SMU EMERGING MARKETS

Summer Publication 2021

The New Road Ahead

A Closer Look Into China's Post Pandemic Developments

SMU Emerging Markets

SMU Emerging Markets (SEM) is a student initiative that aims to be a global and interactive business collaboration centre for research on emerging markets. Brought together by their strong interest in the emerging markets, the founders of SEM share a common goal of propagating the importance of emerging markets to the SMU student population. We recognize the importance of equipping SMU students with a keen acumen for issues pertaining to emerging markets.

In doing so, we also wish to further propel students who already have a keen interest in emerging markets and to distil their knowledge through close partnerships with internationally recognized industry partners. Through our research, events and study missions, we aim to create a thriving environment and platform for students to cultivate knowledge beyond textbooks. SEM is passionate about discovering new opportunities and growth trends in emerging regions. In line with our goals, the club is made up of 6 research desks representing the following key emerging regions: Central and East Asia, Emerging Europe, India, Latin America, Middle East and Africa, and South-East Asia.

Prepared By

Sia Kuang Hong
khsia.2020@accountancy.smu.edu.sg

Sun Han Chen
hanchen.sun.2019@economics.smu.edu.sg

Brennen Tan
brennen.tan.2020@business.smu.edu.sg

James Dang
james.dang.2019@business.smu.edu.sg

Hur Sang Yoon
syhur.2020@business.smu.edu.sg

Jonathan Tan
jonathantan.2020@business.smu.edu.sg

Wang Qiang
qiang.wang.2020@business.smu.edu.sg

Marc Hoo
marc.hoo.2020@business.smu.edu.sg

Leong Chi Yui
cyleong.2020@business.smu.edu.sg

Contacts

https://www.smuem.com

https://www.linkedin.com/company/smu-emerging-markets/

Introduction

Believed to be one of the four cradles of civilisation, the geographical region where modern China now is, played, and still plays, a key role in the world. From the reforms by Qinshihuang and the great voyages in the Ming dynasty by Admiral Zheng He, to the Opium Wars and unrest in the later half of the 19th century, the story of China has had its ups and downs. Modern China, which we are familiar with, began its rise with the gradual opening led by Deng Xiaoping, which greatly accelerated with its participation in the World Trade Organisation. Events, most recently the US-China Trade War and the COVID-19 pandemic have thrust China into negative light, especially in developed European and American states. At the same time, China has transformed its economy and quality of life. Recent roadmaps espouse ambition and drive – "Made in China 2025" targets "70% self sufficiency" in semiconductors; to achieve its environmental obligations China aims to be carbon neutral by 2060, lofty goals to strive for as China develops further.

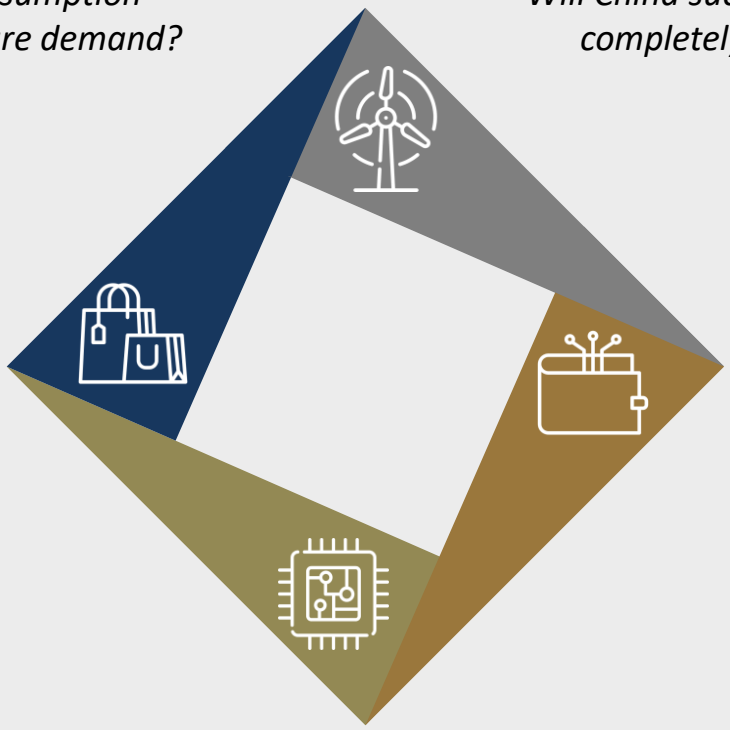
At SMU Emerging Markets, we believe in the need to be cognizant of the advancements in China and its potential to play an even more important role, especially in Southeast Asia. The 4 key areas of our publication weave a balance between more consumer-facing and business-facing aspects of Chinese industry, in the context of obstacles today: an increasingly complex regulatory environment to keep up with technological progress, an increasing divide between China and the West, climate change becoming more urgent than ever and, as China ages, the absence of a demographic dividend that drives growth. Insofar as the road to prosperity is lined with bountiful harvest, one must consider those challenges as China strives towards its goals.

Consumer Goods

How will new consumption trends shape future demand?

Resource & Energy

Will China successfully become completely carbon neutral?



Industrials

Will China be able to resolve its semiconductor predicament?

Financials

How will China's digital economy look like in light of regulations?

Contents

1

New Age of Consumption

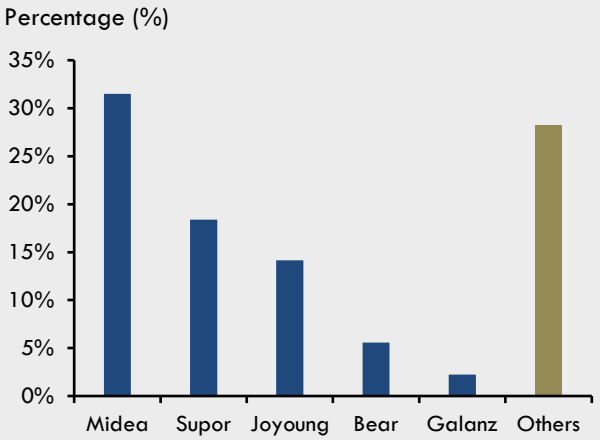
Several potential winners stand to emerge in each of the sectors covered due to recent developments. The home appliances sector has seen steady growth on the back of booming e-commerce and increasing food experimentation during lockdowns, with increasingly cross-compatible smart appliances leading the charge. On the alcohol front, China is pushing heavily with its plan to transform Ningxia into its own Bordeaux, motivated by shifting preferences of the middle class and reduced imports from Australia as a result of the trade war. China's Baijiu producers need to put in comparatively more work to product differentiate due to falling demand by younger consumers. Domestic luxury good producers look to be the emerging victors overall with tightening Chinese government's regulations on the grey market and counterfeit e-commerce luxury goods. Plans have also been set to establish Hainan as its duty-free haven, promoting domestic travel and sales, incentivising market players to develop their industry presence.

Smart Appliances for Smart Consumers

COVID-19's impacts on people's habits at home are well-known – people eat and cook more and take heed more to hygienic practices; some journalists in the West even fantasised about the death of restaurants, while many people have been taking to discovering new cuisines at home. China is not dissimilar and this has driven growth in the home appliance industry. China's competitive kitchen appliance market, which will be the focus of our analysis, has benefitted from changing consumer trends favouring cooking at home and experimentation, while technology has enabled integration of these products with other "smart" household goods.

Housing Market Correlation May Not Last: Although analysts have linked the prospects for home appliances to property's fortunes, the correlation is likely to weaken. Range hood sales growth has largely tracked the residential floor space growth from 2012 to 2019, and despite strong property demand with 62 of 70 major cities reporting a rise in property prices of average 4.8% m-o-m in April 2021[1], it might not mean optimism for home appliances[2]. China's average home vacancy rates in 2020, as researched by academics, was at 17% in tier 1 cities and going up to 21%[3] in tier 3, similar to latest official statistics in 2017[4]. This suggests that high property demand is partly driven by investments and thus might not be occupied.

Figure 1 : Market Share (Small Appliances)



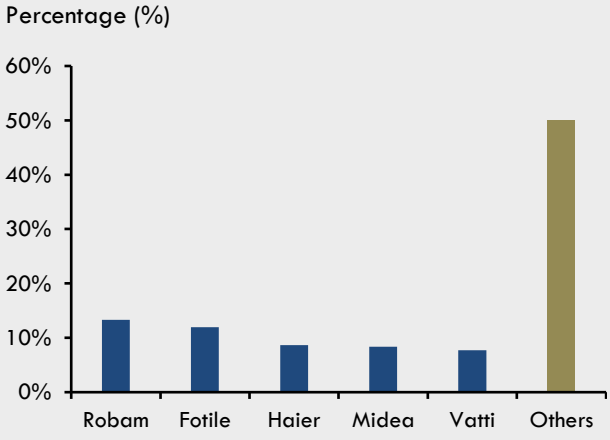
Source: Euromonitor International, 2021

Buoyed by Changing Trends

Suitable Features: The local home appliance giants Haier, Media and Joyoung are virtually unknown in the West. As seen in Figures 1 and 2, for both small (blenders, juice makers etc) and large (stoves, range hoods etc), the market is dominated by local players. The ability of local players to provide appliances suitable for Chinese consumers is one factor that ensures continued popularity. Stoves, for example, are usually gas powered to provide extra heat for stir frying relative to induction or electric hobs, and other appliances like soybean drink makers and rice cookers are uncommon in western markets. Joyoung, which originally specialised in soybean drink makers, took advantage of Chinese eating habits: China is the largest importer of soybeans, at 100 million metric tonnes (mmt), with 2nd place EU only 15.4mmt[5].

E-commerce Drives Accessibility: However, even among appliances, there is still room for growth: the tier 3/4 cities and rural areas will see demand. As urban Chinese returned to their families during the CNY lockdown and stayed put for an extended time period, they could have introduced the older generation to digital technology and got them to remain users. Rural internet penetration rose from 39.8% in Jun 2019 to 55.9% in Dec 2020[6], while above-55 age group's penetration rate

Figure 2 : Market Share (Large Appliances)



Source: Euromonitor International, 2021

increased the greatest. The increased awareness of kitchen appliance amongst rural and lower-tier city dwellers, combined with the developments in logistics networks brought about by COVID-19 will further drive kitchen appliance sales.

Correspondingly, online home appliance sales have seen steady growth, posting a y-o-y rise of 14.48%, while offline channels saw a 21.14% fall in the same period. This presents consolidation opportunities to retailers. Major home appliance retailers like JD.com, with a 27% market share, are expanding into omni-channel retailing by franchising stores in smaller cities and rural areas, while offline retailers like Suning are expanding online[7]. In rural areas, where specialty and franchised stores make up 75% of distribution market share, the entry of e-commerce giants would bring about more diverse product offerings and a more constant market presence, again driving consumer growth in this area – especially when 65% of new JD consumers came from tier 3-5 cities in H1 2020[8].

Competition for Features

Although the rural segment could drive sales, younger, urban consumers also play a role in the sector's performance. Chinese consumer surveys on consumers born after 1990 state price and product features as key concerns for consumers, not unlike trends in automobile and e-commerce. Similarly, half of surveyed respondents enjoy baking and researching new menus on their own[9]. The market players have responded accordingly with smarter, feature-rich appliances catered towards the young consumers.

Smarter Consumers, Smarter Appliances? Haier has leveraged on this strategy with its push towards smart homes, bundling its appliances together and pushing their OTA update features. Casarte, its high-end smart appliance brand sold by subsidiary Haier Smart Home, saw a 79% y-o-y revenue growth, and Haier's kitchen appliance segment posted the highest growth in revenue at 13% from all its business segments. Similarly, Midea has its own smart home segment[10], with 78% of products in-store being "smart". This is especially applicable to young consumers looking to diversify cooking options[11]. The industry – most notably Supor and Joyoung has started to offer products like air fryers and sandwich makers, and more tech-enabled corporates like Haier have attempted to bundle famous recipes into its smart stoves and ovens, which automatically adjust cooking parameters – useful for the younger, busier urban Chinese surveyed.

Integration With The Broader Ecosystem: Related to the trends in smart devices, is the possibility to increase market share and switching cost through the development of a comprehensive ecosystem. Where producers are already diversified in kitchen appliances, they have stepped up to integrate their product offerings with other digital devices. Midea's, Robam's and Joyoung's newer smart product offerings run HarmonyOS, which is an IoT-focused operating system developed by Huawei Technologies. Its key differentiating feature is DSoftBus, enabling different hardware to communicate and control one another remotely[12], which improves cross-compatibility between different IoT device brands. Haier, on the other hand, has its own OS, UHomeOS, but its relatively diversified portfolio and market share gives it the power to do so[13], as it offers a whole suite of smart home products including televisions, locks and refrigerators. As HarmonyOS is open source, it lowers the barrier to entry[14] for potential entrants looking for cross device compatibility through DSoftBus, or more specialised firms like Robam, which makes stoves, and Joyoung, which makes tabletop kitchen appliances, to connect to other smart-enabled kitchen and/or home appliances without first having to build up an entire ecosystem, thus reducing the barrier for competitors.

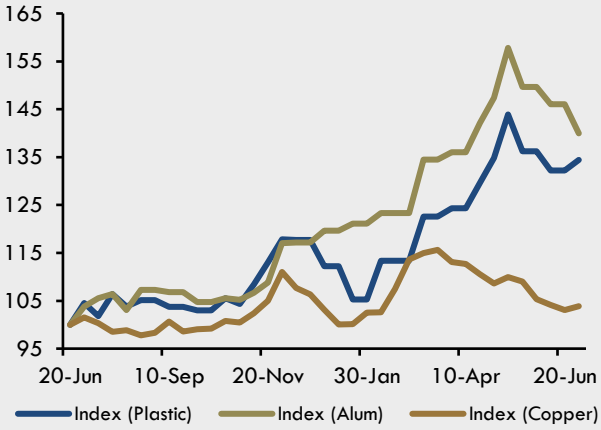
Short-Term Costs Hurt Margins

Higher Cost of Raw Materials: Kitchen appliances' costs are mainly the result of raw

materials, which accounts for about 90% of COGS. The main inputs are plastics like polypropylene for the exterior and buttons, as well as metals like aluminium and copper[15] (Figure 3) for other exterior components and batteries. In line with commodity prices rising, due to supply disruptions in the earlier half of the year for polypropylene[16], and the increased demand for home products and electric vehicles driving aluminium and copper price increases. Furthermore, supply shortages worldwide had increased demand for Chinese polypropylene[17], due to the fluid nature of COVID-19. Margins have been hurt accordingly, as seen by the fall in the gross margins in Q1 (Figure 4), and consequently leading to y-o-y price increases of up to 13%, especially in larger appliances like refrigerators. As societies emerge from lockdowns[18], however, supply is set to increase, abating the shortage.

Figure 3: Plastic, Al and Cu Price Indices

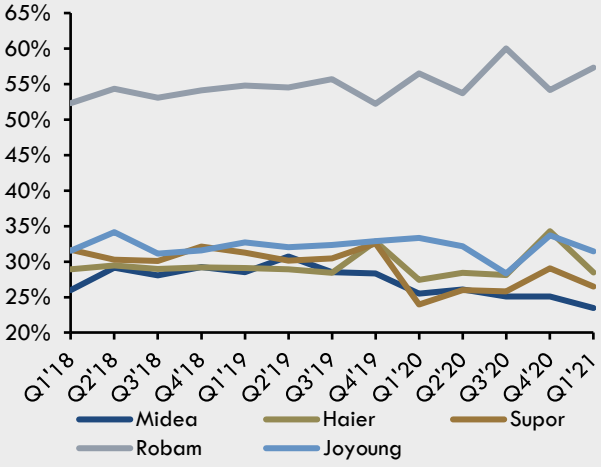
20 Jun 20 = 100



Source: CEIC

Figure 4: Gross Margins of Selected Mfrs

Percentage (%)



Source: Company Filings

Overseas Expansion Double-Edged Sword: The largest diversified Chinese retailers, namely Midea and Haier, derive substantial revenues from their export market. 42.26% of Midea's 48.6%[19] of Haier's revenues originate from export markets. On the contrary, only 0.45%[20] of Robam's revenue However, the gradual appreciation of the Chinese renminbi, brought about by an increase in the demand for Chinese exports as a result of continued supply-chain disruptions, and foreign inflows into China increasing with attractive bond yields and the opening up of the domestic capital markets to foreign investors. The RMB hit a 3-year high against the USD in June 2021 before slightly weakening in July[21]. With a highly-valued RMB, the competitiveness of Chinese exports, including home appliances, would be hit. Midea and Haier had prepared for this possibility, with half of Midea's plants operating outside China in Southeast Asia[22], North Africa and the Americas, while Haier had embarked on a M&A strategy to acquire existing brands like GE Appliances in North America and Candy in Europe[23], over exporting its Chinese-made products to other markets[24], to mitigate exchange rate risks. Nevertheless, regional markets like Southeast Asia could remain as possible opportunities, with also relatively weak currencies relative to the USD.

What's Next for China?

The Chinese consumer's openness to technology, and the associated support that home appliance makers get from device manufacturers create a comprehensive ecosystem that spurs the overall direction of kitchen appliance to a more tech-enabled one, supported by shifting consumer trends towards e-commerce and greater experimentation with cooking styles. In the short term, margins might be hurt and exchange rates might not be favourable, but as these are considered more transient in a turbulent global economy, the strong demand drivers signal optimism for kitchen appliances in the medium term.

Alcohol: Coming of Age

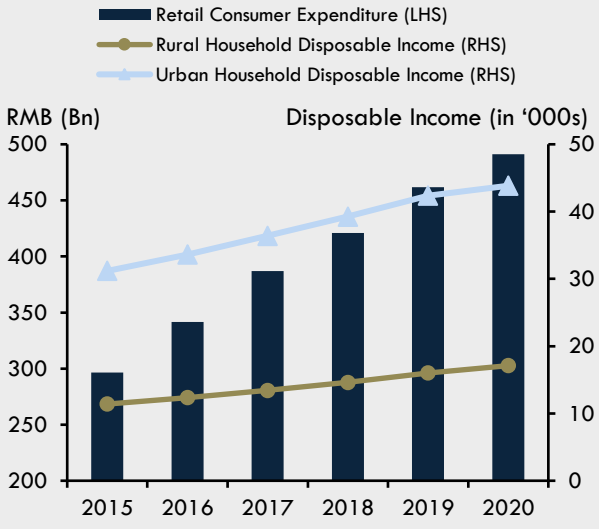
In China, alcohol is referred to as the "Water of History" due to its ever-presence in folklores from almost every period in Chinese history. Today, alcohol still plays a critical role in the development of sectors such as agriculture and remains important in Chinese society through its presence in a myriad of social activities ranging from corporate meetings to familial gatherings.

While the steady increase in both urban and rural disposable household income contributed heavily to rising consumer expenditure on alcoholic beverages and subsequently the growth of China's alcohol industry from 2015-2020, the alcohol market suffered from a decline in total volume in FY2021 owing to the COVID-19 pandemic (Figure 5)[25].

Post-COVID Strategies

Online Retail Shift: Alcoholic drinks are available via several channels in China – the most popular of which are supermarkets and independent small grocers[26]. However, convenience stores located in neighbourhoods became the first choice for consumers to purchase daily necessities, including alcoholic drinks, at the height of the COVID-19 pandemic as most consumers avoided unnecessary travel to larger supermarkets which are located at out-of-town locations. Consequently, industry players such as Tsingtao Brewery and Carlsberg China shifted towards online retailing, reallocating resources to e-commerce channels such as online supermarkets, WeChat stores, and major online business-to-consumer platforms such as Tmall.com and JD.com. While the worst of the impact of the COVID-19 pandemic has subsided, optimizing digital channels will remain as one of the key strategies to be undertaken by large industry players[27].

Figure 5: Retail Consumer Expenditure on Alcoholic Drinks



Source: National Bureau of Statistics of China

Live-Streaming: Cognac giant Rémy Cointreau Group increased its online allocation to 20% of sales revenue to organise promotional and marketing activities through live-streaming and short videos in order to achieve growth during the pandemic[28]. Under the spirits segment, leading players utilised live-streaming as a key tool to launch new products. According to JD.com, sales of whisky products increased by eight times during a special live-streaming event as compared to the same time the day before[29].

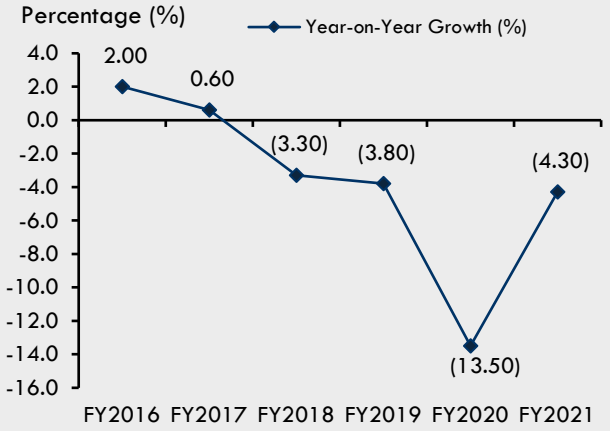
On-trade vs Off-trade Channels: A shift of alcoholic drinks consumption from on-trade to off-trade was observed in some alcohol categories, such as cognac, cream-based liqueurs, Japanese whiskies, Scotch whiskies and ready-to-drinks (RTDs), which recorded increasing y-o-y growth rates in terms of off-trade sales volume. This phenomenon can be largely attributed to the rising popularity of Western-cultivated alcohol amongst the younger Chinese generation, and the rise of e-commerce platforms such as JD.com. Furthermore, the rise in off-trade sales volume can be credited to the shift of alcohol consumption from bars and restaurants into private space due to lockdown restrictions.

Spirits – Age of Innovation

China is the world leader in market revenue of the spirits segment (USD134.5bn), eclipsing the United States (USD83.9bn) and India (USD34.5bn)[30]. However, China's spirits market recorded a decline of 13.5% in total volume of sales in FY 2020 owing to the COVID-19 pandemic which resulted in a sharp drop for on-trade consumption, especially during the Spring Festival which accounts for a substantial proportion of spirit sales annually. Nevertheless, the spirits segment experienced a slowdown in declining sales of 4.3% in FY 2021 due to China's return to normalcy. (Figure 6)

Need for Innovation: China's spirits market experienced y-o-y declining growth prior to the onset of the pandemic; this was heavily attributed to the decline in consumption of its national distilled alcoholic beverage – Baijiu – which accounts for 65% of market share[31]. There was an unwelcoming shift in taste and preferences of alcohol consumers; young consumers born in the 80s and 90s account for only 26% of total consumption of Baijiu, whereas consumers born in the 70s account for 40%. This phenomenon has resulted in an urgent innovative strategic changes for incumbent players such as Kweichou Maotai and Wuliangye Yibin in order to target young adults, such as introducing Baijiu with lower alcoholic concentrations, launching flavored alcohols, and alcoholic sodas[32].

Figure 6: Year-on-year growth (%) of China's Spirits Market



Source: Euromonitor

Wine – China's own Bordeaux

Still light grape wine, which accounted for around 43% of China's total wine consumption in 2020, registered a 6.4% decline in total volume sales in FY 2021 due to the pandemic[33]. Nevertheless, rising consumer affluence, growing health awareness, and increasing dynamism among domestic wine producers will drive positive long-term growth outlook on the Chinese wine sector. A growing thirst for premium wines is testament to consumer up-trading in China; as middle-class consumers enjoy higher incomes, they develop increasingly sophisticated tastes, resulting in wine becoming a status symbol among the emerging middle class in China.

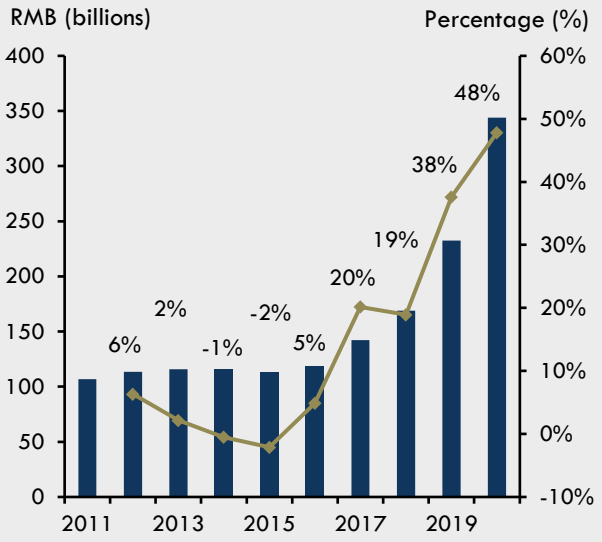
China-Australia Trade Tensions: In recent years, China was Australia's biggest wine export market; 30% of China's wine imports originated from Australia in FY 2020. However, escalating tensions between both countries, which was centred around China's suspicion of Australia exporting wine at a loss to gain market share, resulted in China formalising tariffs of more than 200% on Australian wine for 5 years in November 2020[34]. The introduction of the tariffs marked the end of a years-long run of double-digit growth in Australia-China wine exports by dollar value, which lasted into October 2020.

Ningxia, the Next Bordeaux: With a major source of wine imports banned, China's central government approved a 15-year wine development plan for Ningxia Hui Autonomous Region with a scale that could match the production levels of Bordeaux, France's wine capital. The eastern foothills of Ningxia's Helan Mountains has a diverse variety of grapes on par with that of Bordeaux and Napa Valley in the U.S., and currently accounts for the majority of domestic wine production. The production potential was apparent during the pandemic in 2020, where Ningxia's wine exports rose 46.4%[35]. By 2035, Ningxia's Helan Mountains area aims to produce 600 million bottles which are worth RMB 20 bn annually.

Luxury: From Overseas to Domestic

China's accelerated growth in their luxury goods market in recent years has surmounted other countries and placed them as the top country in terms of consumer spending. The luxury goods market is extremely dependent on the overall economic performance of the country due to its high demand elasticity. Hence, China's quick rebound from the economic downturn in 2020 has allowed for both the market and consumer spending to recover and even exhibit astoundingly high growth rates.

Figure 7: China Luxury Goods Market Size from 2011 – 2020



Source: Bain & Co

In fact, it was estimated by Bain & Co that China has achieved 48% growth in their luxury goods market, reaching nearly 349 billion RMB in 2020 alone[36]. This increase was projected to double China's market share in the global luxury goods market. It is important to note that this growth rate in 2020 alone is unexpected high, partially due to the travel ban initiated in China that forced consumers to reduce overseas luxury goods consumption and bring it back domestically. However, we expect that the shift towards domestic spending will be favourable to the local landscape. In the long term, we will still be expecting sustained moderate growth levels in domestic consumption.

Bringing Back To Local Spending

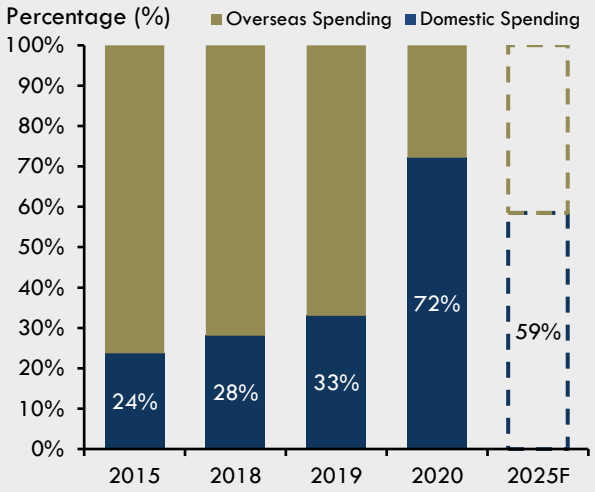
Ever since 2015, the China luxury goods market has experienced increasing repatriation. Previously, the grey market for luxury goods in China was grew rapidly due to a multitude of factors.

Rising Income Levels: Among emerging markets, China has outperformed all other nations with outstanding growth rates in their middle-income population bracket. This is evident from the growth of the Gross National Income per capita, which increased more than ten times since 2000. In fact, the middle-income class as a percentage of population has increased by 47.8 percentage points[37], from 3.1% to 50.8% of the entire population. The only other emerging market to come close to this astounding growth is from Russia, which grew by 42.7 percentage points only. The tremendous rise in income levels for the population has led to increasing affordability of luxury items among the Chinese.

Clamping Down on Grey Market: There has been a consistent disparity of luxury goods prices between China and the overseas market. This can be attributed to the high Value Added Tax (VAT) that China has imposed on imports, as well as the weakening of RMB over the past few years. This has amounted to large price disparities, up to 30% difference for the same luxury good[38]. A pricing arbitrage opportunity arose alongside the 'daigou' phenomenon. These 'daigou' agents would purchase cheaper luxury items from overseas and in turn sell them back in China for a profit. The grey market started then and has expanded ever since[39]. However, recent landscape developments led to the repatriation of overseas luxury goods spending, reducing the consumption outflow. In 2020, the luxury goods spending domestically has amounted to 72.14% of total spending by the Chinese.

Import tax cuts were implemented in 2017, cutting from an average of 17.3% to 7.7%[40] on consumer goods. In addition, the Chinese authorities has put in efforts into clamping down on the grey markets, whereby there was evidently tighter customs control over 'daigou' agents with stricter baggage checks during travels[41]. Luxury brands such as Chanel, Cartier and Patek Phillipe have also jumped into this opportunity and are in attempts to prevent the growth of the grey market as well. They have implemented price harmonization[42] between their key products over the years, in order to remove the price arbitrage between China and other countries.

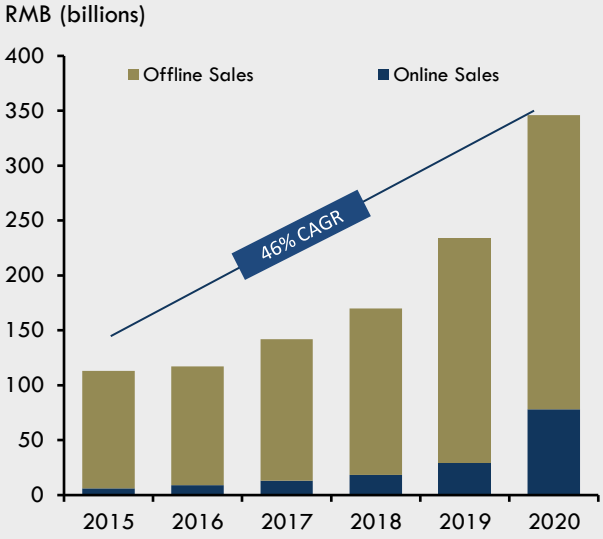
Figure 8: Chinese Spending on Luxury Goods, by Region



Source: Bain & Co.

Intellectual Property Laws: Some Chinese firms have been known for treading thinly on intellectual property laws and producing innumerable amounts of counterfeits to almost any consumer item. Being the global economic powerhouse, the Chinese authorities identified this issue and had finally decided to crack down on breaches of intellectual property laws. As such, with effect from 2019, the Chinese authorities have been actively imposing stricter regulations on counterfeits with heavier penalties such as larger fine. On online platforms, the Chinese authorities will ruthlessly revoke online shops' operating license[43] if they have found to be selling counterfeit goods. The success of these policies on the luxury goods is reflected through Tmall's online sales, whereby the luxury fashion and lifestyle category experienced increasing growth throughout the years. In 2020 alone, there was a 120% YTD growth from January to October.

Figure 9: China Luxury Goods Online & Offline Sales 2015 - 2020



Source: Bain & Co.

Duty-Free Haven

Hainan, China, has been offering duty-free products since 2010. In 2020, when COVID-19 travel restrictions were implemented, this duty-free haven has become the only place was the Chinese population can purchase duty-free goods, luxury products included. Alongside a one-off change in shopping quota from 30,000 RMB per person to 100,000 RMB[44], Hainan gained massive attention. By October 2020, Hainan duty-free sales reached 21 billion RMB, which was already 98% more than the whole of 2019.

Despite the travel restrictions looking to end, Hainan will continue to remain as a hotspot for luxury good consumers. This is due to the increasing in licensing to other operators to sell duty-free goods in Hainan. By 2025, the Chinese authorities has planned to establish Hainan as a free-trade zone. This will attract luxury goods consumers to continue spending domestically and minimize the consumption outflow posed by luxurious goods.

2

Green Transformation

China's reduction of its carbon emissions remains slow for now, with steady, consistent moves in the past decade to curb expansion of coal-based projects. The shift towards cleaner production alternatives for China's steel, its second largest source of carbon emissions, has also been set off by Australia's ban of coking coal imports as a result of the trade war. More promise lies in its renewable energy sector, with big strides made in additions to solar and wind power capacity. This puts China on track to be a formidable global leader and role model in renewable energy. The electric vehicles sector looks to be equally favorable, with China extending various EV subsidies to spur demand and its integrated supply chain serving as desirable protection from input volatility in the face of rising lithium prices and the semiconductor shortage. Overall, while the nation does have a long way to go to achieve its Carbon Neutrality pledge by 2060, it is undeniably making crucial, commendable steps in the right direction.

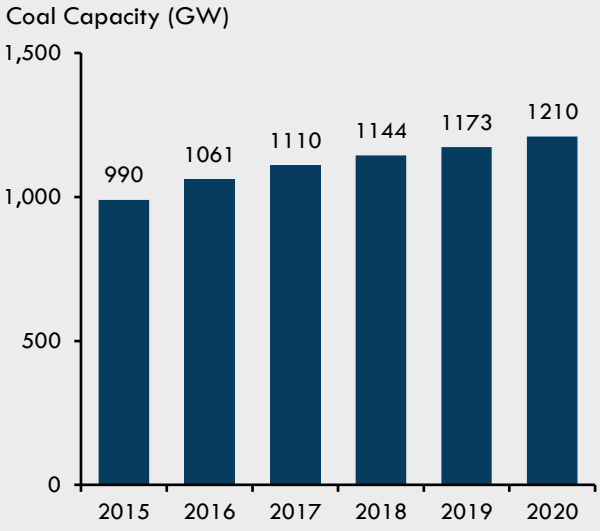
Big Strides Towards Carbon Neutrality

Optimistic Despite Laggard Past Efforts

Coal had always been China's primary source of energy due to its low marginal costs and loosely regulated state emission policies. Despite the Chinese pushing for a green transformation over the past decade, their efforts had largely been futile. The proportion of total energy generation accounted for by coal has only declined by a mere 6%, from 69% in 2015 to 63% in 2020[45]. While proportion of energy from coal has declined, overall coal capacity has increased from 990 GW in 2015 to 1,246 GW in 2020 (Figure 10). As a result, China's share of global CO_2 emissions rose from 12.8 Gt/year, which accounted for 40% of total global CO_2 emissions in 2016, to 14.0 Gt/year in 2020, which is equivalent to 44.3% of global CO_2 emissions[46].

Although China had reached peak emissions in 2020, the ruling party remained optimistic and looked ahead to formulate plans that were green-focused to further curb its carbon emissions and facilitate the nation's transition towards cleaner sources of energy.

Figure 10: China's Coal Capacity for Energy Generation



Source: Fitch Solutions

The Possibility of Complete Carbon Neutrality?

Ambitious Sights Set: At the National People's Congress Session in March 2021, Chinese Premier Li Keqiang presented a summary of how Beijing is planning to get on track to achieve its climate goals of peaking its CO_2 emissions by 2030, and eventually becoming carbon neutral by 2060[47]. Under the watchful eyes of the world, Premier Li said that the road for China to meet its targets would involve the major development of new energy sources by having non-fossil fuels like nuclear accounting for 20% of its energy use by 2025, a 5% increase from 15% in 2019[48]. Premier Li also mentioned that China would "promote the clean and efficient use of coal". While this may appear to be a big shift from China's current carbon position, this came as a big disappointment to many climate activists who were hoping for China's complete transition away from coal, rather than merely promoting the efficient usage of coal, which is still inherently pollutive.

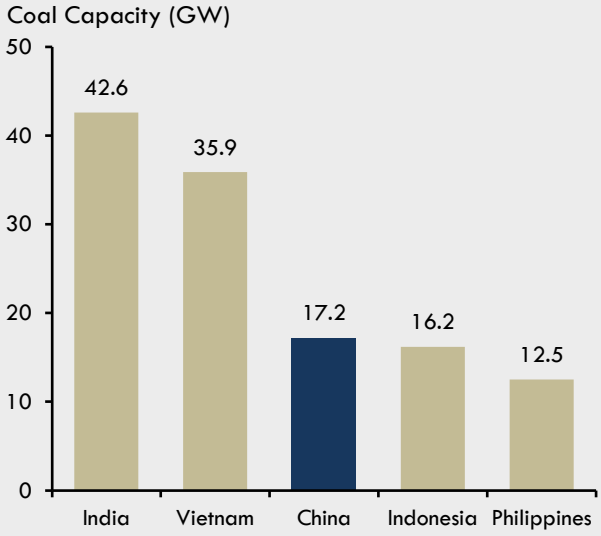
Moving forward, despite Beijing's new ambitious target of reaching carbon neutrality by 2060, many critics have questioned the legitimacy of these plans, and whether the state would once again fall short of its carbon targets. The skepticism towards China's ambitious plans aroused immediately due to the fact that its actions had been largely inconsistent with what it had pledged to achieve. Just months before this ambitious target was set, after Beijing's successful suppression of the virus, the state had rapidly approved the construction of coal powered plants in an attempt to boost economic recovery. This ramped up coal capacity by about 28 GW in 2020, amounting to an exorbitant 270% y-o-y increase from the mere 5 GW capacity expansion in 2019, making it the highest y-o-y capacity expansion recorded since 2013[49].

Slow But Steady Progress

Even though the impact of decisions in 2020 was a step backward from China's goal of complete carbon neutrality, it cannot be denied that the pandemic – which emerged as a black swan event – was a critical causal factor for this deviation. In fact, China's transition away from coal, albeit slow, had been steady and consistent.

Total energy generation from renewable sources like nuclear and solar energy as a percentage of total electricity generation increased from 31% in 2015, to 37% in 2020. Furthermore, from 2021 to 2030, only a mere 17 GW out of a total of 94 GW state approved energy expansion projects, amounting to 18.3%, were accounted for by coal projects, with the rest accrued to renewable projects. On a global scale, this places China in 3rd, behind Vietnam and India, in terms of coal capacity expansions, with India expanding its capacity by 43 GW, almost 2.5 times the amount that China had approved. (Figure 11)[50]. While this may appear to be a hopeful sign for the world's largest emitter of carbon, success would only ensue if Beijing were to strictly curb the approval of coal-based energy projects in the future to not deviate from its ambitious target of peaking carbon emissions by 2030.

Figure 11: Planned Coal Capacity Expansion by Region (2021 – 2030)



Source: Fitch Solutions

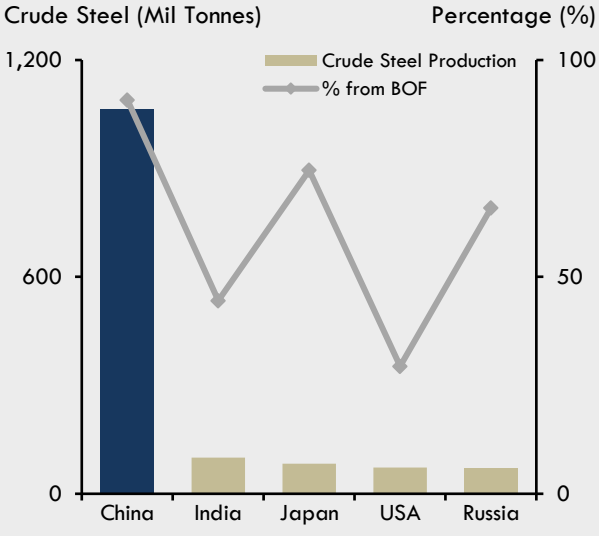
Steel to Aid Ambitious Targets

Tailing right behind the power industry in terms of carbon emissions, contributing to a hefty 15%, (2 Gt out of 13 Gt of CO_2) of China's total carbon emissions in 2020, the Chinese steel industry had been a significant contributing factor to the rising emissions[51].

Globally, steel is produced in two ways: Basic Oxygen Furnaces (BOF) and Electric Arc Furnaces (EAF). BOF steel production is a carbon heavy process that produces around 2 tonnes of CO_2 per tonne of steel. EAF on the other hand, is much less pollutive, producing only around 0.5 tonnes of CO_2 per tonne of steel[52].

Being the global manufacturing hub of steel, China produced 1.1 billion tonnes of crude steel in 2020, accounting for 57% of global crude steel production. Out of the 1.1 billion tonnes of steel produced, 90.8% of production was from the dirty and carbon heavy BOF process, while a mere 9.2% was from EAF production. Despite other prominent global producers of steel like India, Russia and the United States making the move to increase EAF production, China is the only major producer that continues to produce steel using the heavily pollutive BOF process. (Figure 12)[53].

Figure 12: Total Crude Steel Production and Percentage Accounted by BOF Production



Source: World Steel

Strong State Support to Boost EAF Capacity: Bearing in mind the goal of carbon neutrality by 2060, and the environmental damage that had been inflicted by pollutive BOF steel production, in Beijing's 14th Five-Year Plan, the target growth of the EAF steel production ratio to 30% by 2025 was incorporated to support the nation's journey towards carbon neutrality. If this target were to materialize (assuming an extrapolated crude steel production growth rate of 7% (2019 to 2020) from 2020 to 2025)[54], China would see carbon emissions from steel production potentially reduced by over 0.45 Gt of CO_2 in 2025.

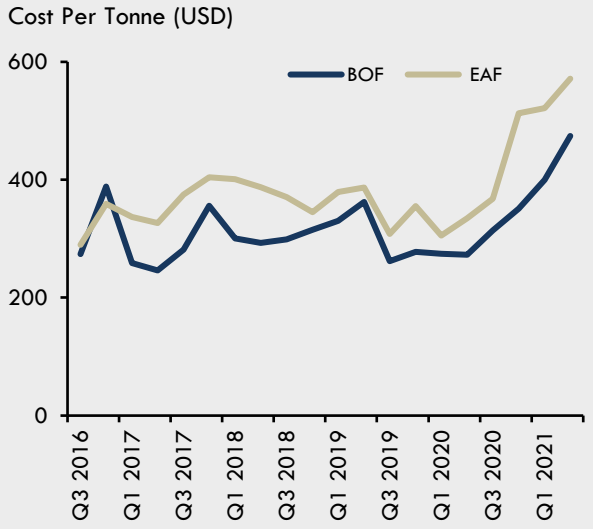
China's COVID-19 Geopolitics Facilitates EAF Transition: Tensions arose between China and Australia in Q1 2020 when Canberra called for an international investigation on the origins of the COVID-19 pandemic. In response, Beijing immediately implemented a de facto ban on all thermal and coking coal imports from Australia for an indefinite period of time.

One year later, the ban on Australian coal imports has yet to be lifted by Beijing. This saw Australian coal imports into China plunging from 4.4 million tonnes in March 2020 to an absolute 0 in March 2021[55]. As a result, total Chinese coal imports fell by over 13%, from 5.6 million tonnes in March 2020 to 4.9 million tonnes, as the Chinese actively sought to diversify its coal demand from other sources. While this may appear to be an act of pure geopolitical powerplay, some economists have theorized that the ban could have served as Beijing's first step towards relying less on Australian coking coal to slowly cut back on BOF steel production and facilitate its transition towards the cleaner EAF production process[56].

To further support its ambitious target of relying less on coal and boosting EAF steel production, Beijing had also lifted a 2-year ban on scrap steel imports in the Q1 2021[57]. The ban was initially placed in 2018 to prevent the dumping of low-grade scrap steel. However, with scrap steel being the key raw material for EAF production, lifting the ban to facilitate its proliferation would be imperative. According to Chinese customs data, scrap steel imports from January to April 2021 amounted to 85 Mt. Although the current rate of scrap steel imports may pale in comparison to the rate of imports prior to the ban (which averaged at around 2,350 Mt/year), if Beijing were to maintain its current rate of imports, it would actually be on track to meet its domestic scrap steel demand (which amounts to approximately 350 Mt) to hit its 30% targeted EAF production ratio by 2025.

Rising Scrap Steel Prices Poses a Threat to EAF Transition: Nevertheless, the surge in demand for scrap steel has led to the prices skyrocketing from a mere USD 292/tonne in Q3 2020 to USD 500/tonne in Q2 2021. This created a significant divergence in the estimated BOF and EAF cost spread, rising by 81.4% from Q3 2020 to Q2 2021 (figure 13). With record high EAF costs, it could potentially serve as a hindrance to the EAF transition process, as China could possibly fall back on cheaper BOF processes, and once again stray away from its objectives. If Beijing strives to achieve carbon neutrality by 2060, it will have to strictly stick to its plan, and not diverge once again.

Figure 13: Estimated Cost of Production Per Tonne of Crude Steel Using EAF and BOF



Source: Desktop Research, LME

Exuberance of Renewables

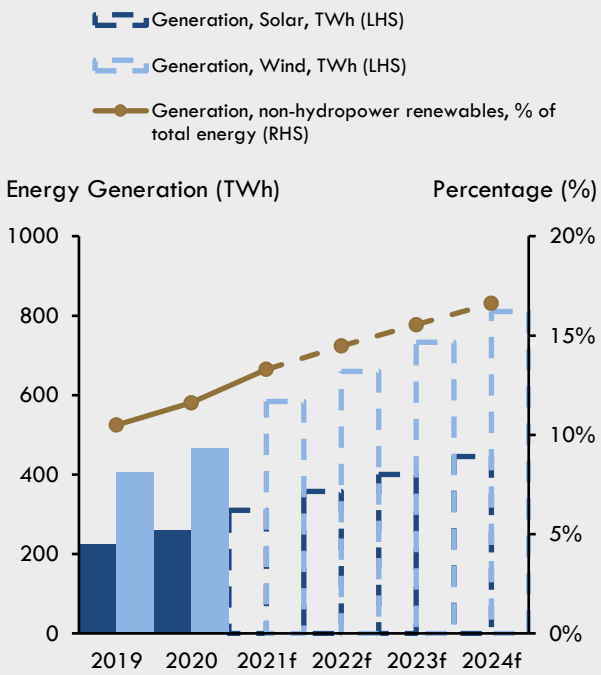
In September 2020, Chinese President Xi Jinping announced to the United Nations General Assembly that China would expedite its voluntary carbon emissions reduction targets ahead of its pre-existing commitments. China declared that it would hit peak emissions before 2030 and become carbon neutral by 2060. As the world's largest polluter of carbon dioxide, responsible for about 40 percent of global emissions, China's pledge to become carbon neutral by the year 2060 will inevitably change the nature of the country's economy, with the spotlight on its renewable energy sector[58].

Non-Hydropower Renewables to Shine

China has shown serious intent to keep that promise, with unprecedented levels of production/growth in 2020. The Chinese National Energy Administration (NEA) stunned the world when it announced total wind and solar capacity additions of 120 gigawatts (GW). Official figures state that photovoltaic (PV) additions in 2020 were around 48 GW. That would be equivalent to almost two-thirds of all the solar power that the United States has installed up until the end of 2019.

Furthermore, it included 22 GW of installations last December alone, roughly double the amount installed in the same month in 2019[59]. End-of-year installation peaks are normal for the market, due to a tariff drop at the end of the year. However, 48 GW of PV additions to the growing capacity levels were still much beyond expectations, as many expected the pandemic to severely disrupt the supply chain of the industry. Even BloombergNEF had a bearish forecast of only 36 GW each of new solar and wind capacity additions for China in 2020. While the amount of PV additions surprised many, the amount of wind energy additions was what really surprised the skeptics.

Figure 14: Current and Forecasted Energy Generation (Non-Hydropower Renewables)



Source: Fitch Solutions

The NEA reported an unprecedented 72 GW of new wind capacity expansions for China in 2020. This amount was more than the amount the Global Wind Energy Council had expected to see installed in the entire world. Furthermore, December's wind capacity expansions alone had topped 47 GW, which was higher than the total Chinese wind capacity additions from 2018 and 2019 combined.

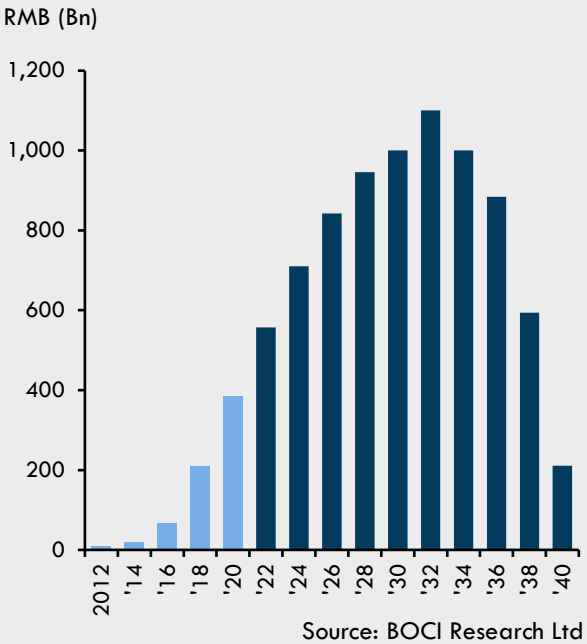
The apparent magnitude of China's 2020 renewables build-out puts observers in a bind. Some are sceptical as not only are these figures outrageous by comparison to other markets and China's own historical records, they also do not match up to observations on the ground. Installing 47 GW of wind in December would have led to severe supply chain constraints, according to many experts. But there has been little evidence of that. Nor does there appear to have been an appreciable increase in the appearance of new wind farms.

Furthermore, in many parts of China, the soil is frozen over in December, making it difficult for any significant construction work to take place. Nevertheless, it also seems unlikely that the Chinese NEA is plucking figures out of thin air. Many experts deduce that a combination of partially completed projects and a change in accounting techniques may be partly responsible for the doubling of its new wind and solar power plants from a year earlier. Whatever the reason may be, the Chinese government shows no signs of slowing down, ordering power transmission firms to connect a minimum of 90 GW of wind and solar capacity to the grid this year as part of their new policy initiative aimed at meeting its low-carbon targets. President Xi's pledge to add 1,200 GW of solar and wind capacity by 2030 and to bring China's carbon emissions to a peak within a decade seems very likely if China's hunger for green energy persists[60].

Reducing Subsidies Key to Sustainability

China has been offering renewable subsidies since 2006, typically in the form of a promised payout for electricity generated over 20 years. The rates were higher than those for coal plants and gave developers and banks confidence their investments in wind and solar installations would pay off. Thanks to these subsidies, China has now dominated the green energy market, which was once considered a European and American business, with 8 of the top 10 solar companies in the world being Chinese[61]. However, renewable energy projects have grown far faster in recent years than the pool of money the government sets aside to pay the fees it promised them. The result is a total debt of $42 billion and growing[62]. China for several years now has not been paying its full subsidy bill, and the mountain of debt keeps growing higher. Now the lack of payments has become a major concern for investors in China's clean power operators. China Longyun Power Group Corp, the country's largest wind operator saw its shares

Figure 15: China's Subsidy Debt/Deficit

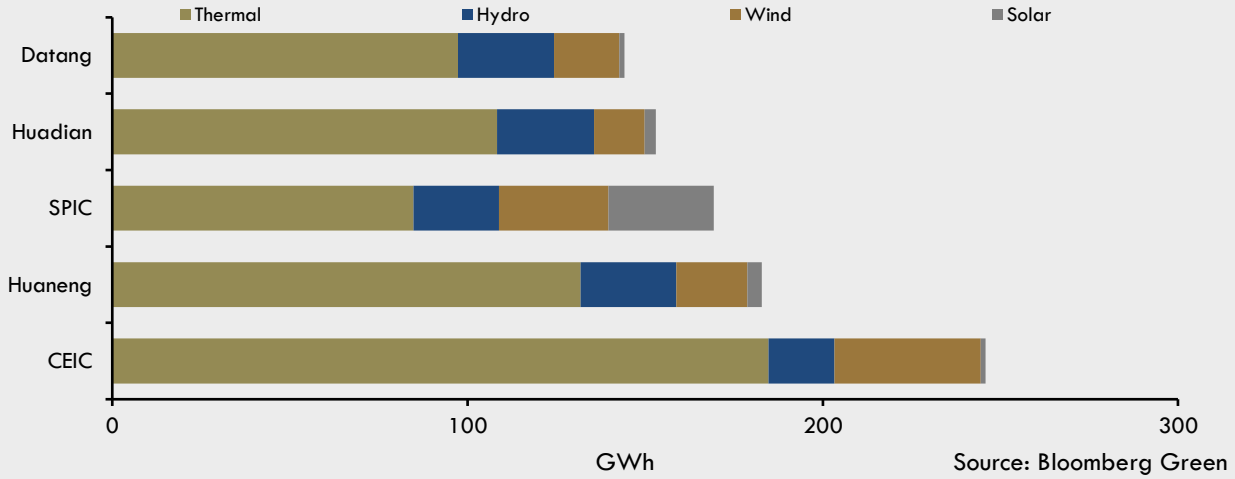


Source: BOCI Research Ltd

plummet as its accounts receivables soared to more than 18 billion yuan in 2020. Longyuan traded below its book value in 2020 because of the mounting delayed payments. The low valuation for Longyuan and other Chinese renewable firms restricts them from issuing more equity to fund new projects. Other private developers, such as GCL New Energy Holdings Ltd., have had to resort to selling off their renewable power assets to help reduce debt.

Chinese state-owned developers, which have easier access to low-cost capital, are happy to snap up such projects to add to their growing portfolio. President Xi's push to boost clean energy and make the country carbon neutral by 2060 is constrained by a simultaneous desire to end the expensive subsidies that were designed to help wind and solar power become economically competitive with coal. With subsidies slowly being phased out, the Chinese government is still confident of long-term growth with continued cost deflation expected in the Chinese market, making the sector more attractive on a cost basis relative to conventional sources of power generation. Wind and solar generation will be increasingly able to compete on an even basis with coal in the market, a precondition highlighted as necessary for the technologies

Figure 16: China's Big Five Breakdown



to continue to grow according to plans announced by the NEA earlier this year. Many other initiatives have been laid out for a subsidy-free future, such as giving subsidy-free renewables projects highest priority for grid integration and using green certificates, set to be awarded to renewables generators. These can be sold to more polluting power generators, which will be required to acquire a set number of certificates to make the footprint of their operations cleaner.

Reliance on SOEs for the Future

China is turning to its state-owned utilities companies to helm the next stage of the country's renewables push, as the sector becomes less attractive to other investors. Private firms have helped the top-polluting nation become the world's largest generator of clean energy. As China chases a target to zero out carbon emissions by 2060, and with subsidies for renewables investments ending, its largest state-owned utilities companies need to take the lead[63]. The five biggest state-backed power firms, collectively known as the Big Five, have announced plans to develop about 305 GW of new wind and solar capacity in the next five years, almost twice the amount it estimates the United States will install over the same period. At peak generation, the total being added would be about enough to power the whole of Japan. In addition to the Big Five's plans, smaller state companies including China Three Gorges Corp, China Resources Holdings Co. and China Power Construction Corp. have also pledged to add more renewables through 2025. This means that the current pipeline will be enough to meet China's energy targets even without any new projects from the private sector. State-owned generation companies will dominate China's future renewable investments, as they optimize fuel mix and achieve organic growth by using their strong funding capability.

Coal the Key to Recovery

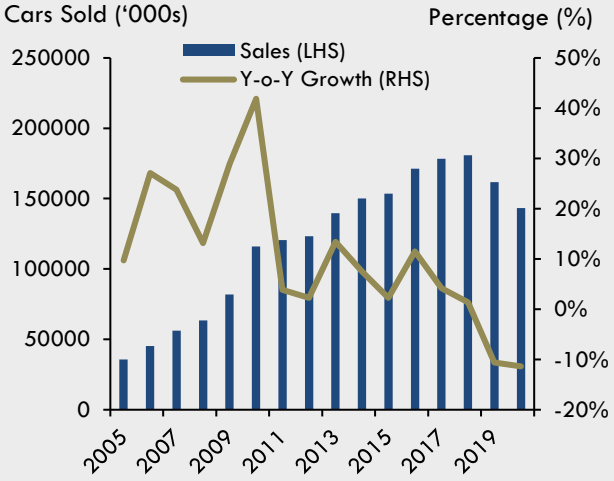
China has vowed to increase its non-fossil fuel energy consumption to around 20% of primary energy use by 2025 and to around 25% by 2030. However, China approved the construction of more coal plants in just the first half of 2020 than it had in each of 2018 and 2019 and has over 200 new plants planned or under construction. In contrast, the UK and Spain have already almost entirely phased out coal from their energy sources[64]. However, as China's economic recovery from the pandemic speeds up, so does its power consumption. Power demand rose by 21.2% y-o-y to 1,921.9GWh in Q1 2021. With plans to cap annual coal output in the coming years, the Chinese government is still heavily relying on Coal as the main source of energy to fuel China's economic growth. However, there's no doubt that if China continues to on this path, it will become a global role model for sustainability and its renewable energy.

Electrifying the Future

Synthesizing the Chinese's long-held trend of increasing automobile production and the need to reduce the country's carbon footprint, many new Chinese automakers have sprung up, buoyed by the worldwide success of Tesla.

The Chinese passenger vehicle market has actually shrunk over the past years (Figure 17), as car ownership restrictions were imposed in more and more cities to mitigate extreme congestion. Amidst this trend, however, EV sales from Jan to May 2021 totalled 967,000, a 2.2x y-o-y increase. Among those, electric cars comprised 94.6%, the remaining being commercial vehicles.

Figure 17: Yearly Car Production in China



Source: CEIC

Although analysts have been bullish on a 15% y-o-y growth in passenger vehicle sales, modelling the market size to increase, it is highly likely some of them were due to pent-up lockdown demand or expending of excess savings. Chinese vehicles, unlike those in US or EU, face more substitutes – like the Chinese high-speed rail (HSR) for intercity transport, and extensive metro networks for intracity transport – the scale of public transport is not seen in those markets; China plans to double its HSR network by 2035 and similarly increase the number of airports[65]. While this does not directly cause a fall in car usage, the availability of transport alternatives cannot be ignored when assessing market potential.

Specific to new-energy vehicles, however, the outlook is brighter. The Chinese government, in an effort to spur demand, had also extended subsidies of RMB18,000 (US$2,800) per car by a year, but reduced it to RMB14,400 this year, with an eventual subsidy phase-out target in 2022. The previous extension was brought about by a slowdown in sales, which fell in February 2019 by 77% y-o-y when subsidies were cut[66]. There is reason for optimism which will be explored, but the Chinese government is bullish: they target 40% of all sales to be electric vehicles by 2030.

Value Chain Concerns Remain

Range Anxiety Remains: Moving in tandem with the growth in EVs is the need for a reliable charging network but is another obstacle in China. Currently, the ratio of charging ports to EVs sit at 5:1, after increasing from 4:1 in 2016, representing two thirds of global charging ports. However, figures alone tell only part of the story. There are reports that only 30% of public charging ports are functional, from Volkswagen's head of Chinese strategy[67], and some charging companies were simply after the subsidies and not considering the distribution of the charging network, or unable to get full cooperation from building or carpark operators, in the case of office building charging – academic research found 60% of office property management companies (PMCs) and 40% of retail PMCs considered reconstruction of parking spaces as a precondition for EV charging stations, while a third of residential PMCs found installation infeasible. Consumers mirror these concerns; 45% cited inconvenient charging as a reason behind not switching to EVs. However, a key advantage the Chinese market enjoys is the standardization of charging socket standards to GB/T, which reduces switching costs and greatly increases installation convenience[68].

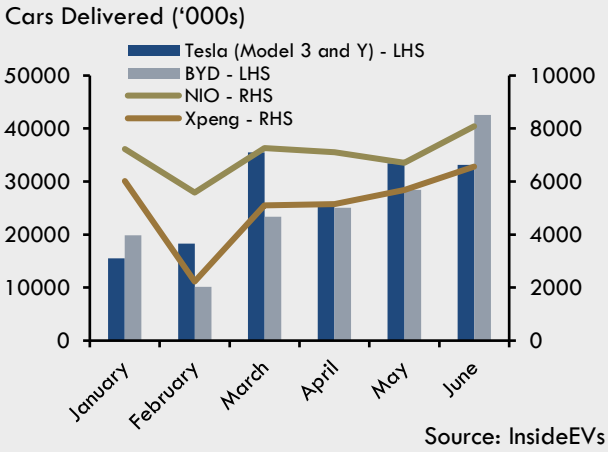
Fossil Fuel Reliance Remains High: Ultimately, however, most electricity in China now is still generated from coal, at about 57%. This reduces the impact of the EV switch, especially at the start of its lifecycle[69]; the production of EV batteries can cause EVs to be up to 50% more polluting to produce than conventional ICEs[70]. While China still stands to benefit from EVs, the impact will not be immediate: the supply chain and electricity generation will need to switch to cleaner energy sources first, although this is already an ongoing trend. The immediate impacts are in other types of pollution: in Liuzhou city where EV adoption is the highest, air quality in 2020 was excellent 97% of the time relative to Beijing at 76%[71], and the river water quality was top-rated for inland rivers.

Upward Cost Pressures

Tough Times for Commodities and Batteries: The commodity rally has affected many industries in China because of their lack of local know-how, with EVs being no exception as they have more electrical components than ICE cars, and rely heavily on lithium. Lithium contributes 42% to the of Chinese EV manufacturing and prices have risen in tandem with other commodities[72]. While prices have not risen to 2018 highs, European automakers are just starting the EV transition, which would pressure lithium prices upwards in the short term, contingent on lithium deposits below the German Rhine not available until 2024-2025. However, a mitigating factor is the localisation[73] of the supply chain: lithium 71% of battery electrolyte, a lithium-based solution, and 46% of cathodes, use Chinese lithium, of which China has the world's 4th largest deposits[74]. At the same time, the cost of battery production has been falling, from more than USD668/kWh in 2013 to USD137/kWh in 2020[75], close to the USD100/kWh it would take to bring EVs to cost competitiveness with ICE vehicles[76]. Xpeng, Tesla, BYD and soon Nio in Q4 2021, have, or will use more lithium-iron-phosphate (LFP) batteries compared to lithium nickel-manganese-cobalt oxide (NMC) and lithium nickel-cobalt-aluminium oxide (NCA) ones, which reduces their reliance on cobalt, where the Democratic Republic of Congo (DRC) holds a 70% market share in production[77], in-line with the greater domestic trend where 63.6% of automotive power batteries were LFP[78]. LFP batteries, although less-energy dense (and thus providing less range), are cheaper to produce, which makes them attractive for cheaper or entry-level EV options targeting price-sensitive consumers amidst falling subsidies. Tesla, in particular, slashed prices of its cheapest China-made Model 3 by 10% after shifting to LFP[79], similar to Xpeng which uses LFP in entry level versions while its mid- and high-range versions use cobalt-based batteries[80]. BYD is using a particular type of in-house LFP cell – the "Blade Battery"[81], with energy density comparable to NMC cells but a safety profile of LFP ones – in all its models.

Semiconductor Shortages: The semiconductor shortage has had a significant impact on the auto industry in general, but Chinese EVs appear not to be impacted as heavily. At 11%[82], it contributes notably, though not significantly, to manufacturing costs. June car sales fell by 5.1%, the first decrease in 11 months, as 90-95%[83] of car chips are imported. For EVs however, there has not been a major decrease in deliveries, with the major automakers reporting consecutive m-o-m increase in deliveries from March to June[84] after the New Year period (Figure 18), bar Nio, which had a fall attributed to a fire at a Japanese chip supplier. However, BYD with its more vertically integrated supply chain and

Figure 18: 2021 China EV Deliveries



Source: InsideEVs

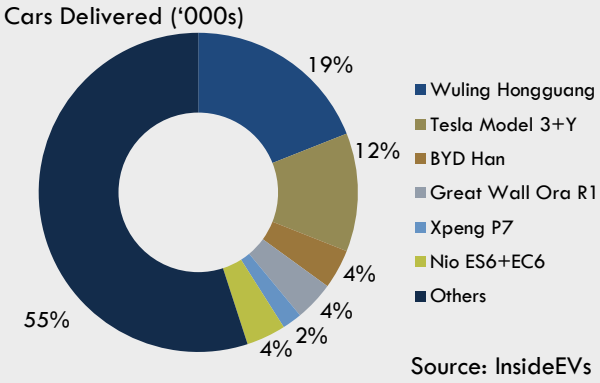
a key player – 20% market share - in insulated gate bipolar transistor (IGBT)[85] technology (to convert direct current from batteries to alternating current for other components), did not experience a shortage at all. This is set to be a major competitive advantage, as its rivals Tesla, Nio and Xpeng source IGBTs from German firm Infineon, which supplies a wide variety of clients[86], unlike BYD Semiconductor, a relatively new player internationally, but the only Chinese independent IGBT manufacturer, increasing lead time and transport costs[87]. Sanctions, however, unlike those plaguing Taiwan's TSMC for 7nm nodes, are not expected to affect Chinese EV makers, as EV semiconductor process nodes are typically 28nm and above (IGBTs at 45nm) and not subject to them. The industry's international reliance on semi-conductors will, however, remain a key risk[88].

Incentives for Demand

The EV market has become much more competitive. Tesla has been domestically producing certain EV models since Oct 2019, and new players like Xpeng, LI Auto, SAIC and Geely all entered the market in mid-late 2019, with different body types. With many options for consumers at a range of prices, the double-digit sales fall in 2019 is unlikely to repeat, even with reduced subsidies.

Wide Range of Strategies: As seen in Figure 19, the market is dominated (in sales terms) by domestic players, with Tesla only placing 3rd. Domestic brands tend to be more price competitive, with a similar feature set to Tesla. Nio's ES8 SUV undercuts the Tesla Model X by over 35%[89]. It has its own OS to compete with Tesla's systems[90], exclusive battery swap stations and lifestyle hubs called "Nio Houses" with workstations and cafes, for exclusivity, brand identity, and ecosystem lock-in, beyond build quality and performance. This is echoed by Xpeng, which has an array of video-streaming services and apps into its in-car systems. However, competing on features is not the only way which Chinese manufacturers have distinguished themselves. Shanghai-GM-

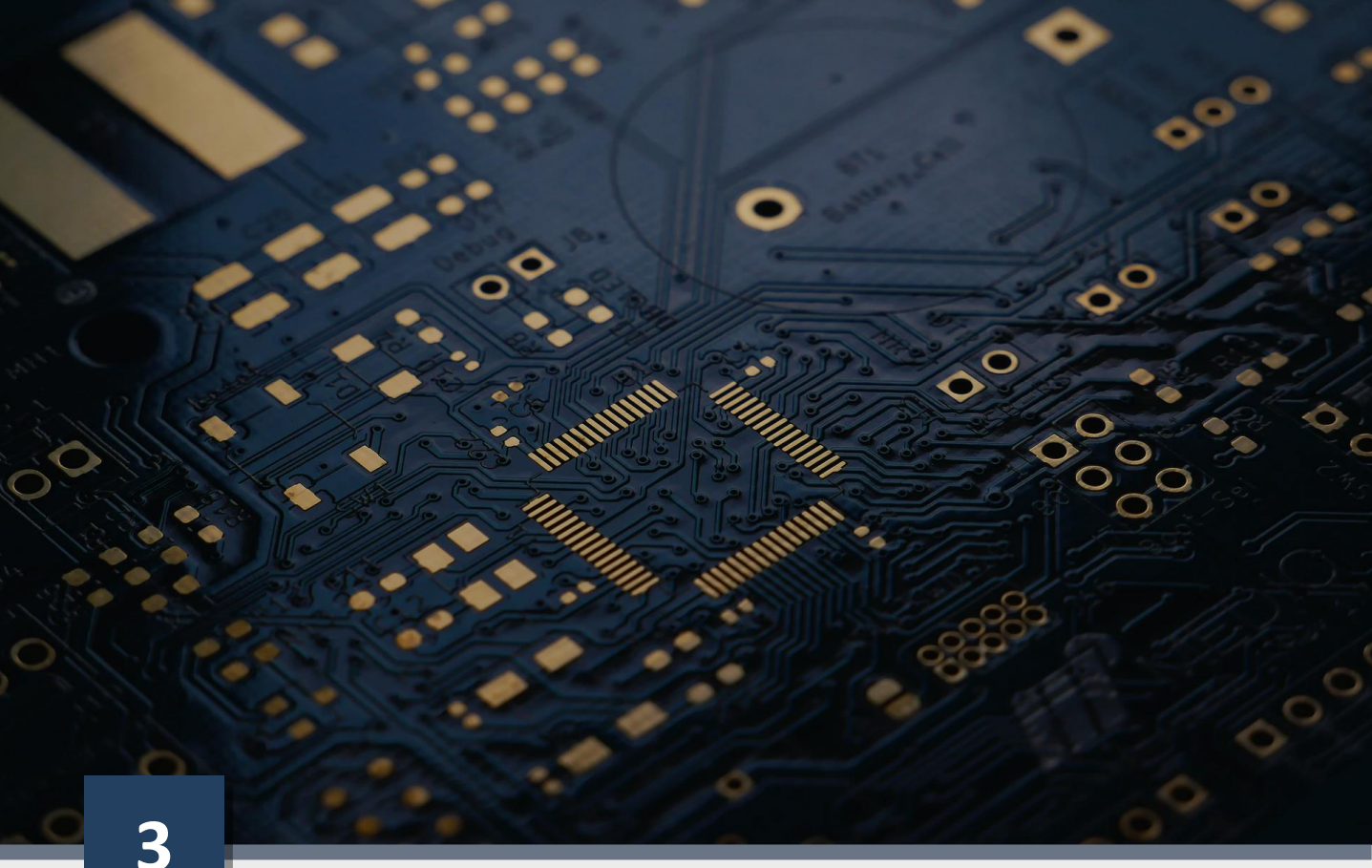
Figure 19: 2021 China EV Deliveries



Source: InsideEVs

Wuling, Great Wall and BYD stand out, with very different strategies. In Mar 2020, 87.9% of Chinese NEV drivers were male, and China was just recovering from COVID-19 – people were predicted to shift to cars to reduce their risk of contracting diseases[91]. Contrasting the feature-rich, large EVs of high-growth startups are super-mini, cheap and functional EVs catered to the young, female city dweller. Wuling launched the best-selling Hongguang Mini hatchback, and Great Wall followed with the R1[92], the former outselling Tesla's Model 3 in 2021 (Figure 19), with a starting price of only RMB28,800. The demographics of EV drivers have shifted, with 18-34 year-olds increasing by 10% to 54.3%, and male drivers falling to 85%. BYD has different priorities - expanding its international brand with electric buses. It won a 1002-bus contract in Bogota to electrify its bus fleet, the largest ex-China EV bus contract, and is partnering British bus builder ADL to supply electric buses for London[93]. By first building up its b2b brand image and market share[94], BYD can cement its reputation in Latin America and Europe as a dependable, sustainable marque, avoiding the perception of poor quality that has dogged Chinese automakers in the West.

There is no denying, however, that government incentives, such as the relative ease to obtain an EV licence plate over an ICE also lead to growth, especially in tier-1 cities[95] – above more "noble" reasons like environmental consciousness. As the green revolution in China is mainly top-down, unlike bottom-up methods in developed Western economies, EV marques need to persistently innovate to develop products outshining their petrol competitors.



3

Chasing Chip Supremacy

Semiconductors are becoming exponentially more complex to produce as processor nodes consistently decrease in size, leading to a very dangerous supply glut of this 'brain' of almost all electronics. To make matters worse, the USA's amicable ties with the world's leading semiconductor manufacturers of Taiwan's TSMC and South Korea's Samsung Electronics allows it to utilise its semiconductor technology control as a geo-political weapon, fueling a desperate need for China to develop its own semiconductor industry to escape the USA's talons. As such, in a bid to secure self-sufficiency, China plans to use 3 key measures. Its first lies in the execution of its 14th Five-Year Plan, focusing heavily on innovation and technological catch-up within the domestic semiconductor industry. The other two involves rising VC investments as well as filling the semiconductor talent-gap. For now, the chip shortage will undoubtedly have wide-reaching impacts on many industries, especially automotives and consumer electronics, among others.

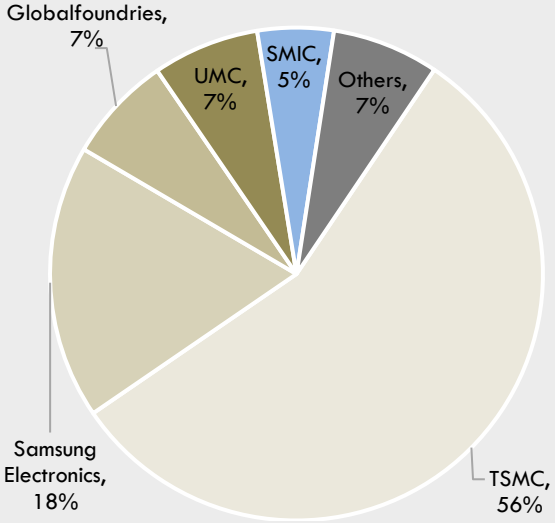
Arduous Path to Self-Sufficiency

One of the headlining news in recent times refer to a severe "chip shortage", pointing towards a crucial supply gut of the "brain" of almost all electronics, namely semiconductors. The shortage is fundamentally resultant of the inherent difficulty in producing semiconductors as chips become exponentially more complex, from Apple's 10nm processor A11 chip in 2017 to just 5nm in its most recent 2020 M1 chip[96]. Coupled with the booming demand of semiconductors which materialised as a 6.5% increase in global semiconductor sales in 2020, it is without doubt that the semiconductor shortage is an inherent risk to reliant supply chains across the world[97]. The amount of time, resources and specialised facilities needed to produce ever-more sophisticated semiconductors create a major barrier for countries and corporations intending to ramp up such production.

Semiconductors - The Weapon of Choice in Geo-Politics

The semiconductor industry is of special importance to global superpowers due to its common usage across electronic devices, from day-to-day consumer electronics to the most advanced military equipment. From a national standpoint, the ability to boost domestic and restrict rival nations' usage of such semiconductors can exacerbate a technological gap between countries. In the US-China superpower rivalry, it is without doubt that the semiconductor industry is one of the primary political weapons wielded.

Figure 20: Global Market Share of Semiconductors by Revenue (2020)



Source: TrendForce

The varying degrees of facilities and technologies necessary to manufacture semiconductors creates discrepancies between countries. Taiwan currently leads the manufacturing race by a large margin, with its Taiwan Semiconductor Manufacturing Company (TSMC) currently owning 56% of the global semiconductor market in terms of revenue. The runner-up, South Korea's Samsung Electronics, only possesses 18%. Of political relevance, these two countries have deep ties with the US, which unsurprisingly comprise the main sources of semiconductors to the world's largest economy. These companies also operate largely using American chip-making technology, thus being subservient to US control over their manufacturing lines. China, whilst being the largest consumer of semiconductors globally at 60%, is reliant on imports especially from Taiwan, as its largest chipmaker, state-backed Semiconductor Manufacturing International Corporation (SMIC) only contributes to 5% of global market share[98].

Apart from the semiconductor technology reliance of China on Taiwan, the latter is also a geopolitical concern of the US administration. An increasingly assertive China and the ongoing spate of events in Beijing's crackdown on Hong Kong has spurred an increasing trend of Taiwanese detaching themselves from the Chinese[99]. This growing rift between Beijing and Taipei provides the US with an opportunity to tighten its control over chip-manufacturing in Taiwan.

In 2020, the US Commerce Department banned the sales of semiconductors and

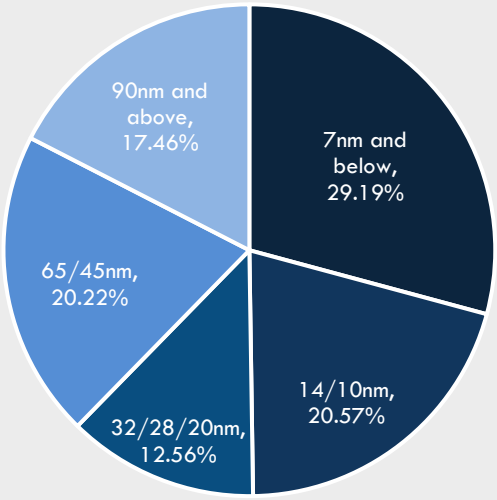
software using American chip-making technology to Huawei, China's largest telecommunications conglomerate[100]. This move virtually halted all transactions between TSMC and Samsung with China, eliminating approximately 20% of the companies' sales and intensifying their reliance on the US market. On Huawei's end, it attempted to shield itself from a supply gut by stockpiling two years' worth of chips, although this essentially also placed a two-year freeze on its technological advancement[101].

With the hawkish US stance in restricting Chinese companies from obtaining American semiconductors unlikely to fade away, China must break out of this stranglehold if it seeks to avoid US political pressure arising from this channel. Beijing has noted this pressing need to develop its semiconductor industry, both in the design and manufacturing aspects, aiming to support it through (1) its 14th Five-Year Plan, (2) private financial support and (3) talent procurement.

Technological Lag – China's Primary Semiconductor Concern

China's semiconductor industry must close its technological gap against its global competitors, namely TSMC and Samsung. Semiconductor are typically compared based on the processor node size, wherein its size and technological capabilities are inversely proportional. Generally, they can be sub-divided into three categories, namely leading-edge nodes (16nm and lower), mature nodes (20nm to 65nm) and older process nodes (95nm and above). Newer nodes are used in cutting-edge applications due to better performance, where mature and older process nodes are gradually used for less computationally intensive electronic equipment such as home appliances[102]. Interestingly, although newer nodes rake in higher revenues as they carry beefier price tags, the continued use of cheaper mature and older process nodes still support the necessity of such manufacturing and thereby minimising revenue disparity by technology[103].

Figure 21: Global Foundry Market by Node (2020)



Source: Gartner, Samsung

In terms of production capability, China is currently playing catch-up as SMIC only recently perfected the 14nm fabrication technology in early 2021 while relatively early in 7nm development[104]. This is a stark contrast compared to industry leader, TSMC, which currently produces 5nm chips, or one generation ahead of SMIC[105].

Furthermore, only 16% of China's semiconductor demand is produced locally, of which only half are manufactured by foreign firms[106]. The remaining demand is entirely fulfilled by foreign imports. Given China's large consumer base, it is only natural for the country to show strong interest in securing semiconductor self-sufficiency, especially for an industry as vital to consumers and corporations alike.

Innovation – The Key Focus of the 14th Five-Year Plan

Understanding the shortcomings of its semiconductor production capabilities, the Chinese government outlined an ambitious plan for the industry as part of its 14th Five-Year Plan for 2021-2025[107]. Although the country has also spotlighted the semiconductor industry in its past 2 Five-Year Plans, it should be noted that the focus has shifted to encapsulating domestic elements, stemming

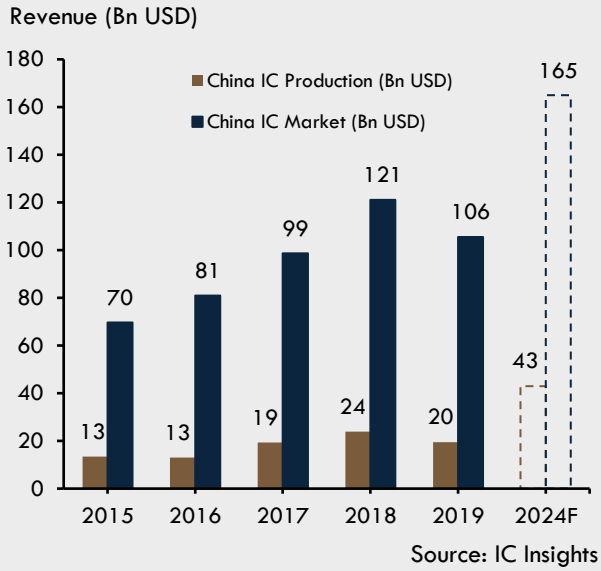
from previous failed joint ventures (JV) and increasing tension between US and China.

The previous 12th and 13th Five-Year plans focused mainly on increasing manufacturing facilities through JVs with notable industry leaders, such as Wuhan-based Wuhan Hongxin Semiconductor Manufacturing, headed by the former COO of TSMC, and Chengdu-based Gexin Integrated Circuit Manufacturing, a JV with US foundry GlobalFoundries, as well as Huaxintong Semitech Co. Ltd, another JV with US chip designer Qualcomm[108]. However, these JVs were hastily launched, having little planning and understanding of coordination between the local Chinese environment and the foreign counterparts, leading to closures of these JVs among others between 2019 to 2020[109].

In addition to the 2019 ban of Huawei's component purchases from US companies and 2020 ban on sales by international suppliers using American technology, the blacklisting of SMIC by the U.S. Commerce Department added fuel to the fire[110]. While SMIC's internal assessment showed no short term risks from the move, the company's plans for producing 10nm and smaller chips did take a significant hit, presenting deterioration from its planned gap closure in technological advancement. On a brighter note, Huawei has shown signs of progress towards supply-chain recovery between 2019 to 2020. It replaced most foreign suppliers with domestic suppliers, as seen from an almost doubling of Chinese-sourced parts in its P40 smartphone to approximately 80%, up from 41% in its P30 smartphone[111]. US-made content was virtually reduced to zero, apart from the processor chips that Huawei stocked up previously.

Moving forward, the grandiose Five-Year plan aims to produce 70% of domestic semiconductor usage by 2025. However, given the current meagre 16% of demand met by domestic production, the target remains highly unfeasible, regardless of a 29.4% increase in output in 2020 y-o-y. In fact, market research firm IC Insights

Figure 22: China's Integrated Circuit (IC) Production and Market by Revenue



Source: IC Insights

estimates that China will only be able to meet 20.4% of its chip consumption by 2024 due to an exponential outpacing of chip consumption over chip production[112].

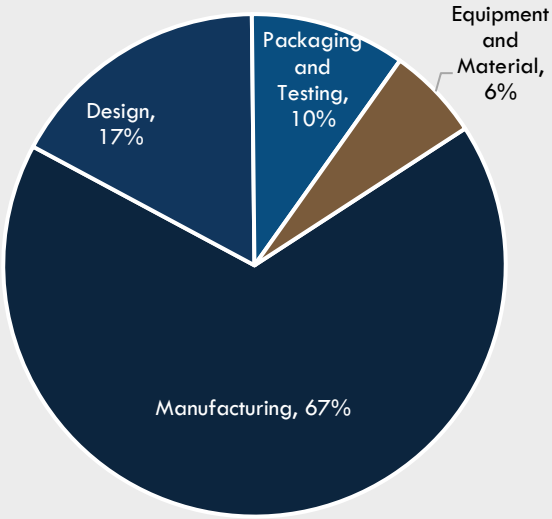
Increasing Funding from Non-Government Sources

Without doubt, interest in the sector has grown exponentially from non-government sources, in the form of venture capital (VC) investments. In 2020, Chinese semiconductor firms saw VC investments rise to 140 billion RMB, up 366% from 2019's 30 billion RMB[113]. While 67.2% of these VC investments were signed off for chip designer firms instead of manufacturing companies, a non-government driven financial foundation provides additional support for the industry in resolving the technological lag.

On the government front, the Chinese government's Big Fund, which totals more than 504 billion RMB from the Finance Ministry and provincial governments, sees the major two-thirds of funding going towards manufacturing companies, thereby balancing the funding available across both the manufacturing and designing areas of the industry.

The presence of VC investments, the Chinese government's Big Fund, as well as the young STAR market with 17% of its exchange

Figure 23: Breakdown of Big-Funds Investment Across Semiconductor Segments



Source: Eastmoney Securities, 2021

comprising of 36 semiconductor firms, indicates notable support to overcome funding-related inertia[114].

Elevating Internal and External Sourcing of Talent

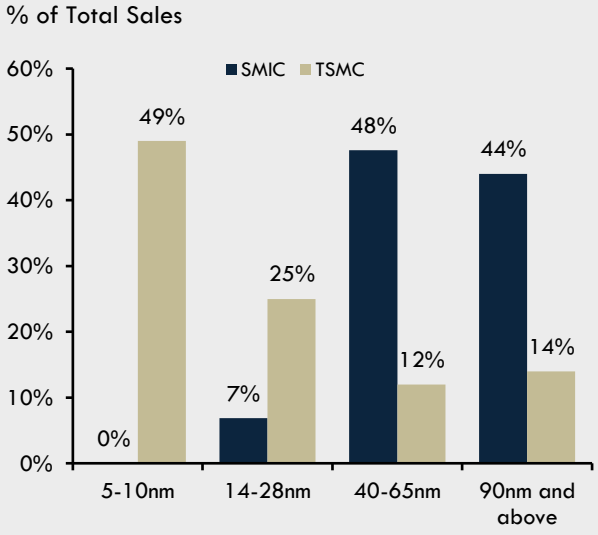
The country's inability to keep up in semiconductor technology is partially also attributed to a shortfall in talent, estimated at around 300,000 people by the China Semiconductor Industry Association. This talent scarcity is purported by lower job entry barriers and better prospects in parallel industries such as big data, cloud computing and artificial intelligence, leading to only 15% of 200,000 integrated circuit graduates opting to work in the semiconductor sector[115].

Externally, China was suspected of 'poaching' more than 100 semiconductor talents from TSMC in Q3 2020, given their knowledge and common linguistics[116]. However, the influx of capital into the industry, could potentially provide graduates and international talents the much-needed prospect for them to fill the talent gap in the long-term.

Bottlenecks Await Progress in Technological Gap-Closing

On the forefront of China's semiconductor industry, namely in SMIC's perspective, the company has made headways to reduce the technological gap between itself and industry leaders such as TSMC and Samsung. Unofficial sources suggest that SMIC's 14nm process has reached a yield of 90-95%, matching that of TSMC[117]. By securing strong yields in the 14nm technology, the company can focus on developing its processes for the smaller, leading-edge chips. On this note, the company opted to skip the 10nm technology, deciding to focus on the 7nm technology based on a unique N+1 node. This move mainly aims to accommodate Huawei's requirements as it seeks to restore supply of its high-performance chips for its advanced smartphones and 5G base stations whilst its stockpile of chips is beginning to dwindle.

Figure 24: Breakdown of Total Sales by Node of SMIC and TSMC



Source: SMIC, TSMC

It should however be noted that SMIC's N+1 chip, although shares similar characteristics with more common TSMC and Samsung 7nm chips, has lower performance across benchmarks[118]. SMIC sees this as an opportunity to set the primary market for this chip to be for lower-cost applications. Despite the company's aggressive strategies to catch up in the technological race of chips, the corporate forces driving it might render SMIC to serve lower-end markets than desired.

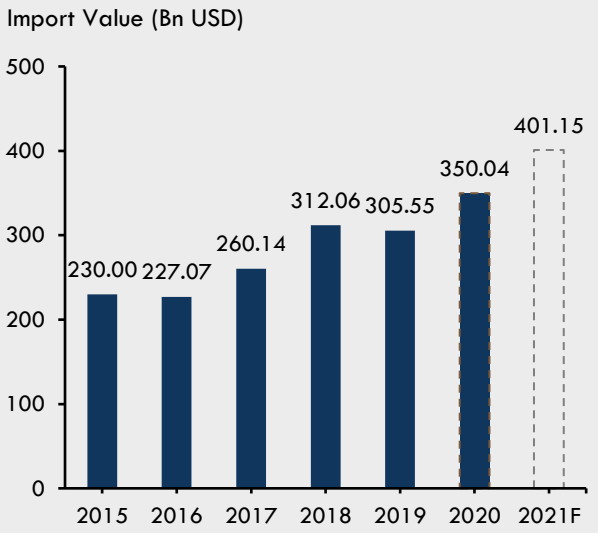
Knowing this, SMIC has plans for an N+2 chip,

which will match the performance of 7nm offerings from TSMC & Samsung[119]. However, its development is halted by the lack of extreme ultraviolet (EUV) lithographic equipment, manufactured only by ASML, a Dutch semiconductor equipment manufacturer. Import plans by China were disrupted as ongoing talks between the Dutch and US governments resulted in an export control for the equipment[120]. Chinese research institutes have made slight headway in developing an alternative lithographic equipment, albeit unlikely in the medium-term[121].

Self-sufficiency Not Feasibly Achievable in the Medium-Term

With the supportive structure by the state in place, newly-registered chip companies in China in the first five months of 2021 grew threefold y-o-y, reaching 15,700 companies. Aside from new entrants, existing tech powerhouses such as carmaker BYD, handset maker Xiaomi, and Huawei Technologies Co have mobilised plans to partake in the critical industry, such as the lattermost's investment of 12.8 million USD in a laser equipment company that contributes to the lithography process. However, these investments would unlikely improve self-sustainability in the medium term. During the same first five-month period of 2021, integrated circuit imports increased by 30% y-o-y as some technologies still lie beyond domestic capabilities[122]. Strong international competition compels Chinese compels to continue imports so that it remains globally competitive[123].

Figure 25: Import Value of Integrated Circuits in China (2015-2021F)



Source: Forward Intelligence (Qianzhan)

Unless the Chinese government takes a hard stance to ban imports of integrated circuits, which is highly unlikely considering the technological fallout, imports will continue to rise alongside chip manufacturing until China's foundries, especially SMIC, closes the two generation process gap. As for the sources of such imports, the U.S. bans are the only barriers that the Chinese government currently considers, which leaves the semiconductor supply chain to realistically only be restricted from American-related sources.

The technological barrier remains a core issue that is unlikely to be resolved within the current Five-Year Plan despite SMIC's aggressive adoption of smaller semiconductor technologies. Semiconductors are generally designed and produced for specific use-cases, which have been long dominated by U.S. and Japanese manufacturers, with TSMC, Samsung and other major foundries serving their needs. Since American and Japanese development of hardware and software products have been the driving force of semiconductor technology for decades, it is difficult for Chinese semiconductor foundries to fully replicate and utilise known technologies. To break the mould, Chinese equipment manufacturers must spearhead the development of semiconductor technologies to suit their products, rather than the current model of importing the most advanced chips to drive their equipment. The scale and sustainability of such operations, however, is especially gargantuan, given the prevalence of non-Chinese equipment in the market.

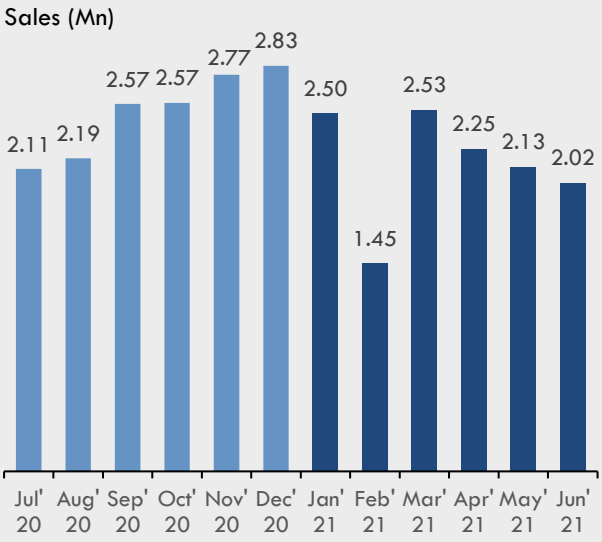
There is still a glimmer of hope as eligible tech conglomerates such as Huawei and Tsinghua Unigroup possess the financial and influential resources to eventually drive semiconductor development in China.

Chip Shortage's Wide-Reaching Impacts

Semiconductors are essential in every electronics product, from simple devices to complex supercomputers. Behind the crucial microchip, however, lies an extremely fragile supply chain, vulnerable to a multitude of external shocks due to the sheer number of different inputs. Additionally, semiconductor chip fabrication is one of the most capital and R&D-intensive manufacturing processes there is, with up to 1,400 intricate process steps requiring highly specialised equipment to achieve the required precision. Producing semiconductors is extremely hard and takes up to 26 weeks for a finished chip to be manufactured[124]. When the pandemic first hit, the automotive industry reduced its chip orders drastically off the back of a 1 million vehicle global production cut and this caused semiconductor plants to have to downscale[125].

It is of no surprise then that when the economy showed signs of recovery and automotive sales rebounded, semiconductor production plants were unable to merely 'flip a switch' and increase its chip output overnight. The automotive industry has thus been hit one of the hardest, with an expected global cost to the industry of $110 billion in revenue in 2021 and a forecasted 3.9 million vehicle production loss this year alone[126]. Up to 1,400 chips are used in a single vehicle alone, in applications like infotainment systems or more basic parts such as power steering or brakes. Domestically, China's car sales in June declined 12.4% year on year to 2.02 million vehicles (Figure 26), breaking an 11-month streak of year-on-year growth[127]. Growth in factories slid to a four-month low in June, due to rising raw material costs and supply chain issues on top of the chip shortage[128]. Several automotive manufacturers have thus resorted to leaving out high end features like navigation systems or digital screens[129]. Furthermore, the industry is quickly moving toward electric vehicles, with the sale of new energy vehicles (NEV) from makers like XPeng, Nio Inc and BYD jumping 139.3% last month to 256,000 units sold[130]. China's traditional automotive industry thus stands to receive the heaviest blow from the global chip shortage.

Figure 26: China's Motor Vehicle Sales



Source: CEIC Data

Aside from the automotive industry, impacts of the chip shortage have bled over into as many as 169 industries globally. Exacerbated by the shift toward working and playing from home due to nation-wide lockdowns worldwide, the lack of semiconductor chips has placed a heavy strain on the consumer electronics industry in China. The increased demand has caused the prices of core chip-making components like panels to increase up to fivefold[131]. Most electronics companies have had to shift the elevated input prices to consumers, like Chinese smartphone giant Xiaomi Corp recently announcing price hikes for their TVs. On the telecommunications front, Huawei and ZTE have slowed down their 5G base station installation due to the shortage, but Huawei's advanced 5G technologies still lead other suppliers by 1-2 years[132]. However, US sanctions and TSMC's supply cut translates to limited advanced Kirin 9000 chipsets available to produce Huawei's 5G phones like the Mate 40, which may be the last model with this advanced chipset[133]. Without a steady phone supply, the 5G base stations will surely remain underutilised.

4

Digital Economy Revolution

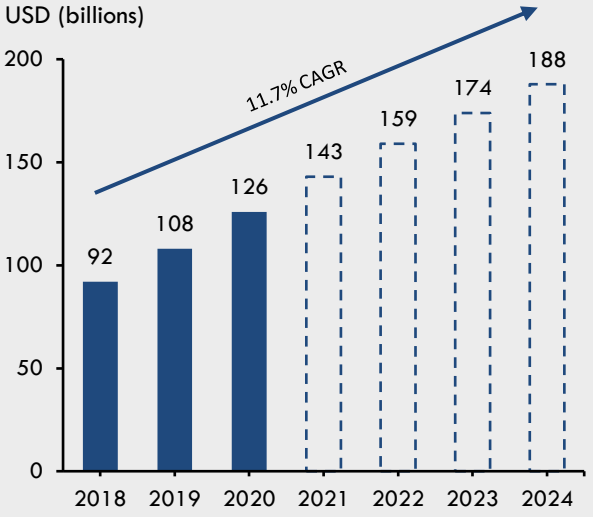
From the 2000s, China's nascent fintech industry benefitted greatly from a 'development first, regulation second' stance adopted by the government at the time. The lack of regulations allowed for the emergence of several ponzi schemes, notably "Ezubao" in 2014. The 2015 stock market crash served as the trigger for the Chinese government to recalibrate restrictions within the fintech industry in recent years, leading to spillover effects into the rest of the technology sector. On the cryptocurrency front, the CCP's aversion to risk and the misalignment of the environmentally destructive cryptocurrency mining to China's carbon neutrality goal prompted the government to shutdown almost all bitcoin mining activities, forcing companies to find alternative locations in the West. China is exploiting the opportunity to accelerate the rollout of its digital yuan, conducting real-world trials in cities like Chengdu and Suzhou. Internationalisation of the currency is also on the agenda, with focuses cross border usage and international collaboration.

Big Tech vs Regulations

China's Fintech Development

The Fintech market aims to extend its reach of financial services beyond the traditional financial methods and cater to a larger proportion of people. In 2018, the global Fintech market was valued at about USD $109 billion and is expected to grow at a CAGR of 11.7% to USD $188 billion by 2024 (Figure 27)[134].

Figure 27: Global Fintech Market Value 2018 to 2024



Source: Deloitte

To date, China's Fintech market is one of the more prominent ones in the world. In 2018, its fintech investment reached USD $25.5 billion, topping other countries and contributed to nearly half of the global total fintech investments. The success of China's Fintech comes from a series of evolutions beginning in the early 2000s.

Fertile Environment for Growth: From 2000 to 2010, the Chinese government took a hands-off approach in regulating the tech sector in pursuit of economic growth. It adopted a "development first, regulation second" (先发展后监管) mentality, providing ample space for the tech sectors to explore. The nascent fintech market was a beneficiary of this lenient regulatory environment[135].

As a result, companies like Ant Group and Tencent started to emerge and soon expanded their dominance. In 2010, digitization of China was gaining traction with mobile online payment and e-commerce becoming more prevalent which contributed to the rise of fintech. With intentions to increase peer-to-peer (P2P) lending to benefit the public, it brought about a slew of illegal activities.

One of the more notorious Ponzi schemes was 'Ezubao' in 2014, which at one point was China's biggest P2P lending platform and amassed about RMB 59.8 billion[136]. Furthermore, the 2015 stock market crash rocked the foundations of their fintech industry. It was not only politically embarrassing but also showed the weakness of China's financial system and raised the alarm on the risk of capital outflows. As such, China started to make attempts to regulate the Fintech sector, to prevent future implications that could trigger large movements in the market.

Stepping Up Regulatory Effort with a Peak in 2020 and 2021: With the unregulated environment, big Fintech companies have enjoyed unparalleled growth. The industry is heavily monopolized by the Ant Group and Tencent, who made up 90% of the mobile payment market in 2019. They surpassed state-owned banks in market size and possess data information accumulated from consumers' shopping behaviour[135].

To limit the power of these Fintech firms, a spate of regulatory efforts were put in place. In 2015, a regulatory parameter for Fintech space "Guiding Opinions on Promoting the Healthy Development of Internet Finance 2015" (关于促进互联网金融健康发展 的指导意见) was released by a collective of Chinese state regulatory agencies. During the 2017 National Financial Work Conference,

President Xi reiterated the importance for the country's financial regulators to step up to their supervisory role and build a regulatory environment with "zero-tolerance" policy for all financial businesses[137], especially after Jack Ma publicly criticised the conventional banking system in October 2020 attracting attention from the Chinese government[138]. This highlighted the urgent need to relinquish power from these big Fintech firms in China. Consequently, the highly anticipated USD 37 billion IPO of Ant Group was suspended[139].

While private companies were being forced back with these regulations, Chinese state-owned banks were doubling down their investments in the Fintech field. In November 2020, the People's Bank of China (PBOC) and the China Banking and Insurance Regulatory Commission (CRIBRC) published a joint regulatory outline to further regulate the Fintech sector. Fintech companies are now classified as online micro-lending companies (MLC) and are required to have a license from banking regulator, subject to renewal every 3 years. More significantly, these MLC are required to at least contribute 30% to the issued joint loans with banks and adhere to more stringent capital and leverage requirements[140]. This will improve the stability of the banking industry, especially since the smaller banks previously relied heavily on these Fintech companies to expand their loan book and were left to shoulder the entire debts in default scenario.

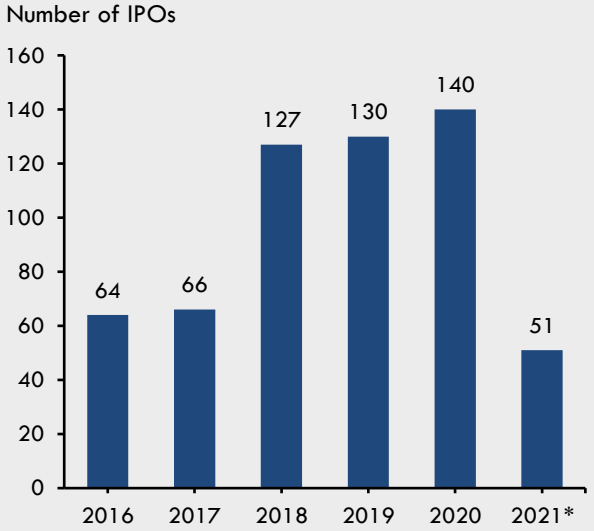
Clampdown on Chinese Tech firms: The crackdown on the Fintech industry has had a spillover effect on the tech industry. In November 2020, the first anti-monopoly guidelines were published by the State Administration for Market Regulation (SAMR) to prevent the market from being monopolised. Alibaba, an e-commerce group in China, was fined a record USD $2.8 billion for abusing its market dominance. Meituan and Pinduoduo, online e-commerce companies, were fined for improper pricing caused by group buying[141].

In July 2021, ride-sharing group Didi Chuxing had its app banned as they were under investigation for violations of China's national and cyber security laws[142]. 360 Finance also had its app temporarily pulled from the Android app store.

Chinese regulators are also looking into its Variable Interest Entity (VIE) structure which has been predominantly used by Chinese firms for listing overseas[143]. Now, Chinese companies who possess data exceeding a million users must undergo a security review Cyberspace Administration of China (CAC) before they are able to be list overseas. Hence, this will make it tougher for overseas IPO of Chinese firms to go through. The number of IPOs of Chinese firms is expected to decrease in 2021 and beyond, after setting record high in 2020 (Figure 28). This is to clampdown on Chinese tech companies which have been going about their business unrestrained for the past two decades[144].

Despite the government's efforts to increase competition in the industry, it is likely that these Chinese tech companies will remain as the dominant players for the time being. However, there is also a growing uncertainty among investors' appetite for Chinese tech stocks as regulatory scrutiny seems to be far more deep-rooted and long-lasting.

Figure 28: Number of IPOs of Chinese Firms Abroad from 2016 to April 2021



*Numbers are accurate as of 1 Apr 2021

Source: Statista

The Great Mining Migration

Crypto Crackdown

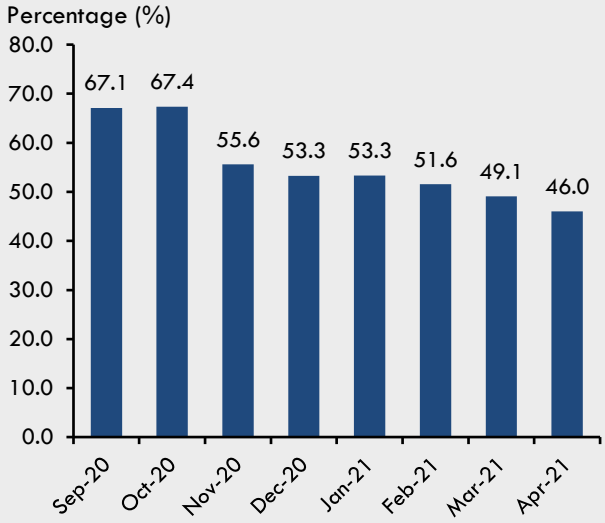
The cryptocurrency market crashed more than 10% in mid-April after blackouts in China led to massive declines in bitcoin's mining rates[145]. In late May, China's State Council signaled a crackdown on cryptocurrency mining, causing bitcoin's price to plunge by 30%, with the industry collectively losing over $1 trillion in value. Chinese Vice Premier Liu He has said that the government would "clamp down on bitcoin mining and trading activity" to ensure financial stability.

Environmental Toll of Cryptocurrencies: The sudden crackdown has been mainly driven by the inherently speculative nature of cryptocurrencies and the Chinese Communist Party's (CCP) aversion to risk – or anything outside its control. Compounding matters is the massive environmental toll of crypto mining, which goes against Chinese President Xi Jinping's ambitious goal to make China carbon neutral by 2060. Prior to the crackdown, bitcoin mining in China was estimated to generate at least 130 million metric tons of carbon emissions by 2024[146]. China's Qinghai became the third province in the nation taking steps to curb cryptocurrency mining operations due to environmental concerns, barring local officials from setting up crypto-mining projects.

Concentration Problem: Cryptocurrencies may have been invented to circumvent government control, but China's culture of top-down regulation has allowed it to hold considerable sway over the industry. Until the recent crackdown, Beijing did not allow financial institutions to trade cryptocurrencies[147], but turned a blind eye to mining, which was tolerated by some local governments.

A high concentration of mining activity in a country will threaten the entire system that underpins cryptocurrencies. China's hashrate (computational power when mining cryptocurrencies) peaked at more than 75% of the global total mining before the crackdown (Figure 29). Vulnerabilities arise when so much mining capacity is concentrated in one place. One of the core security pillars of the blockchain technology which cryptocurrencies operate is that transactions are transparent and publicly verifiable. Beijing's recent crackdown on makes this scenario less of a concern. However, China's bitcoin boom has sown discord in other markets. Demand for graphics cards, which are popular with computer gamers and required for big data processing, has caused prices to surge by 25%, upsetting the gaming and AI industries globally.

Figure 29: China's Bitcoin Mining Hashrate % (Sep 2020 – Apr 2021)



Source: Statista

What's Next for Bitcoin Mining: China's sweeping ban on cryptocurrency mining has paralysed an industry that accounts for over half of global bitcoin production. More than 90% of China's Bitcoin mining capacity is estimated to be shut down as some of China's largest cryptocurrency mining bases, including Sichuan, Xinjiang and Inner Mongolia, have been closed. This has left many companies scrambling to find overseas mines to place their mining devices[148].

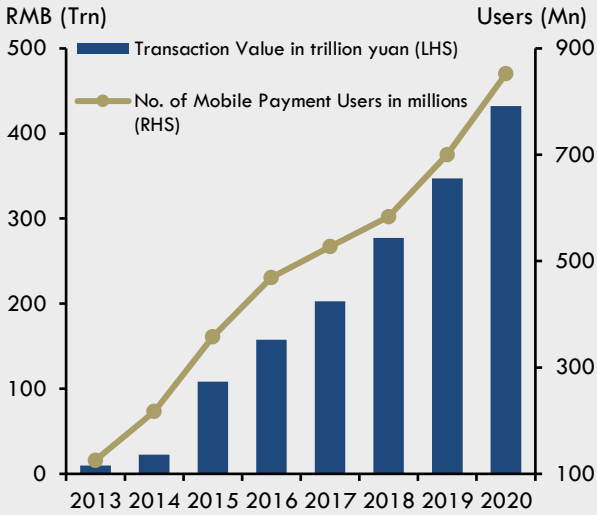
More capital is slowly flowing into the West, as the bitcoin mining industry there is becoming more institutionalized. Prior to the crackdown, there had already been a gradual shift of bitcoin mining operations to countries like Canada and Iceland, who possess year-round cool temperatures and steady renewable energy supplies. Other alternatives include neighbouring Kazakhstan. Kazakhstan's coal mines provide a cheap and abundant energy supply. It also helps that Kazakhstan has a more lax attitude about building, which bodes well for miners who need to construct physical installations in a short period of time[149].

That said, the exodus won't be instantaneous, in part, because it will take miners some time to either move their machines out of China or liquidate their assets and set up shop elsewhere. All in all, the increasing migration of Chinese crypto companies is viewed as a success for Beijing's campaign to rid the country of mining and trading of unregulated digital currencies[150].

China Pushes Forward with Digital Yuan: The rollout of the digital yuan has sped up this year in tandem with the outlawing of crypto trading. Fan Yifei, deputy governor of the PBOC, warned that cryptocurrencies like bitcoin had become "tools for speculation" and were bringing potential risks to financial security and social stability. However, the adoption of China's digital currency could merely be another cover story for the government to increase financial surveillance on its citizens as it will enable them greater power to track spending in real time.

PBOC began exploring the concept currency in 2014 with the success of e-commerce platforms Alibaba, Tencent and Baidu[151]. Mobile transactions reached 347 trillion yuan (Figure 30) in 2019, accounting for 80% of payments in China[152]. To date, China has given away at least 269 million yuan worth of digital currency through their 'red envelope' campaign[153], with real-world trials in several cities including Shenzhen, Chengdu and Suzhou[152]. JD.com, one of China's biggest e-commerce players, was involved in the trial and allowed customers to purchase items with the digital yuan. The next pilot project will focus more on the food, transportation, travel, shopping, entertainment, and information about the 2022 Beijing Winter Olympics[154].

Figure 30: Transaction Value of Mobile Payments and No. of Users in China



Source: Statista

Internationalisation of the Yuan: While its ambition of dethroning the US dollar is thought to be the country's long-term goal, China will first push forward internationalisation of the yuan currency via increased cross-border usage[155]. With over 800 million users actively using mobile payment systems such as WeChat Pay and AliPay, China is well positioned to adopt DC/EP – digital currency and electronic payment. The digital currency will potentially allow for better regulation of fintech, improve risk management for businesses, simplify cross-border transactions and promote overseas circulation of the RMB. International collaboration has also accelerated between China's central bank and its counterparts in Thailand and the United Arab Emirates. The nations are studying the use of digital currencies and blockchain technology in cross-border payments. In the meantime, the PBOC will continue to experiment and increase the scope of its pilot projects, while also strengthening the digital currency ecosystem, including technology and infrastructure[156].

References

1. EMIS
2. Reuters. (2021). *China April home prices quicken to 8-month high.* Retrieved from: *https://www.reuters.com/article/us-china-economy-homeprices-idUSKCN2CY03L*
3. Zhiru T, Donglan W, Zixu Y. (2020). *Housing Vacancy Rate in Major Cities in China: Perspectives from Nighttime Light Data.* Hindawi. Retrieved from: *https://www.hindawi.com/journals/complexity/2020/5104578/*
4. Sohu. (2020). *How high is the vacancy rate of Chinese Housing? May be higher than you think.* Retrieved from: https://www.sohu.com/a/440220340_120554831
5. Statista. (2021). *Import volume of soybeans worldwide in 2020/21, by country.* Retrieved from: https://www.statista.com/statistics/612422/soybeans-import-volume-worldwide-by-country/
6. Ethan C F. (2021). *Unexpected surge pushes China's internet population to brink of 1 billion.* Insider Intelligence. Retrieved from: https://www.emarketer.com/content/after-unexpected-surge-chinas-internet-population-on-brink-of-1-billion
7. Group Research – Equities. (2021). *China Home Appliance Sector: Undergoing transformation.* DBS. Retrieved from: https://www.dbs.com.sg/treasures-private-client/aics/sector-thematics/templatedata/article/generic/data/en/GR/012021/210122_insights_cn_home_appliance.xml#
8. Daxue Consulting. (2020). *Prepare for the burst of C2M (consumer to manufacturer) in China: Pinduoduo, JD.com, Biyao.* Retrieved from: https://daxueconsulting.com/c2m-in-china/
9. Sohu. (2021). *Insight Report on Young Generation Kitchen Appliances-CBNDATA.* Retrieved from:https://www.sohu.com/a/472344586_120855974
10. Haier Smart Home Co., Ltd. (2020). *Annual Report 2020.* Retrieved from: https://smart-home.haier.com/en/gpxx/iv/P020210429639454409151.pdf?appdesc=Annual%20Report%202020
11. Midea Group Co., Ltd. (2020). *Semi-Annual Report 2020.* Retrieved from: https://www.midea-group.com/asset/Midea-Group/Financial%20report.zip/Midea-Group-2020-Semi-annual-Report.PDF
12. Wang J. (2021). *Another listed kitchen appliance company "connected to Hongmeng" has done these things even in the face of cost pressures.* Tencent. Retrieved from: https://xw.qq.com/cmsid/20210714A0DWPX00
13. Baidu. (2021). *Haier Smart Home UhomeOS 3.0 is released as an industry-leading smart home ecological operating system.* Retrieved from: https://baijiahao.baidu.com/s?id=1695001770411728345&wfr=spider&for=pc
14. Yingzhe G. (2020). *Huawei Makes HarmonyOS Open Source to Boost It as Andriod Alternative.* Caixin. Retrieved from: https://www.caixinglobal.com/2021-06-07/huawei-makes-harmonyos-open-source-to-boost-it-as-android-alternative-101724168.html
15. Fitch Ratings. (2020). *Chinese Home Appliances Blue Book.* Retrieved from: https://www.fitchratings.com/research/corporate-finance/chinese-home-appliances-blue-book-17-08-2020
16. Echemi. (2021). *The global polypropylene market forces three major challenges in the second half of the year.* Retrieved from: https://www.echemi.com/cms/280238.html
17. Nigel D S. (2021). *Why Aluminium prices are going up? Here's an analysis.* CNBCTV18. Retrieved from: https://www.cnbctv18.com/energy/why-aluminium-prices-are-going-up-heres-an-analysis-9227621.htm
18. Jufu Finance. (2021). *The cost of raw materials continues to rise, and the home appliance industry has been affected. Will prices fall in 2021?* Retrieved from: https://baijiahao.baidu.com/s?id=1701254246306207378&wfr=spider&for=pc
19. Statista. (2021). *Revenue of Midea in 2017 to 2020, by region.* Retrieved from: https://www.statista.com/statistics/1028515/china-operating-revenue-of-midea-by-region/
20. Statista. (2021). *Domestic and overseas revenue of Haier Smart Home Co., Ltd from 2017 to 2020.* Retrieved from: https://www-statista-com.libproxy.smu.edu.sg/statistics/1037076/revenue-of-qingdao-haier-by-region/
21. Evelyn C. (2021). *China rushes to pull back the yuan from a three-year high.* CNBC. Retrieved from: https://www.cnbc.com/2021/06/03/china-sets-yuan-rmb-weaker-vs-us-dollar-for-first-time-in-a-week.html
22. Iris O. (2021). *Midea, China's top home appliances maker, to expand overseas production as it eyes 10 per cent global market share.* South China Morning Post. Retrieved from: https://www.scmp.com/business/companies/article/3132814/midea-chinas-top-home-appliances-maker-expand-overseas
23. Xie Y. (2021). *Haier bought GE Appliances for US$5.6 billion. Now it's working on fixing it.* South China Morning Post. Retrieved from: https://www.scmp.com/business/companies/article/2116486/chinas-haier-has-plan-help-continue-turnaround-ge-appliances
24. Furnishingidea. (2021). *The Chinese group Haier acquires Candy for 475 million euros.* Retrieved from: https://www.furnishingidea.com/industry-news/the-chinese-group-haier-acquires-candy-for-475-million-euros-10260.php
25. Hermesauto. (2019). *China's alcohol intake on the rise, thanks to growing affluence, more adventurous drinkers.* The Straits Times. Retrieved from: https://www.straitstimes.com/asia/east-asia/chinas-alcohol-intake-on-the-rise-thanks-to-growing-affluence-more-adventurous.
26. Ho, J., Hui, D., Kim, A., & Zhang, Y. (2020). *Cautiously optimistic: Chinese consumer behavior post-COVID-19.* McKinsey & Company. Retrieved from: https://www.mckinsey.com/industries/consumer-packaged-goods/our-insights/cautiously-optimistic-chinese-consumer-behavior-post-covid-19.
27. Lee, G. (2021). *Online deliveries help Carlsberg China keep sales buoyant in world's largest market.* South China Morning Post. Retrieved from: https://www.scmp.com/business/companies/article/3138810/hold-my-beer-carlsberg-shows-industry-how-keep-taps-flowing.
28. Business Wire. (2021). *Rémy Cointreau: First-quarter Sales 2021/21.* Business Wire. Retrieved from: https://www.businesswire.com/news/home/20210719005724/en/R%C3%A9my-Cointreau-First-Quarter-Sales-202121.
29. Warc. (2021). *Online clubbers drive booze sales in China: WARC.* WARC An Ascential Company. Retrieved from: https://www.warc.com/newsandopinion/news/online-clubbers-drive-booze-sales-in-china/43463.
30. Oloruntoba, A. (2020). *Revenue of the spirits market worldwide by country 2019.* Statista. Retrieved from: https://www.statista.com/forecasts/758151/revenue-of-the-spirits-market-worldwide-by-country.
31. Daxue Consulting. (2020). *The spirits market in China: The four most popular alcoholic drinks.* Daxue Consulting Market Research China. Retrieved from: https://daxueconsulting.com/spirits-market-china/.
32. Chang, C. (2021). *Can Chinese liquor companies convince Chinese youths to drink traditional baijiu?* SupChina. Retrieved from: https://supchina.com/2021/05/05/can-chinese-liquor-companies-convince-chinese-youths-to-drink-traditional-baijiu/.
33. Euromonitor.
34. Whitley, A. (2021). *China Is Drinking Barely A Drop of Australian Wine After 200% Tariffs.* Bloomberg.com. Retrieved from: https://www.bloomberg.com/news/articles/2021-04-29/china-is-drinking-barely-a-drop-of-australian-wine-after-tariffs.
35. Cheng, E. (2021). *China wants to build up its wine country into one that could rival France's Bordeaux.* CNBC. Retrieved from: https://www.cnbc.com/2021/06/21/china-wine-ningxia-strives-to-be-france-bordeaux-amid-tariffs-on-australia.html.
36. Lannes, B (2020). *China's unstoppable 2020 luxury market.* Bain. Retrieved from: https://www.bain.com/insights/chinas-unstoppable-2020-luxury-market/.
37. China Power Team. (2020). *How well-off is China's middle class?* Retrieved from: https://chinapower.csis.org/china-middle-class/#:~:text=China's%20Gross%20National%20Income%20(GNI,2000%2C%20reaching%20%2410%2C410%20in%202019.

38. Hancock, T. (2017). *Chinese luxury goods prices start to close gap with Europe.* Subscribe to read | Financial Times. Retrieved from: https://www.ft.com/content/c800fc30-87cb-11e7-bf50-e1c239b45787.
39. DaXue Consulting. (2021*). The Chinese daigou Industry explained: The future of surrogate shopping in China.* Daxue Consulting Market Research China. https://daxueconsulting.com/daigou-in-china/.
40. Qian, Z., & Koty, A. (2017). *China cuts import duties on consumer goods.* China Briefing News. Retrieved from: https://www.china-briefing.com/news/china-cuts-import-duties-consumer-goods/.
41. Xueqiao, W. (2018). *China crackdown on OVERSEAS personal Shoppers Boosts ecommerce.* Subscribe to read | Financial Times. Retrieved from: https://www.ft.com/content/85a4d622-e422-11e8-a6e5-792428919cee.
42. Macaspac, R., & Ni, V. H. (2019). *Price benchmarking is crucial for global luxury brands.* Jing Daily. Retrieved from: https://jingdaily.com/price-benchmarking/.
43. Makichuk, D. (2020). *Counterfeit crackdown nets $242M in fake products.* Asia Times. Retrieved from: https://asiatimes.com/2020/07/counterfeit-crackdown-nets-242m-in-fake-products/.
44. Global Times. (2020). *'Rising star' Hainan to be world's Biggest Duty-free market in 2 YEARS:* KPMG joint report. Retrieved from: Global Times. https://www.globaltimes.cn/page/202105/1222894.shtml.
45. Fitch Solutions
46. Climate Action Tracker
47. Chloe Farand (2021). *China makes no shift away from coal in five-year plan as it 'crawls' to carbon neutrality.* Climate Home News. Retrieved from: https://www.climatechangenews.com/2021/03/05/china-makes-no-shift-away-coal-five-year-plan-crawls-carbon-neutrality/
48. Fitch Solutions
49. Fitch Solutions
50. Fitch Solutions
51. Jun X. (2021). *China's steel sector to achieve carbon emissions peak in 2025.* Global Times. Retrieved from: https://www.globaltimes.cn/page/202103/1219867.shtml
52. Wood Mackenzie. (2021). *Aiming high: can China's steel industry hit its ambitious targets?* Retrieved from: https://www.woodmac.com/news/opinion/aiming-high-can-chinas-steel-industry-hit-its-ambitious-targets/
53. World Steel Organisation. (2021). *World Steel in Figures.* Retrieved from: https://www.worldsteel.org/en/dam/jcr:976723ed-74b3-47b4-92f6-81b6a452b86e/World%2520Steel%2520in%2520Figures%25202021.pdf
54. Fitch Solutions
55. Argus Media. (2021). *China's March met coal imports rise to 5-month high.* Retrieved from: https://www.argusmedia.com/en/news/2208332-chinas-march-met-coal-imports-rise-to-5month-high
56. Michael S. (2021). *China lifts ban on scrap metal imports in new iron ore threat.* The Australian Financial Review. Retrieved from: https://www.afr.com/world/asia/china-lifts-ban-on-scrap-metal-imports-in-new-iron-ore-threat-20210216-p5731j
57. Su Lin T. (2021*). China's scrap-steel imports 'symbolic' after two-year ban lifted, will not reduce need for iron ore.* South China Morning Post. Retrieved from: https://www.scmp.com/economy/china-economy/article/3116472/chinas-scrap-steel-imports-symbolic-after-two-year-ban-lifted
58. Alexander C K. (2021). *China's Carbon Neutrality Pledge: New Opportunities for Foreign Investment in Renewable Energy.* China Briefing. Retrieved from: https://www.china-briefing.com/news/chinas-carbon-neutrality-pledge-new-opportunities-for-foreign-investment-in-renewable-energy/
59. Jason D. (2021). *What Is Going On With China's Crazy Clean Energy Installation Figures?* Greentechmedia. Retrieved from: https://www.greentechmedia.com/articles/read/what-is-going-on-with-chinas-crazy-clean-energy-installation-figures
60. Reuters. (2021). *China to add at least 90 GW wind and solar capacity to the grid in 2021.* Retrieved from: https://www.reuters.com/business/sustainable-business/china-add-least-90-gw-wind-solar-capacity-grid-2021-2021-05-20/
61. Kenneth R. (2021). *How China's Solar Industry Is Set Up To Be The New Green OPEC.* Forbes. Retrieved from: https://www.forbes.com/sites/kenrapoza/2021/03/14/how-chinas-solar-industry-is-set-up-to-be-the-new-green-opec/?sh=7259552a1446
62. Bloomberg News. (2021). *China's $ 42 Billion Clean Energy Debt Is Only Getting Worse.* Retrieved from: https://www.bloomberg.com/news/articles/2020-07-14/china-has-a-42-billion-clean-energy-debt-and-it-s-getting-worse?sref=MzHOT4Jm
63. Dan M. (2021). *The Chinese Government Needs To Become a Clean Energy Supermajor.* Bloomberg Green. Retrieved from: https://www.bloomberg.com/news/articles/2021-05-06/the-chinese-government-needs-to-become-a-clean-energy-supermajor?sref=MzHOT4Jm
64. Fitch Ratings. (2021). *China's Power Demand Exceeds Pre-Pandemic Levels; Renewables to Drive Development.* Retrieved from: https://www.fitchratings.com/research/corporate-finance/china-power-demand-exceeds-pre-pandemic-levels-renewables-to-drive-development-25-05-2021
65. Bangkok Post. (2021). *China sets 15-year transport expansion plan.* Retrieved from: https://www.bangkokpost.com/business/2075115/china-sets-15-year-transport-expansion-plan
66. Eamon B. (2021). *China is rolling back the subsidies that fueled its electric-vehicle boom.* Fortune. Retrieved from: https://fortune.com/2021/01/05/china-electric-vehicle-subsidies-sales-tesla/
67. Joshua S H. (2021). *China dominates rollout of EV charging stations – 4,000 a day in December*. The Driven. Retrieved from: https://thedriven.io/2021/04/20/china-dominates-rollout-of-ev-charging-stations-4000-a-day-in-december/
68. Energy Policy. (2020). *EV Charging China Report.* Retrieved from: https://energypolicy.columbia.edu/sites/default/files/file-uploads/EV_ChargingChina-CGEP_Report_Final.pdf
69. South China Morning Post. (2021). *China's coal share of energy consumption falls in 2020, but overall coal use up.* Retrieved from: https://www.scmp.com/economy/china-economy/article/3123464/chinas-coal-share-energy-consumption-falls-2020-overall-coal
70. Arij L. (2021). *Are electric vehicles really better for the environment?* CGTN. Retrieved from: https://newseu.cgtn.com/news/2021-01-01/Are-electric-vehicles-really-better-for-the-environment--W0FZ67n1qU/index.html
71. ETAuto.com. (2021). *China's electric car capital has lessons for the rest of the world.* Retrieved from: https://auto.economictimes.indiatimes.com/news/passenger-vehicle/cars/chinas-electric-car-capital-has-lessons-for-the-rest-of-world/83887944
72. EMIS
73. Michael N. (2021). *Analysis: Can the Rhine's white gold power Germany's green e-car race?* Reuters. Retrieved from: https://www.reuters.com/business/sustainable-business/can-rhines-white-gold-power-germanys-green-e-car-race-2021-04-28/
74. EMIS
75. Bloomberg NEF. (2020). *Battery Pack Prices Cited Below $100/kWh for the First Time in 2020, While Market Average Sits at $137/kWh.* Retrieved from: https://about.bnef.com/blog/battery-pack-prices-cited-below-100-kwh-for-the-first-time-in-2020-while-market-average-sits-at-137-kwh/
76. Fred L. (2020). *Electric vehicle battery cost officially dips under critical $100/kWh price point but there's a catch.* Electrek. Retrieved from: https://electrek.co/2020/12/16/electric-vehicle-battery-dips-critical-100-kwh-price-point/
77. Valentina R L. (2021). *Artisanal miners could help Congo's state-owned company become world's fourth-largest cobalt producer.* Mining Dot Com. Retrieved from: https://www.mining.com/artisanal-miners-could-help-congo-become-worlds-fourth-largest-cobalt-producer/
78. Susan Z, Carrie S. (2021). *China's LFP battery production exceeds NCM battery output in May.* Metal Bulletin. Retrieved from: https://www.metalbulletin.com/Article/3994511/Chinas-LFP-battery-production-exceeds-NCM-battery-output-in-May.html
79. Bloomberg News. (2021). *Tesla to Cut Price on Chinese Model 3 with CATL Battery.* Retrieved from: https://www.bloomberg.com/news/articles/2020-10-01/tesla-said-to-cut-price-on-chinese-model-3-with-catl-battery

80. Eric W. (2021). *China's Tesla Challenger Xpeng Launches 3 New EV Variants Powered by Cobalt-free, Lithium Iron Phosphate (LFP) Batteries.* FutureCar. Retrieved from: https://www.futurecar.com/4463/Chinas-Tesla-Challenger-Xpeng-Launches-3-New-EV-Variants-Powered-by-Cobalt-free-Lithium-Iron-Phosphate-(LFP)-Batteries
81. Yvonne T. (2021). *BYD's blade battery now used in all of its all-electric models.* CNEV Post. Retrieved from: https://cnevpost.com/2021/07/19/byds-blade-battery-now-used-in-all-of-its-all-electric-models/
82. EMIS
83. CGTN. (2021). *Sales of passenger vehicles in China drop 5.1% in June due to chip shortage.* Retrieved from: https://news.cgtn.com/news/2021-07-09/China-s-passenger-vehicle-sales-drop-5-1-in-June-due-to-chip-shortage-11KxjX5hxV6/index.html
84. Hongpei Z. (2021). *Chinese auto sector seeks bigger local chip base as supply shortage anticipated to ease by year-end.* Global Times. Retrieved from: https://www.globaltimes.cn/page/202104/1220609.shtml
85. China Money AI. (2021). *China's BYD Plans To Spin Off And List Semiconductor Unit.* China Money Network. Retrieved from: https://www.chinamoneynetwork.com/2021/05/12/chinas-byd-plans-to-spin-off-and-list-semiconductor-unit
86. Infineon. (2021). *First Quarter FY 2021 Quarterly Update.* Retrieved from: https://www.infineon.com/dgdl/2021-02-04+Q1+FY21+Investor+Presentation.pdf?fileId=5546d461774fe9d30177691529b20005
87. Rita L. (2020). *China's BYD nabs $113M to produce IGBTs, the 'CPU of Electric Cars'*. TechCrunch. Retrieved from: https://techcrunch.com/2020/06/15/byd-semiconductor-igbt-113-million-funding/
88. Minghe H, Che P. (2021). *Chip Shortage restricts China's car production, leaving showrooms empty, but local brands are faring better.* South China Morning Post. Retrieved from: https://www.scmp.com/tech/tech-trends/article/3138438/chip-shortage-restricts-chinas-car-production-leaving-showrooms
89. Zachary S. (2021). *NIO ES8 – The Chinese Electric SUV Outselling The Tesla Model X.* Clean Technica. Retrieved from: https://cleantechnica.com/nio-es8/
90. Celine D. (2020). *NIO House: Car Manufacturer NIO Launches A New Type of Concept.* Innovation Is Everywhere. Retrieved from: https://innovationiseverywhere.com/nio-house-car-manufacturer-nio-launches-new-type-concept/
91. EMIS
92. Auto Blog. (2020). *GM scores a bestseller in China with $4,200 electric micro car.* Retrieved from: https://www.autoblog.com/2020/09/26/gm-china-electric-micro-car-wuling-mini-ev/
93. Sustainable Bus. (2021). *BYD in Columbia, the awarding of a 1,002 units tender for Transmilenio (Bogota).* Retrieved from: https://www.sustainable-bus.com/news/byd-colombia-bogota-transmilenio/
94. BYD. (2021). *BYD ADL Get Order for 195 Electric Buses.* Retrieved from: https://en.byd.com/news-posts/major-fleet-order-for-195-electric-buses-from-byd-adl-gets-order-for-195-electric-buses/
95. Argus Media. (2021). *China's Shanghai continues to offer free EV licenses. Retrieved from: https://www.argusmedia.com/en/news/2185607-chinas-shanghai-continues-to-offer-free-ev-licences*
96. King, I., Leung, A., & Pogkas, D. (2021). *The Chip Shortage Keeps Getting Worse. Why Can't We Just Make More?* Bloomberg. https://www.bloomberg.com/graphics/2021-chip-production-why-hard-to-make-semiconductors/
97. Semiconductor Industry Association. (2021). *Global Semiconductor Sales Increase 6.5% to $439 billion in 2020.* https://www.semiconductors.org/global-semiconductor-sales-increase-6-5-to-439-billion-in-2020/
98. Congressional Research Service. (2020). *Semiconductors: U.S. Industry, Global Competition, and Federal Policy.* https://crsreports.congress.gov
99. Se, K. K., & Cheng, T.-F. (2017). *Beijing's crackdown on Hong Kong is alienating Taiwan*. Nikkei Asia. https://asia.nikkei.com/Economy/Beijing-s-crackdown-on-Hong-Kong-is-alienating-Taiwan2
100. Davis, B., & Ferek, K. S. (2020). *U.S. Moves to Cut Off Chip Supplies to Huawei*. The Wall Street Journal. https://www.wsj.com/articles/u-s-moves-to-cut-off-chip-supplies-to-huawei-11589545335?mod=article_inline
101. Li, L., & Cheng, T.-F. (2020). *Huawei builds up 2-year reserve of "most important" US chips*. Nikkei Asia. https://asia.nikkei.com/Spotlight/Huawei-crackdown/Huawei-builds-up-2-year-reserve-of-most-important-US-chips
102. Lapedus, M. (2021). *Chip Shortages Grow For Mature Nodes*. Semiconductor Engineering. https://semiengineering.com/chip-shortages-grow-for-mature-nodes/
103. Samsung. (2020). *Samsung Foundry Investor Presentation 2020*. https://images.samsung.com/is/content/samsung/assets/global/ir/docs/business-introduction/Samsung_Investor_Presentation_Foundry_2020_v1.pdf
104. McKellop, M. (2021). *SMIC plants running 'fully loaded,' setting up new $12 billion sub-14nm foundry* . The Burn-In. https://www.theburnin.com/industry/smic-plants-fully-loaded-building-12b-sub-14nm-foundry-2021-02-16/
105. To, Y. (2021). *China chases semiconductor self-sufficiency*. East Asia Forum. https://www.eastasiaforum.org/2021/02/22/china-chases-semiconductor-self-sufficiency/
106. Lewis, J. A. (2019). *China's Pursuit of Semiconductor Independence*. Center for Strategic & International Studies. https://www.csis.org/analysis/chinas-pursuit-semiconductor-independence
107. Kaja, A., Ting, X., Huang, S. (Siyi), & Stein, S. (2021). *China's 14th Five-Year Plan (2021-2025): Spotlight on Semiconductors*. Global Policy Watch. https://www.globalpolicywatch.com/2021/04/chinas-14th-five-year-plan-2021-2025-spotlight-on-semiconductors/
108. VerWey, J. (2020). *Made in China 2025 and Semiconductors: A 2020 Progress Report*. https://semiliterate.substack.com/p/made-in-china-2025-and-semiconductors
109. Leng, S. (2020). *US semiconductor giant shuts China factory hailed as 'a miracle', in blow to Beijing's chip plans*. South China Morning Post. https://www.scmp.com/economy/china-economy/article/3085230/us-semiconductor-giant-shuts-china-factory-hailed-miracle
110. Yuan, G., Al Ali, N., Wu, D., Jing, L., & Martin, P. (2020). *U.S. Blacklists More Than 60 Chinese Firms, Including SMIC*. Bloomberg. https://www.bloomberg.com/news/articles/2020-12-18/u-s-to-blacklist-smic-and-dozens-more-china-firms-reuters-says
111. Fumie, Y. (2020). *Huawei teardown shows US ban made company turn to Chinese parts*. Nikkei Asia. https://asia.nikkei.com/Spotlight/Huawei-crackdown/Huawei-teardown-shows-US-ban-made-company-turn-to-Chinese-parts
112. IC Insights. (2020). *China to Fall Far Short of its "Made-in-China 2025" Goal for IC Devices*. https://www.icinsights.com/news/bulletins/China-To-Fall-Far-Short-Of-Its-MadeinChina-2025-Goal-For-IC-Devices/
113. Wei, S. (2021). *Where China is investing in semiconductors, in charts*. TechNode. https://technode.com/2021/03/04/where-china-is-investing-in-semiconductors-in-charts/
114. Fitch Solutions
115. Lan, S. (2019). *Chips talent shortage predicted to keep widening in China as IC industry booms: experts*. National Business Daily. http://m.nbdpress.com/articles/2019-05-21/6765.html
116. Reuters. (2021). *China pushed to 'poach' Taiwan's semiconductor technology, talent by US-China trade war, economy minister says.* https://www.scmp.com/economy/china-economy/article/3127757/china-pushed-poach-taiwans-semiconductor-technology-talent-us
117. Telenor Tech. (2021). *SMIC's product yields using 14nm process said to have reached TSMC's level ~ Telenor Tech*. https://www.telenor.com.np/2021/03/smics-product-yields-using-14nm-process.html
118. Shilov, A. (2020). *Chinese SMIC Tapes Out First N+1 '7 nm' Chip, But Mass Production Uncertain*. https://www.tomshardware.com/uk/news/chinese-smic-tapes-out-first-n-7-nm-chip-but-mass-production-uncertain
119. Shilov, A. (2020). *SMIC: Advanced Process Technologies and Gov't Funding (Part 2)*. EE Times. https://www.eetimes.com/smic-advanced-process-technologies-and-govt-funding-part-2/
120. Bloomberg. (2021). *US-China tech war: ASML CEO says controlling chip sales to China won't work*. https://www.scmp.com/tech/tech-war/article/3129585/us-china-tech-war-asml-ceo-says-controlling-chip-sales-china-wont
121. Li, X. (2020). *5nm laser lithography breakthrough may lift Chinese chip-making*. Global Times. https://www.globaltimes.cn/content/1194063.shtml

122. Ye, J. (2021). *New Chinese semiconductor firms have tripled in 2021 as Beijing and Washington jockey over technological supremacy*. South China Morning Post. https://www.scmp.com/tech/tech-war/article/3136660/new-chinese-semiconductor-firms-have-tripled-2021-beijing-and
123. Triolo, P. (2021). *The Future of China's Semiconductor Industry*. American Affairs Journal. https://americanaffairsjournal.org/2021/02/the-future-of-chinas-semiconductor-industry/
124. Yinug, F. (2021). *Chipmakers are ramping up production to address semiconductor shortage. Here's why that takes time*. Semiconductor Industry Association. https://www.semiconductors.org/chipmakers-are-ramping-up-production-to-address-semiconductor-shortage-heres-why-that-takes-time/.
125. Qu, H., He, S., Zhai, S., Liu, Y., & Han, W. (2021). *How a perfect storm created the global chip shortage*. Nikkei Asia. https://asia.nikkei.com/Spotlight/Caixin/How-a-perfect-storm-created-the-global-chip-shortage.
126. Wayland, M. (2021). *Chip shortage expected to COST auto Industry $110 billion in revenue in 2021*. CNBC. https://www.cnbc.com/2021/05/14/chip-shortage-expected-to-cost-auto-industry-110-billion-in-2021.html.
127. Yang, S. (2021). *China car sales fall with chips in short supply*. The Wall Street Journal. https://www.wsj.com/articles/china-car-sales-fall-with-chips-in-short-supply-11625747004.
128. Partridge, J. (2021). *Global chip shortage hits car production in China and Japan*. The Guardian. https://www.theguardian.com/world/2021/jun/30/global-semiconductor-shortage-affecting-car-production-in-china-and-japan.
129. Shead, S. (2021). *The global chip shortage is starting to have major real-world consequences*. CNBC. https://www.cnbc.com/2021/05/07/chip-shortage-is-starting-to-have-major-real-world-consequences.html.
130. Reuters. (2021). *Chip shortage pushes China auto sales down 12.4% in June*. Reuters. https://www.reuters.com/world/china/chinas-auto-sales-down-124-june-industry-association-2021-07-09/.
131. Yin, Y. (2021). *China-US chip divergence intensifies as shortages devastate many industries*. Global Times. https://www.globaltimes.cn/page/202106/1225871.shtml.
132. Global Times. (2021). *Huawei still Tops global telecom equipment makers in 2020*. Global Times. https://www.globaltimes.cn/page/202103/1217854.shtml.
133. Tech2. (2020). *Huawei's high-end Kirin chipsets running out under US sanction, Mate 40 to be the last Kirin-powered flagship*. Tech2. https://www.firstpost.com/tech/news-analysis/huaweis-high-end-kirin-chipsets-running-out-under-us-sanction-mate-40-to-be-the-last-kirin-powered-flagship-8690011.html.
134. Deloitte. (2020). *Fintech | On the brink of further disruption.* Deloitte. Retrieved from: https://www2.deloitte.com/content/dam/Deloitte/nl/Documents/financial-services/deloitte-nl-fsi-fintech-report-1.pdf
135. Zhu, V. (2021). *China's Fintech: the End of the Wild West.* Institut Montaigne. Retrieved from: https://www.institutmontaigne.org/en/publications/chinas-fintech-end-wild-west
136. Reuters Staff. (2017). *Leader of China's $9 billion Ezubao online scam gets life; 26 jailed.* Reuters. Retrieved from: https://www.reuters.com/article/us-china-fraud-idUSKCN1BN0J6
137. Benveniste, A. (2021). *China bans Didi, its biggest ride-hailing service, from app stores.* CNN. Retrieved from: https://edition.cnn.com/2021/07/04/tech/china-app-store-didi/index.html
138. Campbell, C. (2021). *How China Is Cracking Down on Its Once Untouchable Tech Titans.* Time. Retrieved from: https://time.com/6048539/china-tech-giants-regulations/
139. Canales, K. (2021). *Jack Ma hasn't been seen in public since Ant Group's IPO was pulled. Here's how Chinese regulators slammed the brakes on the firm's would-be record-breaking $37 billion IPO.* Business Insider. Retrieved from: https://www.businessinsider.com/what-happened-ant-group-ipo-jack-ma-alipay-2020-11
140. Puhar, M., Lor, S., Jiang, J. China Fintech - the Beginning of a New Regulatory Era? Lexology. Retrieved from: https://www.lexology.com/library/detail.aspx?g=c56f79dc-0a68-44e4-97bc-3a885758b993
141. Liu, C., Lung, N., Che, C. *China Fines Alibaba Record $2.8 Billion After Monopoly Probe.* Bloomberg. Retrieved from: https://www.bloomberg.com/news/articles/2021-04-10/china-fines-alibaba-group-2-8-billion-in-monopoly-probe
142. Benveniste, A. (2021). *China bans Didi, its biggest ride-hailing service, from app stores.* CNN. Retrieved from: https://www.cnn.com/2021/07/04/tech/china-app-store-didi/index.html
143. Murdoch, S., Wu, K., (2021). *Explainer: How Chinese clampdown will target offshore listings.* Reuters. Retrieved from: https://www.reuters.com/business/how-chinese-clampdown-will-target-offshore-listings-2021-07-08/
144. Statista
145. Ponciano, J. (2021). *China's Crypto Crackdown Intensifies With New Mining Ban And Censorship—But Bitcoin Is Rallying.* Forbes. Retrieved from: https://www.forbes.com/sites/jonathanponciano/2021/06/09/chinas-crypto-crackdown-intensifies-with-new-mining-ban-and-censorship-but-bitcoin-is-rallying/?sh=5e5eff56150f
146. Lu, D. (2021). *Bitcoin mining emissions in China will hit 130 million tonnes by 2024.* New Scientist. Retrieved from: https://www.newscientist.com/article/2273672-bitcoin-mining-emissions-in-china-will-hit-130-million-tonnes-by-2024/
147. Campbell, C. (2021). *Why China Is Cracking Down on Bitcoin Mining and What It Could Mean for Other Countries.* Time. Retrieved from: https://time.com/6051991/why-china-is-cracking-down-on-bitcoin-mining-and-what-it-could-mean-for-other-countries/
148. GT Staff Reporters. (2021). *China to shut down over 90% of its Bitcoin mining capacity after local bans.* Global Times. Retrieved from: https://www.globaltimes.cn/page/202106/1226598.shtml
149. Sigalos, M. (2021). *China is kicking out more than half the world's bitcoin miners – and a whole lot of them could be headed to Texas.* CNBC. Retrieved from: https://www.cnbc.com/2021/06/15/chinas-bitcoin-miner-exodus-.html
150. Lee, Z. (2021). *Bitcoin Mining Companies Exiting China As Authorities Crackdown On Cryptocurrencies.* Forbes. Retrieved from: https://www.forbes.com/sites/zinnialee/2021/06/23/bitcoin-mining-companies-exiting-china-as-authorities-crackdown-on-cryptocurrencies/?sh=2f0e7ce03983
151. Sigalos, M. (2021). *China's war on bitcoin just hit a new level with its latest crypto crackdown.* CNBC. Retrieved from: https://www.cnbc.com/2021/07/06/china-cracks-down-on-crypto-related-services-in-ongoing-war-on-bitcoin.html
152. Mullen, A., Yeung, K. (2021). *Explainer | China digital currency: when will the e-yuan be launched, and what will it be used for?* South China Morning Post. Retrieved from: https://www.scmp.com/economy/china-economy/article/3135886/china-digital-currency-when-will-e-yuan-be-launched-and-what
153. Tassev, L. (2021). *China Has Dispersed Over $40 Million of Digital Yuan in Red Envelopes, Report Reveals.* Bitcoin.com. Retrieved from: https://news.bitcoin.com/china-has-dispersed-over-40-million-of-digital-yuan-in-red-envelopes-report-reveals/
154. Kharpal, A. (2021). *E-commerce giant JD.com used China's digital currency to pay some employees.* CNBC. Retrieved from: https://www.cnbc.com/2021/04/27/chinas-digital-currency-used-by-jdcom-to-pay-some-employees.html
155. Desai, U. (2020). *Covid-19 accelerating digital payment adoption globally: BIS.* Asia Financial. Retrieved from: https://www.asiafinancial.com/covid-19-accelerating-digital-payment-adoption-globally-bis
156. Tang, F. (2021). *China digital currency: China, Hong Kong begin testing digital yuan as Beijing ramps up research into cross-border use.* South China Morning Post. Retrieved from: https://www.scmp.com/economy/china-economy/article/3128104/china-hong-kong-begin-testing-digital-yuan-beijing-ramps