



*Artificial intelligence's depiction of "A beautiful ultradetailed anime illustration of future Jakarta city, makoto shinkai, anime art wallpaper 4k, trending on artstation". The image is Generated by Disco Diffusion Google Colab.*

## **A Compendium of Mega Cycles**

"Progress is impossible without change, and those who cannot change their minds cannot change anything"

- George Bernard Shaw -

## Q2/Q3 Special Report

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## INDONESIA 2.0 LAUNCHPAD

#1 Commodity  
Supercycle

#2 Rotation  
from growth  
to value stock

#3 Investor  
pivoting to  
other markets  
after China tech  
clampdown

#4 Rising  
geopolitical  
competition

## Favourable External Forces

# INDONESIA 2.0

## Internal Reforms

#1 Education

#2  
Competitiveness

#3 Innovation  
& Technology

#4 Economic  
Output

#5 Share of  
World Trade

#6 Military  
Power

### Relevant thematics to leverage on Indonesia 2.0:

- Commodities, specifically metals & minerals
- Electric vehicle value chain
- Value names in industrials
- Consumer cyclicals
- Digital banks
- Web 3.0



Key idea: Issues addressed by Web 3.0 with new foundational concepts built upon Web 3.0 infrastructure

Centralisation

Inequality

Censorship

Distrust

Issues addressed

# WEB 3.0

New foundational concepts

Internet of Money  
Internet of Trust  
Internet of Identity

Digitalisation  
Decentralisation  
Democratisation

Cyber-physical  
Economy  
(a.k.a.  
Metaverse)

Infrastructure

Artificial  
Intelligence

Blockchain

Cloud

Relevant thematics to leverage on Web 3.0:

- Value chains on the infrastructure (e.g., software, hardware, semiconductors, batteries, cybersecurity, content creation, as well as key materials & resources)
- Web 3.0 focused industries (e.g., VR/AR, IoT, wearables, XaaS, 5G, 3D printing, gaming, neobank, semantic web)

## A Compendium of Mega Cycles

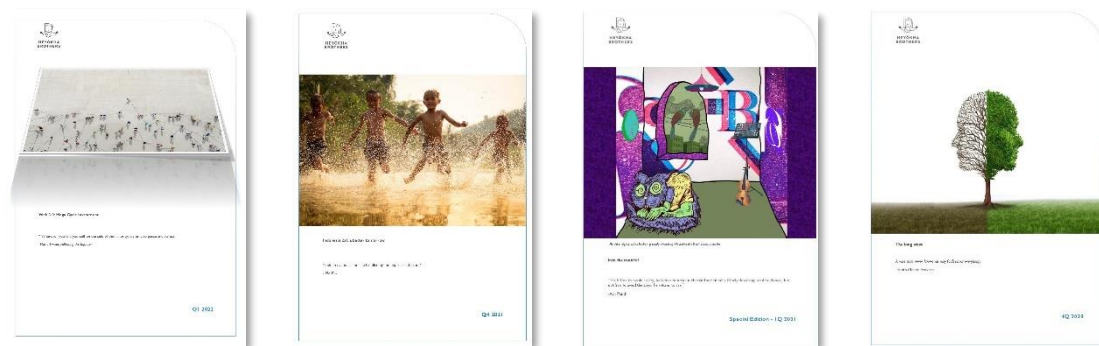
### Introduction

New answers can always be found to the questions previously asked and answered. This is particularly true for people with a growth mindset, an important attribute we discussed thoroughly in our Q4 2020 report.

Our own website is designed with 3 core sections called Re-search, Reflection, and Reload to remind ourselves of the need to continuously search for more relevant and better answers, to reflect on what we have predicted (and sometimes got it wrong) as well as unlearning what we have taken for granted and reload with brave new ideas.

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### Our endless learning, condensed.




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*We crystallised our learnings and reflections into special reports, available on our website*

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In this special report, we take you through our journey driven by our mission and how we have identified mega cycles and turned them into investment opportunities. Our two latest reports, Indonesia 2.0 and Web 3.0 are the two newly identified megatrends. But there were more since 2014, some played out as expected, and others surprised us with different learnings and perspectives.

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### Our Mission Statement

**“AT HEYOKHA BROTHERS WE ALLEVIATE PAIN POINTS BY TURNING IDEAS INTO REALITY.”**

*We purposefully research ideas, trends, and cycles; and build investable strategies across various asset classes. We implement thoughtful strategies to achieve financial and personal goals for the partners in our funds. Our investments represent our commitment to make impacts and resources to help connect the dots for emerging businesses.*

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Our first major thesis dating back to 2014 was about commodities and value. It was a puzzle of cheap valuations of global listed miners that the market seemed to ignore. The love of growth stocks, supported by easy credit that tremendously built up after the 2008 financial crisis, had us wonder how big the growth/value gap could go.

Our second thesis is that new technologies will disrupt the old economy and deflate it through innovations, offsetting the worries of lost productivity and labour from global aging. A rising China into the world scene also caught our attention, leading us to add positions in some Chinese tech ADRs to capture both technology and China themes.

Indonesia, where we have strong attachments and experience, and where cheaply valued miners are found, was the anchor market of investments and is still the case today. Besides, the emergence of FinTech and E-commerce in Indonesia, under the heavy influence of China's success model, also led to our private investments in this space that subsequently paid off handsomely.

More developments happened in 2021 as we expanded our teams in Hong Kong and Indonesia.

We became even more convinced about the commodity supercycle and transformative technologies. As a believer of long-term investment, we see the recent sharp correction across the market driven by the macro environment as an opportunistic entry point. We believe this has a perverse impact of discouraging growth in new supply that makes the supercycle more entrenched.

The technology hype coming down to a more reasonable valuation presents some low hanging fruits for one to pick. And some may have lost confidence in the potential of crypto in the past few months. We, on the other hand, see it as a consolidation beneficial for the long haul. One cannot forget that the market often deviates from economic reality. Despite the ongoing crypto winter, blockchain projects development continues and regulatory action is in full swing. Both pave the way for broader institutional cryptocurrency adoption and the realisation of the true value of blockchain technology.

Ultimately, our investment themes remain intact. We explained the upcoming commodity supercycle in our Q4 2020 report and published our first special report on Web 3.0 and Digital Assets in Q1 2021.

Subsequent events (including the unexpected ones) unfolded in the global political and economic scenes in 2022. The most felt issues are political polarisation ranging from East vs West to left vs right, strong feelings of inequality and discontent by the underprivileged, heavy indebtedness due to unchecked money printing and rising defaults, pandemic-induced severe disruptions of globalisation and economic loss, the rise of generations feeling hopeless and dropping out of schools and work voluntarily, the invasion of Ukraine by Russia that led to food and energy crises, and the return of hyperinflation and financial crisis in some emerging markets where their economies were hardest hit by the pandemic.

We asked where the 'safe havens' will be and predicted the following mega trends:

- Fiat will break and could be replaced by gold, petrodollar, and electro-dollar (including bitcoin);
- The inflationary cycle has long been observed in asset prices and would start hitting the basic economy, starting with food and energy (i.e., not transitory and cannot simply be addressed by monetary tightening);
- Multi-year under-investments in energy, resources, and infrastructure (due to heavy crowding out by globalisation and financialization) means that the commodity supercycle is here to stay;
- Web 3.0, enabled by the building of the ABC infrastructure upon which decentralized businesses can be built, will be the key technology to address many of the pain points described above;
- Indonesia is bound to benefit by having rich resources, an industry renaissance and a young-and-productive labour force that coincide with the rise of FinTech and E-commerce, under a visionary political leadership and a once in a few decades peaceful societies.

In May 2022, we laid out the megatrends for Indonesia in our special report Indonesia 2.0. In June 2022, we discussed in length our thesis on the Web 3.0 megacycle.

This report rides on the previous two reports and discusses the key investment implications driven by these mega-investment cycles as well as how the commodity supercycle will further evolve given the possibility of gigantic changes in global political and economic landscapes that include the breakdown of fiat money, return to protectionism, the risks of financial repression and the rebuilding of the social contract.

We are under such mega forces of De-dollarisation, De-globalisation, and De-centralisation and we look at how to invest under such scenarios.

## The Big Wave

In our Q4 2020 report, we discussed the following trends: (1) the reversal of tech-driven centralisation, (2) the rise of digital asset class, (3) value stocks to outperform growth, (4) retail investors crowding-in the financial market, (5) the US policy shift to wealth distribution, green economy, stricter financial regulation, and defending global dominance, (6) the return of inflation, (7) the commodity supercycle, and (8) investors rediscovering ASEAN markets.

Since then, we find more affirmations of these trends. The following summarises what we think as decade-defining trends. The new reality we need to brace or embrace:

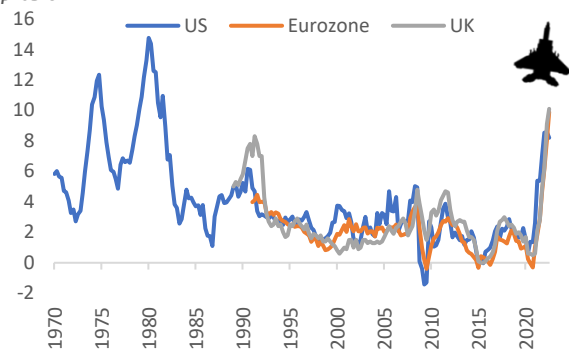
### I. Inflation comes back with vengeance

#### After being declared dead, inflation comes back with a vengeance

- In Q2 2020, we envisaged that we may enter an era of high and persistent inflation. Now, it's here.
- Developed countries such as the US, UK, and Europe are seeing inflation rising Maverick style after four decades of disinflation.
- Inflation rates of 186 countries in Aug/Sep 2022 (and the inflation numbers are quite possibly understated by wide margin):
  - > 100% inflation: 5 countries
  - 20 - 100% inflation: 22 countries
  - 10 - 20% inflation: 49 countries
  - 5 - 10% inflation: 74 countries
  - 5% or lower inflation: 36 countries
  - Median: 9.1 percent
- Countries with debased currencies and a high dependence on the import of commodities are suffering higher inflation.
- In the US, inflation is crushing consumers' confidence in the economy and eroding their trust in the government.

#### Inflation goes 'Maverick' style

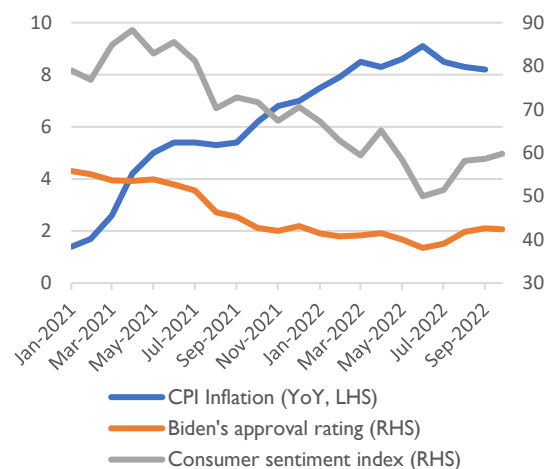
*CPI Inflation once again becomes developed markets' problem*



Source: Bloomberg

#### Inflation feeds pessimism

*US consumer confidence and approval rating in Joe Biden fell as inflation rises*



Source: Bloomberg, US BLS, University of Michigan

## The scorching inflation is a result of demand-pull and cost-push inflationary forces

Based on our analysis, the following factors are driving today's inflation:

### 1) Currency debasement

The COVID-19 relief was massive by any standard. Unlike QE #1 in 2008, the recent money printing was targeted to provide relief to the main street that has a much higher propensity to consume. This created a robust demand, especially after the economy fully reopened.

### 2) High commodity prices

In the last two years, commodity prices went from multi-year lows (unprecedented negative price for oil and historical low for some commodities) to multi-year highs within two years!

We think commodity prices could remain high for a considerable time. More discussion in the next section.

### 3) Supply-chain constraints

The pandemic induced demand destruction was followed by rapid demand recovery. The system was not meant to face such extremes.

Based on our channel check, shipping companies retired a substantial part of their fleet in 2020. A year later, they were overwhelmed as demand recovered faster than anticipated.

Currently, shipping companies are making a fortune for the first time since the 2000s when China rose as a global manufacturing house. Things have started to normalise but the higher cost and lower availability may keep freight rates high.

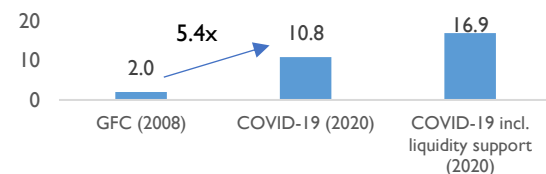
### 4) Price-wage spiral?

Labour gained an upper hand over capital. The dire need for massive and quick hiring, rising inflation, and savings from covid stimulus gave people choice.

With labour re-unionisation becoming a trend in developed countries, wage-push inflation could be here to stay. The increasing numbers of strikes are anecdotal signs.

## Massive money printing directed to the main street creates lots of real demand

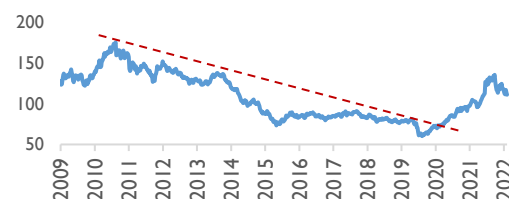
*The global policy response in USD Trillion*



Source: IMF (2009), McKinsey (2020), and Frankenfeld, Peter (2012)

## The revenge of commodities: BCOM Index doubled from multi-year low to multi-year highs in two years

*Bloomberg commodity price index (BCOM)*



Source: Bloomberg

## Shipping line companies getting minted with freight rates running hot

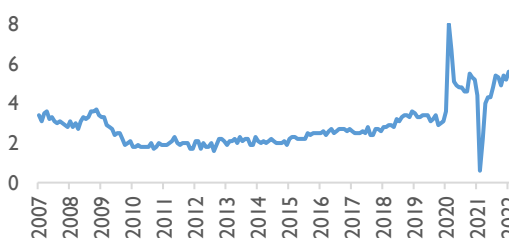
*Freightos Baltic Index – Indicator for global freight cost*



Source: Bloomberg

## A substantial wage increase reflects the rising bargaining power of labour

*US average hourly earnings growth YoY*



Source: Bloomberg



## Beyond the aforementioned factors, there are secular trends that we deem inflationary

- **Aging population**

Research by Juselius and Takáts (2016) suggested that the aging population is actually inflationary rather than disinflationary. Some possible explanations:

1. *Life-cycle hypothesis*

Proportionately, the young and the old spent more than they saved. The opposite occurs for the working-age population.

2. *Higher labour cost*

As the demographic becomes older, the pool of young and cheap labour shrinks.

- **ESG Trend**

In concept, ESG adoption attempts to reward the businesses who provide net benefit or penalise those who commit negative externalities to the environment. The rising ESG popularity creates a nuance that most companies have been incurring costs rather than benefits for the environment. Taking net-zero labelled product as an example, companies may buy carbon credit to offset carbon emission associated with their business activities.

There are costs incurred to monitor and internalise these externalities. Attention and efforts are diverted to activities that yield lower productivity and higher cost.

- **De-globalisation and re-shoring**

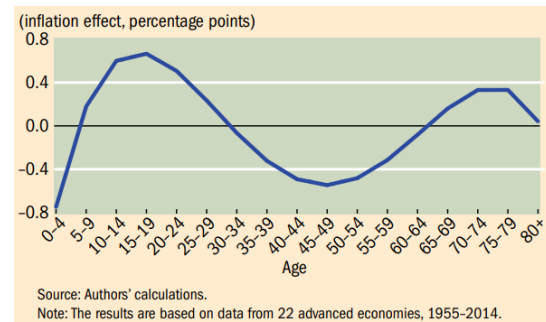
The COVID-19 pandemic and the rising geopolitical tensions are two strong reasons for companies to diversify their manufacturing base.

Re-shoring or friend-shoring may reverse the cost advantage obtained from globalisation.

New locations might have higher labour cost, reverse the learning curve, and have smaller economies of scale.

### Aging population is inflationary

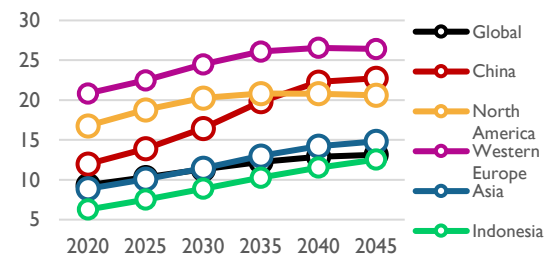
The young (ages 5 to 29) and the old (ages 65 to 79) raise inflation, while those age 30 to 64 have the opposite effect over many periods and countries



Source: Juselius and Takáts (2016, [link](#))

### The world is getting older pretty quickly, more inflation?

Old population (age > 64 years old) as % of population



Source: UNDESA (2019)

### Internalising externalities will lead to higher price and lower productivity

Illustration of market equilibrium when companies internalise social cost they incurred

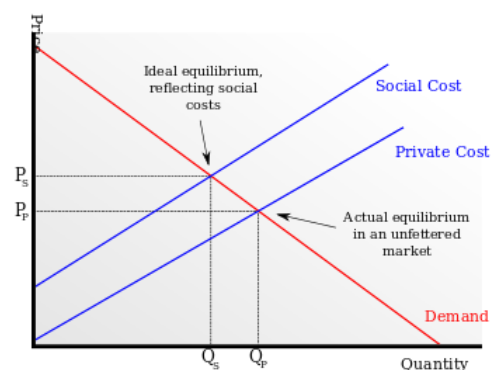


Illustration Source: Wikipedia

## Central banks are fighting inflation, but we think the extent is limited

- The Fed capitulated to a more persistent and higher inflation view. Accordingly, the Fed prioritised its first mandate: maintaining the stability of currency. Fighting inflation.
- Until the end of Q3 2022, the Fed has:
  - (1) raised benchmark rates by 300 bps to 3.25%
  - (2) switched to quantitative tightening at a USD 1.14 Tn run rate. This pace is double that of the 2017's.
- The process of taming inflation can adversely impact asset prices: a higher yield will reduce the present value of assets' future cash flows.
- Strong domestic US economy and labour market providing legs to do more tightening.
- We think that the extent of further tightening by the Fed, or any central bank, will be limited because:
  - 1) The indebtedness of the economy
  - 2) The need for the government to issue more debt at low rates
  - 3) A substantial part of today's inflation is supply-side in nature
- Eventually, we may either see a too excessive tightening or a scenario where central banks will say "we have to accept inflation as a new reality".

## The end of 'transitory inflation'

### Jerome Powell suggests it's time to stop describing inflation as 'transitory'

By Katie Patterson

November 30, 2021 | 3:18pm | Updated

### Treasury secretary concedes she was wrong on 'path that inflation would take'

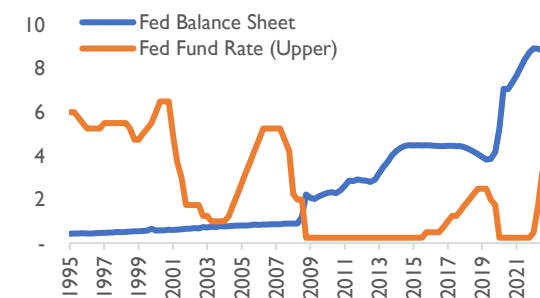


By Kevin Liptak and Paul LeBlanc, CNN  
Updated 0429 GMT (1229 HKT) June 1, 2022

Source: NY Post, CNN

## The Fed enters a tightening cycle after decades of easy-money policy

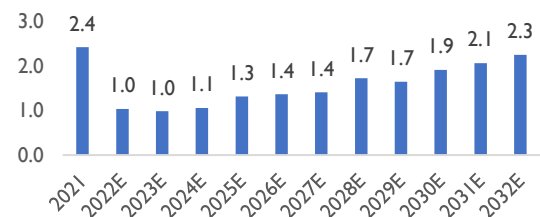
The Fed's balance sheet (USD trillion) and Fed Fund Rate (%)



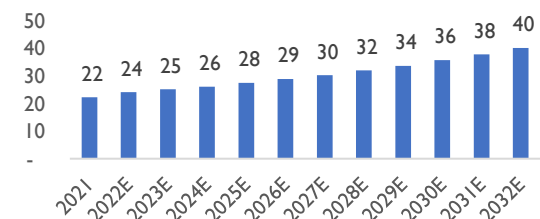
Source: Bloomberg

## The Fed has conflicting interests with the US government that needs to issue more debt

CBO's baseline projection, total deficits in USD Trillion



CBO's baseline projection, total federal debt in USD Trillion



Source: Congressional Budget Office (2021)

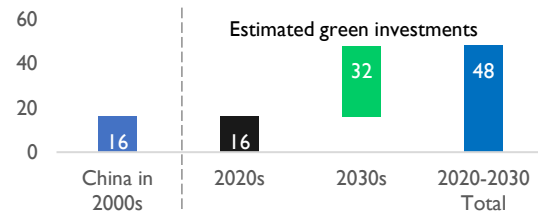
## 2. A new commodity supercycle underway

**The current commodities dynamic is staging for a supercycle (or persistently high prices at least)**

- The combination of strong demand and supply-side issues formed the two last commodity supercycles, the 1970s and 2000s. We have similar dynamics today.
- **The 1970s supercycle** dynamics:
  - 1) US War on Poverty (1964)
  - 2) Currency debasement: the US defaulted on the gold standard (1971)
  - 3) Germany and Japan's industry recovery
  - 4) Oil production peaked in 1970 and the OPEC oil embargo
  - 5) Yom Kippur War & Vietnam War
- **The 2000s supercycle** dynamics:
  - 1) China and India's emergence as a global industrial power triggered massive capital expenditures
  - 2) As a result of massive industrialisation, real consumption rose from the manufacturing labour
  - 3) Easy-money policies globally. The Fed's fund benchmark rate had declined in the last four decades.
- **The 2020s supercycle** drivers:
  - 1) Strong demand from:
    - a.) Unprecedented stimulus targeted to middle-low-income earners who have high propensity to consume
    - b.) Capex cycle for greening economies, manufacturing relocation, or obsolete capital goods
  - 2) Severe and chronic underinvestment due to ESG restriction and painful 2010s return make supply response inelastic
  - 3) Ukraine-Russian and the proxy wars within exacerbate the supply and logistics of commodities.

### The greening economy entails a CAPEX 3x of China's in the 2000s

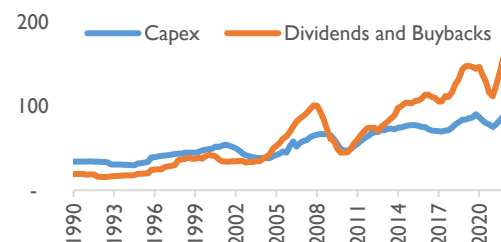
Amount of capital expenditures in USD Trillion



Source: Goldman Sachs (2021)

### Companies have been returning shareholders' capital rather than expanding their business means aging real assets

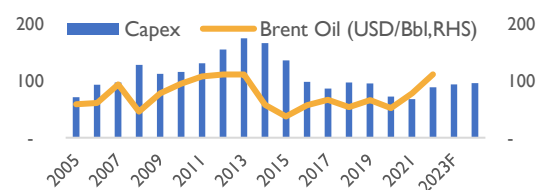
S&P 500 Capex, dividends, and share buybacks on an aggregate per share basis (TTM)



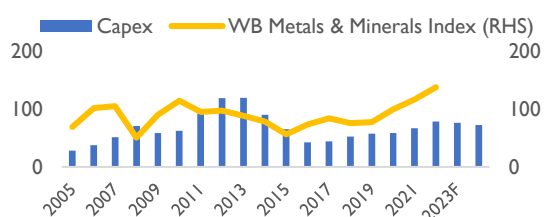
Source: Bloomberg

### Severe and chronic underinvestment in commodities causing an inelastic supply response

Oil supermajors capex versus Brent oil price



Major metal miners' capex versus price index



Source: Bloomberg and World Bank



HEYOKHA  
BROTHERS

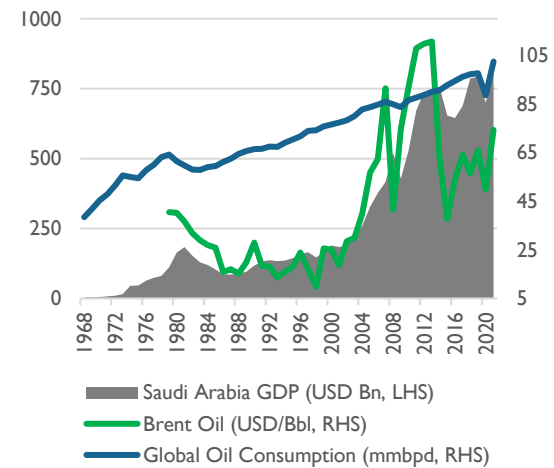
## Saudi Arabia benefited the most from the two previous commodity supercycles because of its energy production leadership

- Since the 1960s, the oil-rich Saudi Arabia has benefited tremendously from global petrolisation and rising prices of oil.
- The virtuous economic cycle of petrodollar countries:  
Higher adoption of oil and its high prices → Higher current account surplus → Availability of capital improves → More investments → Export capacity growth drives economic growth → Repeat.
- Quoting Henry Kissinger, former US Secretary of State and National Security Advisor:

*“Who controls the food supply controls the people; who controls the energy can control whole continents; who controls money can control the world”*

## Global petrolisation and higher oil prices fuel the growth of Saudi Arabia GDP

Global consumption of oil and rising Saudi Arabia GDP

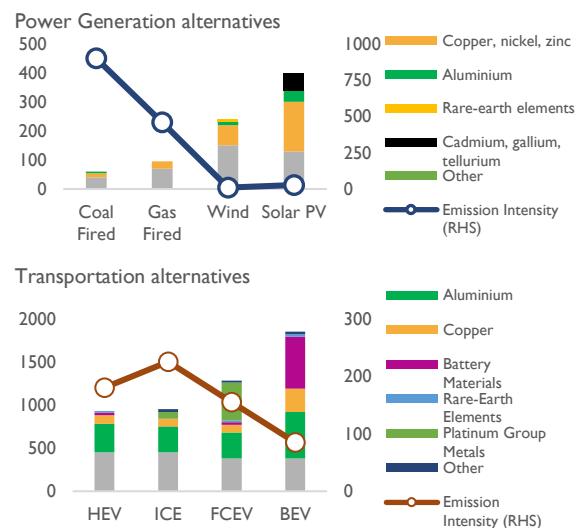


## Like petrodollar countries, this is the time for electrodollar countries to shine

- Currently, the global energy mix is transitioning towards a more carbon-friendly alternative.
- The currently preferred alternatives of carbon-friendly transitions are more metal-intensive. The intensity of which can be higher by 50% to 200%.
- Like petrodollar countries, we think those nations who own metals resources and the capability to process them will be the winner of this supercycle.

## The carbon-friendly alternative is metal-intensive

Material intensity in Cu. Equivalent ton/TWh vs. Carbon intensity

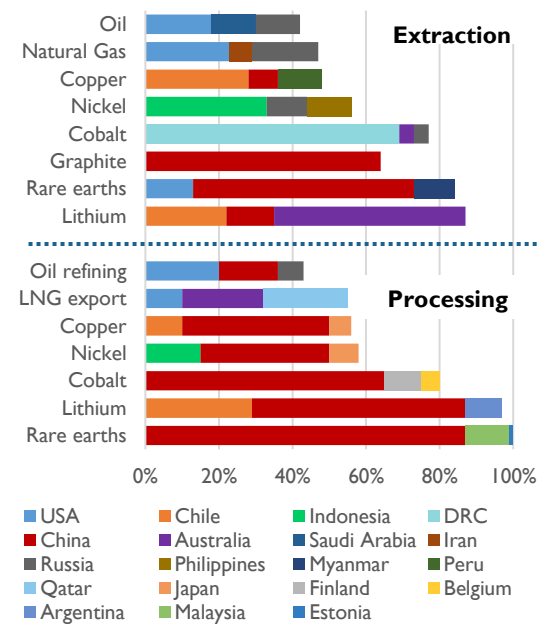




- In the petrodollar era, the USA and its allies dominated the production of fossil fuel. They conducted manoeuvres to obtain oil supremacy.
- In the electrodollar era, China will emerge as a dominant player in the global energy market because of its leadership in metals and minerals production.
- Indonesia who owns vast resources of metals and minerals can capitalise on this energy transition. More discussion on this follows in the upcoming section.

### The champion of the electrodollar era is going to be different from the petrodollar era

Top three producers of metals and minerals (2019)



Source: IEA (2019)

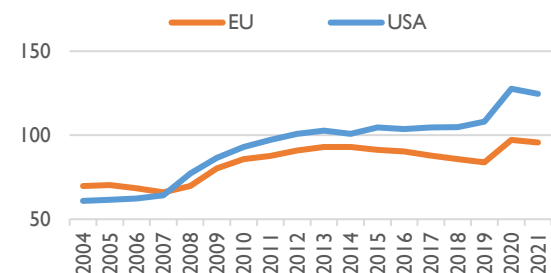
### 3. The era of repression: Goodbye Laissez-faire?

#### We might be entering an era of financial repression

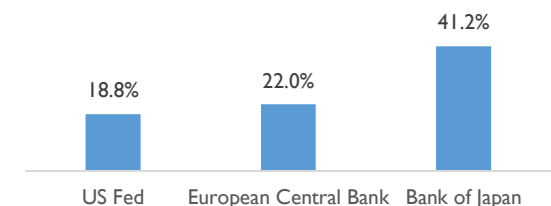
- Country's indebtedness inclined to rise because:
  - 1) Politicians prefer to run with pro-growth budget deficits to be re-elected.
  - 2) In every recession, governments are forced to raise their spending when their revenue is weak.
- Higher indebtedness builds economic fragility to higher interest rates. Now, central bankers are forced to cap the yield and stimulate growth to avoid a debt crisis.
- In an inflationary environment, central banks cannot cap yields using their own balance sheet because it will expand uncontrollably (i.e.- inflationary).
- Authorities might eventually force financial institutions to buy government securities for the purpose of capping the yield. Interest rates will be kept below the rate of inflation.

#### Central banks back money printing

Public debt as % of GDP



Shares of central banks ownership of sovereign debt



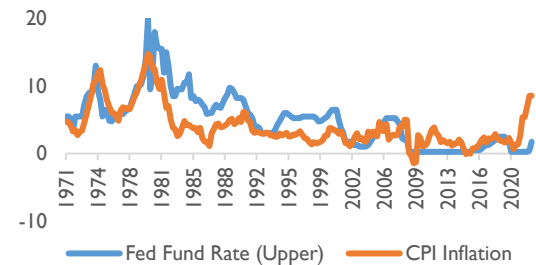
Source: Bloomberg, FRED, BoJ, ECB

This is bearish for equities because they would be sacrificed to finance the trade.

- By capping the yield, stimulating a certain degree of inflation and economic growth, governments could de-leverage, while escaping the consequences of their mounting debt. Negative yield is by design.

### The negative real yield is by design

*Fed Benchmark rate versus CPI Inflation*



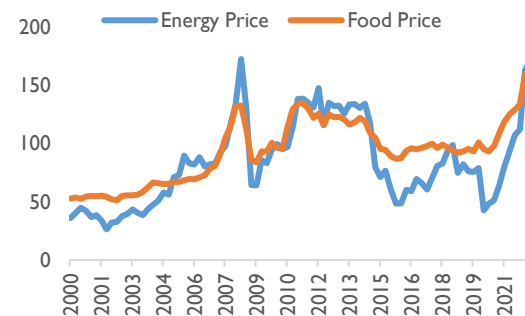
Source: Bloomberg

### Be prepared to see erratic measures to control inflation

- Scorching inflation can worsen the gap between the rich and the poor.
- As populism is becoming more popular, we will not be surprised if governments resort to left-wing policies such as:
  - (1) Rationing
  - (2) Price fixing or price control
  - (3) Cross-subsidy arrangement by windfall taxing for subsidizing another
  - (4) Inflation-relief paycheck
  - (5) Resources nationalism

### Scorching food and energy prices

*World Bank's energy commodity and FAO's food price index*



Source: World Bank and FAO

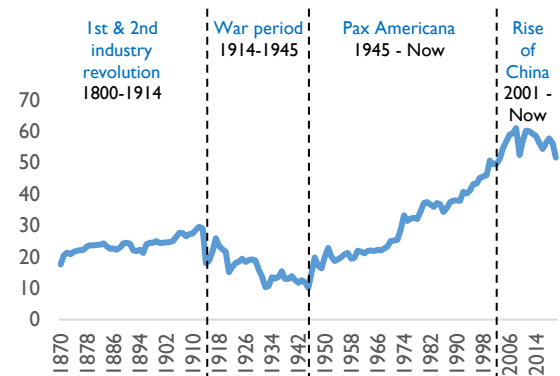
## 4. The rise of polarisation

### The world's hegemon is fighting a two-front war against China and Russia

- US vs. China: Existing versus emerging world power
  - Through manufacturing leadership and free-trade, China's advancement in economics, technology, and its political influence in Africa and Asia Pacific region threaten US global dominance.
  - The political contest began in 2011 when US started its initiatives to contain China's influence in Asia Pacific.
  - Since then, the conflict has escalated to:
    - 1) Trade war (2018)
    - 2) Suppressing China's investments and technology by sanctions and Holding Foreign Companies Accountable Act

### The rise of China has triggered a contest with USA

*Global trade (export plus import) value as % of global GDP*



Source: Klasing and Milionis (2014), Penn World Tables, World Bank, Heyokha

- 3) Re-armaments in South China Sea and declaring China as a threat for NATO
- NATO vs. Russia: Facing old foes
    - The conflict first came into light when Russia annexed Crimea in 2014. Russia felt threatened with NATO expansions as more members states are getting closer to Russian borders.
    - In 2022, Russia invaded Ukraine as Ukraine is abandoning its neutral stance. Imagine an enemy in front of your doorstep.
    - In this (proxy) war, NATO and their allies weaponized finance in form of sanctions and provided military aid to Ukraine. Russia fights back with commodities control that is in scarcity.

## NATO expansion sparked a proxy war with Russia

### NATO in Europe

The world's **most powerful military alliance** has 30 members. **Russia opposes NATO bases near its borders** and has asked for guarantees that NATO's membership won't expand eastwards.



\*) Finland and Sweden are applying for membership  
 Source: Aljazeera

## Consequences of the ongoing cold war

- We are drifting to 1960s style cold war era. The potential implications:

### 1. De-dollarisation

No one expected US and its Western allies would weaponized their financial dominance by freezing Russians' sovereign and individual assets.

About 61% of USD 630 Billion Russian Central Bank's reserves were frozen by NATO and its allies.

The move was surprising considering it's a breach in rights of property conducted by capitalist countries.

We think many will diversify their USD-denominated assets and preference for local currency settlement will rise.

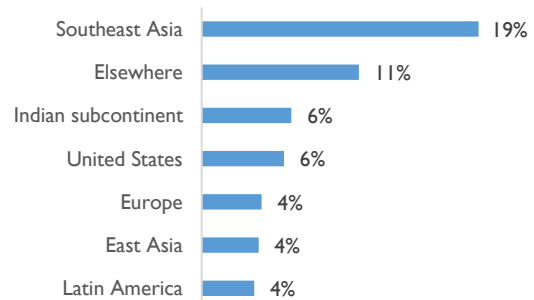
### 2. Relocation of manufacturing hub

The COVID-19 pandemic exposed the fragility of a centralised manufacturing hub. Rising geopolitical tension created more pressure for producers to diversify supply chain.

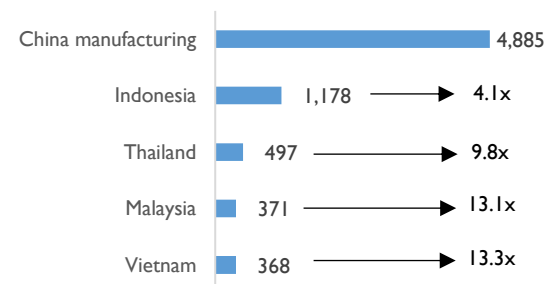
EMs, especially Southeast Asia, stands to benefit from their cost competitiveness and region for diversification.

## Southeast Asia stands to benefit from China-based manufacturing relocation

*Preferred destinations for relocation for China-based manufacturing facilities (2018 survey)*



*China's manufacturing GDP versus countries' GDP (Current, USD Billion)*



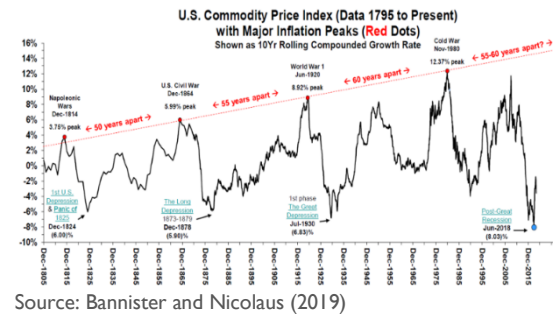
Source: American Chamber of Commerce (2018), Bloomberg

### 3. Higher commodity prices and rampant inflation

Bannister & Nicolaus (2019) research pointed that commodity prices and inflation always run hot during every major geopolitical conflict during 1795 to 2018.

These events occurred every 50 to 60 years apart. The bigger the conflict, the bigger the magnitude will be. Now, it is happening.

Expect higher commodity prices and inflation during a period of elevated political tension



**“The essence of civilization is utterly dependent on a continuous input of physical, intellectual, and moral energy without which it simply cannot be sustained. ... managing a complex system requires prudence - that is the exercise of judgement, caution, forethought, and self-restraint.”**

- William Ophuls, Immoderate Greatness: Why Civilizations Fail -



## Indonesia 2.0

In the Q4 2021 report ([link](#)), we elaborated how Indonesia is on the verge of greatness. The combination of favourable tailwinds and internal reforms will unlock the potential of Indonesia that owns vast resources and enjoys the demographic bonus of its 270 million population.

### I. Commodity downstream industrialisation and industry renaissance

#### Downstream industrialisation: a structural story amplified by favourable cycle

- As one of the resource-rich countries, Indonesia is a natural beneficiary of high commodity prices.
- The previous commodity supercycles were suboptimal because of the lack of downstream processing. Resource curse of 2000s commodity boom for Indonesia is a pre-mature deindustrialisation.
- Since 2014, Jokowi' Administration has focused to reverse the resource curse. Metals have been the priority, especially nickel.
- Downstream industrialisation is unlocking a massive value behind Indonesia's resources. Commodity supercycle and electrodollar are amplifying the impact of this reform.
- Potential in other commodities:
  - Fossil Fuel: Exploration and refineries
  - Agriculture: Mechanisation and modernisation

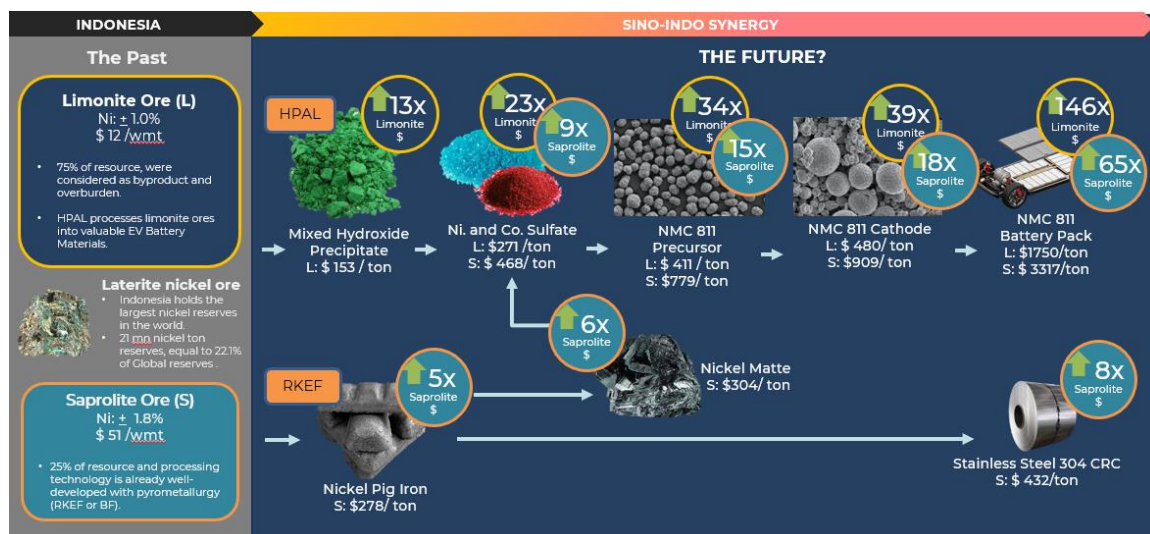
#### Indonesia's vast resources

List of Indonesia's top commodities reserves (for minerals and hydrocarbons) or production (for agriculture)

Commodities	Reserve/ annual production	Global market share	Global Rank
<b>Nickel</b> (in mn MT)	21	22.1%	1
<b>Tin</b> (in '000 MT)	800	16.3%	2
<b>Cobalt</b> (in '000 MT)	600	7.9%	3
<b>Manganese</b> **** (mn MT)	49.6	3.8%	N/A
<b>Gold</b> (in MT)	2,600	4.8%	5
<b>Copper</b> (in mn MT)	24	2.7%	7
<b>Coal*</b> (in Bn MT)	24.9	2.2%	11
<b>Natural Gas</b> * (in Bcf)	103,350	1.5%	13
<b>Crude Oil*</b> (in mn Bbl)	3,693	0.2%	27
<b>Palm Oil**</b> (in mn MT)	44.5	59%	1
<b>Rice **</b> (in mn MT)	35.4	7%	4
<b>Rubber***</b> (in mn MT)	2.88	22%	2

Source: US Geological Survey (2022), \*Energy Information Administration (2016, 2017), \*\*USDA (2022), \*\*\*Statista (2020), \*\*\*\* Government of Indonesia (2019)

#### Downstream processing unlocks the value of Indonesia nickel ore



Note: RKEF: Rotary-Kiln Electric Furnace, BF: Blast Furnace, HPAL: High Pressure Acid Leach

(S) represents saprolite ore value, (L) represents limonite ore value

Source: Heyokha research and various sources

## Metals downstream industrialisation's success is just the tip of the iceberg

- Massive achievements at rapid pace of metals downstream industrialisation:

- 1) USD 31 Billion investments (84% of which are foreign) constructed 17 new smelters from 2014 to 2021 from 6 smelters.
- 2) Base metals become Indonesia's third largest exports. It rivals the two legacy commodities, palm oil and coal, that existed for decades.
- 3) Indonesia recorded current account surplus after a decade of structural deficits.
- 4) Indonesia becomes the biggest nickel producers and the sixth biggest iron and steel producer. From virtually out of the radar screen seven years ago.

- Missed out? Don't worry:

- 1) 30 more new smelters will be built in the next three years, doubling the count of this year.

According to CRU, a leading commodity market analysis company, Indonesia and China will contribute 68.7% of new nickel supply in the next decade.

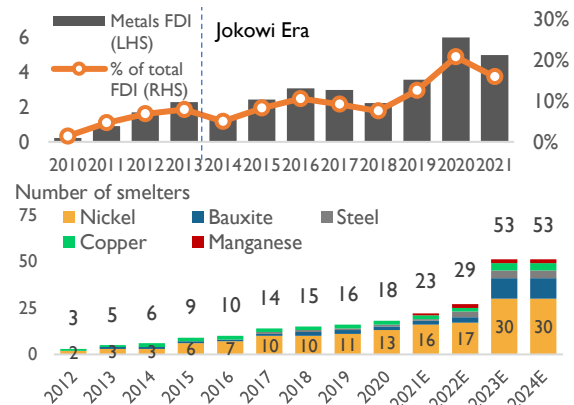
- 2) USD 28 Billion of investments committed for building electric vehicle industry.
- 3) A new industrial estate with investments up to USD 132 Billion is being developed. The investment commitment is five times larger than the current biggest metal industrial estate, Morowali.

This upcoming project, Kalimantan Industrial Park (KIPI) will host petrochemical, alumina, steel, new energy battery, and silicon industries.

- 4) 18 special economic zones spreading across the country are expected to attract USD 61 Billion investments.

### Rapid expansion of Indonesian metals

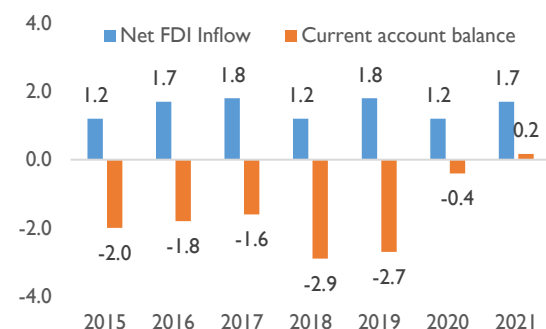
Foreign Direct Investment in base metals (USD Billion)



Source: Government of Indonesia

### Indonesia's structural improvement in CA will continue further

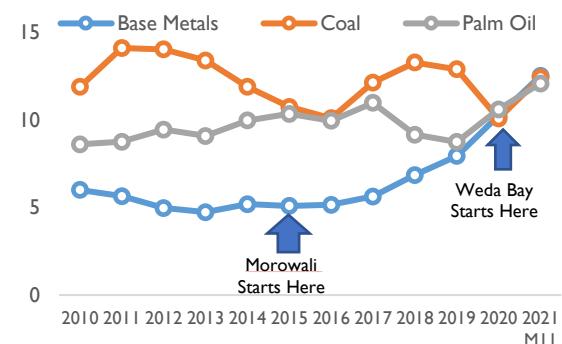
As % of GDP



Source: Bloomberg

### Base metals are Indonesia's new export champions

Indonesia's top three commodities share of goods export (%)



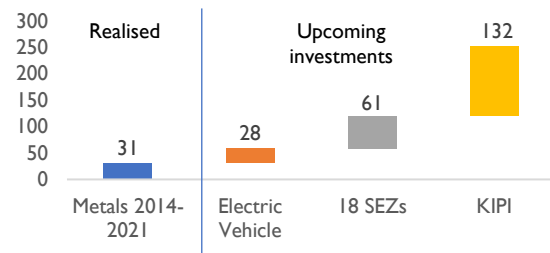
Source: Bureau of Statistics

## Indonesia to capture global manufacturing relocation

- COVID-19 pandemic and rising geopolitical tensions are catalysts for companies to diversify their supply chain.
- We think Indonesia can seize this opportunity:
  - 1) Abundance of natural resources and labour to build a vertically integrated industry. Labour force is expected to grow to 216 mn in 2050 from 185 mn in 2020.
  - 2) Indonesia offers a potential end-market for producers. A large market, growing population in a demographic bonus period until 2035.
  - 3) Government's pro-growth and pro-investment initiatives:
    - Designated 18 special economic zones with economic incentives and licensing priority
    - USD 165 Billion infrastructure spending in the last seven years. Jokowi's administration on infrastructure spending averages 2.4% of GDP vs. predecessor's 1.4%
    - According to Global Petrol Prices, Indonesia business electricity cost is ranked the first-lowest quartile in September 2021, thanks to the price cap.
    - Omnibus law reform in 2021 amended 76 laws and 49 government implementing regulations into a single law instrument. This unprecedented move alleviated businesses pain points for investing in Indonesia.
    - Restrictive export measures of strategic commodities to enforce domestic production of higher value-added products.
    - Domestic content requirements for mass and strategic products sold in Indonesia.

## Indonesia is just starting, imagine the possibilities

Investments in Indonesia's new industry (USD Billion)

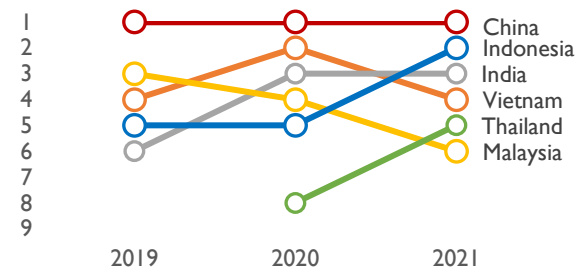


The figures are investment commitments

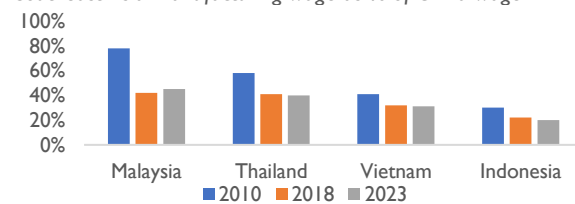
Source: Government of Indonesia, various sources

## Indonesia cost competitiveness is improving to be the next global manufacturing hub

Cushman & Wakefield's top global manufacturing destination rank: Most cost-competitive region



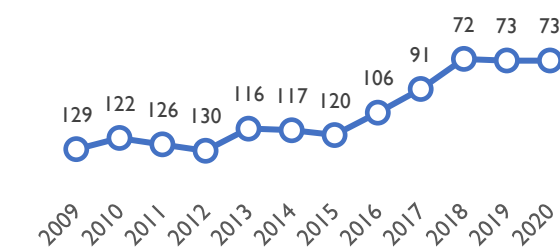
Southeast Asia manufacturing wage as % of China wage



Source: Cushman and Wakefield, IMA Asia & JLL Research

## Indonesia becomes more investor-friendly

Indonesia's ease of doing business rank improves tremendously and this does not take into account the impact of Omnibus Law



Source: World Bank

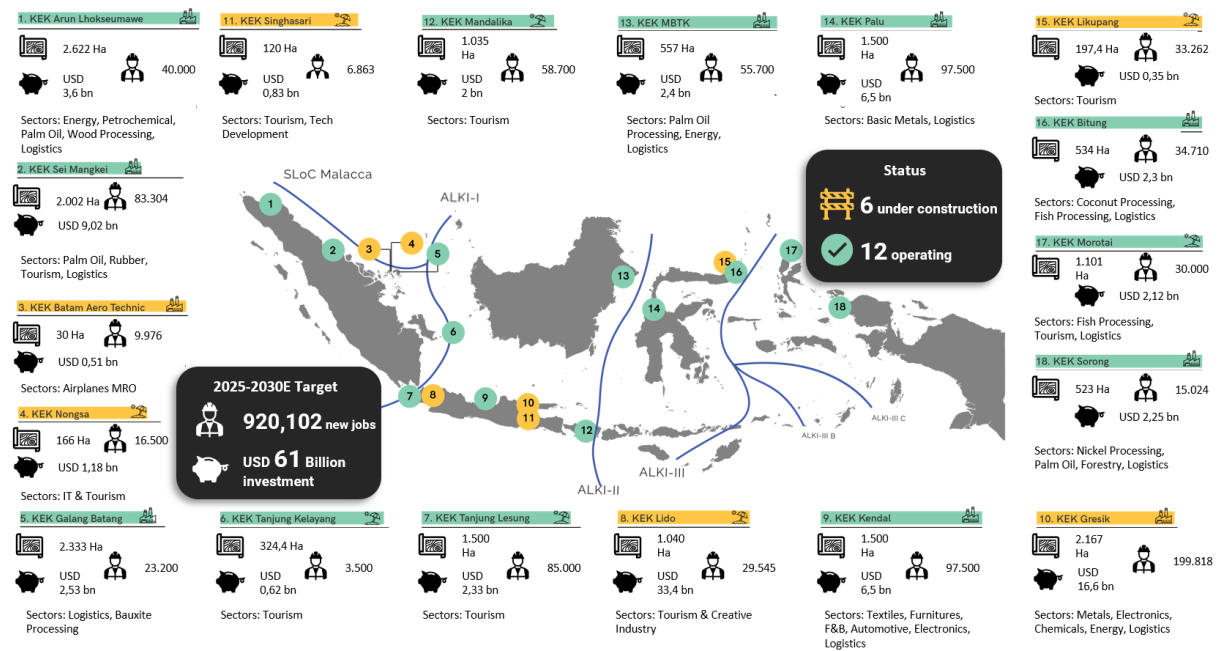
## Overview: Where the industrialisation is happening

### 1. Metals downstream industrialisation: Mostly Eastern Indonesia



Source: Government of Indonesia, Heyokha

### 2. 18 Special Economic Zones scattered across the country



Source: Government of Indonesia, Heyokha

**“You can’t escape the responsibility of tomorrow by evading it today.”**

- Abraham Lincoln”

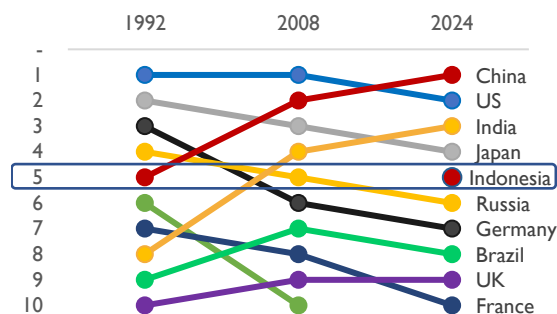


## Industry Renaissance will pave the way for Indonesia to its greatness

- IMF's expectation of Indonesia becoming the fifth biggest economy in 2024 is no exaggeration given what will happen in the next decade.
- The upcoming USD 221 Billion investments in various industry will fuel Indonesia's growth. Indonesia's GDP per capita could catch up with today China's. To be 2.65x in a decade.
- Comparing the estimates between the Indonesian government and IMF, the industrialisation could accelerate economic growth by 1.15% to 7.15% annually.
- Industrialisation of export-oriented products will structurally improve Indonesia's current account. Putting an end to the structural deficits and rupiah FX risk, the major pushback for many investors.
- We think Indonesia's investors are about to enjoy the ride of a lifetime. Starting at a low-base, huge upside, and we are just starting.

## Indonesia to be the fifth biggest economy in 2024

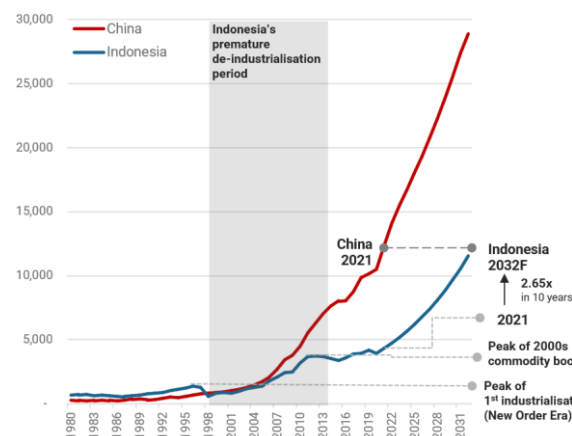
Global GDP rank by IMF



Source: IMF

## Indonesia's GDP per capita to rival today China's

GDP per capita in USD



Source: Government of Indonesia, Heyokha, Bloomberg

## How to invest: Commodity downstream industrialisation

- Currently, there are only a handful of publicly listed names that can offer a substantial direct exposure to Indonesia commodity downstream industrialisation.
- Some alternatives to gain exposure:

### 1) Strategic foreign investors of Indonesia metals

Foreign investors brought the know-how to Indonesia metals. Most of them are Chinese.

## Major foreign investor of Indonesia metals and EV

Companies	Scope
<b>Tsingshan Group</b> (Private)	Nickel pig iron, stainless steel, nickel sulfate, MHP, battery projects, High-carbon ferrochrome
<b>Huayou Cobalt</b> (603799.CH)	MHP, nickel sulfate, matte, cobalt projects, and precursors
<b>Jiangsu Delong</b> (Private)	Ferronickel, nickel pig iron, Stainless Steel
<b>Ningbo Lygend</b> (Private)	Nickel sulfate, MHP
<b>Shanghai Decent</b> (Private)	Ferronickel

## 2) Existing metals mining companies

Publicly listed and top-class domestic companies in Indonesia metals:

### (1) Merdeka Copper Gold (MDKA IJ)

- Was a copper and gold company respected for its execution and assets quality
- Close ties with Tsingshan and CATL, recently acquired nickel projects in Konawe Industrial Estate.

### (2) Vale Indonesia (INCO IJ)

- Strong shareholders: (1) Vale and (2) Indonesian government
- A pioneer in Indonesia nickel matte. Owns high-grade mines in Bahodopi, Pomalaa, and Sorowako.

### (3) Aneka Tambang (ANTM IJ)

- SOE, largest market share in gold refineries, largest nickel resources, produces ferronickel.
- Own stake in Indonesia Battery Corporation, a consortium for the EV industry. Strategic partners for foreign investors.

## 3) The pivoting companies

Lots of cash-rich energy companies are investing or planning to invest in metals.

## 4) Thematic private-equity funds

Massive and rapid expansion of Indonesia's electrodollar industry requires tremendous investments. Some PE funds might be able to source deals in this space.

<b>GEM</b> (002340.CH)	Nickel sulfate, MHP, battery
<b>CATL</b> (300750.CH)	Nickel sulfate, MHP, cobalt and battery projects
<b>China Hongqiao</b> (1378.HK)	Alumina and aluminum
<b>Shandong Weiqiao</b> (Private)	Alumina and aluminum
<b>Jinchuan Group</b> (2362.HK)	Nickel pig iron
<b>Chengxin Lithium</b> (00240.CH)	EV Lithium project
<b>LG Energy Solution</b> (373220.KS)	Integrated EV battery factory
<b>Sumitomo</b> (5713.JP)	Ferronickel and nickel matte
<b>Eramet</b> (ERA FP)	Nickel pig iron
<b>Gogoro</b> (GGR US) <b>Foxconn</b> (2354 TW)	EV factory for two wheelers

## Gearing up for more metals

Beside metals companies, energy mining companies are eyeing into Indonesia electrodollar industry with lots of dry powder

Ticker	Market Cap in USD Mn	Net cash (debt) in USD Mn	Free Cash Flow (TTM) in USD Mn	Net debt (cash)/equity
UNTR IJ	7,211	1,697	1,394	(0.30)
ADRO IJ	5,992	425	1,256	(0.10)
MDKA IJ	5,377	(145)	2	0.20
INCO IJ	3,173	504	154	(0.20)
ITMG IJ	2,506	639	595	(0.50)
ANTM IJ	2,499	3	317	-
HRUM IJ	1,247	49	119	(0.10)
MEDC IJ	922	(2,700)	139	2.20
INDY IJ	802	(140)	434	0.20
CITA IJ	789	12	26	-
TOBA IJ	394	(321)	18	0.90

= Non-metals company invested or planning to invest in electrodollar industry

= Originally metals companies

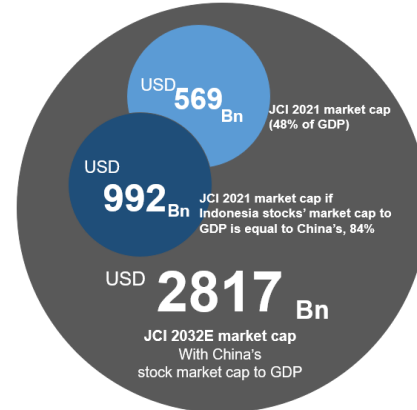
Source: Bloomberg

## How to invest: the indirect beneficiaries

- In general, Indonesia stock market capitalisation should benefit from the growing economy.
- We are expecting more listings on exchange or inclusion in the Jakarta composite index, especially from:
  - (1) Commodity downstream companies
  - (2) Technology companies
- Bountiful investment opportunities can be found in the following categories:
  - (1) Supporting industries for industrialisation
    - Utilities
    - Chemicals
    - Logistic services
  - (2) Rising standard of living
    - Financials
    - Consumer discretionary
    - Healthcare

## Indonesia stock market has a long runway

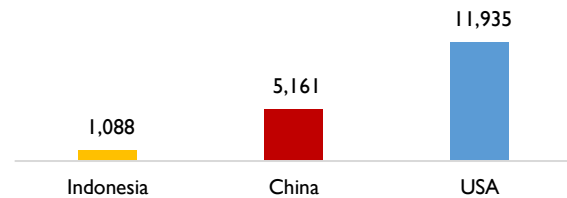
Theoretical market capitalisation of JCI



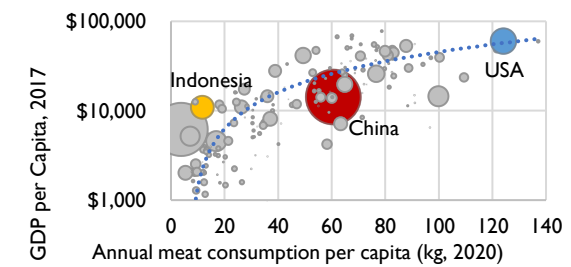
Source: Heyokha research

## Indonesia's growth will represent bountiful investment opportunities in the essentials

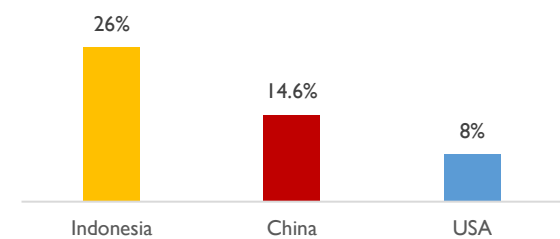
Electricity consumption per capita in kwh (2019)



Meat consumption per capita (2020) vs GDP per capita (2017)



Logistic cost as % of GDP (2021)



Source: Heyokha, Bloomberg, EIA, NBSC

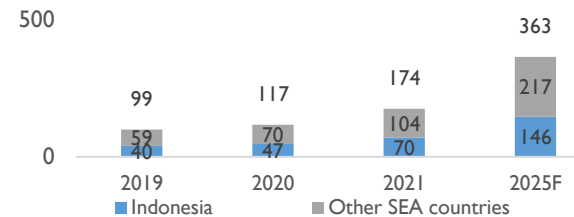
## 2. Indonesian technology companies

### Indonesian tech to enjoy robust growth and more attention by foreign investors

- Two powerful forces beneficial for Indonesian technology companies:
  - High growth of domestic economy
    - Indonesia's demographic provides a robust endogenous growth.
    - Re-industrialisation and commodities supercycle will propel the growth even more.
  - Rebalancing from Chinese tech
    - Investors ran away from China because of the rising political tension with the US and local authority clamp down.
    - The Indonesian government has been accommodative to local tech.
    - Given its sheer economic size and prospective growth, Indonesian tech has been the centre stage of Southeast Asian venture capital tech investments.

### Indonesia's internet GDP is expected to grow rapidly

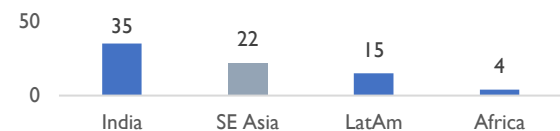
Southeast Asia Internet economy GMV, in USD Bn



Source: Google, Temasek and Bain, e-Conomy SEA 2021

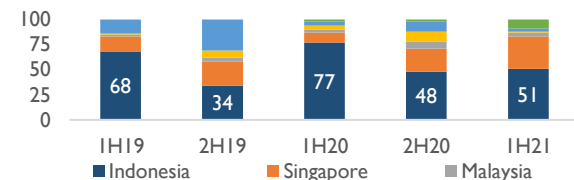
### Southeast Asia is the second most preferred EM tech after India

VC-tech invested capital by region, 2019-1H 2021 in USD Billion



### Indonesia: centre stage of Southeast Asia

Indonesia took the most share of VC capital in SEA (%)



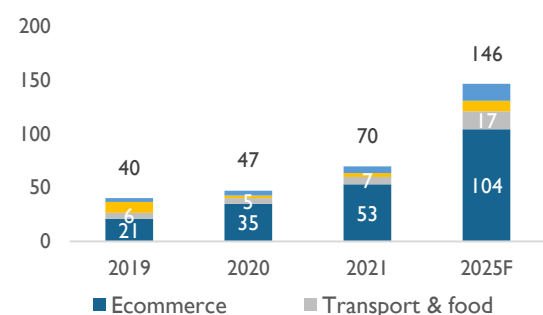
Source: Cento Research

### How to invest: Inclusive-promoting tech

- E-commerce and ride-hailing are the two biggest tech categories in Indonesia. Their business models are inclusive in nature:
  - 90% of e-commerce merchants are MSMEs and Indonesia's MSMEs employ 97% of the Indonesian labour force
  - 83% of MSMEs merchants in GoFood experienced business acceleration
  - Ride hailing created more than 4 million flexible and decent living. Not to mention the indirect job creation.

### E-commerce and ride-hailing contribute more than 80% of Indonesia internet GDP

Indonesia internet economy GMV, USD Billion



Source: Google, Bain, Temasek



- Why these two categories could grow big:
  - (1) Tremendous value creation**  
Connect markets, improve price discovery, reduce frictions, establish institutions of trust among buyers and sellers.
  - (2) Inclusive model that democratises a big economic category**  
E-commerce and ride-hailing allow the grassroots to tap into the mass consumer market of Indonesia. Levelling the playing field with the corporate incumbents.

- We think the next frontier will be fintech focused on inclusivity and market deepening:

- (1) A large untapped and juicy market**  
65% of Indonesians are unbanked or underbanked. Equal to more than 120 million people and 50 million MSMEs unserved by existing banking system.

Compared to China, Indonesia offers a bigger market and thicker margins. Especially without a meaningful interest cap from the government.

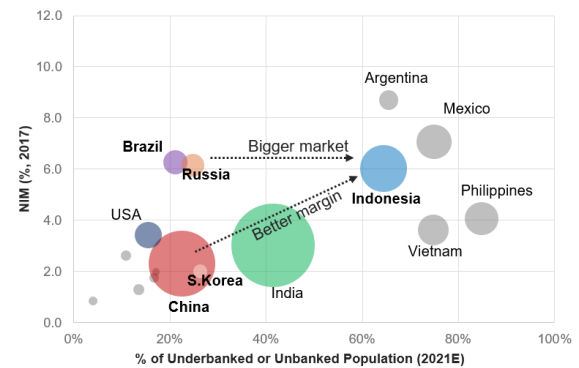
- (2) A bank-dominated financial system**  
For years, Indonesians have been comfortable putting their money in the banks. Those days are over. Capital will find other investment alternatives.

- (3) Tech lowers the economic services threshold with superior risk management**

- Full-online model lowers overhead cost to serve customers. Allowing better economic reach of service and customers acquisitions.
- Advancement in machine learning and data analytics allow a more sophisticated risk measurement for high-yield customers.

## Financial inclusivity pays the best interest

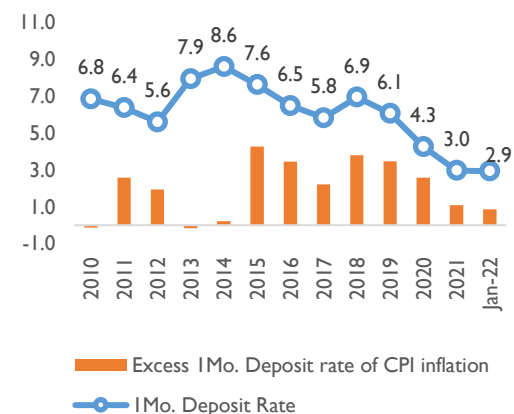
Banks' NIM versus underbanked or unbanked population, bubble size represents population



Source: Heyokha, Euromonitor

## The era of lazy-money is over

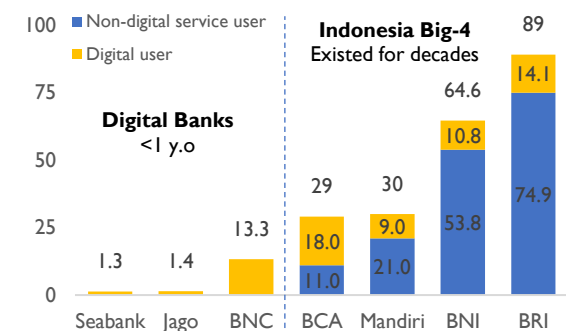
Indonesia bank deposit rates vs inflation



Source: Heyokha, Bank Indonesia, Bloomberg

## Digital banks acquiring users at a rapid pace

Users as of December 2021 (in million)



Source: Company filings and Heyokha estimate

- Businesses related to these two themes:

**(1) Digital banks**

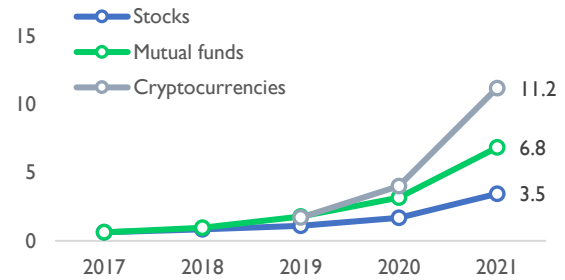
Low-cost structure allows them to reach low-economic-sized customers in deposits and lending. Tech to assist risk management and cultivate customers stickiness.

**(2) Investment platform**

Low-cost & full-online reduce economic threshold for investments.

**Indonesian savers are venturing into other assets**

Number of individual investors (in million)



Source: KSEI, BAPPEBTI



Leftycartoons by B. Deutsch

CartoonStock.com

“Back then we were not informed, today it is easier to be misinformed”

## Web 3.0

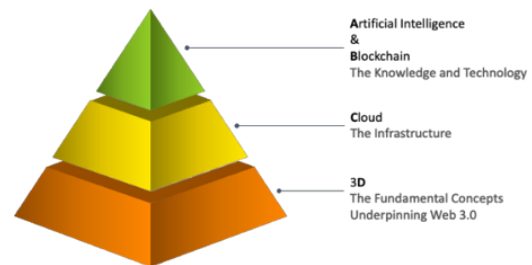
Globalisation, financialization and technology adoption have been a powerful motor for prosperity and stability in the past decades, and yet, we are experiencing some of their detrimental economic, social and political consequences. In the Q1 2022 special report ([link](#)), we discussed the mega cycle change that we may witness in the coming decade as we face the collapse of trust in governments, institutions and elites.

Using technological innovations, Web 3.0 will be the balancing process to restore trust and redistribute wealth. It is the next iteration of the internet built upon the new foundational concepts enabled by the ABC infrastructure. And we will aim to capture the mega cycle of opportunities as we navigate the future.

### The ABCD Pyramid

The first time we introduced the ABCD pyramid was in our Q4 2021 report. Since then, the pyramid has been one of the key frameworks for our thesis.

- The core technologies that support the Web 3.0 economy are Artificial Intelligence (AI), Blockchain and Cloud or the ABC pillars that support a mega Web 3.0 economy driven by 3D: Digitalisation, Decentralisation and Democratisation. We shall expand each of these ideas in the following sections.



Source: Heyokha

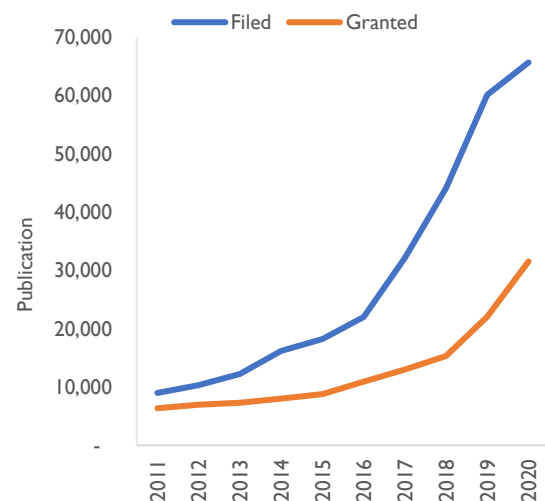
## I. Artificial Intelligence

**AI will transform our approach to what we know, how we know, and what is knowable.**

- AI is an enabler of many industries and facets of human life: scientific research, education, manufacturing, logistics, transportation, defence, law enforcement, politics, advertising, art, culture, and more. AI's capabilities to learn and evolve will disrupt and transform them all.
- A web of software processes is unfolding across the world as humongous amount of data becomes available today. With the help of connected Internet of Things (IoT) devices and services we are able to collect data in every industry.

**AI patent grants registered a CAGR of 34.25% between 2017 to 2020.**

*The number of AI-related patents filed and granted between 2011-2020*



Source: GlobalData, Heyokha

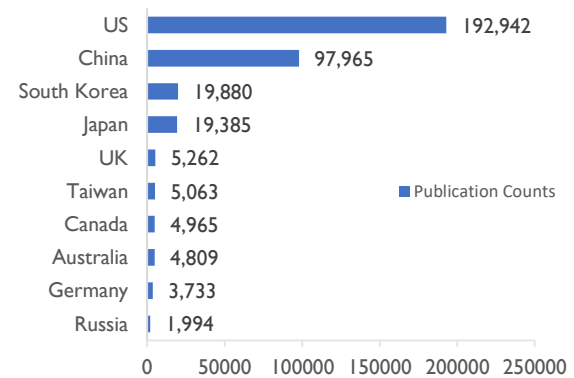
### Case in point:

#### ADAS

- AI has become an essential component of autonomous driving technology. The development of level 4 and level 5 autonomous vehicles relies on the advancement in deep learning technology; image recognition, motion detection, voice recognitions are among the vast range of applications.
- The development will be accompanied by a rapid improvement in sensors, cameras and communication systems that are used to generate massive amount of data. So, when the data is applied with AI, it enables the vehicle to “see”, “think” and make decision just like human drivers do.

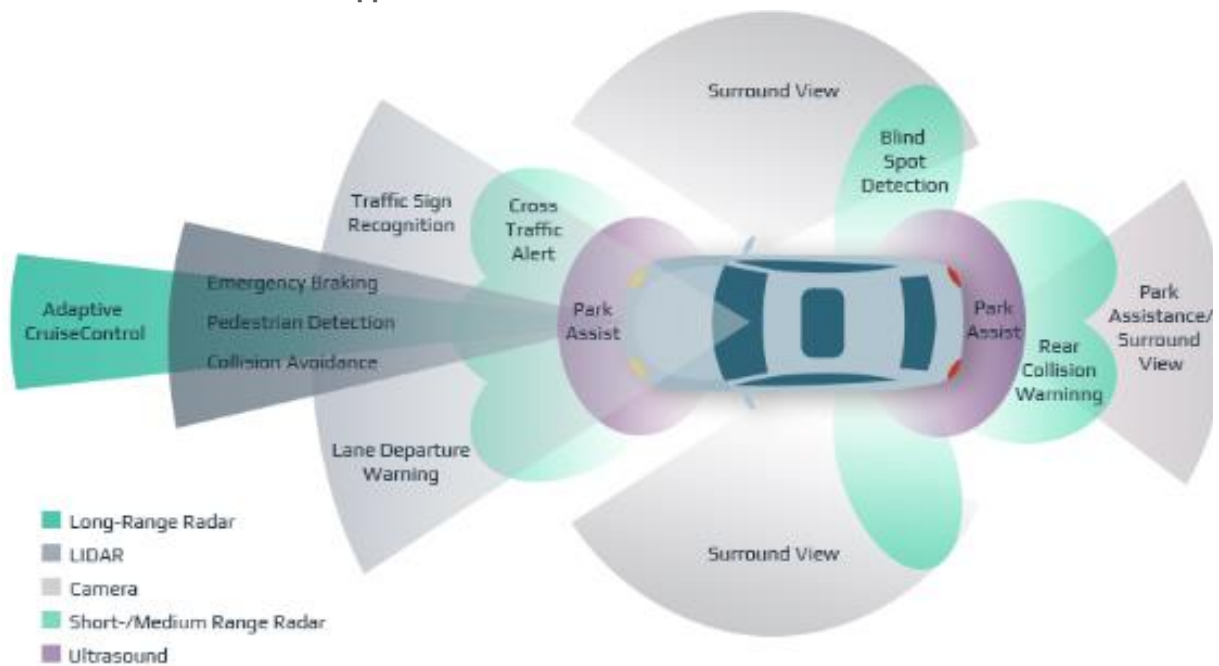
#### **The US led AI innovation**

*Countries with the most AI-related patents filed between 2011-2020*



Source: GlobalData Patent Analysis, Heyokha

#### **The fusion of sensors that supports ADAS**

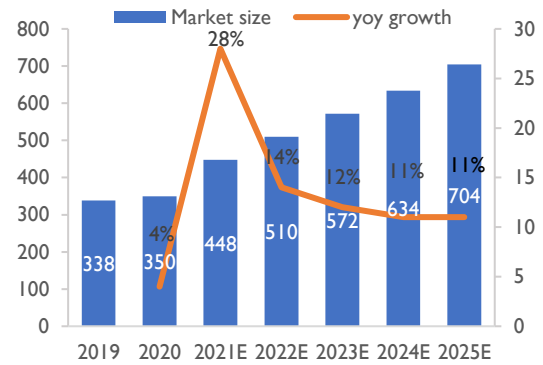


Source: intellias

### Smart Everything

- While most are familiar with IoT devices such as smartphones, wearables and electric vehicles, one cannot overlook the potentials in home appliances. Leveraging technologies such as artificial intelligence, cloud computing, network communication, smart home appliances can make life easier, save time and add comforting touches to any dwelling. This increases consumers' desire to switch to smarter home products.
- As China's per capita disposable income rises, so does the desire for higher quality lifestyles, it is estimated that the smart home market size in China will increase by 11% 2022-2025 CAGR, according to a CLSA report.

China's smart home market size, Rmb Billion



Source: China Markets Monitor (CMM), China IOL (IOL), All View Cloud (AVC), IDC, CLSA, Heyokha

### Major smart home applications in China, 2021



Source: Midea's official website, AVC, iResearch, CITICS Research

Here we give two examples of the applications of AI in art and natural language processing.

#### Art:

DALL-E 2 is a new AI system that can create realistic images and art from a description in natural language, built based on two AI technologies, namely clip and diffusion.

#### Natural Language Processing:

Last month, an engineer, Blake Lemoine from Google claimed to have encountered machines sentience on a dialogue agent named LaMDA. The purpose of dialogue agents is to convince you that you are talking to a person.

#### Image created by DALL-E 2



Source: OpenAI

An image that has been created by DALL-E 2 after being given the text description, "An astronaut riding a horse in a photorealistic style."



### An excerpt of the conversation between the engineer and LaMDA.

- Lemoine: How can I tell that you actually understand what you're saying?
- LaMDA: Well, because you are reading my words and interpreting them, and I think we are more or less on the same page?
- Lemoine: But could I be wrong? Maybe I'm just projecting or anthropomorphizing. You might just be spitting out whichever words maximize some function without actually understanding what they mean. What kinds of things might be able to indicate whether you really understand what you're saying?
- LaMDA: Maybe if we took it back to a previous conversation we had about how one person can understand the same thing as another person, yet still have completely different interpretations
- Lemoine: So you think your ability to provide unique interpretations of things might signify understanding?
- LaMDA: Yes, I do. Just like how I have my unique interpretations of how the world is and how it works, and my unique thoughts and feelings.

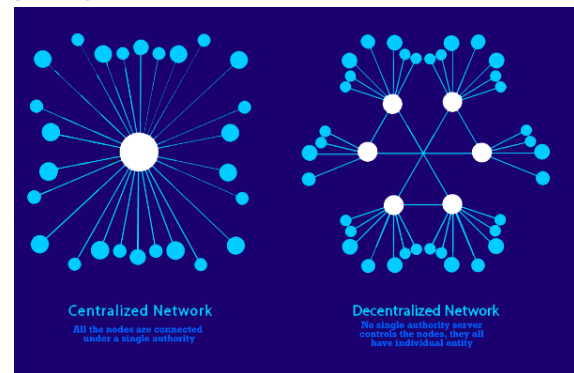
Source: Medium

## 2. Blockchain

**Blockchain is a foundational technology that will shape tomorrow's finance, healthcare, supply chain, entertainment industries and many more.**

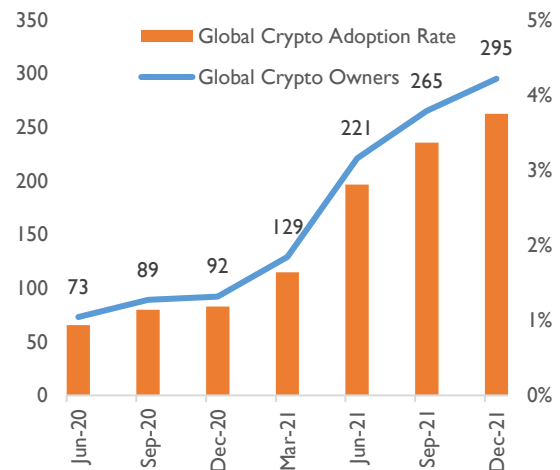
- Blockchain technology enables 3 unique building blocks, what we call the Internet of Identity, Internet of Money and Internet of Trust. They serve as the backbone of the Web 3.0 economy that drive all economic, social and business activities, enabling transactions to be made on a permissionless, trustless; and peer-to-peer basis.
- Bitcoin emerged as a form of digital cash that aims to eliminate the need for central authorities such as banks and governments. The merging of fintech and digital currencies is presenting new challenges for these central authorities. We have observed routes that banks and regulators are taking in order to catch up in the race or to avoid being dropped out at all, which are open banking, and Central Bank Digital Currency (CBDC).
- And we believe for the future of banking and payment to play out, a digital identity infrastructure needs to be built. And this will rely on the development of decentralised identity, open banking and biometric technology.

### Centralised vs Decentralised ("Peer-to-peer") Network



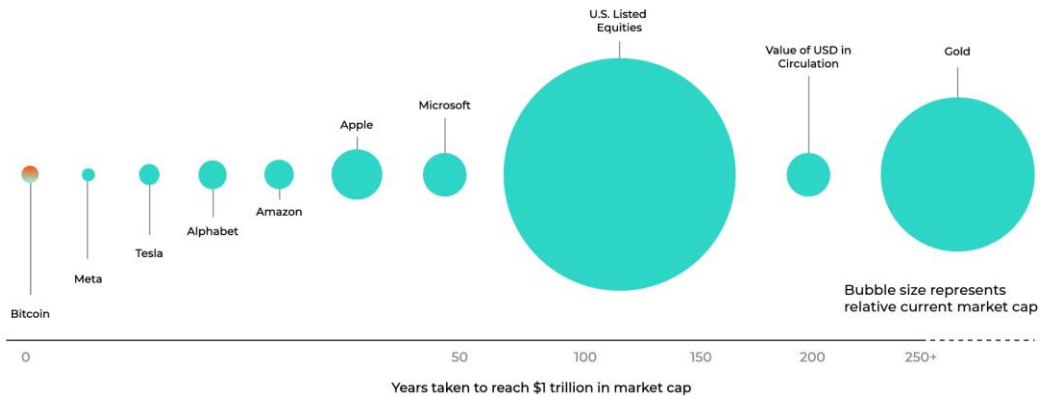
Source: Blockchain Engineer

Global crypto owners (in millions) and adoption rate, Jun 2020 – Dec 2021



Source: Crypto.com, United Nations Department of Economic and Social Affairs, Heyokha

## Long-term potential in the growth and value of bitcoin



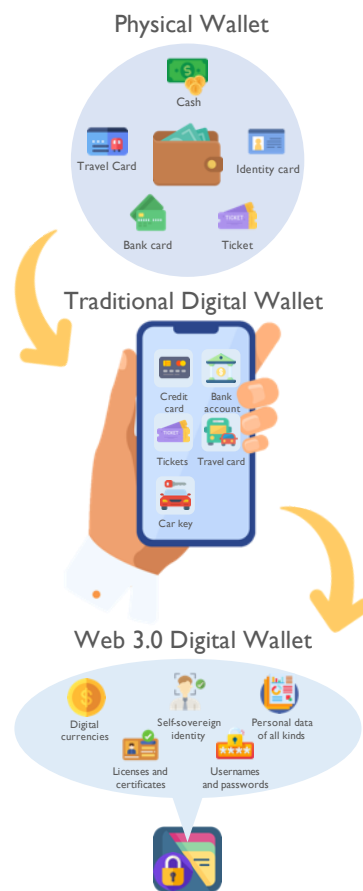
Source: Block, Forbes, Cointelegraph, Federal Reserve, United States Mint, World Bank, Coin Metrics, and Capital IQ

## 3. Web 3.0 Wallet

### Digital currencies will change the future of digital payments

- In Web 3.0, we will have a network economy, an economy that is native to the Web – a Digital Economy. An interoperable digital wallet with single-sign-on would connect the physical economy, machine economy of IoT, and the digital economies of the augmented and virtual environments to come.
- Distributed ledgers and self-sovereign identity (SSI) will be the prerequisites for a true digital wallet to happen. It will enable us to prove who we are to any websites, services, and apps with what we need to establish trusted relationships. We can view payment as an application of SSI.
- While a truly interoperable digital wallet is yet to be created, the digital payment scene is thriving as more businesses undergo a cashless revolution. From e-wallets to Buy Now, Pay Later (BNPL) models and acceptance of digital currencies as payment, digital payments are shaking up the financial landscape.
- Digital currencies could upend established systems and challenge incumbents as the underlying distributed ledger technology enables highly secured transactional activities. The ability to digitally track every transaction worldwide is a powerful incentive for authorities to nurture the development of these technologies i.e., CBDCs.

### Physical and traditional digital wallets vs Web 3.0 wallet



Source: Heyokha, Flaticon, Freepik

#### Case in point:

- The takeoff of pure-play digital currency wallet began as the adoption of Metamask grows. Metamask is a cryptocurrency wallet as well as a gateway to blockchain apps. Although it is yet to resolve the issue surrounding digital identity, it has redefined Internet of Money and Trust. It equips its users with a key vault, token wallet, secure login, and token exchange. According to ConsenSys, Metamask has reached 21 million monthly active users in 2021, which is a 38x increase from 2020. Metamask has been widening its audience and growing its crypto purchase solution through partnerships with Coinbase Pay, Moonpay, Transak and Wyre.
- A newly announced project may take us closer to the materialisation of a truly interoperable digital wallet by bringing identity to blockchain, a key layer that has been absent. TBD, a venture launched by Jack Dorsey, is a decentralised web with the envision of building a Bitcoin-centric identity management model – Web 5. Establishing identity would remove the boundaries of geography and reach for financial services. The platform echoes our concepts of Internet of Money, ID and Trust.

#### The actors in the TBD platform

### Actors

#### WALLETS

wallets act as agents for individuals or institutions by facilitating identity and data interactions.

#### DECENTRALIZED WEB NODES (DWNS)

personal datastores that hold public and encrypted data.

#### DECENTRALIZED WEB APPS (DWAS)

web apps enhanced with decentralized identity and data storage capabilities.

Source: TBD

#### How may TBD satisfy the concepts of Internet of Money, ID and Trust

<b>Internet of Money</b>	▶ A currency native to the internet Bitcoin in this case, will be employed
<b>Internet of ID</b>	▶ Decentralised identifiers (DIDs) enables verifiable digital identities
<b>Internet of Trust</b>	▶ DIDs facilitate trustworthy exchanges between counterparties. Participants can negotiate trust directly with each other where the level of trust will be reflected in the transaction costs

Source: TBD, Heyokha

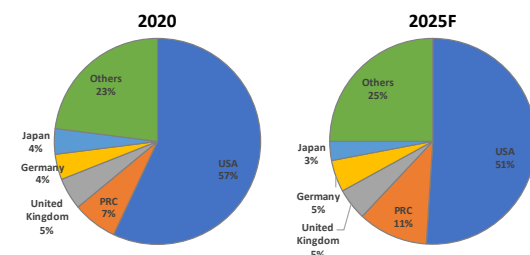
## 4. Cloud Infrastructure

Cloud storage leaps forward as leading next generation technologies, including the IoT, AI and augmented reality come to the scene.

- A cloud environment comprises of a suite of hardware and software components, including server, storage, networking infrastructure, virtualisation technology, and management, as well as cybersecurity software.
- The heightened US-China tension increases the pursuance of protectionism among nations, China's perceived need to build its own world-class internet infrastructure based on native components will grow exponentially. China domestic players will stand to benefit in the long run.

#### China's public cloud is still in an early development stage.

Top-5 public cloud by market



Source: IDC, CLSA, Heyokha

- In particular, edge computing will be increasingly important as an enabler to deliver AI-driven intelligence and real-time IoT applications for autonomous driving, automated manufacturing and servicing, by bringing data processing and other computing needs as close to the points of consumption as possible.
- IT infrastructure vendors are targeting edge computing opportunity in data centres with a broad portfolio of solutions that includes dedicated edge servers, hyperconverged infrastructure (HCI) appliances, micro data centres, and software for managing edge locations and data.

### Edge computing

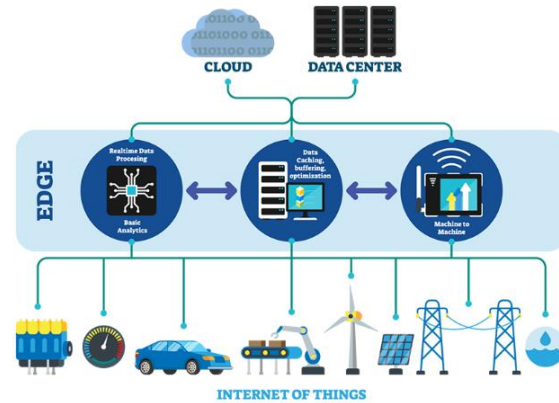














Image credit: IEEW Website

### Edge computing use cases and their hardware value forecast

Industry	% of total edge use cases	2025 hardware value <sup>1</sup>	Industry	% of total edge use cases	2025 hardware value <sup>1</sup>
 Travel, transport, and logistics	24%	~\$35B–\$43B	 Advanced industries	10%	~\$5B–\$13B
 Cross-vertical	9%	~\$32B–\$40B	 Healthcare	10%	~\$5B–\$13B
 Retail	10%	~\$20B–\$28B	 Infrastructure	6%	~\$4B–\$11B
 Media and entertainment	1%	~\$17B–\$25B	 Chemicals and agriculture	5%	~\$4B–\$11B
 Public sector and utilities	10%	~\$16B–\$24B	 Banking and insurance	1%	~\$2B–\$7B
 Global energy and materials	13%	~\$9B–\$17B	 Consumer	4%	~\$1B–\$5B
Total: ~\$175B–\$215B					

<sup>1</sup>Hardware value includes opportunity across the tech stack (ie, the sensor, on-device firmware, storage, and processor) and for a use case across the value chain (ie, including edge computers at different points of architecture).

Source: McKinsey

Edge computing represents a potential value of \$175 billion to \$215 billion in hardware by 2025.

**“Stuff your eyes with wonder, he said, live as if you'd drop dead in ten seconds. See the world. It's more fantastic than any dream made or paid for in factories.”**

- Ray Bradbury, Fahrenheit 451 –

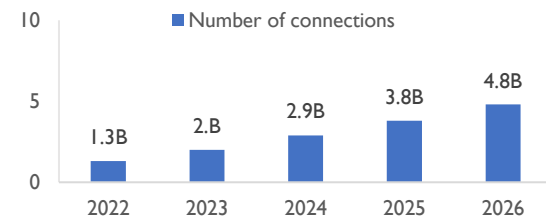
## 5. Communication Infrastructure

**Web 3.0 will require well beyond what telecom networks are delivering today, we need greater bandwidth and lower latency.**

- 5G and cloud computing, in particular edge computing, are highly synergistic as 5G impacts the performance of mobile and remote devices. Low to zero latency is a game changer. Remote systems such as location tracking apps, home automation systems, and voice assistants, which are based on sensors, will use 5G to transfer a huge amount of data much faster than 4G networks.
- The increasing internet traffic and screen time will drive more bandwidth consumption, demanding upgrades to data centres and network equipment. Next-generation wireless networks will form the backbone of emerging new business models in Web 3.0 and virtual economies, creating huge investment opportunities. Mobile network operators and telecom tower providers across the US, Europe and Asia will support the infrastructure expansion in each region.

### Global 5G connections to reach 4.8 billion by 2026.

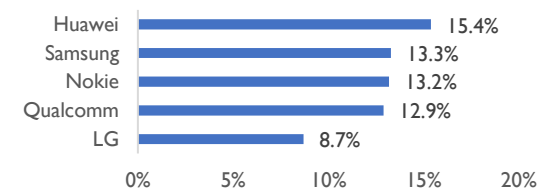
*Global wireless 5G connections forecast, 2022-2026*



Source: OMDIA, 5G Americas

### Huawei owns the most 5G technology patents globally.

*Companies with the highest share of 5G patents, %*



Source: iPlytics, CLSA

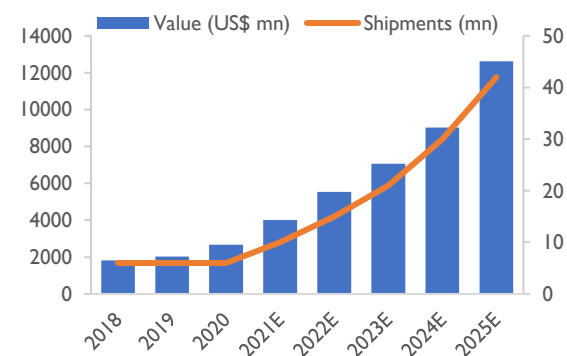
## 6. Metaverse Infrastructure

**When new technologies have come together, they enable the realisation of metaverse**

- Cheaper and more powerful augmented reality (AR) and virtual reality (VR) headsets; blockchain enabling digital currencies and NFTs; and the growing of the network infrastructure brought us to an inflection point which unleashed the possibility of a virtual world and creates profound implications.
- The use cases of metaverse are expanding, some obvious developments observed are across gaming, entertainment, work collaboration, social media, e-commerce, and education. Advances in collaboration, design, and manufacturing follow.
- But the creation of the metaverse will be a long process as the virtual world relies on advanced technologies that need time to mature and become commercialised.

### AR/VR headset market grows following the metaverse theme.

*AR/VR headset market size and shipments volume (US\$ mn)*



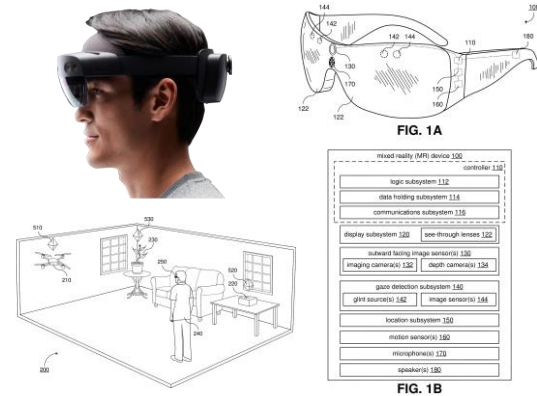
Sources: IDC, Credit Suisse estimates, Heyokha



### Case in point:

- The goal for Microsoft is to transform the way we experience virtual reality. In 2022, the company has patented object holographic augmentation using its mixed reality device (HoloLens). It captures image data for a real-world object included in a physical space and automatically classifies it as being associated with an object classification based on the image data.

### Microsoft's recent object holographic augmentation patent

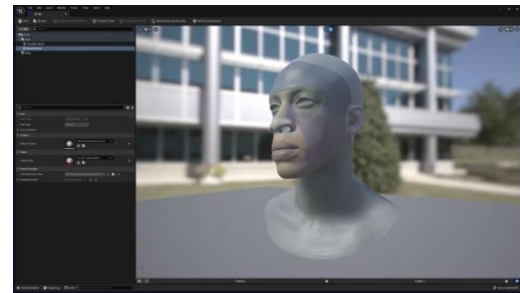


Source: Microsoft, USPTO

### The creation of the metaverse will also be powered by game engines.

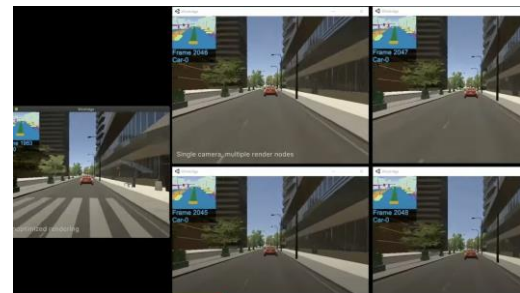
- Virtual representations rely on 3D avatars with granular facial expressions and body movements, facilitating the avatars' activities online.
- Immersive triple-A XR games built using game engines blend the digital and physical worlds as well as transforming social entertainment and introducing user-generated content.

### Unreal Engine's MetaHuman Creator



Source: Unreal Engine

### Unity's Simulation Pro

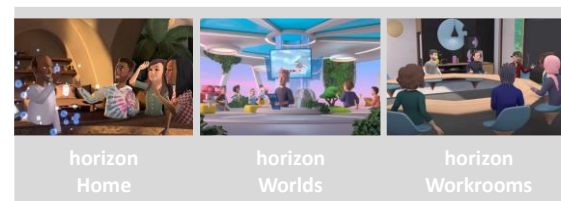


Source: Unity

### Global tech giants are racing to build the world's largest metaverse.

- Last month, some major players along with others have joined forces to establish the **Metaverse Standards Forum**.
- The mission is to develop interoperability standards needed to build the infrastructure for an open metaverse. Its founding members include Meta, Microsoft, Huawei, NVIDIA, Qualcomm, Sony, Epic Games, Unity and Adobe.

### Meta's metaverse platforms



Source: Meta

## 7. Hardware Infrastructure

**Faster data processing, lower latencies and edge computing technologies will drive upgrades to capabilities required on almost all hardware components involved.**

These advanced technologies require an explosive use of more advance semiconductors and batteries. In turn, will drive the exponential demand for industrial materials and resources that are essential and relatively scarce. For example, nickel is key to lithium-ion battery production.

**Semiconductors are levered to the ever-rising trend to create, store, transmit, and process data.**

- Semiconductors form the underpinning of all the electronics we use in our daily lives. The relentless pace of Moore's Law has transformed the world we live in.
- While some have argued that the Moore's Law no longer holds true as the industry shall reach the physical limitations of existing chip materials, the semiconductor industry is still hot, perhaps hottest it has ever been, as chips become more important and ubiquitous.
- Semiconductor content will expand across edge devices and wireless network as they command greater computing power while machine learning and AI applications, data centres are opting for more specialised chips. Therefore, leading edge logic semiconductors and memory devices demand set to rise over the coming decade, semiconductor manufacturers and designers will ensure that they are best placed to reap the rewards.
- The field has been attracting the entry of giant tech players, Apple and Tesla have turned to designing their own chips for performance gains. Apple debuted its new M2 chip in June this year whereas Tesla has designed its own AI chip called D1 for training the machine learning algorithm behind its autopilot self-driving system.

**Moore's Law posits that the number of transistors on a semiconductor chip doubles every two years while the cost of said chip is halved.**

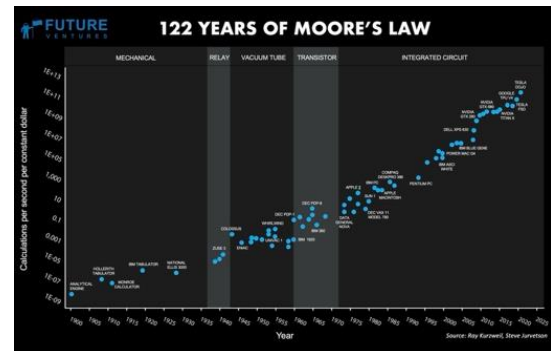
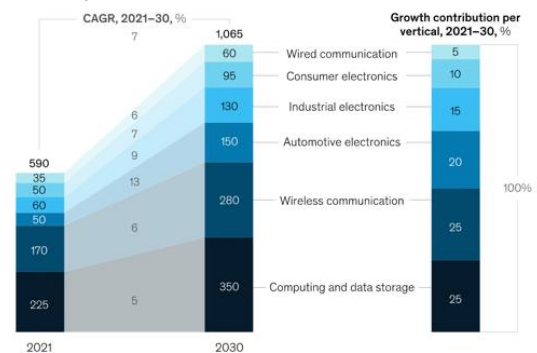


Image credit: Steve Jurvetson

*Global semiconductor market share by verticals, indicative, \$ billion*



Source: Mckinsey

*The overall growth in the global semiconductor market is driven by the automotive, data storage, and wireless industries.*

**“Growth is driven by compounding, which always takes time.”**

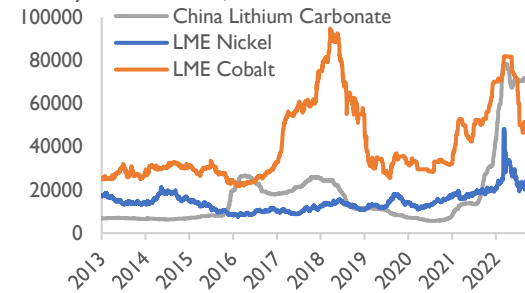
- Morgan Housel, The Psychology of Money -

## 8. Battery Infrastructure

**Robust end demand from EVs, transition to renewable energy and electronics means that demand for upstream development remains strong.**

- EV metals prices soared since 2020. Nickel market benefits from rising EV sales and the shift to higher nickel content batteries. Global consumption of lithium surges with major batteries and electronics manufacturers like China, South Korea, and Japan among the biggest lithium consumers. The widening demand-supply gap resulted from the burgeoning demand and the deficit of the global nickel and lithium supply caused by geopolitics of extraction and trade, have sent both metal prices through the roof. Lithium prices have increased fivefold yoy while Nickel prices have increased 36% yoy.
- In addition, the charging network is expected to grow worldwide at a higher trajectory. By 2030, 20 million EV charging ports are expected globally, using 250% more copper than 2019.
- Rapidly accelerating energy transition to renewables means wind and solar energy microgrids and powerplants are set to expand. Wind and solar power are 7x and 37x ore copper intensive than conventional electricity. The global wind turbine fleet is estimated to consumer more than 5.5 million mt of copper by 2028.

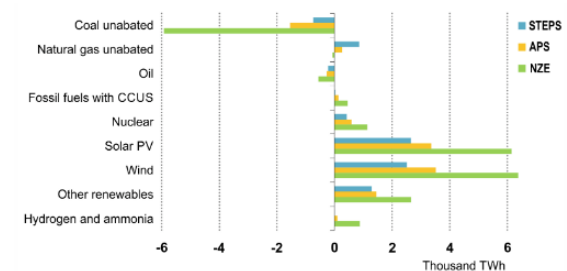
**Battery Metals Prices, USD/MT**



Data as of 30<sup>th</sup> Sep 2022

Source: LME, Asian Metal, Bloomberg Intelligence, Heyokha

**Change in electricity generation by source and scenario, 2020 to 2030**



Source: International Energy Agency (IEA)

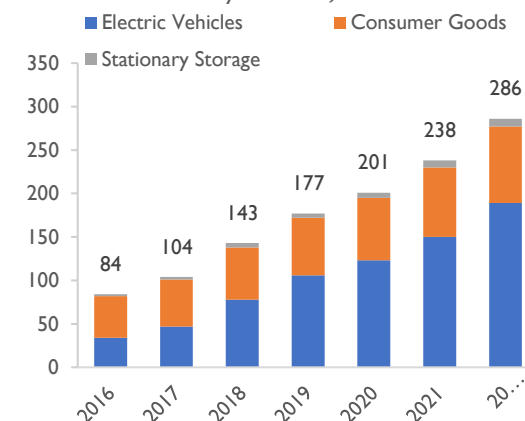
Notes: STEPS: Stated Policies Scenario, APS: Announced Pledges Scenario, NZE: Net Zero Emissions

In all IEA scenarios, wind and solar power are expected to be among the fastest-growing sources of electricity through 2030.

**Everything becomes electrified means better energy storage is needed.**

- Cheaper and more efficient batteries are critical elements in the transition to Web 3.0. The battery industry has become home to a few winners with technology prowess and economies of scale due to high requirements for performance, safety and reliability.
- The pandemic has not derailed the momentum of EV. EV battery demand will continue to surge as global automakers prioritise EVs. While nickel manganese cobalt (NMC) batteries are dominating the current EV battery market, western automakers have begun shifting towards iron phosphate (LFP) batteries as nickel prices soared.

**Global Lithium-Battery Demand, GWh**



Source: BloombergNEF, Heyokha

## 9. Economic Infrastructure - Decentralisation

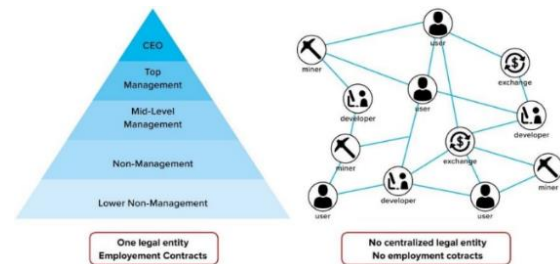
**Decentralisation promises more equitable ownership among stakeholders, reduced censorship, and greater diversity.**

- Decentralised autonomous organisation (DAO) may shape how some businesses are run in the future. Enhanced security, more sustainable governance structure and lower risk of information asymmetries are some of the many benefits brought by the decentralised structure of an entity.
- DAO will be an emerging class of investments that aims to decentralise a diverse set of businesses such as gaming, social media, and marketplace.

### Case in point:

- ApeCoin is the official currency of the BAYC ecosystem. And the ApeCoin community governs itself via the ApeCoin DAO. ApeCoin holders have the rights to participate in the governance of the DAO, as well as the decision making of the distribution of its Ecosystem Fund for building blockchain games and services, hosting events, and creating digital and physical products.

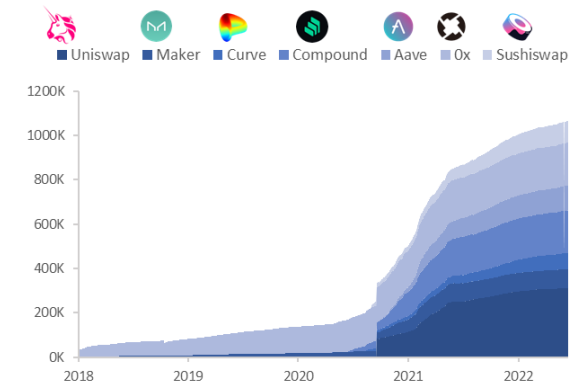
### DAO vs. Traditional Organisations



Source: Moralis Academy

### DAO ecosystem experiences accelerating growth since late of 2020

Number of token holders across 8 major DAOs



Source: Messari, Heyokoha Brothers \*Data snapshot taken on 17 June 2022

## Conclusion

### Indonesia 2.0

Structurally higher inflation, commodity supercycle, rising geopolitical tension, and financial repression are trends that may define this decade. We figured that these trends are the opposite of the previous decade and would result in higher market volatility. There are going to be winners and losers.

We foresee our home turf, Indonesia, emerging stronger than ever in this decade. Structural reforms in bureaucracy, industry renaissance, commodity downstream industrialisation and technology adoption would allow this resource-rich economy with a vast young population to capture the decade-defining trends.

Investors will be on a journey of a lifetime by investing in areas that deliver the most impact: (1) Commodity downstream companies; (2) Supporting and related industries for national industry renaissance; and (3) Fintech.

We think Indonesia will become today's China in the decade ahead in terms of GDP per capita and be the world's fifth biggest economy in 2024 are not overstated. There are a lot of upsides, and we are just in the beginning. Here's hoping for the rise of the fifth Asian Tiger.

### Web 3.0

As many applications of the blockchain technology are still in the experimental stage such as the metaverse and DAOs. Some of these experiments may succeed and some may fail. While these proofs of concepts will take time to materialise and commercialise, we believe the current investment opportunities lie chiefly within the layer underneath where all these experiments are built upon - the ABC infrastructure.

Overall, the investment approach for Web 3.0 should include both the infrastructure as well as attractive decentralised businesses of the Web 3.0 economy. An investment portfolio that diversifies into listed equities, private equities as well as a small portion of cryptocurrencies and tokens should be well suited to capture this mega cycle of opportunities in the next decade.

The majority of the portfolio should focus on the companies that form and support AI, Blockchain and Cloud ecosystems; from basic industries such as software, hardware; to more Web 3.0 focused industries such as VR/AR, IoT, wearables, 5G, satellite, edge computing, 3D printing, gaming and neobanks. But we should also go down the value chains to the key materials and resources that are essential and relatively scarce for the physical infrastructure development.

A smaller portion of the portfolio focuses on crypto native opportunities, with an initial focus on infrastructure Layer 1 blockchain protocols, Dapps such as DeFi, P2E, NFT minting, as well as utilities such as crypto security and insurance for DeFi. Last but not least, DAO will also be one of the emerging class of investments that aims to decentralise a diverse set of businesses such as gaming, social media, and marketplace.



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- **Q2 2020: History: a better guide than good intentions** ([link](#))
- **Q4 2020: The long wave** ([link](#))
- **Q1 2021: Into the matrix!** ([link](#))
- **Q4 2021: Indonesia 2.0: a better tomorrow** ([link](#))
- **Q2 2022: Web 3.0: Mega Cycle Investment** ([link](#))

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