
"Restoration in the Woods: A History of Canada's Forests & Forest Sector, 2000-2050"

Scenario D
(one of four scenarios)

prepared by the

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August 2008

Comments are welcome!

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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 rather few of the issues of the day in the 1990s and 2000s. Forest ecosystem diversity is shameful. Climate change is overwhelming all types of ecosystems. Global timber and forest-products markets are flat, and Canada is a marginal player on the world stage. Continually increasing energy demand has led to growth in supply from all sources except biomass. Local and community-based input and control on forests has flourished, with strong global institutions. What conflicts occur in and over the woods are peacefully resolved. Aboriginal communities are better off politically but not economically. All in all, it's a time of considerable social and economic progress despite forest ecosystems having fallen into a degraded state. Creative and energetic political leadership has helped shape a country where people are working together nationwide to try to restore better conditions in the woods. A few high-profile community collapses in the 2020s and 2030s also helped people understand the profound importance of collaborating, rather than competing, to secure their continued prosperity and the sustainability of their communities. Canada continues as a forest nation, and Canadians finally are behaving as a forest people.

2000-2050 Trends at a Glance - Drivers

Climate Change	<ul style="list-style-type: none"> - huge warming, well beyond the range of adaptability for most sectors - serious expansion of the world's deserts, and serious droughts in the prairies - much less snow across all of Canada; 65 cm rise in sea level - evapotranspiration way up, lower lake levels and reduced river flows nationwide
Geopolitics	<ul style="list-style-type: none"> - UN is thriving; amazing levels of international cooperation - focus is on adapting to and coping with ravages of climate change - Asia has risen to global prominence in commerce
Global Energy	<ul style="list-style-type: none"> - less than twofold increase in real price of fossil fuels; rampant consumption - large increases in nuclear and renewable energy as well - Canada uses little forest bioenergy
Air Pollution	<ul style="list-style-type: none"> - increased due to higher consumption of fossil fuels and climate change - more-frequent and more-serious ozone and smog episodes - poorly understood impacts, but everybody suspects serious cumulative effects
Invasive Species	<ul style="list-style-type: none"> - huge increase in invasive alien species in the forests - many are ravaging forests, resulting in widespread forest declines
Global For Prod Demand	<ul style="list-style-type: none"> - modest growth in consumption of most wood-based products - Canada a small player in global markets - most is for domestic consumption - plantations around the world have had mixed results
Technology	<ul style="list-style-type: none"> - advances in sub-atomic physics, minerals-based materials, and communications - also advances in specialty wood-composite products
Industry Profitability	<ul style="list-style-type: none"> - unfavourable except for some paper producers and tech-advanced firms - Canadian industry a much smaller one; transitional pain has been high
Demographics	<ul style="list-style-type: none"> - Canada grew from 30.9 to 59.8 million people - growth due to immigration as well as rising birth rates - new concept of inhabited forest - brand-new green mini-cities are thriving
Societal Values	<ul style="list-style-type: none"> - very service-oriented society; collaborative behaviours; high volunteerism - people upbeat about socio-economic prosperity, despite degraded forests - people keen on all forests; put excess disposable income into forest restoration
Governance	<ul style="list-style-type: none"> - divestment of forests from provs to communities, Ab. communities, some private - remaining prov land dominated by co-management partnerships - strong influence of global organizations on local forest management
Aboriginal Empowerment	<ul style="list-style-type: none"> - strong progress on political empowerment; considerable land transfers - continued economic struggles; leaning on mining industry for incomes
Conflict over Resources	<ul style="list-style-type: none"> - active users of forest lands are seldom at conflict - when they are, the conflicts are resolved swiftly - this contributes to a strong sense of community in many rural areas

2000-2050 Trends at a Glance - Responses

Biodiversity	<ul style="list-style-type: none"> - climate change has invalidated all models of biodiversity conservation - generally degraded forest across Canada, but with lots of restoration initiatives - many more forest species at risk; several high-profile extinctions - boreal forest under greatest siege due to climate change - new biodiversity opportunities, e.g., expansion of Carolinian forest in ON
Ecosystem Condition and Productivity	<ul style="list-style-type: none"> - greatly impoverished ecological integrity, but less so because of restoration - hugely increased levels of disturbances - gross primary production is high, but net is low due to high disturbance rates
Water and Soil	<ul style="list-style-type: none"> - widespread water quality and quantity problems, due mainly to climate change - lots of investment in waterworks to improve/preserve both quality and quantity - forest soils are stressed nationwide, due to a wide range of pressures
Carbon Cycles	<ul style="list-style-type: none"> - most forests in Canada are strong sources of atmospheric carbon
Amenity Values	<ul style="list-style-type: none"> - heavy recreational use of all forests; people have sympathy for degraded forest - group eco-tourism is a thriving business opportunity for many
Participatory Processes	<ul style="list-style-type: none"> - continuing wide range of opportunities for participation in forest decisions - participation rates are strong, esp with the co-management partnerships - many people nationwide participating in global forums on forest sustainability
Forest Employment	<ul style="list-style-type: none"> - lower jobs in conventional forestry, increased jobs in restoration forestry - workers like being employed by community-based organizations
Wood Harvests	<ul style="list-style-type: none"> - annual industrial harvest nationwide down from 180 to ca. 110 million m³ - partly a market response, but also forests unable to provide much more
Wood-processing Industries	<ul style="list-style-type: none"> - dismal performance overall for the entire 2000-2050 period - winners are paper producers, high-tech materials producers - losers are newsprint and lumber producers
Non-Wood Forest Products	<ul style="list-style-type: none"> - consumption rates high due to high forest visitation rates - sustainability of harvests of most species is seriously in question
Markets for Forest Services	<ul style="list-style-type: none"> - carbon markets exciting for some time, now have disappeared - water markets never materialized - public wants it as a public resource - biodiversity credit idea gave way to forest impoverishment credits

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

D1. 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 kinds of changes we have witnessed in Canada's forests and forest sector since 2000? For long-time observers, the changes have been most interesting, and some surprising. Unfortunately, many of the changes have not been positive. As discussed below, Canadians have high levels of concern for the forests across the country. This is partly because of their propensity to value environmental quality but also because the forests are, comparatively speaking, in dismal condition because of climate change. There are several monikers for this phenomenon - the Titanic effect, the 9/11 effect, to name two - in times of emergency and calamity, people draw together and cooperate as never before in addressing their joint problems.

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.

D2. 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 shall examine a suite of major agents of change that act upon the forests and forest sector. Below we look at a dozen such drivers, charting their paths over the past five decades and inquiring into the ways in which each driver has influenced the Canadian forest and forest-sector scene.

D2.1 Climate Change

The naysayers about global climate change are finally muted. Global warming and other changes in the climate are so pronounced today that no one denies the reality of a radically altered atmosphere. Sea-level rise has averaged 65 cm around the world since 2000. The Earth's seven largest deserts have grown by 40%. Natural potable water supplies in many

countries have dwindled, and despite breakthroughs in the efficiency of desalinization technology, the amounts of electrical energy put into those plants has skyrocketed.

The actual changes in climate have more or less mirrored the predictions of largest conceivable change as envisaged back in the early 2000s. Scientific uncertainties are not to blame here - what is to blame is humanity's insatiable appetite for fossil-fuel energy. Despite the warnings, the surge in coal production and use, combined with false hopes in the technological fix of carbon burial, has resulted in an atmospheric concentration of carbon dioxide topping 600 ppm. Internationally, there has been much rhetoric and many rounds of negotiative dance to try to get effective carbon-mitigation treaties in place - Kyoto in the first quarter of the century, Sydney in the second. Unfortunately, the talk has not translated into action, and many countries seem to behave as they please.

The changes in Canada's climate have been dramatic (Table 1). Of most serious implication for Canadian forests are:

- (a) the hugely increased mean winter temperatures, which have led to dramatic reductions in snow packs and length of time the ground is snow-covered (especially in central and eastern Canada);
- (b) the increase in hot summer days, which has led to severe droughts across the country, and seriously worsened the effects of high-ozone days in urban areas;
- (c) the increase in high-rain events, which is increasing the rates of erosion and flash floods in all parts of the country; and
- (d) the increased numbers and intensity of storms, particularly in Atlantic Canada; huge blowdowns occur pretty much every year in some part of Canada.

The hoped-for productivity gains, based on the notion that trees should grow faster in warmer conditions and with higher atmospheric CO₂ concentrations, have not materialized. Trees everywhere - especially in rural farmed areas and the broad forested landscapes across Canada - are severely stressed. Regeneration in the drier parts of Canada has become increasingly problematic. And even when the trees can be re-established successfully, fires are so frequent that multiple attempts at regeneration are commonplace.

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	4 C incr	6 C incr	8 C incr	10 C incr	8 C incr	6 C incr	4 C incr
Mean Jul Temp	2 C incr	4 C incr	6 C incr	6 C incr	4 C incr	3 C incr	2 C incr
Days over 35C Max T	100% incr	100% incr	100% incr	200% incr	200% incr	100% incr	100% incr
Total Precipitation	10% incr	no change	20% decr	no change	no change	10% incr	10% incr
Prop. Precip as Snow	50% decr	70% decr	70% decr	80% decr	80% decr	80% decr	60% decr
Large Precip Events	100% incr	100% incr	100% incr	100% incr	100% incr	200% incr	100% incr
Wind-storm Events	100% incr	40% incr	40% incr	40% incr	40% incr	100% incr	100% incr

D2.2 Geopolitics

Despite its impotence in getting real progress on climate-change mitigation, the United Nations seems to be thriving. While officials are giving up on mitigating climate change, they are equally excited about international cooperation on adaptation. The UN Environment Programme's failed attempt to achieve ratification on the so-called International Environmental Protection Treaty (INEPT) in the late 2020s gave way to brisk progress with the UNAdapt Protocol in 2032. UNAdapt has become a well-funded and popular mechanism for helping countries hardest hit by climate change, particularly countries with low-elevation, highly populated coastlines. UNAdapt is the primary agent bringing order to what could have turned into true chaos in the domain of environmental refugeeism. As for global commerce, Asia has captured the lion's share of the action, while North America and Europe quietly go about serving their rapidly rising domestic populations.

D2.3 Global Energy

Since the turn of the century, real energy prices have risen only modestly (i.e., about 1.5x). Fossil-fuel supplies are abundant, what with the spate of new finds in temperate South America. Also contributing here is the global renaissance of the nuclear power industry - many countries have been able to shut down oil- and gas-fired power plants, making oil and gas available for the burgeoning transportation, restoration and adaptation sectors.

The excitement many people had for bioenergy in the 2000s and 2010s has turned to serious disinterest. Nuclear power has turned out to be so affordable and convenient, and environmental advocates have been so vocal about leaving biomass in the hinterland forests to rot, that biomass

energy just seems to be a non-starter. At the turn of the century, the UN Food and Agriculture Organization (FAO) estimated that half of all wood harvested globally was used domestically for cooking and home-heating in developing countries. The latter has become less important with global warming, but the greatly expanded global population (see below) has more than compensated, so forests in densely populated, still-developing countries (SDCs) continue to be under siege for local energy requirements.

D2.4 Air Pollution

Fossil-fueled power plants are much smaller culprits today than fifty years ago, but the booming transportation sector has kept air emissions at bothersome levels in many parts of the world. Part of the problem is that the warmed climate has exacerbated air-pollutant effects. For example, climate change has made ozone episodes in southern Ontario and Quebec much worse and more numerous. Overall, the forests of Canada, mostly those in and near cities but to a lesser but still significant degree the hinterland forests, are under continuing and growing stress from air pollutants. The cumulative negative effects of the full range of pollutants, in combination with climate change, are poorly known but feared to be significant. With funding from a huge research grant from Risk Canada, the Institute for Risk Assessment (IRA) at the University of Wawa, ON, just published the findings of its atmospheric risk study and painted a gloomy picture indeed for the last half of the 21st century.

D2.5 Invasive Species

Invasive species have become an ongoing battle for Canadian forest managers, who got experience in dealing with runaway species at the turn of the century with mountain pine beetle in the west, and emerald ash borer and brown spruce longhorn beetle in the east. Decade by decade, there are interesting stories to tell. During the 2010s, it was eastern spruce budworm in the Maritimes - the outbreak made the one of the 1950s-1970s pale by comparison. In the 2020s, Manitoba and Saskatchewan experienced dramatic losses of aspens with a runaway tent caterpillar population. The 2030s were the decade of ravages in the western coastal rainforests - the fir sawfly afflicted Douglas fir throughout its range, and cedar weeder, having found its way to Canada from South America through the Port of Vancouver, devastated vast stands of Western red cedar in lower and middle coastal BC. Finally, a mysterious disease - called the black-spruce decline complex until the culprit organisms are better understood - has for the past decade been spreading from the region of first expression (northern Ontario) both east and west to the coasts.

D2.6 Global Forest Products Demand and Wood Supply

Global consumption of roundwood has risen modestly since 2000. It has indeed risen slower than global population, which means that per-capita consumption has fallen. Part of this is explained by materials substitution - wood has lost ground to new materials based on minerals. Another part is a gradual dematerialization of many economies around the world. Most continents are largely serving their own populations' needs with forest products, so the amount of wood-based product moving around the globe has actually dropped considerably. Climate

change has reduced timber growth rates in most places, and created a huge requirement for salvage cutting.

Canada is a much-diminished player in serving the global community with forest products, compared to its large role in the late 20th century. A wide range of factors is responsible: (a) the continuing strength of the Canadian dollar; (b) the ravages of climate change, reducing tree-growth rates and spawning regional forest declines; (c) the general decline in interest among Canadian and foreign consumers for forest products (except sanitary papers); (d) the allocation of so much public forest land exclusive to environmental services (protected areas) rather than commercial timber production; (e) losses of forest land in areas where agriculture is flourishing (e.g., northern ON); and (f) the takeover of so much northern forest land by Aboriginal communities which are finding little economic incentive to engage in forest-products enterprises.

D2.7 Technology

Technology in sub-atomic physics, minerals-based materials, and communications devices has advanced dramatically in recent decades. Biotechnology turned its attention away from biomass in the 2000s and 2010s to applications in food and medicine in the 2030s and 2040s. Some significant advances were made in engineered wood products, but these are for specialty applications rather than the mass market. Some companies in the wood-products industry welcomed these developments because it allowed them to diversify and not have to rely so much on commodity-grade products which, with climate change, have become much more difficult to manufacture with consistent quality because of wood-quality issues.

D2.8 Industry Profitability

Many pessimistic observers flirted with the notion back in the 2000s that the forest industry was a sunset industry. Close, perhaps, but probably closer to the truth is an industry with a lot of its players at what appears to be dusk, and few perky ones at dawn. These latter are the technological advanced firms making engineered wood products - TechnoLaminators Inc. of Rimouski, QC, is a shining example of a successful firm that turned the corner on prosperity. The overall wood-based industrial complex in Canada is much smaller today than in 2000 - the transition was not pleasant, to say the least, but the survivors are worth investing one's retirement savings in.

D2.9 Demographics

Canada's population grew from 30.9 million in 2000 to 59.8 million people today. The federal government, under the colourful leadership of Prime Minister Hellene Page (People's Party) from 2026 to 2039, was so concerned about a shrinking labour force and tax base that increases in both birth rates and immigration became key policy thrusts. They were almost overly successful. The quadrupled cash baby bonuses started in 2028 were supplemented by free university tuition nationwide in 2035, so Canadian families - both long-established ones and newly arrived immigrants - started having more babies. The average birth rate in Canada today

is 2.8/mother, with Quebec at 3.2 and Newfoundland at a whopping 4.6!

Where are all the new residents living? Cities continue to be the biggest draw, but the ongoing availability of affordable gasoline along with such amazing advances in communications technology has allowed people to live several hours' drive from their employers and function quite normally in their work. The concept of "inhabited forest", first used in Quebec in the 1990s, has come to have new meaning now. Whereas it used to mean a working forest with a few rural dwellers, "inhabited forest" now refers to vast forest estates that are strongly permeated by residential complexes. It is not, however, the urban sprawl that characterized places like the Greater Toronto Area at the turn of the century. These are exceptionally well-planned residential complexes where the forest is highly protected and conserved for all its amenity values. International awards have been won by two of Canada's most successful such complexes - the Huntsville Forest Habitation Complex in central ON (population: 12,500) and the Lillooet Green Refuge (population: 17,000).

D2.10 Societal Values

What are Canadian citizens like today compared to 2000? Can we observe any differences in their values, attitudes and behaviours? The Values_R_Us Research Network (VRURN), based at University of Swan River in Manitoba, conducted a national survey in 2047 to find out what drives Canadians' thinking and behaviours in the mid-21st century. It appears that, while goods consumption is still an important part of what makes the economy tick, Canadians are strongly oriented to pay attention to quality of life in terms of amenities and services. In all national surveys of the 2030s and 2040s, as the 2047 study summarized, Canadians consistently have put education, health, environment and spiritual development at the top of their lists of what is important to them. Volunteerism is showing an increasing trend, charitable givings are at an all-time high, churches and other religious institutions are seeing a resurgence of participation, and participatory processes seldom fail to engage more citizens than organizers could ever have hoped for. At a time when environmental challenges have never been so daunting, Canadians have never been so cooperative and selfless in tackling the problems.

The VRURN report also dealt with Canadians attitudes toward forests. Forests for wood are much less important, it seems, than are forests for environmental services, recreation and education. Urban and peri-urban forests are indeed on people's minds, but hinterland forests, facing huge sustainability challenges, are fetching the lion's share of attention. Phenomenal improvements in people's ability to access information about the forests of Canada has sharply raised the national forest consciousness. Canadian citizens, corporations and governments continue to be relatively wealthy, and people and organizations seem to be happy to put money into forest restoration, partly to gain some relief from their guilt in having polluted the atmosphere to such a degree that forests everywhere are declining. In a twist on the observations some observers made in the 1980s, Canada is not only a forested nation but Canadians are finally also a forest people.

D2.11 Governance

Through the past few decades, the forest-products industry in Canada has lost considerable interest in managing the wood-supplying public forests. Part of this has been due to mill closures early in the century - when forest-management agreements became available, no other timber-using companies stepped up to take over. It is also partly due to the unpredictability of the outcomes of management - climate change and other stressors have made silvicultural investments for wood production quite risky. In most parts of Canada, the forest-products industry has become comfortable with the notion of buying roundwood on the open market.

Three important developments are noteworthy here. One is the devolution of authority over public forests to co-management partnerships involving non-Aboriginal and Aboriginal communities working together. Fully 60 percent of the provincially owned Crown land available for multiple-use licensing (as opposed to protected areas) is managed under co-management partnerships (CMPs). Given the sustainability challenges faced by forests nationwide because of climate change, a big focus of the CMPs is forest restoration.

The second development relates to an abundance of settled land claims for Aboriginal peoples. Forty-three claims were settled in the period 2000-2050, with 76 million hectares of federal and provincial land moved into Aboriginal jurisdiction. Half that is forested, although mainly in the far north where the climate has affected forest ecosystems more than anywhere.

The third development is a function of the rise of several new and influential worldwide forest-governance institutions. The UN Convention on Forests, sought since the 1990s and finally established as a binding instrument in 2026, has been capturing strong attention from forest managers around the world. Three non-government forest-oriented global networks have also risen to prominence: (a) the Community Forest Forum (CFF), headquartered in Kathmandu, Nepal, with a strong Canadian arm based in Pickle Lake, ON; (b) the Forest Restoration Council (FRC, formerly FSC, and still in Bonn, Germany), having long ago abandoned the market-based certification scheme that made it famous at the turn of the century and now focused solely on forest restoration; and (c) the World Woodlot Owners' Survival Union, headquartered in Sussex, NB, and drawing together about two million members in a solidarity movement to promote tree care. All these global institutions have managed to capture strong participation from local forest interests across Canada, and the passage of helpful information and advice from local settings to the global stage, and vice versa, is exceptional.

Through all the forest-governance changes noted above, the forest-land ownership patterns have changed substantially (Table 2). Clearly, senior governments have tried to share some forest responsibility with local institutions, and these in turn, as noted above, have sought inspiration and guidance in forest use and restorative management from global organizations.

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

Year	Ownership Category				
	Federal	Provincial	Private	Community	Aboriginal
2000	23	71	6	0	0
2010	23	71	6	0	0
2020	22	69	6	1	2
2030	22	60	6	3	9
2040	22	52	7	5	14
2050	22	49	8	6	15

D2.12 Aboriginal Empowerment

The first half of the 21st century has witnessed dramatic improvements in the political welfare of Canada's Aboriginal peoples. Most of the court decisions over land claims and other resource issues in the 2010s and 2020s were in their favour. This meant that the federal and provincial governments finally became meaningfully interested in accelerating the pace of political reconciliation. Much formerly provincial forest land, and some federal land, is now in Aboriginal title. Much of what remains in provincial ownership is under management by CFPs, as noted above.

There are isolated cases where the political improvements for Aboriginal communities have led to significant turnarounds in their economies. Unfortunately, much work needs to be done - in terms of capacity-building, political transformation of local Aboriginal governance, and shedding of the culture of dependence - to accelerate strong economic development for many Aboriginal communities. Economic opportunities related to the forests are few, partly due to their degraded condition. A truly positive sign is how some Aboriginal communities have partnered with mining interests to capture significant rents from their new operations on Aboriginal lands. After an allocation from those rents to community development, large portions are earmarked for forest restoration.

D2.13 Conflict over Resources

Several factors have coalesced to produce a situation of relatively calm relations among users of forest space. The enormous population growth experienced in the country has put pressure on forests in all inhabited areas, but people work hard together to try to conserve what forests and trees they have. Companies extracting materials from the earth - oil, gas, coal, minerals - are working hard also at reducing their footprints, and are pumping significant monies into forest-restoration projects. Where agriculture has expanded, it is into areas where forest decline has already signalled that a land-use change may be welcome.

D3. 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.

D3.1 Forest Ecosystem Sustainability

C3.1.1 Biodiversity

The native species and ecosystems of Canada are under siege. Many biodiversity indicators associated with Canada’s forests have shown impoverishment in the past fifty years. The main stressors are climate change, invasive species, urban encroachment, and air pollution. On the other hand, never before has Canada witnessed such a consistent and concerted effort to restore forests and trees to some semblance of their past glory. Of course the past glory can not be attained in terms of species and their stability, because the new climatic circumstances of the 21st century are inhospitable to the kinds of forests European settlers found through the 17th to 19th centuries.

On the species-at-risk front, ecologists are finally yielding to the notion that a new biodiversity regime will characterize Canada’s landscapes and waterscapes, and probably for some time to come it will be a highly dynamic biodiversity. Canada’s Species at Risk Act and indeed most provincial counterpart acts were amended in the 2030s and 2040s to lower the alarm over local extirpations of species, and also to herald a new era of welcoming the inevitable arrival of new species (new to Canada) whose habitat requirements are better met here than anywhere else. Particularly exciting in this regard is the 15-fold increase in the Great Lakes watershed area considered suitable for Carolinian species. Forest restoration efforts in Ontario have succeeded in establishing thriving stands of Carolinian tree species such as hickory, black gum, Kentucky coffee, papaw, tulip, and sassafras in Algonquin Provincial Park.

As expected even back in the 1980s, the boreal forests have been most negatively affected by the new stressors. According to the Canadian Ecosystem Service, the climate suitable for boreal forests in Canada has shrunk over the 2000-2050 period by 32%. On top of that, the boundaries of the zone have shifted north, so that the overlap of what was boreal climate in 2000 and what is boreal climate today is a mere 40%. New studies by Boreal Initiative Canada (BIC) have identified parts of the current boreal forest that have most potential for conserving boreal biodiversity, and large new protected areas are expected in this area by 2060.

D3.1.2 Ecosystem Condition and Productivity

In terms of Canada's standard indicator for ecological integrity, the EI index (or EII for short), the environmental stresses on forests have been pushing it down while substantial restoration efforts have ameliorated the downward pressure. Ecologists at the Academy for Ecological Integrity Options, University of Yellowknife (AEIOUY), recently estimated that, without restoration, Canada's forests would have had an EII dropping from 685 EIU in 2030 to 319 EIU by today, but restoration efforts have had the effect of keeping the EII above 400 in most parts of the country.

Gross rates of primary productivity in Canada's forests are estimated to have risen measurably. This is due to a combination of rising atmospheric CO₂ concentrations and the resulting increased efficiency of water use by trees, and warming in cold areas so that photosynthesis rates have increased. However, rates of fire, diseases, insects and windthrows are up so dramatically that net primary production in most natural forests of Canada have decreased since 2000.

D3.1.3 Water and Soil

Climate change has seriously altered Canada's entire water cycle. River and lake levels are way down, and sea levels are up. However, water-dominated ecosystems have been subject to as much restoration attention as have forests. Fortunately, the many - even if scattered - successes in forest restoration have had concomitantly positive effects of forest water regimes. But Canada's ecologists are now letting go of the notion of re-wilding Canada's rivers and lakes. Water-control works have become vital nationwide, primarily for water conservation. Water diversions are implemented only when absolutely necessary, but many new control structures have been constructed across the country to try to regulate water flows as well as possible given the new vagaries of a changed climate. Since these capital works are necessary for environmental improvement, approvals through environmental assessment processes have been relatively easy to get.

Forest soils are taking a beating with climate change and the attendant forest decline. Erosion, permafrost melting, shortened periods of winter freezing, and higher rates of organic-matter decomposition and mineralization all are stressing forest soils that for centuries supported forests in a relatively stable way. Some serious deep burns occurred during the dry years of the 2030s in the peatland soils of the Hudson's Bay lowlands. Otherwise, though, the only bright light regarding forest soils is the increased organic matter from dying trees in the wetter parts of the country.

D3.1.4 Carbon Cycles

Much of the damaged wood in disturbed forests is not harvested in salvage operations, so the forest carbon pools have had reductions in live biomass and increases in dead organic matter. Such changes in the dead pools are transient, however, because accelerated rates of decomposition will ultimately bring those pools down. Forest-restoration efforts will help

carbon budgets to a degree in the long term, so some stabilization is expected into the 22nd century. Carbon accounting, so vital under the Kyoto Protocol, has been downgraded considerably in the Sydney Protocol, so few forest managers are even keeping track of carbon pools any more.

D3.2 Social and Community Sustainability

D3.2.1 Amenity Values

Forest-based recreation has increased markedly, both in the forests near cities and towns and in Canada's hinterlands. People are out in the woods in droves, for the fresh air and also to observe what climate change is actually doing to the forests and how they are responding. There is a wave of high interest these days in forest ecosystems and their sustainability - it's almost a sympathy movement. Plus, people want to see how their forest-restoration monies - both tax monies and their substantial ENGO givings - are being spent. Group eco-tourism excursions in the shoulder seasons of spring and fall have largely taken over where Caribbean winter vacations left off.

D3.2.2 Participatory Processes

Participation by Canadians in forest management and policy decision-making has grown from almost nil in the 1970s, through promising progress in the 1990s-2000s, to high degrees of citizen influence in the 2040s. Where forest decision-making has been devolved from provincial governments and large companies, participatory opportunities abound in the processes set up under the CMPs. Moreover, citizens across the country, finally well-served with megaband Ultranet services in all locales, are communicating with full video and audio transmission with like-minded forest-thinking citizens around the globe. Thousands upon thousands of educational, and sometimes emotional, conversations are taking place between groups of Canadians and groups of community-forest enthusiasts around the globe.

D3.2.3 Forest-related Employment

The number of forest-based jobs in Canada has stayed relatively constant since 2000. On one hand, traditional logging and silviculture jobs are down, as are jobs in wood-processing industries. On the other hand, jobs in restoration silviculture have exploded exponentially. This has improved the lot, although modestly, of many small rural communities across Canada, Aboriginal and non-Aboriginal alike.

D3.3 Economic Sustainability

D3.3.1 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 plummeted 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 nervous about overall forest sustainability.

Global net wood demand and climate change have altered that picture significantly during the last five decades. Calculations of sustainable timber-harvest levels have plummeted across Canada, largely because of low growing stocks on one hand and poor-quality growing stock on the other. Harvest levels are relatively stable because, in big blowdowns or forest declines, most of the dead trees are left to burn or just rot. In the 2040s, national annual logging volumes have ranged between 105 and 115 million m³.

D3.3.2 Wood-processing Industries

The dismal decades of the 2000s and 2010s set the tone for the whole first half of the 21st century. Surviving companies are doing fairly well, especially producers of sanitary papers, printing papers, and engineered wood products. The value of shipments last year amounted to NAD 22 billion (the USD and CAD joined in 2027), quite a decrease from the roughly CAD 40 billion in 2000. Newsprint is virtually gone, and bioenergy materials have taken a marginal position. With a doubling of Canada's population and sagging demand in world markets, a much greater proportion of our forest-based material is staying in the country.

D3.3.3 Harvests of Non-Wood Products

Despite the deterioration of forest health across Canada, harvests of non-wood goods are strong. Harvest levels for most such goods - e.g., country foods (e.g., berries, mushrooms, nuts, plants), craft materials, medicinals - have risen probably five-fold given the strong visitation rates of all Canadians to the forests. Ecologists are becoming increasingly concerned about the long-term sustainability of such harvests due to high harvest levels and the unknown production rates, especially in view of climate change.

D3.3.4 Markets for Forest Services

Recall the great excitement over carbon markets at the turn of the century. Some naive analysts were predicting that money coming to forest owners and managers would, almost literally, grow on trees - actually, it would grow in trees, especially those left on the stump. Carbon markets were flirted with in the 2010s, but when it became clear that most of the world's forests could not actually be managed to sequester and hold more atmospheric carbon, the markets persisted

only for afforested lands and urban forests.

Biodiversity credits were also a temporary phenomenon, at least in the conventional form. What has flourished is the concept of forest impoverishment credits (FICs). Starting in 2026, with the UN Convention on Forests, forest owners and managers the world over have been calculating their decadal FICs in terms of biodiversity losses due to climate change, and submitting claims to their national governments for restoration funding.

Privatization of forest water rights was vigorously discussed in the 2010s. However, the public-policy debates led to a convergence of opinion that water should remain a common-property resource under the control of provincial governments. All in all, promoters of the concept of privatization of non-timber forest services have been profoundly disappointed in progress over the last fifty years.

D4. 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.