CHASING

GREEN

Environmentally conscious choices usually eat away at profits. But for the Eastside companies on the following pages, environmental stewardship is the business model.

CARBON FOOTPRINTS IN THE FOREST

WORDS BY JAKE BULLINGER
PHOTOS BY RACHEL COWARD
ILLUSTRATIONS BY MIKE FORBUSH

IN THE GLOBAL EFFORT TO CURTAIL GREENHOUSE GAS EMISSIONS, COMPANIES LIKE BELLEVUE-BASED JADORA ARE USING CARBON OFFSETS TO PRESERVE FORESTS

From the late 1980s through the early 2000s, Don Tuttle worked as a conservation biologist for the Smithsonian Institute, studying animals living in sensitive habitats and educating locals on sustainably managing the ecosystem around them.

He had some success. In Southeast Asia, for example, where it is customary to kill venomous cobras, Tuttle's team persuaded local farmers to stop killing cobras by teaching them that a single cobra eats about 100 rats a year. Because rats reproduce about every eight weeks, the farmers learned, those 100 rats could breed a population that would eat a ton of rice a year.

On a broader scale, however, Tuttle doubted the efficacy of his work. The species he studied were imperiled, essentially, by third-world economics. Across the developing world, prime wildlife habitat is leveled by logging firms or burned to create fields that lose fertility in a few years. Tropical forests that are home to thousands of species — many yet undiscovered — are cleared to make room for monoculture plantations that stretch as far as a person can see. If cutting a tree will help a villager pay for his child's medicine but also will endanger a lizard, the lizard's going to lose.

Tuttle figured the best way to prevent the clearing of forests was to pay landowners to keep trees erect. So in 2008, after he had returned home to live on the Eastside and work at Woodland Park Zoo, Tuttle founded Jadora International to tackle this challenge.

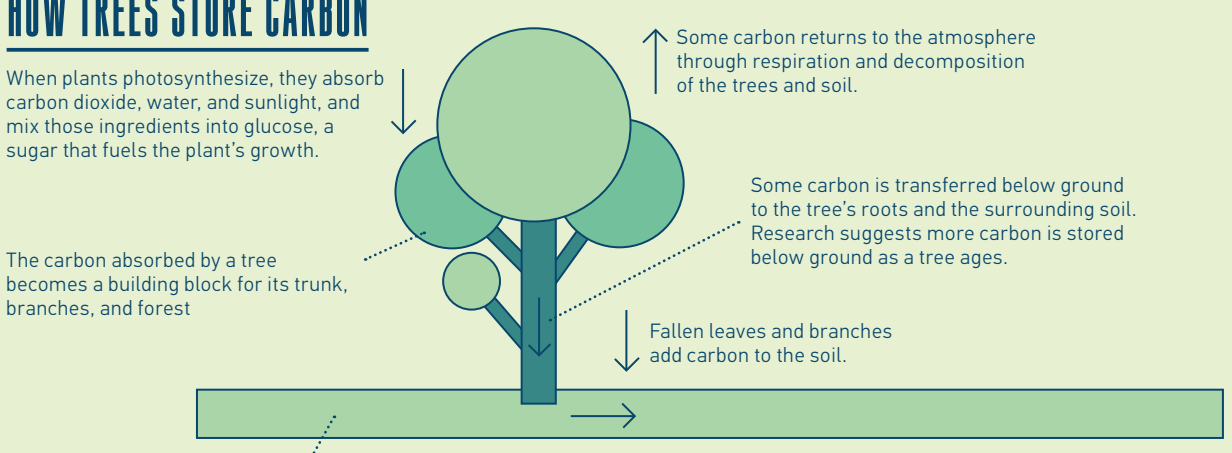
"We figured the big (nongovernmental organizations) — The Nature Conservancy, Conservation International, World Wildlife Fund — they had a big global footprint already, but they were really taking the easiest property — property already designated as national parks, for instance," Tuttle said. "What we wanted to do was go after the logging companies, the guys who were at most risk of doing serious ecological damage."

Tuttle soon connected with Daniel Blattner, managing director of Safbois, an American-owned logging firm with a large presence in the Democratic Republic of the Congo. Safbois had a toxic reputation. Multiple Western publications had run critical stories about its practices in the Congo. One villager told *The Guardian*, "Our forests are being stolen from us. It is misery for the communities. Safbois has come in and is taking our future."

"At that point, I was researching and thinking of alternative sources of revenue for our logging company," Blattner said. "We wanted to do something right at the same time as it being economically viable to convert a logging operation to a conservation concession." Safbois was considering a palm-oil plantation — itself a global driver of deforestation — or returning its logging concessions to the Congolese government, but Tuttle offered another solution: carbon.

During a weekend trip to meet with Blattner, Tuttle convinced him to halt logging on a nearly 465,000-acre plot called Isangi and opt instead to sell the trees' ability to remove

HOW TREES STORE CARBON



Don Tuttle spent most of his career working as a field biologist. He founded Jadora in an attempt to prove conservation could be profitable.

carbon dioxide from the atmosphere to companies looking to reduce their greenhouse gas emissions. Safbois would take a large enough share of the payments to cover land taxes — 51 percent of revenue, Blattner said.

With that one contract, Jadora ensured a forest about 30 percent the size of King County would be preserved for at least 30 years, the duration of Safbois' logging concession. That was in 2009; since, the framework used by the Bellevue-based company to conserve forests has grown in popularity. Selling the carbon-storing capacity of forests is a new paradigm in resource economics, one being called upon by global leaders to hinder the seemingly inevitable warming of the planet.

IN EARLY DECEMBER, representatives of 195 countries gathered in Paris and agreed to a basic framework for reducing global greenhouse gas emissions. The 21st United Nations Conference of the Parties, or COP21, saw delegates arrive having already completed plans to reduce emissions within their borders, and wealthier industrialized nations agreed to pay $100 billion annually by 2020 to help finance climate mitigation and clean energy projects in the developing world.

A good deal of the negotiations was devoted to deforestation. When a mature forest is lost to fire or saw, centuries' worth of carbon sequestration is negated. If the forest is not replanted, there won't be new trees to suck up carbon in the decades to come. It is estimated that 12 to 20 percent of greenhouse gas emissions are the result of deforestation, a larger share than the emissions from global transportation and the primary emissions source in many tropical nations.

The nations at COP21 agreed to provide financial resources and incentives for "reducing emissions from deforestation and forest degradation." That phrase alludes to the REDD+ program the UN started in 2007. REDD+ (the plus stands for other forest ailments such as fire and agricultural clearing) aims to reduce emissions and deforestation in tropical nations by selling offset credits that hinge on trees' ability to sequester carbon dioxide.

Carbon offsets are billed as a method of balancing an organization's carbon footprint. If a company emits, say, 50,000 metric tons of carbon dioxide (or equivalent amounts of other gases), it can buy 50,000 offset credits to theoretically neutralize its carbon footprint. In jurisdictions that don't regulate greenhouse gas emissions, carbon offsets are purchased voluntarily as an act of corporate social responsibility. In areas with cap-and-trade markets, such as California, or carbon taxes, such as British Columbia, offsets are used to comply with a legally mandated cap on emissions or to reduce a tax burden.

Many are critical of offsets because they don't directly reduce emissions; a common trope of critics is to compare carbon offsets to an overweight person paying somebody else to diet. That notion is anathema to Tamara "TJ" DiCaprio, Redmond-based Microsoft's senior director of environmental sustainability and designer of the company's internal carbon fee. In Microsoft's system, which began in 2012, each department must pay a fee for every ton of greenhouse gas it emits. Those fees are collected and spent on internal energy-efficiency measures to decrease Microsoft's energy use.

To zero out the company's remaining carbon footprint, Microsoft purchases carbon offsets. In fiscal 2014, the latest reporting available, the company purchased renewable energy certificates — property rights to power from a renewable energy project — equivalent to 1.52 million tons of carbon, which balanced out most emissions resulting from Microsoft's electricity use. Microsoft directly emitted about 85,000 tons of carbon that year, all of which was negated with offset projects. Offsets also covered the 310,000 tons of carbon emissions that resulted from employee air travel.

Microsoft's offset investments are geographically and developmentally varied. They include wind projects in China and Turkey, REDD+ investments in Kenya and Indonesia, and replacing wood-burning cookstoves in Guatemala and Ghana.

"We invest in projects that not only reduce carbon, but also drive innovative technologies," DiCaprio said. "... Carbon offsets are the primary vehicle in which a corporation can transfer funds out to emerging nations to help them develop low-carbon economies."

RECs are the most popular carbon credit, particularly in compliance markets, because the accounting is simple: Every ton of emissions from coal- or gas-fired power can be neutralized by purchasing solar or wind credits. For forestry offsets, the logic is more complex. Developers like Jadora typically must prove three facets before their offsets can be validated: additionality, leakage avoidance, and permanence.

"CARBON OFFSETS ARE THE PRIMARY VEHICLE IN WHICH A CORPORATION CAN TRANSFER FUNDS OUT TO **EMERGING NATIONS** TO HELP THEM **DEVELOP LOW-CARBON ECONOMIES."**

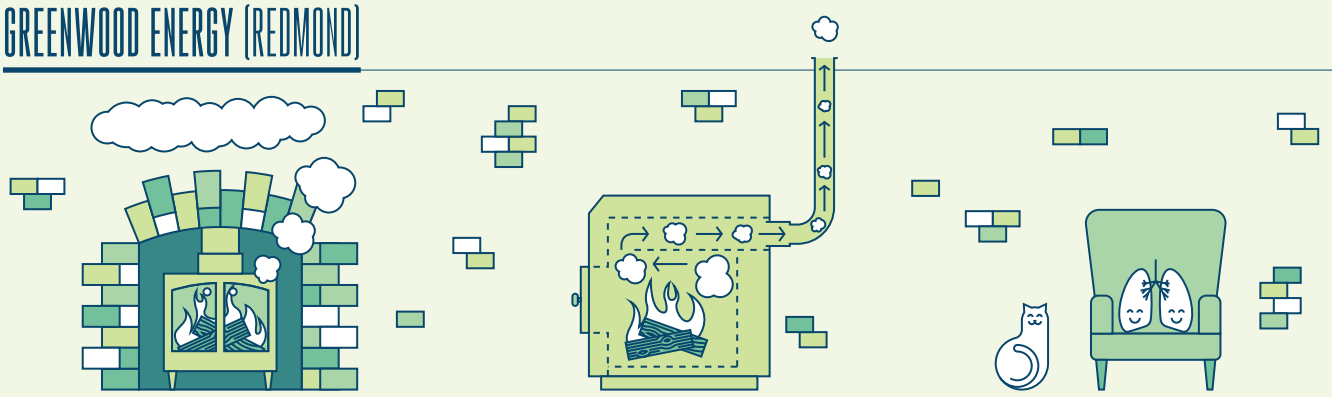
Tuttle (back row, blue shirt) with the Jadora field team in the Isangi project

PHOTO COURTESY JADORA

TRASH? WHAT TRASH?

HERE'S HOW THREE EASTSIDE COMPANIES GIVE WASTE SECOND LIFE

GREENWOOD ENERGY (REDMOND)



WASTE

Many Europeans and rural North Americans receive their heat from wood boilers, but smoke contains carcinogens and particulate matter that can harm the lungs.

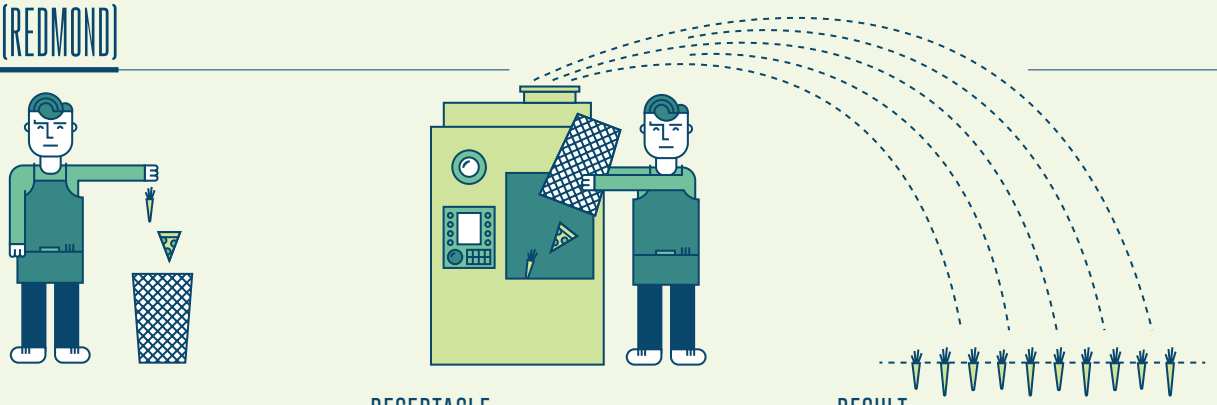
RECEPTACLE

Before expelling smoke, Greenwood's Frontier boiler sends it to a 2,000-degree, second combustion chamber. That second burn can account for half of the heat output.

RESULT

The Frontier hooks up with a home's existing heating system. Folks swapping propane or a traditional boiler for it can cut their heating bill by 70 percent.

WISERG (REDMOND)



WASTE

It's estimated that 31 percent of food produced in the U.S. — 133 billion pounds worth $161 billion, in 2010 — is never eaten.

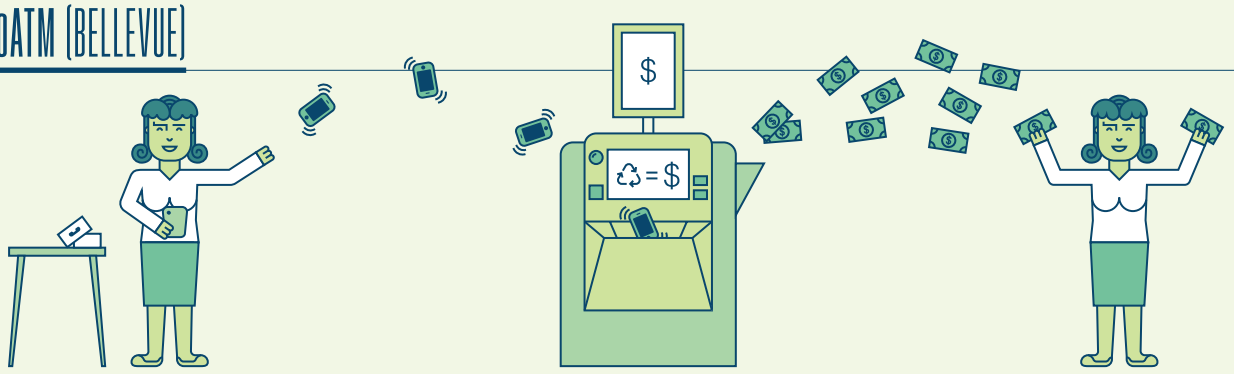
RECEPTACLE

What restaurants or grocers would otherwise waste, though, can instead go into Wiserg's Harvester machine, which grinds scraps into a nutrient-rich liquid.

RESULT

The end result is Wiserg's certified-organic fertilizer, and the Harvester generates reports so grocers better understand the volume of food they're tossing.

ECOATM (BELLEVUE)



WASTE

Consumers threw away 92 billion pounds of used electronics in 2014. Much of that waste leaches chemicals in landfills or is burned to access valuable materials inside.

RECEPTACLE

Upgrading your phone doesn't mean trashing your old one. Dump an old phone into the EcoATM kiosk, and the company will either sell your phone or recycle it.

RESULT

If a buyer wants your old phone, you get cash — which could help you upgrade to an even nicer phone next time around.

Additionality means that the offset contract will protect the forest from imminent harvest. Leakage occurs when protecting one forest results in the destruction of another, so developers must present safeguards and bank extra offset credits to ensure their projects don't result in forest degradation elsewhere. Finally, permanence must be proven — if a customer is paying for a tree to absorb and retain carbon dioxide for 100 years, then that tree has to indeed remain standing for a century.

Despite the complications, forest-related offsets are growing in popularity. According to an annual report from Forest Trends, 31.4 million forest credits were purchased in 2014, enough to offset the annual production of eight coal-fired power plants. Forestry and other land-use credits accounted for more than half of all voluntary credits sold (DiCaprio said about half of Microsoft's offset portfolio is forestry-related). That total is likely to swell in the coming years; at COP21, Germany, Norway, and the United Kingdom pledged to spend $5 billion on REDD+ projects between now and 2020.

JADORA'S ISANGI PROJECT has been issued about 1.6 million offset credits to date. As the forest grows and stores more carbon, it's expected to generate about 400,000 new credits a year. Monitoring and managing Isangi makes Jadora a major employer in the villages in which it operates. About 30 employees work from Safbois' old logging camps, and Jadora solicits work from 25 to 50 day laborers, depending on the season.

Fifteen percent of Jadora's revenue is distributed to locals in the form of projects voted on by the communities. "We don't pay cash," Tuttle said. "If I hand some chief out in the jungle cash, it's not going to his community. It's going straight into his pocket." Instead, representative boards in each village meet quarterly to decide how their funds will be apportioned.

Projects Jadora has paid for read like the goal sheet of many aid organizations. Schools and clinics have been erected. Small coffee and cocoa farms provide cash crops and mend soil, while tilapia ponds provide a consistent source of protein. Small loans have financed a bike repair shop and a seamstress, though many of the loans go unpaid. "A lot of the time, we don't hear from that person again," Tuttle said.

Tuttle hopes these projects will lift villagers above subsistence, a lifestyle that taxes the surrounding forest. The Isangi forest was threatened not only by logging, but also by slash-and-burn farming, the practice of clearing a patch of forest, burning the slash to supply nutrients to the soil, then moving on when its fertility is sapped. A slash-and-burn field typically lasts two years in the Isangi area, Tuttle said. In contrast, fields tended with Jadora's assistance have been productive since their 2009 sowing.

Jadora's executive team operates from Tuttle's condo building in Bellevue, where he lives in a lovely but impersonal 25th-floor pad with expansive west-facing views. Tuttle has the firm grip of someone who has spent years working outdoors, but the smooth hands of someone who hasn't done so in a while. When he's tired, Tuttle chases a cup of coffee with a pinch of green apple-flavored Skoal. "I have one really bad vice — do you mind?" he asked me when we first met. "I was up until 3:30 working this morning, then had a 7:30 conference call."

Tobacco use isn't the only thing Tuttle is self-conscious about. Jadora is one of the few forest-credit developers that is a for-profit organization, and Tuttle often feels the need to justify Jadora's intention to operate in the black. This might be a function of his science background. He refers to researchers he's worked with like idols; one, "a rock star in conservation biology," another, "the father of modern ecology."

The career-long scientist entered a unique commercial position when he founded Jadora. The company's inherent goal is conservation, a concept long associated with goodwill, not profit.

"We've had people in the company say we'd be better off with a standard business model — just sell credits," Tuttle said. "But we're bleeding hearts. We want to see the kids get help. We want to preserve and promote endangered species. Frankly, that doesn't mesh so well with the bottom-line approach."

But the push for ecosystem pricing, in this case carbon sequestration, is being led by people like Tuttle — scientists taking a crack at business in an attempt to fundamentally shape the way a tree is valued. For people accustomed to astute, evidence-based observation, the grandiose talk of a startup founder is difficult, even if they are working in one of the rare sectors that may truly be disruptive.

TWO WEEKS AFTER countries pledged their support to forests in Paris, Paula Swedeen and Joe Kane took a photographer and me for a hike in the Mount Rainier Gateway Reserve, a forest owned by the Nisqually Land Trust, of which Kane is the executive director. On our drive to the high reaches of the reserve we encountered a man named Donnie, who was on his way to the property's ridgeline. Donnie wore jeans and a blue cotton sweater, an attire choice that grew more unfortunate as the falling snow accumulated.

Kane stopped his Toyota Tacoma and explained to the hiker that his organization owned the land. Donnie said he had been hiking there regularly for the last year, and began extolling the virtues of the forest. "Last year, I tracked two mountain lions, one bear, one coyote, and one bobcat," he said.

The observed predatory concentration was welcome news for Swedeen and Kane, who teamed up to help protect this 520-acre swath of forest west of Mount Rainier for at least 100 years by creating the state's first forest carbon offset project. The groves of Douglas fir and Western hemlock hug the steep faces above Ashford, cooling tributaries of the Mashel and Nisqually rivers. Those trees will be protected under the carbon project, a win for the blacktail deer, elk, and endangered marbled murrelet that live among them.

Swedeen, a forest policy specialist with the Washington Environmental Council, developed

"WE'RE BLEEDING HEARTS. WE WANT TO SEE THE KIDS GET HELP. WE WANT TO PRESERVE AND PROMOTE ENDANGERED SPECIES."

the project in accordance with California's cap-and-trade market. (Unlike REDD+ credits such as Jadora's, forest offsets on the California market are compliance-grade, meaning they can be used to meet government-mandated carbon caps.) In late November, the Nisqually Land Trust and Microsoft announced a deal for 35,000 of the available 37,000 offset credits. The land trust purchased the property in 2013 from Hancock Timber for $3.3 million, a price tag made palatable in part by the expected carbon-market revenue in the years to come.

"We borrowed from our own reserves and took the gamble, because we had done the inventory and we knew with high likelihood that there was carbon value," Kane said.

The forest today shows the mark of industrial logging — it is primarily fir, arranged in the checkerboard of age-specific plantings and harvests coordinated over decades. The offset plot's calculated carbon capacity is 223 metric tons per acre, and over the coming decades, a transformation will take place. As these trees age beyond 45, by which time Hancock would normally cut them, they'll become better habitat for spotted owls and other birds nesting in large boughs and trunk cavities. Studies show older trees pump more carbon into the soil through longer roots. Old-growth trees consume less water than do fast-growing young ones, and hold water in the soil, thus stabilizing the water table during dry periods. In 40 years, the forest's carbon capacity is expected to double.

To Swedeen and Kane, the offset project, dubbed the Nisqually Carbon Project, is a step in the right direction when it comes to valuing ecosystem services. But to Elaine Oneil, the best thing for the planet would be to cut down those trees.

Oneil is the director of CORRIM, a consortium of 16 universities, including Washington, Washington State, and Oregon State, that studies the carbon life cycle of wood and wood products. For the past 18 years, CORRIM-affiliated researchers have studied how much carbon trees absorb, how long they retain that carbon, and how carbon-intensive their manufacture is. After seeing the research, Oneil strongly believes conservation for the sake of carbon reductions is flawed.

"There's a carbon cost to doing that," she said. "Yeah, you're storing carbon, but you're turning your factory into a warehouse."

How does Oneil's carbon factory work? During the 45-year timber rotation in the Northwest, a growing tree sequesters more carbon each year. Once that tree is cut down, it doesn't immediately expel its stored carbon; rather, that carbon slowly leaks over the course of years. And when new trees are planted to replace the old ones, the factory chugs along, continually accumulating carbon faster than it can leak from the harvested timber.

Substitute wood products for more energy-intensive ones like concrete or steel, which do not store any carbon, and you have a carbon-negative system. Use a manufactured-wood I-beam instead of a steel floor joist, and you reduce nearly 5 kilograms of carbon for every kilogram of wood fiber used.

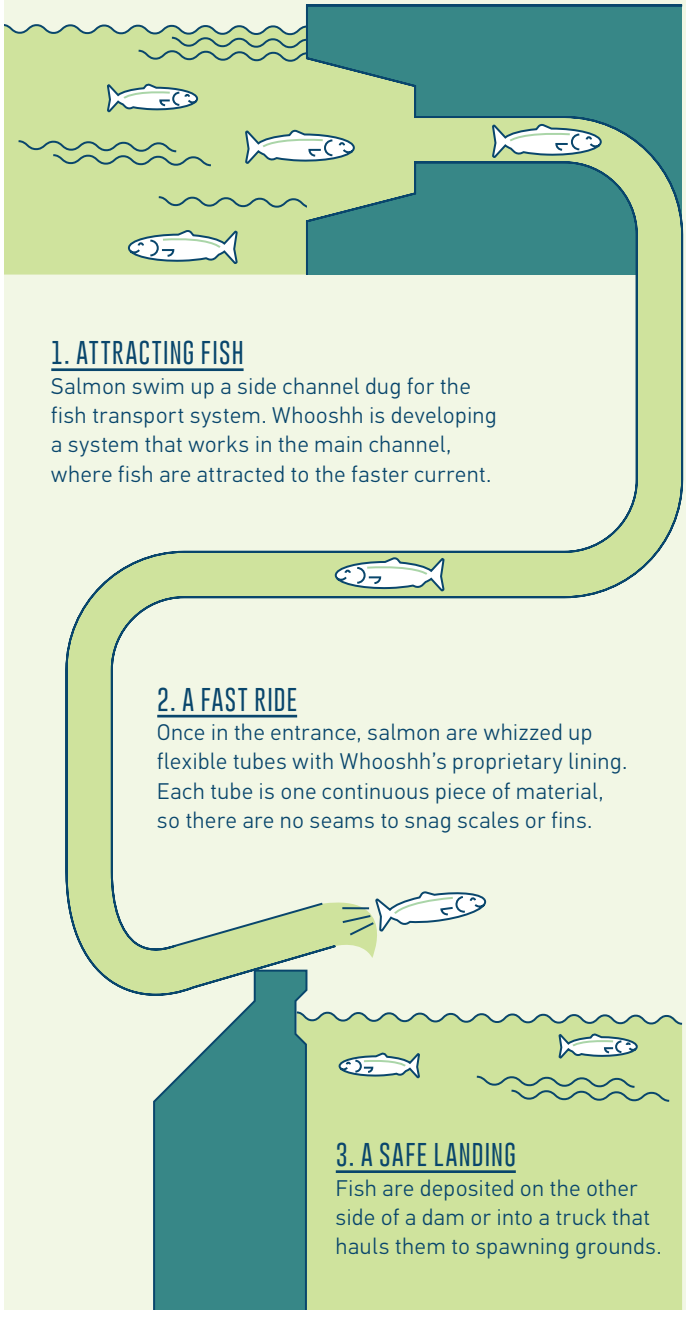
Paula Swedeen, a forest policy specialist with the Washington Environmental Council, and Joe Kane, executive director of the Nisqually Land Trust, stand in the Nisqually Carbon Project they helped create.

ASSISTING WILDLIFE

Human development, by and large, has not been good for wildlife. We have leveled habitat and hunted species to extinction, and our fossil fuel-based energy systems are warming the planet, thus messing with animals' food supplies and habitat chemistry. Two Eastside companies, though, are working to make life better for some animals. Whooshh Innovations wants to help Pacific salmon, one of the Northwest's most beleaguered species, overcome some major hurdles: dams. And to better understand marine animals, researchers turn to Wildlife Computers for the most sophisticated tracking devices on the market.

WHOOSHH MOVES FISH (BELLEVUE)

The Salmon Cannon was born to automate fruit harvesting, but CEO Vince Bryan III realized his tubular system could fling fish as well as fruit when he saw helicopters shuttling salmon to spawning grounds. Whooshh now moves spawning salmon over small dams or into trucks. "We're touching on so many big topics," Bryan said. "We've got water, clean energy, sustainable food, the environment — we're playing in all four constantly."



1. ATTRACTING FISH

Salmon swim up a side channel dug for the fish transport system. Whooshh is developing a system that works in the main channel, where fish are attracted to the faster current.

2. A FAST RIDE

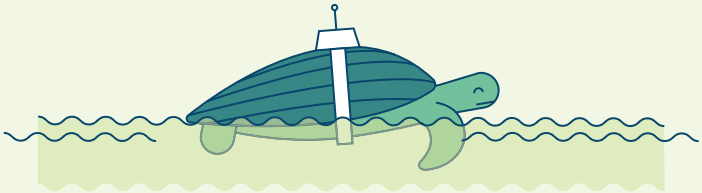
Once in the entrance, salmon are whizzed up flexible tubes with Whooshh's proprietary lining. Each tube is one continuous piece of material, so there are no seams to snag scales or fins.

3. A SAFE LANDING

Fish are deposited on the other side of a dam or into a truck that hauls them to spawning grounds.

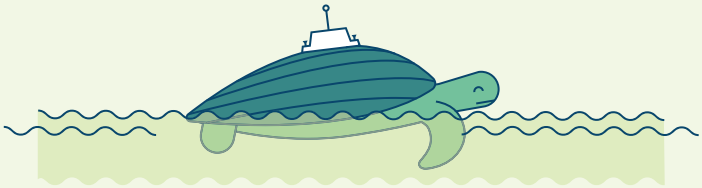
WILDLIFE COMPUTERS TRACKS SWIMMERS (REDMOND)

Researchers remotely tracking a seal's movement need some sturdy gear. "That means cycling depths between zero and a thousand meters, hundreds of thousands of times," said Melinda Holland, CEO of Wildlife Computers. The company's trackers evolve with client needs and available technology, which they nab from cellphones and medical devices. Below, Holland explains iterations of a leatherback turtle tracker.



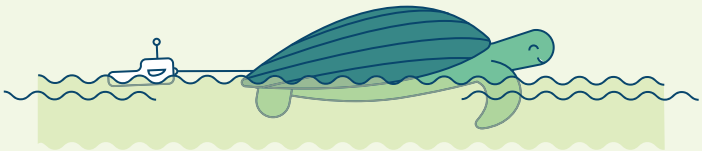
TIED UP

Leatherbacks don't have a hard shell to glue a tracker to, so Wildlife Computers' first sensor was held on with a harness that would eventually deteriorate. "But studies showed that the drag that the harness caused on the animal was huge," Holland said.



STITCHING AN ANSWER

The company turned to bone screws and a suture system after the harness failed. Bone screws were difficult to attach, and multiple sutures would deteriorate unevenly. Finally, a single-suture approach provided the necessary ease and consistency.



TRAILER DYNAMICS

The team also utilized a torpedo-shaped, tow-behind tracker that surfaced when the turtle was at rest, but not when it was swimming. "We couldn't bring it up with buoyancy alone, so we had to come up with a wing-shaped design." Wildlife Computers' sensors don't only track hosts' health and position. Ocean data such as salinity and temperature are also collected, making the animals roving monitors of climate change.

THE NUCLEAR QUESTION

The call for clean energy has largely focused on renewable sources such as solar and wind, but a growing number of technologists and environmentalists are starting to promote nuclear. Two Eastside companies are at the forefront of the push for alternative forms of nuclear energy, but they're going in opposite directions. If TerraPower is successful, our homes will be powered by a safer version of nuclear fission, in which energy is created by splitting uranium atoms. Helion, on the other hand, is focusing on nuclear fusion, a sought-after clean-energy moonshot that produces power by slamming hydrogen atoms together, combining them into helium.

Honing the technology — neither company has a working prototype — isn't the only issue facing Helion and TerraPower. Fission has an image problem — the meltdown of the Fukushima-Daiichi plant in Japan led that country to abandon nuclear energy, and clean energy leader Germany is in the process of doing the same. There is also nuclear waste to be disposed of. Fusion has troubles, too — namely that nobody has made a successful, commercial-grade fusion reactor. It's proven to work, though; fusion reactions power the sun.

Nuclear promises clean power without the intermittent nature of renewables. "We are technology neutral," said Kevan Weaver, TerraPower's director of technology integration, "but you need the baseload power to back intermittent sources up."

Improving battery technology is fast making renewables less intermittent, though. "We already have systems around the world … that are running their systems with what we used to call 'intermittent' sources," said energy researcher Daniel Kammen at the University of California, Berkeley. "'Intermittent' just means we're not being smart enough yet."

TERRAPOWER (BELLEVUE)

PRODUCT: Traveling Wave Reactor

ENERGY SOURCE: Nuclear fission

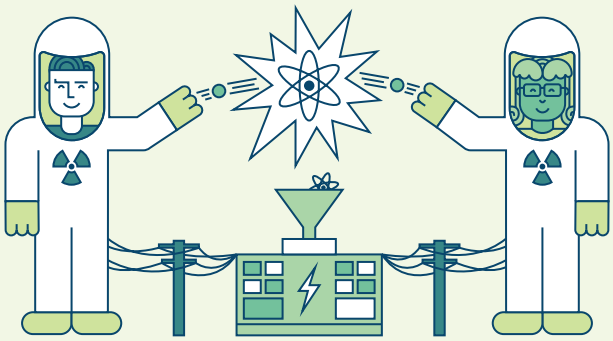
BACKGROUND: TerraPower is Bill Gates' energy darling. The philanthropist backed the company and serves as its chairman. He also helped secure a partnership with the China National Nuclear Corporation, which has pledged to spend $120 billion on nuclear research. After receiving funding from Gates and Intellectual Ventures founder Nathan Myhrvold, TerraPower landed $35 million in 2010.

WHY IT'S UNIQUE: The TerraPower reactor is cooled by sodium, as opposed to the water in today's reactors, and it doesn't require enriched uranium for fuel. These traits mean the traveling wave reactor could run continuously for decades off spent uranium from existing reactors, drastically reducing the cost of operation and eliminating the need for enrichment that can yield weapons-grade uranium.

TIMEFRAME: Working prototype by 2020, commercial pilot plant (estimated cost: $4 billion) in the 2030s

HURDLES: Building a prototype, anti-nuclear regulations and sentiment, upfront cost of new reactors, disposal of radioactive plutonium waste

HELION ENERGY (REDMOND)



PRODUCT: Fusion Engine

ENERGY SOURCE: Nuclear fusion

BACKGROUND: Fusion is fueled by deuterium, a hydrogen isotope derived from seawater, and its radioactive waste quickly deteriorates. Unfortunately, controlled, sustained fusion has yet to be accomplished; humankind's lone success with fusion thus far is the hydrogen bomb. Helion has landed more than $17 million in funding to build the first sustianable fusion reactor.

WHY IT'S UNIQUE: Helion combines two forms of fusion methods that could yield a cheaper, smaller reactor — its latest prototype was about 90 feet long, whereas an international fusion project in France fills 20 stories. Helion's engine also utilizes a molten-salt coolant that should make it more cost-efficient. In the end, one gram of fuel could power a standard house for a full year.

TIMEFRAME: Working prototype by 2017, commercial pilot plant (estimated cost: $200 million) by 2022

HURDLES: Achieving a controlled reaction — Helion must figure out how to heat hydrogen plasma to 100 million degrees centigrade using less energy than the engine produces

Another issue with forest offsets is that the very metric they hinge on — knowing how much carbon a forest can store — has no reliable determination method.

"What we measure is not carbon," said Jeremy Fried, a researcher at the U.S. Forest Service Forestry Sciences Lab in Portland. "We measure the diameters of trees. We estimate the heights of trees. We estimate defect on those trees, all of which are going to affect the amount of carbon in that tree." Once those estimations are made, the figures are plugged into one of many equations to estimate tree volume, and then that figure is plugged into one of many equations to estimate carbon capacity.

Many tree species don't have equations tailored for them, while common species such as Douglas fir have thousands of combinations. Fried said this not only produces inherently unreliable data, but it allows carbon accountants to possibly choose an equation that exaggerates a plot's carbon capacity.

It's also hard to guarantee the three bases — additionality, leakage avoidance, and permanence — of forest offsets. Take the Nisqually project, for example. Now that the land trust owns the forest, does that eliminate the threat of future logging? Can one know for certain a future Hancock purchase isn't motivated by the sale of its Nisqually property, thus constituting leakage? And who's to say the Nisqually Land Trust will exist in 100 years, or what will happen if it sells the land in that timeframe?

According to Greg Fishbein, managing director of forests and climate for the Nature Conservancy, scale is one antidote to these concerns. The nonprofit has become a major forest offset developer, and is increasingly focusing on jurisdictional-scale projects, or those that span entire districts or states rather than parcels of private property.

"Working on a jurisdictional scale reduces the risk of leakage quite a bit because you're talking about a much bigger area," Fishbein said. "If you stop ranching on one place, but clear a different forest nearby, that would be captured (by jurisdictional monitoring) because you're looking at carbon accounting on such a big scale." Jurisdiction-scale developments, of course, require cooperative jurisdictions, and there's little market demand nor political will for these types of projects.

Yet another issue confronting carbon markets is price. Carbon traded between $12 and $13 a ton last year in California's marketplace; globally, avoided-deforestation credits sold for an average of $5.20 a ton in 2014. "If we ever break $30 a ton, we'll see a lot more conservation projects funded with carbon," Swedeen said.

Though reduced emissions is the sales pitch, the conservation of healthy ecosystems is actually what many forest offset developers are after. "When companies want to report zero emissions and use offset credits to do that, you benefit from that," said Don Melnick, director of Columbia University's Center for Environment, Economy, and Society. "But other companies that want to say they're doing the … forest protection, and biodiversity conservation, and helping rural communities, you get that as well."

Customers in the voluntary market also cherish the broader benefits of carbon offsets tied to social development. "Our employees get so proud and excited around the carbon fee when they see the funds going out to our carbon offset projects, when they see that we are having an impact locally to preserve forests," Microsoft's DiCaprio said. "When you can reduce carbon and improve people's lives, then people are proud from a corporate perspective. … That's good will."

For all its imperfections, the widespread adoption of a forest carbon market could yield significant results. A Duke University report found that a carbon price of $30 per ton could reduce 4 billion tons of emissions per year through avoided deforestation. Furthermore, conservation is one of the cheapest ways to achieve greenhouse gas reductions — it's less expensive to preserve a forest than it is to, say, build a huge solar array and hook it to the grid. Making forest carbon part of a global compliance market similar to California's would decrease the global allowance price more than 43 percent, the Duke report said.

Realizing these savings relies on a departure in the way trees are currently valued.

"The benefits of the forest that are monetized right now are timber and clearing it for agriculture," said Brian Murray, a forest economist at Duke. "The idea is we need to price these other ecosystem services. The problem is those other services don't have markets — they have extremely high value, and study after study bears that out, but they don't have markets. Carbon has created a market for this. So the question is, will paying for carbon help bring along all these other ecosystem services the forest has, or will they gear things so we're basically just growing trees for carbon?"

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AMOUNT OF CARBON IN THAT TREE."

Attempts to price carbon typically involve cap-and-trade schemes, such as California's, or a carbon tax like the one employed in British Columbia. Washington voters may get to decide between the two this year. A carbon tax initiative will show up on the November ballot unless the Legislature acts on it, and a cap-and-trade initiative could wind up there, too.

The two pricing systems could have very different effects on regional forest stocks. A carbon tax, according to CORRIM founder and UW professor emeritus Bruce Lippke, would create a greater demand for wood products because more energy-intensive materials would become more expensive.

A cap-and-trade that includes forest-carbon provisions could conversely alter the timber landscape. Research has shown carbon prices of about $14 per ton could slow timber harvest

Jadora employees tend to cacao seedlings in an Isangi village. Fifteen percent of Jadora revenue supports community projects. Since 2009, the company has built tilapia ponds, planted small cacao and coffee plantations, and built new schools (below).

PHOTOS COURTESY JADORA

cycles up to 14 years (and more than double the value of timber in the U.S. South). Jack the price up to $55 a ton, Ohio State University's Brent Sohngen has found, and it would be economically viable for more than 1.98 million acres of Northwest timberland to be permanently set aside for carbon sequestration. "It could fundamentally alter the way we value forests," he said.

Prices, though, are far from $55 in the U.S. (Globally, carbon prices range from less than $1 per ton in Poland to $130 a ton in Sweden). So for nonprofits like the Nisqually Land Trust, offset sales present a method to fund yearly operations, such as maintenance and removal of logging roads, but donations still matter. "We need multiple revenue streams," Kane said. "Carbon markets can be a very nice piece, but I don't see it as being the silver bullet."

DON TUTTLE OFTEN calls Jadora's concessions "my land." Jadora doesn't own any of the land on which it develops offsets — it's all owned by the government of Congo's Orientale province — yet Tuttle still feels a sense of ownership.

"It's a sense of responsibility and obligation at this point. To be honest, I wouldn't mind going back to my job at the Smithsonian or the zoo and not really having that responsibility," he said. "But when I call it 'my property,' it's my property because I've got schools there now. I've got kids depending on education and a reasonable diet. I've convinced the loggers not to log there, which takes away one of their only sources of income on the property. So without me, without Jadora, there's not really a substitute."

The Congo's forests are a prime lab for offset conservation. The harsh landscape and years of strife have left many of its old-growth forests untouched, and Jadora continues racking up concessions. A recent land grant from the provincial government will swell Jadora's total concession portfolio to 21.6 million acres, allowing Jadora and its partners to preserve forest and study management practices in a protected, jurisdictional REDD+ project.

"EACH ACRE OF THIS PLOT IS WORTH THOUSANDS IN ECOSYSTEM SERVICES. WE'RE GETTING ABOUT $40 AN ACRE (FROM CARBON)."

Not all of Jadora's experiments have paid off. In one village, workers planted corn, but the neighboring wildlife decimated it. An incident like this — introducing an otherwise unused crop into natives' lifestyles — is viewed by some as colonial paternalism. A major criticism of REDD+ projects is that Westerners swoop in to change indigenous populations' established ways of life. Advocacy groups allege villagers are required to preserve trees to fulfill contracts that are engineered and signed without their knowledge or understanding.

"There are definitely some ethical issues here that indigenous peoples are just beginning to understand and are concerned about," said Indigenous Environmental Network director Tom Goldtooth, who spoke out against REDD+ projects at COP21. "It goes back to reconciling spiritual knowledge. Some say, how can they reconcile selling the air, the atmosphere, and the trees, which is nothing but privatization of carbon? Who is renting, or leasing to brokers, these trees? At the end of the day, have the local communities actually been ensured title to the trees? No."

Withholding cash payments to locals, as Jadora does, is also controversial in the development-aid world. But Jadora does let community boards decide which projects come to fruition, and it does not displace villages in its concessions, which some REDD+ projects allegedly have done.

Tuttle wouldn't disclose financials, but he did say Jadora recently became profitable. That said, the company is increasingly emulating the nongovernmental organizations Tuttle wanted to diverge from. Grants from and partnerships with Seattle nonprofits PATH and the Bill and Melinda Gates Foundation will help implement nutritional programs for pregnant women within the Isangi concessions. Tuttle also has considered handing off management of some developments to larger conservation organizations with deeper pockets.

But there are bigger issues in the business plans of companies like Jadora. A forest offset tangentially monetizes deforestation avoidance; the actual driver of price is carbon, not the ecosystem as a whole. Tuttle and others want to save ecosystems, but they're doing so by indirectly tackling a byproduct of the industrial revolution. Once carbon is eliminated from our energy systems, the value of forests to suck carbon out of the atmosphere diminishes.

Carbon offsets also value just one element of a forest's ecological worth. Trees provide habitat for animals that can feed locals. A pristine, protected forest can boost tourism; stumps do not. They filter water, hold soil to prevent landslides, and clean the air.

"Each acre of this plot is worth thousands in ecosystem services," Swedeen said of the Nisqually project. "We're getting about $40 an acre (from carbon)."

Today's forest carbon market is too complicated to be easily understood and marketed, yet not complex enough to capture the full value of a standing forest. Some believe, though, it is the best available bandage for wounded forests that are being assailed by global economics that value them in death, not in life.

"I shudder to think if (there were no market for forest carbon credits) because, let's face it, we're living in a fishbowl," Tuttle said. "It doesn't matter if this is occurring in the Congo or if it's occurring in the North Slope of Alaska — we need to protect our global ecosystem. Each of these pieces — the Amazon forest, the Congo forest, the tundra, the coral reefs ... saving these little pieces of the environment is not only a matter of corporate social responsibility or social consciousness, which is what is supplying the funds right now, but it is becoming a matter of global welfare." ■ *@jakebullinger*