



SOLVAY

asking more from chemistry®

Solvay in China

索尔维在中国

UBS investor trip
Shanghai, May 13, 2018

Agenda

- Solvay in China
Leo Sun
- Specialty Polymers in China
Focus on batteries
Chuanqi Tao
- Peroxides in China
Focus on water purification
Gary Zhao
- Lab visit



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Agenda

- Solvay in transformation
Geoffroy Raskin
- **Solvay in China**
Leo Sun
- Specialty Polymers in China
Focus on batteries
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- Peroxides in China
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Gary Zhao
- Lab visit

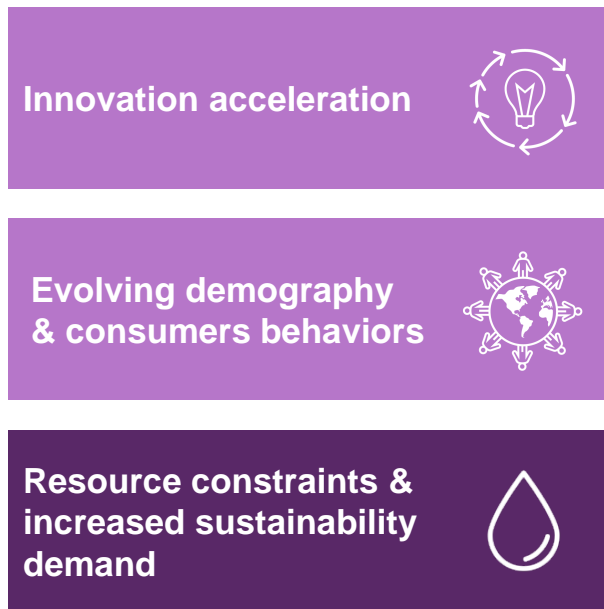


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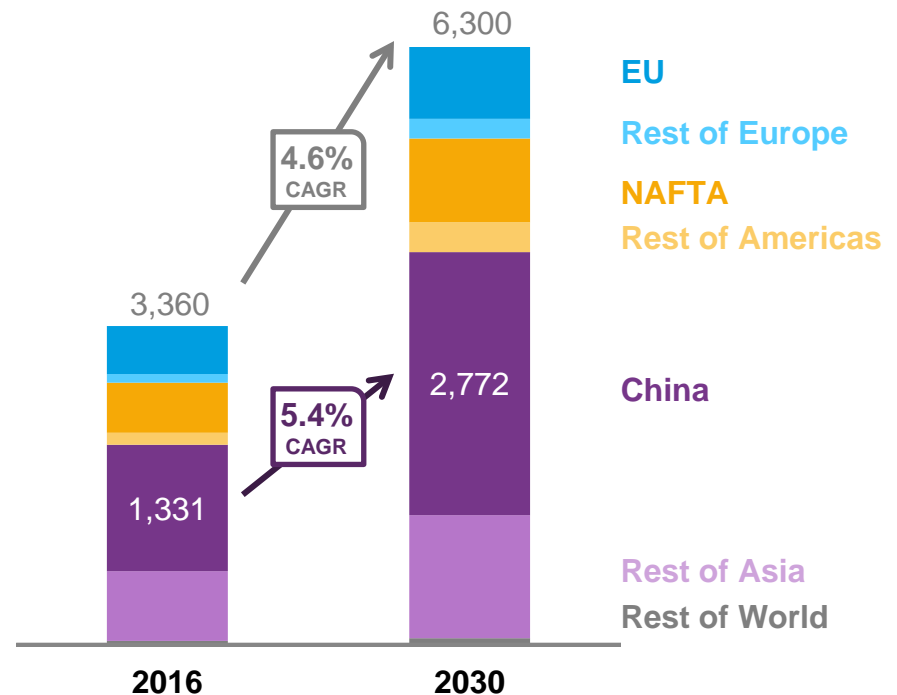
asking more from chemistry®

Global chemical demand growth driven by megatrends... and China

Global market drivers drive Asian growth



Long term global chemical demand (in € bn)



Source: CEFIC

Solvay: well-balanced geographic footprint

With strong and fast growing presence in China

Solvay

€10.1 bn

Net sales

+8%

vs GDP +3%

~24,500

employees

124

Industrial sites

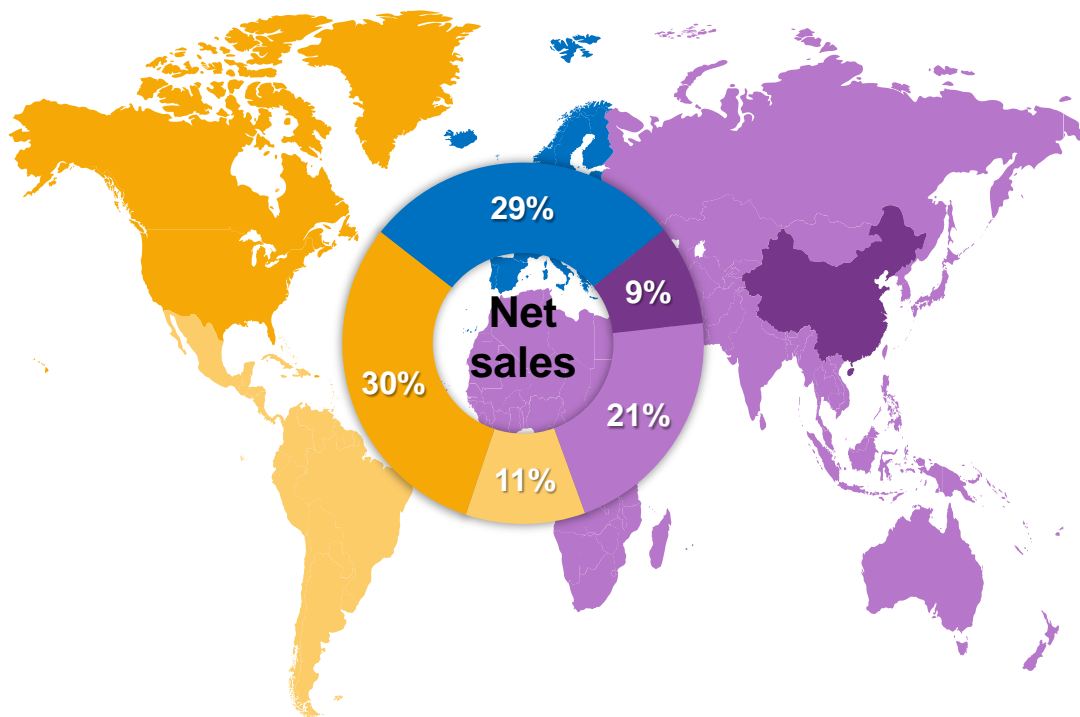
21

Major R&I centers

All figures for 2017 continuing operations

% figures represent
% of net sales by destination

+% figures represent
YoY net sales growth
adjusted for scope, & forex



Solvay China

€0.9 bn

Net sales

+20%

vs GDP +7%

~2,500

employees

15

Industrial sites

1

Major R&I center

**Well placed
to benefit
from growth
in China**

~40 years of experience in China

- 1980** First Rep. Office set up in Beijing (Rhône-Poulenc)
中国第一个代表处1980年在北京成立
- 1993** First Industrial Investment in Qingdao – Silica Plant
在中国的第一家工厂1993年在青岛成立，生产白炭黑
- 1994** First Solvay Representative office in Beijing
1994索尔维北京代表处成立
- 1996** First Solvay Representative office in Shanghai
1996年索尔维上海代表处成立
- 1997** Opening of Solvay Technology Park in Xingzhuang.
1997年索尔维上海科技园成立
- 2011** Rhodia integrated into new Solvay
索尔维2011收购罗地亚2015收购氟特公司成立新的索尔维
- 2015** Cytec integrated into new Solvay
索尔维2011收购罗地亚2015收购氟特公司成立新的索尔维

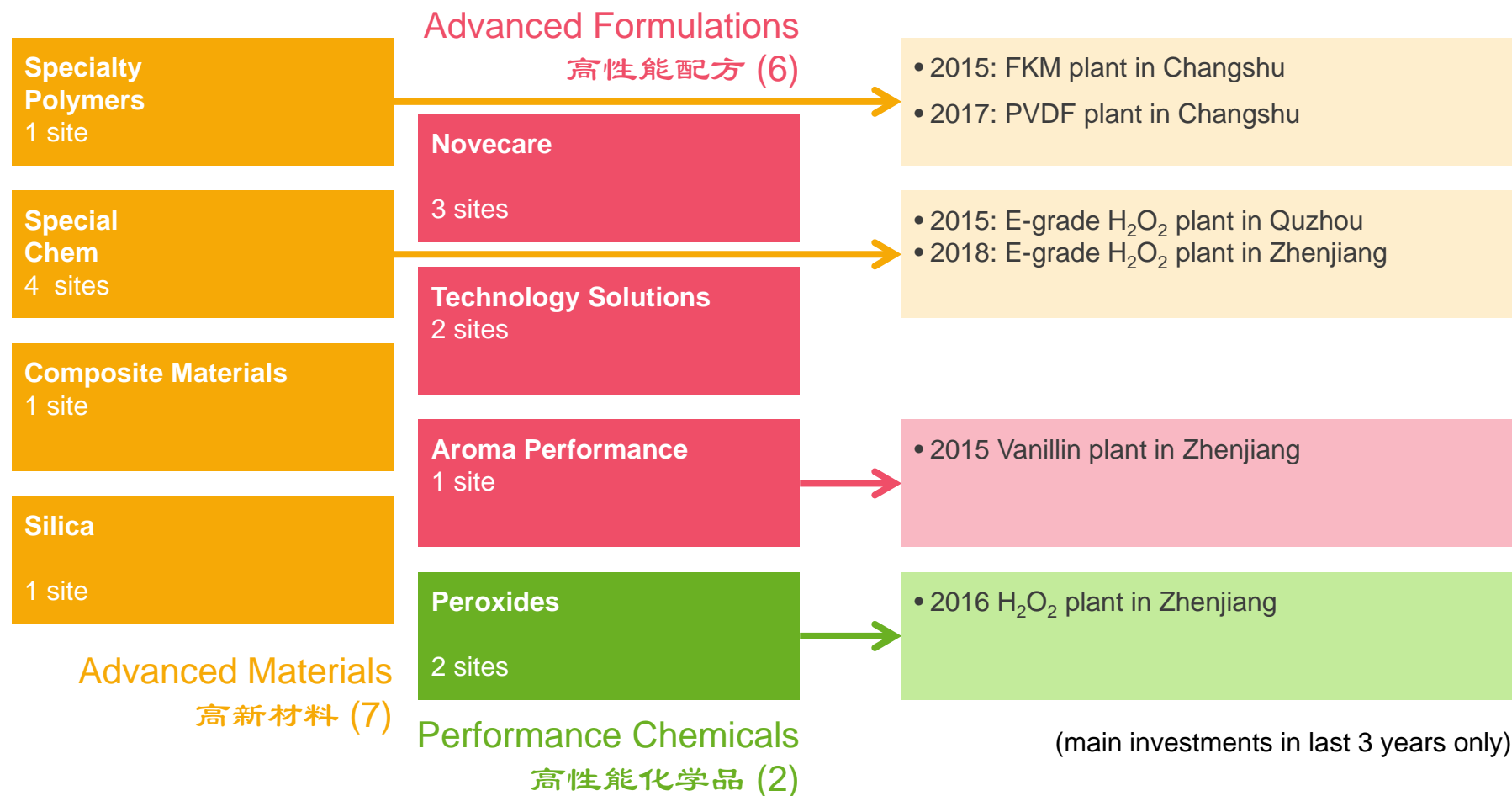
Solid foundation for further growth

- Leading player in specialty chemicals
- Strong relationship with stakeholders
 - Reliable partner to expanding multinational customers
 - Local authorities
 - Successful partnership with Asian industrials
- Capable industrial footprint
 - 40 years of industrial presence in Asia
 - Regional engineering expertise
 - Adapted to local circumstances
- Substantial innovation power
- Loyal manpower base
(low employee turnover)

Solid industrial presence in China

15 sites in China ...

... with continued investment



Solvay Technical Park: Greater China and regional HQ

索尔维科技园及索尔维亚太区总部

Regional Headquarters

Silica
Aroma
Specialty Polymer
Performance Polymer

GBUs & China Management

Special Chem
Peroxides
Novecare
Composite Material
Technology Solution

R&I Center

150 scientists
Corporate & GBU R&I
E2P2L Lab



Regional & Corporate Functions

Legal, HR, SBS
Industrial and GEC
COM. GPA, Treasury
Internal Audit...

Historical Events

1997 - Opening of STP in SXIP
2003 - Greater China headquarters
- Revamped Lab to R&I Center
2006 - Corporate R&I Center
2013 - Songting and Gongjiang
- Zhangjiang integrated
2016 - Junyao integrated

GONGJIAN
弓箭楼

ADMINISTRATION
行政楼

COMMERCIAL
商务楼

Headcount: 730
员工总人数: 730

Shanghai: Solvay's 3rd largest R&I center

Model of Open Innovation



145

Employees in RICS



57

New patent in past 3 years



13

Collaboration project with
local university or institute

- Recognized as “Foreign R&D Center”, “Shanghai Company Technical Center”
- Set up of R&I partnerships with Chinese Universities and Institutes (> 30 collaborations)
- Set up united laboratory in Shanghai with ECNU, French CNRS, ENS, Fudan Uni. and Lille Uni.
- Focused on Eco-Efficient Product and Process.
- GBU R&I labs focus mainly on application development and product support
- Corporate R&I labs focus on new product & process development, environment & safety and analytical services



Key takeaways



China is an important growth engine

- Chemicals industry to grow at faster pace than world average
- Focus on more sustainable growth, respecting environment



Solvay to continue to benefit

- Established footprint and long experience
- Focused investments in specialty and advanced materials



Local R&I support

- Supporting regional developments
- Collaborating with local partners

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Specialty Polymers at a glance

Diversified end markets with
superior growth potential



Aerospace



Automotive



Batteries



Consumer &
Construction



Electrical &
Electronics



Healthcare



Industrial &
Environment

~25%

Net sales



Americas

9 production sites

2 R&I centers



€2.0 bn

Net sales

~ 35%

Net sales



Europe

6 production sites

3 R&I centers



~3,600

employees

~40%

Net sales



Asia & RoW

2 production sites

4 R&I centers



17 production sites

9 R&I centers

2017 data

Specialty Polymers presence in China

特种聚合物事业部在中国

Specialty Polymers 特种聚合物事业部



Solvay Specialty Polymers (Changshu)
Co., Ltd.
索尔维特种聚合物（常熟）有限公司

WFOE:

- Polymist site opened in 2008
- Compounding site opened in 2012
- FKM site opened in 2015
- PVDF site opened in 2017

Main products:

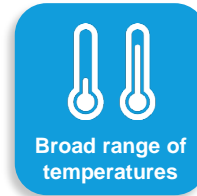
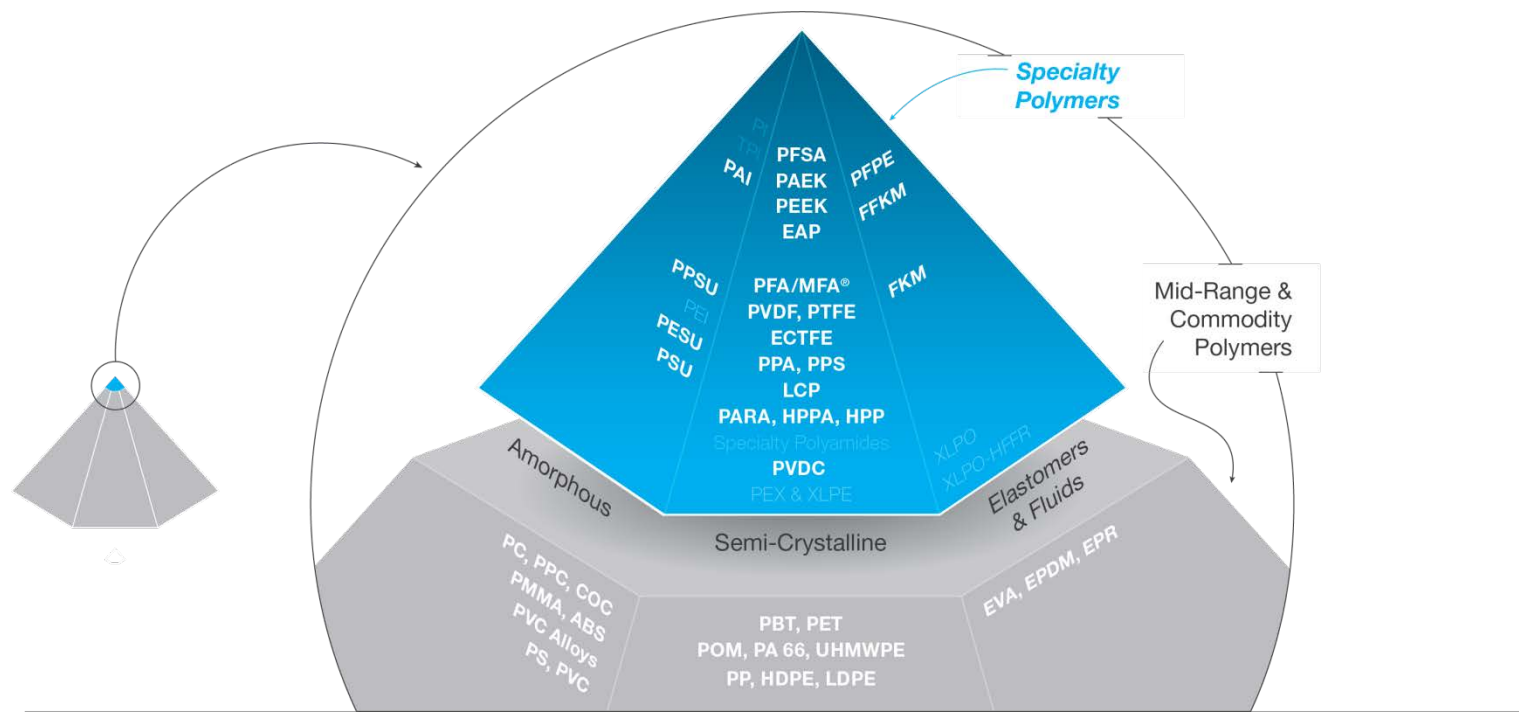
- Algoflon® and Polymist® PTFE
- FKM fluoro-elastomer
- PVDF
- Compounding site (Amodel® PPA, Ixef® PARA, Kalix® PARA blends and Avaspire® PAEK®)

Headcount: 255

聚偏氟乙烯、聚芳醚酮
聚四氟乙烯、氟橡胶等

WFOE = Wholly Foreign-Owned Enterprise















Specialty Polymers comprehensive portfolio through continuous research and innovation



Key performance factors

A unique solutions portfolio

Unmatched in the industry

	Aromatics						Fluoropolymers					Barrier polymers
	LCP	HPPA	PPS	PAEK*	PAI	PSU	PTFE	PVDF	PFA	FKM	PFPE	PVDC
 SOLVAY asking more from chemistry®	●	●	●	●	●	●	●	●	●	●	●	●
 ARKEMA		●		●				●				
 BASF The Chemical Company		●				●						
 DAIKIN							●	●	●	●		
 DUPONT	●	●					●		●	●	●	
 dyneon							●	●	●	●	●	
 EMS		●										
 Celanese	●		●									
 DSM		●										
 vicat				●								
 TORAY Innovation by Chemistry			●									
 AGC							●		●			
 KUREHA			●					●				●
 EVONIK INDUSTRIES		●		●								

* Includes PEEK and PEKK

A Unique Solutions Portfolio

Through Continuous Research and Innovation

	Aromatics						Fluoropolymers					Barrier Polymers
	LCP	HPPA*	PEEK*	PAI	PSU	PPS	PTFE*	PVDF*	PFA	FKM*	PFPE	PVDC
Aerospace	●	●	●	●	●	●	●	●	●	●	●	
Automotive		●	●	●	●	●	●	●	●	●	●	●
Batteries			●		●	●		●		●	●	
Consumer and Construction	●	●	●	●	●	●	●	●	●	●	●	●
Electrical / Electronics	●	●	●	●	●	●		●		●	●	
Healthcare		●	●		●						●	●
Industrial and Environment		●	●	●	●	●	●	●	●	●	●	●

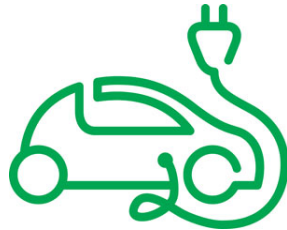
* Currently produced also in Asia

Solvay material solutions:

Various energy storage systems



Consumer Electronics



Electric Vehicle



Energy Storage



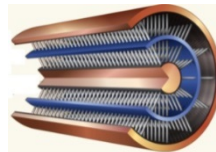
LiB Technology

- Electrode Binder
- Separator Coating
- Cell Gasket
- Electrolyte Additive



Battery Module/Pack

- Structural Component
- HV Component
- Cooling Agents



Super-Capacitor

- Electrode Binder



Re-dox Flow & Fuel Cell

- PEM Membrane

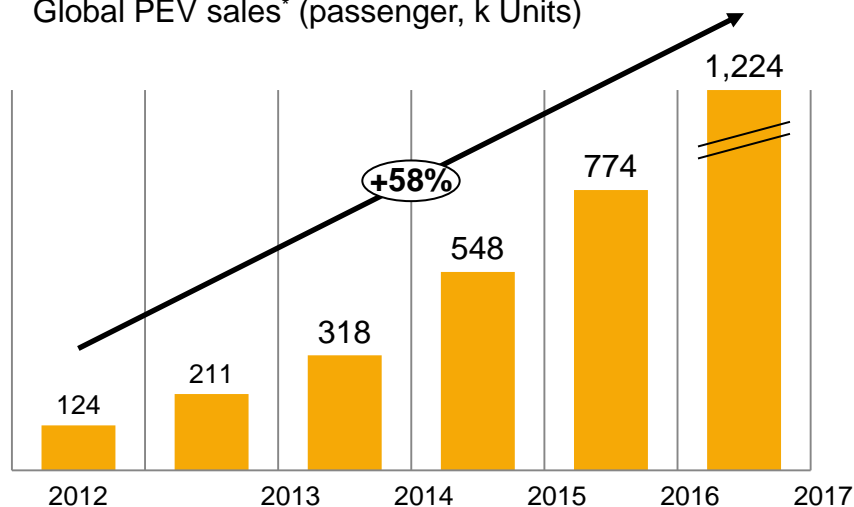


PV

- Frontsheet
- Backsheet

Global PEV Sales: High growth & regionally concentrated

Global PEV sales* (passenger, k Units)



- ❖ From 2012, the global PEV market paced into the fast lane with annual CAGR >50% up to 2017 with the sales of 1.2M units.
- ❖ The PEV penetration rate firstly hit 1% of the global passenger vehicle market in 2016 & above in 2017.
- ❖ China, EU, US and Japan takes up to 95% of the global PEV market.



Total Sales 2017

600,174

306,143

199,822

55,945

% of total

49%

25%

16%

5%

YoY Growth 16-17

↑ 71%

↑ 38%

↑ 26%

↑ 150%

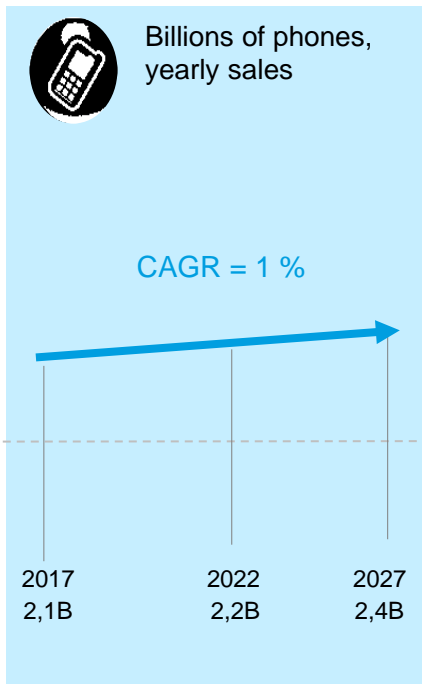
* PEV = Plug-in hybrid or full Electric Vehicle
Source: EV sales, world round data

Car electrification: game changer for the battery industry !

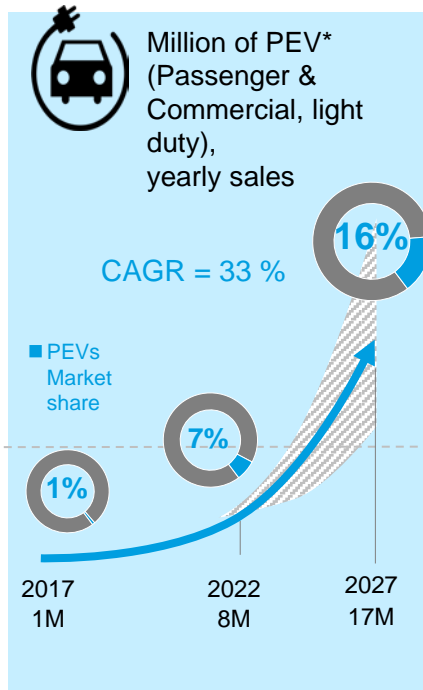
EVOLUTION OF SOME KEY MARKET INDICATORS

(illustrative, base scenario)

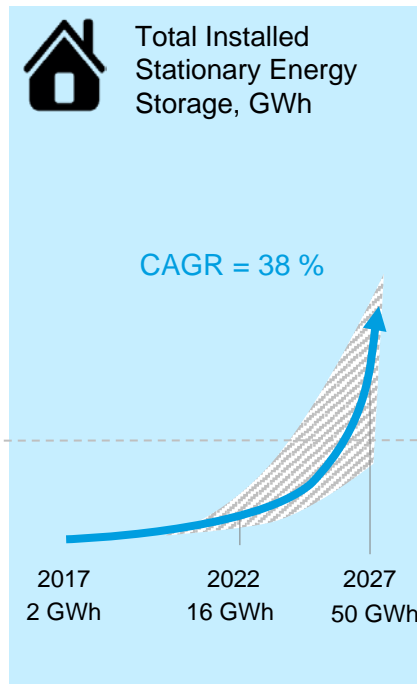
GLOBAL Li-ion BATTERY MARKET SIZE



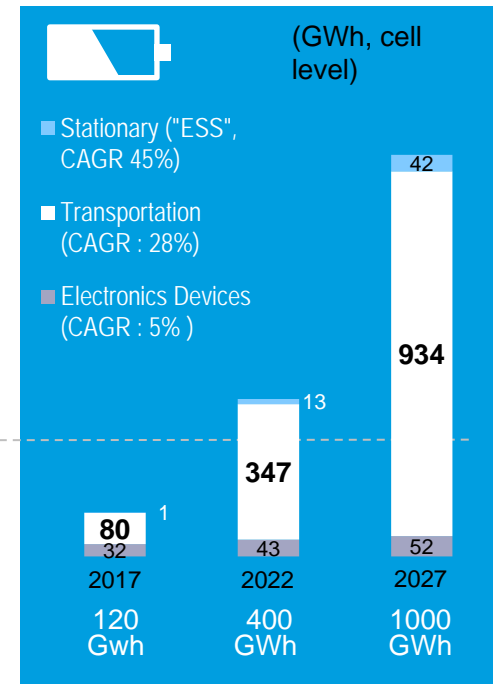
Li-ion (and Advanced Li-ion) is and will remain the dominant technology



Li-ion (and Advanced Li-ion) is and will remain the dominant technology
Next contender : Fuel Cell



Li-ion (and Advanced Li-ion) will be a key technology taking market share also from lead acid.
Next contender : redox flow



Transportation is by far the largest opportunity for Growth, driven by demand of Passenger EVs. Stationary energy storage emerges as new market driven by Automotive Li-ion capacity. Consumer electronics is a mature market although new applications are emerging

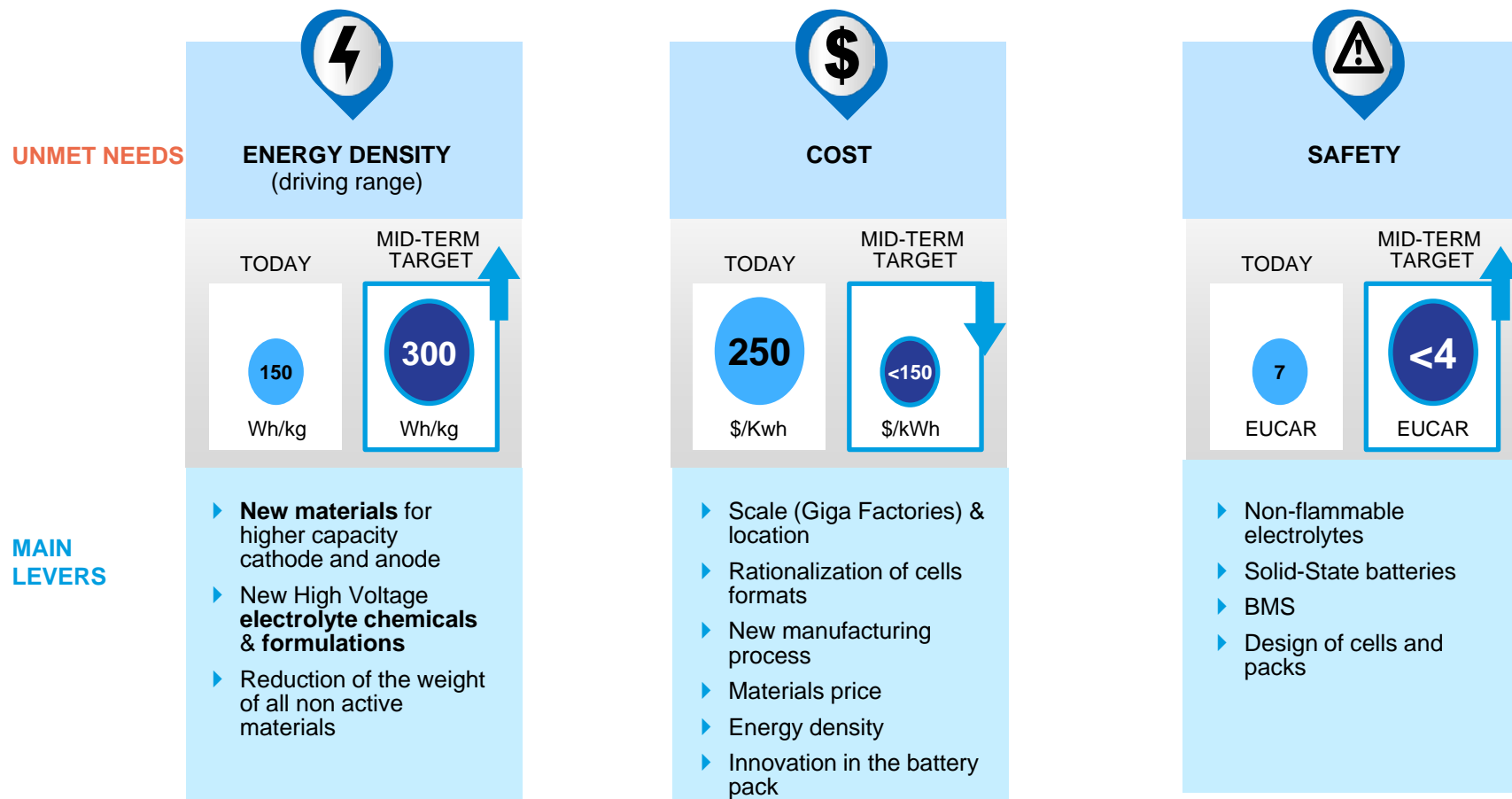
Source : IdTecEx, IHS,

Source : LMC 2018, Solvay

Source : Lux Research

Automotive market needs strong improvements in performance & safety and reduction of cost

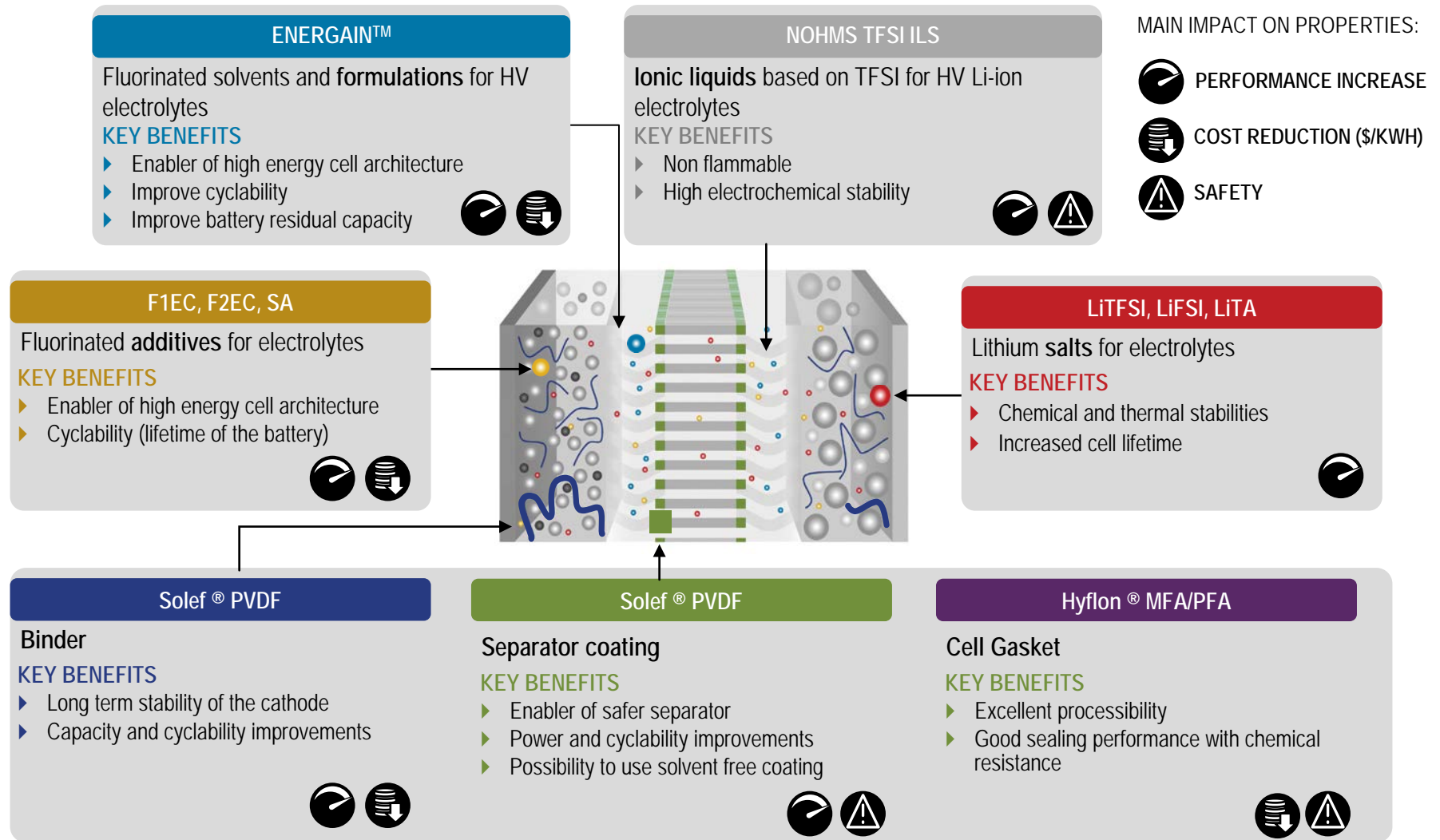
CRITICAL CRITERIA AND LEVERS TO DEVELOP xEV MARKET



NB: Figures provided at cell level

EUCAR: Safety standard

Solvay well placed to serve battery industry today



Battery pack: Solvay offers lighter, safer and higher performance solutions

STRUCTURAL METAL REPLACEMENT



KEY BENEFITS

- ▶ **Less Weight**
 - Reduces Energy Consumption
- ▶ **Ability to consolidate parts**
- ▶ **Reduced corrosion (vs. metal design)**

SOLVAY MATERIALS

**Amodel®
& Ryton®**
Aromatic
polymers

COOLING



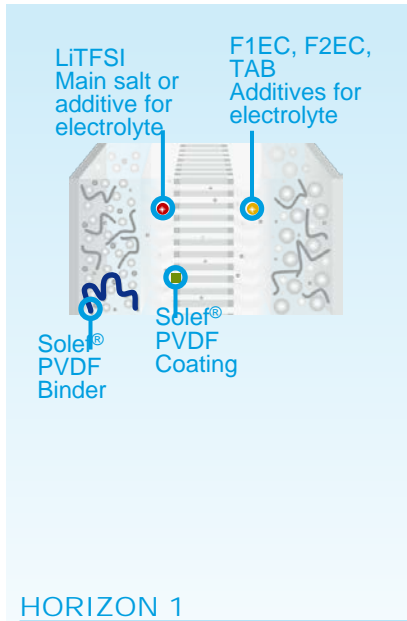
KEY BENEFITS

- ▶ **No Corrosion**
- ▶ **Ability to immerse electronics** into coolant
- ▶ **Safety**
 - Non-flammable
 - Non-toxic

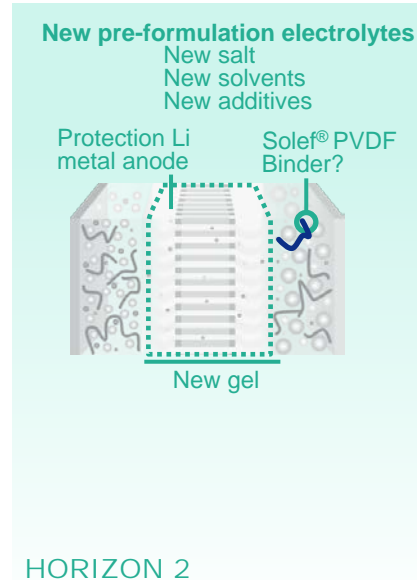
SOLVAY MATERIALS

Galden®
fluorinated
fluids

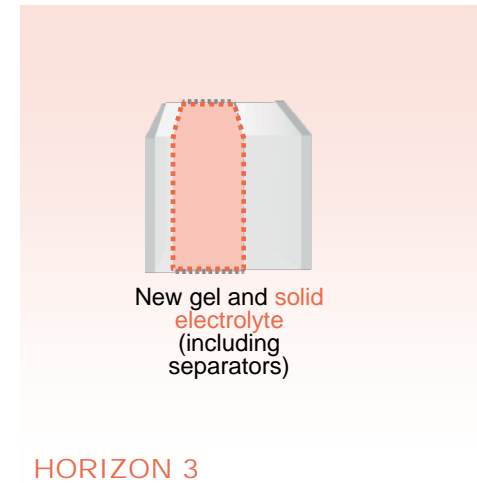
Technology Roadmap: From Li-ion to Solid-state, LiS



- ✓ Binder for cathode
- ✓ Coating for separators
- ✓ Polymer solutions for Battery pack/modules, gaskets



- ✓ New ingredients, Blends for High Voltage (HV) electrolyte
- ✓ Protection Li metal anode
- ✓ New Gel Electrolyte



- ✓ Technologies for LiS
- ✓ Solid Polymer Electrolyte
- ✓ Solid inorganic elect

Solvay global footprint for Li-ion Battery Technology



We are able to support customers globally and locally

Market needs quickly transferred to R&I and Innovative product and solution introduced to market

Partnership with leading institutes: EWha (Korea), DoE in USA, FP7 H2020 in Europe, and CEA in France.

Key takeaways



Industry leader in high performance polymers

- Unmatched portfolio breadth, technology and innovation capabilities
- Wide industry coverage with intimate customer relationship



Position in China to support regional developments

- Expanding industrial footprint and Growing R&I presence
- Strengthening Marketing & Sales regional network



Solvay's specialty materials & technologies offer solutions to the challenges of battery industry

- Comprehensive material solution provider for Chinese customers
- Innovation driven with intimate customer engagement

Agenda

- Solvay in China
Leo Sun
- Specialty Polymers in China
Focus on batteries
Chuanqi Tao
- **Peroxides in China**
Focus on water purification
Gary Zhao
- Lab visit



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Peroxides at a glance

Global market and technology leader



*HPPO = HP (Hydrogen Peroxide)
for PO (Propylene Oxide)

~20%

Production
capacity



Americas

4 production sites

1 R&I center



€0.6 bn

Net sales 2017

~30%

Production
capacity



Europe

9 production sites

2 R&I centers



~900

employees

~50%

Production
capacity



Asia & RoW

6 production sites

1 R&I center



19 production sites

4 R&I centers

2017 Data
Production capacity & sites include all JVs

Peroxides presence in China

过氧化物事业部在中国

Peroxides

过氧化物事业部



Shandong Huatai Interrox Chemical Co.Ltd.
山东华泰英特罗斯化工有限公司

Joint Venture (50%)

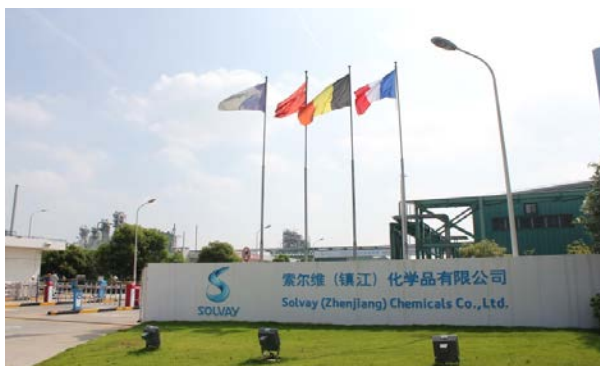
- Established in 2010

Main products:

- Hydrogen peroxide (technical & food grades)
- Peracetic Acid (PAA)

Headcount: 118

工业和食品级双氧水
过氧乙酸



Solvay (Zhenjiang) Chemicals Co., Ltd.*
索尔维（镇江）化学品有限公司

WFOE:

- 60k tonnes in 2016

Main products:

- Hydrogen Peroxide
(concentration 27.5%~70%)

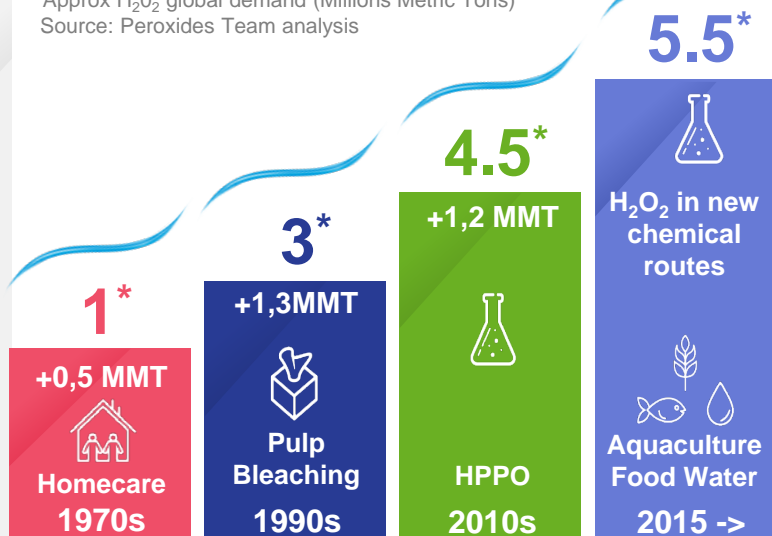
Headcount: 43

浓度在27.5-70%双氧水

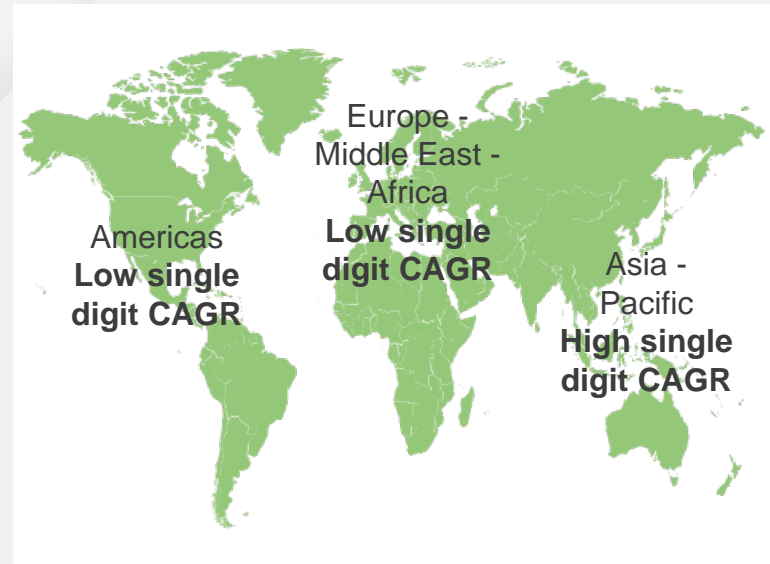
H₂O₂, growth driven by sustainability

Market ruptures

* Approx H₂O₂ global demand (Millions Metric Tons)
Source: Peroxides Team analysis



Demand dynamics



Fast growth in Asia driven by:

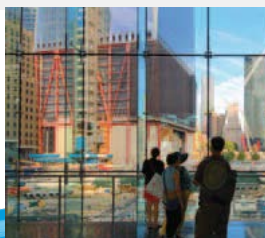
- HPPO (Thailand, Korea and China)
- Chemicals (China)
- Pulp (China and Indonesia)
- Food/Aqua-culture (Region)

Solvay: market and technology leader for H₂O₂

Global market leader



Pulp
bleaching



HPPO



Food and
Aquaculture

Technology leader

- **Fit-for-purpose on-site technologies**
 - High productivity process for H₂O₂: mega plants to serve PO customers
➔ **>70% market share**
 - Reviewed H₂O₂ production process to allow for tailor made customer solutions
- **Process efficiency improvements**
 - Specific consumptions
 - Energy management

Supported by innovation capability

Applications

- **Aquaculture:**
Anti-parasite for salmon farming
- **Environment :**
Advanced oxidation for increasing environmental standards

Technology

- **High Productivity** -> HPPO
- **New process design** -> "MyH₂O₂"
- **Strong energy savings**

Water purification market in China

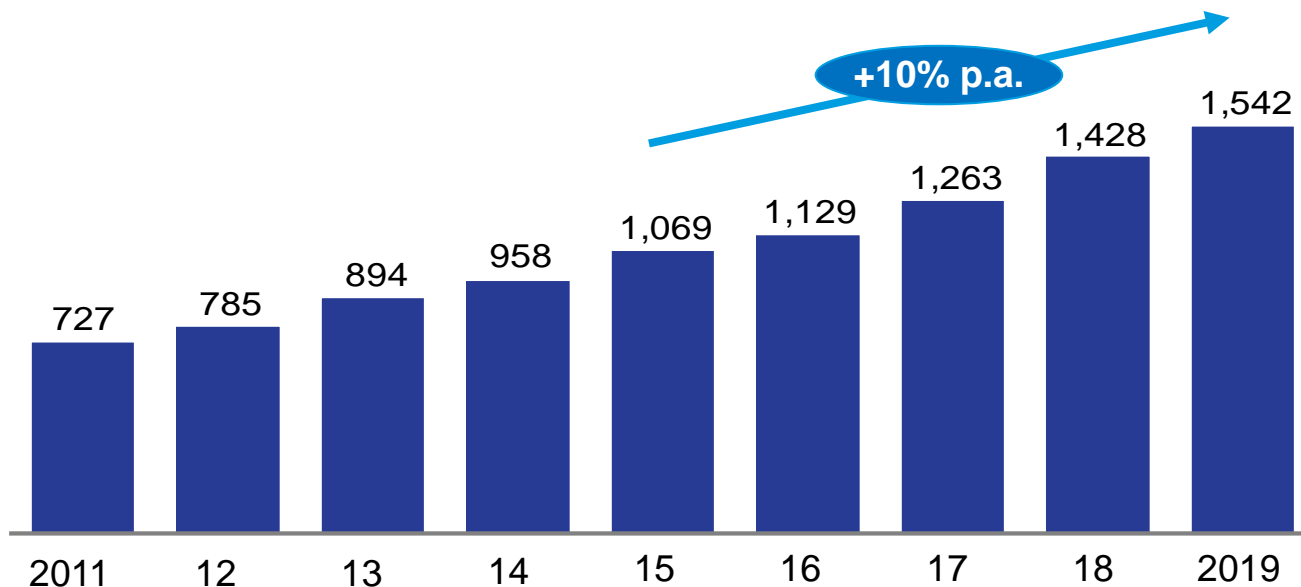
Market size

The industrial wastewater market in China represents a market of approximately USD 1.1 billion in 2015 and is growing attractively at ~10% CAGR

The market is relatively fragmented with 8 key industries constituting ~80% of the industry sales

Industrial wastewater market in China 2011-2019

(CAPEX – m\$)



- Overall market is small but growing
- Recent push on waste water management and **tighter discharge standards** is likely to push growth further

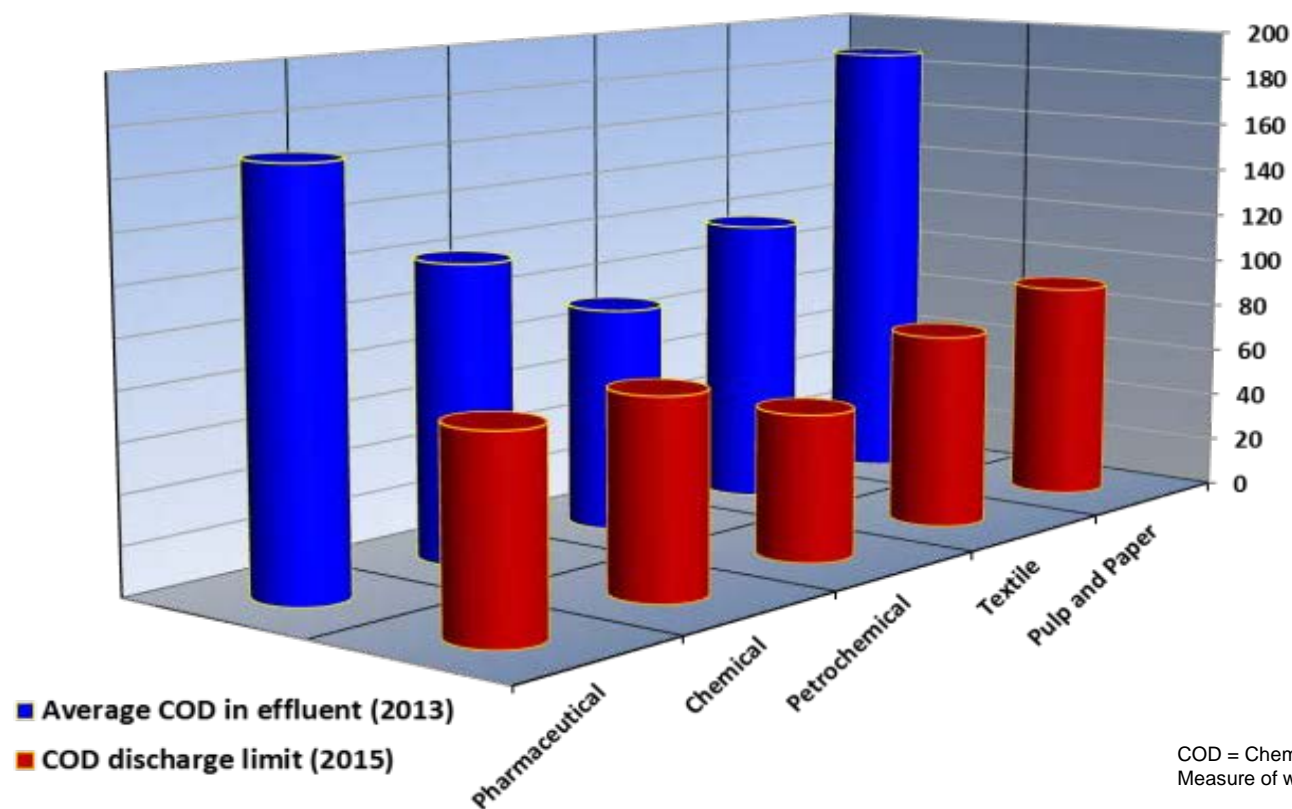
Source: Team estimation based on GWI, Global Water report 2015 (CAPEX for China industrial water market) and GWI, Industrial Industrial Water Technology Markets 2015 (Ratio water/wastewater by industry)

Regulations

Regulation

The MEP recently decided to reinforce waste water treatment standards and control, starting enforcement early 2015, e.g., pthis market

These standard are implemented and enforced by local authorities (provincial and city level)



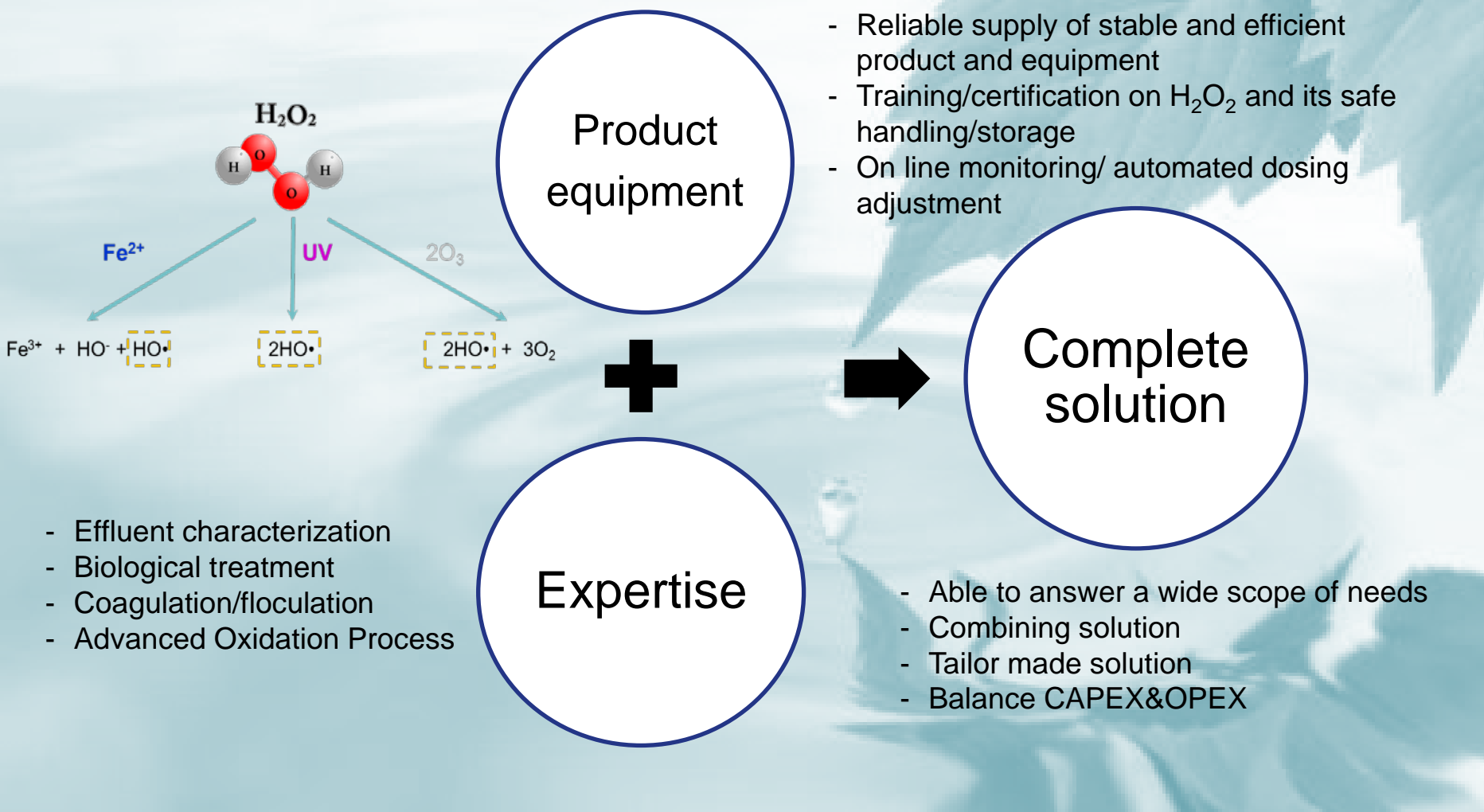
COD = Chemical Oxygen Demand
Measure of water pollution

New business model to capture more of the value chain



AOP : Advanced Oxidation Process

Solvay/Suez Alliance: complete solution for hard COD removal in industrial wastewater treatment



2 key approaches for commercial targets

	H2O2 supply and expertise	Equipment & AOP technology offering	Value-added services
Description	<ul style="list-style-type: none"> Analyze wastewater to define the right solution Run tests on samples in lab in China H2O2 supply Training for safe storage and handling of H2O2 	<ul style="list-style-type: none"> Equipment supply and installation OPEX & CAPEX estimation 	<ul style="list-style-type: none"> Continuous on-line monitoring Automated dosing adjustment Performance improving OPEX and CAPEX optimization Operations & Maintenance

1 “Chemicals + Equipment”



- AOP pilot on-site
- Offer equipment for the whole spectrum of AOP technologies



2 “One-stop shop AOP solution provider”



Fenton Pilot



UV/H2O2 pilot



O3/H2O2 pilot



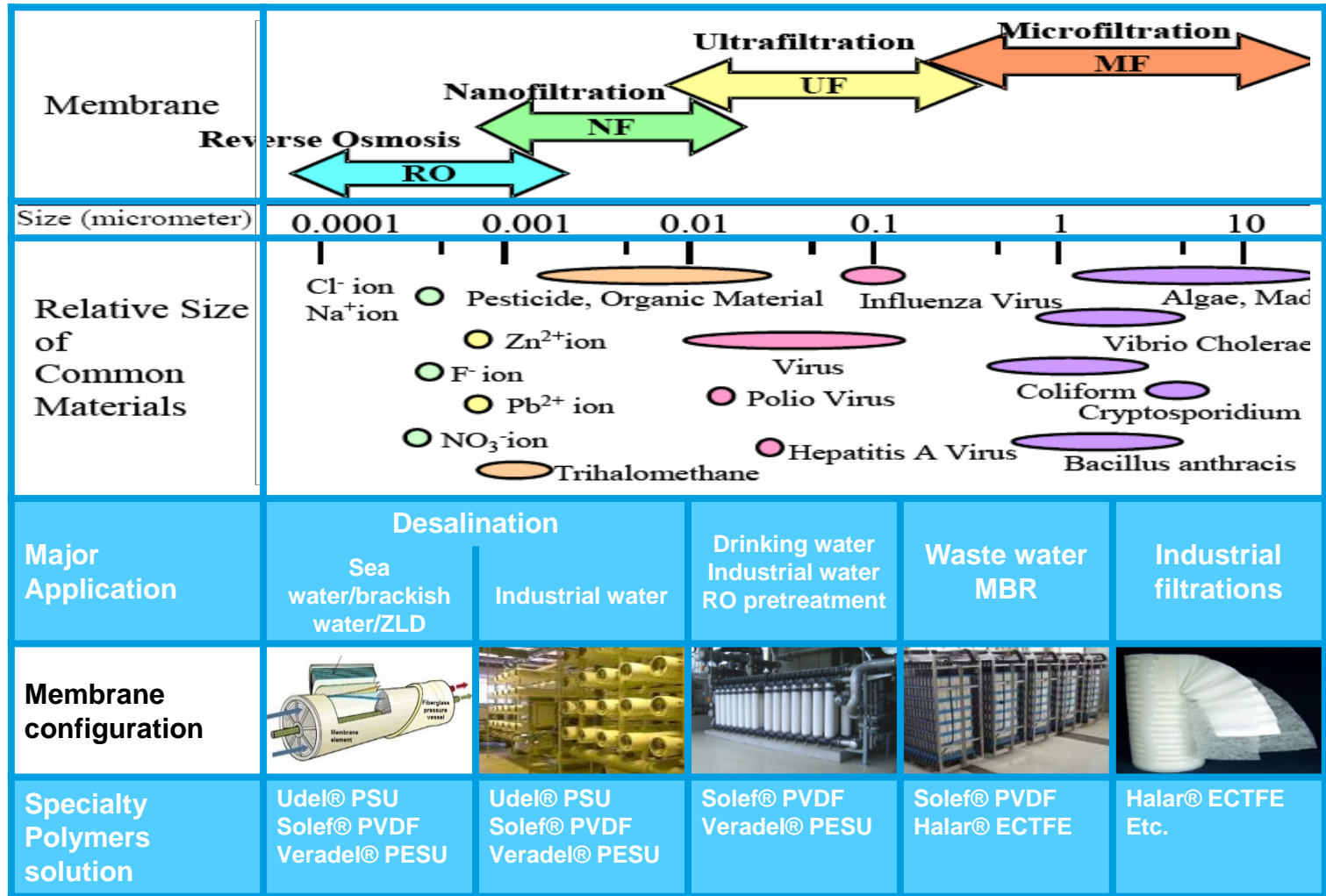
- Stronger lock-in and wider service offering for all AOP technologies with equipment supply
- Added value captured

We established lab to support this Alliance while we get technology support about design and engineering for WWT from Suez on our solution.



Solvay covers the whole spectrum of water purification

Filtration Spectrum



Application & Solvay Specialty Polymers' Solutions

Key takeaways



H₂O₂ markets growing faster than GDP

- New applications in food, aquaculture and water purification
- HPPO



Solvay global market and technology leader in H₂O₂

- Partnerships with key customers
- Strong push for innovation in technology and applications



Solvay has broad offer for water purification

- Peroxides for water purification
- Membrane technology for water filtration

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let's create
more future

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