



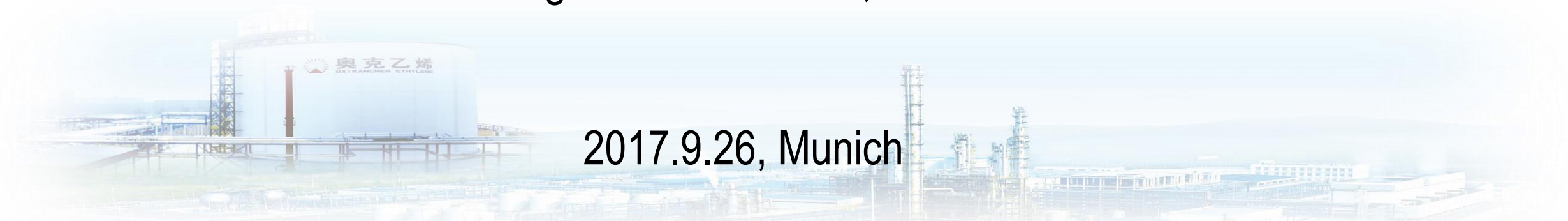
Current Situation and Development Trend of Polycarboxylate Polyether (PCE) Macromonomer in China

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Cotents

- 1. The ethylene oxide (EO) and Polycarboxate polyether (PCE) market in China**
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China commercial ethylene oxide (EO) output

Year	World EO Output (10 Ktons)	China EO Output (10 Ktons)	China Commercial EO Output (10 Ktons)
2012	2400	396	148
2013	2450	450	178
2014	2550	463	205
2015	2650	542	222
2016	2750	578	238

- EO manufacturing capacity in 2016: Asia 40%, Middle east 26%, North America 20%, Europe 13%, South America 1.3% etc.
- During the past 3 years (2014-2016), China EO manufacturing capacity increased 45.4% with 232 ktons newly added capacity.
- During the past 3 years (2014-2016), China commercial EO output increased 72% with 177 ktons newly added output.
- China market and manufacturing capacity contribute nearly 50% to the world EO output growth.





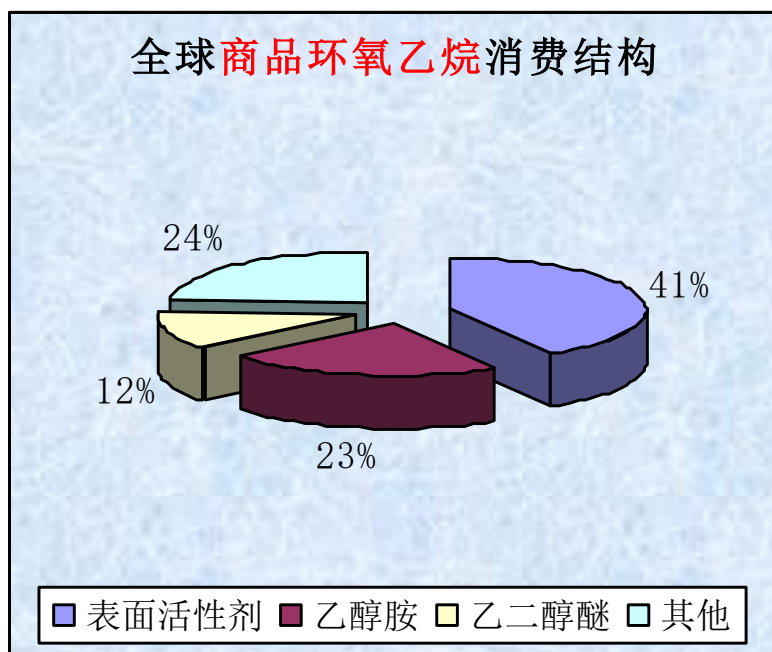
Fundamental changes in the EO supply chain in China

No.	Company	EO Capacity (10 Ktons)	Commercial EO Capacity (10 Ktons)	No.	Company	EO Capacity (10 Ktons)	Commercial EO Capacity (10 Ktons)
1	Sanjiang Chemcial	43	43	11	Jilin Petrochem	19.5	17
2	Shanghai Petrochem	52.9	28	12	Zhenhai Refinery	65	17
3	Oxiranchem	20	20	13	Liaoning Northern	20	17
4	Wuhan Petrochem	38	20	14	Nanjing Dynamic	16	16
5	Sichuan Petrochem	30	20	15	Maoming Petrochem	13	13
6	Liaoyang Petrochem	20	19	16	Link Group	12	12
7	Yangzi Petrochem	42	18	17	Jilin Zhongxin	12	12
8	Fujian Unionchem	40	18	18	Yangzi-BASF	24	10
9	Sanjiang MTO	38	18	19	China-Sabic Tianjin	42	10
10	Jiangsu Sailboat	18	18	Note: only list capacity over 10 ktons/year			

- Commercial EO proportion increase from 30.5% in 2010 to 56.9% in 2016.
- Feedstock diversification: Ethylene, ethyl alcohol, MTO downstream,
- Diversification of investors: Sinopec and PetroChina market share decrease 82% in 2007 to 48% in 2016; Private company occupy 41% market share on commercial EO with 174 ktons in 2016 and Joint Venture 10% with 41 ktons.
- Due to overcapacity, EO price keep in a low level with the lowest as 6950RMB/ton (about 1000USD/ton) in 2015.

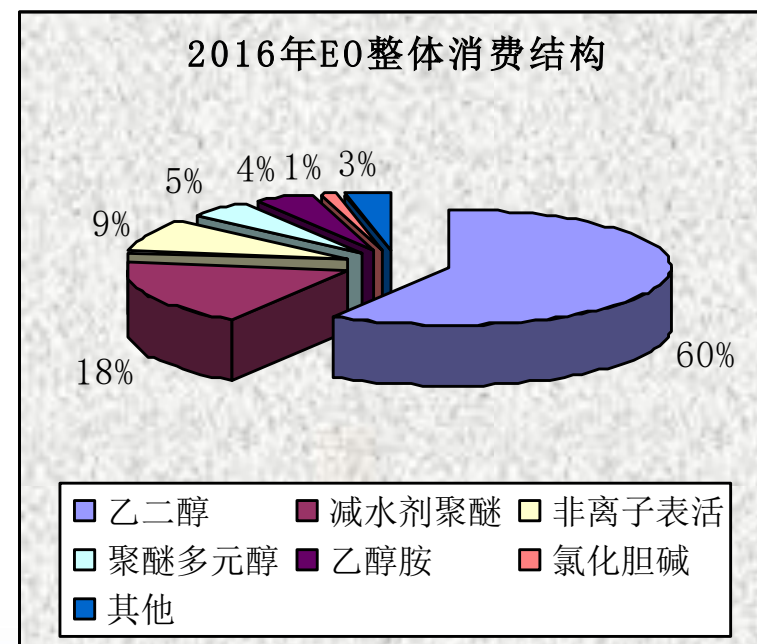
World and China EO derivatives (EOD) market

Global Commercial EO market



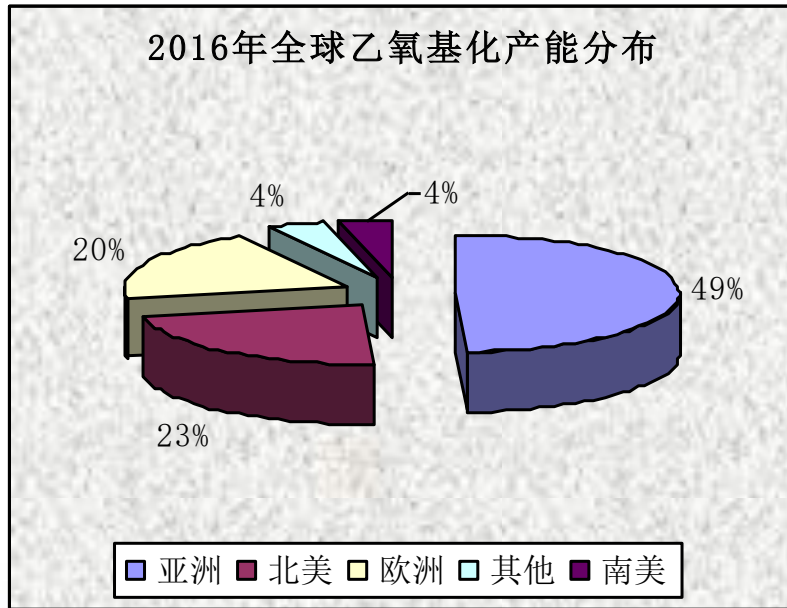
Surfactant, Ethanol amine, Glycol ether, etc.

China EO market in 2016



MEG, PCE Polyether, Surfactants, Glycol ether, Ethanol amine, Cholin chloride, etc.

EO derivatives (EOD): Ethoxylation capacity 2016



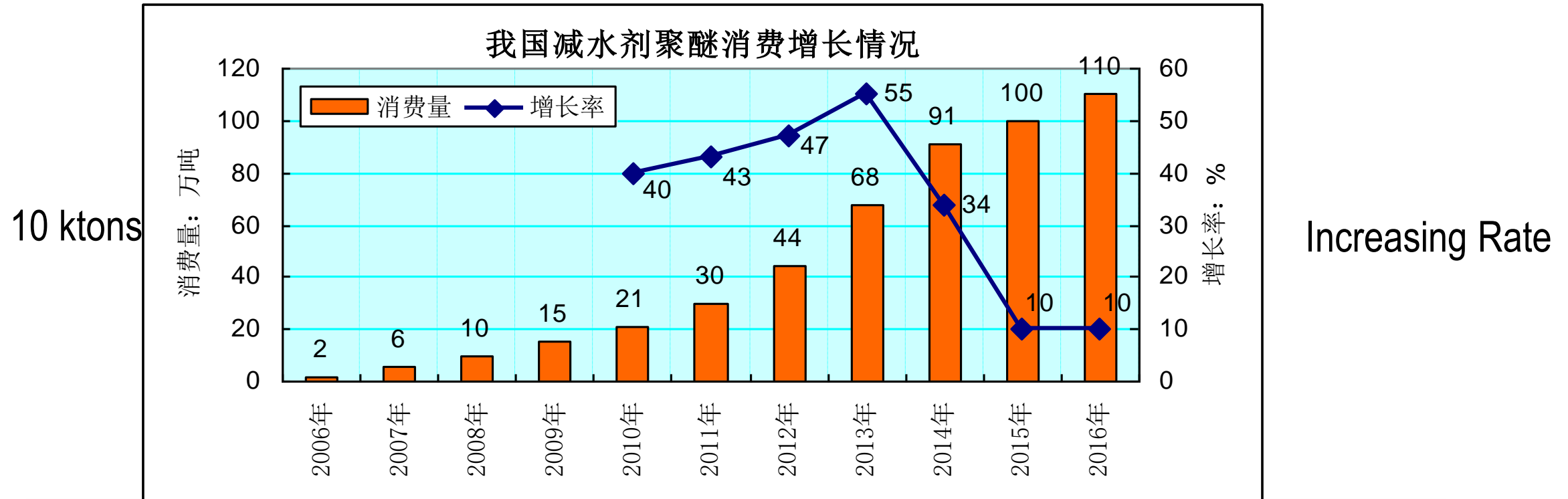
Region	Capacity(10ktons)
North America	2,600
South America	441
Europe	2,243
Asia	5,558
Other Regions	457
Total	11,299

Global Ethoxylation Capacity in 2016





Polycarboxylate polyether macromonomer (PCE macromonomer) in China (1)



Since 2005, The PCE market is rapidly increasing:

- China's investment in infrastructure construction based on high-speed railway and urbanization.
- The commercialization rate of concrete driven by China's industrial policies
- The speed of PCE macromonomer replacing the naphthalene-type water reducer is further increasing.



Polycarboxylate ether macromonomer (PCE macromonomer) in China (2)

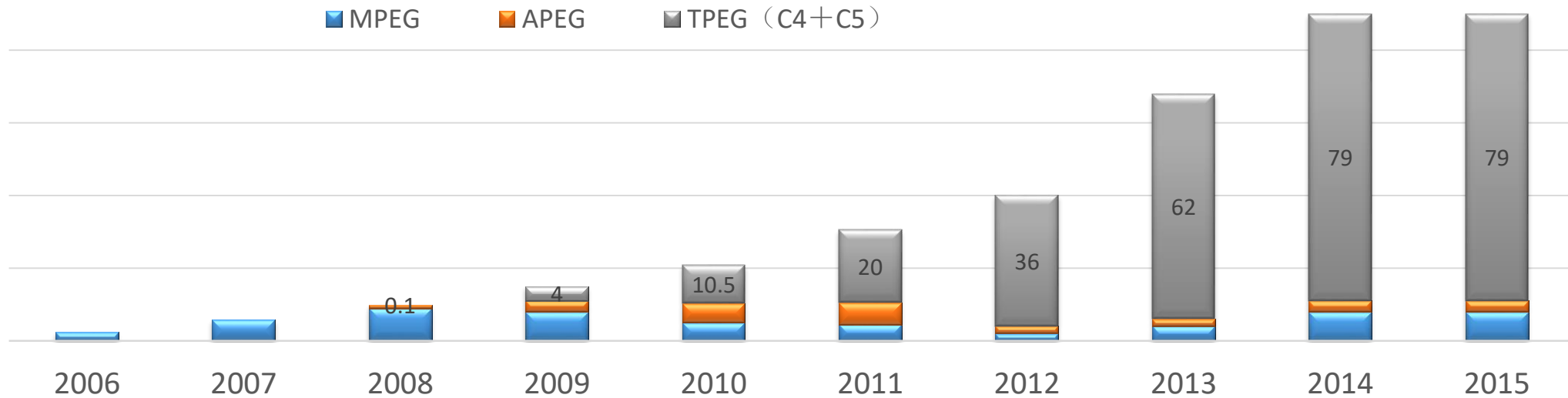
Type	Chemicals	Chemical Structure
M-PEG	Methoxy-PEG	$\text{H}_3\text{CO}-(\text{CH}_2\text{CH}_2\text{O})_n\text{H}$
V-PEG	Vinyl-PEG	$\text{CH}_2=\text{CH}-\text{O}-\text{CH}_2-\text{CH}_2-\text{O}-(\text{CH}_2\text{CH}_2\text{O})_n\text{H}$
A-PEG	Allyl-PEG	$\text{CH}_2=\text{CH}-\text{CH}_2-\text{O}-(\text{CH}_2\text{CH}_2\text{O})_n\text{H}$
H-PEG	Methallyl-PEG	$\text{CH}_2=\text{C}(\text{CH}_3)-\text{CH}_2-\text{O}-(\text{CH}_2\text{CH}_2\text{O})_n\text{H}$
I-PEG/T-PEG	Isoprenyl-PEG	$\text{CH}_2=\text{C}(\text{CH}_3)-\text{CH}_2-\text{CH}_2-\text{O}-(\text{CH}_2\text{CH}_2\text{O})_n\text{H}$

H: High-performance; T: “Tezhong” in Chinese, means special and unique. Both abbreviation was coined by Oxiranchem Salesman.



Polycarboxylate ether macromonomer (PCE macromonomer) in China

During 2006-2015, the evolution of the PCE chemical structure in China market

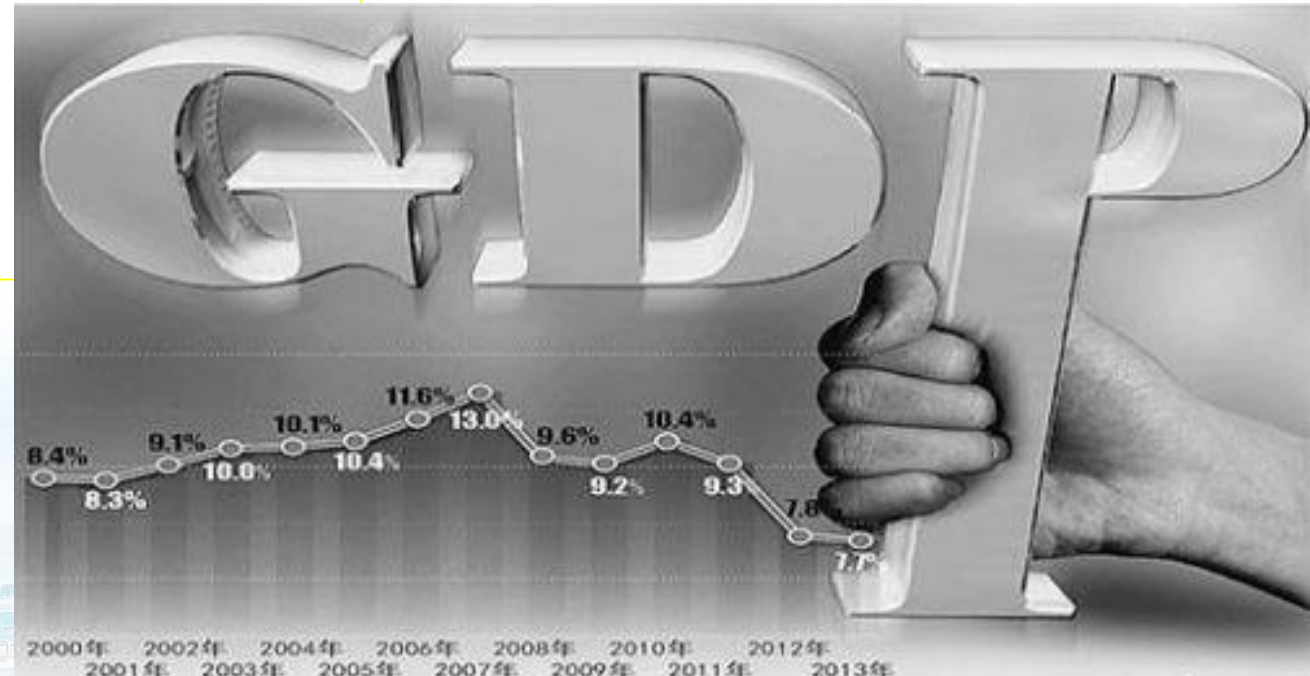


- ❖ Before 2010, MPEG is the main products in the market.
- ❖ While only 1000 tons of HPEG and TPEG being marketed in 2009, the sale amount reached 790 ktons in 2015. The market share is 88% with increase rate of 79% within 6 years.
- ❖ MPEG are caused by wide attention again.



China “New Normal” and PCE macromonomer

- Both demand growth and investment growth in the PCE macromonomer market is slowing down to a “new normal”.
- Other characteristics in the named “new normal” includes surplus capacity.
- Improved environmental protection and safety supervision threshold.
- The frequent irregular price fluctuations of EO.
- Low industry productivity and margin.
- Traditional business model.





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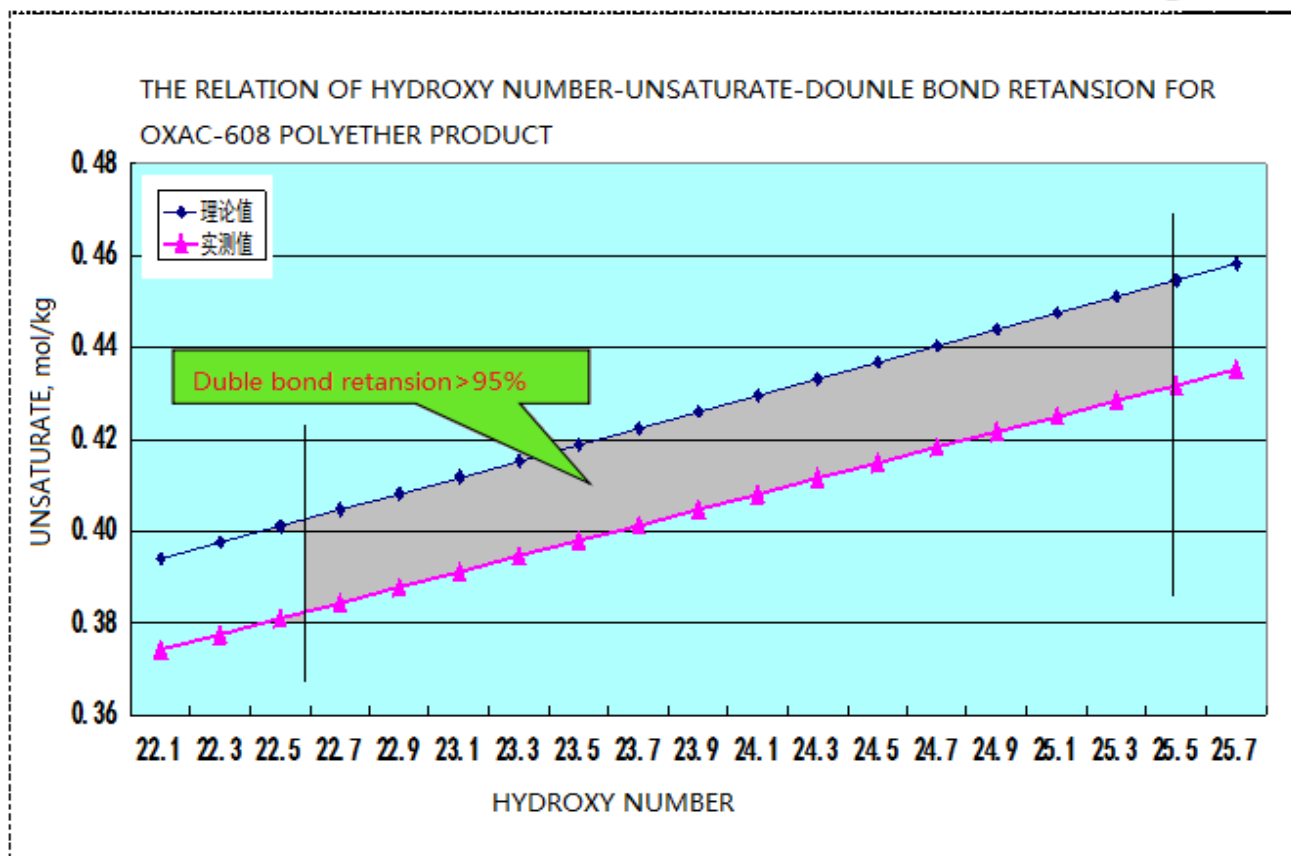
Business Strategy of the local leading enterprises: **Customer-centric** (1)



Oxiranchem as the local leading enterprises through the geographical and logistic layout to save transportation fee and consumption of oil, the example of low-carbon footprint business model. also further improve the market share.



Business Strategy of the local leading enterprises: **Customer-centric** (2)



OXAC-608 Quality Control

- Precise MW. Hydroxy value ± 1.25 ;
- the difference of measured and theoretical unsaturated degree ≤ 0.02 ;
- Double bond contents $\geq 98\%$
- Polydispersity Index (PDI)=1.008
- Low DIOL (PEG) content.

As the tonnage of TPEG and HPEG already have the characteristics of differentiated generic chemicals, research and development focus mainly on process optimization and product quality improvement.

Such as spray tower loop reactor and injector reactor



Green environmental protection practice for sustainable development

Concept and Resource:

- Sustainable development is a mode of economic growth that emphasizes long-term development. It refers to the ability to meet the needs of the generations without harming the future generations to meet their needs.
- Green chemical industry has become an inevitable choice for the sustainable development of the chemical industry. It is the objective requirement of the sustainable development of mankind and the chemical industry, and the most effective means to control the chemical pollution.
- China's status quo: it is urgent to strengthen the environmental awareness of chemical enterprises, and environmental protection has become a long-term trend.

The sustainable development concept of Oxiranchem: green environmental protection, avoiding or reducing the pollution of chemical production to environment.



Case study 1: Upgrade and improvement of process

1. Ethoxylation process

- Comprehensive utilization of reaction heat. No steam consumption.
- Work-up to recover the low pointing substance and no voc emission.
- Changing the heating media from oil to water.

2. Recovery the cold energy from liquid ethylene

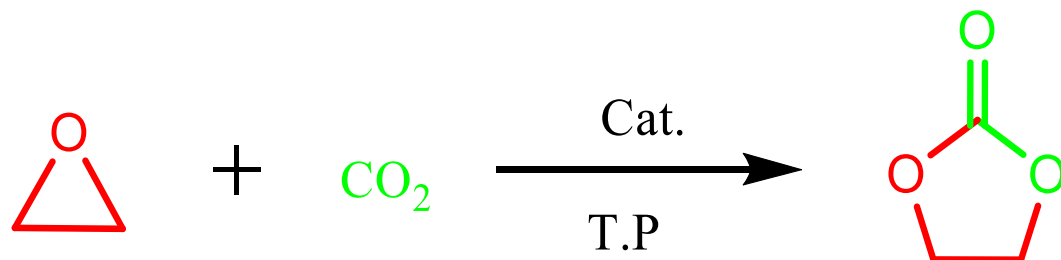
Liquid ethylene (2.8MPa, -30 °C) from the tank and pipeline will be heated and ethylene gas (2.3MPa, 28 °C) will be sent to ethylene oxidation unit. Meanwhile the amount of ethylene gasification heating up is used to produce low temperature water (10°C), which is used in the ethoxylation reaction unit.





Case study 2: green process

20 ktons/year Li-ion battery solvent project (1)



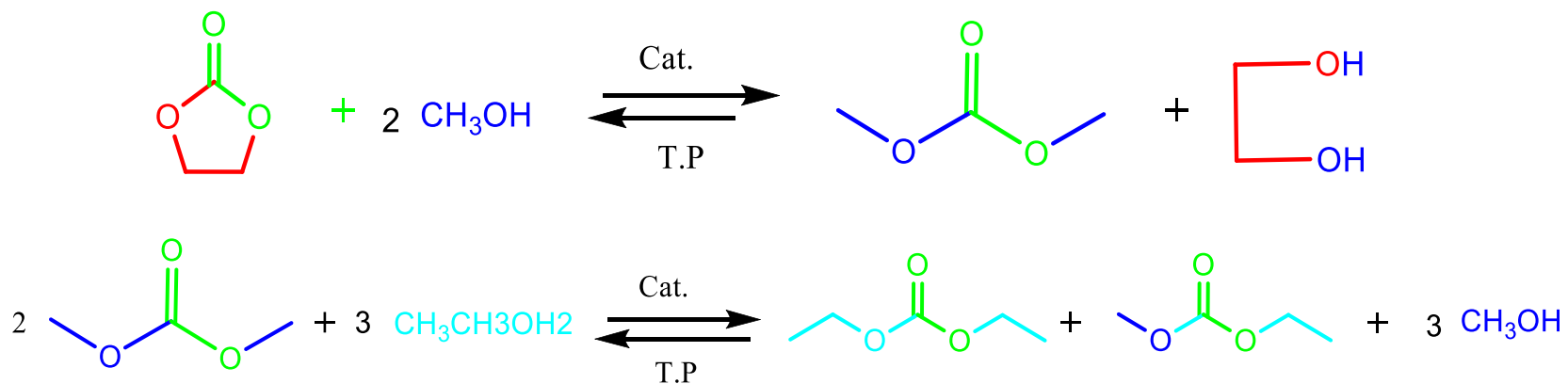
- Using carbon dioxide as raw material to achieve greenhouse gases emission reduction.
- Green chemistry, atom-efficiency reaction
- Immobilized ionic liquid catalysts
- Paints solvent instead of toxic toluene.





Case study 2: green process

20 kt/yr Li-ion battery solvent project (1)



- Via energy coupling and heat integration optimization, the energy consumption is reduced by more than 30% .
- Through advanced purification and refining process, the products can reach the standard of battery level, and can be applied to the new energy lithium battery electrolyte solvent, which can greatly promote the national energy saving and emission reduction and the development of new energy vehicles.



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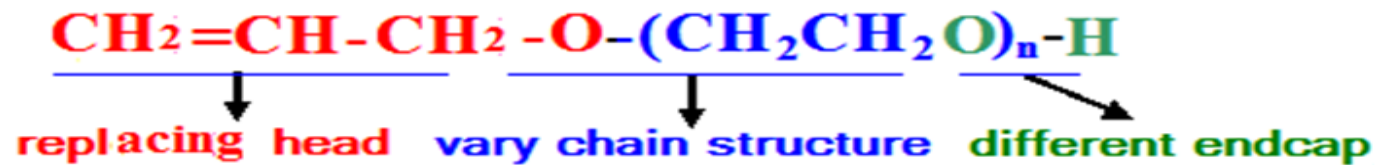




Vision of PCE macromonomer in China

PCE R&D effort in Oxiranchem: **Customer-centric**

- 1、Ethoxylation process update and upgrade
- 2、Design of novel chemical structure polyether macromonomer

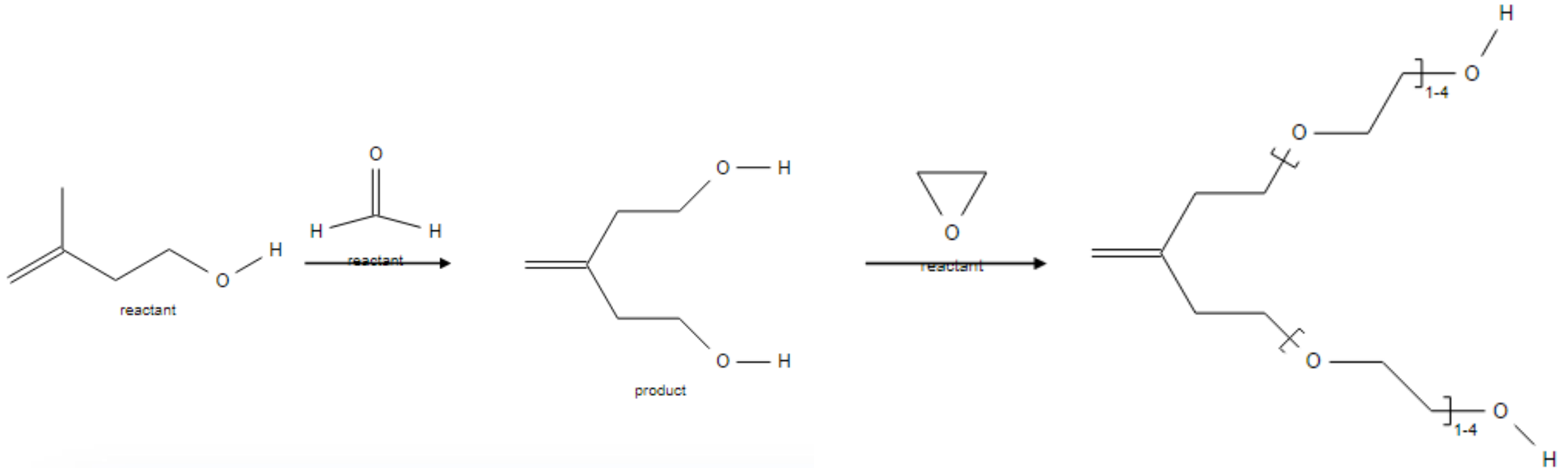


- ◆ double bond moiety: modification of the activity of free radical polymerization.
- ◆ PEG chain modification: develop functional polyether.
- ◆ End-group: additional functionality or special effect.

- 3、Customer service: new PCE synthesis process technology.

奥克乙烯
OXIRANCHEM ETHYLENE

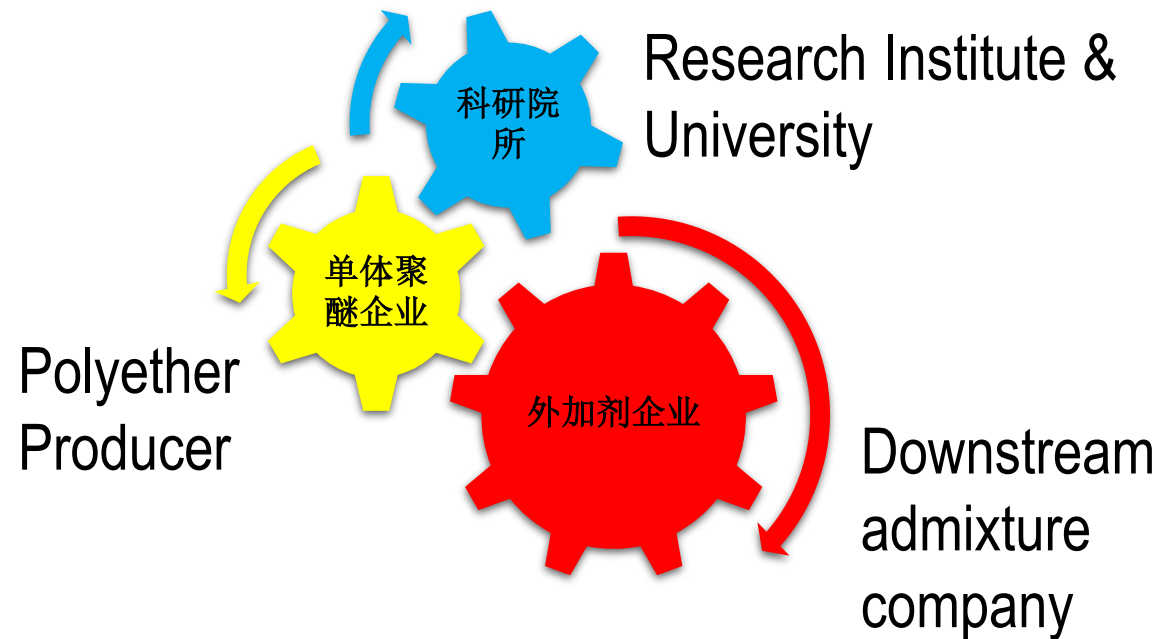
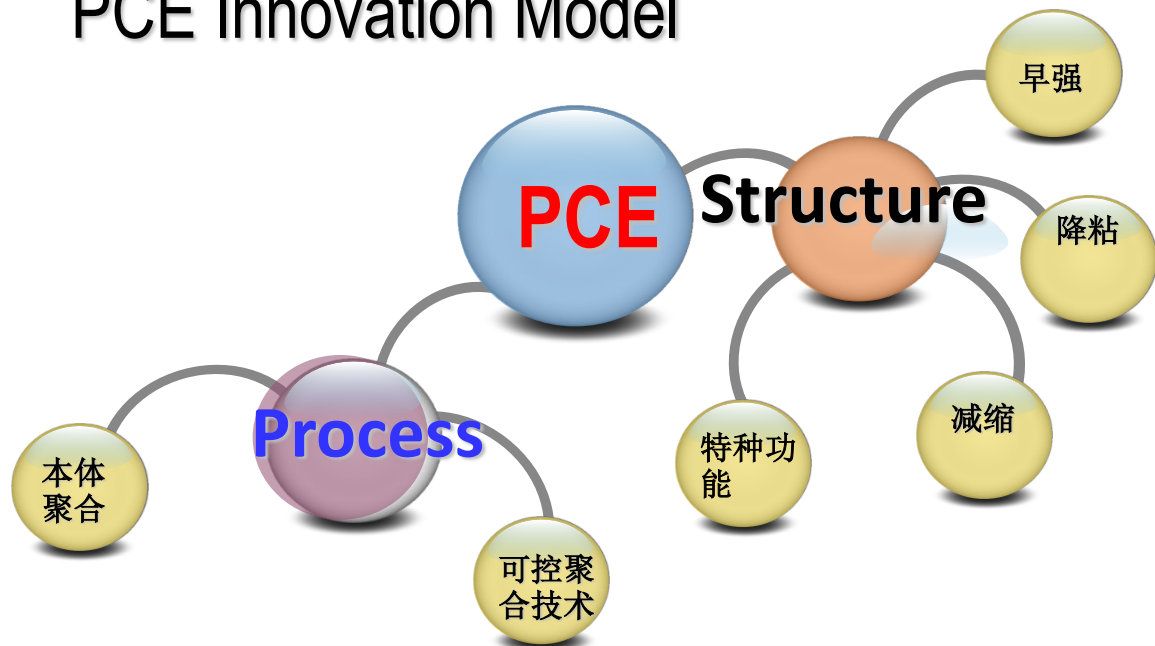
Case Study: PCE Macromonomer in R&D Pipeline



- Double-arm terminal ethylene macromonomer, more steric bulk and lower polyether chain length.
- The final product abbreviation will leave to the salesman,s fabrication as before.

Vision of PCE macromonomer in China

PCE Innovation Model



Technology Innovation

Structure Innovation

Intergration Innovation

- Ω Alkoxylation/烷氧基化技术
- Ω Free radical polymerization/自由基聚合工艺技术
- Ω Molecular structure design/分子结构设计
- Ω Admixture application/外加剂应用技术
- Ω PCE new application field/梳状高分子新应用

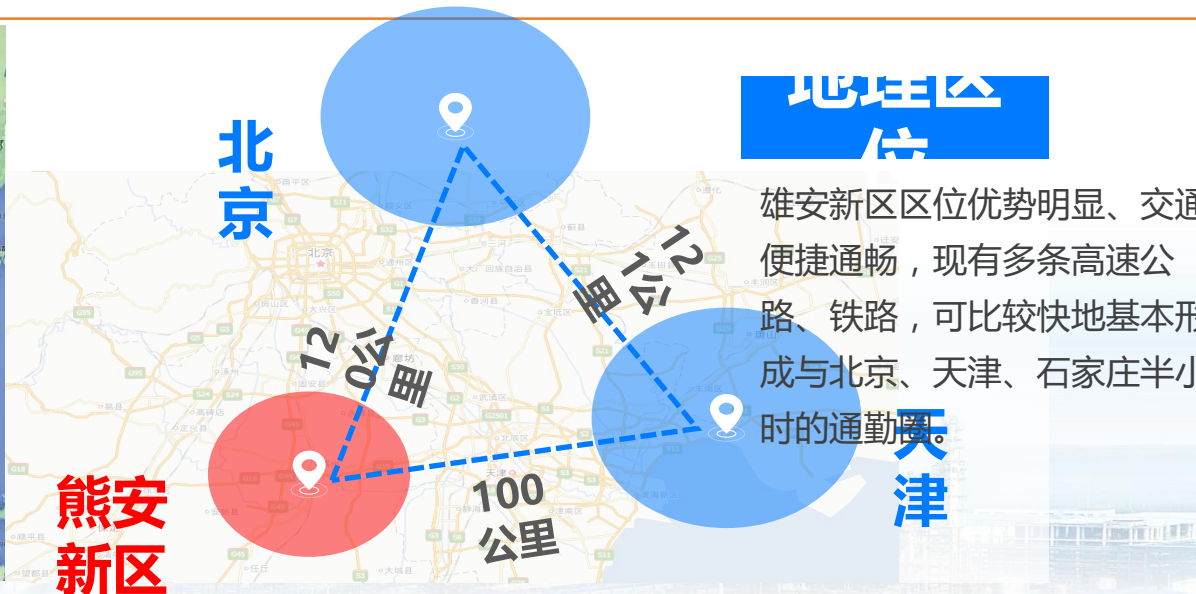


Vision of PCE macromonomer in China: Government Policy

state policy and strategic opportunity period ---- points to a new direction

- The Belt and Road Initiative
- Beijing-Tianjin-Hebei coordinated development
- Yangtze River economic development zone
- The millennium plan “the Xiongan new area”

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Vision of PCE macromonomer in China

Opinion from the leading PCE manufacturer in China, such as Oxiranchem:

Gain unprecedented strategic opportunities to increase their market share.

- Meeting the safety, environmental protection requirement.
- The PCE macromonomer manufacturer with competitive advantage and production efficiency.





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Brief introduction of Oxiranchem



Dong (CEO), Zhu, Liu, Zhong

- Founded in 1992
- 50 ktms of ethylene tanks
- 200 ktms of EO facilities
- 18 plants with 1200 ktms EOD manufacturing capacity
- Intelligent management.
- CO₂ fixation reaction with EO. EC as solvents for the lithium ion battery electrolyte.





Proposal from Oxiranchem

Build business consensus, boost cooperation incentive and provide impetus to the PCE business in China.

【 Strategic cooperation intention 】

- Ethylene procurement/foreign trade business/storage/ logistics
- Ethylene oxide derivatives new technology/new products/application field
- Ethylene derivatives differential products/technology and industry
- Cooperation in EO/EOD project outside China
- Ethylene from ethane technology and project



2017

Thanks



EOD \Rightarrow EO \Rightarrow C₂F

EOD的创新+可持续性

EOD Innovation + Sustainability

Joint Contribution, Collective Sharing