Standing Committee on Agriculture and Agri-Food

STUDY: Growing Forward 2 (Science and Innovation)

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Speaking notes

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VALGEN

1. Introductory comments

Thank you for inviting me today to once-again provide comments on Canada's agri-food policy—this time on Growing Forward 2 and the role science and technology can play in the plan.

Let me start by saying I think this is an important study, as Canada now has the opportunity to renew and revitalize its national agri-food policy, perhaps finally putting innovation at the centre of our policy goals and plans.

I firmly believe there is both a strong case and significant opportunity to renew and accelerate agri-food innovation by intelligently and aggressively developing, adapting, adopting and using advanced technologies, including biotechnology, to enhance Canada's globally competitive agri-food sector.

2. Background and experience

I should preface my remarks with my background and expertise. I am an international political economist with the Johnson Shoyama Graduate School of Policy at the University of Saskatchewan in Saskatoon. I teach, do scholarly research and consult on the role of technology in economic development, markets and trade, with a

particular focus on agricultural biotechnology. I also am the Co-Lead and Principal Investigator of VALGEN (Value Addition through Genomics and GE^{3}LS), a Genome Canada funded project that is investigating the deep governance issues related to science led agri-food development and trade.

In the interests of full disclosure, I should report that I have past employment experience in industry (banking) and government (the federal and Saskatchewan systems) and have held a number of academic appointments in Canada and abroad that have allowed me to investigate matters of technological change and innovation policy. I have been applicant and senior research collaborator on more than 20 national and international grants and contracts that have generated more than C$150 million to support research and scholarly investigation of new technologies in the global agri-food system. I have held peer-reviewed grants from SSHRC, NSERC, CFI, the NCE program and Genome Canada, contracts with Saskatchewan Department of Agriculture and Food, Agriculture and Agri-Food Canada, the Canadian Food Inspection Agency, Western Economic Diversification, the Canola Council of Canada, the Saskatchewan Seed Growers Association, Monsanto, Ag-West Bio, the State of Victoria (Australia), the OECD, and a number of law firms in Canada and the US litigating market effects of innovation. I was a member of the Canadian Biotechnology Advisory Committee for 7 years (I served as co-chair of the review of Canada's regulatory regime

for biotechnology), was a Canadian member a NAFTA Chapter 13 expert panel, am a member of the boards of directors of both the Estey Centre for the Study of Law and Economics in International Trade and Ag-West Bio Inc. and was a founding director of the Canadian Agri-food Policy Institute (CAPI). I am also co-editor of *AgBioForum*, the preeminent on-line peer-reviewed journal that concentrates on the economics and politics of the global agricultural biotechnology industry.

I teach one of the few specialized graduate courses in Canada on innovation policy, I have published more than eight books, 50 book chapters and 30 journal articles on the subject and I am a principle investigator on grants from SSHRC (ISRN), Genome Canada (VALGEN and iBOL) and Agriculture and Agri-food Canada (CATPRN and CAIRN), all focusing on aspects of agri-food policy and innovation.

3. The innovation imperative

Two pressures—one domestic and one international—provide the context for your important deliberations.

First, domestically, the Canadian agri-food sector faces a daunting challenge. When I look at the value added per employed person in the agri-food sector I find that the agri-food sector is returning about 50% less value added per employee than the other sectors in Canada (but about 70% in Western Canada), and that is deteriorating over the past

two decades (overall GDP per employed person in the total economy jumped 70% in the same period that crops and livestock output per person rose only 40%—more depressing yet, Canada's numbers for the overall economy are lower than in the rest of the OECD). If this continues, it won't be the Americans, it won't be the Mexicans and it won't be the Chinese that ultimately overwhelm the Canadian agri-food sector—it will be the other sectors within Canada. They will draw away the high quality land, labour and capital that are so important to a growing and prosperous sector. What will be left is a poor and declining industry.

Second, internationally destructive trade and market policies, compounded by and contributing to inadequate investment in agri-food research and development, have dampened supply, just at the point when demand is accelerating (due to a combination of a larger world population and rising demand from per capita income growth). The result is sharply higher, sustained world food prices and increasing unease in food-insecure countries where more than 850 million malnourished people live.

Canada has an economic and moral imperative to respond, if for no other reason than we are relatively big. The Canadian agriculture and agri-food system accounted for 8% of total Canadian GDP in 2005 and employed one in eight or nearly 2.1 million people.[1] In 2008, Canada

[1] http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1205769582306&lang=eng

was the fourth-largest exporter of agriculture and agri-food products in the world, with exports valued at $38.8 billion.[2]

Canada has more than 100 years of world-class agri-food innovation, leading to world-first innovations for wheat, barley, oats, canola, pulses, cattle and hogs, among others, which now underpin the world's capacity to feed itself.

Agri-food innovation, which can and should include more intelligent and aggressive use of advanced technologies, will require new policy directions, renewed efforts to create appropriate institutions and new ways of bridging the gaps between the test-tube and the plate. Commodity groups, research communities, industry and all orders of government will need to engage and adapt.

The Canadian government has already signaled its awareness and need to amplify the results of investments in R&D in Canada. This is reflected in The Canadian Advantage (2007), the appointment and referrals to the Science, Technology and Innovation Council (STIC) and the commissioning of an expert panel on R&D (Jenkins 2011). All offer potentially valuable advice, but virtually none make more than a glancing reference to the role of science and technology in the agri-food space.

Two key messages from that work can and should be drawn into your deliberations today. First, investing at the front end of the science-

[2] http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1261159658146&lang=eng

technology-innovation supply chain may be necessary but is certainly not sufficient. Canada invests a lot in science and technology relative to many other advanced industrial economies and can point to some important impacts in terms of scholarly outputs (Phillips and Castle 2010; Castle and Phillips 2011) but these are not translating into market opportunities and increasing productivity. Second, more impact might be realized by shifting resources from indirect to more direct support for innovation. SRED grants, in particular, may be underperforming—which is especially true in the agri-food world, where many investments are ineligible for this program.

In that context, let me lay out what I think is a fundamental reality the committee needs to consider and respond to.

4. Innovation in theory and practice[3]

Markusen (1999) asserts that that the innovation literature is rife with 'fuzzy concepts' with 'scanty evidence' that lead to 'wimpy policies'. The difficulty is that four competing paradigms attempt to explain the incidence of innovation have overlapping and interlocking assumptions, hypotheses and methods.

As with much of the literature about technology and the economy, Joseph Schumpeter is credited with the first economic definition of innovation. He defined innovation as the introduction of a new good or a

[3] This section is drawn from a manuscript Phillips and Ryan are contracted to produce for CABI (forthcoming).

new quality of an existing good, a new method of production, the opening of a new market, the introduction of a new supply of inputs to a production system or a new organizational structure in an industry (Schumpeter 1939).

Two points are clear from his definition. First, he very explicitly separates invention from innovation, arguing that "innovation is possible without anything we should identify as invention, and invention does not necessarily induce innovation" (Schumpeter 1939). While some might argue that innovation involves introduction of a 'better way of doing things,' one should keep in mind that many, if not most, technologies typically emerge in a relatively primitive condition. It is increasingly accepted that it may be irrelevant whether an innovation offers any advantages over the product, technology, market or organization it is replacing; rather, all that matters is whether individuals perceive an advantage. Sustainable innovation, however, most certainly requires a net gain to society. Regardless of these nuances, much of the literature and all of the public policy interest tends to focus on those innovations that bring something new—but especially an invention—into widespread, practical use.

Second, Schumpeter is clearly talking about a process ("introduction") by which something new is initiated or adopted. Ruttan (2003) concurs, suggesting the concept of innovation be extended to include the process by which new things emerge in science, technology

and art. A variety of other researchers see creativity—defined as the production of novel and useful ideas in any domain—as the basis for innovation and so they define innovation as the successful implementation of creative ideas within an organization.

Much of what people identify as innovation involves planned, systematic effort to add value through research and development. Stanley Metcalfe, professor of political economy and Director of Policy Research in Engineering, Science and Technology at Manchester University, suggests a number of key stages occur with most innovations: investments in R&D are driven by innovation possibilities anticipated in the minds of technologists, research managers and innovators; it is uncertain whether the research, development and commercialization inputs will generate any innovative output; and innovation co-produces targeted useable output (which might be "agenda reducing") as well as enhances the number of possibilities (which is "agenda enhancing"). The Committee for Study of Invention produced a report for the US National Science Foundation that explicitly differentiates invention ("the process of devising and producing by independent investigation, experimentation, and mental activity something that is useful and that was not previously known or existing.") from innovation, which they define as "the complex process of introducing novel ideas into use or practice. Inventions, thus, generate

value from their use (innovation) and not from their creation and existence."

There are two main competing views about the processes of innovation. The economic theory of technological change has for many years focused on the firm as the primary research unit (e.g. Nobel Prize winning economists Kenneth Arrow and Robert Solow) and, in the footsteps of Schumpeter, has examined the microeconomic incentives for and impacts of private research and commercialization. Some economists recently have examined the impact innovative activity at the firm level has on the larger economy, focusing especially on the implications of "endogenously" generated innovation on macroeconomic growth, trade and industrial location. Even so, they tend to assume that innovation is a discrete event that occurs within firms. Recently a few economists have begun to note that firms are not self-sufficient and often must reach beyond their boundaries to supplement their capacity. Nevertheless, their focus remains steadfastly on innovation that is orchestrated by a single corporate leader.

Alternatively, a group of political economists, business theorists and sociologists with more of an interest in the influence of institutions, ideas and individuals has developed a range of theoretical "systems" approaches to innovation. Most hark back to Alfred Marshall and his *Principles of Economics* (1890) and look at the role of economies of

scale and scope in the local, regional, national or sectoral innovation systems themselves.

These perspectives can be parsed into four broad, competing theories of R&D, innovation and growth that offer a range of prospective policy advice (Table 1). While innovation systems are all the rage in policy circles, growth theorists and development economists abstract from the focus on innovation processes, asserting that optimal investment will be derived in well-structured economies, while a mix of business economists, economic geographers and sociologists posit that innovation is the result of one a combination of 'special people' doing 'special things' in 'special places' (Leadbeater).

Table 1.2: Four models of innovation

Assumptions	**Neo-Classical Trade Theory**	**Clusters**	**Innovation Systems**	**Economies of Creativity**
Place	Heckscher-Ohlin theorem posits production locates where comparative advantages match comparative endowments	"Agglomeration" of firms and industries create economies of scale where interdependences are traded (e.g. thick labour market and dense forward and backward linkages).	Untraded interdependencies (mysteries in the air) are geographically sticky	Creatives live in cities endowed by technology, talent and tolerance
Processes	Relative prices (e.g. wages, exchange rates, inflation, interest rates) more important than organizational structures	Mode 1 style system, where MNEs and Universities, interact in hierarchical processes; both are posited to be anchors for clusters	Social networks drive innovation in a mixture of Mode 1 and Mode 2 systems (e.g. Triple Helix; Regional Innovation Systems)	Creative people live in purpose-built, heterogeneous, Mode 2 style networks
People	Individual optimization drives innovation	Angels and venture capitalists generate demand pull system	Research stars at core of science and technological push system	Creative, talented people ('creatives') driven by mix of personal and commercial motive

Three distinct but interrelated theories of development, innovation and growth are often conflated into the innovation debate. While each theory makes glancing reference to place, processes and people, they tend to focus on one driver, holding the others constant (see table 1.2). The search for deeper meaning was at least partly triggered by the advent of the 'new' economics of growth (Romer 1990; Lucas 1988), trade (Krugman 1996) and geography (Krugman 1998). While the new economics showed that endogenous growth could be exploited to generate economic advantage, it did not explicitly examine the growth processes.

The earliest and most popular among policy makers is that the pursuit of policies that create 'special places' will generate all these positive outcomes. Marshall (1890) and Porter (1990) both noticed the presence of 'agglomerations' of firms and industries and attempted to explain them in the context of what are now called economies of scale. Firms co-locating in regions are likely to gain through competition and trade benefits from interdependencies, such as extensive, supportive forward and backward linkages and 'thick' labour markets (i.e., where both demand for, and supply of, skilled labour is high). Policies directed at nurturing 'special places' tend to encourage firm, sectoral or industrial co-location and creation of attractors for firms (e.g. universities, public laboratories and industrial parks). Firms pursuing a product-based view of the world, where competition through cost minimization is critical,

are most attracted to such centres as they facilitate cost efficiencies that allow them to gain or sustain their targeted market share. Ironically, while the clusters model has been subsumed in the larger innovation literature, there is no explicit focus in the theory or the policy prescriptions on innovation or knowledge management.

In the 1980s the 'special processes approach to innovation gained ascendancy. Variously described as national systems of innovation (Lundvall 1992), regional systems of innovation (Wolfe and Gertler 2004) and the triple helix model (Etzkowitz and Leydesdorff 1995, 2000), the special processes approach posits that economies of scope generate untraded interdependencies between people and firms that co-exist in innovation systems. The frequent and complex interactions of individuals and firms as they develop and test new ideas in the market create social capital that facilitates the transmission of information and knowledge. Unlike in the 'special places' theory, these interactions happen outside formal transactions—they emerge organically and are a collective product of local culture and context. Policy focused on generating innovation systems tends to be largely supply push, involving investment in institutions, programs or processes where research, development and commercialization activities can prosper. Firms attracted to this type of system are likely to be pursuing resource-based strategies (Penrose 1959), where they focus more on core competencies rather than products and market share.

At about the turn of the millennium, a group of business theorists and economic geographers broke away from the 'special processes' group and began to explore the role of the individual in the context of the innovation process (e.g. Florida 2002; Gertler et al 2002). A set of interrelated theories and policy prescriptions assume that 'creative' individuals are at the core of the innovation process. A mix of sociology, psychology and economic theories assert that highly creative individuals can be nurtured and 'unleashed' in communities that invest in technology and talent and celebrate tolerance to diversity and change (e.g. Florida's three Ts). The institutional and social pathways of change are not fully delimited in this literature, but the central tendency of those promoting this approach is to generate high quality, creative human capital through education and investments in research and networking programs and to invest in talent attraction through nurturing the local quality of life. Firms that are attracted by this type of milieu tend to be pursuing knowledge-based strategies (Grant 2002), seeking to be on the leading edge of technology, product and organizational innovation. The open-source, creative commons approach is often wistfully cited as the perfect environment for creative types, as it least constrains novel recombinations of knowledge and ideas.

While the benefits of clusters might accrue on a number of levels, the firm plays a central role in deploying economic resources and contributing to economic activity. Maskell and Kebir identify three

complimentary lines of inquiry labelled: (1) the competitiveness perspective, (2) the externalities perspective and (3) the territorial perspective

While the separation of these perspectives—the place/process/people or competitiveness/externality/territorial perspectives—is an important step toward conceptual clarity it is important to note that in practice none of these perspectives can realistically be separated from the others. Every location will find some form of formal business to business linkages alongside informal links to local public goods as well as a some higher form of motivation (higher than economic motives) to push the local community toward a limitless frontier. However, making the distinction between the different perspectives and their underlying relational mechanisms creates the opportunity to investigate the causal mechanisms and behavioural models with more clarity and simplicity so as to prove or disprove our understating of when, where and to whom clustering is relevant.

In essence, theorists and policy-makers in the modern, knowledge-based economy are currently trying to balance competing views of how society can optimize the creation and use of new knowledge. This task has engaged scholars, scientists, policy makers, inventors, entrepreneurs, capitalists, consultants, and NGOs in a heated debate (with both positivist and normative elements) about which model is best.

The main lesson of all the contextualized theory, is that exciting things happen in tight locales—disbursing activities beyond the locations where scale economies operate, innovation dynamics function and creative individuals flourish simply is not feasible except with rising subsidies or barriers.

5. So what can or should the Canadian government do?

When I last talked to the committee in March I offered some comments and advice related to biotechnology in the agri-food space. All of those comments remain valid in the context of your review of science and innovation related to GFII.

As I noted then, ultimately, accelerating innovation in the Canadian agri-food system will require new policies, programs and partnerships that will mobilize capacity from industry, government, universities and farmers—the trick to mobilizing those resources will be to create a sense of purpose and commitment. Conflict and lack of focus create uncertainty, which simply signals to others to avoid engaging.

At a minimum, the federal government, in partnership with other stakeholders and partners, needs to work on three priority policy areas.

5.1 Federal research needs to refocus on agri-food opportunity

To the dismay of many in the industry, the federal government has sent some troubling signals that agri-food research is not on the A-list of

priorities. In 2007 the federal government released its strategic statement on Mobilizing Science and Technology to Canada's Advantage. The strategy targets to invest in Canada's entrepreneurial, knowledge and people advantages in four priority areas: environmental science and technologies; natural resources and energy; health and related sciences and technologies; and information and communications technologies. While parts of the agri-food sector (e.g. healthy foods, nutraceuticals and biofuels) might be shoehorned into the various priority areas, the strategy and its proponents show a detectable bias against national S&T investments in the agri-food area. One effect is that existing and new S&T programs are no longer open to the Canadian agri-food sector. Already the National Centres of Excellence, NSERC and the Canada Excellence Research Chairs programs have explicitly rejected proposals to invest in the agri-food sector.

One major concern for many in the agri-food space is the recent set of musings about how the NRC might change in coming years. The Plant Biotechnology Institute, and other NRC institutes across Canada, have been key players that have accelerated agri-food innovation in the past. Canola, and more recently herbicide tolerant canola, is Canada's multi-billion-dollar-a-year annual mega project—it is highly unlikely it would have been developed if we had to rely only on the private sector, university researchers or commodity groups. The stated plans to shift the focus from upstream foundational science to downstream technology

transfer may be appropriate in some sectors, but is likely the wrong approach for the agri-food sector. There are no shortage of knowledge adaptors and adopters in the agri-food space—instead there is a lack of scale and focus on the foundational of the seed, the plant, the animal and plant and animal diseases. That has been NRC's space and it would be a major error to vacate it. Above and beyond what the NRC or any federal lab is able to deliver directly, their research has been demonstrated to have major spill-over effects on private investments—all the more reason to spend money strategically rather than tactically (Alston et al; Malla 2001).

Moving along, I would also reiterate a point I made earlier—more effort needs to put on aligning federal funding towards the areas of greatest opportunity. Two points come out of theory and practice. First, while macroeconomic and sector wide-policies are perhaps necessary conditions for innovation, successful and sustainable innovation occurs most often in special places, using special processes and engaging special people.[4] Federal policy too often has sought to work against the agglomeration of innovative activity:

- federal research efforts are often disconnected from each other (e.g. federal labs cannot participate as full partners in Industry Canada funded programming) and from industrial or sectoral

[4] P. Phillips, G. Webb, B. Boland and C. Ryan. 2010. Research and Innovation Delivery Models in Agri-based Innovation Systems. Contract 01B68-10-0121 for Innovation Policy Analysis, Research Branch, AAFC.

opportunities (e.g. federal investments too often follow political priorities rather than industrial needs or regional capacity);

- federal funds are increasingly provided on extremely short-terms that ignore the long gestational periods for innovation; most successful research investment efforts tend to last 5-15 years while federal programming now focuses on the 1-3 year horizon; and
- federal administrative rules are so restrictive that the cost of doing business with government programs and agencies is becoming prohibitively expensive in terms of time and money.
- Ultimately, federal agencies too often try to spread their capital widely in pursuit of some ill-defined and unattainable goal of regional equity—this ultimately ends up being counterproductive, as areas of potential success are undercut by inadequate scale economies while those funds used to prime the pump or backfill weak areas often never generate any incremental value.

5.2 Intellectual property policy needs to be clarified

If and when the research system generates an invention, inventors and investors seek to lock in their ownership and control as a precondition to justifying the frequently expensive costs of gestating the invention. Reducing any invention to practice, scaling up, gaining regulatory and market acceptance and positioning an invention in the market usually costs more than the research effort, and is largely

unrecoverable without effective property rights.[5] Hence, intellectual property rights policy and practice is important. As discussed earlier this year by my colleague, Dr. Richard Gold, there are a range of policies and practices the federal government could adopt that would go a long way to removing some major uncertainties in this area.

5.3 Canada needs to complete its regulatory system

If Canada is serious about being a major agri-food innovator, the federal government needs to revitalize its regulatory capacity.[6] While Canada arguably has one of the best and most respected regulatory systems for foods and crops, it lacks the authority and capacity to deal with the new products that will come from accelerated innovation. Our regulators need to be vested with the authority to develop rules and procedures for efficiently and effectively evaluating and judging new crops and animals. Canada was among the first to develop regulations for plants with novel traits, but it has lagged in developing rules and procedures for dealing with new product candidates. For more than a decade the system has languished. I was co-chair of the CBAC review of

[5] Smyth, S. P. Phillips, W. Kerr and G. Khachatourians. 2004. Regulating the Liabilities of Agricultural Biotechnology. Wallingford, UK: CABI Publishing, pp. 210.

[6] Phillips, P., S. Smyth and W. Kerr (eds). 2006. Governing Risk in the 21st Century: Lessons from the World of Biotechnology. Nova Science Publishers, pp. 112. Smyth, S., W. Kerr and P. Phillips. Forthcoming 2011. Recent Trends in the Scientific Basis of Sanitary and Phytosanitary Trade Rules and Their Potential Impact on Investment. World Investment. Smyth, Stuart, Peter W.B. Phillips & William A. Kerr. 2009. 'Global Governance Quandaries Regarding Transformative Technologies for Bioproducts, Crops, and Foods'. Journal of World Trade 43(6), 1299–1323.

the system in 2001[7] and have participated at times in efforts to develop rules for evaluating GM animals (including fish), industrial plants, plant-made pharmaceuticals (PMPs) and a range of other technologies and applications, including rules to govern post-market monitoring and quality management[8]—but virtually no new rules have emerged. The system has ground to a halt. This is not the fault of our regulators—it is the lack of leadership by our government and the industry.

I want to emphasize this point. I am joining you today by video-conference because I am one of the organizers of the GM Coexistence Conference in Vancouver, an international event with 180 world leaders in the grains and oilseeds business who have come to Canada to discuss co-existence in the food chain between GM, conventional, organic and other differentiated food products. While Canada is one of the leading countries doing this, it has been next to impossible to attract the attention of ministers, senior officials or parts of the industry about the vital importance of effective and efficient marketing systems for all the varieties of foods we will need to develop to succeed in coming years.

6. Conclusion

In conclusion, let me say you have a golden opportunity to shift the debate about agri-food policy in Canada in a positive direction that

[7] CBAC. 2002. Improving the Regulation of Genetically Modified Foods and Other Novel Foods in Canada: A Report to the Government of Canada Biotechnology Ministerial Coordinating Committee (Final report).
[8] Smyth, S. and P. W. B. Phillips. 2004. Identity Preservation, Segregation and Traceability: Marketplace Features and Uses. In R. E. Evenson and V. Santaniello (eds.), The Regulation of Agricultural Biotechnology. CAB International, pp. 191-200.

should both strengthen the economic underpinnings of this important sector but also to contribute to global welfare.

All of these policy prescriptions are eminently doable. The simple need is will. The choice is simple—the Canadian government needs to lead, follow or get out of the way.