

# Chlorine/Hydrogen Derivatives Technology on Advanced Engineering Polymers

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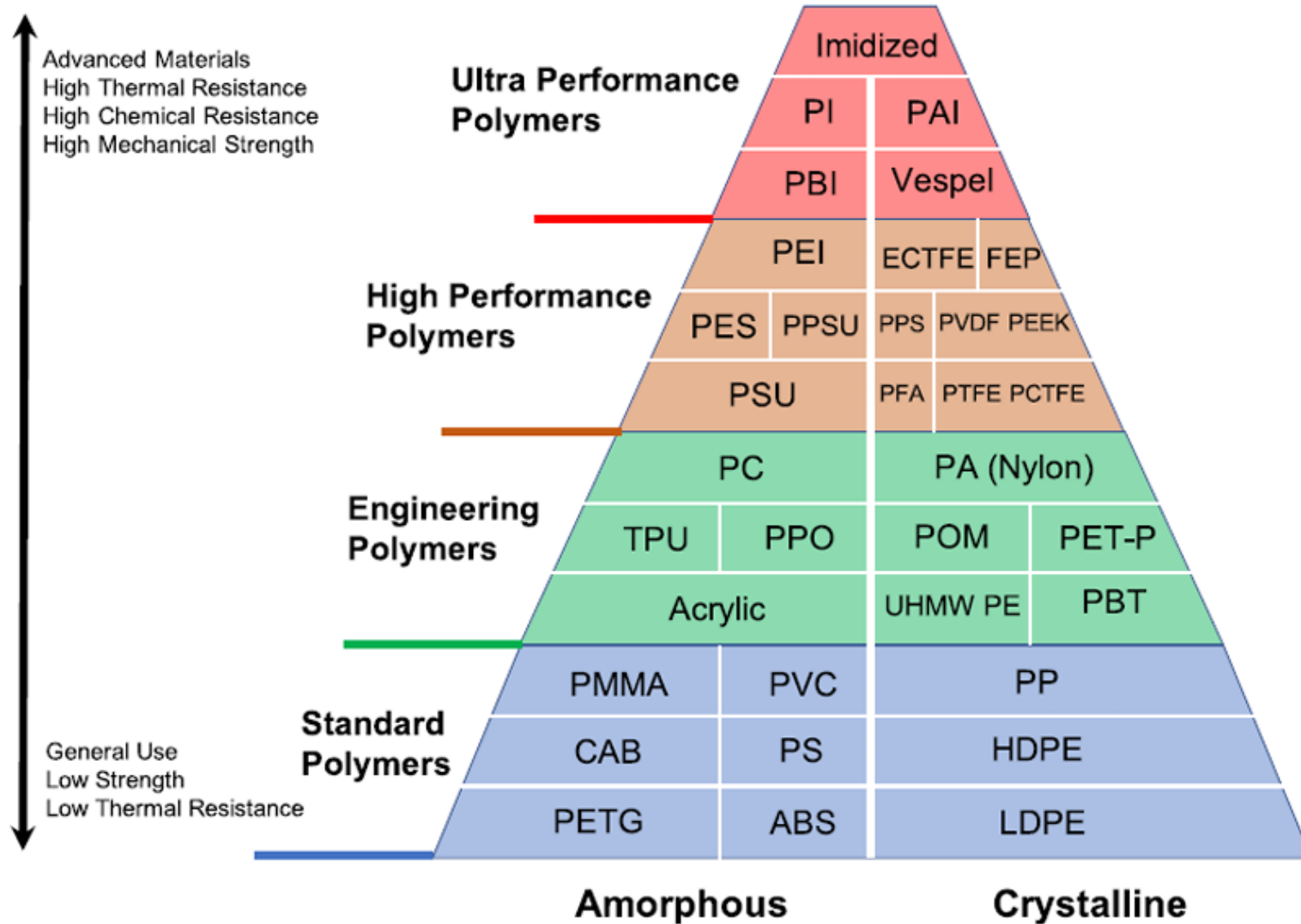


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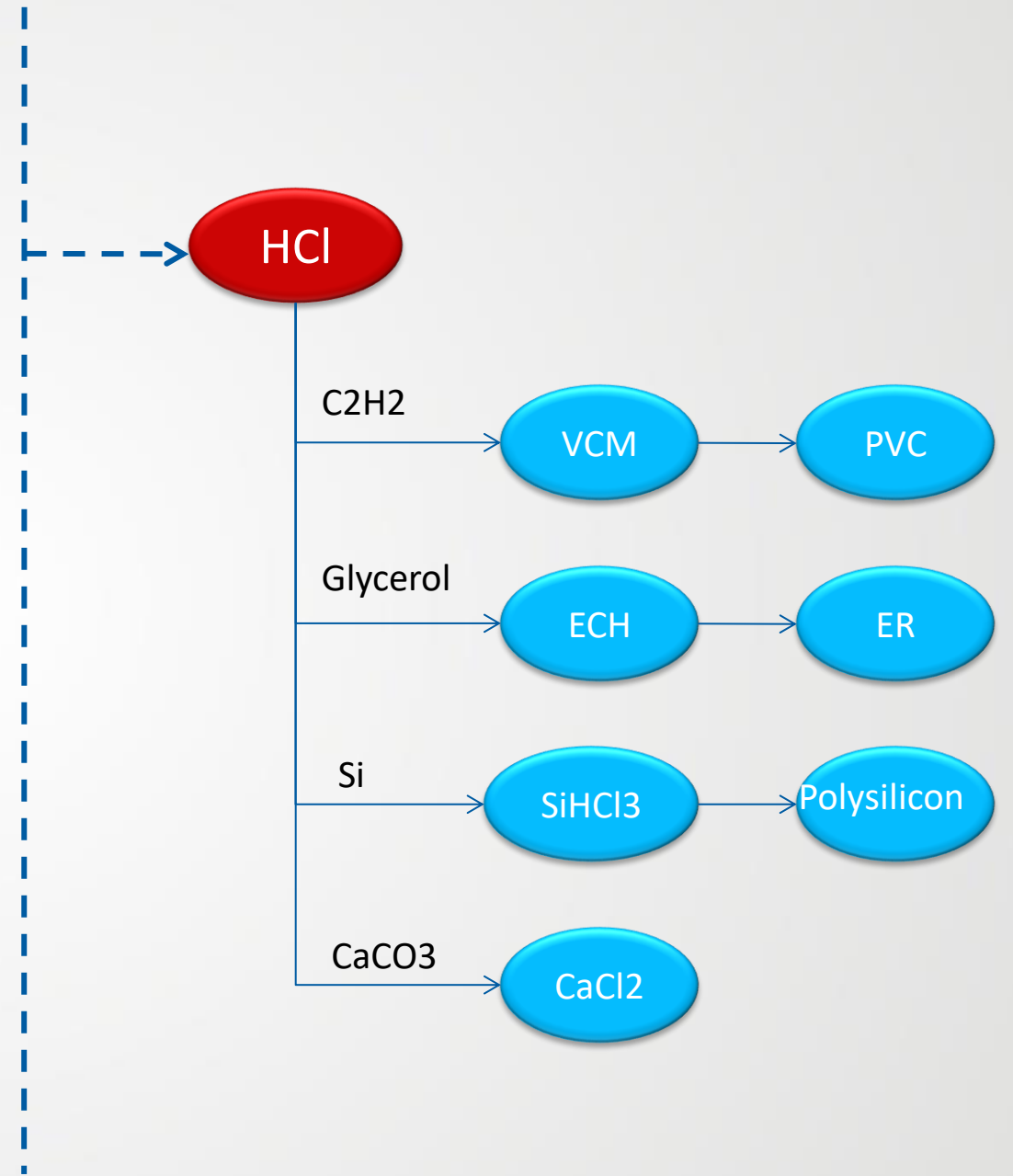
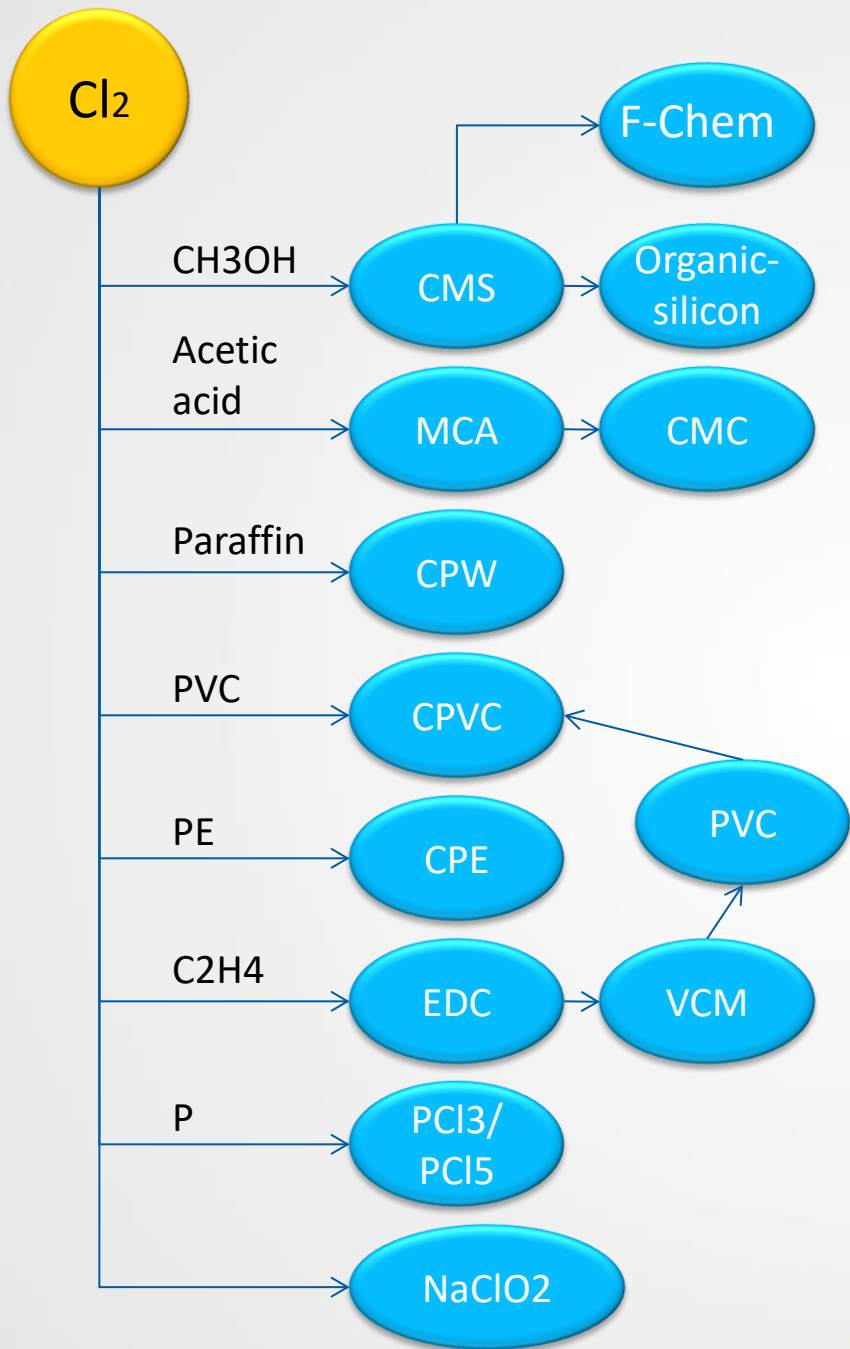
## **Definition of Engineering Polymers**

Engineering polymers are a group of plastic materials that have improved mechanical and thermal properties that make them ideal for all types of engineering applications, replacing traditional materials equal or greater in weight, hardness or other properties, while being much simpler to manufacture, especially with complex shapes.



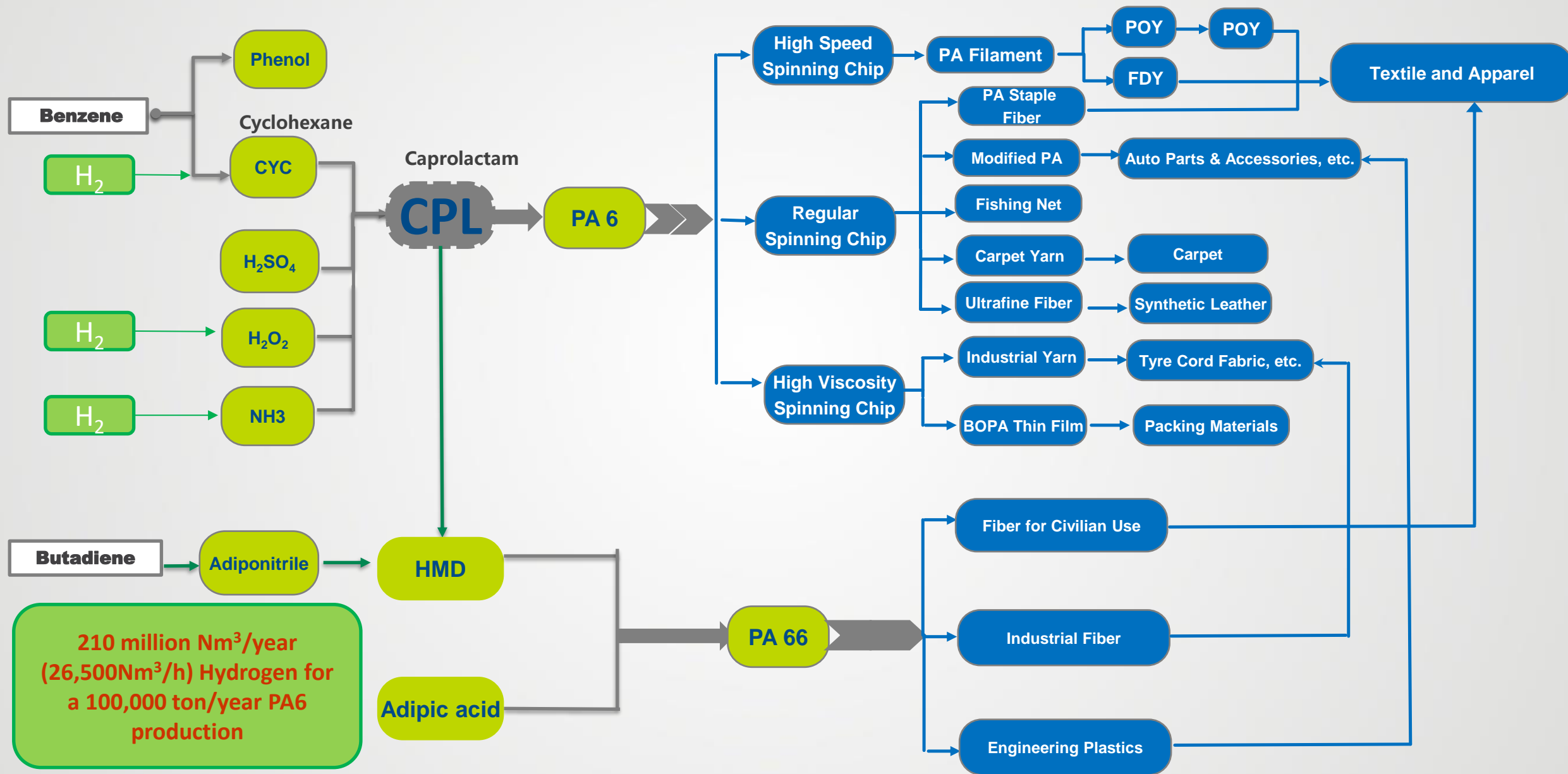
# How many Engineering Polymers coming from Salt?

- PVC, CPVC, CPE
- PA6, PA66
- Epoxy Resin
- Fluorchemical Polymer: PTFE, FEP, FKM, PVDF
- Silicone Oil, Silicone Rubber, Silicone Resin





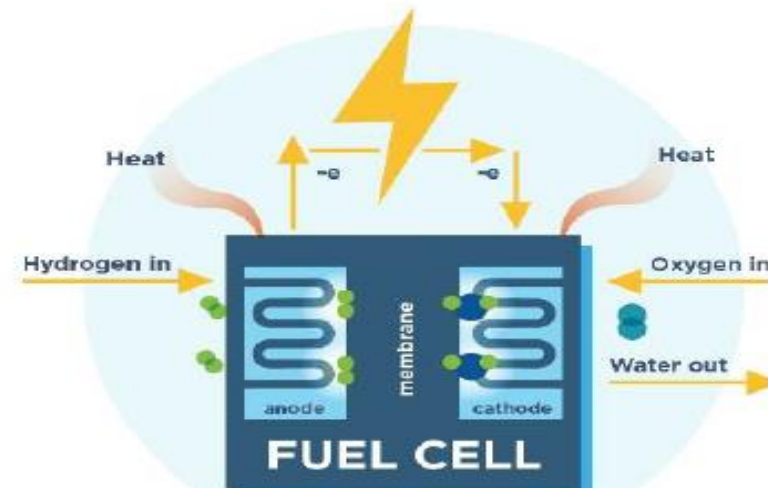
# Polyamide 6 and 66 is coming from Hydrogen



# Renewable Energy Transition – Uses of Fluorspar

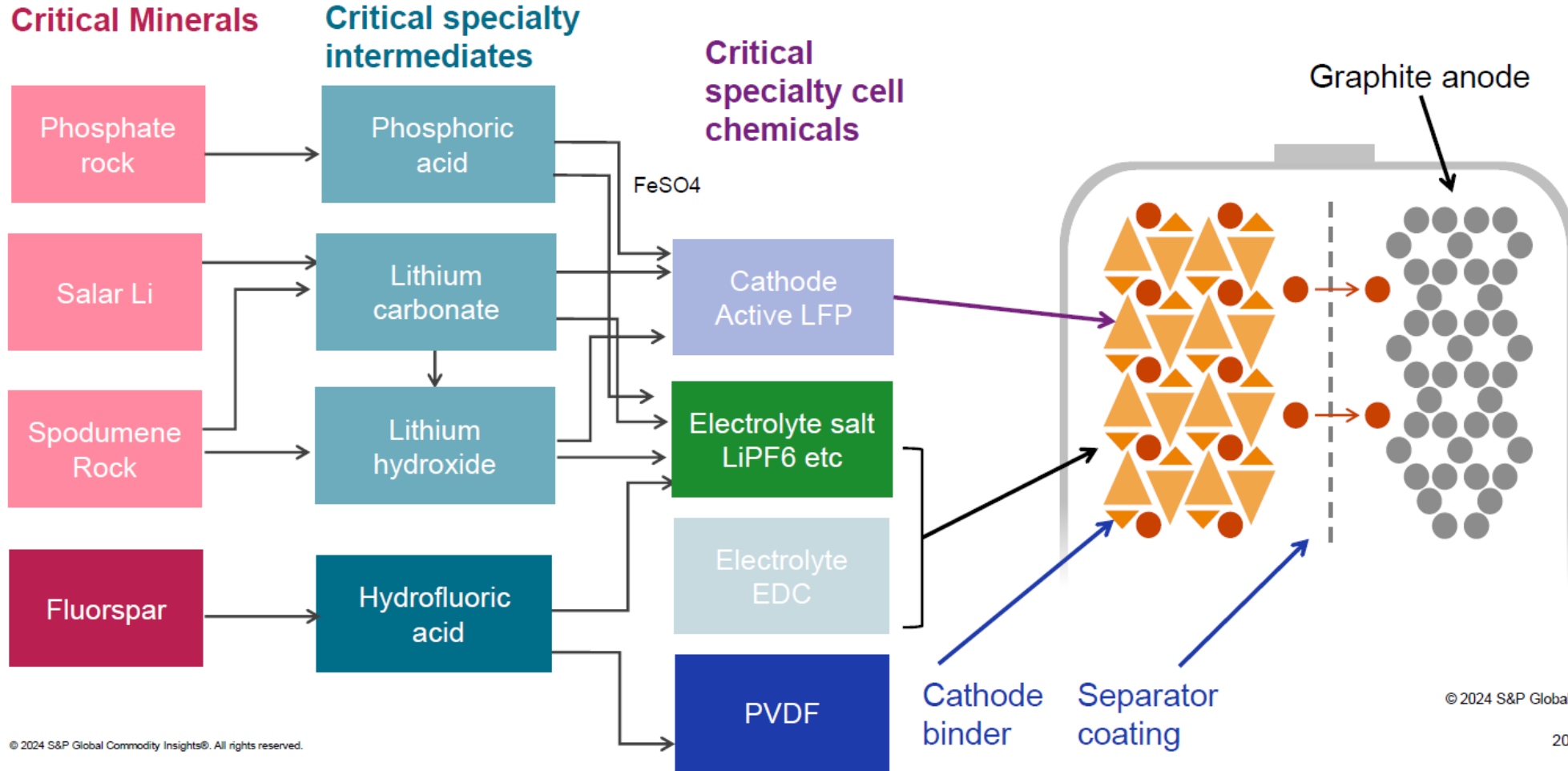
End use of fluorspar derived materials is changing and driving changes in demand.

- **Li-Ion Batteries:**
  - Electrolyte salts (e.g LiPF<sub>6</sub>)
  - Separator between the cathode & electrode
  - Binders - PVDF used to hold CAM together in cathode
  - Flake graphite processing – for use in Anodes
- **Solar PV:**
  - Fluorinated materials are used to enhance the durability of the solar cell, and also to enhance the photovoltaic performance, particularly in perovskite solar cells
- **Hydrogen Fuel Cells:**
  - Fluoropolymers are intrinsic to the function of both the electrolyser (for production of hydrogen) and the fuel cell as they are used as the basis for the Proton Exchange Membrane that allows electrons to flow between cathode and anode
  - Also used as binders in the cathode and anode.



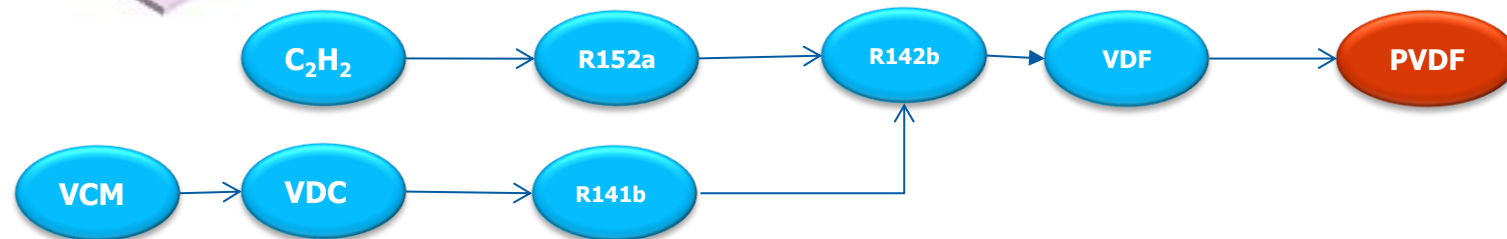
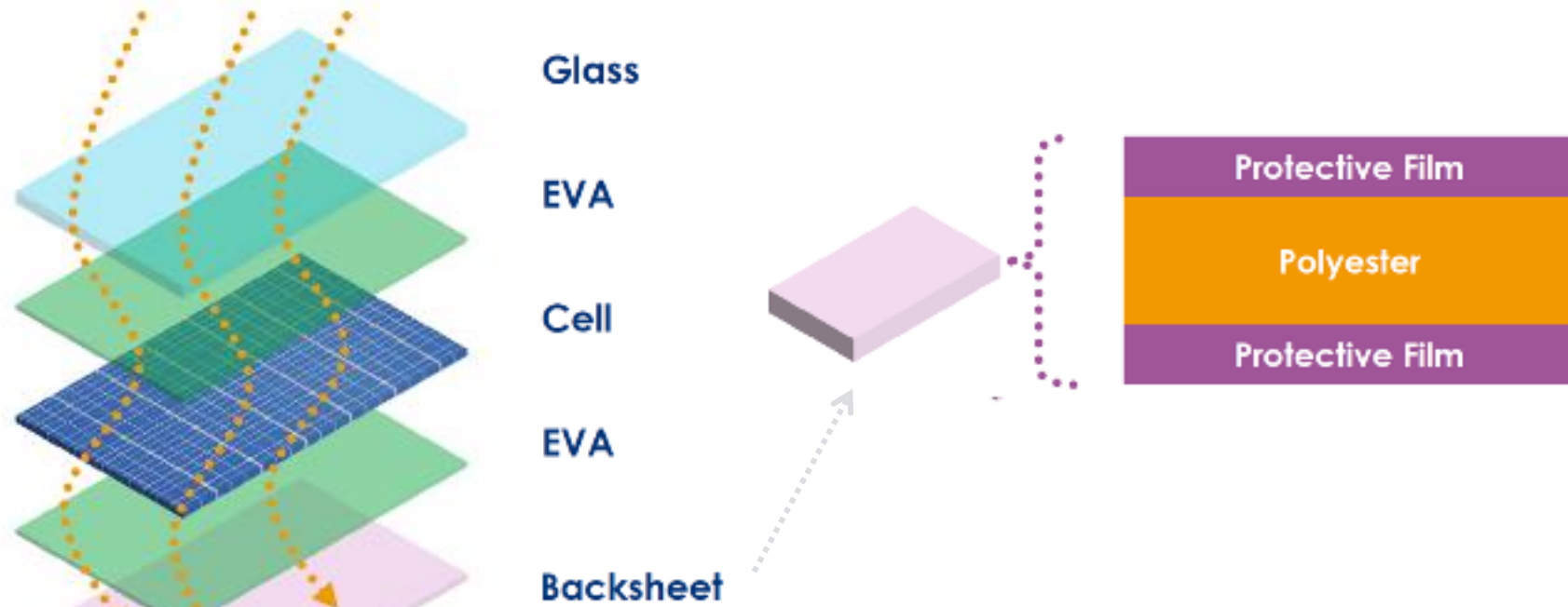


# Critical fluorinated specialty chemicals in (LFP) battery cell





# PVDF Application on PV backsheet



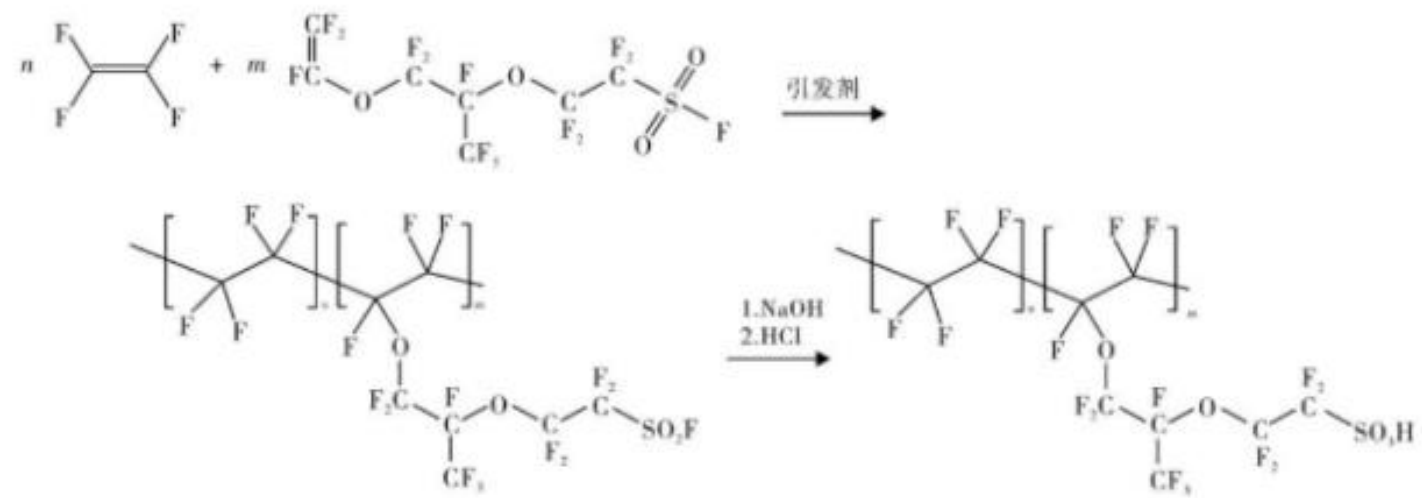
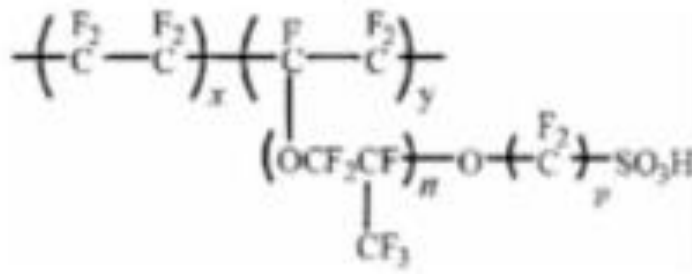


# Membrane for Electrolyzer

- Resistant against a 32% sodium hydroxide solution (or potassium hydroxide solution), acidified brine and chlorine;
- Gas-tight to keep any produced gases (hydrogen and chlorine) separate to avoid explosive reactions between these two components;
- Enabling  $\text{Na}^+$  ions (or  $\text{K}^+$  ions) to migrate from the anode chamber to the cathode chamber;
- Blocking any form of anions ( $\text{Cl}$  or  $\text{OH}^-$ ) from migrating into the other chamber;
- Stable under process conditions for an extended duration (3-6 years) in all three spatial dimensions;
- In order to have low electricity consumption, the electrical resistance of the membrane must be as low as possible. (i.e. it must be highly conductive).



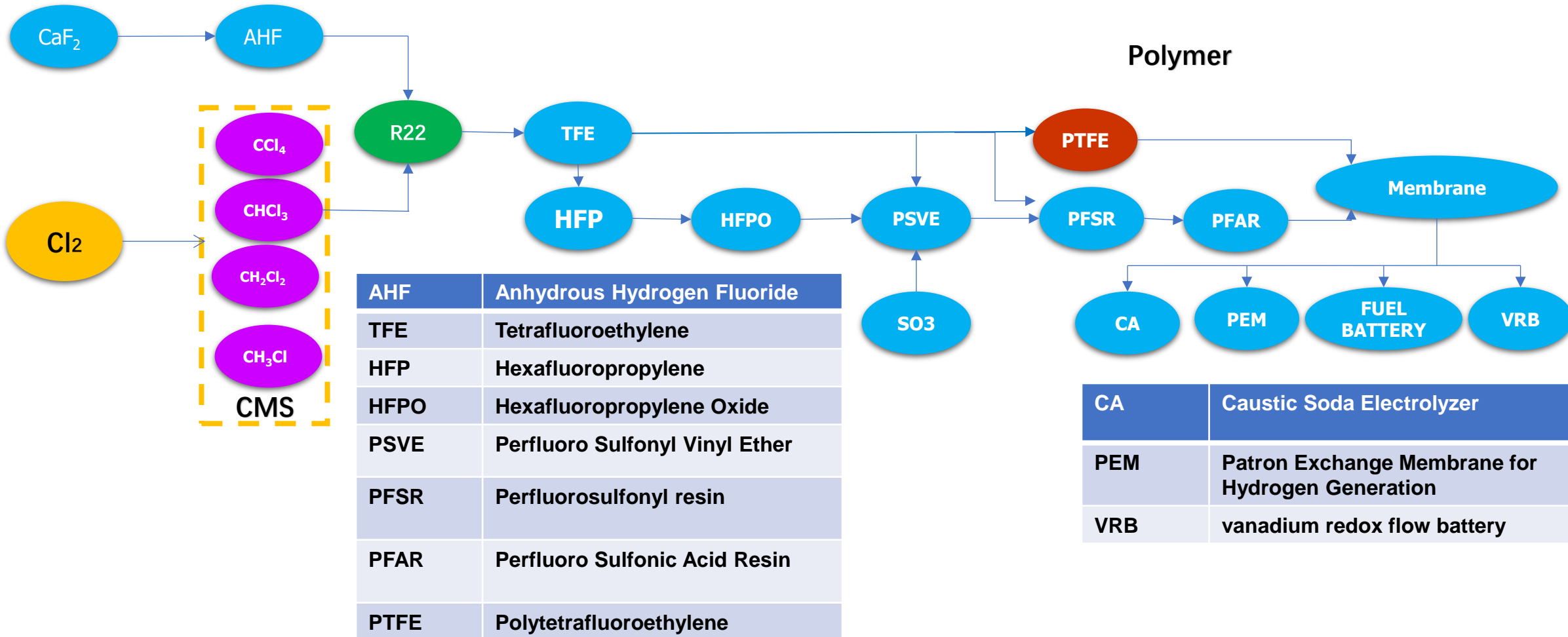
结构参数	制造商	商标	EW值 / (g.mmol <sup>-1</sup> )	厚度 / μm
$n=1, x=5-13.5, p=2$	Du Pont	Nafion	1100-1200	25-250
$n=0-1, p=1-5$	Asahi Glass	Flemion	1000	50-120
$n=0-1, p=2-5, x=1.5-14$	Asahi Chemical	Aciplex	1000-1200	25-1000
$n=0, p=2$	Dow Chemical	Dow	800	125
$n=0, p=2$	Solvay		800	125
$n=1, x=5-13.5, p=2$ 或 $n=0, p=2$	东岳集团		800-1200	50-150



图：全氟磺酸树脂的制备



# From Salt to Electrolyze Membrane need Min. 10 Chemical Units+1 Film Line





# Application of Chlorine Derivatives/Fluorchemicals in Chlor Alkali Plants

The chemicals involved in the chlor alkali plant include:

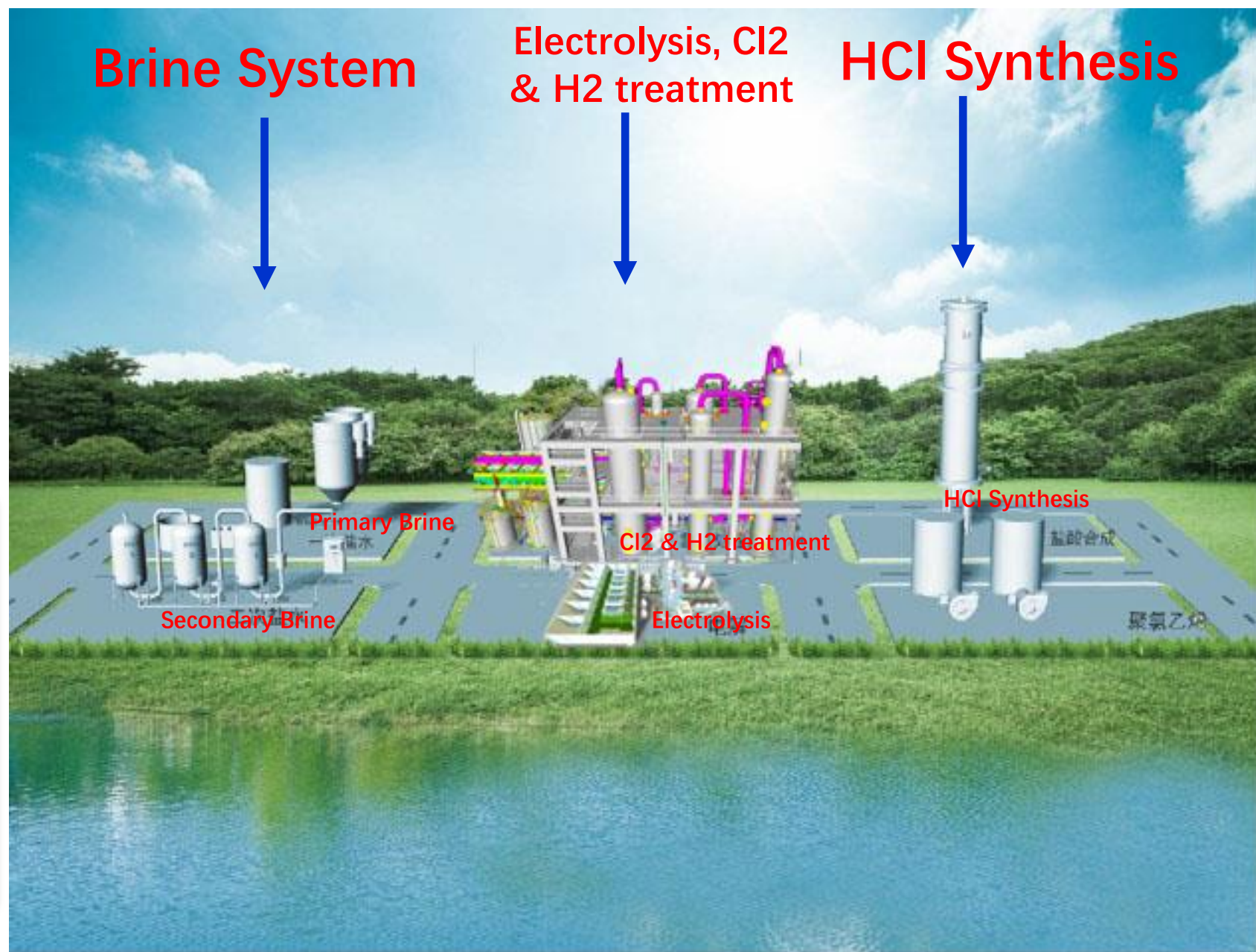
**Acidic corrosive:** HCl(L), dilute H<sub>2</sub>SO<sub>4</sub>, wet HCl(V) and etc.

**Alkaline corrosive:** NaOH

**Salt corrosive:** NaCl(L), NaClO(L) and etc.

**Strong oxidizing:** Cl<sub>2</sub>(V), Cl<sub>2</sub>(L), NaClO and etc.

The selection of materials for equipment, pipelines and other facilities in chlor alkali plants should consider the corrosiveness of the medium, while **non-metallic materials such as fluororubber** have advantages such as good corrosion resistance, lightweight and easy processing, low cost, good insulation performance and environmental friendliness, which are widely used in plants.





PVC/FRP, FRP Equipment



FRP Pipe



CPVC Pipe

CS/HRLL

CS/PTFE Valve

CS/PTFE Fitting

CS/PTFE Pipe

CS/PFA Pump

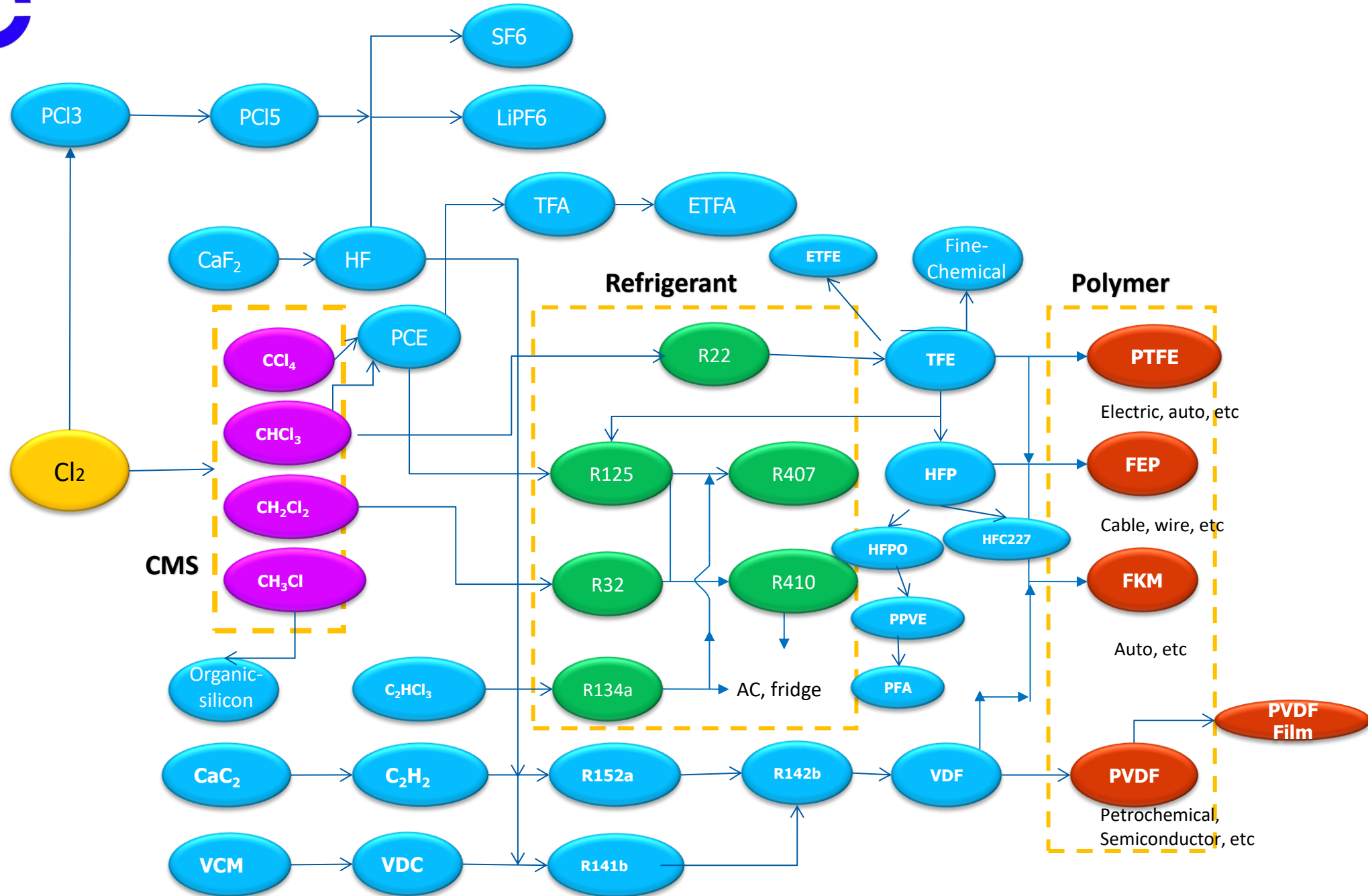
CPVC Packing





ITEM	MOC	APPLICABLE CHEMICALS	REMARK
Pipe and Fitting	CPVC, FRP, PPR, FRP/CPVC, CS/PTFE, CS/PVDF	Hydrochloric Acid, Dilute Sulfuric Acid, Wet Hydrogen Chloride, Brine, Sodium Hypochlorite, Cl <sub>2</sub> (Vapor), Cl <sub>2</sub> (Liquid)	FRP pipes are not applicable for caustic soda solutions.
Valve	WCB/HRL, WCB/HRLL, WCB/PTFE, WCB/PFA, PVC/PTFE, WCB/FEP, CPVC, PVDF, PPR		Secondary brine purification requires the use of low calcium magnesium materials
Pump	CS/PTFE, CS/PFA, CS/FEP		
Non-standard equipment	CPVC, FRP, PPR, FRP/CPVC, CS/PTFE, CS/PVDF		

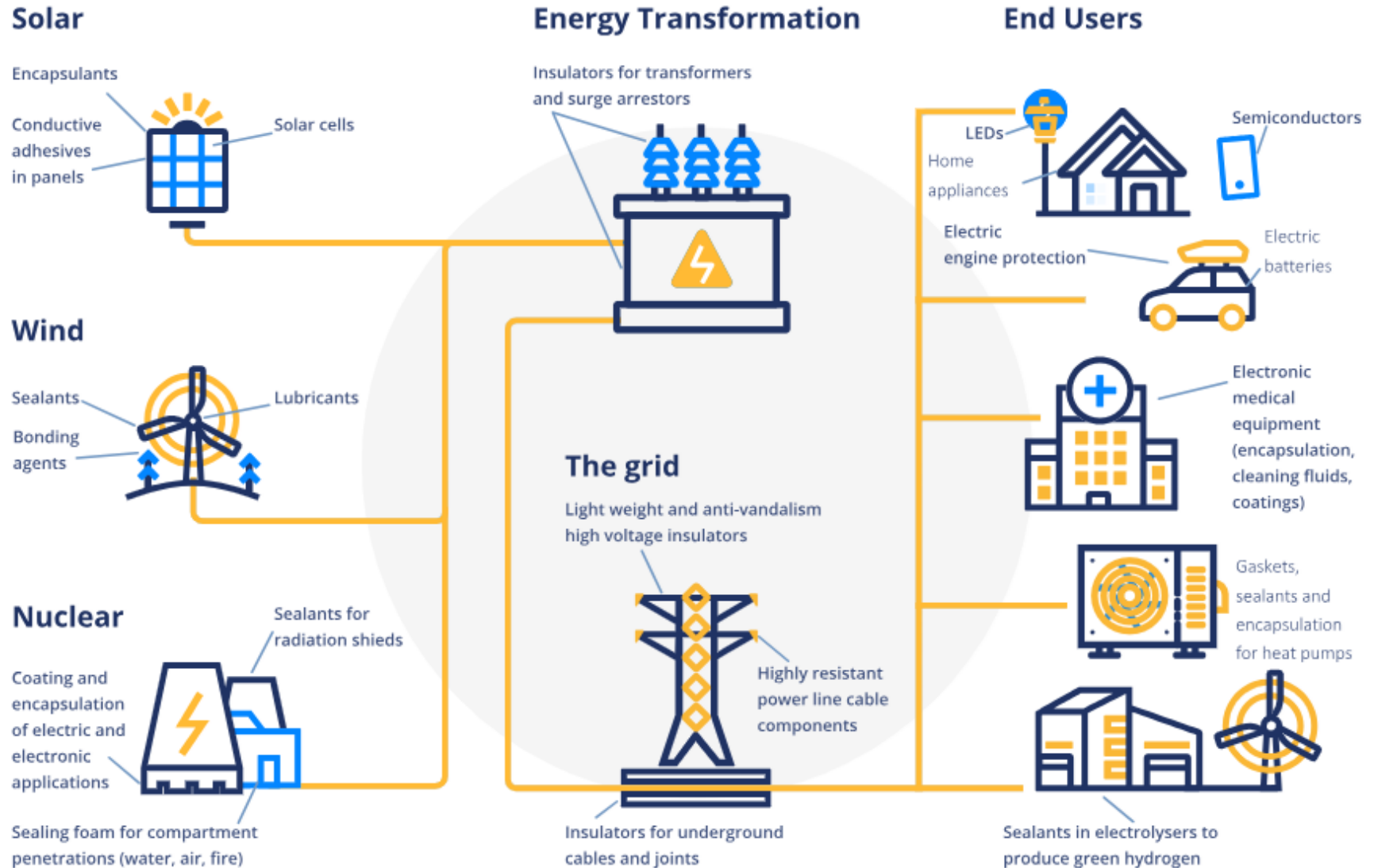






# How Silicones enable low-carbon electricity and durable solutions

By using products made with silicones, you save 14 times more greenhouse gases than what was emitted during the manufacture of these silicone materials\*



(Global Silicones Council. 2020. Socio-economic evaluation of the global silicones industry.)

# How Silicones enable our digital economy

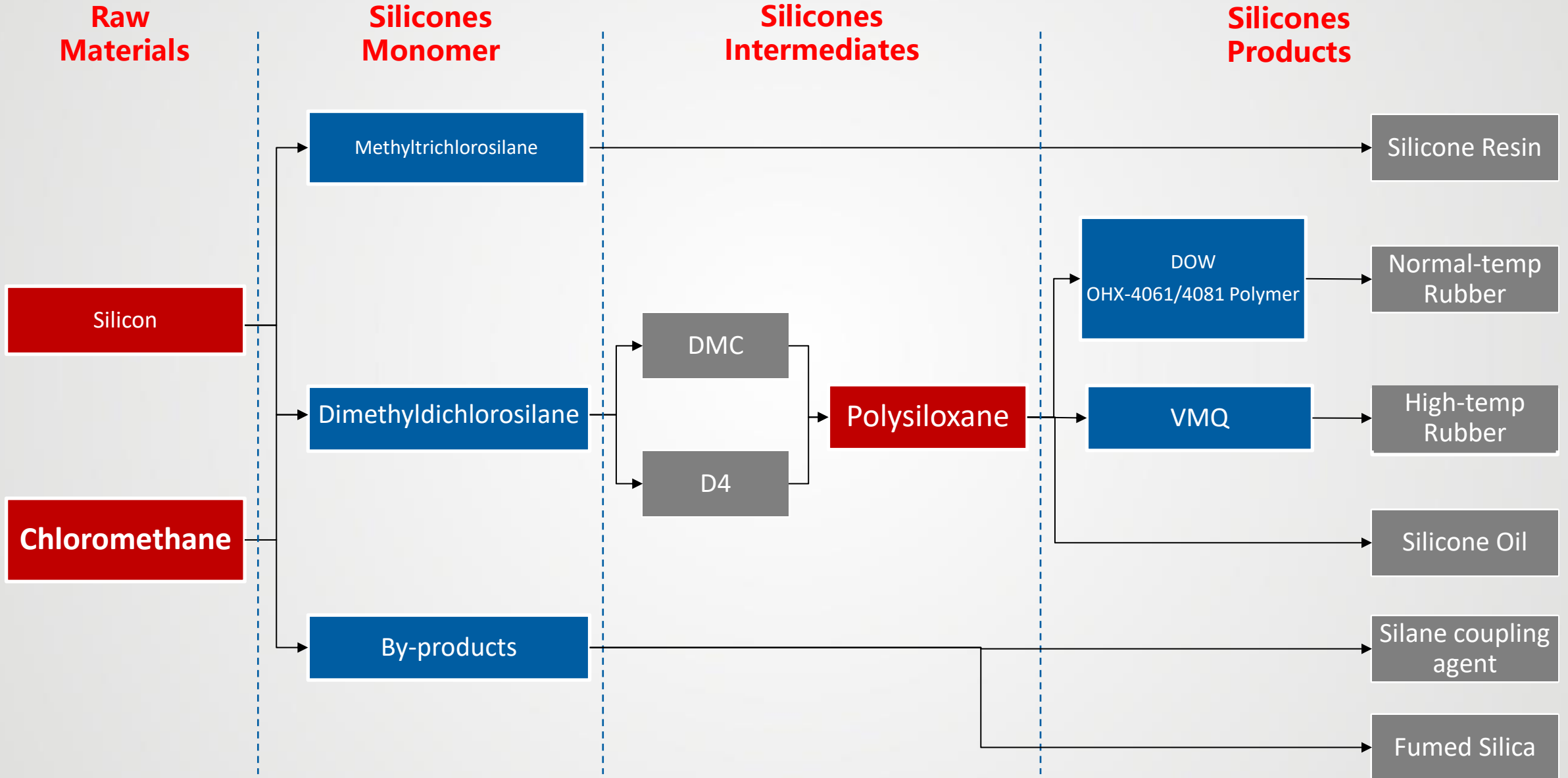


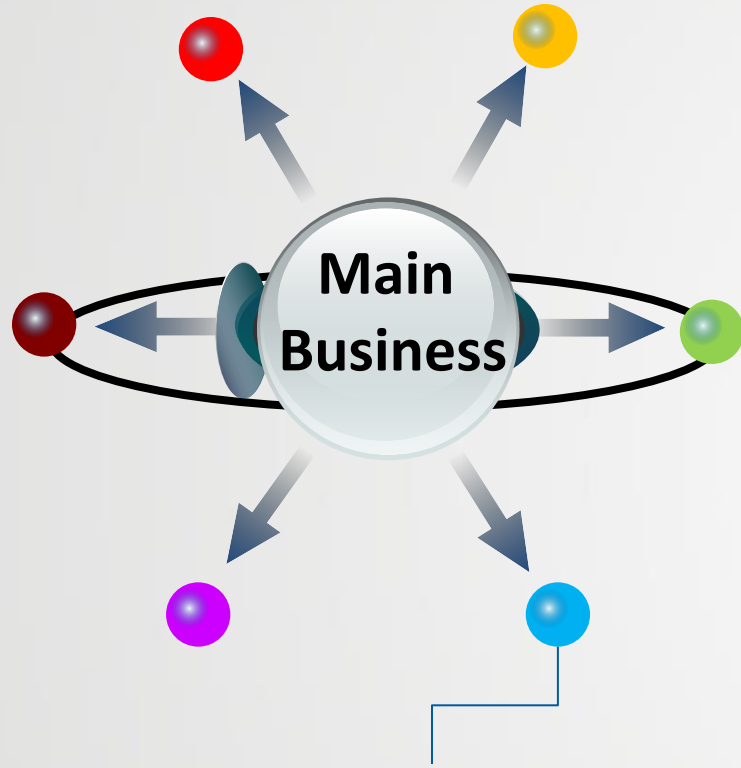
**Semiconductors**

- Microprocessor bonds
- PCB coatings
- PCB seal and bond substrates



# Silicones Chain





成套工程与咨询服务

Engineering and Consulting Service

## JOC Technical Engineering Co., Ltd. (JOC)

**Establish: 2002**

**The paid up capital: RMB60 million (USD 9.3million)**

**Turnover (2022): USD 507million**

**Employees: 202**

**2022 Procurement Assistant value:**

**Imported 230 Mil USD+Domestic23 Bil RMB(equal to 365 mil USD)**

### Planning, Engineering, Technology, Procurement Operation and Project Management in the following sectors:

• **Infrastructure:**

- Urban Transit (Metro), Road and Bridge

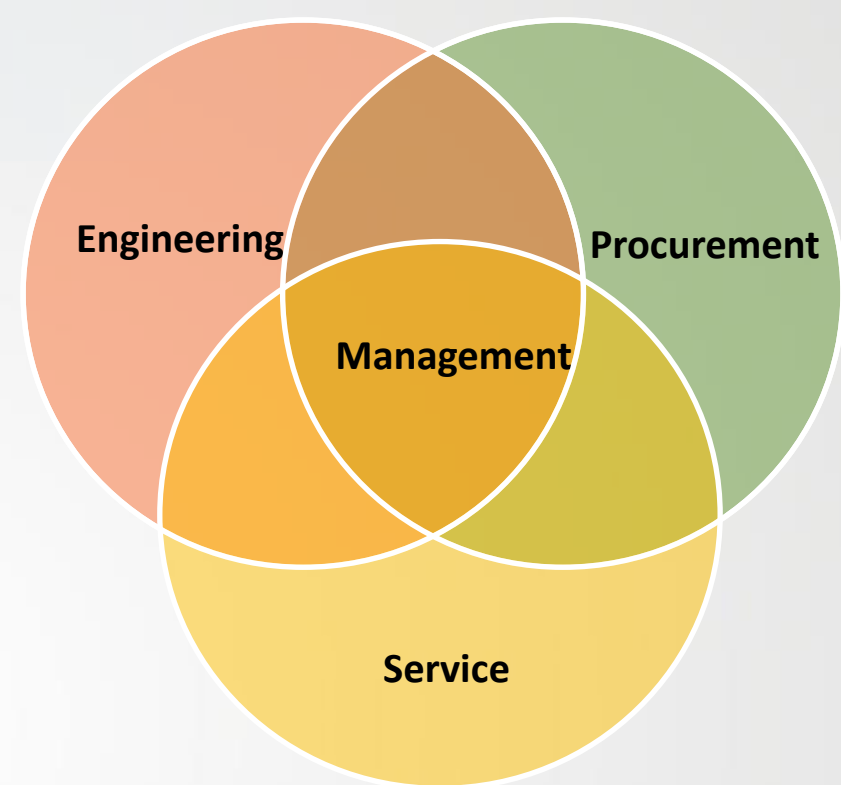
• **Power Industry**

- Power generation, transmission, distribution & rectification,

- Renewable Energy

• **Chemical Industry**

- Fluorochemical, Chlor-Alkali Chemical, Petrochemicals



- ✓ Planning, Feasibility study
- ✓ Finance Support
- ✓ Technology License/Engineering
- ✓ Supply Proprietary Equipment
- ✓ Installation supervision
- ✓ Commissioning
- ✓ Training
- ✓ After-sale service
- ✓ Updated technology
- ✓ Operation/Marketing Assistance



## EPS(Engineering+Procurement+Supervision) Provider in Chlor Alkali

- **A comprehensive Green+Intelligent solution provider for chlor alkali industry**
  - ❑ Ceramic/PTFE Membrane Primary Brine Purification System
  - ❑ Rectifier Transformer System
  - ❑ Zero Gap Electrolyser
  - ❑ Evaporation & Flaking System
  - ❑ Membrane Sulfate Removing Unit
  - ❑ Planning, Feasibility Study, Engineering, Sourcing, Supply, Management, Installation & start-up Supervision
- **Over 32 years experience of technology, equipment supply, project implementation and management in Overseas of China.**

### **Now We engaged in 7.5mtpa chlor-alkali projects in 18 countries:**

- ❑ **Europe: Solvay/Inoes:** Sweden, France, Belgium, Russia, Turkey
- ❑ **Asia:**
  - ❑ **China**
  - ❑ Korea, India(18 Clients), Vietnam, Indonesia, Bangladesh, Thailand, Oman, Qatar, Jordan
- ❑ **Africa:** Egypt, Ethiopia



**KLJ GROUP**



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**NUBERG EPC**  
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**ADITYA BIRLA**



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More JOC service centers in other countries and  
districts are under planning...