

**AMC Three Mile Island Camp
2023 Summer Read**

The Peace of Wild Things

When despair for the world grows in me
and I wake in the night at the least sound
in fear of what my life and my children's lives may be,
I go and lie down where the wood drake
rests in his beauty on the water, and the great heron feeds.
I come in to the peace of wild things
who do not tax their lives with forethought
of grief. I come into the presence of still water.
And I feel above me the day-blind stars
waiting with their light. For a time
I rest in the grace of the world, and I am free.

Wendell Berry

Introduction

Despite a growing body of scientific evidence documenting the negative impact of human population and consumption on the world's ecosystems (including their human communities), it is also becoming clear that "we lack the perspectives, the cultural norms, the habits, and the institutions to cope." Our beliefs do not match our reality. A shift in worldview is necessary to bring industrialized societies into ecological balance. In her list of the 12 leverage points that create systemic change, activist and scholar Donella Meadows said that the most effective leverage point is also the most difficult--the mindset or paradigm out of which the system arises.

What worldview will emerge as sustainability becomes the driving force for our communities? A mechanistic worldview focuses on objects while a participatory worldview emphasizes process and relationship. The former is characterized by separation and the latter by interdependence. It makes sense that developing a participatory worldview will help us create a just and sustainable world for all beings.

As conscious beings made of the sun, water, air and earth, we participate as co-creators in an alive, intelligent universe. Knowledge evolves as interplay—a dialogue—between matter and mind, human and other, the stars and the grasses. Restoring a conscious participation in this dance could expand our capacity to make decisions that serve the whole.

Engaging consciously in the creative transformation of a mechanized, industrial worldview to a participatory worldview at a societal level requires an understanding of the need for such a change and the capacity to do it. The earth is currently speaking to us through a changing climate and compromised ecosystems. Some of us are listening and changing—whether we have the capacity to make it a revolution on the scale of the agricultural and industrial revolutions will depend on how we respond to the coming challenges as educators and citizens. This response must be an integrated approach to the whole of our experience—to our embeddedness in nature as bodies, minds and spirits.

The recognition that many people are disconnected from nature is not new, nor is the idea that restoring that connection might contribute to our personal and planetary health. The four articles in this reader offer perspectives and ideas that challenge the current paradigm and destructive belief systems.

Kimmerer, R.W. (June 2017). Speaking of nature, Finding language that affirms our kinship with the natural world. Orion. pp.3-17

Lurgio, J. (29, November, 2019). Saving the Whanganui: Can personhood rescue a river? The Guardian. pp.18-25

van Ham, Chantal (25, January, 2018). In the spirit of nature, everything is connected. International Union for Conservation of Nature. pp. 26-34

[For the 2022 IUCN report of the circular economy see

<https://portals.iucn.org/library/sites/library/files/documents/2022-051-En.pdf>]

Lovins, A.B., Lovins, L.H., Hawken, P. (2007) A road map for natural capitalism. Harvard Business Review. [summary of a seminal book on environmental economics] pp. 35-51

Discussion Questions

1. After reading these articles, what ideas or viewpoints did you discover that you hadn't considered before?
2. What insights in these articles challenge your thinking about what we need to or can do?
3. What wisdom did you find in these readings that feels vital during this historical moment?
4. If we are at a crossroads of peril and promise, where do you see possibility alive and growing?
5. How is the climate crisis challenging our relationship to nature? Where do you see necessary and effective "reshaping" taking place (at any scale)?
6. What values do we need to bring into or nourish our connection to Earth' living systems? What values do we need to release or root out? What values do we need to recover from older / ancestral ways of knowing?
7. How has your relationship with nature impacted your life choices? What perspectives in these readings captured your attention or imagination?
8. Can you imagine the community that will heal our separation from nature? Tell us about what you imagine...

ROBIN KIMMERER

Speaking of Nature

Finding language that affirms our kinship with the natural world

Orion MARCH/APRIL 2017 | JUNE 12, 2017

A CEMETERY SEEMED AN ODD PLACE to

contemplate the boundaries of being. Sandwiched between the campus and the interstate, this old burial ground is our cherished slice of nearby nature where the long dead are silent companions to college students wandering the hilly paths beneath rewilding oaks. The engraved names on overgrown headstones are upholstered in moss and crows congregate in the bare branches of an old beech, which is also carved with names. Reading the messages of a graveyard you understand the deep human longing for the enduring respect that comes with personhood. Names, names, names: the stones seem to say, “I am. You are. He was.” Grammar, especially our use of pronouns, is the way we chart relationships in language and, as it happens, how we relate to each other and to the natural world.

Tiptoeing in her mud boots, Caroline skirts around a crumbling family plot to veer into the barberry hedge where a plastic bag is caught in the thorns. “Isn’t it funny,” she says, “that we think it’s disrespectful to walk over the dead, but it’s perfectly okay to disrespect the other species who actually live here?”

We have a special grammar for personhood. We would never say of our late neighbor, “*It* is buried in Oakwood Cemetery.” Such language would be deeply disrespectful and would rob him of his humanity. We use instead a special grammar for humans: we distinguish them with the use of *he* or *she*, a grammar of

personhood for both living and dead *Homo sapiens*. Yet we say of the oriole warbling comfort to mourners from the treetops or the oak tree herself beneath whom we stand, “*It* lives in Oakwood Cemetery.” In the English language, a human alone has distinction while all other living beings are lumped with the nonliving “its.”

As a botany professor, I am as interested in the pale-green lichens slowly dissolving the words on the gravestones as in the almost-forgotten names, and the students, too, look past the stones for inky cap mushrooms in the grass or a glimpse of an urban fox. The students out for a walk on this late fall day are freshmen in Janine DeBaise’s environmental writing class at the SUNY College of Environmental Science and Forestry where we both teach. I’ve invited them on a mission to experiment with the nature of language and the language of personhood. Janine would correct me: she would not refer to her students as “freshmen” since they are neither *fresh* nor all men. We call them “first-year students.” Words matter. She has collected their assignment, a written reflection on a cemetery walk last week, as baseline data. Now we revisit the same place, but with new ideas about grammar bouncing around in the students’ heads. New to them, perhaps, but in fact ancient—the grammar of animacy.

For me, this story began in another classroom, in another century, at the Carlisle Indian School where my Potawatomi grandfather was taken as a small boy. My chance of knowing my native language and your chance of ever hearing it were stolen in the Indian boarding schools where native children were forbidden to speak their own language. Within the walls of that school, the clipped syllables of English replaced the lush Potawatomi sounds of water splashing on rocks and wind in the trees, a language that emerged from the lands of the Great Lakes. Our language hovers at the edge of extinction, an endangered species of knowledge and wisdom dwindling away with the loss of every elder.

So, bit by bit, I have been trying to learn my lost language. My house is spangled with Post-it notes labeling *wiisgaak*,

gokpenagen, and *ishkodenhs*. It's a very difficult language to learn, but what keeps me going is the pulse of animacy in every sentence. There are words for states of being that have no equivalent in English. The language that my grandfather was forbidden to speak is composed primarily of verbs, ways to describe the vital beingness of the world. Both nouns and verbs come in two forms, the animate and the inanimate. You hear a blue jay with a different verb than you hear an airplane, distinguishing that which possesses the quality of life from that which is merely an object. Birds, bugs, and berries are spoken of with the same respectful grammar as humans are, as if we were all members of the same family. Because we are. There is no *it* for nature. Living beings are referred to as subjects, never as objects, and personhood is extended to all who breathe and some who don't. I greet the silent boulder people with the same respect as I do the talkative chickadees.

It's no wonder that our language was forbidden. The language we speak is an affront to the ears of the colonist in every way, because it is a language that challenges the fundamental tenets of Western thinking—that humans alone are possessed of rights and all the rest of the living world exists for human use. Those whom my ancestors called relatives were renamed *natural resources*. In contrast to verb-based Potawatomi, the English language is made up primarily of nouns, somehow appropriate for a culture so obsessed with things.

At the same time that the language of the land was being suppressed, the land itself was being converted from the communal responsibility of native people to the private property of settlers, in a one-two punch of colonization. Replacing the aboriginal idea of land as a revered living being with the colonial understanding of land as a warehouse of natural resources was essential to Manifest Destiny, so languages that told a different story were an enemy. Indigenous languages and thought were as much an impediment to land-taking as were the vast herds of buffalo, and so were likewise targeted for extermination.

Linguistic imperialism has always been a tool of colonization, meant to obliterate history and the visibility of the people who were displaced along with their languages. But five hundred years later, in a renamed landscape, it has become a nearly invisible tool. We forget the original names, that the Hudson River was “the river that runs both ways,” that Devils Tower was the sacred Bear Butte of the Lakota. Beyond the renaming of places, I think the most profound act of linguistic imperialism was the replacement of a language of animacy with one of objectification of nature, which renders the beloved land as lifeless object, the forest as board feet of timber. Because we speak and live with this language every day, our minds have also been colonized by this notion that the nonhuman living world and the world of inanimate objects have equal status. Bulldozers, buttons, berries, and butterflies are all referred to as *it*, as things, whether they are inanimate industrial products or living beings.

English has come to be the dominant language of commerce, in which contracts to convert a forest to a copper mine are written. It’s just the right language for the purpose, because the forest and the copper ore are equivalent “its.” English encodes human exceptionalism, which privileges the needs and wants of humans above all others and understands us as detached from the commonwealth of life. But I wonder if it was always that way. I can’t help but think that the land spoke clearly to early Anglo-Saxons, just as it did to the Potawatomi. Robert Macfarlane’s wonderful book *Landmarks*, about land and language, documents myriad place names of great particularity that illuminate an ancient Anglo-Saxon intimacy with the land and her beings. It is said that we are known by the company we keep, and I wonder if English sharpened its verbal ax and lost the companionship of oaks and primroses when it began to keep company with capitalism. I want to suggest that we can begin to mend that rift—with pronouns. As a reluctant student of the formalities of writing, I never would have imagined that I would one day be advocating for grammar as a tool of the revolution.

SOME OF THE STUDENTS in the cemetery have read the chapter in my book *Braiding Sweetgrass* that invokes the grammar of animacy. They are taken aback by the implicit assumption of the hierarchy of being on which English grammar is built, something they had not considered before. They dive headfirst into the philosophical implications of English-language pronouns.

One student, Carson, writes in his essay that *it* is a numbing word: “*It* numbs us to the consequences of what we do and allows us to take advantage of nature, to harm it even, free of guilt, because we declare other beings to be less than ourselves, just things.” He echoes the words of Wendell Berry who writes, “People exploit what they have merely concluded to be of value, but they defend what they love, and to defend what we love we need a particularizing language, for we love what we particularly know.”

While it’s true that words are simply vessels for meaning, without meaning of their own, many cultures imbue the utterance of words with spirit because they originate with the breath, with the mystery of life itself. In her book *Becoming Wise*, Krista Tippett writes, “The words we use shape how we understand ourselves, how we interpret the world, how we treat others. Words make worlds.”

I don’t mean to say that we are constrained to act in a certain way because of our grammar. I’ve been saying *it* for most of my life and so far I have not clearcut a forest. (I can’t even bring myself to litter, although I tried once, just to see what it would feel like.) Nor does a language of animacy dictate that its speakers will behave with respect toward nonhumans. After all, there are leaders of indigenous nations, raised speaking a grammar of animacy, who willingly surrender their homelands to the use of mining or timber companies. And the Russian language, while embracing animacy in its structure, has not exactly led to a flowering of sustainability there. The relationship between the structure of a language and the behavior characteristic of a culture, is not a causal one, but many linguists and psychologists

agree that language reveals unconscious cultural assumptions and exerts some influence over patterns of thought.

As we talk beneath the oaks, one of the students emphatically disagrees: “Just because I say *it* doesn’t mean I disrespect nature. I grew up on a farm and we called all of our animals *it*, but we took great care of them. We just said *it* because everyone knows that you don’t give a name to the thing that you’re going to eat.” Exactly! We use *it* to distance ourselves, to set others outside our circle of moral consideration, creating hierarchies of difference that justify our actions—so we don’t feel.

In contrast, indigenous philosophy recognizes other beings as our relatives, *including* the ones we intend to eat. Sadly, since we cannot photosynthesize, we humans must take other lives in order to live. We have no choice but to consume, but we can choose to consume a plant or animal in a way that honors the life that is given and the life that flourishes as a consequence. Instead of avoiding ethical jeopardy by creating distance, we can embrace and reconcile that tension. We can acknowledge food plants and animals as fellow beings and through sophisticated practices of reciprocity demonstrate respect for the sacred exchange of life among relatives.

The students we walk with in the cemetery are primarily environmental scientists in training. The practice of *it*-ing everything in nature is not only prevalent, but is required in scientific writing. Rachel points out that in her biology class, there are “strict taboos governing personification of nature, and even a whisper of anthropomorphism will lose you a grade on a paper.”

I have had the privilege of spending my life kneeling before plants. As a plant scientist, sometimes I am collecting data. As an indigenous plant woman, sometimes I am gathering medicine. These two roles offer a sharp contrast in ways of thinking, but I am always in awe, and always in relationship. In both cases the plants provide for me, teach me, and inspire me. When I write as a scientist, I must say, “An 8 cm root was extracted from the soil,”

as if the leafy beings were objects, and, for that matter, as if I were too. Scientific writing prefers passive voice to subject pronouns of any kind. And yet its technical language, which is designed to be highly accurate, obscures the greater truth.

Writing as an indigenous plant woman I might say, “My plant relatives have shared healing knowledge with me and given me a root medicine.” Instead of ignoring our mutual relationship, I celebrate it. Yet English grammar demands that I refer to my esteemed healer as *it*, not as a respected teacher, as all plants are understood to be in Potawatomi. That has always made me uncomfortable. I want a word for beingness. Can we unlearn the language of objectification and throw off colonized thought? Can we make a new world with new words?

Inspired by the grammar of animacy in Potawatomi that feels so right and true, I’ve been searching for a new expression that could be slipped into the English language in place of *it* when we are speaking of living beings. Mumbling to myself through the woods and fields, I’ve tried many different words, hoping that one would sound right to my leafy or feathered companions. There was one that kept rising through my musings. So I sought the counsel of my elder and language guide, Stewart King, and explained my purpose in seeking a word to instill animacy in English grammar, to heal disrespect. He rightly cautioned that “our language holds no responsibility to heal the society that sought to exterminate it.” With deep respect for his response, I thought also of how the teachings of our traditional wisdom might one day be needed as medicine for a broken world. So I asked him if there was a word in our language that captured the simple but miraculous state of just being. And of course there is. “*Aakibmaadiziiwin*,” he said, “means ‘a being of the earth.’” I sighed with relief and gratitude for the existence of that word. However, those beautiful syllables would not slide easily into English to take the place of the pronoun *it*. But I wondered about that first sound, the one that came to me as I walked over the land. With full recognition and celebration of its Potawatomi roots, might we hear a new pronoun at the beginning of the word, from the “aaki” part that means

land? *Ki* to signify a being of the living earth.

Not *he* or *she*, but *ki*. So that when the robin warbles on a summer morning, we can say, “*Ki* is singing up the sun.” *Ki* runs through the branches on squirrel feet, *ki* howls at the moon, *ki*’s branches sway in the pine-scented breeze, all alive in our language as in our world.

We’ll need a plural form of course, to speak of these many beings with whom we share the planet. We don’t need to borrow from Potawatomi since—lo and behold—we already have the perfect English word for them: *kin*. *Kin* are ripening in the fields; *kin* are nesting under the eaves; *kin* are flying south for the winter, come back soon. Our words can be an antidote to human exceptionalism, to unthinking exploitation, an antidote to loneliness, an opening to kinship. If words can make the world, can these two little sounds call back the grammar of animacy that was scrubbed from the mouths of children at Carlisle?

I have no illusions that we can suddenly change language and, with it, our worldview, but in fact English evolves all the time. We drop words we don’t need anymore and invent words that we do. The *Oxford Children’s Dictionary* notoriously dropped the words *acorn* and *buttercup* in favor of *bandwidth* and *chatroom*, but restored them after public pressure. I don’t think that we need words that distance us from nature; we need words that heal that relationship, that invite us into an inclusive worldview of personhood for all beings.

As I’ve sent these two little words out into the world like seeds on the wind, they have fallen here and there on fertile ground. Several writers have incorporated them into children’s books and into music. Readers have reported that the very sound, the phoneme pronounced “*kee*,” has resonance with other words of similar meaning. *Ki* is a parallel spelling of *chi*—the word for the inherent life energy that flows through all things. It finds harmony with *qui* or “*who*” in Latinate languages. I’ve been told it is the name of a Sumerian Earth goddess and the root of Turkic words

for *tree*. Could *ki* be a key to unlocking a new way of thinking, or remembering an ancient one?

But these responses are from nature writers, artists, teachers, and philosophers; I want to know how young people, the language makers among us, react. Our little environmental college is dominated by tree huggers, so if there were ever an audience open to *ki*, they would be it.



WITH *ki* and *kin* rattling around in their heads, the students walk together in the cemetery again, playing with using the words and seeing how they feel on their tongues and in their heads.

Steeped in the formalities of syntax, a fair number of student questions revolve around wanting “rules” for the use of the new words, rules that we don’t have. Is there a possessive case? Where are the boundaries? “I could say ‘*ki*’ about this shrub,” Renee says, “but what about the wind?”

“Yes,” I tell her, “in my language, the wind is understood as animate.”

As we stand beneath the stoutly branched oak, the students debate how to use the words. If the tree is *ki*, what about the acorns? They agree that the acorns are *kin*, a whole family of little beings. The ground is also littered, in this unkempt portion of the cemetery, with fallen branches. “Are these dead limbs considered *kin* too? Even though they’re dead?” Evelyn asks. “Looking at the dead branches on the ground, I found myself thinking a lot about firewood,” she says. “I’ve always spoken—and thought—as if *I* was the one who made firewood. But when I thought of that tree as *ki*, as a being, I suddenly saw how preposterous that was. I didn’t make the firewood. The tree did. I only picked it up from the ground.” In just one sentence Evelyn experiences a transfer of agency or capacity for action from humankind to the tree itself. The grammar of animacy is an antidote to arrogance; it reminds us that we are not alone. Evelyn later writes, “Using *ki* made me see everything differently, like all these persons were giving gifts—and I couldn’t help but feel grateful. We call that kind of firewood *kindling*, and for me it has kindled a new understanding. And look—that word *kin* is right there in *kindling*.”

Another student, Amanda, adds, “Having this word makes me regard the trees more as individuals. Before, I would just call them all ‘oak’ as if they were a species and not individuals. That’s how we learn it in dendrology, but using *ki* makes me think of

them each, as not just ‘oak,’ but as that particular oak, the one with the broken branch and the brown leaves.”

Despite their very brief introduction to *ki* and *kin*, the students get right to the heart of the words’ implications: “I imagine that this would be a challenge for most religious people,” Paul says. “It kind of knocks humans off the pedestal of being the only ones with souls.” Indeed, Christian missionaries were the spearhead of language suppression in indigenous cultures and were among the prime architects of the Indian-boarding-school movement. War on a language of animacy and relationship to the natural world was essential to the dual mission of religious and economic conversion. Certainly the biblical mandate for human subjugation of the creation was incompatible with indigenous languages.

Another student, Kieran, observes, “Using these words as I walk around opened my eyes to how we are all connected. When you start using *ki* and *kin*, you will feel remorseful that all of your life you took them for granted.”

Ecopsychologists have suggested that our conceptions of self as inherently separate from the natural world have negative outcomes on the well-being of humans and ecosystems. Perhaps these words can be medicine for them both, so that every time we speak of the living world we breathe out respect and inhale kinship, turning the very atmosphere into a medium of relatedness. If pronouns can kindle empathy, I want to shower the world with their sound.

The most outspoken students voice some enthusiasm for the new pronouns, but the quiet skeptics save their reservations for the writing assignment when we are back in class. One student puts it this way: “This is a warm-hearted and generous idea, but it will never work. People don’t like change and they will be pissed off if you try and tell them how to talk. Most people don’t want to think of nature as being as good as them.” One student writes in a scrawl that carries his impatience in every half-formed letter: “If changing the world is what you’re after, do something real.

Volunteer at the food bank, plant a tree. Dreaming up pronouns is a major waste of time.”

This is why I love teaching, the way we are forced to be accountable.

The abstraction of “dreaming up pronouns” does seem fruitless during a time in our nation’s history when the language of disrespect is the currency of political discourse. American nationalism, to say nothing of human exceptionalism, is being elevated as a lofty goal, which leaves little room for humility and ecological compassion. It seems quixotic to argue for respect for nonhuman beings when we refuse to extend it to human refugees. But I think this student is wrong. Words do matter, and they can ripple out to make waves in the “real” world.

The ecological compassion that resides in our indigenous languages is dangerous once again to the enterprise of domination, as political and economic forces are arrayed against the natural world and extractive colonialism is reborn under the gospel of prosperity. The contrast in worldview is as stark today as it was in my grandfather’s time, and once again it is land and native peoples who are made to pay the price.

If you think this is only an arcane linguistic matter, just look to the North Dakota prairie where, as I write this, there are hundreds of people camping out in a blizzard enduring bitter cold to continue the protective vigil for their river, which is threatened by the construction of the Dakota Access Pipeline and the pipeline’s inevitable oil spills. The river is not an *it* for them—the river lies within their circle of moral responsibility and compassion and so they protect *ki* fiercely, as if the river were their relative, because *ki* is. But the ones they are protecting *ki* from speak of the river and the oil and the pipe all with the same term, as if “it” were their property, as if “it” were nothing more than resources for them to use. As if it were dead.

At Standing Rock, between the ones armed with water cannons and the ones armed with prayer, exist two different languages for the world, and that is where the battle lines are being drawn. Do we treat the earth as if *ki* is our relative—as if the earth were animated by being—with reciprocity and reverence, or as stuff that we may treat with or without respect, as we choose? The language and worldview of the colonizer are once again in a showdown with the indigenous worldview. Knowing this, the water protectors at Standing Rock were joined by thousands of non-native allies, who also speak with the voice of resistance, who speak for the living world, for the grammar of animacy.

Thankfully, human history is marked by an ever-expanding recognition of personhood, from the time when aboriginals were not seen as human, when slaves were counted as three-fifths of a person, and when a woman was worth less than a man. Language, personhood, and politics have always been linked to human rights. Will we have the wisdom to expand the circle yet again? Naming is the beginning of justice.

Around the world, ideas of justice for nature are emerging in political and legal arenas. In New Zealand, when the Whanganui River was threatened, indigenous Maori leadership earned protection for the sacred waters by getting the river declared a legal “person” with rights to its own well-being. The constitutions of indigenous-led Ecuador and Bolivia enshrine the rights of Mother Nature. The Swiss amended their constitution to define animals as beings instead of objects. Just last year, the Ho-Chunk Nation in Wisconsin amended its tribal constitution, recognizing that “ecosystems and natural communities within the Ho-Chunk territory possess an inherent, fundamental, and inalienable right to exist and thrive.” This legal structure will allow the tribe to protect its homelands from mining for fracking sand and fossil fuel extraction because the land will have legal standing as a person. Supported by the revolutionary initiatives of the Community Environmental Legal Defense Fund, the burgeoning Rights of Nature movement is flowering from the roots of

animacy, from the personhood of all beings. We'll need a new pronoun for that.



THE STUDENTS COMMENT that they'd like to use *ki* and *kin*, but stumble over the changes in phrasing. "This would be much easier if I'd learned it as a child," they say. They're right of course. Not only because language patterns are established early in development, but because children quite naturally speak of other beings as persons. I delight in listening to my grandson, who like most toddlers watching a butterfly flit across the yard says, "He is flying," or "She sits on a flower."

Children speak at first with a universal grammar of animacy, until we teach them not to. My grandson is also completely smitten with bulldozers and will watch them endlessly, but despite their motion and their roar he is not confused as to their nature: he calls them “it.”

I am also introducing him to Potawatomi words. In honor of the language that was taken from his great-grandfather, I want to give that language back to my grandson, so he will never be alone in the world and live surrounded by kin. He already has the basics of animacy; he hugs trees and kisses moss. My heart cracked with happiness when he looked up from the blueberries in his oatmeal and said, “*Nokomis*, are these *minan*?”

He’s growing up in a time when respect among peoples has grown threadbare and there are gaping holes in the fabric of life. The mending we need will require reweaving the relationship between humans and our more-than-human kin. Maybe now, in this time when the myth of human exceptionalism has proven illusory, we will listen to intelligences other than our own, to kin. To get there, we may all need a new language to help us honor and be open to the beings who will teach us. I hope my grandson will always know the other beings as a source of counsel and inspiration, and listen more to butterflies than to bulldozers. ○

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Saving the Whanganui: can personhood rescue a river?

The Guardian travelled the length of the Whanganui in New Zealand to investigate whether new legal protections will make a difference

by Jeremy Lurgio in Whanganui

Fri 29 Nov 2019 14.00 EST

Adam Daniel wades waist deep through the glassy water. Pumice stones

spiral in the shallow eddy, while the shrill whistles of a male whio (blue duck) echo upstream through the green canyon walls. The mountain stream's deep current slows around a lone tree standing on a small rocky island before rushing toward the sea.

Like a doctor, Daniel spends the morning checking the pulse of the river's upper arteries, taking temperature readings and drawing water samples to diagnose its vitality. Thirty kilometres to his south-east, the Whanganui River's pristine headwaters begin in the internationally renowned Tongariro National Park, on the western flanks of three cone volcanoes, Ruapehu, Tongariro and Ngauruhoe.

From there the river carves through two national parks, a national forest, farmland, two large towns and many smaller communities on its journey 260km to the south, where it empties into the Tasman Sea.

But the body of water flowing past Daniel is more than a geographical feature. Granted personhood in 2017 by an act of the [New Zealand](#) parliament, the Whanganui is the first river in the world to be recognised as an indivisible and living being.

The Māori tribes that live along the Whanganui have always seen the river as sacred – its waters have nourished and blessed the people throughout the 700 years they have lived beside it. The law set in motion new intentions to uphold the mana (prestige) and mauri (life force) of the river.

This river is our river. It is all of ours, and how we look after it belongs to all of us.

Whanganui elder John Maihi

Yet despite the river's new legal status, it still faces challenges from farming and forestry to dams and development. And Daniel – a biologist charged with monitoring river habitat health – is troubled with recent temperature and clarity readings.

The river is sick, and he needs to know where the illness begins.

Defining the river's rights

Spring rain cascades down the Ngapuwaiwaha Marae's decorative roofline in Taumarunui, the first large town the Whanganui River meets. Hundreds gather at 8am to celebrate the river, the new act and the inauguration of the two people selected to speak on behalf of the river: Dame Tariana Turia, an influential Māori political leader, and Turama Hawira, an experienced Māori advisor and educator.

Visitors await the powhiri, a ritual welcoming people to the marae, a fenced-in complex of carved buildings belonging to a particular tribe.

As the rain subsides, Gerrard Albert steps up to the microphone. He is one in a long line of leaders who have fought for recognition of their deep relationship to the river since the 1840 signing of the Treaty of Waitangi, New Zealand's founding document. He addressed the crowd in Māori and then in English.

“The settlement legislation recognises Te Awa Tupua as this: a living and indivisible whole comprising the Whanganui River from the mountains to the sea, incorporating its tributaries and all its physical and metaphysical elements,” Albert says. “For the first time, a framework stems from the intrinsic spiritual values of an indigenous belief system.”

When the New Zealand parliament passed the Te Awa Tupua Act granting the Whanganui River system legal personhood, the decision sent waves across the globe, settling the longest water dispute in the nation's history and establishing a unique legal framework rooted in the Māori worldview of the Whanganui tribes, who revere the river as a tupuna, or ancestor.

The law begins by recognising the river as an indivisible and living being called Te Awa Tupua and outlines four core principles from the tribes' perspective, including their inalienable connection to the river. Then, it states this being “has all the rights, powers, duties and liabilities of a legal person”.

Tom Barraclough, a legal researcher and expert on the Te Awa Tupua law, says the legislation will give tribes “significant influence” over the future of the river. “As a consequence of giving iwi greater rights, there may be greater protection for nature.”

Dr Erin O'Donnell, a senior fellow at the University of Melbourne law school and author of a book on river rights, agrees. “The act shifts us away from this resource construction where we ask, ‘what do we want from the river?’ and into a space where we can say, ‘what do we want for the river and how do we get there with the river?’”

Over the course of six months, the Guardian travelled the Whanganui to investigate the impact of the new protections – and good intentions.

“You are defining, essentially, the river’s rights,” Albert says. “It puts the river at the centre of the picture and asks us to organise around it.”

This view isn’t unique in the larger legal framework of New Zealand. In 2014, New Zealand gave the same rights to a former national park, Te Urewera, and soon after Mount Taranaki as well.

The trend has also taken hold outside the country. In February 2019, citizens of Toledo, Ohio, granted legal rights to Lake Erie – a fight that began after a 2014 toxic algae bloom shut down city water for three days. India recognised the Ganges and Yamuna rivers as legal entities in 2017, but those rights were overturned. In July 2019, Bangladesh joined suit and granted all of its rivers this same status. And in September the Yurok Tribe in California granted personhood to the Klamath River.

But it’s unclear whether it will work. In the case of Te Awa Tupua, the hard work lies downstream, where the river and its branches encounter development, farming, forestry and run-off which challenge its health and ecology.

Water woes are not unique to the Whanganui River - similar concerns exist across the country. A 600-page Waitangi Tribunal report released last August criticised the government’s Resource Management Act for allowing “a serious degradation of water to occur in many ancestral water bodies”. It highlighted the government’s failure to recognise Māori rights and interests in water. It recommends sweeping changes for both.

Today, those gathered in Taumarunui are celebrating the first step, as the two voices of the river begin meeting with the communities along it to build a strategy that addresses the body of water as an indivisible whole. However, Albert says the law will take years to have an impact.

A fine balance

Despite the Whanganui’s new legal status, it still faces challenges from farming and forestry to dams and development. Near the river’s source at Tongariro National Park, Dave Pickett looks below the surface of the Mangatepopo Stream with a bathyscope. Knee deep in the swift current of this Whanganui tributary, he measures small bugs and algae life clinging to the river bottom, one gauge of a river’s health. He shouts numbers to his colleague.

The men are conducting ecology assessments for Genesis Energy, the company that operates the Tongariro Power Scheme that provides 4% of New Zealand’s energy. The hydropower system diverts the water of the Whanganui River and five of its upper tributaries, including the Mangatepopo. Pickett surveys the stream’s health above and below an intake structure which draws 75% of the water, leaving 25% to flow back into

the river. The intake is just outside the park, 15km from the stream's source and 15km from its confluence with the Whanganui.

The contractors join Campbell Speedy, the environmental coordinator and ecologist working for Genesis. He knows bugs, fish, ecology and the watershed. And he understands the environmental impacts of energy development and the complex cultural landscape of the river.

"This landscape behind us here is Tongariro National Park," Speedy says. "It's got dual world heritage status, not only for its volcanic landscape but for its cultural landscape. The water's coming off a pristine environment. It doesn't get much better than what we're seeing right here."

But like Daniel, Speedy knows the river faces complex issues downstream.

New Zealand's clean, green image has been mired with reports signalling major water quality issues in many of its rivers. In particular, water quality data from the National Institute of Water and Atmospheric Research shows the lower Whanganui River is often badly contaminated with fecal bacteria and fine sediment from extensive farming on its steep slopes and on the slopes of many of its tributaries.

In addition to these threats, many point the finger at hydropower.

Since the 1970s the power scheme has harnessed energy from these rivers, often leaving the river beds dry below the intakes. In 2004, when Genesis was granted rights to use this water for 35 more years, it came with stipulations requiring the company to keep a certain amount of water in the Whanganui and Mangatepopo. The minimum flows were set to a level to maximise whio food production and food access. Speedy says this aimed to improve the ecology of the Mangatepopo stream and the Whanganui River – leading to healthy levels of bugs and algae, and a water level optimal for the ducks to thrive.

These methods and serious predator eradication programs are working. Speedy says 500 of New Zealand's 3,000 blue ducks are in this watershed, four times more than in 2001.

Yet the scheme's viability depends on water. The power company takes only 7% of the entire Whanganui River, but it's the clearest, cleanest, coldest water at the head. That water is pushed through tunnels, canals, lakes and power stations until it eventually flows into an entirely different river system. On average, only 20% of the Whanganui's headwaters flow past the intake structure to the sea.

To the tribes that hold this river sacred, this causes environmental, cultural and spiritual damage. They categorically oppose the extraction of their river's water, and though the new law gives the river newfound rights, it does not reverse pre-existing laws, including the consent granting Genesis the rights to divert water for hydroelectric power until 2039.

Speedy walks across a massive diversion culvert carrying water from the upper tributaries to the power station. He looks down at the narrow Whanganui River below.

“The energy in this river ... can be used for electricity, but it also energises the cultural and spiritual values of this landscape, [which is] very important to Māori,” he says. “It energises biodiversity, in the form of animals and fish, like whio and eels, angling for trout fishermen, kayaking, rafting.”

But it is a delicate balance for the country of nearly 5 million people.

“There’s a whole lot of uses from this energy that’s flowing past us here,” Speedy says. “And it’s important to strike that balance between renewable energy to run our society and our economy, but not wreck the environments that we take the energy from.”

‘More dirt than there should be’

Thirty kilometres downriver, Adam Daniel, who works for Fish & Game New Zealand, ploughs through a narrow tunnel of sopping wet ferns and gorse with his quad bike. He checks the GPS and navigates deeper into the steep undulating bush country of the 20,000-hectare Tongariro Forest [Conservation](#) Area.

Daniel is on a multi-day adventure collecting water samples on the Whanganui’s upper tributaries. He is using money raised from increased foreign angler licences and Genesis Energy funding intended to mitigate some of its environmental impacts to conduct a two-year water quality study on the upper river.

Previous studies alerted Daniel that the Whanganui River is far dirtier than its tributary the Whakapapa River, even though they both start in the national park. So every month – rain, shine or snow – he visits 16 backcountry study areas to gather water samples and log electro-conductivity and temperature readings.

“We’ve recognised the turbidity in the river is really high – there’s more dirt than there should be,” says Daniel, whose job is to protect river habitat. “So I am trying to identify the catchments [watersheds] here in the upper end of the Whanganui that have high loads of sediment.”

More than halfway through his study, Daniel became alarmed. He was in the back-country preparing to drift down the upper river in a wetsuit to count fish. He waded into the river and looked down.

The energy in this river ... also energises the cultural and spiritual values of this landscape.
Campbell Speedy

The Whanganui River had less than a metre visibility (the neighbouring Whakapapa River still had seven metres of visibility).

Daniel hiked every stream on the upper river – they were clear. However, when he checked the stream below the large discharge pipe from Lake Otamangakau, the picture became clearer.

Genesis Energy diverts 80% of Whanganui’s headwaters into the Lake Otamangaka. During low flows in summer, up to three cubic metres of cool water is discharged from

the lake. Those flows are intended to help trout, whio and other species during stressful hot weather, but Daniel is concerned it may not be working as intended.

“They can take nearly the entire river of crystal-clear cold water and run it through their man-made lake to keep fish alive, then dump the mixed water with algae and sediment back in the river,” Daniel says.

This drastic change in visibility, coupled with higher water temperatures, has major impacts on the river’s downstream habitat and the non-native trout and other native fish that rely on cold, clean water to thrive in the critical hot and dry summer months.

“We are arguing that their consent condition does not exempt them from the temperature change and that the discharge is clearly having an impact on the river, so they should stop,” Daniel says.

Nigel Clarke, the executive general manager of wholesale operations at Genesis, says the company is compliant with the regulations. “Genesis is committed to the principle of kaitiakitanga; water is essential to our country, our business and to the communities we operate in.

“In complex locations like the Tongariro Power Scheme where there are multiple users of water, we work closely in partnership with local iwi and local communities to positively influence and improve the ecological health and mauri of our waterways.

“Genesis operates the Tongariro Power Scheme in line with resource consents and always welcomes the opportunity to better understand any potential effects of its operations.”

Speedy maintains the turbidity “is not massive ... there is some discolouration. It’s not crystal clear but it’s not real dirty brown either.”

But he says Genesis is looking into the issue. “We are going to implement a regime this summer where we do more sampling, where we try and tease out the difference between the various components of the turbidity.”

‘The river is our playground, the river is our work’

The Whanganui has ‘always been a part of us’, Josephine Haworth says. ‘It always will be, until the day we die.’

Some 145km downstream, Josephine Haworth and her husband operate Whanganui River Adventures. They live in Pipiriki, a small village 85km from the sea. The town is nestled in the lush green hills on a curved bend in the river at the southern edge of Whanganui National Park – home to the famous Whanganui Journey, a five-day, 145km canoe trip through the park. Haworth is from the Whanganui tribes and is the third generation of her family to operate a tour business on the river. Her husband grew up here and his family has been in the business since the 1970s.

“The river is nothing new,” Haworth says about the river that runs through her backyard. “It’s always been a part of us. It always will be, until the day we die.”

But the river here is often the colour of chocolate milk from the myriad tributaries that swell with rain and carry soil and sediment from the forest and farm country. The streams bring water, but they also bring sediment and E coli. That’s a concern for the about 18,000 people who canoe it each year. The Haworths lives are intertwined with the river, so it concerns her too.

It’s always been a big part of our lives growing up. The river has always been us.
Josephine Haworth

When it comes to the river’s personhood, she says it’s hard to explain because the river has always been a big part of her family’s lives. “The river is our food source, the river is our playground, the river is our work. It’s always been a big part of our lives growing up. The river has always been us.”

A place to grow

A canoe on the river, areas of which are home to kayaking, rowing and clubs for waka ama, traditional outrigger canoes.

In the town of Whanganui near the river’s mouth, Howard Hyland hosed thick mud off the cement boat ramp connecting the Whanganui River Outrigger Canoe Club’s boathouse to the river. The 76-year-old New Zealander is a national coach and paddler for waka ama, traditional outrigger canoes.

Here, near the sea, the river is wide, slow and steady – home to kayaking, rowing and waka ama clubs. Hyland returned from Whakatane to his roots on the river to start a waka ama club for youth.

“I wanted to start a club that was for all peoples, not just for Māori, not just for pākehā, not just for islanders. I wanted it for all of Whanganui,” he says.

Hyland is connected to the river through his grandmother. When he was four years old, he learned to paddle the waka while she fished. Through her love of the river, he became involved in the river and the sport.

Waka on the Whanganui: the outrigger canoeists taking care of the river – video

A paddler calls out “hup”, signalling the paddlers to switch sides in unison as the team paddle up the river past Hyland. Hyland sees the macro and micro problems the river faces. The biggest issue, he says, is the siphoning of the headwaters for power, but he also details the simple problem of polluting.

“You watch these kids, you see they bring back all the plastics that they see on the river,” Hyland says with a hint of pride. “It tells you they have learned something while they’ve been here. They understand we’ve got to stop polluting the river.”

For Hyland, the river is a vehicle to train good paddlers and good people who care for the river. The river provides his rowers with a place to succeed, a place to grow and a place to find solace at 5:30am as the sun casts first light across the river's mist.

While the paddlers disappear up river, Howard shares the whakatauki, or philosophy, shared by those connected to the river.

If you give the river a voice, are you going to listen? *Howard Hyland*

This river is now Te Awa Tupua. The new status offers New Zealand a framework to chart a new course to protect the Whanganui River and provide the world with a blueprint for caring for the earth's arteries.

Barracrough says there are now guardians who can argue for the river in court, if its rights are infringed. The law doesn't offer iron-clad protections, but "it does mean that it stands a better chance."

O'Donnell agrees. "It definitely has power to drive long-term change. How it holds people to account, I think that is going to be the tricky part."

Hosing off the last mud from the ramp, Hyland wonders what the future will bring for his beloved river. "If you give the river a voice, are you going to listen?"

The International Union for Conservation of Nature (IUCN) is a membership Union uniquely composed of both government and civil society organisations. By harnessing the experience, resources and reach of its more than 1,400 Member organisations and the input of some 15,000 experts, IUCN is the global authority on the status of the natural world and the measures needed to safeguard it.

Story | 25 Jan, 2018

In the spirit of nature, everything is connected Chantal van Ham

To bring the natural system into balance, a new economy that is sustainable and respects the limits of natural resources and the functions of ecosystems is fundamental. This requires a shift in how we value, use and dispose of resources, creating a circular system, as in nature.

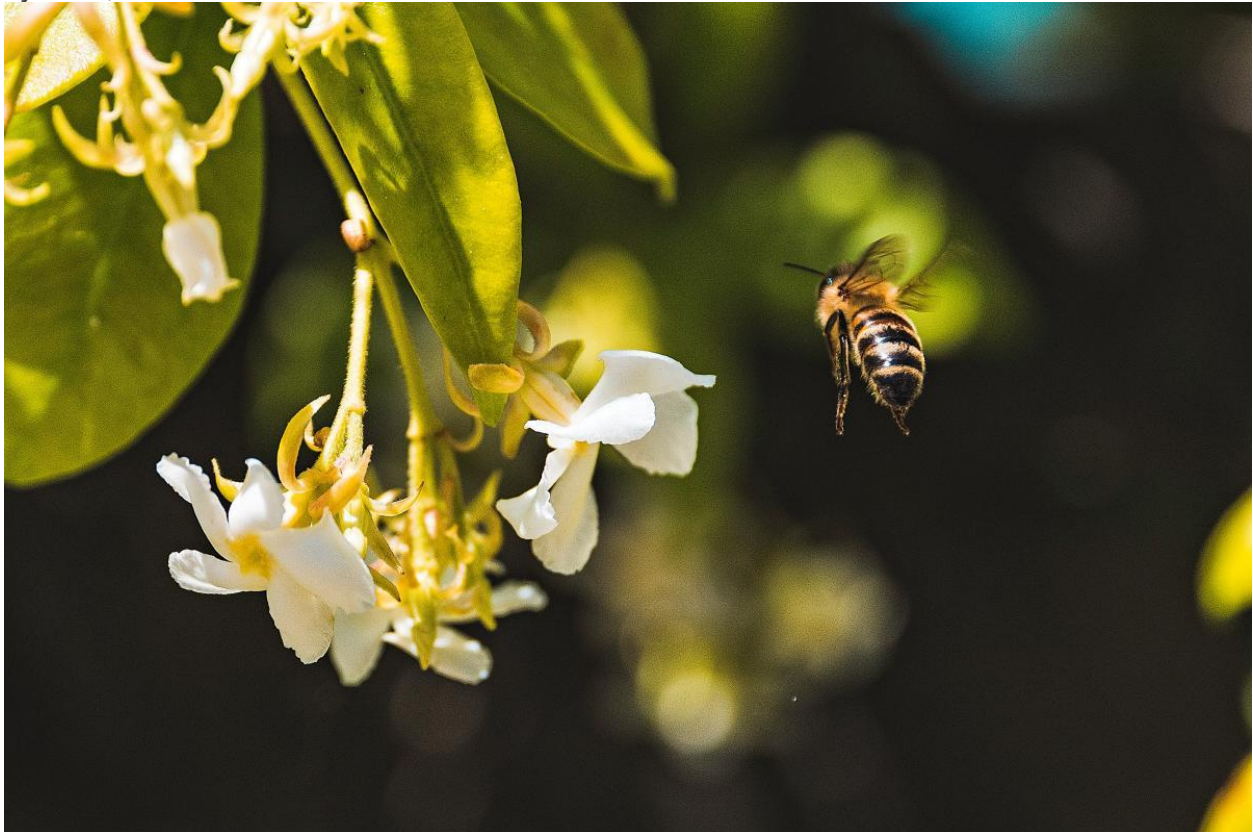


Photo: Andrea Sonda

Earth's ecosystems have evolved for millions of years, resulting in diverse and complex biological communities living in balance with their environment. Since the 16th century, human activity has impacted nature in practically every part of the world, wild plants and animals are at risk of extinction, deforestation and land degradation are causing water scarcity and erosion, and climate change leads to acidification of oceans.

In countries like Bangladesh and India, for example, the clearing of forests causes deadly [floods during the monsoon season](#). To bring the natural system into balance, a new economy that is sustainable and respects the limits of natural resources and the functions of ecosystems is fundamental. This requires a shift in how we value, use and dispose of resources, creating a circular system, as in nature.

Urban planning would benefit tremendously if it recognised the connection between cities and their natural surroundings. Most of us do not realise that what we use is directly related to the natural balance on the planet. Almost all consumer goods contain minerals and metals: a mobile phone can contain 50 different materials, but no country is self-sufficient in these materials and all too often this global trade comes with an environmental and social cost. A growing use of synthetic fertilizer to increase food production now sustains about half of the world's population but also causes pollution of air, water, and soils, and fossil fuels provide energy to many but only at the cost of rising atmospheric CO₂ concentrations and global warming (WWF Living Planet Report, 2016).



Photo: Chantal van Ham

Cities like Portland, US, point to ways for people and nature to coexist
[Earth Overshoot Day](#), a concept developed by the Global Footprint Network, calculates when the people on Earth have consumed the globe's renewable resources for the year. This day falls earlier and earlier every year. In 2017 it was on the 2nd of August, whereas 15 years earlier, it was on the 19th of September. This shows the incredible speed at which we are using natural resources, such as air, water, fish stocks and food crops, minerals and other valuable materials extracted from the earth. The natural capital of the planet is limited, and a better understanding of the connections between people and nature can help to restore the balance.

The circle of life

Ecosystems consist of living organisms interacting with the non-living elements in their environment, such as soil, atmosphere, water, and heat and sunlight, in ways that are essential for their survival. We all know that trees produce the oxygen we breathe, but most of us do not know that our oceans are at least as important for producing healthy air. Another example is that over 500 plant species rely on bats to pollinate their flowers, including species of mango, banana, and cocoa. Like birds, some bats play a critical role in spreading the seeds of trees and other plants and also help to reduce the number of mosquitos ([Bat Conservation Trust](#)).

Alexander Von Humboldt, the 18th-century scientist and explorer, world famous in his time, was the first to explain the fundamental functions of the forest for the ecosystem and climate, claiming that the world is a single interconnected organism. This is the concept of nature as we know it today. According to Von Humboldt, everything, to the smallest creature, has its role and together makes the whole, in which humankind is just one small part (Andrea Wulf, 2015).

What if we would celebrate nature, the way we celebrate Christmas around the world? Planting trees and visiting seeds markets and natural history museums, gazing at the stars, exploring nature areas near and far from our home, bringing light to rivers, oceans and mountains, and celebrating natural diversity, instead of buying presents that end up in full cupboards and drawers, shipping the most exotic food around the world and extracting valuable resources from the earth.

As Stephanie Pincetl, explained in her essay ["Inhabiting a Post-Urban Twenty-First Century"](#): earth resources are treated as inputs, not assets with which humans are not engaged and responsible for, thus ensuring on-going existence of both the resource and human well-being. Currently, the environment is an abstraction, not a living, reacting, and creating life force with which we are in a co-productive relationship.

Contrary to what Milton Friedman (1962) believed, ecological values are not finding their place in the market, which explains why they are vastly underrated and exploited. Even more, the economic system is failing to value our natural and social capital. Sixteen percent of the US Forest Service budget used to be for fire suppression, now it is 50 percent. Instead of proactively managing the forests to reduce the risk of fire, the Forest Service has to use funds meant for other purposes, such as restoration to control blazes. Another example is that there is no bailing out of home owners who are facing a growing number of climate-related flooding events. Eighty percent of the home owners in Houston, who were affected by Hurricane Harvey, had no insurance.

If we look at food production, healthy soil is critical, not only for water and food crops, but also to clean and store water, support biodiversity, and regulation of climate. If we think of the web of life, soil perfectly demonstrates the interconnectedness of nature. Organic matter in soil, such as decomposing plant and animal residues, stores more carbon than do plants and the atmosphere combined (Stanford Earth School). It is hard to imagine that a single teaspoon of healthy soil can contain more organisms (e.g., bacteria and fungi) than there are people on the planet (United States Department of

Agriculture), a foundation of life (Oregon State University). Better soil management can solve a lot of today's challenges, even though there is hardly any attention given to it in landscape management and agriculture.

There is a lot of potential in getting a better understanding of these regenerative natural processes to learn how to design a more sustainable society and future-proof business models. There are a variety of ways to stimulate this learning, ranging from early childhood experience of nature, integrated natural resource management, bringing nature to schoolyards and in education programmes and the use of one of the most powerful engines of change of this century: social media.

Can nature make the headlines?

The International Union for the Conservation of Nature's [Red List](#) has assessed around 85,000 species of which almost 25,000 face extinction. According to the WWF Living Planet Report 2016, loss and degradation of habitat and climate change are the main threats for the loss of species. As the rate of extinction is going at a faster speed than ever before, understanding the reasons for the decline of animal and plant species is essential to protect them and the future of human life.

On 26 September 2016, the last Rabbs' fringe-limbed treefrog died in the Atlanta Botanical Garden. His name was Toughie. The species lived in [Panama](#) before it became extinct in the wild as a result of habitat destruction and the amphibian disease, chytrid fungus. The Guardian wrote an interesting [article](#) last year that highlighted how the extinction of a frog species gets little attention in the media. If this single frog species is looked at in the context of declining amphibian populations and the mass extinction crisis described by researchers in 2015 in a paper lead by Mark Williams from the University of Leicester, called "[The Anthropocene biosphere](#)" many more species could become the last of their kind due to human actions. If frogs do not make headlines, one could wonder about other species, for example lions admired by all, shown in children's books and movies, and show-stoppers in the zoo. However, what most people do not know is that in the wild, the lion population declined by approximately 43 percent between 1993 and 2014 (IUCN Red List).

As humans and nature are inextricably coupled, and people depend on the plants, animals and microorganisms that supply important ecosystem services, it is really important to find ways to reach the minds and hearts of all people and to create a better understanding of nature and what loss of biodiversity means.



Photo: Chantal van Ham

March for Science, 2017

It is clear that science alone will not do the trick. What is promising though is the revelation of processes that influence policy through internet and social media. It has a power that is stronger than ever, bringing out into the open what remained hidden for a long time and facilitating analysis of data, interactions and flows of information in a mind-boggling way.

The WWF Living Planet Report 2016 presents an example of an integrated landscape approach to help reconcile competing objectives of economic development and environmental sustainability. Lake Naivasha is Kenya's second largest freshwater body which supports a large horticulture industry, representing about 70 percent of Kenya's cut-flower exports as well as a fishing industry, a growing tourism and holiday homes sector, and dairy and beef industries. The lake is home to a growing human population and is recognized for its rich biodiversity. A severe drought in 2009 was a wake-up call to develop an integrated approach to natural resource management. Formerly antagonistic stakeholders came together to develop a common vision for the Lake Naivasha basin, and this process was supported by political commitment. This led to an action plan that included a payment for environmental services scheme in which stakeholders in the lower reaches of the catchments offer small incentive payments to upstream smallholders for carrying out good land-use practices.

Another inspiring example is that Paris is transforming school playgrounds into green public spaces as part of the cities' resilience strategy. The first step consists of taking out the concrete and the asphalt, using more sustainable materials, greenery, and water in the schoolyards and using them as an educational programme for children about climate change. The second step is to open 600,000 square metres of schoolyards to the public.



Photo: Chantal van Ham

Mural at bus station at Playa del Carmen, Mexico

In May 2015, WWF-Hong Kong launched a [project to discover biodiversity in Hong Kong wetlands](#). With the help of many experts and volunteer citizen scientists, the number of plant and animal species recorded in this area rose to over 2,050. This project has helped raise awareness of biodiversity among the public in one of the world's most urbanized areas and biodiversity hotspots and helps with the future management of the area. The project was funded by HSBC, who have been funding WWF's wetland conservation work since 1999, in the belief that economic development should be underpinned by the health of the world's ecosystem and resources.

An example that demonstrates how nature can become part of the life of urban citizens is the Island Bay Marine Education Centre in Wellington, New Zealand. The city is located on a peninsula and has a marine reserve along its beach, 6 kilometres from the city centre. The reserve brings nature into close proximity of citizens and many, including the mayor, speak passionately about the connections with nature and protecting the sea and marine environment (Beatley, 2014).

How can each and every one of us help shift the balance?

In a time when we often see that scientific disciplines become more specialized, the lessons from Alexander Von Humboldt to understanding nature in a holistic way are as relevant today as they were back in the 19th century.

Restoring the natural cycle and ecological functions of soil, water and nutrients are key, as well as new ways to measure development beyond GDP, capturing the value of nature. How does this link to the world's cities?

To make a transition toward an economic model that is in balance with nature requires solid knowledge and understanding of the linkages between environmental wellbeing and quality of urban life, economic development, climate change, as well as continuous monitoring of biodiversity and ecosystems and their services at all levels, within and around cities.

The extensive green spaces found in many cities are often part of an integrated network that links them to forests and other natural ecosystems far outside the city. To ensure this interconnectivity at the governance level, local authorities have a lot to win when they pursue the protection and management of natural resources and landscape planning, creating multiple benefits for citizens.

The **City Parks Alliance** in the U.S. is a wonderful nationwide initiative that shows there is a growing interest among city leaders to invest in creating space for nature in urban areas for health, economic reasons and the environment.

For urban planners and decision makers it is essential to work across disciplines and city departments to find common ground to integrate nature-based solutions in urban planning, design and development. This starts by creating a better understanding of the natural assets.



Photo: Chantal van Ham

Interesting examples, such as [a Corporate Natural Capital Account](#), developed by The London Borough of Barnet, provide evidence to quantify the economic, social and environmental benefits of its green infrastructure assets. This account shows the

enormous value of parks and open spaces for the wellbeing of the residents. The total value of these benefits is estimated at more than £1 billion over the next 25 years, with the costs of maintaining them estimated at £72 million.

Ecosystem services need to be taken into account in planning and development processes. Creating ways for urban citizens to understand their connections with the natural surroundings, such as education centers, trails, spaces for recreation, school projects, maps of parks and biodiversity, increases their appreciation and willingness to become stewards of nature in and around their cities.

Solutions that combine ecology and economy, and innovative business models that create value based on the potential of circular systems, inspired by nature, are key for restoring the balance. This includes the restoration of damaged ecosystems and ecosystem services, halting the loss of priority habitats and significantly expanding the global protected areas network.

The most important mission of current and future generations is to make the shift that disentangles economic development from environmental degradation, to create a future that is in harmony with nature. Cities are excellent places to create this change, as they are full of innovative ideas, business opportunities, and creative minds. We need to become stewards of the planet, and as most of the examples above show, when we are able to bring back the motivation and imagination to protect and restore the wondrous connectivity of our natural world a lot of opportunities arise.

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A Road Map for Natural Capitalism

by Amory B. Lovins, L.Hunter Lovins and Paul Hawken

A version of this article appeared in the [July–August 2007](#) issue of *Harvard Business Review*.

Summary.

No one would run a business without accounting for its capital outlays. Yet in 1999, when this article was originally published, most companies overlooked one major capital component—the value of the earth’s ecosystem services. It was a staggering omission: Calculations at that time placed the value of those services—water storage, atmosphere regulation, climate control, and others—at \$33 trillion per year.

Not accounting for that cost has led to waste on a grand scale, the authors maintain. This article shows how a few farsighted companies, like DuPont and Xerox, were able to find powerful business opportunities in conserving resources on a similarly grand scale. Their early embrace of *natural capitalism* is even more important to emulate today.

Natural capitalism comprises four major shifts in business practices. The first involves dramatically increasing the productivity of natural resources—by as much as 100-fold. In the second stage, companies adopt closed-loop production systems that yield no waste or toxicity. The third stage requires a fundamental change of business model—from selling products to delivering services. For example, instead of selling lightbulbs, a manufacturer sells lighting services, with both the seller and the customer benefiting from the development of extremely efficient, durable bulbs. The last stage involves reinvesting in natural capital to restore, sustain, and expand the planet’s ecosystem.

Because natural capitalism is both necessary and profitable, it will subsume traditional industrialism, the authors argue, just as industrialism subsumed agrarianism. And the companies that are furthest down the road will have the competitive edge.

Editor’s Note: The unsettling warning this article delivers has only grown more urgent since 1999, when it first appeared in HBR. But the value here lies not so much in the alarm that sounds as in the vivid and sometimes startling reconceptualization of how we think about the environment and economic value.

The value to the economy of the services provided by the earth’s ecosystem—as distinct from the value of the natural resources we extract from it—runs into tens of trillions of dollars annually, say the authors. They provide numerous examples of companies that leverage this insight in the interest of their own bottom lines and the health of the environment as a whole.

On September 16, 1991, a small group of scientists was sealed inside Biosphere II, a glittering 3.2-acre glass and metal dome in Oracle, Arizona. Two years later, when the radical attempt to replicate the earth’s main ecosystems in miniature ended, the engineered environment was dying. The gaunt researchers had survived only because fresh air had been pumped in. Despite \$200 million worth of elaborate equipment, Biosphere II had failed to generate breathable air, drinkable water, and adequate food for just eight people. Yet Biosphere I, the planet we all inhabit, effortlessly performs those tasks every day for 6 billion of us.

Disturbingly, Biosphere I is now itself at risk. The earth's ability to sustain life, and therefore economic activity, is threatened by the way we extract, process, transport, and dispose of a vast flow of resources—some 220 billion tons a year, or more than 20 times the average American's body weight every day. With dangerously narrow focus, our industries look only at the exploitable resources of the earth's ecosystems—its oceans, forests, and plains—and not at the larger services that those systems provide for free. Resources and ecosystem services both come from the earth—even from the same biological systems—but they're two different things. Forests, for instance, not only produce the resource of wood fiber but also provide such ecosystem services as water storage, habitat, and regulation of the atmosphere and climate. Yet companies that earn income from harvesting the wood fiber resource often do so in ways that damage the forest's ability to carry out its other vital tasks.

Unfortunately, the cost of destroying ecosystem services becomes apparent only when the services start to break down. In China's Yangtze basin in 1998, for example, deforestation triggered flooding that killed 3,700 people, dislocated 223 million, and inundated 60 million acres of cropland. That \$30 billion disaster forced a logging moratorium and a \$12 billion crash program of reforestation.

The reason companies (and governments) are so prodigal with ecosystem services is that the value of those services doesn't appear on the business balance sheet. But that's a staggering omission. The economy, after all, is embedded in the environment. Recent calculations published in the journal *Nature* conservatively estimate the value of all the earth's ecosystem services to be at least \$33 trillion a year. That's close to the gross world product, and it implies a capitalized book value on the order of half a quadrillion dollars. What's more, for most of these services, there is no known substitute at any price, and we can't live without them.

This article puts forward a new approach not only for protecting the biosphere but also for improving profits and competitiveness. Some very simple changes to the way we run our businesses, built on advanced techniques for making resources more productive, can yield startling benefits both for today's shareholders and for future generations.

This approach is called *natural capitalism* because it's what capitalism might become if its largest category of capital—the “natural capital” of ecosystem services—were properly valued. The journey to natural capitalism involves four major shifts in business practices, all vitally interlinked:

- **Dramatically increase the productivity of natural resources.** Reducing the wasteful and destructive flow of resources from depletion to pollution represents a major business opportunity. Through fundamental changes in both production design and technology, farsighted companies are developing ways to make natural resources—energy, minerals, water, forests—stretch five, ten, even 100 times further than they do today. These major resource savings often yield higher profits than small resource savings do—or even saving no resources at all would—and not only pay for themselves over time but in many cases reduce initial capital investments.
- **Shift to biologically inspired production models.** Natural capitalism seeks not merely to reduce waste but to eliminate the very concept of waste. In closed-loop production systems, modeled on nature's designs, every output either is

returned harmlessly to the ecosystem as a nutrient, like compost, or becomes an input for manufacturing another product. Such systems can often be designed to eliminate the use of toxic materials, which can hamper nature's ability to reprocess materials.

- **Move to a solutions-based business model.** The business model of traditional manufacturing rests on the sale of goods. In the new model, value is instead delivered as a flow of services—providing illumination, for example, rather than selling lightbulbs. This model entails a new perception of value, a move from the acquisition of goods as a measure of affluence to one where well-being is measured by the continuous satisfaction of changing expectations for quality, utility, and performance. The new relationship aligns the interests of providers and customers in ways that reward them for implementing the first two innovations of natural capitalism—resource productivity and closed-loop manufacturing.
- **Reinvest in natural capital.** Ultimately, business must restore, sustain, and expand the planet's ecosystems so that they can produce their vital services and biological resources even more abundantly. Pressures to do so are mounting as human needs expand, the costs engendered by deteriorating ecosystems rise, and the environmental awareness of consumers increases. Fortunately, these pressures all create business value.

Natural capitalism is not motivated by a current scarcity of natural resources. Indeed, although many biological resources, like fish, are becoming scarce, most mined resources, such as copper and oil, seem ever more abundant. Indices of average commodity prices are at 28-year lows, thanks partly to powerful extractive technologies, which are often subsidized and whose damage to natural capital remains unaccounted for. Yet even despite these artificially low prices, using resources manyfold more productively can now be so profitable that pioneering companies—large and small—have already embarked on the journey toward natural capitalism.¹

Still the question arises—if large resource savings are available and profitable, why haven't they all been captured already? The answer is simple: Scores of common practices in both the private and public sectors systematically reward companies for wasting natural resources and penalize them for boosting resource productivity. For example, most companies expense their consumption of raw materials through the income statement but pass resource-saving investment through the balance sheet. That distortion makes it more tax efficient to waste fuel than to invest in improving fuel efficiency. In short, even though the road seems clear, the compass that companies use to direct their journey is broken. Later we'll look in more detail at some of the obstacles to resource productivity—and some of the important business opportunities they reveal. But first, let's map the route toward natural capitalism.

Dramatically Increase the Productivity of Natural Resources

In the first stage of a company's journey toward natural capitalism, it strives to wring out the waste of energy, water, materials, and other resources throughout its production systems and other operations. There are two main ways companies can do this at a profit. First, they can adopt a fresh approach to design that considers industrial systems

as a whole rather than part by part. Second, companies can replace old industrial technologies with new ones, particularly with those based on natural processes and materials.

Implementing whole-system design.

Inventor Edwin Land once remarked that “people who seem to have had a new idea have often simply stopped having an old idea.” This is particularly true when designing for resource savings. The old idea is one of diminishing returns—the greater the resource saving, the higher the cost. But that old idea is giving way to the new idea that bigger savings can cost less—that saving a large fraction of resources can actually cost less than saving a small fraction of resources. This is the concept of expanding returns, and it governs much of the revolutionary thinking behind whole-system design. Lean manufacturing is an example of whole-system thinking that has helped many companies dramatically reduce such forms of waste as lead times, defect rates, and inventory. Applying whole-system thinking to the productivity of natural resources can achieve even more.

Consider Interface, a leading maker of materials for commercial interiors. In its new Shanghai carpet factory, a liquid had to be circulated through a standard pumping loop similar to those used in nearly all industries. A top European company designed the system to use pumps requiring a total of 95 horsepower. But before construction began, Interface’s engineer, Jan Schilham, realized that two embarrassingly simple design changes would cut that power requirement to only seven horsepower—a 92% reduction. His redesigned system cost less to build, involved no new technology, and worked better in all respects.

What two design changes achieved this 12-fold saving in pumping power? First, Schilham chose fatter-than-usual pipes, which create much less friction than thin pipes do and therefore need far less pumping energy. The original designer had chosen thin pipes because, according to the textbook method, the extra cost of fatter ones wouldn’t be justified by the pumping energy that they would save. This standard design trade-off optimizes the pipes by themselves but “pessimizes” the larger system. Schilham optimized the *whole* system by counting not only the higher capital cost of the fatter pipes but also the *lower* capital cost of the smaller pumping equipment that would be needed. The pumps, motors, motor controls, and electrical components could all be much smaller because there’d be less friction to overcome. Capital cost would fall far more for the smaller equipment than it would rise for the fatter pipe. Choosing big pipes and small pumps—rather than small pipes and big pumps—would therefore make the whole system cost less to build, even before counting its future energy savings.

Schilham’s second innovation was to reduce the friction even more by making the pipes short and straight rather than long and crooked. He did this by laying out the pipes first, *then* positioning the various tanks, boilers, and other equipment that they connected. Designers normally locate the production equipment in arbitrary positions and then have a pipe fitter connect everything. Awkward placement forces the pipes to make numerous bends that greatly increase friction. The pipe fitters don’t mind: They’re paid by the hour, they profit from the extra pipes and fittings, and they don’t pay for the oversized pumps or inflated electric bills. In addition to reducing those four kinds of

costs, Schilham's short, straight pipes were easier to insulate, saving an extra 70 kilowatts of heat loss and repaying the insulation's cost in three months.

This small example has big implications for two reasons. First, pumping is the largest application of motors, and motors use three-quarters of all industrial electricity. Second, the lessons are very widely relevant. Interface's pumping loop shows how simple changes in design mentality can yield huge resource savings and returns on investment. This isn't rocket science; often it's just a rediscovery of good Victorian engineering principles that have been lost because of specialization.

Whole-system thinking can help managers find small changes that lead to big savings that are cheap, free, or even better than free (because they make the whole system cheaper to build). They can do this because often the right investment in one part of the system can produce multiple benefits throughout the system. For example, companies would gain 18 distinct economic benefits—of which direct energy savings is only one—if they switched from ordinary motors to premium-efficiency motors or from ordinary lighting ballasts (the transformer-like boxes that control fluorescent lamps) to electronic ballasts that automatically dim the lamps to match available daylight. If everyone in America integrated these and other selected technologies into all existing motor and lighting systems in an optimal way, the nation's \$220-billion-a-year electric bill would be cut in half. The after-tax return on investing in these changes would in most cases exceed 100% per year.

The profits from saving electricity could be increased even further if companies also incorporated the best off-the-shelf improvements into their building structure and their office, heating, cooling, and other equipment. Overall, such changes could cut national electricity consumption by at least 75% and produce returns of around 100% a year on the investments made. More important, because workers would be more comfortable, better able to see, and less fatigued by noise, their productivity and the quality of their output would rise. Eight recent case studies of people working in well-designed, energy-efficient buildings measured labor productivity gains of 6% to 16%. Since a typical office pays about 100 times as much for people as it does for energy, this increased productivity in people is worth about 6 to 16 times as much as eliminating the entire energy bill.

Energy-saving, productivity-enhancing improvements can often be achieved at even lower cost by piggybacking them onto the periodic renovations that all buildings and factories need. A recent proposal for reallocating the normal 20-year renovation budget for a standard 200,000-square-foot glass-clad office tower near Chicago shows the potential of whole-system design. The proposal suggested replacing the aging glazing system with a new kind of window that lets in nearly six times more daylight than the old sun-blocking glass units. The new windows would reduce the flow of heat and noise four times better than traditional windows do. So even though the glass costs slightly more, the overall cost of the renovation would be reduced because the windows would let in cool, glare-free daylight that, when combined with more efficient lighting and office equipment, would reduce the need for air-conditioning by 75%. Installing a fourfold more efficient, but fourfold smaller, air-conditioning system would cost \$200,000 less than giving the old system its normal 20-year renovation. The \$200,000 saved would, in turn, pay for the extra cost of the new windows and other improvements. This whole-system approach to renovation would not only save 75% of

the building's total energy use, it would also greatly improve the building's comfort and marketability. Yet it would cost essentially the same as the normal renovation. There are about 100,000 20-year-old glass office towers in the United States that are ripe for such improvement.

Major gains in resource productivity require that the right steps be taken in the right order. Small changes made at the downstream end of a process often create far larger savings further upstream. In almost any industry that uses a pumping system, for example, saving one unit of liquid flow or friction in an exit pipe saves about ten units of fuel, cost, and pollution at the power station.

Of course, the original reduction in flow itself can bring direct benefits, which are often the reason changes are made in the first place. In the 1980s, while California's industry grew 30%, for example, its water use was cut by 30%, largely to avoid increased wastewater fees. But the resulting reduction in pumping energy (and the roughly tenfold larger saving in power-plant fuel and pollution) delivered bonus savings that were at the time largely unanticipated.

To see how downstream cuts in resource consumption can create huge savings upstream, consider how reducing the use of wood fiber disproportionately reduces the pressure to cut down forests. In round numbers, half of all harvested wood fiber is used for such structural products as lumber; the other half is used for paper and cardboard. In both cases, the biggest leverage comes from reducing the amount of the retail product used. If it takes, for example, three pounds of harvested trees to produce one pound of product, then saving one pound of product will save three pounds of trees—plus all the environmental damage avoided by not having to cut them down in the first place.

The easiest savings come from not using paper that's unwanted or unneeded. In an experiment at its Swiss headquarters, for example, Dow Europe cut office paper flow by about 30% in six weeks simply by discouraging unneeded information. For instance, mailing lists were eliminated and senders of memos got back receipts indicating whether each recipient had wanted the information. Taking those and other small steps, Dow was also able to increase labor productivity by a similar proportion because people could focus on what they really needed to read. Similarly, Danish hearing-aid maker Oticon saved upwards of 30% of its paper as a by-product of redesigning its business processes to produce better decisions faster. Setting the default on office printers and copiers to double-sided mode reduced AT&T's paper costs by about 15%. Recently developed copiers and printers can even strip off old toner and printer ink, permitting each sheet to be reused about ten times.

Further savings can come from using thinner but stronger and more opaque paper and from designing packaging more thoughtfully. In a 30-month effort at reducing such waste, Johnson & Johnson saved 2,750 tons of packaging, 1,600 tons of paper, \$2.8 million, and at least 330 acres of forest annually. The downstream savings in paper use are multiplied by the savings further upstream, as less need for paper products (or less need for fiber to make each product) translates into less raw paper, less raw paper means less pulp, and less pulp requires fewer trees to be harvested from the forest. Recycling paper and substituting alternative fibers such as wheat straw will save even more.

Comparable savings can be achieved for the wood fiber used in structural products. Pacific Gas and Electric, for example, sponsored an innovative design developed by Davis Energy Group that used engineered wood products to reduce the amount of wood needed in a stud wall for a typical tract house by more than 70%. These walls were stronger, cheaper, more stable, and insulated twice as well. Using them enabled the designers to eliminate heating and cooling equipment in a climate where temperatures range from freezing to 113°F. Eliminating the equipment made the whole house much less expensive both to build and to run while still maintaining high levels of comfort. Taken together, these and many other savings in the paper and construction industries could make our use of wood fiber so much more productive that, in principle, the entire world's present wood fiber needs could probably be met by an intensive tree farm about the size of Iowa.

Adopting innovative technologies.

Implementing whole-system design goes hand in hand with introducing alternative, environmentally friendly technologies. Many of these are already available and profitable but not widely known. Some, like the “designer catalysts” that are transforming the chemical industry, are already runaway successes. Others are still making their way to market, delayed by cultural rather than by economic or technical barriers.

The automobile industry is particularly ripe for technological change. After a century of development, motorcar technology is showing signs of age. Only 1% of the energy consumed by today's cars is actually used to move the driver: Only 15% to 20% of the power generated by burning gasoline reaches the wheels (the rest is lost in the engine and drivetrain) and 95% of the resulting propulsion moves the car, not the driver. The industry's infrastructure is hugely expensive and inefficient. Its convergent products compete for narrow niches in saturated core markets at commodity-like prices. Auto making is capital intensive, and product cycles are long. It is profitable in good years but subject to large losses in bad years. Like the typewriter industry just before the advent of personal computers, it is vulnerable to displacement by something completely different.

Enter the Hypercar. Since 1993, when Rocky Mountain Institute placed this automotive concept in the public domain, several dozen current and potential auto manufacturers have committed billions of dollars to its development and commercialization. The Hypercar integrates the best existing technologies to reduce the consumption of fuel as much as 85% and the amount of materials used up to 90% by introducing four main innovations.

First, making the vehicle out of advanced polymer composites, chiefly carbon fiber, reduces its weight by two-thirds while maintaining crashworthiness. Second, aerodynamic design and better tires reduce air resistance by as much as 70% and rolling resistance by up to 80%. Together, these innovations save about two-thirds of the fuel. Third, 30% to 50% of the remaining fuel is saved by using a “hybrid-electric” drive. In such a system, the wheels are turned by electric motors whose power is made onboard by a small engine or turbine, or even more efficiently by a fuel cell. The fuel cell generates electricity directly by chemically combining stored hydrogen with oxygen, producing pure hot water as its only by-product. Interactions between the small, clean,

efficient power source and the ultralight, low-drag auto body then further reduce the weight, cost, and complexity of both. Fourth, much of the traditional hardware—from transmissions and differentials to gauges and certain parts of the suspension—can be replaced by electronics controlled with highly integrated, customizable, and upgradable software.

These technologies make it feasible to manufacture pollution-free, high-performance cars, sport utilities, pickup trucks, and vans that get 80 to 200 miles per gallon (or its energy equivalent in other fuels). These improvements will not require any compromise in quality or utility. Fuel savings will not come from making the vehicles small, sluggish, unsafe, or unaffordable, nor will they depend on government fuel taxes, mandates, or subsidies. Rather, Hypercars will succeed for the same reason that people buy compact discs instead of phonograph records: The CD is a superior product that redefines market expectations. From the manufacturers' perspective, Hypercars will cut cycle times, capital needs, body part counts, and assembly effort and space by as much as tenfold. Early adopters will have a huge competitive advantage—which is why dozens of corporations, including most automakers, are now racing to bring Hypercar-like products to market.²

In the long term, the Hypercar will transform industries other than automobiles. It will displace about an eighth of the steel market directly and most of the rest eventually, as carbon fiber becomes far cheaper. Hypercars and their cousins could ultimately save as much oil as OPEC now sells. Indeed, oil may well become uncompetitive as a fuel long before it becomes scarce and costly. Similar challenges face the coal and electricity industries because the development of the Hypercar is likely to accelerate greatly the commercialization of inexpensive hydrogen fuel cells. These fuel cells will help shift power production from centralized coal-fired and nuclear power stations to networks of decentralized, small-scale generators. In fact, fuel cell-powered Hypercars could themselves be part of these networks. They'd be, in effect, 20-kilowatt power plants on wheels. Given that cars are left parked—that is, unused—more than 95% of the time, these Hypercars could be plugged into a grid and could then sell back enough electricity to repay as much as half the predicted cost of leasing them. A national Hypercar fleet could ultimately have five to ten times the generating capacity of the national electric grid.

As radical as it sounds, the Hypercar is not an isolated case. Similar ideas are emerging in such industries as chemicals, semiconductors, general manufacturing, transportation, water and wastewater treatment, agriculture, forestry, energy, real estate, and urban design. For example, the amount of carbon dioxide released for each microchip manufactured can be reduced almost 100-fold through improvements that are now profitable or soon will be.

Some of the most striking developments come from emulating nature's techniques. In her book, *Biomimicry*, Janine Benyus points out that spiders convert digested crickets and flies into silk that's as strong as Kevlar without the need for boiling sulfuric acid and high-temperature extruders. Using no furnaces, abalone can convert seawater into an inner shell twice as tough as our best ceramics. Trees turn sunlight, water, soil, and air into cellulose, a sugar stronger than nylon but one-fourth as dense. They then bind it into wood, a natural composite with a higher bending strength than concrete, aluminum alloy, or steel. We may never become as skillful as spiders, abalone, or trees, but smart

designers are already realizing that nature's environmentally benign chemistry offers attractive alternatives to industrial brute force.

Whether through better design or through new technologies, reducing waste represents a vast business opportunity. The U.S. economy is not even 10% as energy efficient as the laws of physics allow. Just the energy thrown off as waste heat by U.S. power stations equals the total energy use of Japan. Materials efficiency is even worse: only about 1% of all the materials mobilized to serve America is actually made into products and still in use six months after sale. In every sector, there are opportunities for reducing the amount of resources that go into a production process, the steps required to run that process, and the amount of pollution generated and by-products discarded at the end. These all represent avoidable costs and hence profits to be won.

Redesign Production According to Biological Models

In the second stage on the journey to natural capitalism, companies use closed-loop manufacturing to create new products and processes that can totally prevent waste. This plus more efficient production processes could cut companies' long-term materials requirements by more than 90% in most sectors.

The central principle of closed-loop manufacturing, as architect Paul Bierman-Lytle of the engineering firm CH2M Hill puts it, is "waste equals food." Every output of manufacturing should be either composted into natural nutrients or remanufactured into technical nutrients—that is, it should be returned to the ecosystem or recycled for further production. Closed-loop production systems are designed to eliminate any materials that incur disposal costs, especially toxic ones, because the alternative—isolating them to prevent harm to natural systems—tends to be costly and risky. Indeed, meeting EPA and OSHA standards by eliminating harmful materials often makes a manufacturing process cost less than the hazardous process it replaced. Motorola, for example, formerly used chlorofluorocarbons for cleaning printed circuit boards after soldering. When CFCs were outlawed because they destroy stratospheric ozone, Motorola at first explored such alternatives as orange-peel terpenes. But it turned out to be even cheaper—and to produce a better product—to redesign the whole soldering process so that it needed no cleaning operations or cleaning materials at all.

Closed-loop manufacturing is more than just a theory. The U.S. remanufacturing industry in 1996 reported revenues of \$53 billion—more than consumer-durables manufacturing (appliances; furniture; audio, video, farm, and garden equipment). Xerox, whose bottom line has swelled by \$700 million from remanufacturing, expects to save another \$1 billion just by remanufacturing its new, entirely reusable or recyclable line of "green" photocopiers. What's more, policy makers in some countries are already taking steps to encourage industry to think along these lines. German law, for example, makes many manufacturers responsible for their products forever, and Japan is following suit.

Combining closed-loop manufacturing with resource efficiency is especially powerful. DuPont, for example, gets much of its polyester industrial film back from customers after they use it and recycles it into new film. DuPont also makes its polyester film ever stronger and thinner so it uses less material and costs less to make. Yet because the film

performs better, customers are willing to pay more for it. As DuPont chairman Jack Krol noted in 1997, “Our ability to continually improve the inherent properties [of our films] enables this process [of developing more productive materials, at lower cost, and higher profits] to go on indefinitely.”

Interface is leading the way to this next frontier of industrial ecology. While its competitors are “down cycling” nylon-and-PVC-based carpet into less valuable carpet backing, Interface has invented a new floor-covering material called Solenium, which can be completely remanufactured into identical new product. This fundamental innovation emerged from a clean-sheet redesign. Executives at Interface didn’t ask how they could sell more carpet of the familiar kind; they asked how they could create a dream product that would best meet their customers’ needs while protecting and nourishing natural capital.

Solenium lasts four times longer and uses 40% less material than ordinary carpets—an 86% reduction in materials intensity. What’s more, Solenium is free of chlorine and other toxic materials, is virtually stainproof, doesn’t grow mildew, can easily be cleaned with water, and offers aesthetic advantages over traditional carpets. It’s so superior in every respect that Interface doesn’t market it as an environmental product—just a better one.

Solenium is only one part of Interface’s drive to eliminate every form of waste. Chairman Ray C. Anderson defines waste as “any measurable input that does not produce customer value,” and he considers all inputs to be waste until shown otherwise. Between 1994 and 1998, this zero-waste approach led to a systematic treasure hunt that helped to keep resource inputs constant while revenues rose by \$200 million. Indeed, \$67 million of the revenue increase can be directly attributed to the company’s 60% reduction in landfill waste.

Subsequently, president Charlie Eitel expanded the definition of waste to include all fossil fuel inputs, and now many customers are eager to buy products from the company’s recently opened solar-powered carpet factory. Interface’s green strategy has not only won plaudits from environmentalists, it has also proved a remarkably successful business strategy. Between 1993 and 1998, revenue has more than doubled, profits have more than tripled, and the number of employees has increased by 73%.

Change the Business Model

In addition to its drive to eliminate waste, Interface has made a fundamental shift in its business model—the third stage on the journey toward natural capitalism. The company has realized that clients want to walk on and look at carpets—but not necessarily to own them. Traditionally, broadloom carpets in office buildings are replaced every decade because some portions look worn out. When that happens, companies suffer the disruption of shutting down their offices and removing their furniture. Billions of pounds of carpets are removed each year and sent to landfills, where they will last up to 20,000 years. To escape this unproductive and wasteful cycle, Interface is transforming itself from a company that sells and fits carpets into one that provides floor-covering services.

Under its Evergreen Lease, Interface no longer sells carpets but rather leases a floor-covering service for a monthly fee, accepting responsibility for keeping the carpet fresh and clean. Monthly inspections detect and replace worn carpet tiles. Since at most 20% of an area typically shows at least 80% of the wear, replacing only the worn parts reduces the consumption of carpeting material by about 80%. It also minimizes the disruption that customers experience—worn tiles are seldom found under furniture. Finally, for the customer, leasing carpets can provide a tax advantage by turning a capital expenditure into a tax-deductible expense. The result: The customer gets cheaper and better services that cost the supplier far less to produce. Indeed, the energy saved from not producing a whole new carpet is in itself enough to produce all the carpeting that the new business model requires. Taken together, the fivefold savings in carpeting material that Interface achieves through the Evergreen Lease and the sevenfold materials savings achieved through the use of Solenium deliver a stunning 35-fold reduction in the flow of materials needed to sustain a superior floor-covering service. Remanufacturing, and even making carpet initially from renewable materials, can then reduce the extraction of virgin resources essentially to the company's goal of zero.

Interface's shift to a service-leasing business reflects a fundamental change from the basic model of most manufacturing companies, which still look on their businesses as machines for producing and selling products. The more products sold, the better—at least for the company, if not always for the customer or the earth. But any model that wastes natural resources also wastes money. Ultimately, that model will be unable to compete with a service model that emphasizes solving problems and building long-term relationships with customers rather than making and selling products. The shift to what James Womack of the Lean Enterprise Institute calls a "solutions economy" will almost always improve customer value *and* providers' bottom lines because it aligns both parties' interests, offering rewards for doing more and better with less.

Interface is not alone. Elevator giant Schindler, for example, prefers leasing vertical transportation services to selling elevators because leasing lets it capture the savings from its elevators' lower energy and maintenance costs. Dow Chemical and Safety-Kleen prefer leasing dissolving services to selling solvents because they can reuse the same solvent scores of times, reducing costs. United Technologies' Carrier division, the world's largest manufacturer of air conditioners, is shifting its mission from selling air conditioners to leasing comfort. Making its air conditioners more durable and efficient may compromise future equipment sales, but it provides what customers want and will pay for—better comfort at lower cost. But Carrier is going even further. It's starting to team up with other companies to make buildings more efficient so that they need less air-conditioning, or even none at all, to yield the same level of comfort. Carrier will get paid to provide the agreed-upon level of comfort, however that's delivered. Higher profits will come from providing better solutions rather than from selling more equipment. Since comfort with little or no air-conditioning (via better building design) works better and costs less than comfort with copious air-conditioning, Carrier is smart to capture this opportunity itself before its competitors do. As they say at 3M: "We'd rather eat our *own* lunch, thank you."

The shift to a service business model promises benefits not just to participating businesses but to the entire economy as well. Womack points out that by helping customers reduce their need for capital goods such as carpets or elevators, and by rewarding suppliers for extending and maximizing asset values rather than for churning

them, adoption of the service model will reduce the volatility in the turnover of capital goods that lies at the heart of the business cycle. That would significantly reduce the overall volatility of the world's economy. At present, the producers of capital goods face feast or famine because the buying decisions of households and corporations are extremely sensitive to fluctuating income. But in a continuous-flow-of-services economy, those swings would be greatly reduced, bringing a welcome stability to businesses. Excess capacity—another form of waste and source of risk—need no longer be retained for meeting peak demand. The result of adopting the new model would be an economy in which we grow and get richer by using less and become stronger by being leaner and more stable.

Reinvest in Natural Capital

The foundation of textbook capitalism is the prudent reinvestment of earnings in productive capital. Natural capitalists who have dramatically raised their resource productivity, closed their loops, and shifted to a solutions-based business model have one key task remaining. They must reinvest in restoring, sustaining, and expanding the most important form of capital—their own natural habitat and biological resource base.

This was not always so important. Until recently, business could ignore damage to the ecosystem because it didn't affect production and didn't increase costs. But that situation is changing. In 1998 alone, violent weather displaced 300 million people and caused upwards of \$90 billion worth of damage, representing more weather-related destruction than was reported through the entire decade of the 1980s. The increase in damage is strongly linked to deforestation and climate change, factors that accelerate the frequency and severity of natural disasters and are the consequences of inefficient industrialization. If the flow of services from industrial systems is to be sustained or increased in the future for a growing population, the vital flow of services from living systems will have to be maintained or increased as well. Without reinvestment in natural capital, shortages of ecosystem services are likely to become the limiting factor to prosperity in the next century. When a manufacturer realizes that a supplier of key components is overextended and running behind on deliveries, it takes immediate action lest its own production lines come to a halt. The ecosystem is a supplier of key components for the life of the planet, and it is now falling behind on its orders.

Failure to protect and reinvest in natural capital can also hit a company's revenues indirectly. Many companies are discovering that public perceptions of environmental responsibility, or its lack thereof, affect sales. MacMillan Bloedel, targeted by environmental activists as an emblematic clear-cutter and chlorine user, lost 5% of its sales almost overnight when dropped as a U.K. supplier by Scott Paper and Kimberly-Clark. Numerous case studies show that companies leading the way in implementing changes that help protect the environment tend to gain disproportionate advantage, while companies perceived as irresponsible lose their franchise, their legitimacy, and their shirts. Even businesses that claim to be committed to the concept of sustainable development but whose strategy is seen as mistaken, like Monsanto, are encountering stiffening public resistance to their products. Not surprisingly, University of Oregon business professor Michael Russo, along with many other analysts, has found that a strong environmental rating is "a consistent predictor of profitability."

The pioneering corporations that have made reinvestments in natural capital are starting to see some interesting paybacks. The independent power producer AES, for example, has long pursued a policy of planting trees to offset the carbon emissions of its power plants. That ethical stance, once thought quixotic, now looks like a smart investment because a dozen brokers are now starting to create markets in carbon reduction. Similarly, certification by the Forest Stewardship Council of certain sustainably grown and harvested products has given Collins Pine the extra profit margins that enabled its U.S. manufacturing operations to survive brutal competition. Taking an even longer view, Swiss Re and other European reinsurers are seeking to cut their storm-damage losses by pressing for international public policy to protect the climate and by investing in climate-safe technologies that also promise good profits. Yet most companies still do not realize that a vibrant ecological web underpins their survival and their business success. Enriching natural capital is not just a public good—it is vital to every company's longevity.

It turns out that changing industrial processes so that they actually replenish and magnify the stock of natural capital can prove especially profitable because nature does the production; people need to just step back and let life flourish. Industries that directly harvest living resources, such as forestry, farming, and fishing, offer the most suggestive examples. Here are three:

- Allan Savory of the Center for Holistic Management in Albuquerque, New Mexico, has redesigned cattle ranching to raise the carrying capacity of rangelands, which have often been degraded not by overgrazing but by undergrazing and grazing the wrong way. Savory's solution is to keep the cattle moving from place to place, grazing intensively but briefly at each site, so that they mimic the dense but constantly moving herds of native grazing animals that coevolved with grasslands. Thousands of ranchers are estimated to be applying this approach, improving both their range and their profits. This "management-intensive rotational grazing" method, long standard in New Zealand, yields such clearly superior returns that over 15% of Wisconsin's dairy farms have adopted it in the past few years.
- The California Rice Industry Association has discovered that letting nature's diversity flourish can be more profitable than forcing it to produce a single product. By flooding 150,000 to 200,000 acres of Sacramento valley rice fields—about 30% of California's rice-growing area—after harvest, farmers are able to create seasonal wetlands that support millions of wildfowl, replenish groundwater, improve fertility, and yield other valuable benefits. In addition, the farmers bale and sell the rice straw, whose high silica content—formerly an air-pollution hazard when the straw was burned—adds insect resistance and hence value as a construction material when it's resold instead.
- John Todd of Living Technologies in Burlington, Vermont, has used biological Living Machines—linked tanks of bacteria, algae, plants, and other organisms—to turn sewage into clean water. That not only yields cleaner water at a reduced cost, with no toxicity or odor, but it also produces commercially valuable flowers and makes the plant compatible with its residential neighborhood. A similar plant at the Ethel M Chocolates factory in Las Vegas, Nevada, not only handles difficult industrial wastes effectively but is showcased in its public tours.

Although such practices are still evolving, the broad lessons they teach are clear. In almost all climates, soils, and societies, working with nature is more productive than working against it. Reinvesting in nature allows farmers, fishermen, and forest managers to match or exceed the high yields and profits sustained by traditional input-intensive, chemically driven practices. Although much of mainstream business is still headed the other way, the profitability of sustainable, nature-emulating practices is already being proven. In the future, many industries that don't now consider themselves dependent on a biological resource base will become more so as they shift their raw materials and production processes more to biological ones. There is evidence that many business leaders are starting to think this way. The consulting firm Arthur D. Little surveyed a group of North American and European business leaders and found that 83% of them already believe that they can derive "real business value [from implementing a] sustainable-development approach to strategy and operations."

A Broken Compass?

If the road ahead is this clear, why are so many companies straying or falling by the wayside? We believe the reason is that the instruments companies use to set their targets, measure their performance, and hand out rewards are faulty. In other words, the markets are full of distortions and perverse incentives. Of the more than 60 specific forms of misdirection that we have identified,³ the most obvious involve the ways companies allocate capital and the way governments set policy and impose taxes. Merely correcting these defective practices would uncover huge opportunities for profit.

Consider how companies make purchasing decisions. Decisions to buy small items are typically based on their initial cost rather than their full life-cycle cost, a practice that can add up to major wastage. Distribution transformers that supply electricity to buildings and factories, for example, are a minor item at just \$320 apiece, and most companies try to save a quick buck by buying the lowest-price models. Yet nearly all the nation's electricity must flow through transformers, and using the cheaper but less efficient models wastes \$1 billion a year. Such examples are legion. Equipping standard new office-lighting circuits with fatter wire that reduces electrical resistance could generate after-tax returns of 193% a year. Instead, wire as thin as the National Electrical Code permits is usually selected because it costs less up front. But the code is meant only to prevent fires from overheated wiring, not to save money. Ironically, an electrician who chooses fatter wire—thereby reducing long-term electricity bills—doesn't get the job. After paying for the extra copper, he's no longer the low bidder.

Some companies do consider more than just the initial price in their purchasing decisions but still don't go far enough. Most of them use a crude payback estimate rather than more accurate metrics like discounted cash flow. A few years ago, the median simple payback these companies were demanding from energy efficiency was 1.9 years. That's equivalent to requiring an after-tax return of around 71% per year—about six times the marginal cost of capital.

Most companies also miss major opportunities by treating their facilities costs as an overhead to be minimized, typically by laying off engineers, rather than as a profit center to be optimized—by using those engineers to save resources. Deficient measurement and accounting practices also prevent companies from allocating costs—

and waste—with any accuracy. For example, only a few semiconductor plants worldwide regularly and accurately measure how much energy they’re using to produce a unit of chilled water or clean air for their clean-room production facilities. That makes it hard for them to improve efficiency. In fact, in an effort to save time, semiconductor makers frequently build new plants as exact copies of previous ones—a design method nicknamed “infectious repetitis.”

Many executives pay too little attention to saving resources because they are often a small percentage of total costs (energy costs run to about 2% in most industries). But those resource savings drop straight to the bottom line and so represent a far greater percentage of profits. Many executives also think they already “did” efficiency in the 1970s, when the oil shock forced them to rethink old habits. They’re forgetting that with today’s far better technologies, it’s profitable to start all over again. Malden Mills, the Massachusetts maker of such products as Polartec, was already using “efficient” metal-halide lamps in the mid-1990s. But a recent warehouse retrofit reduced the energy used for lighting by another 93%, improved visibility, and paid for itself in 18 months.

The way people are rewarded often creates perverse incentives. Architects and engineers, for example, are traditionally compensated for what they spend, not for what they save. Even the striking economics of the retrofit design for the Chicago office tower described earlier wasn’t incentive enough actually to implement it. The property was controlled by a leasing agent who earned a commission every time she leased space, so she didn’t want to wait the few extra months needed to refit the building. Her decision to reject the efficiency-quadrupling renovation proved costly for both her and her client. The building was so uncomfortable and expensive to occupy that it didn’t lease, so ultimately the owner had to unload it at a fire-sale price. Moreover, the new owner will for the next 20 years be deprived of the opportunity to save capital cost.

If corporate practices obscure the benefits of natural capitalism, government policy positively undermines it. In nearly every country on the planet, tax laws penalize what we want more of—jobs and income—while subsidizing what we want less of—resource depletion and pollution. In every state but Oregon, regulated utilities are rewarded for selling more energy, water, and other resources, and penalized for selling less, even if increased production would cost more than improved customer efficiency. In most of America’s arid western states, use-it-or-lose-it water laws encourage inefficient water consumption. Additionally, in many towns, inefficient use of land is enforced through outdated regulations, such as guidelines for ultrawide suburban streets recommended by 1950s civil-defense planners to accommodate the heavy equipment needed to clear up rubble after a nuclear attack.

The costs of these perverse incentives are staggering: \$300 billion in annual energy wasted in the United States, and \$1 trillion already misallocated to unnecessary air-conditioning equipment and the power supplies to run it (about 40% of the nation’s peak electric load). Across the entire economy, unneeded expenditures to subsidize, encourage, and try to remedy inefficiency and damage that should not have occurred in the first place probably account for most, if not all, of the GDP growth of the past two decades. Indeed, according to former World Bank economist Herman Daly and his colleague John Cobb (along with many other analysts), Americans are hardly better off than they were in 1980. But if the U.S. government and private industry could redirect the dollars currently earmarked for remedial costs toward reinvestment in natural and

human capital, they could bring about a genuine improvement in the nation's welfare. Companies, too, are finding that wasting resources also means wasting money and people. These intertwined forms of waste have equally intertwined solutions. Firing the unproductive tons, gallons, and kilowatt-hours often makes it possible to keep the people, who will have more and better work to do.

Recognizing the Scarcity Shift

In the end, the real trouble with our economic compass is that it points in exactly the wrong direction. Most businesses are behaving as if people were still scarce and nature still abundant—the conditions that helped to fuel the first Industrial Revolution. At that time, people were relatively scarce compared with the present-day population. The rapid mechanization of the textile industries caused explosive economic growth that created labor shortages in the factory and the field. The Industrial Revolution, responding to those shortages and mechanizing one industry after another, made people a hundred times more productive than they had ever been.

The logic of economizing on the scarcest resource, because it limits progress, remains correct. But the pattern of scarcity is shifting: Now people aren't scarce but nature is. This shows up first in industries that depend directly on ecological health. Here, production is increasingly constrained by fish rather than by boats and nets, by forests rather than by chain saws, by fertile topsoil rather than by plows. Moreover, unlike the traditional factors of industrial production—capital and labor—the biological limiting factors cannot be substituted for one another. In the industrial system, we can easily exchange machinery for labor. But no technology or amount of money can substitute for a stable climate and a productive biosphere. Even proper pricing can't replace the priceless.

Natural capitalism addresses those problems by reintegrating ecological with economic goals. Because it is both necessary and profitable, it will subsume traditional industrialism within a new economy and a new paradigm of production, just as industrialism previously subsumed agrarianism. The companies that first make the changes we have described will have a competitive edge. Those that don't make that effort won't be a problem because ultimately they won't be around. In making that choice, as Henry Ford said, "Whether you believe you can, or whether you believe you can't, you're absolutely right."

1. Our book, *Natural Capitalism*, provides hundreds of examples of how companies of almost every type and size, often through modest shifts in business logic and practice, have dramatically improved their bottom lines.

2. Nonproprietary details are posted at www.hypercar.com.

3. Summarized in the report "Climate: Making Sense *and* Making Money," at www.rmi.org/images/other/Climate/C97-13_ClimateMSMM.pdf.

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