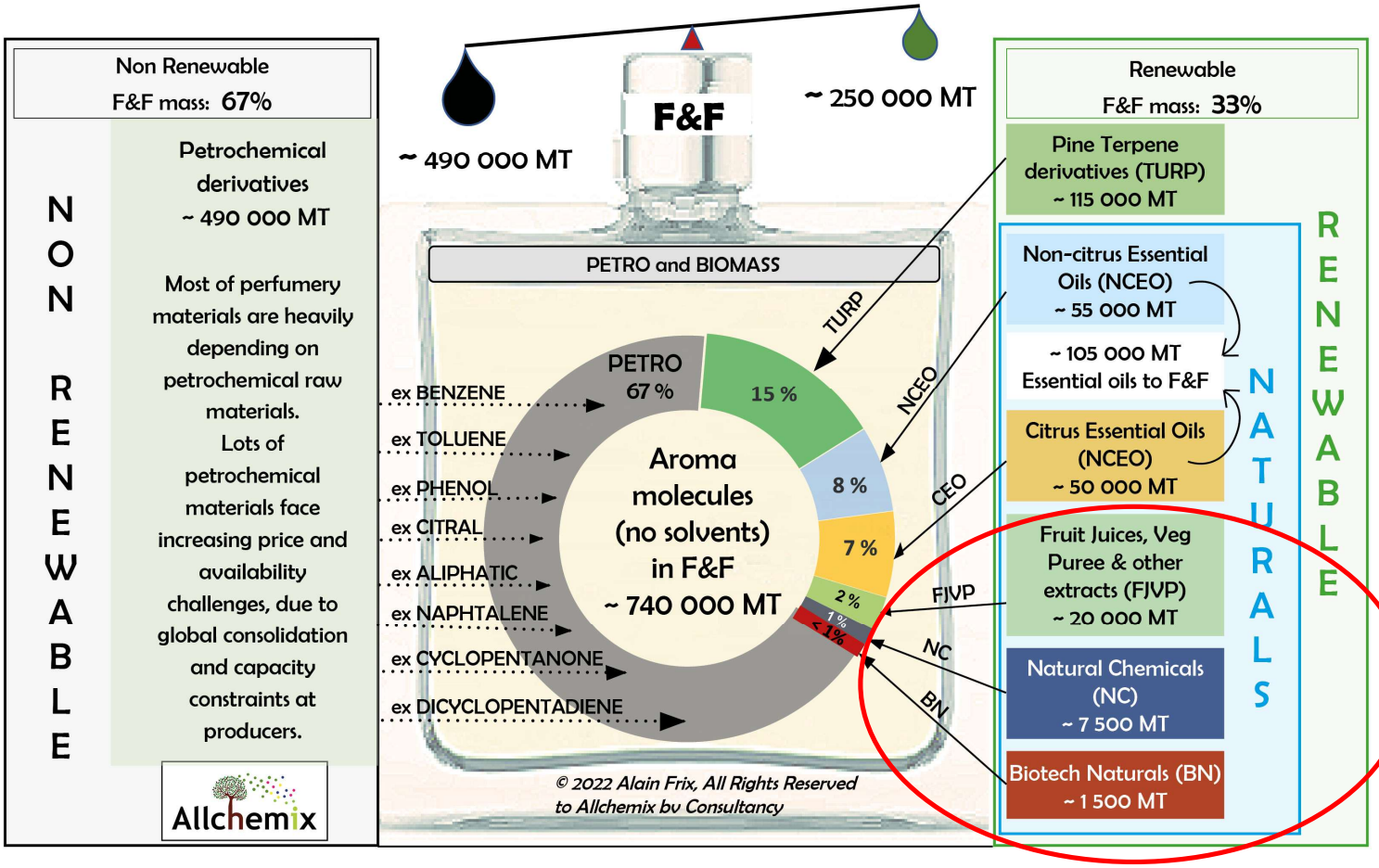
...a very good social footprint comes at the expense of environmental impact...

Difficult to excel on all 3 pillars (economic, environmental and social)

.

More than scores, it is <u>progress</u> that companies should seek: continuous improvement of its own internal framework, year after year, whether it is a producer of petrochemical derivatives, or agricultural products.

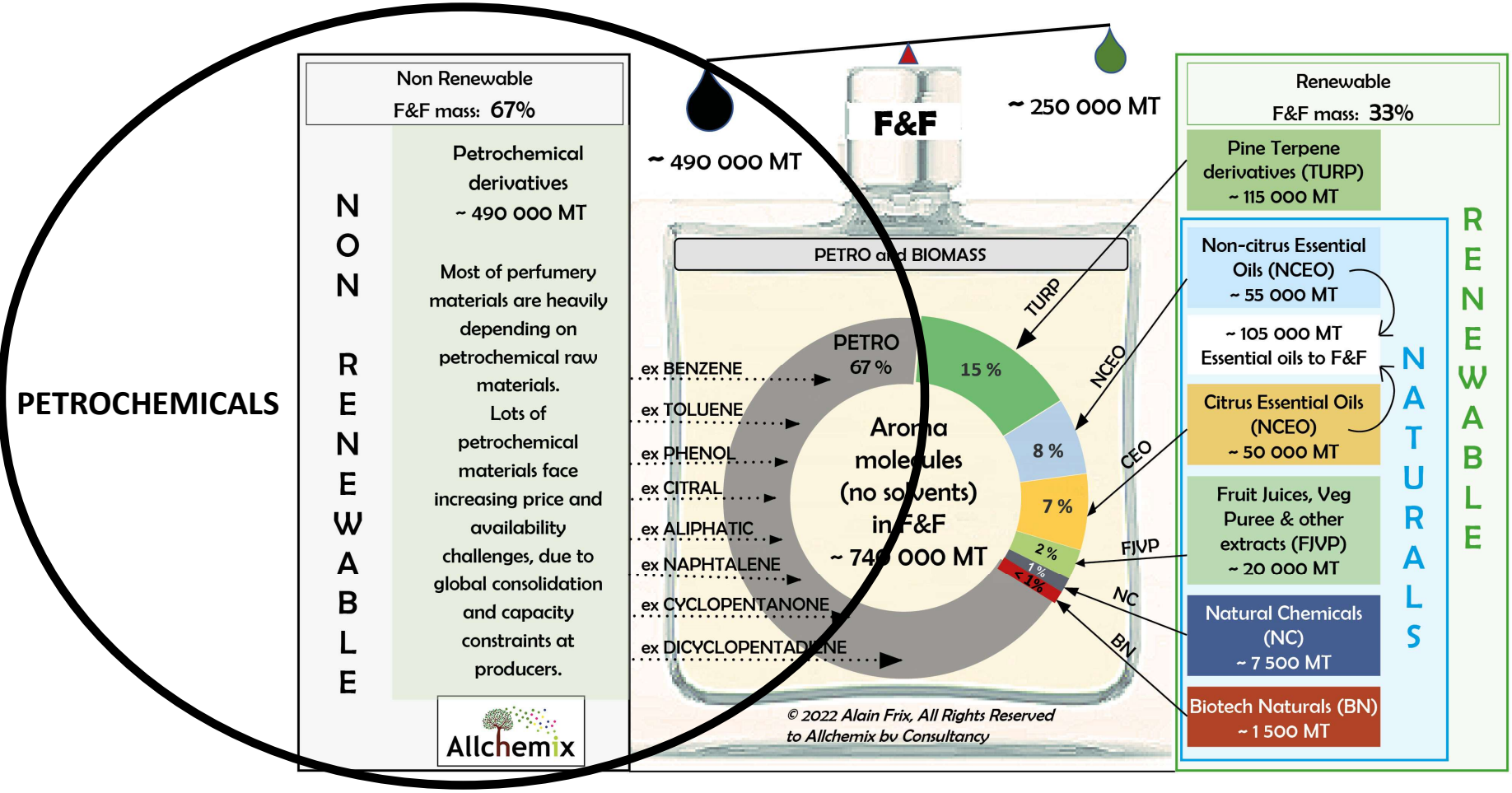
Overview of F&F Feedstocks



OTHERS : SMALL to EXTREMELY SMALL…as Biotech is today

Overview of F&F Feedstocks

Petro-chemicals



Petro-chemicals

Naphtha C2 C3 C4

= co-products of Gazoline production from Crude Oil
= Key starting blocks to all kind of plastics PET / PU / POLYAMIDES / RESINS / SOLVENTS / VITAMINS / Etc

Butadiene C4

Propylene C3

Ethylene C2

Naphtha Cracker

Crude oil

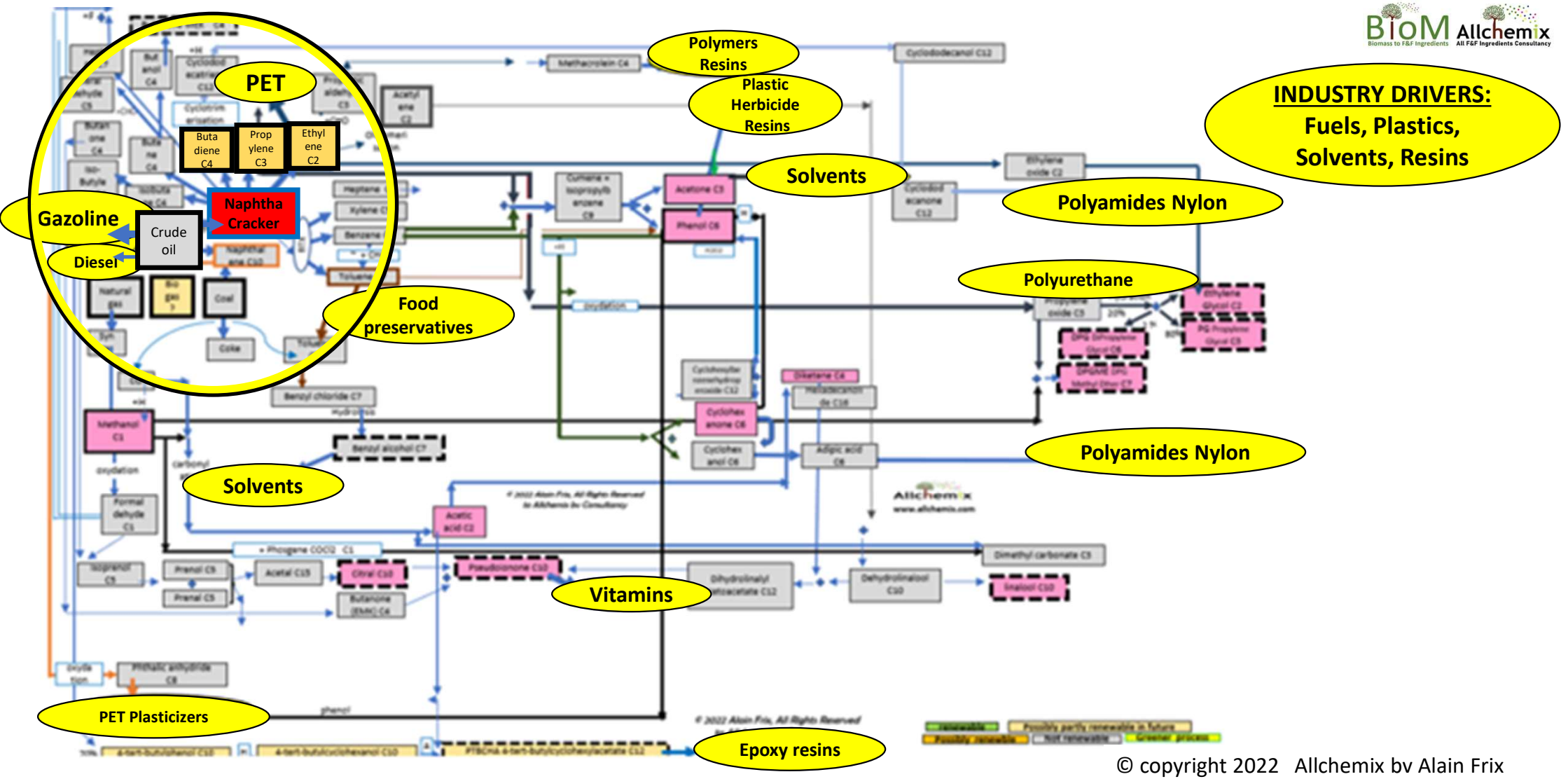
Gazoline

Diesel

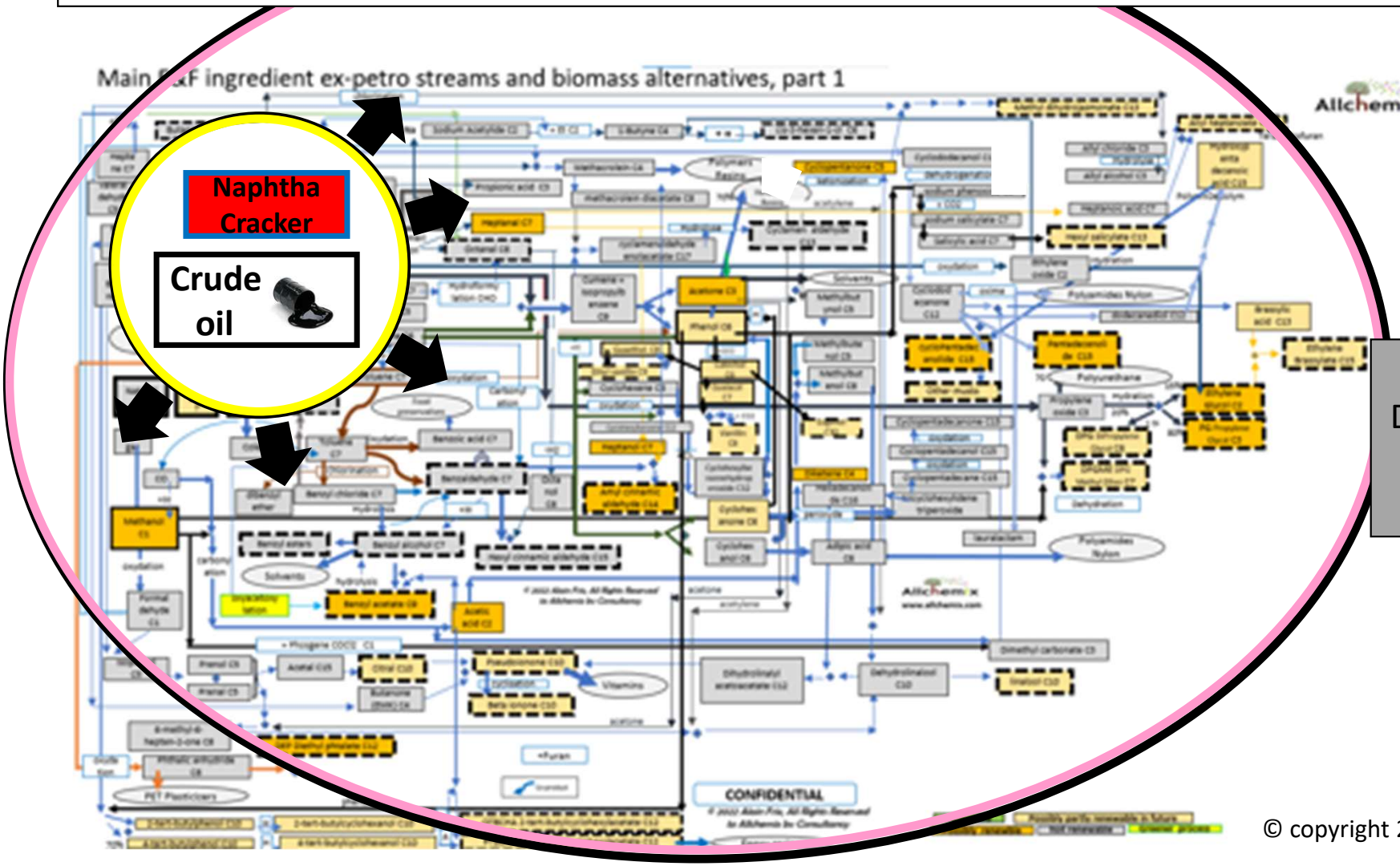
Other fuels

Petrochemicals are mainly designed for big industries such as Plastics, Textile, Adhesives, Solvents, Vitamins, etc.

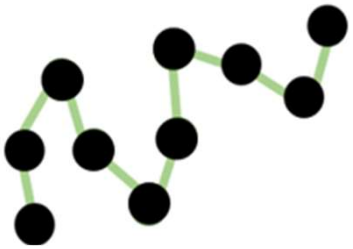
Such markets are more than 1000 times larger than F&F market, F&F will access those volumes made available in the petro chain



F&F Industry : over 2000 F&F ingredients are made from petrochemical route from Crude Oil Nahphta crackers.
This represents 500,000 MT of F&F odoriferous materials = 67% of all F&F core ingredients

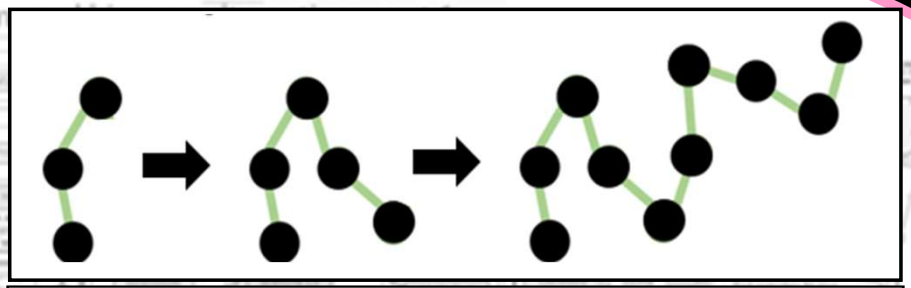


PETROCHEMICAL DERIVATIVES TO F&F ~ 67% of F&F ingredients



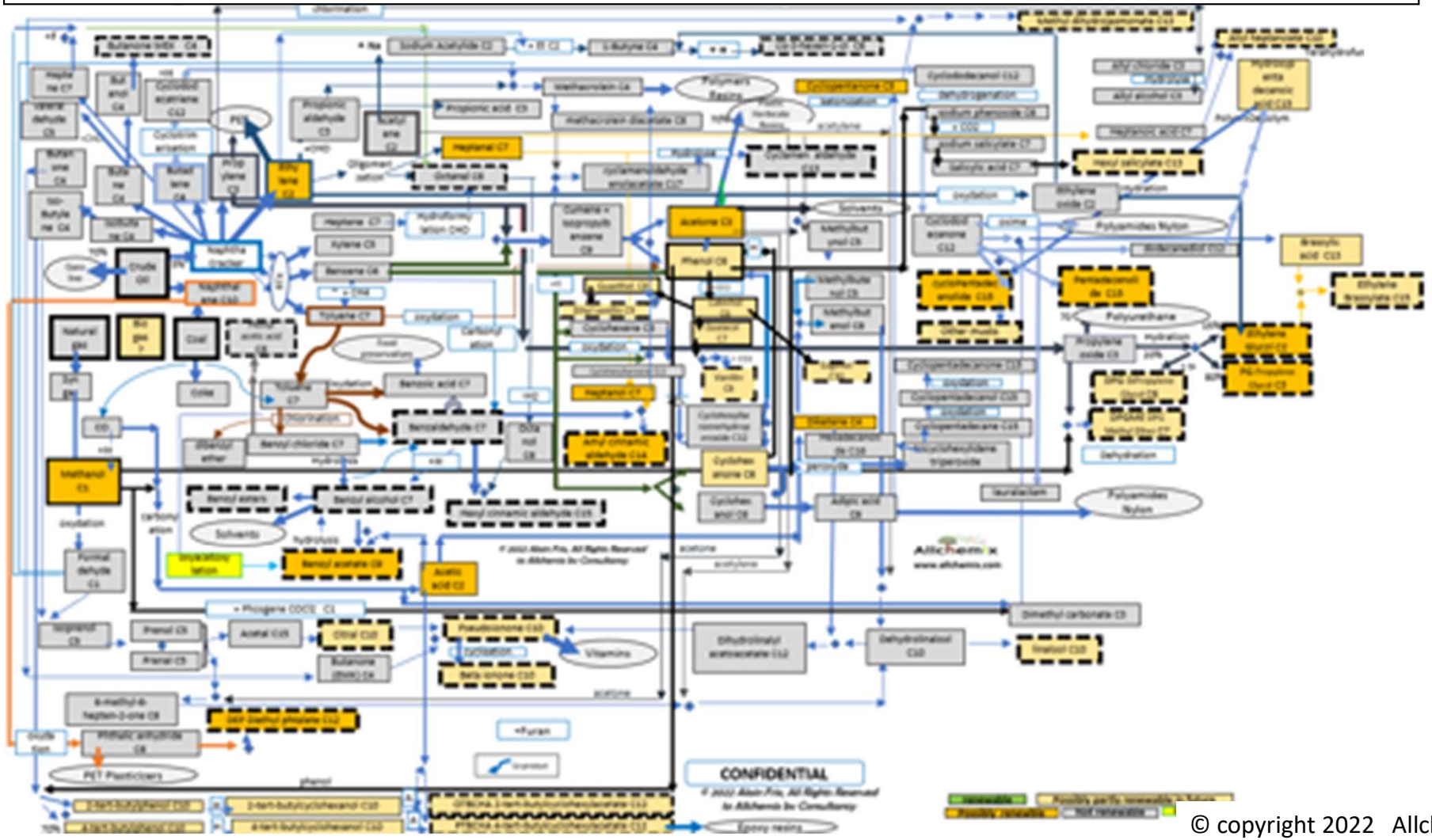
Naphtha Cracker

Crude oil

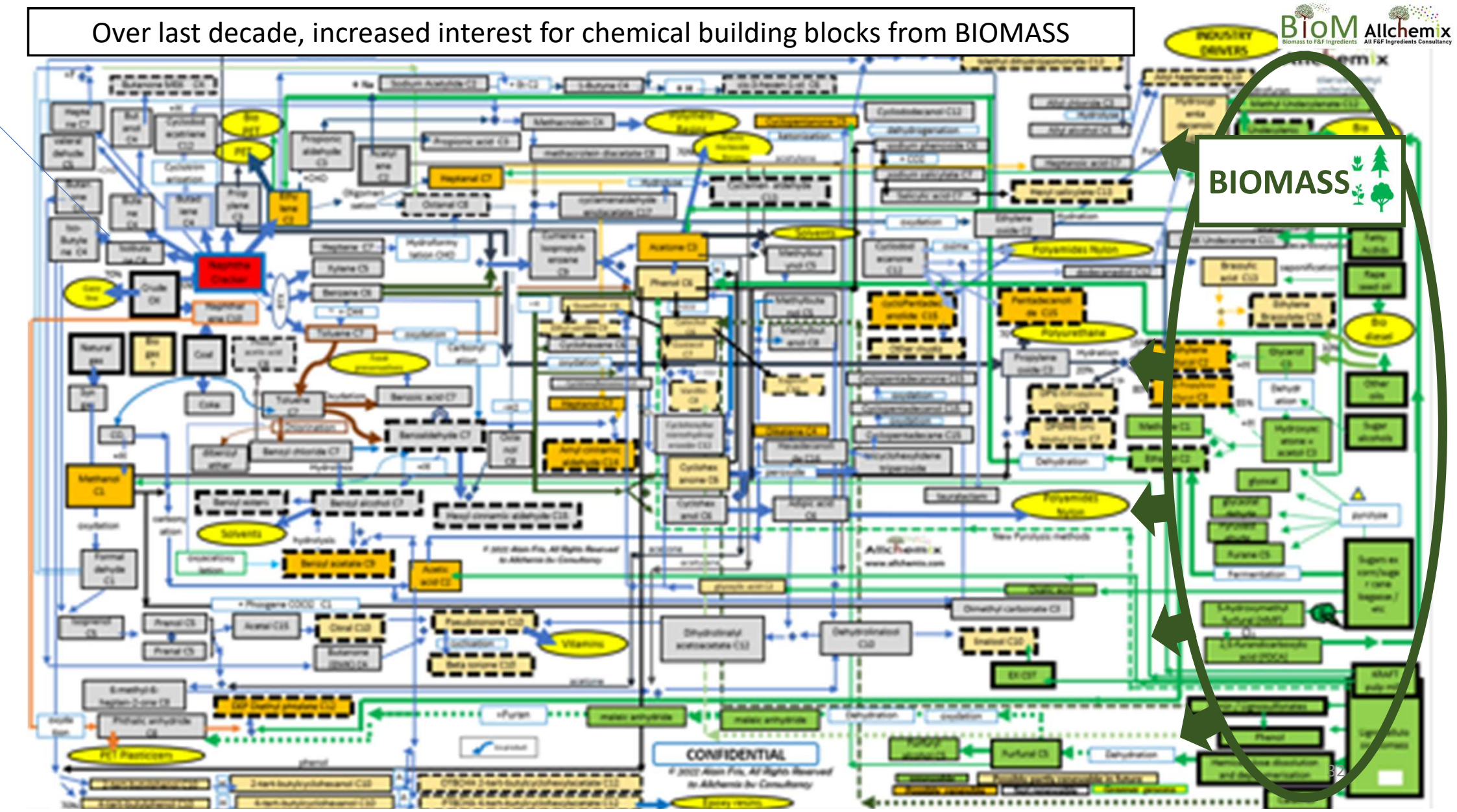


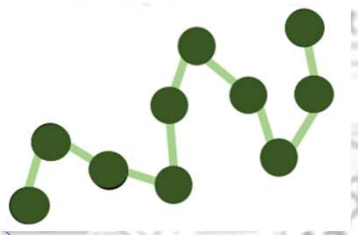
Petrochemistry is often a construction job, adding building blocks.

Petrochemicals have an history of more than 150 years, they provide many F&F molecules at low cost

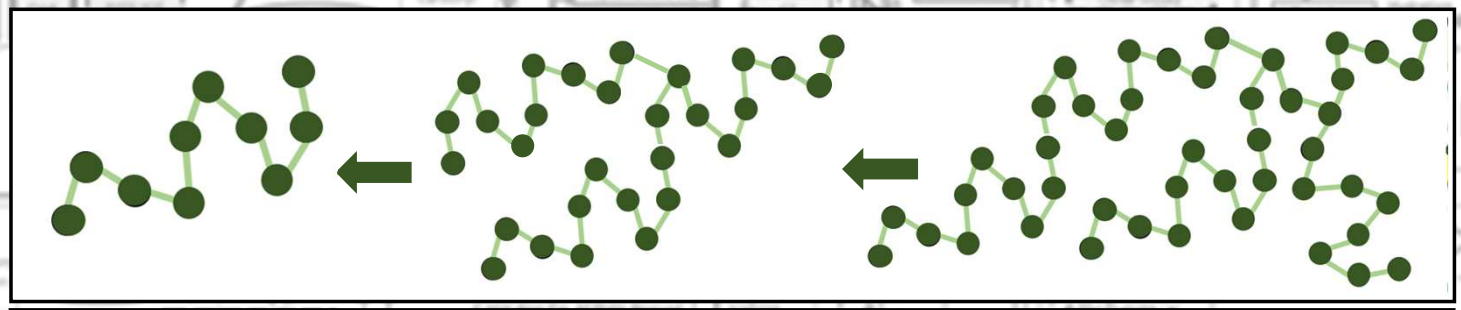


Over last decade, increased interest for chemical building blocks from BIOMASS



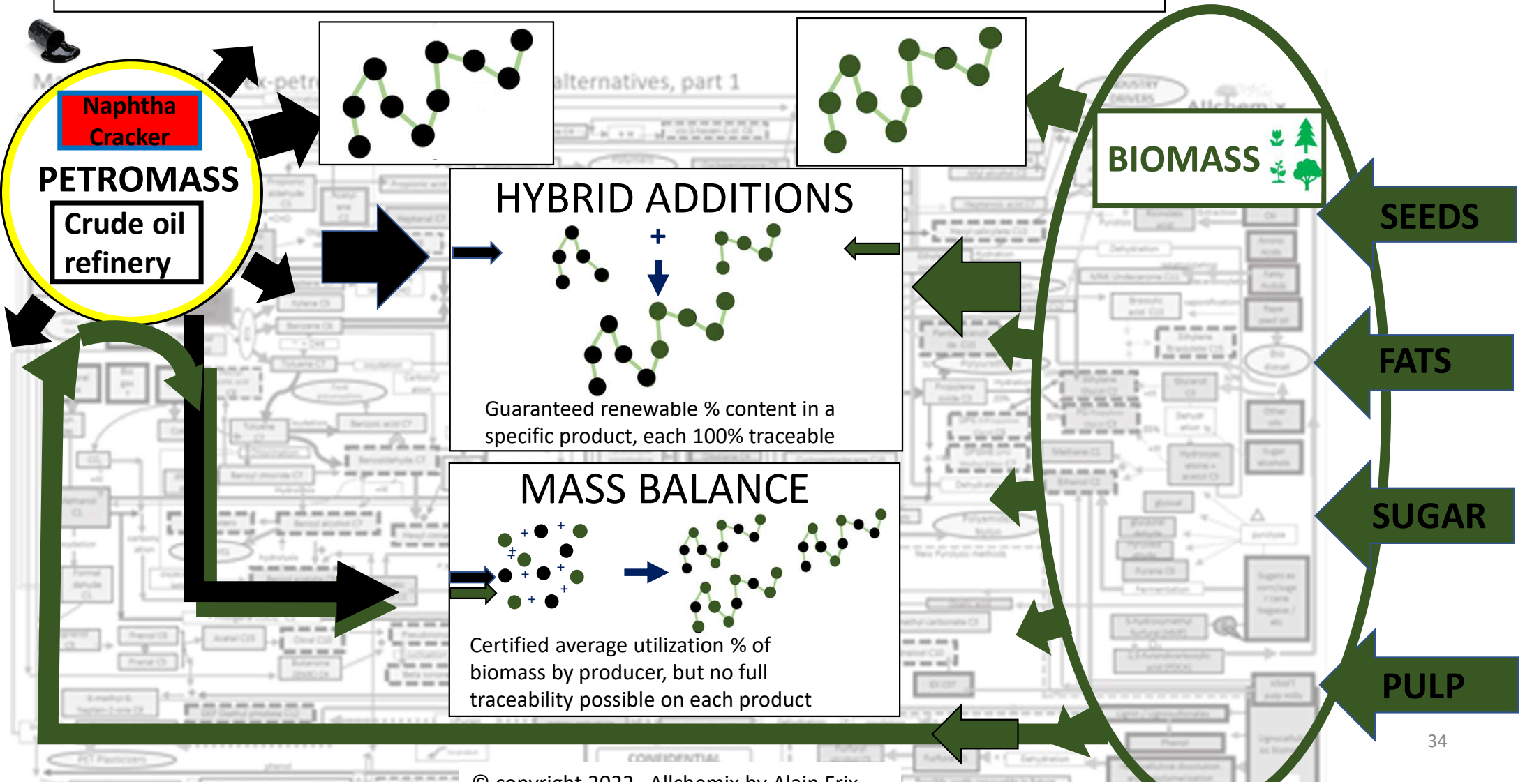


BIOMASS



Nature produces very complex and long molecules. Using biomass often requires breaking down complex molecules into easier building blocks.

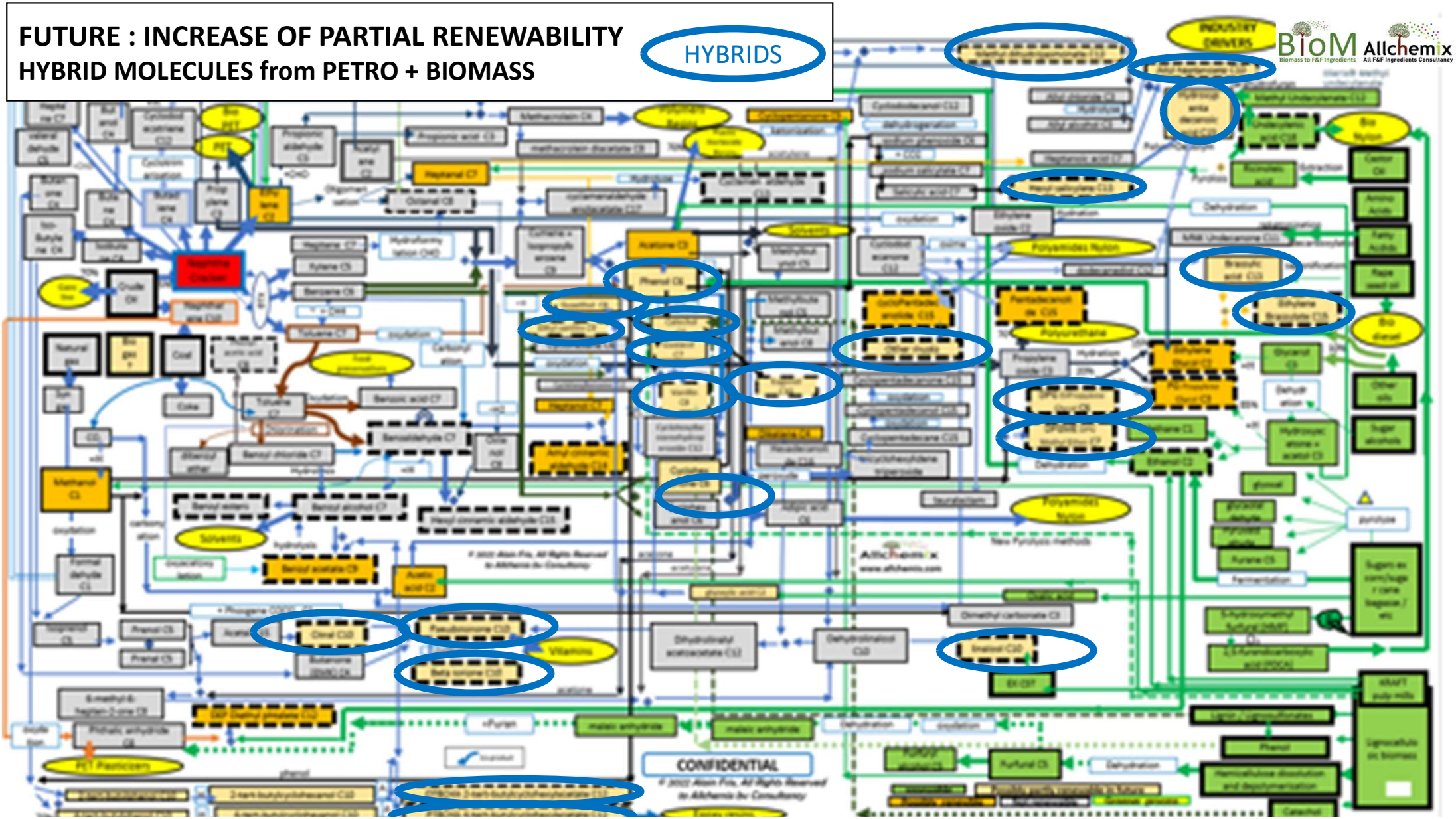
FUTURE : INCREASE OF PARTIAL RENEWABILITY
HYBRID MOLECULES from PETRO + BIOMASS, DIFFERENT CONCEPT THAN MASS BALANCE



FUTURE : INCREASE OF PARTIAL RENEWABILITY

HYBRID MOLECULES from PETRO + BIOMASS

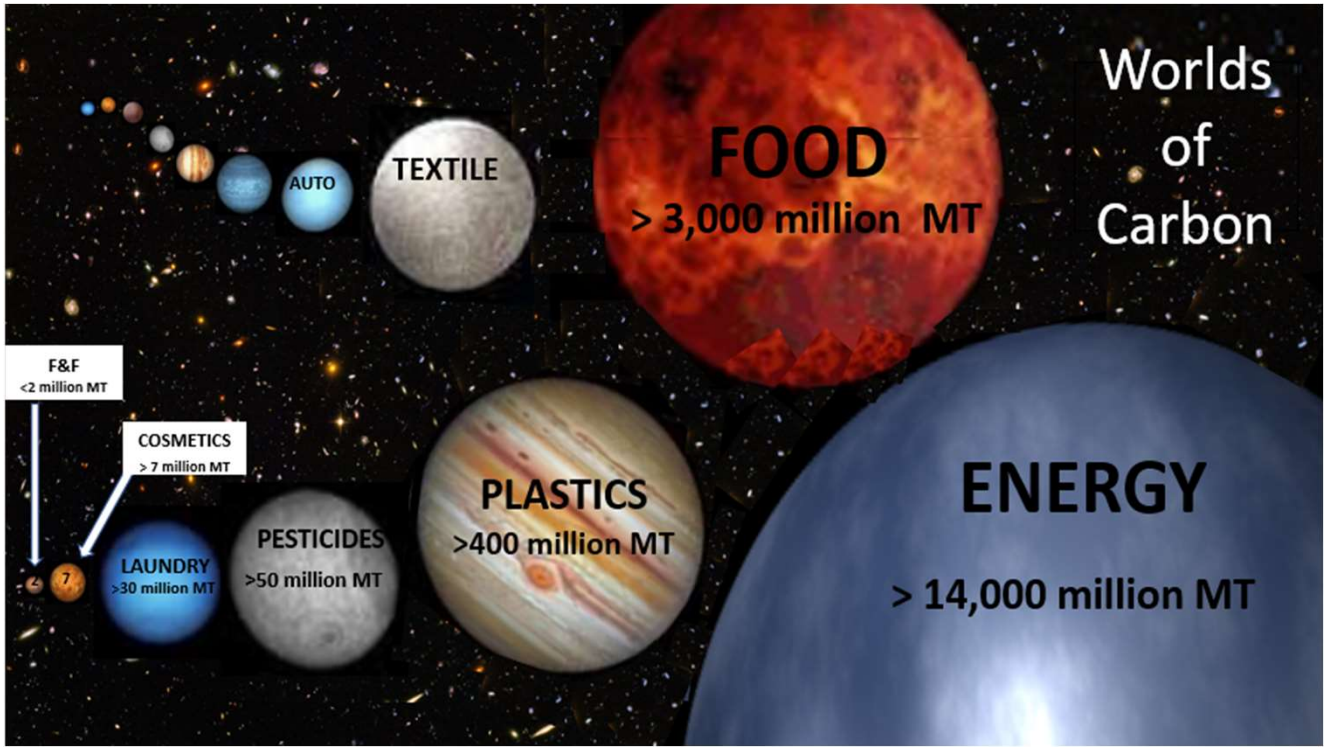
HYBRIDS



Biomass is not endlessly accessible…

World industries's appetite for more renewables is just starting :

What to expect: In the growing struggle to obtain biomass feedstocks, it is essential to better understand the dynamics of other industries, and create partnerships where possible.



Where will the biomass move ?

More information available on free article in free **IFEAT World magazine**

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F&F INGREDIENTS: A CHANGING MARKET

BY ALAIN FRIX, FOUNDER, ALLCHEMIX BV

The F&F industry is probably one of the most complex industries, as it involves art, science and culture, combining the intricacies of nature and human ingenuity.

AN ELEGANT AND IMPORTANT INDUSTRY

Each of the products which compose our palette, be they natural or man-made, will drive people to purchase consumer goods which contain them: a fine perfume, a child's lollipop, a cosmetic, a detergent for clothing, an incense stick to inspire, a refreshing beverage on a hot summer's afternoon. Indeed, flavours and fragrances evoke a large spectrum of emotions, invisible partners in reassurance, seduction, appetites, relaxation and meditation, a conjunction between well-acting and well-being.

The F&F industry is not only about stimulating emotions, but also a significant provider of work and income to over ten million farmers worldwide as well as other people involved in transforming natural feedstock into a highly diversified offering of perfumes and flavour materials. Equally important are those technicians who spend their lives creating new synthetic molecules which have apparently been "forgotten by nature," carrying out research guided by scientists in chemistry, biology, physics and finally IT. All these materials will fill the magician's hat of those perfumers and flavourists who can assemble these olfactive colours into a quantum of happiness.

Whether synthetics or naturals, F&F aroma ingredients are mostly relatively tiny hydrocarbon molecules. Solvents, fillers, carrier agents, preservatives or other products which do not contribute to odour or taste are excluded from this definition of aroma ingredients. Furthermore, from an ingredient standpoint, there is no universal rule - as long as regulation permits - that a fragrance ingredient could become a flavour ingredient and vice versa.

QUANTIFICATION OF THE F&F INDUSTRY

Many articles provide F&F industry turnover without a good indication of volumes. Moreover, turnover estimations are always subject to the price volatility of ingredients and therefore a weak indicator in volatile markets. Nature produces a biomass of hydrocarbons; it does not produce bio-dollars nor bio-euros. To assess F&F renewability and sustainability factors, it is necessary to estimate volumes as a key indicator, helping us to think proactively where and how to source material in the future — those pools of hydrocarbons that we will continue to tap for both synthetic and natural odouriferous substances.

COMPLEXITY OF F&F INGREDIENTS

There are over 1,500 main types of fragrance ingredients and over 3,000 main types of flavour ingredients. Generally, each product type is available in different commercial grades or purities. Very often further specifications are required, involving detailed analysis of all components according to dozens of parameters. Manufacturers need to guarantee perfect product performance and safety in their application, and the absence of traces that could create off-notes (human sense of smell can detect traces with a very low odour threshold). It is unusual to see the same aroma ingredient being prominent in both F&F industries, often a major ingredient used in fragrances — dihydromyrcenol for example — will have a much smaller, even negligible presence in flavours. And vice versa, a sizeable flavour ingredient, such as vanillin, will likely be present only to a smaller extent in fragrances. Besides, both markets comply with different regulations (REACH for fragrances, but not for flavours, food versus skin allergens, etc.). From a structural standpoint, the fragrance market is quite globalised, while the flavours market is much more fragmented and relies more on local producers of ingredients. Cultural values start with food and tradition, the taste of your first spoonful will constitute the first steps of a long cultural journey. Quite likely, as a result, flavours reflect ethnicity even more than fragrances do. The combination of all of the above explains why the F&F world is extremely complex and this complexity is further increased with issues related to raw material availability.

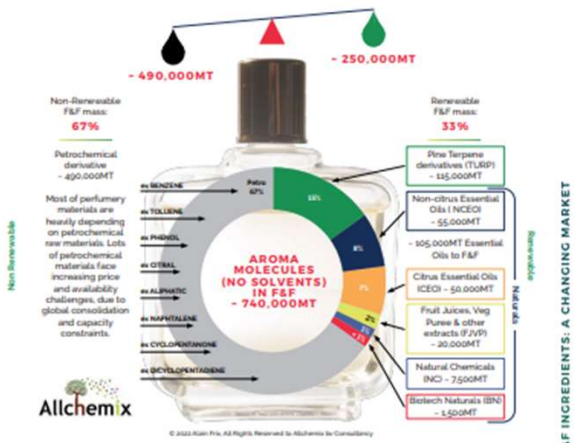
CERTIFICATES, REGULATIONS AND CASUALTIES

In recent years, further requirements such as renewability, traceability, sustainability programmes, organic or vegan nature and compliance with the rules of a myriad of other certifying bodies have added a sizeable burden and complexity. These additional constraints have proven to be very demanding to many small producers, as they lack the personnel or expertise to complete the paperwork being requested. Ultimately many small players discontinue or sell their business to larger entities, which are facing continued consolidation themselves. The pond of F&F companies is being drained at an alarmingly fast rate as a result of excessive and often unnecessary regulations.

SOURCES FOR F&F INGREDIENTS AND ESTIMATION OF USAGE LEVEL

For this study, the aroma ingredients are classified into five main categories or segments. They are interconnected in complex streams of materials and these will evolve as the F&F market is exposed to new stimuli from consumer demand, regulations, technology and biomass availability. The calculations which follow are estimations of a substance's aromatic components following correction referring to all masses being expressed as 100% pure products (Figure 1).

FIG 1. SOURCES OF F&F AROMA INGREDIENTS



Turpentine derivatives (TURP):

Turpentine is a renewable product extracted from pine trees, as a by-product from the tree tapping resins, as well as a by-product from cellulose (pulp) production. Most of the turpentine derivatives used in F&F are chemically transformed and therefore considered synthetic by regulatory bodies. About 115,000 MT of turpentine derivatives end up as ingredients in the F&F world, which equates to about 15% of the total F&F aroma feedstock. Other industries also consume turpentine derivatives such as agrochemicals, polyterpene resins, solvents, pharmaceuticals and camphor. More industries will look toward turpentine derivatives as a source of renewable feedstock in the future.

Essential oils and extracts (NCEO+CEO):

All are natural and renewable products. In some rare cases, extracts might be chemically transformed into other ingredients to become renewable synthetics. There is a global biodiversity of essential oils, with an excess of 200 commercial essential oils, providing vital resources to both developed and less developed countries. About 105,000 MT of essential oils are used in the F&F trades each year. As their production provides work to millions of farmers, they are by far the biggest socio-economic contributors of our industry. Although essential oils are primarily geared towards the F&F industries, there are increasing applications in the aromatherapy, pharmaceutical, organic phytosanitary products and other ancillary industries.

Other extracts such as fruit juices and vegetable purees (FJVP): these are almost exclusively used in flavours and are much less concentrated than their corresponding essential oils. The use of fruit juices and vegetable purees and other extracts is quite sizeable in flavours, roughly equivalent to about 20,000 MT of pure aromatic component.

Natural chemicals (NC) and biotechnology naturals (BN):

These chemicals are produced complying with either US or EU natural chemical protocols. An