

Changes that are coming

Consider our values

- Nature is perfect
- It was like that when I got it here, so it must be OK
- Humans are the cause of all the problems
- Evolution is real, but it is too slow and uncertain to depend upon. It might not come out the way we want.
- We want to “fix” things and keep them the way they were.

“Nature” does not work that way

- Survival of the fittest is the only way that evolution works. Adapt or go extinct.
- It takes a long time
- It is often such a small variation that provides some improved survival and reproduction that we can seldom identify it.
- Humans are getting involved through genetic modifying.

AND – here is proof of active human evolution

- We know that there are some environments that can make us unwell. Mountain climbers often succumb to [altitude sickness](#) – the body's reaction to a significant drop in atmospheric pressure which means less oxygen is taken in with each breath.
- And yet, in high altitudes on the Tibetan Plateau, where oxygen levels in the air people breathe are notably lower than lower altitudes, human communities thrive.
- In the more than 10,000 years the region has been settled, the bodies of those living there have changed in ways that allow the inhabitants to make the most of an atmosphere that for most humans would result in not enough oxygen being delivered via blood cells to the body's tissues, a condition known as hypoxia.
- "Adaptation to high-altitude hypoxia is fascinating because the stress is severe, experienced equally by everyone at a given altitude, and quantifiable," anthropologist Cynthia Beall of Case Western Reserve University in the US told ScienceAlert.
- "It is a beautiful example of how and why our species has so much biological variation."

Likely happenings in NE forests

- Less winter
- More rain – less snow – more precipitation in winter and less in summer. More downpours and road washouts. Rain will be more acid.
- More high winds and storms due to a warmer ocean. More blow down of trees. Wind is the largest change agent in forests
- More non-natives plants, insects and diseases. Affecting plants and people. These will be largely uncontrollable. We will lose the ash trees.
- Changes in the life cycles of native insects and other organisms.
- This year has had less black flies and mosquitoes. ????

Changes continued

- More deer
 - Winter kill (starvation) use to be a population control.
 - Sever browsing affect on tree regeneration.
 - Mostly affects hardwood tree species
- More fires because of drier conditions in spring and fall with leaf off.
- Animals and birds
 - Increase - Possums & Southern flying squirrels – Jumping worms etc.
 - Decrease – Eider ducks and others
- Mass Audubon projection
 - 30 (49%) of the forest-breeding species are classified as Highly Vulnerable

Some affects of precipitation changes

- More rain – less snow – more precipitation in winter and less in summer.
- More downpours and road washouts. Need to use bigger more expensive culverts and bridges.
- Forest accessibility is changing significantly
 - Old Days – ground froze hard and deep. This resulted in mud free easier smoother trails for skidders and other equipment. Little soil compaction or rutting.
 - Now – Good hard deep frozen ground conditions have largely disappeared. BUT, there are now dry conditions in the summer that allow equipment access. There is more soil compaction.
 - Ground that is flat and wetter that will neither freeze nor become sufficiently dry will be “inoperable” and stop being a source of wood.

Tree species change in New England Forests

- Tree with small light seeds will migrate faster, while trees with large heavy nuts will migrate slowly.
- We will likely lose Butternut to a canker of unknown origin
- Trees on the southern edge of their range may find it too warm and retreat northward.
 - Red pine, larch, balsam fir, red spruce, quaking aspen, paper birch, yellow birch, pin cherry.
- Trees on the northern edge of their range may find it better and expand northward.
 - Sweet gum, sourwood, post oak, chinkapin oak, loblolly pine, black gum.

Changes to the Gulf Stream

- Top cryosphere scientists are growing increasingly worried that the Atlantic Meridional Overturning Circulation (AMOC), a key ocean current that governs how heat cycles in the Atlantic Ocean, is on a path toward collapse.
- A rapid halt to the current would cause rapid cooling in the North Atlantic, warming in the Southern Hemisphere and extreme changes in precipitation. If that happens, the new report suggests, northern Europe could cool by about 5.4 degrees Fahrenheit in a decade.

How can we address changes?

Reality check – The world is way behind on taking large steps to address atmospheric CO₂. There are some good ideas, but not enough implementation.

- Use electric power, not generated from fossil fuels.
- The chances of sufficiently controlling “invasive” species are very low.
- We can defend small areas but cannot defend the landscape.

A little history story

- Ohio – 1980 +/-
- Boise Cascade owned thousands of acres – mostly hardwood.
- Gypsy Moth, now called spongy moth, first arrived in that part of the country. The so called “killing front”.
- They decided to cut all the oak logs they could before the moth killed them.

Rocky Mnt beetles – Native insect

- From 2005 to 2017, a [severe outbreak](#) of spruce bark beetles killed more than 90 percent of the Engelmann spruce trees across 800,000 acres in the southern Rocky Mountains. During the same period, an outbreak of western balsam bark beetles decimated subalpine fir across 116,000 of those acres.

Spruce Budworm – NE and Canada

- Native insect – Feeds on balsam fir, red spruce, black spruce and white spruce.
- Has a 30 to 60 year population boom cycle.
- Last in Maine in the 1980's and is coming back now.
- 1980 event killed 20 to 25 million cord of wood on 136 million acres eastern Canada and Maine.
- Current event is now crossing the border in NW me. Affecting 14,000 acres now and expected to increase rapidly.
- Two pesticides are being used very carefully – Mimic (\$42/ac) and BTK (\$60/ac).

Changes in forest products

- Traditional wood products
 - Sawlogs of different species – affected by market swings but largely stable.
 - Pulpwood – significant decrease in market demand due to closure of papermills, largely resulting from the decrease in print media and increase in electronic communication.
 - Firewood/fuel wood – strong locally but decreased overall. Heating with oil , propane or electricity is easier.

Changes in forest products continued

- New products
 - Wood based home insulation – Madison ME
 - Biofuels – fossil oil fuel substitute
 - Biochar charcoal produced from plant matter and stored in the soil as a means of removing carbon [dioxide](#) from the atmosphere, and improve soil properties.
 - Oriented strandboard – new mill in Jay ME

Optimism about forest products.

- The Northeast is Going to Be Fine...
- For better or worse, the forest industry is accustomed to boom-and-bust cycles, and has experience handling them.
- We have markets, and are incredibly well positioned compared to other parts of the country
- We have the forest resource and supply infrastructure (landowners, loggers, entire forest industry ecosystem) that would make other regions jealous
- We live in close proximity to (and are part of) the greatest collection of consumers in the history of the world

Another new forest product

Sequestered Carbon

- The total biomass acceptable by carbon traders is about 2.0 times the biomass of the traditionally merchantable stem.
- green Wood (biomass) is 50% water
- dry wood (biomass) is 50% carbon
- the CO₂ equivalent is 3.67 times the weight of the dry carbon.

1 ton of green wood keeps .92 tons of CO₂ out of the atmosphere.

The rapidly evolving stored carbon market

- Stored carbon in living trees is now a forest product just like any other “traditional” forest product. Instead of growing lumber, pulpwood or firewood, landowners can grow stored carbon and sell it.
- Thus, every tree in the world now has an economic value for two “products”. Their definitions and valuation processes are rapidly evolving.
- The Carbon Market concept. Rather than stopping producing CO₂ entirely, the purchaser can “offset” their amount produced by removing an equivalent amount and storing it for a set period of time.
- With CO₂ stored in wood it is either in a living tree OR in a long lived wooden product.

<https://carboncredits.com/the-ultimate-guide-to-understanding-carbon-credits/>

- Mandatory – Carbon Credits - Around the world, cap-and-trade programs exist in some form in the US, Canada, the EU, the UK, China, New Zealand, Japan, and South Korea, with many more countries and states considering implementation.
 - Value = \$26 to \$32 / ton of CO₂
- Voluntary – Carbon Offsets - Organizations with operations or agreements with landowners, that reduce the amount of carbon already in the atmosphere, by reducing tree harvesting, planting more trees or investing in renewable energy, can issue carbon offsets. The purchase of these offsets is voluntary, which is why carbon offsets form what's known as the “Voluntary Carbon Market”. However, by buying these carbon offsets, companies can measurably decrease the amount of CO₂e they emit even further.
 - Value - \$24 to \$28/ton of CO₂

World Bank – AMAZING WEBSITE

- https://carbonpricingdashboard.worldbank.org/map_data
- They describe emission control systems as either
 - ETS – emission trading systemOR
 - Carbon Tax

Carbon price choices

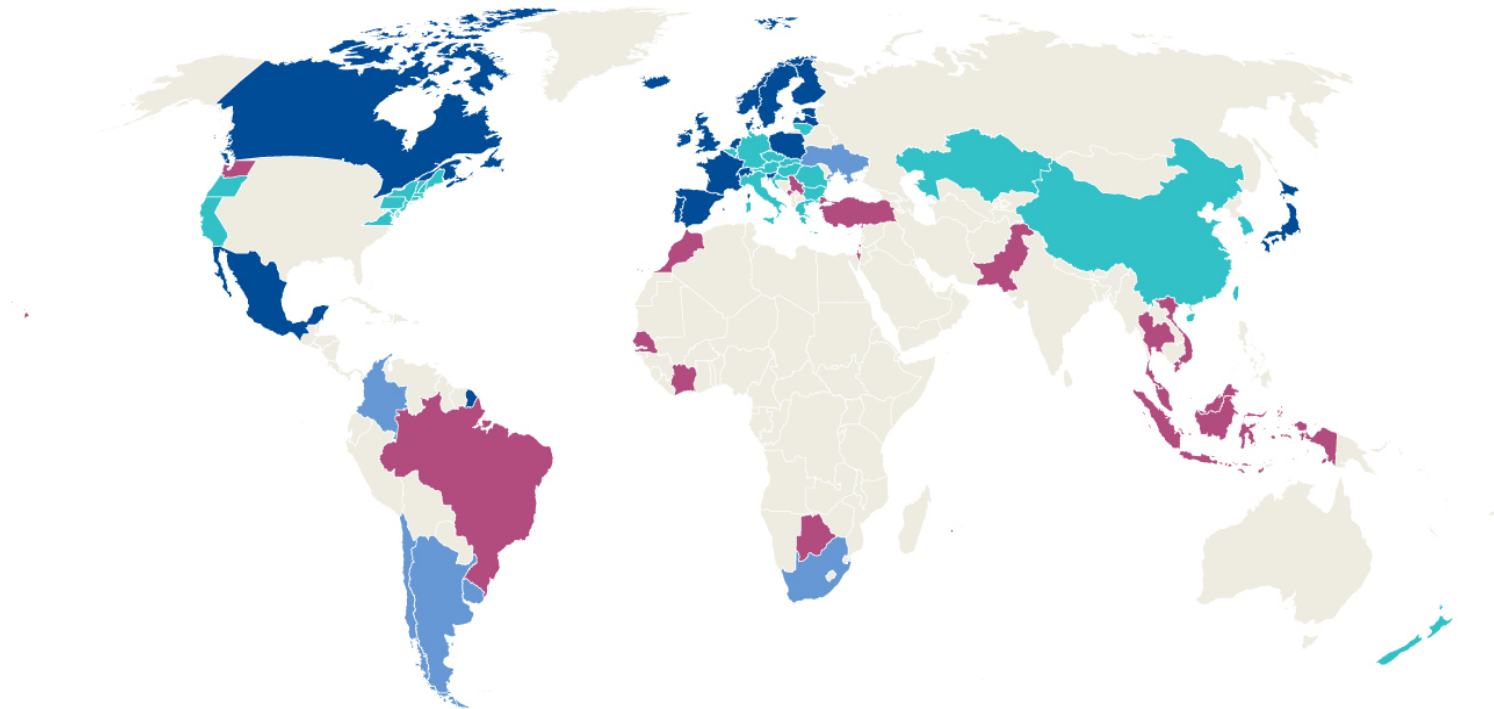
Countries and states are choosing different approaches to carbon pricing based on their own circumstances and objectives.

Under consideration
or planned

Carbon tax

Emissions trading
scheme (ETS)

Carbon tax
and ETS



Source: WBG, IMF staff calculations, and national sources. Note: The boundaries and other information shown on any maps do not imply on the part of the IMF any judgment on the legal status of any territory or any endorsement or acceptance of such boundaries.