



On-going transforming— Taiwan Petroleum Industry grows with Circular Economy

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個人簡歷



- ✍ 1981大同工學院化工系
- ✍ 1986輔仁大學化學研究所
- ✍ 1988工業技術研究院化工所(國防役)
- ✍ 工研院化工所:分析檢驗組/企推組專案PM
橡塑室計畫主持人/1990年經濟部石化高值化策略規劃專案專案聯絡人
- ✍ 2002工研院IEK:中油八輕可行性研究計畫主持人
- ✍ 承德油脂業務經理(硬脂酸鋅)/特化工場場長
- ✍ **工研院工安衛中心企推部經理**
- ✍ 工研院光電所企推組前瞻專案經理(代組長)
- ✍ 工研院IEK材化組(石化)專案經理(代組長):中油八輕可行性研究
- ✍ 佳美貿易總經理室專案經理(企業轉型/LCD產業市場開發)
- ✍ 新光合纖:新事業群行企組組長/研發推廣委員會新產品推廣組組長
- ✍ 台橡公司:總經理室PMIS專案經理/台橡(上海)實業總經理
- ✍ 經濟部石化產業高值化推動辦公室特約研究員
- ✍ 經濟部石化產業高值化南部推動辦公室(副)執行長
- ✍ 經濟部石化產業高值化推動辦公室執行長

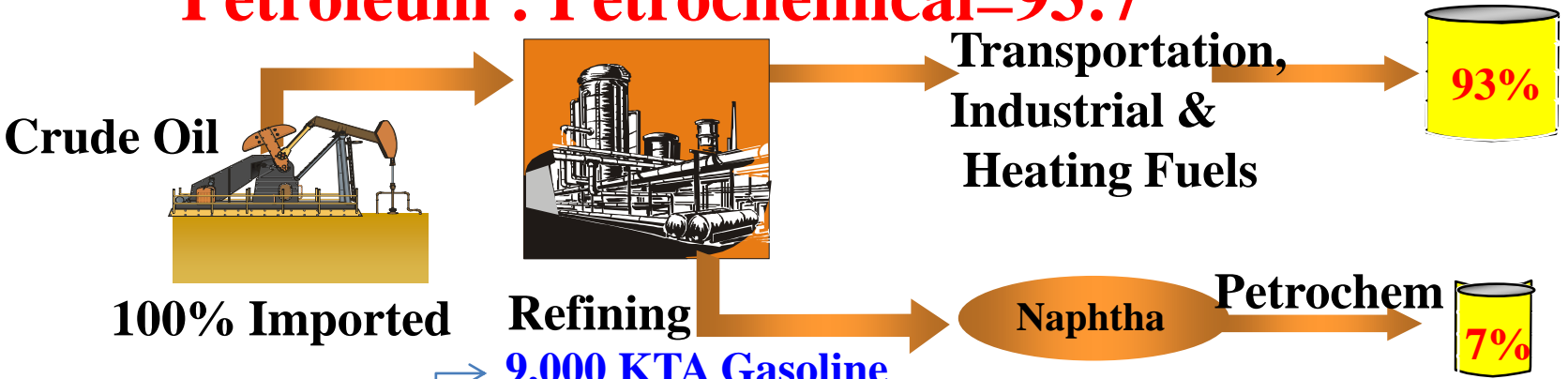
Outline

- What is Petrochemistry & Why is it so important to Modern Life
- Evolution & Statu Quo of Taiwan's Petroleum Industry
- How to lead companies towards Transformation
- Taiwan's advantages and models
- Conclusion

WHAT IS PETROCHEMISTRY & WHY IS IT SO IMPORTANT TO MODERN LIFE

Mass balance Showing Petrochemical is Standard of Circular Economics

Petroleum : Petrochemical=93:7



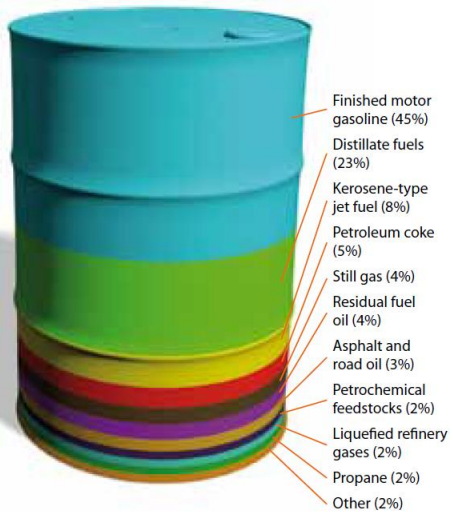
10,000 KTA Oil → **Refinery**

What you get from a barrel of crude

9,000 KTA Gasoline

Cracker
1,000 KTA Naphtha

- 500 KTA Ethylene
- 250 KTA Propylene
- 60 KTA Butadiene
- 15 KTA Isoprene

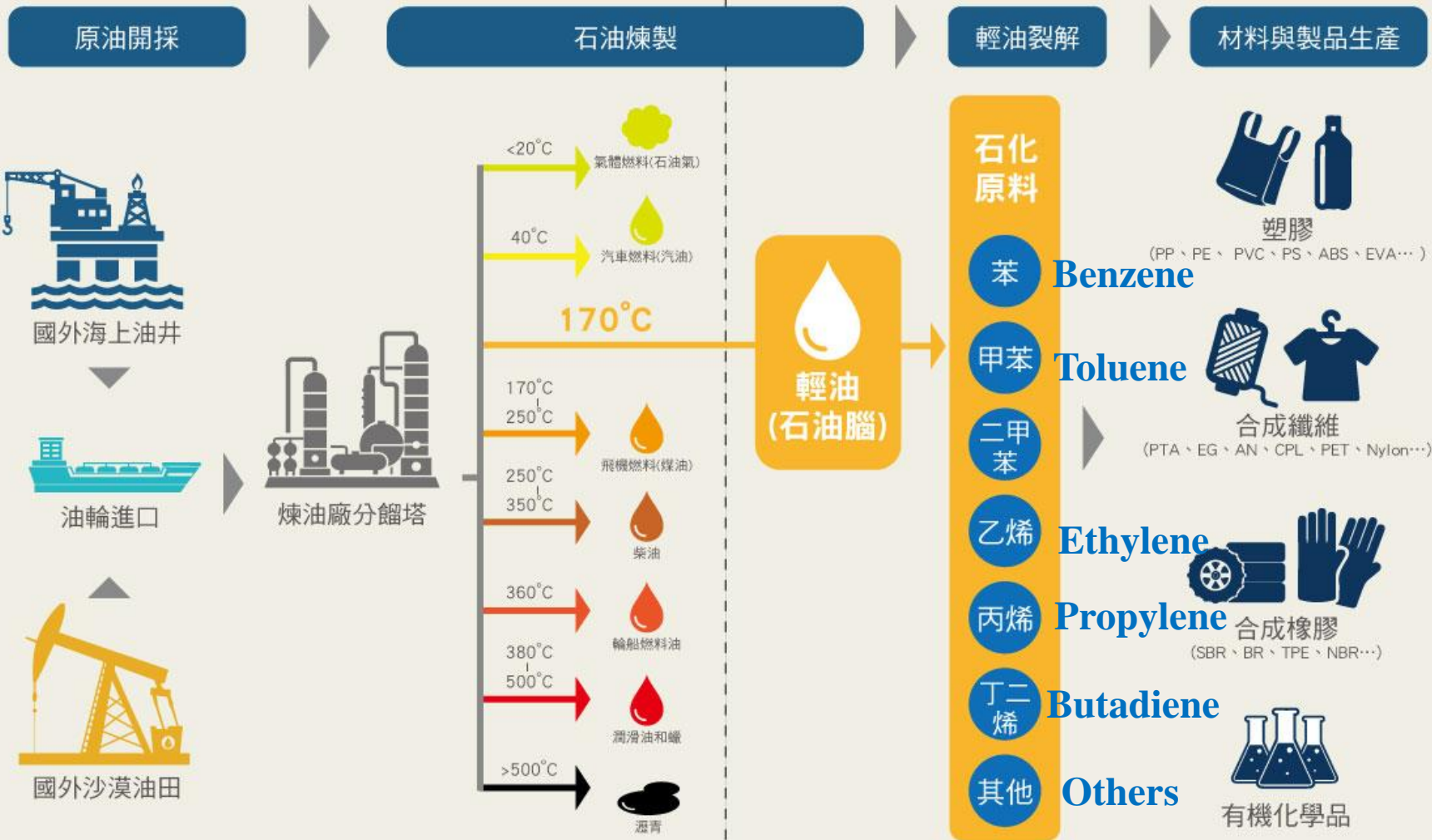


Evolution or Revolution on Business Model

- **Past: Gasoline as Majority**
- **Now: Dynamic balance between Gasoline & Chemicals**
- **Future: Chemical as Majority?**

Everything comes From a Barrel of Oil

石化材料 哪裡來?



Petrochemistry:

Cornerstone for Modern Industry

輔助新興產業發展

綠色能源

生技產業

醫療照顧

精緻農業

Output from Petrochemistry

2.5兆元
2016年

占全國工業
1/5

Employment from Petrochemistry

42.3萬
2015年

占**16%**
全國工業



石化產業包含下游塑膠、橡膠、醫藥製品等齒葉



衣服



輪胎



塑膠盒



3C產品



安全帽



彩妝品

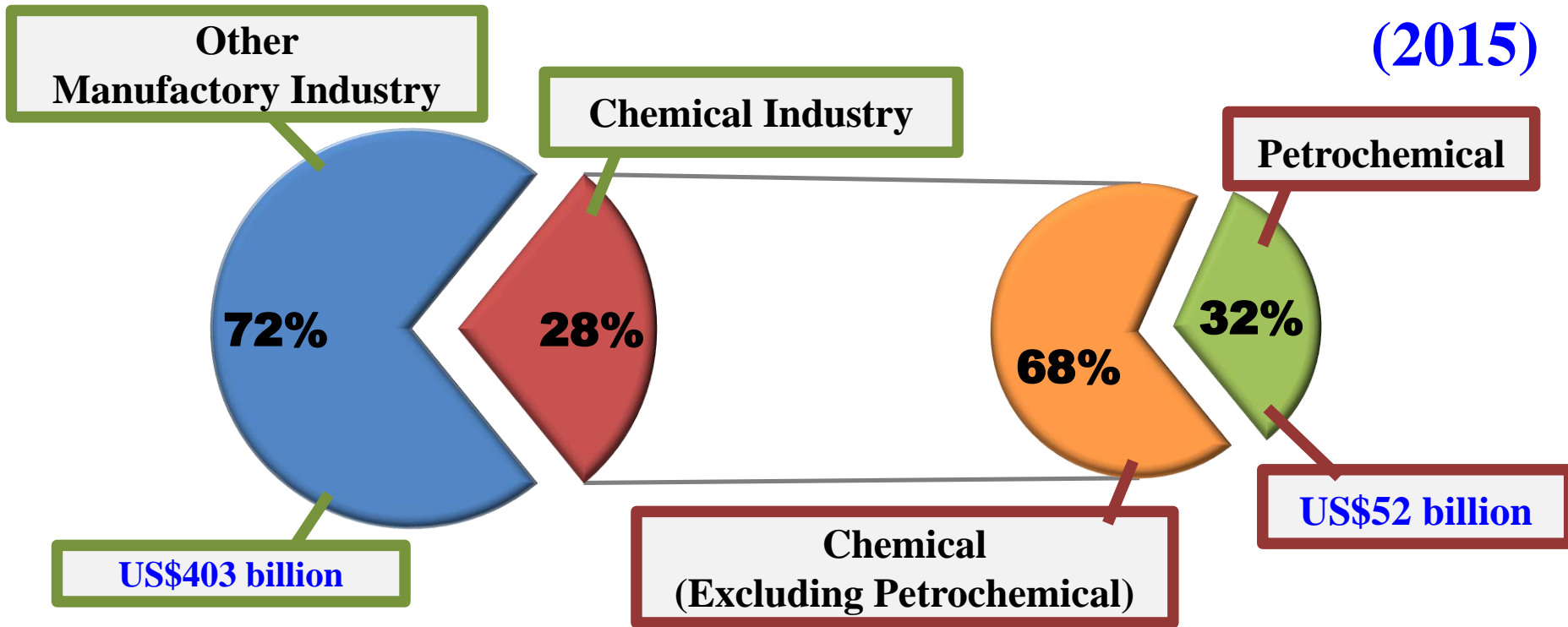


LED燈



Evolution & Statu Quo of Taiwan's Petroleum Industry

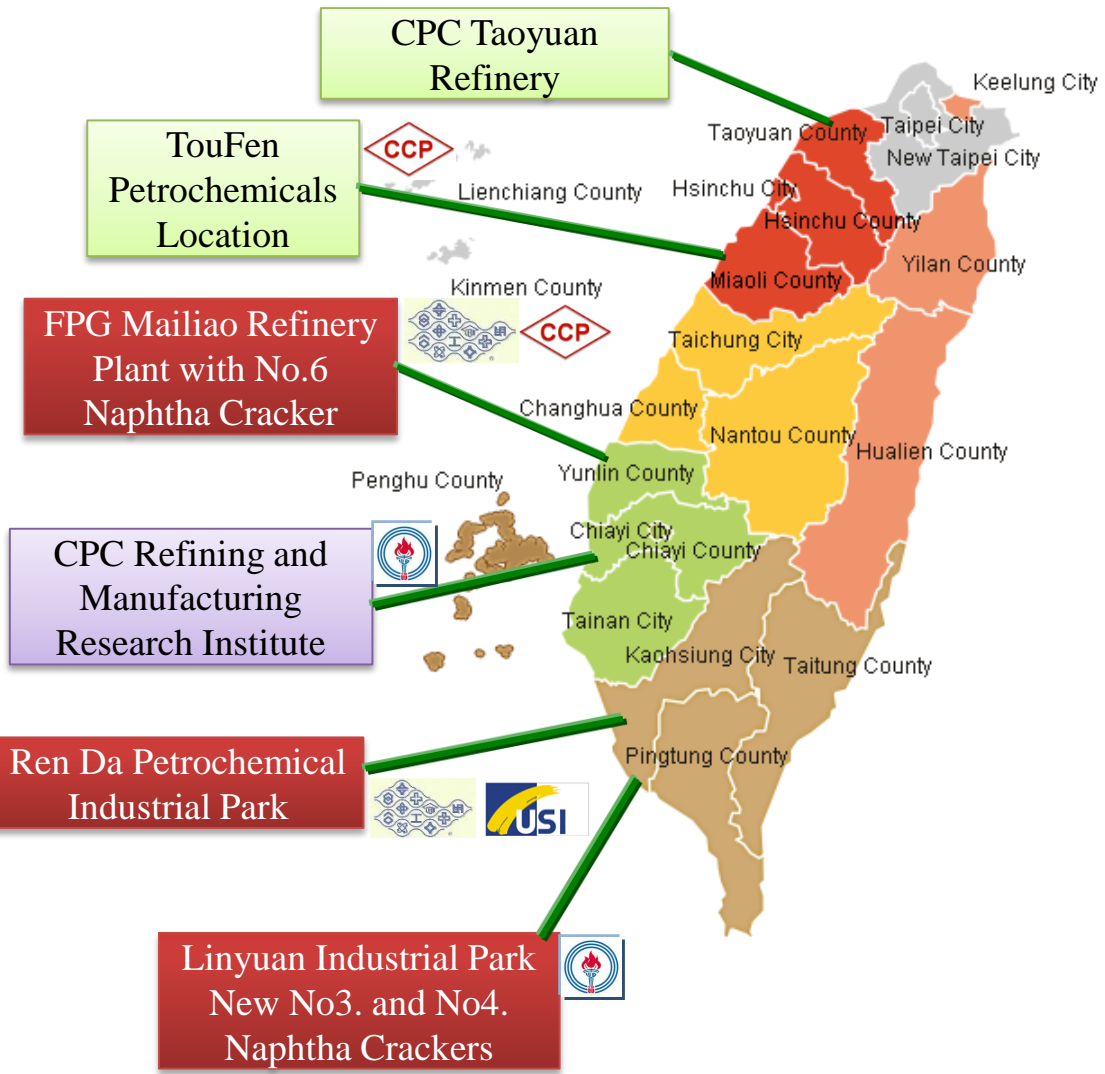
Statu Quo of Taiwan's Petrochemical Industry (2015)



- Total gross output of manufacturing sector in Taiwan is **US\$403billion in 2015.**
- Total gross output of petrochemical industry is **US\$52billion, or 13%** of total gross output by all industries.
- Total 1,062 Companies, 66,000 employees
- Domestic Sales : Export = 55% : 45%

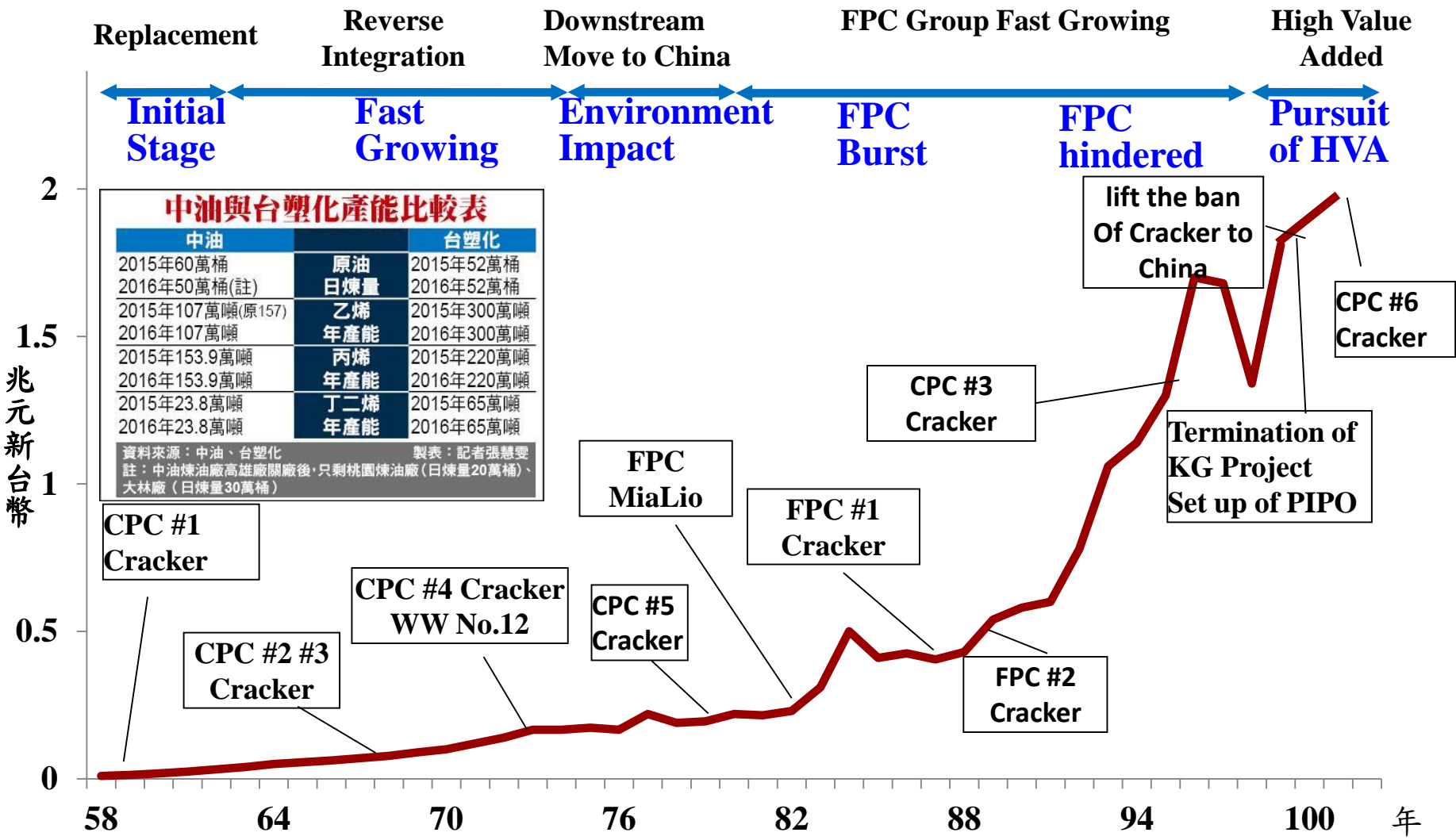
Source : Department of Statistics, MOEA
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Trends & Petrochemical Complex in Taiwan



1. **99%** of domestic consumptions of coal, crude oil, and LNG are **imported**.
2. Petrochemical industry in Taiwan has been developed since 1960'. The current ethylene capacity is about 4.0 million tons/year.
3. Two Main Petrochemical Complex Groups, i.e., CPC group and Formosa Plastics group(FPG), are developed.
4. CPC, FPG, CCP and USI contribute ~60% of total production value for petrochemical industry in Taiwan.
5. Chimei and LCY are the well-known producers of ABS and TPE worldwide, respectively.

Progress of Taiwan Petrochemicals



Capacities of Naphtha Crackers in Taiwan (2016)



		Design Capacity (kta)	Remark
CPC	New NC3	720	
	NC4	365	
	NC5	465	Shutting down at the end of 2015
Total Amount of CPC System		1,550	
FPG	OL-1	700	
	OL-2	1,035	
	OL-3	1,200	
Total Amount of FPG System		2,935	
2015 Total Amount		4,485	New NC3 + NC4 + NC5 + FPG1~3
2016 Total Amount		4,020	- NC5 shut-down(End of 2015) (Decrease 465)

Note: The productivity of ethylene is calculated by design capacity.

Source: Petrochemical Industry Association of Taiwan

Chemical Industrial clusters in Taiwan

Northern Taiwan

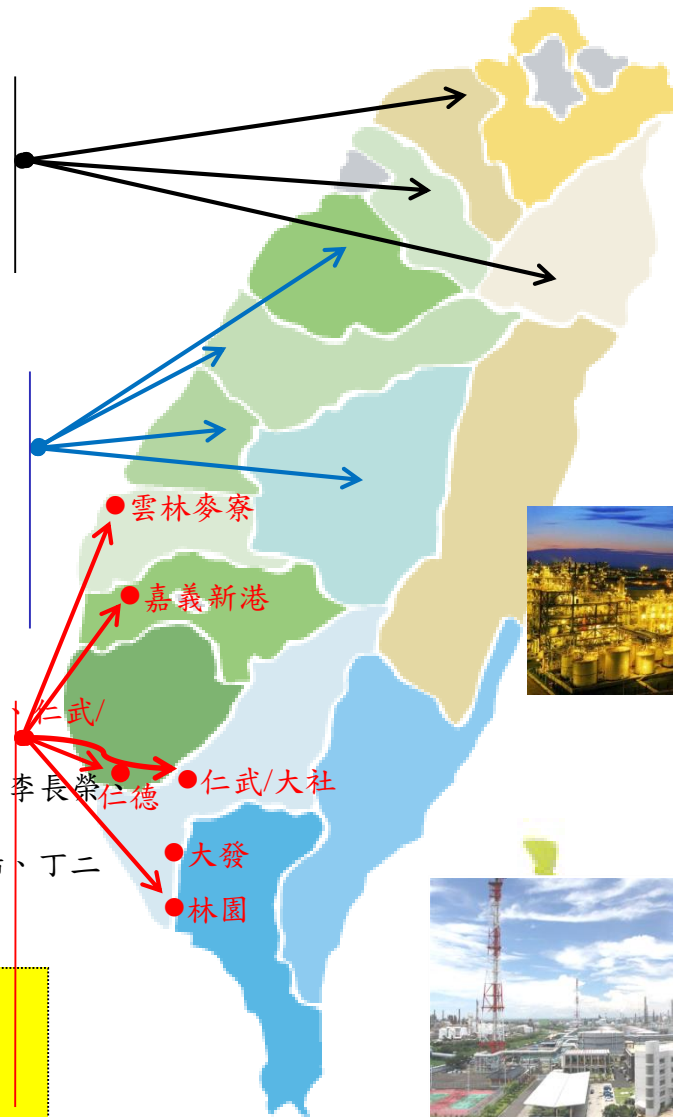
- 區域-桃園、新竹、宜蘭
- 代表廠商-中油、遠東新世紀、新合光纖、長春、久聯、台化..
- 生產原料-聚酯(PET)、TiO₂、樹脂、對苯二甲酸(PTA)

Central Taiwan

- 區域-苗栗、台中、彰化、南投
- 石化產業聚落-頭份石化中心(苗栗)
- 代表廠商-中石化、台氣、上緯
- 生產原料-己內醯胺(CPL)、聚氯乙烯(PVC)、聚氨酯(PU)、ABS橡膠、不飽和聚酯(UP)

Southern Taiwan

- 區域-雲林、嘉義、台南、高雄
- 石化產業聚落-台塑麥寮廠區(雲林)、林園石化中心(高雄)、大社石化中心(高雄)、大發工業區(高雄)
- 代表廠商-台塑、台化、東展、奇美、中油、台聚、台橡、李長榮、仁德、仁武/大社
- 生產原料-對苯二甲酸(PTA)、ABS橡膠、二甲苯、苯乙烯、丁二烯橡膠(SBR)、聚乙烯(PE)、聚丙烯(PP)、乙二醇(EG)



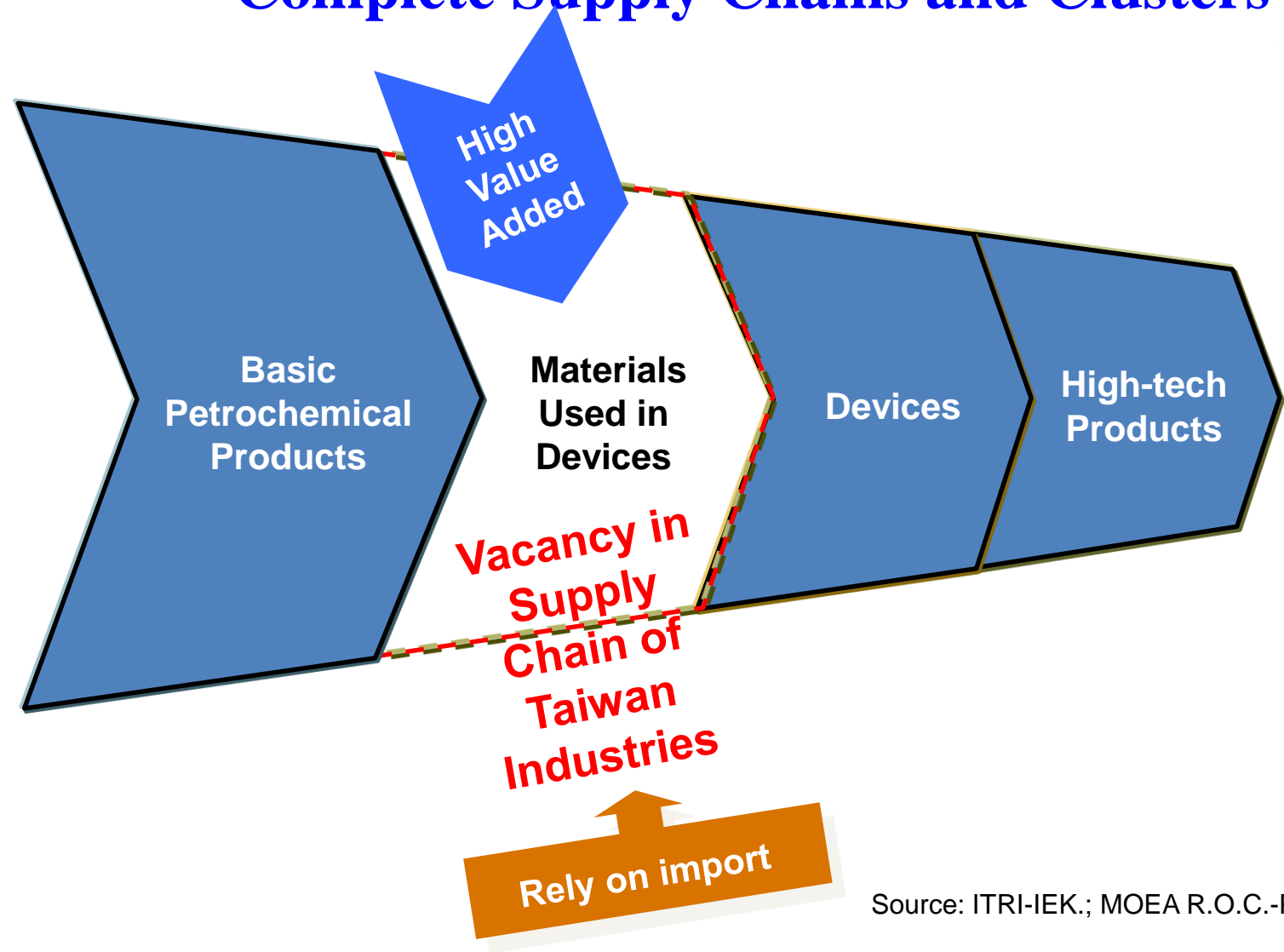
Divided into 3 Major Group

- Pan CPC system: based in Kaohsiung
- FPC Group: Mainly Mia-Liao Park/HsinKang Park/Renwu Park
- CCP Group: mainly Miaoli

Domestic Market & Industry Clusters



Advantages for Taiwan's Petrochemical Industry: Complete Supply Chains and Clusters



Display



LED



PV

Source: ITRI-IEK.; MOEA R.O.C.-PIPO(2011/06)

Challenges of the Petroleum Industry *Now*

High crude oil price and limited resources

Shale gas in US and coal chemicals in China

Ecological and environmental concerns

Expansions in emerging countries (Middle east, China, ASEAN, India)

IMPACT ON PETROCHEMICAL INDUSTRY

NC5 shutdown
Lack of New Large Petrochemical Industry Park
Termination of Kuokuang Petrochemical project

Constraints

Water scarcity and limited land
Restriction on CO₂ emissions
Environmental assessment

Secure Market by Fast to Market


+

HIGH VALUE-ADDED IS THE ONLY SOLUTION.

Government Policy – High Value-Added Petrochemicals



 **Increase GDP by NTD \$600 Billion**

 **✓ Achieve 30% of Value-Added Rate (VAR)¹ for individual high value-added petrochemical;**
✓ Achieve 20% of VAR for overall petrochemicals in 2020²

Increase overall R&D expenses to 1% in 2016

Increase overall R&D expenses to 2% in 2020

2012 -----> **2016** -----> **2020**









Note: 1. See the appendix for the formula for VAR.
2. VAR for overall petrochemicals in 2012 is 12 %.

How to lead companies toward Transformation

How USA Transforms_1

North America vs. Middle East

II. Grade slates (*some examples)

Polyethylene			
	129		8
	205		8
	189		11



Different strategies on the market therefore, different focus on sales (direct sales vs traders/off-takers; specialties + commodities vs pure commodities)

North American companies will push more for Western Europe sales, reshaping Middle Eastern sales to China and Africa

How USA Transforms_2

North America vs. Middle East

III. Plant sizes

North America average PE line 200kt

Middle Eastern average PE line 450kt

Today, GCC plants run smoothly, low number of grades, world scale and quick and efficient transitions

- 3 years from now, American companies will be able to:
- (1) Maximize operations – commodity grades in the new word scale plants
 - (2) Maximize specialties – small units to produce high value added products
 - (3) Shut down or mothball units, controlling supply/demand

How BASF Keeps Innovative Power

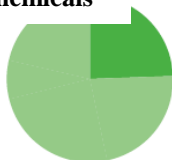
2013 BASF Revenue: 74.6 B EU (2.93 兆新台幣), Ethylene Capacity: 3,400 KTA

BASF KSF:

- Economic Scale
- Vertical Integration
- Lean Production
- Process: Green & High Efficiency
- Product : Functionalization

Business Segmentation

Basic Chemicals



23%

Divisi
- Petr
- Mor
- Inter

產品內容
- 石化原料
- 化學單體
- 中間體

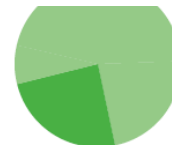
Functional Chemicals



21%

產品內容
- 染指/分散劑
- 保養品
- 保健品
- 功能化學品

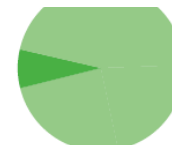
Functional Materials



23%

產品內容
- 觸媒
- 建材用化學品
- 塗料
- 功能材料

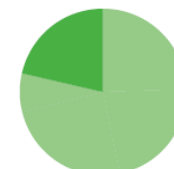
Agricultural Chemicals



7%

產品內容
- 農業保護

Oil

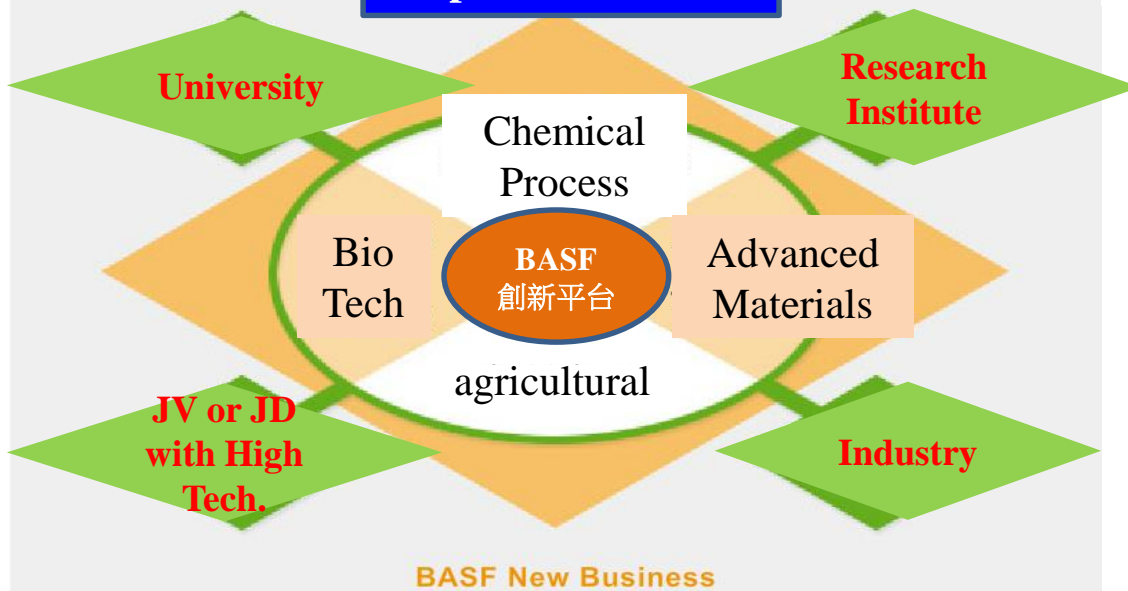


20%

原油及天然氣的
探勘/開採/銷售

¹ The 6% of sales not shown bel

Open Innovation



BASF Rules of Innovation:

Globalization

Multi-Displine

Market Driving

➤ >70 Application Research Centers

➤ Open Innovation : JD with >300 Research center

➤ Open Platform: with potential customers

Japanese Way _ Portfolio Analysis

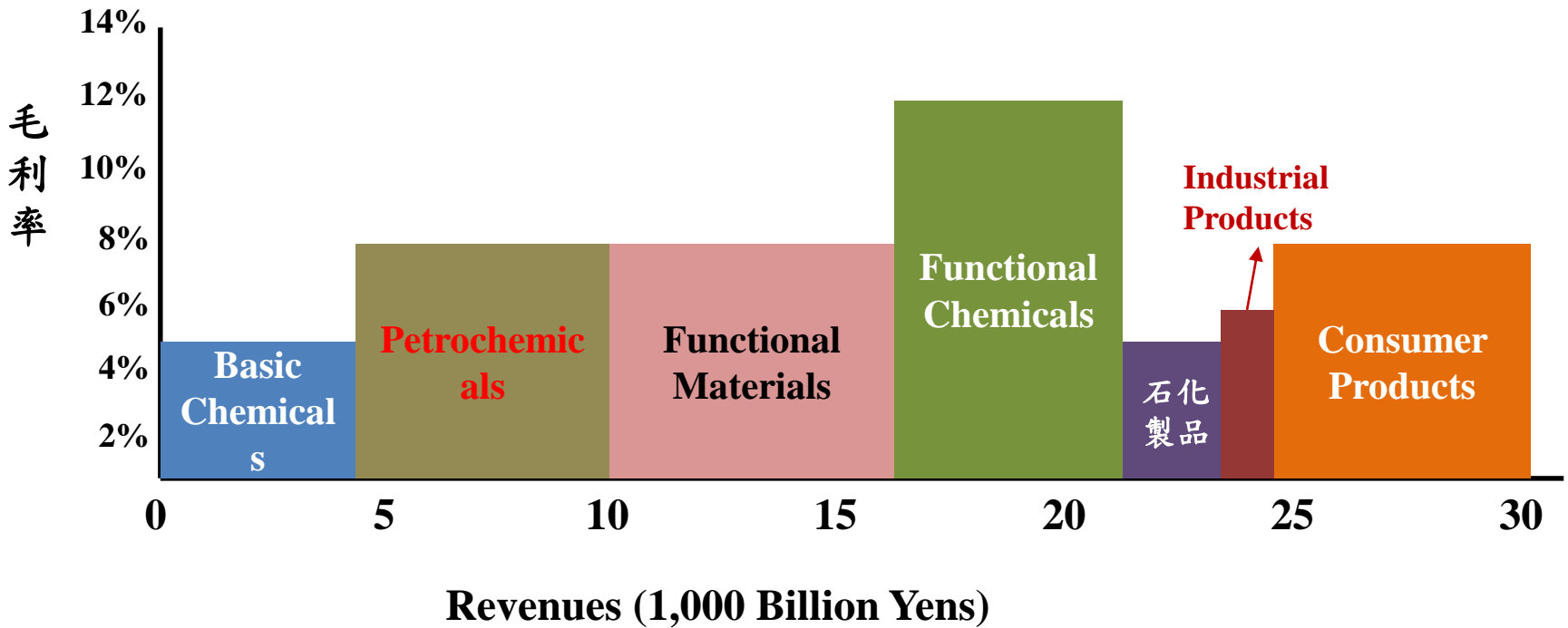
Starting from Core Competence

Mfg.Oriented ⇒ **Marketing Oriented** (Forecasting of future Life Style)

Mfg.Oriented ⇒ **Technical Oriented** (solution provider: as a platform)

From materials ⇒ Devices ⇒ System key components (functional Sheet/film)

From Industry ⇒ Health care



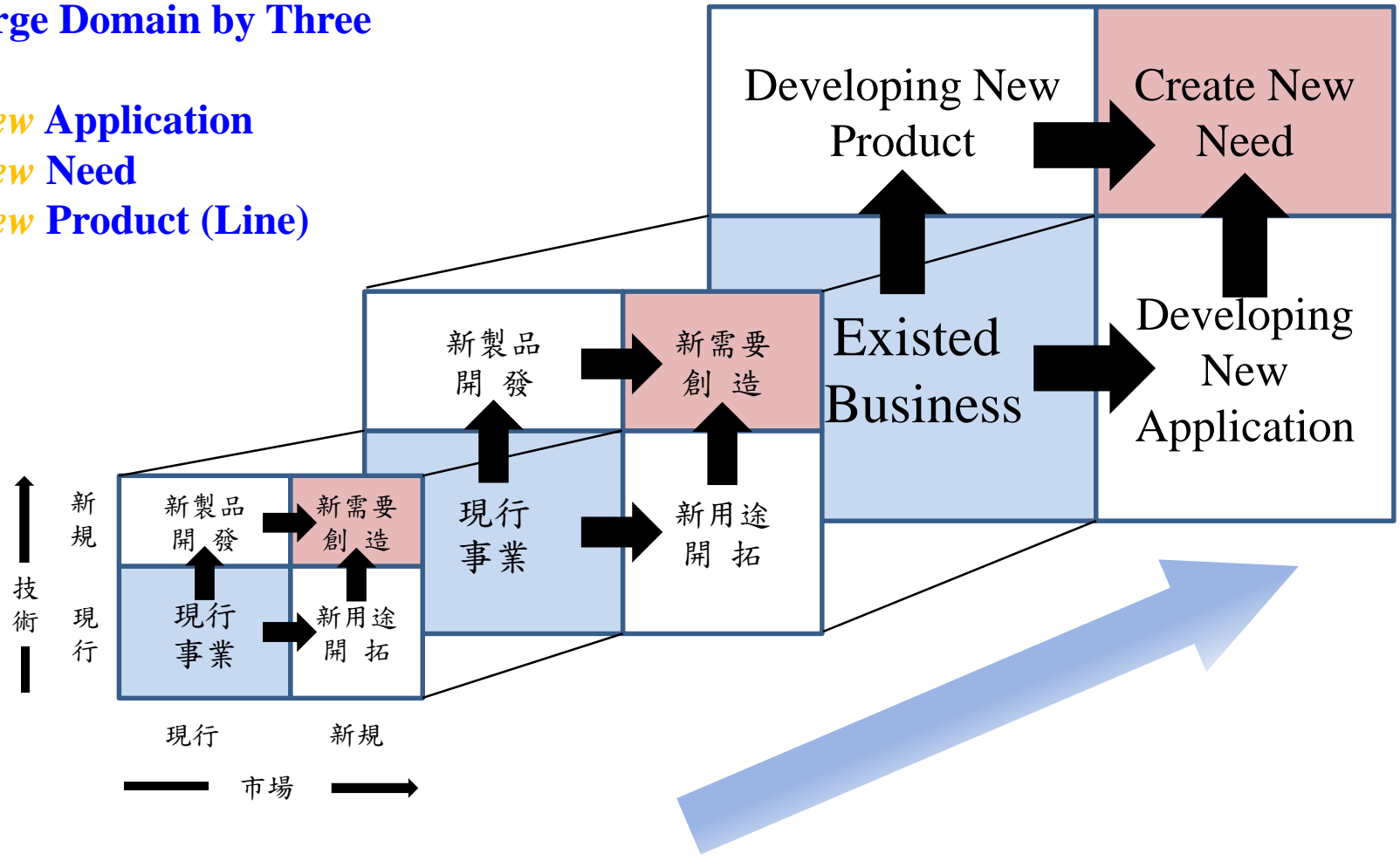
(Analysis based on 74 companies Rev. >50 B Yen)

Japanese Way: Nitto Denko

Enlarge Domain by Three

New;

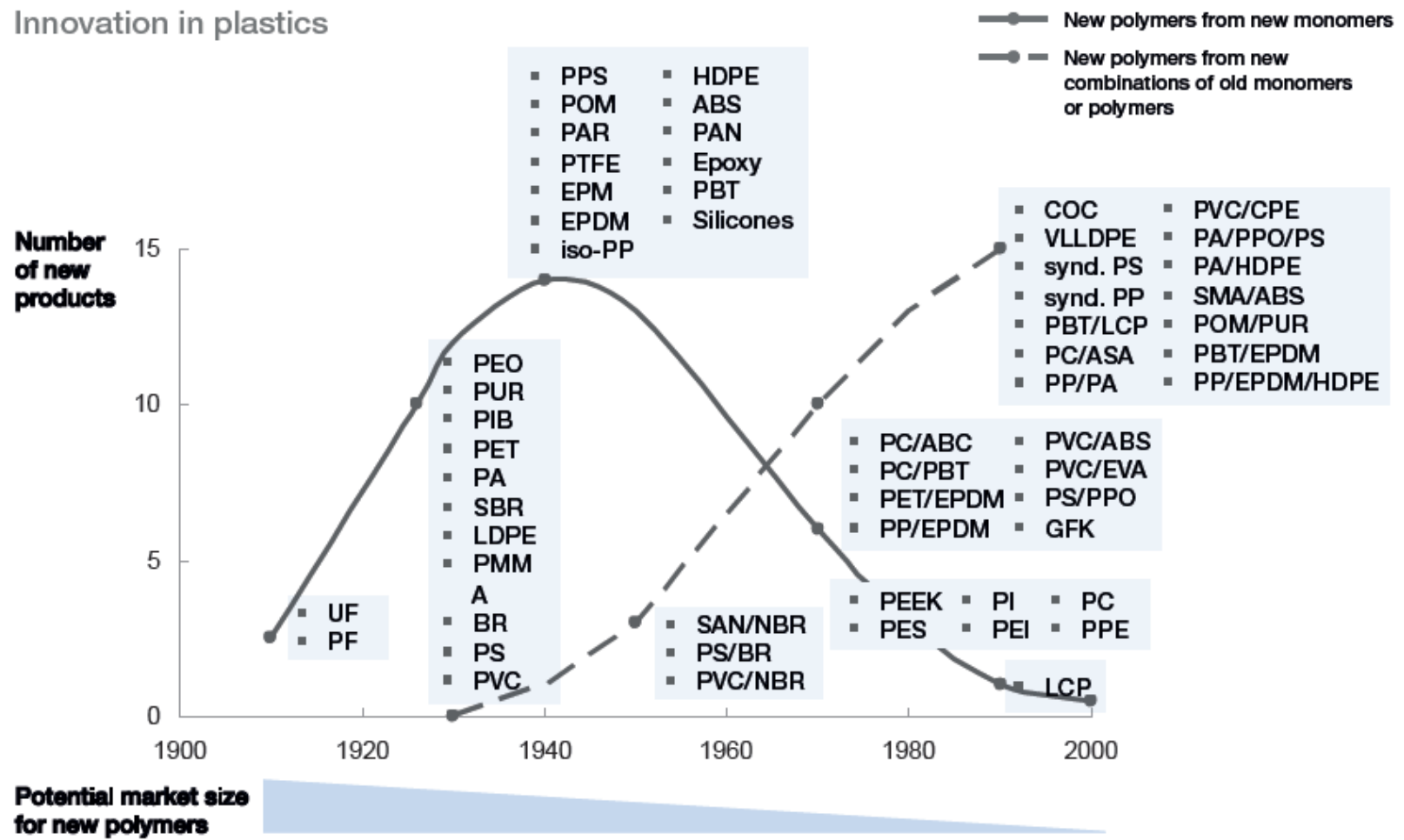
- *New Application*
- *New Need*
- *New Product (Line)*



Innovation in Composites

Figure 17: New polymers continue to emerge, mostly driven by new combinations of old monomers

Innovation in plastics



2014年艾倫·麥克阿瑟基金會 (ELLEN MACARTHUR FOUNDATION) 在瑞士達沃斯世界經濟論壇發布「邁向循環經濟」報告

Source:

Taiwan's advantages and models

Fiber comes to sunset or Keeps Growing



(2) 聚酯事業

2013年聚酯行業產量維持穩定成長5%，全球聚酯總產量達到6,133萬噸(聚酯資料來源：PCI)，與2012年增速相同。中國當年新增產量223萬噸，保持全球領先地位。

聚酯用於製造聚酯PET及聚酯纖維(含聚酯長纖與聚酯短纖)。依據2013年全球產量資料計算，聚酯纖維佔70%，聚酯PET佔30%。

① 聚酯PET

聚酯PET依用途區分為食品級及產業級。自1970年代起運用食品級PET製作成聚酯寶特瓶，用於水、碳酸飲料、果汁及茶等飲料包裝。此外，也可將其運用在生鮮、冷凍、微波耐熱食品等用途包裝。

產業級PET則廣泛使用於汽車、農業、漁業、電子、醫療、交通等各式產業，重點產品包括安全帶、安全氣囊、輪胎簾布、輸送帶、電子產品包材、土工織物、醫療防護、漁網等等。

② 聚酯纖維

依日本化學纖維協會統計2013年全球纖維產量中化學纖維佔68%，其餘為天然纖維(棉、羊毛、絲)等等，化學纖維比重較前一年度增加3%。化學纖維中又以聚酯纖維為最大宗，2013年全球產量4,528萬噸，涵蓋聚酯長纖、聚酯短纖兩大類。

2013年全球聚酯長纖產量3,050萬噸，成長7%，亞洲國家產量近全球95%。中國聚酯長纖產量2,318萬噸，較前一年度成長8%，占世界總產量76%。台灣聚酯長纖產量95萬噸，小幅成長3%，占全球3%。

2013年全球聚酯短纖產量為1,478萬噸，成長2%，生產重心同樣在亞洲(佔85%)。中國聚酯短纖產量916萬噸，成長2%，占全球產量62%；台灣聚酯短纖產量56萬噸，較前一年度減少3%，約為全球產量4%。

Far Eastern_Shin Pu Factories

Capacities:

Shin Pu 400 KTA PET

Lin Yuan : 350 KTA EG

YanZoe: 400 KTA EG

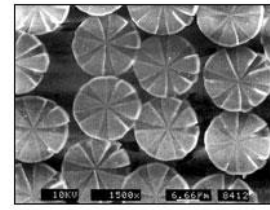
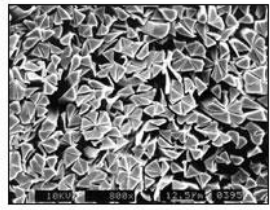
Kang Yin: 700 KTA PTA

**Total : >2,000 KTA PET ,
WW No.5**

Much more than just Fiber: PET



PET



PBT

denier : 9000 meters length fiber how much weight
Wool ; 15 denier / Silk : 1 denier

Starting From Clothes ⇒ PET Synthesis ⇒ Then Produce EG & PTA
2nd Curve:

Mass Production moves to China
Taiwan High Valued Development

- Functional Fabrics
- Food Packages & Industrial Packages (Bottles /Films /Sheets)
- Optical Films



TPEE

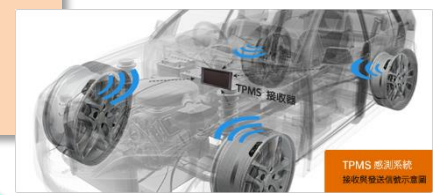
3rd Growing Curves on-going:

PET ⇒ PBT ⇒ TPEE

From Consumer ⇒ 3C ⇒ Railway Industry (Advanced Infrastructures)

From Materials to Device: TPEE

Application: Health care Elastomers/
Vehicle-anti vibration/ Sport Shoes



End user
Products



Anti Vibration
Parts

→ Application service

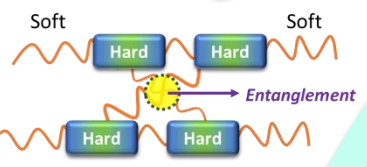
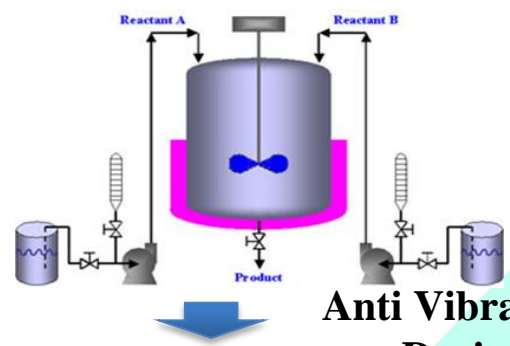
→ Materials and
Mechanical Design

Anti Vibration
Device

→ Fine Polymerization Process
Control

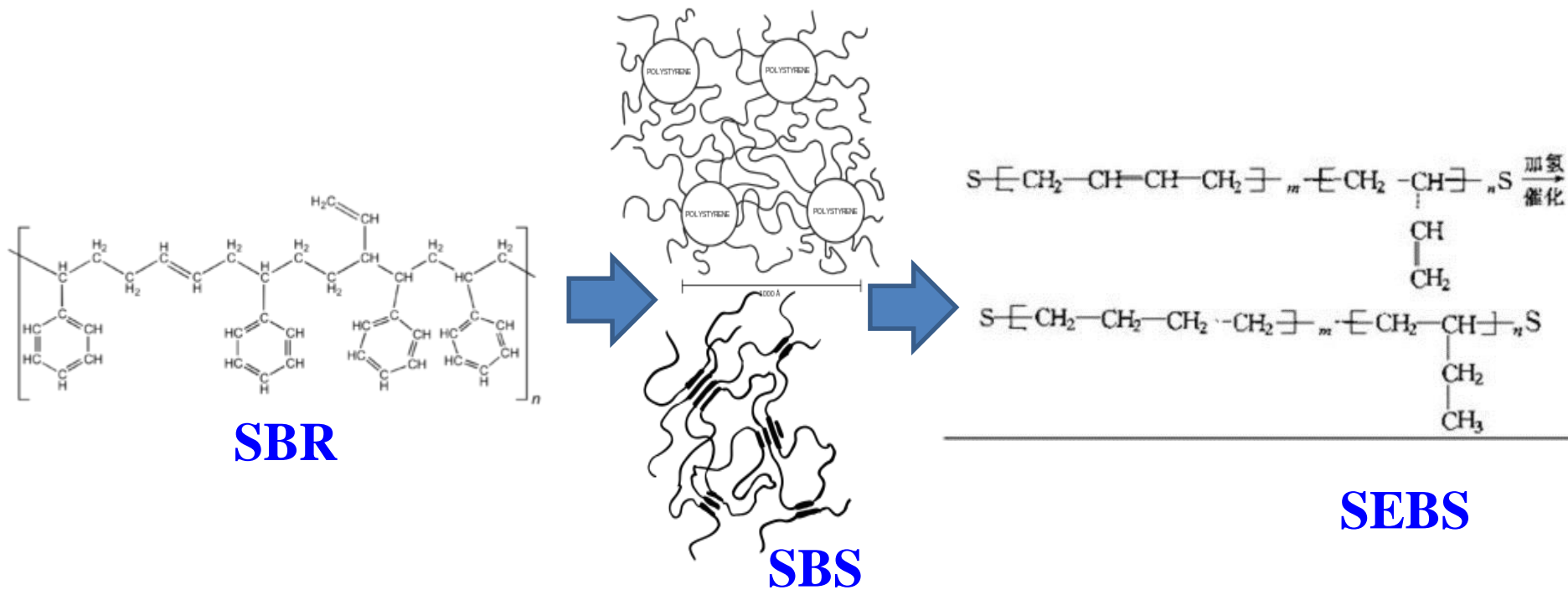


→ Key Issue: High Purity Polyol



Elastomers

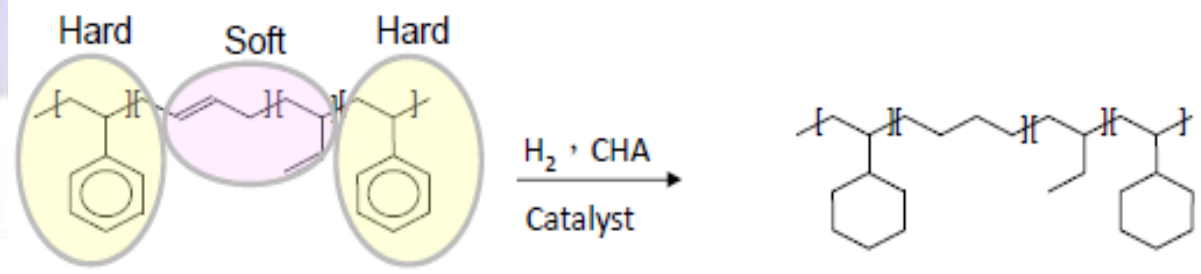
Another Taiwan Miracle : From Space to Shoes



Initial	Developed by TWN	On Going	Note
SBS by Philips	Replace PVC on Shoes	Waterproof Mat	
SEBS	Replace Rubber/Poly blend with EVA	Sport Shoes/ 3D Printing	

From Rubber To Optical Polymer

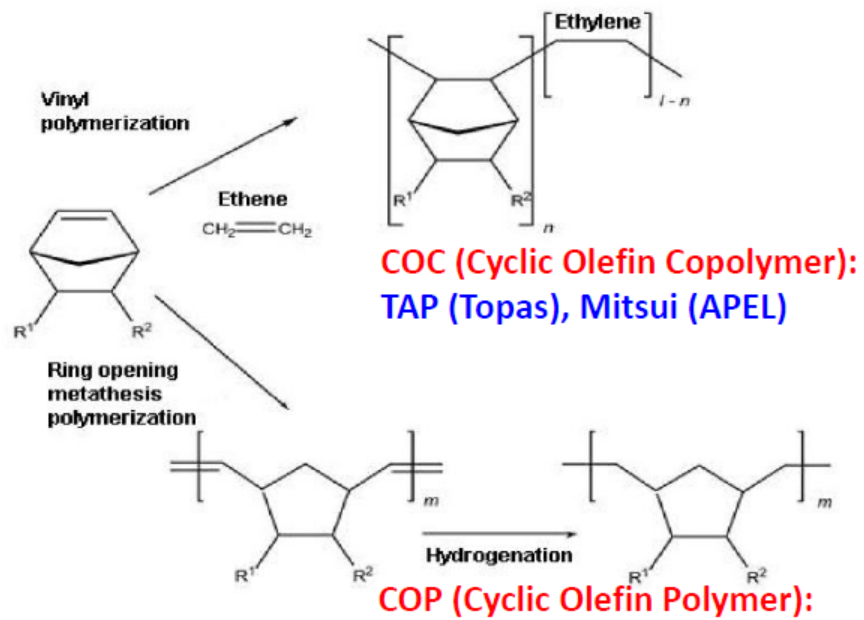
CBC: Cyclic Block Copolymer



Styrene-Butadiene-Styrene Block Copolymer, SBS

Cyclic Block Copolymer, CBC, PCHE-EB-PCHE

CBC – COC & COP



On Going Revolution of Chi Mei_1



1960 PMMA Processing



1965 PE Processed (Chi-Lin/JV with Mitsubishi)



1968 Poly Chemical PS Polymerization

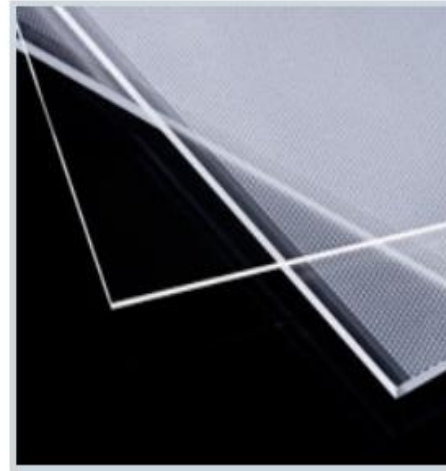
Year	Products	Notes
1969	GPS/HPS/EPS	
1976	Produces ABS	monthly capacity of 200 tons
1980	PMMA pellet and panel	Acquires technology
1981	Produces AS	
1994	ABS WW No.1	annual capacity exceeds 800,000 tons
1995	Produces TPE	
1998	Produces LCD chemical	
1999	Produces PC	CO2 process/JV with Asahi Kasei/a new "non-phosgene, no solvent" method
2009	phosphor used in LEDs	

Chi-Mei: A Leading Innovator_2



Plastics

- ›ABS
- ›MABS
- ›PS
- ›SAN
- ›PC
- ›ASA
- ›PC Alloy
- ›Q-resin
- ›PMMA
- ›MS



Electronic Materials

- ›Optical PMMA Resins
- ›Optical PMMA Sheet
- ›Optical Diffuser Plate
- ›Phosphor



Rubbers

- ›TPE
- ›SSBR
- ›LBR
- ›HBR



Specialty Chemicals

- ›Photoresist
- ›Polyimide
- ›Wet Chemicals

PS+PMMA made LCD Bigger but Thinnest

Issue

Poor size Stability and Humidity resistance of PMMA

Chi-Mei Solution:

Block copolymerization with MMA and Styrene

Records:

- Applied 13 Patents (3 approved)
- Light guide plate > 60 % WW market share



超窄邊框電視



3D TV



Curved TV



4K TV

-興采實業綠色創新讓商機無限



- 由一般型布廠OEM代工，利用綠色創新技術增值至高階型布廠OBM，發展全方位**節能環保機能性紡織品**。
- 2008年自行研發出全球第一件**回收咖啡渣製成咖啡紗**，2011年與回收寶特瓶布料結合，開發出全球唯一混合回收寶特瓶之咖啡紗，榮獲多項國際發明獎項。
- 「3杯咖啡渣，加12個寶特瓶，可以做成1件衣服！」
- 與各超商、星巴克、伯朗等知名咖啡店及金車、味全等飲料公司，合作回收廢棄的咖啡渣，一天約回收500~1,000公斤，咖啡紗布料一年出口約360萬碼，可以製成180萬件「咖啡衫」。

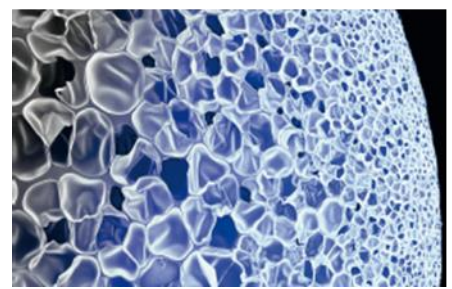


(資料來源:興采實業)

Fashion is my name! Circular Textiles- adidas



adidas與致力於創意環保的Parley公司宣布合作，將會推出一款以海洋廢棄物和深海刺網為原料的運動鞋。據悉，adidas推出的環保運動鞋就將以這次收繳的漁網作為原料，鞋面採用海洋垃圾中的塑料和真正的綠色漁網，而鞋底將會採用其他的可持續材料。這款鞋子是不是會大規模生產還未可知，但是adidas承諾最遲會在2016年開始使用環保纖維作為原材料



E-TPU輕量化具彈性的發泡泡沫珠已應用於台灣製鞋業生產目前市面最流行之Adidas Energy Boost 跑鞋（「爆米花」鞋）

Conclusion

Why choose Taiwan?

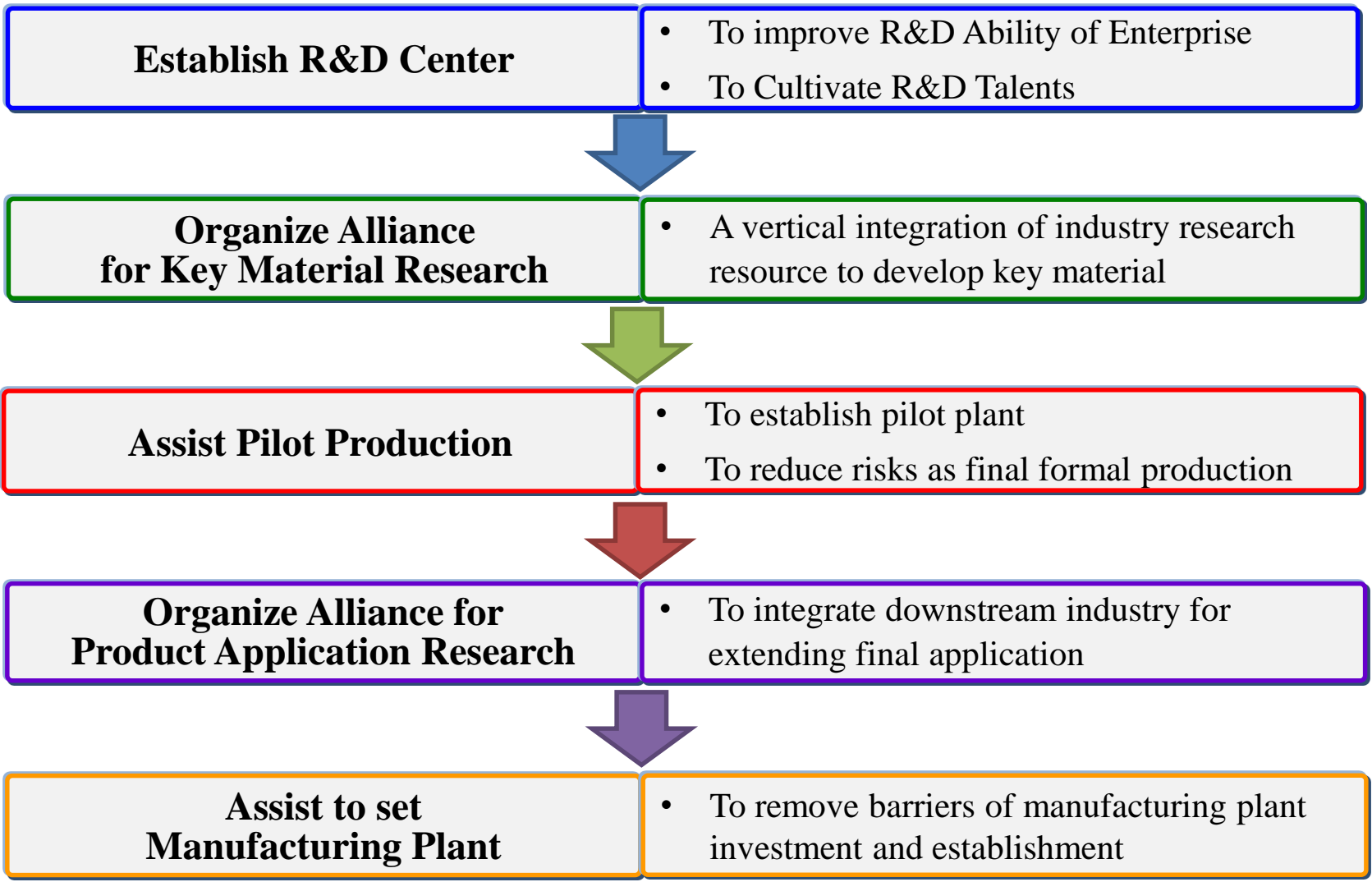


Fast to Market (From Bench to Demo. Plant)

Initiative: A Comp. has developed a new catalyst and tried to apply this catalyst to produce a Optical Polymer

Stage	Location	Progress	Comment
Lab. Scale	A comp.	Select suitable catalyst and proper condition	A comp. RD
Bench	Taiwan/ITRI	Optimize catalyst	A comp. applied and approved by TWN MOEA RD Center Project
Pilot Plant	Taiwan/B comp	Pilot	Funded by MOEA
Pre-Marketing	A comp + C/D/E Taiwan users	Light guiding plate Optical compensation film	Funded by MOEA
Licensing and Demo Plant	A comp Licensing to G G comp gained a pilot plant funding from MOEA	Start commercial test with end users (under going)	Funded by MOEA

5 Steps of R&D Strategy – High Value-Added Petrochemicals Promotion



Source: PIPO, MOEA

Government R&D Incentives

1. Special Tax Refund for High Level R&D Investment

— Part of R&D investment can be applied for a tax refund (Max 15%).

Tax Credit Rate	Total Corporation Credit Amount
15%	30%

2. Encourage Taiwan Companies to establish R&D Center Project

— To support a hiring of R&D talents and of consultant

3. A+ Industrial Innovation R&D Project

— To support joint venture (R&D) between with companies and/or with 1 company and 1 research institution

4. Global Innovation Partnership Initiative Project

— To support foreign companies establishing R&D centers which links local industry

5. The Promotion Project for Insufficiency Link of Key Chemical Materials

— To support companies for investment in R&D and trials for pilot program

IP Protect

- Enacted Intellectual Property Court Organic Act and Intellectual Property Case Adjudication Act.
- Intellectual Property Court in operation. Organized Intellectual Property Rights Police Team
- Mature and complete trademark, patent and copyright laws.



Tax Incentive

- Corporate income tax is reduced from 25% to 17%, starting from the year of 2010.

	Taiwan	Japan	Thailand	China	South Korea
Corporate Income Tax	17%	34.62%	20%	25%	24.20%
Value-added Business Tax	5%	8%	7%	17%	10%

- Offset or Refund of Duties and Taxes for Raw Materials for Export Products
 - Tax for the imported raw material processed in Taiwan for exported could be offset or refunded.

Incentive Programs

- R&D Subsidies

15% of a company's R&D expenditures may be claimed as a deductible expense against the current fiscal year's payable business income tax.

- Tariff-free treatment for importing specific machineries

Importing machinery which can not yet be manufactured domestically may enjoy tariff-free treatment.

- Tax exemption on licensee fees paid overseas

A company imports new production technologies / products which uses patent, trademark, or other special right owned by a foreign profit-seeking business may enjoy tax exemption on the licensee fee paid to the foreign profit-seeking business.

Global Innovation Partnership Initiatives

R & D Incentive Programs_2

Actively importing foreign corporations to establish R&D energy in Taiwan in order to strengthen/extend the global layout of industrial chain of our country

Actively importing international R&D energy



Connecting with mutually beneficial multi-national corporations

Developing Taiwan into the best partner for international innovative R&D, production cooperation, and value creation

Cooperating with domestic business to co-construct industrial ecosystem



Expanding the R&D investment in Taiwan to facilitate the birth of new businesses

Establishing new connection with global value chain and enhancing the advantages and technologies of domestic businesses in order to bring in new business opportunities

Global Innovation Partnership Initiatives

R & D Incentive Programs_3

R&D Subsidies

□ Subjects of Subsidy:

- Salaries of R&D personnel
- Consultant fees
- Foreign expert payments
- Travel expenses
- Expenses of consumable equipment and raw materials
- Technology transfer fees, commissioned research fees, verification fees
- Overseas training expenses
- R&D equipment use fees
- R&D equipment maintenance fees

□ Budget Allocation:

- The maximum amount of project subsidy budget shall not be greater than 50% of the total project budget. The subsidy for each joint company shall not be greater than 50% of the project budget of that company, and the remaining fund should be raised by the applicants.

Taiwan, your best partner in Petrochemical Industry

Invest Taiwan Your gateway to the Asia & World !



Maybe Now you can
Call me David Go A Way
Not David Go Away!

