

Canada's Moonshot

SOLVING GRAND CHALLENGES THROUGH
TRANSFORMATIONAL INNOVATION



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Executive Summary

From COVID-19 to climate change, from the need to guarantee food security to how we cope with an ageing society, from ensuring everyone has access to digital connectivity to repairing our country's ravaged and threatened ecosystems, we face many deep and complex challenges as a society.

For all of these challenges, and many more, innovation has a key role to play. Yet Canada's innovation policy framework does not sufficiently align innovation with solving the most pressing social, economic, and environmental problems that Canada and the world face today.

Canadian federal and provincial governments spend billions to foster innovation, but Canada remains stuck in what has been coined a “low-innovation equilibrium.”¹ Despite producing some of the world's leading research, we are not doing enough to harness the long-term economic benefits associated with catalyzing breakthrough inventions, or transitioning enough of these innovations through to commercialization at scale, with widespread adoption and export.

Canada's Moonshot: Solving grand challenges through transformational innovation seeks to better understand how Canada can best use its innovation policy toolkit to intentionally direct, support, and fund innovation that solves the challenges we face—in other words, how we can reach for our own moonshots.

Moonshot innovation policies are outcome- and impact-oriented, with a focus on ambitious but specific and measurable goals. They seek to achieve transformational change, yielding sustainable economic, social, and environmental benefits. Solving the central challenge is the goal—not economic metrics like job creation or GDP growth. As Mariana Mazzucato has described, these economic spillovers “do not happen because you want them to: they happen along the way to solving bigger problems.”²

Moonshot innovation policies focus on unaddressed needs, areas that are not priorities for public or private investment, either because of their complexity or their lack of profitability. And they are focused on long-term impact, seeking

to create sustainable ecosystems by building out the connective tissue between different actors invested in solving challenges, whether they are from academia, industry, government, communities, or third sectors (NGOs or non-profit organizations).

There have been many reports, articles, and books that have examined the strengths and weaknesses in Canada's innovation ecosystem.³ *Canada's Moonshot* builds on these foundations, and, guided by the project's expert advisory panel and informed by insights from interviews with innovation thinkers and practitioners, offers suggestions on how Canada can use a moonshot approach to innovation that not only solves those central challenges, but is also cognizant of the barriers and opportunities that come from our particular Canadian context.

How We Define Innovation

We draw on Daniel Munro's definition of innovation in the Brookfield Institute's *An Inclusive Innovation Monitor for Canada*: "the process of using ideas and knowledge to develop new or improved products, services, or processes that generate value. This includes both the development and diffusion of innovations, covers both economic and social value, and applies to activities conducted by individuals, firms, communities, and/or economies as a whole. The process itself can run from the initial vision to the design, development, production, sale, and use of products, services, and processes."



Best Practices and Design Principles

Canada can draw on the experiences of other countries that have sought to deploy innovation policies to solve real-world challenges. *Canada's Moonshot* puts forward five design principles to ensure the innovation continuum is supported end-to-end, from invention to commercialization.

These principles draw from global successes such as Norway's PILOT-E, the efforts to transform Japan's energy system, and the Defense Advanced Research Projects Agency (DARPA), which, over its lifetime, has helped catalyze breakthroughs from the internet and GPS, to autonomous vehicles and mRNA therapeutics. The principles include:

- Select "grand challenges" that have clear, bold, measurable, and time-limited goals that are sector-, discipline-, and technology-agnostic and that align with top government priorities
- Seek a lean, agile, and independent governance structure
- Coordinate end-to-end support, using a wide range of policy instruments, to help scale the most promising ideas and help them reach their intended markets
- Create meaningful engagement with willing stakeholders, including existing innovation ecosystem actors, leading industry and research experts, communities, and the wider public
- Use a portfolio approach to managing risk, a high tolerance for failure, and an evaluation framework focused on learning and adaptation



Understanding Canada's Innovation Landscape: Challenges and Opportunities

This report identifies six challenges that have historically impeded the success of transformational innovation, and that moonshot innovation policies must address:

- 1. Moving from an unintentional to an intentional innovation system.** The bulk of Canada's innovation policies have traditionally been unintentional in their design, focused on inputs not on impact, and for decades have generally failed to spur significant economic growth. Whereas, moonshot innovation policies are inherently intentional—seeking to provide direction to innovation towards a specific purpose.
- 2. Unleashing the power of demand-side instruments.** Government measures such as procurement, tax incentives, pricing negative externalities, standard-setting, and regulations all have crucial roles in supporting a wider transition to new behaviours and technologies, and in shaping consumer behaviour and market demand. There is often a disconnect between innovation inputs and these demand side levers—moonshots are an opportunity to close that gap.
- 3. Overcoming the challenges of coordinating between and within governments.** Canada's high degree of decentralization means that a range of important policy areas, such as health care and education, sit with provincial governments. This can complicate the ability to use moonshot innovation policies to bring a greater emphasis to demand-side instruments at the federal level, but it can open opportunities to experimentation and innovation with a wider range of actors if effort is put in to build coalitions across jurisdictional, sectoral, and disciplinary boundaries.
- 4. Centering inclusion and reconciliation in innovation.** Canada has failed to build an inclusive innovation system and fails to engage with Canada's full diversity of people, perspectives, and ideas. Deep and persistent inequities in the distribution of opportunities and benefits for innovation highlight the need for moonshot innovation policies that ensure inclusion and reconciliation are centred as key tenets of their design.
- 5. Connecting a complex innovation-actor landscape.** Progress often gets stuck in a congested landscape of innovation actors, funders, agencies, programs, and other organizations that are frequently working in silos trying to solve a part of the problem. Moonshots can provide the pathways that smooth processes for firms and individuals that are, as Dan Breznitz describes, the actual "agents of innovation."⁴
- 6. Instilling a new culture around success.** Current metrics and measurements of success are often more closely tied to short-term political needs and timetables than to the longer-term horizons and needs of innovating firms. Moonshots require a new approach that recognizes that investing in innovation can take time to succeed and that measuring impact is what matters most.



Deploying Moonshot Innovation: Policy Recommendations

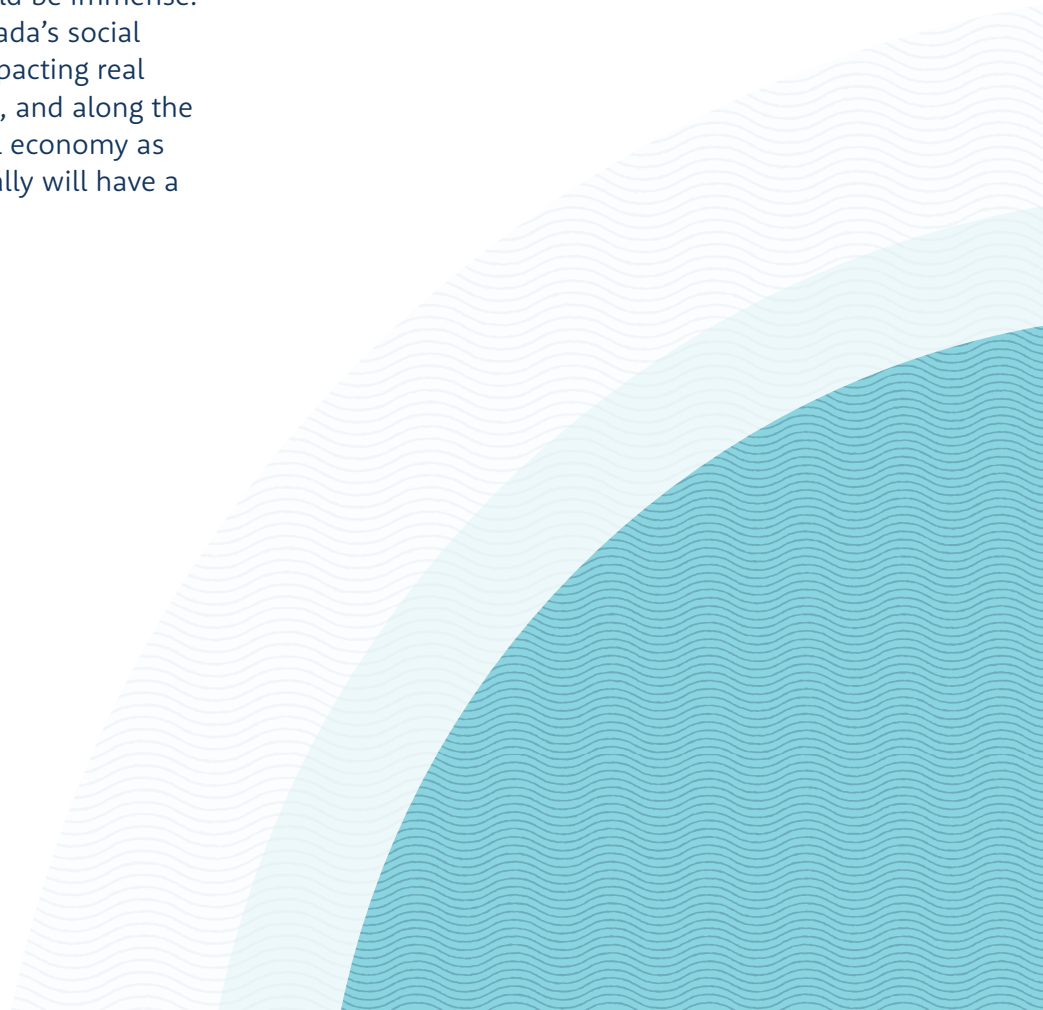
The following five recommendations address some of the key governance, operational, and design considerations that will need to be considered when seeking to select and deploy moonshot innovation policies in Canada.

- 1. Define a clear grand challenge anchored in unaddressed real-world needs, through an open and inclusive consultation process.**
Grand challenges should seek to focus on unaddressed gaps that are not being sufficiently served by public or private investment, or where there is a need for an organization to serve as the connective tissue across disciplines and stakeholders to help build a sustainable ecosystem. These should be identified with meaningful consultation and engagement with diverse voices across Canada and should also reflect pan-Canadian opportunities to deliver public value. They should also be rooted either in distinct need, assets that can be successfully leveraged, or key existing strengths that would be served by the success of projects under it.
- 2. Facilitate policy innovation through providing delivery agencies with lean, agile, and independent governance structures.**
Government structures are oftentimes not suited for the nimbleness and experimental phases of the innovation process. While a national approach is needed, the delivery of moonshot innovation policies do not necessarily have to sit within the federal government directly. An independent agency has greater nimbleness and more flexibility as a neutral convener to engage with multiple levels of government, different departments and agencies, industry, academia, and communities.
- 3. Develop a portfolio of moonshot projects that are cross-disciplinary and cross-sectoral, embrace a range of different risk levels and types, and are inclusive of different types of individuals, organizations, industries, and regions.** A portfolio of diverse multi-stage projects with varying scales and timeframes, along with a healthy appetite for risk and an openness to failure, can significantly increase the chances of landing a successful moonshot.
- 4. Support the full innovation continuum, and the full value chain, from invention through manufacturing, commercialization, and deployment, using the full policy toolkit of supply- and demand-side levers.** The diversity of organizations in the innovation landscape means that there is a need for a “herding” organization that is able to crowd in different pools of existing government funding streams, different streams of activity and help connect-the-dots to commercialize and deploy innovations at scale. Achieving the moonshot also requires a focus on building out the “soft infrastructure” that helps create a successful ecosystem that is vibrant and sustainable in the long term.
- 5. Focus on the metrics that matter for the success of the grand challenge.** It is important that grand challenges are guided by clear, central metrics that are consistent across projects and that have a strong focus on impact. For example, a net zero emissions moonshot should be measured by the amount of emissions prevented. Projects in the grand challenge portfolio should be actively tracked, with program managers who are empowered to end them early if they are failing to reach their targets. There must also be a focus on an internal culture of learning and experimentation to help improve impact over time.

Many of the resources needed for moonshot innovation policies already exist in Canada, but need to be brought together to streamline the process. The take-home message is that policymakers need to change their mindset. This includes taking more risks, not letting short-term political interests impede momentum, and engaging stakeholders, experts, and the public to really understand the biggest grand challenges that need solving. They cannot assume good outcomes are going to happen by chance.

A fundamental shift is required to embrace risk-taking, set clear outcome-oriented goals, foster collaboration across multiple sectors, and engage the private sector in partnerships that are oriented around solving problems using new ideas and technologies.

The potential impact from solving our challenges through moonshot innovation could be immense. If we can sustainably improve Canada's social and environmental well-being, impacting real lives and addressing real problems, and along the way solidify our place in the global economy as a leader in innovation, then we really will have a shot for the moon.





About this Report

This report seeks to draw on existing literature and case studies to understand the policy pathway for Canada to unleash its innovation potential in the pursuit of the next generation of moonshots.

Its ideas and analysis reflect a combination of primary research, interviews with leading policy scholars and practitioners, and engagement with the project's expert advisory panel.⁵ The following pages and its recommendations reflect the views of the author only and should not necessarily be viewed as endorsed by those who were interviewed or served as members of the expert advisory panel. They have graciously shared their collective expertise and wisdom. The author alone is ultimately responsible for any errors or omissions.

The report is organized into three major sections:

Section 1 explores what moonshot innovation policies are and highlights five key design principles, drawing from international case studies and examples.

Section 2 examines Canada's existing innovation landscape in more detail, identifying some crucial considerations and structural issues and where moonshot innovation policies fit in.

Finally, **Section 3** makes some high-level recommendations for how moonshot innovation policies can be applied in Canada.



Introduction

Innovation is essential for Canada's economy. The invention and adoption of new products, services, and processes holds the promise of generating world-leading technologies and firms, driving long-term prosperity and employment, enhancing productivity growth, and creating new export opportunities.

Innovation is also essential for Canada's society and national wellbeing. New ideas and technologies can drive solutions to challenges affecting Canadians, from the climate crisis to the COVID-19 pandemic. Transitioning ideas into deployable innovations in the places and communities that need them, in an equitable way, can help lead to new vaccines for tackling future pandemics saving the lives of Canadians; emerging green technologies that reduce emissions, improve air and water quality, and mitigate climate impacts; and enable faster and fairer digital access across communities, to list just a few examples.

These are good outcomes for people, for communities, and for the economy at large.

Innovation has been treated as an end in itself rather than a means to a bigger goal.

Yet these potential outcomes are not currently being maximized for Canada's economy or society. A fragmented innovation landscape has been overly focused on supply-side interventions and indirect incentives for innovation activity. The result is that it has struggled to move inventions along the innovation continuum to achieve adoption at scale or to move innovation towards outcomes that align with broader public policy goals. Research conducted by the Brookfield Institute for Innovation + Entrepreneurship's (BII+E) and Innovation Policy Lab found that "innovation in Canada has been lacklustre compared with our international peers, and its benefits have been poorly distributed among people and communities," with this itself, in turn, having "consequences for innovation and growth."⁶

Box 1: What is Innovation?

Daniel Munro in “An Inclusive Innovation Monitor for Canada” defines innovation as: “the process of using ideas and knowledge to develop new or improved products, services, or processes that generate value. This includes both the development and diffusion of innovations, covers both economic and social value, and applies to activities conducted by individuals, firms, communities, and/ or economies as a whole. The process itself can run from the initial vision to the design, development, production, sale, and use of products, services, and processes.

Commonly associated with technology and technological change, innovation is a much broader phenomenon that covers new marketing methods, business models, organizational structures and processes, management practices, and a range of other activities that produce value for firms, economies, and societies. Similarly, while new start-up and scaling firms are often viewed as emblematic innovation actors, established firms and sectors can be just as innovative. For example, changes in supply chain logistics by large, established firms have fundamentally transformed the retail sector. Therefore, key criteria for identifying innovation are:

- the emergence or adoption of a new or improved product, service, or process
- that generates new value

An innovation does not have to be new to the world. It can include products, services, or processes that are new to a particular firm, organization, or sector. An established organization that implements an existing technology to improve efficiency and lower costs is innovating because the change generates value. Similarly, a new health procedure might allow for more efficient or more accurate diagnosis and treatment for patients, thereby producing value in terms of better health or lower cost of services.”⁷

We are stuck in what has been described as a “low-innovation equilibrium” – largely prospering as a spoke in the wheel of the United States’ much bigger economy, but facing little pressure to pursue Canadian-based transformational innovation. Instead, we rely on a combination of American breakthroughs and our own incremental innovation.⁸

Historically, Canadian innovation policy has tended to adopt a mostly laissez-faire approach to the application of scientific and technical knowledge—innovation has been treated as an end in itself rather than a means to a bigger goal. While recent years have seen more funding allocated towards government-identified research priorities, traditionally scientific research has been funded by governments for purely academic-led priorities that are often disconnected to end users. This approach is an important and necessary guarantee of scientific freedom and enabler of discovery, but it has also meant that research often has only weak connections to market and societal needs, instead being driven by metrics such as the pursuit of citations. Furthermore, a lack of diversity in academia has often led to situations where “gatekeepers and authors may simply replicate themselves, reducing diversity in science”⁹ and exclude those voices and approaches that do not fit within existing models.

A similar case of misaligned incentives is common in the private sector. The commercialization of industrial research and development in recent decades has often been focused on products with clear short-term sales channels and markets, rather than those with higher risks but potentially higher rewards.¹⁰ Innovation failures in the private sector can also occur when firms “cannot maximize innovation by working in isolation,” but must work with a wide array of other actors, and, following on from this, where “multiple parties need to act synergistically to build new technology platforms” such as health IT platforms, smart electricity grids or intelligent transportation systems.¹¹ Similar synergistic collaborations are needed to address complex systemic barriers that

face underserved groups who fall outside of the usual incentives of the private sector.

As a result, we are failing both to seize the opportunity to align innovation with solving problems that will benefit people in Canada and abroad, and to transition the often world-leading innovation we produce through the innovation process to commercialize them, scale their use, and enable widespread adoption and export (see Box 2).

Canada's overall policy framework needs to shift more towards the goal of catalyzing scientific and technological breakthroughs, and then connecting the dots around them to deploy them quickly to solve major economic, environmental, and social challenges.

There is an opportunity for Canadian policymakers to think bigger and take a new approach. The idea of governments intentionally setting goals to apply innovation to tackle massive environmental, economic, and social challenges has been gaining more attention in Canada and around the world. As one of the leading advocates of this idea, Mariana Mazzucato argues governments have a critical role to play not only in creating the enabling conditions for innovation but in providing greater direction: partnering with businesses and researchers to generate ideas and technologies in response to big economic and social problems, and supporting the translation of these ideas and technologies into commercializable solutions. Mazzucato argues that it is precisely by focusing on these challenges that the economic benefits of innovation will ultimately be realized: “Innovation

Box 2: From Invention to Commercialization

Scientific and technological breakthroughs and inventions are a necessary but insufficient condition for progress. As the CEO of UK Research and Innovation, Dame Ottoline Leyser, often argues: “If you are only doing ground-breaking research, you simply end up with a lot of holes in the ground.”¹² The whole innovation system only works if we have a regular supply of breakthrough discoveries that can be transitioned through the innovation process to commercialization, scale, and global export.

As Dan Breznitz has put it: “The true impact of innovation was not the invention of the internal combustion engine, nor even the invention of the first automobile. The true impact of innovation is represented by the continuous stream of implementation of large and small inventions to make the car a better and cheaper product, to improve the way it is produced, and to continuously find ingenious ways to sell, market, and service cars. If innovation was invention, there would be no continued progress and growth and welfare.”¹³

Innovation is ultimately about bridging the gap between inventions and their practical application in the market or the broader society. This requires a combination of private and public support to develop and test the initial discoveries and then commercialize and scale them for export to global markets. This is the role of innovation, properly understood.

and the commercialization of ideas do not happen because you want them to: they happen along the way to solving bigger problems.”¹⁴

To do this, Canada's overall policy framework needs to shift more towards the goal of catalyzing scientific and technological breakthroughs, and then connecting the dots around them to deploy them quickly to solve major economic, environmental, and social challenges. This

framework has to focus on commercializing these technologies in Canada to ensure that economic benefits are realized domestically, and an emphasis on helping them to reach global markets where they will contribute to solving similar challenges in other parts of the world.

The underlying basis of the institutional, programmatic, and policy reforms needed in

order to achieve this goal are often described as “mission-oriented innovation policies”²¹ and will hereafter be referred to as “moonshot innovation policies” (see Box 3). The idea is that the best means to connect the dots between invention and eventual commercialization at scale is to pursue so-called “moonshots” that bring greater intentionality to government policy by organizing and coordinating science and technology and

Box 3: On Moonshots and Missions: Reconciliation and the Terminology of this Report

The term “missions” is used today colloquially to mean “a specific task with which a person or a group is charged,” a “calling” or “vocation.”¹⁵ The term is common in scientific and international relations contexts. However, the word has deep religious, military, and colonial roots and was originally borrowed from the Latin *mittere* (to send) to describe conversionary missions.¹⁶ In Canada, Christian missionaries and missions played “a complex but central role in the European colonial project,”¹⁷ and, through residential and day schools, for over a century perpetrated what the Truth and Reconciliation Commission of Canada has called a “cultural genocide” against Indigenous people.¹⁸

As part of the process of reconciliation, it is incumbent on everyone to continue to be aware of the impact that our language may have on groups and communities that are still impacted by the discriminatory policies of the past and to take steps to decolonize our work now. To be successful, policies need to be adapted to their local context in a way that is respectful and inclusive. Therefore, this report will not use the terminology of “missions” and will instead use the term “moonshots”—drawing on the original moonshot—the Apollo program. Moonshot innovation policy is outcome-oriented, focused on ambitious but specific and measurable goals, that seeks to achieve transformational change yielding both economic and social benefits.

More broadly, there is a strong need to bring a greater focus on reconciliation to Canada’s innovation policies. As summarized in a budget submission by the Indigenous Innovation Initiative:

Innovation is a critical driver of economic, social and environmental progress and is crucial both for solving complex and intractable problems and driving sustainable and inclusive growth. Too often, however, efforts to catalyze innovation are inaccessible to or exclude Indigenous peoples. Currently, although innovation and social enterprises are a part of Indigenous communities, there is no formal framework or structure to support Indigenous Innovation in Canada.¹⁹

The United Nations Declaration on the Rights of Indigenous Peoples states that “Indigenous peoples have the right, without discrimination, to the improvement of their economic and social conditions”.²⁰ Innovation is an essential part of that and policies need to be in place to enable it. There needs to be a much greater inclusion of Indigenous expertise, innovators, leadership, and worldviews across the entire Canadian innovation system. A whole-of-government approach is required to ensure that all departments, agencies, and initiatives are doing this, and ensuring that reconciliation and equitable access for all innovators is embedded as a core feature of future policies.

innovation strategies, as well as policy and regulatory measures, around a set of overarching and well-defined objectives such as achieving net-zero emissions or finding cures for debilitating diseases, all within a defined timeframe.²²

Moonshot innovation policies are not new—some of the earliest were the Manhattan Project and

the original moonshot, the Apollo program—but they have received renewed policy and political attention in recent years. As countries across the globe face their own mix of environmental, economic, and social challenges, many have begun to experiment with different innovation policy models of their own to better support scientific and technological breakthroughs that can address these challenges and build up new comparative advantages in the intangible economy. Canada can learn from these examples.

These moonshots will not succeed in Canada without the federal government playing an ambitious and proactive role in setting the high-level direction of innovation and with the full participation of willing partners in other levels of government, in the private sector, and in communities and social innovation sectors. A fundamental shift is required to embrace risk-taking, set clear outcome-oriented goals, foster collaboration across multiple sectors, and engage the private sector in partnerships that are oriented around solving problems using new ideas and technologies.²³ Our collective wealth, productivity, and wellbeing ultimately depend on it.

A fundamental shift is required to embrace risk-taking, set clear outcome-oriented goals, foster collaboration across multiple sectors, and engage the private sector in partnerships that are oriented around solving problems using new ideas and technologies.



Section 1

Learning from the Best: Understanding Moonshot Innovation Policies

We live in a hyper-connected world, but one where silos are endemic. We face global challenges, yet the impacts are felt at the local level, threatening communities and livelihoods. The sum of human knowledge is greater than ever before, yet collaboration across sectors and regions can be harder than ever. Moonshot innovation policies are designed to bridge these gaps and provide the connective tissue that enables transformative change. Crucially, existing moonshot innovation policies and agencies are outcome-focused. They provide directionality and intentionality around what innovation needs to solve.

Examples of moonshot innovation policies differ from much of the existing innovation policy toolkit, which comprises policies that are largely input-focused. Existing policies provide the resources for innovation to happen at the front end—such as grants for researchers or through the subsidy of training and education for the next generation of innovators—or they reimburse the research that has already been conducted at the backend—through research and development tax credits, for example, that firms can use to offset the salaries of employers working on research

In an economy that is deeply unequal, where many sections of the population have had little voice in setting the agenda for innovation, where there are important regional differences, and where we face a startling range of complex and pressing challenges, there is a clear and urgent need for the types of intentional and outcome-focused policies that moonshot innovation policies represent.



and development. Sometimes these policies are focused on specific classes of businesses, such as small- and medium-sized enterprises (SMEs), or on specific sectors that are often important employers.

These types of policies often have a crucial role to play and do a lot to support innovations in established sectors. But these are not producing transformational results, are mostly agnostic about the outcomes of innovation, tend to focus on established players and sectors,²⁴ and are in need of improvement even on their own terms and objectives.

In an economy that is deeply unequal, where many sections of the population have had little voice in setting the agenda for innovation, where there are important regional differences, and where we face a startling range of complex and pressing challenges, there is a clear and urgent need for the types of intentional and outcome-focused policies that moonshot innovation policies represent.

In recent memory, there has been no bigger challenge than COVID-19. The pandemic has been a once-in-a-century public health crisis, where breakthrough ideas and technologies became the ultimate solutions. The success of the United States' "Operation Warp Speed", which relied on public-private collaboration to catalyze the unprecedented development and production of multiple vaccines,²⁵ signals the immense strengths of a connected and intentional approach to solving specific problems (see Box 4).

Pre-pandemic, there have been a number of other initiatives and agencies that have embedded a moonshot approach in their design. PILOT-E in Norway, for example, is a cross-agency challenge-based scheme launched in 2016 that was designed to provide seamless support from idea to market to various climate emission-free and energy-saving solutions.³¹ In Japan, Hydrogen Society is a whole-of-government plan to transform the Japanese energy system through the wide-scale deployment and use of carbon-free hydrogen.

Box 4: Lessons from COVID-19: Operation Warp Speed and Moderna

mRNA vaccines have transformed the fight against COVID-19, and deep private and public sector collaboration has been an essential ingredient in that success story.

Moderna, one of the first companies to get an mRNA COVID-19 vaccine approved by regulators, built on the decades of research and effort of Hungarian biochemist Katalin Karikó on mRNA, who often worked in obscurity and without much funding or institutional support. The transformative potential of the breakthroughs of Karikó and her collaborator, American physician-scientist Drew Weissman, were noticed by Canadian scientist, and expert advisory panel member of this project, Derrick Rossi, who co-founded Moderna in Cambridge, Massachusetts, to commercialize the potential of mRNA.²⁶

But bridging the gap from a promising idea to commercialization and deployment at scale was helped significantly from directed governmental support. In 2013, for instance, the Defense Advanced Research Projects Agency (DARPA) awarded Moderna \$25 million to research and develop mRNA therapeutics as part of its Autonomous Diagnostics to Enable Prevention and Therapeutics program that sought new ways to protect US soldiers from natural and engineered diseases and toxins.²⁷

It was the multi-agency "Operation Warp Speed" (OWS) initiative that helped rapidly turn promising science into vaccines ready for people's arms after COVID-19 hit. Moderna's vaccine was successfully co-developed in partnership with scientists from the National Institute of Allergy and Infectious Diseases, part of the United States' National Institutes of Health, manufacturing was supported by the Biomedical Advanced Research and Development Authority (BARDA), and the US

Lessons from COVID-19: Operation Warp Speed and Moderna (continued)

government committed to buy 100 million doses before the vaccine was approved.²⁸

This process of simultaneous rather than sequential steps of innovation, overcoming manufacturing challenges, regulatory approval and commercialization, all with the US government setting the direction and the pace, were crucial in deploying the vaccine on such an expedited timeline. As one manufacturer of revolutionary glass-plastic vials needed for ultracold temperatures attested, “Before Warp Speed I thought the government would only slow things down [...] I am shocked at the speed of government. They are facilitating things.”²⁹

OWS encapsulates a moonshot-driven approach to innovation—with government working in partnership with the private sector and academic researchers to make ambitious high-risk investments that answer specific problems simultaneously with ambition and at pace. Support was provided across every stage of the innovation process, with early and regular communication with regulators, which, combined, ultimately helped to

translate a breakthrough technology into a commercialized and large-scale solution to a massive societal challenge.

However, the case of COVID-19 vaccines also highlights the importance of how success is defined. For OWS, this was narrowly defined in terms of catalyzing the development of innovative new vaccines and getting them into American arms. In this regard, OWS was immensely successful. Yet pandemics, by their very definition, are global, and as we have seen with the rise of new variants, no one is safe until everyone is safe. Decisions made during the early stages of OWS procurement meant that the US government forfeited the intellectual property rights they would normally receive from products derived from federally-funded research.³⁰ More narrowly held intellectual property has potentially slowed down the deployment of vaccines at scale globally, undermining efforts to end the pandemic. This speaks to the essential importance of focusing on the outcomes and deployment of innovative technologies at their maximum scale when seeking to solve major challenges.

Launched in 2015, it was a response to the 2011 earthquake and tsunami and the resulting nuclear disaster which highlighted the need for alternative sources of clean energy.³² While not strictly moonshot-oriented, Germany’s network of Fraunhofer Institutes offer an example of a “public-private solution to fix the market and network failures,” that enables small- and medium-sized companies to compete in the innovation economy when they would not be able to on their own.³³ These, and other programs and agencies, are marked by a clear acknowledgement of the need for government support and policies to play a bridging role that enables innovations to reach market and widespread use to solve a specific challenge the country-of-origin faces.³⁴

These recent programs and other moonshot-oriented agencies often draw on the expertise of the Defense Advanced Research Projects Agency (DARPA). Founded in 1958 as the Advanced Research Projects Agencies, in response to the launch of Sputnik by the USSR, the function of DARPA then and now is to ensure that the US military is never surprised again by another country’s military technology.³⁵ It does this by funding projects that falls within “Pasteur’s Quadrant”, research that not only makes fundamental scientific advances, but is also highly focused on its practical applications and end uses.³⁶ The approach has led to DARPA supporting early work that has eventually led to important innovations such as GPS, mRNA vaccines, and, famously, the internet.³⁷



The Design Principles

Canada can learn a lot from these agencies and other policies like them to inform the use of moonshot innovation policies here. International examples come in a range of forms, crafted to suit their specific circumstances and challenges. They can range from decades-old agencies with multi-billion-dollar annual budgets through to newly founded bodies with much smaller budgets. They can be located within a single government department, which will be the main procurer of the solutions that are developed, or they can be cross-agency organizations that provide support to numerous key stakeholders sometimes without a guaranteed customer. Some are funded entirely by public funds; others lean more on jointly funded projects with private partners. The variation goes on.

There is a lot of policy and academic work exploring some of the common design features of moonshot innovation policies and other related innovation agencies.³⁸ Some key recommended design principles, which we explore in-depth below, are:

1. Select “grand challenges” that have clear, bold, measurable, and time-limited goals that are sector-, discipline-, and technology-agnostic and that align with top government priorities
2. Seek a lean, agile, and independent governance structure
3. Coordinate end-to-end support, using a wide range of policy instruments, to help scale the most promising ideas and help them reach their intended markets
4. Create meaningful engagement with willing stakeholders, including existing innovation ecosystem actors, leading industry and research experts, communities, and the wider public

5. Use a portfolio approach to managing risk, a high tolerance for failure, and an evaluation framework focused on learning and adaptation

While there is significant variation in the design of moonshot innovation policies in practice, these principles can provide high level guidance to help solve Canadian challenges through innovation.



Select “grand challenges” that have clear, bold, measurable, and time-limited goals that are sector-, discipline-, and technology-agnostic and that align with top government priorities

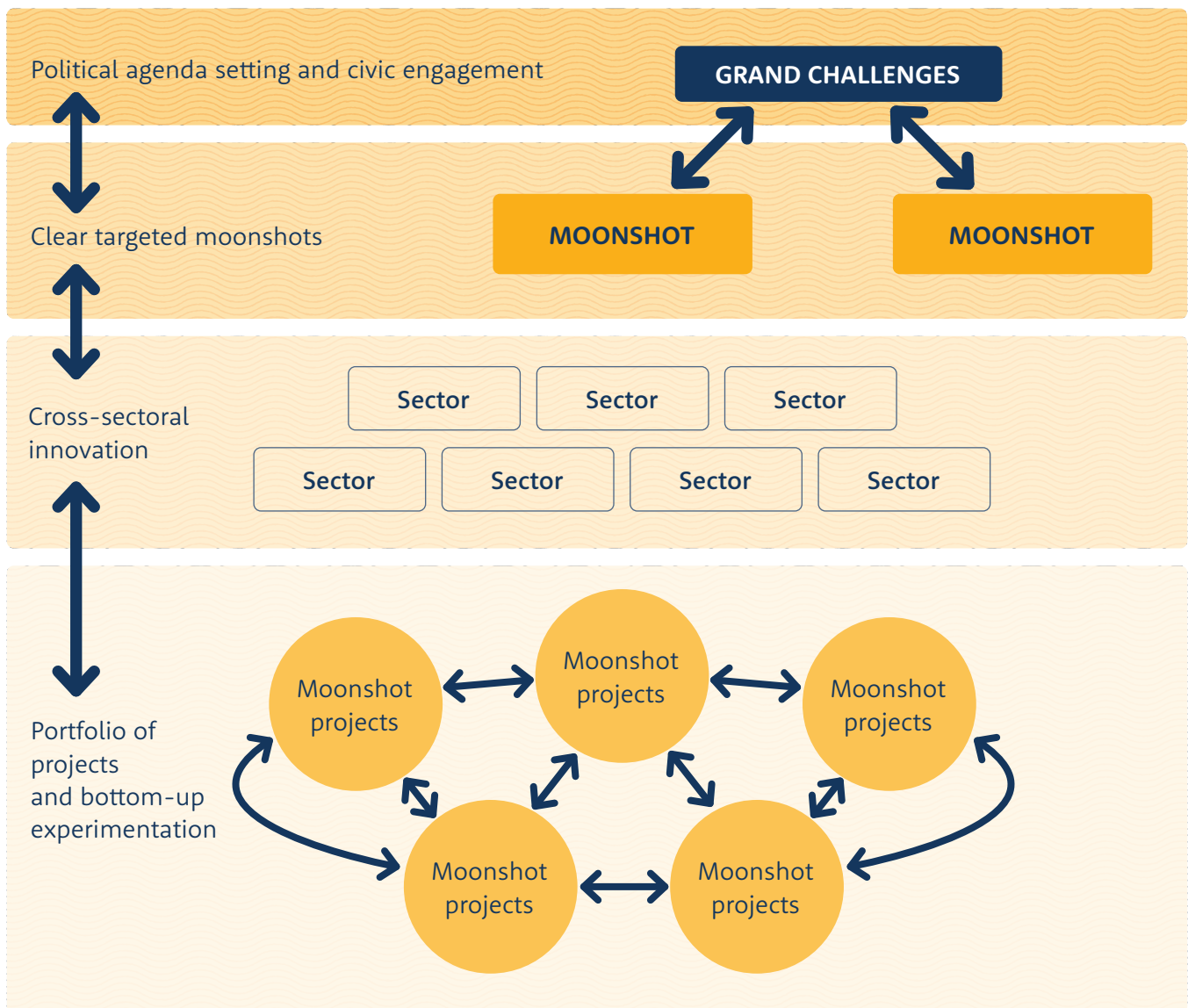
Crucial to the success of a moonshot innovation policy is the initial step of selecting a challenge: as Mazzucato notes, “first and foremost, a [grand challenge] has to be bold and inspirational while having wide societal relevance. It must be clear in its intention to develop ambitious solutions that will directly improve people’s daily lives, and it should appeal to the imagination.”³⁹ Without these elements, a moonshot-oriented policy is unlikely to galvanize the effort and collaboration needed to achieve transformational change.

Under an overarching, broad and inspirational vision that is rooted in a complex technological, societal, and economic challenge (a grand challenge) are “realistic, targeted, measurable, time-bound, and solution-neutral”⁴⁰ moonshots, each with their own set of projects that help achieve their goal (See Figure 1). These moonshots are about solving problems and imagining the future, rather than focused on innovation, commercialization, or market success as ends in themselves. They focus on outcomes: defining the problems a country wants to tackle and catalyzing innovation on the way to solving them. In the process, they open up a wider space for public-private, cross-sectoral and interdisciplinary collaboration, plus accidental discovery, with potential for massive spillover effects.⁴¹

Successful moonshots do not seek to “pick winners,” whether from sectors, firms, or technologies. Instead, they seek to “create favourable conditions for the best solutions to merge, co-evolve, and compete.”⁴² The outcomes from this approach can be far richer than a narrow sectoral method, as can be seen with the Apollo program that catalyzed innovation in a range of sectors, from electronics and computing to textiles and food.⁴³

Successful moonshots do not seek to “pick winners,” whether from sectors, firms, or technologies. Instead, they seek to “create favourable conditions for the best solutions to merge, co-evolve, and compete.”

Figure 1
From challenges, to moonshots, and projects



Source: Mariana Mazzucato & George Dobb, “Mission’s: A Beginner’s Guide”, UCL Institute for Innovation and Public Purpose Policy Brief, December 2019, https://www.ucl.ac.uk/bartlett/public-purpose/sites/public-purpose/files/iipp_policy_brief_09_missions_a_beginners_guide.pdf

By working within a framework of governmental policy priorities, innovations stemming from the moonshot feed into a wider market-creation process. These can come from international commitments such as the United Nations Sustainable Development Goals or the Paris Climate Accords, or be based on more local priorities, such as flooding from sea level rise in the Netherlands (see Box 5).⁴⁴

Moonshots can also impose public interest conditions as part of subsidizing the development and commercialization of new innovations that are aligned with governmental priorities. For example,

NASA imposed a “no excess profits” clause as part of their Apollo contracts to prevent space from becoming “a speculative affair, driven by overcharging and by companies more competent in ‘brochure manship’ (whose descendant is the shiny PowerPoint of modern-day consulting companies) than getting the job done.”⁴⁵ More recently, there has been an active debate on the question of whether intellectual property rights (IPR) should be waived in the case of COVID-19 vaccines that received significant public support in their development to ensure that they have their intended impact globally without profiteering.⁴⁶

Box 5: The UN Sustainable Development Goals and Grand Challenge Selection

In building modern moonshot innovation policies that seek transformational technological and societal change, it is important to go beyond solely top-down priority setting by “elite experts” to ensure that different people and perspectives are represented and reflected.⁴⁷ In this effort, the United Nations Sustainable Development Goals (SDGs), a global set of 17 key societal and technological grand challenges with 169 sub-targets,⁴⁸ can provide a helpful roadmap for “grand challenge” and moonshot selection. The SDGs are globally agreed-on and based

on extensive consultation, with many of them requiring a complex range of technological and societal innovation to achieve. While it is necessary to ensure they are translated to the local cultural and economic context, especially through further engagement with Indigenous communities, the SDGs can provide a useful framework to begin the process of moonshot selection and move beyond the conflict-focused moonshots of the twentieth century and towards the existential challenges of the twenty-first century.⁴⁹



Source: <https://www.un.org/sustainabledevelopment/news/communications-material/>

2

Seek a lean, agile, and independent governance structure

Moonshot initiatives require a new, thoughtfully designed governance structure that breaks from bureaucratic and corporate norms and provides strategic orientation and coordination. While there is an important role for governments in helping to set the direction of innovation and the goals, if the moonshots are centrally located, they can suffer from high “transaction costs” stemming from the challenge of achieving buy-in from different departments with access to different policy levers.⁵⁰ Instead, the agencies that act on this government direction require autonomy to enable their success and to bring together different ecosystem actors from the outside.

When it comes to “truly radical restructuring” and transformative change, this is “more likely to emerge at the periphery of the public and private sector, in agencies with the freedom to experiment with novel technologies, new private sector partners, heterodox policy instruments, and unconventional business models.”⁵¹ The UK’s MOIIS Commission agreed with this, noting that “organisations that have successfully tackled ambitious [*moonshot*]-oriented projects in the past have implemented structures that are flexible, adaptable, and able to foster bottom-up solutions.”⁵²

The agility of the most successful moonshot-focused agencies is also supported by greater flexibility in procurement and human resources than is usual in government. In particular, DARPA’s “flat non-hierarchical organization, with empowered program managers” and “emphasis on selecting highly talented, entrepreneurial program managers (PMs) who serve for limited (three- to five-year) duration”⁵³ is supported by their exemption from “traditional civilian personnel requirements” and they also have other transactions (OT) authority that “do not have to comply with the government’s procurement regulations.”⁵⁴ This organizational structure, which empowers the PMs to make decisions


about individual moonshots and to take risks, has proven very successful and has been replicated in other agencies including ARPA-E (Advanced Research Projects Agency-Energy), the US agency, modelled on DARPA, that is responsible for advanced energy research.

This independence has been a major factor in the success of Canadian moonshot-oriented agencies and programs. In an interview, David Brook, Chief Strategy Officer at Grand Challenges Canada (GCC), described how “one of the key factors about GCC is that we are outside of government. We have an independent board and an independent governance system” and that this has allowed them much greater flexibility and ability to pivot quickly when circumstances change, such as when the pandemic hit.⁵⁵ Being arm’s length from government allowed them to enable a nimble, cross-sectoral, ecosystem-wide response, a position that was similarly important to helping facilitate Genome Canada’s moonshot-oriented approach to fighting COVID-19 by creating the Canadian COVID-19 Genomics Network (CanCOGeN). With an urgent injection of federal COVID-19 funding, the organization was able to respond quickly to mobilize existing relationships and organizations, and to bring in key new partners such as federal and provincial public health labs and policymakers. This helped the organization ensure it was responsive to changing needs as the pandemic evolved.⁵⁶

3

Coordinate end-to-end support, using a wide range of policy instruments, to help scale the most promising ideas and help them reach their intended markets

Moonshot innovation policies ideally span the entire innovation continuum, from idea to market, mobilizing and facilitating connections between supply- and demand-side policy levers that are typically siloed. This is a departure from normal innovation policy, which tends to focus more on supply-side policy instruments.



Linking moonshots with demand is critical to their success. They typically operate in what has been characterized as in “Pasteur’s quadrant” — use-inspired basic research that advances the quest for fundamental understanding as well as aiming for practical applications.⁵⁷ Many types of challenges would benefit from this kind of approach. As is explored further in Section 3, the quest to reach net-zero emissions, for example, is one that involves applying cutting-edge science, on a number of different fronts, and at scale, solving manufacturing, regulatory, and financial challenges on the way. Other areas include ensuring everyone is food secure, also profiled below, sustainable construction at scale, many healthcare challenges involving new therapeutics and research methods, and many more.

Linking moonshots with demand is critical to their success.

By focusing on areas that need this kind of transformative innovation, moonshots reduce the potential for market uncertainty and clear a path for the commercialization and adoption of solutions at scale. They also create crucial feedback loops, for example with simultaneous work on overcoming manufacturing challenges informing earlier research and prototype stages.

The policy toolkit to enable this end-to-end support is broad and can vary by moonshot and agency. On the supply-side, moonshot innovation policies can draw on more traditional levers such as R&D funding programs and research partnerships, among others. However, moonshots seek to draw more on demand-side tools, in particular because demand has been shown to be more important for innovation than supply-side measures such as R&D subsidies.⁵⁸ The demand-side toolkit can include policies such as public procurement, industrial-standard setting, training support, tax incentives, regulatory measures, academic-industry applied research programs, and low-cost loans to facilitate adoption.⁵⁹

Moonshot innovation policies should be acting to pull together what is usually a fragmented policy landscape.

Throughout all of these policy measures, moonshot innovation policies should be acting to pull together what is usually a fragmented policy landscape, providing a shared strategic orientation and coordination within the scope of the specific moonshots being tackled.

Consideration should also be given to how intellectual property rights (IPR) are approached in order to facilitate their use at scale by innovation actors in the ecosystem. Often, the state of IPR globally means that they can be a restricting factor to innovation, rather than a positive incentive. A lack of an effective IPR strategy can also undermine the long-term success of a local ecosystem in the face of patent trolls and multinational corporations.⁶⁰ Given that concern, it is important that moonshot innovation policies should seek to support and encourage the generation and ownership of as much high-quality IPR as possible. These can include measures such as IPR/patent pooling to support current and future local innovators—such has been successfully modelled at an industry level in Canada by Canada’s Oil Sands Innovation Alliance (COSIA)⁶¹ —support for firms involved in moonshots to participate in international standard-setting organizations, provisions for IPR education, or assistance to moonshot participants targeted by IPR attacks.⁶²

4

Create meaningful engagement with willing stakeholders, including existing innovation ecosystem actors, leading industry and research experts, communities, and the wider public

It is essential to the success of moonshots to bring together cross-disciplinary, cross-sectoral, and cross-actor alliances that “activate bottom-up, cross-sectoral innovation with real purpose and intent.”⁶³ Stakeholder engagement with diverse groups and different innovation actors is critical in a number of ways. These include bringing technical and contextual expertise into moonshot design, increasing diversity of thought and ideas to create more inclusive and relevant solutions, understanding citizen and community perspectives and needs, and building support and facilitating implementation, for example by bringing policymakers and regulators into the loop early to preempt hurdles later. However, the aim should not be to please everyone, but rather to identify and work with “the willing.”⁶⁴

There are different stages of stakeholder engagement within a moonshot:

- at the “grand challenge definition” stage
- while developing moonshot goals and the projects that fit within them
- in the implementation and reporting stage

These different stages engage with different alliances of stakeholders, with a variety of relevant functional and thematic expertise.

At the grand challenge definition stage, it is essential to provide “opportunities for people to participate in decision-making about the priorities, direction, and regulation of innovation” —an important criteria for inclusive innovation.⁶⁵ This engagement can take many different forms, including both national and local consultations as well as public polling to help understand

the priorities of different communities and stakeholders. In the view of a report conducted for the European Commission, this “should go beyond mere buy-in of [*moonshot*]-oriented R&I initiatives and demand articulation. New forms of involvement must be found to ensure that [*moonshots*] target what matters to the citizens.”⁶⁶

When developing specific moonshots under a grand challenge, a different type of engagement is needed. This can be seen in the “focused networking” that DARPA project managers do—they “have a clear purpose for building the network—first to generate a clear target in an area, then to solicit paths towards the target, and then to make sure that the people who are executing on those paths know about each other so small adjustments to the plan can happen as frictionlessly as possible.”⁶⁷

Such approaches flow into the final area of stakeholder engagement around implementation. This comprises an organizational element and an end-user element. On the former, it is important to draw agencies and ministries together to support shared goals and make better use of existing policy tools. The level of cross-ministerial and cross-organizational coordination tends to be high to ensure that promising innovators and innovations receive continuous support and are not falling through the cracks between different organizations or having to continuously re-qualify for different forms of support as they move to commercialize innovations.⁶⁸ Accountability and reporting are also crucial to ensure that lessons are learned and that there is transparency around who is being served by the moonshot projects.

Moonshots can help to ‘crowd-in’ commercial investment by guiding business expectations about where future growth opportunities might lie.



When it comes to end users, this can include identification and engagement with procuring entities, within government departments, within provincial or municipal governments, or it can include working with customers within the private sector. This can further leverage further private-sector investments. As the UK's MOIS Commission concluded, "by providing a direction for economic growth, [moonshots] can [...] help to 'crowd-in' commercial investment by guiding business expectations about where future growth opportunities might lie."⁶⁹



Use a portfolio approach to managing risk, a high tolerance for failure, and an evaluation framework focused on learning and adaptation

The final key design principle for moonshot innovation policies is the use of a portfolio approach that enables many different potential solutions to be developed and tested, and then either rejected or scaled. Transformative innovation is inherently high-risk and there are no guaranteed slam dunks. As former DARPA official John Launchbury has said, "If none of our programs fail, we're not stretching far enough."⁷⁰

Moonshots seek to accelerate innovation through a portfolio of projects with ambitious targets, helping to speed up the process of trial-and-error that ultimately delivers change. Essential to this is a culture shift to accept a high rate of failure along the way—requiring a different approach to budgeting, stage-gating, including off-ramps, cost-benefit calculations and evaluation, with a longer-term horizon and a focus on outcomes and impact rather than merely outputs.⁷¹

DARPA is an example of a moonshot innovation agency that makes good use of a portfolio approach through its empowered program manager culture. Program managers are given strong authority and discretion to administer their portfolio of projects within their program

area, with a streamlined process for approval to get projects moving quickly.⁷² Given that program managers have only short tenures in charge, the portfolio has to be built around projects that are seeking breakthroughs in a few years, helping accelerate innovation.⁷³

Because moonshots are time-limited with measurable goals, progress can be clearly assessed and tracked. Moonshot innovation policies benefit from monitoring and evaluation practices that are focused on learning and adaptation, as well as accountability. These evaluations ideally consider the success or failure of specific projects relative to the moonshot, the success of the moonshot overall based on a portfolio of projects, and measure the impact of efforts to address gaps in the innovation ecosystem and to coordinate policy tools across agencies and ministries.

Rigorous monitoring is important to support the long-term success of a moonshot, but should be implemented in a way that facilitates, rather than impedes, agility. Reflexivity should be built in. Program managers should be enabled to respond and pivot as needed based on new learning, emerging research, and market and technological developments, rather than being stuck in a single unbending framework.⁷⁴



Section 2 Where Are We Now: Canada's Innovation Landscape and Where Moonshots Fit In

While Canada's innovation ecosystem has many strengths, and its policy framework for innovation has evolved significantly over recent years, more intentionality is needed to ensure the full potential of innovation to contribute to solving social and environmental challenges is being reached, and that those innovations are being scaled and used here and abroad, with all of the economic spillovers that follow. Improving Canada's innovation outcomes to achieve this goal requires a deep understanding of our existing context to inform the needed improvements across the innovation continuum.



Interviews with expert informants and discussions with the project's expert advisory panel helped to identify **six key challenges** within Canada's innovation ecosystem that well-designed moonshot innovation policies must address: Canada's unintentional innovation system, poor use of demand-side instruments, relationships between and within governments, a lack of inclusion and reconciliation, a complex innovation actor landscape, and an outdated culture around success.

“We are not bad at developing and advancing science, we are bad at applying science.”



Moving from an unintentional to an intentional innovation system

At their heart, moonshot innovation policies are about intentional innovation. Yet the bulk of Canada's innovation policies have been traditionally unintentional in their design, and for decades have generally failed to spur much business innovation.⁷⁵ While general innovation policies such as funding for university-based research, research and development tax credits, sector-based strategies, and so on, all play roles in stimulating invention and innovation, the total result is often less than the sum of its parts, especially when it comes to generating and then commercializing in Canada transformational technologies.

Canada is “home to world-leading researchers, facilities, and programs, and their accomplishments and importance continue to be regarded with much esteem by the international community.”⁷⁶ Yet, this has “not translated strongly enough into innovation performance or economic growth”.⁷⁷ As one interviewee framed

it, “we are not bad at developing and advancing science, we are bad at applying science”⁷⁸ (see Box 6).

Canada’s unintentional innovation policies have been built on the idea that with enough supply of innovation inputs, broad-based economic growth

Box 6:

From Developing Science to Deploying Science: Planting the Seeds of Long-term Prosperity

Solving challenges through innovation is not only about groundbreaking invention. What comes after matters too.

The year 2021 marked the 100th anniversary of the discovery of insulin by Frederick Banting and Charles Best. That discovery has had a transformative impact on the lives of millions of people with diabetes. However, the discovery was not commercialized in Canada as there were not any labs with the capability or capacity to produce insulin at scale. That technique was instead perfected by the US firm Eli Lilly, which continues to this day to be one of the major global manufacturers of insulin.

A similar story has played out with machine learning—something with the potential to be a paradigm-changing “general purpose technology.”⁷⁹ Yet, despite the fact that a lot of the foundational research was done by Canadian researchers and research institutions, and made possible by Canadian public funding, once again the later stages of innovation and commercialization have not taken place in Canada or by Canadian companies. As of July 2017, the number of machine-learning patent applications made over the previous ten years by Microsoft was 1,030 and IBM was 580, whereas the total applications for all Canadian firms, research institutions, and individuals, was 48.⁸⁰

Canada does have success stories, however. The substantial leadership and investment shown by the federal government in the 1960s to ensure that Canada could be a leader in areas of space technologies was essential to seeding the success of an ecosystem of firms, most notably MDA.⁸¹ Those investments continue to reap dividends in jobs and, crucially, new innovations that serve national priorities, such as through geointelligence systems that support Canadian agencies in managing wildfires and reducing property damage, economic loss, and health risks.⁸² More recently, federal and provincial investment over the last 20 years in Canada’s genomics enterprise—Genome Canada and the six regional Genome Centres—has helped support the growth of a vibrant research and commercial genomics ecosystem across the country that has a keen focus on the societal implications of its work.⁸³

We need to support the next generation of Bantings and Bests in their generation of new breakthroughs. But we cannot just leave it there. We must have the policies and frameworks in place to support them as they grow their ideas from inventions to game-changing innovations deployed at scale.

will result. These policies are a necessary but not sufficient condition. While they have provided crucial inputs, such as highly-qualified graduates, they have failed to create the conditions needed for breakthrough scientific and technological inventions to be commercialized and scaled for domestic consumption or global markets. By providing defined use-cases for new innovations around solving the central “grand challenge,” moonshot innovation policies can provide more intentionality and help direct energies to clear ends.



Unleashing the power of demand-side instruments

Central to the success of moonshot innovation policies is the successful use of demand-side policy levers, yet this is an area where Canada has not made full use of existing demand-side tools to help create and shape markets for innovation. This was described by one interviewee as a “huge mismatch between supply and demand” thanks to being “overly focused on supply.”⁸⁴

Governments have an immense ability to create entirely new markets through their powers of procurement.

Governments have an immense ability to create entirely new markets through their powers of procurement, and the Canadian public sector is the country’s largest purchaser of goods and services.⁸⁵ Yet this power to be an anchor buyer for innovation has not been adequately used. It reflects a significant disconnect within government, with one interviewee describing a “complete separation between policy people and procurement people.”⁸⁶ Another reflected that “Canada is completely underdeveloped around procurement practices” and that “incentives structures in the US [...] are not present in Canada.”⁸⁷ Recent years have seen


sustained efforts to begin to change the culture of procurement in the federal government, for example through Innovative Solutions Canada, Impact Canada, and the National Research Council of Canada’s Challenge Programs. These are new initiatives, and their full impact will take time to assess, but one interviewee noted that these kinds of programs so far have not affected “the main culture of how ministries go about procurement—very focused on lowest cost, rule-following.”⁸⁸

Beyond procurement, the government also has powers to shape markets that can be better used to achieve moonshots. Measures such as tax incentives, pricing negative externalities, standard-setting, and regulatory measures can all support a wider transition to new behaviours and technologies. On regulation, for example, research shows that environmental regulations are some of the most effective tools that have helped shift companies towards green innovation.⁸⁹ One interviewee agreed on the importance of regulation, arguing that there is a “need to be able to start leveraging regulations” as part of the demand-side toolkit.⁹⁰ Canada has been slow to introduce modern regulations that are essential to provide market certainty for emerging technologies,⁹¹ that reduce regulatory burdens for innovative startups,⁹² and that incentivize the adoption of innovative products, processes, and services that align with public policy goals, while disincentivizing others—such as carbon pricing. Government can also play a bigger role in providing “public information to influence the uptake for products in the public interest.”⁹³



Overcoming the challenges of coordinating between and within governments

Canada’s high degree of decentralization is a crucial differentiator from many comparator countries, and one that moonshot innovation policies will need to grapple with. Canada’s share of GDP and public spending by sub-national governments—provinces and municipalities—is the highest in the OECD, with



those governments also employing more people and making a higher share of investments than the OECD average.⁹⁴ This decentralization means that a range of important policy areas, such as health care, sit with provincial governments. While there are notable and positive areas of federal-provincial cooperation, such as investments from the Strategic Innovation Fund,⁹⁵ one interviewee still noted, “as a country, we really limit our potential because of the way we are set up.”⁹⁶ This decentralization complicates the ability to use moonshot innovation policies to bring greater emphasis to demand-side instruments at the federal level given so much falls within the scope of provincial powers. However, decentralization can also bring greater opportunities for experimentation and innovation at the periphery, if the effort is put in to build coalitions across jurisdictional, sectoral, and disciplinary boundaries.

Decentralization can also bring greater opportunities for experimentation and innovation at the periphery.

A multitude of governments can also create a proliferation of departmental and inter-agency friction. When new approaches have been attempted within government, one interviewee described how these have sometimes been met with resistance and hostility, as well as a lack of support from key departments that has “undermined success.”⁹⁷ Another interviewee described the importance of working to improve internal partnerships within government to co-develop and co-implement new programs and “think beyond the excuses that we’re familiar with” such as “ministerial accountabilities that make it impossible to achieve horizontal ways of working.”⁹⁸


Canada has failed to build an inclusive innovation system and fails to engage with our full diversity of people, perspectives, and ideas



Centering inclusion and reconciliation in innovation

Canada has failed to build an inclusive innovation system and fails to engage with our full diversity of people, perspectives, and ideas. As the federal government itself has concluded, “Canada is not arming underrepresented groups with the knowledge and skills to create, succeed, and take advantage of opportunities in the innovation economy.”⁹⁹ Furthermore, there has been a failure to ensure that innovation and economic policies more broadly embody reconciliation and reflect the reality of Canada’s treaty and constitutional commitments to Indigenous peoples, instead often operating through “systems [that] are still colonial.”¹⁰⁰

An inclusive system requires a change in the nature of production that allows “vastly more people to be makers and shapers of the innovation economy.”¹⁰¹ In their 2021 report for the Brookfield Institute, Daniel Munro and Joshua Zachariah describe how despite Canada’s innovation strengths, “there are deep and persistent inequities in the distribution of these opportunities.”¹⁰² The federal government identified the fact that “Canada’s research community lacks diversity” as a key weakness that holds back Canada’s fundamental research capabilities.¹⁰³



The lack of inclusion in Canada’s innovation system has particularly affected Indigenous participation in the spheres of science and technology. University of Alberta Faculty of Native Studies professor Jessica Kolopenuk has described how:

Colonial ideas about race, sex, gender, reason, and property have concurrently framed Indigenous peoples as objects of scientific curiosity and as experimental material, rather than as producers of knowledge; as primitive peoples to be civilized through western education, rather than as innovators of complex cultures and societies; and as wards of nation-state governance, rather than as sovereign nations and self-determining peoples.¹⁰⁴

Indigenous and other non-western epistemologies have long been undervalued when it comes to science and innovation, and colonial and exclusionary approaches have further influenced which communities are being served by them. Many rural and Indigenous communities are held back through a lack of digital connectivity that restricts entrepreneurship, innovation, and the gains facilitated by digital adoption.¹⁰⁵ Similarly, low-income households could have proportional savings from owning electric vehicles—on top of helping reduce emissions—but current incentive programs are not designed to support an equitable uptake.¹⁰⁶ And, as has been extensively covered, innovation by major pharmaceutical companies both in Canada and globally is guided primarily by profit and market size rather than by reducing the global toll of disease.¹⁰⁷

One interviewee emphasized that rather than pursuing top-down solutions and programs, there is a need to instead “start with the community-level” to guide innovation. This must include allowing the time and space for the success of programs to be defined by communities themselves, on their terms, while retaining the sense of urgency needed to solve the underlying challenge.¹⁰⁸ For Indigenous peoples, Carol Anne Hilton has argued that there is a need for “a new story—of economic empowerment,

Indigenous and other non-western epistemologies have long been undervalued when it comes to science and innovation.

inclusion, and of Indigenous Peoples taking our seats at the economic table of this country. [...] It is time for modern, constructive, generative, Indigenous economic design”.¹⁰⁹ Robin Wall Kimmerer envisages “a time when the intellectual monoculture of science will be replaced with a polyculture of complementary knowledges. And so all may be fed.”¹¹⁰ Moonshot innovation offers an opportunity to do that in practice.



Connecting a complex innovation-actor landscape

A legacy of the governmental landscape is a matching “very congested landscape”¹¹¹ of innovation actors, funders, agencies, programs, and other organizations. These exist at federal, provincial, and municipal levels, and are further added to by a range of nonprofit and for-profit organizations. These organizations are “often working in silos trying to solve a part of the problem.”¹¹²

For companies, “the navigation of systems can be so tough”¹¹³ though initiatives such as the federal Business Benefits Finder are making it easier to find available supports, if not smoothing the process of applications and reporting.¹¹⁴ Structurally, one interviewee described the “disconnect” between different innovation organizations and the need to try and “herd” different programs and prizes together to “allow for more funding, and stronger signalling of where government wants industry to go and of where industry wants to go.”¹¹⁵

The range of poorly connected organizations and initiatives created problems during the pandemic. One interviewee described how there were “too many platforms around bringing companies together to respond to COVID-19” which created “proposal exhaustion, when time and money was spent in developing proposals but nothing came out of them...There were incredible ideas that were not funded—and [these companies] won’t apply again—although many of these companies have tremendous potential.”¹¹⁶ If moonshot innovation policies can facilitate a better interface for the firms and individuals that are the actual “agents of innovation”¹¹⁷ with the range of governmental supports and agencies that exist, then they will be a powerful tool helping to smooth the path to deploying innovations.



6 Instilling a new culture around success

Expert interviews stressed how the way that Canada measures success is too often outdated and an impediment to actually achieving that success. In particular, the tendency for the federal government to focus on economic “jobs and growth” metrics when funding ambitious innovation projects was criticized, since they often miss the mark of capturing the ultimate objectives. “The change [a *moonshot*] is trying to generate cannot always be measured as data points.”¹¹⁸ Entrepreneur and innovation commentator, Ben Reinhardt has argued that “it’s not clear at all what success metrics should be when you’re creating something new” and if you “are consistently trying to create appreciably different new things there will consistently be new ways to evaluate those things.”¹¹⁹

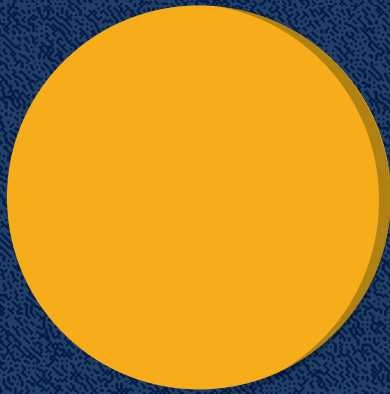
Rather than economic factors and spillovers being the primary measurements of success, as Mazzucato has described, they “do not happen because you want them to: they happen along the way to solving bigger problems.”¹²⁰ This was supported by other interviewees. “Economic benefits are spillovers that result from solving the problem the [*moonshot*] was set up to solve—and

If you “are consistently trying to create appreciably different new things there will consistently be new ways to evaluate those things.”

this should be the focus. If [you] add all these metrics in, [we] will start optimizing for all these other things that aren’t the [*moonshot*].”¹²¹


Unfortunately, current metrics are more closely tied to “short term political challenges.”¹²² Those metrics that are “used for funding programs [are often] more in line with how the parliamentary budget may measure success, not an innovating firm.”¹²³ One expert put the challenge around using the right metrics for success as “How do you get incentive for risk taking when [the] government is incentivized not to take risks?”¹²⁴ Politics dictates that success needs to happen within the confines of political cycles. However, innovation, and policies investing in innovation, can take much longer to bear fruit, and moonshot innovation policies will have to be built with that mindset foremost.

None of these landmarks on the Canadian innovation landscape create insurmountable roadblocks to successfully implementing moonshot innovation policies designed to solve real challenges facing Canadians. However, they do clearly highlight particular areas where new initiatives will need to avoid existing pitfalls and be bold in departing from existing innovation policy norms.



Section 3 Where to Next? Deploying Moonshot Innovation to Solve Real World Challenges in Canada

Taken together, the lessons from international examples and a deep understanding of the Canadian context can help to chart a path forward for the greater use of moonshot innovation policies to better deploy innovation and technology to solve challenges here in Canada. There is no one-size-fits-all model that can be copied to do this well and some commentators have argued that the chances for failure are high when applying moonshot approaches.¹²⁵ However, just because there are barriers in the way does not mean Canada cannot or should not seek to use moonshot innovation policies, or that it is impossible to create the conditions for success.



The following five recommendations address some of the key governance, operational, and design considerations that will need to be taken when seeking to select and deploy moonshot innovation policies in Canada.

Recommendations

1. Define a clear “grand challenge” anchored in unaddressed real-world needs, through an open and inclusive consultation process.
2. Facilitate policy innovation through providing delivery agencies with lean, agile, and independent governance structures.
3. Develop a portfolio of moonshot projects that are cross-disciplinary and cross-sectoral, embrace a range of different risk levels and types, and are inclusive of different types of individuals, organizations, industries, and regions.
4. Support the full innovation continuum and value chain, from invention, through manufacturing, commercialization, and deployment, using a broader policy toolkit of supply- and demand-side levers.
5. Focus on the metrics that matter for the success of the grand challenge.



1 Define a clear “grand challenge” anchored in unaddressed real-world needs, through an open and inclusive consultation process

Defining the grand challenges that moonshot innovation policies are trying to solve is crucial. These need to be aspirational and rooted in problems that require both groundbreaking science and the scaled deployment of innovations in areas where the private or public sector is currently either unable or unwilling to meet this need.

Experts engaged were clear that the grand challenge should seek to focus “on an unaddressed gap” that is not being sufficiently served by public or private investment, or where the challenge is such that there is a need for an organization to serve as the connective tissue across disciplines and stakeholders to help build a sustainable ecosystem.¹²⁶ There should also be a path-to-market for innovations arising from the grand challenge—such as through an active role from government in market-creating and shaping through regulatory policy and procurement,¹²⁷ and through links into venture and scale-up capital, and to domestic businesses that have the absorptive capacity to take ideas through to commercialization.

Community engagement with diverse voices from across Canada should be a central part of the process of defining the overarching goal. Indigenous peoples should be engaged early and meaningfully to ensure that the resulting projects reflect the real innovation needs and priorities of their communities.

The grand challenge should also reflect pan-Canadian opportunities to deliver public value and be rooted in either distinct needs, assets that can be successfully leveraged, or key existing strengths that would be served by the success of projects under it. Canada has important strengths, but these are often siloed and not working together to solve immediate challenges. Facilitating greater interactions and integrations between these

Community engagement with diverse voices from across Canada should be a central part of the process of defining the overarching goal.

silos can help build out new challenge-focused ecosystems.

To do this, there must also be an awareness and articulation of the return on investment for businesses that participate in grand challenge projects, beyond just their contribution to social good. While economic factors must not be the primary drivers of the grand challenges, their selection should not be blind to the advantages of creating successful Canadian leaders, with the job and tax base growth that comes with it. The potential for creating new export opportunities from solving similar grand challenges globally should be a consideration.

These grand challenges must be identified and defined through an intentional process of outreach and engagement, and as such this report is not recommending any single grand challenge in particular to be the focus of future moonshot innovation initiatives. However, to aid the reader in understanding what a grand challenge and the moonshot projects under it could look like in practice, we have provided two examples, around achieving net-zero emissions and guaranteeing Canada’s food security.

While economic factors must not be the primary drivers of the grand challenges, their selection should not be blind to the advantages of creating successful Canadian leaders, with the job and tax base growth that comes with it.



Example Grand Challenges



Achieving net-zero emissions ahead of 2050

What it is: As one expert advisor framed it, no other moonshots matter “if the planet ain’t here.”¹²⁸ A grand challenge on net-zero emissions would look to rapidly accelerate the development and the deployment of clean technologies, helping Canada as a whole and individual communities de-carbonize, and seek to establish Canada as a global leader in clean technology exports.

Why does it matter to Canada: Canada has committed to reaching net-zero emissions by 2050 and enshrined this in law in the *Canadian Net-Zero Emissions Accountability Act*. This Act also includes \$15 billion towards 64 measures including “funding for green community buildings; home energy-efficiency upgrades; commercial and large building retrofits; money to plant two billion trees; funding for rapid decarbonization projects; smart grid and grid-modernization projects; and subsidies for zero-emission vehicles.”¹²⁹

Since passing the Act, the federal government has increased its ambitions for 2030, committing to cut greenhouse gas emissions by 40 to 45 percent below 2005 levels,¹³⁰ though even this has been described as “falling short of what is needed to keep on track for a livable planet” and also lagging other comparable countries,¹³¹ and mandate letters have included other net-zero initiatives, including a “buy clean” strategy encouraging the procurement of materials produced using low-carbon processes.¹³²

Why does it matter to the world: The United Nations Secretary-General António Guterres described the Intergovernmental Panel on Climate Change’s Working Group 1 report as “a code red for humanity” and noted that “We are at imminent risk of hitting 1.5°C in the near term. The only way to prevent exceeding this threshold is by urgently stepping up our efforts and pursuing the most ambitious path.”¹³³ With extreme weather events

becoming more common and more intense, reaching net-zero emissions as soon as possible is essential to the livability of vast swathes of the planet.

What consultation is needed: Reaching net-zero emissions is a challenge that impacts all areas of Canada’s society and economy. Yet not all areas are equally well equipped to achieve it. Consultation would be needed to identify the unaddressed gaps and underserved communities and sectors, to help map out the structural and technological barriers that a moonshot could help tackle. These could include understanding the net-zero challenges for rural and remote communities that might rely on diesel generators for power and how they could be replaced with reliable renewable alternatives. Or they could examine the construction sector, where progress could be made on greener building materials but where action is needed to adapt regulations and building codes to incentivize these innovations.

Example moonshots and projects: Swift action to halt the progress of climate change and adapt to the impacts that are already happening is probably the ultimate grand challenge. Canada already has a substantial environmental and clean technology products sector, worth \$70.5 billion in 2019, and growing twice as fast as the rest of the Canadian economy.¹³⁴ But this is only a small slice of a global market that is expected to exceed \$2.5 trillion by 2022.¹³⁵ A big part of growing Canada’s clean technology sector, and, in the process, helping companies, communities, individuals, and governments all reduce their emissions, is going to be maturing what the Canadian Institute for Climate Choices call “wild card” technologies. These technologies, such as carbon capture, utilization, and storage, and hydrogen for fuel cells and heating, are ones that are in early stages of their development and face significant barriers to being deployed at scale, but that are potentially incredibly important to reaching net-zero emissions.¹³⁶

Example Grand Challenges (continued)

A grand challenge around these technologies could play an important role in accelerating their development and deployment in Canada. New mechanisms can help coordinate across the numerous existing funders in this space, helping to crowd in resources and investment and ensure that lessons are shared. These can be supported through new demand-side government initiatives, such as increasing the energy efficiency requirements for new buildings and products, as well as sufficiently pricing emissions as negative externalities.

Furthermore, a grand challenge could help create and sustain new feedback loops that provide information from pilot deployments and in communities or by other end users that can inform the scientific research and the design of scaled manufacturing processes. Tools and metrics available to innovators, such as maps of initiatives and interactive dashboards of up-to-date metrics, could support these feedback loops.

Finally, new policies could also be introduced to further support Canadian innovators to develop and protect their intellectual property in this rapidly growing global market.



Guaranteeing Canada's food security

What it is: Ensuring that Canadians have safe and reliable access to food is a complex technological, societal, and economic challenge. A grand challenge focused on guaranteeing Canada's food security would help protect a key export market in the face of threats from climate change, create new areas of growth and employment in the food economy, and fulfil a fundamental part of the social contract and social safety net by ensuring no one goes hungry.

Why does it matter to Canada: As 2021 demonstrated, Canada's position as a major food exporter is threatened by the impacts of climate change. A historic drought on the Prairies drastically cut crop yields,¹³⁷ a heatwave on the Pacific coast boiled millions of sea creatures alive,¹³⁸ and the catastrophic flooding in British Columbia devastated farms, destroying crops, ruining machinery and killing animals.¹³⁹ As Canada continues to heat up and extreme weather events become more common, our current crops and practices might become unsustainable.

Meanwhile, despite Canada exporting \$56 billion a year in agriculture and agri-food products,¹⁴⁰ as of 2017-18, 12.7 percent of Canadian households were food insecure— amounting to at least 4.4 million people. This situation is even worse in the North, with 57 percent of households in Nunavut food insecure.¹⁴¹ While much of this insecurity can and should be solved with existing policy tools, innovation can play a major role in improving resiliency of food supplies and reducing costs.

Why does it matter to the world: Food security is the aim of the second Sustainable Development Goal, Zero Hunger.¹⁴² Globally, 746 million people were exposed to severe levels of food insecurity in 2019 and a further 1.25 billion people experienced moderate food insecurity—lacking regular access to nutritious and sufficient food.¹⁴³ Healthy diets are too expensive for many people in every region of the world, leaving them out of reach of more than three billion people.¹⁴⁴ Transformative

Example Grand Challenges (continued)

Canadian innovation in this moonshot could have a major impact on global food security, health, and productivity.

What consultation is needed: Food security is again a multi-faceted grand challenge that impacts a vast range of Canada's society and economy. The needs of underserved communities facing food insecurity are both independent and interlinked with those facing farmers devastated by the impacts of climate change. Consultation would be needed to understand these differing challenges to help identify the interlinkages where transformational innovation can best be applied.

Example moonshots and projects: There are currently numerous disconnected initiatives that seek to address elements around food security that could form the basis of a portfolio of moonshot projects. These include: creating a circular food economy through reducing food waste,¹⁴⁵ identifying resilient and adaptable food sources in the face of climate change through partnering Indigenous food growers with seed banks,¹⁴⁶ using greenhouse gas emissions to create new feed sources,¹⁴⁷ and supporting data use in the agriculture sector.¹⁴⁸

A grand challenge could accelerate projects such as these through matched funding and additional support, helping projects reach critical scale and deliver real world impacts and value. It would further connect learnings and build capacity across different projects through a wider portfolio of related moonshot projects, and catalyze the growth of a connected ecosystem.

2


Facilitate policy innovation through providing delivery agencies with lean, agile, and independent governance structures

There was a clear consensus from experts interviewed that moonshot innovation policies should sit at the federal level to enable them to take a truly pan-Canadian approach.¹⁴⁹ Only by pursuing moonshots through a national lens will it be possible to draw together regional strengths in a way that combines the whole to be greater than the sum of its parts. However, one interviewee described how any moonshot will have to be crafted in a way so they “don’t trample over jurisdictional lines.” Giving the example of health, they argued that there is “too much focus on fighting jurisdictional battles, which would make it hard to focus” a moonshot in that area.¹⁵⁰

While a federal approach is needed, the delivery of moonshot innovation policies does not necessarily have to sit centrally. As detailed above, lean, agile, and independent governance structures are hallmarks of successful moonshot innovation policies and delivery agencies globally. With a focus on end-user engagement, these can be powerful organizational approaches to catalyzing innovation and deployment.

This approach was also supported by experts interviewed. While being directly within government opens the possibility to directly shape policy and use procurement powers, it does come with the high transaction costs and potential friction between different partners.¹⁵¹ One interview described how “trying to do something new and different in the existing government structure is really challenging,” and emphasized that whether internal or external, it is essential to ensure that there is “nimbleness”.¹⁵² Interviewees overall were skeptical whether nimbleness could be achieved without organizational independence.

An added advantage for an external organization, that one interviewee described, is that it is more likely to be seen as a “neutral convener not



Only by pursuing moonshots through a national lens will it be possible to draw together regional strengths in a way that combines the whole to be greater than the sum of its parts.

linked to federal mandate in the same way,” meaning that other partners feel they have a greater role and more control.¹⁵³ In doing this, an external organization is able to identify a need and channel funding and effort in a way the federal government cannot do. This can further help circumvent the impression of trampling over jurisdictional competencies. However, while a separate interviewee thought an arms-length organization is the right approach, they also noted that this will be “very challenging” because of how “to do this in a way that is transparent and legitimate.”¹⁵⁴

While an independent agency is not the only vehicle for moonshot innovation policies to be actioned in Canada (as detailed further below), such an agency could play a key role in engaging multiple departments, other federal agencies, different levels of government, industry and academia, all helping to facilitate the inclusion of a much wider range of demand-side tools and market creation powers than could be provided in any one department.

A crucial element in the success of any delivery agency in being able to innovate is allowing flexibility in both funding and personnel decisions. For the former, when it comes to funding, the ability to make independent decisions and to be able to crowd-in funding from both other public sources and from the private sector will be key. For the latter, it is said that “personnel is policy.”¹⁵⁵ As DARPA has shown, hiring people

with the right mindset and skill set can be a key component of success. Empowered program managers that are able to make decisions to back projects with different risk profiles, informed by deep technical expertise and vision, can play a powerful role in advancing use-inspired innovation. When combined with a wider team with commercialization experience and business backgrounds as well as strong relationship-building skills, the potential to bring innovations to market and mass-deploy them at accelerated timelines is increased.

The long-term success of grand challenges to solve their central purpose and produce economic spillovers will be aided by adopting, to the maximum extent possible, personnel policies that facilitate the flow of talented individuals between the delivery agency, academia, and industry. This will help spread knowledge and build sustainable ecosystems and networks. This can be achieved through short-term contracts for program managers that encourage secondments and sabbaticals, rather than long-term drains of talent away from research and industry.

3

Develop a portfolio of moonshot projects that are cross-disciplinary and cross-sectoral, embrace a range of different risk levels and types, and are inclusive of different types of individuals, organizations, industries, and regions

Portfolio approaches are essential for the success of moonshot innovation policies. As one interviewee put it: “You have to kiss a lot of frogs before you meet Prince Charming.”¹⁵⁶ These projects are at their heart solving a grand challenge and they need to be ambitious enough to drive forward transformational change.

To do this means that failure needs to be embraced and that means taking on different types of projects, with different scales and timeframes. A grand challenge portfolio should include a mix of seedling projects (proof-of-concept projects with timelines under 12 months), full seed stage projects that seek to apply transformational research to real-world uses with longer time frames (up to eight to 10 years to realize impact and commercialization) and scale stage projects that have shorter time frames (less than four years). The mix should include a range of projects at different technology-readiness levels and manufacturing-readiness levels to provide feedback loops and build connective tissue to help scale innovation overall.

Projects should also involve different risks. Risks are not all created equal—a fiduciary risk from a project is very different to risk rooted in the science or a project execution that could impact users or community members: “Risk management and mitigation is very different from risk appetite.”¹⁵⁷ A Risk Appetite Statement, such as that developed by the United States Agency for International Development (USAID), can be an important tool to help shape these portfolio risks.¹⁵⁸

Feedback from experts interviewed for this report described how Canada often lacks focus and that limited funding is spread too thinly to catalyze transformational change: “The government often does not invest enough in one area. Just wants to make everyone happy so fund a little bit everywhere—but then you don’t see impact”.¹⁵⁹ Instead, we should “do fewer bigger things.” While there should be a diverse portfolio across regions and innovation stages, it should remain tightly focused on pushing forward innovation only within the focus on the main moonshot objective.¹⁶⁰

Portfolio approaches are essential for the success of moonshot innovation policies. As one interviewee put it: “You have to kiss a lot of frogs before you meet Prince Charming .”

It is important that sustained attention is paid to ensuring there is a diverse mix of projects and groups represented within the overall portfolio, from competitive bids for projects, through open calls to diverse innovators, to targeted outreach to individual communities that could be ideal homes for pilot projects.

The overall portfolio must stay firmly aligned with the goals of the overall grand challenge to solve real-world problems at scale. It is worth exploring whether projects above the seedling level should have conditions that support this tight focus, such as limits to profit, as was a requirement of the Apollo program. The creation of intellectual property/patent pools to support the growth of the wider ecosystem by allowing the licensing of intellectual property rights to Canadian innovators with lower costs and with reduced friction could be another impactful tool.

4

Support the full innovation continuum and value chain, from invention, through manufacturing, commercialization, and deployment, using a broader policy toolkit of supply- and demand-side levers

Moonshot innovation policies will be most impactful when they are structured to make their processes as smooth and straightforward for the firms and individuals that are the actual “agents of innovation.”¹⁶¹ Where possible, participants in the grand challenge portfolio of projects should be able to access different types of federal funding and support without requiring new applications or multiple systems or reporting to reduce the time they spend on paperwork and increase the time they actually spend innovating.

This speaks to a wider role for moonshot innovation policies in the complex Canadian innovation landscape. With so many organizations out there, there is a need for a “herding” organization that is able to crowd in different pools of existing government funding streams. Given that there is often some overlap in programs and organizational mandates, there is an opportunity to “do fewer, bigger things” with “multiple organizations putting money in rather than each organization running its own activity.”¹⁶² This can be achieved by giving other federally-funded organizations the flexibility to support projects within the grand challenge portfolio if those projects align with their core mandates, without requiring additional applications and reporting. This should be supported by structures to encourage national ecosystem coordination.

Long term, moonshot innovation policies will be a failure if they just become another justification for more of the many funding organizations that already exist in Canada. Achieving the innovation and the change required to solve grand challenges requires more than just funding—they must draw on the broader range of tools available to support innovation.

A delivery agency that meets the recommendation of being independent will have limited direct procurement powers. Given that it is essential that there is a focus on advancing innovation that has a clearly defined immediate or future use-case and that there are efforts to help connect innovators with potential end users.

Achieving the innovation and the change required to solve grand challenges requires more than just funding—they must draw on the broader range of tools available to support innovation.

A key advantage of independence in a delivery agency is being able to engage more freely with different stakeholders and other levels of government beyond just the federal level. There should be an active process to identify procurement opportunities in both the public and private sectors for innovations emerging from the moonshot portfolio and to connect innovators with emerging regulatory conversations. This should also extend to supporting innovators in international trade and standard-setting forums to help embed Canadian innovation at the heart of international markets.

A repeated theme in expert interviews was the importance of “soft infrastructure” that enables both building and leveraging an ecosystem focused on solving the moonshot.¹⁶³ In practice, this means employing a range of different tactics, such as ensuring there are forums for shared learning and cross-pollination across projects, enabling the trusted infrastructure for data sharing, and helping to nurture talent. Too often this has been an afterthought, but the importance of ecosystem building should be embraced in moonshot design from the start. When it has been prioritized, such as in Genome Canada’s CanCOGeN, it has been incredibly impactful.

5

Focus on the metrics that matter for the success of the grand challenge

Too often, what we choose to measure incentivizes behaviours and actions that, at best, serve little purpose, and, at their worst, actively harm achievement of the central goal. Experts interviewed were critical of the usual approach from the federal government to measuring success of funded projects. Previous projects and initiatives had been measured “more in line with how the parliamentary budget may measure success, not an innovating firm”.¹⁶⁴ This can create misalignments between different partners who have different objectives, with the government, for example, focusing on job creation, academic partners focused on research outputs, and industry on sales and revenue targets, leading to the failure or underperformance of projects.¹⁶⁵

It is important that grand challenges are guided by clear central metrics that are consistent across projects, such as greenhouse gas emissions prevented for a net-zero emissions moonshot.¹⁶⁶ This should focus on measuring impact rather than just outputs—crucial for delivering transformational change.¹⁶⁷ Beneath that central metric, individual projects should be measured by a flexible range of different metrics. As one expert put it, if you look at a startup that goes from an idea to something big, “there are different metrics that you use at different stages of an innovative entity before it gets to economic measures.”¹⁶⁸ Metrics should be designed to be appropriate at those different stages.

For Indigenous-led projects and others involving community participation, for example, those looking at the piloting and deployment of new innovations, there should be time, space, and funding provided for a bottom-up process of identifying what matters and what should be measured. It is important to ensure that you are “engaging directly with the community about what this would look like to them.”¹⁶⁹ However, “when you’re working with outcome-based

metrics, it can be quite challenging to meet them because you are working with a lot of uncertainty.”¹⁷⁰ This needs to be understood and there needs to be focused work with communities in developing baseline metrics without imposing top-down solutions.

Projects within the overall grand challenge portfolio should be time-limited but success should be actively tracked during the process. If it is clear that a project is off track and will not deliver the intended goals, program managers should be empowered to end those projects early and free up funding for other projects. All metrics should be clearly measurable and facilitate an internal culture of learning and experimentation within any delivery agency to improve performance and impacts over time.¹⁷¹

Appendix

Key Informant Interviews

The Brookfield Institute conducted a series of interviews to help guide and inform the research on moonshot innovation policy. We would like to thank the following individuals for sharing their expertise with us.

Full Name	Title	Organization
David Messer	Manager – Circular Opportunity Innovation Launchpad (COIL)	City of Guelph
John Buck	President and Chief Executive Officer	Community Economic Development and Employability Corporation (CEDEC)
Jocelyn Mackie	Co-CEO	Grand Challenges Canada
David Brook	Chief Strategy Officer	Grand Challenges Canada
Jayne Engle	Director, Cities & Places	McConnell Foundation
Bruce Simpson	Senior Partner / Senior Advisor	McKinsey / Blackstone
Michael Greenley	Chief Executive Officer	MDA
Amy MacLeod	Vice President of Corporate Communications	MDA
Leslie Swartman	Senior Director, Government and Public Affairs	MDA
Cameron Ower	Chief Technology Officer	MDA
Phil De Luna	Director, Materials for Clean Fuels Challenge Program	National Research Council of Canada
Rachelle Bruton	Director, National Programs Office	National Research Council of Canada
Lynne Genik	Director, High Throughput and Secure Networks Challenge Program	National Research Council of Canada
Kevin Thomson	Program Director	National Research Council of Canada
Kelley Parato	Program Director	National Research Council of Canada
Rodney Ghali	Assistant Secretary, Impact & Innovation Unit	Privy Council Office, Impact Canada
Stephanie Choo	Partner	Portag3 Ventures
Gerri Sinclair	Innovation Commissioner	Province of British Columbia
Irene Sterian	Chief Executive Officer	Refined Manufacturing Acceleration process (ReMAP)
Loretta Renard	Chief Operating Officer	Refined Manufacturing Acceleration process (ReMAP)
Matthew Mendelsohn	Visiting professor	Ryerson University
Nevin French	Vice President, Policy	TECHNATION
Michele Lajeunesse	Senior Vice President, Government Relations, Policy Development and Advocacy	TECHNATION
Jonathan Fowlie	Vice President, Government Relations, Public Affairs & Community Investment	Vancity

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