Has PVC already entered the next round ‘up cycle’ in China?

China National Chemical Information Centre
CNCIC

TAIPEI, TAIWAN
May 17th, 2019

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1984 – Established Economic Information Center of the Ministry of Chemical Industry

1992 – Merged to establish CNCIC

1999 – Transferred to enterprise

2019

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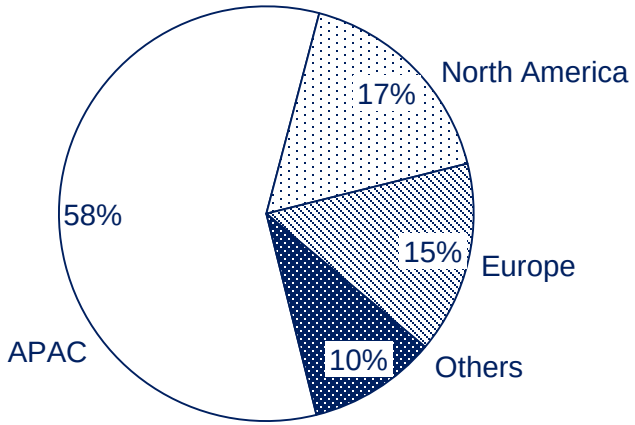
Customized In-depth Market Report

Strategic Planning	Enterprise strategy planning	Product/product chain strategy planning	Industrial park planning…		
Market Research	Market size and segmentation	Value-chain analysis	Market entry opportunities	Competitive intelligence & benchmarking	Regulatory analysis
	Manufacturing cost analysis	Customer needs and satisfaction	Technology evaluation	Acquisition/alliance evaluation	Site selection…
Investment & financing consulting	IPO report	Pre-due diligence & due diligence	Dumping & Anti-dumping report…		
Engineering Consulting	Feasibility study report	Fund application report	Post-evaluation Report…		

In 2018, global PVC capacity is around 55.3 Mt/y, and APAC account for 58% of the total

- **Global PVC capacity**
  - In 2018, the total global PVC capacity is around 55.3 Mt/y, increasing by 3% compared with 2017 and by a CAGR of 0.6% since 2013
  - Northeast Asia, North America and Europe account for largest capacities, representing nearly 90% of the total
  - In 2016-2018, the expansion rate of PVC capacity is relatively slow, while the demand for PVC is growing steadily

Global PVC capacity by region in 2018



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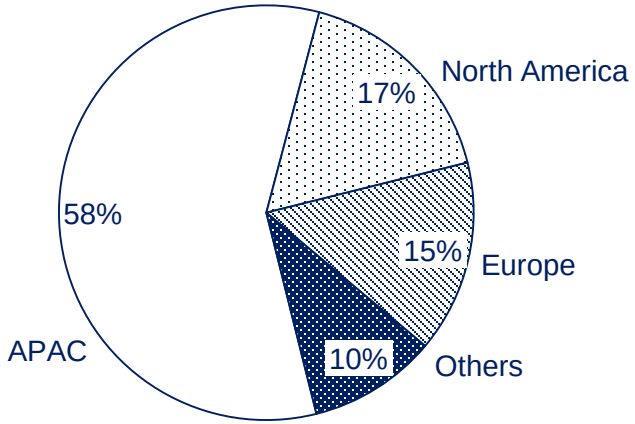
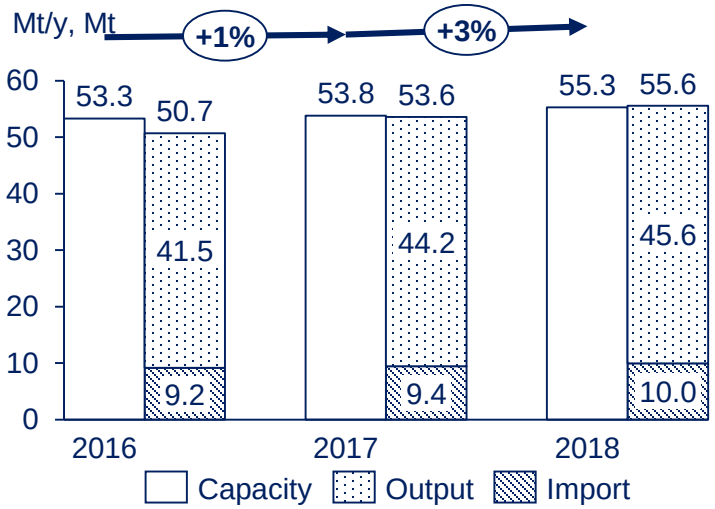
- **Global PVC production**
  - The total global PVC output is around 45.6 Mt in 2018 with an average operating rate of 82%
  - Global trade of PVC increases by a CAGR of 4.3% over the past three years

Global PVC capacity by region in 2018



Global PVC output and imports from 2016 to 2018



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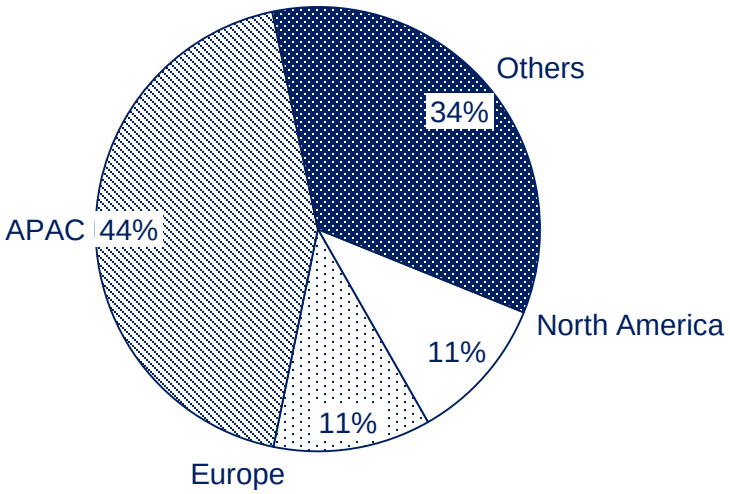
In 2018, global PVC demand is around 55.6 Mt; the supply and demand are not geographically balanced

- **Global PVC demand**
  - Demand for PVC is aligned with economic development, which is mainly driven by construction sector and the growth gets slower for well developed economies

Global PVC demand by region in 2018



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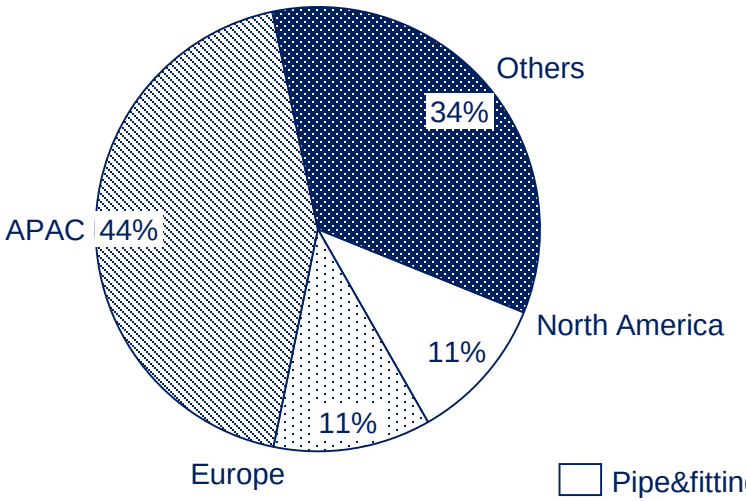
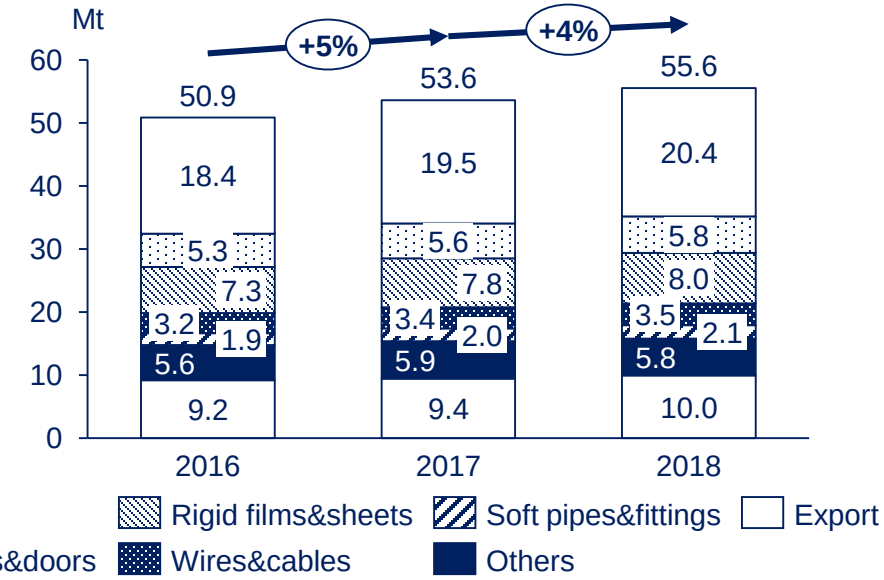
- **Global PVC demand**
  - Demand for PVC is aligned with economic development, which is mainly driven by construction sector and the growth gets slower for well developed economies
  - The global PVC demand increases by a CAGR of 5% over the past 3 years
  - Pipe and fittings amongst rigid products represent the main application fields, accounting for 37% of the total demand in 2018
  - In North America, PVC is mainly used for pipe and siding, while in Europe and Asia, it is most commonly used for pipes and window frames

Global PVC demand by region in 2018



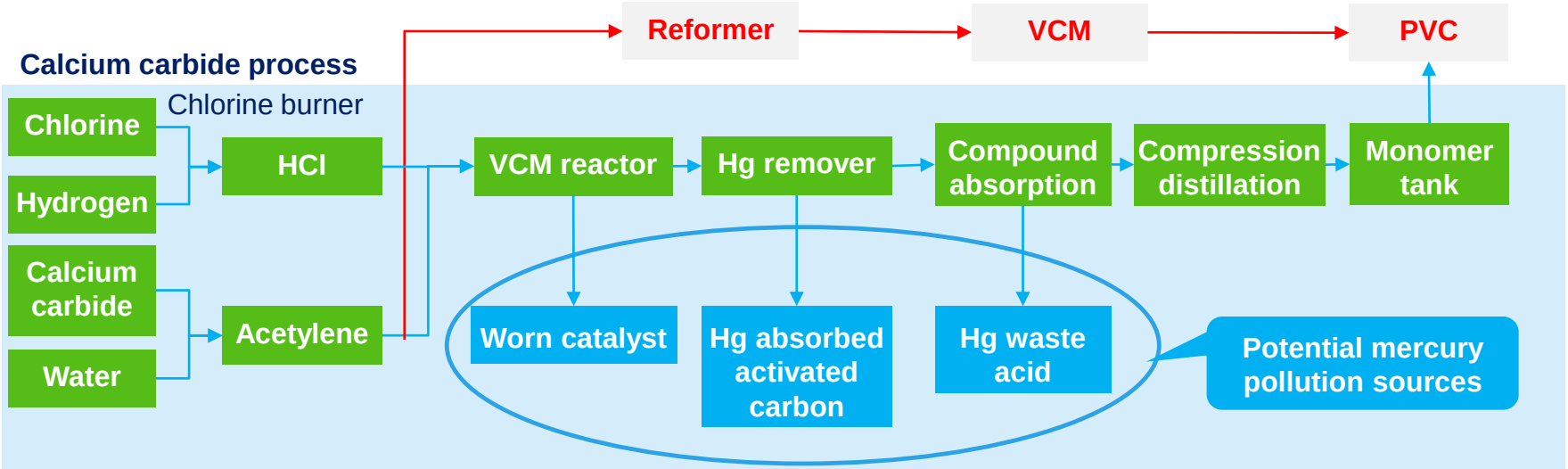
Global PVC demand by segments in 2018



Source: IHS Markit

Calcium carbide (CP) and ethylene (EP) processes are commonly used to produce PVC in China, with the former accounts for majority of the share

- Due to rich coal and limited natural gas and crude resources (essentially ethylene) in China, PVC is more commonly produced by calcium carbide process
  - Mercury-containing waste acid and catalyst are produced and China approved <Minamata Convention on Mercury> in Aug. 2017 to encourage low mercury and mercury-free process
  - 85% of mercury is consumed in producing PVC through CP, representing 17 kt waste catalysts annually



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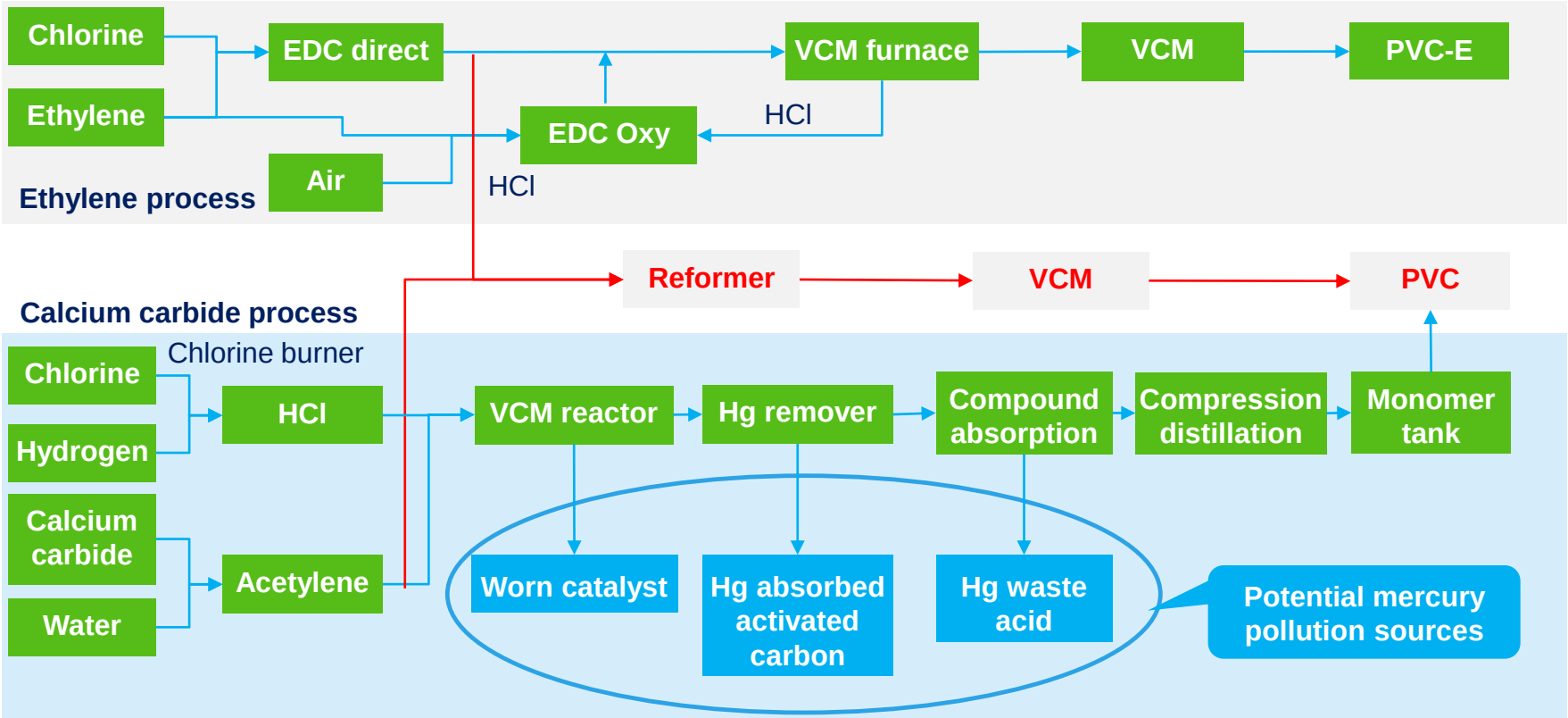

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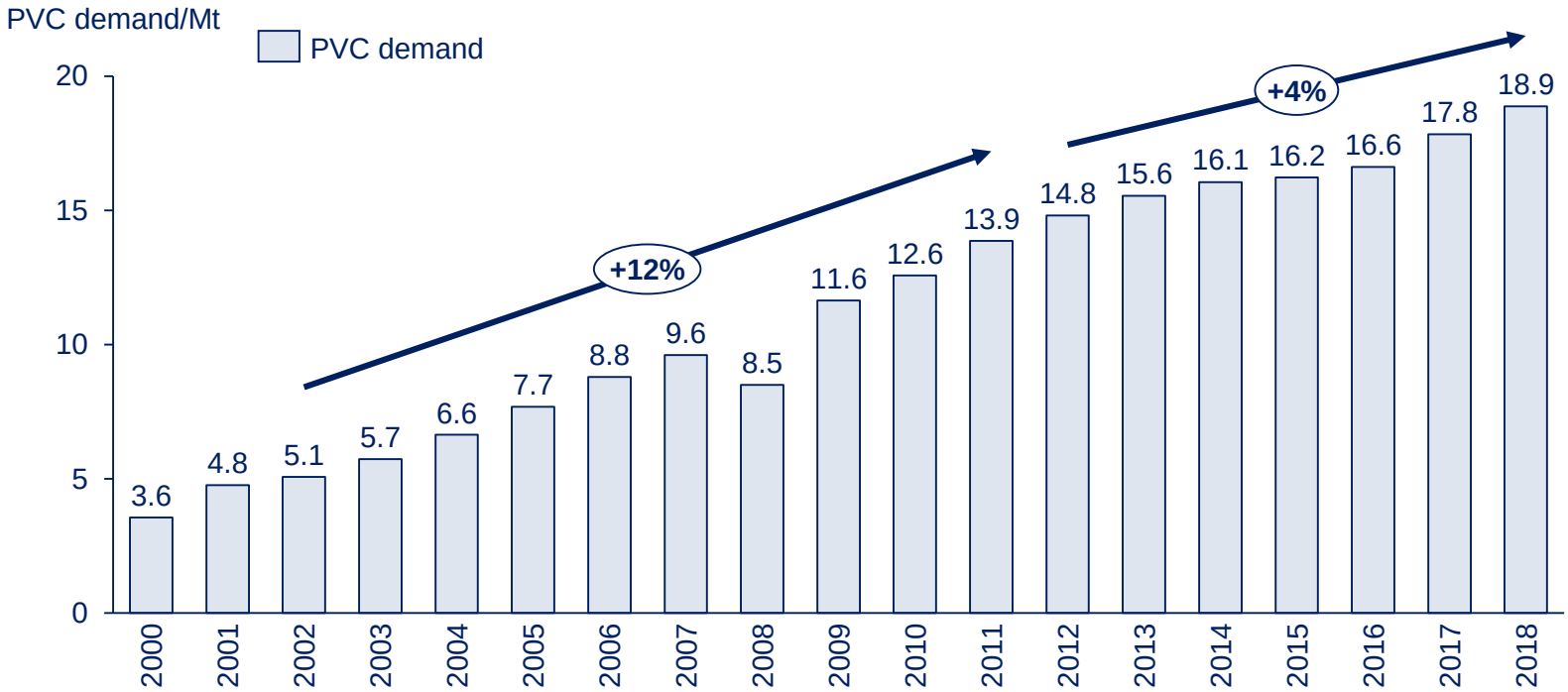
The PVC consumption is strongly correlated to macroeconomy in China

- **Evolution**
  - From 2002 to 2012, PVC consumption increased by a CAGR of 12%, where the GDP was above 8% despite the temporary depression in 2008
  - Since 2012, PVC demand slowed down by a CAGR of 4% over the past 7 years, during which the GDP fluctuated around 6%
  - The US-China trade dispute had less impact on PVC trade owing to a large domestic demand capacity

PVC demand evolution from 2000 to 2018



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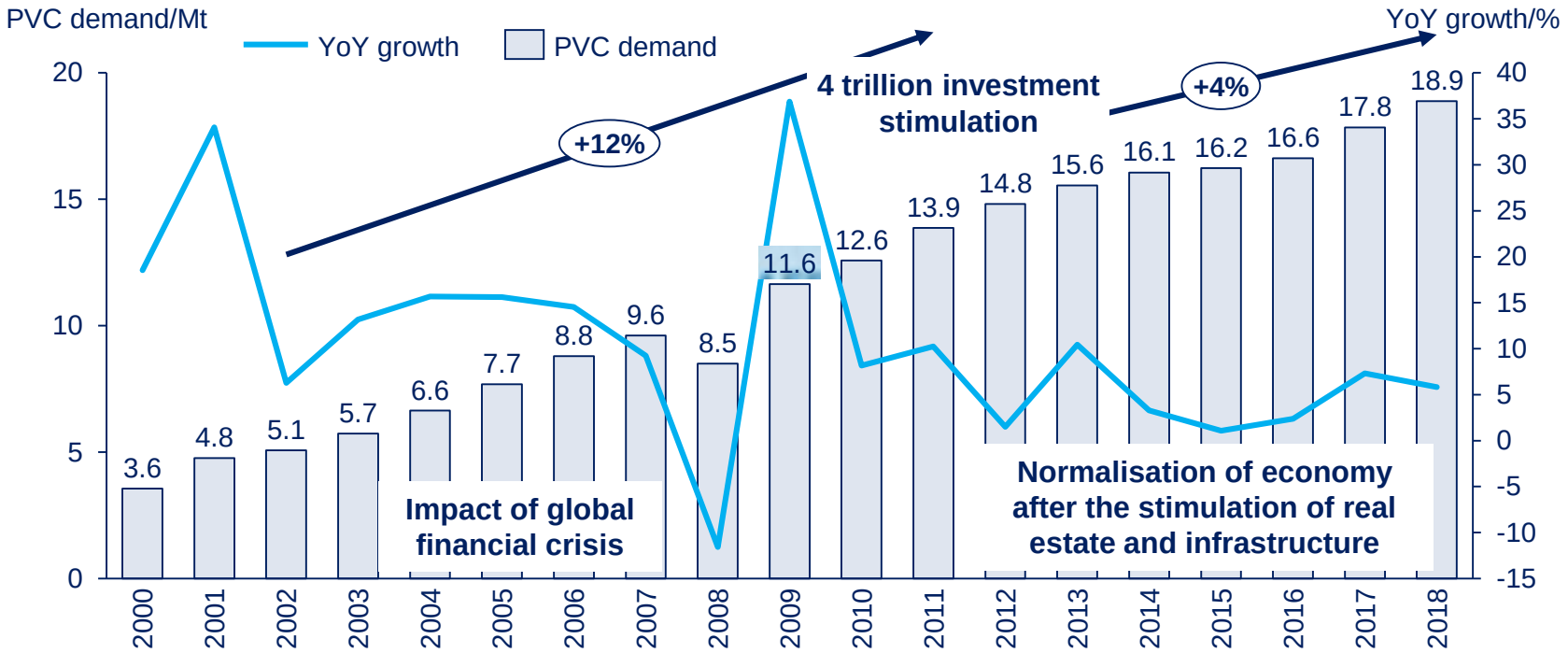

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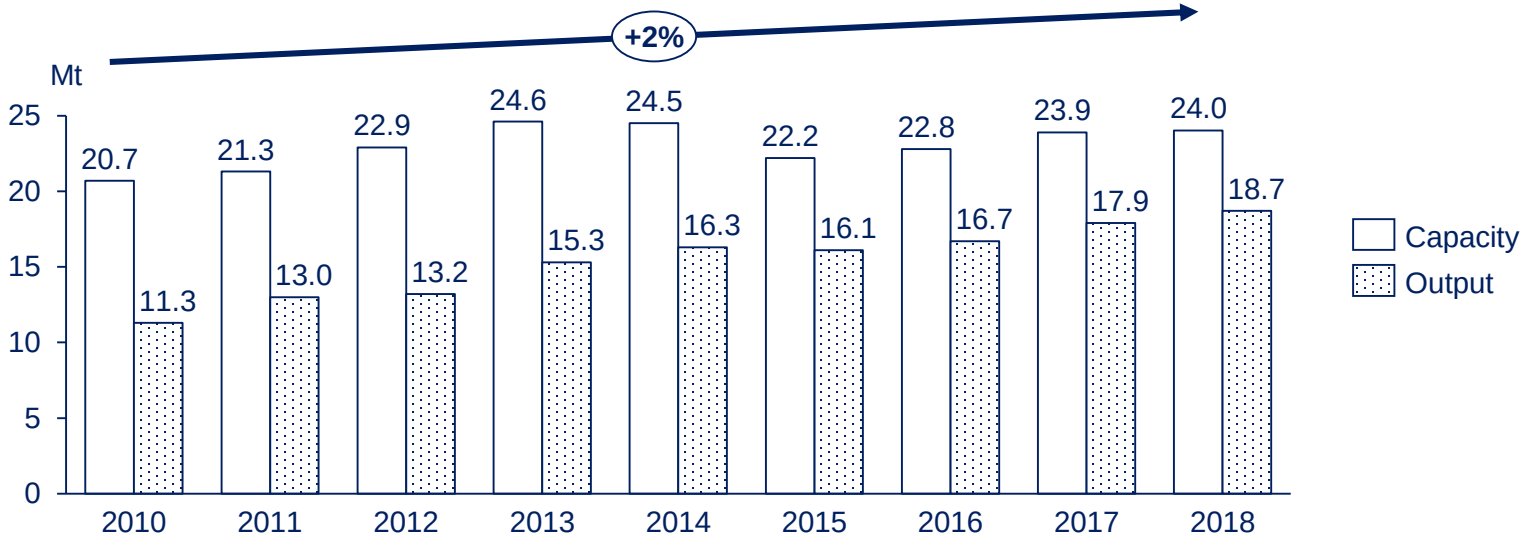
As demand is growing faster than supply and supply is approaching the upper limit, insufficient supply is likely to appear in the next 5 years

- **Evolution**
  - Considering regular maintenance, 80% of operating rate has already been high; given the environment restrictions, especially in the East regions, the Chinese PVC production is no longer in overcapacity but close to the upper operation limit
    - ◆ If demand continues to grow steadily, the supply of PVC may not be sufficient

PVC capacity and consumption in China from 2010 to 2018



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    - ◆ If demand continues to grow steadily, the supply of PVC may not be sufficient
  - Demand grew at a CAGR of 5% since 2010 and this was mainly driven by the growth in construction and infrastructure sectors

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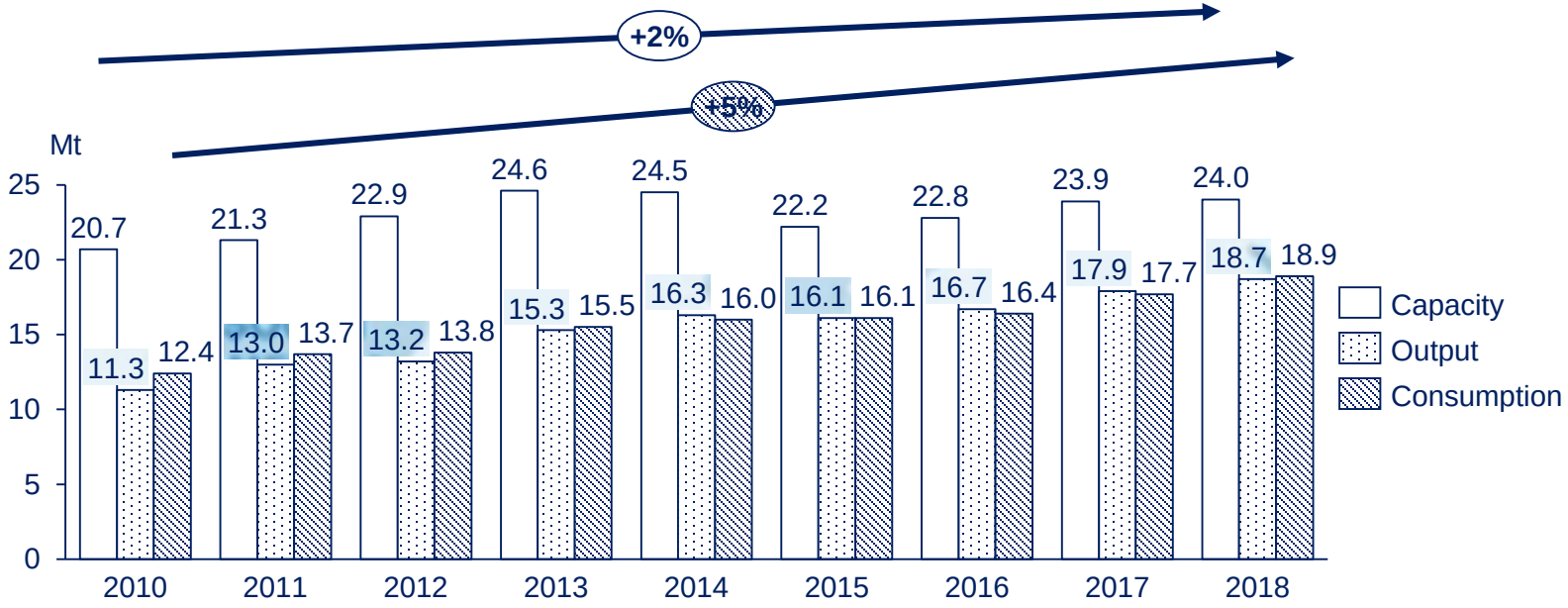


Source: CNCIC database

In 2018, there are 75 PVC manufacturers, and top 10 producers account for 45.9% of the total, similar to 2017

- **Major manufacturers**
  - There are 75 PVC manufacturers in 2018; Top 10 producers account for 45.9% of China's total capacity, similar to 2017
    - ◆ The concentration ratio remains similar over the past 3 years and the market is consolidating
  - Capacity is mainly distributed in Northwest, North and East regions in China due to abundant raw material supply
  - Manufacturers located in the East generally have a lower operating rate due to stricter restrictions on environmental protection regulations

Capacity of major PVC manufacturers in 2018

No.	Company	Region	PVC capacity /kt/y	Share/%	Process
1	Zhongtai Chemical[1]	Northwest	2,330	9.7%	CP
2	ChemChina[2]	-	1,300	5.4%	CP/EP
3	Tianye Group	Northwest	1,300	5.4%	CP
4	Beiyuan Chemical	Northwest	1,250	5.3%	CP
5	Bohai Chemical[3]	North	1,200	5.0%	EP
6	Yihua Group[4]	-	1,000	4.2%	CP
7	Qinghai Salt Lake Industry	Northwest	800	3.3%	CP
8	Xinfa Group	East	750	3.1%	CP
9	Junzheng Energy	North	700	2.9%	CP
10	Xinjiang Shengxiong	Northwest	400	1.7%	CP
-	Others	-	13,010	54.1%	CP/EP
-	Total	-	24,040	100.0%	-

Note. 1: Zhongtai Chemical and Shengxiong Energy; 2: Bluestar (Shenyang Chemical), New Materials (Dezhou Shihua, Hebei Shenghua, Henan Yuhang, Heilongjiang Haohua); 3: Dagu Chemical, Lejin Bohai Chemistry;4: Xinjiang, Qinghai and Inner Mongolia

CP is calcium carbide process, and EP is ethylene based process Source: CNCIC database

Around 2,830 kt/y new capacity is expected to be added in 2019, but only around 670 kt/y has a clear timeline for operation

- **Proposed new capacity**
  - Around 15 new PVC capacity is proposed to be added from 2019 and mainly distributed in the North, Northwest, and East regions
  - In total, around 1,320 kt/y capacity is expected to be operated, including
    - ◆ 6 projects having a clear timeline and approx. 670 kt/y in operation by the end of 2019
    - ◆ 30% capacity of projects with unclear timeline, *i.e.* 650 kt/y in operation by the end of 2019

Proposed new capacity on PVC (including EPVC) in China

No.	Manufacturer	Manufacturer CN	Region	Province	Capacity kt/y	Process	Est. operating year
1	Dezhou Shihua, ChemChina	德州实华	East	Shandong	200	CP+EDC	Nov. 2019
2	Anhui Huasu	安徽华塑	East	Anhui	160	CP	Dec. 2019
3	Taizhou Liancheng	泰州联成	East	Jiangsu	150	EP	May 2019
4	Xinjiang Zhongtai	新疆中泰	Northwest	Xinjiang	120	CP	May 2019
5	Ningbo Hanhua	宁波韩华	East	Zhejiang	100	EP	Jul. 2019
6	Shanxi Ruiheng	山西瑞恒	North	Shanxi	10	CP	Jun. 2019
	Sub total				**740**	70 kt/y in pending	
7	Ordos Chlor-Alkali Group	鄂尔多斯氯碱化工	North	Inner Mongolia	400	CP	Pending
8	Qingdao Haijing	青岛海晶	East	Shandong	400	EP	Pending
9	Hebei Julong Chemical	河北聚隆化工	North	Hebei	230	EP	Pending
10	Hebei Shenghua	河北盛华	North	Hebei	200	CP	Pending
11	Ningxia Jinyuyuan	宁夏金昱元	Northwest	Ningxia	200	CP	Pending
12	China Salt Jilantai	中盐吉兰泰	North	Inner Mongolia	160	CP	Pending
13	Taizhou Liancheng	泰州联成	East	Jiangsu	150	CP	Pending
14	Tangshan Sanyou	唐山三友	North	Hebei	20	CP	Pending
	Others				330		
	Sub total				**2,090**	1,440 kt/y in pending	
	Total				**2,830**		

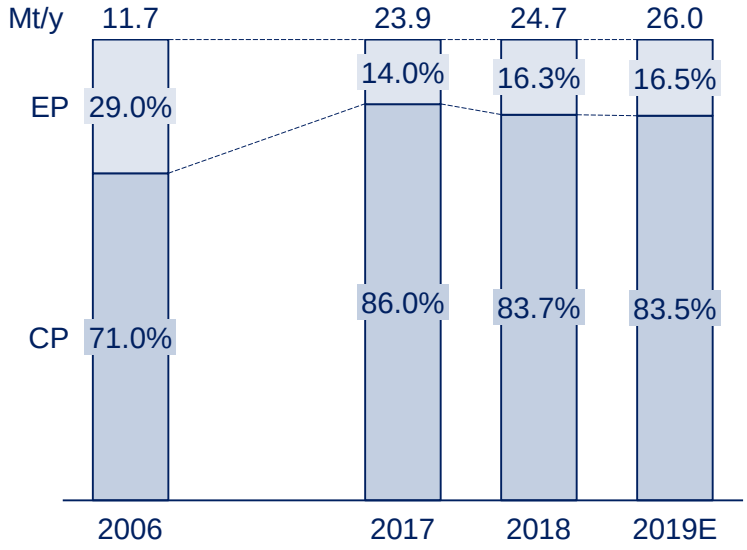
CP is calcium carbide process, EP is ethylene based process, and Jiangzhong is a Hg free process using CaC_2+EDC

Source: CNCIC database

Calcium carbide process is more commonly used in China

- **PVC process by capacity**
  - CP increased by 20% over the last decade
  - In 2018, 20.7 Mt/y and 4.0 Mt/y are produced from CP and EP, respectively, accounting for 84% and 16% of total capacity
    - ◆ Newly added capacity in 2018 are all ethylene based process
    - ◆ 66% CP and 34% EP new capacities are expected to be added in 2019
  - EP capacity includes plants with back integrated EDC, and stand-alone PVC plants dependent on imported VCM or EDC

China's PVC capacity by process from 2006 to 2019 (Mt/y)



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  - EP capacities are mainly distributed in the East region due to relatively abundant ethylene supply

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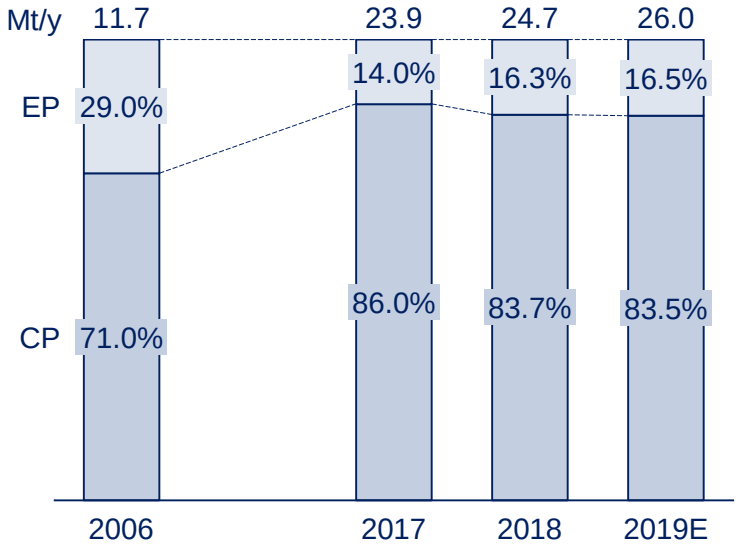
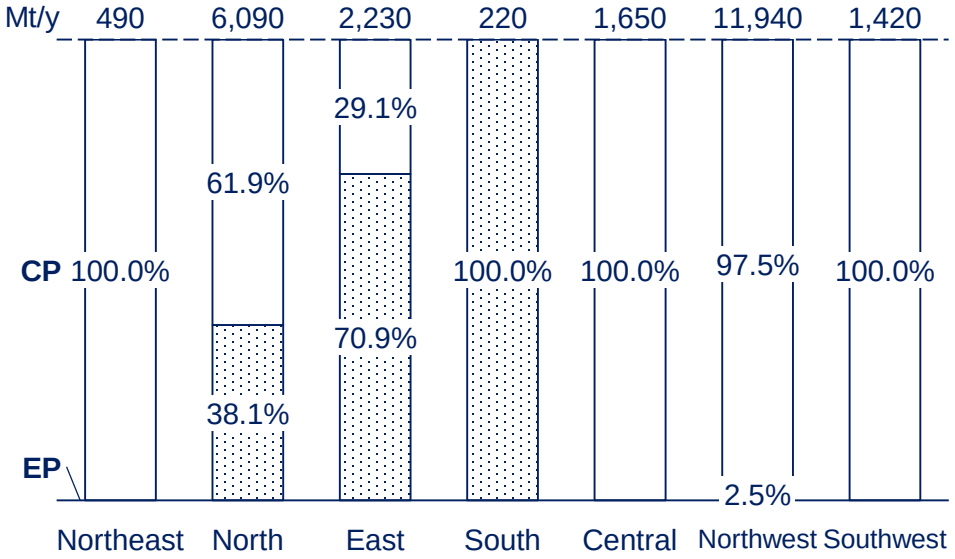


Process by region in 2018 (Mt/y)



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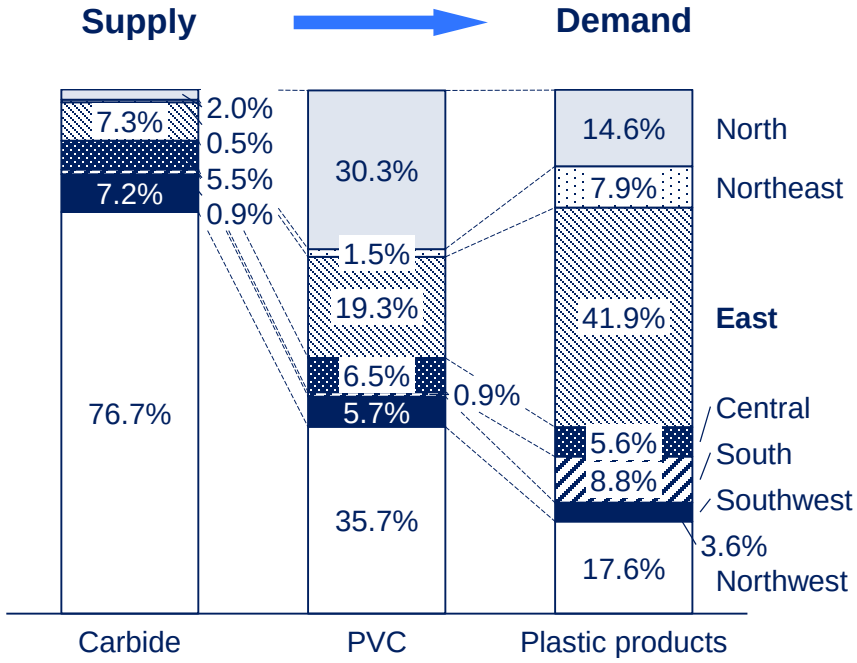
China presents uneven geographical distribution of raw material, PVC resin and PVC products and it configures the transportation map of PVC resin in China today

- **Supply distribution and transportation**
  - Calcium carbide producers are mainly concentrated in the northern, central and western regions, where there are abundant and cheap electricity, coal and calcium carbide resources
  - Ethylene producers are mainly located near the coastal areas, where raw material transportation is more convenient

Production distribution of carbide, PVC resin and plastic products in 2018



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  - Ethylene producers are mainly located near the coastal areas, where raw material transportation is more convenient
  - The demand is mainly distributed in the East and South, and the supply and demand are not balanced

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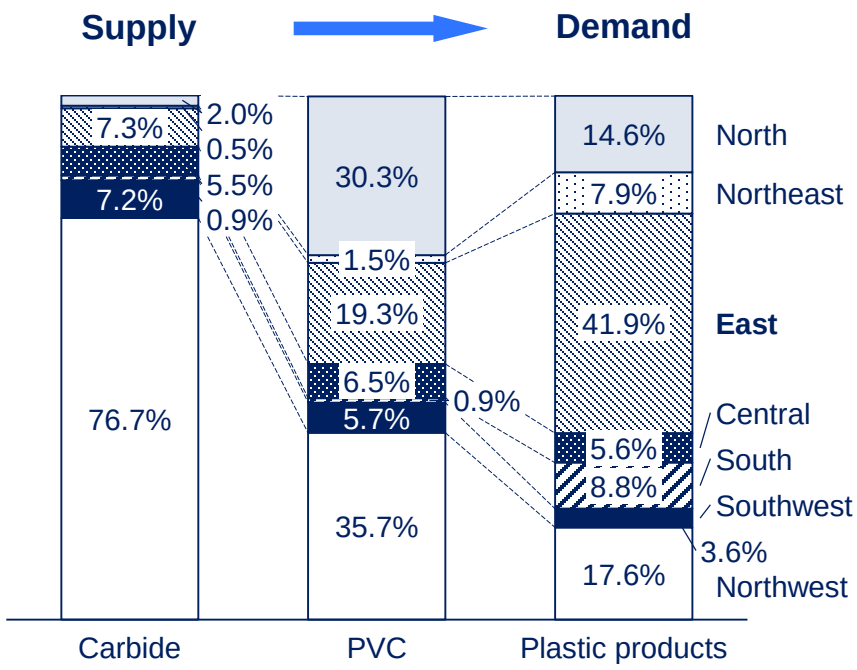

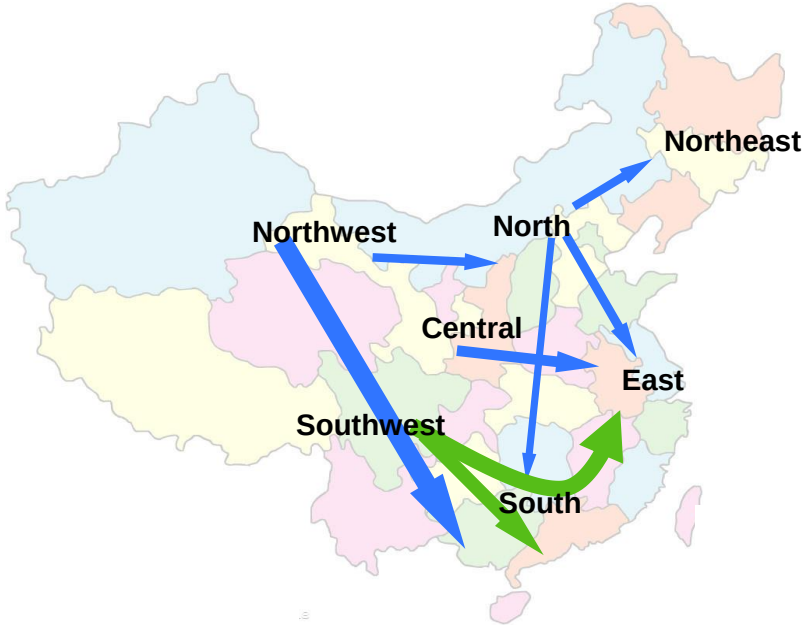

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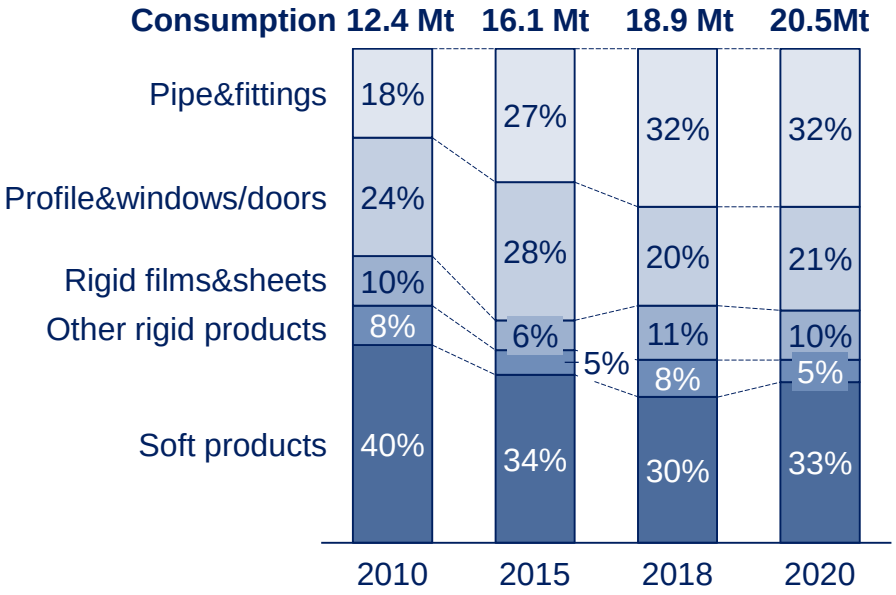
PVC demand is 18.9 Mt in 2018, by a CAGR of 5.4% over the past decade, and more than 60% is used in construction sector

- **PVC downstream application**
  - In 2018, PVC demand is 18.9 Mt, around 32% consumed in pipe and fittings, 21% in profile, windows and doors, and 30% in soft products
    - ◆ Amongst soft products, thin film and cables are the most commonly applications

PVC consumption by application in China



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    - ◆ Amongst soft products, thin film and cables are the most commonly applications
  - PVC is mostly consumed in construction sector in China
    - ◆ Around 60% of PVC is to produce building materials, such as pipes, profiles and rigid sheets etc.
    - ◆ Due to scheduling of construction and stock-up, PVC consumption in building industry normally lags behind for 6-12 months

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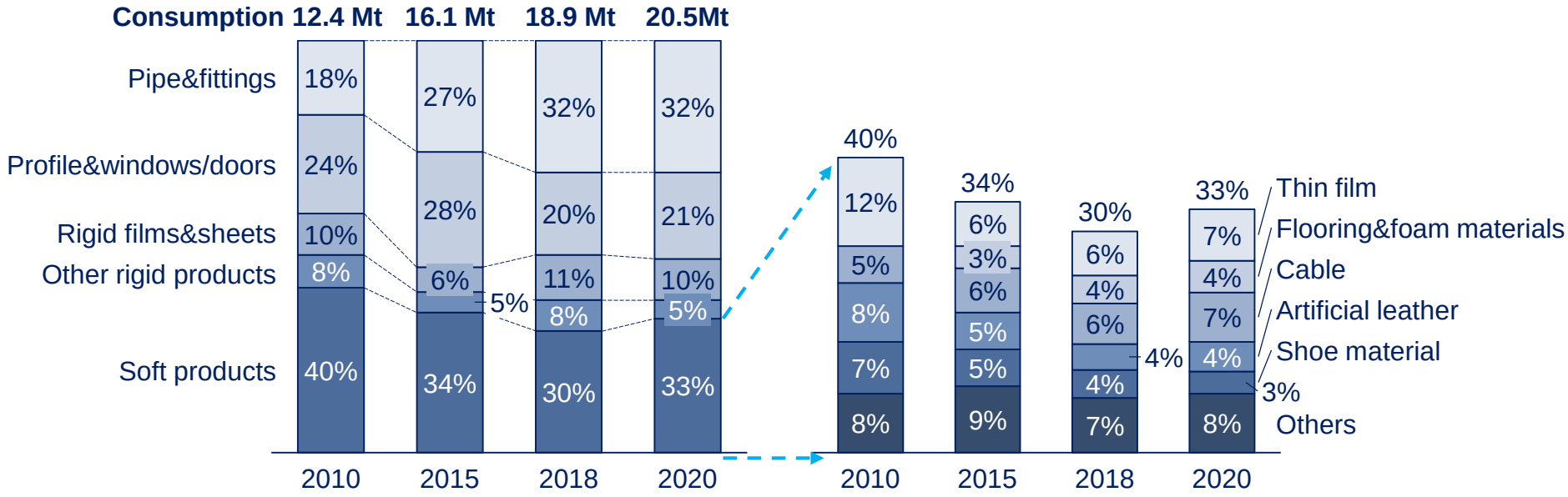
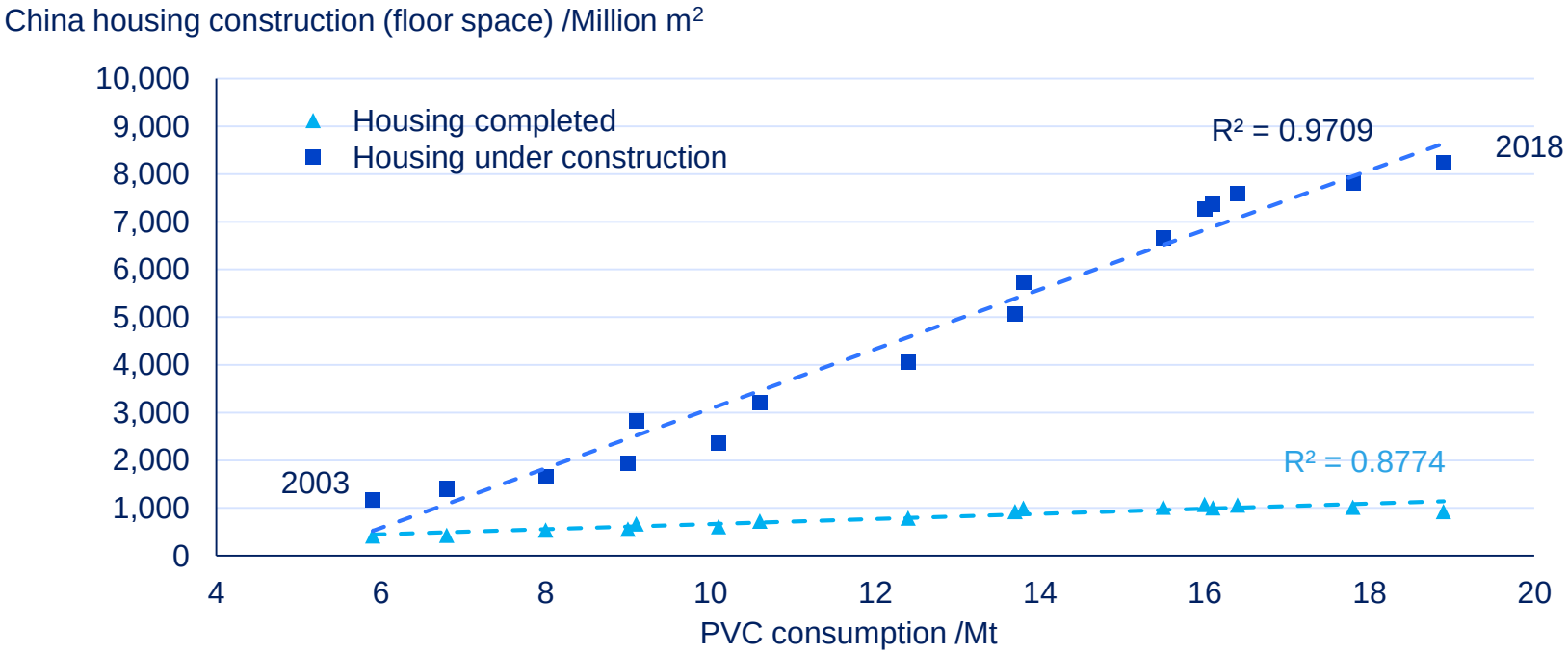


PVC consumption is positively correlated with house construction and automotive industries in China

- **PVC downstream application**
  - PVC consumption is positively correlated with real estate
  - Although there is a large demand in such industries, **substitutes**, such as PP, PE, aluminium profile become more competitive
    - ◆ PVC consumption in profile decreased over the past decade
  - In the downturn of real estate industry, government infrastructure investment will increase or at least stabilise the PVC demand to hedge against the decline

PVC consumption *vs.* house construction from 2003 to 2018



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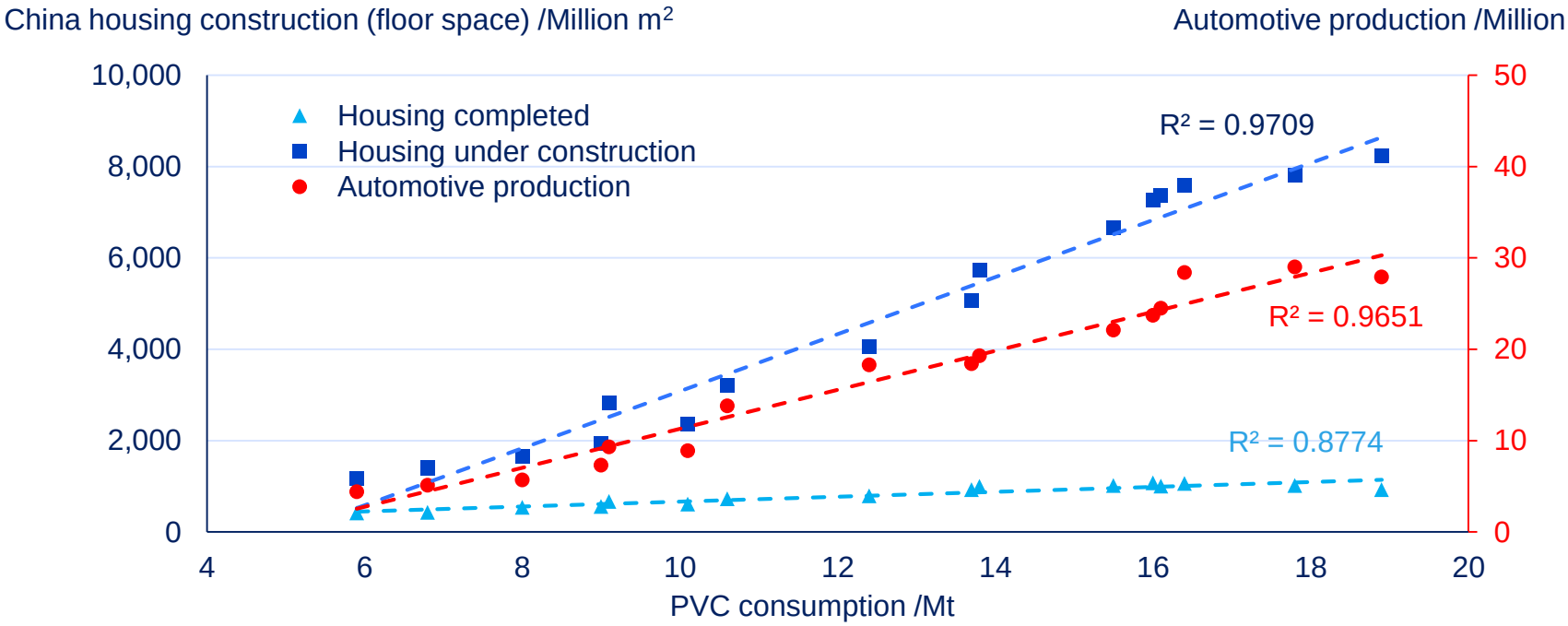

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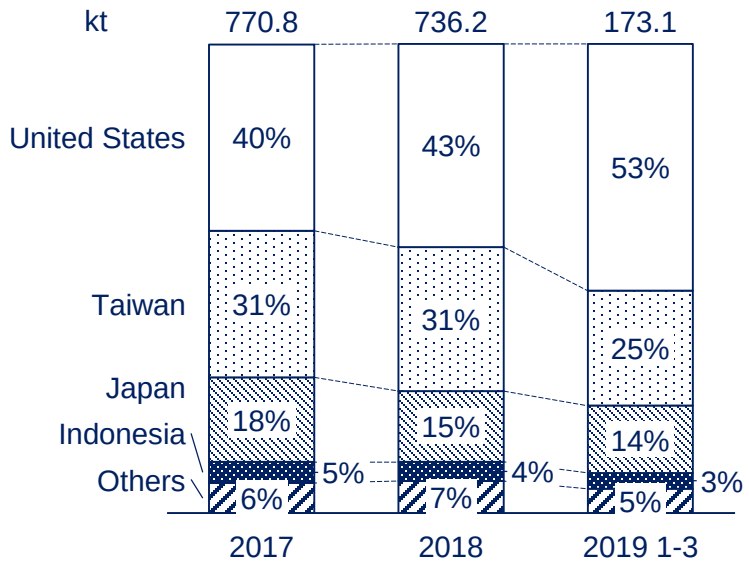
The US-China trade conflicts have little impacts on PVC imported from the US

- The net export only accounts for less than 2% of domestic consumption
  - In 2018, the total consumption is around 18.9 Mt, where the next trade is only 140 kt
- Less impacts appear after MoC of China imposed 25% tariff on some imported chemicals originating in the US
  - The PVC imported from the US is not affected. 320 kt is imported, slightly higher than the total import in 2017, accounting for 43% of total Chinese import

Major PVC importing regions from 2017 to 2019



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  - The PVC imported from the US is not affected. 320 kt is imported, slightly higher than the total import in 2017, accounting for 43% of total Chinese import
- Chinese PVC is mainly exported to Asia countries, such as India, Malaysia, Uzbekistan and Kazakhstan, accounting for nearly 40% of total export
  - Negligible amount of PVC exports to the US and there is no impact on US lifting tariff on Chinese PVC

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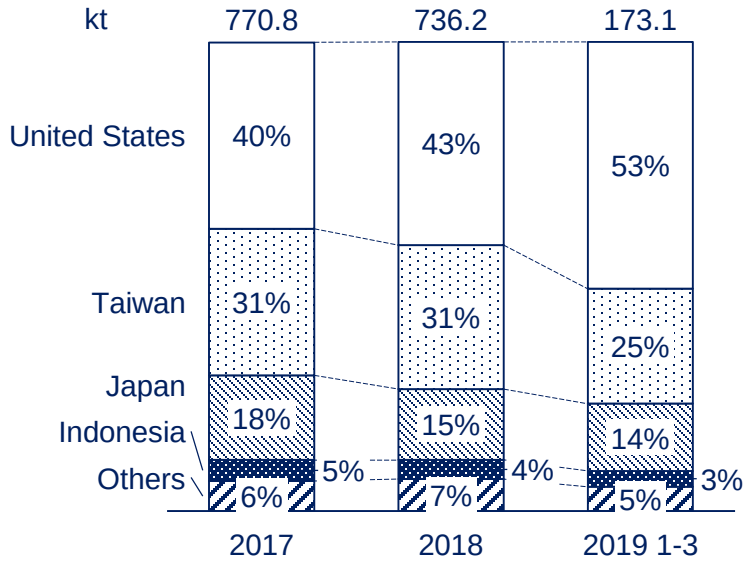
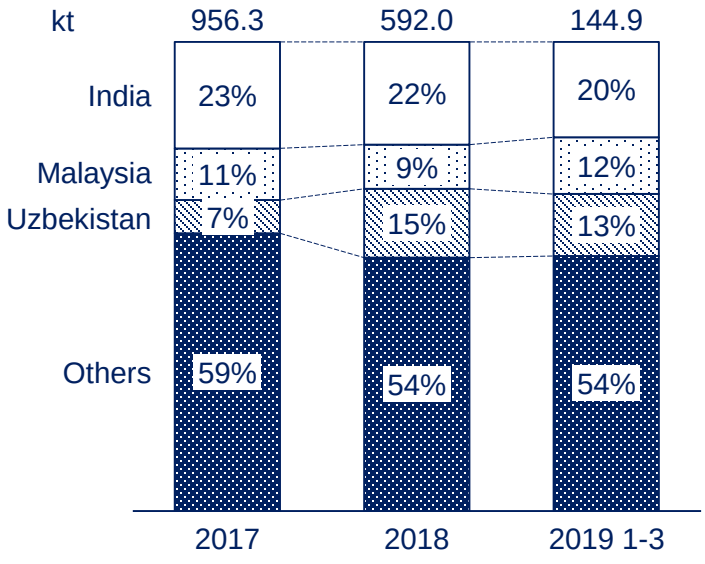


Major PVC exporting regions from 2017 to 2019

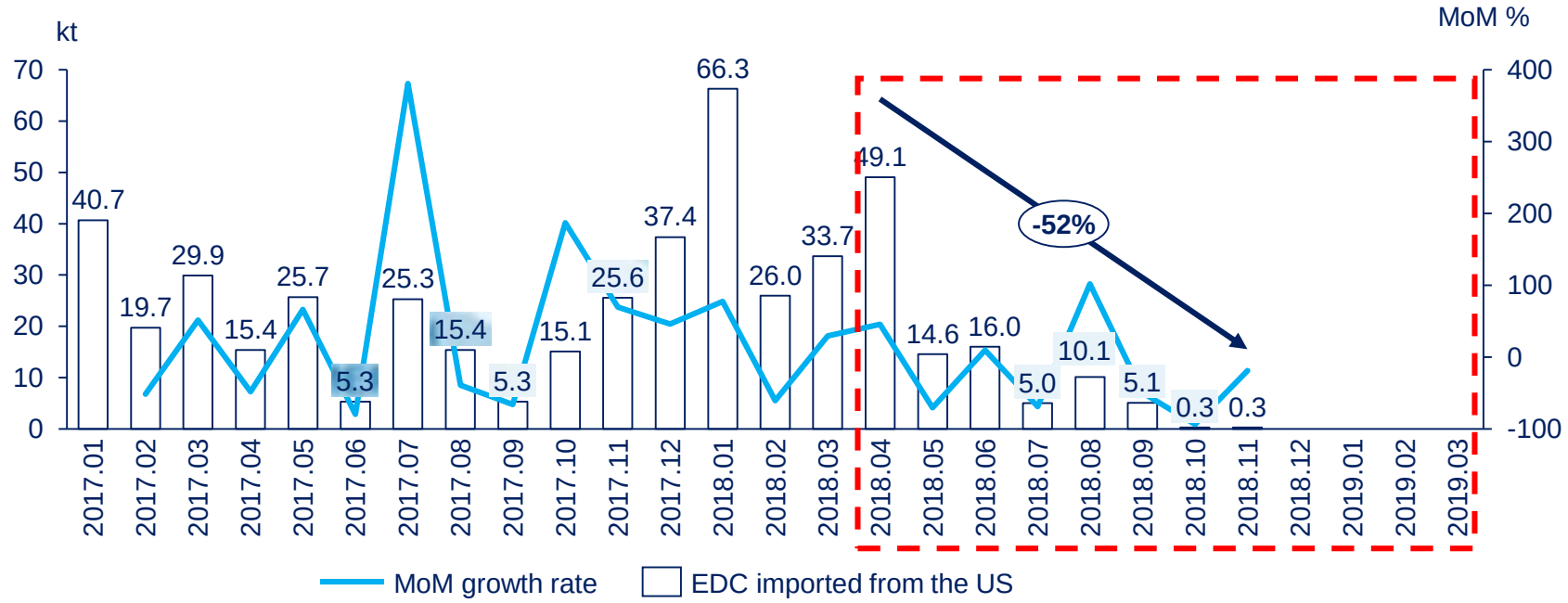


Source: CNCIC database, and General Administration of Customs

The US-China trade conflicts have some negative impacts on PVC raw material, EDC, to some extents

- EDC is a main raw material to produce PVC through Ethylene process, and the US and South Korea are the major importing countries for this product
  - In 2017, China imported 260.6 kt and 75.4 kt from the US and South Korea, respectively; while in 2018, EDC imported from the US decreased by 34.7 kt
  - After China imposing a 25% tariff, causing the higher price for EDC, the importing quantity decreased by 52% from April to November 2018
  - Negative impacts impose on Chinese producers who rely on importing EDC for PVC production

EDC imported from the US from Jan. 2017 to Mar. 2019

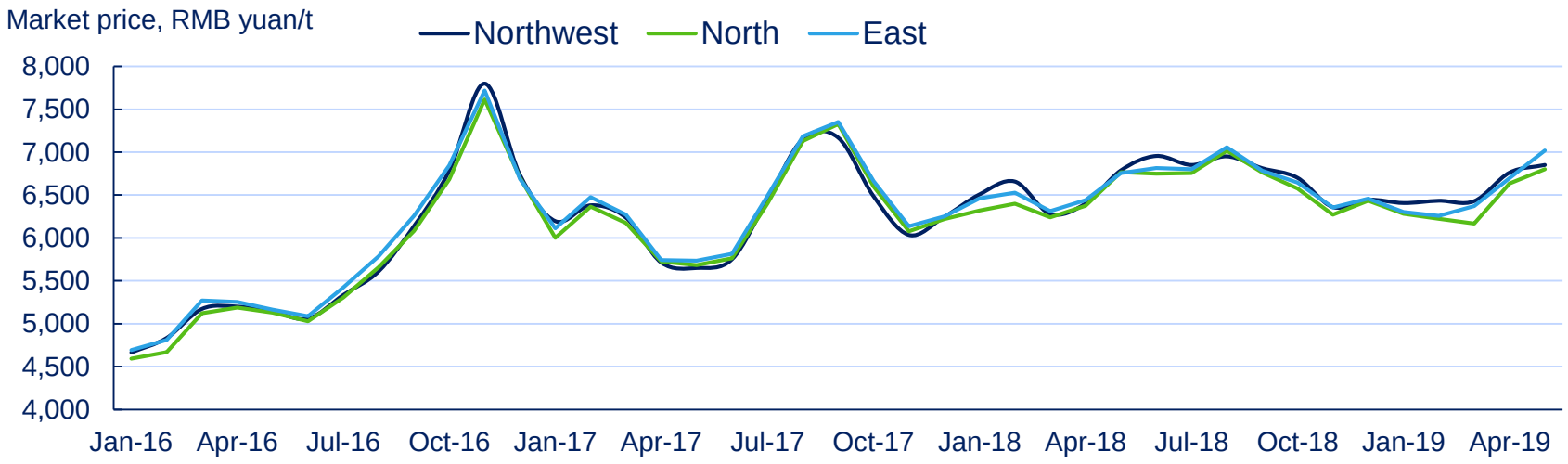


Source: CNCIC database, and General Administration of Customs

The PVC resin market price is similar in different regions

- **Market price by region**
  - PVC average prices amongst different regions do not vary greatly; price in East region is generally higher than Northwest and North
  - **Price evolution**
    - From 2016, the price increase in coal led to an increase in PVC, where it reached above RMB 8,000 yuan/t, followed by a fallback to around RMB 6,000 yuan/t in 1Q2017
    - Since 2Q2017, the 'Environmental Storm' led to a large number of stall and limited capacity, where such tight supply, once again, pushed the price to around RMB 7,500 yuan/t
    - The price fluctuated around RMB 6,500 yuan/t
    - The average price is expected to fluctuate around RMB 7,000 yuan/t, supported by the likely increase of crude oil and high demand

PVC resin price by region (SG-5) from 2016 to 2019 in China



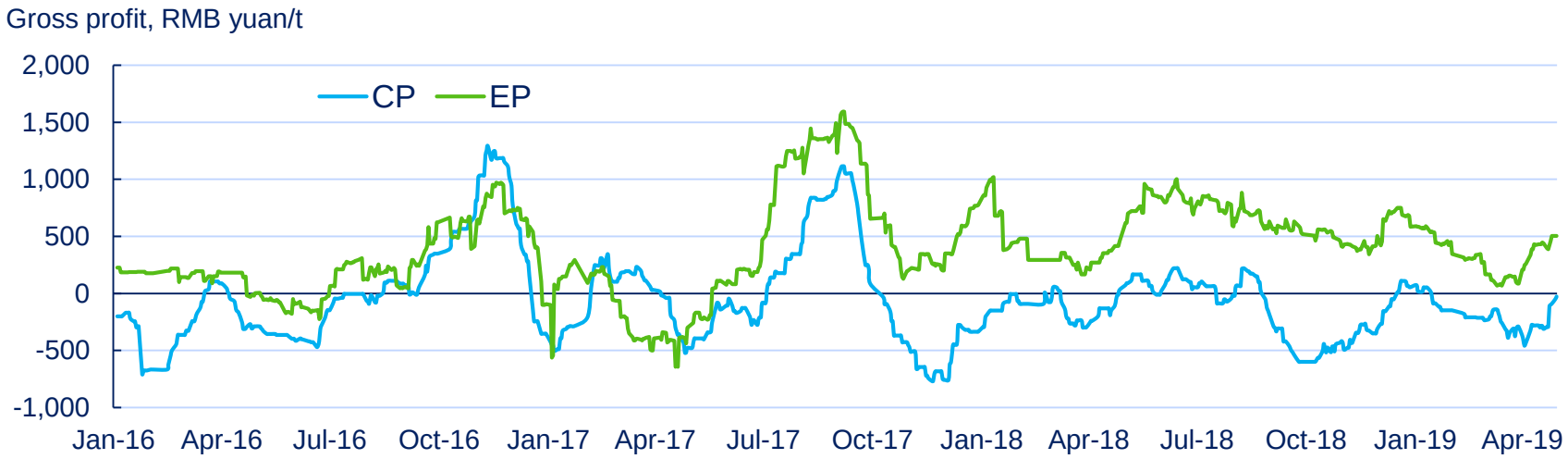
Northwest: Xinjiang Zhongtai, local price; North: Tangshan Sanyou, ex-factory price; East: Shandong Xinfa, ex-factory price

Source: CNCIC database

PVC gross profit in different processes becomes more diverged; the profit lost again after 3Q2018

- **Market profitability**
  - **Evolution**
    - The PVC industry has been through an industry-wide loss in 2014 and 2015 due to economic downturn and 'Environmental Protection Storm', with avg. EBT of -0.4% ~ -0.5%
    - In 2016, the profit was lost by 27%, and became **profitable** in **2017**
    - From 3Q2018, the profit decreased again due to the price increase in raw chemical materials
  - **Comparison**
    - From 2014 to 2016, manufacturers, located in in Xinjiang, Inner Mongolia, Shaanxi and Shanxi provinces, have better cost advantages and profit; the price advantages seem lost after 4Q2018
    - For a common practice, when PVC average operating rate is around 80%, upstream feedstock, such as calcium carbide, and downstream products are more likely to have better profit margin

PVC gross profit in CP and EP processes from 2016 to 2019 in China

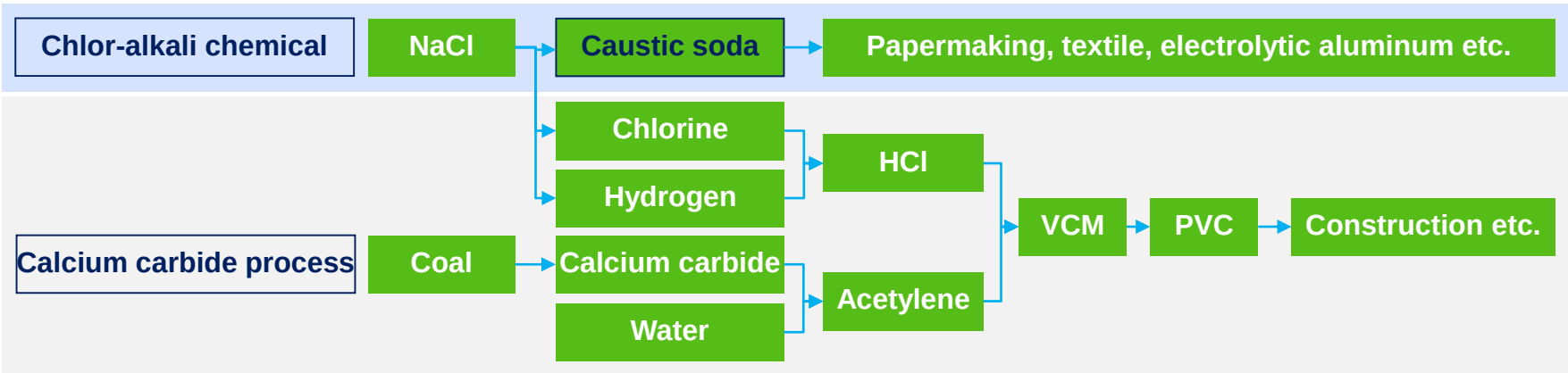


Freight to East China includes the cost in Xinjiang, market price in east China; Ethylene price—CFR NEA.

Source: CNCIC database

Domestic caustic soda output showed negative growth in 2016 and the consumption is highly correlated to macroeconomy

Chlor-alkali and PVC (CP) value chain

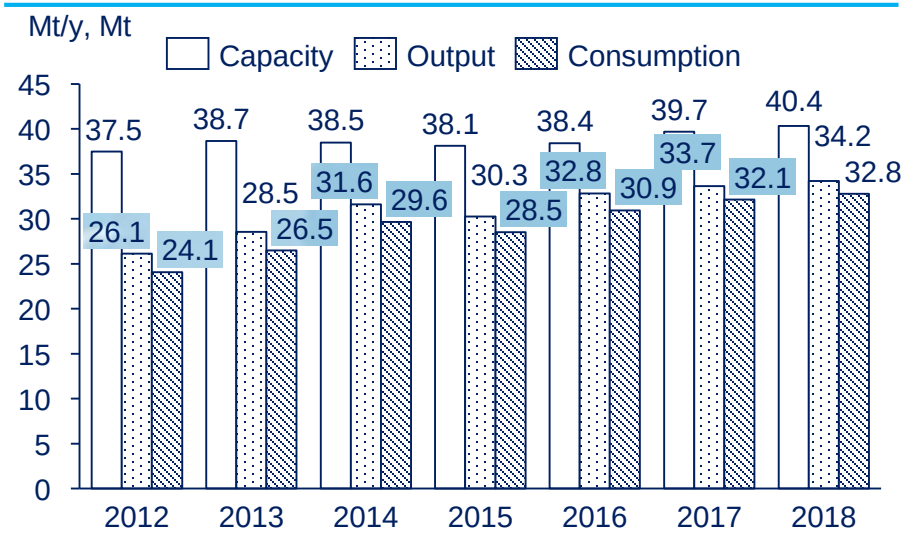


Source: CNCIC database

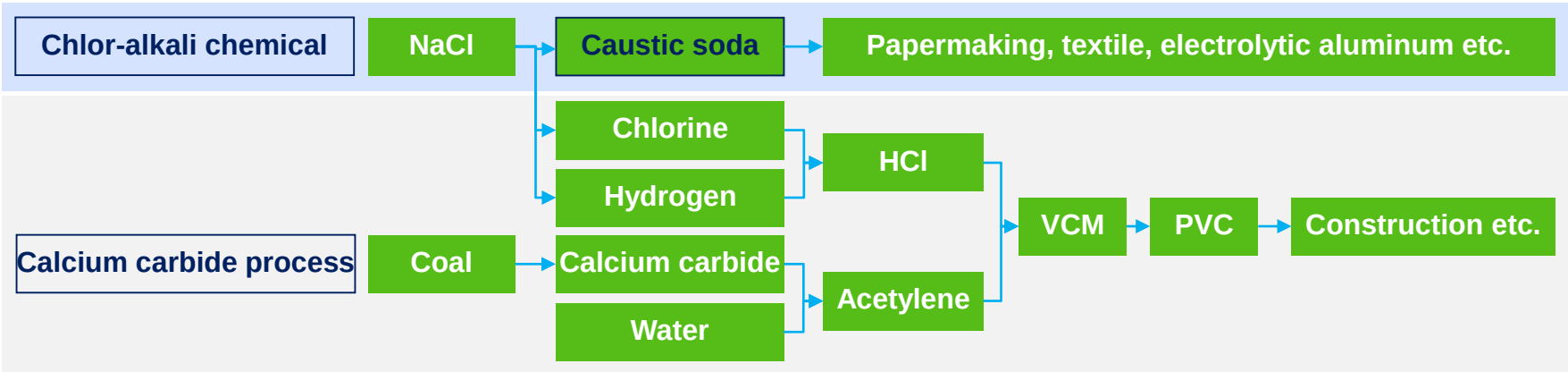
Domestic caustic soda output showed negative growth in 2016 and the consumption is highly correlated to macroeconomy

- **Caustic soda**
  - The supply and consumption gradually increase due to the recovery of macroeconomy, mainly driven by the demand in automotive (Al_2O_3), construction (Al_2O_3), textile, printing and dyeing sectors
  - The capacity and output are mainly distributed in the North, Northwest and East regions, aligned with PVC producers
  - 1,700 kt/y new capacity is expected to added and the market price is expected to be weak

NaOH supply-demand from 2012 to 2018



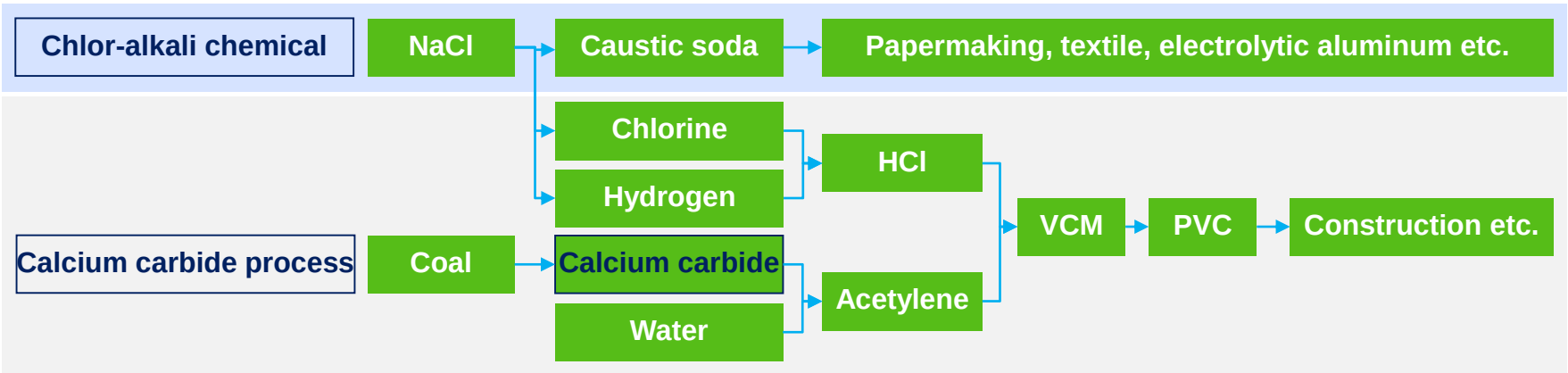
Chlor-alkali and PVC (CP) value chain



Source: CNCIC database

Environmental protection highly impacts the development of calcium carbide, which is also limited by the demand of PVC

CaC_2 and PVC (CP) value chain

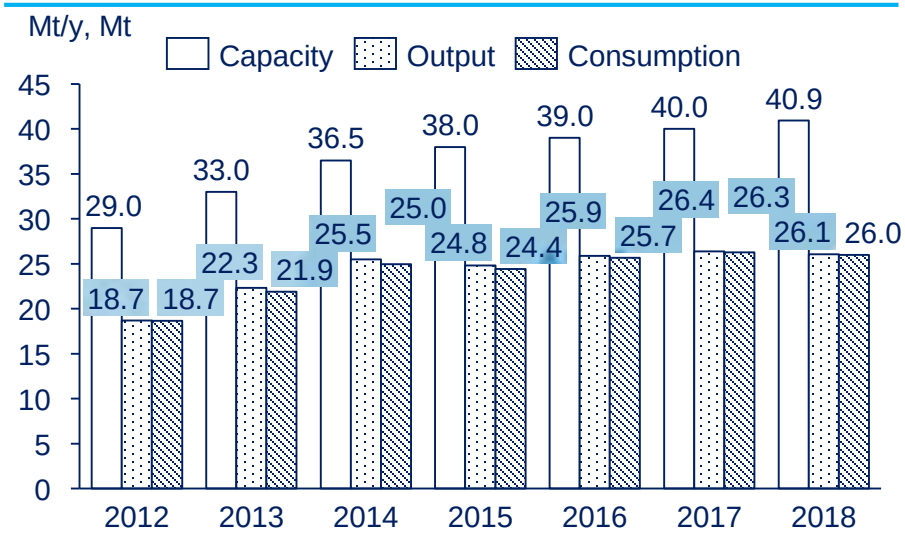


Source: CNCIC database

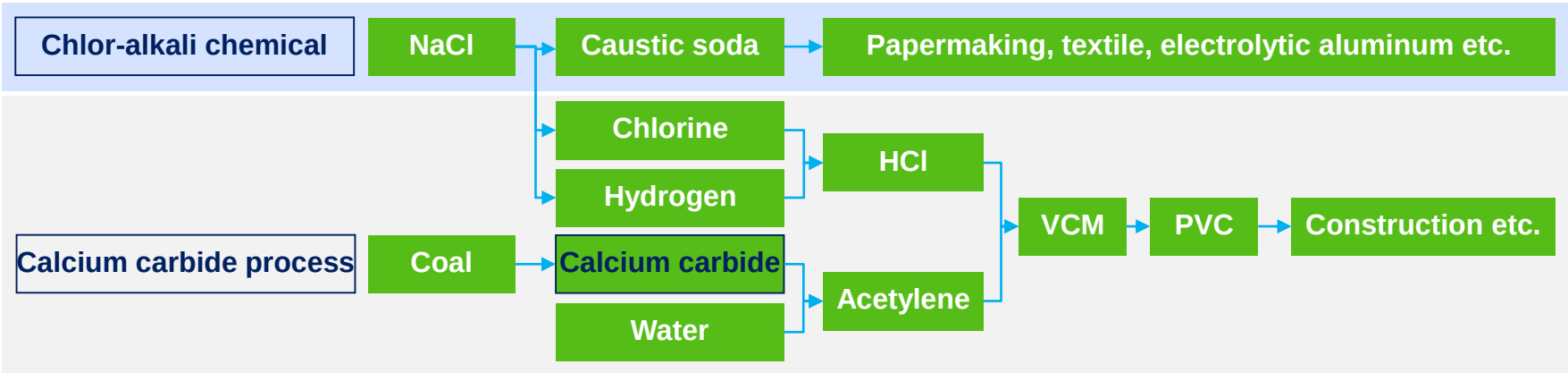
Environmental protection highly impacts the development of calcium carbide, which is also limited by the demand of PVC

- **Calcium carbide**
  - China's CaC_2 capacity accounts for 95% of total global capacity
  - The average operating rate is low, caused by stricter regulations and inspections
  - Majority of capacity is distributed in Northwest and North regions, due to abundant reserve of $CaCO_3$, coal and semi-coke
  - Acetylene, produced by CaC_2, is mainly used in organic synthesis (PVC, PVA, CR), desulphurization, welding etc.
  - The output is expected to be affected by environmental protection inspections and the market price is expected to slightly increase

CaC_2 supply-demand from 2012 to 2018



CaC_2 and PVC (CP) value chain

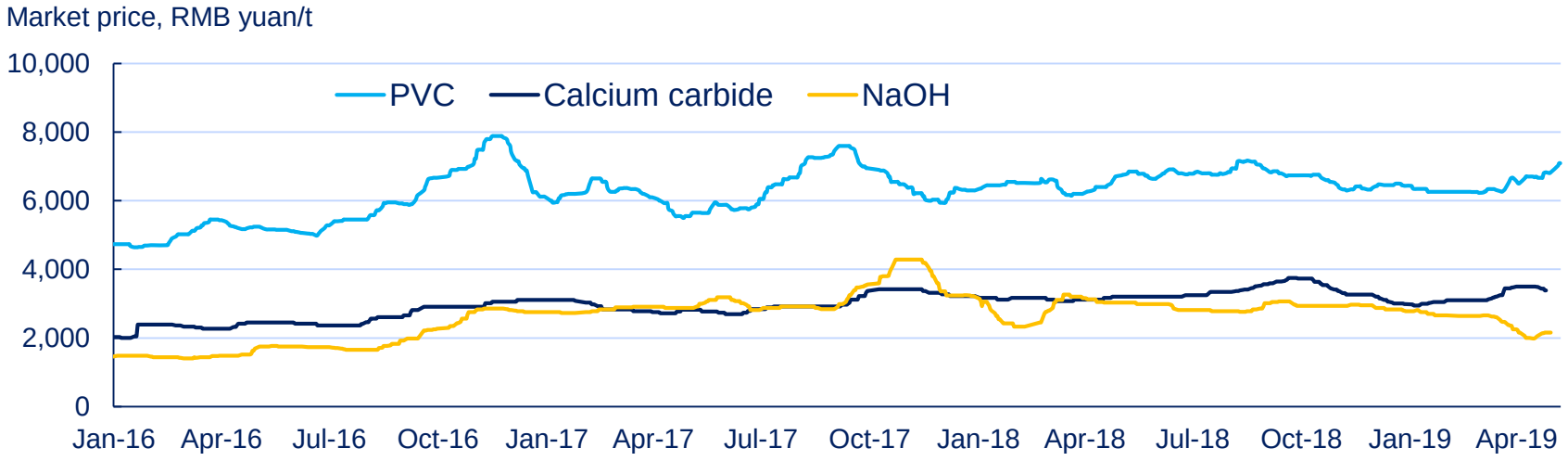


Source: CNCIC database

PVC market price roughly aligned with calcium carbide, but showed more fluctuations

- **Market prices along the PVC value chain**
  - During 2016, caused by a general price increase in raw materials, the product prices increased and reached a 3-year high by the end of the year
  - The prices soon started to drop caused by oversupply of various chemical products, and relatively low demand
    - ◆ The oversupply was caused by high price, where more and more chlor-alkali players entering the market, leading to additional capacity to be operated
  - In 2018, given the market has adjusted itself to a relatively steady state, products along the value chain of PVC show relatively stable market prices
  - The prices of calcium carbide and PVC are expected to increase in 2019

Calcium carbide, PVC and NaOH price evolution from 2016 to 2019 in China



PVC: average price of SG-3, SG-5 and SG-8 through CP; calcium carbide: average price of above 295L/kg in Shandong; NaOH: average prices of 32%, 48% and 50% liquid in Shandong

Industrial planning policies significantly controls PVC blind expansion and the capacity is no long in surplus

- **Industrial planning policy**
  - <Guidance for Industrial Structure Adjustment Catalogue (2019, draft)>
    - ◆Limits newly construction on EP process with capacity lower than 300 kt/y
    - ◆Limits newly construction on calcium carbide capacity
    - ◆Prohibits new CP capacity with high Hg based catalyst ($HgCl_2$ > 6.5%)
  - <Guidance on the Adjustment and Structure of Petrochemical Industry to Promote Transformation and Increasing Benefit (2016)>
    - ◆Strictly controls PVC, and grants capacity replacement and reduction with advanced technology

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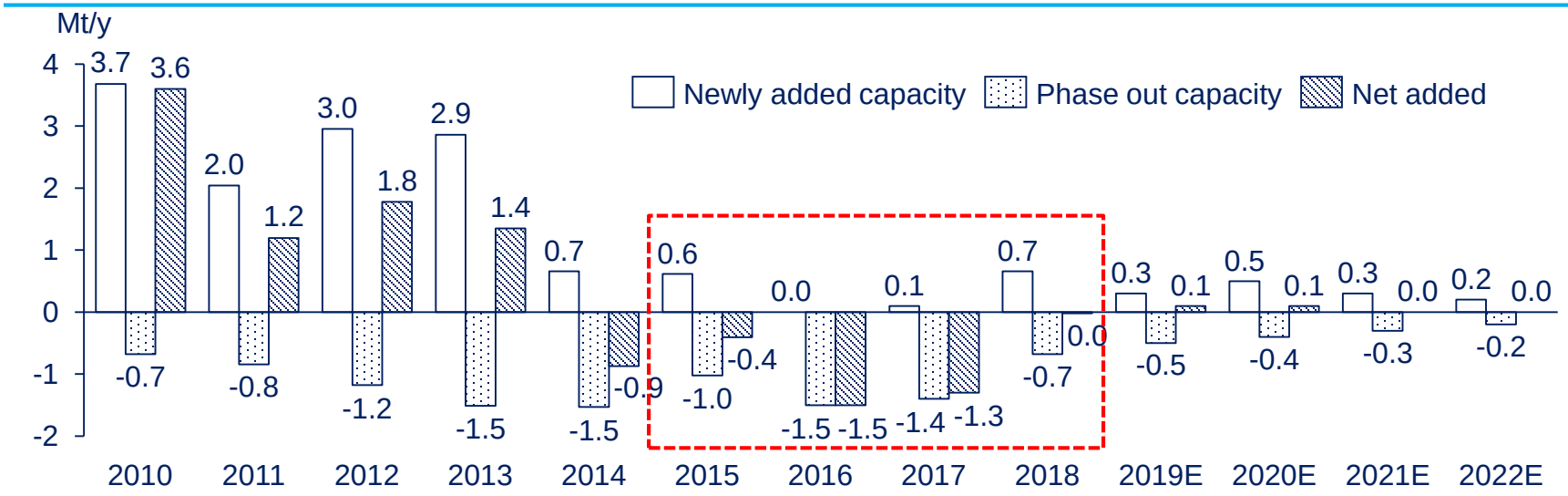
    - ◆Strictly controls PVC, and grants capacity replacement and reduction with advanced technology
  - **Impact: such policy limited blind expansion and the capacity is no long in surplus; more capacities with low energy efficiency and high emission will be phased out**

PVC capacity status in China from 2010 to 2022



China will gradually phase out capacities using Hg as catalysts in the chlor-alkali production

- **Environmental protection**
  - <Minamata Convention on Mercury>, China Officially got approved in Aug. 2017
    - ◆ China will slightly phase out the usage of Hg in PVC production and eventually prohibit exploitation of primary Hg mines

Source: CNCIC database, and National Development and Reform Commission

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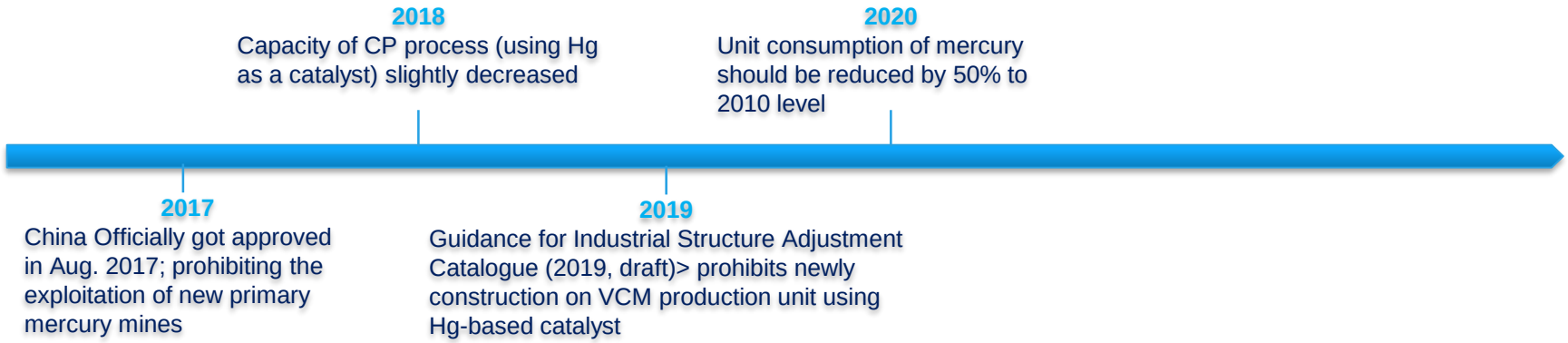

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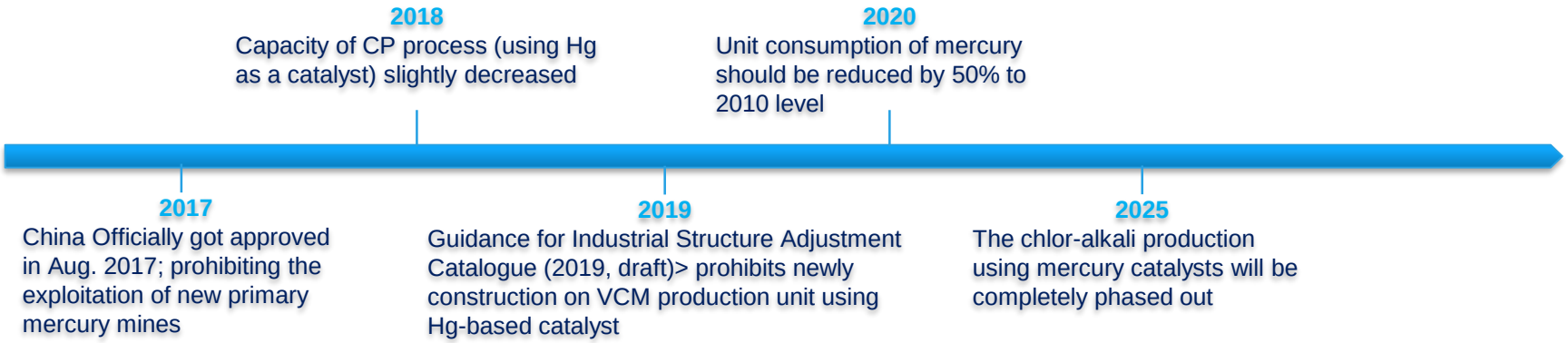

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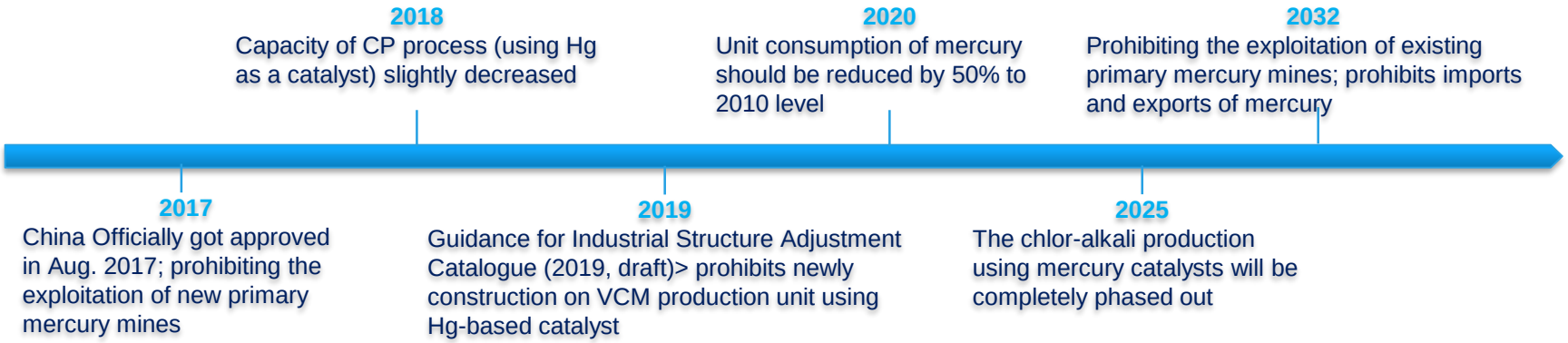

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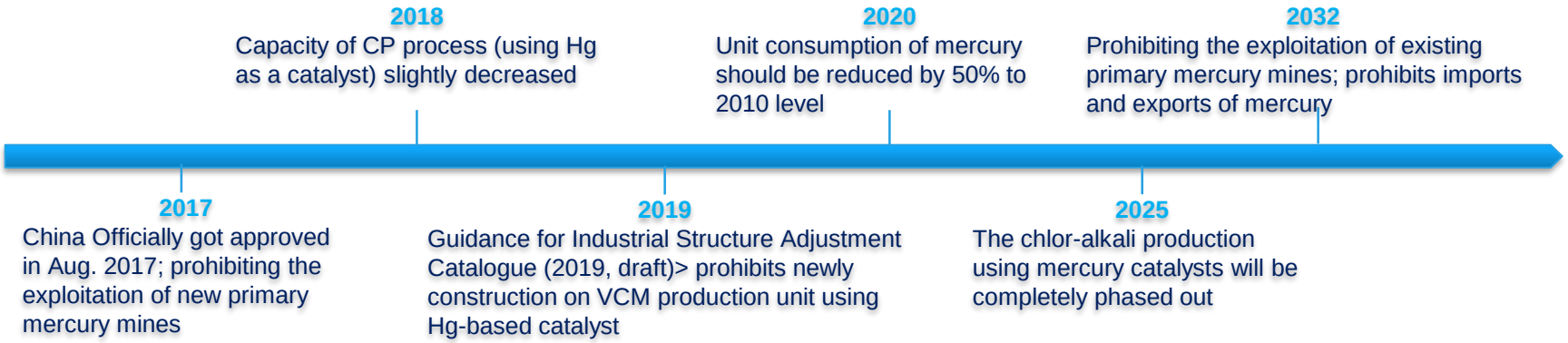

- **Technology upgrade**
  - Chlor-alkali industry under high pressure on Hg consumption as 60% of Hg is consumed in this sector
  - Low Hg catalyst (6.5 w%) will have to substitute the traditional ones, in order to reach the goal of 50% reduction on Hg consumption
    - ◆ Alert: the increase of total Hg consumption aligned with PVC production from 2014 to 2018

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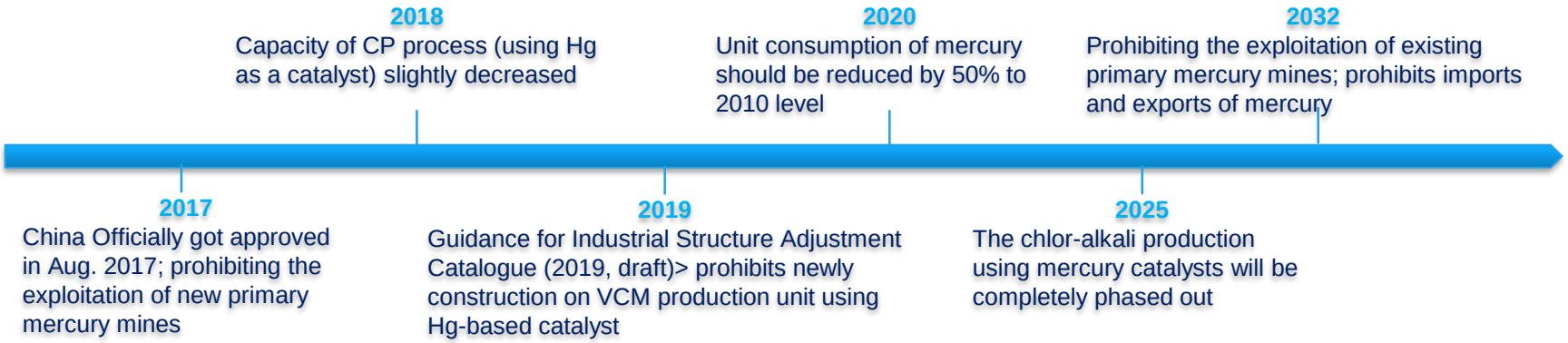

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    - ◆ Alert: the increase of total Hg consumption aligned with PVC production from 2014 to 2018
  - Domestic manufacturers have achieved low-mercury and mercury-free technology
    - ◆ Dezhou Shihua is constructing a 200 kt/y capacity using ‘CP+EDC Method’ (姜钟法) in Shandong
      - Mercury-free, barium salt based catalyst with catalytic efficiency of 90% and low production cost

Source: CNCIC database, and National Development and Reform Commission

Thanks for listening and any question?

CNCIC Consulting

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