PART 1. PRODUCT EXPLORATION AND DISCOVERY

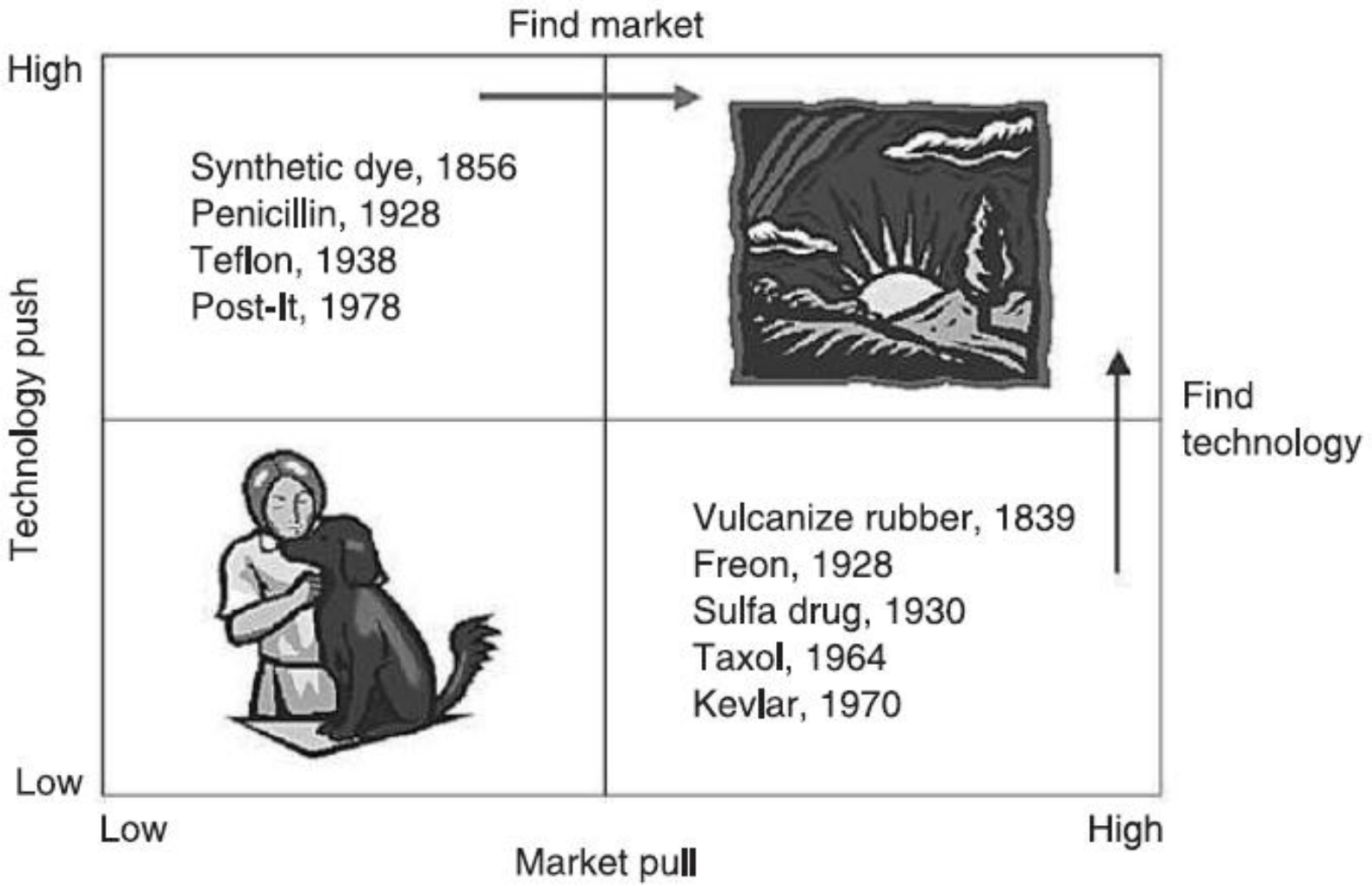
Market-Pull → Search for Technology

- Modifying current products
- Search for materials not currently used
- Creation of new synthetic material

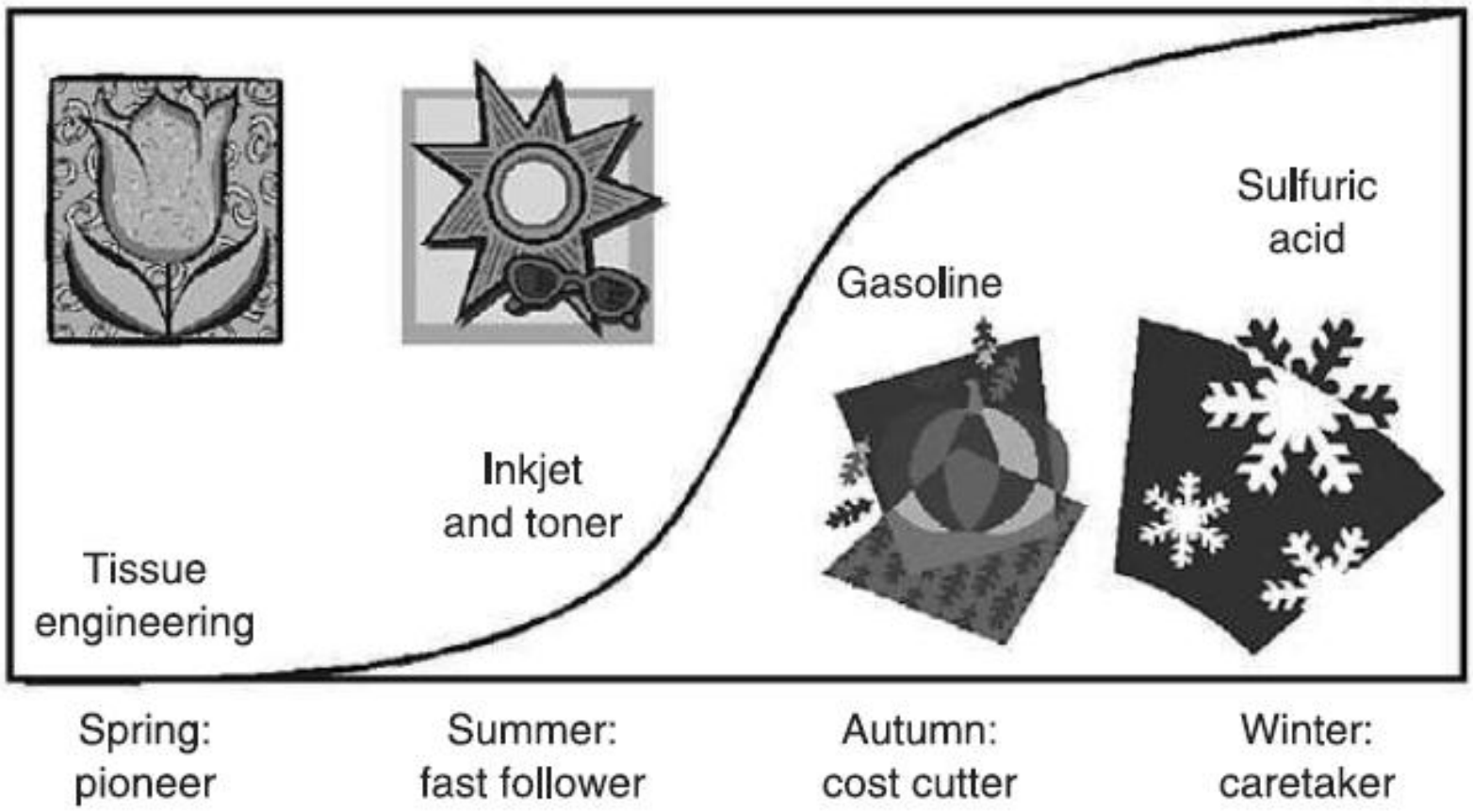
Technology-Push → Search for Market

- Adapt “platform” technology to new markets
- Invention of new technologies

HISTORIC of INNOVATIONS



PRODUCT LIFE CYCLE



FREON, CFC

Thomas Midgley, J.R.
-Mechanical engineer
-No formal education in chemical and chemical Engineering
-1921 invented TEL (tetraethyl lead)
-1928, CFC

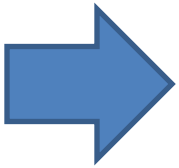
Market Need Food Preservation Technology

Traditional method → drying

Another Technology:
-Lowering temperature (decrease the speed of bacteria growth)

FREON, CFC

Refrigerant in that time:
-Toxic
-Flamable

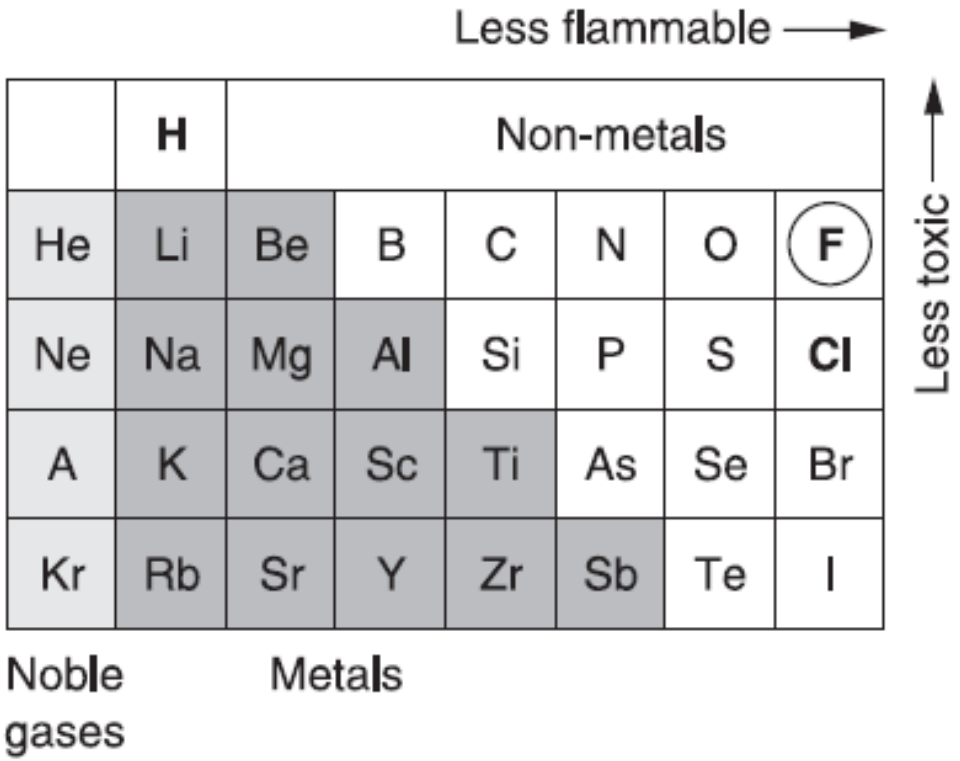


Need new refrigerant

Possibility → Mixing of two substance to reduce toxicity and flammability

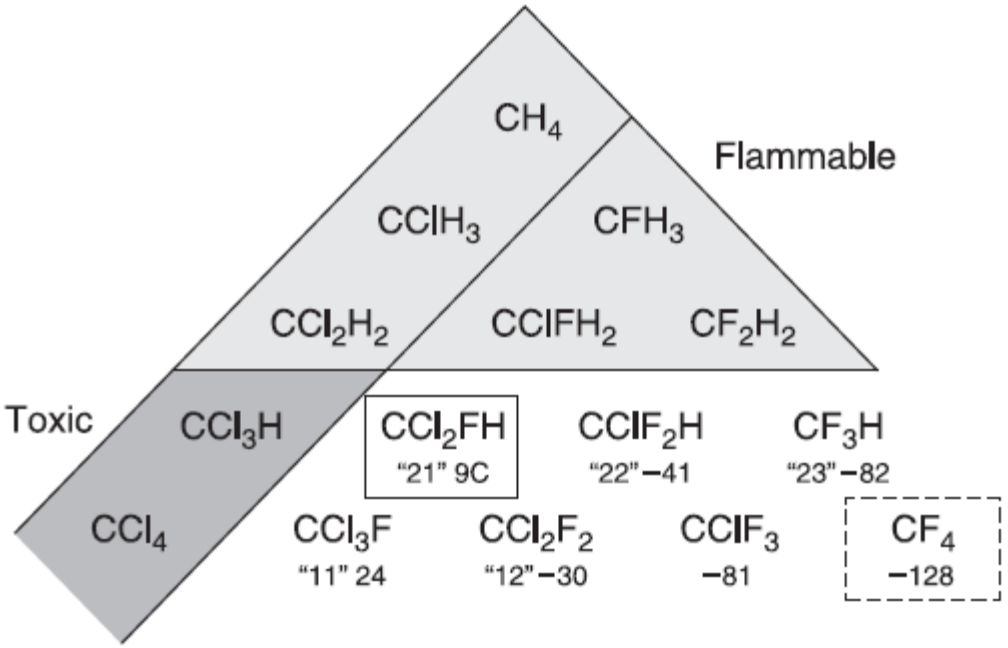
Desired compound → Boiling point 0 and -40, Stability, Nontoxicity, Nonflammability

FREON, CFC (Chlorofluorocarbons)



Midgley's analysis of refrigerant candidates

FREON, CFC (Chlorofluorocarbons)



Triangular diagram based on methane

FREON, CFC (Chlorofluorocarbons)

Reaction: 1 atm, 60^{o}C for 24 Hr

$$CHCl_3 + 2HF \xrightarrow{SbCl_5} CHClF_2 + 2HCl$$

The product is washed with water and sodium hydroxide to remove the hydrochloric acid, and then distilled to separate the different forms of CFC.

MARKET-PULL, SEARCH FOR TECHNOLOGY

- Start from identification of market that is not well served by current products

- Identification of potential market that presently doesnot exist

Divided into:

1. Modifying current product
2. Search for materials not currently used
3. Creation of new synthetic material

MODIFYING CURRENT PRODUCT

Vulcanization of rubber – goodyear, 1839
Celluloid-Hyatt, 1870
Aspirin-Hoffman, 1898
Tetraethyl Lead as Gasoline additive – Midgley, 1921

SEARCH FOR MATERIALS NOT CURRENTLY USED

-Ether as anesthetic – Morton, 1846
-Incandescent Lamp-Thomas Edison, 1879
-Chlorination of drinking water, Chicago, 1908
-Sulfa drug – Gerhard Domagk, 1930
-Dichlorodiphenyltrichloroethane, Muller, 1939

CREATION of NEW SYNTHETIC MATERIAL

-Salvarsan-Ehrlich, 1909
-Kevlar, DuPont, 1970

TECHNOLOGY-PUSH, SEARCH FOR MARKET

Investigator have technology that they believe has potential

A platform technology is a technology successful in one or more markets and has more potential application in more markets

Examples:
-Sandpaper to mending and recording tapes
-Botox to remove skin wrinkles

INVENTION OF NEW TECHNOLOGIES

Starting point of greatest invention → discovery of new technology

-Synthetic dye-Perkin, 1856
-Penicillin-Fleming, 1928
-Nylon, Carothers, 1938
-Teflon-Plunkett, 1938
-Post it- silver and Fry, 1964

Exercise

Do a literature research on your top two *chemical product innovations, read up* on the inventors, the circumstances leading to their invention, whether they led the commercialization, the impact of the invention in changing many lives the world, and in opening doors to other inventions.