

## **EDC Economics**

By Prerna Sharma

October 2023



Canadä



## Table of contents

Executive summary3			
Introduction	4		
The global cleantech market	6		
Global cleantech policy in 2023: Accelerating the global cleantech race	6		
Market estimates	7		
Venture investment estimates: Highlights from 2022	7		
Sector highlights from 2022	8		
Global cleantech investment patterns	10		
Emerging and developing economies	10		
Top innovative cleantech firms	11		
The Canadian cleantech market	14		
Government of Canada cleantech initiatives .	14		
Canadian market and investment patterns	15		
Canadian cleantech companies	16		

Contribution of environmental and		
clean technologies to Canadian GDP16		
ECT trade flows		
Exports		
Imports19		
Net trade flows		
Geographic destination of ECT exports22		
Global cleantech trends and opportunities23		
Challenges25		
Canadian cleantech trends and opportunities 26		
Growing Canadian cleantech exports26		
Areas of improvements—A Canadian		
perspective27		
Conclusion		
References		
About this report		



## **Executive summary**

Clean technology (cleantech) is widely recognized as a critical component in mitigating climate change in line with the objectives of the Paris Agreement. Russia's war in Ukraine led to a slew of global energy policy announcements in 2022 and 2023, which are expected to redefine the global green industrial landscape. As supply chain bottlenecks ease, raw material and shipping costs decline, and the world recovers from the pandemic and subsequent economic slowdown, clean technologies, products, and services will offer immense opportunities for trade, innovation, and employment in the years to come.

The International Energy Agency (IEA) expects US\$1.7 trillion to be invested in clean technologies globally in 2023.<sup>1</sup> Despite multiple global headwinds, global cleantech investment—though muted remained resilient throughout 2022 and 2023, largely driven by regional energy security concerns and turbulent energy markets. It's no surprise then that despite recording lower aggregate venture investment numbers, energy, and power innovators within cleantech saw record investments in 2022. Deployment of renewable energy sources such as solar and wind also made significant headway in 2022 as these technologies became increasingly cost-effective. Global momentum in niche and nascent areas such as low-emissions hydrogen, battery technologies, and carbon capture, usage, and storage (CCUS) also saw significant movement.

In Canada, we find a strong and vibrant cleantech ecosystem, with 12 companies making it to the Top 100 global innovators of 2023. But we also find consistent trade deficits in environment and clean technologies (ECT) driven by our reliance on cleantech goods imports. There are challenges in terms of commercialization of research and in levels of high value funding and seed funding—although some challenges are addressed through government support programs. The vital and timely mobilization of private capital for clean technologies will be imperative, as will closing the gap in private sector R&D activity.

To boost Canadian competitiveness, the "startup to scaleup support gap" must be addressed, and investments need to be channelled across clean energy value chains and nascent technologies. Policy competition from the Inflation Reduction Act (IRA) and other global industrial policy pushes will provide significant headwinds to ECT sector growth in Canada, including the movement of capital, labour and technologies to more lucrative destinations in the United States and Europe. As the government responds to these policies, the private sector must support future growth through timely investments that foster Canadian entrepreneurship and nascent technologies.

<sup>1</sup>This includes renewables, electric vehicles, nuclear power, grids, storage, low-emissions fuels, efficiency improvements and health pumps. Source: World Energy Investment Report, 2023, International Energy Agency, May 2023.



## Introduction

Achieving the goals of the Paris Agreement and limiting global warming to 1.5 C requires significant reductions in greenhouse gas (GHG) emissions by 2030. To achieve this, amongst other actions, the rapid adoption of innovative clean technology solutions at scale is imperative. Innovative cleantech plays a key role in climate action by supporting the energy transition, while also promoting entrepreneurship and creating green jobs.

Over the past three years, global cleantech has been challenged by the pandemic lockdowns, geopolitics and the Russia-Ukraine war wreaking havoc on critical supply chains for the energy industry. Large energy consumers have responded by making "energy security" front and centre of public policy, reducing dependence on imported gas as prices surge and supplies curtail. This has triggered a global policy response, including two big energy announcements: The passing of the landmark *Inflation Reduction Act* (IRA) in the U.S and the REPowerEU in the European Union (EU).

Increasingly, "onshoring" and "friendshoring" policies have been adopted that address local selfsufficiency, human rights concerns and promote local employment, which have led to global governments offering massive tax incentives for cleantech players. In 2024, the industry is expected to continue to respond to the various policy mechanisms, including a rapid buildout of local manufacturing for solar and batteries in the U.S. and Europe. Clean technologies have implications across sectors, with positive technological and production externalities and spillovers. Broadly speaking, policy support helps maintain cost competitiveness as firms transition to cleaner production processes. This is particularly helpful in cutting emissions from traditional hard-toabate industrial and manufacturing sectors. From a trade perspective, policy support helps reduce the cost for firms to adopt low-carbon technologies, which potentially positions them at an advantage vis-à-vis other global firms that don't adopt cleaner or green technologies. This includes the adoption of clean technologies for a range of manufacturing industries across production processes and supply chains, including Scope 2 or 3 emissions. Globally, this will become increasing relevant for trade-exposed sectors and countries as the EU's Carbon Border Adjustment Mechanism (CBAM)<sup>2</sup> comes into play.

Government incentives also help expand investment in growing technology companies that help firms secure the capital and support they need to scale their inventions. As costs to innovate reduce, firms become more competitive, charting global markets, and boosting exports. Beyond this, policy incentives indirectly incentivize private research and investment in cleantech initiated by entrepreneurs or businesses to produce early intellectual property (IP) that gets refined through subsequent stages of innovation before becoming commercially viable or successful.

<sup>2</sup> The EU CBAM is set to be introduced in October 2023 (transitional phase) and will apply to imports of certain goods whose production is carbon intensive and at most significant risk of carbon leakage. It's being introduced primarily to put a fair price on carbon emitted during the production of carbon-intensive goods entering the EU to encourage cleaner industrial production in non-EU countries.

Market-ready and emerging clean technologies will play an important role in Canada's energy transition. Maintaining competitiveness with other countries will be key as we look to drive cleantech exports and diversify our market exposure. The global energy transition represents a massive economic opportunity: The global cleantech market is projected to reach US\$26 trillion over the next 10 years<sup>3</sup>, with the IEA projecting key mass-manufactured clean technologies to be worth around US\$650 billion a year by 2030<sup>4</sup>.

Bolstering homegrown Canadian technologies and companies to compete in the future clean and innovative global economy will be imperative. As will boosting Canada's export potential through increasing domestic adoption of clean and innovative tech to meet our own net zero targets.



 <sup>3</sup> Global Commission on the Economy and Climate, 2018. Unlocking the Inclusive Growth Story of the 21st century: Accelerating Climate Action in Urgent Times. Available at: http://www.camecon.com/wp-content/ uploads/2018/10/2020-11-03-NCE-2018-Technical-Modelling.pdf
 <sup>4</sup> Energy Technology Perspectives, International Energy Agency, 2023, see here: The world is entering a new age of clean technology manufacturing, and countries' industrial strategies will be key to success - News - IEA



## The global cleantech market

## Global cleantech policy in 2023: Accelerating the global cleantech race

The Russia-Ukraine war created a full-blown energy crisis in Europe. This led to a substantive shift away from direct Russian gas, affecting energy prices across the world, spurring several global policy announcements.

Born out of U.S. President Joe Biden's Build Back Better agenda, the IRA is designed to nudge the U.S. economy towards investing meaningfully in the path to net zero, while reducing the government's budget deficit and inflation. The bulk of the IRA investments costing an estimated US\$370 billion over the next decade—are directed towards promoting clean energy investment and building related supply chains. The IRA provisions offer multiple subsidies in the form of tax credits that can be claimed for deploying clean technologies. More crucially, at the centre of the act, is industrial policy offering output-based subsidies for American factories across the wind, solar and battery value chain.

On the flipside of these subsidy carrots are policy sticks in the form of trade barriers, which have been carried over from the former Donald Trump administration. For example, the local content provision requirements for electric vehicle (EV) battery value chains and the incentives offered to solar manufacturing and hydrogen, which are only available to U.S. firms making things on American soil. Despite the strong domestic target, the IRA is expected to spur investments in nascent and ready-toadopt technologies that would eventually lower costs across wind, solar, battery and other technology value chains, benefiting the entire world as it transitions. As the driving engine, the IRA is expected to boost clean energy investments that would help bring many of these technologies to scale and market maturity.

The REPowerEU proposal was introduced in 2022 to reduce the EU's reliance on Russian gas and provide safe, clean, and affordable energy to its citizens. On Feb.1, the EU Commission also unveiled its Green Deal Industrial Plan (GDIP) as a complement to the European Green Deal, which sets out the EU's green transition ambitions and targets to reach net zero by 2050. The GDIP was specifically designed in the context of the IRA, with an aim of catalyzing European cleantech innovation spurring investments, building local manufacturing capacity, and boosting clean energy supply.

Other green deal initiatives in the EU, including the Fit for 55 package (which includes a series of legislative proposals aimed at reducing the EU's net emissions by at least 55% by 2030), alongside the REPowerEU, have been specifically designed to boost European cleantech competitiveness. The GDIP comprises of a host of legislations such as the *Net Zero Industry Act* (NZIA), *Critical Raw Materials Act* (CRMA) and a reform on *Electricity Market Design* (EMD).

### **Market estimates**

The IEA estimates that more than US\$1.7 trillion will be invested in clean energy and related technologies<sup>5</sup> in 2023, a 24% rise between 2021 and 2023.<sup>6</sup> Investments in the sector in 2023 were spurred by renewable energy (primarily solar and wind) and electric vehicles (EVs) alongside batteries, heat pumps and nuclear power. If countries fully implement their announced climate targets, the market for clean energy technologies is expected to triple from current 2023 levels, settling at US\$650 billion a year by 2030.<sup>7</sup> Clean energy jobs, too, could more than double from six million today to nearly 14 million by 2030, with further employment growth expected as cleantech industries mature.

Despite the positive momentum, clean energy and cleantech investment isn't evenly distributed across countries or sectors. Clean energy spending is heavily concentrated in a handful of countries, in fact, more than 90% of the increase in cleantech investment since 2021 has taken place in China and advanced economies (the EU, U.S, Japan),<sup>8</sup> leaving many emerging and developing markets behind. While there are positive developments (in funding and deployment) in India, Brazil and the Middle East, a vast majority of emerging and developing economies remain excluded from crucial cleantech financing.

## Venture investment estimates: Highlights from 2022

Global cleantech attracted US\$51 billion in venture investment across 2,094 deals in 2022.<sup>9</sup> In general, cleantech venture investments saw muted activity in 2022 given multiple headwinds facing the global energy market and challenging economic conditions affecting the overall venture capital (VC) space globally.<sup>10</sup> The greatest amount of investment in 2022 was focused on transportation and logistics (US\$13.2 billion), closely followed by the energy and power sector (US\$12.4 billion). The agriculture and food sector attracted US\$10.4 billion in VC investment, while investments in the resources and environment sector totalled US\$8.7 billion (Chart 1).

## Chart 1: Total cleantech investment by sector (US\$ billions), 2022



Source: Cleantech Group 2023, EDC Economics



<sup>5</sup> This includes renewables, electric vehicles, nuclear power, grids, storage, low-emissions fuels, efficiency improvements and health pumps. Source: World Energy Investment Report, 2023, International Energy Agency, May 2023.

<sup>6</sup> World Energy Investment Report, 2023, International Energy Agency, May 2023.

<sup>7</sup> See more here: <u>The world is entering a new age of clean technology manufacturing, and countries' industrial strategies will be key to success - News - IEA</u> <sup>8</sup> World Energy Investment Report, 2023, International Energy Agency, May 2023.

<sup>9</sup> Global Cleantech 100: From Commitments to Actions: The Sprint to Net Zero is on, Cleantech Group, 2023

<sup>10</sup> See pitchbook, <u>The state of VC in 6 charts | PitchBook</u>

## Sector highlights from 2022

#### **Transportation and logistics**

- Total investment in 2022: US\$13.2 billion (down 19% from 2021)
- Total deals concluded in 2022: 391 (down 25% from 2021)

Despite a drop in investments and deal count investment activity in supply chain and logistics, EV charging and on-road vehicles saw substantial increases in funding. Declines were seen in investments in electric mobility services, vehicle components and aircraft systems. But EV-charging infrastructure and technologies dominated funding in the sector with investments up 60% from 2021. Investments in electrification of on-road passenger vehicles and charging infrastructure are expected to continue to gain momentum going forward. Energy conglomerates and automotive firms will also continue to partner with key innovators across the charging value chain--from charging infrastructure to energy storage.<sup>11</sup>

#### **Energy and power**

- Total investment in 2022: US\$12.49 billion (up 33% from 2021)
- Total deals concluded in 2022: 480 (down 7% from 2021)

The energy and power sector showed strong year-onyear (YOY) growth in 2022, with investors capitalizing on the unique energy and power opportunities as energy price volatility strengthened enthusiasm for alternative energy sources and energy users. This was largely driven by sustained investments in nuclear fusion technologies and new investments in geothermal, biomass, energy and power technologies for buildings, and energy optimization and grid network products. Hydrogen investments also significant jumped in 2022, sustaining momentum from 2021 with venture investments increasing 54%. These investments were seen at the production (electrolyzer) level and in end-use technologies across the hydrogen value chain. Specifically, fuel cell investments tripled from 2021. Renewable natural gas production funding also accelerated given the geopolitical environment in 2022.

#### Materials and chemicals

- Total investment in 2022: US\$5.7 billion (up 12% from 2021)
- Total deals concluded in 2022: 285 (down 7% from 2021)

Investments in materials and chemicals remained strong in 2022, with large market investments in industrial process improvements for steel, cement, and chemicals. Going forward, the materials and chemicals sector is likely to benefit from policy tailwinds triggered by the IRA and pending introduction of the EU's Carbon Border Adjustment Mechanism (CBAM). Initially, the EU CBAM is set to apply to five emissions-intensive sectors deemed at greatest risk of carbon leakage, including cement, iron and steel, aluminum, fertilizers and electricity. This will likely spur innovation in material and chemical technologies that address emissions of industrial processes such as steel, cement and chemicals.

<sup>&</sup>lt;sup>11</sup> A current example of this is Ford's and Volvo's partnership with battery recycling company Redwood Materials and Volvo's partnership with EV-charging company ChargePoint.

#### **Resources and environment**

- Total investment in 2022: US\$8.7 billion (up 38% from 2021)
- Total deals concluded in 2022: 380 (down 12% from 2021)

The resources and environment sector also saw a healthy rise in investment activity in 2022, with funding activity rising nearly sevenfold since 2017.<sup>12</sup> Investment activity was driven by waste management (primarily plastic recycling), CCUS and carbon offsets, and critical metal mining and circular battery materials subsectors.

#### Agriculture and food

- Total investment in 2022: US\$10.4 billion (down 37% from 2021)
- Total deals concluded in 2022: 522 (down 24% from 2021)

The agriculture and food sector saw a drop in funding in 2022 after witnessing all-time highs in 2021, with 2022 recording the smallest number of deals since 2018. The alternative protein sector remains the largest subsector, in terms of dollars invested, with startups raising US\$2.1 billion cumulatively in 2022. Animal ag-tech startups scored US\$816 million in funding in 2022, particularly insect farming startups. Despite the drops, the sector is expected to remain relevant in the years to come marked by interest in food security, environmental sustainability, the impact of the Russia-Ukraine war on grain trade and fertilizer production, and negative impacts of climate and weather events.

## Chart 2: Number of cleantech deals and average cleantech deal value, 2022



Source: Cleantech Group 2023, EDC Economics

A sectoral comparison of the number of deals recorded in 2022 shows that the greatest deals in 2022 were in the agriculture and food sector. The sector recorded 522 deals averaging US\$20 million per deal. This was followed by the energy and power sector with 480 deals averaging US\$26 million. The transportation and logistics sector closed 391 deals averaging US\$34 million per deal (Chart 2). The largest deals on average have been in the transportation and logistics sector, followed by energy and power and the resources and environment sectors (Chart 2).



<sup>12</sup> Authors own calculations, 2017 recorded US\$1.31 billion in venture investment, and 2022 recorded \$8.76 billion in investment.

### **Global cleantech investment patterns**

Transportation and agriculture accounted for nearly 50% of all cleantech investments in 2022 (Chart 3). Between 2017 and 2022, the transportation sector attracted the most funding, with US\$70 billion in cumulative investments, followed by the agriculture and food sector (US\$52 billion) (Chart 4). Together, these two sectors accounted for nearly 60% of all investments in the past five years.

## Chart 3: Sectoral breakdown of cleantech investments, 2022



Source: Cleantech Group 2023, EDC Economics

#### Chart 4: Cumulative cleantech funding, 2017-2022



Source: Cleantech Group 2023, EDC Economics

It must be noted that these investments represent only a fraction of total investment or expenditure in the clean energy and technology sector, which is supported by a host of government programs and alternate funding instruments not captured in VC activity. In fact, global cleantech contribution to GDP is estimated to be at US\$2 trillion to US\$3trillion with investments spurring technological advancements, boosting innovation, and providing employment in the field. Beyond impact in these traditional economic accounts, cleantech investments inherently spur economic activity along a larger supply chain, as labour and capital are employed to convert goods into finished products. Naturally, this has multiplier effects that contribute to other sectors of the economy. For instance, our calculations indicate that in Canada every \$1 investment in cleantech spurs \$1.7 in related economic activities along the supply chain.

### **Emerging and developing economies**

For a transition that's consistent with the goals of the Paris Agreement, ensuring universal access to sustainable and clean energy in emerging and developing markets will require a massive scale up of renewable energy and power sector infrastructure. Beyond this, mobilization of financing will be crucial. Despite accounting for more than 65% of the world's population, developing economies receive only 20% of the world's global clean energy investment.<sup>13</sup> At present, estimates from the IEA suggest that US\$770 billion was invested in clean energy in developing countries in 2022, with China accounting for 65% of this total and China, India and Brazil accounting for more than 75%. To meet the goals of the Paris Agreement, annual investment in clean energy in developing economies will need to more than triple from 2022 levels, at US\$2.2 trillion to US\$2.8 trillion per year by 2030.14

<sup>13</sup> Scaling Up to Phase Down: Financing Energy Transitions in the Power Sector, World Bank, 2023
 <sup>14</sup> Scaling up private finance for clean energy in emerging and developing economies, The International Energy Agency, June 2023

### Top innovative cleantech firms

Each year, the Cleantech Group compiles a list of the Top 100 private firms that are most likely to make significant cleantech market impacts in the next five to 10 years. Based on a three-step process of nominations (from experts and sector analysts), evaluation (of the nominated firms from industry experts) and compilation (of the final companies that are pooled and adjusted for geographic and other biases), a list of 100 companies is published. In 2023, based on 15,752 nominations from more than 93 countries, 330 companies were shortlisted and reviewed by 81 members of the Global Cleantech 100 expert panel.

This resulted in the 2023 list of the most-innovative 100 global companies. In the 2023 ranking, 18 countries were represented, of these:

- 65 North American firms were listed in the Top 100 cleantech innovators of 2022. Of these, 53 companies were based in the U.S. and 12 in Canada.
- European cleantech firms had 28 companies in the Top 100,<sup>15</sup> with eight companies in the United Kingdom (U.K), seven in Germany and two each in Sweden, Netherlands, France and Finland.
- Asia-Pacific was a distant third with only three companies in the Top 100, with one each in Australia, China and India.
- Notably three companies from Israel made the Top 100 list.



#### Chart 5: Ranking of innovative and successfully funded cleantech firms by country, 2022



As a block, the sheer number of Canadian firms represented yearly (12 companies in 2022 and 13 companies in 2021) in the global ranking is impressive. Of the 12 Canadian companies in the 2023 list, five were in the energy and power space, three in materials and chemicals, and four in the resource and environment industry (Table 1). While there are only three sectors of Canadian strength represented in 2023 rankings, Canadian companies across other sectors have made the list in the past.

Name	Sector	Description
Carbon Upcycling	Resources and en-vironment	Sequesters carbon dioxide in concrete.
Eavor Technologies	Energy and power	Produces reverse radiators that absorb geothermal heat and use it to generate electricity.
Ekona Power	Energy and power	Uses low-cost, pulse-combustion technology to convert natural gas into hydrogen.
e-Zinc	Energy and power	Large-scale electricity storage systems using low-cost zinc reactor technologies.
GaN Systems	Materials and chemicals	Semiconductor company that produces gallium nitride (GaN) semiconductors for electronics that emit less heat than usual. $^{\rm 16}$
GHGSat	Resources and environment	Satellite-based remote sensing for detecting GHG emissions from facilities. The company updates a methane map <sup>17</sup> on its website that shows where emission hotspots are located.
Hydrostor	Energy and power	Specializes in storing surplus renewable energy into compressed air.
lonomr Innovations	Materials and chemicals	Specializes in anion-exchange membranes for fuel cells specifically for capturing hydrogen at low costs.
Mangrove Lithium	Materials and chemicals	Produces modular platforms for the cost-effective production of lithium hydroxide (used for batteries).
Moment Energy	Energy and power	EV battery vehicle recycling company that converts batteries into affordable energy-storage sys-tems.
Pani	Resources and environment	Monitors sensor data using artificial intelligence (AI) from water treatment plants.
Svante	Resources and environment	Uses metal-organic filters to capture carbon dioxide emitted from heavy manufacturing industries.

#### Table 1: Canadian firms in the Top 100 most innovative cleantech companies of 2022

Source: Cleantech Group, 2023, EDC Economics

<sup>16</sup> GaN systems was sold in March 2023 to a non-Canadian (German) entity Infineon Technologies for US\$830 million, see more here - Semiconductor firm GaN Systems to be acquired by Infineon for US\$830 million | BetaKit
<sup>17</sup> GHGSat's methane map: <u>ghgsat.com/en/pulse/</u>

Exploring the profiles, activities and focus of the most innovative Canadian cleantech firms offers some insights on areas of cleantech innovation and opportunity in 2023. It's important to not generalize overall Canadian strengths based on this list itself as it is created via a process of nomination and not a global market scan and there might be Canadian firms in other sectors. However, based on the Global Cleantech top 100, Canadian strengths appear to be, in the energy and power (five out of 37 companies) and the resources and environment (four out of 23 firms) sectors. (Chart 7) This isn't surprising given our domestic strength in energy infrastructure and renewable power and that we're a resource-driven export economy. A second area of strength is that six of the 12 Canadian firms in the Top 100 are repeats from the previous year. This demonstrates capacity to sustain performance and innovation, both of which bode well for future funding, market share, exports, and ecosystem development.<sup>18</sup>

The 2022 rankings also exposed areas where Canadian performance appears to lag. There was no Canadian

representation in agriculture and food, and unlike 2021, none in the materials and chemicals, and transportation and logistics sectors (both had one firm each in the 2021 rankings). While this difference from 2021 isn't positive, it's not necessarily bad news, since a lack of representation doesn't necessarily equate to a lack of innovation or market players in the field.



## Chart 7: Top 100 innovative cleantech companies by category, 2022

Source: Cleantech Group, EDC Economics



<sup>18</sup> This list is created via a process of nomination and not a global market scan. Canadian strengths may appear in other areas, too.

## The Canadian cleantech market

## **Government of Canada cleantech initiatives**

Several Canadian policies have been designed to drive clean innovation in Canada. Beyond our legislated commitment to achieve net zero emissions by 2050 and a federal carbon pricing system, which is set out to grow to \$170 per tonne of carbon dioxide emissions by 2030, several public investments totalling more than \$100 billion have been committed towards climate action. Supporting clean technology has been prioritized as being central to the government's goal for promoting clean economic growth.

To respond to the IRA and the EU's programs, the 2023 federal budget also made announcements, including an additional \$83 billion through investment tax credits (ITCs) for clean electricity and cleantech, manufacturing investment tax credits, strategic financing from investment vehicles (Canada Infrastructure Bank and Canada Growth Fund) and other targeted government programs through Natural Resources Canada (NRCan) and Innovation Science and Economic Development Canada (ISED). Specific policies and regulations include:

#### **Cleantech funding commitments**

- Canada Growth Fund (CGF): The \$15-billion Canada growth fund, announced in 2022, is a public investment vehicle intended to spur private investment in clean energy and cleantech projects and supply chains.
- Strategic Innovation Fund (SIF): In the 2023 budget, the federal government allocated an additional \$500 million over 10 years towards investment in cleantech to support the development and application of clean technologies in Canada and directed up to \$1.5 billion of SIF's existing resources towards projects in sectors, including clean technologies, critical minerals and industrial transformation.

#### **Cleantech tax credits**

- Clean technology investment tax credit: In response to the U.S.'s IRA, Canada proposed the cleantech ITC in the federal government's 2022 *Fall Economic Statement* and formalized it in the 2023 budget. The ITC provides a refundable 30% tax credit on the capital cost of investments made by companies in wind, solar and energy-storage technologies. This tax credit<sup>19</sup> is also available for machinery and equipment used to manufacture cleantech products and solutions and extract critical minerals.
- Clean hydrogen investment tax credit: Varying between 15% and 40% of project costs, the clean energy hydrogen tax credit offers the highest level of support for projects that produce the cleanest hydrogen. The tax credit also extends a 15% tax credit for equipment that converts hydrogen to ammonia.
- CCUS investment tax credit: The tax credit is available for capital invested in a broad range of CCUS applications across different industrial subsectors (for e.g., plastics, concrete, fuels, direct air capture, blue hydrogen).

#### Other support

- Clean Growth Hub: This is a federal governmentled focal point for cleantech companies helping cleantech stakeholders navigate various federal government programs and services. To ensure that the energy transition is inclusive and resilient, the hub has also launched an inclusion strategy and action plan, as well as a toolkit to help stakeholders apply for federal funding.
- Clean Technology Data Strategy (CTDS): The strategy measures the economic, environmental, and social contributions of Canada's clean technology sector providing key data on the environmental and cleantech sector. With the aim of democratizing cleantech data, the strategy aims to inform policy, support sector growth, and enable private sector decision-making.

<sup>&</sup>lt;sup>19</sup> Access the toolkit here: <u>Applying for federal cleantech funding: A toolkit (canada.ca)</u>

## **Canadian market and investment patterns**

Canada has seen dramatic growth in private cleantech investment in recent years, with some estimates suggesting funding quadrupling between 2018 and 2022.<sup>20</sup> As per the Canadian Venture Capital and Private Equity Association, Canadian cleantech VC investment activity in 2022 was recorded at C\$1.2 billion across 46 deals.<sup>21</sup> This was comprised of \$40 million in seed investment, \$452 million in earlystage (Series A and B) and \$621 million in late-stage VC investment.

In the past five years, 2021 recorded the highest number of deals (53) and 2022 saw record investment in the cleantech sector at \$1.2 billion. Since more dollars were invested across select deals in 2022, average deal size was \$26 million—the highest recorded since 2018.

So far, the first quarter (Q1) of 2023 has recorded \$174-million investments across 21 deals, with an average deal value of \$8.26 million.

## Chart 8: Canadian cleantech investment activity, 2018-2022



Source: Canadian venture capital and private equity association, EDC Economics

Deal activity in Canadian cleantech has been consistently driven by high levels of late-stage investments (Chart 9). Late-stage investments represented 56% of all investments in 2022 and have averaged about half of all investments in the Canadian cleantech sector since 2018. In general, seed investments have only averaged about \$25 million since 2018 and have represented only 5% of all Canadian investment in cleantech since 2018. While seed investments are typically smaller financial amounts, the Canadian average is much below average seed deal sizes in the U.S., for example.<sup>22</sup>

The lack of capital for seed and early-stage deals is a market failure representing a critical funding gap and missed opportunities. Despite 12-13 companies featuring in the top global innovative cleantech firms every year, conservatism in investing can be a key constraint in building true global Canadian cleantech champions. Even though investing in seed and earlystage startups globally is notoriously high risk given steep failure rates, it must be noted that many seed ventures in Canada are supported through government programs and entities that represent non-dilutive funding options, which are very attractive for earlystage companies.

<sup>&</sup>lt;sup>20</sup> As per the Boston Consulting Group, see more <u>bcg-ccf-climate-tech-report-en.pdf</u> & author's calculations

<sup>&</sup>lt;sup>21</sup> Canadian venture capital and private equity association; Canadian Cleantech Sector Gains Momentum with Record... | CVCA Central

<sup>&</sup>lt;sup>22</sup> See pitchbook data for average U.S. seed investment sizes, <u>Q2\_2023\_PitchBook\_Analyst\_Note\_VC\_Investment\_in\_Climate\_Technology\_Preview.pdf</u>



#### Chart 9: Canadian cleantech investment activity: Seed, early-stage, and late-stage breakdown

## **Canadian cleantech companies**

Natural Resources Canada (NRCan) and Innovation, Science and Economic Development Canada (ISED) collect data on the number of Canadian "pure-play" cleantech companies (companies predominantly engaged in developing and/or using innovative technologies that provide environmental benefits). As of July 2023, there were 2,427 pureplay cleantech firms in Canada: 852 in Ontario, 492 in British Columbia, 400 in Quebec, and 391 in Alberta. These four provinces account for 88% of all cleantech firms in Canada. Ontario has the most firms across industries, except in air, environment, and remediation. The air, environment and remediation industry tends to be predominantly located in Alberta. This may be attributed to the oil extraction industries in Alberta, and the incentives to reduce environmental impacts from oil extraction.<sup>23</sup>

While extensive, the database isn't representative of all cleantech players in Canada and the number of cleantech companies in Canada is likely higher as the commercialization stage of many companies is unknown and may not be captured in these official accounts.

## **Contribution of environmental and clean technologies to Canadian GDP**

Statistics Canada categorizes the environmental and clean technology (ECT) products sector in two broad product and process categories<sup>24</sup>:

- 1. Environmental goods and services that include clean electricity from renewables and nuclear power generation, biofuels and primary goods, and waste management and remediation services.<sup>25</sup>
- 2. Clean technology goods and services that include manufactured goods, scientific and research and development services, construction services, and support services. Examples of clean technology goods and services include solar panels and the construction of energy-efficient buildings.

The Environmental and Clean Technology Products Economic Account (ECTPEA) from Statistics Canada measures the economic contribution of the sector in terms of output, gross domestic product (GDP), valueadded and other economic variables.<sup>26</sup>

Source: Canadian Venture Capital and Private Equity Association, EDC Economics

<sup>&</sup>lt;sup>23</sup> To view the cleantech companies' dashboard, please go to Cleantech companies (canada.ca)

<sup>&</sup>lt;sup>24</sup> Examples of environmental goods and services and clean technologies are available in the Statistics Canada publication *Clean technologies and the Survey of Environmental Goods and Services: A technical reference guide, accessible at* Clean technologies and the Survey of Environmental Goods and Services: A technical reference guide (statcan.gc.ca)

<sup>&</sup>lt;sup>25</sup> In December 2022, waste and scrap goods for recycling were added to this sector, leading to revisions in all data series from 2012 onwards.
<sup>26</sup> Per this definition, ECT's contribution to Canadian GDP is defined as "any process, product or service that reduces environmental impacts through any of the following three strategies: environmental protection activities that prevent, reduce or eliminate pollution or any other degradation of the environment; resource management activities that result in the more efficient use of natural resources, thus safeguarding against their depletion; the use of goods that have been adapted to be significantly less energy or resource intensive than the industry standard. See Statistics Canada for the definition: The Daily — Environmental and Clean Technology Products Economic Account, 2021 (statcan.gc.ca)

In 2021, the ECT sector's contribution to Canadian GDP was \$73 billion, approximately 3% of Canadian GDP (at current market prices).<sup>2728</sup> More than half of this contribution was attributed to the environmental goods and services (53.5%) and the remaining 46.5% attributed to the clean technology goods and services subsector.

## Chart 10: Composition of GDP from environmental and clean technology products, 2012-2021



Historically, Ontario, Quebec and British Columbia have contributed the most GDP shares in the ECT sector. In 2021, Ontario accounted for more than one-third (34.5%) of the sector GDP, while Quebec (29.8%) accounted for more than one-quarter and British Columbia (15.1%) accounted for one-seventh. Valueadded at the provincial level also shines light on the importance of Ontario and Quebec in the Canadian cleantech sector. Between 2012 and 2021, Ontario accounted for 34% of cumulative ECT value-added, Quebec 30% and British Columbia as a distant third at 13%. All other provinces and territories combined accounted for the balance 23%. (Chart 11).

## Chart 11: Provincial contribution to value-added, 2012-2021



Source: Statistics Canada, EDC Economics

<sup>27</sup> GDP at current markets prices in 2021 was estimated at \$2.5 trillion by Statistics Canada, see https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610022201

<sup>28</sup> ECT contribution to GDP was 59% of total ECT sector output in 2021 and the compound annual growth rate (CAGR) from 2012-2021 for ECT output was 0.67%, and 0.72% for ECT contribution to GDP.

## **ECT trade flows**

#### **Exports**

In 2021, Canadian ECT products comprised 2.3% of total exports, and amounted to \$17.9 billion. This was an increase of \$14.6 billion from 2020, a 22% year-on-year (YOY) rise.<sup>29</sup> On average, ECT exports have grown annually 0.56%. ECT exports have consistently trended upwards since 2012, and in 2021, hit the highest level on record. (Chart 12).

Within the subcategories, environmental product exports were \$8.7 billion compared with \$9.2 billion in cleantech exports (51% of total ECT exports).<sup>30</sup> With the recent inclusion of waste and scrap goods for recycling in environmental products from cleantech products, shares of environmental products have risen due to data revisions. Cleantech goods have accounted for a higher share of ECT exports in most years (six out of the 10 years analyzed), but on average, shares of environmental and cleantech products have remained the same at 50% each. Following the trend from 2020, environmental product exports increased 29% YOY, mainly driven by a 22% YOY growth in exports of clean electricity. In contrast, cleantech exports rose 17% YOY between 2020 and 2021.

#### Chart 12: ECT exports, 2012-2021



Source: Statistics Canada, EDC Economics



<sup>29</sup> See Statistics Canada, Table 36-10-0646-01 for ECT trade data. Note: In February 2023, the whole time series was revised to reflect the move of the waste and scrap goods" category from the clean technology goods sub-group to the environmental goods sub-group. Differences from last year's Cleantech report data is due to this.

<sup>30</sup> Note: Any changes from last years data are due to the statistical revision of the time series by Statistics Canada in February 2023

Most Canadian ECT exports are cleantech manufactured goods (40%) or waste and scrap goods (28%). This presents a conundrum for Canadian exporters since manufacturing only accounted for 19% of total cleantech output in 2021<sup>31</sup> and 13% of total cleantech value-added in 2021.<sup>32</sup> This might be driven by the number of manufacturers in the ECT sector exporting as a whole.

## Chart 13: ECT exports across select product categories



- Manufactured cleantech goods (cleantech)
- Waste and scrap goods (environmental)
- Clean electricity (environmental)
- Scientific and research and development services (cleantech)
- Biofuels and primary goods (environmental)
- Support services (cleantech)

Source: Statistics Canada, EDC Economics

### Imports

In 2021, imports of ECT products reached \$21.8 billion, representing 2.8% of total Canadian imports. Environmental product imports totalled \$5.9 billion in 2021, compared to nearly \$16 billion in cleantech imports. Despite the outsize share of cleantech imports in Canada's total ECT imports, environmental goods imports rose 30% YOY driven by increases in clean electricity imports between 2021 and 2020.

### Chart 14: ECT imports: Shares of environmental and clean technology products as a percentage of total, 2012-2021



Environmental product imports/Total ECT imports

Source: Statistics Canada, EDC Economics

<sup>31</sup> 10% of total ECT output

<sup>32</sup> 6% of total ECT value-added in 2021. This means that while dominating the export trade, manufacturers contribute very modestly to Canadian output and GDP.

As with exports, most Canadian ECT imports are clean technology products (mainly manufactured cleantech goods), which have accounted for 70% of total ECT imports from 2012-2020. This suggests supply chain linkages, as manufactured goods account for most cleantech manufacturing in Canada. (Chart 15)





Source: Statistics Canada, EDC Economics

### Net trade flows

Due to a reliance on ECT imports, Canada's trade balance has experienced a consistent deficit since 2012. After rising to a record high of \$5.9 billion in 2018, Canada's ECT trade deficit has been steadily decreasing since 2019, settling at \$3.9 billion in 2021. Notably, this deficit has been entirely driven by the cleantech subsector. Barring 2013 (when the trade deficit was \$551 million), environmental products' trade balance has been consistently positive (a surplus). (Charts 16 & 17).







Chart 17: Total ECT trade balance; environmental and cleantech products (negative vertical axis represents deficit; positive vertical axis represents surplus)



Source: Statistics Canada, EDC Economics

At a subsector level, the main contributor to Canada's ECT trade deficit is its imports of clean technology goods (primary and complex manufactured goods) vis-à-vis clean technology services.<sup>33</sup> Cleantech goods imports have constituted on average 88% of total cleantech imports since 2012. In 2021, the trade deficit in cleantech goods was \$6.7 billion—\$2.8 billion greater than Canada's total ECT trade deficit.

<sup>33</sup> Note till 2022, Statistics Canada provided segregated data for primary and complex manufactured. As of summer 2023, this data is no longer segregated and values for primary and complex manufactured goods aren't available 2018 onwards.

More positively, waste and scrap products have shown continued trade surpluses. Clean electricity, too, has consistently been at a surplus, mainly reflecting electricity exports to the United States and the benefits of cross-border integration of electricity grids. Meanwhile, the biofuels and primary goods deficit grew 41% YOY between 2020 and 2021, totalling almost \$3 billion in 2021 and the cleantech goods deficit remained unchanged between 2020 and 2021 totalling \$6.7 billion in 2021 (Chart 18). Given the deep trade deficits in cleantech goods (cleantech) and biofuels and primary goods (environmental products) Canada's ECT sector is expected to run up persistent aggregate trade deficits.

Chart 18: ECT trade balance across select product categories (negative vertical axis represents deficit, positive vertical axis represents surplus)



Source: Statistics Canada, EDC Economics

A key weakness of Canada's ECT exports centres on ECT services. All categories in environmental and cleantech services experienced deficits in 2021 (except for scientific and R&D services, which posted a modest surplus). This weakness has been persistent, with net trade in ECT services accounting for a \$1 billion cumulative deficit between 2012 and 2021. Given the importance of services in output and value-added in the Canadian economy, it's in these areas that Canadian businesses active in ECT sectors will need to build competitiveness to capture economic benefits.

#### Geographic destination of ECT exports

Most Canadian ECT exports go to the U.S., accounting for more than 75% of total ECT product exports in 2021.<sup>34</sup> Of total ECT exports to the U.S., environmental goods account for almost half (47%, \$6.4 billion) followed by cleantech manufactured goods (\$5.8 billion), cleantech services (\$1.3 billion) and waste and remediation (\$140.3 million). Exports of clean electricity (environmental) totalled \$2.5 billion representing less than 20% of total ECT product exports to the U.S. in 2021. Within cleantech services, Canada exported \$883.4 million of scientific and R&D services to the U.S. representing 69% of all cleantech services.

Non-U.S. markets have constituted about 25% of Canadian ECT exports, driven largely by Europe, China and India.<sup>35</sup> After the U.S., Europe was Canada's second-largest export partner receiving \$2.1 billion of Canadian ECT exports. The United Kingdom (19.3%), Norway (17.4%) and Netherlands (14.5%) combined purchased more than half of Canadian European exports. Canada also exported \$304.5 million of ECT products to China in 2021, followed by India at \$255.3 million.

<sup>34</sup> See The Daily — International trade in environmental and clean technology products by origin and destination, 2021 (statcan.gc.ca)
<sup>35</sup> See International Trade in Environmental and Clean Technology Products by Origin and Destination, 2007 to 2017 (statcan.gc.ca)

# Global cleantech trends and opportunities

The U.S. and Europe are likely to lead the solar and battery manufacturing race in 2023-2024, driven by strong policy incentives and energy security concerns. The industry will continue to respond to various policy drivers as concerns geographic concentration in manufacturing processes (particularly for solar and batteries) and critical minerals (particularly in processing) persist. In 2023, several large electric vehicle (EV) factories are expected to become operational, driven by joint ventures with large Asian battery manufacturers and automotive original equipment manufacturers (OEMs).<sup>36</sup> Automakers will also continue to invest large sums in electrification and related technologies (Chart 19).<sup>37</sup> But imports will continue to make up a large proportion of the North American and European EV markets as the processing of majority of critical raw materials for battery cell manufacturing continues in China and as announced North American facilities advance slowly towards production.

### Chart 19: Annual CAPEX and R&D spending commitments on EVs and digital technologies by select automakers, 2019-2022



Source: International Energy Agency, 2023, <sup>38</sup> EDC Economics



<sup>36</sup> These include Volkswagen, Ford, Toyota, Stelantis amongst others

<sup>37</sup> As per the IEA just seven global automakers, which were collectively responsible for nearly half of light-duty vehicle sales in 2022, have capital expenditures of more than US\$55 billion on emerging automotive technologies since 2019, including for manufacturing facilities.
 <sup>38</sup> See here: Annual CAPEX and R&D spending commitments on EVs and digital technologies by selected automakers, 2019-2022 – Charts – Data & Statistics - IEA

In 2022, the increase in renewables as a share of energy supply was the second largest in history.<sup>39</sup> Policy support for solar, wind and energy storage is expected to continue well into 2024 and beyond, advancing applications in electricity production and consumption. These trends will be further honed by positive policy developments and increasing supply diversification in China, the EU, the U.S. and India. This includes the IRA's impact on wind and solar photovoltaics (PVs) in the U.S., streamlining of permitting processes in Europe as part of the REPowerEU plan, India's push to expand domestic PV manufacturing through the government's productionlinked incentives and expansion of auctions to expand capacity<sup>40</sup> and various Chinese pushes towards largescale renewable deployment and manufacturing. While China will dominate global wind and solar PV manufacturing capacity in the short term, PV and wind project announcements indicate supply chain diversification by 2025.

The IRA has accelerated the United States' role as a leader in the development of low-carbon hydrogen production. Alongside the IRA's multiple tax credits and the Infrastructure Investment and Jobs Act's clean hydrogen initiatives have led to multiple announcements of U.S. hydrogen hubs, spurring massive hydrogen-related project developments. Since the legislation provides stimuli across the entire hydrogen value chain, stacking of tax credits is expected to transform the hydrogen production landscape with some pundits calling for cheaper green hydrogen than grey in the coming years. This is expected to spur policy responses across the globe. Canadian policy-makers are planning to enact similar tax concessions and Japan and South Korea are exploring opportunities of importing low-cost hydrogen from North America.<sup>42</sup> India has responded with a

US\$2 billion national green hydrogen mission focused on building local production capacity while creating export opportunities for green hydrogen.<sup>43</sup>

Incentives from the IRA, the Infrastructure Investment and Jobs Act and the Low Carbon Fuel Standard (LCFS) are also expected to accelerate investments in U.S. carbon capture, usage and storage (CCUS) projects if permitting related backlogs are cleared in a timely manner. These include specific provisions in the IRA around carbon sequestration<sup>44</sup> with US\$12 billion of new investments supporting CCUS in the Infrastructure Investment and Jobs Act and the inclusion of credits from carbon capture and sequestration in the LCFS. Despite the U.S policy momentum and additions to capture capacity in the second half of 2022, the market for CCUS technologies remains niche. More than 70% of global CCUS projects remain at early planning stages of development and only 3% are currently under construction.<sup>45</sup> As the importance for CCUS in hard-to-abate sectors (such as cement) builds and more CCUS hubs are announced, there could be significant global traction in this sector.46

Global momentum around nuclear power is expected to continue into 2023 as attitudes shift and investments in capacity additions build globally. The IRA offers production tax credits for existing nuclear plants and planned expansions and extensions. New build nuclear programs in France, the U.S. and Eastern Europe have also been announced after the addition of nuclear to the EU's list of sustainable and green activities. Canada has launched the small modular reactors (SMRs) enabling program providing funding of \$29.6 million over four years to fund SMR research and develop supply chains for SMR manu-facturing.<sup>47</sup> SMRs are expected to power small regions, industrial sites and remote locations.

<sup>&</sup>lt;sup>39</sup> Renewables - Energy System - IEA

<sup>&</sup>lt;sup>40</sup> See more here: https://www.pib.gov.in/PressReleasePage.aspx?PRID=1913789

<sup>&</sup>lt;sup>41</sup> The announcement of the US's first offshore wind equipment manufacturing plant is also expected to come online by 2025.

<sup>&</sup>lt;sup>42</sup> Global-Hydrogen-Flows.pdf (hydrogencouncil.com)

<sup>&</sup>lt;sup>43</sup> See more here: file\_f-1673581748609.pdf (mnre.gov.in)

<sup>&</sup>lt;sup>44</sup> IRA specific CUUS provisions include a combination of tax credits (advanced energy project credit, extension and modification of the carbon oxide sequestration) and access to CCUS specific funding streams (the advanced industrial facilities deployment program and grants for non-federal forest landowners amongst others).

<sup>&</sup>lt;sup>45</sup> <u>10 Cleantech Trends in 2023 whitepaper.pdf (spglobal.com)</u>

<sup>&</sup>lt;sup>46</sup> Direct air capture (DAC) technologies are expected to impact various energy projects but are yet to be commercialized given high costs.

<sup>&</sup>lt;sup>47</sup> Canada Launches New Small Modular Reactor Funding Program - Canada.ca

Beyond this, large opportunities for broader non-power cleantech are expected to gain momentum in 2024 and beyond. This includes the wider decarbonization of heat and the role of heat pumps in this transformation. Half of total final energy is consumed in the form of heat, versus 20% for power generation and 30% for transport. Despite this, only 11% of heat is produced using renewables. And while the share of renewables in power generation has almost tripled in the last 10 years, the share of renewables in heat has barely grown by one-third.<sup>48</sup>

In an effort to bring heat back in the policy focus, several policy announcements are expected to produce significant opportunities in this space. Between 2020 and 2021, heat pump sales increased 13% globally and 34% in Europe.<sup>49</sup> Heat pumps are being supported in the EU by the REPowerEU that targets doubling the current deployment of heat pumps between 2022 and 2030. The IRA provides specific rebates for home energy supply improvements, including the installation of heat pumps. Mergers and acquisitions activity in the heat pump space is expected to grow, given the fragmented nature of the industry as cost and smart innovations push towards improved and easy installation and operation.

China is expected to remain the dominant manufacturer in the short term for many clean technologies (especially solar photovoltaic cells and lithium-ion batteries). Industrial policy pushes, at least in manufacturing, will promote domestic jurisdictionspecific jobs as the race to attract climate and STEM talent gains momentum. This could be supported by competitive wages for cleantech jobs and attractive immigration policies. In contrast, securing safe supply chains of critical raw materials may have larger geostrategic implications, making Organisation of Economic Co-operation and Development (OECD) co-operation in the sector more likely. Whether that'll translate to the U.S. softening its protectionist mineral procurement policies in the IRA remains to be seen.

Reshoring is likely to increase overall costs in the short term, which will be more pronounced in some sectors such as solar panels or batteries where China already holds competitive advantages. In general, an approach that encompasses both carrots and sticks is needed to achieve long-term sustainability and emission reductions. Incentives to discourage highemissions activities, generally absent from the U.S. policies, may slow the place of immediate emissions reductions as proving nascent technologies (they've yet to commercialize or have positive economic uses) take precedence over incentives to reduce emissions in the immediate term.

### Challenges

Despite the policy push towards clean energy deployment in 2022, several critical hurdles are impacting the cleantech industry globally. These include:

- **Complicated permitting processes:** Long administrative and permitting delays are persistent in the U.S. and EU.
- Grid constraints: A key constraint for renewable energy adoption is the low rate of grid enhancements due to a lack of investment in upgrading grid infrastructure to mitigate congestion and reinforce grid capability to handle higher levels of intermittent renewables. Energy storage and batteries are set to play an increasing role here beyond investments in conventional grid upgrades.
- New infrastructure and supply chain development: Beyond planning offshore and onshore grid infrastructure for supporting offshore wind projects, several clean energy supply chains, including the deployment of critical and rare earth minerals need to come online to ensure the deployment of cleantech at a pace that is warranted. This requires sufficient global investment in a timely manner.
- Labour shortages: Tight labour markets in advanced economies and a lack of skilled workers in developing economies have slowed deployment of renewable installations. S&P Global specifically lists the need for installers,

<sup>&</sup>lt;sup>48</sup> S&P Global 2023 <sup>49</sup> S&P Global 2023

electricians, and grid specialists as the immediate labour demands for 2023.<sup>50</sup> Increasing the supply of "green" workers through skilling and training programs, alongside promoting transferrable skills from traditional industries towards green industries, will be crucial.

# Canadian cleantech trends and opportunities

The *Inflation Reduction Act* in the U.S. has further intensified the need to level the field for Canadian companies to fully leverage the economic development opportunities of the transition. Canadian cleantech and the broader ECT sector could find considerable trade and investment opportunities given global demand for innovative solutions and increasing collaboration amongst "friendly" nations and firms. As supply chains and energy market relationships realign, several opportunities arise for Canadian firms to increase R&D collaboration, joint ventures and commercialize their intellectual capital through the export of cleantech goods and services.

Canada has a very strong talent base to push innovations in cleantech given our well-educated workforce. Canada boasts the highest share of adults with a post-secondary degree globally (10% above the second-place country, Japan), with nearly 20% of them being in the science and engineering stream (STEM).<sup>51</sup> This strong talent pool, alongside healthy immigration rates, bodes well for Canada. But as all countries compete to attract climate-specific talent from abroad, Canada needs to be well-prepared to keep its climate talent local and reverse any significant brain drain in top STEM talent.

Canada also has a vibrant startup and accelerator network and boasts a healthy level of startups in the climate tech space, producing a relative high level of cleantech startups per capita. Canada outperforms its OECD peers by a healthy margin, producing 12 startups-per-million people versus just eight for the OECD-peer average, 1.7 times the U.S. and 3.1 times Germany's rate of per capita startups.<sup>52</sup> This bodes well for the sector in general. Canadian startups are also supported by a host of government programs and federal and provincial innovation programs and face few regulatory hurdles while setting up their businesses.

## **Growing Canadian cleantech exports**

Through existing trade agreements Canada-United States-Mexico (CUSMA), Canada-Europe Union Comprehensive Economic and Trade agreement (CETA), Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP). Canada already has preferential market access to export homegrown cleantech goods and services, with several countries that are already importers of value chains from Canada. By leveraging existing trade agreements and expanding or forging new trade alliances, Canadian companies may be able to leverage opportunities that arise from international agreements and commitments. This includes consideration of a carbon-border adjustment mechanisms for countries that don't put a price on carbon and subsequently, benefit from carbon leakage from countries, like Canada, that's making efforts to lower emissions.

Serving the transition and energy needs of many emerging and developing economies also offers unique opportunity for Canadian cleantech players. Many emerging and developing economies have severe deficits of reliable and affordable energy. More than 775 million people lack access to electricity and 2.4 billion lack access to clean cooking fuels in emerging and developing economies.<sup>53</sup>

While affordable clean technologies offer a compelling way to close these gaps, energy demand in these regions is set to grow at a much faster rate than the pace of current adoption. The surge in investments needed in infrastructure, cleantech, power system transformation and renewable energy provides immense opportunities for Canadian cleantech companies. As an energy exporter and hub for large critical earth minerals that are essential for clean and renewable energy sources,

<sup>&</sup>lt;sup>50</sup> 10 Cleantech Trends in 2023 whitepaper.pdf (spglobal.com)

<sup>&</sup>lt;sup>51</sup> World Bank and OECD, and Statistics Canada; The Daily: Canada leads the G7 for the most-educated workforce, thanks to immigrants, young adults and a strong college sector, but is experiencing significant losses in apprenticeship certificate holders in key trades (statcan.gc.ca) <sup>52</sup> As per the Boston Consulting Group, see more bcg-ccf-climate-tech-report-en.pdf

<sup>&</sup>lt;sup>53</sup> Scaling up private finance for clean energy in emerging and developing economies, The International Energy Agency, June 2023

Canada is in a unique position to serve the demands of these economies. This includes the ability to export our cleantech technical expertise and innovative technologies, while also supplying the raw materials needed towards the energy transition.

## Areas of improvements—A Canadian perspective

Despite the favourable environment, the Canadian cleantech sector suffers from various challenges. At the centre are currently inadequate levels of private sector R&D spending, with Canada trailing its peers in total R&D investment per capita. The U.S., for example, boasts four times Canada's level of private sector R&D per capita, Germany 2.7 times and the broader OECD peer set at 2.4 times.<sup>54</sup> This is further shown in a comparative lack of commercialization of research and challenges in commercializing intellectual capital in the Canadian cleantech industry specifically. For example, there are evident gaps in Canadian research publications and patents as Canada only produces 15-20 patents for every 1,000 peer-reviewed publications in cleantech while the world average is at 70.55

Most Canadian cleantech investments are driven by international investors or pension funds. The market also relies heavily on public sources of financing and Government of Canada crown corporations. Canadian corporates and investors also deploy most of their funding to international jurisdictions with some estimates suggesting that nearly 80% of domestic Canadian cleantech capital is deployed outside of Canada.<sup>56</sup> In the same vein, nearly 55% of Canadian private cleantech investment comes from foreign investors.

The \$1.2 billion of total venture capital funding for Canadian cleantech companies in 2022 pales in comparison to the U.S., which deployed 40 times more capital in cleantech in 2022.<sup>57</sup> Canadian cleantech also suffers from lower shares of larger deals (greater than \$ 50 million) and major rounds compared to our OECD peers. According to one estimate, only 7% of Canadian funding events over the last five years were greater than US\$50 million, whereas the U.S. saw double of that at 12%.<sup>58</sup> This is exacerbated by the predominance of small- and medium-sized enterprises in the Canadian cleantech sector<sup>59</sup> that struggle to achieve market acceptance, build teams, and thereby, attract funds to grow and scale. This contributes to Canada trailing its OECD peers in converting startups to scaleups.60

While proximity to and active integration with the U.S. markets help position Canada for future success, the scale and size of incentives (many of them uncapped) being offered by IRA represents significant headwinds for the growth of the Canadian cleantech sector.



<sup>54</sup> As per the Boston Consulting Group, see more bcg-ccf-climate-tech-report-en.pdf & author's calculations.

<sup>55</sup>As per the Boston Consulting Group, see more bcg-ccf-climate-tech-report-en.pdf

<sup>56</sup> As per the Boston Consulting Group, see more bcg-ccf-climate-tech-report-en.pdf

<sup>57</sup> As per Climate Tech VC- the US attracted US\$40billion in cleantech VC funding in 2022.

<sup>58</sup> As per the Boston Consulting Group, see more bcg-ccf-climate-tech-report-en.pdf

<sup>59</sup> ISED estimates that approximately 25% of cleantech SMEs in Canada were micro-sized (having between 1 and 4 employees), 31% had between 20 and 99 employee and only 4.5% had between 100 and 499 employees. See more, "SME profile: Clean technology in Canada." SME Profile: Clean technology in Canada <sup>60</sup> See more here - Canada Has a Scale-up Problem, Not a Start-up Problem - Centre for International Governance Innovation (cigionline.org)

#### Figure 1: Areas of improvement in Canada



#### **Tech development**

- Growing gap in private R&D
- Low levels of commercialization of research (IP, patents)
- Brain-drain in STEM labour



#### **Scaleup funding**

- Few Canadian investors
- Low share of larger deals (>\$50 million)
- Few seed-funding rounds



#### **At-scale demonstrations**

- Few at-scale demonstration projects or companies
- Migration of top Canadian startups to more favourable markets

Source: EDC Economics

## Conclusion

Rising energy costs and aggressive policy drivers made 2022 a landmark year for cleantech policy. Adopting clean technologies at scale and at a pace that puts us on the path to net zero requires action on various fronts. While the evolution of existing and new technologies is inherently uncertain, going forward, capital mobilization will be crucial. Rapid growth of cleantech manufacturing is set to create new markets worth billions of dollars where there will be winners and losers. Ensuring a sustainable, but also equitable energy transition, is the need of the hour as is creating a new trade economy, which is both open and fair.

Ultimately, the success or failure of new startups will depend on factors beyond performance, cost, and scale. The readiness of the market will be determined, in large part, by the perceptions of investors who provide followup funding. This is where private and corporate capital will need to step up in Canada. As each country adjusts to the realities of the new global green economy, Canada must focus its efforts in helping high-growth, IP-generating companies scale while providing the appropriate funding across each stage.





## References

- 10 Cleantech Trends in 2023: Technologies to reduce emissions and confront climate change, S&P Global – Commodity Insights, 2023
- Canada has a Scale-up Problem, not a Start-up Problem, Bergen, B., CIGI Online, 2017
- Canadian Cleantech Sector Gains Momentum with record number of Investment in Q1 2023, Canadian venture capital and private equity association, June 2023
- 4. Climate Tech: The Canadian Venture Opportunity, The Boston Consulting Group, June 2023
- 5. Exploring Canada's cleantech sector, EDC Economics, October 2022
- 6. Global Cleantech 100: From Commitments to Actions: The Sprint to Net Zero is on, Cleantech Group, 2023

- Global Hydrogen Flows: Hydrogen trade as a key enabler for efficient decarbonization, Hydrogen Council and McKinsey & Company, October 2022
- 8. National Green Hydrogen Mission, Ministry of New and Renewable Energy, Government of India, January 2023
- 9. Pitchbook, various data sources
- Renewable data, International Energy Agency, accessed August 2023
- 11. Scaling up private finance for clean energy in emerging and developing economies, The International Energy Agency, June 2023
- Scaling Up to Phase Down: Financing Energy Transitions in the Power Sector, World Bank, 2023
- 13. SME profile: clean technology in Canada, Innovation, Science and

Economic Development Canada, March 2023

- 14. Statistics Canada, Cleantech companies' dashboard
- 15. Statistics Canada, various tables
- The world is entering a new age of clean technology manufacturing, and countries' industrial strategies will be key to success, International Energy Agency, January 2023
- 17. Unlocking the Inclusive Growth Story of the 21st Century: Accelerating Climate Action in Urgent Times, Global Commission on the Economy, and Climate, 2018.
- World Energy Investment Report

   2023, International Energy
   Agency, May 2023.



## **About this report**

The cleantech report is part of a publication series of concise reports written by Export Development Canada's Economics staff on the future potential for Canadian exports. The views expressed in this report are those of the author and shouldn't be attributed to Export Development Canada or its Board of Directors.

This report is written by EDC senior economist Prerna Sharma and reviewed by EDC's national cleantech lead Lynn Côté and EDC's Economics' manager Meena Aier. The report was copy edited by Karen Turner and Janet Wilson. The French report was copy edited by Gilles Brault.

For questions or comments, please contact Prerna Sharma (psharma@edc.ca).

For media inquiries, please contact media@edc.ca.

## ABOUT EXPORT DEVELOPMENT CANADA

### Who are we?

Export Development Canada (EDC) is a financial Crown corporation dedicated to helping Canadian businesses make an impact at home and abroad. EDC has the financial products and knowledge Canadian companies need to confidently enter new markets, reduce financial risk and grow their business as they go from local to global. Together, EDC and Canadian companies are building a more prosperous, stronger and sustainable economy for all Canadians.

For more information and to learn how we can help your company, call us at 1-800-229-0575 or visit www.edc.ca.

## Disclaimer

This document is a compilation of publicly available information. It's not intended to provide specific advice and shouldn't be relied on as such. It's detailed independent research and professional advice concerning the specific subject matter of such action or decision. While EDC has made reasonable commercial efforts to ensure that the information contained accurateness, timeliness or completeness of the information contained herein. This document or any part of it may become obsolete at any time. It's the user's responsibility to verify any information contained herein before relying on such information. EDC isn't liable in any manner whatsoever for any loss or damage caused by or resulting from any document. This document isn't intended to and doesn't constitute legal or tax advice. For legal or tax advice, please consult a qualified professional. EDC is the owner of trademarks and official marks. Any use of an EDC trademark or official mark without written permission is strictly prohibited. All other trademarks appearing in this document are the property of their respective owners. The information presented is subject to change without notice. EDC assumes no responsibility for inaccuracies contained herein. Copyright © 2023 Export Development Canada. All rights reserved.





