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Deloitte.

GUIDE TO NAVIGATE THE GREEN TECH MARKET

Hong Kong's Path to Carbon Neutrality

December 2024

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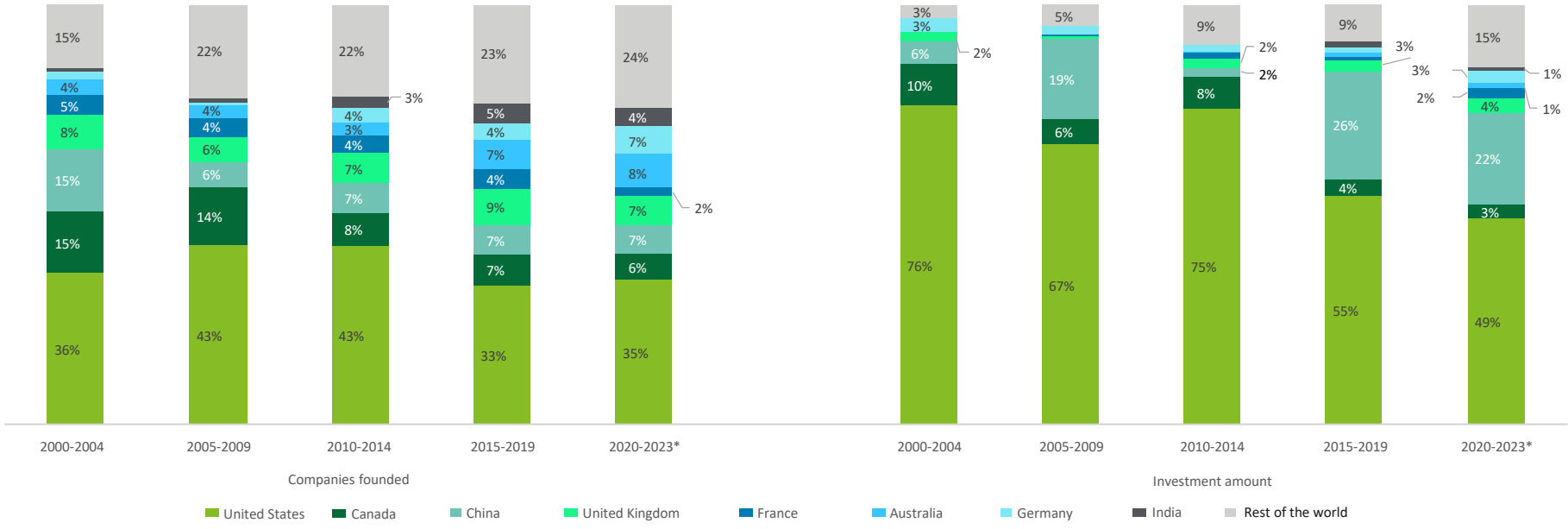
Global Green Tech Market

The United States has been a global leader in Green Tech entrepreneurship and investment, but the geography of Green Tech is changing. In 2000- 2004, just three countries—the United States, Canada, and China—accounted for two-thirds of climate technology company formations globally.

US companies' share of investment slipped from 76% in 2000-2004 to 49% in 2020-2023 while that of Chinese companies grew from 6% to 22%[1]. While the eight countries continue to dominate in company formation and investment, it appears that other markets have increasing appeal for investors who may be seeking investments in new technologies and the potential for higher returns.

In 2023, the number of Green Tech unicorns (start-ups valued at over US$1 billion) reached 80 globally. China accounted for approximately 29.5% of global Green Tech unicorns, second only to US, which held 54%.[2]

Percentage share of global climate tech activity by year and country[1]



Source: (1) Deloitte analysis (2) HolonIQ, Startup Basecamp

Global Green Tech Market

Eight countries lead the way with China on the rise

Green Tech entrepreneurship and investment is a global phenomenon with these companies in more than 65 countries, but they are concentrated in eight nations whose economies are among the world's largest: Australia, Canada, China, France, Germany, India, the United Kingdom, and the United States. Collectively, those countries are the headquarters for approximately three-fourths of global Green Tech companies. These dominant nations have an outsized influence on the trajectory and velocity of climate technology development.

Country	Technology Type (Proportion of Green Tech companies)*					
USA	Recycling & waste mgmt. (9.4%)	SDES (7.5%)	Alternative proteins (7.2%)	CCUS (6.3%)	LDES (6.2%)	
Canada	Recycling & waste mgmt. (14.8%)	*Bioenergy (7.0%)*	Alternative proteins (6.6%)	CCUS (6.6%)	Building electricity mgmt. (5.3%)	
United Kingdom	Recycling & waste mgmt. (15.1%)	CCUS (8.0%)	Passenger road vehicles (6.7%)	LDES (6.7%)	Alternative proteins (6.2%)	
China	SDES (41.7%)	Recycling & waste mgmt. (13.1%)	Passenger road vehicles (11.2%)	LDES (7.8%)	Solar (4.4%)	
Australia	Recycling & waste mgmt. (10.5%)	Building electricity mgmt. (7.8%)	Passenger road vehicles (7.2%)	Electric vehicle charging (6.5%)	LDES (6.5%)	
France	Recycling & waste mgmt. (14.4%)	SDES (8.0%)	*H2 production (8.0%)*	Passenger road vehicles (7.2%)	LDES (6.4%)	Alternative proteins (6.4%)
Germany	Passenger road vehicles (10.3%)	LDES (8.6%)	EV charging (8.6%)	Recycling & waste mgmt. (7.8%)	SDES (7.8%)	
India	Passenger road vehicles (25.0%)	Recycling (13.0%)	EV charging (11.0%)	*Commercial road vehicles. (9.0%)*	SDES (6.0%)	Solar (6.0%)

*Note: **CCUS**: carbon capture, utilization, and sequestration. **LDES**: long-duration energy storage. **SDES**: short-duration energy storage. Where the 5th and 6th technology are tied for share of companies, both are shown.*

*Deloitte analysis based on information disclosed on public data sources

Global Green Tech Market

Venture capital (VC) investment broadly, and investment in climate tech specifically, has surged in recent years. Two-thirds of the funding since 2021 has come in megadeals of US$100 million or greater compared to 58% from 2000 to 2020. In line with overall climate tech funding, climate tech megadeals have diversified geographically. Prior to 2021, mega rounds went to companies in 12 countries. From 2021 through 2023 they went to 19 countries (see below) highlighting heightened awareness for the market opportunity of Green Tech solutions – as such megadeals tend to be viewed as validating technologies and markets.

From a tech point of view, since 2021, megadeals accounted for a disproportionate share of funding in five climate tech categories: passenger road vehicles, SDES, farming in vertical or controlled environments, and low greenhouse gas (GHG) farming inputs (see below). Seventy percent of megadeals across these five climate techs are later-stage venture funding raised mainly to help support the expansion or establishment of commercial-scale production and continued product development.

Notably, the megadeal activity includes countries other than the dominant eight: Croatia, Indonesia, and Sweden. Meanwhile, Sweden has had eight megadeals since 2021 covering not only passenger road vehicles and SDES, but also commercial road vehicles and steel. Government support, a history of academic research, inventor-favoring patent laws, and a vibrant auto industry promote green innovation here.

Contribution of megadeals in climate tech funding

	2000-2020	2021-2023*
Deal value: **≥US$100 million**		
Number of countries with deals	12	19
Number of companies with deals	74	125
Number of deals	147	161
Amount invested (US$ billion)	45	53
Deal value: **≥US$1,000 million**		
Number of countries with deals	2	3
Number of companies with deals	6	6
Number of deals	9	8
Amount invested (US$ billion)	13	16

Source: Deloitte analysis

Megadeal funding details since 2021*

Technology	Megadeals share of total funds	Number of megadeals		Funds via megadeals US($Billion)	Highlights
		≥US$100M	≥US$1,00M		
Passenger road vehicles	90%	23	3	13.6	**China** and the **United States** led with eight and seven deals, respectively, and all US$1 billion deals for lithium battery-powered four-wheeler makers. **Australia**, **Croatia**, **Germany**, **India**, and **Sweden** were other recipients.
Nuclear	85%	3	1	2.1	The **United States** received all the deals in this space, including a US$1.8 billion deal for a nuclear fusion innovator, US$162 million for another fusion player, and US$152 million for a small modular reactor developer.
Short duration energy storage (SDES)	83%	36	3	14.7	**China** and the **United States** led with 19 and nine deals, respectively. Other recipients include **France**, **Sweden**, **Taiwan** (China), and the **United Kingdom**. The US$1 billion+ deals went to China and Sweden. SDES deals are mainly for lithium-ion batteries with a few for solid-state and hydrogen fuel cell batteries.
Vertical or controlled environment farming	80%	5	-	1.2	The **United States** and **Indonesia** received three and two deals respectively, for pesticide-free vertical farming and hi-tech aquaculture.
Low GHG farming inputs	71%	5	-	1.3	The **United States** received all deals in this space for bio-based crop yield enhancers.

* From January 1, 2021 to July 31, 2023

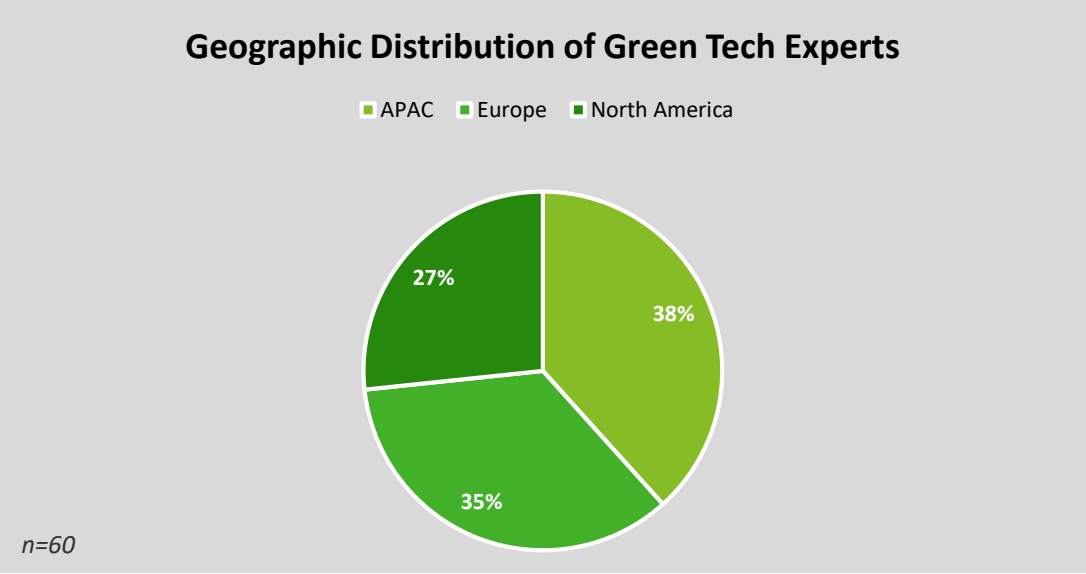
Insights from Green Tech Market Experts

Green Tech leaders across key markets were asked on the major challenges and opportunities shaping the industry.

Green Tech Experts Survey:

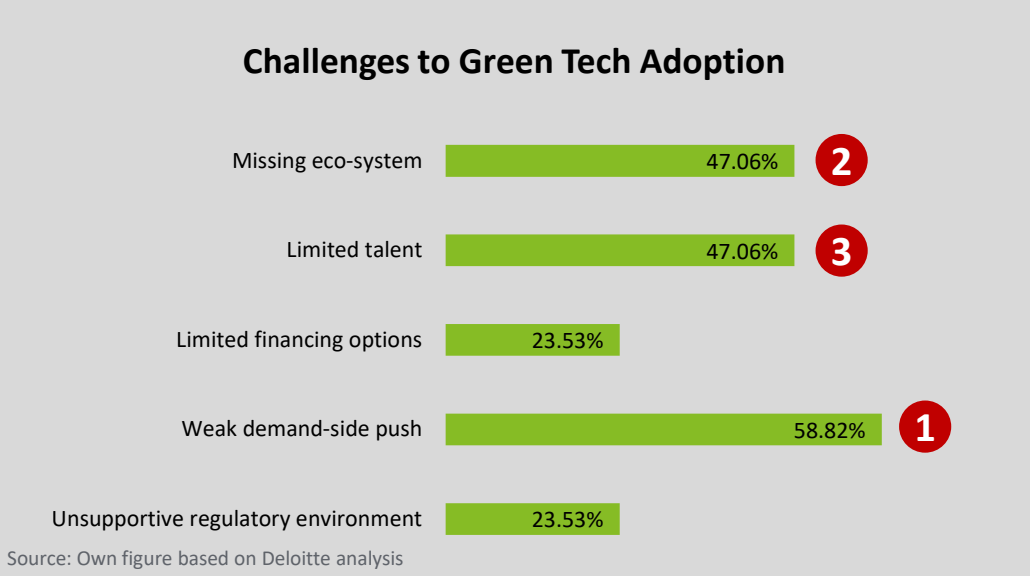
- 60 Green Tech experts were asked what the biggest challenges are when introducing environmental technologies and what the key success factors are.
- The sample of Green Tech experts for this insights survey shows a balanced panel in terms of geographic origin as well as thematic focus.

Source: Own figure based on Deloitte analysis



Source: Own figure based on Deloitte analysis

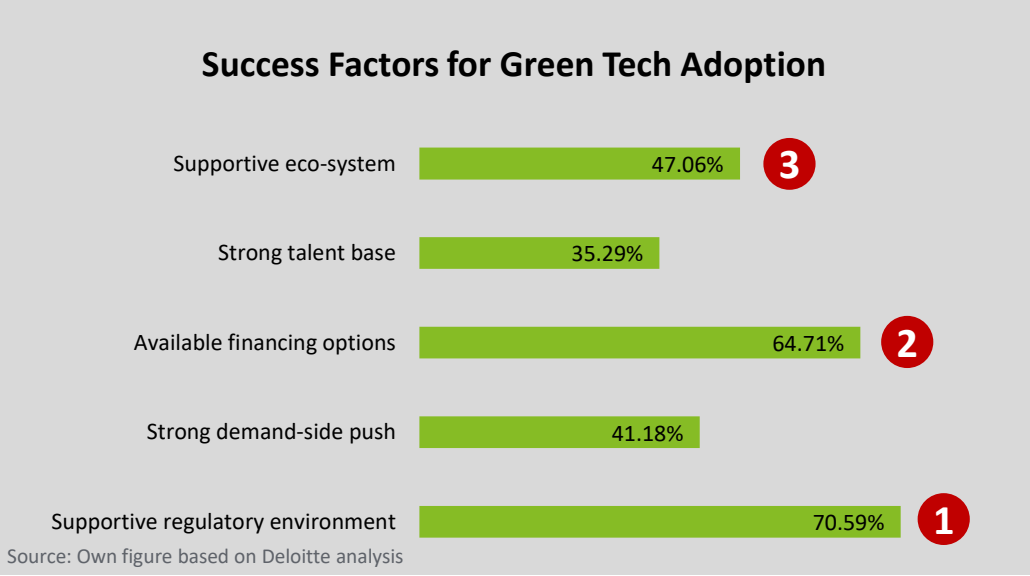
Insights from Green Tech Market Experts



Source: Own figure based on Deloitte analysis

A weak demand-side push, a missing eco-system and a limited talent base are the three main challenges to Green Tech adoption based on the insights of our SMEs. Broken down to the various focus sectors, small differences emerge in the most important obstacles:

- For the Built Environment, Waste Management and Green Transportation sectors, the weak demand-side push was found to be the biggest obstacle
- For the New and Renewable Energy sector - the results show a more balanced picture, with lack of talent and weak demand-side push also standing out slightly.
- For the Biodiversity, the missing eco-system is the predominant major obstacle.



Source: Own figure based on Deloitte analysis

On the success factors side, the supportive regulatory environment is the strongest driver, followed by available financing options as well as a supportive eco-system. The key success factors also show small differences across the different focus sectors:

- For the New and Renewable Energy sector, the right financing options are particularly important for further expansion.
- For the Built Environment and Green Transportation, the right regulatory conditions are key - this is not necessarily about financial support, but also about regulatory simplicity to bring new technologies in these sectors to market (e.g., simplicity to run pilot projects, to get licenses).
- Across the sectors – a functioning and supportive eco-system emerges as important to further establish the Green Tech solution.

Insights from Green Tech Market Experts

1 Supportive Ecosystem

The ecosystem can help on two key aspects: Reduce regulatory hurdles and improve the business case.

Reducing regulatory hurdles by means of a supportive ecosystem:

A supportive ecosystem can help reduce certain regulatory hurdles (e.g., through collaboration with academic institutions on R&D Green Tech solution providers can show the readiness of their technology for the specific market environment).

Improving the business case:

The ecosystem can help to increase the attractiveness of the business case (e.g., through buying consortia which help to strengthen the demand-side push and give the respective Green Tech solution a clear sales plan for the years to come).

2 Functioning Business Case

Without a functioning business case, there is no dialog with stakeholders and further discussions around market entry and potential of the Green Tech solution is difficult.

Therefore, a functioning business case requires rather mature technologies with a secured customer basis and a sound financial situation and, depending on the market, a customization of the Green Tech solution to the respective market.

In line with the findings from the SME survey, a strong demand-side push is advantageous for the business case; the lower the demand-side push, the more difficult it is to demonstrate a robust business case.

In addition, available financing options are considered important for a successful business case, giving additional weight to providing the necessary financing options to Green Tech solution providers.

3 Policy Support

Within the supportive policy environment, it is essential to recognize the distinction between traditional financial support (e.g., via subsidies or grants) and the importance of policy efficiency, that foster innovation and the adoption of new Green Tech solutions.

Supportive policy and financial incentives can effectively facilitate the entry of new Green Tech technologies into the market. Key considerations include:

- Identifying the key steps to enhance the smooth introduction of new Green Tech solutions.
- Developing blueprints, frameworks, and initiatives for emerging technologies.
- Facilitating the landing of tech ventures and promoting of Green Tech research and development, encouraging go-to-market adoption through pilot projects and commercialization.

Green Tech Market – Focus to Advance on the Journey

All the insights depend on continued efforts to build capacity and skills on sustainability and climate knowledge across Hong Kong: from government leaders, administrators, to company Board members and Directors, to management staff tasked with driving action, through to the general public. The ESG training programmes are gaining traction and could be further expanded in industry and professional associations as well as academic institutions.

The outlook for Hong Kong accelerating its Green Tech adoption and becoming a Green Tech hub in APAC is strong: The Deloitte Economics Institute has found that a well-managed climate transition could increase the size of the world economy by US$43 trillion between 2021 and 2070. The Deloitte report estimates that effective climate action can generate 300 million 'green collar' jobs in the low carbon economy, offering the opportunity for a just transition that leaves no one behind during the restructuring.

Focus: Hong Kong as a trusted hub for Green Tech investment

Underpinning the Green Tech market plans lies the important task of monitoring, reporting and verifying progress in each sector. Reporting methodologies standards are rapidly evolving, and industry leaders are making efforts to ensure companies are measuring what they need to manage, for example:

From city-wide initiatives to individual corporate net-zero plans, the reliable, timely, comparable, comprehensive, verifiable data in line with international reporting standards and green taxonomies recognised by importers, exporters, and investors worldwide are important. Strengthening Hong Kong's position as a trusted hub for investment, fostering long-term economic benefits.

Focus: Flourishing Ecosystem Development

For Green Tech solutions to get to sufficiently high demand levels, a functioning ecosystem is very important. The exchange between academia and industry is already functioning efficiently in Hong Kong with several new projects lined up and in the implementation phase (please refer to the next slide on the different developments around the Hong Kong Shenzhen Innovation & Technology Park as well as the San Tin Technopole development).

In addition to the ecosystem between academia and industry, more demand-side focused eco-systems have proven to be important to drive low-carbon solutions. One key aspect of demand-side eco-systems are the so-called **buying consortia for low-carbon solutions** in the respective economic sectors such as built environment, power or green transportation have emerged in recent years as a central element of an ecosystem.

The formation of such consortia is important in the further process of becoming a Green Tech hub - the formation can be initiated by the government in the context of industry associations or other vehicles through which the government interacts with industry.

Green Tech Market – Advancing on the Journey through Ecosystem Development

Case Study – Hong Kong Shenzhen Innovation & Technology Park & San Tin Technopole:

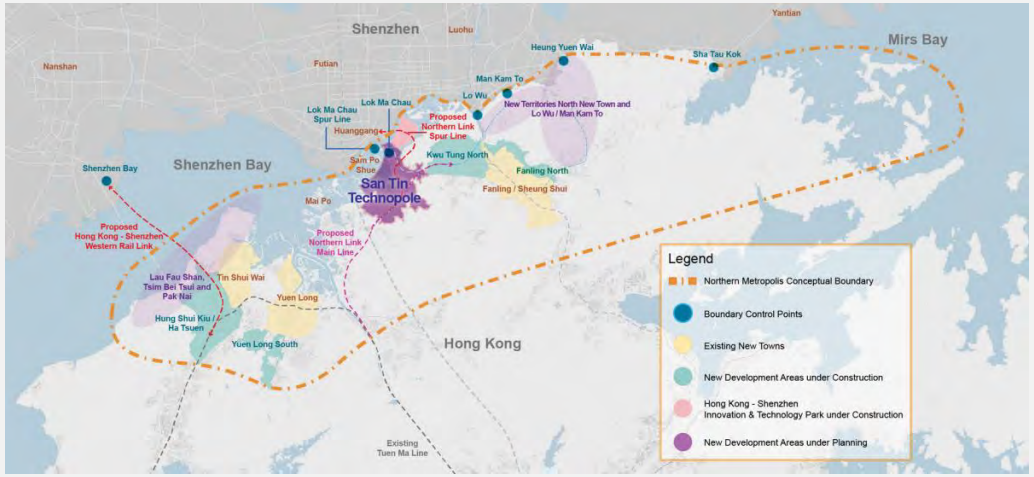
Hong Kong's National 14th Five-Year Plan sets forth an ambitious vision for the region to transform into a global hub for green tech, innovation, and technology. At the core of this strategy are two key projects, the San Tin Technopole, as well as the Hong Kong Shenzhen Innovation and Technology Park, all aiming to evolve into a dynamic "new international green tech and innovation technology city."

Both parks share a common goal to focus on key themes:

- RESEARCH & DEVELOPMENT: By enhancing collaboration among industry, academia, and research sectors, they aim to connect upstream and midstream research to downstream markets.
- HIGHER EDUCATION: These parks will leverage teaching and R&D resources to establish an integrated advanced training platform in Hong Kong.
- CULTURAL & CREATIVE INDUSTRIES: The focus will be on developing R&D-intensive or technology-enabled C&C sub-industries.

The rapid development of this focused eco-system in the parks will lead to the establishment of world-leading research institutes and innovation and technology enterprises, contributing significantly to Hong Kong's innovation and technology landscape. Additionally, an open collaboration platform will encourage knowledge exchange and applied research across academia, research institutes, industry, government, and society, fostering ideation and cross-disciplinary research.

These parks will serve as catalysts for green tech, innovation, and technology growth within the Greater Bay Area (GBA), connecting research institutes and enterprises with Mainland China and overseas countries. Ultimately, this will accelerate the pace of innovation and technology development in Hong Kong, elevating its global reputation in the field.



- The strategic location of San Tin Technopole, situated at the heart of the Northern Metropolis and in close proximity to Shenzhen's I&T zone, makes it an ideal hub for clustered I&T development. By fostering synergy with the Shenzhen I&T Zone, it will become a vibrant community promoting quality, healthy, and eco-friendly living.
- On the other hand, the Hong Kong-Shenzhen Innovation and Technology Park, situated in the Lok Ma Chau Loop, is designed to be a vital centre for scientific research collaboration. It will offer advanced higher education, cultural and creative industries, and other complementary facilities to attract top-tier enterprises, R&D institutions, and higher education institutes from the local region, Mainland China, and worldwide.

Source: Hong Kong Shenzhen Innovation and Technology Park HSITP, Home - Northern Metropolis | San Tin Technopole

2 | Green Tech Market – Five Focus Sectors

Market Analysis – Five Focus Sectors

Market Analysis – Power & New Energy Sector

Green Economy Taxonomy – Power & New Energy Sector

After compiling up the insightful suggestions from stakeholders in the market, the taxonomy can help to mobilize private capital towards investments that contribute to environmental sustainability and help to identify the most promising sustainable activities in Hong Kong.

Focus Sector	Power & New Energy Sector						
Subcategories	**Wind**	**Solar**	**Bioenergy**	**Hydrogen**	**Energy efficiency**	**Energy storage / Grid energy storage**	**Carbon Capture**
	Floating offshore wind turbines	Floating solar photovoltaics (FSPV)	Biogas from anaerobic digestion	Direct solar water splitting	Advanced metering infrastructure	Lithium-ion batteries	Solid direct air capture
	Floating hybrid energy platform	Perovskite solar cell	Biomethane from gasification & methanation	Seawater electrolysis	Household appliance	Smart inverters	Liquid direct air capture
	Hydrogen storage in wind turbine towers	Building-integrated photovoltaics		Liquified hydrogen (hydrogen storage)	Energy management	Lithium iron phosphate	Membrane-based direct air capture
		Energy optimization		Compressed hydrogen in pressure vessels (hydrogen storage)		Liquid air energy storage	
				Ammonia to Energy			

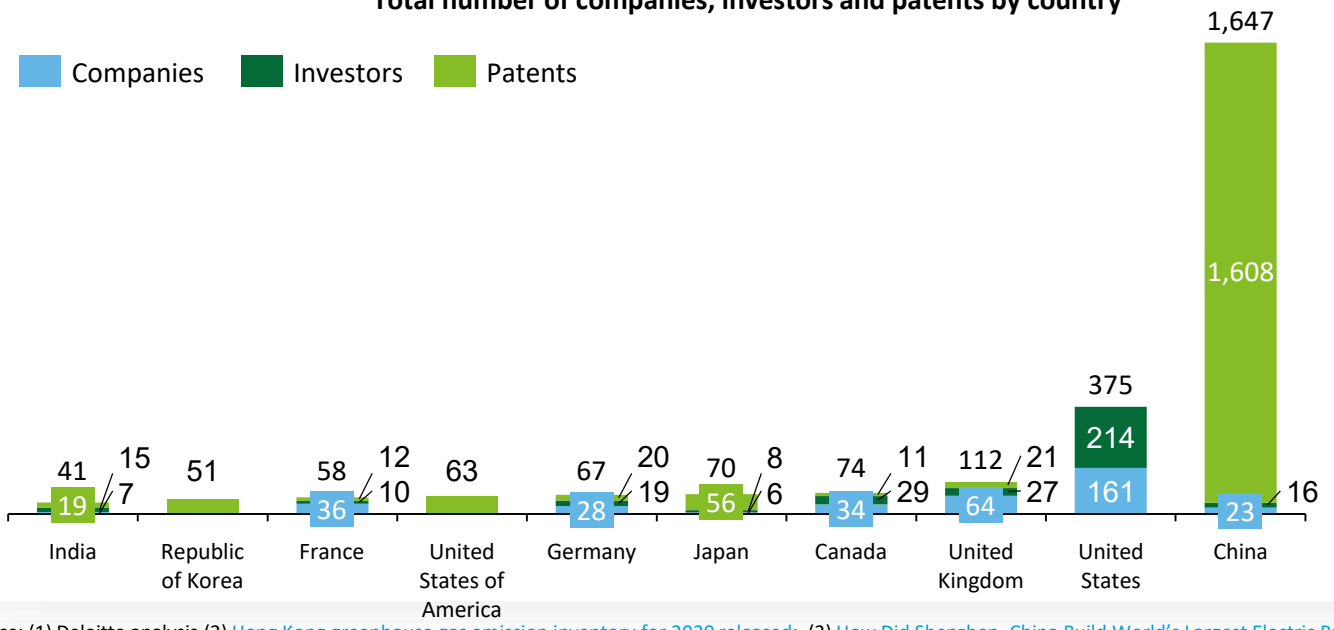
Global Market Snapshot | Focus Power & New Energy

The global power market is undergoing significant changes and challenges, as well as opportunities for innovation and sustainability.

Global overview, as of 2022[1]

549 Companies identified including start-ups	**$.179b** Average funding round (AUD)
602 Investors identified	**$188b** Total funding (AUD)
2k Patents	**2k** Funding events

Total number of companies, investors and patents by country



Key callouts

- **UAE is seeking 25% of global share in low carbon hydrogen by 2030**. The oil-rich nation is seeking investor participation after releasing its hydrogen strategy in 2030. UAE has up until now spent US$43 billion on renewable energy projects and is expected to spend up to US$163 billion globally by 2050.
- **China continues to dominate all 3 stages of solar photovoltaic manufacturing.** With China dominating the production of solar panels, it is also expected to exceed 33% target of renewable energy by 2025.
- **Green Energy Investments sets a US$1.1 trillion record for 2022.** This reaffirms the fact that investing in green energy is not only the right thing to do but also the profitable thing to do.

Source: (1) Deloitte analysis (2) Hong Kong greenhouse gas emission inventory for 2020 released; (3) How Did Shenzhen, China Build World's Largest Electric Bus Fleet? | World Resources Institute;

The Future of Power & New Energy

The power sector accounts for approximately 40% of total global CO_2 emissions — playing a key role in the value chain of many sectors, including buildings, transportation, steel, or chemicals.

Renewables are set to account for 100% of the net increase in global power capacity between now and 2025. That growth is due to rising investor interest, the technology competitiveness of renewable technologies vis-à-vis conventional sources, creative financing models, and active policymaking at both the global and local level.

That said, the path to net-zero will inevitably be a complex and challenging one, although already underway. Power is not only essential for modern day societies, but demand for it is on the rise. In fact, the International Energy Agency (IEA) expects global electricity demand to grow steadily at 2% CAGR until doubling current-day levels in 2050.

Evolving regulations: to accelerate future power sector abatement, regulatory and policy frameworks are already in place in key markets.

Regulatory landscape in some key geographies

	Asia Pacific	Europe	Americas
Emissions targets	• **China**: reduce CO_2 intensity of economy by 18% from 2021 to 2025 • **India**: reduce emissions intensity of its GDP by 45% from 2005 to 2030 • **Japan**: reduce emissions by 46% from 2013 to 2030	• EU targets for **climate neutrality** by 2050 and **55% emissions reduction** by 2030 compared to 1990 • UK targets to reduce emissions in 2030 by at least 68% compared to 1990 levels and a 78% reduction by 2035	• **US and Canada**: National targets for net-zero GHG emissions by 2050 • **Central and South America**: Net-zero emission targets by 2050 (Chile, Costa Rica, and Colombia)
Power generation	• **China**: by 2030, Indicative target of 40% electricity consumption from renewable energy sources (RES) and 70 GW nuclear generation by 2025 • **India**: 60% of total installed capacity from renewables by 2030 • **Japan**: 36-38% RES target by 2030	• Renewable Energy Directive set the target of 40% **renewable energy sources in the EU's overall energy mix by 2030**. REPowerEU plan increased the target in the directive to **45% by 2030** • UK's new commitments to accelerate transition and to reach **95% of electricity by 2030 being low carbon**	• **US**: 100% carbon pollution-free electricity by 2035. Extension of renewable tax credits for solar and wind. Nuclear compensated with zero emissions credits in five states • **Canada**: reach nearly 90% renewables generation by 2030 in Canada
Electric vehicle	• **Japan**: aim for 100% zero emissions passenger vehicles (including hybrids) by 2035 and for light commercial by 2040 • **China**: reward scheme for fuel cell electric vehicles (FCEVs) and exemption of vehicle purchase tax for zero-emissions vehicles	• The national plans of member states support green mobility and EU **banned** sales of new petrol and diesel cars for 2035 onwards • Light vehicle **emissions need to be reduced to zero by 2026** to comply with taxonomy	• **US**: Target of 50% of all new passenger cars and light-duty trucks to be zero-emissions vehicles by 2030

Source: 2025 Power and Utilities Industry Outlook | Deloitte Insights

The Future of Power & New Energy

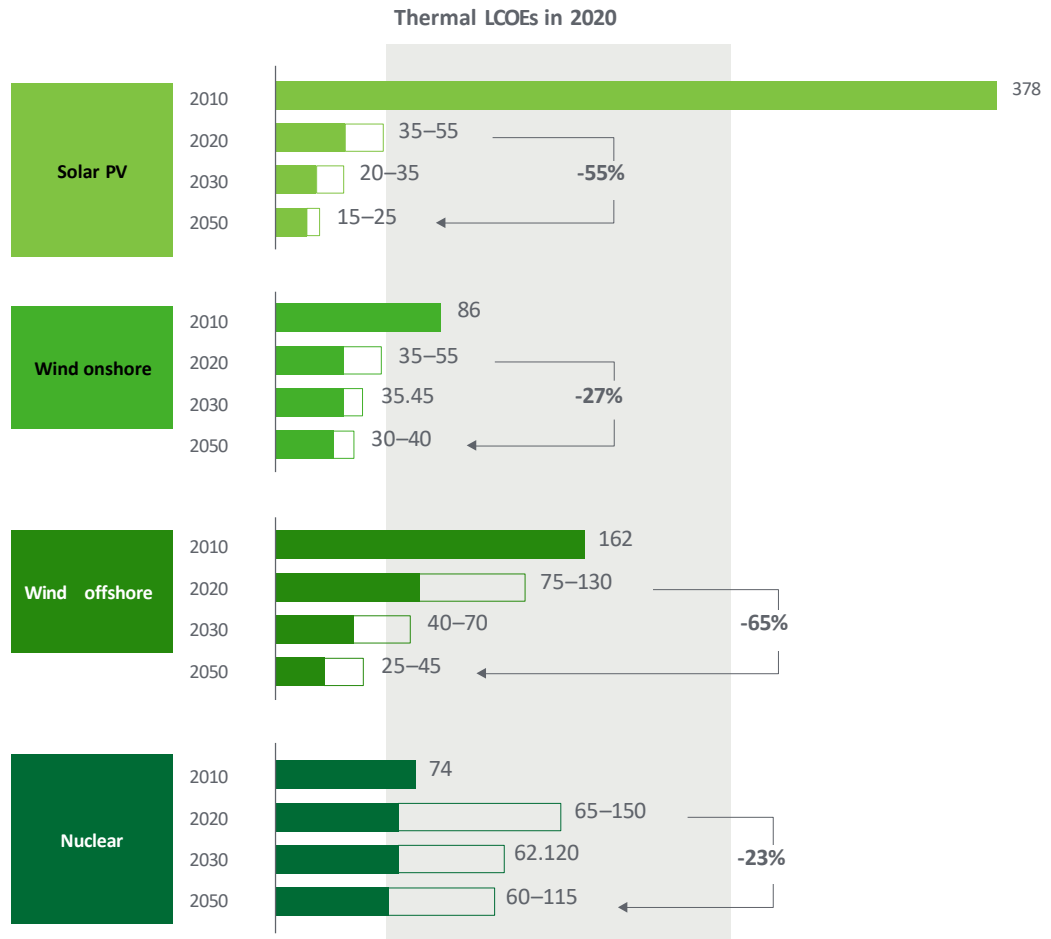
Renewables have all the growth – powered by large-scale cost reductions over the past decade.

The power sector is increasingly ramping up capacity in both solar photovoltaic (PV) and wind energy to substitute fossil fuel generation.

Solar PV is expected to be one of the most competitive power generation technologies in Asia Pacific by 2050, constituting almost half of global power capacity. This, in turn, will be followed by wind, which will represent approximately a quarter of available power capacity. Reaching this point will require an increase in grid assets and a new set of products and services to support energy carrier switching and power-demand management.

The electrification of transportation, buildings, industry, and other sectors will be a key pillar in economy's path to net-zero—with electricity expected to constitute the largest portion of total energy consumption for buildings (67%), industry (50%), and transportation (48%) in 2050.

Key power generation technologies LCOEs [€/MWh]



Source: [2025 Power and Utilities Industry Outlook | Deloitte Insights]

The Future of Power & New Energy – Opportunities

Contending with these growth challenges with modern, flexible, and smart grid systems could be a significant challenge as existing systems need to be transformed significantly to remain reliable under the influx of variable renewable energy and increasing deployment of behind-the-meter energy sources and devices.

The technologies being commercialized to address this issue are worth a closer look (please also refer to the Section 2 for a more detailed analysis). Although wind and solar installations are certainly the public face of renewables, the future of the energy sector may depend on a widening mix of other technologies that address the intermittency issue.

1

Storage

Storage is likely the single most important technology to integrate renewables and address grid bottlenecks, as the surge of renewables will require energy storage and demand response to enhance system flexibility.

2

Hybridization

Hybridization can help integrate renewables by firming their variable output so that they can operate more like conventional, dispatchable power plants. For example, floating offshore wind platforms with complementary tidal, wave, and ocean thermal energy generation, as well as floating solar generation and hydrogen production.

3

Carbon Capture

Carbon capture and storage (“CCS”) could yet prove a useful interim technology to extend the life of fossil plants while greatly decreasing their carbon emissions. However, the current costs of implementing CCS in the power sector remain very high, and in some cases even higher than building new renewable generation.

4

Digitalization

Digitalization will likely be central to solving the challenges of integrating renewables. Information and communications technologies such as big data, virtual power plants, demand response technologies, smart grids, internet of things, artificial intelligence (AI), and blockchain can help create a more flexible and efficient electricity system. Smart meters communicate real time data about power demand and generation, making it easier to balance them.

5

Green Hydrogen

The growing interest in green hydrogen not only for power generation and energy storage, but also for heating, transport, and industrial use, has propelled this technology forward. Decarbonized hydrogen can be used as a fuel for power generation, to provide load balancing for intermittent renewables.

The Future of Power & New Energy – Challenges

Given the pace and breadth of change, the power sector will encounter a range of hurdles.

To meet the Paris Agreement targets, and avoid a worst-case climate scenario, the transition must be rapid—which compresses decision-making timeframes and amplifies risk. Additionally, a successful effort must involve the collaboration of stakeholders along the entire power value chain—including power utilities and their customers, public entities, material and component suppliers, and financing parties.

1

Stretched Supply Chains and Workforces

To achieve long-term success, manufacturing capacity and access to raw materials will be key—as there's a chance today's global paradigm of fossil fuel dependency may transform into a mineral and equipment dependency. To illustrate this point, the IEA anticipates that in 2040 the power sector will require between four and six times more minerals to create the renewable capacity necessary to achieve carbon neutrality. This is a challenge that will require growth in local supply chains, geographical diversification, innovation to reduce critical material usage, long-term supply agreements, and the circularity scale-up of key elements (e.g., lithium for batteries).

2

Unincentivized System Stability

To ensure stability over the coming decades, the system must allow for greater flexibility on an hourly, daily, and seasonal basis. This requires increasing firmness and balancing/ ancillary services capabilities through measures like demand management, flexibility services, and storage. The latter enables larger two-way flows between supply and demand. Battery storage, bioenergy, Concentrated Solar Power (CSP), geothermal or thermal generation coupled with Carbon Capture and Storage (CCS), nuclear, and hydrogen/ammonia could ensure security of supply over the long term.

3

Capped in-Sector Financing

Annual global investment in clean power and grid infrastructure will need to be about three times larger than historical investment levels over the next decade. Afterwards, the financing needs will be even larger, at least until 2050, according to the IEA. However, today's in-sector cash flow is not enough to finance the transition. Involvement from both public institutions and private entities will be essential to meet the investment levels required to cover technology costs and improve efficiency.

4

Engaging Customers to Play an active Role

Economic development and demographic growth will result in increased power demand. Enabling customers to play an active role in demand management and efficiency improvement may create a more flexible system. Moreover, the rise of distributed generation and the changing nature of supply and demand will create enormous disruption in infrastructure (e.g., grids) and in power markets. Additionally, new opportunities may arise for new service providers, as well as for customers to reduce energy costs.

Hong Kong Market Landscape

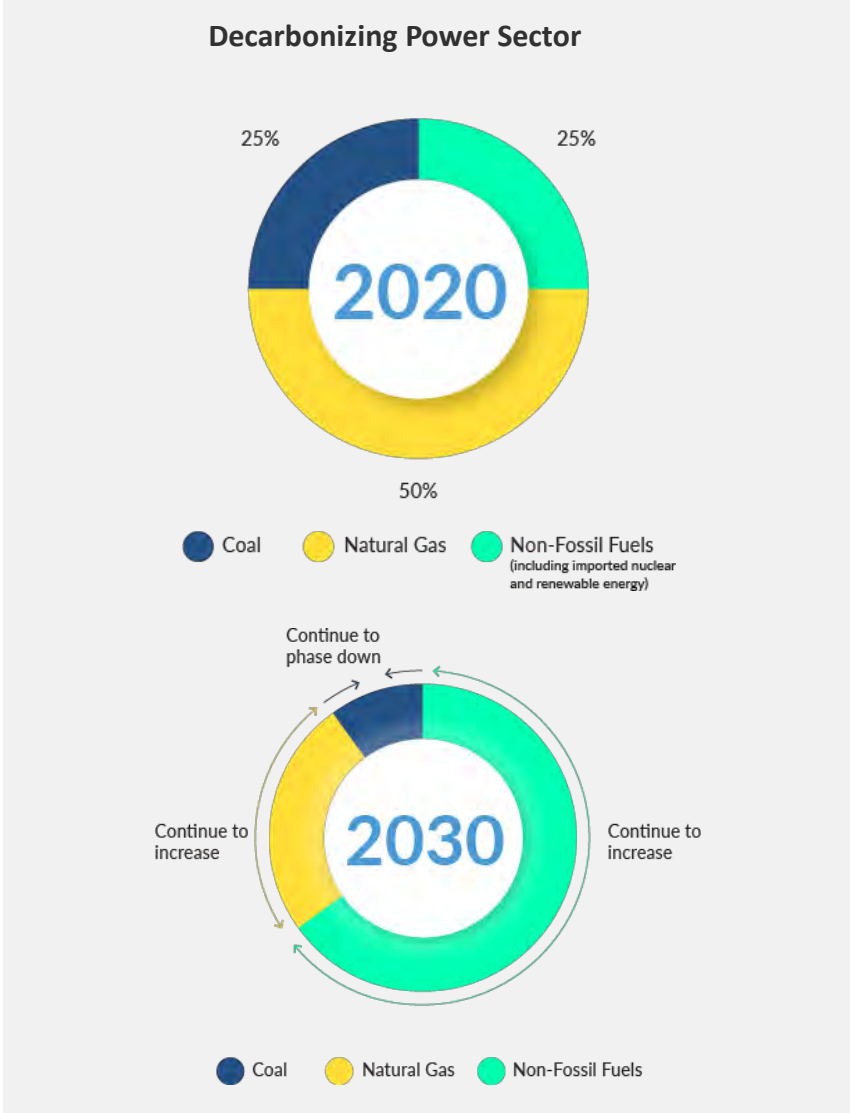
There are plenty of opportunities for businesses and stakeholders to work towards a more sustainable and low-carbon power market in Hong Kong.

Where we are today:

- Electricity generation in Hong Kong has been dominated by carbon-intensive coal but in recent years both CLP and Hong Kong Electric have gradually phased out coal and shifted to natural gas.
- The government aims to achieve net-zero carbon electricity generation before 2050 through renewable energy development and exploring new energy sources for electricity generation and regional cooperation.
- Hong Kong also imports around 25% of our electricity from the Daya Bay nuclear energy plant, which is a near zero-emissions source.
- Town gas is one of the main types of fuel gas used in Hong Kong. Hydrogen makes up almost half of its composition.

Where are headed:

- 70% of carbon emissions can be eliminated by switching to Net-Zero emission sources of electricity, so Hong Kong needs to grasp this opportunity to create the “grid of the future”. Renewable energy will be gradually increased to 15% in fuel mix, along with substantially increasing electricity from nuclear energy, with consideration of safety and ongoing research into specific opportunities. To efficiently match supply and demand, Hong Kong will also focus on:
    - Increasing energy storage - overall, supply side policies need to also be integrated with policies
    - Encouraging energy savings in individual households for best emissions reduction effect
    - Adopting hydrogen given it is highly regarded by China, Hong Kong and the international community as a new, clean and low-carbon energy source



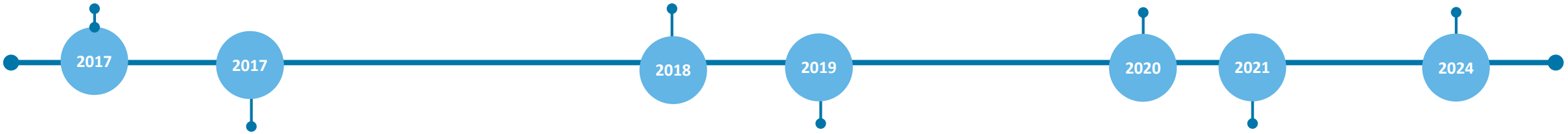
Source: Sector: Energy - HK 2050 is Now

Hong Kong Regulatory Landscape – Selected Policy Instruments

The Hong Kong government has been taking steps to promote sustainability in the power sector.

Policies/Initiatives/Regulations

Financial support; e.g. funding scheme



Feed-in-tariff
The Feed-in Tariff (FiT) Scheme is an important new initiative to promote the development of renewable energy (RE) under the current Scheme of Control Agreements (SCAs), which were signed between the Government and the respective two power companies in April 2017. Under the scheme, people who install solar or wind energy generation systems at their premises can sell the RE they generate to the power companies at a rate higher than the normal electricity tariff rate.

Renewable Energy Certificates
The Renewable Energy Certificates (RE Certificates) Scheme is one of the important RE initiatives introduced under the current Scheme of Control Agreements (SCAs) (which were signed between the Government and the two respective power companies in April 2017) to promote the development of RE in Hong Kong.

Government lead in RE
The Government has taken the lead in developing RE, and a number of waste-to-energy projects have been launched progressively or are under planning. We are also actively developing larger-scale RE projects in suitable reservoirs, sewage treatment and flood prevention facilities, as well as restored landfills. Besides, the Government has earmarked a total of $3 billion to install small-scale RE systems at government premises since 2017-18.

Solar Harvest Scheme
Under the Solar Harvest Scheme, the Electrical and Mechanical Services Department (EMSD) installs solar energy generation systems for schools and social welfare organisations for free. Students can learn about carbon reduction from first-hand experience of the RE systems at their schools.

New Energy Transport fund
The Government put in place a $300 million Pilot Green Transport Fund (PGTF) to subsidise and to try out green innovative transport technologies.

Hong Kong Climate Action Plan
Various power market related targets and initiatives such as the renewable energy targets or to cease coal usage for daily electricity generation by 2035.

Strategy of Hydrogen Development in Hong Kong
The Strategy sets out the four major strategies of improving legislations, establishing standards, aligning with the market, and advancing with prudence to create an environment conducive to the development of hydrogen energy in Hong Kong.

2

Stakeholder's Role in the Market

Stakeholders have a critical role to play in decarbonizing the power sector and can take a range of actions to reduce carbon emissions.

Necessary Actions

Government

- Investigate the possibility of diversifying the mix to include more low-carbon electricity.
- Explore whether carbon capture and storage can be localized once that technology is readily available.
- Provide an updated framework for the power supplier to be able to implement demand-management.

Commercial & Industry

- Actively deploy localized renewable energy technologies.
- Consider importing electricity generated by renewables in the GBA.

Community & Individuals

- Reduce electricity usage in daily life to lessen the burden on power generation.

Challenges

- **Regulation – procurement side**: there are limited options for Hong Kong based companies to engage in the power market – this is not unique to Hong Kong as power markets around the world tend to be one of the most regulated markets – however, there are opportunities for allowing more market players to engage in the power market also by integrating more with the GBA region
- **Regulation – participation side**: demand-side management will be a critical element in achieving a low-carbon power market in Hong Kong, demand-side management however requires reliable and constant high-quality data (smart meter roll-out is a key first step) to allow for new business opportunities. Securing this data driven ecosystem for the new demand-side part of the power market needs further development.
- **Regulation – investment side**: in the local market environment there are limited opportunities for companies outside CLP, HKE or Towngas to invest in the power market, limiting the commercial attractiveness for market entrants.

2 Insights from Hong Kong Market Stakeholder Engagement Sessions – Power & New Energy Sector

By interviewing the different financial sector focused stakeholders on the Hong Kong marketplace, we have identified the following key insights for the technology, innovation & entrepreneurship sector to be taken into account.

Ecosystem Landscape

- Hon Kong's electricity and Towngas are **produced primarily from fossil fuel**
- Two major energy suppliers in Hong Kong: HK Electric and CLP Power
- **Share of coal** in the fuel mix has been **reduced to less than a quarter** while **share of natural gas has significantly increased** to almost half; the government targets to **increase share of renewable energy** in fuel mix for electricity generation to 7.5-10% by 2035
- **Growing demand for electricity** will **spur demand for energy efficiency** technologies

Market Strengths

- **Connectivity to Mainland China** and western markets to exchange green energy studies
- Well-recognised **financial market to add branding effect**
- **Receptivity to innovation** and green technologies attracts international startups
- Convenient **access to bountiful resources** in the international market
- Potential to **lead hydrogen energy**
- SoC* provide **certain and clear policy framework** to deliver quality electricity supply
- Opportunity **in electrification of the robust transportation infrastructure**

Key Industry Offerings

- New green energy technologies under development are **offshore wind plants and hydrogen power**; city planning includes building two offshore wind energy plants
- Government has reserved **land in Tseung Kwan O to build new electricity facilities** for receiving and processing electricity transmitted to Hong Kong
- **Feed-in-Tariff scheme (FiT)** to encourage distribution of renewable energy
- **Renewable Energy Certificates (RECs)** for residential, commercial, and industrial buyers

Top Business Challenges

- The **scale of New Energy Technology Innovation** is small compared to other markets
- To **cease the use of coal** for daily electricity generation by 2035
- To enable **better energy savings** and **better energy management** to combat growing electricity needs
- **Geographical limitation** (unavailable lands) slows renewable energy development

Advice for Market Entrants

- Collaborate with other markets to **expand industry limitation**; collaborate with **global technology providers**
- To conduct **further studies into hydrogen energy** by leveraging Hong Kong's research data and resources in relevant field to become global leader in hydrogen fuel
- **Digitise the power ecosystem** (generation, consumption, storage, and trading) using cloud computing, artificial intelligence, Internet of Things, etc.

Power Market Business Models

The opportunities, challenges and changing business dynamics in the power sector will trigger business model shifts. New players may appear and current business models may be reshaped.

The overall opportunities center around three key features: Power sector growth, power market design and value chain economics.

Power sector growth: Electrification is a key driver for achieving decarbonization targets and will require significant investments across each step of the value chain (renewable generation, grids, and end customer). The significant financing needs and new business will foster new entrants, such as telcos or funds.

Power market design: Future power markets will need to provide energy supply efficiently, balancing services and stability with a combination of technologies.

Value chain economics: The power sector is going through a deep system value redistribution, bringing up new winners and relevant players. Renewables' role as the main power source will carry long-term fixed revenues for generators through long- term contracts. Thanks to electrification, retail could experience a significant spread of products and services (e.g., heating, electric mobility, maintenance, and insurance) that could generate abundant opportunities.

Main business models on the road to net-zero emissions in the power sector

	Integrated player	Circular player	Operator	Asset rotator	Product play	Aggregator	Distress
	Captures value through **synergies** between each step of the **value chain**	Focus on **waste management** and **recycling** and **re-purposing** of decommissioned assets	**Efficient players** focus on **operation and management** of **physical assets:** generation, grid and charging infrastructure	**Low-risk and low-return** business focus on asset rotation and steady **revenues**	**Customer oriented** that provides value to final customers through distributed energy sources (DERs), EVs, charging points, distributed generation, etc.	**Power marketing:** manages and sells the energy and attributes through different markets (physical and financial)	**Focus on assets that are not ready for net-zero but they have a role to provide security of supply:** maximize value/ cash today
Generation	✓	✓	✓	✓		✓	✓
Grids	✓	✓	✓	✓			
Client	✓	✓		✓	✓		

Source: [2025 Power and Utilities Industry Outlook | Deloitte Insights]

Case Study| ClearVue Technologies | Australia

Power and New Energy

ClearVue Technologies Limited, an Australian Stock Exchange listed public company, is an innovative leader in the design and deployment of Building Integrated Photovoltaic (BIPV) solutions for the construction and property industries. With building operations responsible for 27% of global greenhouse gas emissions during operation and an additional 13% during construction, ClearVue addresses one of the world's most pressing challenges: decarbonizing the built environment. The company's mission is to support this transition by creating cutting-edge building and façade systems that enhance energy efficiency through improved thermal performance while generating clean energy on-site.

Green Tech market opportunity:

- Enhancing Energy Efficiency: Driving sustainable improvements in building performance.
- Energy Generation: Seamlessly integrated renewable energy solutions.
- Optimized Thermal Performance: Advanced designs to maximize energy conservation.
- Innovative Product Pipeline: Launching groundbreaking BIPV solutions in 2025 for sustainability and commercial impact.
- Specialized Data Centre Design: Tailored solutions for energy-efficient infrastructure.
- Advanced Fire Safety: Incorporating cutting-edge fire-resilient technologies.
- Customizable BIPV Design: Delivering the highest quality with unparalleled flexibility to meet diverse architectural needs.

Leveraging Hong Kong market strengths :

- Access to highly educated human capital
- Geographical location for access to Southeast Asia
- Ability to easily access our business partners in Mainland China to speed up development
- Hong Kong Government focus on being the "Sandbox" for Green Tech in commercial building
- Indications of High Demand from the construction industry in HK

CFMEU, Melbourne, Australia

Case Study| Oxford Green Innotech | United Kingdom

Power and New Energy

Oxford Green Innotech Limited (OXGRIN), founded in 2021 as a spin-out from the University of Oxford, is a pioneering green technology company specializing in ammonia-powered systems for zero-carbon energy solutions. Headquartered in the UK, Oxgrin leverages over a decade of cutting-edge research in catalytic technology to develop ammonia-to-energy solutions that replace diesel in off-grid and backup power applications. Oxgrin's innovations include compact ammonia-to-electricity generators and scalable ammonia cracking systems, addressing markets in energy, transport, and infrastructure. The company's commercial deployments span Southeast Asia and beyond, with partnerships like PT-PLN in Indonesia, where Oxgrin is transforming remote islands' power supply. Focused on sustainability, affordability, and resilience, Oxgrin serves sectors such as mining, construction, and marine industries. With a significant addressable market, Oxgrin is driving the global transition to zero-carbon energy while enabling cost-effective, independent electricity for off-grid applications.

Green Tech market opportunity

Diesel generators are a cornerstone of global energy infrastructure, providing independent, reliable power in off-grid areas and acting as critical backup systems during outages. They are essential in remote locations, such as islands, mining sites, and rural areas, where access to grid electricity is limited or nonexistent. However, their heavy reliance on fossil fuels contributes significantly to greenhouse gas emissions, air pollution, and rising operational costs, making their replacement a pressing environmental and economic imperative.

Ammonia-powered generators developed by Oxgrin, on the other hand, present a unique solution to this challenge. Unlike traditional alternatives, ammonia is a zero-carbon fuel with established transportation and storage infrastructure, offering scalability and cost-efficiency. Oxgrin's generators further stand out with compact designs and proven reliability, demonstrated through successful deployments such as powering the Innovation Center of Brunei and collaborating with Indonesia's national electricity company PT-PLN to phase out diesel generators across remote islands. These applications showcase the versatility and impact of ammonia-powered systems, positioning them as a transformative force in the Green Tech market.

Leveraging Hong Kong market strengths:

Hong Kong's 2024 Hydrogen Development Plan and commitment to achieving carbon neutrality by 2050 present an ideal opportunity for Oxgrin to expand its presence. The plan emphasizes replacing fossil fuel in construction, transport, and off-grid power, which aligns with Oxgrin's ammonia-powered, zero-carbon solutions.

As part of the Greater Bay Area, Hong Kong offers strategic advantages, including access to regional collaboration and funding programs like the Green Tech Fund and New Energy Transport Fund. By aligning with the city's hydrogen development strategy, Oxgrin can support the transition to clean energy while positioning itself as a leader in providing innovative, sustainable solutions to replace the hard-to-abate fossil fuel-based systems.

Case Study | Power Sector Digitalization

After compiling up the insightful suggestions from stakeholders in the market, the taxonomy can help to mobilize private capital towards investments that contribute to environmental sustainability and help to identify the most promising sustainable activities in Hong Kong.

Digitalization will likely be central to solving the challenges of integrating renewables. Information and communications technologies such as big data, virtual power plants, demand response technologies, smart grids, internet of things, artificial intelligence (AI), and blockchain technology can help create a more flexible and efficient electricity system.

The next wave of advanced metering infrastructure (AMI)

Residential meters are becoming edge computing devices that can better understand how electricity is being used or generated behind the meter. This is of increasing important as consumers add solar panels, electric vehicles, or battery storage and seek to interact with the grid. Fifty-three percent of our survey respondents said the most important capability AMI could provide would be to support utility flexible load programs with real-time, device level usage analysis. Figure 1 highlights the wide variety of capabilities anticipated from AMI:

- AI can predict supply and demand peaks and forecast weather and renewable output more precisely.
- Cloud-based IT systems control pools of distributed energy resources in virtual power plants that can reduce load or provide supply when needed.
- Blockchain technology could facilitate peer-to-peer trading, adding more of the flexibility required to integrate variable renewables.

The potential future usage for energy digitalization

- Cloud computing allows for the storage and processing of vast amounts of data related to energy use. This data can be gathered from a variety of sources, including smart meters, sensors, and other monitoring devices. By leveraging the power of the cloud, energy companies can analyze this data in real-time, identifying patterns and trends that can inform more efficient energy production and distribution.
- By analyzing data from multiple sources, energy companies can gain a more holistic view of energy usage across different sectors and geographies. This can inform more effective energy policies and help to identify opportunities for innovation and improvement.

Source: 2025 Power and Utilities Industry Outlook | Deloitte Insights

Case Study | Energy Storage

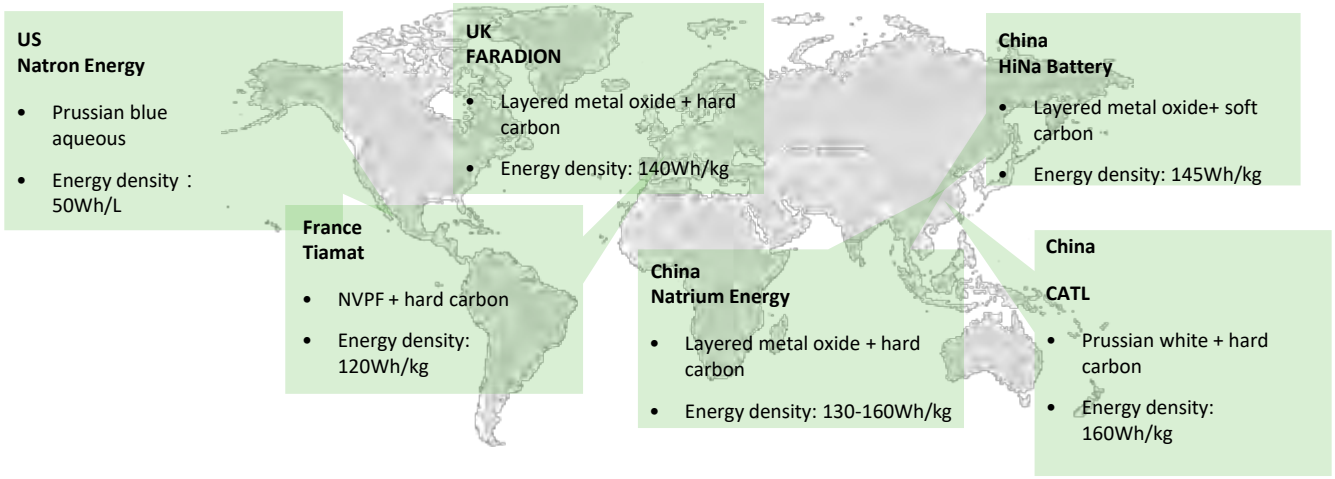
After compiling up the insightful suggestions from stakeholders in the market, the taxonomy can help to mobilize private capital towards investments that contribute to environmental sustainability and help to identify the most promising sustainable activities in Hong Kong.

Energy storage is poised to become more important with increasing renewable energy penetration, sparking arbitrage opportunities:

- Battery storage can charge with low-marginal-cost wind or solar power and discharge when more expensive natural gas or coal-fired plants are setting electricity prices.
- Increasingly extreme weather and climate events make storage more attractive as a hedge against outages.
- Developers will be integrating battery storage into most of new solar projects, increasing the importance of battery storage.

Supply chain kinks could continue into 2023, largely due to the paucity of battery and critical mineral suppliers and concern about unethical labor practices, especially in cobalt mining. However, alternate battery chemistries (such as lithium iron phosphate or sodium-based batteries - see figure on the right) could scale up for the electric vehicle (EV) market, helping reduce the demand for lithium-ion batteries.

Technical landscape of global major sodium-ion battery companies



Source: Deloitte - Battery o the Time, Deloitte China Lithium Industry

Market Analysis – Sustainable Built Environment Sector

Green Economy Taxonomy – Sustainable Built Environment

After compiling the insightful suggestions from stakeholders in the market, the taxonomy can help to mobilize private capital towards investments that contribute to environmental sustainability and help to identify the most promising sustainable activities in Hong Kong.

Focus Sector	Sustainable Built Environment Sector			
Subcategories	**Energy management in buildings**	**Heating ventilation & cooling in buildings**	**Green building materials**	**Smart construction**
	Direct current data centres	Air conditioning using liquid or solid desiccants	Bio-based materials	Electric construction vehicles
	Smart energy management system	Automated climate control for buildings	Carbon neutral concrete, steel and glass	Modular integrated construction
	Digital twin & data analytics	Hydrogen boilers	Reflective and cool coating / painting	Distributed clean energy battery systems for construction sites
	Rooftop and building-integrated solar PV systems	Various heat pumps	Recycled bricks / timber from construction waste	
			Recycled interior design materials	

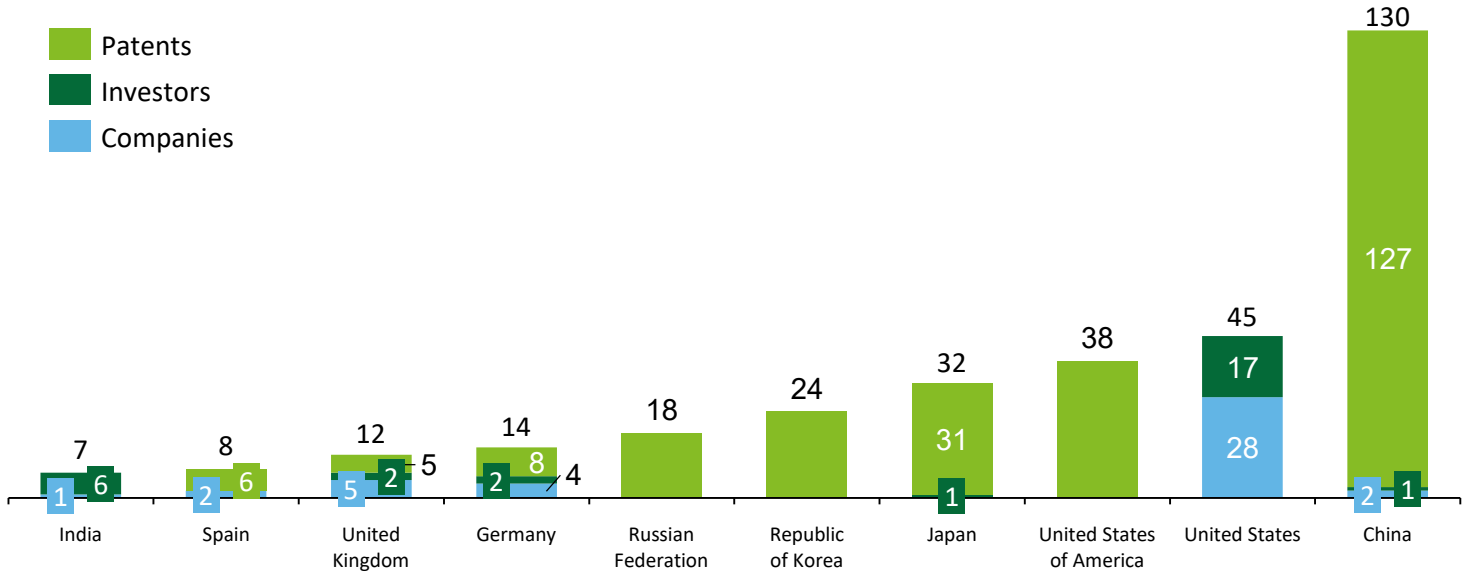
Global Market Snapshot – Focus Sustainable Built Environment

Green Building Revolution could open US$1.8 Trillion Global Market Opportunity by 2030, with China, the world's largest construction market, poised to play a pivotal role in driving sustainable innovation across the global building industry.[1]

Global overview, as of 2022[2]

431 Companies identified including start-ups	**$10m** Average funding round (AUD)
69 Investors identified	**$821m** Total funding (AUD)
310 Patents	**194** Funding events

Total number of companies, investors and patents by country



Key callouts

- **Over one third of global emissions is from construction.** Construction and operations of buildings accounted for 37% of global energy related to CO_2 emissions in 2021.[3]
- **Built environment is expected to experience significant growth.** The global industry for built environment and green building materials was valued at US$160 billion in 2020 and estimated to grow to US$390 billion in 2024.[4]
- **Technologies that are used in Zero-Energy buildings is a huge portion of the green built environment sector.** Valued at US$72 billion in 2021 and projected to reach $403 billion in 2031[5], zero-energy buildings aim to use a range of hard and soft tech to eliminate its reliance to the standard grid.
- **China is an active inventor of new technologies.** China leads its peers with a large amount of patents in emerging technology for green buildings.

Source: (1) Green Building Revolution Could Open $1.8 Trillion Global Market Opportunity by 2030, World Economic Forum (2) Deloitte analysis (3) 2021 Global Status Report for Buildings and Construction by UN Environment Programme; (4) Green Building Statistics: Important Step Towards Sustainability; (5) Zero Energy Buildings Market Size, Share, Growth Outlook 2031 (alliedmarketresearch.com)

The Future of Sustainable Built Environment

The global built environment market is expected to continue growing in the coming years, driven by a range of technological, economic, and social factors.

Today's Challenges

Sustainability: One of the biggest challenges facing the built environment is sustainability. Buildings account for a significant portion of global energy consumption and greenhouse gas emissions. To address this, there is a growing demand for green buildings that are designed to be energy-efficient and environmentally sustainable.

Urbanization: The world's population is increasingly concentrated in urban areas, which puts pressure on existing infrastructure and creates a need for new buildings and infrastructure. This presents challenges in terms of managing growth, ensuring equitable access to services, and addressing the social and economic impacts of urbanization.

Resilience: The built environment is vulnerable to a range of natural and man-made hazards, including extreme weather events, earthquakes, and cyber attacks. Ensuring the resilience of buildings and infrastructure is a growing concern, particularly in the face of climate change.

Aging infrastructure: Much of the world's infrastructure is aging and in need of repair or replacement. This presents challenges in terms of funding, prioritization, and ensuring that new infrastructure is designed to meet modern needs and standards.

New opportunities

Building automation: The increasing use of building automation systems (BAS) presents opportunities for improving building performance, reducing energy consumption, and enhancing occupant comfort and productivity. As BAS become more sophisticated and integrated, they have the potential to transform the way buildings are designed, constructed, and operated.

Modular construction: Modular construction methods, which involve building components off-site and assembling them on-site, are gaining popularity due to their efficiency, cost-effectiveness, and sustainability benefits. This presents opportunities for improving construction productivity, reducing waste, and delivering projects more quickly and reliably.

Smart cities: The rise of smart cities, which use technology to optimize urban infrastructure and services, presents opportunities for improving the quality of life for urban residents while also addressing environmental and social challenges. By leveraging data and analytics, smart cities can improve the efficiency of transportation, energy, and water systems, and enhance public safety and security.

Circular economy: The circular economy, which involves designing out waste and maximizing the use of resources, presents opportunities for creating more sustainable and resilient buildings and infrastructure. By using recycled materials, reducing waste, and adopting circular business models, the built environment can become more sustainable, cost-effective, and resilient.

Built Environment – Green Buildings

With government initiatives, public awareness, technology, and regional collaboration, Hong Kong can continue to make progress towards more sustainable and eco-friendly building practices.

Where we are today:

- According to the Hong Kong government's Climate Action Plan 2030+, buildings account for around 60% of the city's total carbon emissions.
- A high demand for energy, which puts pressure on the city's resources and contributes to carbon emissions.
- Limited natural resources, such as water and land, which makes it challenging to implement sustainable building practices.
- Green architecture and sustainable building practices can be more expensive than traditional building methods, which can make it difficult for developers to implement sustainable practices.

Where we are headed:

- Consistent government support such as several initiatives to promote sustainable building practices, including setting up designated groups to help sustainable design and architecture firms.
- Promote public awareness and demand for sustainable buildings and green architecture, which can help drive innovation and investment in sustainable building practices.
- Invest in technology, such as the use of renewable energy sources and smart building systems
- Collaborate with other cities in the region to share knowledge and best practices

The public's awareness of sustainability has been increasing as Hong Kong aims to be carbon neutral by 2050, which has led public and private developers to commit to making buildings smart and sustainable across all building types.

Source: Smart and Sustainable Buildings and Infrastructure | Deloitte Global

Built Environment – Green Buildings

Hong Kong, once known for industrial manufacturing, now relies heavily on buildings such as housing estates, offices, and malls for its electricity consumption – green architecture / green design are therefore critical areas for Hong Kong's Green Tech sector.

42,000+ buildings in the private sector

8,000 high-rise buildings and skyscrapers

Activities in buildings account for over 90% of electricity consumption or over 50% of carbon emissions in Hong Kong

A green building & architecture is often thought of merely as a structure with green walls and solar panels, seen as a means to enhance aesthetics and environmental protection. However, the concept extends far beyond these elements. Green building & architecture **constitutes a multidisciplinary field with significant implications for society**.

In essence, green building & architecture involves practices aimed at **minimizing the environmental impact of buildings and promoting the health and well-being of occupants**. This encompasses a comprehensive approach throughout the entire life cycle of a building or community – from initial planning, site selection, design, and construction to operation, maintenance, renovation, and eventual demolition. The focus is on evaluating the effects on both the environment and people.

Key aspects of green building & architecture include optimizing the **efficient use of energy, water, and resources to prevent overconsumption**. This involves the adoption of renewable energy sources and eco-friendly materials to reduce carbon footprint and emissions. Furthermore, efforts are made to minimize waste production and prevent pollution of water, air, noise, and land.

Indoor environmental quality is also prioritized, achieved through natural ventilation, lighting, and deliberate design choices to ensure good indoor air quality. In the context of Hong Kong, a city known for its unique subtropical built environment **characterized by high-rise, high-density urban areas alongside hilly terrain, the significance of green building becomes even more pronounced**.

Hong Kong, once known for industrial manufacturing, now relies heavily on buildings such as housing estates, offices, and shopping malls for its electricity consumption. Over 90% of the city's total electricity usage is attributed to building-related activities. This high energy consumption from buildings contributes to 50% of the city's greenhouse gas emissions, a stark contrast to the global average of below 40%. In this context, green buildings & architecture play a **vital role in achieving energy savings in Hong Kong and aligning with global targets outlined in the Paris Agreement.**

Source: What is Green Building? | HKGBC

Importance of the Cleantech Hub

The built environment sector plays an essential role in the development and functioning of cities. Consequently, Hong Kong considers the Future of the Built Environment to be of strategic priority.

A circular built environment sector mitigates these impacts. More efficient design, construction, and use of buildings and infrastructure can extend their life and improve their life cycle impacts. Implementation of circular design principles during construction can reduce energy and material consumption as well as enabling longer and more flexible use and better maintenance of buildings. Refurbishment and/or repurposing of end-of-design-life buildings extends their life and reduces waste production and virgin material use, and reduces associated life cycle impact. With many buildings concentrated in cities, there is a great potential for a circular transition in the built environment.

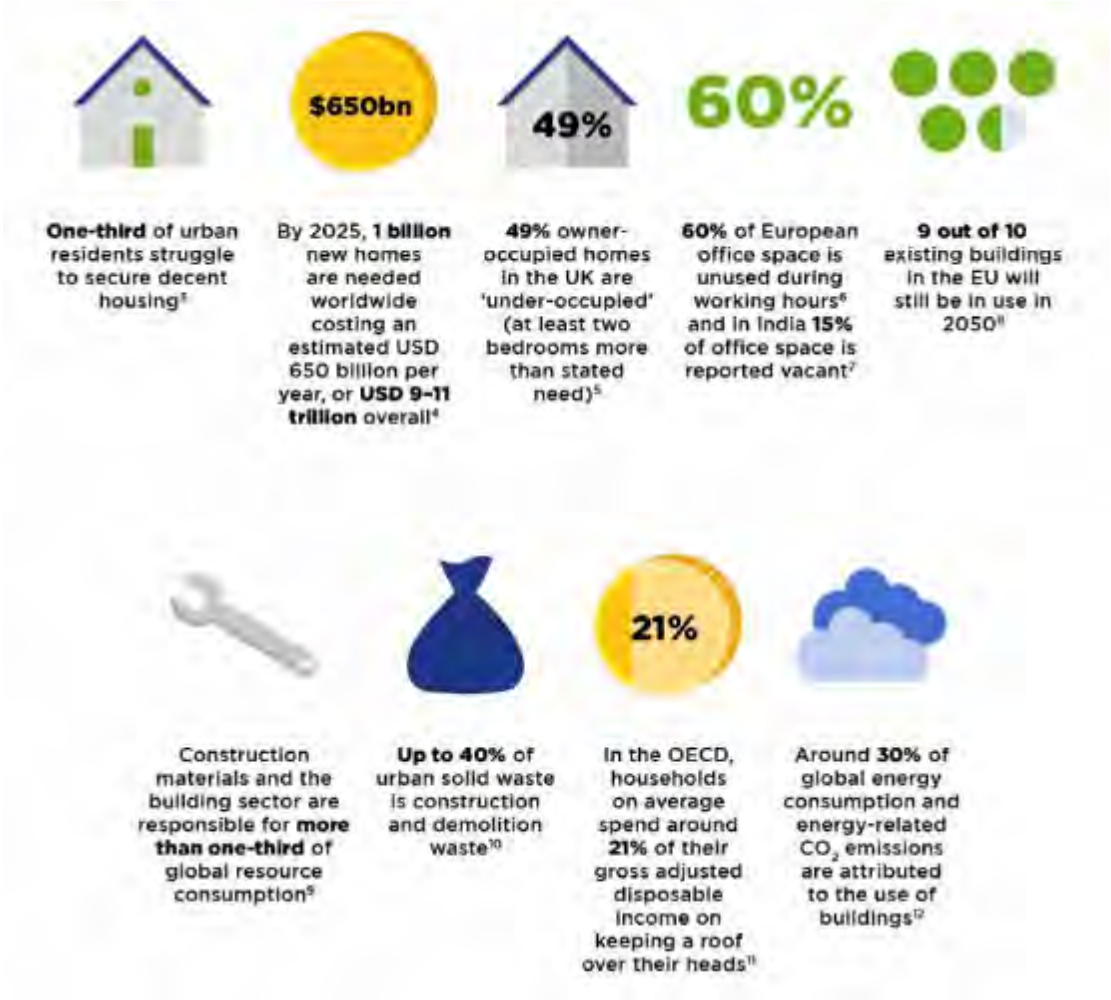
What will a circular built environment sector look like?

Several criteria can be envisioned that are required for the built environment sector to become circular. Three overarching principles for a circular built environment sector are identified by Circle Economy and ARUP:

- Focus on the full life cycle of a building
- Keep materials and resources in use as long as possible
- Decouple economic development from resource consumption

Source: Circular Built Environment | WBCSD

Current linear built environment system (Ellen Macarthur Foundation, 2019)



Focus: Electricity Management in Buildings

Electricity management in buildings is an important aspect of building design and operations, as buildings are significant energy consumers and can account for a large portion of a city's total energy consumption. Effective electricity management can help reduce energy consumption, save costs, and improve sustainability.

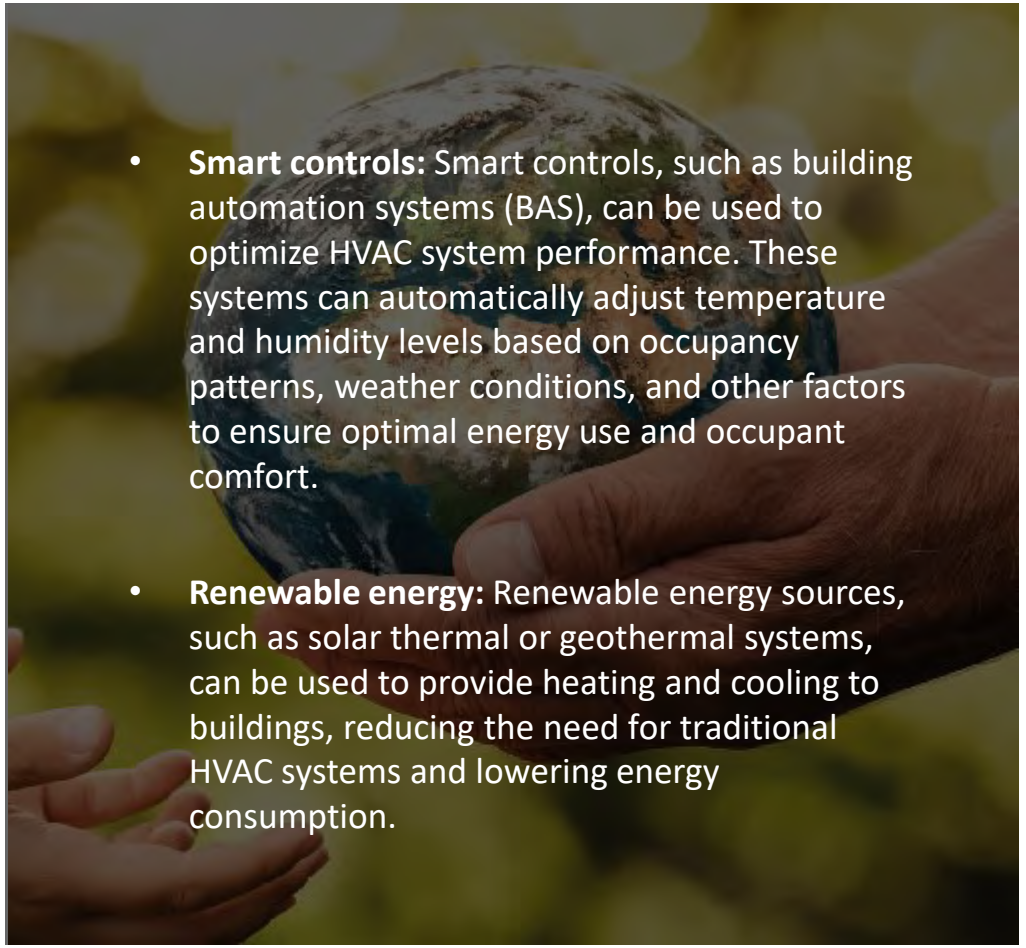
- **Energy-efficient lighting:** One of the simplest and most effective ways to reduce electricity consumption in buildings is to use energy-efficient lighting systems. This can include LED lights, which use less energy and have a longer lifespan than traditional lighting systems.
- **Energy management systems**: Energy management systems (EMS) can be used to monitor and optimize energy use in buildings. These systems can provide real-time data on energy consumption, identify areas where energy is being wasted, and automatically adjust lighting, heating, and cooling systems to optimize energy use.
- **Renewable energy:** Renewable energy sources, such as solar panels or wind turbines, can be used to generate electricity on-site and reduce the need for grid-supplied electricity. In some cases, buildings can even generate more energy than they consume, allowing them to contribute to the local energy grid.
- **Smart building technologies:** Smart building technologies, such as building automation systems (BAS) and Internet of Things (IoT) sensors, can optimize energy use in buildings. These technologies can automatically adjust lighting, heating, and cooling systems based on occupancy levels, weather conditions, and other factors to reduce energy consumption.
- **Building design:** Building design can also play a role in electricity management. For example, passive solar design can be used to optimize natural light and heating, reducing the need for electric lighting and heating systems.

Focus: Heating Ventilation & Cooling in Buildings

Heating, Ventilation, and Air Conditioning (HVAC) systems play a critical role in maintaining indoor air quality, thermal comfort, and energy efficiency in buildings. Effective HVAC systems can provide a healthy and comfortable environment for occupants while reducing energy consumption and costs.

Some strategies for effective HVAC management in buildings:

- **Efficient equipment selection:** Choosing the right HVAC equipment for a building can have a significant impact on energy consumption and costs. Energy-efficient HVAC systems, such as variable refrigerant flow (VRF) systems, can help reduce energy consumption while providing effective heating and cooling.
- **Proper system design**: Proper system design is critical for effective HVAC management. Systems should be designed to meet the specific needs of the building and its occupants, taking into account factors such as occupancy levels, building orientation, and weather patterns.
- **Regular maintenance**: Regular maintenance of HVAC systems is essential to ensure they are operating at peak efficiency. Maintenance can include regular cleaning, filter replacement, and equipment inspections to identify and address potential issues before they become major problems.



- **Smart controls:** Smart controls, such as building automation systems (BAS), can be used to optimize HVAC system performance. These systems can automatically adjust temperature and humidity levels based on occupancy patterns, weather conditions, and other factors to ensure optimal energy use and occupant comfort.
- **Renewable energy:** Renewable energy sources, such as solar thermal or geothermal systems, can be used to provide heating and cooling to buildings, reducing the need for traditional HVAC systems and lowering energy consumption.

Focus: Green Construction Materials

Green construction materials are materials that are environmentally friendly, sustainable, and have a low impact on the environment. These materials can be used in the construction of buildings to reduce the environmental impact of the building industry, which is a major contributor to global greenhouse gas emissions and resource depletion.

- **Recycled materials:** Recycled materials, such as recycled steel, concrete, and glass, can be used in building construction. These materials can help reduce waste and the environmental impact of extracting and manufacturing new materials.
- **Renewable materials**: Renewable materials, such as bamboo, cork, and straw bales, can be used in building construction. These materials can be replenished naturally and have a low environmental impact.
- **Sustainable materials:** Sustainable materials, such as FSC-certified wood, can be used in building construction. These materials are sourced from responsibly managed forests and can help reduce deforestation and habitat destruction.
- **Low-impact insulation**: Low-impact insulation, such as cellulose insulation or spray foam made from soy or recycled materials, can be used to reduce energy consumption and improve energy efficiency in buildings.
- **Green roofing:** Green roofs, which are covered with vegetation, can help reduce energy consumption, absorb rainwater, and improve air quality.

Focus: Smart Construction

Smart construction is an innovative approach to building design and construction that uses advanced technologies and data analytics to optimize the construction process, improve efficiency, and reduce costs. Smart construction can also help improve safety, quality, and sustainability in the construction industry.

- **Building Information Modeling (BIM):** BIM is a digital representation of a building that allows architects, engineers, and construction professionals to visualize and simulate the construction process. BIM can help optimize construction processes, reduce waste, and improve project coordination.
- **Drones:** Drones can be used to perform site surveys, inspections, and progress monitoring. This can help improve safety, reduce costs, and improve project efficiency.
- **Internet of Things (IoT):** IoT sensors can be used to collect data on construction materials, equipment, and workers. This data can be analyzed to optimize construction processes, improve safety, and reduce costs.
- **Augmented Reality (AR) and Virtual Reality (VR):** AR and VR technologies can be used to visualize and simulate building designs, allowing construction professionals to identify potential issues before construction begins. This can help reduce costs and improve construction quality.
- **Prefabrication and modular construction:** Prefabrication and modular construction can help reduce construction time and costs by manufacturing building components off-site and assembling them on-site. This can also help improve construction quality and reduce waste.

Hong Kong Market Landscape

The built environment sector in Hong Kong encompasses various aspects of the construction and development industry. The built environment sector can be influenced by various factors, including economic conditions, government policies, regulatory frameworks, and market trends.

Growing local customer demand

Population Growth: Hong Kong's population has been steadily growing, leading to increased demand for housing, commercial spaces, and infrastructure.

Urban Renewal and Redevelopment: The city's aging infrastructure and building require regular maintenance and upgrading.

Economic Growth and Business Expansion: The growing business activity and economic growth create demand for office spaces, commercial buildings, and business parks.

Sustainable and Green Building Demand: There is a growing emphasis on sustainability and green building practices in Hong Kong.

Smart City Development: Hong Kong's push towards becoming a smart city has created a demand for innovative infrastructure and technologies.

Cost saving opportunities due to alignment with government plans

Sustainable companies in the Hong Kong built environment sector can also benefit from cost savings in the long run with the government support. From the regulatory landscape that has been mapped out, the following topics are the current focus areas.

- **Carbon reduction projects including the built environment**
- **Energy-saving measures in existing buildings**
- **Reduction and recycling of construction waste**
- **Green building design**

Having said that, using locally sourced and seasonal ingredients can also reduce transportation costs and minimize the carbon footprint of the business.

Stronger market synergies comparing to the other jurisdictions

Proximity to Mainland China and advantages of GBA: Hong Kong's geographical location and proximity to Mainland China create unique market synergies. The city serves as a gateway for international companies and investors seeking opportunities in both Hong Kong and Mainland China. The integration of Hong Kong into the Greater Bay Area initiative further enhances market synergies, allowing for collaboration and partnerships across the region's built environment sector.

Established Professional Services: Hong Kong has a well-developed ecosystem of professional services, including architecture, engineering, legal, financial, and consulting services.

Strong Connectivity and Infrastructure: Hong Kong boasts a well-developed transportation network, including airports, seaports, and a highly efficient public transit system. The city's connectivity, both locally and internationally, facilitates the movement of goods, services, and professionals within the built environment sector. This strong connectivity supports efficient project execution and enhances market synergies.

Hong Kong Regulatory Landscape – Selected Policy Instruments

The regulatory landscape for the built environment sector in Hong Kong is complex, with a wide range of regulations, codes, and guidelines that must be followed by all players in the sector.

Policy support/ guidelines

Financial support; e.g., funding scheme

Environmental Impact Assessment Ordinance (EIAO): The EIAO requires that an environmental impact assessment (EIA) be conducted for all major development projects in Hong Kong. The EIA assesses the potential environmental impact of a project and identifies measures to mitigate any negative impacts.

1997

Building Energy Efficiency Ordinance (BEEO): The BEEO is a regulatory framework that requires the implementation of energy-efficient building practices and technologies. It applies to all new buildings and major retrofit projects in Hong Kong.

2015

Hong Kong's Environmental Bureau unveiled the **Energy Saving Plan for the Built Environment 2015-2025**, which sets a new target of reducing Hong Kong's energy intensity by 40% by 2025.

2018

The Government introduced the **Hong Kong Energy Efficiency Registration Scheme for Buildings (HKEERSB)** to encourage building owners to achieve better energy performance beyond the statutory requirements.

Building Energy Efficiency Funding provides funding for energy audits, retrofits, and other energy-saving measures in existing buildings. It is launched by the Hong Kong government and managed by the Electrical and Mechanical Services Department (EMSD).

Recycling Fund provides financial support for waste reduction and recycling projects, including those related to construction waste. It is launched by the Hong Kong government and managed by the Environmental Protection Department (EPD).

2019

Hong Kong Green Innovation Funding Scheme (GIFS) - This scheme provides funding for innovative and sustainable projects related to the built environment, including energy efficiency, green building design, and waste reduction. It is launched by the Innovation and Technology Commission (ITC) and the Environmental Protection Department (EPD).

The Buildings Ordinance is the main piece of legislation that governs the construction, alteration, and maintenance of buildings in Hong Kong. It sets out the requirements for building safety, fire safety, and environmental protection.

2021

In 2021, the Government announced **Hong Kong's Climate Action Plan 2050**, which outlines four major decarbonisation strategies, namely "net-zero electricity generation", "energy saving and green buildings", "green transport" and "waste reduction".

2022

The Environment Bureau (ENB) and the Electrical and Mechanical Services Department (EMSD) launched the **Energy Saving and Decarbonisation for All 2022** campaign to encourage the community to achieve low-carbon transformation by saving energy and decarbonizing.

2 Stakeholders' Role in the Market

Decarbonizing the built environment sector in Hong Kong is essential to meet the city's goal of achieving carbon neutrality by 2050.

Necessary Actions

Government

- Establish building energy codes that set energy efficiency standards for new buildings and retrofitting of existing buildings
- Offer financial incentives
- Promote Green Building Certification
- Increase Public Awareness

Commercial & Industry

- Implement Energy Efficiency Measures
- Retrofitting existing buildings with energy-efficient technologies and materials
- Establish Green Building Certifications
- Educate Employees and Customers
- Embrace Circular Economy

Community & Individuals

- Individuals can reduce energy consumption by adopting energy-saving habits
- Use Sustainable Transportation
- Choose Sustainable Products
- Participate in Green Initiatives
- Support Sustainable Businesses
- Advocate for change

Challenges

- **Regulation – materials side**: low-carbon building materials are available on the market, also in various APAC markets such as Japan or South Korea – however, regulatory approvals for new low-carbon building materials take time for the Hong Kong market – this time-lag creates less incentives for property developers to consider low-carbon materials as part of their procurement.
- **Green building ambition**: the current green building policy offers useful incentives (e.g. GFA concession), however offers them already for the lowest level of Green buildings. In order to accelerate the journey to a low-carbon built environment, the green building certification should be more progressive, offering the incentives for achieving the highest form of green building certification only.
- **Regulation – operating phase of the building**: the regulation and monitoring of the energy consumption once the building is in operation is lacking a clear policy. Currently, there is no requirement to monitor the energy consumption on a regular basis, reducing the business opportunities in this particular area of the built environment sector.

2 Insights from Hong Kong Market Stakeholder Engagement Sessions – Built Environment

By interviewing the different financial sector focused stakeholders on the Hong Kong marketplace, we have identified the following key insights for the technology, innovation & entrepreneurship sector to be taken into account.

Ecosystem Landscape

- **Extensive stakeholder ecosystem** spanning material suppliers, constructors, and developers
- Hong Kong's buildings are subjected to **"double-aging"**
- Different **sustainability prerequisites for old and new buildings**
- **Local market is small** relative to its neighbours

Market Strengths

- Consistent and recognised development standards that makes **global commercial practices convenient**
- **Favorable policies** supportive of overseas collaboration
- Deep pool of professional **talents to digitise value chain** (e.g. material simulation, sourcing, carbon credits)
- **Zero-carbon parks** to demonstrate green lifecycle

Key Industry Offerings

- **BEAM Plus** building standards to bind new development to sustainability practices
- **Retrofits standards** to set benchmarks for old building's maintenance and green transformation
- Government's **carbon neutrality committee** to oversee industry regulations and systematize practices

Top Business Challenges

- **Standardise taxonomy** for buildings and to include sections for pumping and drainage, fire services, etc.
- Need **best practices to become common practices**
- Material deduction and building design improvement
- Educate contractors on **green procurement**
- **About 10% more expensive** to use green material

Advice for Market Entrants

- Register licenses and patented technology into **Green Product Directory**
- **Leverage local agencies** to provide warranty and maintenance services
- Import proven **overseas use cases** with successful pilots
- Exchange industry knowledge with government bodies

2 Key Industry Associations for the Green Buildings Focus Sector

BEAM (Building Environmental Assessment Method) Plus is Hong Kong's leading initiative to offer an independent assessment of building sustainability performance. BEAM Plus offers a comprehensive set of performance criteria for a wide range of sustainability issues including energy use and carbon emissions, climate adaptation and resilience, land use and transport, site ecology, materials and waste, water use, health and wellbeing, pollution management, integrative design, smart technology and innovations, etc. By providing a fair and objective assessment of a building's overall performance, BEAM Plus enables organisations and companies of all sizes to demonstrate their commitment to sustainable development.

LEED (Leadership in Energy and Environmental Design):LEED, a globally recognized green building certification system, has a significant impact in Hong Kong as an industry standard for sustainable building design, construction, operation, and maintenance. While not a local association, LEED's influence extends worldwide, including Hong Kong. Many developers and building owners in the region pursue LEED certification, aligning their projects with international best practices for energy efficiency, water conservation, and overall environmental responsibility.

Construction Industry Council (CIC):The CIC in Hong Kong serves as a vital association bridging various stakeholders in the construction sector. While addressing a broad spectrum of industry concerns, CIC actively promotes sustainable and green construction practices. Through training programs, research, and collaborative efforts, CIC contributes to enhancing industry standards and raising awareness about the importance of environmentally friendly approaches in the construction industry.

The Hong Kong Green Building Council (HKGBC) is a non-profit, member-led organisation established in 2009 and has become a public body under the Prevention of Bribery Ordinance since 2016. The HKGBC strives to promote the standard and development of sustainable buildings in Hong Kong. The HKGBC also aims to raise green building awareness by engaging the government, the industry and the public, and to develop practical solutions for Hong Kong's unique, subtropical built environment of high-rise, high density urban area, leading Hong Kong to achieve carbon neutrality by 2050 and to become a world's exemplar of green building development. The Founding Members of the HKGBC include the Construction Industry Council (CIC), the Business Environment Council (BEC), the BEAM Society Limited (BSL) and the Professional Green Building Council (PGBC).

Business Environment Council (BEC):The BEC in Hong Kong is a key industry association committed to promoting environmental sustainability in the business sector. While not exclusively focused on green buildings, BEC plays a crucial role in advocating for environmentally responsible practices, including those related to building construction and operation. Through collaborative initiatives, BEC encourages businesses to adopt eco-friendly building practices, fostering a more sustainable built environment in Hong Kong.

Source: Hong Kong Green Building Council Limited | HKGBC, LEED rating system | U.S. Green Building Council, Construction Industry Council, Home | Business Environment Council

Case Study| Saint-Gobain Hong Kong & Macau | France

Sustainable Built Environment

Worldwide leader in light and sustainable construction, Saint-Gobain designs, manufactures and distributes materials and services for the construction and industrial markets since 1665. Its integrated solutions for the renovation of public and private buildings, light construction and the decarbonization of construction and industry are developed through a continuous innovation process and provide sustainability and performance. The Group's commitment is guided by its purpose, "MAKING THE WORLD A BETTER HOME". Its recent technologies for sustainable construction help reduce energy consumption, lower the carbon footprint of cements and concrete and foster the circular economy. Saint-Gobain is the largest mortar manufacturer with factory in Hong Kong & Southern China and has a strong positioning across Asia.

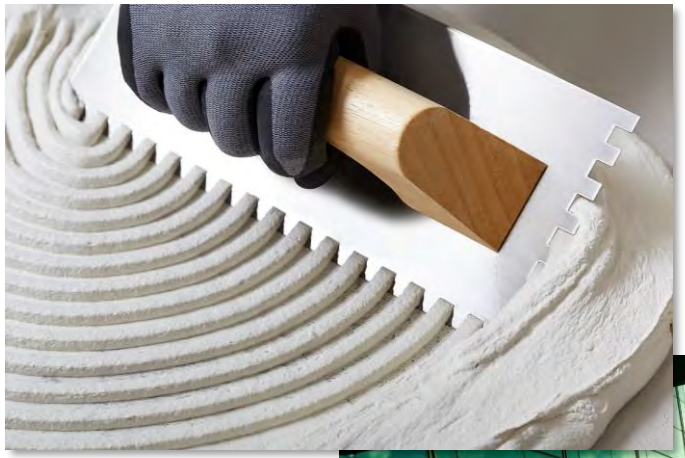
Green Tech market opportunity:

1. **Green Building Solutions**: Meeting the demand for energy-efficient facades, thermal insulation, and low-carbon construction materials to comply with green certifications like BEAM Plus.
2. **Energy-Efficient Retrofitting:** Supporting the government's initiatives for building upgrades by offering solutions for thermal, acoustic, and energy performance improvements in existing structures.
3. **Sustainable Infrastructure:** Contributing to major infrastructure projects with materials that reduce embodied carbon while ensuring durability and performance.

Hong Kong's strong regulatory framework, skilled professional network, and global visibility make it an ideal platform to showcase our leadership in sustainable construction and capture Green Tech opportunities.

Hong Kong market strengths:

Hong Kong is a strategic hub for Saint-Gobain, offering access to the Asia-Pacific markets, a robust infrastructure pipeline, and a strong commitment to sustainability through initiatives like BEAM Plus and the Carbon Neutrality 2050 vision. Its talented workforce and innovation ecosystem further support our growth in Green Tech and sustainable construction.



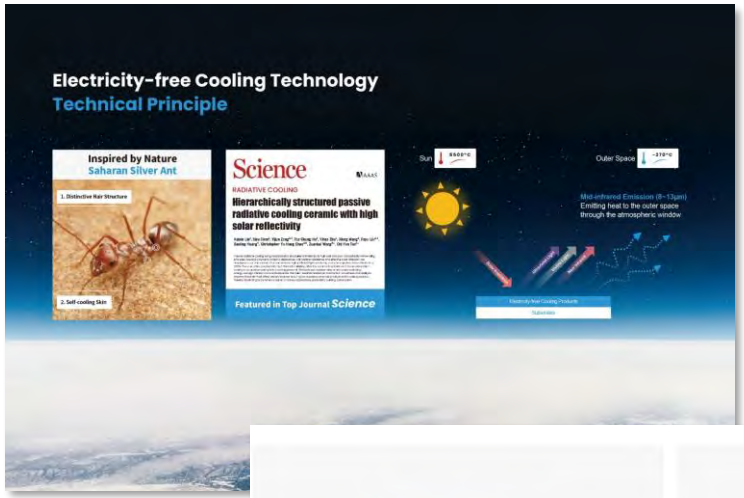
Case Study| i2Cool | Mainland China

Built Environment

i2Cool is transforming how the world approaches electricity-free cooling technology. The company was founded by experts from the School of Energy and Environment at the City University of Hong Kong. i2Cool team has taken groundbreaking research, published in prestigious journals like Science, and turned it into commercial applications that revolutionize energy efficiency. The innovative products, including passive radiative cooling paints and films made from polymers and proprietary nanomaterials, boast exceptional solar reflectivity and mid-infrared emissivity, reducing surface temperatures by up to 42°C. With a presence in over 20 countries across various industries such as architecture, power & telecom, new energy, logistics, grain storage, photovoltaic and chemical industry, i2Cool is at the forefront of creating green communities and advancing global sustainability.

Green Tech market opportunity:
As the global discourse increasingly emphasizes climate change and environmental sustainability, the demand for energy-efficient and eco-friendly cooling solutions is more critical than ever. i2Cool, with their groundbreaking electricity-free cooling technology, is leading this transformative shift, offering a sustainable, cost-effective, and easy-to-apply cooling solution. This commitment to environmental preservation extends beyond their current accomplishments. i2Cool continually pushes for advancement, exploring potential applications in textiles, automotive exteriors, and community design, which could revolutionize multiple industries and promote global sustainable practices. With their commitment to research and development, i2Cool is setting new standards in the cooling industry, championing energy efficiency, and inspiring a shift towards environmentally-conscious solutions, which symbolizes a significant stride towards a more sustainable future where cooling technology aids in preserving our planet for future generations.

Hong Kong market strengths:
Strategic Location: Hong Kong serves as a gateway to Asia, providing access to key markets in the Greater Bay Area and beyond. This geographical advantage facilitates trade and collaboration with regional partners and reach oversea market like our Dubai Mall project.
Supportive Government Policies: The Hong Kong government actively promotes green technology and sustainability initiatives, offering various incentives for companies in the Green Tech sector.
Robust Infrastructure: Hong Kong boasts a well-developed transportation and logistics network, which is crucial for the distribution of i2Cool's products and services.



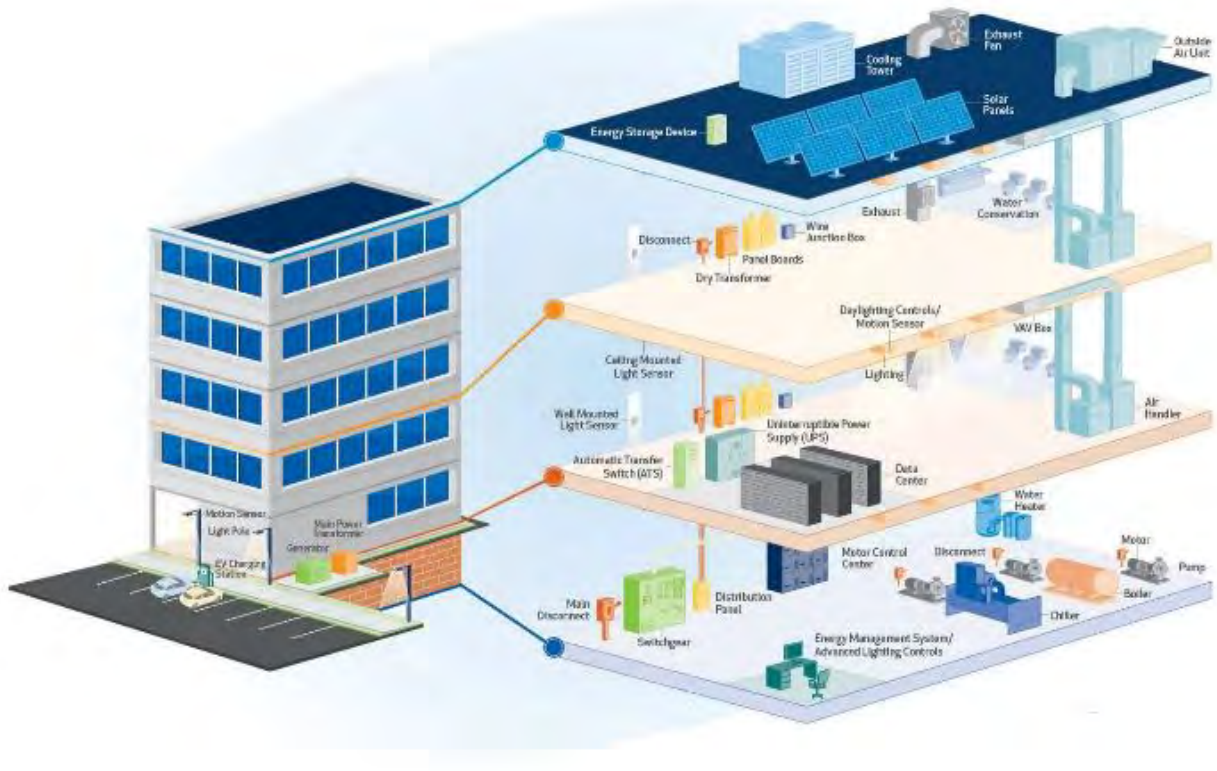
Case Study | Electricity Management in Buildings

The Bullitt Center is a prime example for the effectiveness of electricity management in buildings. In 2009, the building underwent a large energy retrofitting project that aimed to reduce energy consumption and carbon emissions. The project involved several energy efficiency measures, including the installation of energy-efficient lighting, the upgrade of the building's HVAC system, and the installation of a building management system (BMS) to optimize energy use.

The BMS is a centralized computer system that controls various building systems, including lighting, heating, and cooling. It uses real-time data and analytics to optimize energy use and reduce waste. The BMS in the Empire State Building allowed the building managers to monitor energy consumption and identify areas where energy could be saved.

The energy retrofitting project at the building was a massive success. It reduced energy consumption by **38% saving US$4.4 million** per year on energy costs. It also reduced carbon emissions by **105,000 metric tons** over a 15-year period, equivalent to **removing 20,000 cars from the road**.

The project demonstrates the importance of electricity management in buildings and the significant impact it can have on energy consumption and carbon emissions. By implementing energy efficiency measures and using building management systems, buildings can significantly reduce their energy consumption, save money on energy costs, and contribute to a more sustainable future.



Source: Smart and Sustainable Buildings and Infrastructure | Deloitte Global

Case Study | Green Construction Materials

The Edge is a state-of-the-art office building that was designed to be one of the most sustainable buildings in the world.

The building uses several innovative green construction materials, including:

- **Smart glass:** The Edge has a façade made of smart glass that automatically adjusts its tint to optimize natural lighting and reduce energy consumption. The glass is also equipped with photovoltaic cells that generate electricity from sunlight.
- **Cradle-to-Cradle (C2C) materials:** The building's materials were selected based on the Cradle-to-Cradle (C2C) design principles, which emphasize using materials that can be reused or recycled at the end of their life. For example, the building's carpet tiles are made from recycled materials and can be easily disassembled and reused.
- **Rainwater collection system:** The Edge collects rainwater from the roof and stores it in an underground tank. The rainwater is then used for toilet flushing and irrigation.
- **Green roof:** The building has a green roof with over 30,000 plants that absorb rainwater, reduce the urban heat island effect, and provide insulation.

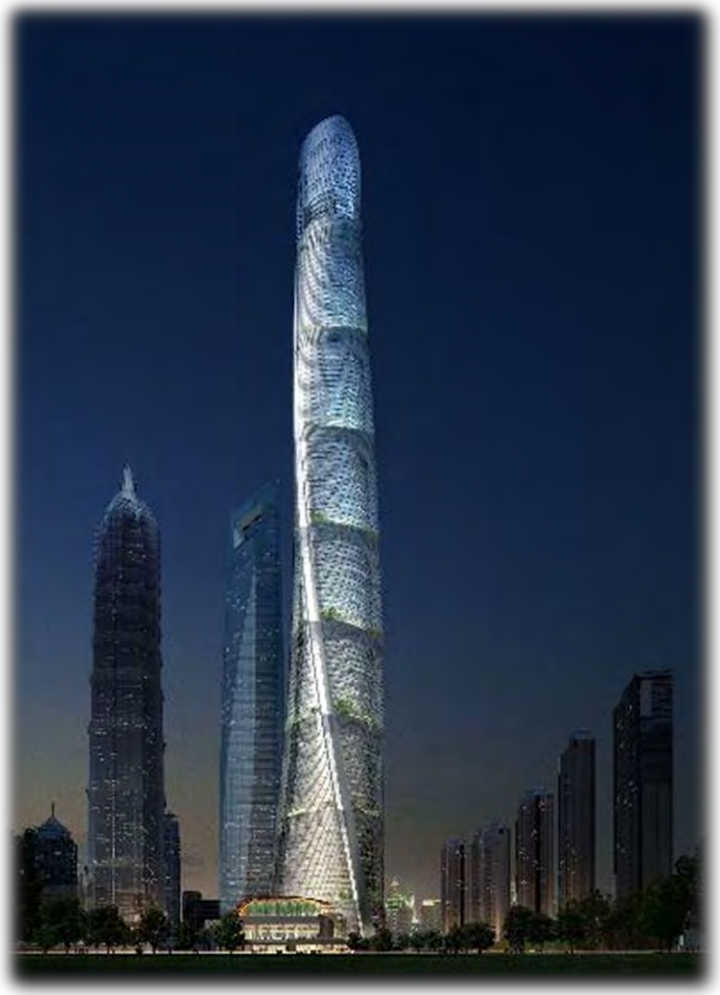
The Edge has been highly effective in reducing its environmental impact and has received several awards and certifications for its sustainability features, including the highest sustainability rating in the world, BREEAM Outstanding certification. The Edge demonstrates the importance of using innovative and sustainable construction materials in reducing the environmental impact of buildings. By using green construction materials, buildings can reduce their carbon footprint, conserve natural resources, and contribute to a more sustainable future.

Case Study | Smart Construction

The Shanghai Tower is a 632-meter, 128-story skyscraper that was designed using advanced digital technology and smart construction techniques.

The building's smart construction features include:

- **Building Information Modeling (BIM):** The Shanghai Tower was designed using BIM, a digital model that integrates all aspects of the building's design and construction. This allowed for more efficient and accurate planning and construction.
- **Prefabrication:** Much of the building's structural and mechanical components were prefabricated off-site, reducing construction time and waste.
- **Real-time monitoring:** The building is equipped with sensors and monitoring systems that collect real-time data on its energy use, air quality, and water usage. This data is used to optimize the building's performance and reduce its environmental impact.
- **Intelligent lighting:** The building's lighting system uses sensors to detect occupancy and adjust lighting levels accordingly, reducing energy use.



The Shanghai Tower has been highly effective in reducing its environmental impact and has received several awards and certifications for its sustainability features, including the LEED Platinum certification and the China Green Building Design Label certification. The Shanghai Tower demonstrates the importance of using smart construction techniques to reduce the environmental impact of buildings. By using advanced digital technology and real-time monitoring, buildings can optimize their performance, reduce their energy consumption and carbon footprint, and contribute to a more sustainable future.

Market Analysis – Green Mobility Sector

Green Economy Taxonomy – Green Mobility Sector

After compiling the insightful suggestions from stakeholders in the market, the taxonomy can help to mobilize private capital towards investments that contribute to environmental sustainability and help to identify the most promising sustainable activities in Hong Kong.

Focus Sector	Green Mobility Sector				
Subcategories	**EV Charging**	**Commercial road vehicles**	**Passenger road vehicles**	**Aviation**	**Maritime**
	Destination charging	Biodiesel/bioethanol buses	E-motorcycles	Electric Green Taxiing Systems	Green maritime fuels production
	Electrified roads	Hydrogen fuel-cell buses	ICE-EV	Sustainable aviation fuels production	Alternate fuel powered ships
	EV fleet charging solutions	Hydrogen fuel-cell heavy duty vehicles	Micro-mobility	Hydrogen powered aircrafts	Battery electric ships
	EV smart charging	ICE-EV or CNG conversion	Passenger electric vehicles	Short-distance electric aircraft	Wind assisted ship propulsion
	Fast charging		Solar electric cars	Green ammonia powered aircraft	Green bunker infrastructure
	Modular EV battery swapping				
	Vehicle to grid charging				

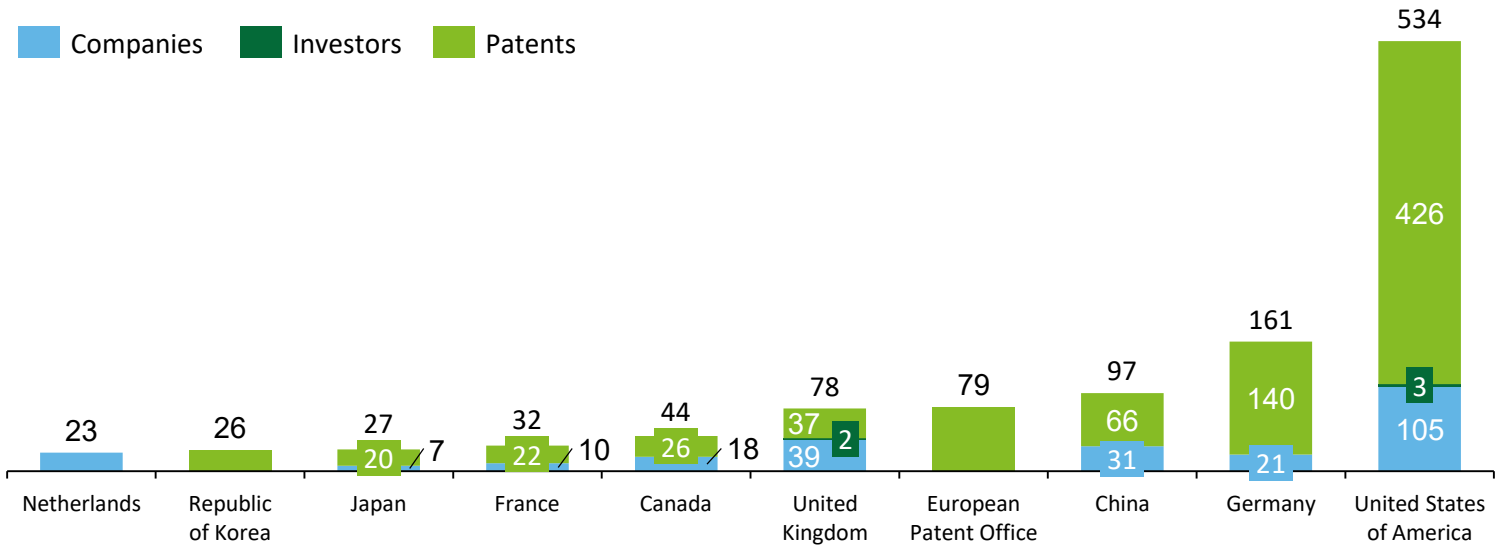
Global Market Snapshot | Focus Green Mobility

The global mobility market is undergoing significant changes and challenges, as well as opportunities for innovation and sustainability.

Global overview, as of 2022[1]

431 Companies identified including start-ups	**$.47b** Average funding round (AUD)
16 Investors identified	**$14b** Total funding (AUD)
1220 Patents	**77** Funding events

Total number of companies, investors and patents by country (Top 10)



Key callouts

- **GHG emissions**. In 2020, 20% of Hong Kong's emissions came from transport. Two large contributors of this sector were public transport and logistics transportation[1].
- **Hong Kong's transport infrastructure needs to find green alternatives.** In Hong Kong, ~90% of all passenger movements is on public transport, with the sector still heavily reliant on fossil fuels.
- **China is pushing electric mobility.** As of 2021, mainland China is implementing a scheme to promote electric mobility. Currently there are more than half a million fully electric buses now in operations across three cities: Guangzhou, Shenzhen and Xi'an.
- **Big investments are being made.** As countries look to electrify their transport sectors, big investments are being made to enable this transition. It is expected that this number will need to significantly grow to support the transition to a greener transport system.

Source: (1) Deloitte analysis (2) Hong Kong greenhouse gas emission inventory for 2020 released; (3) How Did Shenzhen, China Build World's Largest Electric Bus Fleet? | World Resources Institute;

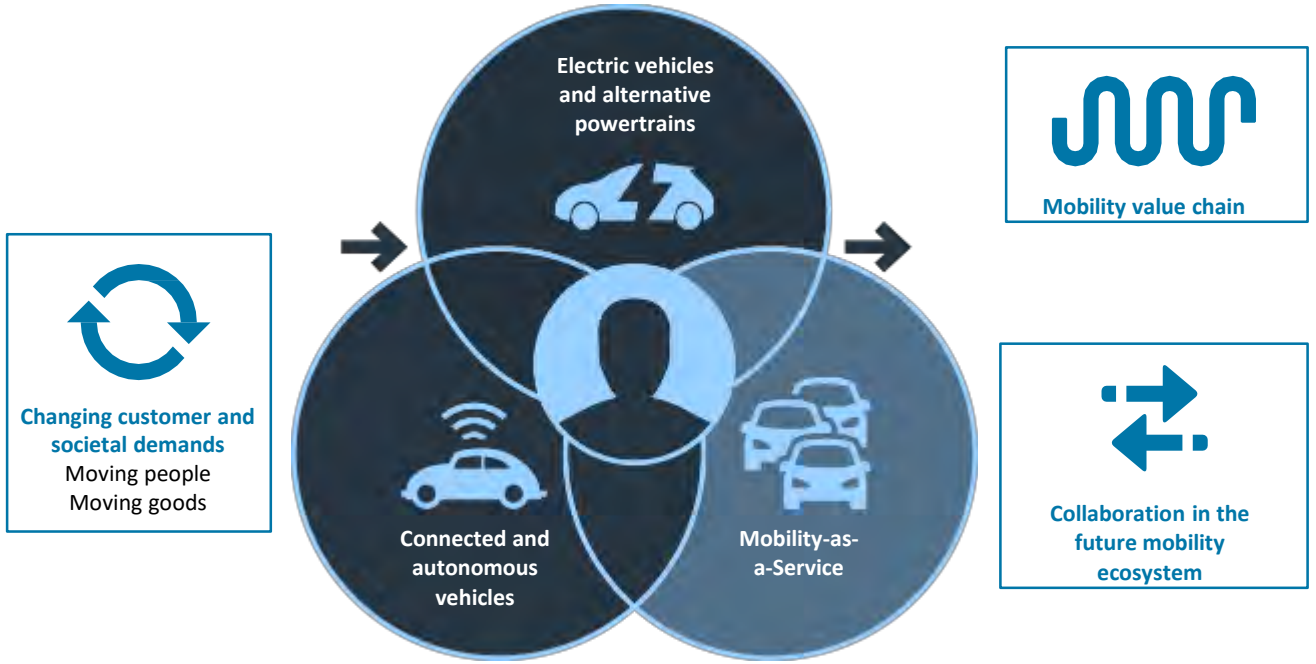
The Future of Green Mobility

The future of the mobility eco-system.

The mobility market in the broader sense is undergoing a social, technological and economic upheaval that is fundamentally changing the way people and products are moved. New markets are emerging, existing markets are converging, and others are shrinking and possibly disappearing. New entrants and start-ups are challenging incumbents, who in turn are trying to leverage their experience and resources to build a sustainable market position.

With continued population growth, urbanization, and environmental concerns, new forms of mobility are critical to support tomorrow's population centers and economic activities. Today's mobility systems suffer from traffic congestion, inefficiency, accidents and high prices. However, the future promises convenient, safe, and economical mobility with reduced health and environmental impacts.

The mobility transformation is being driven by three technology-driven disruptive trends: **(1) Vehicle electrification and alternative powertrains, (2) connected and autonomous vehicles, and (3) mobility-as-a-service (MaaS).** Independently, each of these trends would significantly disrupt the ecosystem; however, in combination, they are likely to drive unprecedented change.



Source: Mobility of the Future | Deloitte

The Future of Green Mobility

Vehicle electrification and alternative powertrains: Electric vehicles leading the disruption in the automotive sector.

EV take-up has seen a steady growth with accelerating uptake in the last two years - disrupting the automotive industry. This exponential growth is relying on key success factors:

1

Total Cost of Ownership (TCO): EVs achieved TCO parity with ICE vehicles driven by a number of developments:

- Falling battery pack costs: the cost of battery packs – which typically account for 40 percent of the cost of an entire EV – has declined by over 70% in the past 7 years and is expected to further halve by 2030 due to technological developments (such as cell chemistry) and production scale economies.
- Lower running costs: predominantly driven by:
  - decreasing 'fuel' costs: EV charging is significantly cheaper than petrol/diesel on a per mile basis, aided by technologies such as smart chargers and vehicle-to-grid (V2G) energy trading
  - 40-50% lower service, maintenance and repair (SMR) costs, due to substantially fewer moving parts.
  - Improved residual values (RVs) for EVs: RVs have improved thanks to battery and range improvements in newer, higher-quality, mass-market models and supportive regulation.

2

Infrastructure: A significant increase in home and public charging applications has helped improve the EV charging network. EV charging is currently dominated by home charging, however, we expect public charging to make up an increasing proportion of charging behavior over time. For the optimal EV charging infrastructure to shape, it is clear that public and private collaboration is needed to facilitate roll-out, with either party potentially taking the lead.

Source: Mobility of the Future | Deloitte

The Future of Green Mobility

Connected and autonomous vehicles and mobility-as-a-service (MaaS) are set to be the next big revolution in the global transport ecosystem.

The move toward highly automated (Level 4) CAVs continues to progress. Several OEMs have pledged to bring Level 4 AVs to market between now and 2025, with much of the initial deployment likely in urban areas.

As increasingly connected cars become "computers on wheels," they will generate more data than ever before, which can benefit consumers by increasing safety, comfort and enjoyment. Maintenance can become predictive rather than reactive, new parts can be ordered automatically, and entire fleets can be managed dynamically.

From a passenger perspective, connectivity should greatly expand the possibilities for in-vehicle entertainment, commerce, health, and work. CAVs should also improve road management and enable transportation authorities to manage capacity on busy routes by using CAV communications infrastructure to keep traffic flowing and reduce congestion.

Source: Mobility of the Future | Deloitte

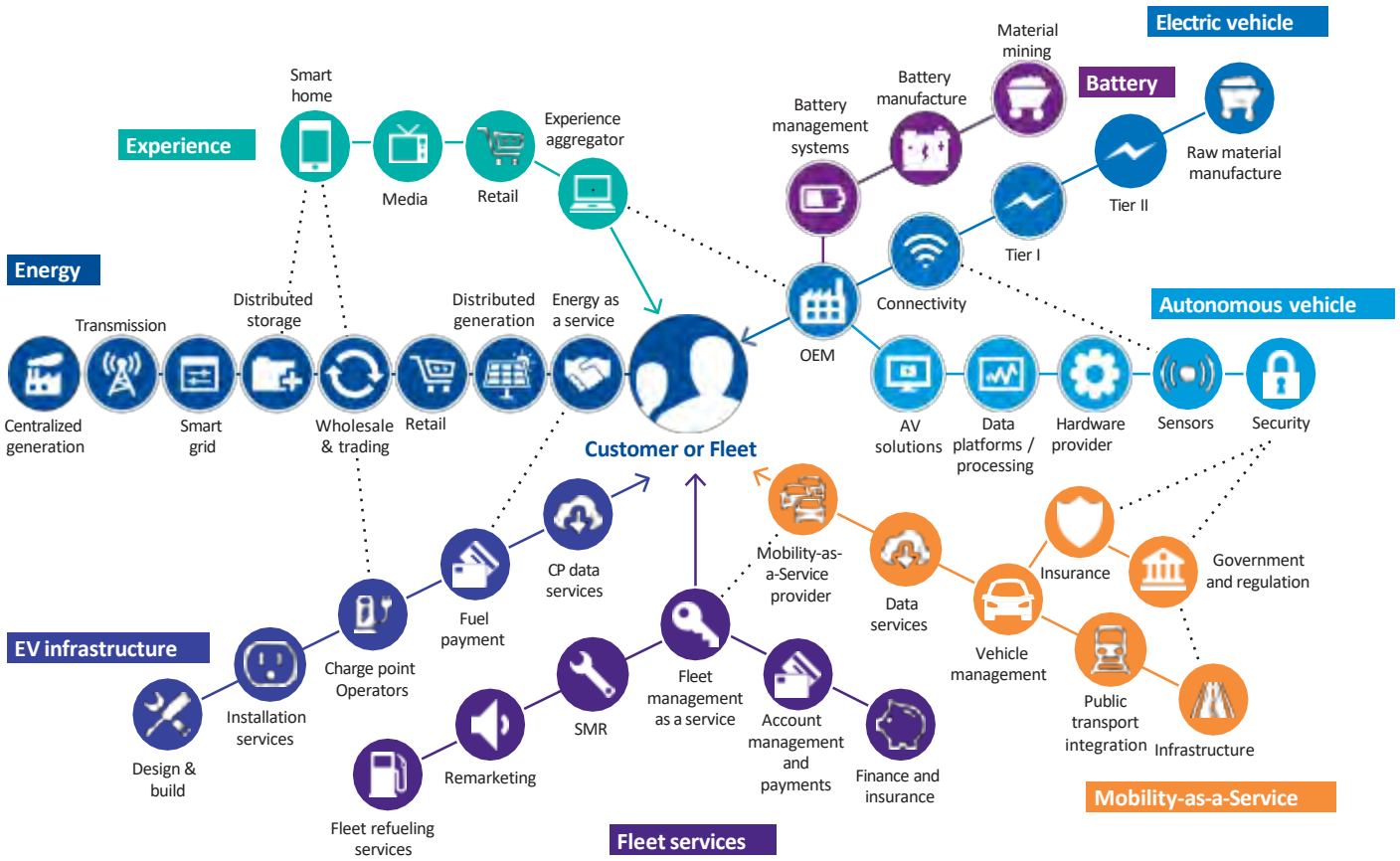
Mobility-as-a-Service is an evolving concept of how consumers and businesses move away from vehicle ownership towards service-based transport. In this sense, MaaS includes multi-modal aggregation of transport modes as well as on-demand mobility. In the overall landscape of mobility we highlight four areas where organizations are innovating to create new business and service models.

While passenger transport is often the focus when considering the benefits of mobility, commercial vehicles and logistics should not be forgotten, given the significant economic and sustainability impact. There is widespread innovation in business models – with the rise of peer-to-peer logistics platforms and consignment sharing – as well as new modes like drone delivery (as tested by several large technology players). Companies such as Starship Technologies – with autonomous robotic delivery pods – are shaking up the future urban logistics landscape.

Source: Mobility of the Future | Deloitte

The Future of Green Mobility – Opportunities

Historically, the transportation industry has operated along largely linear value chains. This is changing. The result is a complex web of interconnected value chains, with opportunities for new entrants to take a share of this new market. Also the sources of value will fundamentally shift both within value chains and across the ecosystem. The value derived from today's personal car is fairly equally split between upstream (raw materials to finished vehicles) and downstream (all other parts of the value chain). By 2030, in an EV-CAV-MaaS world, the downstream value could be as much as ten times larger, driven by new, digitally-enabled revenue streams. The impact is likely to be far-reaching, shown for two illustrative sectors below:



Automotive:
Vehicle brands and driving performance may cease to be the key purchase decision criteria; customers may look instead for a strong user interface and vehicle utility. This trend could well open the door for technology players to become the main customer interface.

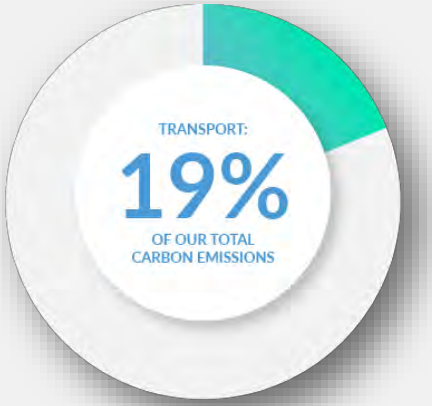
Financial services:
Huge changes are expected in a sector with strong ties to high-value vehicle assets. As vehicles become autonomous, individuals may no longer require insurance coverage, forcing providers to develop product liability solutions to sell into major mobility services fleets. Within the payments market, new mobility services, such as charge point payments and mobility services contracts, call for innovative new payment mechanisms. In vehicle finance – traditionally a key driver of car sales – the focus is likely to shift from individual finance to new mobility fleets.

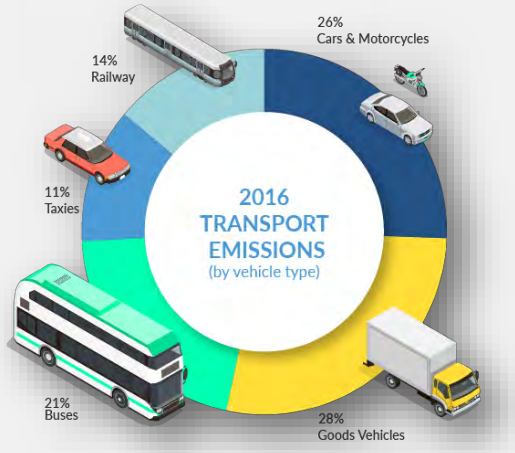
Source: Mobility of the Future | Deloitte

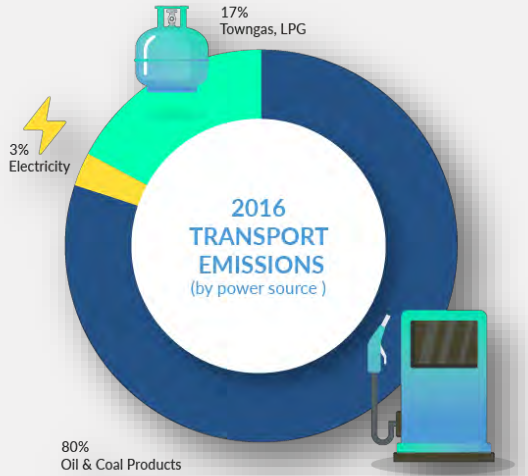
Hong Kong Market Landscape

There are plenty of opportunities for businesses and stakeholders to work towards a more sustainable and low-carbon mobility sector in Hong Kong.

Decarbonizing the Mobility Sector







Where we are headed:

- 70% of carbon emissions can be eliminated by switching to Net-Zero emission sources of electricity, so Hong Kong needs to grasp this opportunity to create the “grid of the future”. Renewable energy needs to be heavily promoted and serious consideration given to substantially increasing electricity from nuclear energy, following safety and other research into the specific opportunities. To efficiently match supply and demand, Hong Kong should focus on:
    - Increase energy storage - overall, supply side policies need to also be integrated with policies
    - Encourage energy savings in individual households for best emissions reduction effect.
    - Allow electricity companies to manage the demand for electricity.

Source: Sector: Mobility - HK 2050 is Now

Hong Kong Regulatory Landscape – Selected Policy Instruments

The Hong Kong government has been taking steps to promote sustainability in the mobility sector.

Policies/Initiatives/Regulations

Financial support; e.g. funding scheme

Registration Tax Concessions for EVs
"One-for-one replacement" scheme to allow eligible private car owners to scrap an eligible private car and switch to an electric private vehicle to enjoy a higher first registration tax concession of up to HK$250,000.

EV-Charging at Home Subsidy Scheme
The Government has rolled out a HKD$3.5 billion "EV-charging at Home Subsidy Scheme" ("EHSS") to subsidise the installation of EV charging-enabling infrastructure ("EVCEI") in car parks of existing private residential buildings, and hence further facilitate EV owners to install EV chargers at car parks of their residences according to their own needs in the future in a simple and easy manner.

Policy Address emphasizing Sustainable Aviation Fuels
The Government will also promote the development of new energy by: setting a target for sustainable aviation fuel ("SAF") consumption; developing sustainable supply chains for SAF and green maritime fuel in terms of fuel supply and demand, storage and bunkering.

Action Plan on Green Maritime Fuel Bunkering
Among the goals of the Action Plan to ensure that at least seven percent of Hong Kong-registered ships take up green maritime fuels by 2030. The government projects that the bunkering service will involve over 200,000 tonnes of green maritime fuels by 2030, with at least 60 bunkering operations.

2018 — 2020 — 2021 — 2021 — 2024

New Energy Transport Fund
In 2020, the Government allocated additional funding of $800 million for the New Energy Transport Fund and expanded its scope to cover additional types of electric commercial vehicles. $350 million earmarked to provide subsidies to ferry operators to test out electric ferries on Victoria Harbour routes from 2023.

Hong Kong Roadmap on Popularization of Electric Vehicles
The Government announced the Hong Kong Roadmap on Popularisation of Electric Vehicles (the EV Roadmap) in March 2021, setting the target to cease new registration of fuel-propelled and hybrid private cars (PCs) in 2035 or earlier. The Government is committed to promote green transport.

Hong Kong Climate Action Plan
Various power market related targets and initiatives such as the renewable energy targets or to cease coal usage for daily electricity generation by 2035.

2 Stakeholder's Role in the Market

Stakeholders have a critical role to play in decarbonizing the mobility sector and can take a range of actions to reduce carbon emissions.

Necessary Actions

Government

- Create a roadmap to improve transportation infrastructure and financially incentivize the public to shift to low carbon transportation methods.
- Develop tangible initiatives supporting the roadmap.

Commercial & Industry

- Make use of government funding under the New Energy Transport Fund.
- Actively shift to more sustainable transportation options.

Community & Individuals

- Actively switch and opt for low-carbon modes of travel (e.g. public transportation, cycling).

Challenges

- **From roadmap to implementation**: Hong Kong has clear policy signs to drive for a low-carbon transportation sector (e.g. ban of sale for ICE vehicles, etc.), however the implementation roadmap to deliver on the set policy targets lacks clarity (e.g. pilot schemes vs. large scale transformation). An example would be the taxi fleet (in GBA cities such as Shenzhen or Guangzhou the taxi fleet is already almost 100% electrified with a clear and ambitious roadmap to deliver).
- **Infrastructure need**: to deliver on the electrification of the transportation sector (road, but also maritime) critical investment into supporting infrastructure is needed to spur change from the private sector (e.g. incentivizing the installation of charging networks, reducing the hurdles to install charging stations in existing buildings).
- **Building the low-carbon transport eco-system**: the transition to a low-carbon transport systems offers opportunities also for adjacent sectors (e.g. IT, power, recycling) – actively building the network to create opportunities (e.g. second-life of batteries) will help grow the market.

2 Insights from Hong Kong Market Stakeholder Engagement Sessions – Green Mobility Sector

By interviewing the different financial sector focused stakeholders on the Hong Kong marketplace, we have identified the following key insights for the technology, innovation & entrepreneurship sector to be taken into account.

Ecosystem Landscape

- Extensive and **well-developed transportation and data infrastructure** that lays a solid foundation for digital solutions and green mobility
- Percentage of electric private cars (PCs) among all **newly registered PCs has soared in recent years** from 6.3% in 2019 to 52.8% in 2022
- **EVs accounting for more than half of new private cars** licenced in the city
- Collaboration across relevant stakeholders to **execute charging infrastructures**

Market Strengths

- Comprehensive **vehicle application approval standards**
- An ideal pilot location as **testbed for new solutions** to promote carbon neutral solutions
- **Highly compact city area** to facilitate efficient solution implementation (e.g. e-Toll)
- Active promotion **efforts by government** (e.g. subsidisation) to grow EV adoption
- **International connectivity** and unique proximity to the GBA region
- Commercial reaction to policy: **Eco Charge 2.0** launched by CLP power to provide one-stop technical support and customer service for customer interested in funding for EVs

Key Industry Offerings

- Government's **Smart Traffic Fund 1B** to support mobility-related research and development projects initiated by local institutions
- **Electric public light bus, electric taxis, and electric ferries** to commence testing to improve vehicle designs and charging technologies before commercialisation
- Government's **inter-departmental working group** established to oversee the trial of **hydrogen double-deck buses** and heavy vehicles

Top Business Challenges

- Completely decarbonise the transportation sector to **meet the goals set out by the Climate Plan 2030+**
- To **meet the continuously growing needs of electricity** with zero-carbon energy
- To cease the new registration of fuel-propelled and hybrid private cars in 2035 or earlier

Advice for Market Entrants

- To **leverage government's supportive policies** to grow green energy transportation to bring market electric vehicles
- Look into the **waste-to-energy facilities** to replace development of landfills

Case Study| REFIRE Group | Mainland China

Green Mobility

REFIRE Group is a full value chain hydrogen energy technology enterprise that offers complete, turnkey products and ecosystems. Founded in 2015, the company's purpose is to accelerate the global transition to a renewable energy mix rich in hydrogen. REFIRE is a listed company in Hong Kong as of the end of 2024. Upstream on the hydrogen value chain, REFIRE delivers equipment for hydrogen production including electrolysers and power transformers. Downstream, the company designs, integrates, and manufactures turnkey fuel cell solutions for mobility and stationary power.

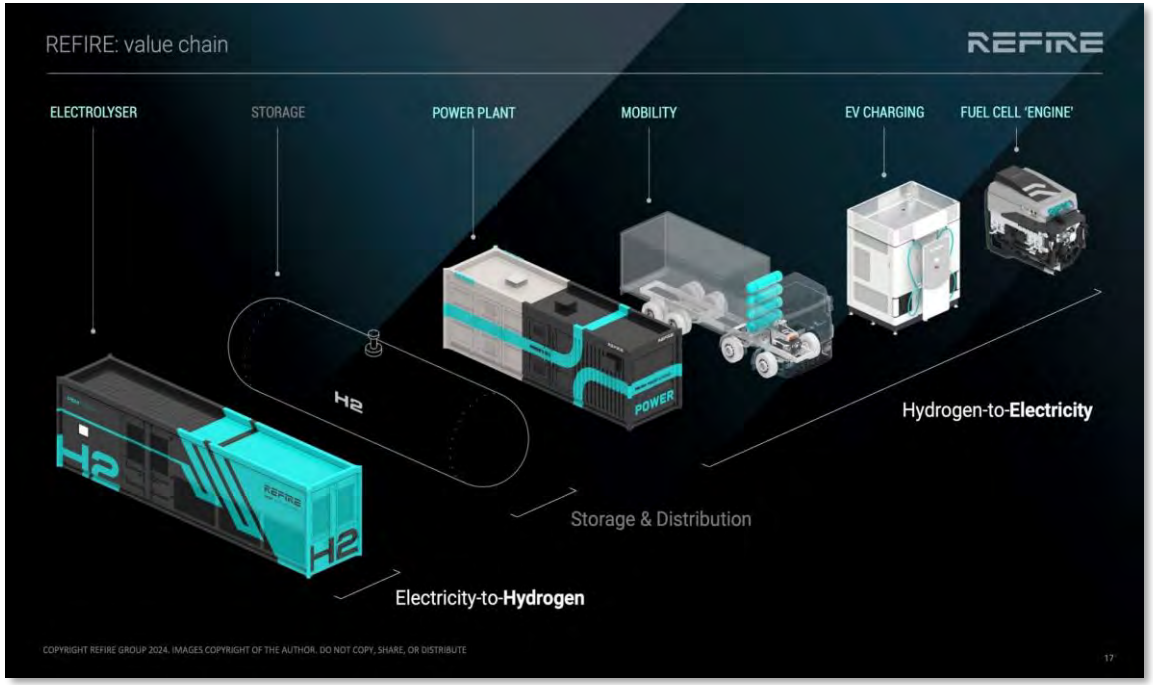
Green Tech market opportunity

With over 80 percent of the world's energy still delivered by fossil fuels, REFIRE believes that hydrogen is the best storage medium and energy carrier to decarbonise diesel and other heavy duty polluting fuels. In terms of 'green tech opportunities', this represents enormous market potential. Simply put, hydrogen could replace much of the US$244 billions of diesel consumed globally per year by heavy-duty engines. REFIRE currently enjoys around a 42% market share of China's commercial vehicle fuel cell market. With a footprint spanning Europe, North America, and Asia, the company is the global heavy-duty fuel cell power leader with over 5,900 commercial vehicles deployed, and a cumulative mileage of more than 210 million kilometres.

With several Hong Kong MoU's and partnership agreements in place, and many more in process, REFIRE has already completed several fuel cell-powered projects in Hong Kong, including a demonstration EV charger in conjunction with local R&D centre, APAS (Automotive Platforms and Application Systems), as well as a small fleet of street washing trucks operated by the Food and Environmental Hygiene Department (FEHD).

Hong Kong market strengths

REFIRE been active in developing a hydrogen economy in Hong Kong since 2020. The company has forged strong links with HKSAR Government to accelerate development of a regulatory framework for hydrogen as a fuel. REFIRE has been exclusively tasked with educating hydrogen equipment handlers through the city's Vocational Training Council (VTC).



Case Study| WSD Holdings (HK) | Mainland China

Green Mobility

Wisdom Motor, a high-end innovative company, is dedicated to provide zero-emission commercial vehicles to international markets. Specializing in battery electric vehicles (BEVs) and hydrogen fuel cell electric vehicles (FCEVs), the company has paved the way as a global leader in zero-emission transportation, with a product portfolio that includes buses, trucks, logistic vans, and specialty vehicles. Wisdom Motor provides three categories of products: buses and coaches, trucks and logistic vans, and specialized vehicles. Since its establishment, Wisdom Motor has delivered more than 22 countries and regions, including Hong Kong, Australia, New Zealand, the Netherlands, the United Kingdoms, the United States, Canada, Japan, South Korea, Israel, the Nordic countries and Gulf Cooperation Council (GCC) countries so on.

Green Tech market opportunity:
Wisdom specializes in designing, developing, and manufacturing EVs and FCEVs, including buses, coaches, vans, trucks, and specialty vehicles. Wisdom also offer related products and services, providing environmentally friendly manufacturing solutions and a cost-effective setup compared to traditional vehicle manufacturers. This is achievable due to its advanced production capabilities, which utilizes proprietary in-house production of composite materials eliminates the need for an electrophoresis process or stamping. Additionally, the self-developed vehicle control units meet customer operational demands.

By leveraging expertise in technology, transportation, and urban planning, we are committed to promoting innovative solutions that reduce the ecological impact of transportation and contribute to a greener urban environment.

Hong Kong market strengths:
Wisdom holds a significant first-mover advantage as it designed and delivered Hong Kong's first electric double-decker bus in October 2021. Furthermore, in 2023, Wisdom introduced the world's first fuel-cell electric double-decker bus to Hong Kong, further advancing the region’s green mobility and hydrogen strategy milestones.

With forged strategic collaborations with a wide range of local organizations and stakeholders across multiple sectors. Wisdom with these partnerships focus on advancing the industrialization of Hong Kong, aiming to create a future for mobility that prioritizes environmental sustainability.

2 Case Study | Decarbonizing the Aviation Sector

The road to truly zero-emissions aviation will take incremental steps, from making current aircraft more efficient, to replacing kerosene with hydrogen or integrating all-electric propulsion systems into new aircraft designs, while offsetting equivalent GHG emissions and introducing hybrid systems along the way. The different technologies will coexist for a certain period of time until a complete switch towards zero-carbon and zero-emissions aviation can be achieved.

I. Efficient aviation

Reduce GHG emissions through technological and operational efficiency, such as propulsion system and aerodynamic efficiency improvements, electrification of control systems, optimized flight patterns and optimized taxi operations (or use of electric systems).

II. Net-zero aviation

Offset equivalent GHG emissions via carbon offsetting investments (e.g. renewable energy, carbon sequestration) or reduce net emissions by replacing kerosene with sustainable aviation fuels (e.g. biofuel from biomass or waste, or power-to-liquid fuels synthesized from hydrogen and CO_2).

III. Hybrid-electric aviation

Implement hybrid-electric powertrains to partially reduce GHG emissions. Done via the integration of electric motors powered by batteries or fuel cells to complement a combustion engine or via the use of a combustion engine to drive an electric generator powering an electric motor.

VI. Zero-carbon aviation[ii]

Replace kerosene with non-carbon emitting fuels (e.g. hydrogen), which can be combusted in modified turbines or reacted in fuel cells to power an electric powertrain.

Hydrogen-based propulsion aircraft

V. Zero-emissions aviation[ii]

Replace all propulsion systems with fully electric propulsion systems. Combustion engines are replaced by electric motors powered by batteries to drive propellers or ducted fans. Electricity must be produced without emitting carbon.

Battery based propulsion aircraft

i) The timeline indicates dates at which the first pilot projects or new propulsion systems are expected to be implemented by commercial passenger airlines.
ii) Zero-emissions (battery-powered) aircraft are expected to have the energy capacity to serve the short-haul market, whereas zero-carbon (hydrogen-powered) aircraft have the potential to serve long-haul routes. These technologies are therefore expected to coexist for the foreseeable future.

Source: Decarbonizing aerospace | Deloitte Insights

2 Case Study | Decarbonizing the Aviation Sector

Battery and hydrogen propulsion technologies represent the most promising paths towards a zero-carbon and zero-emissions aviation industry. While there is no all-round answer to decarbonize aircrafts' operations, batteries and hydrogen can offer sustainable solutions across the different distance segments of the market. Therefore, this combination of technologies has the potential to greatly decrease the overall climate impact of the aviation sector.

Zero-carbon aviation | Zero-emissions aviation

	Hydrogen-powered combustion aircraft	Hydrogen fuel cell electric aircraft	Battery-powered electric aircraft
	Up to 2000 km Distance range	Up to 1000 km Distance range	Up to 500 km Distance range
Technology overview	Hydrogen, and oxygen captured from the air, are combusted in modified engines to generate thrust	hydrogen is reacted in a fuel cell to provide electricity to electric motors than spin propellers or ducted fans to generate thrust	Electric batteries are used to power electric motors that spin propellers or ducted fans to generate thrust
Performance indicators[i, ii]	**– 50-75%** Climate impact reduction potential **+ 5-15%** Flight time **+ 10-35%** Ticket price	**– 75-90%** Climate impact reduction potential **+ 20-30%** Flight time **+ 0-15%** Ticket price	**– 100%** Climate impact reduction potential **+ 20-30%** Flight time **+ 0-20%** Ticket price
Benefits	✓ No carbon emissions (water and NOx are still produced) ✓ Scalable technology derived from conventional aircraft designs and engines ✓ Economies of scale benefits from synergies with other hydrogen dependent industries	✓ Near-Zero emissions (water is still produced) ✓ Quieter engines ✓ Economy of scale benefits from synergies with other hydrogen dependent industries	✓ Zero emissions ✓ Quieter engines ✓ Reduced maintenance costs (fewer moving parts) ✓ Economy of scale benefits from synergies with other battery dependent industries
Constraints	The low energy density of battery and hydrogen propulsion systems will decrease the flight range and optimal cruise speed compared to conventional kerosene systems	By 2040, higher energy costs (hydrogen), capital costs (energy storage, propulsion system) and maintenance costs (landing gear, battery replacement) of hydrogen and battery aircraft compared to conventional kerosene aircraft will lead to increased ticket prices. However, these costs are expected to decrease with the large-scale implementation of hydrogen and battery technologies.	
Required development	1. Significant increase in sustainable hydrogen production capacities 2. Development of large-scale hydrogen supply chains (transport) and required airport infrastructures (storage) 3. Important Innovations required to adapt aircraft for the use of liquid hydrogen as a fuel (adapted aircraft designs and engines, power-dense fuel cells, light hydrogen storage systems)		1. Further improvement of battery technologies, especially in terms of energy density 2. Significant increase in renewable electricity production 3. Innovations required to adapt aircraft to large battery systems (design, electrical systems, electric motors)

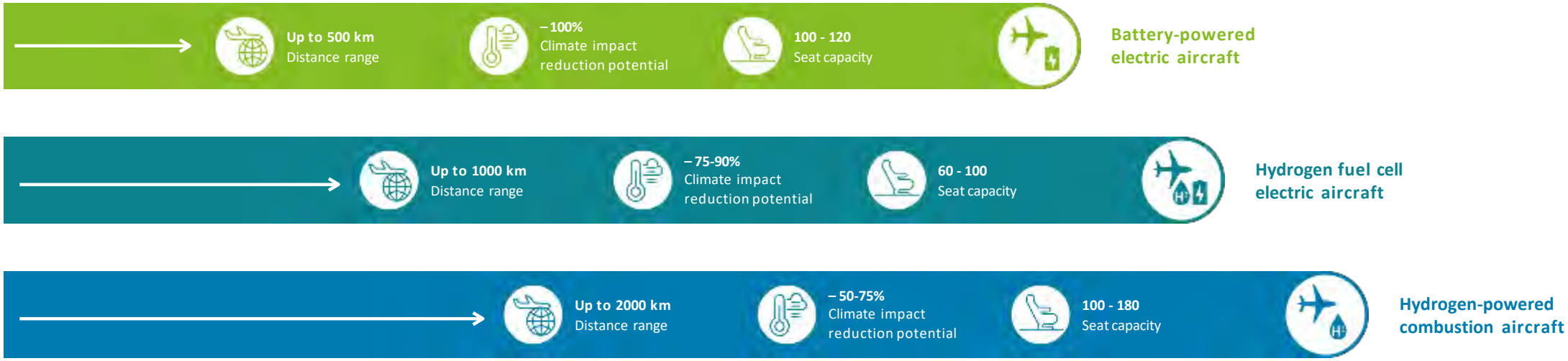
i) Comparisons are made for similar routes and aircraft within the mentioned distance segments
ii) Ticket prices do not consider potential increase in carbon tax until 2040

Source: Decarbonizing aerospace | Deloitte Insights

Case Study | Decarbonizing the Aviation Sector

In the near future, the energy and power density of battery- and hydrogen-based propulsion technologies (depending on the battery technology development) will still be lower than existing kerosene-based systems, resulting in zero-carbon and zero-emissions aircraft being limited in terms of passenger capacity and flight range.

Following the assumption that the use of aircraft with the highest climate impact reduction potential needs to be maximized, battery-powered airplanes should serve routes up to 500 km, followed by hydrogen fuel- cell-powered planes from 500 km to 1000 km, and hydrogen combustion airplanes covering distances between 1000 km and 2000 km (based on performance and limitations expected by 2040, these ranges are expected to be extended with further technology developments).



Source: Decarbonizing aerospace | Deloitte Insights

2 Case Study | Decarbonizing the Aviation Sector

In addition to the existing air travel market, battery- and fuel-cell-powered aircraft have the potential to further develop regional short-haul air transport.

In addition to the existing air travel market, battery- and fuel-cell-powered aircraft have the potential to further develop regional short-haul air transport. Thanks to shorter and quieter take-off and landings, as well as reduced operating and maintenance costs (expected in the long-term), electric aircraft can overcome the current challenges of regional routes and serve smaller airports economically. Additionally, they can contribute to fast, safe, and effective mobility in less populated areas, where the investment in alternative transport solutions is not justified from a traffic density, cost, or environmental and landscape impact point of view.

Reduced noise
Thanks to the absence of a combustion core, slower propeller rotation speed, and significantly fewer moving parts

Shorter take-off distance Thanks to increased static thrust leading to improved acceleration

Lower operating costs Thanks to reduced energy costs and to the simplicity and longevity of electricity-powered motors and drivetrains

Lower maintenance costs Thanks to decreased system complexity and a significantly smaller number of moving parts

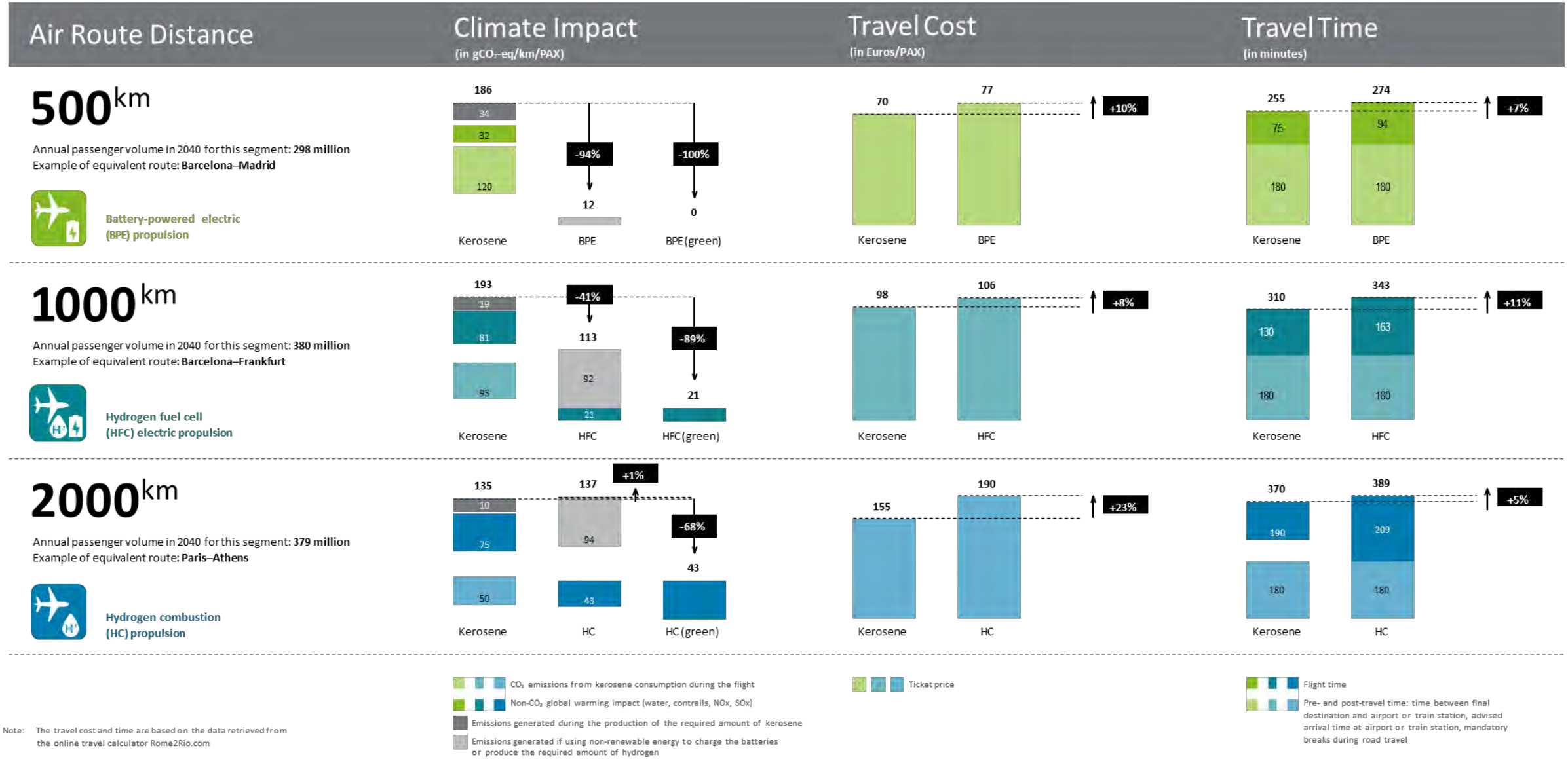
Benefits expected in the longer term thanks to future innovation and economies of scale

Note: From a technology and operations perspective, hydrogen combustion-powered airplanes don't differ significantly from kerosene-powered ones, and therefore, the benefits of electric propulsion systems mentioned here do not apply.

Source: Decarbonizing aerospace | Deloitte Insights

Case Study | Decarbonizing the Aviation Sector

Comparing conventional kerosene aircraft with zero-carbon and zero-emissions alternatives: significant environmental benefits, with slightly increased travel time and costs.



Note: The travel cost and time are based on the data retrieved from the online travel calculator Rome2Rio.com

Source: Decarbonizing aerospace | Deloitte Insights

Market Analysis – Waste Reduction & Management

Green Economy Taxonomy – Waste Reduction & Management Sector

After compiling up the insightful suggestions from stakeholders in the market, the taxonomy can help to mobilize private capital towards investments that contribute to environmental sustainability and help to identify the most promising sustainable activities in Hong Kong.

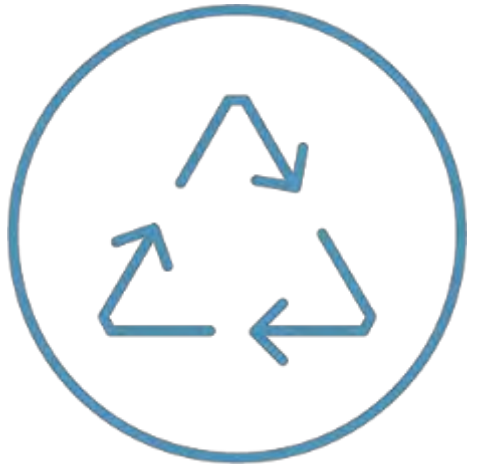
Focus Sector	Waste Reduction & Management Sector		
Subcategories	**Processing**	**Recycling**	**Recovery**
	Landfill gas capture & use / Organic waste processing (anaerobic digestion)	EV battery recycling	E-waste recovery using biomining
	AI sorting and senor-based waste management	Plastic recycling using biocatalysts / bio enzymes	Incineration for energy recovery
	Waste tracking solutions (RFID, GPS)	Biochar and composite materials	Valuable metals recovery
	Solar-powered compacting bin	Plastic to fuels technology	

The Future of Waste Reduction & Management

Recycling and reuse can easily cut by a third the GHG emissions embedded in our products.

Deloitte has identified seven different types of circular economy business models, which can provide as a useful method for thinking, highlighting different logics and rationales:

- **Cradle to cradle** – A manufacturer designs waste-free products that can be integrated in fully recyclable loops or biodegradable processes;
- **Take-back management** (including reverse logistics) – A manufacturer or retailer takes back the product using reverse logistics streams – the manufacturer is responsible for the product end-of-life;
- **Deposit systems** – A manufacturer or retailer (or groups of) takes back its own products / packaging (or a common product) for reuse and may refund the customer;
- **Repair** – A manufacturer or retailer offers to take a faulty product and return it to good working conditions by replacing or repairing failing components;
- **Refurbishment** (including resale) – A manufacturer or retailer offers to update the appearance of the product by cleaning, changing fabric, painting, refinishing, etc. – as opposed to repair, refurbish is more linked to 'cosmetic' changes but definitions might overlap in some cases;
- **Remanufacturing** – A manufacturer disassembles and employs reusable parts on a new product – this practice is generally associated with a guarantee for functionality / performance;
- **Rematerialisation** (including recycling and cascading use) – A manufacturer recovers materials from a given product that has become waste into a reusable material that may be employed for the same purpose or not – when the conversion is into a material of reduced quality, this process is called downcycling.

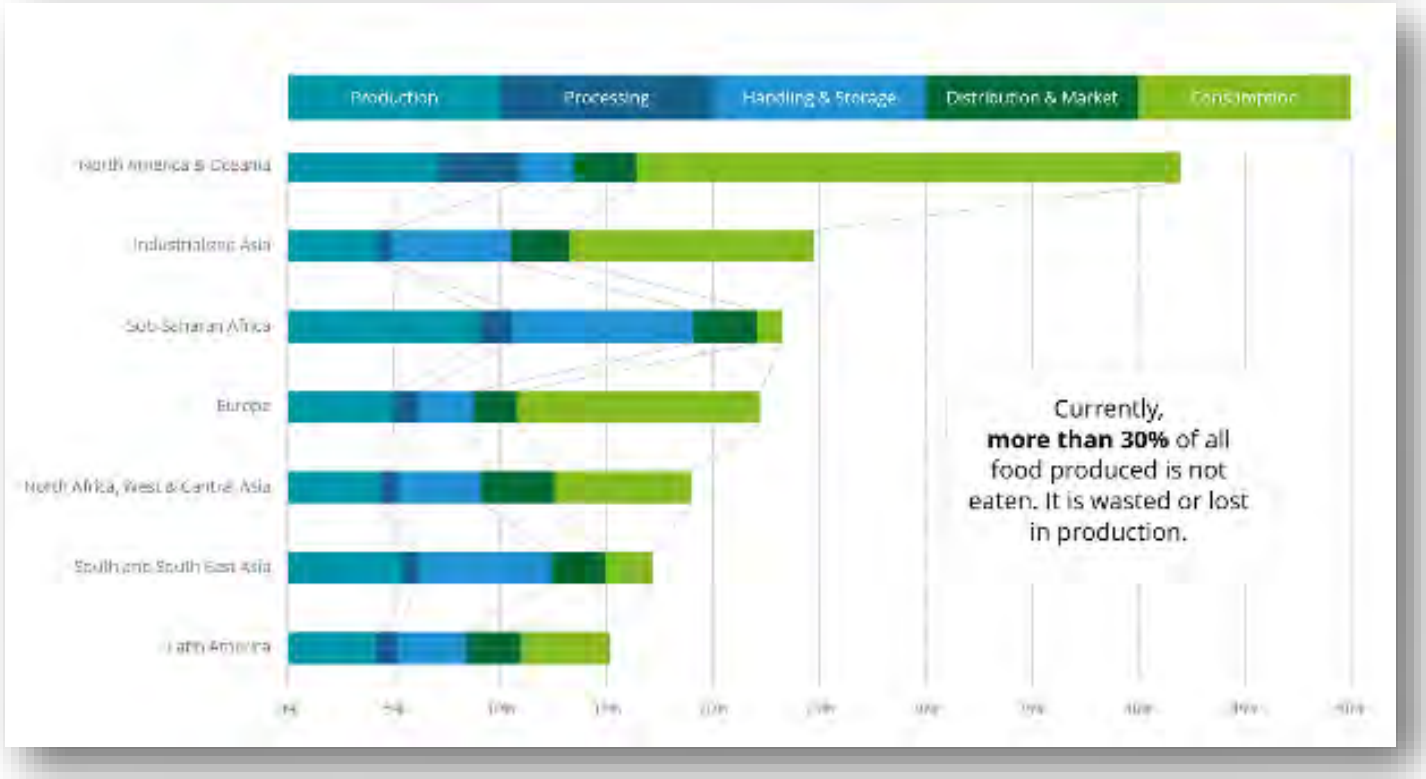


The Future of Waste Reduction & Management

33% of all food produced globally is wasted, which is equivalent to approximately 1.3 billion tons of food. This is about 185 kg per world inhabitant, over half a kilo every single day. The value of this massive loss is around Euro 0.9 trillion.

Reductions in food loss and waste would positively impact the bottom line of many companies throughout the food chain, while improving sustainability and food security. If food waste were to be cut in half, most of the food recovered would be vegetables, dairy products, grains and fruits. These food groups should be targeted to reduce the environmental impact of food waste and loss, though it is important to note that reducing loss and waste in meat production would result in significant reductions in GHG emissions.

Reducing food waste makes economic sense for all stakeholders across the value chain. Farmers are able to sell more of what they produce. Retailers lose no money on unsold food. Consumers save money they would otherwise spend on food that would not be eaten. However, not everyone is aware of the impact that reducing food waste and losses can have. Stakeholders in the food industry should therefore actively encourage and educate businesses and consumers to waste less.



Source: Future of Food | Deloitte Global

The Future of Waste Reduction & Management – Opportunities to reduce Food Waste

There are a number of solutions that businesses can implement to reduce food loss and waste. However, businesses struggle to realise the cost savings associated with these solutions. Sometimes this is because they lack access to reliable markets, sometimes because they are unaware of why and where food is wasted.

1

Food safety insight

Sensors and machine-learning algorithms tracking freshness are helping retailers cut food losses along the value chain. Leveraging machine-learning algorithms and sensors to provide retailers with more complete data about the freshness of food products can inform their decisions about where food should be routed, when it should be displayed, and what the appropriate shelf life of a product is.

2

Food waste insight

Better insight into food waste through AI helps food service providers develop targeted action plans. In developing plans to prevent food waste, a key challenge is knowing what is thrown out, how much, and where this food originates. Smart waste bins that use a camera, scales and artificial intelligence can recognize different foods, identify specific menu items in the bin, and even deduce why certain foods are being thrown out.

3

Supply chain traceability

Digital technologies like blockchain can bring order and transparency to the system as food moves from farm to plate. Experimentation is underway with new technologies that enable a more seamless handoff of food data as it moves through the value chain. Ultimately, this will give customers more trust in the safety of their food, resulting in less waste. Benefits include the facilitation of product recalls, increased transparency for customers and above all, reduction of food waste.

4

Market access

Better market access prevents post-harvest food losses on smallholder farms. Linking producers to profitable markets is an important step in increasing investment in food loss reduction activities. Mobile platforms help connect smallholder farmers to retail vendors in cities where they can access markets for their produce and get the most competitive prices. Existing solutions have helped in reducing post-harvest losses by 25%.

5

Make food for the future

New technologies such as freeze drying help to make the most of residual fresh food streams. With modern drying technology, it is possible to conserve produce (fruit and vegetables) while retaining up to 98% of the nutritional value.

The Imperative EV Battery Recycling: Alleviation to The Constraint of Upstream Resources

The scarcity of upstream resources is a long-term constraint to the development of downstream application market. EV battery recycling will alleviate the constraints of resource supply and demand imbalance on industry development to a certain extent.

Supply: resource pressure

Resource shortage in China

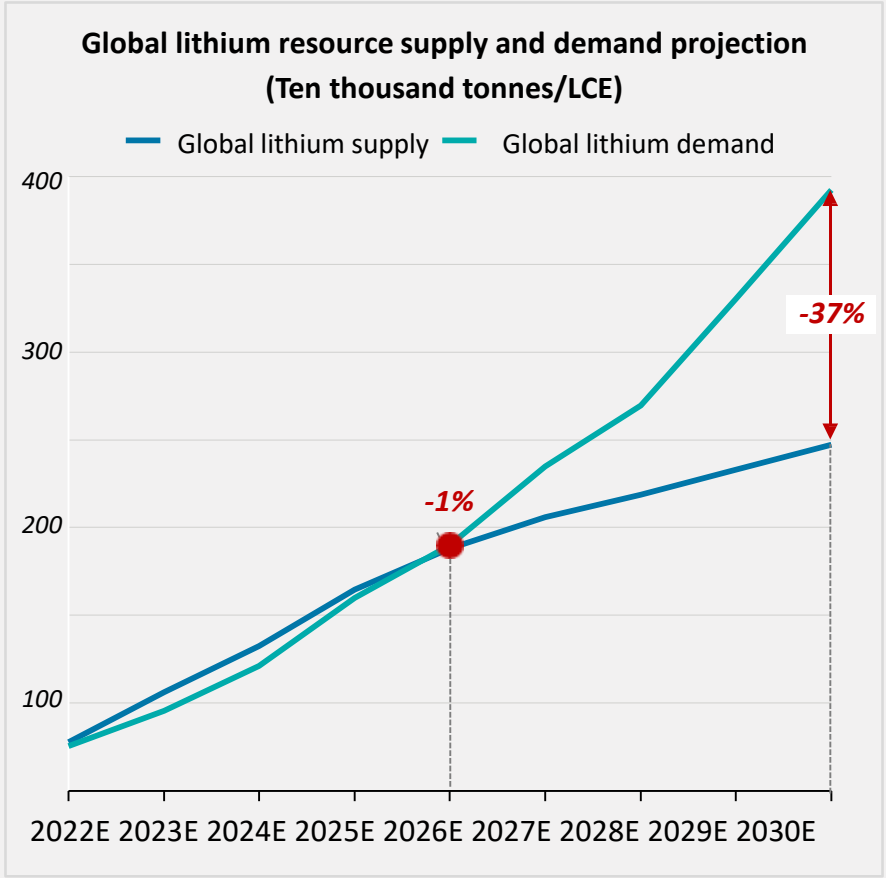
High-quality mineral resources are relatively scarce in China. There are few high-quality hard rock lithium mines, and the technology and production capacity of lithium extraction from salt-lake brine require breakthroughs.

Uncertainty of international supply

The supply of global raw materials is concentrated, and the production fluctuates wildly. Emergencies such as the pandemic outbreak and the Russian-Ukrainian conflict have exacerbated the uncertainty of the global supply chain.

Long capacity development cycle

The development cycle of raw materials and minerals is relatively long. The resource production expansion cycle is about four times that of the EV batteries expansion cycle, thus leading to the mismatch between supply and demand.



Demand: surging EV market

Strong application demand

The EV market, as the main application scenario of lithium resources, has entered a period of rapid growth, and the sales volume of EVs in China increased by more than 150% year-on-year in 2021.

Difficulty in alternative R&D

The R&D of EV batteries with different chemicals is challenging. In the long run, Li-batteries, which have a relatively fixed demand for mineral resources, will still be the mainstay, and it is hard to find an alternative solution in the short term.

Intensive competition

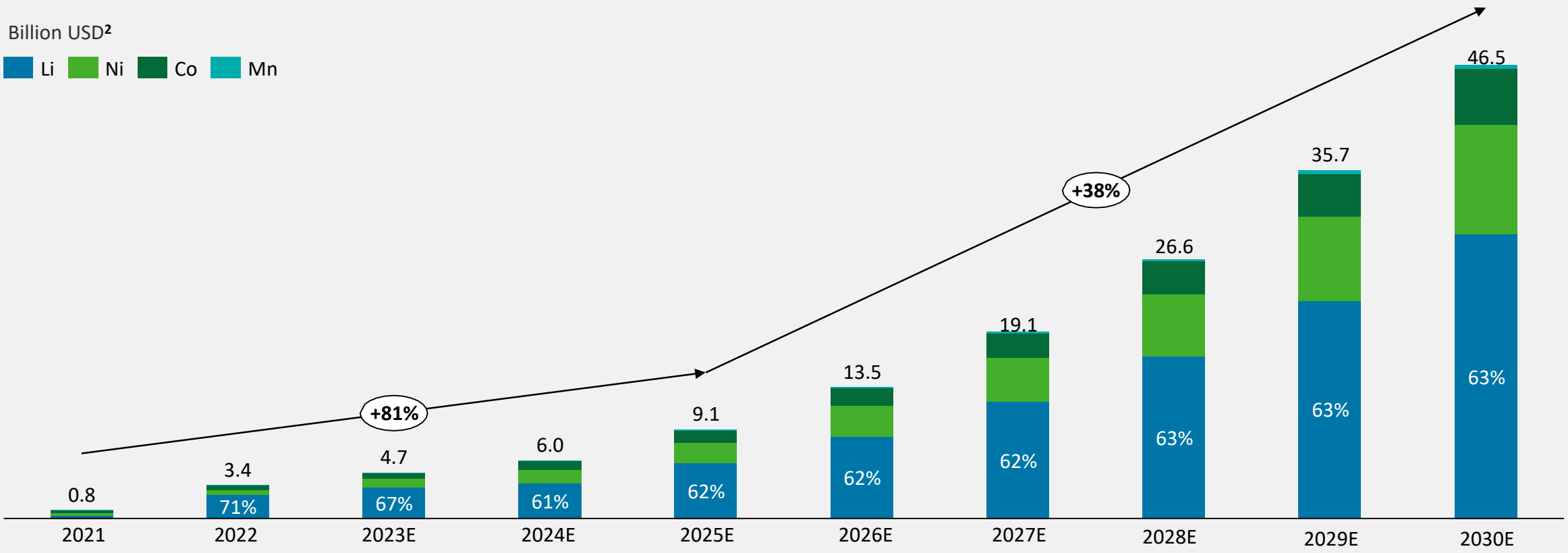
Battery companies maintain a rapid pace of expansion to seize market share and drive the demand for upstream resources, amid the increasingly fierce competition in the EV battery industry.

Source: Deloitte Sustainable Future of Lithium Recycling

Global EV Battery Recycling Market Size Prospects

The development of the global EV battery recycling market is about to accelerate, which is expected to exceed 10 billion dollars in the next five years, among which the recycling market of the lithium is the most considerable.

Global EV battery recycling market size projection[1]



Remarks: 1. Estimate based on the theoretical recyclable quantity and price of lithium, nickel, cobalt and manganese; 2. Converted at the annual average exchange rate of USD to RMB in 2021 (1USD = 6.45RMB)

Source: Deloitte Sustainable Future of Lithium Recycling

EV Battery Recycling Market Drivers - Macro Policy Guidance

After years of development, battery recycling policies and legislation in developed countries are complete with stricter requirements; China has significantly accelerated the introduction of battery recycling policies over the past decade, aiming to promote and ensure the construction of recycling systems and guide the standardized and integrated development of the industry.

North America

Complete federal, state and local battery recycling regulations

The U.S. DOE 2021

Enables the end-of-life reuse of lithium-ion batteries and recycling of critical materials at scale, plan the construction of **a full competitive value chain** in the United States, and **promote the development of cost- effective recycling technology**

National Blueprint for Lithium Batteries 2021-2030

The U.S. EPA 1996

Creates the framework for the proper management of hazardous and non-hazardous solid waste, including rechargeable batteries, lithium-ion car batteries, etc.

The Resource Conservation and Recovery Act

The U.S. State Governments

Makes regulations for the types of waste recycling, disposal methods, cost, etc. to **encourage** all parties in the industry chain to collaborate to help **properly recycle batteries**

Europe

Enhanced requirements and strengthen regulatory systems

EU 2022

The proposed battery regulations set increased targets related to power battery recycling, with stricter requirements for **battery recycling measures and battery metal material recovery rates**

New EU Regulatory Framework for Batteries

Switzerland 2022

Guide to Waste issued by the Federal Office for Environmental clarify rules for recycling lithium batteries for vehicles and encourage automotive OEMs to implement environmentally sound disposal system

FOEN *Guide to Waste*

Germany 2021

Regulatory agencies (Stiftung EAR) have the responsibility to regulate the battery manufacturing market and to check the collection and recycling efficiency of each recycling system and report market participation

BattG2

Japan & South Korea

Regulate the industry from the legislative level

South Korean's Parliament 2021

Ease regulation for mandatory battery recycling of previously registered vehicles and allow for environmental-friendly utilize of end-of-life batteries **to improve the secondary utilization rate of power batteries**

Clean Air Conservation Act

The Ministries of Japan 2004

The Japan Portable Rechargeable Battery Recycling Center, aims **to promote the comprehensive recycling of used rechargeable battery materials**

Diet of Japan 2001

Manufacturing enterprises should fulfill the responsibility of recycling the used products, follow the 3R principle, and **encourage that end-users send end-of-life batteries to special recycling sites**

The Law for Promotion of Effective Utilization of Resources in Japan

China

Gradually improve the establishment of the policy system to strengthen the regulation and policy implementation

MIIT and other two 2022

To develop and introduce new energy vehicle power battery **recycling management methods** and related departmental rules

Implementation Plan for Industrial Carbon Dioxide Peaking

MIIT and other seven 2022

To promote **upstream and downstream cooperation in the industry chain** to build recycling channels

Accelerating the Promotion of Comprehensive Utilization of Industrial Resources

NEA 2021

Request for establishing the **battery consistency management**, and make requirements for the evaluation, monitoring and supervision of energy storage projects **for secondary use**

The Management Standards for New Energy Storage Projects (Provisional)

MIIT 2020

To promote the NEV power battery recycling **system development**, and to establish a number of exemplary enterprises for the secondary use and recycling of waste power batteries

Key Points of Energy Conservation and Comprehensive Utilization in Industry in 2020

MIIT and other six 2018

Implementation of **the extended producer responsibility system**, clarify the primary responsibility fulfillers of battery recycling

Interim Measures for the Management of Recovery and Utilization of New Energy Vehicle Power Battery

MIIT 2018

Establish a "**comprehensive management platform for traceability**" to collect information on the whole process from production to recycling of power batteries

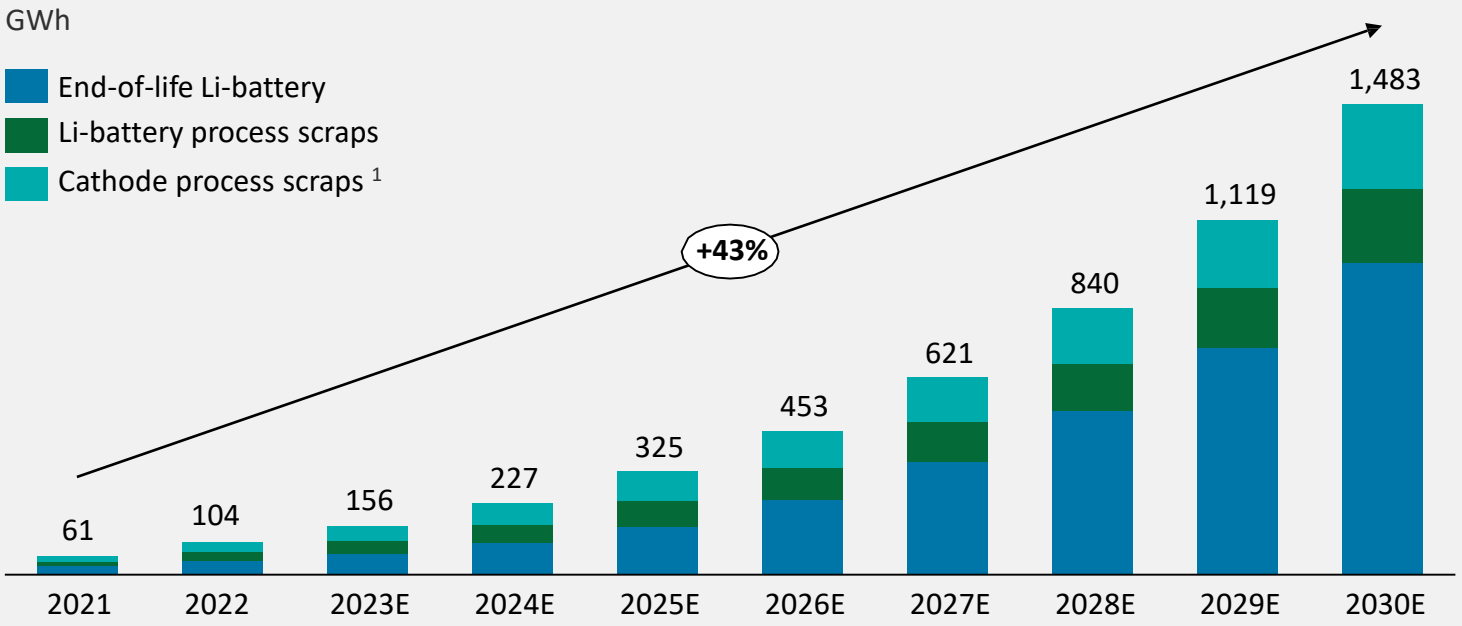
Interim Provisions on the Management of Traceability of New Energy Vehicle Power Battery Recycling

Source: Deloitte Sustainable Future of Lithium Recycling

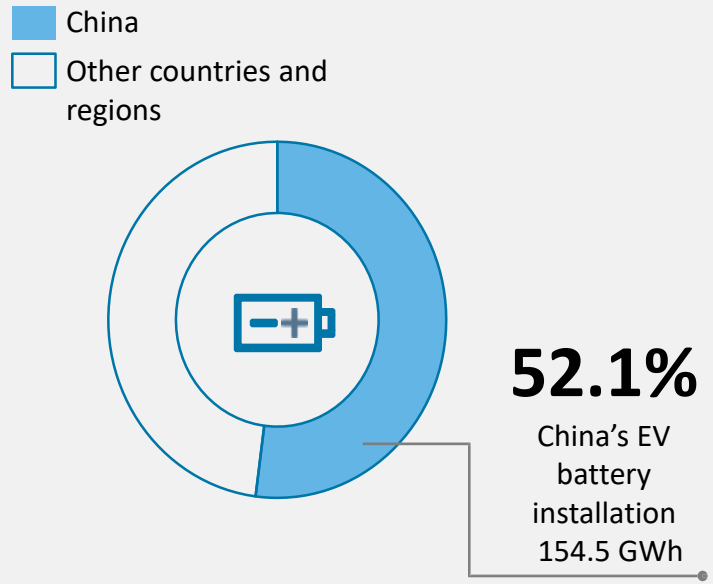
Driving Factor of Battery Recycling Market: The Upcoming Trend of EV Battery Retirement

The retirement tide of EV batteries has promoted the gradual release of recyclable battery waste and driven the development of the global lithium recycling market, with the volume of end-of-life batteries and process scraps rising at a CAGR of 43% over the next decade; The Chinese market, which leads the global EV market, is also expected to usher in considerable growth in the field of Li-battery recycling.

The projection of global recyclable end-of-life Li-batteries & battery production scraps



Global EV battery installation shares in 2021



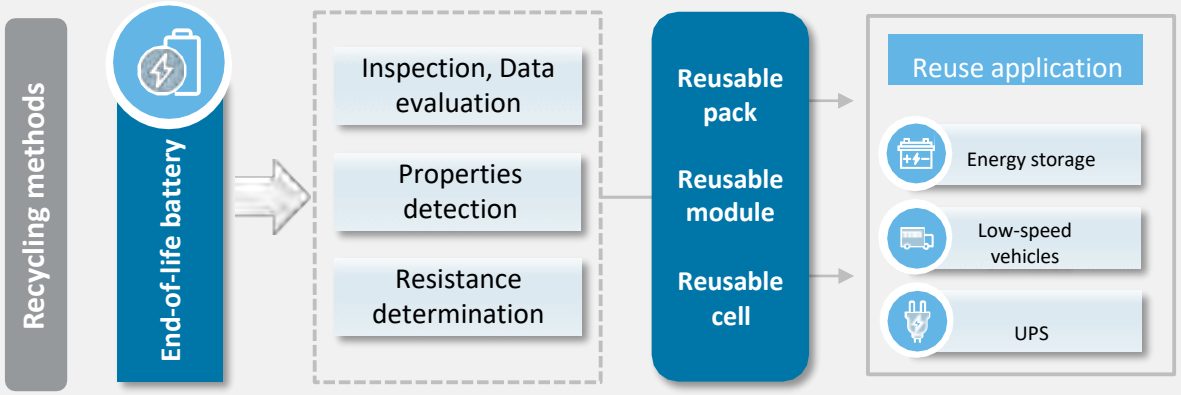
- With the vigorous development of the global EV market, the installed capacity of EV batteries has risen rapidly. The service life of EV batteries is about 5-8 years. Therefore, the first batch of batteries put into the market has ushered in a "retirement tide", especially in the Chinese market, where the production output and sales of EVs and EV batteries have soared since 2015.
- End-of-life batteries are the primary "raw materials" for EV battery recycling. The advent of the EV battery retirement tide will continue to provide recyclable waste for the Li-battery recycling.

Source: Deloitte Sustainable Future of Lithium Recycling

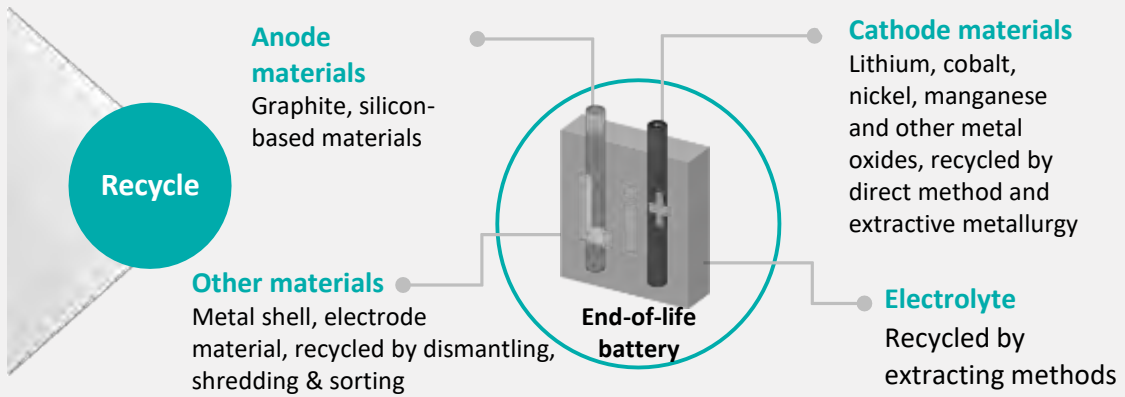
Recycling Methods of EV Battery

Reuse and direct recycle are the most generally acceptable and environmentally friendly methods of batteries disposal. Large-scale applications of EV battery reuse is challenging, and EV battery recycling might be dominated by direct recycle in the medium and long term.

Reuse: utilization of the residual capacity of battery



Recycle: recovery of metal materials and other resources



Pros

Reuse

+ **Increase value:** optimize the utilization of batteries & maximize the residual value
+ **Cost reduction:** reduce the cost of energy storage, low-speed electric vehicles and other related industries, and promote the development of the circular economy
+ **Reduce pollution:** effectively reduce the pollution of waste lithium-ion batteries and reduce waste of resources

Recycle

+ **High recovery rate:** Mature in technology, thus the resource recovery rate is high
+ **Simple process:** The process is more straightforward than reuse, and there is no need for screening and safety assessment
+ **Complementary techniques:** a combined approach can be applied to improve the economic benefits of recycling and solve the problem of energy over-consumption

Cons

Reuse

– **Applicable limitations:** not suitable for ternary (NMC) lithium battery, difficulty to maintain economies of scale subject to many qualifications
– **Inefficiency:** The evaluation process of batteries is time-consuming and inefficient
– **Potential safety risks:** The internal safety hazards of retired batteries are highly concealed, which affects the remaining life and safety of the battery pack

Recycle

– **Cost issues:** The pyro has a large investment and high energy consumption in the early stage, while the hydro is relative time-consuming
– **Environmental pollution:** Both pyro and hydro cause severe environmental pollution easily, and the requirements for pollution treatment are high
– **Uncertainty:** Emerging techniques such as biological processes and supercritical CO_2 extraction are still in startup

Source: Deloitte Sustainable Future of Lithium Recycling

Reuse: Development Limitation Factors

The reuse industry has significant development limitations and bottlenecks at the current stage. The downstream application development is expected to be slow before the policy system is improved and the industry standard is established.

Policy Factor

- **The reuse industry management system still needs to be improved:** The policy management system for the reuse of EV batteries is still in the initial stage of establishment, and it takes time to improve the national regulatory system and local implementation
- **Policy guidance maintains a moderately positive attitude:** Although the policy intends to promote reuse, it also emphasizes the importance of strict management of the safety of EV battery reuse, and is especially cautious towards reuse in energy storage scenarios.

2022.02

Accelerating the Promotion of Comprehensive Utilization of Industrial Resources

Requirements to improve the recycling system and management system of end-of-life power batteries, strengthen traceability management within the whole life cycle of battery, promote the safe reuse application of end-of-life power batteries in the field of power backup, charging and replacement

2021.09

The Management Standards for New Energy Storage Projects (Provisional)

Require newly-built energy storage projects to establish a battery consistency management and traceability systems and obtain the safety assessment reports issued by corresponding qualified organization for reuse of batteries

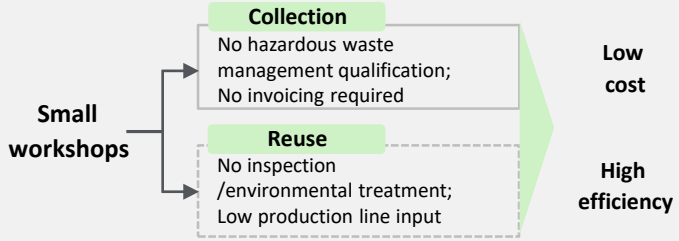
Market Factor

Demand side - uncertain potential:

- **Low acceptance in the downstream market:** Due to unclear standards and immature regulatory system, frequent accidents of battery reused for energy storage have led to low market acceptance. Users are concerned about the safety and consistency of reused batteries
- **Impact of potential alternative products:** the rise of sodium-ion batteries and fuel cells and other technologies may replace and squeeze the market of LFP batteries for secondary use

Supply side - "bad money drives out good":

- **Long-standing market confusion:** In the absence of effective regulation, many non-compliant small workshops have long been entrenched in the reuse market, and it is difficult for enterprises with high investments to profit and survive in the competition

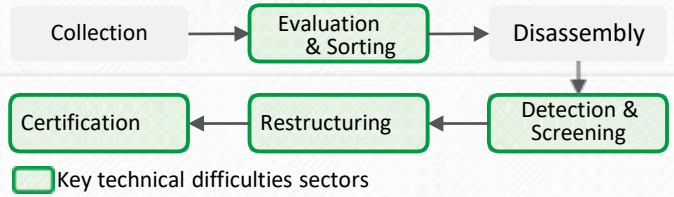


Technology Factor

- **Key technologies to be broken through, industry standards to be established:** The battery life-cycle traceability management and industry-standard system are to be established, and technical problems still exist in several sectors of the reuse technology process

Evaluation and sorting - Battery specifications are complex, and life evaluation is difficult
Detection and screening - Lack of battery use records, complicated detecting technology
Restructuring - High technical barriers to battery consistency management
Product certification - For the formation of industry standards, product certification is difficult

Battery reuse process

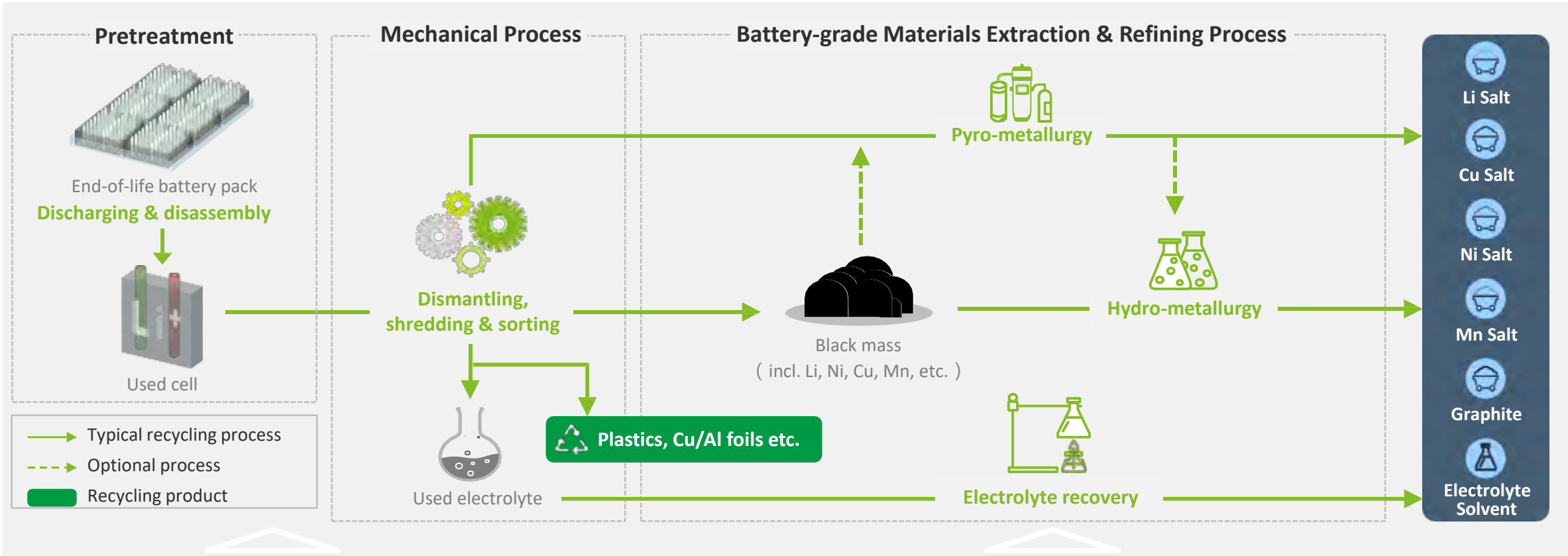


The current market situation: the current commercialization cases of EV battery reuse are few. Most of the projects are pilot programs, with only a few regular enterprises with qualifications participating, such as GEM, China Tower, etc.; the current reuse market is not yet standardized and in chaos. Market confusion caused by non-compliant small workshops forces the regular enterprises into a dilemma, which makes the market less attractive to enterprises that have not entered, and the market is difficult to scale up in the short term.

Source: Deloitte Sustainable Future of Lithium Recycling

Recycle: Process Flow of EV Battery Recycle

The main challenge of power battery dismantling and recycling lies in the instability of front-end battery recycling channels that make it difficult to scale up the production of back-end battery grade raw material refining.



The instability and high cost due to the highly-fragmented battery recycling channels, and **the difficulties of pretreatment** due to wide range of battery pack specifications are the two main difficulties in the disassembly and recycling process

The mechanical process and the metal refining process after the pretreatment of the battery pack have been relatively mature, can realize the effective conversion of the end-of-life EV batteries to recyclable high-purity raw materials; in the situation of sharply-rising lithium metal raw material prices, large-scale production, stable supply of end-of-life batteries and client relations can realize considerable economic returns

Source: Deloitte Sustainable Future of Lithium Recycling

Recycle: Mainstream Battery-grade Material Extraction Techniques

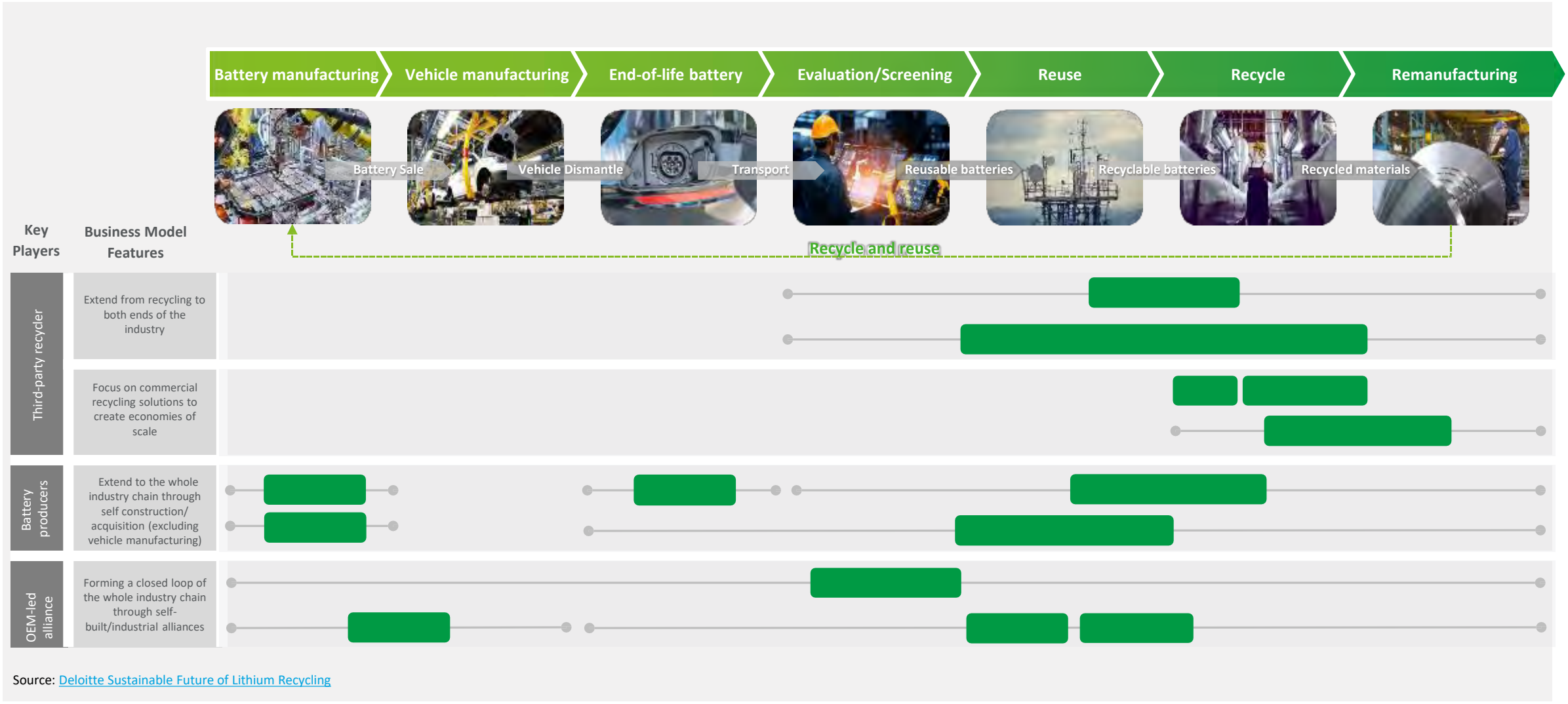
Recycling enterprises generally refine the valuable metals in end-of-life EV batteries through hydro or pyro-metallurgy, which are highly-technical maturity and with clear steps, while other emerging processes, such as biological processes and supercritical CO_2 extraction, are still in the early stages of research and development; currently, in China, EV battery recycling enterprises' processes are mainly based on hydro-metallurgy

	Hydrometallurgy	Pyrometallurgy
Process characteristics	• Use acids to dissolve the metal components of batteries and then separate the constituent elements as inorganic salts and metallic oxide through solvent extractions, chemical precipitation, and electrolysis steps. Hydro is suitable for the recycling of small and medium-scale end-of-life batteries.	• Use high-temperature to convert metal oxides end-of-life in battery materials to metals or metal compounds, which proceeds to condensation and refining. Pyro has high compatibility and is applicable to large-scale recycling of various types of end-of-life Li-batteries.
Facilities/Energy cost	Low cost and energy-efficient	High investment and energy-intensive
Efficiency/Period	High recovery and purity, but relatively long recycle period	The recovery rate is relatively lower, but is capable of recovering various heavy metals such as Hg and Zn
Process complexity	Relatively more complicated, and needs to be adjusted optimized for certain battery chemistries	Simpler pretreatment methods but not effective for Lithium-iron-phosphate (LFP) batteries
Pollution treatment	Require process effluent treatment to avoid water pollution	Require gas clean-up process to avoid toxic air emission
Representative enterprises	Li-Cycle, Fortum, GEM 格林美, 邦普循环	umicore, ACCUREC, GanfengLithium 赣锋锂业

Source: Deloitte Sustainable Future of Lithium Recycling

EV Battery Recycling Industrial Chain

Lithium battery recycling, which has a substantial development momentum, is taking shape to support a sustainable EV supply chain. Up and downstream players in the industry use their advantages to develop vertical cooperation and seek opportunities to gradually extend the industry chain coverage, forming a closed-loop industrial chain from battery recycling to battery material reproduction and integration.

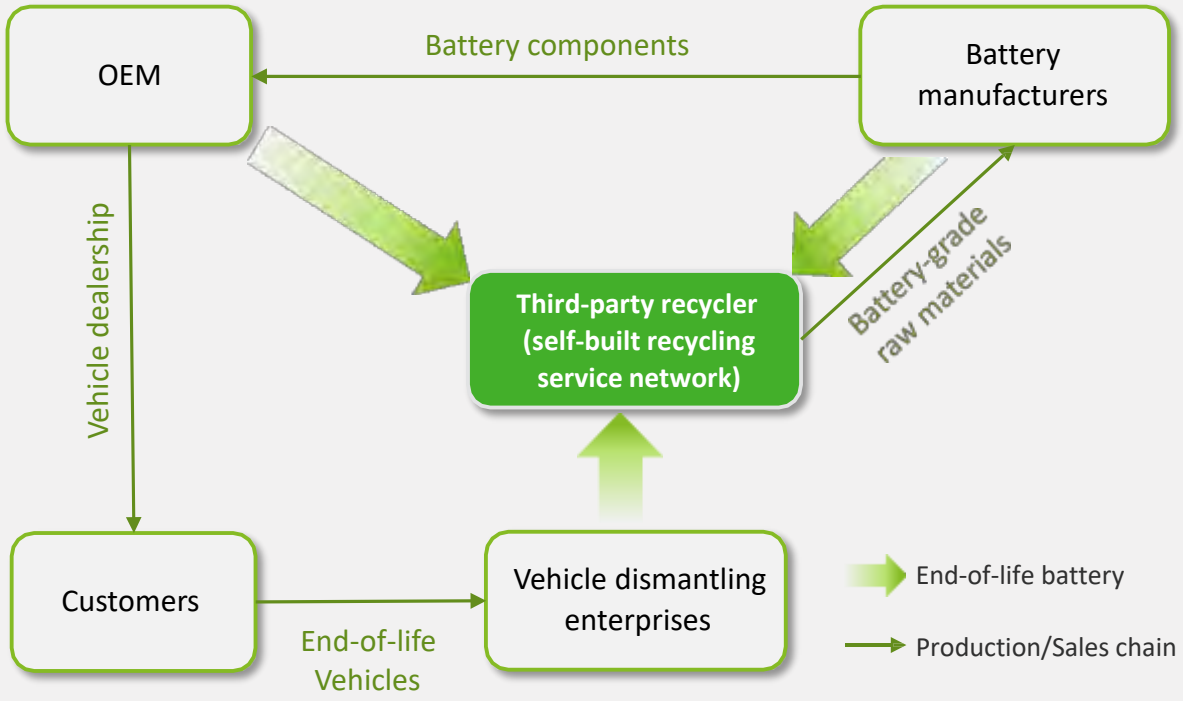


Source: Deloitte Sustainable Future of Lithium Recycling

Business Model: Third-party Recycling

Third-party recycling companies, as the primary recycler of EV batteries, independently establish a recycling service network to complete the process from battery recycling to resource utilization.

Illustration of third-party recycling



Business model analysis

Model features

Third-party recycling companies, as the primary recycler of EV batteries, generally are entrusted by battery and vehicle manufacturers to complete the transportation, recycling and subsequent resource utilization of end-of-life EV batteries

Pros

Highly mature and professional recycling processes, which are widely used, can realize more efficient recycling of end-of-life EV batteries

Cons

The self-built recycling service network poses severe challenges on its high recycling costs, difficulties in transportation and storage, and limited material resale channels

Source: Deloitte Sustainable Future of Lithium Recycling

Third-party Battery Recyclers: GEM (1/2)

GEM pays attention to the construction and maintenance of recycling networks and industrial ecology. Meanwhile, the company is committed to building a new energy life-cycle value chain and has established an industrial chain advantage in the field of power battery green treatment.

The pioneer circular enterprise of end-of-life battery comprehensive utilization

GEM, incorporated in 2001, started with the recycling of nickel-cobalt resources and mobile phone batteries and has gradually expanded to the recycling of waste electrical, electronic equipment, end-of-life vehicles and EV batteries. Over the past 20 years, GEM has been committed to the dual-track driven strategic development of "exploiting urban mines + developing new energy materials".

KSF 1: Secured resource channels and strong recycling network

Through deepened collaborative development of the industrial chain, the company continues to expand its recycling and resale channels and successfully construct EV battery recycling facilities and laboratories in South Africa, South Korea, Indonesia, etc., with its partners. It is expected to deploy a recycling business in Europe in 2022 to accelerate its global business layout

Stable resource channels

GEM has reached recycling cooperation with **more than 500** OEMs and battery suppliers worldwide:

Car manufacturers

BYD, Volkswagen, Toyota, XPENG

Battery suppliers

SAMSUNG, EVE 亿纬锂能, Farasis, LISHEN

National recycling network

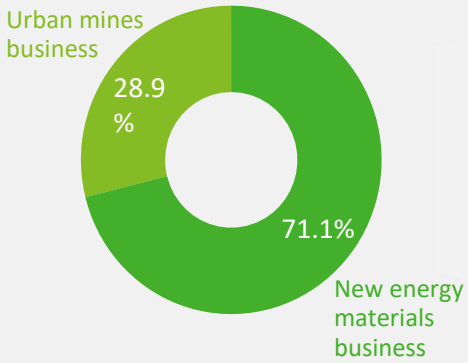
Country-wide integrated recycling networks and the unique "2+N+2" pattern of power battery recycling businesses

- 2 — Two **battery recycling** centers
- \+
- N — Other recycling networks covering **more than 60%** of total NEV in China
- \+
- 2 — Two **resource utilization** and **remanufacturing** parks

KSF 2: Globally-advanced new energy life-cycle value chain

In order to create a closed-loop value chain for the entire life-cycle of EV batteries, the company has tackled many technical challenges in recycling. It is working to ensure the safety of the raw material supply system for new energy material recycling, address the urgent need for the supply chain of critical new energy raw materials, and realize the recycling and deep processing from waste to raw materials for high-end brand products.

GEM Revenue share by business in 2021



"Recycle + Remanufacturing"

The company builds a collaborative recycling industry chain system, and upgrades its business from waste recycling to new energy material manufacturing.

The revenue share of new energy material manufacturing increased from 26.5% in 2016 to 71.1% in 2021

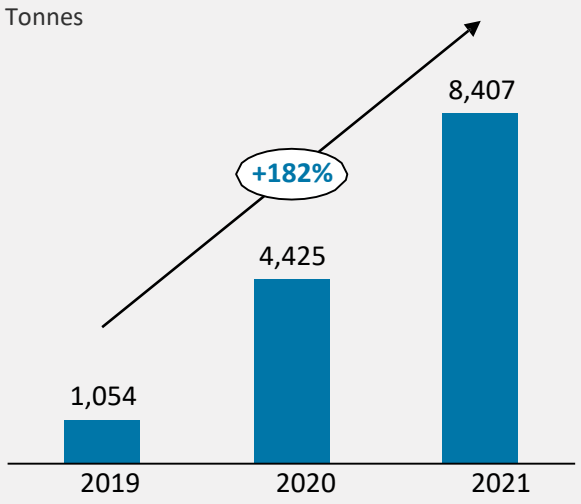
Source: Deloitte Sustainable Future of Lithium Recycling

Third-party Battery Recyclers: GEM (2/2)

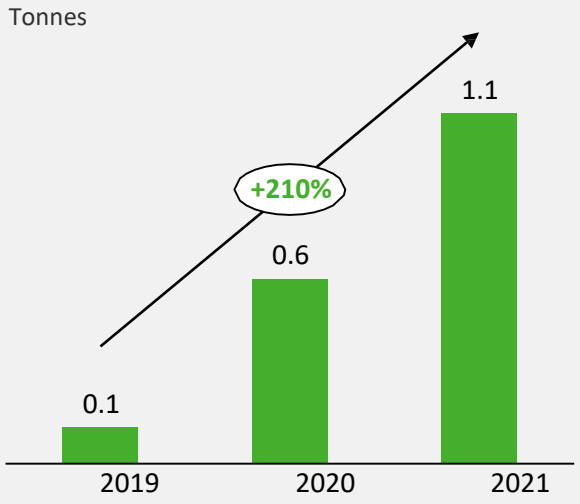
GEM's battery recycling capacity and business income have rapidly grown in recent years. The company has included "expanding recycling" as one of its development strategies. With the advent of the battery retirement tide, GEM will further expand the comprehensive utilization scale of the company's EV battery in the near future.

Rapidly rising battery recycle and reuse capacity

Recycle amount



Reuse amount

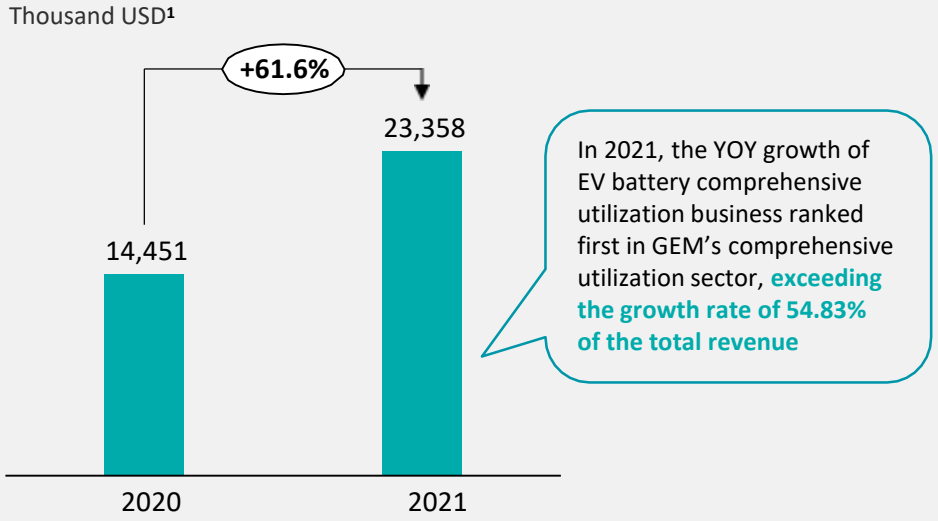


GEM's EV battery recycling and reuse business has shown substantial development momentum, expecting to recycle 30,000 tonnes of EV batteries and reuse around 2Gwh EoL batteries in 2022.

It has been announced that GEM has had a total dismantling, processing and recycling capacity of end-of-life is 215,000 tonnes/year, the total planned capacity in the future for dismantling and recycling is close to 700,000 tonnes/year, and the total planned capacity for reuse exceeds 11GWh.

One of the future business growth engines

Battery comprehensive utilization revenue



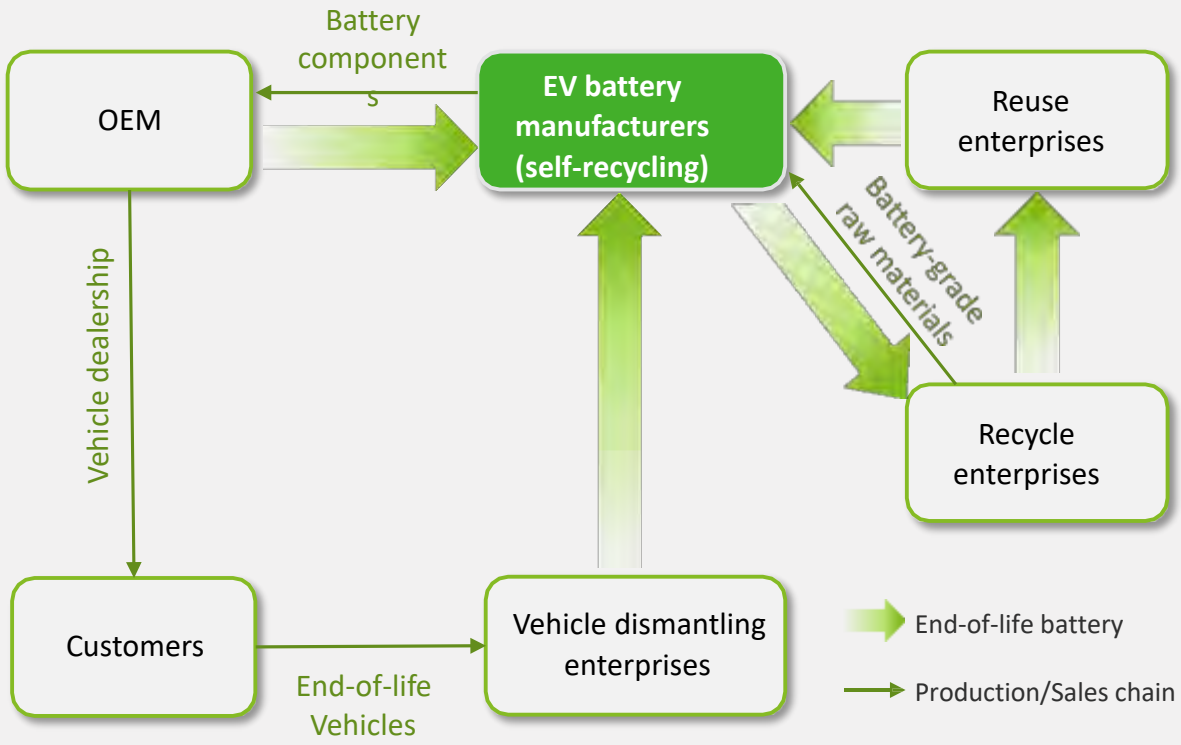
GEM continues to make technological breakthroughs to improve the recycling capacity of EV batteries. In 2025, the company's recycling target will be more than 20 times the recycling capacity in 2021. With the advent of the battery retirement tide, GEM's EV battery recycling and reuse business is projected to become one of the main contributors to the company's future revenue.

Source: Deloitte Sustainable Future of Lithium Recycling

Business Model: Battery Manufacturer as Recycler

Battery manufacturers, as the primary recycler of EV batteries, use their channel advantages to create an industrial closed-loop within the battery life cycle, from collecting and recycling to remanufacturing.

Illustration of battery manufacturer recycling



Business model analysis

Model features

Battery manufacturers, as the primary recycler of EV batteries, have arranged the recycling network by establishing subsidiaries, acquiring recycling enterprises, industrial cooperation, etc. to form circular recycling of EV batteries, realize the cost reduction of recycling, and mitigate the bargaining power of upstream raw material suppliers

Pros

Diversified recycling and resale channels are critical factors for battery manufacturers to effectively control the directional circulation of end- of-life batteries and reduce the recycling and reproduction costs of EV batteries

Cons

Technical restrictions on self-recycling. Due to the dependence of crucial recycling technologies on recycling enterprises, the operation efficiency of the model is usually low, which further hinders the formation of the scale effect

Source: Deloitte Sustainable Future of Lithium Recycling

Hong Kong Market Landscape

Giving waste a new value and closing the loop.

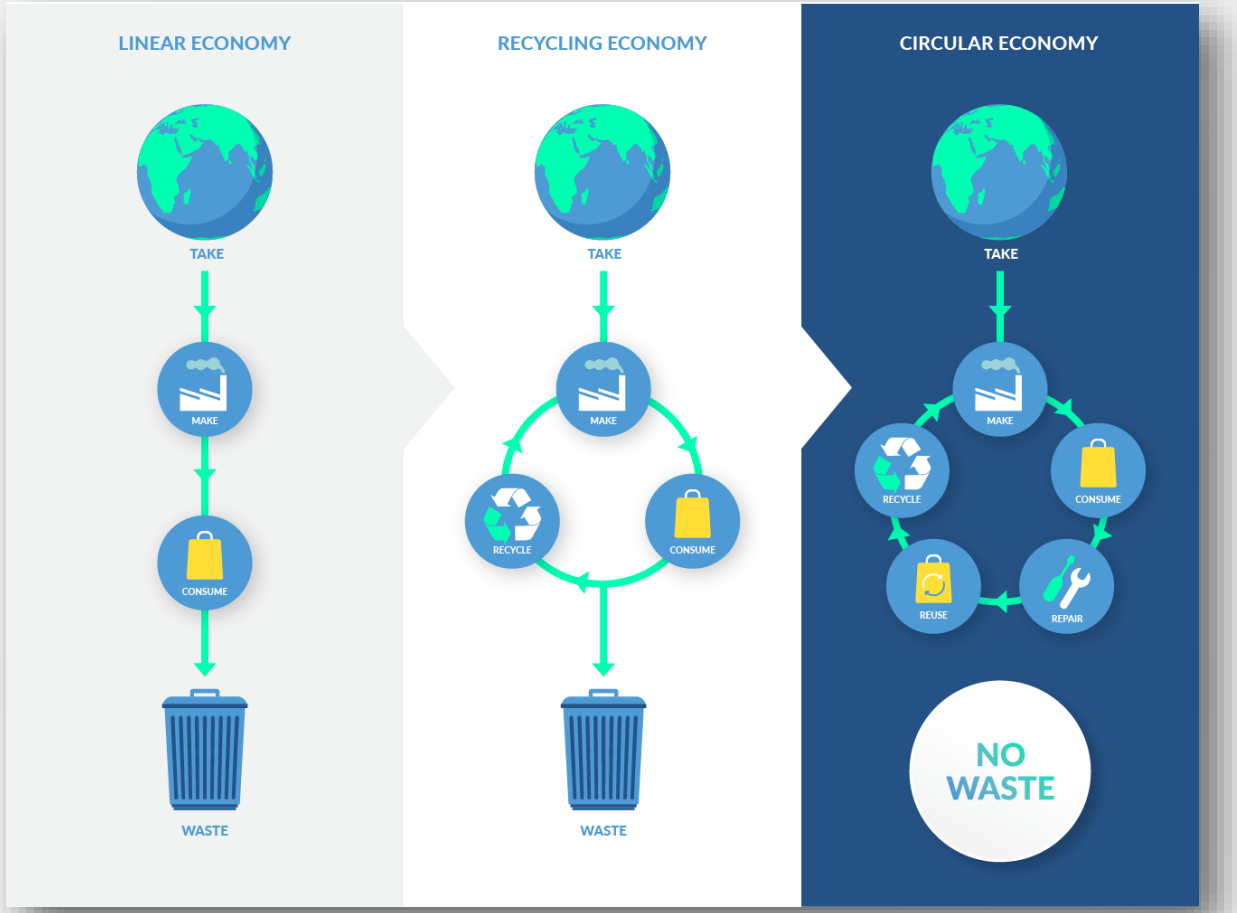
Where we are today:

- Hong Kong Government studies show that Hong Kong produces significantly more waste per capita compared to Tokyo, Seoul and Taipei.
- Instead of improving as per the targets set in 2013, Hong Kong's waste management performance has worsened.
- As of late, business efforts are beginning to emerge, local recycling infrastructure is increasing, enhancing the prospects for Hong Kong to lower its waste footprint.

Where we are headed:

- The final goal is for the circular economy to replace the current make-use-dispose model – We need to re-conceptualise waste as being a resource that can create new value, so that we are less dependent on new resources and inputs.

Moving from a linear economy to a recycling economy and finally a circular economy



Source: Sector: Waste - HK 2050 is Now

Hong Kong Regulatory Landscape – Selected Policy Instruments

The Hong Kong government has been taking steps to promote sustainability in the waste sector.

Policies/Initiatives/Regulations

Financial support; e.g. funding scheme

Waste Blueprint (2013-2022)

The Waste Blueprint, which was unveiled by the Environment Bureau in May 2013, analyses the challenges and opportunities of waste management in Hong Kong, and maps out a comprehensive strategy, targets, policies and action plans for waste management for the coming 10 years with a view to tackling the waste. The government aimed to reduce the per capita disposal rate of municipal solid waste by 40% by 2022, however did not succeed in achieving the target.

Plastic Shopping Bags Charging Scheme

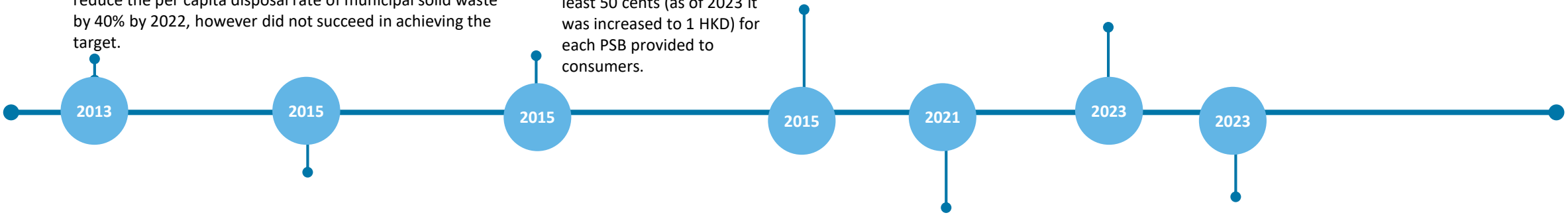
The first phase of the PSB Charging Scheme was implemented on 7 July 2009 and the scheme was fully implemented for the entire retail sector as of 1 April 2015. The scheme bans free PSB distribution at all points of retail sales in the territory. Retailers should charge at least 50 cents (as of 2023 it was increased to 1 HKD) for each PSB provided to consumers.

Recycling Fund

The $1 billion Recycling Fund has been launched in October 2015 and is open for applications.

Producer Responsibility Scheme on glass beverage containers and Waste Electrical and Electronic Equipment

In line with the "polluter pays" principle, collecting a container recycling levy from manufacturers and importers for glass-bottled beverages/ REE products that they distribute or consume in Hong Kong to recover the full cost of recycling.



Waste Charging Scheme

The Waste Charging Scheme's framework was first developed and presented to the LegCo in February 2015. The ordinance is passed on 26 August 2021. A period of 18 months were commenced to allow the public to prepare. There are two charging modes: Charging by designated garbage bags/designated labels ($0.11 per liter for the first three years of implementation) and charging by weight-based "gate-fee". The aim of the waste charging scheme is to reduce waste and incentivize recycling.

Waste Blueprint (2035)

In February 2021, the Environment Bureau announced the "Waste Blueprint for Hong Kong 2035". Building on the blueprint released in 2013, this blueprint outlines the strategies, goals and measures to tackle the challenge of waste management up to 2035. The medium-term goal is to gradually reduce the per capita MSW disposal rate by 40-45% and raise the recovery rate to about 55% by implementing the Municipal Solid Waste Charging scheme.

Ban on single-use plastic tableware

In the first phase of the government's two-step plan, restaurants will be prohibited from providing disposable plastic tableware, cutleries, straws, and stirrers. Restaurants will also not be allowed to give dine-in customers single-use plastic containers. The sale or free distribution of other plastic products, such as hotel toiletries, umbrella covers, plastic cotton buds, and toothbrushes, will also be forbidden in the first phase.

2 Stakeholders' Role in the Market

Stakeholders have a critical role to play in decarbonizing the waste sector and can take a range of actions to reduce carbon emissions.

Necessary Actions

Government

- Proactively push forward ambitious waste reduction policy measures.
- Work with the Mainland so that Hong Kong becomes part of its circular economy.

Commercial & Industry

- Design items that can be repaired, reused, and recycled.

Community & Individuals

- Actively recycle, and bring reusable containers and bags when shopping.

Challenges

- **Regulation push**: the recent announcement of one of the leading recyclers of Hong Kong to seize operations, highlights the need for immediate policy action to provide the necessary material flow for recycling. The delayed introduction of the municipal waste charging scheme is one example of where important policy action was delayed instead of accelerated.
- **Raising public awareness**: Hong Kong, in comparison with other APAC cities, produces the highest per capita waste for many years. Raising the awareness for waste reduction (MSW including food waste) is a critical element of the journey to a low-waste society. Behavioral policies to reduce waste beyond the increased recycling efforts will be needed.
- **Recycling ecosystem**: a high-consumption market such as Hong Kong also provides business opportunities for recycling – to fully capitalize on those opportunities a large eco-system needs to be built, including government as well as leading private sector players and academia. This ecosystem is still under development and needs to be accelerated.

2 Insights from Hong Kong Market Stakeholder Engagement Sessions – Waste Sector

By interviewing the different financial sector focused stakeholders on the Hong Kong marketplace, we have identified the following key insights for the technology, innovation & entrepreneurship sector to be taken into account.

Ecosystem Landscape

- Many “quick wins” **small scale solutions** in the waste industry in Hong Kong; insufficient infrastructure
- Implemented the **municipal solid waste (''MSW'') charging scheme** to encourage waste reduction
- To introduce **legislative control** on disposable plastic products for implementation by 2024

Market Strengths

- Abundant innovative **technologies** and professional industry **talents** to expand the capacity of local waste industry
- Robust and **regulated IP protection** for waste-related solution development
- An ideal **testbed for solutions** before offshoring

Key Industry Offerings

- Waste treatment/transformation facilities such as landfills, **O Park 1 & 2**, and **T Park**)
- **Extensive funding** scheme: Green Tech Fund, Innovation & Technology Fund, Recycling Fund, and Environmental & Conservation Fund
- **Smart Recycling Systems** to try out the local application

Top Business Challenges

- **Identify the best-fitting waste treatment** solution for Hong Kong
- Tailor international use cases and applications to **assimilate to local culture**, standards, and consumer preferences

Advice for Market Entrants

- **Import advanced technologies** leveraging Hong Kong’s unparallel “world city” position
- Use Hong Kong as a **stepping-stone to other markets**
- Redefine **value proposition** to build local capacity
- **Reference** Hong Kong’s **technology parks** to understand the city’s unique culture, applications, and talents.

Case Study | Veolia| France

Waste Reduction and Management

Founded in 1853 by a decree from Emperor Napoleon III in France, Veolia Group has a longstanding history of over 170 years in environmental management, with an ambition to become the benchmark company for ecological transformation. With nearly 218,000 employees on five continents, the Group designs and deploys useful, practical solutions for managing water, waste and energy that help to radically change the world. Through its three complementary activities, Veolia contributes to 3 main pillars - decarbonization, depollution, and regeneration of resources. In 2023, the Veolia group served 113 million people with drinking water and 103 million with wastewater services, produced 42 terawatt-hours of energy and recovered 63 million metric tons of waste. Veolia Environment (Paris Euronext: VIE) generated consolidated sales of €45.3 billion in 2023.

Green Tech market opportunity

Veolia aims to capture market opportunities by offering integrated solutions that address all three key pillars: decarbonization, depollution, and resource regeneration to support Hong Kong's carbon neutrality targets. Our comprehensive approach includes operations across water, waste, and energy management, enabling us to provide holistic solutions that simultaneously tackle multiple environmental challenges.

We target large infrastructure projects in Hong Kong, particularly government initiatives under the DBO scheme, such as drinking water and sewage treatment, waste-to-energy facilities, and district cooling systems. These projects often intersect multiple pillars, demonstrating our ability to offer integrated solutions.

In the private sector, we're expanding building energy services and providing our expertise to help our customers in their decarbonization journey. We also provide innovative solutions within these three key areas, including but not limited to the following:

-Green hydrogen production from landfill biogas

-Solar farm development on a landfill

-Hubgrade, our AI-powered smart monitoring center for energy efficiency

Hong Kong market strengths:
Veolia, with its 30-year presence in Hong Kong, is uniquely positioned to address the city's environmental challenges by combining global expertise with local knowledge. We offer integrated solutions (including operation) across the 3 main pillars - (decarbonization, depollution, and regeneration of resources).

Case Study | ZENCE OBJECT| Macau

Waste Reduction and Management

ZENCE OBJECT is a green-tech company that uses advanced plant extraction and biosynthesis techniques to transform waste into eco-friendly substitutes for traditional timber and plastics. It is founded in Macau in 2020, currently has a team of about 30 people and expanded to Hong Kong since 2023. They have joined the Hong Kong Science Park Accelerator Program this year. The company operates their own factory in Dongguan, specializing in the production and processing of bio-based materials. Their materials can be used in a variety of industries, including FMCG packaging, electronics enclosures, construction materials, and more. Clients include TCL, Starbucks, Heytea, Four Seasons, MGM, Andaz Macau and many more.

Green Tech market opportunity:

The company aims to establish a recycling line in Hong Kong to assist clients in managing waste by converting it into semi-finished products for transport to the mainland for further processing. This initiative aligns with the Hong Kong government's efforts to promote the development of light industry, anticipating significant future demand in the recycling sector. Consequently, the company is increasing its investment in research and development of equipment technology.

Hong Kong is home to numerous food and beverage manufacturers that generate substantial amounts of waste daily. By effectively utilizing this waste, the company can not only reduce environmental impact but also generate revenue. Achieving this goal has become a key priority for the company in Hong Kong.

Hong Kong market strengths:

The requirement to disclose carbon reduction information has created a significant demand for green products and solutions, establishing an excellent business environment for green technology companies.

Case Study| Clearbot | India

Waste Reduction and Management

Clear Robotics builds unmanned, electric boats and ships that do dull, dirty and dangerous marine work. Their solar chargeable vessels cut marine emissions (and fuel cost) by 90%. As a startup company, currently they have more than 10 fleets for garbage removal, ship survey and sea-bed mapping with government agencies and ports across Asia. The company aims to decarbonize the marine sector assets such as boats and ships as well as converting traditional marine operations to emission free alternatives. We are also looking at the management of marine pollution sector for government departments, ports and marinas.

Green Tech market opportunity

The company revolutionizes marine services by delivering unparalleled value through electric, autonomous boats. Aside from traditional debris removal, the company offers a comprehensive suite of services, including surveillance, water quality measurements, and efficient goods delivery across water bodies. Clearbot ensures precise and reliable performance by harnessing advanced robotics and artificial intelligence, empowering clients to achieve their environmental objectives while maximising operational efficiency.

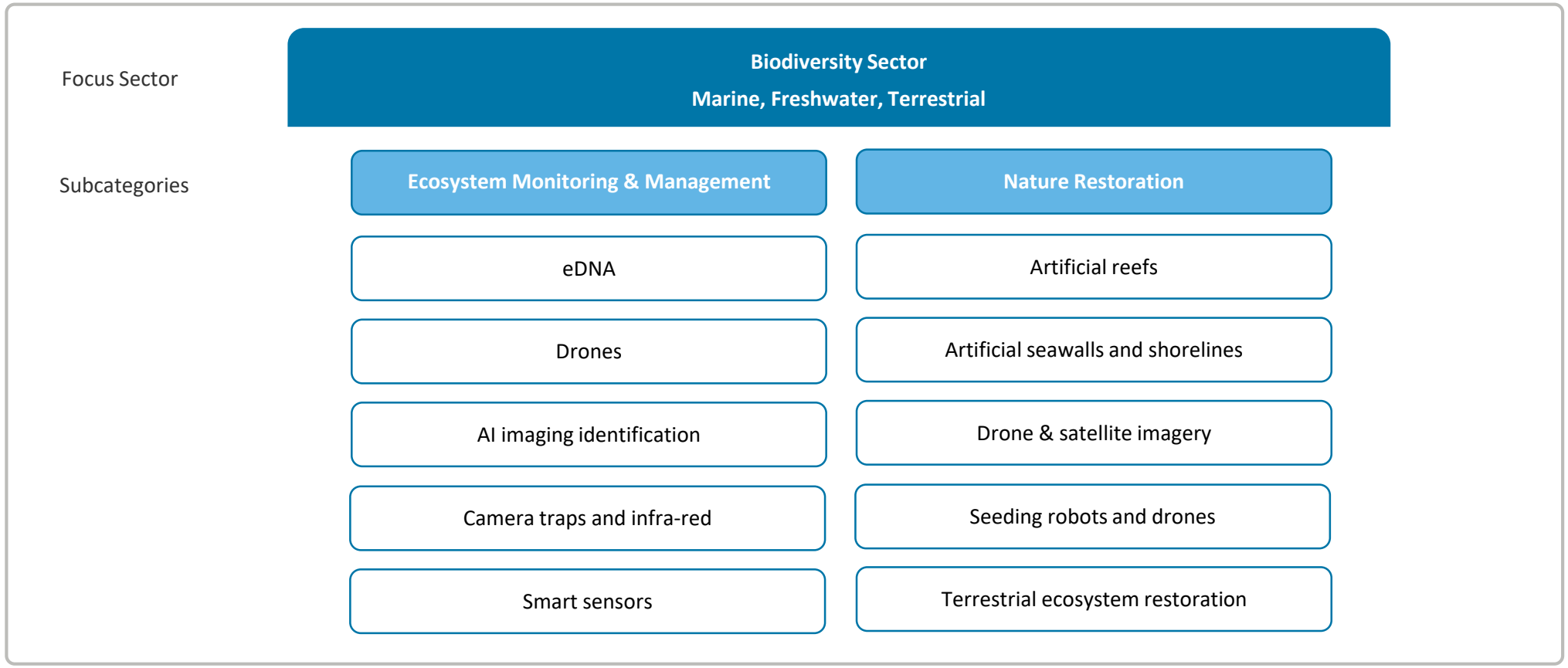
Hong Kong market strengths:

The company has been established in Hong Kong for four years, leveraging the region as a strategic springboard to access both the Chinese market and international opportunities. Hong Kong is an ideal location for carbon markets, as it hosts numerous company headquarters and sustainability offices. Additionally, both the government and the stock market actively promote the adoption of green and ESG initiatives.

Market Analysis – Biodiversity Sector

Green Economy Taxonomy – Biodiversity Sector

After compiling the insightful suggestions from stakeholders in the market, the taxonomy can help to mobilize private capital towards investments that contribute to environmental sustainability and help to identify the most promising sustainable activities in Hong Kong.



The Future of Biodiversity

Biodiversity is crucial for the functioning of ecosystems and the provision of essential services that support human well-being, such as clean water, air, and food.

Today's Challenges

1. **Habitat destruction and fragmentation:** Human activities such as deforestation, urbanization, and agriculture are causing the loss and fragmentation of natural habitats.
    - Between 1990 and 2016, the world lost 178 million hectares of forest, an area larger than the size of Libya. (Source: FAO)
    - Habitat loss and degradation are the primary threats to 85% of all species classified as threatened or endangered. (Source: IUCN)

2. Climate change: Rising temperatures, changing rainfall patterns, and extreme weather events are having a profound impact on biodiversity.

- The global average temperature has increased by 1.1°C since the pre-industrial era, and is projected to increase by 1.5°C by 2040. (Source: IPCC)

3. Invasive species: Non-native species that are introduced to an ecosystem can have devastating effects on native species and the ecosystem as a whole.

- Invasive species have contributed to the extinction of at least 75 vertebrate species, and are a major threat to many more. (Source: CBD)
- Invasive species are estimated to cost the global economy $1.4 trillion per year. (Source: CBD)

4. Pollution: Pollution from sources such as industrial activities, agriculture, and plastic waste is impacting both terrestrial and aquatic ecosystems.

- More than 8 million tons of plastic waste enter the world's oceans every year, harming marine life and ecosystems. (Source: UNEP)
- Pesticides and other agricultural chemicals are a major source of pollution, with up to 40% of all insect species at risk of extinction due to pesticide use. (Source: IPBES)

New opportunities

1. Nature-based solutions: There is increasing recognition of the value of nature-based solutions, which use natural systems to address societal challenges. For example, restoring degraded ecosystems can help mitigate climate change, while also providing other benefits such as flood control and improved water quality.

2. Sustainable agriculture: There is growing interest in sustainable agriculture practices that prioritize biodiversity conservation and ecosystem health. Practices such as agroforestry, conservation agriculture, and organic farming can improve soil health, increase biodiversity, and reduce the use of synthetic fertilizers and pesticides.

3. Ecotourism: Sustainable tourism that prioritizes conservation and community development can provide economic benefits while also supporting biodiversity conservation. Ecotourism can also raise awareness of the value of biodiversity and the importance of protecting it.

4. Biodiversity Mapping, Monitoring & Management: This involves collecting and analyzing data about the distribution, abundance, and diversity of living organisms in a particular ecosystem. Using this data, we can gain a better understanding of ecosystem health, identify areas with high biodiversity, track changes in biodiversity over time, and make informed conservation and management decisions. Satellites or aerial images via drones are used in remote sensing to gather data about the surface of the Earth.

5. Leveraging the Environmental DNA : Water, soil, air, and snow contain DNA naturally shed by animals through their hair, feces, saliva, and skin. eDNA can't determine an animal's age or a species' population size. But when combined with other tools, it can improve our ability to assess the status of wildlife populations and habitats, empowering scientists to design more timely and effective conservation strategies.

The International trend and policy of Biodiversity

Biodiversity is crucial for the functioning of ecosystems and the provision of essential services that support human well-being, such as clean water, air, and food.

1. Kunming-Montreal Global Biodiversity Framework:

- The Kunming-Montreal Global Biodiversity Framework (GBF) was adopted during the fifteenth meeting of the Conference of the Parties (COP 15) following a four-year consultation and negotiation process. This historic Framework, which supports the achievement of the Sustainable Development Goals and builds on the Convention's previous Strategic Plans, sets out an ambitious pathway to reach the global vision of a world living in harmony with nature by 2050. Among the Framework's key elements are 4 goals for 2050 and 23 targets for 2030.
- The implementation of the Kunming-Montreal Global Biodiversity Framework will be guided and supported through a comprehensive package of decisions also adopted at COP 15. This package includes a monitoring framework for the GBF, an enhanced mechanism for planning, monitoring, reporting and reviewing implementation, the necessary financial resources for implementation, strategic frameworks for capacity development and technical and scientific cooperation, as well as an agreement on digital sequence information on genetic resources.

2. The Taskforce on Nature-related Financial Disclosures (TNFD):

- The TNFD aims to build a risk management and disclosure framework that can be used by organisations of all sizes in all jurisdictions to identify, assess, manage and disclose nature-related dependencies, impacts, risks and opportunities.
- To achieve these outcomes, the Taskforce resolved at its first meeting in October 2021 that the TNFD risk management and disclosure framework should be applicable to, and used by, business and financial institutions of different sizes, across sectors and jurisdictions, irrespective of their preferred or required approach to materiality. Halting and reversing nature loss, achieving nature-positive outcomes and mitigating and managing nature-related risks will only be possible if large and small businesses across supply chains and financial institutions of all types are collectively identifying, assessing, managing and disclosing nature-related dependencies, impacts, risks and opportunities.

3. EU CSRD:

- On 5 January 2023, the Corporate Sustainability Reporting Directive (CSRD) entered into force. This new directive modernises and strengthens the rules concerning the social and environmental information that companies have to report. A broader set of large companies, as well as listed SMEs, will now be required to report on sustainability – approximately 50 000 companies in total.
- The new rules will ensure that investors and other stakeholders have access to the information they need to assess investment risks arising from climate change and other sustainability issues. They will also create a culture of transparency about the impact of companies on people and the environment. Finally, reporting costs will be reduced for companies over the medium to long term by harmonising the information to be provided.

Source: Kunming-Montreal Global Biodiversity Framework, The Taskforce on Nature-related Financial Disclosures, Corporate sustainability reporting - European Commission

Importance of the Green Tech Hub

Biodiversity creates significant economic value in the form of such ecosystem services as food provisioning, carbon storage, and water and air filtration, which are worth more than US$150 trillion annually—about twice the world's GDP—according to academic research.

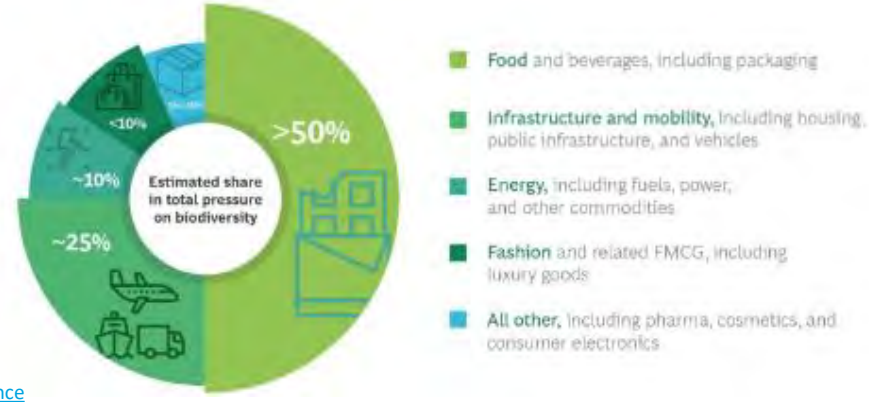
Opportunities. Companies that lead on biodiversity will have significant opportunities to benefit from these efforts:

- They will position themselves to enter profitable new markets by developing valuable new products, services, and entire business models.
- They can improve their value proposition and their brand by responding to public demand for sustainability.
- They will have better access to capital and potential operational synergies, including through reductions in raw material and energy costs.

BUSINESS ACTIVITIES AND VALUE CHAINS CONTRIBUTING TO BIODIVERSITY LOSS

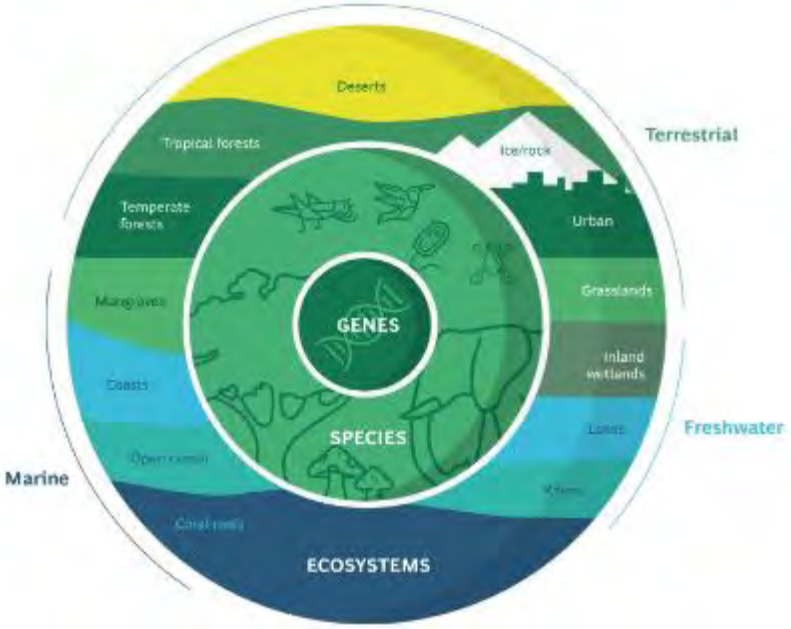
Biodiversity impacts arise all along the economic value chain: The largest impact results from resource extraction and cultivation activities, which account for more than **60%** of overall pressure.

These four categories of activities occur in virtually every major value chain in the global economy. Four value chains are responsible for roughly **90%** of biodiversity loss.



Source: PRB-Biodiversity-Guidance

Exhibit 1 - Biodiversity Is Defined by the Variability in Ecosystems, Species, and Genes



THE ECONOMIC VALUE OF BIODIVERSITY

These ecosystem services fall into four primary categories: regulating, cultural, habitat, and provisioning. The value is split across the categories as follows:

Focus: Marine Biodiversity

Marine biodiversity is important for several reasons:

- Ecological importance: Marine biodiversity supports the functioning of ecosystems and contributes to important ecological processes such as nutrient cycling, carbon sequestration, and the production of oxygen.
- Economic importance: The oceans provide a wide range of goods and services that support human well-being, including fisheries, tourism, and transportation.
- Scientific importance: Marine biodiversity provides a valuable resource for scientific research and discovery, including the development of new medicines and biotechnologies.

Focus Coral Conservation:

The decline in coral reefs causes major problems. Coral reefs make up only 0.2% of our ocean however they are home to over 25% of marine fish species and other organisms. Innovative conservation solutions have emerged:

- One of the new ways they are doing this is by 3D printing. 3D printing of portions of reefs can replace lost pieces of coral. Scientists are using 3D printing technology that helps them to create fake reefs to mimic the texture and structure of the natural reefs in an effort for restoration.
- To help preserve and restore coral, scientists are using an innovative technology called biorock. Biorock is a piece of technology that has a low-voltage direct current which is run through steel. This electricity can then interact with minerals in the seawater and cause solid limestone to grow on the structure. It uses the same principles as electrolysis, where the electric current causes a chemical reaction to occur that would not normally happen.

Source: Status of Coral Reefs of the World

Focus: Terrestrial Biodiversity

Conserving terrestrial biodiversity is crucial for the long-term health and sustainability of ecosystems and the benefits they provide to both humans and the environment.

Terrestrial biodiversity refers to the variety of life on land, including plants, animals, and microorganisms, as well as the ecosystems and habitats in which they live. Terrestrial biodiversity is essential for maintaining the health of ecosystems and providing a range of services that benefit humans, such as pollination, nutrient cycling, and carbon sequestration.

Terrestrial biodiversity is under threat from a variety of human activities, including habitat destruction, overexploitation of natural resources, pollution, and climate change. Some of the consequences of biodiversity loss on land include soil degradation, desertification, and a decline in ecosystem services.

Efforts to protect and conserve terrestrial biodiversity are crucial to ensure the long-term health and sustainability of ecosystems and the benefits they provide. This can involve a range of strategies, such as establishing protected areas, promoting sustainable land use practices, and restoring degraded habitats. By conserving terrestrial biodiversity, we can ensure the continued provision of important ecosystem services, support the livelihoods of local communities, and help mitigate the impacts of climate change.

Sustainability Solutions

Habitat conservation: This involves protecting and restoring natural habitats and ecosystems, such as forests, grasslands, wetlands, and deserts, to maintain biodiversity and support ecosystem functions.

Protected areas: Establishing protected areas, such as national parks and wildlife reserves, can help to safeguard biodiversity and provide a safe haven for threatened and endangered species.

Sustainable land use: Promoting sustainable land use practices, such as agroforestry, integrated pest management, and conservation agriculture, can help to reduce the impacts of human activities on biodiversity and support ecosystem functions.

Restoration: Restoring degraded habitats, such as degraded forests, wetlands, and grasslands, can help to improve ecosystem health, support biodiversity, and provide a range of ecosystem services.

Hong Kong Market Landscape

There are plenty of opportunities for businesses and stakeholders to work towards a more sustainable biodiversity sector in Hong Kong.

Where we are today:

- A 2018 report by the Hong Kong Sustainable Finance Forum estimated that the environmental goods and services sector in Hong Kong, which includes businesses involved in environmental protection, pollution control, and biodiversity conservation, had a total output value of HK$31.5 billion (approximately US$4 billion) in 2015. This represents a growth rate of 7.6% over the previous five years.

Where we are headed:

- There is significant potential for growth in the environmental sector in Hong Kong, particularly in areas such as sustainable tourism and renewable energy. With its unique biodiversity and natural landscapes, Hong Kong has the potential to develop a thriving ecotourism industry that supports conservation efforts while providing economic benefits to local communities. In addition, there is growing interest in sustainable practices such as urban farming and rooftop gardens, which can help to reduce food miles, increase local food security, and promote biodiversity conservation.

Carbon emissions from biodiversity sector in Hong Kong

Carbon emissions from the biodiversity sector are the emissions that result from human activities that affect the diversity of life on Earth. These activities include land use change, resource extraction, and primary processing of metals and minerals. According to a study by the UN Environment Programme, these activities are responsible for half of the world's carbon emissions and **more than 80%** of biodiversity loss.

The biodiversity sector in Hong Kong is not explicitly reported in the greenhouse gas inventory, but it may be related to some of the emission sources such as land use change and waste management. For example, land use change may affect the carbon storage capacity of forests and wetlands, while waste management may affect the methane emissions from landfills.

According to a report by WWF-Hong Kong, Hong Kong's ecological footprint (a measure of human demand on nature) was 4.3 global hectares per person in 2016, which was about three times higher than the global average. This indicates that Hong Kong's consumption patterns are putting high pressure on biodiversity and natural resources.

Hong Kong Market Landscape

In recent years, there has been a growing recognition of the economic value of biodiversity, leading to increased interest in green business opportunities. Hong Kong's government has shown commitment to sustainable development and has implemented policies to encourage green innovation and conservation-related initiatives.

Growing local customer demand

The Hong Kong government, along with various environmental organizations, plays a crucial role in conserving and protecting the city's biodiversity. Several nature reserves, country parks, and marine parks have been established to safeguard habitats and promote conservation efforts.

Numerous research institutions and universities in Hong Kong conduct studies on biodiversity and related fields. These institutions work on various aspects, such as species identification, ecological surveys, monitoring programs, and conservation strategies. Research findings contribute to better understanding and management of Hong Kong's biodiversity.

Hong Kong's biodiversity also attracts tourists interested in exploring nature and wildlife. Ecotourism operators offer guided tours, nature walks, birdwatching excursions, and eco-adventures in the city's protected areas.

Cost saving opportunities due to alignment with government plans

The Hong Kong government launched its updated Climate Action Plan 2050 in 2021, aiming to reach carbon neutrality by 2050 and pledging HK$240 billion (US$30.9 billion) for climate actions.

In Hong Kong, development and unsustainable use of natural resources are the major derivers of biodiversity loss on land at sea – Hong Kong's consumption of natural resources is the third-worst per capita in the Asia-Pacific.

The Hong Kong government launched many Financial supports (funding schemes) in biodiversity sector. Such as Environment and Conservation Fund (ECF), Sustainable Agricultural Development Fund and Biodiversity Conservation Fund.

Stronger market synergies comparing to the other jurisdictions

Proximity to Mainland China and advantages of GBA

Hong Kong's Biodiversity Strategy and Action Plan (BSAP) sets out strategies and actions to be taken in the future to conserve Hong Kong's biodiversity and support sustainable development for future generations.

Growing sustainability market

There is a growing demand for biodiversity sector in Hong Kong. Compared to Singapore, a more mature market, Hong Kong provides more opportunities for companies to grow and prosper.

Hong Kong Regulatory Landscape – Selected Policy Instruments

The Hong Kong government has been taking steps to promote sustainability in the biodiversity sector.

Policies/Initiatives/Regulations

Financial support; e.g. funding scheme

1994

The government has been **party to the Convention on Biological Diversity since 2011**, after China extended it to cover the city as well. Countries under the agreement have to craft policies to conserve biodiversity, ensure sustainable use of natural resources that affect biodiversity, and guarantee fair and equal sharing of those resources.

2011

The government has formulated the first city-level **Biodiversity Strategy and Action Plan (BSAP)** for Hong Kong in 2016, to step up biodiversity conservation and support sustainable development in the next five years. The BSAP covers four main areas: conservation, mainstreaming, knowledge and community involvement.

2016

Countryside Conservation Funding Scheme:
The Countryside Conservation Office (CCO) was established in July 2018. The Government has earmarked HK$1 billion to support countryside conservation initiatives implemented under the CCO, of which HK$500 million will be deployed to provide financial support to local non-profit-making organisations (NPOs) and villagers through the Countryside Conservation Funding Scheme (CCFS). The CCFS is dedicated to support sustainable and holistic conservation efforts in Hong Kong's rural countryside. A new project type entitled Proactive Conservation (PC) was introduced under the CCFS in February 2023, with a view to deepening the sustainable conservation and revitalisation efforts for the countryside.

2018

Sustainable Agricultural Development Fund supports sustainable agricultural practices that promote biodiversity conservation and environmental protection. Projects that are eligible for funding include the development of sustainable farming techniques, the protection and restoration of habitats, and the promotion of eco-tourism.

2018

Lantau Conservation Fund (LCF)
The Government announced in the 2018 Policy Address the $1 billion funded Lantau Conservation Fund (LCF) to promote conservation of Lantau ($500 million), and to pursue minor local improvement works in villages and communities in support of conservation initiatives ($500 million). The LCF will support projects that would contribute to the overall conservation of Lantau, raise community awareness on the conservation of Lantau, and engage the community.

2021

The government has announced Hong Kong's **Climate Action Plan 2050 in 2021**, setting out the vision of "Zero-carbon Emissions, Liveable City, Sustainable Development", and outlining the strategies and targets for combating climate change and achieving carbon neutrality. The plan includes four major decarbonisation strategies: net-zero electricity generation, energy saving and green buildings, green transport and waste reduction.

Environment and Conservation Fund (ECF): The ECF provides funding for a wide range of environmental and conservation projects, including those related to biodiversity. Projects funded by the ECF can include research, education and public awareness campaigns, and habitat restoration and management.

2 Stakeholders' Role in the Market

Stakeholders have a critical role to play in decarbonizing the biodiversity market and can take a range of actions to reduce carbon emissions across the entire biodiversity sector.

Necessary Actions

Government

- Implement carbon pricing
- Support biodiversity conservation
- Invest in the protection and restoration of natural habitats
- Raise public awareness

Commercial & Industry

- Develop sustainable products and services
- Engage in carbon offsetting
- Collaborate with stakeholders
- Report on carbon emissions and sustainability performance
- Raise awareness among employees and customers
- Adopt sustainable practices

Community & Individuals

- Reduce carbon footprint
- Support biodiversity conservation by participating in conservation activities
- Support sustainable products and services by choosing environmentally-friendly products, supporting local eco-friendly businesses, and advocating for sustainable policies
- Advocate for sustainable policies

Challenges

- **Bankability of biodiversity projects**: nature-based projects are more difficult to quantify in terms of benefit commercially as well as from an environmental point of view – requiring also much more detailed data points compared to technology-based solutions such as renewable energy. Having credible players on the marketplace providing such credible and specific data points for the biodiversity sector would close this gap.

- **Regulation framework to include the impact on nature**: whilst the climate risk reporting framework with the TCFD is established and will be mandatory for Hong Kong listed companies as of 2025, the requirement to report on nature using the TNFD (mandatory in Australia) is not yet on the policy agenda, limiting the awareness for nature-based solutions on the marketplace.

2 Insights from Hong Kong Market Stakeholder Engagement Sessions – Biodiversity Sector

By interviewing the different financial sector focused stakeholders on the Hong Kong marketplace, we have identified the following key insights for the technology, innovation & entrepreneurship sector to be taken into account.

Ecosystem Landscape

- The city is small yet **rich in biodiversity with 5000+ marine and terrestrial species**
- Rapid growth in **urban biodiversity** with more initiatives like urban parks, green landscape, organic farms, etc
- Commitment to protecting **indigenous communities**
- **40-50% of land is under preservation**

Market Strengths

- Abundant training courses offered by universities and NGOs (e.g. Wetland Training Program)
- High **demand for restoration-related advisory** services and technology due to rapid urban development
- **Innovative biotech** development (e.g. gene editing)
- **Large drug markets** to fuel biomedical research

Key Industry Offerings

- **Public funding** from bodies such as Agriculture, Fisheries, & Conservation Department (AFCD) and Food & Environmental Hygiene Department (FEHD)
- Climate Action Plan 2030 and **emphasis on marine resources** are conducive to **bio-innovation**
- Synergy with **Mainland projects** (e.g. Shenzhen's Mangrove Nature Reserves)

Top Business Challenges

- Eco-tourism gaining popularity, yet **mismanagement** could lead to further destruction
- Environmental impact assessment (EIA) and implementation are **long-process**
- Need active thinking and action to **commercialise university researches**

Advice for Market Entrants

- Build **foundation in biodiversity cultivation** during the industry's infancy stage
- Leverage **blockchain technology** to track production
- **Partner with local universities**
- Leverage non-government organisations to penetrate different local communities (e.g. schools)

Case Study | Archireef | Hong Kong

Biodiversity

Archireef

Archireef is a nature-tech company specializing in the development of climate resilience solutions for marine ecosystem restoration, with a primary focus on coral reefs. Leveraging innovation, science, and sustainability, its products are designed from natural materials and have garnered global recognition from organizations such as the World Economic Forum, IUCN, and CNN. Among its pioneering offerings is the 3D-printed Reef Tiles™, crafted entirely from clay to promote coral regrowth and marine biodiversity. Operating on a B2B model, the company provides clients with a holistic service framework that includes a setup fee for hardware deployment and a subscription-based model for ongoing monitoring services. This approach enables businesses to achieve sustainable transformation while aligning with global nature-positive frameworks. Since its founding in Hong Kong in 2020, it has expanded its footprint to the UAE, Saudi Arabia, and Singapore, underscoring a commitment to addressing marine ecosystem challenges on a global scale.

Green Tech market opportunity:
The global blue and Green Tech market is poised for significant growth, driven by increasing demand for sustainable solutions in response to climate change and environmental degradation. Marine ecosystems, which contribute over US$2.5 trillion annually to the global economy, are under severe threat due to rising sea temperatures, pollution, and overfishing.

Governments and businesses are investing in marine conservation as part of the blue economy, expected to reach $3 trillion by 2030. The company solutions directly contribute to marine biodiversity restoration, a critical component of this economic segment. The integration of sustainability into coastal and urban development also creates demand for innovative Green Tech solutions.

The Taskforce on Nature-related Financial Disclosures (TNFD) framework is driving corporate awareness of biodiversity-related risks and opportunities. Archireef's solutions allow businesses to mitigate risks associated with biodiversity loss while capitalizing on opportunities for nature-positive investments and compliance.

Hong Kong market strengths:
Strategic Location: As a gateway to Asia, Hong Kong provides direct access to fast-growing markets in the region, including Mainland China and Southeast Asia, which have significant coastal and marine conservation needs.
Innovation Ecosystem: Hong Kong's robust innovation ecosystem, supported by government funding and academic collaboration, provides fertile ground for research and development
Global Financial Center: Hong Kong's status as a leading financial hub offers access to investors and partners who are increasingly prioritizing ESG-aligned ventures.

3 | Hong Kong as the Global Green Tech Hub

Hong Kong as an International Green Tech Hub

Hong Kong stands out as a premier international Green Tech hub, leveraging its strategic gateway to Mainland China and other growth markets, robust regulatory framework, highly-skilled talent pool, accessible funding, conducive innovation environment, and world-class infrastructure to drive sustainable development.

Achievements By Numbers

 # 1 ranked globally as the world's **freest economy**

 # 1 hub for **new tech** in Asia, HKD 150B devoted on I&T by the HK government

 # 3 ranked globally for **foreign direct investment inflows** in 2021

 # 1 ranked globally for **investment environment** 2023

 # 1 ranked in APAC and #2 globally for **enterprise conditions**

 # 4 ranked globally in **Globally Financial Centres Index**

Opportunities At a Glance

Gateway to Growth Markets

Close ties with Mainland China and a perfect gateway to key international and growth markets, with 9,000+ MNCs, of which 3,600+ have regional headquarters or offices in Hong Kong

Robust Regulatory Regime

Government shows strong commitment to carbon neutrality, particularly through Climate Action Plan 2050 to set out decarbonisation strategies, covering waste reduction, net zero electricity, green transport, energy savings building

Highly-Skilled Talents

Top-notch universities with five of them being ranked among the top 100 universities worldwide, and research facilities including 5 government-established centres covering automotive, applied science, textiles, logistics and advanced materials to ensure healthy industry supply

Ease of Funding Access

As APAC financial node to onshore and offshore fund, Hong Kong demonstrates strong financial sophistication with an abundance of investors and funding programmes such as Green Tech and New Energy Transport Fund, coupled with a supportive green finance system

Conducive I&T Environment

International innovation capital to facilitate openness of innovation and flow of knowledge, innovation and technology under a comprehensive ecosystem supported by an internationally renowned professional services industry, providing a homebase for nurturing ESG startups

World-Class Infrastructure

Well-developed smart city with advanced hard and soft infrastructure provided by incubators including HKSTP, InnoParks, Cyberport, HSITP, HKPC, etc. to offer spaces for innovation and accelerate translation of R&D outputs, providing an impetus for sustainable growth

Hong Kong as Green Tech Hub – Key Reasons to Invest: Power & New Energy

From top-down active inter-government policies and funding to bottom-up talents exposure and environmental compatibility for innovative product testing, Hong Kong is a great place to invest to potentially maximise commercial value of clean energy.

Strong Government Commitment

Regulations, policies, and campaigns supporting zero-carbon endeavours

Opportunities

- ✓ **Plethora Use Cases Commercialising and Reinforcing Value of Clean Energy:** Execute top-down policies and industry guidelines as well as bottom-up campaigns to enable favourable conditions to cement the city's foundational resources, fortifying organic and inorganic demand from across the public and private sector for clean energy, creating a conducive environment for new businesses and green investment

Talents Hub for Green Energy R&D

A city carrying two champion universities and well-funded research centres

Opportunities

- ✓ **Leader in Global Hydrogen Energy:** Pioneer discoveries in hydrogen energy opens doorway to possible real, sustainable commercial value, with potentials to partner with Mainland China as the leader in hydrogen economy to develop use cases in different business scenarios
- ✓ **Platform for World-class Expertise:** Use the academically attractive platform to collaborate with local universities to establish a centralised knowledge transfer office for accelerating research translation and business matching

Robust Financing Options

Governmental sponsorship and cross investment funds dedicated to local and Mainland China's decarbonisation projects

Opportunities

- ✓ **APAC Financial Node to Onshore and Offshore Funds:** Enables distribution of variously-sources investment across zero-carbon projects through pitching competition that comprises of renowned investors from Hong Kong and the GBA to expand fund raising
- ✓ **Leeway for FDI to Enter Mainland China:** Use Hong Kong's unique "World City" positioning and leverage China's mandatory requirement for disclosure of social responsibility reports for listed companies to capture the net-zero opportunities

Avant-Garde I&T Environment

City's culture and commercial genetics make it an ideal testing center for latest innovation and digital solutions

Opportunities

- ✓ **Abundant Energy Data with Mature Provision:** Take advantage of the prevalent digital adoption that enables timely energy-related data across government departments and public-serving enterprises for facilitating commercial and public planning
- ✓ **Testing Environment for Innovation:** Hong Kong's receptivity to green innovation drives positive R&D feedback loop, establishing itself as a test bed for new innovations supported by a multicultural market pool

Source: Hong Kong Government, Enerdata, Hong Kong University, South China Morning Post , Hong Kong Green Building Council, Environment Protection Development, Hong Kong University of Science and Technology, Electrical and Mechanical Services Department, Census and Statistics Department, Civic Exchange, China Securities Regulatory Commission

Hong Kong as Green Tech Hub – Key Reasons to Invest: Sustainable Built Environment

Hong Kong offers a springboard for China inbound and outbound investment, supportive government policies and business environment, highly skilled talent pool, and a wide range of financial services and funding support to support capital intensive infrastructure projects.

Gateway to China & Growth Markets

Close ties with Mainland China and a perfect gateway to key international and growth markets for market expansion

Opportunities

- ✓ **China Inbound Investment:** Explore synergy in the enormous market in the Greater Bay Area, rest of China and proximity markets
- ✓ **China Outbound Investment:** Expand business into rest of the world leveraging Hong Kong's international building and construction system

Robust Regulatory Regime & Policy

Strong commitment to carbon neutrality through policy changes and regulatory support from national and local government

Opportunities

- ✓ **Top Choice for Headquarter:** Leverage the business-friendly climate to set up regional headquarters to facilitate cross-border expansion
- ✓ **Prototyping Paradise:** Protect new technologies through the effective and standardised patent system and international rating solutions

Deep Industry Expertise

Top-notch universities and research facilities to develop human capital and a healthy industry supply for driving operational excellence

Opportunities

- ✓ **Rich Talent Pool:** Utilise the strong local government support to cultivate and attract quality talents to serve as pioneers for developing iconic building and construction projects
- ✓ **Talents Driven Digitisation:** Digitise value chain to optimise design simulation and construction

Easy Access to Public & Private Funding

Financial sophistication with an abundance of investors and funding programmes coupled with a supportive green finance system

Opportunities

- ✓ **Fund Raising Hub:** Scout public and private investors and funding sources to support capital intensive, large-scale infrastructure and construction projects in Hong Kong and other markets

Source: Hong Kong Government, Statista, Hong Kong Construction Industry Council, Hong Kong Green Building Council

A Hong Kong as Green Tech Hub – Key Reasons to Invest: Green Mobility

Hong Kong offers a springboard for China inbound and outbound growth, supportive government policies and incentives, and a conducive innovation and technology environment to facilitate the development of smart mobility solutions and foster a sustainable transport system.

Gateway to China & Growth Markets

Close ties with Mainland China and a perfect gateway to key international and growth markets for market expansion

Opportunities

- ✓ **Springboard to China:** Take advantage of Hong Kong's strong ties with Mainland China to tap into the R&D resources and enter the enormous market in the GBA and rest of China

Favourable Government Policies & Incentives

Strong commitment to smart mobility through policy modernisation and incentive support from the government

Opportunities

- ✓ **Strong local demand:** Ride the government's investment and efforts to capture the rising demand across electric vehicles, autonomous/connected driving and other green mobility services

Conducive Innovation & Technology Environment

International innovation & technology hub to facilitate continuous development and adoption of digital solutions

Opportunities

- ✓ **Prototyping Paradise:** Leverage Hong Kong's international consumers and use the city as a new technology testing and demonstration zone, and accelerate speed-to-market

Source: United Nations, Transport Department, Environment Bureau, Hong Kong Trade Development Council (HKTDC), Zero Emissions Mobility Consortium, World Resources Institute, Civic Exchange, Statista, South China Morning Post, Environmental Protection Department

Hong Kong as Green Tech Hub – Key Reasons to Invest: Waste Reduction & Management

The pressing needs to manage waste across Hong Kong and mainland China under restricting policies invited more funding and more active commercial practices to tackle the issues in the market, giving rise to large market value.

Gateway to China & Growth Markets

A perfect gateway to tap into Mainland Chinese market for waste management innovations

Opportunities

- ✓ **Expansion Path into Mainland China:** Collaborate with mainland merchants to commercialise and localise research and development
- ✓ **IP Registration Haven:** Penetrate markets with research & development enabled by globally recognised IP protection

Robust Regulatory Regime & Policy

Strong government commitment to waste management under a robust policy framework

Opportunities

- ✓ **Fundraising Hub:** Demonstrate path to success beginning as startups and acquire extensive funding opportunities with tailored consultative services

Talent Retention & Development

Top-notch universities and research facilities to provide readily supply of talents and drive research excellence

Opportunities

- ✓ **Homebase for Nurturing Waste Management Startups:** Hire the abundant supply of local and international talents to develop effective value chain

Ease of Funding Access

Financial sophistication with an abundance of investors and funding programmes coupled with a supportive green finance system

Opportunities

- ✓ **Top Choice for Test-pad/ Business Case:** Make use of the strong market demand combined with ample fundraising opportunities allow Hong Kong to be a valuable mature market test-pad

Source: Hong Kong Government, Environment Protection Development, Hong Kong Productivity Council

Hong Kong as Green Tech Hub – Key Reasons to Invest: Biodiversity

There are abundant financial resources and cross-border (mainland-Hong Kong) governmental efforts promoting tourism and green infrastructure, making Hong Kong a treasure city to conduct studies and development on wildlife preservation.

Gateway to China & Growth Markets

A perfect gateway to tap into Mainland Chinese market for eco-tourism and recreation

Opportunities

- ✓ **Ideal Test-pad for Chinese Market Expansion:** Prototype innovative biodiversity before production scale-up in GBA facilitated by favorable regulatory conditions in Hong Kong

Robust Regulatory Regime & Policy

Strong government commitment to biodiversity conservation under a robust policy framework

Opportunities

- ✓ **Funding Hotspot Backed by Governmental Support:** Tap into a wealth of financing opportunities, leverage in-flight governmental initiatives and rising local awareness in biodiversity conservation for commercial success

Thriving Talent Pool

Top-notch universities and research facilities to provide readily supply of talents and drive research excellence

Opportunities

- ✓ **High-impact Research Hub:** Drive R&D collaborations with world-leading researchers and tap into Hong Kong's thriving conservation community

Natural Resources Conducive to Research

Home to a myriad of terrestrial and marine habitats and niches

Opportunities

- ✓ **Nature Habitat Haven:** Optimise environment for researcher to collect high quality data for future research by anchoring research facilities in Hong Kong

Source: Hong Kong Government, United Nation Foundation, Agriculture Fisheries & Conservation Department , Hong Kong University, Chinese University of Hong Kong, World Wide Fund for Nature

Contact Details

About InvestHK

InvestHK
The Government of the Hong Kong Special Administrative Region of the People's Republic of China

Invest Hong Kong (InvestHK) is the Hong Kong Government's department for attracting foreign direct investment. We have offices in major cities around the world and industry experts across a range of business sectors. Our goal is to help overseas and the Mainland companies to set up and develop their businesses in Hong Kong. For those foreign companies that are already established in Hong Kong, we extend our services to help them expand in our city.

All of our services are free, confidential and tailored to clients' needs. Our comprehensive range of services includes:

Latest information on Hong Kong's business environment:
- Sector-specific advice and opportunities
- Business incorporation procedures
- Tax and business regulations
- Cost-of-business models
- Employment legislation
- Immigration requirements

Business networking opportunities and introduction to business contacts:
- Lawyers, accountants, human resource specialists, consultancies, designers, interior specialists and real estate companies
- Meetings with service providers, professional associations and government officials and departments

Business support facilitation:
- Support and assistance with business licences, visa applications, trademark registration, IP and trade regulations
- Marketing and public relations services during the launch and expansion of your company
- Advice on living and working in Hong Kong — housing, healthcare, schooling and networking

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