Clean Technology

Horizontal Business Innovation and Clean Technology Review

Agenda

1. Context
2. Phase II Data
3. Expert Advice

What was the context of Clean Technology in the review?

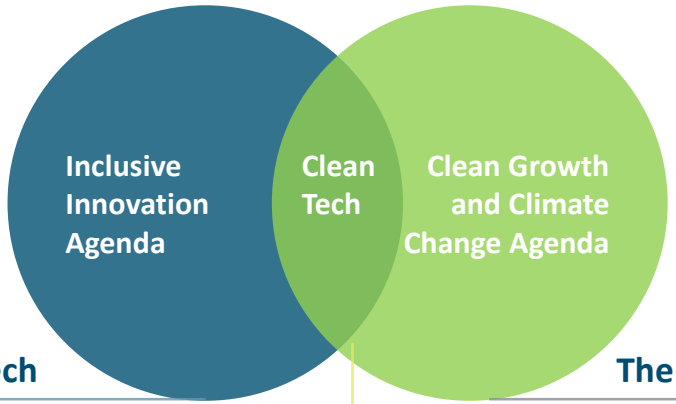
Clean technology innovation plays a key role in two major policy agendas ….

- Clean Technology: *any product, process, or service designed with the primary purpose of contributing to, remediating or preventing any type of environmental damage*
- What differentiates clean technology is the '*clean*' – a positive impact in the environment

Priority is well resourced, need to improve capacity to measure 'clean" outcomes.

Objective: Innovation to drive growth, improve lives of Canadians, and create jobs economy-wide

The most globally marketable clean tech



Priority not well resourced

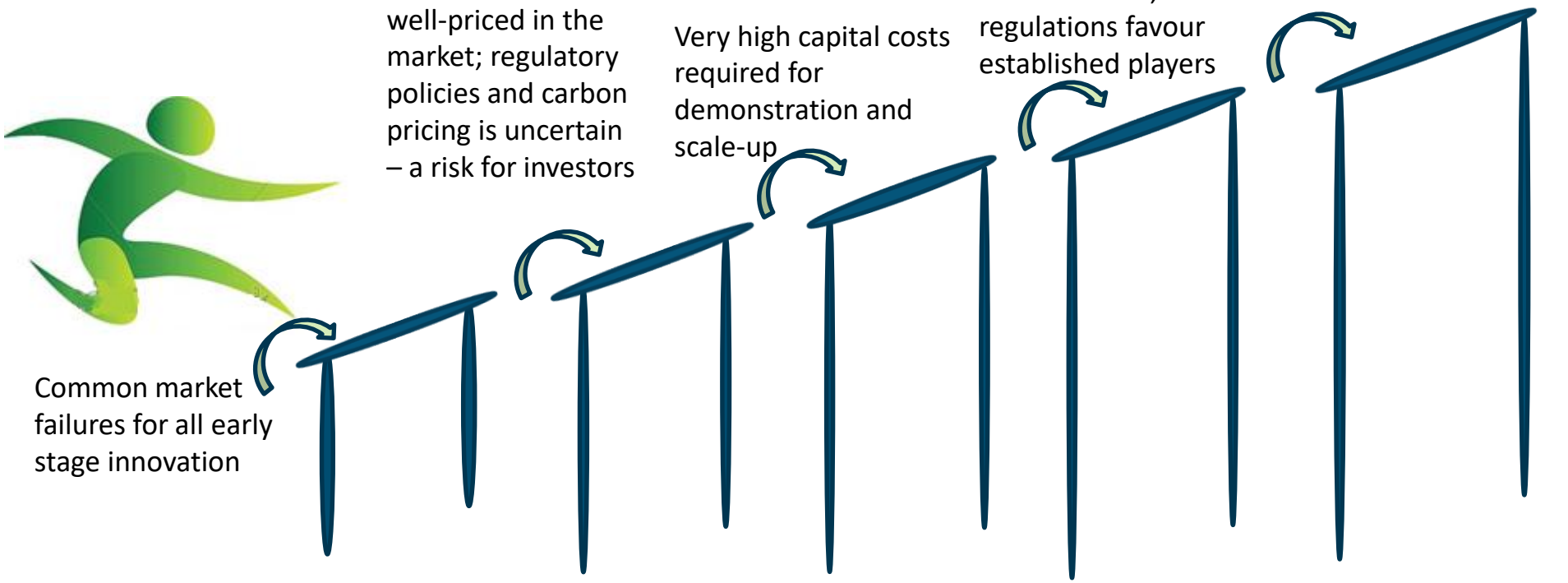
Objective: Meet Canada's GHG emissions reduction target and grow the economy sustainably

The most domestically impactful clean tech

Clean Technology is a key element of two agendas, funding is targeting two different objectives

… but faces a significantly more challenging path to market than most other innovations.

Clean tech needs more / different public support than other types:



‘Clean’ innovation happens in producer and adopter firms.

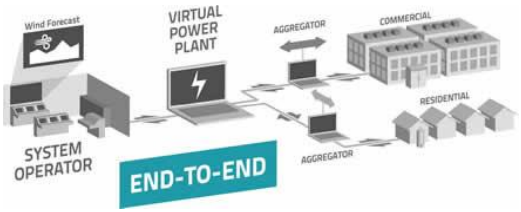
Producer-focused: A Canadian firm is developing a new clean technology for sale.

Example: Enerkem – Converting municipal solid waste into biofuels

Research and Development	Demonstration	Growth and Scale up / Early Market Adoption	Commercial production and export / broad market adoption
2011-2014: NRCan supports Enerkem to develop processes that convert synthesis gas from thermal gasification of non-recyclable municipal solid waste (MSW) into “drop-in” renewable fuels.	2015: SDTC supports Enerkem Inc. in building a large-scale commercial next generation cellulosic ethanol plant capable converting Municipal Solid Waste (MSW) into 38 million litres of cellulosic ethanol.	2016: WD supports commercialization of methanol – to – ethanol technology at Enerkem’s Edmonton, Alberta biofuels plant.	2017: Enerkem started commercial production of cellulosic ethanol - the first commercial-scale plant in the world to produce cellulosic ethanol made from non-recyclable, non-compostable mixed municipal solid waste.

Adopter-focused: A Canadian firm is looking to improve the environmental impact of operations.

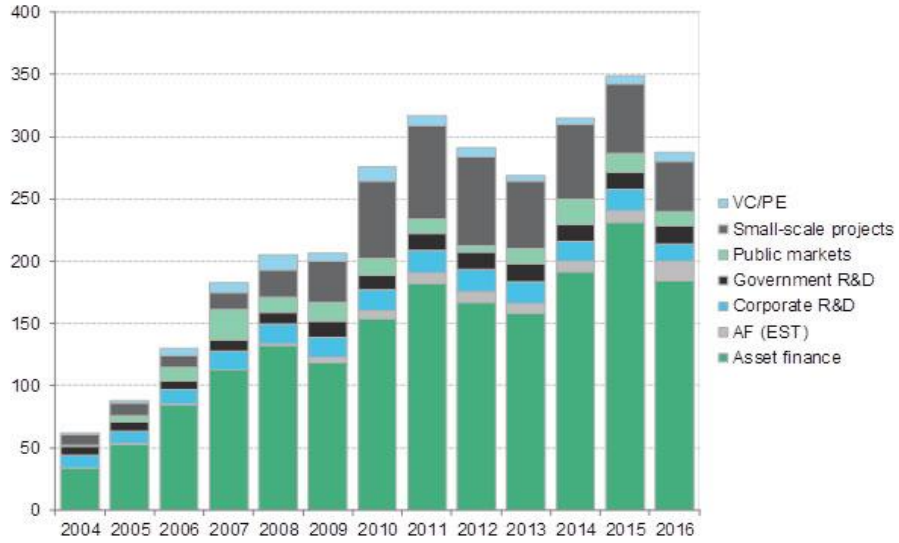
*Example: New Brunswick Power’s “*PowerShift Atlantic*” (PSA) - one of the world’s first fully grid-integrated virtual power plants (VPP)*

Research and Development	Demonstration	Growth and Scale up / Early Market Adoption	Commercial production and export / broad market adoption
Mid-2000s: Collaborative R&D with CanmetEnergy & Universities, NRCan-PERD, NSERC Research Networks to test individual concepts, develop models and evaluate options.	2009-2013: NRCan supports a large scale, multi-province VPP demonstration with consumers and businesses 	2013: Siemens Canada opens smart grid centre of competence in New Brunswick with support from ACOA and NSERC , working with NB Power to further develop its Reduce-And-Shift-Demand (RASD) strategy.	2017: New Brunswick identifies RASD as a key component of their strategy for coal displacement to achieve PCF objectives.

The Inclusive Innovation Agenda focuses on innovation to capture the global clean technology market opportunity …

Budget 2017: the global market for **clean technology** (cleantech) has surpassed $1 trillion per year and will continue to grow over the next decade. As the world increasingly seeks out more sustainable and renewable sources of energy, and new technologies to improve the quality of air and water, Canadian companies can lead the way. Our clean technology companies are well-positioned to compete and win in this large and growing global market.

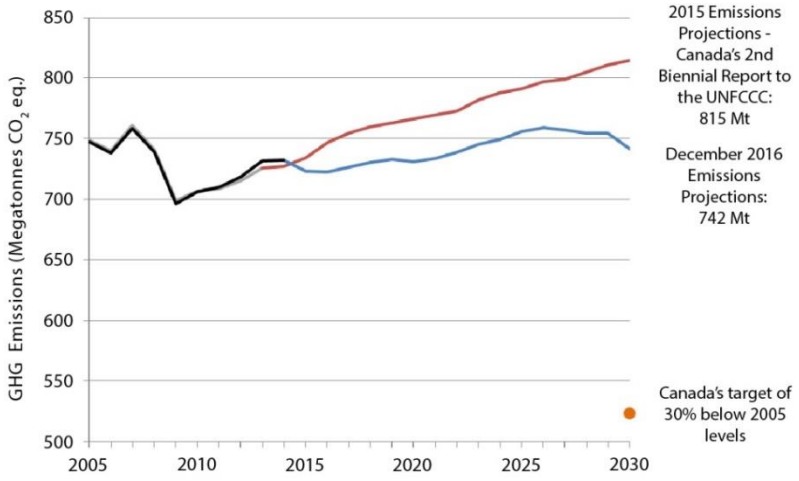
Global new investment in clean energy by category, 2004 to 2016, $bn



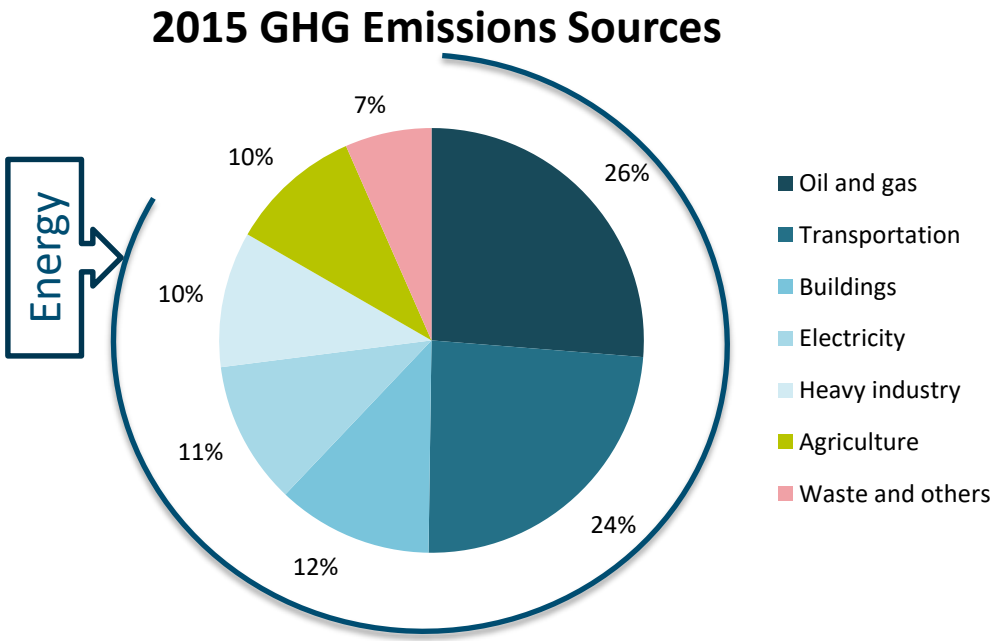
Source: Bloomberg New Energy Finance.

- Canadian companies can't rely on the domestic market alone - 83 % of companies expect to be exporting in 2015.
- In 2014, more than half the industry revenues came from exports.

… while the Clean Growth and Climate Change Agenda focuses on innovation to drive significant emissions reductions in Canada …



- Energy, a key input in the economy, is responsible for 83% of GHGs with additional significant negative impacts on air, and water.
- Energy system needs to be transformed over the next 35 years
- Firms are deeply implicated in the process of transformation as both suppliers and users of energy



Source: International Energy Agency

… but the two agendas reinforce each other – each agenda's success strengthens the other.

Developing globally competitive clean technology companies:

- Increases the tool set for reducing Canada's emissions
- Increases expertise, skills and knowledge available in the market
- Establishes global reputation for strength in the sector

Inclusive Innovation Agenda

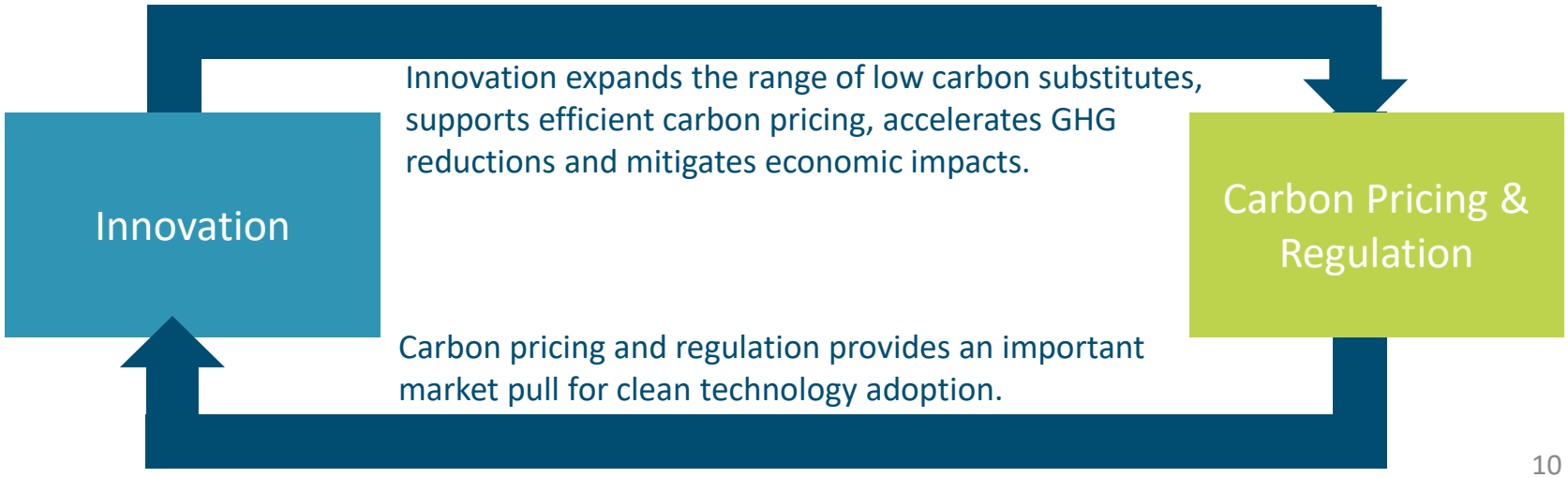
Clean Growth and Climate Change

Driving innovation in Canada to reduce GHGs:

- Strengthens the domestic market for clean technology producers
- Increases long term competitiveness of resource industries
- Lowers long-term cost of energy – important input to economy
- Establishes global reputation for strength in the sector
- Complements carbon pricing and reduces carbon leakage risk.

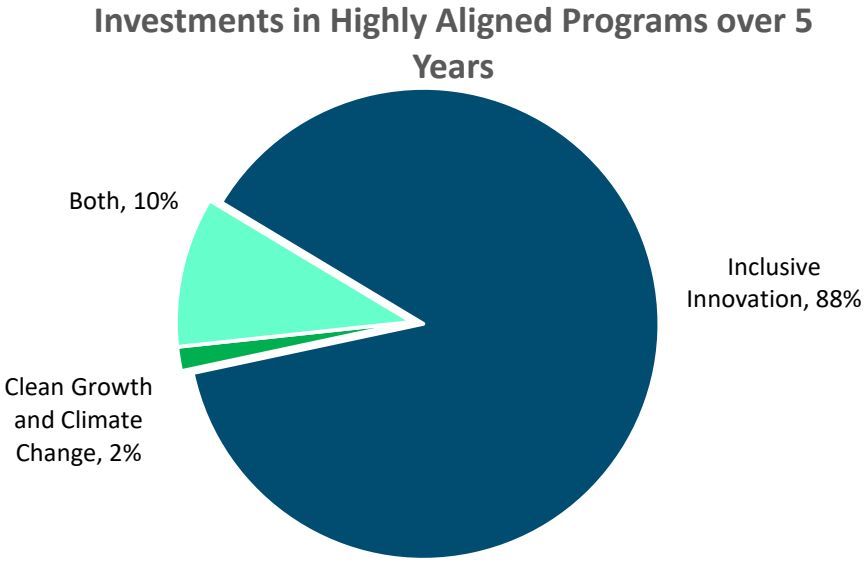
Regulations have a Significant Impact on Clean Technology

- Although not in the scope of this review, regulation will have a major impact on adoption of clean technology - the introduction of a carbon price in Canada, development of a Clean Fuel Standard and accelerating the phase-out of conventional coal-fired electricity by 2030 are key elements of Canada's emissions reduction strategy.
- Carbon pricing will increase the effectiveness of innovation programming in supporting emissions reductions by providing market pull.
- Innovation is required to succeed:
  - ECCC has identified a 66 Mt gap between 2030 targets and current measures that is to be filled by public transit, green infrastructure, technology and innovation and stored carbon – a short timeline to achieve results.
  - the Deep Decarbonisation Pathways Project concluded that Canada requires 'next generation' technologies to achieve 50% of its total required abatement by 2050.



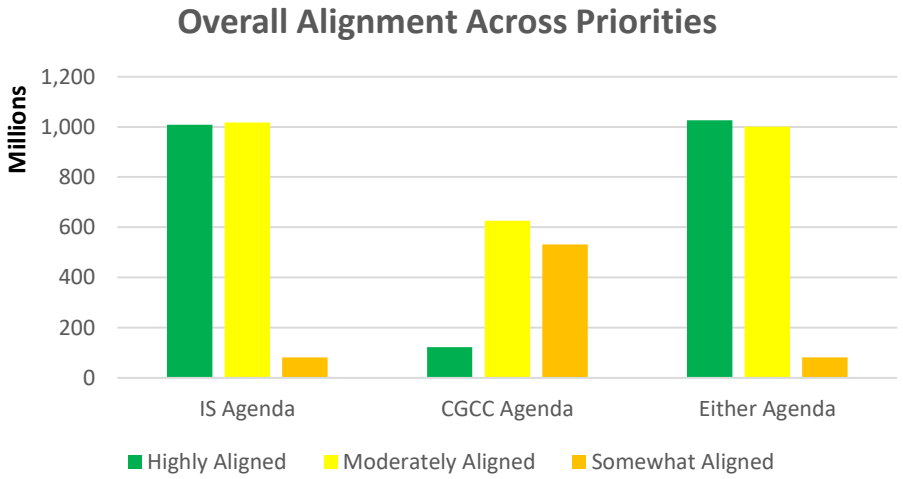
What does the Phase II Data tell us?

Alignment of Clean Technology Spending is Primarily to the Inclusive Innovation Agenda …



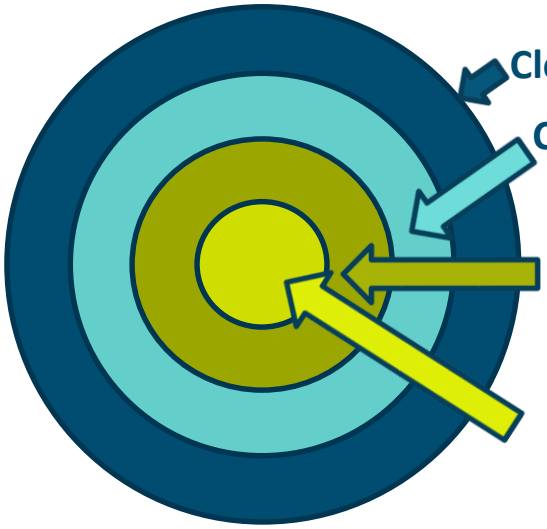
- 98% of clean tech spending was rated as highly aligned to the Inclusive Innovation Agenda
- Only 12% was considered highly aligned to the clean growth and climate change agenda

- Most clean technology innovation spending is targeting the producer-focused articulation of clean tech
- Environmental outcomes are only tracked in two programs - even 'moderately aligned' CGCC programs didn't monitor environmental outcomes (e.g.,GHGs)



… with limited monitoring and reporting on ‘clean’ outcomes

Involvement of program streams in clean technology



Clean tech is eligible in 45 program streams

Clean tech is targeted in 32 program streams

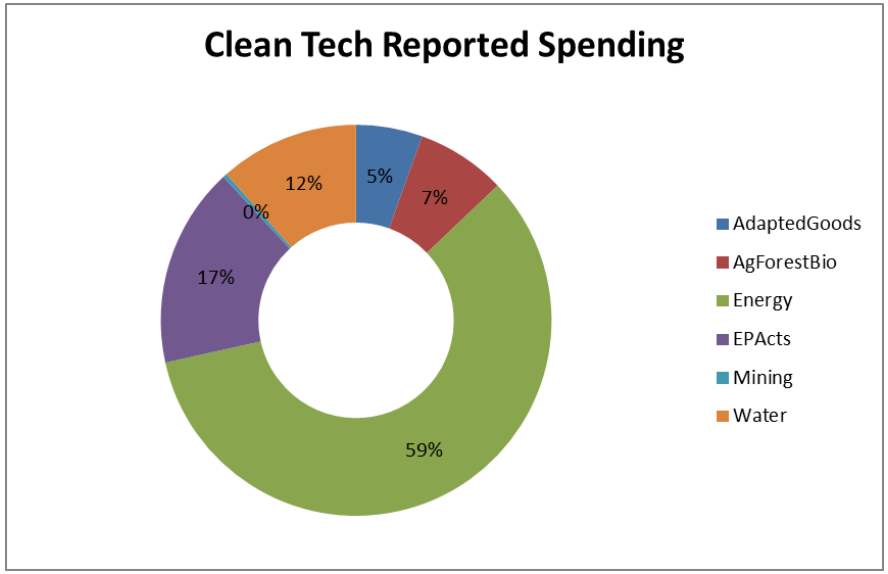
Clean tech funding is tracked in only 15 program streams

Clean tech funding is tracked and environmental outcomes are monitored in only 2 program streams → **Measurable ‘clean’ outcomes**

- Low capacity in the system for monitoring and reporting on ‘clean’ – exceptions are SDTC and NRCan’s Energy Innovation Program.

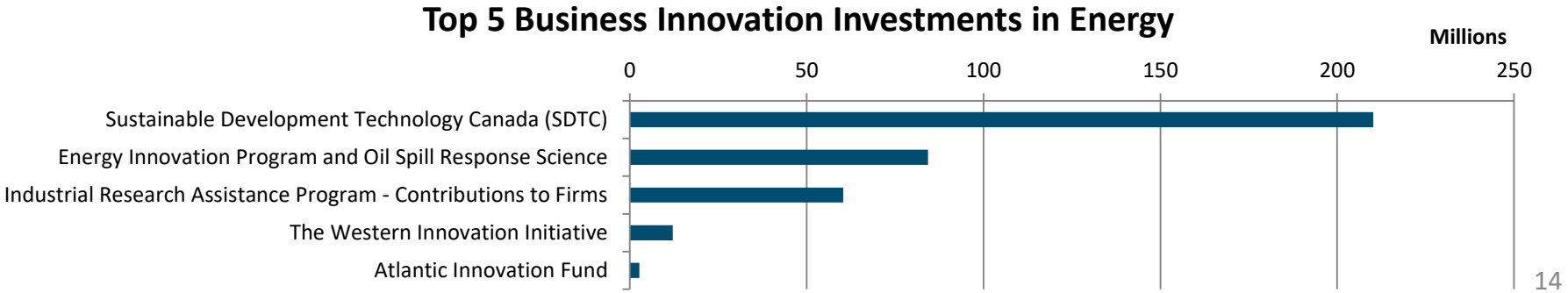
- “What gets measured gets done”: Not tracking clean outcomes suggests programs will have less impact on the Clean Growth and Climate Change agenda.

Investments by category suggests an underinvestment in energy …

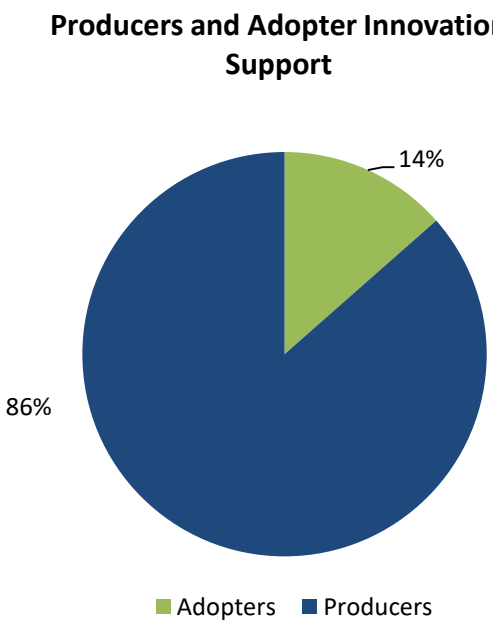


- At 83% of GHG emissions, energy represents only 59% of innovation investments.
- While other environmental outcomes are also important, transformational change is required in energy to achieve emissions reduction targets.
- Other notable gaps: mining, and agriculture

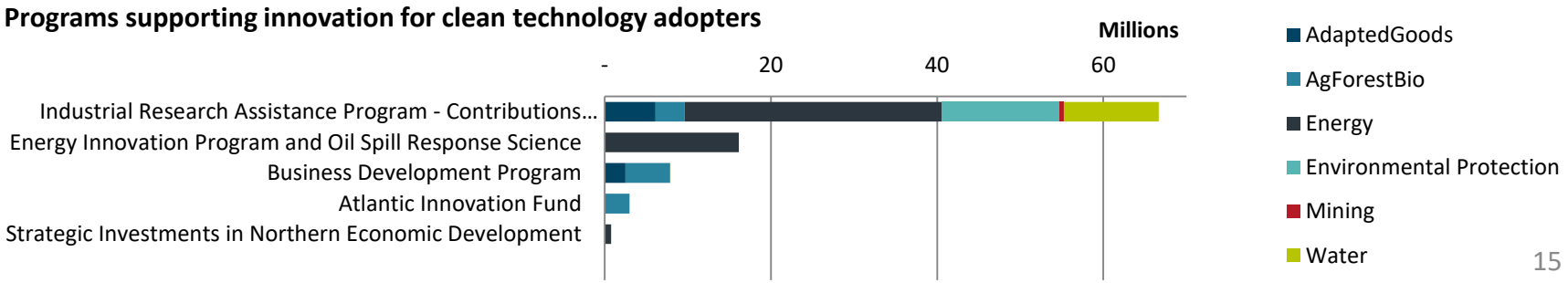
- The 59% spent on energy is scattered between 14 program streams, with a few larger players making significant investments



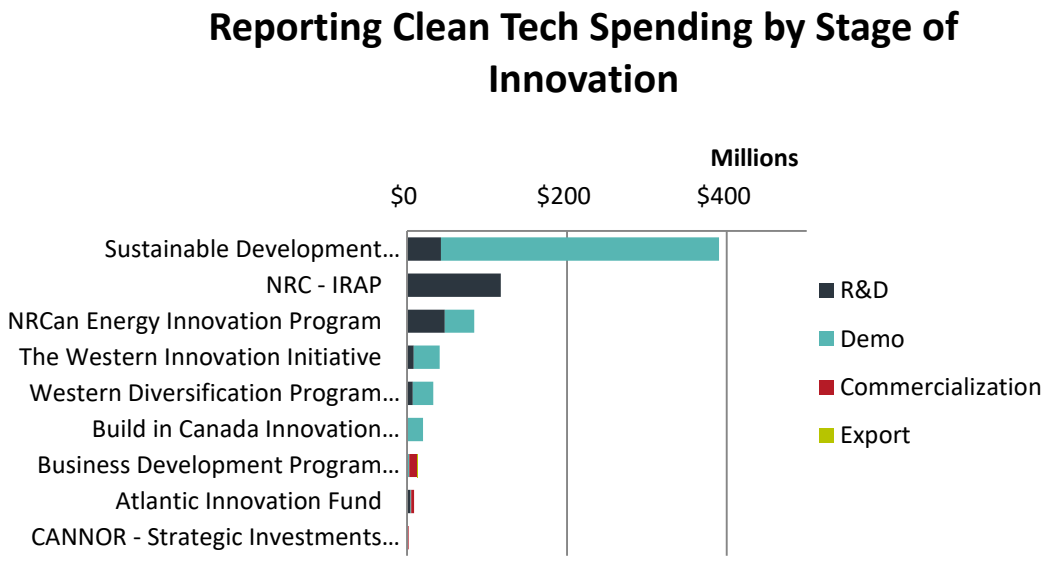
… and an underinvestment in support of adopter-led innovation …

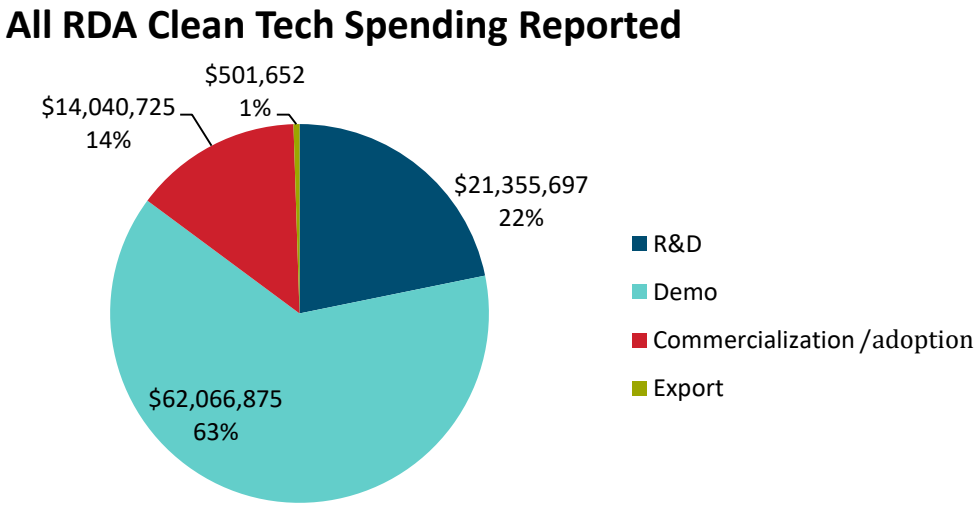


- Regulations impact adopters – carbon pricing impacts natural resources sectors in particular, which represent 16% of GDP, $25B in government revenues, and 93% of GHG emissions.
- **Innovation reduces the negative impact of climate change policies on GDP in 2050 by half** and significantly lowers the carbon price needed. ***(OECD Taxation, Innovation and Environment)***
- **Canadian clean technology producers are responsible for only 1.6% of global clean technology** – Canadian firms may not meet a Canadian adopters innovation needs.



… with too many players concentrating in demonstration.



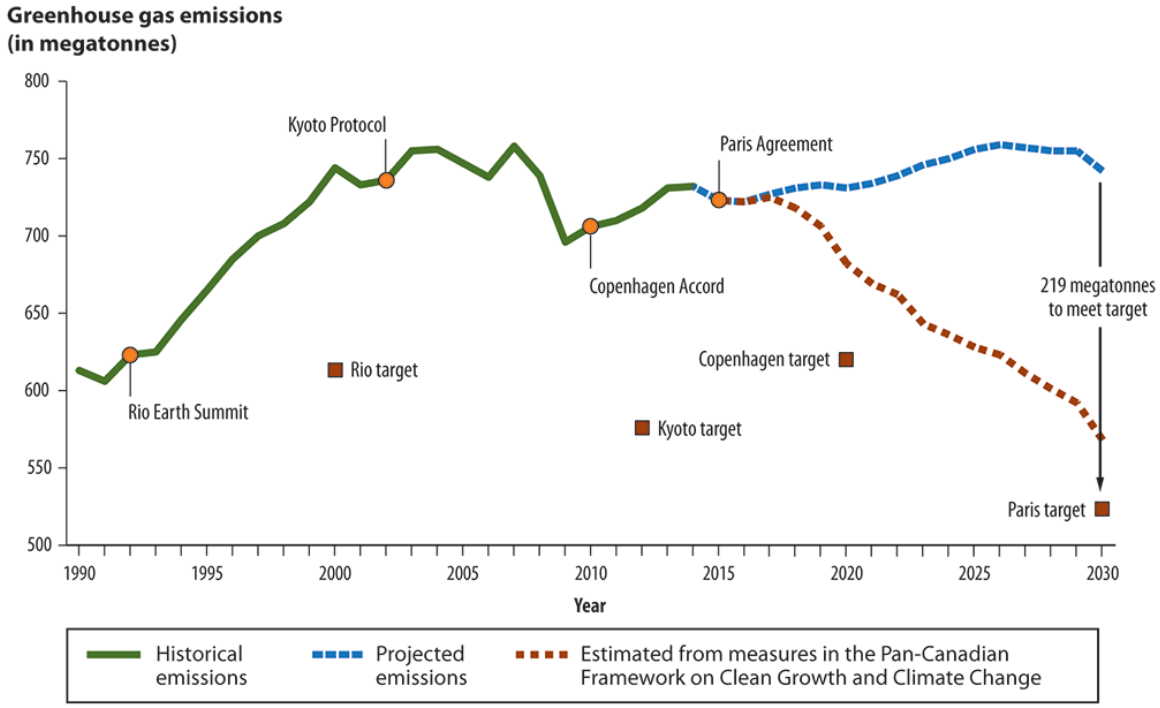


- 85% of reported RDA funding is in RD&D.
- IRAP is funding early, small interventions in firms.
- SDTC is funding larger interventions in firms.
- SBDAs are funding medium to large interventions with a range of stakeholders (firms, non-profits, other government)

- RDA funding would be better placed post-demonstration to support market adoption of clean technologies to support clean growth targets.
- This would move roughly $85M from RD&D to adoption.

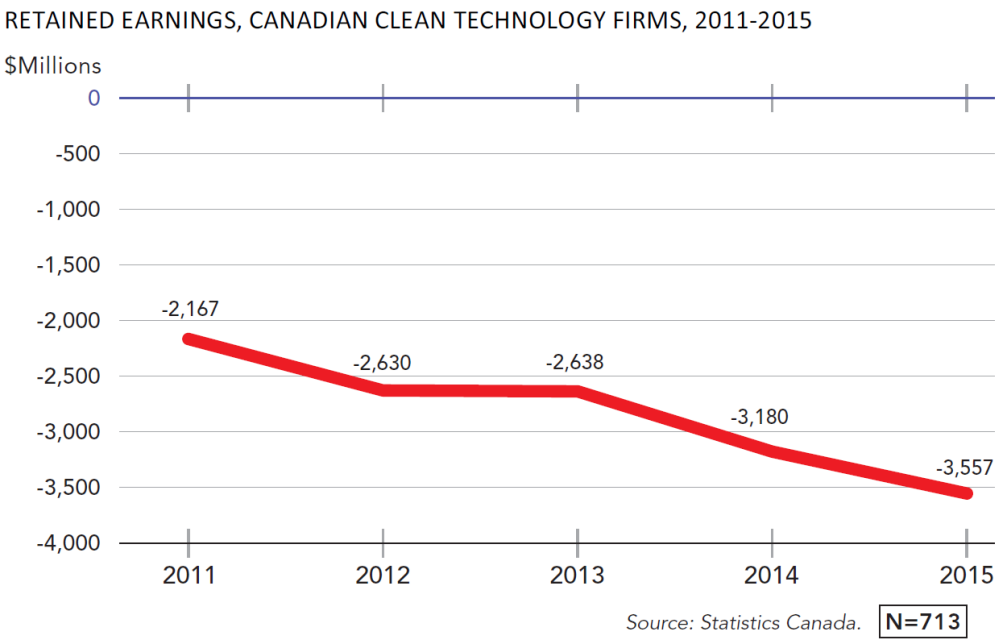
What did the experts tell us?

Previous approaches have not worked in achieving emissions reduction objectives …



CESD 2017 Audit: *"Over the past 25 years, the Government of Canada announced four federal commitments for reducing greenhouse gas emissions, as part of international agreements. With each commitment, the timeline for the federal government to meet its emission target was pushed further into the future"*

… and it also hasn't worked for clean technology producers.



Source: Analytica Advisors

- Retained earnings for the industry have declined each year for the past five years.
- Firm-level financial data reveals a negative return on sales since 2011, most operate in unprofitable markets.
- Returns to shareholders even for mature firms remain below those of the lowest-risk investments in the economy.
- Markets for low-carbon innovation have yet to emerge.

Canada's clean-technology industry now includes 850+ technology companies, including many SMEs operating across Canada. (aerospace - 700, automotive – 450)

An integrated systems approach to key challenges is required.

Input from experts through a SSHRC literature review:

- Driving clean innovation requires more than just fixing market failures
- Must also address *system* failures and barriers
  - Overcome *incumbent technology lock-in* that impedes innovation uptake
  - Understand specific systems, target barriers, foster innovation
- Emerging research says governments don't just fix markets; *co-create and shape* them to achieve important *public missions* (e.g. low carbon)
  - Must 'tilt' the playing field (i.e. provide direction) towards 'clean'.

Growth has not only a rate, but also a direction – Mariana Mazzucato

Many opportunities for further analysis were identified

- Linking program data to large data stores at Statistics Canada and ECCC provides the opportunity to better understand innovation program impacts and potentially simplify client reporting.
    - Statistics Canada, e.g.,:
        - Survey on Environmental Goods and Services
        - Annual Industrial Consumption of Energy Survey
        - Economic data on revenues, employment, exports and R&D expenditures
    - ECCC data, e.g.,: large final emitters reporting, National Pollutant Release Inventory data.
- This approach requires a coordinated investment of time and money
- Ideally, innovation programs track and provide data on both successful and unsuccessful but eligible applicants.