MACKENZIE

GREEN BOOK

2023 ENVIRONMENTAL OUTLOOK

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2023 ENVIRONMENTAL OUTLOOK

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MACRO VIEW

Creating solutions for an unprecedented global challenge

Todd Mattina, Ph.D
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SUMMARY POINTS

- The path to net zero is bumpy
- We believe that energy prices will decline from 2022 peaks
- The role of private capital continues to grow

The path to net zero is bumpy

Containing global warming to within 1.5° to 2°C will require aggressive cuts to global greenhouse gas (GHG) emissions in order to reach net zero by 2050. While the magnitude of the challenge is clear, and the potential cost of failure is high, the path to net zero remains elusive. By some estimates, current carbon reduction commitments will only reduce emissions by about 10% in 2030 relative to 2019 levels, well below what is necessary to achieve Paris Agreement goals. More ambitious national targets will likely be needed.

To accelerate the decarbonization process, policymakers must reach into their toolkit and provide incentives in two key ways[1]:

Implementing carbon taxes. Profit-maximizing businesses and budget-conscious households make their investment and spending decisions based on prices. Carbon taxes can ensure those prices reflect the full social cost of GHG emissions, providing incentives for greener production and consumption[2].

Cutting fossil fuel subsidies. Governments worldwide, especially in developing countries, subsidized fossil fuel consumption at an estimated cost of about U.S.$700 billion in 2021, counteracting decarbonization efforts. This enormous subsidy can be redirected to mitigation and adaptation, including green infrastructure and transition-related capital expenditures by business[3].

[1] Source: Getting on Track to Net Zero: Accelerating a Global Just Transition in This Decade. IMF Staff Climate Note, 2022/010. S. Black, J. Chateau, F. Jaumotte, I. Parry, G. Schwerhoff, S. Thube and K. Zhunussova. November 2022.

[2] Source: Climate Mitigation, IMF.

[3] Source: M. Wolf, FT, 2022.

NET ZERO

Pledge vs. Reality

Containing global warming to within 1.5° to 2°C will require cutting global GHG emissions by an estimated 50% below 2019 levels by 2030, followed by further aggressive cuts to reach net zero by 2050.

Source: https://climateactiontracker.org/press/global-update-projected-warming-from-paris-pledges-drops-to-two-point-four-degrees/

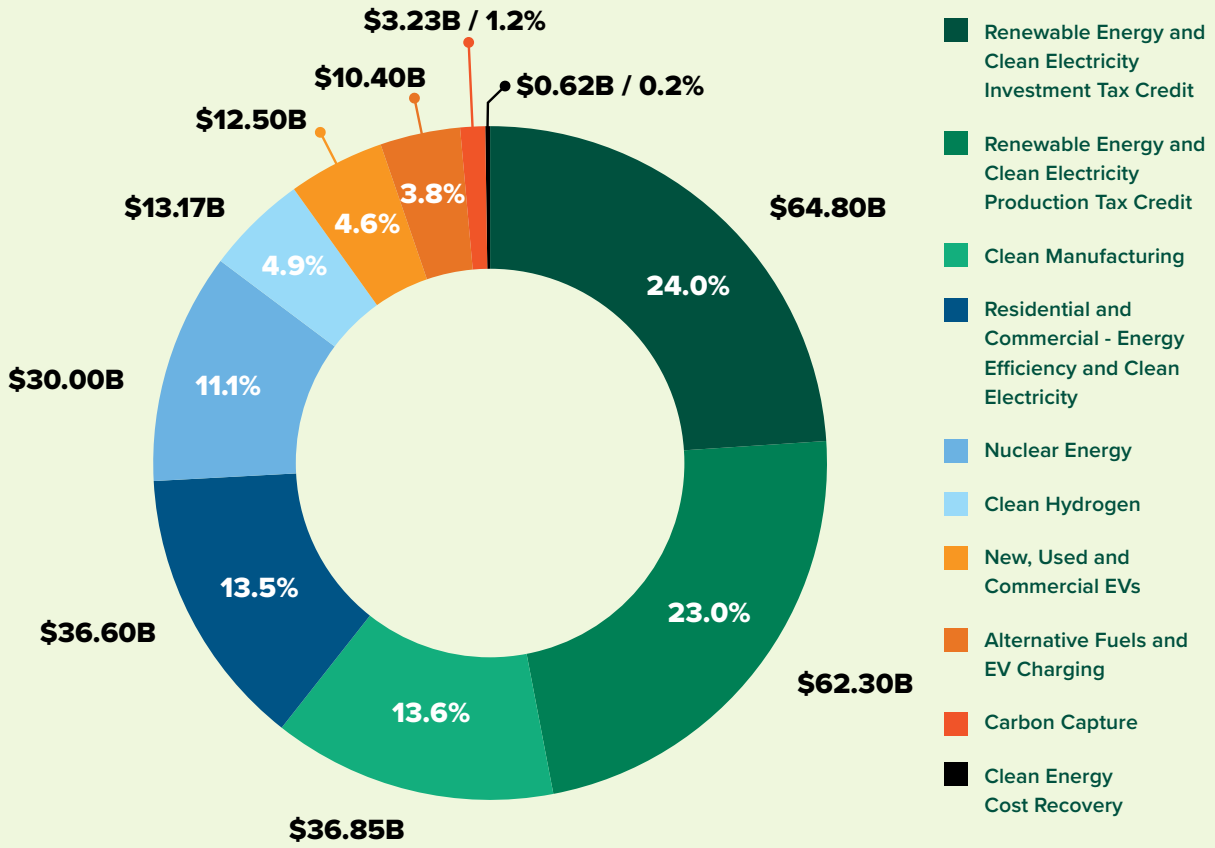
We believe that energy prices will decline from 2022 peaks

World energy prices are expected to decline from elevated 2022 levels. In response, national carbon taxes and subsidies can be adjusted over time to prevent a large decline in prices. By holding fossil fuel prices stable, policymakers can encourage adoption of greener energy as the relative cost of renewables falls.

- **Promoting greener energy.** Achieving net zero will require a transition to renewable energy. The cost of adding new renewable energy capacity has declined dramatically in recent years, even falling below the cost of adding new fossil fuel capacity in some cases. However, the trend toward wider adoption of renewables has stalled. The lower incremental cost and financing requirement for GHG-emitting fossil fuels remains a hurdle for broader adoption.
- **Developing carbon capture.** New technologies have significant potential, such as capturing carbon directly from the atmosphere. However, more research and innovation are needed to develop effective and scalable technologies.

Government support can help overcome hurdles to greater adoption. In the U.S., for example, the Biden administration's Inflation Reduction Act (IRA) allocates U.S.$369 billion to promote more energy-efficient appliances, weatherizing homes, encouraging heat pumps and solar panels. It also provides tax credits for new projects from electric vehicles to green energy, such as wind farms and hydrogen projects. Other major economies could roll out similar packages.

Green tax credits in the Inflation Reduction Act (IRA)



Source: Congressional Budget Office, Environmental and Energy Study Institute (EESI), currency in USD

The role of private capital continues to grow

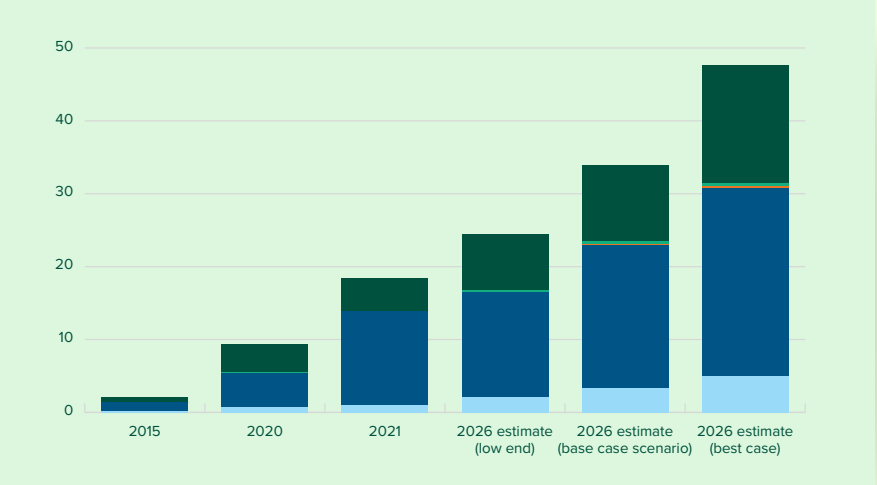
While governments have a critical role to play, private financing will also be needed to achieve net zero. **Private capital has increasingly embraced sustainable investing via initiatives such as the Net Zero Asset Managers initiative and others.** With growing investor demand for sustainable assets, the cost of capital for low GHG emitters is expected to fall over time, encouraging investment in renewables.

The IMF estimates that private sustainable finance in developing countries reached U.S.$250 billion in 2021 and will need to double by 2030[4]. The UN estimates that the financing gap for climate adaptation could reach up to U.S.$300 billion per year by 2030[5].

To achieve net zero, governments will need to ratchet up emission reduction commitments and strengthen implementation, which includes adjusting tax and subsidy programs, expanding green infrastructure and strengthening price incentives. This process will need to accelerate sharply in coming years if the world is to reach emission targets in 2030 and 2050. **Increasingly aggressive commitments coupled with more effective carbon pricing could provide the incentives for attracting more private capital in industries that are well-aligned with net zero.** The transition will be challenging, creating new risks to navigate and new opportunities to add value in the years ahead.

Growth in sustainable investments is expected to outpace the industry

Global sustainable investment AUM by region (US$tn)



Source: PwC Global ESG and AWM Market Research Centre analysis, Lipper, Preqin, ESG Global. From PwC report "Exponential expectations for ESG"

Our view

The transition to net zero will require increasingly aggressive carbon reduction targets over time and firmer implementation of existing commitments. This process will likely be bumpy for the global economy and will require skillful navigation by policymakers and investors alike.

[4] Source: How to scale up private climate finance in emerging economies, IMF Blog, October 7, 2022. [5] Source: Adaptation Gap Report, 3 November 2022.

ENVIRONMENTAL UPDATE

Environmental solutions are where capital needs to go

John Cook
SVP, Co-head,
Mackenzie Greenchip Team

Theme 1
The future looks bright for solar energy in renewables

Theme 2
Efficiency solutions get a boost from high energy cost

Theme 3
Energy production and recycling converge in clean tech sector

Theme 4
Water and sustainable agriculture to serve growing populations

Theme 5
Mass transit is a growing opportunity

The future looks bright for solar energy in renewables

The Mackenzie Greenchip team continued to favour solar power over wind through 2022 for a few key reasons. Generally, solar output is more predictable than wind, and solar equipment is easier and quicker to install. At the same time, the equipment costs as a percentage of overall development are much lower than for wind. As material costs for both technologies increased in 2022, inflation seemed to affect wind economics much more than solar – it just takes a lot more molecules to build a wind turbine. Finally, because it can take up to 10 years to plan and develop a wind farm (vs. two years or less for solar), financing costs can increase exponentially as rates increase.

Renewable installations for 2022 have not been published yet, but we predict solar could exceed 250 GW this year, a 25% YOY increase, while wind installations will be challenged to meet the 94 GW installed in 2021. Generally, gross margins for solar manufacturers increased in 2022. Several turbine manufacturers lost money.

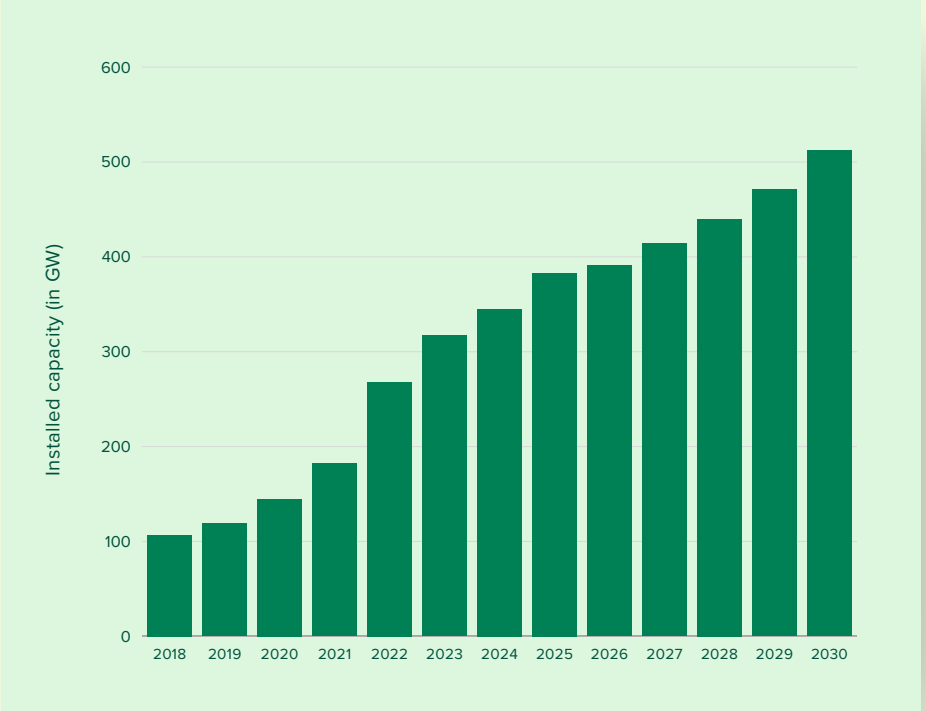
That all said, concern is growing that the solar industry will eventually overextend itself and, despite a decade of incredible growth, history suggests the growth will have to reverse at some point. We don't think that moment is here yet, but when installations slow, prices and margins will retreat. Our view has been that in a retrenchment, the larger players we've backed will become even more dominant.

Notably, solar remains less than 3% of total global energy generation. If prices do eventually decline, the relative cost advantages that solar (and wind) already have over natural gas, coal and nuclear will increase. We've done very well investing in solar when others were most skeptical. Our positions are smaller today than two years ago, but we still see a compelling risk/return outlook.

In other renewable sectors, we recently added a large sugar cane ethanol manufacturer to the portfolio and maintained our positions in companies producing ethanol and hydro turbine equipment. Given the significant increases in natural gas prices around the world, the more interesting developments in renewable energy might be operators such as diversified utilities. These companies have the resources to execute more robust development pipelines.

In 2022, we added two electricity transmission and distribution utilities, both with exciting offshore wind developments in Scotland and the U.S. east coast. We also added to our existing holdings of utilities (including water) to provide important stability and diversification in the portfolio.

Global installed solar capacity from 2018-2022, with estimates to 2030



Source: Bloomberg New Energy Finance (BNEF)

Efficiency solutions get a boost from high energy costs

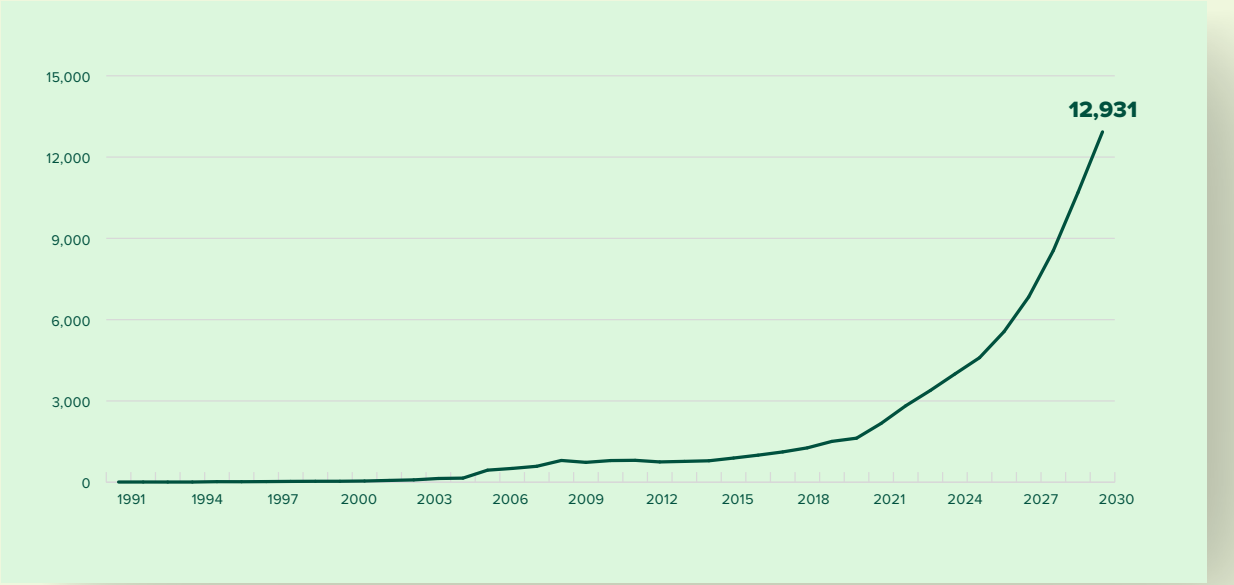
Energy inflation drives demand for efficiency solutions. One of the main beneficiaries of higher gas prices this year has been electric heat pumps. These wondrous "reverse" air conditioners can be up to five times more efficient than combusting natural gas in home furnaces. It is a 1970s technology that has made significant efficiency advances in recent years and now works in all but the most extreme climates. According to Reuters, heat pump sales grew 34% in Europe in 2021. In 2022, YOY growth exceeded 80% in some countries. Another efficiency technology we've backed for years is LED lighting. Our longstanding holding in one large LED company continues to perform well fundamentally although the company's stock price suffered last year on fears that increasing input costs couldn't be passed on to customers. This was a challenge faced by many industrial companies last year.

Efficiency technologies are based on electrification, so power management has become another focus area for us. Investing in semiconductor and electronic component manufacturers has generally been a profitable allocation.

In 2022, investors needed to be choosy. Following post-COVID supply chain concerns, and a slowdown in consumer technology demand, inventories built up and the industry entered a cyclical downturn and bifurcated; high margin businesses producing leading edge software embedded processors and graphic chips were hit hard while secular demand for power componentry enabled power management semi manufacturing companies to fare relatively well.

We have also backed a few companies making new semiconductor substrate materials, silicon carbide (SiC) and gallium nitride (GaN). These materials enable semiconductors to operate efficiently at higher voltages and frequencies. Both have promising futures in a more electrified world. Power management is an area in which we are likely to increase investment going forward.

Annual sales of heat pumps in Europe from 1990 to 2020, with forecasts until 2030 (in 1,000s)



Source: Statista, EHPA (European Heat Pump Association)

Energy production and recycling converge in clean tech sector

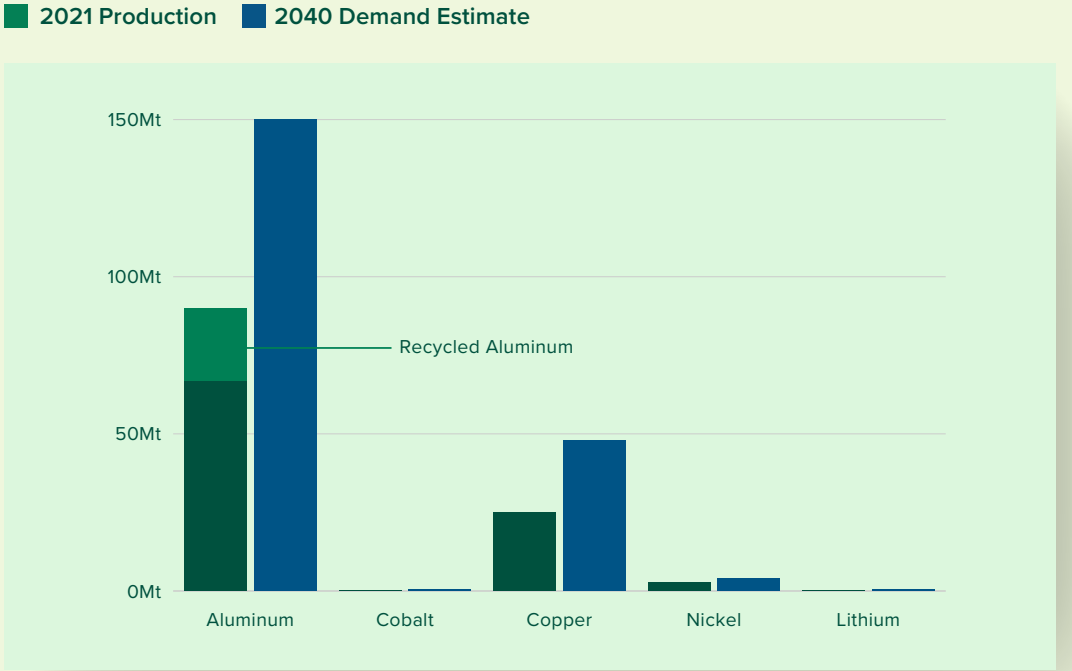
Clean technology is a wide-reaching sector and Mackenzie Greenchip team's investments generally fall into three areas: waste management, metals recycling, and paper and packaging that use recycled fiber. Waste and energy are increasingly connected as evidenced by one of our longstanding holdings, a waste management company that now produces 1.2M MWh of electricity from over 14 million metric tons of annual landfill waste, enough to power about 400,000 homes. The same company is also starting to build solar plants on older landfill sites.

Conditions were not as universally positive for many recycling businesses last year. Soaring energy, water and other input costs hit margins. Repurposed materials generally became more expensive in 2022. Our paper and packaging holdings had a tough year while metals recyclers benefitted from higher average commodity prices.

Unsurprisingly, hype has started building for technologies focused on EV battery recycling. While EVs represented about 10% of global auto sales last year, it will take some time for the inventory of used EV batteries to reach an economic tipping point for even the best recycling business models. At the same time, most countries are significantly short of the metals needed to meet high density battery production demands and recycling these materials has been identified as part of the solution.

Recycling is crucial but will never meet future material requirements. It is easy to forecast significant shortages of cobalt, copper, lithium, nickel, rare earths and so on. Yet investors continue to demand mining companies return free cash to shareholders instead of investing in new mines. It is our view that investing in these materials' producers is as important as backing "cleaner" technologies. We cannot build the sustainable infrastructure we need on fairy dust.

Aluminum, Cobalt, Copper, Nickel and Lithium are the most critical metals for electrification



Sources/notes: All amounts in Megatonnes. For production, International Aluminium Institute, Bloomberg New Energy Finance and the International Energy Agency (IEA). For estimates, S&P Global, International Monetary Fund (IMF) and IHS Markit. The demand estimates are what the Mackenzie Greenchip team has calculated to be reasonable based on current growth trajectories.

Water and sustainable agriculture to serve growing populations

WATER

Given the importance of water, one would think the world would be awash in great water investments. This is simply not the case. Water utilities can be interesting, however, while they help us manage water, they don't really solve our greatest water problems. In the past we have invested in leak detection technologies, water meter manufacturers and irrigation technologies. Presently, the Mackenzie Greenchip team is not finding many water investments that meet our valuation criteria. It is an area we would like to have more exposure to, but only at prices that make sense.

SUSTAINABLE AGRICULTURE

Modern agriculture depends overwhelmingly on massive energy inputs, primarily from fossil fuels. Today, it accounts for almost 20% of global emissions. Growing enough food to feed eight billion people is currently unsustainable – but the good news is that energy efficiencies are being discovered and implemented. The concept of precision agriculture is a good example. It combines soil and environmental data with GPS technologies and modern farm equipment in order to reduce the amount of fertilizers, herbicides and irrigation required to optimize food yields. Modern logistics technologies, efficient refrigeration and transportation are also reducing the energy needed to get that food from field to table.

It would be impossible to feed eight billion people without nitrogenous fertilizers, however, the production of ammonia involves natural gas inputs and high emissions. There have been improvements in green ammonia, carbon capture and other technologies that can reduce emissions.

Farmers also continue to be exceptionally innovative and are largely embracing modern agricultural practices. Agricultural innovation must also come from laboratories, so we are watching promising biological technologies such as enzyme production and rhizobium bacteria that can help fix nitrogen to plant roots. We also increased our allocation to agricultural solutions in 2022, an exciting sector that is ripe with innovation to aid in the struggle to feed a growing population.

"Without significant investments in agricultural efficiencies, better water technologies, and food handling logistics, our ability to feed 8 billion people sustainably will come to an end. Some of the most compelling investments today are related to food production.

– John Cook

With a temperature increase of slightly under 2°C, the world will experience periodic food shocks across several regions. If the temperature increase is greater than 4°, there will be sustained food supply disruptions occurring globally, as crop yields and food supply chains are two of the most impacted aspects of a global temperature rise.**

** Source: IPCC, Figure SPM.2 — Special Report on Climate Change and Land (ipcc.ch)

Mass transit is a growing opportunity

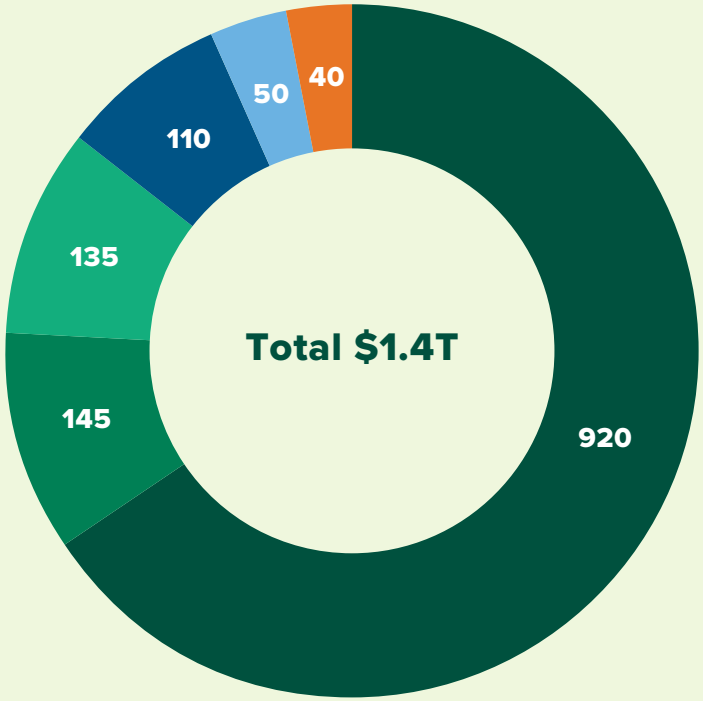
Moving materials and people around the planet is an incredibly energy intensive business that is responsible for around 15% of global emissions – more if you include the manufacturing of vehicles. There has been too much focus on private automobiles and not enough on other modes of transportation. Generally, electric vehicle and battery companies have been some of the most expensive stocks in our universe. However, the Mackenzie Greenchip team believes that there are better investments in mass transit, or derivative transportation plays such as power electronics equipment.

It is far more efficient to move people by train and other forms of public transportation than it is by private car. It is encouraging to see strong order demand for rail equipment.

In the past few years, hydrogen as a fuel seems to have had another renaissance. Green hydrogen, produced through an electrolyzer, remains too expensive to produce, transport and store to serve well for most applications. We have some small derivative plays through large industrials and materials companies that would benefit if the hydrogen dream does finally take off. However, we are more circumspect about the pace of change in the transportation sector than many seem to be.

Over $1.4 trillion of light-rail and metro-system projects are underway or planned globally in the coming years

2019-2025 projects



Source: McKinsey & Co. Includes light-rail and metro-system projects of ≥ $100 million in the environmental, bidding/negotiating, design and execution phases.

Our view

In 2022, the global population surpassed 8 billion, resource prices reached historic levels, and global CO2 emissions surpassed 37.5 billion tons, the most ever. Our key takeaway — the value of environmental solutions has never been greater!

GREEN LABELED DEBT

A need for change. A time to act.

Konstantin Boehmer
SVP, Co-head
Mackenzie Fixed Income Team

Theme 1
Helping companies evolve their business models

Theme 2
Avoiding challenging regions or companies is not an option

Theme 3
Quality rather than quantity defines evolution in sustainable markets

Helping companies evolve their business models

Sustainable debt serves a critical purpose in supporting and accelerating the transition efforts of companies seeking to evolve their business models to become more sustainable. Given that the bond's credit risk is toward the entire company and not against the specific project, these bonds offer an impactful spin on existing credit structures.

For example, one of our holdings is in an Alberta-based power generator, with present-day exposure to coal, high ESG (environmental, social and governance) risk and a high WACI (weighted average carbon intensity).
By investing in a labelled "green" bond, we had the opportunity to proactively invest in the company's expanding portfolio of renewable energy sources to support the proactive retirement of the company's coal assets and avoid millions of tonnes of future emissions.

While this methodology requires an increased level of sophistication to mitigate undesirable exposures, the opportunity to mitigate risk while enhancing credit-worthiness is an economic as well as an environmental opportunity.

Investments in renewables by oil and gas companies are expected to grow significantly through 2030.*

* Source: Big Oil spending more own renewables, but it's still tiny share of overall budgets (axios.com)

"By investing in a labelled "green" bond, we had the opportunity to proactively invest in the company's expanding portfolio of renewable energy sources...

Avoiding challenging regions or companies is not an option

Investors have tended to stick with a “do no significant harm” mandate and avoid regions or companies in sectors where ESG risks are greatest. This includes developing countries where exponential emissions are highly correlated with GDP growth and companies in legacy, high-emissions industries with outdated practices or potential reputational risk.

However, such countries and companies will need to transition in order to achieve investors’ goal of creating the greatest impact. Change cannot occur without capital investment and collaborative engagement. Avoidance is not an option for those investors looking to maximize impact.

Fixed-income investors are presented with extraordinary opportunities because these issuers are often starved for desperately needed capital to fund their transition. This is now enabling the emergence and exponential growth of the labelled debt market.

Deforestation is a major problem in developing countries

The loss of the world’s forests is a top concern, particularly in developing countries. By working with companies and governments to address deforestation in these regions, investors can help to reverse this trend.

Country	Net change in forest area (1990-2020)	Percentage change in forest area
Brazil	-356,287 sq mi	-15.67%
Indonesia	-101,977 sq mi	-22.28%
Democratic Republic of the Congo	-94,495 sq mi	-16.25%
Angola	-48,865 sq mi	-15.97%
Tanzania	-44,962 sq mi	-20.29%
Myanmar	-41,213 sq mi	-27.22%
Paraguay	-36,463 sq mi	-36.97%
Bolivia	-26,915 sq mi	-12.06%
Mozambique	-25,614 sq mi	-15.29%
Argentina	-25,602 sq mi	-18.84%

Source: UN Food and Agriculture Organization, Visual Capitalist

Quality over quantity

After years of exponential growth, for the first time, the hallmark of 2022 hasn't been quantity – rather the quality of sustainable debt issuance. This has been defined by an evolution in the sophistication of project financing, the rise of material key performance targets and improved impact reporting. Investors are now focused on understanding the causal impact of their investments on greenhouse gas emissions, equitable representation and transition acceleration.

Issuers have begun to develop innovative structures such as step-down Sustainability-Linked Bonds, Ocean Conservation "Blue" Bonds and the Wildlife Conservation "Rhino" Bond, each reflecting the innovation afforded by the contributions of private investors, local governments and supranational organizations. Such developments illustrate the impact that global collaboration can have within the sustainable finance space.

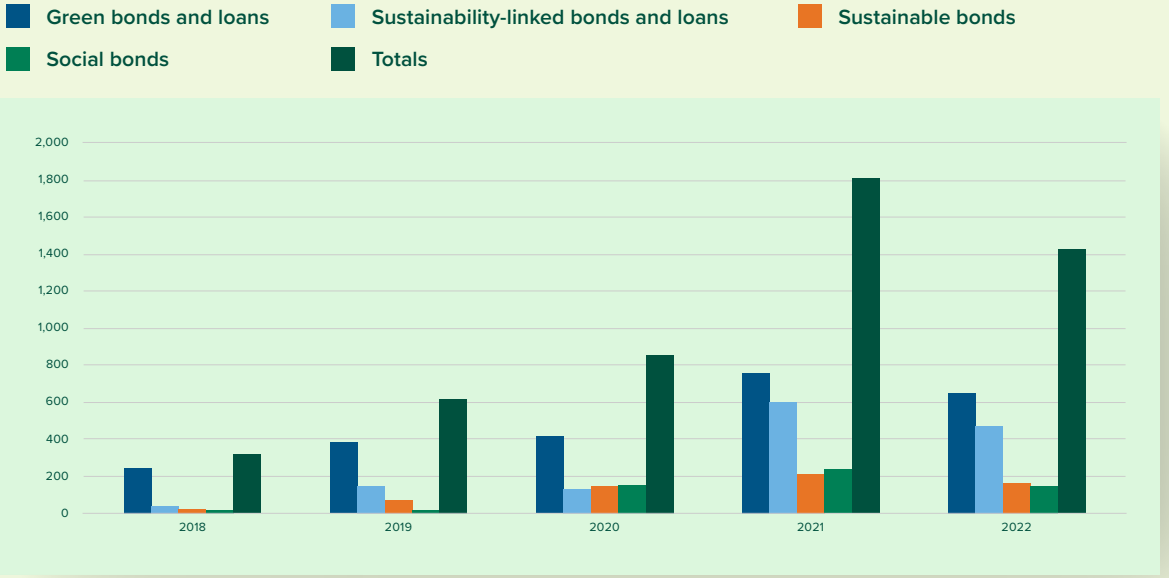
While the total volume of sustainable debt has declined year over year, this can be largely attributed to challenging market conditions, as labelled debt retained a comparable percentage of issuance. However, we expect this trend to revert as according to a report published by McKinsey in early 2022, it is estimated that $3.5 trillion per year will be required to finance an accelerated energy transition*. Given this continued velocity of sustainable fixed-income markets, we expect the momentum to continue to contribute to relative and absolute growth to return in coming years.

*Source: McKinsey & Co. "The net-zero transition - what it would cost, what it could bring." January, 2022

Source: Bloomberg, Dec. 2022. Green ABS bonds are included in green bond and loan totals. Municipal bonds are included in green, social or sustainable bond categories.

Growth of sustainable debt issuance since 2018

Quantity of issuance has shifted to quality



Our view

Sustainable debt serves a critical purpose in supporting and accelerating the transition efforts of companies and regions seeking to become more sustainable.

REGULATORY UPDATE

Smoothing the path to net zero through smart policies

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Rebecca Francolini
Environmental Sr Analyst, Sustainability Team

Canada United States Other developments

Canada

The 2022 budget estimated a gap of approximately $115 billion per year in investment required to achieve net zero by 2050. To bridge the gap, it is anticipated that an increasing amount of net-zero aligned tax incentives will be issued. Additionally, due to lack of standardized reporting and taxonomy, sustainable finance will continue to be challenged with “greenwashing” allegations and scrutiny. It is expected that regulators will begin to adopt mandatory disclosures to financial institutions beyond those that are regulated under OSFI to ensure the integrity of the transition.

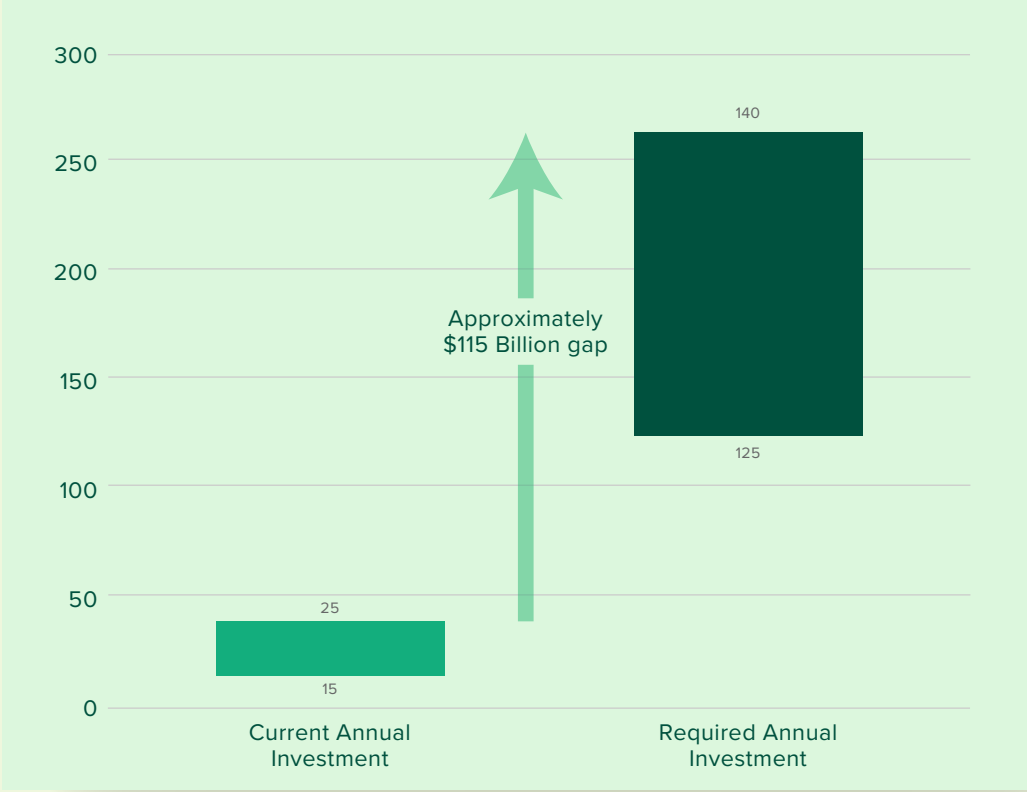
After multiple delays, the Sustainable Finance Action Council is expected to issue a draft sustainable taxonomy which will offer issuers and investors a framework for investing sustainably and in alignment with the energy transition.

On the horizon are two additional developments including the implementation of the Canadian Sustainability Standards Board (CSSB) which will support Canadian-led sustainability disclosure standards, and an initiative that builds off the efforts of the IFRS International Sustainability Standards Boards.

We also expect to see more climate- or transition-friendly regulation come forward, such as the Climate-Aligned Finance Act, which is intended to mandate financial and other federally regulated entities to mitigate and adapt to the impacts of climate change. This will ensure that capital allocators, banks and investors have credible climate action plans with the appropriate board expertise.

Annual investment to attain net-zero emissions in Canada by 2050

(Total private and government investment)



Sources: Government of Canada. Global Financial Markets Association and Boston Consulting Group, Climate Finance Markets and the Real Economy (2020); United Nations Framework Convention on Climate Change (2018). Chapter 3: Climate and Energy Security | Budget 2022 (canada.ca)

United States

The most notable development in the U.S. has been the Inflation Reduction Act (IRA) which was signed into law by President Joe Biden on August 16, 2022. To date, the IRA is the largest piece of climate legislation in U.S. history with an expected U.S.$369 billion in spending dedicated to energy security and climate change. Although not solely climate focused, it includes tax credits, incentives and other provisions to aid the U.S. with its transition to a low-carbon economy. Additionally, the Act supports lower drug prices and extends the Affordable Care Act for an additional three years as a key enabler of societal equity.

It increases investments in renewable energy and energy efficiency, all key to decreasing the country's emissions. With the surprising outcome of the U.S. midterm elections, it is expected that this act and its target investment will come into full effect in 2023, putting the U.S. on a more realistic path to its commitments.

The investment industry can also expect clarity of fund disclosures for ESG investment objectives and strategy as well as fund naming for ESG or sustainability related funds.

The SEC is also expected to pass mandatory climate risk reporting for corporations which will provide investors with comparable climate data. Such regulatory developments are expected to increase investor confidence in the sustainable finance space and put it on a similar trajectory to Europe.

Focus on IRA

14,000 **in direct consumer rebates** for families to buy heat pumps or other energy efficient home appliances, saving families at least $350 per year

$7,500 **in maximum tax credits** for new electric vehicles

$4,000 **in maximum tax credits** for used electric vehicles

1 gigaton approximate **reduction in greenhouse gas emissions** by 2030, or a billion metric tons

42 M **people served** by advance cost-saving clean energy projects at rural electric cooperatives

By 2030 Power homes, businesses, and communities with much more clean energy, including:

950 million solar panels
120,000 wind turbines
2,300 grid-scale battery plants

Source: https://www.whitehouse.gov/briefing-room/statements-releases/2022/08/15/by-the-numbers-the-inflation-reduction-act/

Other developments

EU

While many countries in the EU have struggled with access to energy and countries like Germany fired back up their coal-fired plants, the member states have recognized their immediate reliance on natural gas as a transitional resource while signalling a doubling down on green investment.

In July 2022, a Complementary Climate Delegated Act was published to include specific nuclear and gas activities within the EU Taxonomy. This means that investments in gas and nuclear will continue to be classed as sustainable during the short- and medium-term. This new delegated act will apply from January 2023.

From an investment perspective, following the IRA legislation in the U.S., European politicians have become increasingly vocal about how U.S. climate subsidies may drive green capital investment into U.S. markets and away from European markets. As a result, European politicians are beginning to talk about the potential of a similar Europe-wide subsidy regime to finance their own green economic transformation.

NEW RULES IN THE U.K.

In autumn 2022, the U.K.'s financial conduct regulator, the FCA (Financial Conduct Authority), published proposals for sustainable finance disclosure requirements for investment products. The SDR (Sustainability Disclosure Requirements) regime will apply to asset managers in respect of their U.K. fund products and portfolio management activities. Additionally, the Task Force on Climate-Related Financial Disclosures has become the most widely used climate risk and strategy disclosure framework globally and is now mandatory reporting in the U.K. for companies with more than 500 employees and more than £500 million annual revenue. In this coming year, we expect this regulation to impact over 1,300 of the largest U.K.-registered companies and financial institutions. New disclosures on diversity and inclusion on boards will also start to appear in annual financial reports published from Q2 2023 onwards setting out whether companies have met specific board diversity targets.

ESG IN CHINA

China will take a proactive and steady approach to achieve its dual carbon goals — emissions peak by 2030 and carbon neutrality by 2060, highlighting the importance of establishing new energy capacity first before reducing total carbon emissions and fossil fuel consumption. China has also made tremendous headway on ESG-related standardization and, in 2023, Chinese authorities and regulators may put more focus on addressing issues of greenwashing in the capital markets, carbon accounting and climate stress testing.

Our view

Regulators have stayed the course to address climate change risk and advance sustainable practices. Allegations of greenwashing have forged a slew of regulations to bring transparency, consistency and clarity. And most importantly are the varying disclosure standards that will require companies to report their impact to global warming across their entire value chain through the reporting of scope 1, 2 and the highly debated scope 3.

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