# The Next 30 Years

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***What can we do in 30 years? The three legs of sustainability. Possible futures. What if we plant some trees? Two legs of sustainability. All three legs. Population-carbon nexus. References.***

## What Can We Do In 30 Years?

The year 2050, a little less than 30 years from now, seems to come up quite a bit when we're talking about climate goals. I guess it's as good a time frame as any. We have to pick some sort of time frame if we're going to talk about things like reducing emissions over time, and getting our planet into balance over time. We could use 10 years, which feels like too short a time frame to make much difference, or 50 years, a nice, even half-century, but it seems way out there, even though we've been comparing our current status to 50 years ago, when we had the first Earth Day. A century, which is definitely a nice, round number, seems way too far out there, as far as the future goes, but it's easy enough to look at in terms of the past century, and where we are now compared to then. 30 years into the future seems definable and easy to grasp. Our grandkids will be adults, and we, or at least one of us, meaning my husband and I, might even still be here.

Make no mistake, the next 30 years will be very telling, in terms of whether or not we can turn the anthropogenic destruction of our planet around. If we can get it turned around, with less overall emissions, and start to see signs of improving balance, like decreasing atmospheric $CO_2$ concentration, decreasing average temperatures, cessation of sea level rise, and recovering populations of wildlife on land and in the oceans, we'll know in the next 30 years. If we can't get this turned around, we'll know that in the next 30 years too, as the consequences will be clear if we continue to push our planet past the tipping point. That wouldn't be a happy thing. We would continue to see increasing loss of more and more species and life forms, and increasing food scarcity and drought for those of us who are still here, with increasing storms and wildfires, and increasing losses of loved ones to disease, starvation, wars and murder as we continue to lose personal rights, freedoms, flexibility and resources.

The comparison in Table 1 in Chapter 2 shows that we've managed to throw our planet out of balance in the past century, or at least that's how long we've seen clear signs of imbalance, so it's unlikely to imagine we can turn it around in less than a century. In fact, it might take a lot longer than a century to see results of changes that we make now, because of the absorption capacity of our planet's land, air and oceans, that were probably filling up and becoming saturated long before we noticed any changes of concern. However, the reality is that we need to move fast and make some major changes, and make them soon, to have any chance at all of turning this around, ever. And, if we make our changes soon, in the next few years, we should begin to see some measures that convince, or reassure us, that we can get our planet in balance for future generations. At least in theory. Since we can't exactly know what's going to happen, I will turn to modelling, in order to get an idea of what our cumulative impacts could be if we take action, or if we don't. Modelling is simply a way of projecting what we know about the past and present, in order to get a sense of what the future could look like.

We definitely have enough historical data to do that, and it will help us get a handle directionally, if nothing else. So, why not?

## The Three Legs of Sustainability

In order to model potential future states of our planet, and link those possible states to human behavior and emissions, we first need to define what measures to use. We need to have something that is not only measurable, but is also human-caused and controllable. From Chapter 2, we already know that atmospheric $CO_2$ concentration is related to temperature, and that human $CO_2$ emissions increase the $CO_2$ concentration. We also learned that the more people we have on the planet, the more $CO_2$ emissions we have in total. We also saw how much forest cover we have currently, and we know how much $CO_2$ trees can absorb, which tells us how much we can increase the $CO_2$ sink with trees, to offset our emissions. Ideally, the ultimate goal here would be to get the planet's natural $CO_2$ sinks approximately even with how much $CO_2$ we emit. That would feel like balance, wouldn't it? Seems to me. Anyway.

There are obviously a lot of other variables that can impact temperature and climate, as well as resource depletion, but if we want to keep our model simple, while giving us a good idea of what we can expect in the future, these three variables, total $CO_2$ emissions, total human population and total forest cover, seem like a good place to start. They should tell us most of what we want to know, given that together they comprise about 80% of the underlying causes of global warming. Also, these are three things that we can actually control by modifying our behavior. Unlike other stuff, like earthquakes and volcanoes. So, why bother with those? They only make up about 20% of the problem anyway. At most. So, how about we focus on things we might be able to do something about. At least, if we can grow the spine and the will to at least bother. The good news is that with a model, we can always go back and add variables to refine it as we learn. It's actually pretty fun. You'll see.

Modelling is a simple, yet important way to see how our actions can help or destroy our planet. We can get a feel for how effective it will be if we make specific changes. For example, if we plant a billion trees a year, will this actually make a significant difference and help our planet, or will it just make us feel better? Do we need to plant 2 billion trees? Do we even have enough land to plant all the trees we need for enough carbon sink to neutralize our emissions? What if each of us reduces our carbon emissions by half, but we still keep growing the population? What if we reduce our population? Or keep it the same? Can we get our total emissions down to where it was in 1910, when we were in balance with our planet? Is it necessary to get back to that point? Is it even possible? Or, should we just try and stop the carnage enough to prevent further damage? Hmmmm. Good questions, all. Let's see what we can see.

## Possible Futures

Before we go all crazy on modelling, we first have to define some constants, based on assumptions, to use in our model. Then we can use those assumptions in the math in our model, to determine the cumulative and future impacts of our actions. The main assumptions I had to make were around trees and forests, since the references I found were all over the map, with $CO_2$ uptake for trees ranging from 16 to 55 LBS per tree per year,[1,2,3,4] and tree densities from 229 to 1000 trees per acre.[5,6,7,8,9,10] The problem with modelling tree uptake on a large scale is that all of these are probably correct, taken in context, given that there are so many species of trees, sizes of trees, and environments in which they live. I finally settled on throwing out the extreme numbers and taking averages of the others. Table 1 is an overview of the assumptions used in this model. While there is no single value that can realistically describe the entire earth's forests, the numbers I decided to use are in the ballpark of average numbers, leaning to the conservative. I simply input the assumptions into a spreadsheet and organized it to create the model.

**Table 1 – Constants Used for Forest CO2 Uptake Calculations**

| **Description** | **Assumption** | **Notes** |
|---|---|---|
| Trees, $CO_2$ Uptake, tonnes/year | 0.0083 tonnes/year | 0.25 tonne/tree/30 years |
| Trees/acre | 300 | Conservative |
| Global Land Mass, Acres | 25.7 billion | Total Habitable Land[12] |
| Maximum Possible Trees | 3.86 trillion | Assume half of habitable land mass is available for trees |
| Maximum $CO_2$ Uptake Possible | 32.1 billion tonnes/year | By trees |

Based on these assumptions, if we used half the arable land for forests to take up $CO_2$, keeping the other half for human wants and needs, including material resources and food, the maximum $CO_2$ that we can offset with trees is about 32.1 billion tonnes/year. Even though we know that there are plenty of land practices, such as regenerative agriculture practices, that can increase carbon sinks naturally, for the purpose of this simple model we'll refer to the carbon sink as trees, at least for now.

As a starting point for our model, we can start with the current human population on the planet, which is 7.71 billion, and the total carbon emissions, which was 40.53 billion tonnes/year, as of the end of 2019. For a reference, in 2019 the global average $CO_2$e/capita was 5.26 tonnes/person.

Our goal with modelling is to see what happens if we plant a bunch of trees, or if we reduce our $CO_2$ usage or our population. Or if we don't do anything. The first graph, Figure 1, which we'll call "Business as Usual", models the next 30 years of $CO_2$ emissions if we continue our current practices. In 2019, we grew our global population by 1%, there were no appreciable changes in $CO_2$e per capita, and we scraped 13.5 billion trees with continued deforestation.

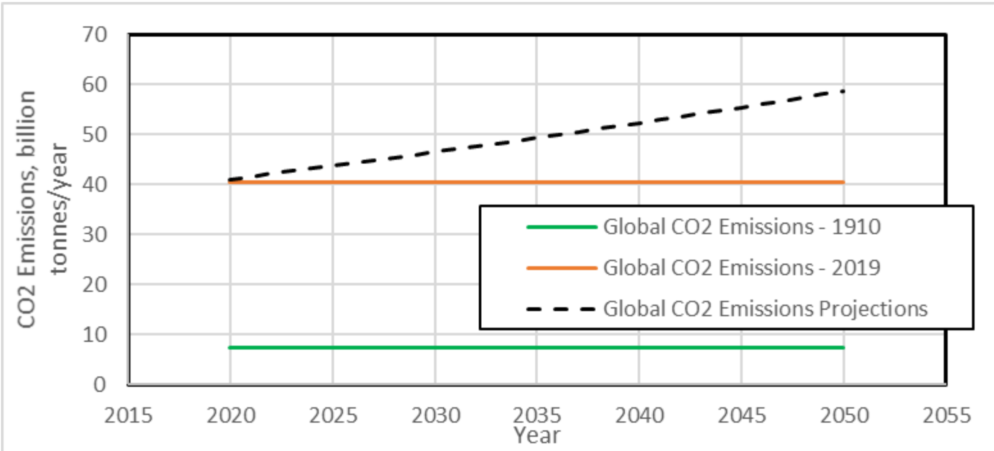


*Figure 1 - Global CO2 Emissions - 30-year Projections - Business as Usual*

Figure 1 shows that business as usual would result in continued increase in $CO_2$ emissions, up to 58.7 billion tonnes/year, about eight times as much as the emissions in 1910, the green line at the bottom, which is shown on the graph for reference. If our goal is to get back in $CO_2$ balance with our planet, the “Business as Usual” scenario definitely won’t get it done, since we’d be spewing nearly 20 billion additional tonnes/year by then. Ouch.

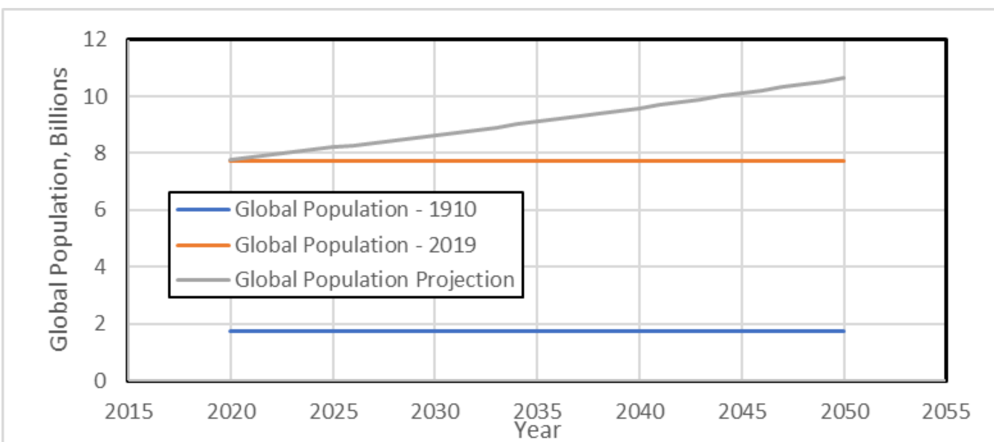


*Figure 2 - Global Population in 30 Years - Business as Usual - 1% Increase/Year*

Figure 2 shows that our population will also be well over 10 billion by then. Also, we’ll have further depleted the forest cover that we need for a carbon sink, reducing it from the current 37.5% of habitable land to 32%, shown in Figure 3, which also shows the 1910 forest cover of 56.7%, for reference. And, of course, in addition to losing our carbon sink, we will also remove wildlife habitat as we destroy the forests, so we can expect yet more wildlife decimation if we continue on this path. And as if all this weren’t depressing enough, if we don’t change our ways, if we really emit all that $CO_2$ in year 2050, by then the atmospheric $CO_2$ concentration would be a horrifying 451 ppm, and the temperature will have increased by at least 1.6 ºC, blowing the 1.5 ºC limit set by climate scientists.

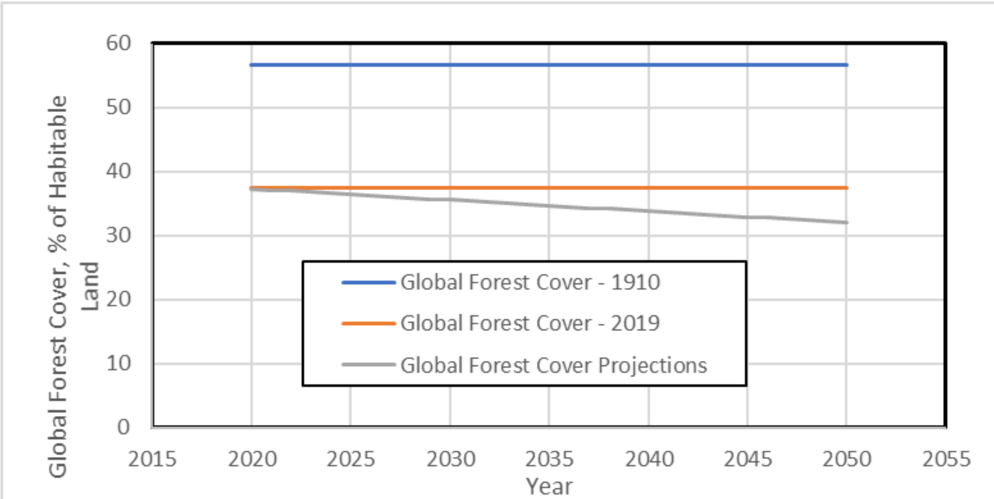


*Figure 3 - Forest Depletion with Business as Usual.*

The good news, if you want to call it that, is that we don't really have enough fossil fuels to do any worse, since we only have enough fossil fuel to spew another 1,475 billion tonnes of $CO_2$ into the atmosphere. This means that in 30 years, if we don't move away from fossil fuels, we'll hit a virtual brick wall at that point. Given that reality, we would do well to make sure we figure out alternative sources now and get them into normal use across the globe. Table 2 shows a breakdown of the current fossil fuel usages and estimated continued availability, based on current usage rates. Of course, if these are based on current usage rates, then we'll run out faster if we continue increasing usage rates, as we would in the modeled "Business as Usual" case. Remember that the "Business as Usual" scenario has an increase in fossil fuel emissions that is strictly from human population growth, assuming no change in $CO_2$ emissions per person. That means that if we gain more people on the planet, we'll run out of fossil fuels faster, and warm the plant faster.

**Table 2 - How Much Fossil Fuel is Left?**

| Fuel | Recoverable Reserves | Usage Rate per Year | Time, years | CO2e, billion tonnes |
|---|---|---|---|---|
| Natural Gas | 1,949.7 tcf (trillion cubic feet) | 33.5 tcf[14] | 58.2[13] | 107.44[18] |
| Crude Oil | 1.651 trillion bbls[15] | 35.472 billion bbls | 47 | 712.84 |
| Coal | 252 billion[16] short tons (bst) | 1.895 bst | 133[17] | 655.20 |
| Total | | | | 1,475.48 |

Of course, it turns out that we've already blown the Paris Treaty[19] limit, since we already went over by 1.8 ºC and 1.6 ºC in 2020 and 2021, respectively, which is a scary indication that we may be heading on an entirely new exponential increasing trend in temperature. Which is a real and truly terrifying possibility. Hopefully, they're simply upward ticks in the same trend we've been on for several decades. If not, the past two years would actually render my model, which is based on data through 2019, both extremely conservative and possibly obsolete right from the get-go. However, it can still give us a sense of the impact of our collective actions, and I think it's better to leave the more challenging task of dealing with this potential new trajectory to professional climate scientists and stick with my original task, which is to figure out what we can do about it. I hope this book will be relevant for years to come, so I've chosen to leave the base date at 2019.

Of course, if temperature really stays this high, we'll lose more of our currently habitable coastal regions as glaciers continue to melt and sea levels continue to rise. And, naturally, as we fight that and desperately continue construction efforts to rebuild as we scramble to move inland, we'll trash yet more forests and spew yet more $CO_2$ as we try to save ourselves while spiraling our planet out of control in an unstoppable feedback loop. Meanwhile, pretty much all of us will be fussing and fighting over basic needs like food and water and shelter that the planet just won't be able to provide for all of us. Does that sound like a shit show? Yeah, I think so too. I really and truly hope we don't do that. Don't you?

Using the same assumptions from Table 1, Table 3 shows an overview of modelling some different cases, or scenarios that could happen, at least in theory, depending on what measures we take. The first case, Case 1, is our base case, that depressing "Business as Usual" case, while Cases 2 – 6 show different possible outcomes, if we bother to get over ourselves and at least try to do something about our climate. For Cases 1, 2 and 3, the negative numbers for population reduction and trees planted indicate the opposite actions. Specifically, for Case 1, the negative annual population reduction of negative 1% means an increase in population of 1% per year, a weird sort of example of two wrongs making another wrong. Similarly, the negative 13.5 billion trees planted per annum for Case 1 means that we are doing the opposite in that case, that we are actually killing 13.5 billion trees per year. Again, Case 1 represents what I sincerely hope is a worst-case scenario, the base case, which is what we are doing right now, what we did last year, and what we will continue doing if we don't change for the better. Nowhere to go from here but down. Meaning better. In other words, lower temperatures. I hope.

**Table 3 – Possible Global Status in 30 years – Impact of Population and Stop Deforestation**

| **Case** | **1-Base** | **2** | **3** | **4** | **5** | **6** |
|---|---|---|---|---|---|---|
| Global Human Actions on Three Legs of Sustainability | | | | | | |
| Annual $CO_2$ Reduction per Capita, % | 0 | 0 | 0 | 0 | 0 | 0 |
| Annual Population Reduction, % | -1 | -1 | -0.5 | 0 | 0.5 | 1 |
| Trees Planted per Year, billions | -13.5 | 0 | 0 | 0 | 0 | 0 |
| 30-Year Projected Outcomes | | | | | | |
| Global Population, billions | 10.5 | 10.5 | 9.04 | 7.79 | 6.7 | 5.76 |
| Global Forests, % of Arable Land | 32.1 | 37.3 | 37.3 | 37.3 | 37.3 | 37.3 |
| Net $CO_2e$, billion tonnes/year | 58.7 | 55.2 | 47.5 | 40.9 | 35.2 | 30.3 |
| Net $CO_2e$, tonnes/capita/year | 5.26 | 5.26 | 5.26 | 5.26 | 5.26 | 5.26 |
| Atmospheric $CO_2$, ppm | 451 | 441 | 418 | 399 | 382 | 367 |
| Temperature Change, ºC | 1.6 | 1.5 | 1.3 | 1.1 | 1.0 | 0.8 |

Cases 2 and 3 show what can happen if we make a few changes for the better. In Case 2, we still don't bother to stop growing our population, but we at least stop trashing forests at the rate of 13.5 billion trees per year. That allows us to keep the carbon sink we currently have in our forests the same, but without doing anything else, it doesn't make much difference in the end, because as far as temperature increase, we won't reduce it by much. If we reduce population growth to half of what it is now, Case 3 shows that we'd be around 9 billion people, so we'd be emitting less $CO_2$, at 47.5 billion tonnes per year, which would restrain the global temperature increase to 1.3 ºC, which would help a little, I guess. In Case 4, we simply stop growing the population, maintaining around 7.8 billion, and this helps even more, because we see less net $CO_2$ emissions, since we stopped killing the trees, and we manage to tweak the atmospheric carbon to just under 400 ppm, with a temperature increase of 1.1 ºC, basically about where we're at currently, at least through 2019. And, given the past two years, in 30 years we might look back at 2019 as an actual goal that we wish we could have at least maintained. Who knows?

However, the problem is, we're already too high on temperature, and we're already out of balance with the planet, we're already seeing extreme weather and drought, and we're already losing keystone sea life that can't take the acidity. So, ideally, we will ultimately need to reduce our carbon output below what we have now, in a last-ditch attempt to get that global temperature back down as far as possible. How far do we need to go? I don't know. I don't think anybody really does. If we can begin to reduce our global population by 0.5% per year, or by 1% per year, we can see in Cases 5 and 6 that reducing global population has a really strong impact on our $CO_2$ emissions, reducing them all the way down to 35.2 and 30.3 billion tons per year, which is where we were in the 2000 – 2010 time-frame, and our temperature change would be headed in the right direction, down around 0.8 – 1.0 ºC, where we were in the 1990 – 2000 time-frame. It looks like a gradual reduction in population, just changing our 1% annual increase in population to a decrease of 1% per year, would get us about halfway to where we need to be.

Keep in mind this is a very simple model, so it doesn't account for everything. Not by a long shot. No model does. But the point here is to explore impacts of potential changes that we can make. The point of these first cases is to show that controlling and reducing our population can help a lot, and we don't have to reduce by much. Population reductions of 0.5% and 1% should be pretty simple, the kindest, gentlest way to reduce population in the long-term, and certainly better than letting it grow out of control until everybody starts killing each other, or dies of heat stroke, or starves to death or croaks in the next pandemic, whichever comes first. We have birth control technology, and we know how to use it, so we just need to do that. Our own family is a part of this reduction, simply through planning decisions that have led to a reduction of about 50% in my generation alone. And it was mainly through judicious application of birth control. It's not that hard.

Note that in Cases 5 and 6 we have not reduced $CO_2$/capita at all, so we're talking about reducing net $CO_2$ emissions worldwide by stopping decimation of forests and slowly reducing population over time, while maintaining the same basic lifestyle that we have now, with lots of waste, travelling, construction and tanning salons.

## **What if We Plant Some Trees?**

In Table 4, Cases 7 – 9 show the impact of planting increasing numbers of trees, while stopping population growth. In Case 9, if we plant up to 50 billion trees per year for the next 30 years, we'll be at around 50% of the arable land on the planet. By increasing our tree cover to half of the arable land, the increase in this important carbon sink would reduce our atmospheric $CO_2$ to 362 ppm, and actually reduce our temperature increase down to 0.8 ºC, which is about where it was in the 1990 – 2000 time-frame. So, reforestation can definitely get us moving in the right direction, even at our current population, which is encouraging. I didn't bother modelling reforestation with continued population growth, simply because I think that would be a stupid thing to do going forward. It's pretty obvious what will happen if we do that. We'll trash the planet and leave nothing for our future generations. Continuing to trash obscene numbers of trees and forests that take up emissions while continuing to increase population is obviously a futile, run-in-place exercise that we can intuitively see the outcome, so why waste time modelling it?

**Table 4 – Reforestation Reduces That Global Temperature Increase**

| Case | 7 | 8 | 9 |
|---|---|---|---|
| Global Human Actions on Three Legs of Sustainability | | | |
| Annual CO2 Reduction per Capita, % | 0 | 0 | 0 |
| Annual Population Reduction, % | 0 | 0 | 0 |
| Trees Planted per Year, billions | 13.5 | 25 | 50 |
| 30-Year Projected Outcomes | | | |
| Global Population, billions | 7.79 | 7.79 | 7.79 |
| Global Forests, % of Arable Land | 42.6 | 47.0 | 56.8 |
| CO2e, billion tonnes/year | 37.67 | 34.80 | 28.55 |
| CO2e, tonnes/capita/year | 5.26 | 5.26 | 5.26 |
| Atmospheric CO2, ppm | 389 | 380 | 362 |
| Temperature Change, ºC | 1.0 | 1.0 | 0.8 |

A couple things worth noting in Table 4. For one thing, now that we're planting trees, we're impacting our total $CO_2$ emissions without reducing $CO_2$ per capita or population. This may look strange, so to avoid confusion this is a good point to explain the modelled $CO_2$ emissions. In my model, like any model, I made choices as to how to present the results, so that they make sense in the context of the goals of the model. Or, at least, that's what I'm trying my best to do. For the $CO_2$ emissions, the starting point was comprised of the conditions in 2019, and the modelling from 2020 – 2050 shows changes from 2019. The goal was to examine the impact of these *changes* on net $CO_2$ emissions, so the net emissions are reduced if we plant trees, even if we are emitting the same amount of $CO_2$ by burning fossil fuels, because the trees we plant reduce the net emissions by taking up more of the $CO_2$ that we emit. So, I subtract off the $CO_2$ that is absorbed by the additional trees from the $CO_2$ that we are emitting with fossil fuels. The end results of atmospheric $CO_2$ and temperature are then easier to define using the correlations between $CO_2$ emissions and atmospheric $CO_2$ and between atmospheric $CO_2$ and temperature. If that makes sense. If not, just hit me on my blog[20] and I'll try to help.

The other thing to note from Cases 7 – 9 is that we arrive at about the same endpoint on temperature by planting trees as we did by reducing our population in Cases 2 – 6, getting down to an increase of about 0.8 ºC. While this is definitely in the right direction, I think personally that we should strive for more reduction, and make our best effort to get back to where we were back in 1910, which requires a temperature increase of as close to zero as we can get. But that's just me. I tend to be an overachiever, because my life experience has taught me that it always costs twice as much for any project, and delivery tends to fall short of expectations. It's always something. This is why engineers tend to shoot for under-promising and over-delivering, just to hedge things and get in the ballpark, at the end of the day. Just saying. A survival tactic to protect one's job. Anyway.

Back to the 1910 thing, I think it's a worthy goal, since we were truly in balance with the planet at that point. It represents a point before we started noticing changes that were probably beginning long before that, but we didn't see them because the planet's natural resiliency and redundance was masking the changes. Basically, we were already in trouble, but just didn't see it yet. Sort of like cancer cells multiplying for years or decades before we notice symptoms, because our body's immune and metabolic systems and such can compensate for it, at first, until it becomes too much. Then a tumor shows up and starts taking over, and we notice the symptoms. Also, at this point, with the past few years of extreme increase in temperature, we are more likely to have some success in saving what's left of our planet's resiliency by shooting for as low a temperature as we can.

Now, let's see what happens if we try simply reducing our carbon footprint per capita. This will include all that awesome renewable energy technology, other cool stuff that saves energy that's coming on the market every day, EV's, and our own personal choices. And, it turns out, we can save more energy faster with our own personal choices than the best of the latest and greatest technology. And money, too. Just by paying attention to what's going on and not wasting. We can step up and stop wasting and buying stuff we don't need, turn down the air conditioner and heat, turn off lights if we're not in the room, recycling, not wasting food, no red meat, only organic food, stuff like that. It's not hard. Hilary and I have a carbon footprint vastly lower than the national average simply with our consumer choices. And, the good news is, it saves money too! If we leave our population the same, and at least stop increasing it, and we don't plant any more trees, but we at least stop killing them. That last part is definitely wishful thinking, since our current temperature won't really change any time soon, so we'll probably continue to have wildfires that destroy forests by the millions of acres, at least in the American west and Australia, for many years to come. Anyway, let's just see what we can do with just this one leg of sustainability, just for the helluvit, if for no other reason. Why not?

**Table 5 – Impact of Reducing $CO_2$/Capita.**

| Case | 10 | 11 | 12 | 13 |
|---|---|---|---|---|
| Global Human Actions on Three Legs of Sustainability | | | | |
| Annual $CO_2$ Reduction per Capita, % | 0.5 | 1 | 2 | 5 |
| Annual Population Reduction, % | 0 | 0 | 0 | 0 |
| Trees Planted per Year, billions | 0 | 0 | 0 | 0 |
| 30-Year Projected Outcomes | | | | |
| Global Population, billions | 7.79 | 7.79 | 7.79 | 7.79 |
| Global Forests, % of Arable Land | 37.3 | 37.3 | 37.3 | 37.3 |
| $CO_2e$, billion tonnes/year | 35.33 | 30.39 | 22.44 | 8.9 |
| $CO_2e$, tonnes/capita/year | 4.52 | 3.89 | 2.87 | 1.13 |
| Atmospheric $CO_2$, ppm | 382 | 367 | 344 | 303 |
| Temperature Change, ºC | 1.0 | 0.8 | 0.6 | 0.3 |

Cases 10 – 13 in Table 5 show us that we can certainly get where we need to be in 30 years with the same population we have now, and the same forest cover, as long as each of us can reduce our individual carbon footprint down far enough. An annual reduction of 0.5% of carbon footprint would help a lot, getting our temperature increase down to 1.0 ºC, which is within the Paris Accord limit of 1.5

ºC. This would be the least we could do, although it wouldn't really do much for the other hapless life forms that we are driving to extinction. If we step it up to a 1% reduction in $CO_2$ per capita per year, or even 2%, it will help more, and a reduction of 5% would get our temperature almost down to where it was in the pre-industrial period. At this point, notice that the global average carbon footprint would be reduced to just over 1 tonne per capita per year, which is equivalent to the poorest of nations. This would in reality be hard to pull off, because it would mean, at least for wealthier countries, some major changes in everyday life. I'm guessing most Americans are far too spoiled and entitled for that. We'd face limited access to the goods and services we are used to now, very limited energy, and probably little or no traveling, other than by foot or bike. Maybe some train travel. Horses, anyone? So, not great, but can be done. In this scenario, the reality is that if we don't make the other changes, reducing population and reforestation, the wars and violence that would ensue over limited resources as our economy tanks would leave us in this position anyway. This is basically what I mean when I say that if we don't get going on this very important issue, the planet will likely do it for us, and it won't be pretty.

## Two Legs of Sustainability

This brings us to the next question in our modelling. What happens if we address just two of the three legs of sustainability? What if we get all those trees planted and each of us steps up and reduces our individual carbon footprint by doing something new each year? On these cases, we'll leave the population the same, without reducing it, but at least not growing it any more.

**Table 6 – Impact of Reducing Carbon per Capita and Planting a Lot of Trees.**

| **Case** | **14** | **15** | **16** | **17** |
|---|---|---|---|---|
| Global Human Actions on Three Legs of Sustainability | | | | |
| Annual $CO_2$ Reduction per Capita, % | 0.2 | 0.5 | 1 | 2 |
| Annual Population Reduction, % | 0 | 0 | 0 | 0 |
| Trees Planted per Year, billions | 50 | 50 | 50 | 50 |
| 30-Year Projected Outcomes | | | | |
| Global Population, billions | 7.79 | 7.79 | 7.79 | 7.79 |
| Global Forests, % of Arable Land | 56.8 | 56.8 | 56.8 | 56.8 |
| $CO_2$e, billion tonnes/year | 26.16 | 22.83 | 17.89 | 9.94 |
| $CO_2$e, tonnes/capita/year | 4.95 | 4.52 | 3.89 | 2.87 |
| Atmospheric CO2, ppm | 355 | 345 | 330 | 306 |
| Temperature Change, ºC | 0.7 | 0.6 | 0.5 | 0.3 |

Table 6 shows that as long as we plant all the trees we can, then we can make some real headway with individual carbon footprint reduction. Even as little as a reduction of 0.2% per year per capita, in Case 14, can get our temperature increase down to less than 0.7 ºC. To get down to pre-industrial temperatures, we would need to reduce our carbon footprint by 2% per year, shown in Case 17. This would result in net carbon emissions of just under 10 billion tonnes per year, and each of us would be using about half of what we use now. So, not a bad outcome, although it's extremely important that we avoid growing our population for this to work. And we absolutely must reforest all available land.

## All Three Legs

It looks like we'll need all three legs to get back to the pre-industrial balance we had with our planet, so, our final set of cases will include all three legs of sustainability. In Cases 18 – 20 in Table 7, we can see the impact of increasing annual reductions per capita if we reduce our population by 1% per year, and plant 50 billion trees per year. The global population would be just under 6 billion, about where we were in 1998, and we'd have a lot more flexibility in carbon footprint per capita. Reducing our carbon footprint per capita would get us down to about where we were in 1910, with a net global carbon output of less than 6 billion tonnes/year, and $CO_2$ per capita of around 3 tonnes/year, which is about 60% of what we have now. With the energy efficient technologies that we are currently developing, this is a very comfortable and realistic scenario, and our future descendants would likely be fine. They probably wouldn't even notice a serious difference in lifestyle. Personally, I would feel pretty good leaving this scenario for future generations. Depending on the unforeseen consequences of our glutinous behavior to date, we might actually have a planet that is pretty nearly in balance, or moving nicely in that direction, in 30 years. Of course, we do have some serious underlying consequences, such as potential of accelerated runaway temperature increase and sudden polar ice cap disintegration if they are already past a tipping point, but from where we are now, this is promising. A kind and gentle balancing of humans with the planet, and with the other life that lives on planet earth. When you think about it, is this all that much to do? Is it that much to ask? To give our children and grandchildren a better future? Doesn't this approach seem kinder than being forced to send our children to war to fight over the last scrap of arable land on the planet? I think so. Now, let's get to work and let's turn this mess around. The sooner, the better.

**Table 7 – What if we Act on All Three Legs of Sustainability?**

| Case | 18 | 19 | 20 |
|---|---|---|---|
| Global Human Actions on Three Legs of Sustainability | | | |
| Annual $CO_2$ Reduction per Capita, % | 0.5 | 1 | 2 |
| Annual Population Reduction, % | 1 | 1 | 1 |
| Trees Planted per Year, billions | 50 | 50 | 50 |
| 30-Year Projected Outcomes | | | |
| Global Population, billions | 5.76 | 5.76 | 5.76 |
| Global Forests, % of Arable Land | 56.8 | 56.8 | 56.8 |
| $CO_2$e, billion tonnes/year | 13.67 | 10.01 | 5.70 |
| $CO_2$e, tonnes/capita/year | 4.52 | 3.89 | 3.05 |
| Atmospheric $CO_2$, ppm | 317 | 306 | 294 |
| Temperature Change, ºC | 0.4 | 0.3 | 0.2 |

## Population Carbon Nexus

One caveat to consider is that the more people we have on the planet, the less personal flexibility each of us can enjoy as individuals. And, the less individual flexibility, the lower the individual freedoms and the higher the individual frustration. We definitely need to consider the impacts of global warming on social problems that it will exacerbate. We are already seeing the impacts of too many people in places that can't handle that many people, like southern California, Arizona and South Africa, to name a few examples. They are already experiencing shortages of water, more severe storms and higher sea level encroaching on land and forcing people to migrate and move to higher ground. This is happening now. And not just in the U.S., but in the world. And we seem to be accepting it as though growth were a fact of life, something we just have to figure out how to deal with. When it's not. Knowing that, in reality, it will be a long time before forested land actually increases, given the propensity for more wildfires at the temperatures we have now, we really only have two legs of sustainability that we can really count on in the near-term. Those are a combination of reducing population and reducing carbon footprint per capita. On forests, in reality we will have to plant a lot more than 50 billion trees per year just to keep up with the current losses. At least, that's my take. So, we need to get started on the $CO_2$ reduction per capita and combine it with kind, gentle, gradual population reduction now, in order to avoid a complete implosion, just in the next couple decades.

The optimist in me thinks this is achievable, as long as we're serious about switching to renewables in particular, and continuing to develop technologies that are efficient. Also, we waste a lot of resources currently, and just eliminating that waste will get us a long way down a better path. Make no mistake, it's a lot of work and a lot of change, to get down to a third or less of where we are now in terms of overall net emissions. If we don't include measures to bring our population into balance, we will either fail to get in carbon balance with our planet, or each of us will face a severely reduced lifestyle, with increasing restrictions on our personal choices and freedoms, at the very least. In the first case, the planet will likely force us to balance, which wouldn't likely be pretty, and in the second case, significant fussing and fighting among increasingly stressed populations are likely, which wouldn't be much fun either.

For my part, I much prefer the kind and gentle gradual changes that can get us in balance with our planet, rather than the ugliness and evil that is likely to dominate our lives if we choose to do nothing. Which we would richly deserve if we continue on our lazy path of complacency. If we truly want a decent future for our planet and our children, it would behoove us to start making our changes sooner rather than later.

So, at this point, I still think we as a human species still have choices. We can choose to act now for a better future, involving peace and plenty for all, or we can choose continued arrogant complacency, and secure a future of war, insecurity and misery for all. Now that we have established a case for change, the remainder of this book will be dedicated to what we need to do. If you want to make a difference, read on. Thank you for joining me!

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