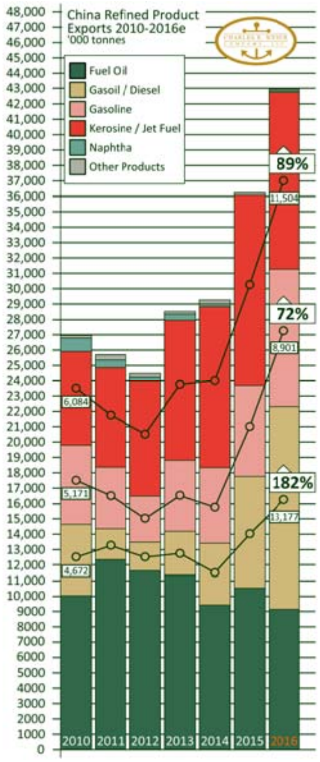
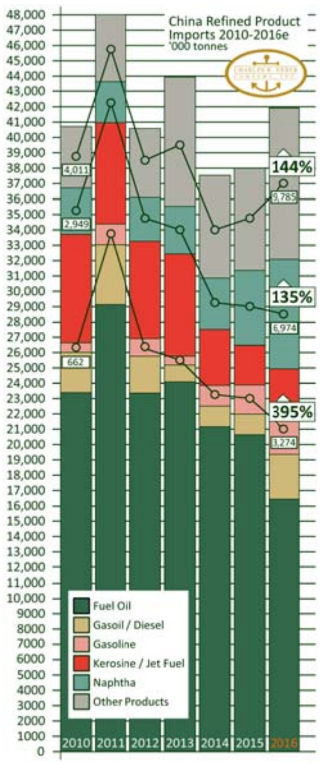
China

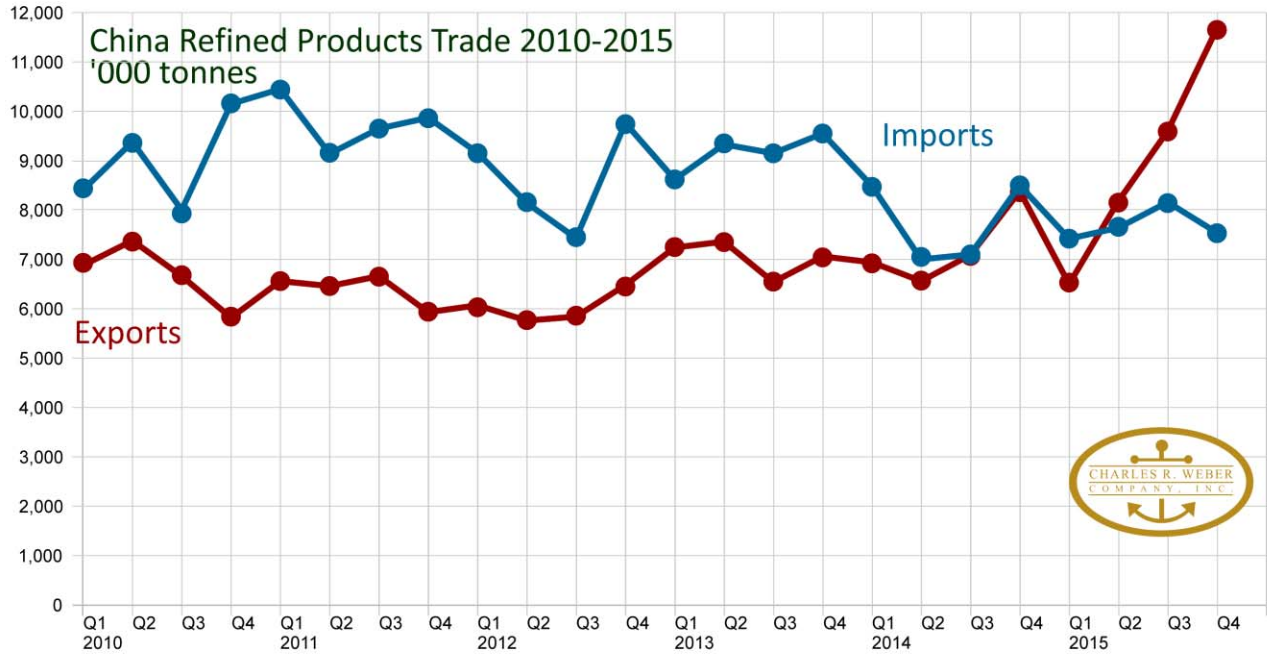
A Charles R. Weber Country File

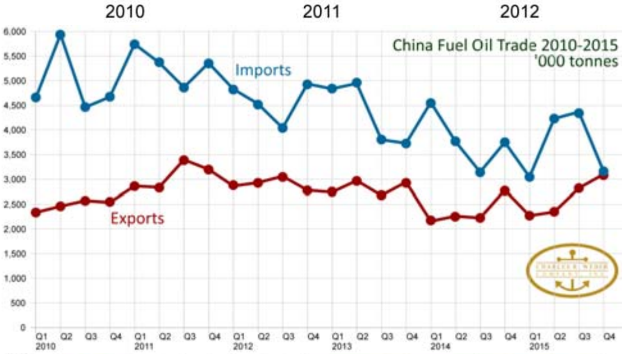

China Refined Product
Exports 2010-2016e
'000 tonnes
Fuel Oil
Gasoil / Diesel
Gasoline
Kerosine / Jet Fuel
Naphtha
Other Products
89%
11,504
72%
8,901
6,084
182%
5,171
13,177
4,672
2010 2011 2012 2013 2014 2015 2016

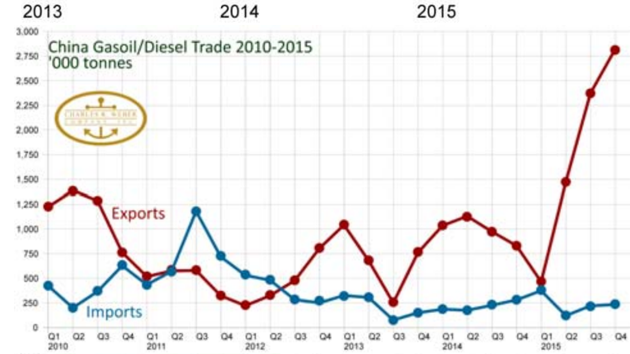

2014-2016
China Total Refined Product Imports & Exports
'000 Tonnes
imports
exports
Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2
2014 2015 2016

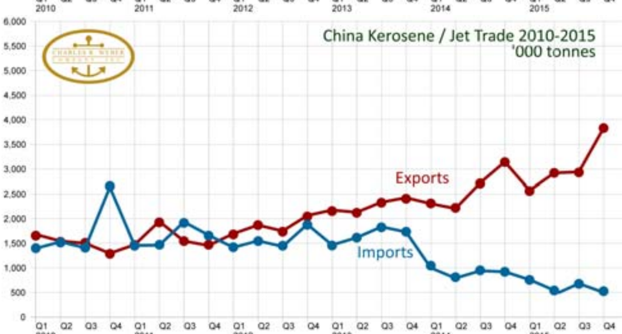

China Refined Product
Imports 2010-2016e
'000 tonnes
144%
4,011
9,785
2,949
135%
6,974
662
395%
3,274
Fuel Oil
Gasoil / Diesel
Gasoline
Kerosine / Jet Fuel
Naphtha
Other Products
2010 2011 2012 2013 2014 2015 2016


2010-2015
China & India
Total Refined Product Exports
'000 Tonnes
India
China
2010 2011 2012 2013 2014 2015

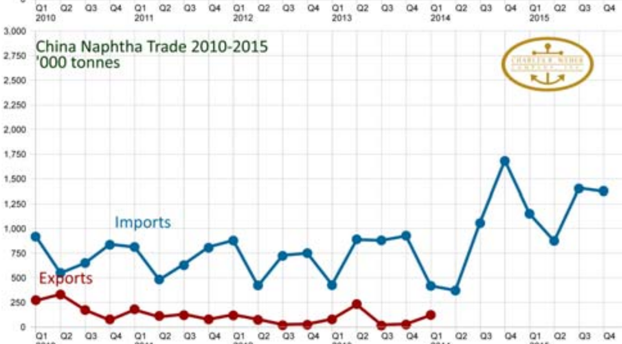

China Refined Products Trade 2010-2015
'000 tonnes
Imports
Exports
CHARLES R. WEBER
COMPANY, INC.


China Fuel Oil Trade 2010-2015
'000 tonnes
Imports
Exports


China Gasoil/Diesel Trade 2010-2015
'000 tonnes
Exports
Imports

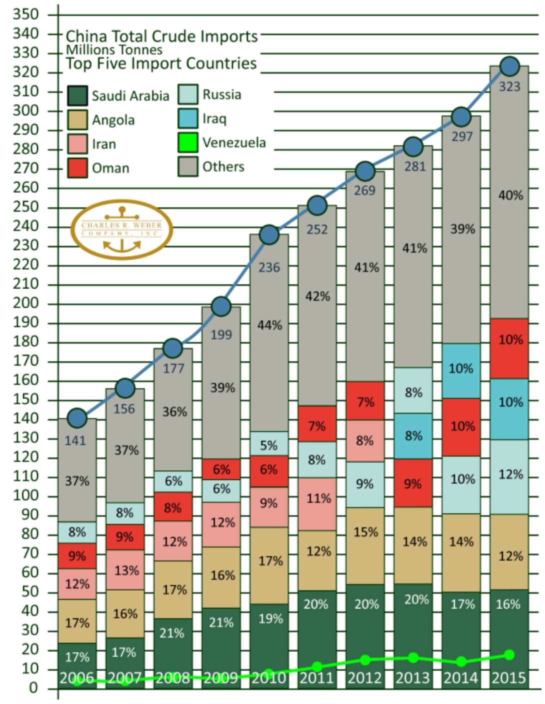

China Kerosene / Jet Trade 2010-2015
'000 tonnes
Exports
Imports


China Gasoline Trade 2010-2015
'000 tonnes
Exports
Imports


China Naphtha Trade 2010-2015
'000 tonnes
Imports
Exports


China Other Products Trade 2010-2015
'000 tonnes
Imports
Exports

China economic health

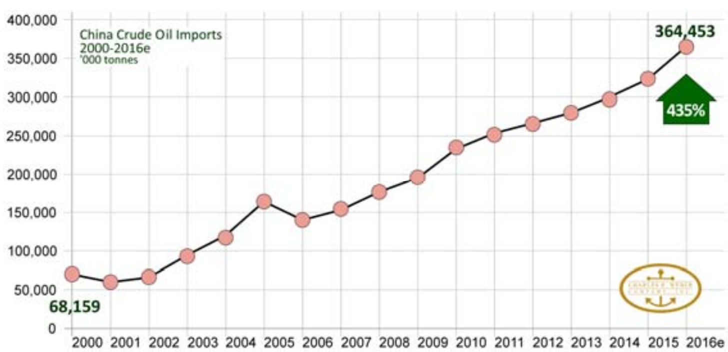


China GDP growth is predicted to fall from 7.3% in 2014 and 6.9% in 2015 to 6.5% in 2016 and 6.2% in 2017. However, it is looking to end the year on high, notwithstanding the storm clouds that may be brewing for 2017, with the signaled change in trade policy towards China by the incoming US President. In November, China's imports (+6.7%) grew at the fastest pace in more than two years, fuelled by its renewed appetite for commodities from coal to iron ore, while exports (+0.1%) also rose unexpectedly, reflecting a pick-up in both domestic and global demand.

Despite the strong end to the year, it should not disguise China's difficult year in 2016, with exports falling 7.5% year on year in the first 11 months, while imports dropped 6.2% year on year. It is also clear that China could be exposed to protectionist measures next year if the new President follows through on pledges to brand it a currency manipulator and impose heavy tariffs on imports of Chinese goods.

China crude oil imports

For much of the year, there were concerns that the slowing pace of Chinese economic growth and burgeoning refined product stocks would lead to a softening in China's appetite to import oil. However, we estimate that China's full year imports are set to increase by 9%.



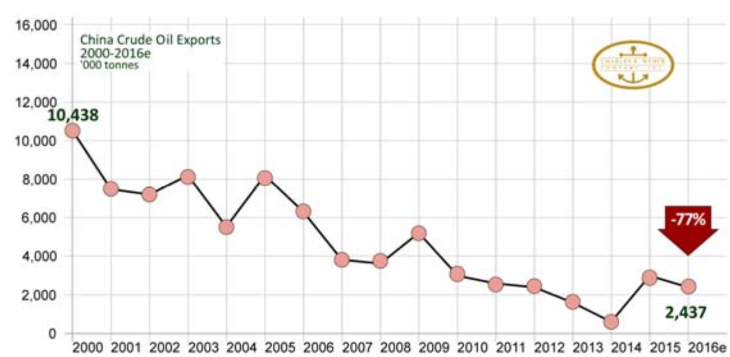
Several factors underpinned the recovery in crude oil imports:

- Decline in Chinese crude oil production
- Revival of refinery throughputs
- Drive to add to strategic crude oil reserves

Decline in Chinese crude oil production

Chinese crude oil production has dropped sharply in 2016 from 4.25million b/d in December 2015 to 3.8million b/d in October, which was a seven year low. It recovered to 3.93million b/d in November. Low oil prices were an important factor undermining crude oil production in 2016, but we anticipate the decline to continue – with output set to fall to 3.5million b/d by 2020

Revival of refinery throughputs led by teapot refineries



The rise of the independent teapot refinery has been a market-transforming phenomenon in 2016, emerging as a brand new source of crude oil demand growth. This group of refineries accounts for about 30% of total present Chinese refinery capacity (14.4million b/d). Traditionally teapots were required to purchase crude oil from state petrochemical companies. In

September 2015, seven teapot refiners received their own import licenses. More licenses followed pushing total teapot quotas to 1.26million b/d at the end of 2016.

Teapots are expected to add between 200-400'000 b/d to Chinese crude oil import demand growth in 2017, if – as seems likely - quota levels for the next year are maintained at end-2016 levels. Some estimates suggest that Chinese crude oil import demand will increase by 500-700,000 b/d next year.

Drive to add to strategic crude oil reserves

Since 2008, when China completed building its first phase strategic crude oil infrastructure, stockpiling has been a very important part of Chinese crude oil import demand growth. However, this source of demand doesn't always hit the headlines because of uncertainty about the exact size of current Chinese reserve capacity and a market perception that it is close to its maximum ceiling.

This uncertainty has generated attention in recent months because of the disparity between government statements about stock levels and increasingly sophisticated independent stock measurements made by market observers using AIS tracking and satellite imagery.

Under the latest five year plan 2015-2020, China's government is targeting combined government (SPR, 476 million barrels) and commercial reserves (209 million barrels) to reach the equivalent of 90 days (685 million barrels) of emergency cover i.e. cover sufficient to replace its net import requirement.

However, there are suggestions from Orbital Insight and others that the storage building programme may already even exceed this target, in part because of the identification of possible additional storage sites – including underground caverns by the Yellow Sea and a scattering of islands in the Yangtze River delta. As a result, we think that China's strategic stockpiling is still not completed and will continue to be an important source of crude oil demand growth – at least while oil prices remain relatively low.

Note: Some describe the Chinese SPR as being built in two phases, but it seems that the idea of three phases more accurately reflects the stages of development.

- *Phase 1 - China Government SPR, 103 million barrels across 4 locations*
- *Phase 2 - China Government SPR, added 190 million barrels – giving a new total of 293+ million barrels*
- *Phase 3 - China Government SPR, which may have been delayed, was forecast to be completed by 2020 (under latest 5 year plan) – aiming to add a further 204 million barrels – giving a new total of 497 million barrels. This is equivalent to just 62,000 b/d spread over nine years*

China refined product demand

Chinese oil product demand was essentially flat year-on-year in 3Q16, which contrasted with overall economic growth averaging 6.7% over the same period. LPG and gasoline were the primary drivers of domestic demand, but were cancelled out by declines in gasoil/diesel and residual fuel oil, two products that fell due to government restrictions on factory activity ahead of September's G20 meeting in Hangzhou. Also ongoing industrial weaknesses dampened demand.

China Refined Product Demand

	Demand (kb/d)			Annual Change (kb/d)		Annual Change (%)	
	2015	2016	2017	2016	2017	2016	2017
LPG & Ethane	1,112	1,315	1,433	203	118	18.2	9.0
Naphtha	997	1,061	1,095	64	34	6.4	3.2
Motor Gasoline	2,624	2,834	3,026	210	192	8.0	6.8
Jet Fuel and Kerosene	605	645	680	41	35	6.8	5.4
Gasoil/Diesel	3,332	3,323	3,316	-9	-7	-0.3	-0.2
Residual Fuel Oil	297	213	148	-83	-65	-28.1	-30.5
Other Products	2,516	2,350	2,299	-166	-51	-6.6	-2.2
Total Products	**11,482**	**11,741**	**11,998**	**259**	**257**	**2.3**	**2.2**

Source: IEA Oil Market Report 11/2016

However, tentative signs of growth returned from September, which included a revival in crude oil imports and strong gains in domestic car sales. The IEA are anticipating a broadly similar picture for product demand growth next year with gains in LPG and gasoline demand once again contrasting with falling demand for residual fuel oil and gasoil/diesel.

China refined product imports/exports

Chinese product exports took off in 2015 (+23.5%). This dramatic growth has been sustained in 2016 (+25.6%). The emergence of independent exporters (e.g. Chambroad Petrochemicals, Luqing Petrochemical, Wonfull Petrochemical and Lihuayi Group) has helped sustain the export surge.

Gasoil/diesel (+101%, e16 7.3 million tonnes), which has struggled to find a domestic market, has been the star export commodity. Gasoline (+57%, e16 3.3 million tonnes) has also performed strongly, while fuel oil exports (-10%, e16 -1.0 million tonnes) have been the big loser.

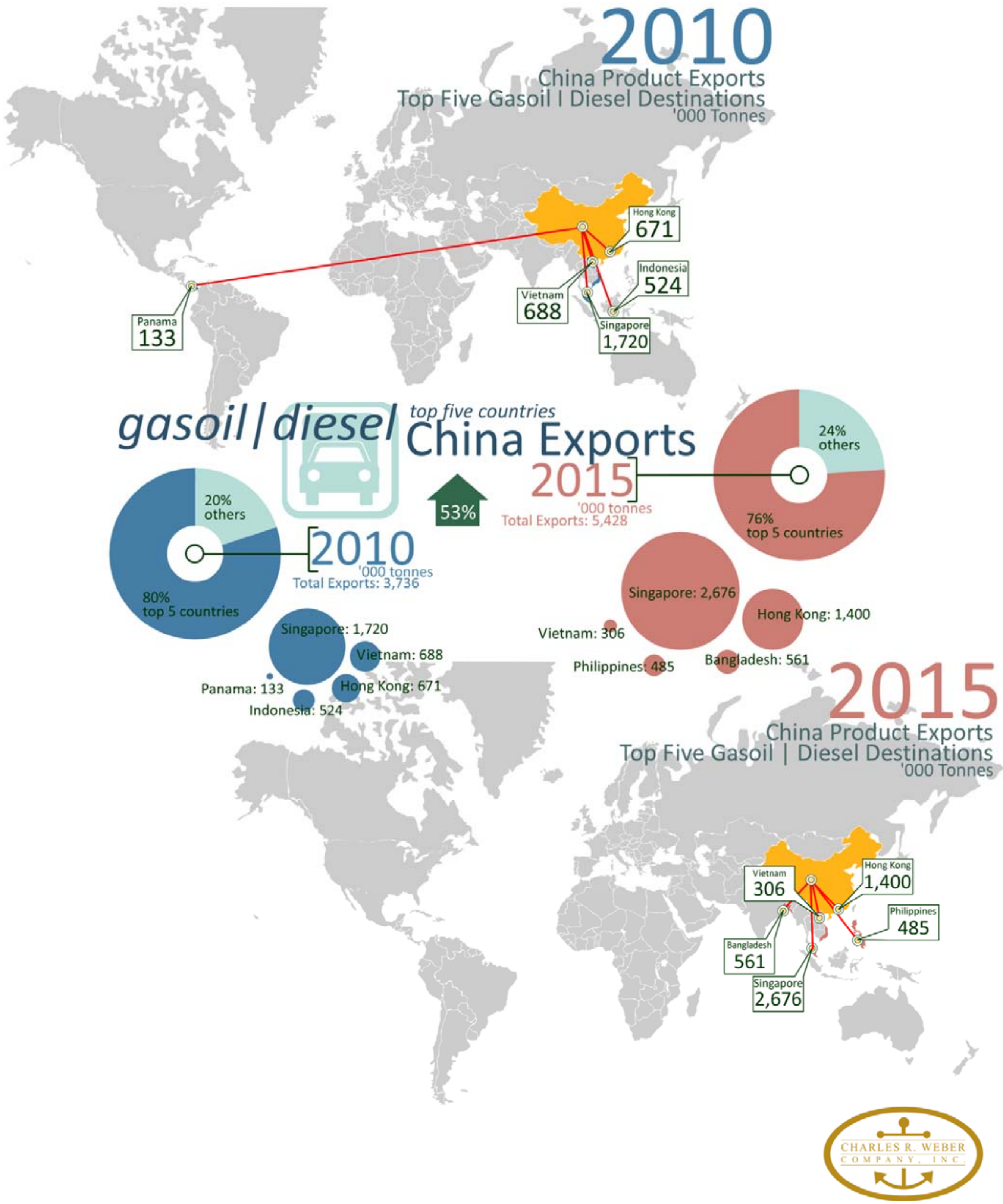
Singapore is the primary destination for China's refined products, accounting for 23% of all exports. While this trade has expanded by an impressive 50% in the year to date, it is by no means the only rapidly expanding trade. A global collection of countries including Philippines (+252%), Australia (+79%), Malaysia (+175%), United States (+53%), Bangladesh (+111%), Sri Lanka (+114%), United Arab Emirates (+81%), Netherlands (+156%) and Thailand (347%) have all shown significant growth this year.

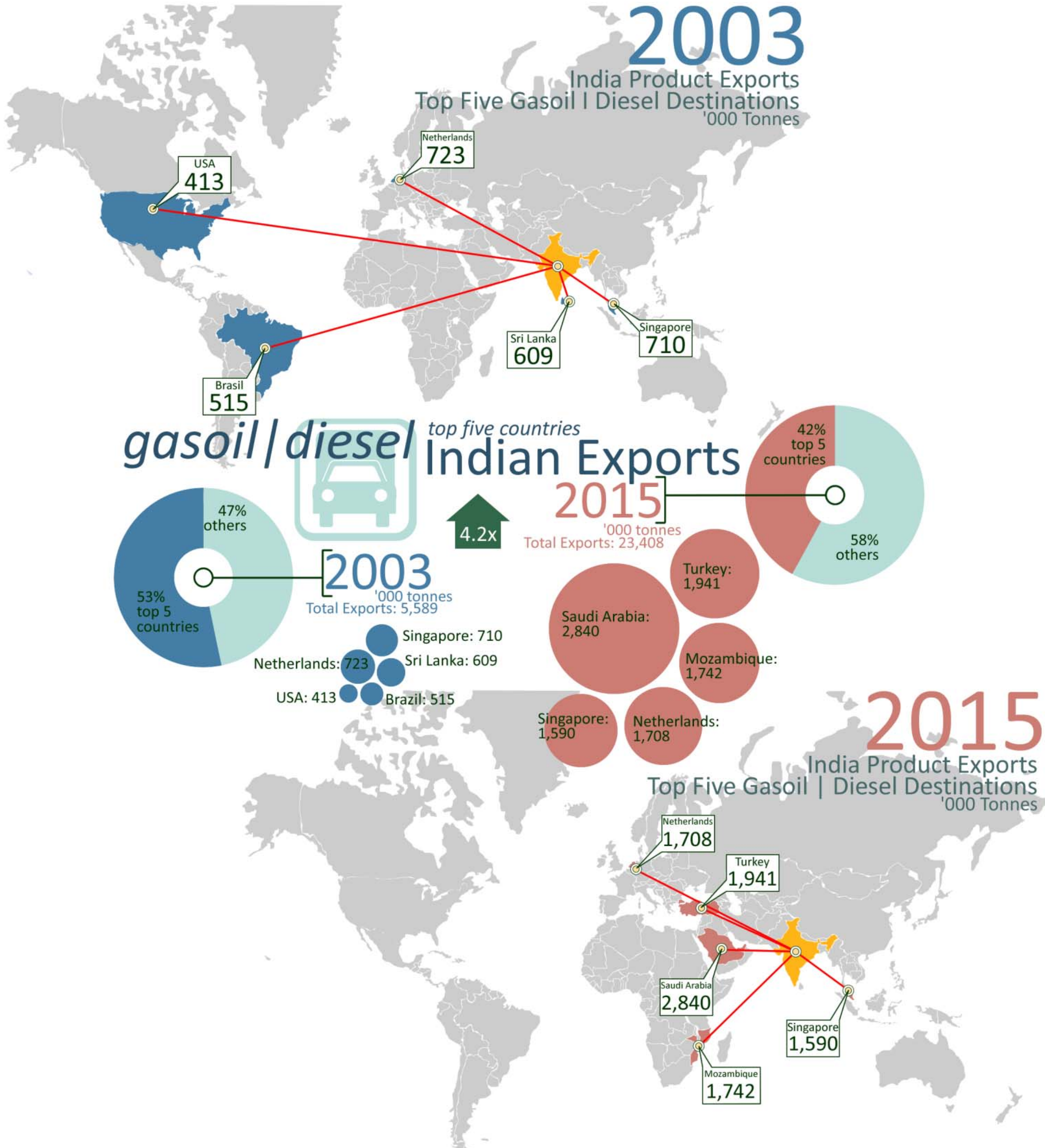
Bucking a downward trend, Chinese product imports are on course to expand by 6.5% this year largely due to increased exports from South Korea, the market leader. Imports of all refined imports have risen significantly in 2016 with the exception of residual fuel oil, which nevertheless remains by far the largest imported product.

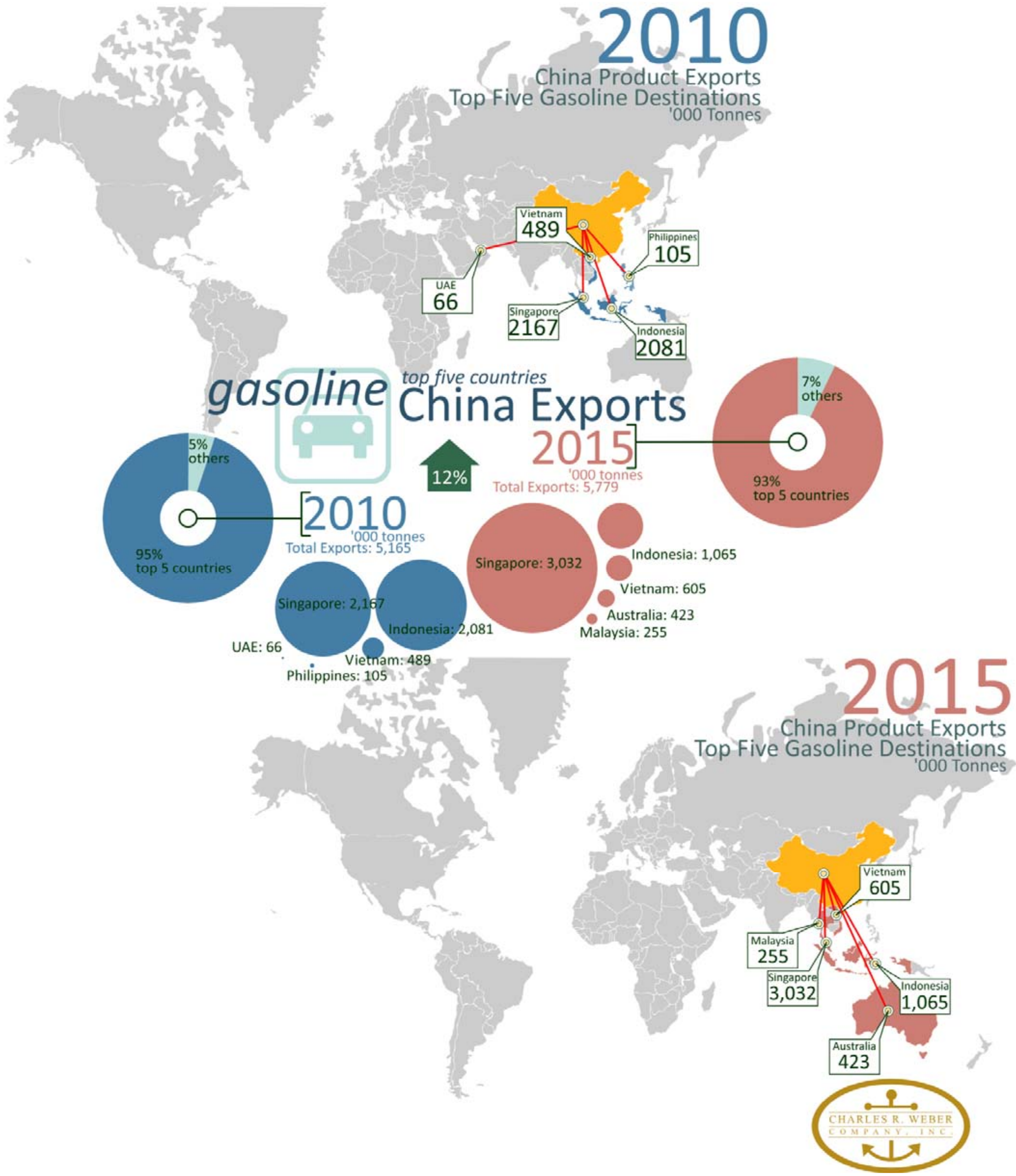
Utilization and Pollution

Refinery utilization rates in China have declined to less than 75% in the past year as Chinese companies continued to build refining capacity against a backdrop of slower oil demand growth in China and around the world. The government expanded refining companies' product export quotas in 2014 and 2015 because domestic demand growth had slackened since 2012. The NDRC claims that incremental refining capacity is expected to be 3.4 million bbl/d between 2016 and 2020. However, industry analysts anticipate China would add only 1.5 million bbl/d of net capacity between 2015 and 2020, as a result of several project delays and overcapacity during the past two years.

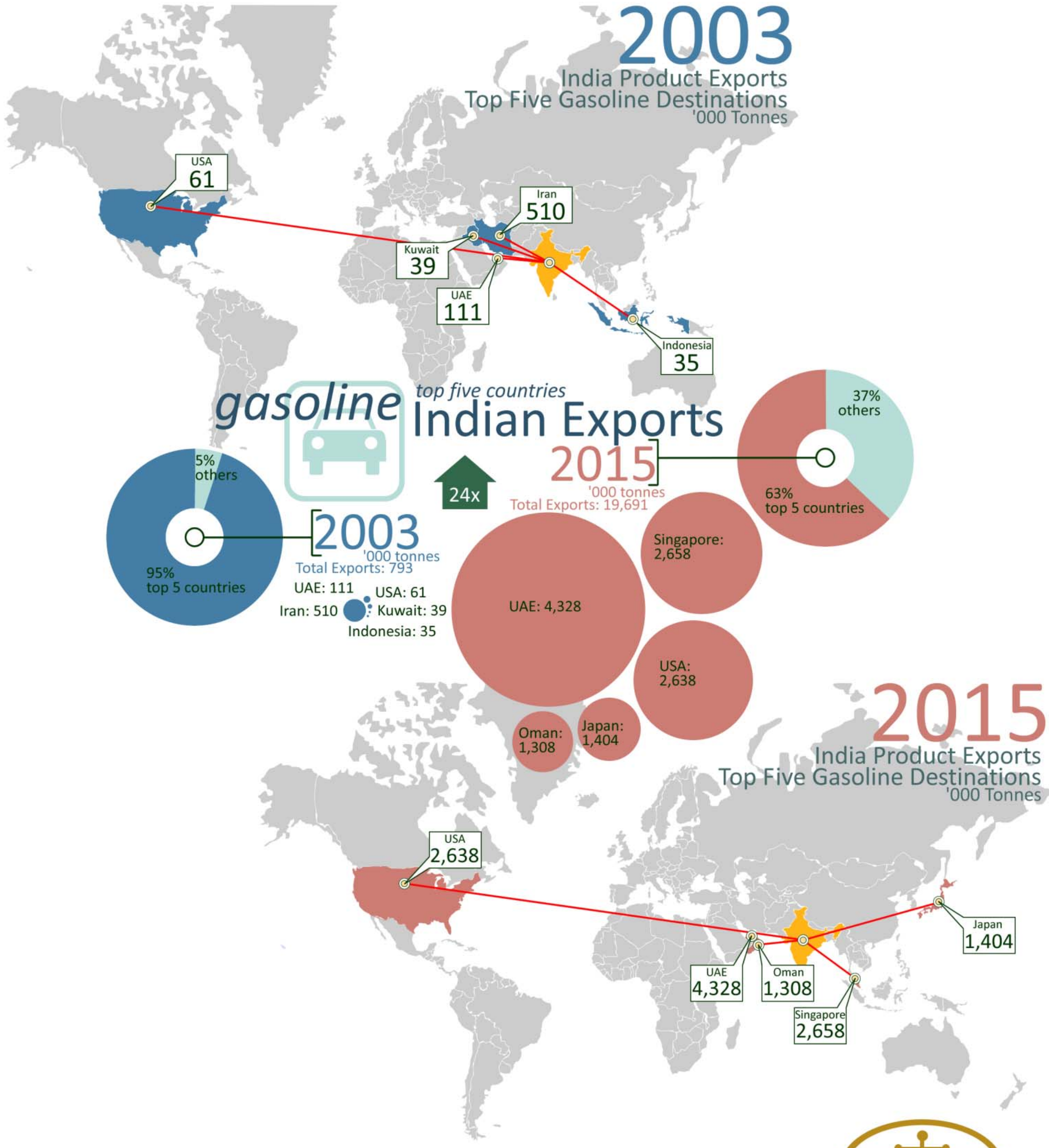
Recent heavy pollution in certain areas of China prompted the NDRC to adopt stricter petroleum product specifications that are intended to lower sulfur emissions from gasoline and diesel use. The agency requires refineries to implement the equivalent of Euro IV standards for transportation fuels nationwide in 2015 and Euro V standards by January 2017, a year ahead of the prior schedule. Shanghai and Beijing are already supplying only fuels that meet Euro V standards. Sinopec and CNPC are investing in refinery upgrades to meet these emissions standards, but the small independent refineries are facing economic challenges of additional cost.

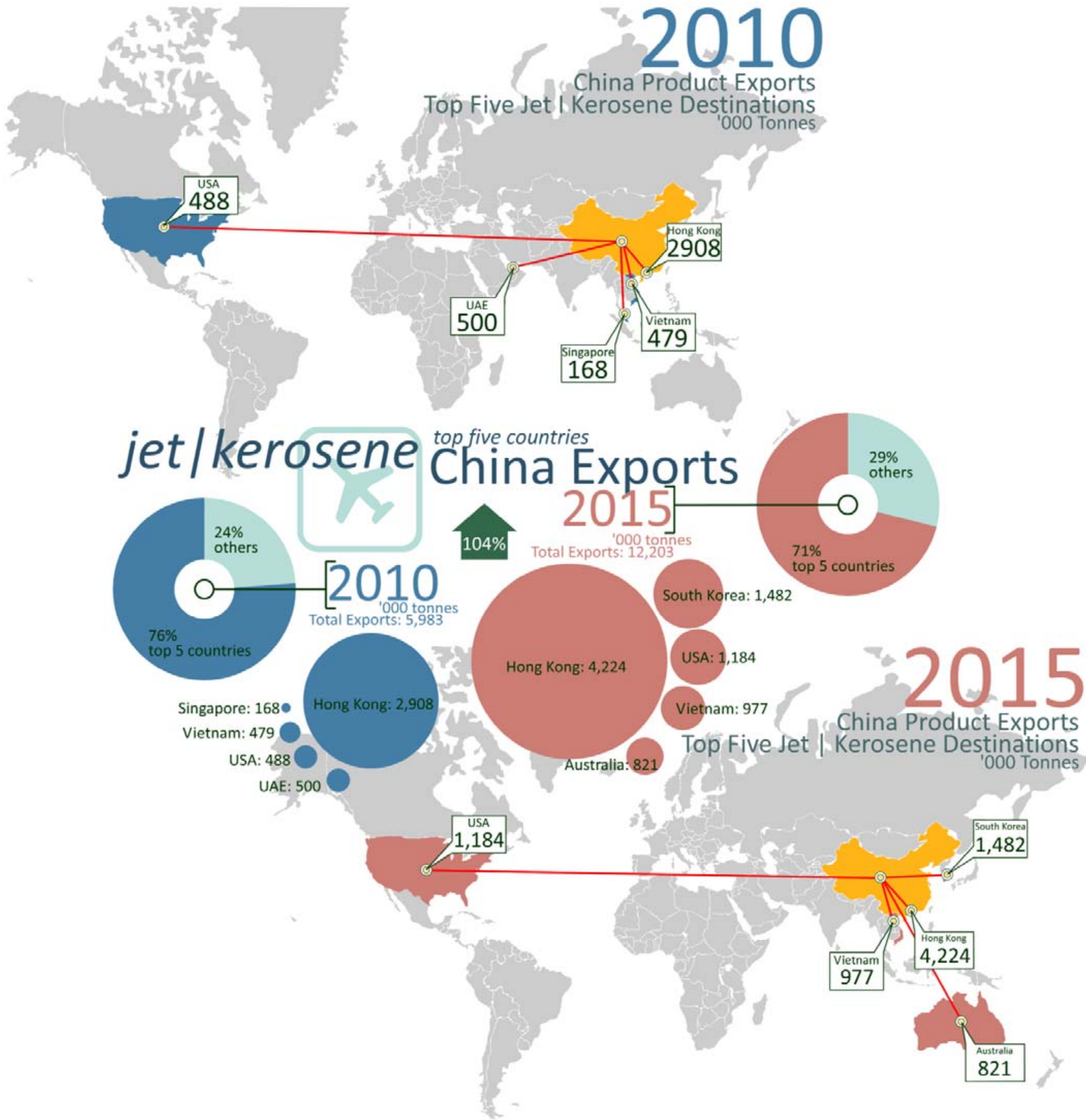

2010
China Product Exports
Top Five Gasoil I Diesel Destinations
'000 Tonnes
Hong Kong
671
Indonesia
524
Vietnam
688
Singapore
1,720
Panama
133
gasoil | diesel
top five countries
China Exports
2015
'000 tonnes
Total Exports: 5,428
53%
24%
others
76%
top 5 countries
20%
others
80%
top 5 countries
2010
'000 tonnes
Total Exports: 3,736
Singapore: 1,720
Vietnam: 688
Panama: 133
Hong Kong: 671
Indonesia: 524
Singapore: 2,676
Hong Kong: 1,400
Vietnam: 306
Philippines: 485
Bangladesh: 561
2015
China Product Exports
Top Five Gasoil | Diesel Destinations
'000 Tonnes
Vietnam
306
Hong Kong
1,400
Philippines
485
Bangladesh
561
Singapore
2,676


2003
India Product Exports
Top Five Gasoil I Diesel Destinations
'000 Tonnes
USA
413
Netherlands
723
Sri Lanka
609
Singapore
710
Brasil
515
gasoil | diesel
top five countries
Indian Exports
2015
'000 tonnes
Total Exports: 23,408
42%
top 5
countries
58%
others
47%
others
53%
top 5
countries
4.2x
2003
'000 tonnes
Total Exports: 5,589
Singapore: 710
Netherlands: 723
Sri Lanka: 609
USA: 413
Brazil: 515
Turkey:
1,941
Saudi Arabia:
2,840
Mozambique:
1,742
Singapore:
1,590
Netherlands:
1,708
2015
India Product Exports
Top Five Gasoil | Diesel Destinations
'000 Tonnes
Netherlands
1,708
Turkey
1,941
Saudi Arabia
2,840
Singapore
1,590
Mozambique
1,742

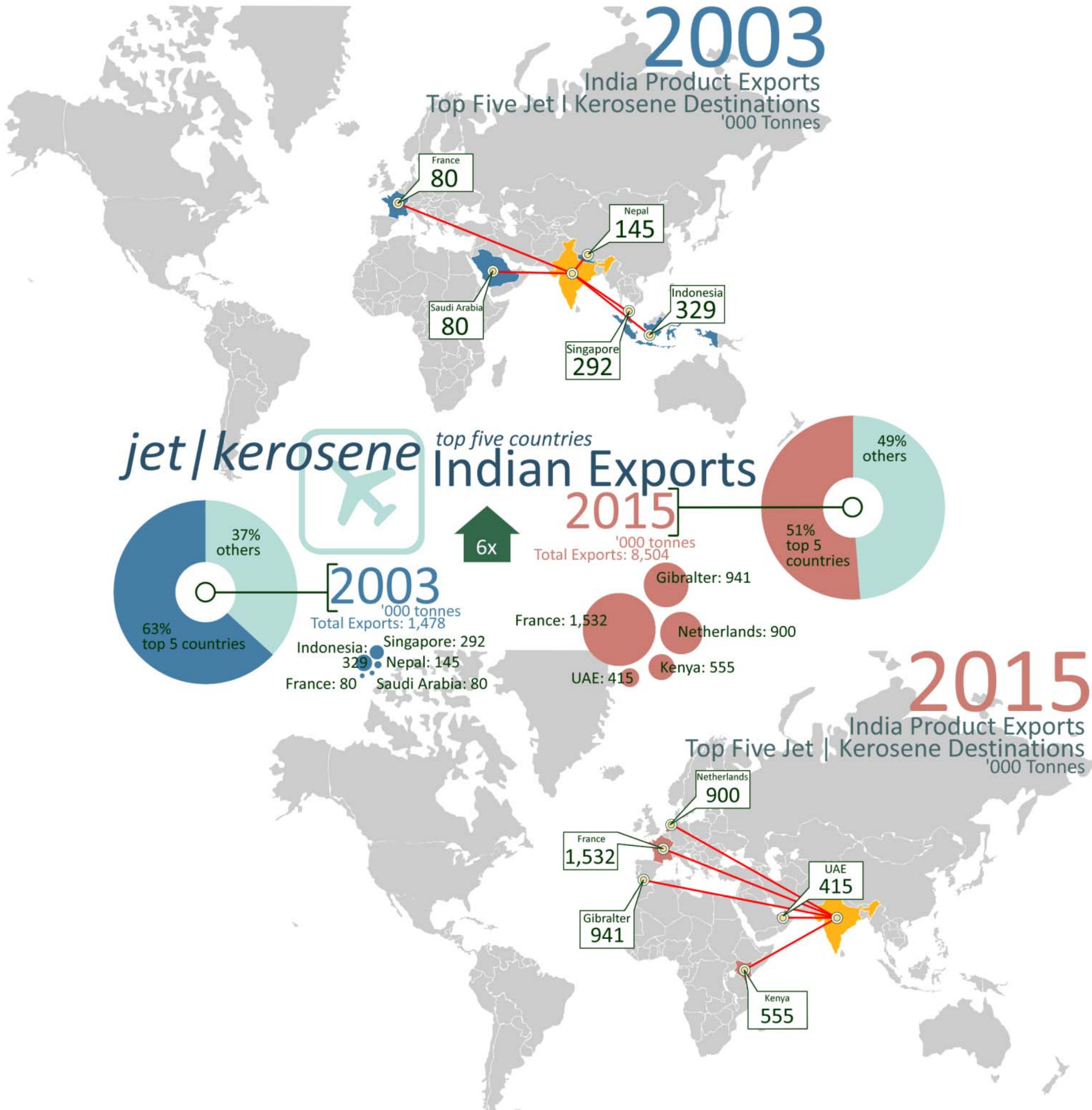


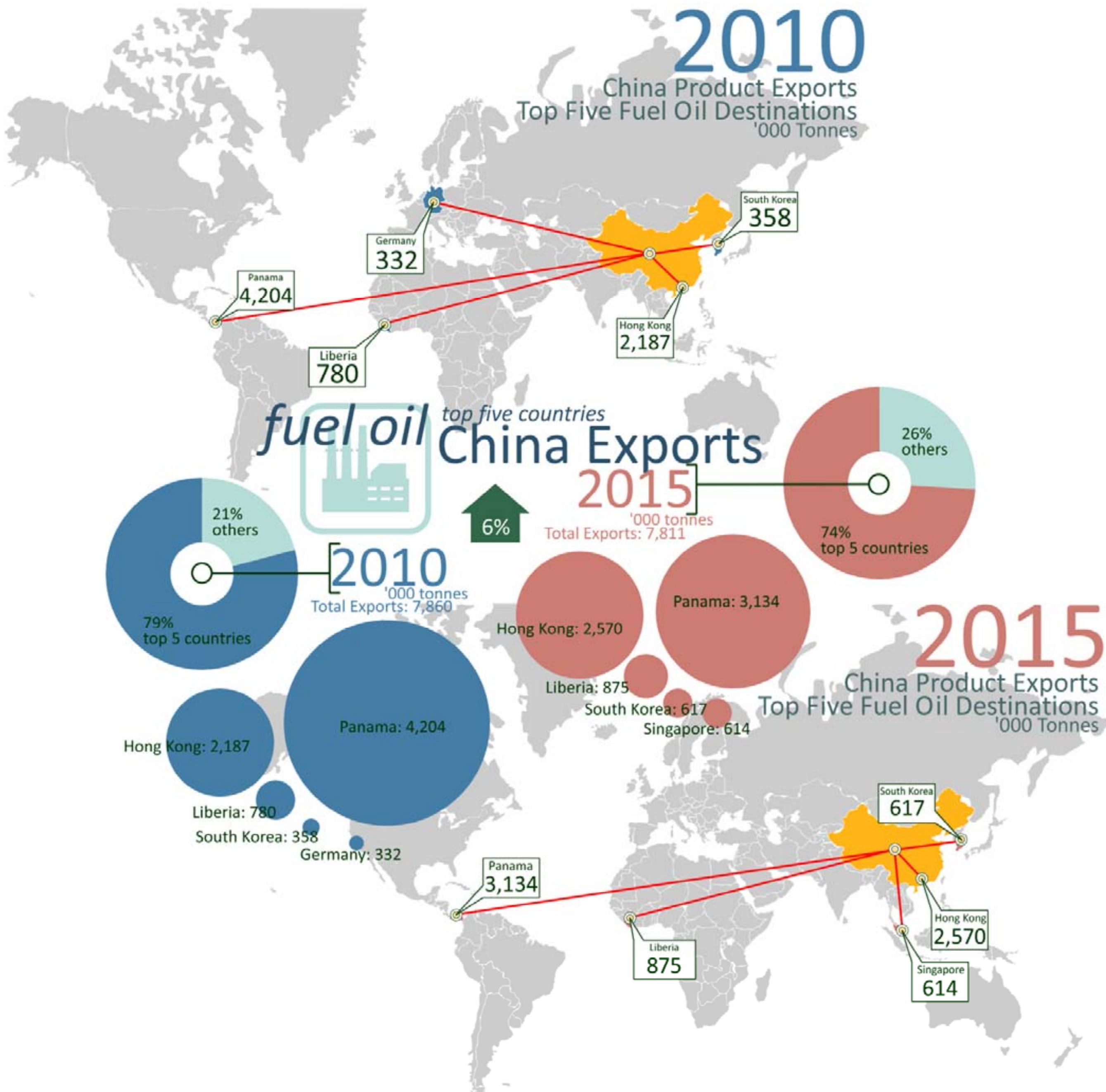
2010
China Product Exports
Top Five Gasoline Destinations
'000 Tonnes
Vietnam 489
Philippines 105
UAE 66
Singapore 2167
Indonesia 2081
gasoline
top five countries
China Exports
2015
'000 tonnes
Total Exports: 5,779
7% others
93% top 5 countries
12%
5% others
95% top 5 countries
2010
'000 tonnes
Total Exports: 5,165
Singapore: 3,032
Indonesia: 1,065
Vietnam: 605
Australia: 423
Malaysia: 255
Singapore: 2,167
Indonesia: 2,081
UAE: 66
Vietnam: 489
Philippines: 105
2015
China Product Exports
Top Five Gasoline Destinations
'000 Tonnes
Vietnam 605
Malaysia 255
Singapore 3,032
Indonesia 1,065
Australia 423

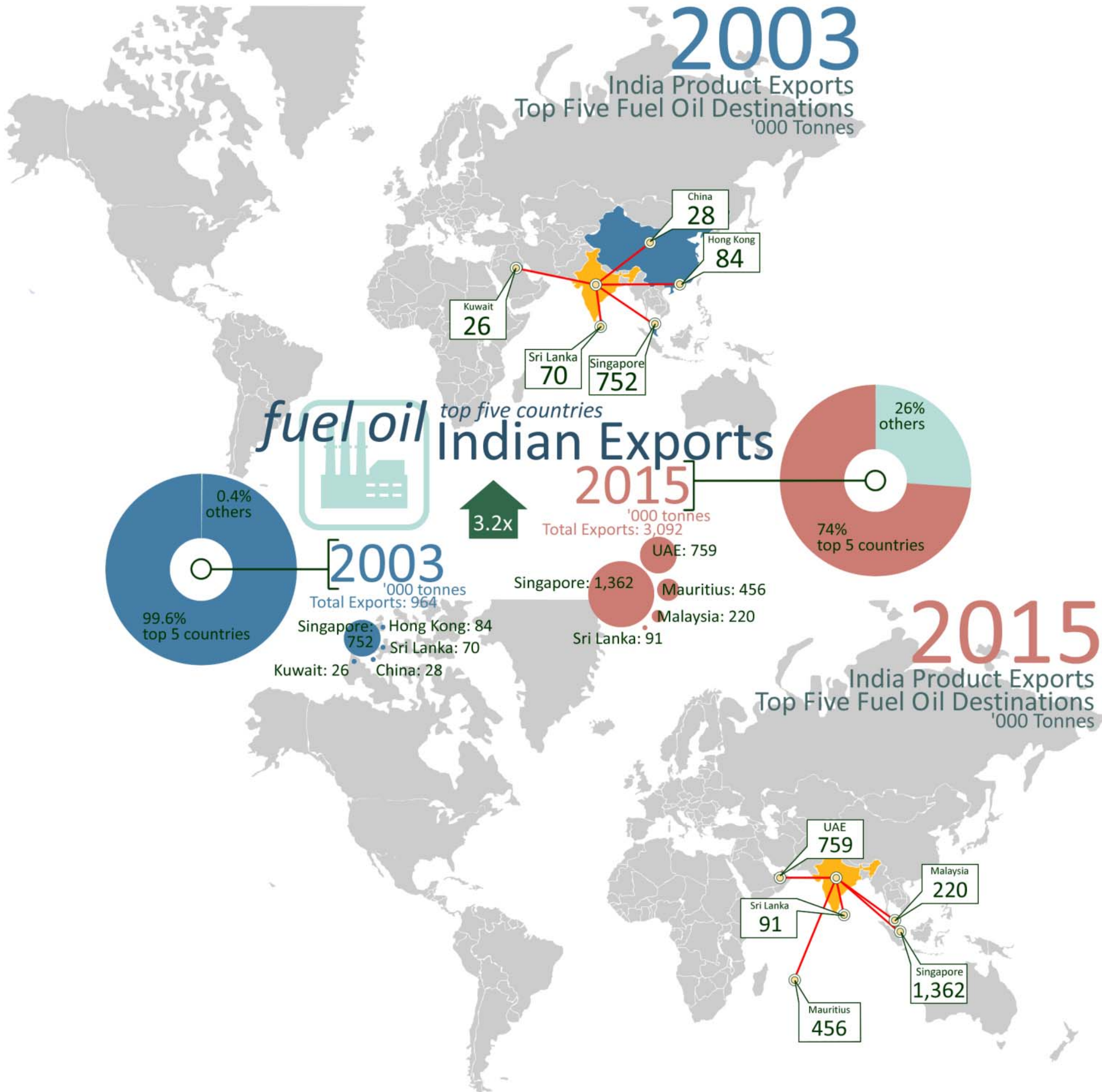

2003
India Product Exports
Top Five Gasoline Destinations
'000 Tonnes
USA
61
Iran
510
Kuwait
39
UAE
111
Indonesia
35
gasoline
top five countries
Indian Exports
37%
others
63%
top 5 countries
2015
'000 tonnes
Total Exports: 19,691
24x
5%
others
95%
top 5 countries
2003
'000 tonnes
Total Exports: 793
UAE: 111
USA: 61
Iran: 510
Kuwait: 39
Indonesia: 35
Singapore:
2,658
UAE: 4,328
USA:
2,638
Oman:
1,308
Japan:
1,404
2015
India Product Exports
Top Five Gasoline Destinations
'000 Tonnes
USA
2,638
Japan
1,404
UAE
4,328
Oman
1,308
Singapore
2,658



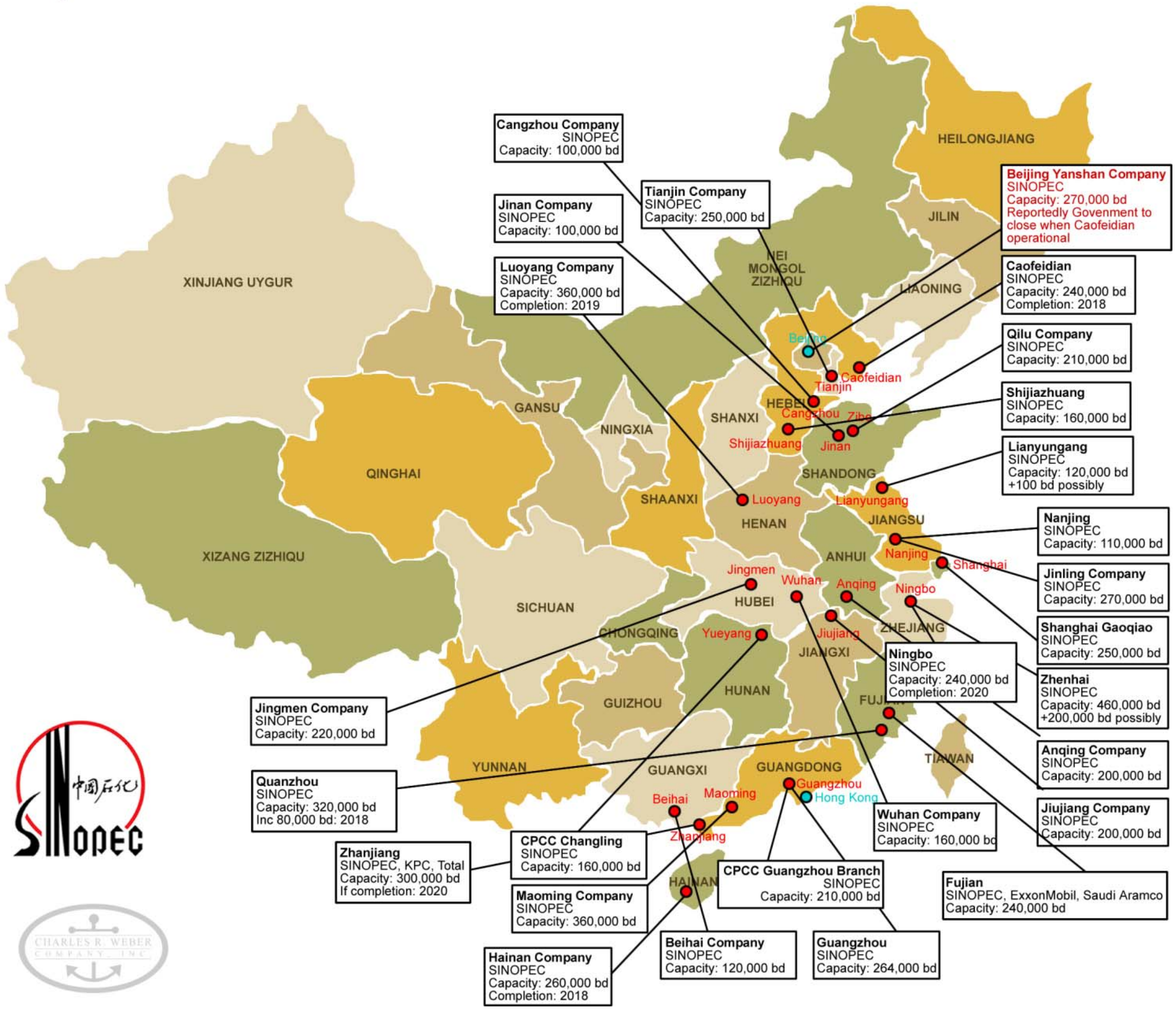
2010
China Product Exports
Top Five Jet | Kerosene Destinations
'000 Tonnes
USA 488
Hong Kong 2908
UAE 500
Vietnam 479
Singapore 168
jet|kerosene
top five countries
China Exports
2015
'000 tonnes
Total Exports: 12,203
29% others
71% top 5 countries
104%
24% others
76% top 5 countries
2010
'000 tonnes
Total Exports: 5,983
South Korea: 1,482
Hong Kong: 4,224
USA: 1,184
Vietnam: 977
Australia: 821
Singapore: 168
Vietnam: 479
USA: 488
UAE: 500
Hong Kong: 2,908
2015
China Product Exports
Top Five Jet | Kerosene Destinations
'000 Tonnes
USA 1,184
South Korea 1,482
Hong Kong 4,224
Vietnam 977
Australia 821


2003
India Product Exports
Top Five Jet | Kerosene Destinations
'000 Tonnes
France
80
Nepal
145
Saudi Arabia
80
Indonesia
329
Singapore
292
jet|kerosene
top five countries
Indian Exports
2015
'000 tonnes
Total Exports: 8,504
49%
others
51%
top 5
countries
6x
37%
others
63%
top 5 countries
2003
'000 tonnes
Total Exports: 1,478
Indonesia:
329
Singapore: 292
Nepal: 145
France: 80
Saudi Arabia: 80
Gibralter: 941
France: 1,532
Netherlands: 900
Kenya: 555
UAE: 415
2015
India Product Exports
Top Five Jet | Kerosene Destinations
'000 Tonnes
Netherlands
900
France
1,532
UAE
415
Gibralter
941
Kenya
555


2010
China Product Exports
Top Five Fuel Oil Destinations
'000 Tonnes
South Korea
358
Germany
332
Panama
4,204
Hong Kong
2,187
Liberia
780
fuel oil
top five countries
China Exports
2015
'000 tonnes
Total Exports: 7,811
26%
others
74%
top 5 countries
6%
21%
others
79%
top 5 countries
2010
'000 tonnes
Total Exports: 7,860
Hong Kong: 2,570
Panama: 3,134
Liberia: 875
South Korea: 617
Singapore: 614
Hong Kong: 2,187
Panama: 4,204
Liberia: 780
South Korea: 358
Germany: 332
2015
China Product Exports
Top Five Fuel Oil Destinations
'000 Tonnes
South Korea
617
Panama
3,134
Hong Kong
2,570
Liberia
875
Singapore
614

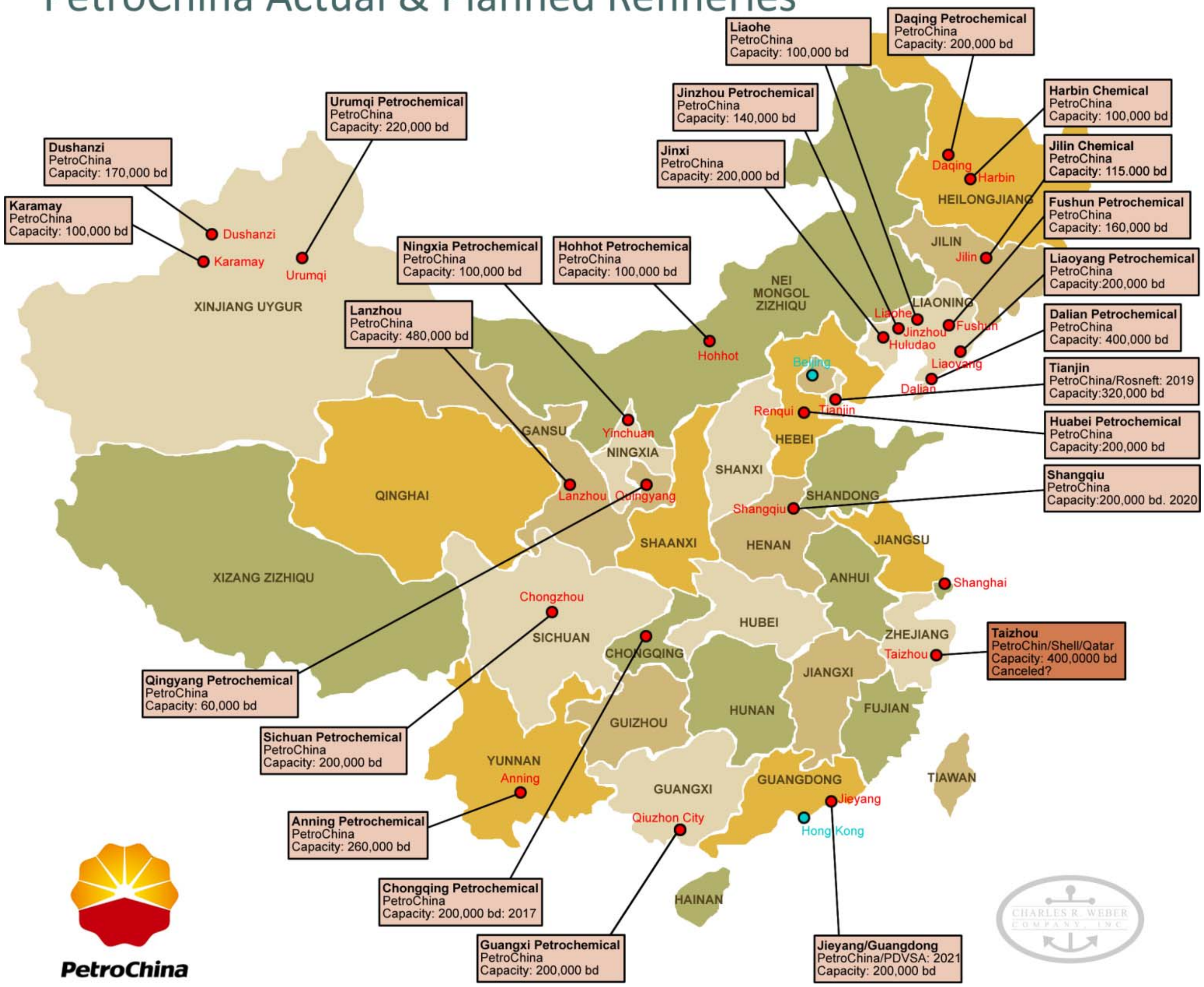

2003
India Product Exports
Top Five Fuel Oil Destinations
'000 Tonnes
China
28
Hong Kong
84
Kuwait
26
Sri Lanka
70
Singapore
752
fuel oil
top five countries
Indian Exports
0.4%
others
99.6%
top 5 countries
2003
'000 tonnes
Total Exports: 964
Singapore: 752
Hong Kong: 84
Sri Lanka: 70
Kuwait: 26
China: 28
3.2x
2015
'000 tonnes
Total Exports: 3,092
UAE: 759
Singapore: 1,362
Mauritius: 456
Malaysia: 220
Sri Lanka: 91
26%
others
74%
top 5 countries
2015
India Product Exports
Top Five Fuel Oil Destinations
'000 Tonnes
UAE
759
Malaysia
220
Sri Lanka
91
Singapore
1,362
Mauritius
456

Sinopec Actual & Planned Refineries



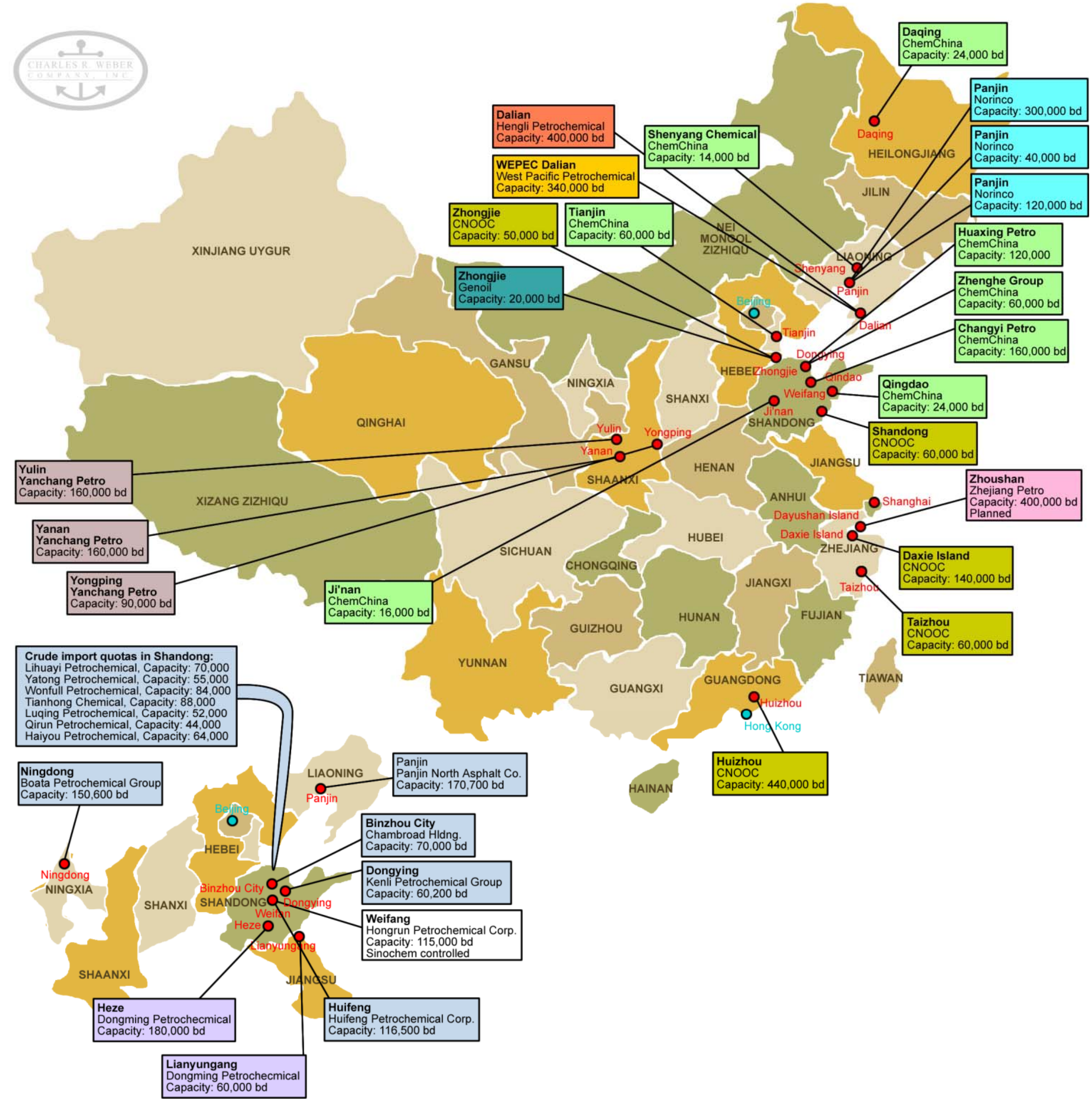
Sinopec Refinery	B/D	Notes	Sinopec Refinery	B/D	Notes
Cangzhou	100,000		Anqing	200,000	
Tianjin	250,000		Jiujiang	200,000	
Jinan	100,000		Wuhan	160,000	
Luoyang	360,000	2019	Fujian	240,000	Sinopec, ExxonMobil, Saudi Aramco
Beijing Yanshan	270,000	To close after Caofeidan opens	CPCC Guangzhou	210,000	
Caofeidian	240,000	2018	Guangzhou	264,000	
Qilu	210,000		Beihai	120,000	
Shijiazhuang	160,000		CPCC Changling	160,000	
Lianyungang	220,000		Maoming	360,000	
Nanjing	110,000		Hainan	260,000	2018
Jinling	270,000		Zhanjiang	300,000	2020. Sinopec, KPC
Shanghai Gaoqiao	250,000		Quanzhou	320,000	Inc 80,000 in 2018
Zhenhai	660,000		Jingmen	220,000	
Ningbo	240,000	2020	**Total:**	**6,454,000**	

PetroChina Actual & Planned Refineries



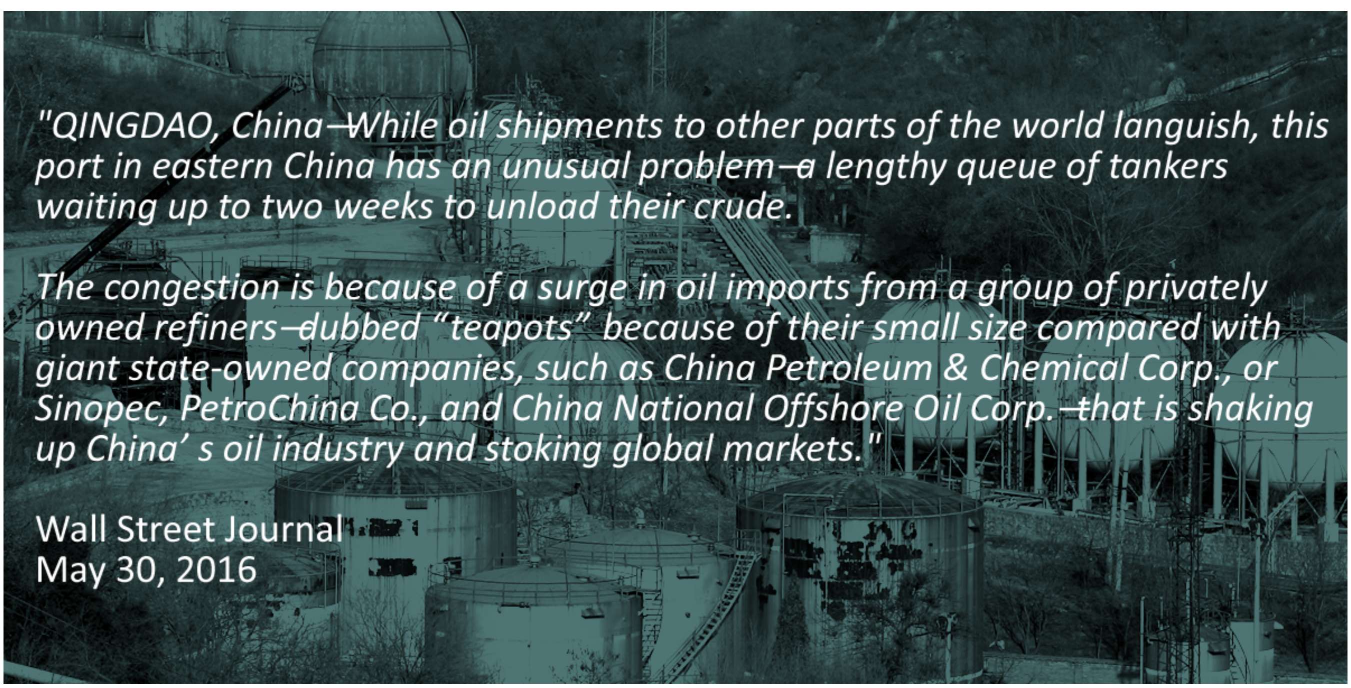
PetroChina Refinery	B/D	Notes	PetroChina Refinery	B/D	Notes
Karamay	100,000		Dalian	400,000	
Dushanzi	170,000		Tianjin	320,000	
Urumqi	220,000		Huabei	200,000	
Lanzhou	480,000		Shangqiu	200,000	
Ningxia	100,000		Taizhou	400,000	PetroChina, Shell, Qatar – Cancelled?
Hohhot	100,000		Jieyang/Guangdong	200,000	PetroChina, PDVSA – 2021?
Jinxi	200,000		Guangxi	200,000	
Jinzhou	140,000		Chongqing	200,000	
Daqing	200,000		Anning	260,000	
Harbin	100,000		Sichuan	200,000	
Jilin	115,000		Qingyang	60,000	
Fushun	160,000		Liaohe	100,000	
Liaoyang	200,000		**Total:**	**5,025,000**	

Independent & Other Actual & Planned Refineries



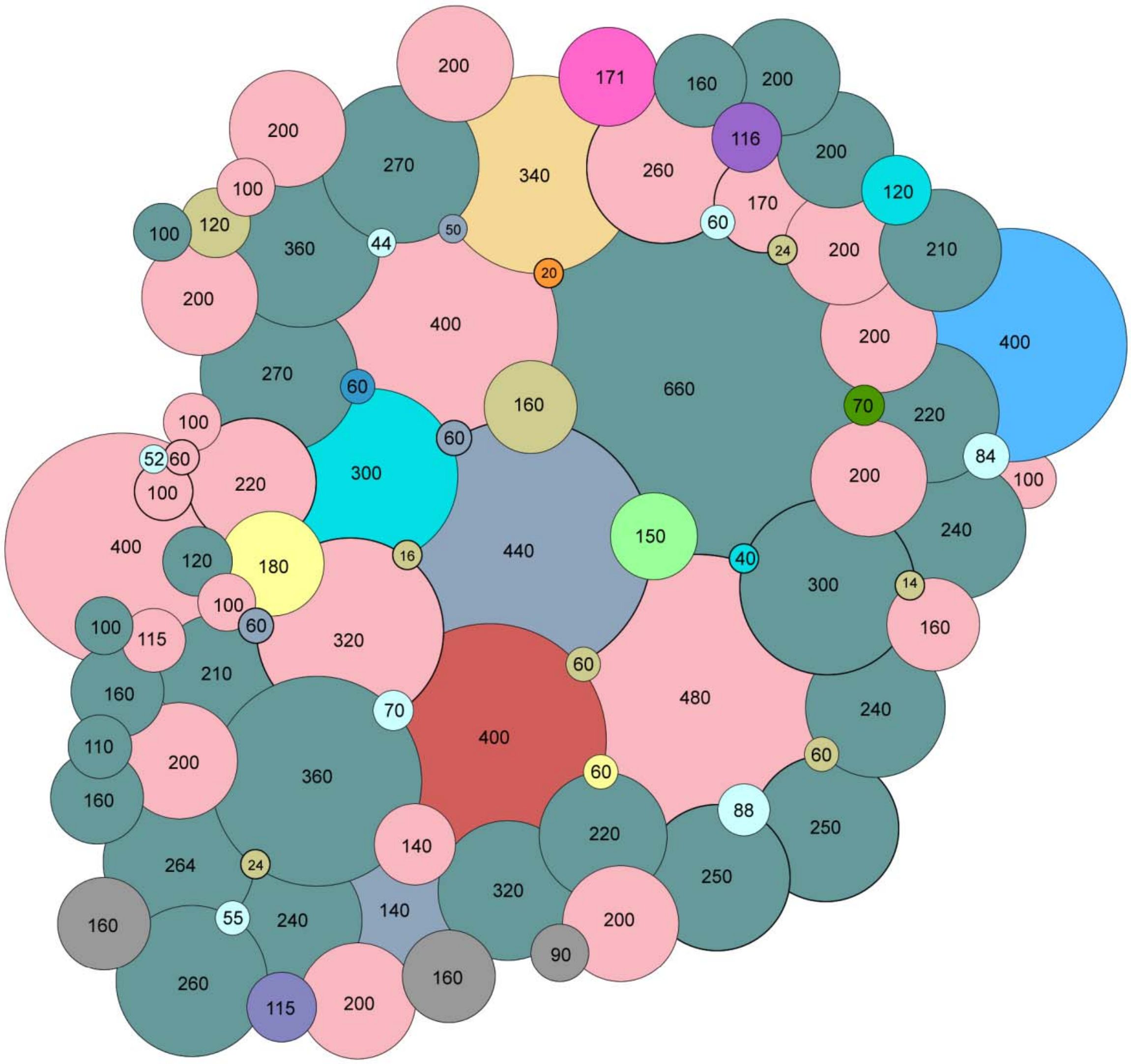
Other & Independent Refineries	Company	B/D	Notes
Dalian	Hengli Petro	400,000	
WEPC Dalian	West Pacific Petro	340,000	Sinochem major shareholder
Shenyang	ChemChina	14,000	
Tianjin	ChemChina	60,000	
Daqing	ChemChina	24,000	
Huaxing	ChemChina	120,000	
Zhenghe	ChemChina	60,000	
Changyi	ChemChina	160,000	

Qingdao	ChemChina	24,000	
Ji'nan	ChemChina	16,000	
Zhongie	CNOOC	50,000	
Shandong	CNOOC	60,000	
Daxie Island	CNOOC	140,000	
Taizhou	CNOOC	60,000	
Huizhou	CNOOC	440,000	
Panjin	Norinco	300,000	
Panjin	Norinco	40,000	
Panjin	Norinco	120,000	
Yulin	Yanchang Petro	160,000	
Yanan	Yanchang Petro	160,000	
Yongping	Yanchang Petro	90,000	
Zhongjie	Genoil	20,000	
Zhoushan	Zhejiang Petro	400,000	Planned
Ningdong	Baota Petro	150,600	
Heze	Dongming Petro	180,000	
Lianyungang	Dongming Petro	60,000	
Huifeng	Huifeng Petro	116,500	
Weifang	Hongrun Petro	115,000	Sinochem controlled
Dongying	Kenli Petro	60,200	
Binzhou City	Chambroad Hldng.	70,000	
Panjin	Panjin North Asphalt	170,700	
Shandong	Lihuayi Petro	70,000	Crude import quota
Shandong	Yatong Petro	55,000	Crude import quota
Shandong	Wonfull Petro	84,000	Crude import quota
Shandong	Tianhong Chemical	88,000	Crude import quota
Shandong	Luqing Petro	52,000	Crude import quota
Shandong	Qirun Petro	44,000	Crude import quota
Shandong	Haiyou Petro	64,000	Crude import quota
	Total:	**4,638,000**	



China Actual & Planned Refining Capacity

'000 Bbls / Day

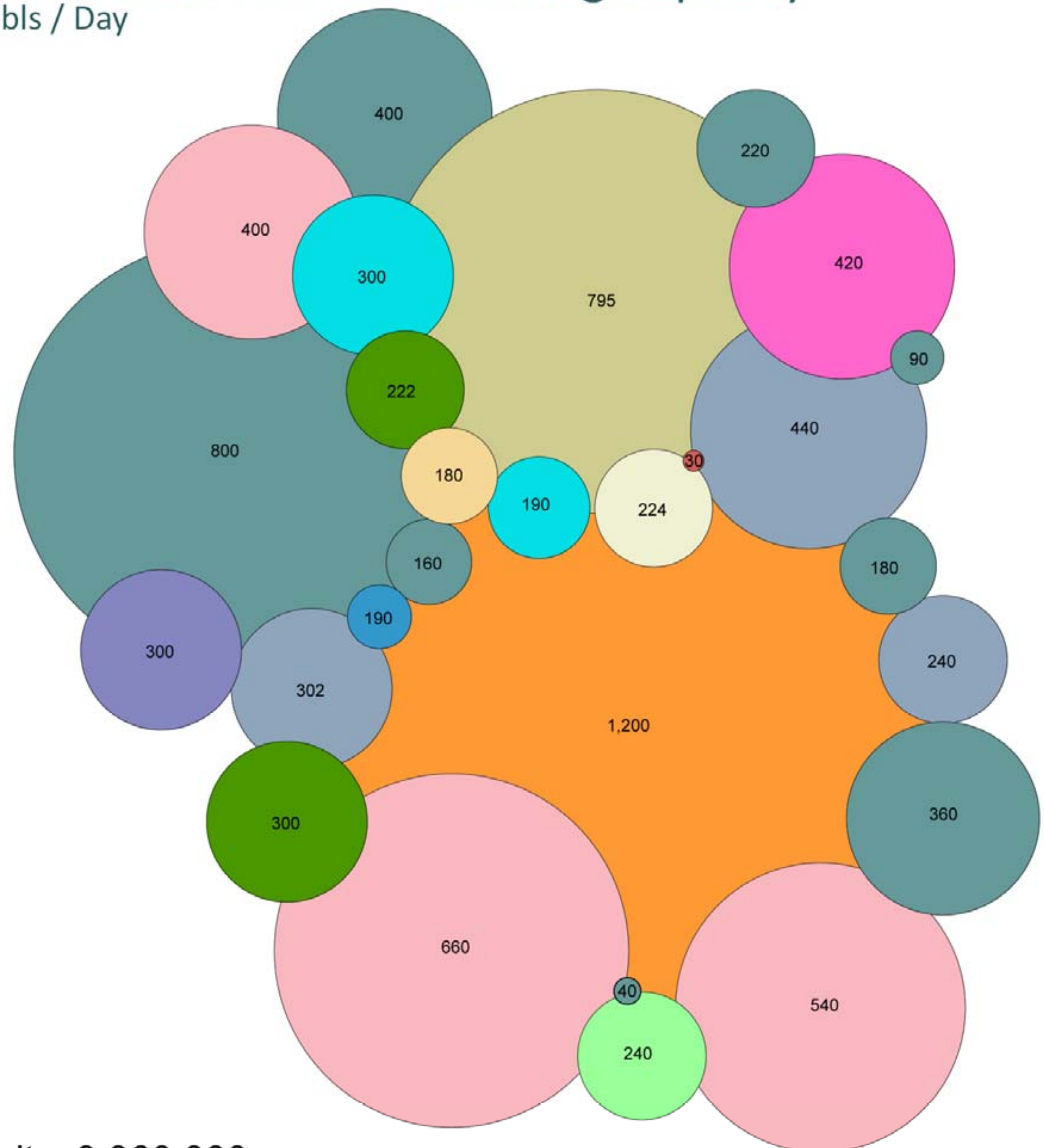


Capacity: 16,117,000

- SINOPEC: 6,454,000
- PetroChina: 5,025,000
- ChemChina: 478,000
- CNOOC: 750,000
- WEPEC: 340,000
- Norinco: 460,000
- Hengli Petro: 400,000
- Genoil: 20,000
- Dongming Petro: 240,000
- Panjin North Asphalt Co.: 170,700
- Chambroad Hldng.: 70,000
- Kenli Petro: 60,200
- Hongrun Petro: 115,000
- Huifeng Petro: 116,500
- Baota Petro: 150,600
- Yanchang Petro: 410,000
- Zhejiang Petro: 400,000
- Lihuayi Petro: 70,000
- Yatong Petro: 55,000
- Wonfull Petro: 84,000
- Tianhong Chemical: 88,000
- Luqing Petro: 52,000
- Qirun Petro: 44,000
- Haiyou Petro: 64,000

CHARLES R. WEBER COMPANY, INC.

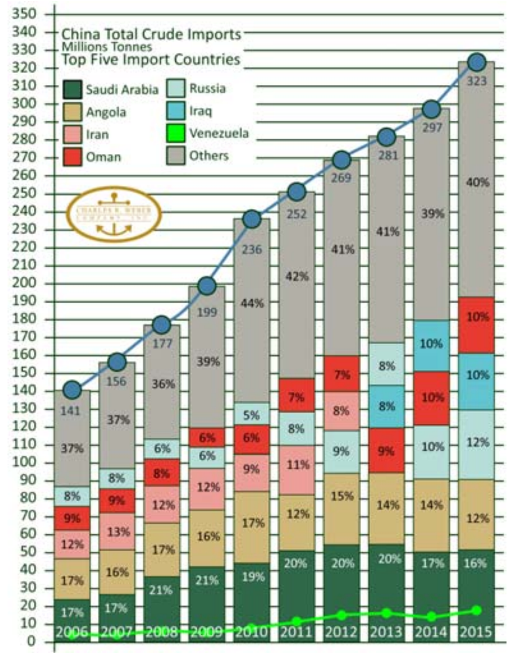
India Actual & Planned Refining Capacity
'000 Bbls / Day



Capacity: 9,360,000

- IOCL: 2,257,000
- RIL: 1,600,000
- EOL: 795,000
- BPCL: 982,000
- HPCL,ONGC: 180,000
- HPCL: 490,000
- IOCL,Adani: 30,000
- BPCL,HPCL,IOCL: 1,200,000
- HMEL: 224,000
- MRPL: 420,000
- CPCL: 522,000
- NOCL: 120,000
- BORL: 300,000
- BPCL,OIL,ASSAM: 240,000

China Accelerates Upgrade of Emissions Standards



It has been widely reported that China is speeding up its upgrading of vehicle sulphur emission standards to control car exhaust pollution, an alleged culprit for the smog that shrouds nearly half the country on many winter days.

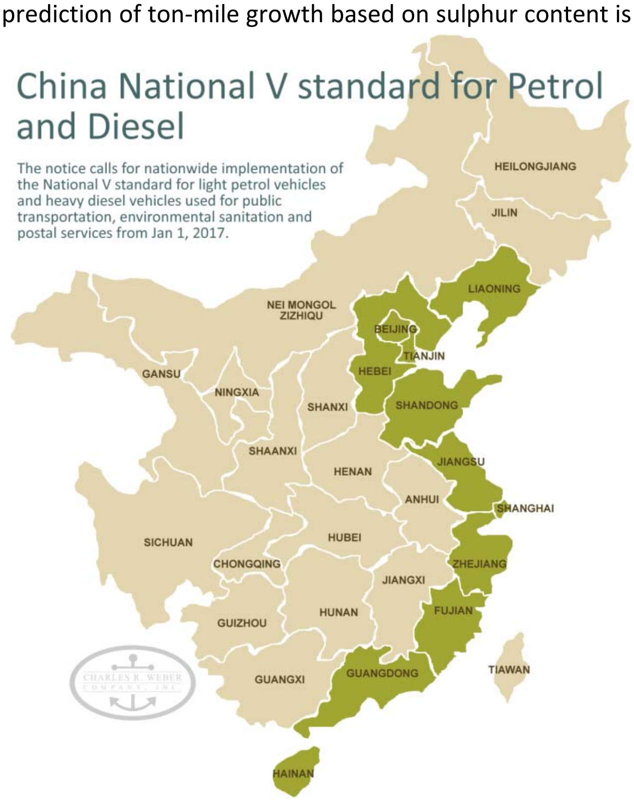
The 11 provinces in East China, where the economy is more advanced than the remainder, were required to put the new emissions standards into effect from April 2016, nine months earlier than originally planned. Those provincial regions are Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong and Hainan.

The standard is similar to the Euro V standard, and requires sulphur content in fuel to be no more than 10 parts per million, one-fifth of previous National IV's 50 ppm requirement.

According to the China ministries' notice, all light petrol vehicles, light diesel buses, and heavy diesel vehicles (for the purposes of public transportation, environmental sanitation and postal services) must comply.

The notice calls for nationwide implementation of the National V standard for light petrol vehicles and heavy diesel vehicles used for public transportation, environmental sanitation and postal services from Jan 1, 2017. It also requires all heavy diesel vehicles across the country to meet the standard from July 1, 2017. All light diesel vehicles throughout China must conform to the standard from Jan 1, 2018.

There has been much talk of whether the imposing of new emission standards for cars and trucks will seriously influence the make-up of China's crude oil import slate. There is a school of thought that believes that China will be forced to import more light, sweet crude from farther afield, West Africa and the Med, which after basic refining will produce lower sulphur products. If China were to start to source lighter, sweet crudes from farther afield it would be a reversal of their present import slate for crudes, which are led by Saudi Arabia and followed by Angola (see above). But what's not noted in the prediction of ton-mile growth based on sulphur content is that the top crudes that China brings in are both light and sweet: Arab Light and Extra Light and Cabinda crudes. (see grades chart).

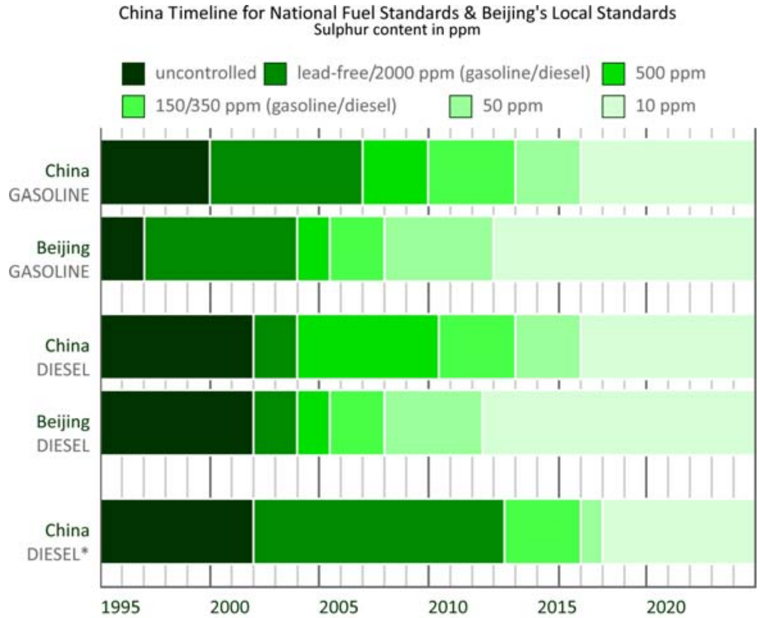


On top of this China has adapted their refinery capacity in order to achieve the sulfur control needed to meet their new fuel standards of 10 ppm sulphur. This has been done through the construction of brand new refineries, closing of obsolete capacity and the addition and/or upgrades of sulphur control and secondary process equipment (see below for refining process).

In addition to upgrading actual process equipment, low sulphur production also requires adequate capacity for hydrogen production, refinery energy supply and sulfur recovery. In very broad terms, refining in China has had three investment routes for upgrading their existing refining capacity to produce low sulphur fuels that meet the new, more stringent 10 ppm standards:

They have added new "grass-roots" process units for sulfur control: fluid catalytic crackers (FCC) naphtha hydrotreating for ULSG and distillate hydrotreating for low sulphur fuels. They have expanded their throughput capacity of existing sulfur control units; and revamped existing sulfur control units to enable more stringent sulfur control.

Some combination of the above, depending on individual refinery needs, is the most economical and practical route to producing lower sulphur products. Once the refinery has been upgraded; or new refinery complex's completed, operators can then adjust their Crude slate properties (i.e. API and sulfur content) in order to extract the best production from the equipment.



*Sulphur requirement for nonroad diesel before Jan 1, 2002, was 10,000 ppm.

In PetroChina's case, they are heralding the initiative they have taken "to develop and apply new technologies to constantly upgrade the quality of their gasoline and diesel products." They have completed upgrading at their 14 refineries. In addition, Dalian Petrochemical, Jinzhou Petrochemical, Huabei Petrochemical, and Guangxi Petrochemical are already capable of producing National V gasoline (with sulfur content of no more than 10ppm).

In 2014 PetroChina domestically processed 150.16 million tons of crude, and produced 101.84 million tons of refined products and 4.98 million tons of ethylene, up 3%, 4% and 25% year-on-year, respectively. They produced 5.69 million tons of 95 octane and higher grade gasoline, 5.45 million tons of National V standard refined products, and 7.11 million tons of jet fuel, up 13.9%, 177% and 18.3% year-on-year, respectively.

Refinery Configurations

China's refining configuration has several distinguishing characteristics.

First of all, it has a huge amount of cracking capacity. In mid 2010, China's ratio of combined cat cracking, hydrocracking, visbreaking, coking, and thermal cracking to CDU was 47%. That is nearly twice the share in Japan, much higher than the Asia-Pacific's average, and only slightly lower than the share in the US.

The high cracking/CDU ratio is attributable to the country's long history of using mainly domestic crudes, which are heavy and waxy with high pour points, as refinery feedstock. Of the cracking plants, however, fluid catalytic cracking and resid catalytic cracking (FCC/RCC) outweigh the others. As 2011 began, China had 2.6 million b/d of FCC/RCC capacity, accounting for 50% of their total cracking capacity.

In addition to FCC/RCC, China's coking and hydrocracking capacities are also large. Coking capacity has been expanded at a rapid pace since 2004, reaching 1.3 million b/d at the start of 2011. Hydrocracking capacity is even more dramatic. Before 2004, China only had 270,000 b/d of hydrocracking capacity. By early 2011, China's hydrocracking capacity had topped 1 million b/d.

The second characteristic of China's refinery configuration is that its cat reforming capacity (nearly 800,000 b/d at the start of 2011, or 7% of CDU capacity) is still lower than the shares of cat reformers in Japan (17%) and the US (20%). China's reformer/CDU ratio is also less than the average ratio of 11% for the Asia-Pacific region. This difference is again partly due to China's historical crude slate, of which the naphtha yield was low and insufficient to support a large reformer capacity.

Refinery Classification Scheme		
	Complexity	
Configuration	Ranking	Range
Topping	Low	<2
Hydroskimming	Moderate	2-6
Conversion	High	6-12
Deep Conversion	Very High	>12

Though it should be noted that the Cat reforming capacity in China at the start of 2011 was more than double the capacity of 316,000 b/d at the start of 2001 and is even larger now.

Thirdly, China has sharply increased its hydrotreating/hydrorefining capacity in recent years to address the tightening specification for gas oil and gasoline. At the start of 2011, China had 3.2 million b/d of hydrotreating/hydrorefining capacity, a jump from less than 800,000 b/d at the start of 2001.

Fourthly, China's capability for handling sour crudes has increased substantially since the mid-1990s. China has increased its capability to handle heavy oil as well as fuel oil as feedstock. This is partly due to the refiners associations with domestic fields in the northeast whose crudes produced in aging fields have become increasingly heavy.

China's capability and experience in handing sour crudes deserve a special note. With some exceptions, such as crudes from Oman, Yemen, part of Abu Dhabi, as well as Arab Extra Light from Saudi Arabia, Middle East crudes all have high sulfur content, while many Chinese refineries, until the mid-1990s, were unable to process such crudes. China has since moved to raise its sour-crude handling capability. In the mid-1990s, in anticipation of rising Middle East oil imports, Sinopec started revamping, upgrading, and expanding its refineries to add sour-crude processing capabilities.

These efforts have produced some notable results. China presently has about 5.3 million b/d of processing capacity for imported sour crudes. Plus conversion and deep conversion refineries constitute the majority of crude running capacity in facilities with capacity over 50,000 b/d. All new refineries being built in China are either conversion or deep conversion refineries.

Each refinery's configuration and operating characteristics are unique. They are determined primarily by the refinery's location, vintage, preferred crude oil slate, market requirements for refined products, and quality specifications (e.g., sulfur content) for refined products. In this context, the term *configuration* denotes the specific set of refining process units in a given refinery, the size (throughput capacity) of the various units, their salient technical characteristics, and the flow patterns that connect these units.

Although no two refineries have identical configurations, they can be classified into groups of comparable refineries, defined by refinery *complexity*. In this context, the term *complexity* has two meanings. One is its non-technical meaning: intricate, complicated, consisting of many connected parts. The other is a term of art in the refining industry referred to as the Nelson Complexity Index. The Nelson Index is a numerical score that denotes, for a given refinery, the extent, capability, and capital intensity of the refining processes downstream of the crude distillation unit (which, by definition, has complexity of 1.0).

The higher a refinery's complexity, the greater the refinery's capital investment intensity and the greater the refinery's ability to add value to crude oil by:

- Converting more of the heavy crude fractions into lighter, high-value products and
- Producing light products to more stringent quality specifications (e.g., ultra-low sulfur fuels).

Broadly speaking, all refineries belong to one of four classes, defined by process configuration and refinery complexity (complexity figures are based on Nelson complexity index).

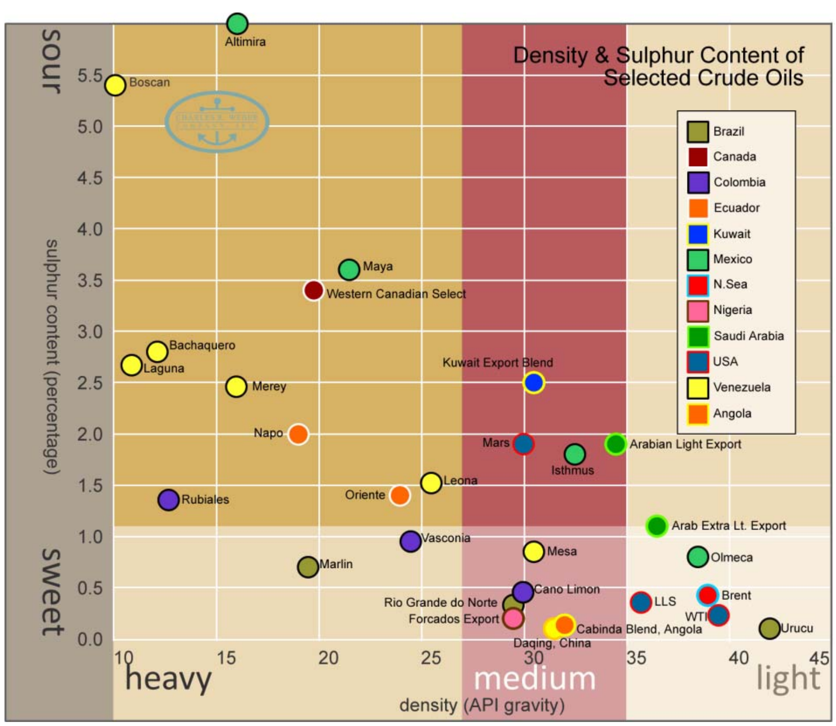
Topping refineries have only *crude distillation* and basic *support operations*. They have no capability to alter the natural yield pattern of the crude oils that they process; they simply separate crude oil into light gas and refinery fuel, naphtha (gasoline boiling range), distillates (kerosene, jet fuel, diesel and heating oil), and residual or heavy fuel oil. A portion of the naphtha material may be suitable for very low octane gasoline in some cases. Topping refineries have no facilities for controlling product sulfur levels and hence cannot produce ULSF.

Hydroskimming refineries include not only crude distillation and support services but also *catalytic reforming*, *various hydrotreating units*, and *product blending*. These processes enable (1) upgrading naphtha to gasoline and (2) controlling the sulfur content of refined products. Catalytic reforming upgrades straight run naphtha to meet gasoline octane specification and produces by-product hydrogen for the hydrotreating units. Hydrotreating units remove sulfur from the light products (including gasoline and diesel fuel) to meet product specifications and/or to allow for processing higher-sulfur crudes. Hydroskimming refineries, common in regions with low gasoline demand, have no capability to alter the natural yield patterns of the crudes they process.

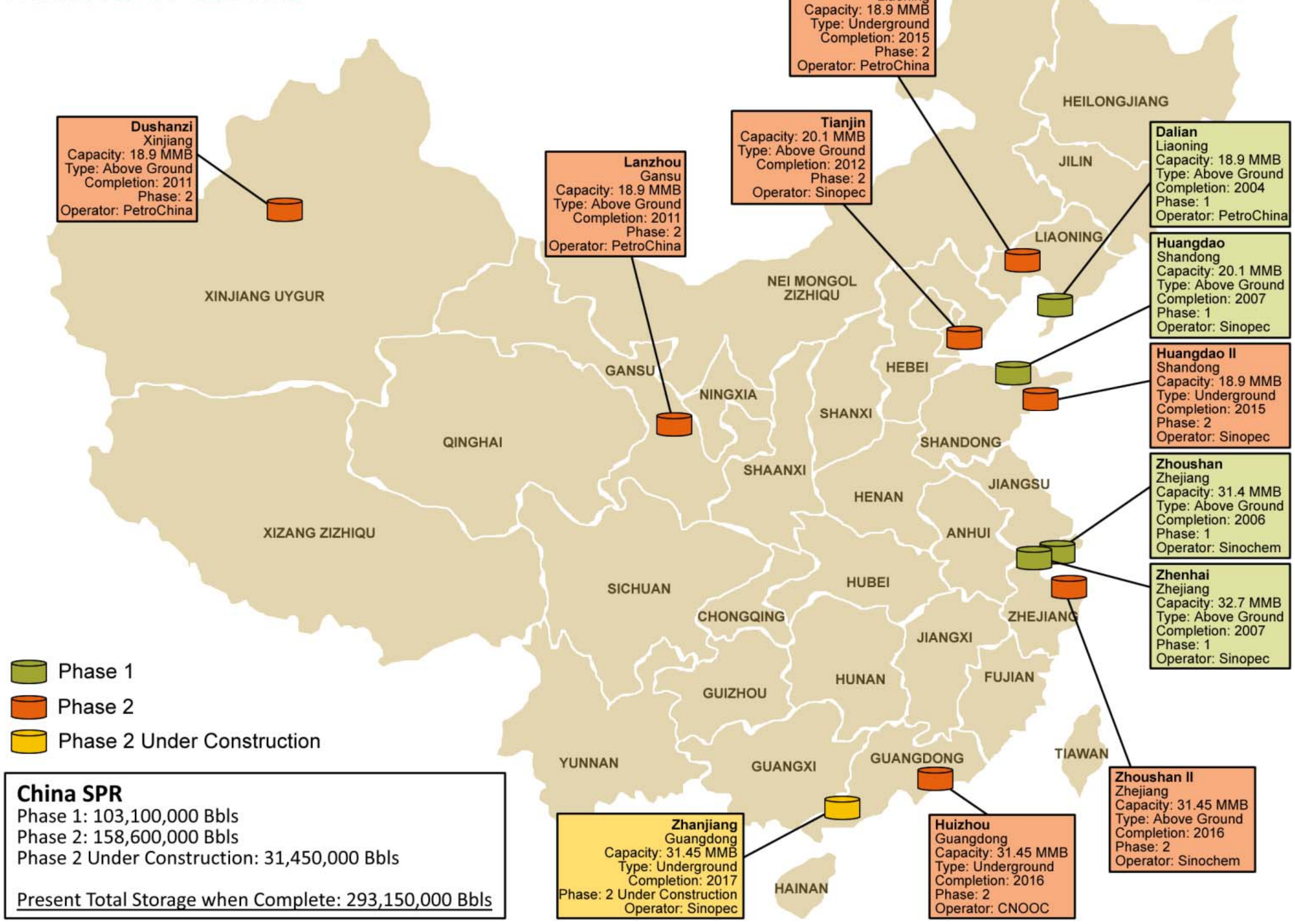
Conversion (cracking) refineries include not only all of the processes present in hydroskimming refineries but also, and most importantly, *catalytic cracking* and/or *hydrocracking*. These two conversion processes transform heavy crude oil fractions (primarily *gas oils*), which have high natural yields in most crude oils, into light refinery streams that go to gasoline, jet fuel, diesel fuel, and petrochemical feedstocks. Conversion refineries have the capability to improve the natural yield patterns of the crudes they process as needed to meet market demands for light products, but they still (unavoidably) produce some heavy, low-value products, such as residual fuel and asphalt.

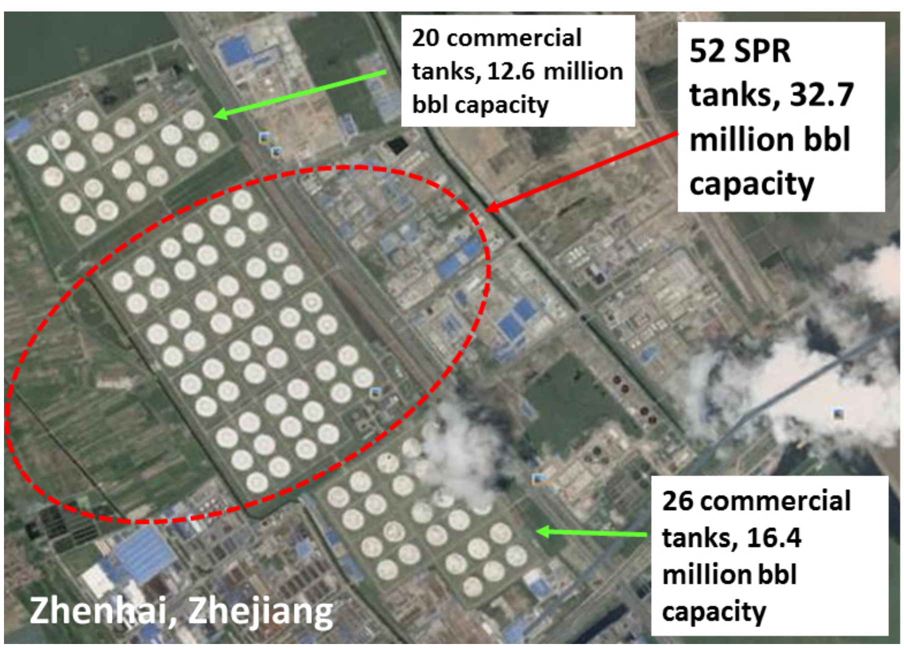
Deep Conversion (coking) refineries are, as the name implies, a special class of conversion refinery. They include not only catalytic cracking and/or hydrocracking to convert gas oil fractions, but also coking *or* residual hydrocracking. Coking units "destroy" residual oil (the heaviest and least valuable crude oil fraction) by converting it into lighter streams that serve as additional feed to other conversion processes (e.g., catalytic cracking) and to upgrading processes (e.g., catalytic reforming) that produce the more valuable light products. In residual hydrocracking, the hydroprocessing part of the operation yields a higher quality product, suitable for product blending. Deep conversion refineries with sufficient coking or residual hydrocracking capacity destroy essentially all of the residual oil in their crude slates, converting them into light products.

Almost all U.S. refineries are either *conversion* or *deep conversion* refineries, as are the newer refineries in Asia, the Middle East, South America, and other areas experiencing rapid growth in demand for light products. By contrast, most refining capacity in Europe and Japan is in hydroskimming and conversion refineries.

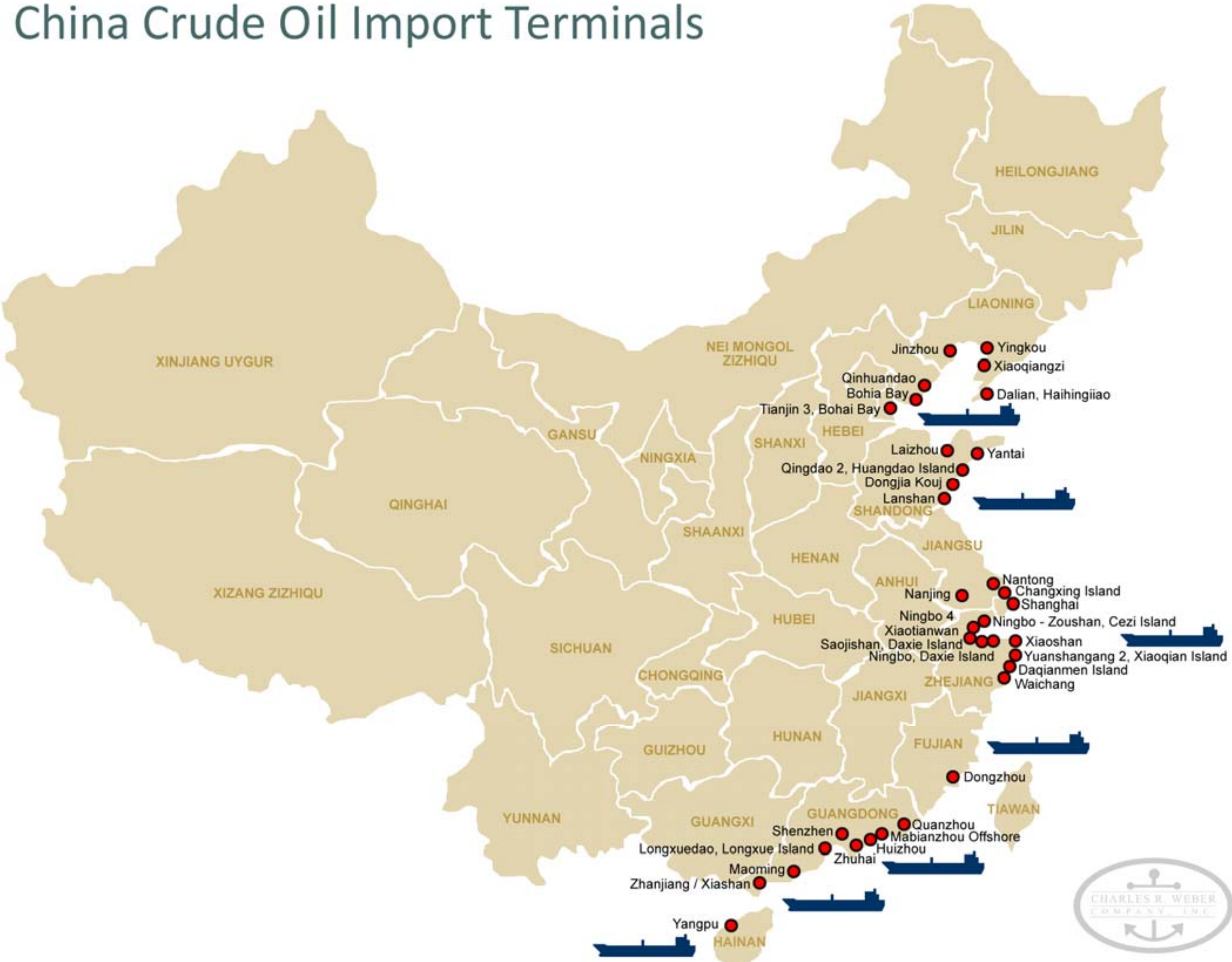


China Strategic Petroleum Reserve (SPR)
Millions of Barrels





China Crude Oil Import Terminals



Global Regulations

2016 2017 2018 2019 2020 2021 2022 2023 2024 2025

BWMS

The committee was concerned about the lack of international agreement on how to implement the BWM treaty, it may decide to give shipowners more time to comply.
MEPC will decide whether to require BWM compliance from Sept. 2017, or whether to push the requirement back until the first such survey after the autumn of 2019 (under certain conditions).

BWM compliance at the ship's first five-year IOPP survey after Sept. 2017.
First five-year IOPP survey
May push the requirement back until the first IOPP survey after autumn 2019.

CO2

Each vessel will also have to have a certified Ship Energy Efficiency Management Plan outlining its methods for collecting and reporting the data. Each year, the shipowner will collect data for a fleet, aggregate it into annual values and report it to the appropriate flag administration or recognized organization. The IMO will collect this annualized data from the flag states.

IMO CO2 strategy not finalized until 2023, when data on fleet fuel consumption will be available.

From 2019 vessels over 5,000 gt on international voyages must record:
Fuel consumption for each type of fuel used.
Distance travelled and hours under way.

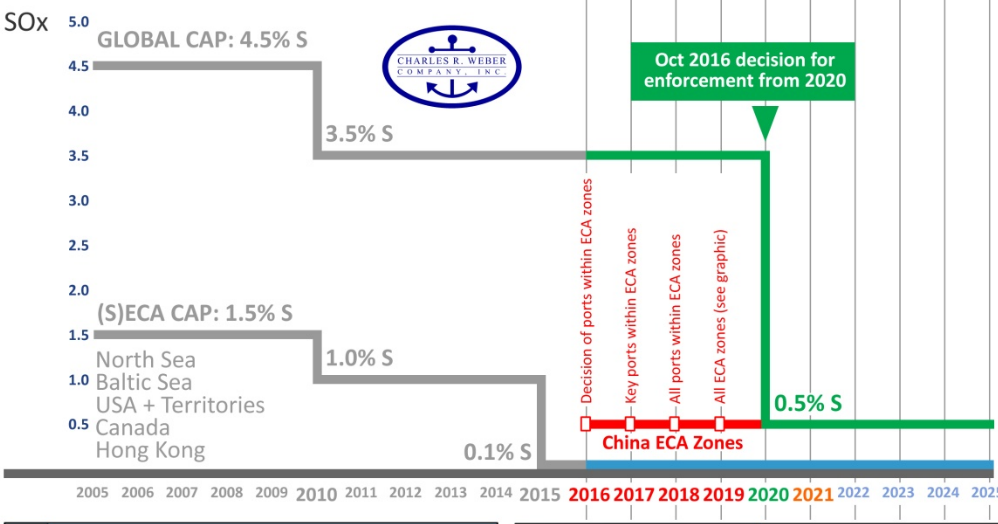
NOx

Euro: Vessels built on or after January 1, 2021 must comply with NOx Tier III standards when operating in the North Sea or Baltic Sea NECA.

Tier II Europe
Tier II North America
Vessels blt after 1/1/21
Tier III Europe
Vessels blt after 1/1/16
Tier III North America

N.A.: Vessels built on or after January 1, 2016, must comply with NOx Tier III standards when operating in the North American, Hawaii or the U.S. Caribbean Sea NECA.

SOx



Yangtze River Delta Emission Control Area

Inland water areas: navigable waters under the administrative jurisdiction of 15 cities including Nanjing, Zhenjiang, Yangzhou, Taizhou, Nantong, Changzhou, Wuxi, Suzhou, Shanghai, Jiaxing, Huzhou, Hangzhou, Shaoxing, Ningbo, Zhoushan and Taizhou.

Key ports: Shanghai, Ningbo-Zhoushan, Suzhou, Nantong.

Bohai-rim Emission Control Area

Inland water areas: navigable inland waters under the administrative jurisdiction of 13 cities including Dalian, Yingkou, Panjin, Jinzhou, Huludao, Qinghuangdao, Tangshan, Tianjin, Cangzhou, Binzhou, Dongying, Weifang, Yantai.

Key ports: Tianjin, Qinhuangdao, Tangshan and Huanghua.

China Regulations

Year January 1	Sulfur Content	Area Applicable
2016	Current standard as stipulated in international conventions. Domestic laws remain unchanged.*	**All areas.** Local ports in ECAs may in view of its own situation exercise its discretion to raise higher requirements than current standard, such as requiring ships to use fuel with sulfur content of .0.5% during berthing.**
2017	≤0.5%m/m	**Geographical area:** key ports in ECAs **Time period:** berthing period excluding 1 hour after berthing and 1 hour before departure
2018	≤0.5%m/m	**Geographical area:** all ports in ECAs **Time period:** whole berthing period
2019	≤0.5%m/m	**Geographical area:** whole area of ECAs **Time period**: whole period when the ship is in the ECAs

*China is a contracting state to Marpol 73/78 and Annex VI came into effect from 23 Aug 2006 in China. The current Marpol limit in terms of SOx is:
(1) outside ECAs: 3.5%m/m since 01 Jan 2012; (2) within ECAs:0.1% as from01Jan 2015.

**We understand that most of the port authorities don't have the intention to adopt higher requirement than the current standard in 2016, except Shanghai. We understand that it is likely Shanghai MSA will start to require the calling ships to use fuel with sulfur content of 0.5%m/m while at berth excluding 1 hour after berthing and 1 hour before departure in 2016, however an accurate timetable is still under consideration now.

Pearl River Delta Emission Control Area

Inland water areas: navigable inland waters under administrative jurisdiction of 9 cities including Guangzhou, Dongguan, Huizhou, Shenzhen, Zhuhai, Zhongshan, Foshan, Jiangmen and Zhaoqing.
Key ports: Shenzhen, Guangzhou and Zhuhai.

Before 31 Dec 2019, the government will evaluate the effect of the above requirements in order to determine whether to take the following steps in the future:
(i) When entering the ECAs, ship shall be required to use fuel with a sulfur content of no more than 0.1% m/m;
(ii) Enlarge the geographical scope of ECAs;
(iii) Other further measures.
According to the regulation, MSA shall enhance inspection of IAPP certificate, oil record book, fuel supply document and check of fuel quality, etc. to ensure implementation of the relevant requirements.

Global Top Five Crude Oil Importers