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Freshwater Fix
A glass half salty

Great White Adaptation
Boats biomimic sharks

Bamboo Bike
Build your own sustainable ride
Dear Reader,

Technology is the proverbial double-edged sword. It transcends every aspect of life, fulfilling our wants and needs and connecting us to the rest of the world. But the same technologies that satisfy our needs can also devastate our home planet, ultimately threatening our own existence. We must use technologies that accommodate our needs and those of the Earth if we are all to survive.

This winter, The Planet delves into some of these green technologies, many of which are already making an impact: Toilets that use little or no water, houses made from straw, and nontoxic dry cleaning solvents.

Other technologies help conserve resources. Smoother airplane approaches reduce emissions and make fights more enjoyable. Synthetic sharkskin on boats cuts down on drag and eliminates the need for toxic paint, proving technology doesn’t always have to be at odds with Nature.

Many of these technologies have global influence. Some people far from rivers and lakes convert saltwater to drinking water to combat shortages. Others living off the power grid use sophisticated technology to generate their own electricity and heat.

Still others are going back to basics, creating things with their own hands. These people are building their own bamboo bikes and living off the land, cultivating their own crops.

These technologies reflect our understanding of the necessary balance between human interests and ecological preservation. They are powerful tools for rebalancing our relationship with Earth and shaping our future.

We appreciate your readership and welcome comments, suggestions and questions in the form of e-mail, letters or conversation.

Sincerely,

Emily A. Linroth
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Toilets consume more water than any other appliance in the average home, but three new designs could significantly lower this amount, saving you money and the earth a precious resource.

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Have you ever considered the environmental impacts of air travel? Seattle-Tacoma International Airport is attempting to make flying less harmful to the environment by reducing emissions with several new technologies.
Using the toilet is an activity best kept behind closed doors. Only minutes are spent in there and there’s not much to talk about anyway. You go in, sit down, do your business and...flush. But this is the step people should be talking about.

A single person flushes a toilet an average of four times a day. According to a study done by the American Waterworks Association, toilets use 31 percent of the water in the average home—more than any other appliance.

The typical flush sends 1.6 gallons down the drain and into a maze that leads to a wastewater plant where the water is treated and disinfected.

In the 1950s, toilets used as much as 7 gallons per flush—by the 1980s this had been reduced to 3.6. In 1992, the National Energy Policy Act went into effect and the federal government began requiring that new toilets use no more than 1.6 gallons every flush.

But even with the strides that have been made over the past 50 years, flushing the toilet is literally flushing money and resources down the drain. However, in the last decade, three types of toilet technology have floated to the surface. These composting toilets, waterless urinals and dual-flush toilets could save households and businesses around the world a lot of water.

At least 36 states, including Washington, will experience water-shortages by 2013 because of increased water use and old, inefficient water management technology, the Environmental Protection Agency reported in 2008.

According to the U.S. Geological Survey, the U.S. used more than 148 trillion gallons of fresh water in 2000—that’s enough to drown Washington State with more than 10.5 feet of water.

IslandWood Environmental Learning Center on Bainbridge Island realized the reality of these statistics and decided to blaze a trail—using composting toilets, waterless urinals and dual-flush toilets in their facility. When the learning center was built in 2001, the staff made a commitment to preserving the environment, according to facilities manager Dave Newcomb. If nature calls, students use composting toilets along the learning center’s outdoor trails.

Composting toilets are waterless systems that churn human excrement into a muck called humus that can be used the same way as fertilizer.

There are a couple different styles of composting toilet systems. One consists of a standard toilet bowl that drains to a large compartment located beneath the building. The compost then builds up in the compartment and moisture, oxygen, earthworms and microorganisms help decompose the material.

Many parks and islands, such as some in the San Juans, don’t have sewer systems. This style of toilet is often selected in these cases and can be built without the help of a company.

Composting Toilet Systems, Inc. (CTS), a company based out of Newport, Wash., builds composting toilets for those who aren’t so handy.

Not a lot needs to be done to maintain a composting toilet, CTS manager John Hinchliff said. A bulking agent such as wood chips, coarse sawdust or bark is added to start the composting
A new dual-flush toilet in the Academic Instructional Center at Western. Photo Illustration by Ryan Scott. Photo by Tristen Biando.

process. Other compostable materials such as banana peels, tea bags and egg shells can also be thrown into the mix. Every 50 to 100 uses, a gallon of bulking agent is added to the tank, and every 1,000 to 1,500 uses, the composting material should be mixed with a pitchfork, Hinckliff said.

Biolet, a company that distributes Swedish-made composting toilets, offers a second option. The system is smaller, about the size of a standard toilet bowl, but uses electricity to break down the compost. After each fecal use, bulking material is added through the bowl instead of flushing. A compartment under the toilet holds the composted waste and is removed by the user when it is full.

Newcomb said there are four outdoor systems along the trails on IslandWood campus and two indoor systems that can handle two bowls each. This is more than enough accommodation for the 8,000 people that visit the learning center each year, he said. Only a quarter of human feces is comprised from solids—the rest is just water.

"After 7 years, we haven't needed to harvest any compost from the containers. The toilets in the facility won't be full for another 5 years and the ones along the trail won't need to be emptied for another 20," Newcomb said.

But these systems raise some sanitation concerns. Human waste carries harmful bacteria, and owners of composting toilets are advised not to come in contact with the composting material for six months to a year.

The finished product of a composting toilet is classified as domestic septage, according to the Whatcom County Health Department's Environmental Health Specialist Kyle Dodd. This classification allows humus to be applied to forest and agricultural land, but it cannot be deposited in areas where the public would have contact with the land—like a lawn or home garden.

Another downside is that they are expensive. At Home Depot, a Biolet toilet for a three-person household sells for nearly $2,000 and the price goes up from there.

But despite the cost, buildings around the Northwest have started to make the switch to composting toilets. The C.K. Choi Building for the Institute of Asian Research at the University of British Columbia opened in 1996 with 10 composting toilets.

For toilets that deal solely with liquid waste, going completely waterless is a viable option. At Chuckanut Brewery in downtown Bellingham uses this new technology in their men's rooms, and manager Mari Kemper said she's glad they chose to go waterless.

"It saves us a lot of money," Kemper said. "Water is expensive and we're happy saving as much of it as we can."

This attitude of water-saving toilets is catching many in its swirl—including Western.

The Academic Instructional Center (AIC) opened to students in early 2009 featuring water-saving dual-flush toilets—complete with a handle treated to protect the user from germs. The directions are simple—pull the handle up for liquid waste, push it down for solids.

Solid waste will flush with a federally regulated 1.6 gallons, but dual-flush toilets allow liquid...
An illustration of the diagram on the plaques next to the dual-flush toilets in the Academic Instructional Center at Western Washington University. Push the handle up for less water, down for more.

waste to use half that amount.

Caroma Industries, an Australian-based company, created dual-flush toilets in 1980. Dual-flush toilets are capable of saving 68 percent of the water used by toilets, according to Caroma. Regular toilets use a siphon, a tube that allows liquid to drain from one chamber to a lower one, to flush waste. Dual-flush toilets use a larger diameter trap that allows the water to flow freely and quickly down the drain. When the liquid waste option is chosen, only half the trap opens and half the water is used in the process.

Steve Morrow, the plumbing shop supervisor at Western, said dual-flush toilets will make a measurable difference after Miller Hall is renovated, starting in the spring of 2009. Morrow said the plan is to replace all the old toilets with the dual-flush variety.

"We can take most toilets on campus and convert them to dual-flush," Morrow said. "There's been some talk about a project like that, but there hasn't really been anything done about it because of the way the budget is now."

But dual-flush toilets are comparable in price to standard toilets. Prices range from about $260 to $1000 for a top-of-the-line system while standard toilets cost at about $200.

Online companies like SelectAFlush also sell kits to convert standard toilets to the dual-flush variety. This option is less expensive—kits range from $30 to $75—and can easily be installed by a homeowner.

So it's time to start thinking about the step before you wash your hands. The direction you push the handle or the urinal you use could determine how much water your state has left by 2013. Using your toilet could even help feed farmland—and leave enough water to irrigate it.

Alexis Tahiri studies public relations and music. He has been published in The Western Front.
The small dogfish lay in the drift line on the shores of the Finistère coast in northwestern France. Walking along the beach, Professor Antonia Kesel noticed the dead shark was barnacle-free, while other deceased sea dwellers are usually covered with marine growth. This discovery led Kesel to commit her life's research to the potential applications of sharkskin.

Above: Sixgill shark scales, magnified 334 times on a scanning electron microscope.

Dogfish and sixgill sharks are observable to the people residing in the Puget Sound area, said Leo Bodensteiner, associate professor at Western Washington University. Almost two million dogfish are residents in Washington's inland waters, according to 2001 statistics from the Florida Museum of Natural History.

Boats, submarines and aircrafts mimic the contours of sharks. The skin of these creatures is also being used as a model to develop coverings for the hulls of boats that could prevent the attachment and accumulation of marine creatures.

The University of Applied Science in Bremen, Germany is one of the places that synthetic sharkskin texture has been created using dogfish shark models. The group, with Prof. Kesel, who is head of the master program of biomimetics at the university, works for shipbuilding and applied science. Katrin Mühlenbruch, assistant professor at the university, said applying artificial sharkskin to boat hulls prevents biofouling, the accumulation of organism growth. The engineered surface results in less fuel consumption and CO2 emission to the environment.

Unlike most fish scales, which are flat and smooth, shark scales have a texture similar to sand paper, Bodensteiner said. Shark scales, called dermal denticles, are arranged in a microscopic diamond pattern. Each scale has one principle spike protruding out of its center. This creates tiny drag points on the sharkskin instead of one larger drag point that pushes through the water. Small drag points help to reduce drag and allow sharks to swim faster and easier than other fish, Bodensteiner said.

In addition, the roughness of sharkskin makes it difficult for bacteria and marine organisms to adhere to its surface.

Sharklet Technology LLC, a spin-off company from the University of Florida, has been using the model of a Galapagos sharks' skin pattern for engineered sharkskin. Two hypotheses for why the design works have emerged.

First, the surface creates an energetically unstable area for the bacteria. The energy that it would take for the organism to establish a home on the surface is more than it is willing to expend, so the organism will leave to find another place to settle.

Second, the surface would halt the grouping of barnacles and other marine organisms by not allowing them to send signals to each other, said Mark Spiecker, vice-president of Sharklet Technology.
The major task of barnacle larvae is to find a place to settle where the adult will survive," said Dr. Brian Bingham, a professor of environmental science at Western.

They like dark places to settle, such as the bottom of ships, he said.

The idea of this technology is to mimic sharkskin structure. This is a non-toxic way to delay the attachment of fouling organisms. The material contains manmade gradients that copy sharkskin patterns.

The engineered surface is made of a variety of microscopic-sized surface structures in a diamond shape. These structures are smaller than a human hair and 10 times smaller than the actual size of sharkskin, Spiecker said.

Submerged surfaces of boats, ships and ferries can be the perfect environment for marine organisms such as barnacles, slime and algae to grow. Such marine biofouling increases drag resistance and reduces speed, resulting in extra maintenance that can cause up to a 40 percent increase in fuel costs for ships, according to the International Maritime Organization (IMO).

To prevent biofouling, most boat owners use anti-fouling paints: paints designed to inhibit sea creatures' growth. Many do this by leaching their toxic chemicals into the water. Copper paints are used as a biocide to kill marine life, said Kevin C. Fitzpatrick, water quality section manager of the Department of Ecology. Copper-based paints have been used more widely since tributyltin (TBT) paints were banned due to their highly toxic nature, said Phil Riise, CEO of Seaview Boatyard East.

Synthetic sharkskin surfaces have micro-sized diamond shapes carved out of non-toxic silicon wafers. On the diamond-shaped topographies, the marine organisms can only reach a maximum of three contact points. Since they prefer more than three contact points to get a better grip, organisms are discouraged from growing on the surface.

Synthetic sharkskin can be applied to more than boats, Spieker said. The material could also be used on high chairs, toilet seats and wallpaper to reduce bacterial buildup. He said the solution of making a texture to apply to boat hulls is in progress. Since this product is not currently on the market, the price of it has yet to be determined, Spieker said.

"It could be applied to anywhere you would like to keep macroorganisms from growing," Spieker said.

Synthetic sharkskin could also combat growth of microorganisms. Application to hospital equipment has the most potential for being on the market at the end of this year, Spiecker said. Currently, the application to hygienic surfaces is under field trial at some hospitals. The engineered surface could be embedded or could be directly imprinted into a device or a piece of equipment such as a catheter, Spiecker said. Synthetic sharkskin could impair bacterial growth on the equipment the same way it discourages barnacles to attach to boats, reducing the potential for growth of bacteria like Staph and E. coli and limiting the spread of disease.

This eco-friendly approach could help eliminate the need for anti-fouling paints, benefiting human and marine ocean travelers, said Dr. Ruth M. Sofield, assistant professor of Environmental Sciences at Western.

"If you have something that is not allowing chemicals to reach into the marine environment, it is a better scenario for the marine environment," Sofield said.

Kwihwa Lee is a journalism major. She has been published in The Western Front, Klipsun and The North American Post.
A bicycle is the most energy-efficient form of transportation on the planet — but there's one way it can improve even more. Think pandas.

Or at least panda food. Bamboo is a completely renewable resource. It is the fastest growing plant in the world — some species can grow 48 inches in a day and reach heights over 100 feet, according to the American Bamboo Society. It releases 35 percent more oxygen than a timber forest, and is as strong as mild steel when stretched, according to the Environmental Bamboo Foundation. It can be harvested without soil erosion and grown in almost any climate, including the Pacific Northwest.

And now it's being used to make bicycles.

Most new bikes are made from aluminum or carbon. Aluminum production emits a chemical that has up to 10,000 times the global warming potential as carbon dioxide, according to the United Kingdom's Environment Agency.

Damaged carbon fiber bike frames are almost impossible to repair, and because of this, most are cut in half and thrown away.

Live bamboo, however, removes carbon dioxide from the atmosphere and dead bamboo can be disposed of in a compost bin instead of a landfill.

Craig Calfee, owner of Calfee Design in Santa Cruz, Calif., was one of the first people to realize the environmental potential of bamboo in bicycles. While bamboo bikes were originally built as a publicity stunt, the company began selling them commercially in 2006 and have since been featured in publications such as Time, Newsweek and the Los Angeles Times.

However, the labor-intensive building process has kept the price high on Calfee's bamboo bicycle line. The company hand-builds their bikes using specially heat-treated bamboo connected by a hemp/Kevlar/carbon/epoxy blend. The whole process takes 35 to 40 hours. As a result, a Calfee Design bamboo frame currently sells for around $2,700.

I built mine for $160.

My search for local bamboo sources led me to Tom Burton, owner of Tom's Bamboo in Blaine, Wash. Burton grows and sells his own bamboo from his home, which is easily identifiable by the 35 foot stalks peaking above his roof. During my first visit, he had me stand in the middle of a bamboo grove at night, without a flashlight, and lean back against a stalk to look at the stars. Burton's love for bamboo, gained over 20 years working with the plant, is infectious.

"When you get the fever, you get the fever," Burton said.

Earlier, Burton had referred to bamboo as a lesson on the virtues of flexibility in life. Looking up as the grove leaned quietly with the wind, the lesson was not lost.

I was starting to get the fever.
Sak's completed bamboo bike, standing in the grove where it's bamboo originated.

2 New & Old

Like Calfee's design, only the basic V-shapes of my frame would be made from bamboo. To avoid buying new parts or cutting up usable bike frames for the remaining components, I went to The Hub, a non-profit community bike shop in Bellingham. The Hub reconditions used bikes and bike parts that would otherwise sit neglected in someone's garage or rust in a landfill.

Searching through the Hub is like sifting through a greasy antique shop - shelves holding boxes of different parts sit against the wall beneath dozens of wheels dangling from the ceiling. Franken-bikes, bikes built from the remains of unusable ones, hang from hooks or lean hopefully against kickstands, ready for purchase. Rows of other bikes brood in dark corners, waiting to be dismantled.

After an hour of rummaging and cutting up broken frames, I had the wheels, cranks and other parts that I needed to flesh out my frame, as well as a gruesome pile of bike remains. Instead of dumping it into a landfill, I was able to recycle it all at Northwest Recycling of Bellingham.

3 Tying It Together

To hold all the bamboo tubes together, I decided to use the castaway-on-a-deserted-island method, lashing the joints with strands of hemp and epoxy. Steve Dillman, a professor in the Engineering Technologies Department at Western Washington University, recommended an epoxy used for fiberglass where the hemp would replace the fiberglass fibers. After a difficult search, I found the hemp I needed through the Hempest, a local dealer of hemp clothing and accessories, and through a Portland-based fabric dealer called Aurora Silk.

4 Sticky Business

To cure their bamboo, Calfee Design smokes it for 12 days in a specially designed smoke-room, saturating it with carbon from the smoke to give it maximum strength. I wanted mine faster, so I used a propane blowtorch instead.

The green bamboo, spitting and steaming under the flame and smelling strangely like sweet potatoes, went from tan to a beautiful teak as it dried out. I leaned all my weight onto it to test it. It didn't even budge.

After cutting the tubes to length with a hacksaw, fitting the pieces together required only a fresh file and a lot of skinned, bloody knuckles. The ends of each tube had to be roughened with a rasp to give the hemp something to grab onto, and after eight hours of filing, cutting and rasping in my brother's basement, my forearms were completely useless - but the bike tubes were ready to go.

Before permanently setting the frame with the hemp and epoxy, I used superglue to temporarily put it together. This would guarantee there would be no problems with its shape, but to my frustration, there was—the rear wheel rubbed against both surrounding tubes. Adjusting the wheel didn't fix it, nor did pulling the tubes apart. The stubborn frame was moments from a ghastly and unspeakable demise when I realized I could just snap the glue and reset the tubes.
To my delight, the frame turned out beautiful. But it wasn’t finished until the joints were lashed together with the hemp and epoxy.

As soon as the epoxy touched the hemp, madness broke loose. Imagine brushing long, blonde hair with a dead pine bough full of sap. The hemp tangled and stuck to everything it touched, including my clothes, the epoxy bottles and anything that came within 10 feet of the mess. But after four hours of applying the goo to the joints and one night for the epoxy to cure, the frame was done. Fitting the rest of the parts required four files, six hours of filing and another devastating forearm workout.

After 90 hours, $160, six files, two hacksaw blades and countless curse words, the bike was ready to ride.

My stomach sat in my throat and my hands shook nervously with excitement as I pushed it into the alley behind my brother’s house. This first ride could go perfectly — or it could end horrifically with compound fractures and massive brain trauma.

I put my feet in the pedals, took a deep breath and shifted all my weight onto the bike.

Instead of an explosion of bamboo shards, I was pedaling a stable bicycle. I took it down the alley, then Magnolia Street and then Samish Way. With each mile I went faster, blasting through gravel and rough concrete and jamming over speed bumps. It rode smoother than any aluminum or carbon bike I had ever ridden, absorbing the vibrations of gnarly sections of road and the jolts of cracks in concrete.

The bike is still far from perfect. It looks like a cave man built it. The front wheel only turns 45 degrees in either direction, making sharp corners terrifying. The alignment is off and the bamboo handlebars broke immediately, nearly killing me.

But that’s not the point.

It is completely ride-able and built with materials that are for the most part sustainable. If someone who has never even thought of building a bike before can do it in two weeks, using no special tools, then there’s serious potential here, especially in a community as environmentally conscious as Bellingham.

Calfee also sees this potential. He is currently working on a project in Ghana where he is teaching Africans to build bikes from local bamboo that could provide reliable and inexpensive transportation as well as a profitable export to bring money into the area. Calfee says that this could also lower the cost in the United States and bring affordable, sustainable bamboo bikes to mainstream markets like Bellingham.

Sakeus Bankson studies environmental journalism. This is his first published piece.
Your electric alarm clock goes off. It’s 7 a.m. and time for class. Hot water pumps from the showerhead when you turn it on and the coffee pot brews in less than five minutes. Do you ever stop to consider what goes on behind the scenes of your daily routines?

Some people have found ways to simultaneously reduce their costs and help the environment by living off the grid – even if it may mean no morning coffee.

Living off the grid can be as simple as generating part of a home’s power through wind and solar energy, or as radical as moving into a mud hut with no electricity, water, natural gas or sewage at all. Both can save money and help the environment, but this lifestyle is not for everyone. Stepping off the grid means stepping up to face the challenges modern day conveniences let us ignore.

Laura Plaut owns Common Threads Farm, an off-grid farm on Lummi Island. In the summer, she runs camps to teach children how to live sustainably. Although she doesn’t yet live on the property full time, she plans to build a home there eventually. She believes in her investment in solar panels to harness Lummi Island’s sometimes 100-mile-per-hour winds and to leave a better world for our children.

“I feel like we live in a world where if you’re not part of the solution, you’re part of the problem,” Plaut said.

Many of us who live on the grid thoughtlessly use electricity every day. For people like Plaut, there is no mindlessness to flipping on a switch or plugging in an appliance. Generating electricity is one of the major obstacles to jumping off the grid.

Plaut’s farm is currently powered by a solar-panel system that costs $20,000. Plaut said she thinks it will pay itself off in about seven years.
Although she has a battery bank to store energy, she does not have an endless supply and most of it goes to pump the water from her well.

"I could power a coffee pot right now in the middle of a bright sunny day, but I can't with my setup at six o'clock in the morning," Plaut said. "[You have to] start somewhere."

Plaut's hope is to soon connect to the grid using the Production Metering Program through Puget Sound Energy (PSE). The program will allow her to feed the extra energy she produces back into the grid so it doesn't go to waste, and let her take energy from the grid when she needs more.

"I feel like we live in a world where if you're not part of the solution, you're part of the problem."  
Laura Plaut

By living without any connections to utility companies, Jai Boreen encompasses the definition of living off the grid. Boreen and his family live in mud huts that rise from the hills of Missing Mountain Farm in Friday Harbor. He has taken an extreme approach to disposing of his waste—a technique he calls "humanure."

Boreen uses five-gallon buckets lined with paper garbage bags as a toilet. He covers his waste with sawdust and empties them once they're full. He swears it doesn't smell.

"You have a certain intimacy with your shit, and some people don't want that intimacy," Boreen laughed.

Boreen's devices don't stop with the toilet. His house doesn't provide the same primitive images the word "mud hut" would usually provoke. It is much more home than hut—industrially sound and aesthetically pleasing.

His hut is made of mud dredged from a pond on the property. As long as it doesn't get wet, the mud is an excellent building material, and a large roof protects it from Washington weather. Boreen mixed the mud with straw and even used old empty crushed beer cans for extra support for his kitchen unit.

Large windows line the hut's south walls, revealing scenes of Puget Sound. The windows also allow sunlight to pour in all day, which Boreen said is a great way to heat his home without lifting a finger.

"You wake up and it's absolutely gorgeous," Boreen said. "Every morning, it never fails. This kind of lifestyle is constant therapy."

When warmth from the sun isn't enough, Boreen has two wood stoves that provide ample heat. One stove sits on the side of the room, running warmth through a large pipe up the wall. The other is a downdraft stove, which is lit outside the hut. Heat from the fire is sucked under the floor through pipes to warm the hut from the ground up. The pipes run directly under Boreen's bathtub, so although it may take more than just turning a nozzle, hot baths aren't out of the question.

Perhaps all pioneers have to deal with the bugs that plague an alternate lifestyle, and living off the grid is no different. Living sustainably isn't without its hardships. For Boreen, some problems stem from skeptics in the community. He thinks people who connect to the power grid without a second thought aren't scrutinized as much.

"Some people idealize our lifestyle and some people stare at it," Boreen said. "I don't think that people who stay mainstream have to deal with that as much. Our culture is pretty judgmental."

Boreen hasn't let criticism change the way he lives. He is proud of the existence he created. Even with examples like Boreen, it doesn't always work out for everyone.

Pat Savatgy lived outside of Deming for 25
years before moving to Bellingham in 2007. Though he embraced the off-the-grid lifestyle and still keeps up with off-the-grid technologies as a hobby, he spent too much time commuting to town and decided to move.

Savatgy built his Whatcom County home far from electric lines. In order to produce energy, he created a hydroelectric system that cost much less than running power lines to his house.

Savatgy hooked up a car alternator to a homemade dam on a creek near his house. The alternator charged batteries to power his home. He produced enough energy to live frugally, but couldn't power all his appliances. Savatgy used a propane refrigerator and wood stove to conserve the energy that he produced.

Savatgy connected a water heater to the stove so whenever a fire was burning, he also had hot water. Considering he installed the stove for warmth, the entertainment value was a bonus.

"We had a glass door and watched the fire like most people would watch TV," Savatgy said. "You have a chance to collect your thoughts."

Savatgy said among the technical problems he encountered, on-the-grid technology started to dominate his low-tech lifestyle. When his son Rory was 12, he discovered the Nintendo 64 and wanted to play all the time.

"That would mean starting the generator to play games," Savatgy said. "It was using gas to play games; it went against my whole philosophy."

For many of us, exchanging video games for nights of watching a fire or coming home to a lightless house is simply too much to ask. But those who embrace the possibility of an off-the-grid lifestyle aren't alone. Perhaps we could all take a tip and be a little more off, a little less on.

Kaylin Bettinger studies visual journalism and Spanish. She has been published in the Western Front. This is her first published piece for The Planet.
Diane and Michael Bumstead find their refuge from the stresses of civilization on the rocky shores of Lopez Island, 27 miles from Bellingham Bay. For years, the Bumsteads vacationed in a tiny lodge Michael's father built in the 1940s. To accommodate a growing family, the couple recently decided to build a larger cabin on their property. Preparations were made and development was underway. Then disaster struck.

Salinity testing showed the Bumstead's well water was too salty to drink. They had to find another freshwater source or give up their home. In need of clean H2O, the couple did what a rising number of communities facing water shortages around the world are doing: they turned their attention and their checkbooks to the sea.

This story is familiar for residents of the San Juans. Lopez Island's population has grown roughly 20 percent since the year 2000, and so have pressures on the island's freshwater resources. The decline in available drinking water means many of the island's inhabitants—including the Bumsteads—may be forced to move.

At present, 6 percent of San Juan Islanders get their drinking water via desalination—the process of turning saltwater into freshwater. While some promoters hail the practice as the answer to freshwater woes, others are concerned. Desalination releases salty effluent into the sea, is initially more expensive than groundwater sources and may open up untapped coastline to developers. Considering all this, is desalination the answer?

Meet Andrew Evers: consulting engineer and environmentalist. For the last 10 years, his company, Watek LLC, has brought alternative freshwater sources to the San Juan Islands. "I've been to Mexico, Australia and the Middle East—I've seen the problems they have over there," Evers said. "As far as Washington and Oregon, there's so much water here that nobody really thinks about it. But since we [on Lopez] have an isolated case where we have no rivers, we have no reliable supply of water. We fit with the rest of the world and their water shortage—trying to meet population demand and growth."

As Evers said, many parts of the world are facing water supply problems. In the United States alone, large cities like Santa Barbara, Calif., and Tampa Bay, Fla., began large-scale desalination projects in the 1960s in response to droughts and shortages.

On Lopez, Watek specializes in what's called seawater reverse osmosis—a type of desalination that pushes saltwater at high pressure through a series of membranes, separating the water molecules from everything else.

Evers pointed out that over 97 percent of the world's water is found in the oceans. Only a very small fraction of the remaining 3 percent freshwater is accessible to humans. If Evers and other supporters can show that desalination is environmentally safe, coastal communities around the world will have a new, virtually unlimited source of clean, drinkable water.

So what's happening to the freshwater supply on Lopez Island? Ronald Mayo, a former water consultant for San Juan County, is concerned about seawater intrusion. Freshwater is contained in the ground in what is known as an aquifer. When water in the aquifer has been pumped out faster than rainfall can replace it, the level of the aquifer drops and the connected well runs dry. If the well sits on a coastline, gravity eventually pulls the nearby seawater through the soil and into the aquifer.

"Lopez Islanders have over-exceeded the replacement rate of the aquifers, so the freshwater line is receding," Evers said. Humans may not be the only ones affected. Research still needs to be done to understand how seawater intrusion may affect soil quality and vegetation growth.

While Evers said reverse osmosis is a safe and sustainable way to meet freshwater demand, not everyone is convinced.

Doctor Richard Strathmann heads the University of Washington's biology research laboratory at Friday Harbor on San Juan Island. Like other opponents of reverse osmosis, he is concerned about the negative impact desalination plants may have on marine ecosystems. According to Strathmann, the salty wastewater produced by the plants is usually sent back into the ocean, resulting in a measurable increase in salt concentration.

When the wastewater is mismanaged, as when it is released into a slow-moving current, it can pool on the seafloor and threaten marine life. In a letter response to Ronald Mayo, Strathmann
wrote that dense pockets of high-salinity water decrease oxygen levels, making these areas uninhabitable for many marine animals. These dead-zones are unlikely to occur where effluent is released into a fast-moving current, Strathmann said.

Evers acknowledged the risk of waste management. Watek's research shows that none of their facilities create dead-zones. No independent studies of Watek's impact exist at this time.

Strathmann is also concerned about potential pollution caused by added chemicals. In Evers' facilities, no chemicals are added to the wastewater. However, chlorine and calcium are added to the desalinated water. The Washington State Department of Health requires chlorine be added to any public water system to kill bacteria. Calcium is also added to prevent the rusting of pipes used to transport the water.

Watek also requires the cleaning of its desalination equipment to occur off-site. None of the chemicals involved in cleaning are at risk of finding their way into the ocean, according to Evers.

Still, Strathmann remains wary. More research needs to be done in order to understand how desalination effluent affects marine as well as near-shore ecosystems.

For now, the environmental cost of reverse osmosis is up for debate, but there is no question about desalination's financial expenses.

According to Mayo's report, a glass of desalinated water will cost the Bumsteads roughly twice as much as a glass of well water. To begin with, Watek charges an average of $300,000 to build a reverse osmosis plant capable of serving up to 40 households—typical for a plant in the San Juan Islands. Well installations serving a handful of homes cost roughly $30,000.

After initial construction costs, a customer's monthly bill reflects the price of energy, maintenance and repair. Extra steps in the desalination process mean the plants can be expensive to fuel. While renewable energy sources like wind and solar power can provide electricity, the last 30 years saw desalination primarily in oil-rich countries like Saudi Arabia. Recent improvements in efficiency have made the practice more viable for the rest of the developed world.

Energy is initially used to draw seawater uphill, from the ocean to the plant. Once inside, seawater is forced through a large strainer to filter out any visible solids. Since groundwater aquifers do this naturally, this extra step means more energy for reverse osmosis. After the initial filtration, the water is forced against the membranes at high pressure.

According to Watek's Web site, $1 spent on energy can yield 600 gallons of clean water. Evers also said newly designed energy recapture devices are being installed to recycle energy expended in desalination—resulting in even lower prices for consumers.

More technological improvement means the cost of equipment is falling as well. In 2000, one membrane cost over $5,000. Today's membranes sell for less than $1,000.

While reverse osmosis desalination may seem more expensive, many Lopez Islanders have no other choice. Rainwater catchment—the process of collecting and purifying rainwater—has become more common, but it is not a reliable source of drinking water during the summer's dry spells.

"It does cost more, there's no way around it," Evers said. "Wells are much cheaper, but they're not sustainable over the long run. Reverse osmosis is virtually limitless."

Mayo said the difficulty is in persuading people that the switch from wells to reverse osmosis is worth the expense. At $300,000 per plant, sharing the initial construction cost between 40 households would come out to $7,500 each—well below the price of installing an individual well capable of serving a fraction of the consumers.

Outside of small communities, where costs are diffused over a wider customer base, prices begin to drop. In Sydney, Australia, large-scale desalination systems only cost customers roughly 5 percent more per month than previously existing water sources. For now, a smaller desalination system spread over fewer customers means Lopez Islanders will pay more for freshwater.

Regardless of the cost, the need for desalination is growing. Evers believes reverse osmosis will replace well water sources in the future.

The Bumstead home was completed in late
Without access to freshwater, their project would not have been possible. The couple’s success has left island conservationists worried. Many are concerned that virtually unlimited access to freshwater will open up the island’s coastline for development.

"By its very nature, desalination promotes development," said Mike Kaill, former professor at the University of the Pacific in Stockton, Calif., and marine aquarium manager for the Port of Friday Harbor. "It means we’ve gone beyond the natural water supply. With this technology, anyone with enough money can move in and start building."

Mayo anticipates Kaill’s apprehension, but thinks development and water issues should be addressed separately. In his view, water policies should not be manipulated to restrict development.

"I’m probably more interested than most in controlling development out here, but to arbitrarily pick out something like reverse osmosis—why not just keep people from drinking surface water?"

There is currently no county-determined protocol in place to ensure the responsible management of reverse osmosis facilities. Kaill anticipates the need for desalination, but wants to see the county hold facility operators responsible for any mismanagement that could adversely affect the island’s ecosystems, such as the irresponsible handling of effluent discharge.

Evers shares Kaill’s concern. To ensure Watek’s plants meet environmental standards, each facility is regulated by a number of federal, state and local permitting agencies. Among them are the U.S. Army Corps of Engineers, the U.S. Department of Fish and Wildlife and the Washington State Department of Ecology.

Although the debate continues, the water scarcity issue needs to be addressed soon.

"One of the biggest problems for the planet right now is that there are too many people," Evers said.

Overuse of traditional water sources has put unnatural strain on rivers and aquifers. Because of that overuse, rivers like the Colorado no longer meet their oceans. If we do not stop over-pumping these sources, the natural environment will be affected much more than we are, Evers said. He believes desalination is a safe and sustainable way to reduce the pressure on natural sources and provide communities with access to clean water.

"The skeptics say reverse osmosis uses too much energy; we’re polluting our oceans, etc. No matter what we do, we’ll have an impact," Evers said. "Reverse osmosis will reduce our impact on the environment. Just because it’s not zero impact doesn’t mean it’s not a useful tool. It’s better than where we are today."

Alexander Kelly spends most of his time in the Liberal Studies Department. This is his first published piece.
As Americans search supermarket produce departments for perfectly shaped, evenly-colored fruits and vegetables, the dangers of a uniform food supply remain hidden. Behind the scenes, an agricultural system based on a few, homogenous crop species teeters on the brink of extinction.

Replacing small farms with thousand-acre fields of a single species has catastrophic consequences for food diversity. According to the Food and Agriculture Organization of the United Nations (FAO), three-quarters of agricultural crop varieties disappeared during the last century. This spells trouble for anyone who likes to eat.

"If we had no diversity in our plants, we wouldn't have plants in a couple years," said Steve Jones, director of agricultural research at the Washington State University Extension Center in Mount Vernon.

It's the same for humans. If everybody had similar genetics, one disease could wipe us all out. Responding to the dangers of a uniform food supply, local farmers are cultivating genetic diversity with their own hands.

"I think of seeds as the fundamental technology for agriculture," said Dr. John Tuxill, assistant professor of ethnobotany at Fairhaven College. Seed genetics determine the conditions in which a plant will grow and reproduce and what kind of care it needs. Farmers have cultivated diversity for 10,000 years by saving seed from their own crops. This results in genetic variation as plants become adapted to specific environments.

At Wake Robin Farm in Ferndale, Brigitte LeClair relies on her own hands to sustain a 10-acre farm teeming with life. As early morning sun burns through the mist, she's out shoveling manure, building the compost pile that will feed her one-acre garden come spring. The farm is home to flocks of chickens and sheep, copious vegetables, one horse and four humans. LeClair maintains this agricultural diversity through careful selection and tending.

"My philosophy is that if it doesn't work, if it's not going to survive, I pull it out," LeClair said. She wants her plants to be fit. If a variety thrives in her northern Whatcom County microclimate, LeClair saves seeds and plants the same strain next season. In the case of winter squash, she has been cultivating a single variety for 22 years. Sally's Tennessee Squash is a unique variety full of dry, sweet, dark-orange meat. The seed traveled from Tennessee to eastern Washington to Bellingham, an example of how plants adapt to changing conditions. The seed produces an heirloom variety, one that has retained a distinct set of characteristics for 50 to 100 years.

"I feel pretty honored to carry this seed forward," LeClair said.

After getting her start with squash, LeClair now saves seed from heirloom lettuces, chard, dry beans, flowers and eight varieties of potatoes. "Anybody can be doing this," said LeClair. She started with a shovel and a half-acre in north Bellingham, and moved to the county when her crops and flocks outgrew the plot. Today, Wake Robin Farm provides eggs, meat, milk, wool and heirloom vegetables for her family and the local economy.

While LeClair wants to promote diversity, she only has two hands. For some crops, the danger of cross-pollination limits the number of varieties one farmer can maintain. In order to protect the distinct qualities of Sally's Tennessee Squash, LeClair has to keep other squash blossoms a mile away.

Fortunately, a neighbor down the road cultivates his own unique variety of winter squash, out of reach of the bees that pollinate LeClair's flowers. Walter Haugen of F.A. Farm has been perfecting the characteristics of Flame Buttercup squash for 10 years.

"It's an aesthetic," Haugen said, pointing to a specimen's square shoulders and deep green skin laced with orange. Besides its eye-catching value, the squash's meat tastes remarkably like sweet potato.

Haugen developed Flame Buttercup from a mutation and continues to select for genetic diversity. Rather than saving all the seeds from a few fruit, Haugen sets aside a handful of seeds from each squash he cuts open. This technique ensures that his variety retains "elasticity," or enough genetic variation to adapt to changing conditions.
"If we had no diversity in our plants, we wouldn't have plants in a couple years."

Steve Jones

Threats of global warming and species extinction have also prompted high-tech responses. On an island chain north of Norway, the Svalbard Global Seed Vault has been drilled into the side of an Arctic glacier. Constructed to hold up to 4.5 million seed samples, the permafrost-buried chamber won't rise above freezing—even in an electrical failure. At these temperatures, some seeds can remain viable for thousands of years. But not everyone agrees that seed banks are a functional panacea.

“It’s absolutely essential that we only see seed banks as a back-up, not a primary means of conserving seed diversity on this planet,” said Gary Nabhan, world-traveled ethnobotanist and author.

According to Nabhan, farmers have to be actively planting and harvesting seeds, adapting varieties to changing conditions. This is what makes LeClair and Haugen’s work so important.

At the Washington State University Research and Extension Center in Mount Vernon, specialists work with farmers to develop plant varieties especially suited to their location, a process research director Steve Jones terms “evolutionary breeding.” They also support preserving local and native foods that people have been cultivating in the region for generations.

“There’s no doubt that we live with a changing climate,” Jones said. “How will plants react to that? We don’t know.”

That’s why it’s important that farmers maintain diversity in their fields. If one variety struggles, farmers can cross it with another that does well, or find different varieties to sustain them. In order to find these genetic alternatives, someone has to be growing them.

Mara Mitchell studies sustainable agriculture at Fairhaven College. She has been published in the Whatcom Independent, SageWoman Magazine and the Fairhaven Free Press.
Steve Fishman, his hands gloved up to his elbows, reached into the steaming washer and pulled out a pile of freshly dry-cleaned clothes. He held his breath to avoid the thick, chemical clouds of perchloroethylene pouring out of the machine and filling the air around him.

Fishman, an employee at Northeast Cleaners in Lake City, Wash., said inhaling perchloroethylene causes him headaches and dizzy spells.

For many decades now, perchloroethylene, or perc, has been the dry cleaning industry’s standard solvent. But perc’s status as an environmental pollutant and carcinogen has many dry cleaners rethinking the way they launder clothing.

There are policies in place to reduce perc pollution. But new dry cleaning systems that don’t require perc, such as petroleum and silicone based cleaners, have been developed to cut the use of this chemical. These eco-friendly dry cleaning techniques, along with regulations, have helped make perc both easier to avoid and safer to use.

Since 1855, dry cleaning has become a regular service for many Americans. Brian Richards, owner of Vienna Cleaners in Bellingham, said that dry cleaning was discovered when people began looking for new ways to wash clothes without shrinking them.

Dry cleaning, as its name implies, cleans garments without the use of water. Instead, the clothes are washed in a mixture of soap, a liquid solvent and a bit of moisture. Early dry cleaning solvents included liquids such as gasoline and kerosene.

Today, however, perc is the most commonly used dry cleaning chemical, and it has its fair share of risks. According to the Occupational Safety and Health Administration (OSHA), inhaling perc can cause dizziness and impaired coordination, and long-term exposure can lead to memory loss. Perc is also known to cause cancer in laboratory animals.

Dixie Ervick, a dry cleaning employee from 1967 to 1986, worked with perc daily. At the time of her employment, there were no safety regulations in place for drycleaners, Ervick said.

“We used to take the loads of clothes soaked with perc out of the machines and carry them over to the dryer,” Ervick said. “This part of my job made me feel very sick.”

One employee who worked at the cleaners with her developed rashes and a nerve condition, Ervick said. She left her job at the dry cleaner shortly after.

Today, Ervick said she has sarcoidosis, a lung condition that she and her doctors blame on many years of working with perc.

“No one told us that perchloroethylene was dangerous until the Right-To-Know Act was passed,” Ervick said. “Then we were educated about the chemical and the owner had to buy new filters and machines.”

The Right-To-Know Act, enacted in 1986, ensures that the public is informed about chemicals they may be living near or working with. The act is meant to improve public safety and protect the environment, according to the Environmental Protection Agency.

Even though there are regulations and safety considerations in place now, the state of California is steering away from perc. According to the Coalition for Clean Air, 10 percent of water wells in California are contaminated with perc. In 1991, California declared perc a toxic chemical, and in 2007, the state enacted a law to ban the use of it in dry cleaning establishments by 2023.

Bri Silbaugh is a specialist who visits Bellingham businesses and helps them identify and reduce pollution. Silbaugh said perc enters the environment when holding containers leak or spill. Perc is stored in plastic drums with tightly secured lids. However, accidents happen, and leaked perc can mix with rain and stormwater. It can even leach through concrete.

Perc waste is created in two main ways, Silbaugh said. Separator water is accumulated during the dry cleaning process. This water is not used for dry cleaning, but comes from moisture in the surrounding air and from moisture in the clothes. It is contaminated with perc and must be disposed of as hazardous waste. The second waste material is known in the dry cleaning industry as sludge. Sludge is a black slime that is made up of sweat, skin, hair and any other grime that is removed during the cleaning cycle. This is contaminated with perc and must be stored and disposed of as hazardous waste as well.

Following in the footsteps of California, many corporations are turning away from perc to eco-
An endless array of clothes sways above as the conveyor belt makes its rounds. Photo by Paul Israel

friendly processes. Although these techniques are relatively new, they have already been shown to be gentler on both clothing and the environment.

One alternative to perc is DF-2000 Fluid, a petroleum-based cleaning solvent that is sold by Exxon-Mobil. Vienna Cleaners in downtown Bellingham uses DF-2000. For 50 years, Vienna Cleaners used perc as their solvent of choice, Richards said. After his machine broke down in 2000, he decided to invest in machinery designed for use with DF-2000 Fluid.

DF-2000 compatible equipment can run about $70,000, Richards said. The machine sits in a 280-gallon containment tray designed to catch all of the cleaning solution in case of a leak.

Although perc is a faster and better cleaning agent, Richards said he is happy with the DF-2000 solvent. Clothes washed with DF-2000 come out softer and better smelling than clothes washed with perc, Richards said.

Another alternative solution is liquid silicone. Liquid silicone is a common household substance and can be found in toiletries and cosmetics. Dry Cleaning Station, a dry cleaning business in Greenlake, Wash., uses the GreenEarth Cleaning System, a patented method that employs liquid silicone.

Andrea Wallace, owner of Dry Cleaning Station, said she only invested in a dry cleaning business because the process she uses is environmentally friendly.
Skin reactions to the silicon solution have proven mild in comparison to perc in sensitivity tests, Wallace said. The liquid silicone is also gentle on clothing; even garments with pearls and sequins are unharmed in the cleaning process.

And liquid silicone is not harmful to the earth. The non-toxic solution is biodegradable, and if it does make its way into the environment, it will break down into sand, water and carbon dioxide—all natural components, Wallace said.

Despite the options for more eco-friendly dry cleaning techniques, some companies don’t see eliminating perc as a financially feasible option. The GreenEarth Cleaning System machines cost approximately $80,000, Wallace said. Many dry cleaning establishments are small, privately owned businesses. With such businesses already struggling to stay afloat financially, upgrading to new machines could be too costly.

However, Wallace said there are ways to avoid the high cost of new machines. Her business is a clothing drop-off site only, meaning that no washing is done at her store. This relieves Wallace of the cost of purchasing and repairing the machines. She collects customer’s garments and sends them to a main GreenEarth Cleaning System facility in Auburn, and the clothes are returned in three days, Wallace said.

The eco-friendly aspect of dry cleaning is appealing to many customers, Wallace said.

“I would say that 30 percent to 40 percent of customers come in because we are an environmentally green cleaner,” she said.

But if switching to a new process is still not practical, educating dry cleaning business on how to prevent perc from entering the environment is yet another strategy to help reduce its impact.

Silbaugh is a Huxley graduate who works for Local Source Control, part of the City of Bellingham Public Works Department, that helps businesses such as dry cleaners reduce their pollution output. She advises dry cleaners to store plastic barrels of hazardous perc material indoors and away from any floor drains. She said barrels should have proper, tight-fitting lids, and they should be stored in a secondary container in case of leaks and spills.

While the outright ban of perc may not be in the near future for Washington, businesses like Vienna Cleaners in Bellingham are paving the way with more eco-friendly laundering practices.

Perc remains the industry standard solvent, but until that changes, consumers and dry cleaning owners should be aware that environmentally-friendly alternatives are available.

Heather Brogan studies chemistry. This is her first published piece.
It looks like a modern, stucco home, but there is one thing that gives its structure away. The bloated window ledges covered in art are about 15 inches wide because of the width of the straw bales behind the plaster.

Below exposed wooden rafters is a reclaimed hardwood floor. The pot-bellied woodstove in the middle of the living room can easily warm the 1340-square-foot, one-bedroom home.

And for $578,500, this little gem and its 2.3 acres can be yours. But there is more to it than romance. This home offers a chance to live green.

Straw-bale construction can reduce lumber usage, increase insulation efficiency, reduce pollutants emitted into the atmosphere and offer a unique structural design.

Architect Terry Phelan, owner of Living Shelter Design in Issaquah, Wash., started her business as a conventional architecture firm. A few years after it opened, she read an environmental publication about green design and had an "Aha" moment.

"I'd been an environmentalist for years, but I was designing these houses that were bad for the planet," Phelan said.

Nestled amongst the moss-covered maples of Vashon Island is a small cottage that exudes old-world charm. The whitewashed walls and pitched, metal roof invite all who come across it to enter. An onlooker wouldn't know that this house's walls are made of compacted agricultural byproduct called straw bales.
It felt like a dichotomy of interests, she said, so she decided to learn as much about green building as she could. She was especially interested in straw-bale, and focused her business on the design of eco-friendly homes. Since then, she has designed several straw-bale homes. This includes a three-story home in Carnation, Wash. It was the first of its kind to be built in King County.

Building walls with these bales can reduce lumber use up to 50 percent. In an average, single-family home, that is a reduction of about 16,000 board feet, the same amount of board feet found in 32 Douglas Firs, totaling $5000 worth of raw lumber, according to David Wallin, an environmental science professor at Western Washington University.

In the United States, 200 million tons of straw is either burned or left to decompose on its own annually, according to Strawbale.com. Rather than let this straw go to waste, a straw-bale home uses it for housing. The home is built using the straw bales stacked like giant bricks, tied together by twine and then covered with plaster. Bamboo or rebar runs through the bales and into the foundation, holding the structure in place. The walls go up quickly, but tying them together is a bit tedious. The tool used to pull the twine through the bales looks like a very large needle. The finished product resembles adobe houses of the Southwest.

The first of these straw-bale homes were built in Nebraska at the turn of the 20th century because wood was a scarce resource while the grasses of the Great Plains were plentiful. Some of these original 100-year-old homes still stand, which is a testament to their longevity, Phelan said. The plaster on some of these old houses has been peeled back to see how the straw has survived, and the straw still shines as golden as the day it was harvested. By plastering the outside of the straw bales, oxygen and water are unable to touch the straw, which prevents decomposition, Phelan said.

"A straw bale is denser than a phone book," Phelan said, "Which means it won't burn easily, and there are no cavities for rodents to occupy."

The insulation value of a straw-bale wall is triple that of a conventional wall. This means a much lower heating and cooling bill because the warm stays in, and with the help of the plaster coating, the cool stays out.

Bryan Jones is a civil engineer with Jones Engineers in Bellingham, Wash. He said straw-bale homes are not only feasible in the Northwest, but they're already being built. However, many people are skeptical about the quality and durability of a straw-bale structure. Jones said they have reason to be skeptical if the homeowner is unwilling to perform regular moisture checks and fill cracks in the plaster. Not taking care of the home means the structure will start to rot and create crevices for pests and water problems.
"If you don't take care of it, you'll be miserable and never sell it, but if you take care of it, why not?" Jones said.

Finding an insurer and financial backing, as well as getting the permits necessary to build, can often be the most challenging part of straw-bale construction. State Farm Insurance won't insure straw-bale structures because there has not been enough testing done on the buildings, according to company policy.

Companies often cite flammability as the main reason they cannot back the building. In reality, the density and high silica content of the straw-bales make the walls less likely to catch fire, Phelan said. They will smolder, but they won't burn easily.

Bill Jevney and his wife Juanita Ramsey-Jevney took out a personal loan on their home to finance a private primary school built out of straw bales in Sequim, Wash. Five Acre School is insured through an insurer that covers all private schools in Washington State. They built the school because the environmental benefits and energy savings made sense, Jevney said. Five Acre School was built in 1994 as a 2000-square-foot, one-room schoolhouse and was expanded nine years ago to 4000 square feet. Electric heat is used to warm the school, and Jevney estimates that it costs $200 per month to heat the structure in the winter.

The interior of the school looks normal, cluttered with toys, a small computer lab and a music room. White boards and cubbies hang from the walls. Outlets on the exterior wall are connected to insulated electrical wires that run through the bales of straw. This is how all exterior electrical is handled. The plywood floor and tile ceiling are more traditional. To simplify plumbing, the bathroom is in the center of the building so fewer pipes run through the straw.

The L-shaped school creates an exterior nook where students have painted a mural of fictitious characters in a forest. One of the painted trees has a small plate of glass in its center. Spiky, golden straw shines behind the "Window of Truth," giving away the mass hidden behind the plaster.

This plaster plays a vital role in structural soundness in an earthquake. Phelan said straw-bale structures are much more flexible than stud-framed homes, so rather than breaking, the bales are held together by the plaster and move with the tremors.

"It's not going to slump if it's designed well," Phelan said.

Phelan usually teaches classes on straw-bale design in the summer.

"One of the things I've found is people feel so empowered by realizing this is something they could do themselves," Phelan said.

Depending on the type of straw, a bale costs around $3 per bale and weighs about 60 pounds. They're usually for sale at farm or pet supply stores or online, but Phelan said it is best to inspect them in person to ensure quality. A good straw bale for home building is tightly compacted with straight sides.

Phelan said she has learned several lessons about designing straw-bale homes. One thing she recommends, especially in the Pacific Northwest where rain bears down on these moisture-sensitive shelters, is to build roof overhangs carefully. Moisture sensors are also installed into the wall so that homeowners can be sure their walls aren't leaking.

Sometimes people approach Phelan looking for a maintenance-free house, and she said she tells them there is no such thing. For a straw-bale home, moisture checks, plaster patching, and overall home care needs to be maintained, but the upkeep is easy to do. However, if the owner were to abandon the home, the walls would eventually biodegrade.

"It's a compostable house, but it won't compost until you're ready, or at least until you stop caring for it," Phelan said.

In the meantime, one little eco-friendly home on Vashon Island waits for a new patron, not yet ready to be returned back to the earth.

Anne Maertens studies environmental journalism. This is her first published piece.
A plane descends from the North into the airfield at Sea-Tac airport.

“...We are now preparing for our descent. Please make sure seatbacks and tray tables are in their upright and locked position...”

These words precede the long, nerve-racking and environmentally damaging process of taking a plane from a cruising altitude of nearly 35,000 feet to docking at an airport. Seattle-Tacoma International Airport (Sea-Tac) is battling this inefficient process through the implementation of programs that will save passengers time, airlines fuel and the environment from harmful emissions.

According to the most recent emissions report by Sea-Tac from 2006, aircraft and ground activity in the area surrounding the airport produced approximately 641,000 metric tons of carbon dioxide per year. That's equivalent to the weight of 4,000 Boeing 747s.

Sea-Tac is working on several environmentally-conscious projects, including continuous descent approach and pre-conditioned air.

“We see a competitive advantage of being the cleanest, greenest most energy efficient port in the nation,” said Steve Rybolt, environmental management specialist for Sea-Tac.

Do you remember a descent that left your stomach upset or made your head spin? The plane lurches as it falls from 14,000 to 10,000 feet. As it drops abruptly, so do the passengers' stomachs. Some people are nervous; others are nauseous or lightheaded. Hands clutch armrests, magazines or books to relieve the tension of descent.

This experience will hopefully be a thing of the past with the adoption of continuous descent.

The Federal Aviation Administration, Alaska Airlines, Horizon Air, Southwest Airlines, Delta Air Lines and Sea-Tac are working together to begin using continuous descent, a new landing approach. The standard descent process relies on a tiered approach where planes are brought down in steps, resulting in a descent path resembling a flight of stairs. Each time the plane drops a step, the pilot must decelerate and then accelerate to maintain speed, which burns through fuel quickly.

Continuous descent brings planes to the runway on a smooth slope, thus saving the pilot from increasing and decreasing the throttle until they touch the ground. Each landing with this approach saves 300 to 600 pounds of fuel, said John-Paul Clarke, associate professor in the school of aerospace at Georgia Tech University.

If every one of the 170,000 landings at Sea-Tac each year used the continuous descent approach, it could prevent almost 54,000 metric tons of carbon dioxide from entering the air, which is equivalent to the emissions created by nearly 11,300 cars per year.

Clarke, who has worked on the continuous descent landing since 1993, said the approach has been tested with many models of passenger aircraft and it not only decreases fuel burn, it also cuts flight time by 2 1/2 minutes and noise by up to six decibels.

To use this landing method, a pilot looks for minimal air traffic, a defined path from the top of the descent and no further directions from air traffic control, said Sarah Dalton, Director of Airspace and Technology for Alaska Airlines.

Planes using this method have to be spaced out further away from the airport than with the current system because the descent process starts nearly 150 miles away from the destination.

Currently, there are points along an airplane's descent that must be hit at specific altitudes, causing pilots to make more adjustments using the throttle, Dalton said.

Knowing where your plane is in relation to others is vital to successful continuous descent landings. The idea is to have a clear path, allowing pilots to adjust the plane as little as possible, Dalton said. This requires spacing technology that integrates your plane with the others around it.

A difficulty in switching all descents to this procedure is that new instrumentation would have to be installed on the ground and in many of the aircrafts, Rybolt said. This problem is being
The plane on the left demonstrates the standard “step down” approach to the runway, while the one on the right employs a continuous descent approach that saves fuel and reduces noise and emissions.

Compiled by Harte Onewein  Infographics by Ryan Scott
A diesel-powered, pre-conditioned air unit pumps cool air into an Alaska Airlines plane docked at Sea-Tac.

dealt with in older planes, and newer models of planes will come equipped with the necessary technology to use continuous descent.

Alaska is one of the airlines using basic forms of continuous descent. However, they will not reap major rewards until more advanced systems and technologies are in place to deal with these barriers, Dalton said.

The only three airports in the U.S. using this landing procedure on a regular basis are Los Angeles, San Diego and Louisville, but Seattle hopes to join this group by early 2010. Continuous descent approach will likely be the standard descent process in 10 years, Clarke said.

The reduction of fuel burn and emissions is not only a priority while an airplane is in flight, it’s also important while it is on the ground.

Imagine you’re sitting in a window seat as other passengers continue to board a plane bound for Hawaii. A look out the window reveals a flurry of activity. The runway below is littered with several large carts, thick tubes and heavy machinery. As you reach up to turn on the air above, you wonder what all the equipment outside is used for. The cool air blows toward you, instantly relieving the stuffiness of the cabin. Next stop, Hawaii.

Air-conditioning is a necessity on planes in order to keep the cabin at a comfortable temperature, Rybolt said.

Many airports are making efforts to improve air quality through the use of pre-conditioned air, and Sea-Tac is ready to take the technology to the next step.

"Imagine taking 13,000 cars off the road a year—that’s the equivalent of us putting in a centralized pre-conditioned air system." Steve Rybolt

Whether in the air or on the ground, an airplane constantly runs air-conditioning. When an aircraft is in flight, its engines create the cool air, but on the ground, the auxiliary power unit aboard the plane takes over the task. Running the power unit wastes fuel and spews greenhouse gases such as nitrous oxide and carbon dioxide into the atmosphere.

Airports offer diesel or electric ground pre-conditioned air units – this equipment is what you saw while waiting for your flight to Hawaii to take off. The units look like giant stand-alone freezers on wheels. They connect to planes through a yellow tube resembling a covered slinky. A thick electrical cord connected to the gate is also plugged into the plane so cabin lights and cockpit instruments can function. The combination of these two services allows the aircraft’s engines to be turned off.

Sea-Tac is planning to build a centralized pre-conditioned air system that will significantly reduce emissions and fuel consumption, said Russ Simonson, a senior environmental program manager at Sea-Tac.

The centralized system will be housed within the main terminal and works the opposite of the boiler. Air flows over a chiller, which is essentially a large block of ice, and is then pumped through ducts to each gate. At the gate, the air travels through a tube leading from the gate directly into the plane.

Over a year, the new system could reduce carbon dioxide emissions by 69,000 metric tons, according to Sea-Tac studies.

"Imagine taking 13,000 cars off the road a year—that’s the equivalent of us putting in a centralized pre-conditioned air system," Rybolt said.

Simonson said the $30 million project has been in development for the last seven years but didn’t gain broad airline support until the fuel prices increased and the environmental benefits had been fully explored.

The reduction in fuel is good for the environment and the airlines’ pocketbooks, which will hopefully save travelers money, Rybolt said.

If everything runs smoothly, the centralized unit should be functional in early 2011.

While continuous descent approach helps reduce plane emissions during flight, pre-conditioned air will help planes conserve fuel while they stay idled at the gate. Airports are making the effort to reduce their carbon footprint, and procedures like these will only make this next step more feasible.

Harte Onewein studies journalism and public relations. He has been published in the Western Front and the Whatcom Community College Horizon.
After the immense January flooding in Bellingham, I wandered North Garden taking photos of the standing water. Inspired by the storm water story, the reflection of this flooded parking garage caught my attention and I imagined how helpful permeable concrete would be here. — Jane Gershovich.

Read the stormwater story exclusively online at planet.wwu.edu.
A society is defined not only by what it creates, but by what it refuses to destroy.
– John Sawhill