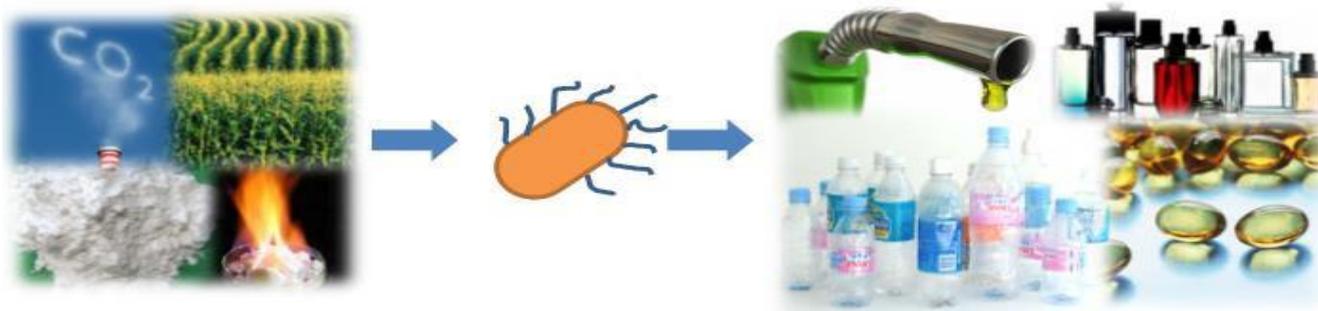


生質染料的過去、現在與未來



張珮菁

工研院材化所

纖維暨紡織化學品技術組

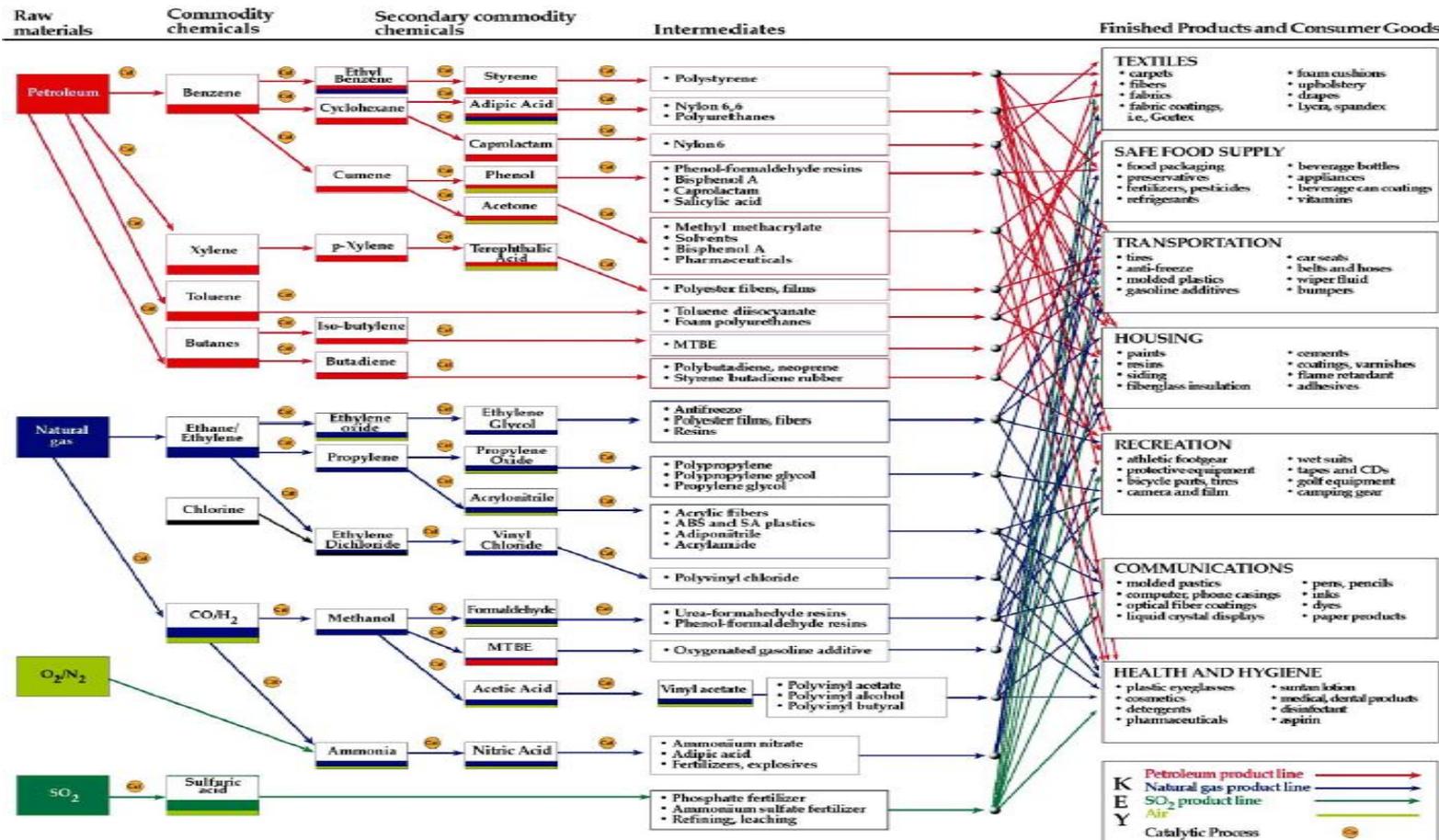


簡報大綱

- 永續的重要性
- 全球趨勢
 - 以生質原料取代石化原料
- 生物合成化學品
 - 開發流程
- 國際現況
 - 化學品與衍生物
 - 染料
- 結論

Necessity for Sustainable Products

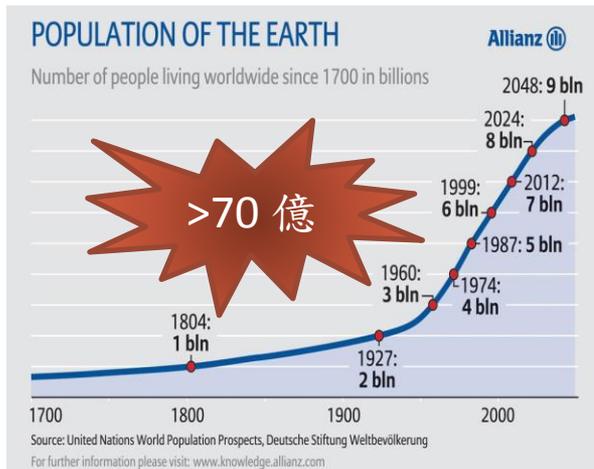
我們的社會是以不可再生的化石資源為基礎





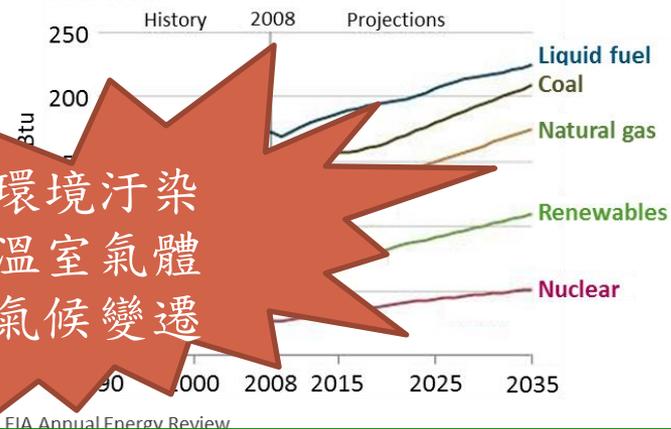
Necessity for Sustainable Products

人口數量急速攀升

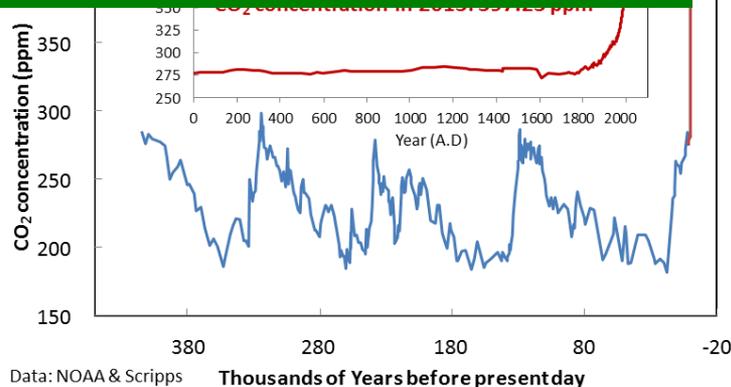
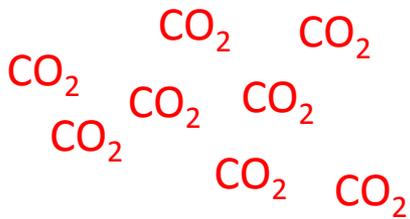


需求增加

World Energy Consumption by Fuels



人類活動對環境造成負面的影響
氣候變遷刺激可再生化學品的發展





Today's Clothing System

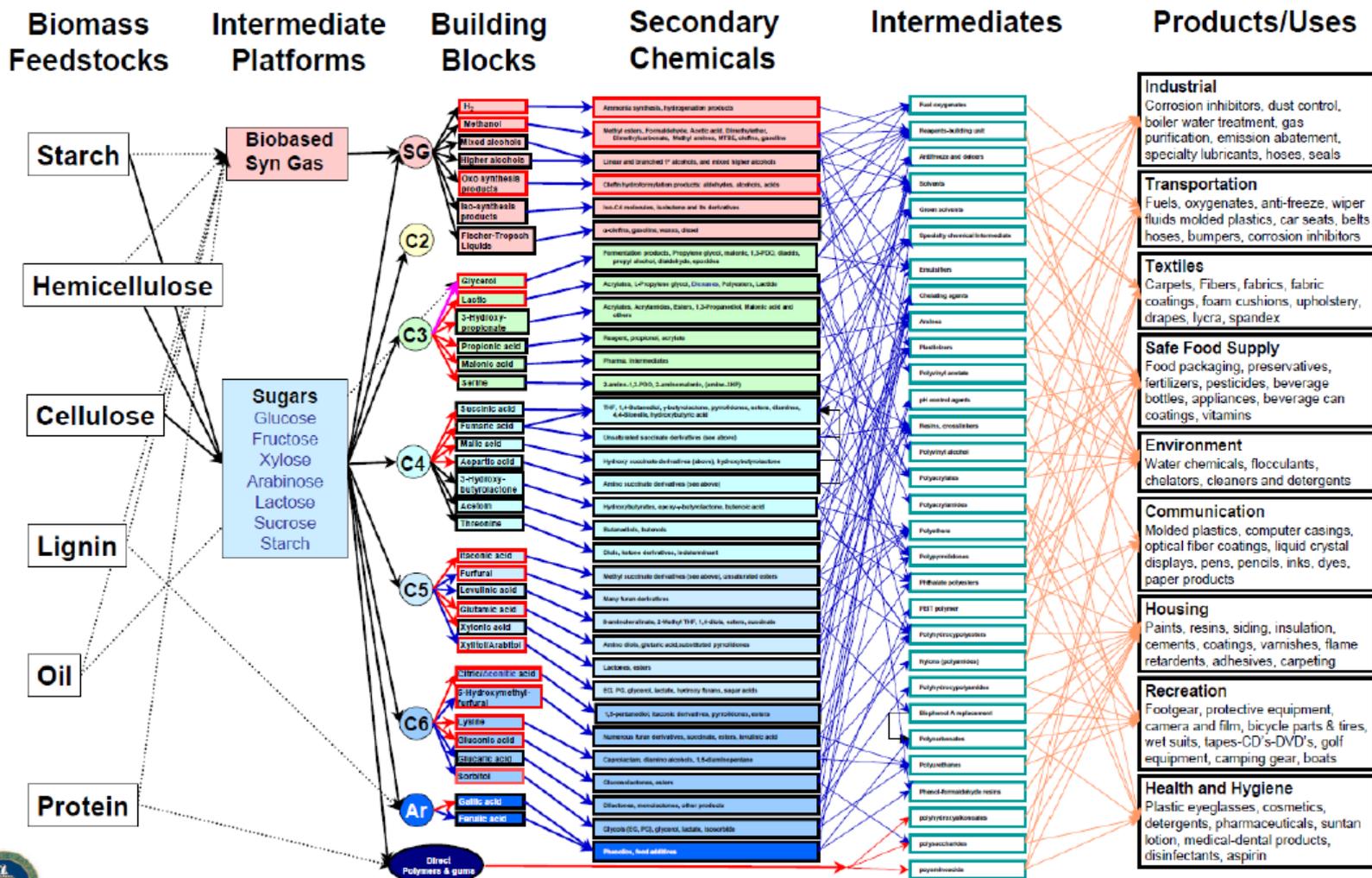
紡織產業碳排放量約 **12億噸/年** > 所有國際航班+海運
總排放量

紡織業每年消耗不可再生資源 8000萬噸

主要原則
Design out waste and pollution
Keep products and materials in use

1. **Replace Petrochemicals with Biomass**
2. 種植棉花
3. 染整

Replace Petrochemicals with Biomass





Production of Dyes



環境影響

製程產生大量
染性廢水

廢棄物生物可分解或再
利用

廢棄物生物可分解或再
利用



3. 缺乏工業化染料

生物合成染料

There are beautiful colors in nature- a wide palette of colors.

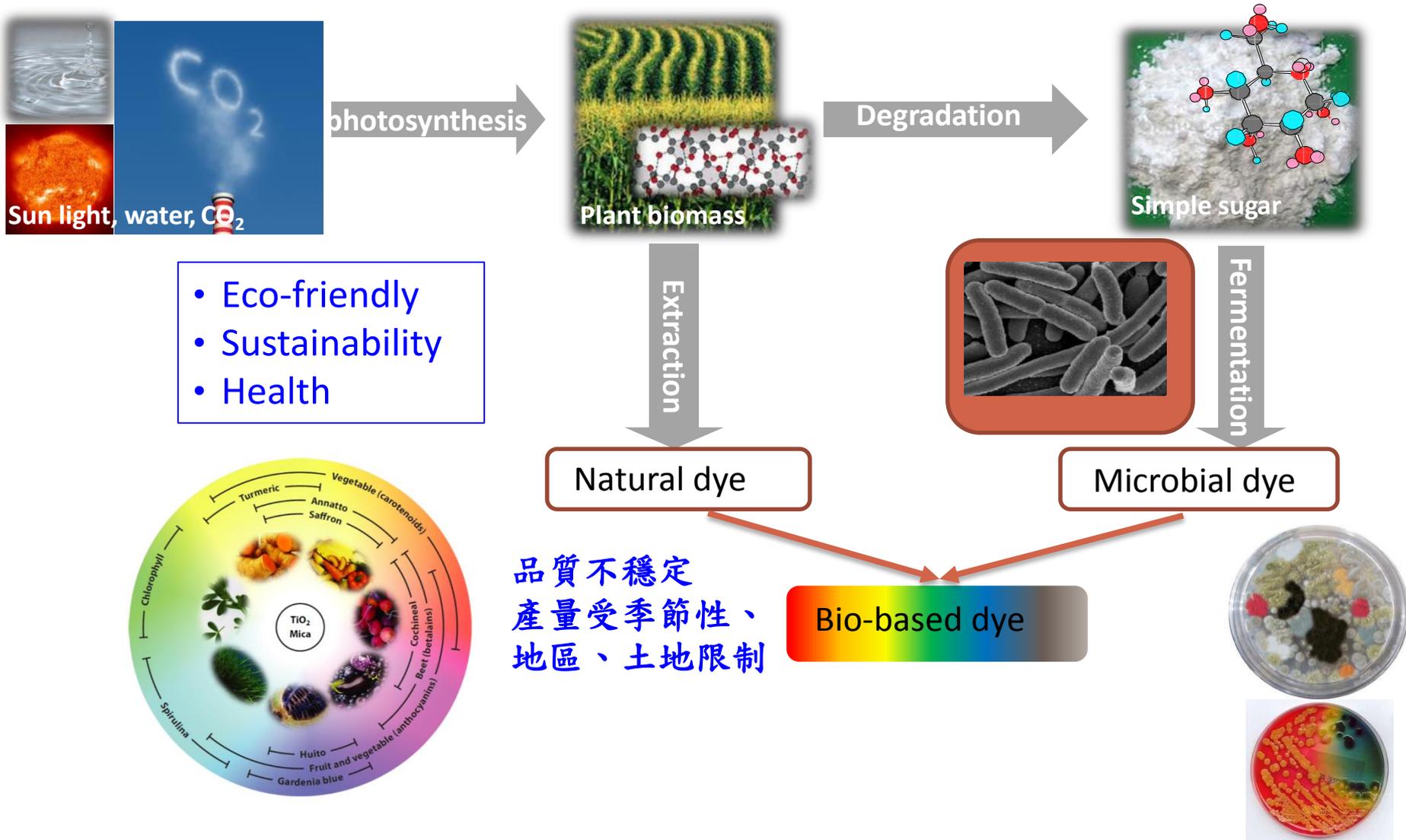


生物合成染料公司(例)

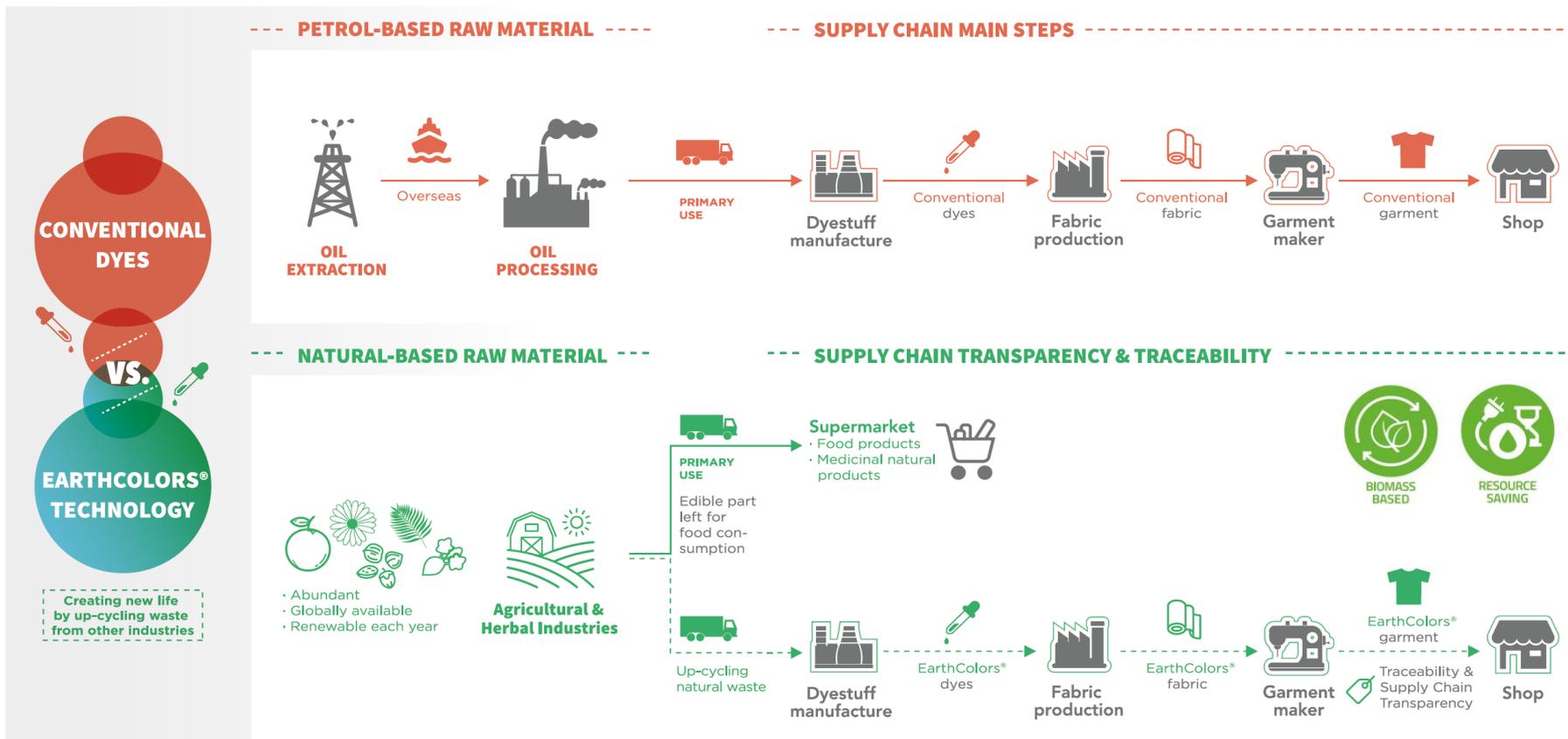
- 植物來源染料
 - ARCHROMA
 - STONY CREEK
- 微生物來源
 - Pili
 - Colorifix



Making Bio-based Dyes from Renewable Resources



• EarthColors by Archroma, a range of dyes synthesized from agricultural waste.

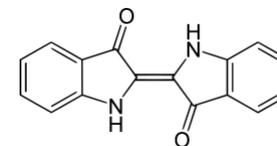




STONY CREEK COLORS



- natural indigo is a sustainable crop—it improves the health of people and ecosystems.
- the next four to five years is to produce 15,000 acres of indigo in the USA.
 - replace 2.8% of synthetic indigo dye globally.





微生物來源染料

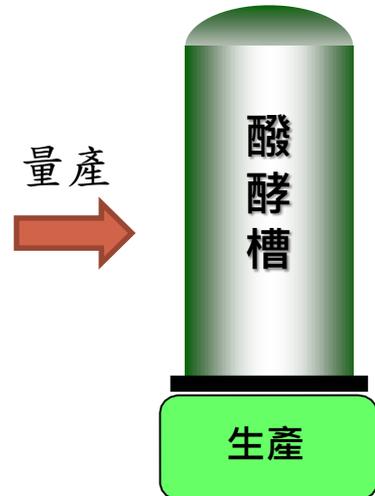
- 微生物在水中生長，使用糖/甘油等可再生原料，不產生任何污染副產品
 - 不需要任何化石資源，沒有有毒化學物質
- 但先天會產生染料之微生物通常生產速率低
- 需重新建構新的染料生產菌株



染料生產菌株



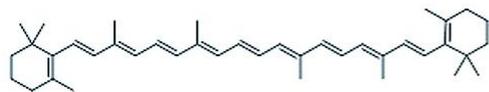
放入染料生合成路徑



可再生原料

- 澱粉
- 甘油
- 葡萄糖

Microbial Dyes

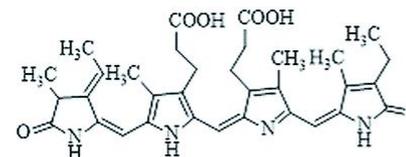


β -carotene

Carotenoids
(Orange)

Flavobacterium
Sphingobacterium
Actinobacteria
Agrobacterium aurantiacum

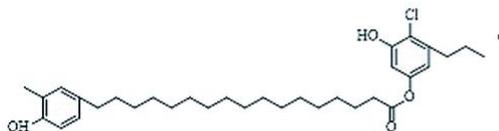
Antioxidants
Food supplement
for humans and as
food additives for
animals and fish.



Phycocyanin
(Blue)

Cyanobacteria

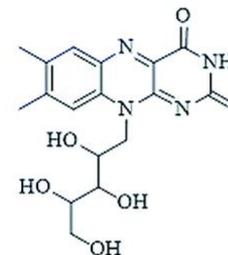
Dietary supplement
rich in proteins



Flexirubin
(Yellowish-Orange)

Chryseobacterium
Flavobacterium

Treatment for
chronic skin
disease, eczema,
gastric ulcers etc.



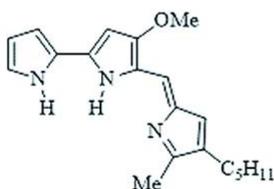
Riboflavin
(Yellow)

Bacillus subtilis

Used in foods,
vitamin enriched
milk products and
energy drinks.



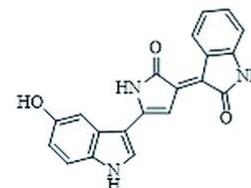
Chryseobacterium sp.



Prodigiosin
(Red)

Serratia marcescens
Pseudomonas
Pseudoalteromonas
Alteromonas
denitrificans
Hahella
Vibrio

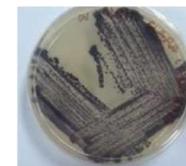
Antibacterial
Antifungal
Antimalarial
Immunosuppressive
Anticancer



Violacein
(Purple-blue)

Chromobacterium violaceum
Alteromonas luteoviolacea
Janthinobacterium

Antiviral
Antibacterial
Antileishmanial
Anticancer



Chromobacterium violaceum



Serratia marcescens

結論

- 由於自然資源逐漸耗盡及氣候變遷等因素，再生資源的應用會更為重要，這也是紡織產業未來的發展趨勢。
- 現有99%染料都是用石化原料製成的。
- 利用微生物生產化學品已經運用在許多產業，包括紡織、醫療、食品等。
- 微生物染料生產使用可再生原料，能使用既有的纖維染色製程。
- 微生物染料製程放大僅需要發酵槽。生產製程無毒、對環境與人體危害低。
- 工研院材化所多年來投入大量資源與人力開發微生物生產高值化學品，包括染料的開發。目前已成功利用微生物生產染料。



2018 TITAS 工研院展區：生物合成化學品

