"Goods from the Woods: A History of Canada's Forests and Forest Sector, 2000-2050"

Scenario A
(one of four scenarios)

prepared by the

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Summary: Can Canada and Canadians be proud of their forests and the forest sector at this halfway point of the 21st century? Have we moved smartly along the road to sustainability? Are we better off, forest-wise, than we were in 2000? The forest sector has been able to make good on some of the issues of the day in the 1990s and 2000s, but not on others. Forest ecosystem diversity is not shameful, even if the species-at-risk situation is. Climate change - touch wood - has so far been tolerable, and even helpful in some respects. The strong global timber and forest-products markets have repositioned Canada as a profitable player on the world stage. The energy situation has brought new emphasis to bioenergy, much to the delight of the business community and governments. Local and community-based input and control on forests has waned in light of globalization and a return to stronger provincial governance and the influence of large multinational corporations. Conflicts in and over forest use are abundant and rarely expeditiously resolved. Aboriginal communities, while not much better off politically, have certainly improved their lot economically.

2000-2050 Trends at a Glance - Drivers

Climate Change	- measurable warming, but within range of adaptability - drier conditions in the prairies - reduced snowpacks across most of Canada
Geopolitics	- increased international conflict and armed aggression - strong regional trading blocs; softwood lumber dispute ended 2031 - WTO of little influence
Global Energy	- fivefold increase in real price of fossil fuels - huge increases in nuclear and renewable energy - Canada a world leader in bioenergy
Air Pollution	- strong reductions due to lower consumption of fossil fuels and better regulations - fewer ozone episodes (but more severe due to warming)
Invasive Species	- more invasive alien species in the forests - however, most are merely local/regional nuisances
Global For Prod Demand	- strong growth in consumption; wood seen as good for making many products - prices buoyant, even for roundwood - lots of value-added production in addition to strong basic commodities - plantations around the world have had disappointing growth rates
Technology	- high levels of investment by both governments and private sector - strong innovation development and implementation in all tech sectors - bioenergy and biopulping technology has seen major advances
Industry Profitability	- after rough times in 2000-2020, return to stability and prosperity - strong wood supply, very strong demand for all forest products
Demographics	- Canada grew from 30.9 to 45.9 million people; growth due to immigration - continued urbanization; people moving downtown to urban cores - Aboriginal populations continue strong growth in numbers
Societal Values	- continued consumeristic society; individualistic behaviours; low volunteerism - people accept strong regulations on waste and pollution - people focus on urban and peri-urban forests, not hinterland forests
Governance	- strong trend toward increased influence of ultra-large multinational corporations - comparatively strong forest regulations by provincial governments - huge divestment of productive Crown land to private ownership
Aboriginal Empowerment	- political empowerment slow to materialize, and uneven across Canada - despite that, many Aboriginal groups are doing well economically
Conflict over Resources	- active users of forest lands, esp. multiple-use lands, are frequently at conflict - most conflict resolutions are without violence - however, many conflicts remain unresolved and fester away - this erodes any sense of community in many rural areas

2000-2050 Trends at a Glance - Responses

Biodiversity	- 22% of all forests formally protected (13% in timber-productive forests) - widespread implementation of triad (and later quad) land-use zoning - more old forest on the landscape; better balance of conifers and non-conifers - more forest species at risk
Ecosystem Condition and Productivity	- slightly improved ecological integrity - modestly increased levels of disturbances - adequate forest regeneration, with strong investments in assisted regeneration
Water and Soil	- improved water quality due to stronger regulations and privatization - no major soils issues except in wet parts of Canada with steep slopes
Carbon Cycles	- hinterland forests are neither clear sources or sinks of atmospheric carbon - counting of wood products in forest carbon budget helps Canada greatly
Amenity Values	- per-capita visitation rates down, but visitors willing to spend on services - large increase in commercial forest recreation businesses - successful series of DisneyForest franchise sites - people comfortable with the look and feel of industrial forestry
Participatory Processes	- continuing wide range of opportunities for participation in forest decisions - however, few people get involved and public influence is low
Forest Employment	- numbers of traditional forest jobs relatively stable, but improved quality - large increases in forest jobs related to recreation and water enterprises - Aboriginal share of forest employment quadrupled since 2000
Wood Harvests	- annual industrial harvest nationwide up from 180 to about 270 million m3 - increases due to strong investments in silviculture and afforestation - on balance, climate change has also helped us grow wood faster
Wood-processing Industries	- dismal period 2000-2020, but industrial fortunes picked up strongly since - bioenergy way up, newsprint way down - traditional markets still served, but new markets in Africa and Latin America
Non-Wood Forest Products	- strongly increased harvest levels, especially commercial country foods - by and large, harvest rates are still sustainable, due to regulation and control
Markets for Forest Services	- carbon markets exciting for two decades - then failed because of foresters' inability to hold carbon in hinterland forests - water markets have emerged and become quite vibrant - biodiversity markets much discussed but never materialized

(Note: text in italics is common to all four scenarios)

"Goods from the Woods: A History of Canada's Forests and Forest Sector from 2000 to 2050"

A1. Introduction

Canada has long been described as a forest nation. For ages before Europeans arrived to settle in North America, Aboriginal peoples exercised strong relationships with the land. For many, the forests were the lifeblood of economy, society and spirit. Over recent centuries, settlers from Europe built up a series of wood-using enterprises based on Canada's forests, making Canada one of the world's top producers and exporters of wood-based forest products through much of the 20th century.

In this year 2050, marking the half-way point in the 21st century, what can we say about the unprecedented rates and kinds of changes we have witnessed in Canada's forests and forest sector since 2000? For long-time observers, the changes have been nothing but spectacular. As would only be expected, some of the changes have been warmly welcomed by Canadian society, while others have been unhelpful and a few even seriously undesirable.

The purpose of this paper is to summarize trends and developments in Canada's forests and the forest sector during the period 2000-2050. We have based our account partly on the data sets assembled through provincial state-of-the-forest reporting exercises and the Canada Forest Information Program (CFIP), and partly by interviewing a few dozen forest-sector old-timers who have followed developments closely as far back as the turn of the century. The trends and developments are first put into the context of a suite of major drivers of change, followed by synopses of key indicators commonly used to track the Canadian forest and forest-sector situation.

A2. Drivers of Change

To understand how and why the Canadian forests and the forest sector have changed so dramatically in the past fifty years, we will examine a suite of major agents of change that act upon the forests and forest sector. For thirteen such drivers below, we chart their paths over the past five decades and inquire into the ways in which each driver has influenced the Canadian forest and forest-sector scene.

A2.1 Climate Change

The present climate is certainly different from that at the turn of the century. Fortunately for humankind, the actual changes in climate have more or less mirrored the predictions of least conceivable change as envisaged back in the early 2000s. This had been due to two factors: (a) overestimates of the role of non-CO_2 greenhouse gases (such as methane) and underestimates of the role of oceans in absorbing CO_2; and (b) rather successful transitioning of the world economy off fossil-based fuels and onto renewable (mostly solar, wind, hydro and biomass) and non-

carbon, non-renewable sources (mostly nuclear). Constant bickering over the Kyoto Protocol during the 2010s led to a much more comprehensive agreement on fossil-fuel production and use with the Sydney Protocol, signed in 2024 and still in force today. As expected though, even with such positive developments in weaning ourselves off fossil fuels, changes in climate are still notable (Table 1). Of most serious implication for Canadian forests are:

(a) increased mean winter temperatures, which have led to reductions in snow packs and length of time the ground is snow-covered (especially in central and eastern Canada);

(b) an increase in hot summer days, which has worsened the effects of high-ozone days in urban areas;

(c) an increase in high-rain events, which is increasing the rates of erosion and flash floods in areas of steep slopes (especially in BC); and

(d) an increase in number and intensity of storms in Atlantic Canada, with the attendant forest blowdowns.

Table 1. Regional changes in key climate variables. Changes are defined as means for the period 2040-2050 minus means for the period 1990-2000.

Climate Variable	**Region of Canada**						
	BC Coast	**BC Interior**	**Prairie Provs**	**North ON & QC**	**South ON & QC**	**Maritimes**	**NL**
Mean Jan Temp	2 C incr	3 C incr	3 C incr	3 C incr	3 C incr	2 C incr	2 C incr
Mean Jul Temp	1 C incr	2 C incr	2 C incr	2 C incr	2 C incr	1 C incr	1 C incr
Days over 35C Max T	50% incr	50% incr	50% incr	50% incr	50% incr	50% incr	50% incr
Total Precipitation	10% incr	no change	10% decr	no change	no change	10% incr	10% incr
Prop. Precip as Snow	10% decr	10% decr	20% decr	40% decr	50% decr	40% decr	40% decr
Large Precip Events	50% incr	50% incr	50% incr	50% incr	50% incr	50% incr	50% incr
Wind-storm Events	20% incr	20% incr	20% incr	20% incr	20% incr	40% incr	40% incr

A2.2 Geopolitics

During the past fifty years, the general increase in international conflict and armed aggression, as well as sporadic environmental crises and other events of violence, have resulted in a shift away from the global free-trade regime to regional blocs of like-minded and interdependent neighbouring nations. Goods now seldom move across more than one ocean. Canada has a strategic trading advantage today because it has coastline on three oceans, and relations with the

USA, our traditional main trading partner, are warm. These factors all play into Canada's hand as a key supplier of wood-based materials. It helped tremendously, of course, that the softwood lumber dispute with the USA, a major thorn in the side of Canada's lumber industry, finally ended in 2031. This would not have been possible if then USA President Bartlett had not married Prime Minister Pear's son Anjou in 2029. The WTO had considerable influence forty and more years ago, but it exists today more or less in name only.

A2.3 Global Energy

World fossil-fuel prices took incredible hikes at various points during the last fifty years. Prices of the past decade, in the range of Euro 300-400 per hectolitre (in old units, abandoned in 2036, that is NAD 450-600 per barrel) made the USD 200 per barrel of 2010 look like a bargain. This put lots of money in the coffers of oil producers, but demand has been severely curbed as countries around the world have agreed to implement a vigorous campaign of climate-change mitigation. While nuclear energy (using reactors everyone agrees have vastly improved safety standards compared to those of the 20th century) and renewables such as wind, solar and hydro have taken dramatic leaps forward, so has biomass energy in all its forms - chunk wood, hog fuel, pellets, liquid fuels, etc. Luckily for Canada compared to most other countries, our forests are huge and the land has little other useful purpose than to grow trees. Having made substantial investments in bioenergy technology in the 2010s and 2020s, Canada has become a world leader in serving its economy with forest-based energy.

A2.4 Air Pollution

Compared to what they were in 2010, Canada's rural ecosystems today are said to be in reasonably good condition. Of course one can expect government sources to create and publicize such a statement, but it was recently corroborated in a news release from the Canadian Forum on Ecological Integrity, a scholarly think-tank based at the University of Western Ontario. Canada's ecosystems face continuing challenges from the changing climate, but other stressors are actually reduced. A combination of high fossil-fuel costs leading to conservation, major switches in energy sources from fossil fuels to alternatives, and more-stringent regulations has, over the decades, reduced the pollution burden in Canada's major urban centres such as the BC lower mainland and southern Ontario. There have recently been sharp declines in depositions of airborne sulphur and nitrogen pollutants, and ozone episodes, while more severe, are actually less frequent compared to the turn of the century.

A2.5 Invasive Species

A particularly optimistic sign in regard to invasive species has been the apparent success of the revamped Canadian Invasive Alien Species Agency (CIASA) to hold some potentially serious invasive alien species in check. The emerald ash borer, coming into southern Ontario at the turn of the century from the USA, decimated ash populations in Ontario and Quebec, but this had little effect on the forest-products industry. On the east coast, the brown spruce longhorned beetle was declared eradicated in 2019, and on the west coast, the green fir short-eared sawfly,

found first in Stanley Park in 2032 and suspected to have arrived from east Asia, has been contained to the southern mainland. CIASA, unlike its forerunner the Canadian Food Inspection Agency, has been well-funded in the past couple of decades. Positive results of CIASA's work are apparent - while there are indeed new major invasive alien species found in Canada's forests each decade, none is wreaking havoc to any significant degree.

A2.6 Global Forest Products Demand and Wood Supply

Global consumption of roundwood has climbed steadily for the past 50 years, from 3.3 billion m3 in 2000 to 4.6 billion m3 in 2049. Part of this is simply a tracking of population growth in various areas of the world. But another key part is the long-awaited realization by consumers around the globe that wood is good - that is, it is good for both the economy and the environment to use wood for paper, building materials, furniture and artisanal products rather than nonwood materials (e.g. concrete and steel in buildings), which have much higher embodied energies. One must also mention the demand for woody material in the energy cycle (addressed more fully below) as well as in sylvichemical processes, which now rival petrochemicals as a source of high-quality carbon-based materials for plastics, polymers and other high-tech materials.

Given the strong global demands for wood and other forest-produced fibres, prices have risen sharply. One result of this is that roundwood producers are finally getting a decent return on woodlands investment and money is aplenty for tending of the forest landscapes worldwide. As for Canada, after the serious industrial downturns of the first two decades of the 21st century, the Canadian forest-products industry has re-invented itself and become re-established as a main supplier of wood-based products around the world. We ship a smaller proportion today of commodities such as pulp, newsprint and dimension lumber, and more value-added products such as specialty papers and composite wood products. While our costs of wood production are still relatively high by global standards, roundwood prices can support vigorous timber harvests across the country. The much-heralded glut of wood on the global marketplace from fast-growing plantations fizzled by the 2020s (disease and pest problems mainly, not to mention also the prohibitive costs of producing inorganic fertilizers), and this also contributed to Canada's good fortunes in the global timber supply.

A2.7 Technology

During the last half of the 20th century, Canada fell behind much of the rest of the world in technology investment and innovation. However, we have more than made up for that in the first half of the 21st century. The federal government finally got the picture in 2017 and announced a huge new technology research fund. In true federal style, the funds had to be matched by money from provincial governments and the private sector, and they were. Government, university and private labs were all winners in the technology development game, and innovations came fast and furious through the 2020s and 2030s. Because of the fossil-fuel energy crisis and the need for climate-change mitigation, technological developments were particularly impressive in the biofuels domain. The establishment in 2022 of a permanent network of centres of excellence called BioEnergy Canada, headquartered at Nipissing

University in North Bay, Ontario, was pivotal in this regard.

Bioenergy was not the only focus of technological innovation related to Canada's forest sector. Biopulping processes finally became feasible on a large scale and dramatically reduced pulpmakers' need for electricity. Biomaterials technology advanced so strongly that Canada has become a leading producer of wood composite materials for a variety of applications including furniture manufacture and instrument-making.

A2.8 Industry Profitability

The roller coaster of industrial fortunes characterizing the forest industry of the late 20th and early 21st centuries has given way to a fairly stable high for the past three decades. Things were difficult for industry in the 2000s and 2010s, with many bankruptcies and mill closures across the country. The pendulum swung back in earnest in the 2020s and onward, with a number of factors - technological innovation, increasing wood supplies, dramatic improvements in energy efficiency, strong demand for all kinds of forest products, ownership consolidation, a favourable business and policy environment from governments, and favourable currency exchange rates, to name the major ones - contributing to a resurgence of industrial profitability. The sector does not look today anything like the industry did in 2000, but it is a solid industry making healthy contributions to Canada's employment situation, balance of payments, and overall economic prosperity.

A2.9 Demographics

Canada's population grew from 30.9 million in 2000 to 45.9 million people today. During that period, total birth rates have been roughly at replacement levels. Aboriginal populations in Canada still have birth rates way above replacement levels, but the rest of Canada has birth rates below replacement. Immigration, arguably essential for the economy given domestic labour shortages as the population ages, accounts for essentially all the population growth - Canada has admitted almost 300 thousand new citizens to the country each year since 2000.

The urbanization trend of the late 20th century strengthened slightly up to today. According to Statistics Canada, 95% of the population lives in urban areas. All major cities in Canada have grown substantially. Thankfully the population expansions have been accommodated mostly within the existing urban centres and suburban areas - redevelopment accounts for most of the new housing and associated infrastructure, not new sub-divisions in formerly forested or agricultural areas. Forest-based rural communities across Canada have been hard-hit by the out-migration, and the wood-using industries in these communities have had to increase wages substantially to keep a vibrant labour force at hand. Aboriginal communities in particular have capitalized on the abundance of career opportunities in the sector, but have experienced difficult times reconciling their interests with those of the labour unions.

A2.10 Societal Values

What are Canadian citizens like today compared to 2000? Can we observe any differences in their values, attitudes and behaviours? The Centre for Social Research at York University recently published a major study aimed at this very question. The study found two main trends. One is that, during the past few decades of unprecedented numbers of well-off Canadian citizens living in a vibrant economy, people have generally become more competitive in their behaviours. Volunteerism is down considerably, people confess to being tired of endless collaborative ventures that have little impact, and non-violent crime is up. The other is that, with commerce vibrant, people are still encouraged at every turn to consume and consume. It is well-established that consumers are buying less fossil fuels, partly because of the need to control climate change, but they are clearly buying more of just about every other material thing made. Fortunately, we have established sufficiently strong regulations on environmental performance so that, along with continued attention by companies to their corporate social responsibility, the huge draw on Canada's natural resources to serve its economy is having only a modest toll on environmental integrity.

The York University study of 2046 also asked people about their forest values. People are willing to say they really value forests for ecological and social reasons, but their willingness to pay for amenities and things like existence value is negligible. The survey also found that, when asked which trees and forests are most important to people, they invariably identified their urban street trees and treed parks as what fetches their attention most. This is good news, of course, to urban foresters, but the disconnection between Canada's people and the vast expanses of forest they collectively own has continued to deepen. By and large, Canada's urban populations, particularly the younger strata, don't care much about forests, focussed as they are on entertainment technology and urban services.

A2.11 Governance

Perhaps the most significant evolution of the power structure associated with forests and the forest sector is the continued strengthening of global integrated forest-products companies. The most illustrative example is Exron Global Enterprises. Exron emerged in 2027 from a combination of already large corporations involved in fossil fuels, forest products, real estate, shipping, and investment fund management. Headquartered in Montevideo, with a Canadian regional office in Winnipeg, it has large holdings on every continent, with particularly interesting wood-products operations in Siberia, China and Canada. Indeed, Exron holds timber licenses on fully one-third of Canada's publicly owned timber landbase. Many analysts believe that provincial politicians shudder when Exron officials call on them and demand policy shifts in favour of the company. Exron's relationships with Canada's Aboriginal people are mixed - in some provinces there are viable and smooth-running co-management arrangements, whereas in others the company and the First Nations are constantly in court over resource rights and uses.

Regarding forest ownership, some interesting changes have taken place (Table 2). In 2019, the federal government made the three territories into provinces, so that explains the sudden drop in federal forest lands in the middle of the period. On top of that, the last three decades have seen a pair of divestments from provincial governments - to the private sector as well as to Aboriginal

communities. This has not affected the Maritime provinces of NS, NB and PE because their divestitures to private hands took place in the 18th and 19th centuries. The increases in private ownership occurred mainly in the big provinces like BC, ON, and QC.

Table 2. Proportion of total forest land (excluding urban forests) by ownership category.

	Ownership Category				
Year	**Federal**	**Provincial**	**Private**	**Community**	**Aboriginal**
2000	23	71	6	0	0
2010	23	71	6	0	0
2020	4	85	8	1	2
2030	4	65	26	1	4
2040	4	51	36	1	8
2050	4	44	42	1	9

A2.12 Aboriginal Empowerment

The 21st century was supposed to be the one for great progress in reconciliation of relationships between the Aboriginal peoples living in the territory of Canada and the rest of the population of the country. Surely the Aboriginal peoples are hoping that the last half of the century, yet to come, will show more positive signs than the first half, just finished. One can point to continuing mixed messages from the frequent court decisions we've had over the past decades - two or three cases per decade on various matters of Aboriginal and treaty rights, and Aboriginal title, in relation to land and natural resources. Unfortunately, the judgements do not add much clarity as to how to interpret earlier treaties, agreements, constitutions, arrangements and such.

Progress has been mixed across Canada. Aboriginal peoples in the far north, BC and Labrador have witnessed some gain in land ownership, but in the rest of Canada things are questionable. Fortunately, despite lack of progress on the governance and land ownership, Aboriginal peoples across the country are not standing idly by but rather are engaging vigorously in a wide range of commercial enterprises, both as owners and as employees, and socio-economic conditions in most Aboriginal communities have improved substantially.

A2.13 Conflict over Resources

There are about 50% more people in Canada today than in 2000 (see below), and the economy is buoyant. This has meant that people are demanding more and more from Canada's forests. Production of conventional forest products is strong, but so is manufacture of hi-tech products, biomaterials and bioenergy. Beef prices have skyrocketed, so a lot of western ranchers want to graze their cattle in forests. Early in the century, both oil and gas were significant competitors for forest land in Alberta and BC, but while the shine is off oil, it is definitely on gas. Indeed, even in Nova Scotia there have been significant land-based gas finds such that a thriving gas-production industry has developed. Finally, even though the urbanization of Canada has

continued its trends, people have enough disposable income to want to take their vacations and recreate in nearby forests.

All in all, Canada's forests are subject to high levels of attention as everyone wants to get something valuable from them. Unfortunately, regulatory systems have not kept pace in a way that could foster truly integrated resource management. Attempts across the country to implement triad systems of forest-land allocation have certainly reduced conflicts in the zones of protection and intensive plantations, but land use on the rest of the forest land base is frequently conflict-ridden. The Canadian Centre for Resolving Forest Disputes, set up at Dalhousie University in 2018, has lately been swamped with cases crying for resolution, but the centre is so grossly underfunded that it can not even meet a small fraction of that demand.

A3. Evolution of Canadian Forests and Forest Sector

Forest analysts worldwide have developed systems of tracking the state of the forests and forest sector with sets of so-called criteria and indicators. Original sets for Canada were developed in the 1990s under the auspices of the Montreal Process and the Canadian Council of Forest Ministers. The C&I systems have evolved significantly during the past half-century, but the basic structures have remained intact. Here, we examine how Canada's forests and forest sector have responded to the driver forces described above and to the various policies put in place since 2000.

A3.1 Forest Ecosystem Sustainability

A3.1.1 Biodiversity

Compared to the state of Canada's forests in 2000, some elements of biodiversity have improved in the past fify years, and some elements have worsened. Progress toward formally protecting 12% of Canada's forest ecosystems was steady through the 2000s and 2010s. The concept of triad, where working forests are divided into protected, multiple-use, and intentive-timber-production zones, moved from concept to much greater reality by the 2020s. In the last couple of decades it has transitioned into a "quad" concept, with the multiple-use zone being divided into biodiversity-dominant vs. timber-dominant sub-zones. This has encouraged much greater acceptance of expansion of protected areas beyond the 12% level, so that, today, the proportion of forests in formal protected status has risen to 22%. In the timber-productive zone, which has expanded northward given the gradually changing climate, the number is 13%, but in the far north it is fully one-third of all forests. Subsistence timber harvests for domestic use by Aboriginal peoples is allowed in most protected forests of the boreal zone.

Two trends in ecosystem diversity are positive. The amount of Canada's forests classified as old growth has been increasing. This has occurred partly due to the increase in protected forests, but also due to much more accurate aging of forest stands using ultrasoniclaser technology. The new stem-measurement equipment is in common use across Canada, showing that many more forest stands than earlier realized contain significant components of old (>150 yr) trees. The other

positive trend is a balancing of the type structure of Canada's forests. The forests of Canada in 2000 were strongly conifer-dominated. This occurred for two main reasons: first, our climate used to favour conifers, and second, our industries favoured conifers for pulp and lumber. Both drivers have shifted considerably, so that the total forest across Canada today is just under half conifer, about one quarter non-conifer, and almost 30% mixedwood. Current wood-using industries don't actually mind the shift in forest types - pioneer broadleaved forests are just as attractive today in the cellulosic refineries that sprang up across the country in the 2020s and 2030s.

Unfortunately, the picture today for species at risk is not quite so positive. The most recent report of the Canadian Council on Species at Risk (CCSR; formerly COSEWIC) shows an increase in forest-dwelling species at risk in the endangered category to have risen since 2000 by 50%, and the numbers of species added to the threatened category to have doubled. Many factors are at play here. Even with modest climate change, some species at the edge of their range have succumbed - an example is the mainland moose population of NS, which was extirpated by 2044. Continued poaching was a contributing factor in the moose extinction. Another disturbing trend relates to migrant songbirds which collectively lost million of hectares of wintering habitat in Central and northern South America since the turn of the century. Overall, the cumulative effects of a range of human activities have worsened the lot for many Canadian forest species, even with the expanded network of protected areas.

A3.1.2 Ecosystem Condition and Productivity

Establishment of the ecological integrity index (EII) by Protected Areas Canada (successor to Parks Canada Agency) in 2029 was a break-through in harnessing the efforts of hundreds of ecologists and protected-areas advocates to gauge ecosystem condition. These Canadians based their work on early index development in Australia, and took it to a much higher level of sophistication such that, in 2041, UNEP adopted the EII for worldwide use and it has become an accepted measurement of the metric system. Canada's forests have been slightly improving in EII since its first adoption, moving from 685 ecological integrity units (EIU) in 2030 to 741 EIU today. Among the factors used to calculate the EII, forests have improved in age-class and type structure and net primary productivity and lost in terms of species at risk (as noted above).

Climate change has driven increases in overall forest disturbances due to fire, diseases, insects and windstorms. Area burned is up across the country, but increases are much greater in the boreal forest, particularly the western boreal, than in other forest regions of Canada. Much of the burned forest was actually insect-damaged first, so the areas - with a small time lag - overlap to a considerable degree. The mountain pine beetle outbreak of the 2000s and 2010s first devastated the lodgepole pine forests of BC and immediately thereafter the jack pine forests of the western boreal. Winters of the uncharacteristically cold late 2010s and early 2020s brought the pine-beetle epidemic to a halt, and despite renewed warming in the 2030s and 2040s, the beetle has not resurfaced as any kind of problem.

Wind continues to be the disturbance curse of the Maritime forests. Hurricanes Juan (2003),

Emma (2011), Peter (2019), Wallace (2022), Gertrude (2031), Fiona (2035), and Bruno (2042) all caused considerable damages to the forests of NB, NS and PE. Fortunately, markets for low-quality downed wood remained bouyant throughout the period - biofuels can be made out of anything cellulosic. Moreover, the harvest contracting community learned early in the century how to marshall its collective forces to undertake salvage harvests, and in all the hurricane blowdown events, the windthrown logs were cleaned up within a few years.

Forest regeneration remains a key indicator of forest ecosystem condition. Global warming has made natural regeneration more difficult in some areas (e.g., southern boreal zone of the prairie provinces), but improved rainfalls in other parts of Canada have made up for the stresses of increased temperatures. Given the improved fortunes of the forest-products industry in Canada, money for artificial regeneration is adequate to secure full stocking on all but the most recalcitrant harvested sites. A trend disturbing to some in the environmental community is the growing proportion of fast-growing cultivars of hybrid and alien species in areas zoned for intensive timber production. However, this was a needed concession in the 2020s to be able to get the protected-areas agenda so well served with new designations.

A3.1.3 Water and Soil

The gradually increasing timber harvests across the country brought stern warnings in the first quarter of the century from academics that both water quality and quantity in and emanating from forests would deteriorate. This raised concern for all Canadians, since water issues were on the rise for decades. Amid much controversy, increased privatization of water rights began in the 2020s, and by the early 2040s, most of the waterways running through Canada's public forests had become subject to a variety of forms of private use rights. This had the hoped-for effect of raising water-sustainability concerns to the forefront, and any new companies holding water rights had over-riding obligations to government to maintain or improve water quality. Fortunately, most were to a large degree successful in negotiating much-improved and more-sophisticated behaviours of the timber companies.

Forest soils appear to be in reasonable overall condition across the country. As for soil erosion in BC, the increase in large rain events has had the effect of increasing erosion associated with roads and harvest areas, but the response by foresters to improve design and engineering of roads and cutblocks has kept the increases in check. As for soil nutrient pools, great quarrels broke out in the 2010s between the timber foresters and the environmental community over removal of foliar and fine woody materials for biofuel production. Pioneering work by the SFM Network brought the significant voices of the scholarly community to bear on the issue, and the Canadian Council of Forest Ministers agreed in 2019 that bolewood and large branches would be the only biomass materials removed from public lands. Certification of private lands brought the same practices onto private land.

A3.1.4 Carbon Cycles

Despite huge improvements in scientists' abilities to estimate carbon pools and fluxes associated

with Canada's forests, the picture is still far from clear as to whether the forests are, overall, net contributors to or net receivers of atmospheric carbon. The Sydney Protocol requires all countries to include forest carbon (even urban-forest carbon) in their inventories and reporting of carbon sources and sinks, but the inter-decadal changes in forest carbon budgets are rather insignificant compared to changes in ocean carbon budgets and fossil-fuel-derived carbon. CFIP data show significant year-to-year fluctuations in the carbon budget of Canadian forests, depending on what is happening on the forest-fire front. However, decadal averages show that overall patterns of change are modest. Now that the fate of wood-based products is part of the calculation for forest-related carbon, Canada's data have become much more favourable. As explained in more detail below, the euphoric rise of forest carbon markets in the 2010s and 2020s gave way to a gradual market softening through the 2030s and 2040s.

A3.2 Social and Community Sustainability

A3.2.1 Amenity Values

Forest-based recreation, measured in terms of person-visits to registered establishments as well as estimated expenditures on recreational activities, has increased only modestly over fifty years despite the 50% increase in Canada's population. This is explained by the urbanization trend of Canadians and their propensity to recreate close to home. However, despite this, the economic enterprises related to forest recreation have burgeoned. The people who do insist on recreating in Canada's forests, protected or not, have clearly demonstrated an increased willingness to pay for recreational services, and the ongoing privatization of recreational rights in public forests has met with little resistance. At this time, 62% of Canada's timber-producing industrial forests have some level of privatized recreational rights, compared to none in 2000. Of course, the boom in forest recreation is due in no small part to the string of franchised operations across Canada, near the larger cities, of DisneyForest sites.

Today's forests across Canada are considerably different from those of 2000. A re-mixing of forest types has occurred, and industrial timber production increased substantially (see below). But it seems that the Canadians of 2050 look at forests much as the Europeans of 2000 did their own forests. Europeans have long been comfortable with the looks and sounds of industrial human activity in and associated with forests. Indeed, their whole conception of parks includes "traditional" human activities. In the most recent Canadian survey of people's reactions to the state of the forests and how attractive they are, done by University of New Brunswick in 2044, most respondents agreed that Canadian forests, on the whole, are indeed pleasant to look at and be in.

A3.2.2 Participatory Processes

By 2000, Canadians had enjoyed unprecedented increases in opportunities to participate in forest decision-making processes. Such increases came, we must remember, from a situation of virtually no participation in the 1970s and 1980s. Interesting trends have characterized the last fifty years. Urbanites are focussing more of their attention on city sustainability, and rural

people are tiring of the endless encouragements of participation enthusiasts - including a particularly zealous group of academic social scientists called Professors Promoting Public Participation Processes (P^5) - for citizens to get involved in forest decision-making. So, while many opportunities for participation still exist today, they are poorly attended (people just go for the refreshments) and governments and industry hardly listen. The alleged sham of participatory democracy in relation to forests, as hinted at back in the 2010s by a few insightful scholars, has more or less become a reality in the mid-21st century.

A3.2.3 Forest-related Employment

Employment associated with Canada's forests has both improved and increased in the first half of this century. In conventional industries, the number of jobs per unit of wood processed has gone down, due mainly to continued technological developments and mechanization. However, with the steady increase in timber-harvest levels, the reductions in per-unit job levels have been mitigated. Moreover, the increase in water- and recreation-related rights in forests has meant new employment opportunities for a wide range of both job-seekers and entrepreneurs. As noted above, with the ever-expanding Aboriginal population, especially in northern forested areas, and the steady out-migration of non-Aboriginal youth to Canada's big cities, the Aboriginal share of forest-based employment has quadrupled since 2000.

A3.3 Economic Sustainability

A3.3.1 Wood Harvests

Through much of the last half of the 20th century, calculated sustainable timber-harvest levels from Canada's forests hovered around the 230-240 million m3/yr mark, and actual harvest levels remained significantly below. Indeed, at the turn of the century, actual harvesting had slid down to about 180 million m3/yr. This is clearly explained by the declining fortunes of the wood-products industry, and the reductions in harvest levels by governments concerned about overall forest sustainability.

Climate change and global wood demand changed that picture significantly during the last five decades. The modest climate changes have significantly increased wood productivity in many forests across Canada, and finally the wood-using industries and provincial governments have become interested in actually growing wood rather than just taking what nature grows by itself. Despite the strongly enhanced system of forested protected areas, these two factors combined have led to a situation where, today, both the calculated sustainable and the actual timber-harvest levels sit at about 270 million m3. Unless the climate turns for the worse, or people turn away from a desire to use wood in all aspects of life, this aggressive level of timber harvest is likely to continue for some decades more. Analysts at the Forest Economics and Policy Analysis unit of UBC's Faculty of Forestry even forecast increases to about 310 million m3/yr by 2080.

A3.3.2 Wood-processing Industries

After the dismal decades of 2000-2020, the industry has, as hoped, responded favourably to the changing market conditions and wood supplies. Of most note is the value of shipments - this year at NAD 120 billion (the USD and CAD joined in 2027), up from about CAD 40 billion in 2000. Newsprint is virtually gone, and biofuel production is commanding almost a quarter of the attention. This includes both solid and liquid fuels.

With a 50% increase in the population of Canada, a much greater proportion of our forest-based material is staying in the country. But of what we do export, the USA share is way down to 60%, Europe has gone slightly up to 12%, Asia slightly up to 9%, but big proportional increases have come from Africa, and South and Central America.

A3.3.3 Harvests of Non-Wood Products

Given the continuing reasonably good health of Canada's forest ecosystems, production of non-wood goods is unimpaired. Harvest levels for most such goods - e.g., country foods (e.g., berries, mushrooms, nuts, plants), craft materials, medicinals - have increased substantially since 2000, but are still below anybody's calculation of sustainable harvest levels. Canada is still trying to sort out a good system of property rights for non-wood products on public land. On private land (much expanded today compared to earlier, as noted above), the owners' right to limit access is the main control mechanism on harvest rates. Indeed, many owners have found new sources of revenue by issuing their own permits for harvesters of country foods. By far the largest increases in harvests have been made by Aboriginal people, many of whom have flourishing businesses selling non-wood forest products into urban markets.

A3.3.4 Markets for Forest Services

At the beginning of the 21st century, there were increasingly strong signals from hopeful enterprisers and entrepreneurs that rights systems and markets should be developed for forest services. Carbon sequestration was the first such service to move into a fully operational market. On commercial timber land owned by provincial governments, carbon sequestration rights have become commercialized in much the same manner as has timber. Thus, private-sector industrial forest managers holding forest-management rights on such lands vigorously promoted the sale of carbon credits when they had them. As indicated above, there was much excitement over how carbon would be a big money-maker for forest managers in the 21st century. Indeed it was in the first couple of decades, but foresters' inability to hold carbon in the forests brought confusion to the market and it turned sour.

As hinted above, water rights are today a hot commodity, with a forest water-rights market having been established in 2037 at the Regina Stock Exchange. Unfortunately for small and medium enterprises and the entrepreneurial community, timber lessees were given first refusal to buy water rights associated with their forests, and many of them took up the opportunity. Nevertheless, water has become a thriving business, and hundreds of Canadians have become veritable water-barons.

In the 2010s and 2020s, much discussion took place about starting up some biodiversity markets associated with Canadian forests. When it became clear throughout the potential buyer

community that forests managed for timber, according to the advanced standards applied by governments and through certification requirements, were as kind to biodiversity as were protected areas, the whole idea came crashing down. By 2035, no one was discussing biodiversity markets any more.

A4. Conclusions

Making predictions about the future - in particular the future we are concerned with here, the forests and forest sector - is a risky venture at the best of times. Our ability to foresee the future with any useful clarity is restricted to the very short term. However, our forests are far too cherished for us to sit idly by. We must consider seriously their long-term future and the policies needed to shape them and use them so that we can speak positively about the forests and our relationships with them as the year 2100 approaches in fifty short years. What Canada needs now is a policy-planning exercise that generates a small set of radically different yet plausible scenarios of how the forests and forest sector could develop through the decades to 2100. These will serve as a sound basis for enriched policy discussions dedicated to an even stronger pursuit of sustainability.