

Pachamama Alliance Drawdown Initiative

Solution Descriptions by Sector

LAND USE	
AFFORESTATION	Afforestation—creating forests where there were none before—creates a carbon sink, drawing in and holding on to carbon and distributing it into the soil.
BAMBOO	Bamboo rapidly sequesters carbon in biomass and soil and can thrive on degraded lands. It has more than 1,000 uses, from buildings to food to paper.
COASTAL WETLANDS	The world's salt marshes, mangroves, and sea grasses provide vital habitat, flood protection, and water filtration, and sequester huge amounts of carbon in plants and soil.
FOREST PROTECTION	With mature canopy trees and complex understories, primary forests contain 300 billion tons of carbon and are the greatest repositories of biodiversity on the planet.
INDIGENOUS PEOPLES' LAND MANAGEMENT	Growing the acreage under secure indigenous land tenure can increase above- and belowground carbon stocks and reduce greenhouse gas emissions from deforestation.
PEATLANDS	Although peatlands cover just 3 percent of the earth's land area, they are second only to oceans in the amount of carbon they store.
PERENNIAL BIOMASS	Using perennial bioenergy crops (e.g., switchgrass, silver grass, willow, eucalyptus) rather than annuals (e.g., corn) reduces emissions and raises carbon sequestration in soil.
TEMPERATE FORESTS	Ninety-nine percent of temperate forests have been altered in some way—timbered, converted to agriculture, disrupted by development. Restoring them sequesters carbon and revives ecosystems.
TROPICAL FORESTS	Tropical forests have suffered extensive clearing, fragmentation, degradation, and depletion of biodiversity. Restoring them may sequester as much as six gigatons of carbon dioxide per year.

WOMEN & GIRLS	
EDUCATING GIRLS	Education lays a foundation for vibrant lives for girls and women, their families, and their communities. It also avoids emissions by curbing population growth.
FAMILY PLANNING	Securing women's right to voluntary, high-quality family planning dramatically improves the health and well-being of women and their children. It also avoids emissions.
WOMEN SMALLHOLDERS	If women smallholders receive equal farming resources and land rights, their yields will rise by 20 to 30 percent, avoiding emissions from deforestation.

BUILDINGS AND CITIES	
BIKE INFRASTRUCTURE	Infrastructure is essential for supporting safe, pleasant, and abundant bicycle use—which can relieve city congestion, improve public health, and reduce emissions from cars.
BUILDING AUTOMATION	Building automation systems serve as the “brain” of large commercial buildings. Controlling temperature, lighting, and more, they can improve energy efficiency and occupants' comfort.
DISTRICT HEATING	With district systems, a central plant channels hot and/or cool water via a network of pipes to many buildings—heating and cooling them more efficiently.
GREEN ROOFS	Green roofs use soil and vegetation as living insulation. Cool roofs reflect solar energy. Both reduce building energy use for heating and/or cooling.
HEAT PUMPS	Heat pumps transfers heat from a cold space to a hot one. Highly efficient, they can dramatically lower building energy use for heating and cooling.
INSULATION	Insulation is one of the most cost-effective ways to make buildings more energy efficient—both in new construction and through retrofitting older buildings.
LANDFILL METHANE	Landfills are a top source of methane emissions. Instead, landfill methane can be captured, preventing emissions, and used as a fairly clean energy source.
LED LIGHTING (COMMERCIAL)	Lighting accounts for 15 percent of global electricity use. LEDs (light emitting diodes) require less energy and create less waste heat than other bulbs.
LED LIGHTING (HOUSEHOLD)	By transferring most of their energy use into creating light—rather than heat, like older technologies—LEDs reduce electricity consumption and air-conditioning loads.
NET ZERO BUILDINGS	A net zero building is one that has zero net energy consumption, producing as much energy, through onsite renewables, as it uses in a year.
RETROFITTING	Up to 80 percent of the energy buildings consume is wasted. Retrofitting them can address waste through efficient insulation, heating and cooling systems, and lighting.
SMART GLASS	Compared to walls, windows are inefficient insulators. Smart glass can respond to sunlight and weather, reducing a building's energy load for lighting, heating, and cooling.
SMART THERMOSTATS	Thermostats are mission control for heating and cooling homes. Smart thermostats use algorithms and sensors to learn and become more energy efficient over time.

Submitted by CASA Re: S-G
3/19/18



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WALKABLE CITIES	Walkable cities prioritize two feet over four wheels through careful planning and design. As people need to drive less and want to walk more, emissions decrease.
WATER DISTRIBUTION	Pumping water requires enormous amounts of energy. By minimizing leaks in water-distribution networks—currently wasting 8.6 trillion gallons annually—both energy and water are saved.

MATERIALS

ALTERNATIVE CEMENT	Cement, a vital material for infrastructure, generates 5 to 6 percent of annual emissions. The key strategy to reduce them is to change its composition.
BIOPLASTIC	Ninety percent of plastics could be derived from plants instead of fossil fuels. Bio-plastics can be biodegradable and often have lower emissions.
HOUSEHOLD RECYCLING	Household recycling can reduce emissions because producing new products from recovered materials often saves energy. It also reduces resource extraction and creates jobs.
INDUSTRIAL RECYCLING	Industrial recycling reduces emissions when new products are made from recovered materials, rather than virgin resources. It can also address the challenge of resource scarcity.
RECYCLED PAPER	Half of paper is used once and then trashed. Recycling makes paper's journey circular, rather than a straight line from logging to landfill, which reduces emissions.
REFRIGERANT MANAGEMENT	The primary chemical refrigerant, HFCs, is a potent greenhouse gas. Phasing out its use will reduce global warming by nearly one degree Fahrenheit.
WATER SAVING - HOME	Cleaning, transporting, and heating water requires energy. More efficient fixtures and appliances can reduce home water use by 45 percent, thereby reducing emissions.

FOOD

BIOCHAR	Biochar results from slowly baking biomass in the absence of oxygen. Retaining most of the feedstock's carbon, biochar can be buried for sequestration, while enriching soil.
CLEAN COOKSTOVES	Traditional cooking practices produce toxic smoke and 2 to 5 percent of annual greenhouse gas emissions. Clean cookstoves reduce emissions and protect human health.
COMPOSTING	From backyard bins to industrial-scale operations, composting food waste converts organic material into stable soil carbon and valuable fertilizer, averting methane emissions.
CONSERVATION AGRICULTURE	Conservation agriculture avoids tilling and employs cover crops and crop rotation. By protecting the soil, it makes land more resilient and sequesters carbon.
FARMLAND IRRIGATION	Pumping and distributing water requires large quantities of energy. Drip and sprinkler irrigation, among other practices and technologies, make water use more precise and efficient.
FARMLAND RESTORATION	The world's abandoned farmland is an opportunity for drawdown. Restoring it sequesters carbon and can improve food security, farmers' livelihoods, and ecosystem health.
IMPROVED RICE CULTIVATION	Flooded rice paddies produce large quantities of methane—10 percent of agricultural emissions. Techniques exist to reduce methane, while improving production and sequestering carbon.
MANAGED GRAZING	Managed grazing imitates the activity of migratory herds to improve soil health, carbon sequestration, water retention, and forage productivity.
MULTISTRATA AGROFORESTRY	Multistrata agroforestry blends taller trees and one or more layers of crops. It achieves high rates of carbon sequestration, similar to forests, while producing food.
NUTRIENT MANAGEMENT	When overused, nitrogen fertilizers destroy soil organic matter, pollute waterways, and create nitrous oxide. They can be more efficiently managed to reduce these negative impacts.
PLANT-RICH DIET	Meat-centric diets come with a steep climate price tag: one-fifth of global emissions. Plant-rich diets dramatically reduce emissions and rates of chronic disease.
REDUCED FOOD WASTE	Producing uneaten food squanders resources and generates 8 percent of emissions. Interventions can reduce waste at key points, as food moves from farm to fork.
REGENERATIVE AGRICULTURE	The practices of regenerative agriculture increase carbon-rich soil organic matter. Enhancing and sustaining the health of the soil sequesters carbon and improves productivity.
SILVOPASTURE	Silvopasture is an ancient practice, integrating trees and pasture into a single system for raising livestock. It sequesters carbon while improving animal health and productivity.
SYSTEM OF RICE INTENSIFICATION	SRI is a holistic approach to sustainable rice cultivation. It improves soil, lowers inputs of seeds and water, and increases yields, while reducing emissions.
TREE INTERCROPPING	Like all regenerative land-use practices, tree intercropping—intermingling trees and crops—increases the carbon content of the soil and productivity of the land.
TROPICAL STAPLE TREES	Tropical staple trees provide important foods, such as bananas and avocado. Compared to annual crops, they have similar yields but higher rates of carbon sequestration.



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ELECTRICITY GENERATION

BIOMASS	Biomass energy is a “bridge” solution for transitioning to 100 percent clean, renewable energy. Using sustainable feedstock—waste biomass or perennial crops—is crucial.
COGENERATION	Power plants produce large amounts of waste heat. Cogeneration systems capture that thermal energy and put it to work—for district heating or additional electricity.
CONCENTRATED SOLAR	Concentrated solar power uses solar radiation as its primary fuel. Arrays of mirrors concentrate incoming rays to heat a fluid, produce steam, and turn turbines.
ENERGY STORAGE (DISTRIBUTED)	Standalone batteries and electric vehicles make it possible to store energy at home or work. They ensure supply even when variable renewables are not producing.
ENERGY STORAGE (UTILITIES)	Energy storage—daily, multiday, and longer-term or seasonal—is vital to reduce emissions from polluting “peaker” plants and accommodate the shift to variable renewables.
GEOTHERMAL	Geothermal power—literally “earth heat”—taps into underground reservoirs of steamy hot water, which can be piped to the surface to drive turbines that produce electricity.
GRID FLEXIBILITY	For electricity supply to become predominantly or entirely renewable, the grid needs to become more flexible and adaptable than it is today.
IN-STREAM HYDRO	Placed within a free-flowing river or stream, in-stream turbines capture water’s energy without a dam. In remote communities, they can replace expensive, dirty diesel generators.
METHANE DIGESTERS (LARGE)	Industrial-scale anaerobic digesters control decomposition of organic waste, and thus its methane emissions. They also produce biogas, an energy source, and digestate, a nutrient-rich fertilizer.
METHANE DIGESTERS (SMALL)	At backyard- and farmyard-scale, anaerobic digesters are used to manage organic waste. They control methane emissions, while producing biogas (an energy source) and digestate (nutrient-rich fertilizer).
MICRO WIND	With capacity of 100 kilowatts or less, micro wind turbines are often used to pump water, charge batteries, and provide electrification in rural locations.
MICROGRIDS	A microgrid is a localized grouping of distributed energy sources, like solar and wind, together with energy storage or backup generation and load management tools.
NUCLEAR	Nuclear power is complex, expensive, and risky, but it has the potential to avoid emissions from fossil fuel electricity. We consider it a “regrets solution.”
ROOFTOP SOLAR	Rooftop solar is spreading as its cost falls, driven by incentives to accelerate growth, economies of scale in manufacturing, and advances in photovoltaic technology.
SOLAR FARMS	Solar farms tap the sun’s virtually unlimited, clean, and free fuel, using large-scale arrays of hundreds, thousands, or in some cases millions of photovoltaic panels.
SOLAR WATER	Water heating is a major energy use. Solar water heaters use the sun’s radiation and can reduce energy consumption by 50 to 70 percent.
WASTE-TO-ENERGY	Incineration, gasification, and pyrolysis are means of deriving energy from trash. A transitional solution, waste-to-energy can reduce emissions, but has high social and environmental costs.
WAVE AND TIDAL	Wave- and tidal-energy systems harness natural oceanic flows—among the most powerful and constant dynamics on earth—to generate electricity.
WIND TURBINES (OFFSHORE)	With competitive costs and investment growing, offshore wind energy is at the crest of initiatives to supply the world with clean power.
WIND TURBINES (ONSHORE)	Proliferation of turbines, dropping costs, and heightened performance mean onshore wind farms are at the forefront of initiatives to address global warming.

TRANSPORT

AIRPLANES	The airline industry produces at minimum 2.5 percent of emissions, and it is growing. Fuel efficiency measures are on the rise to reduce that impact.
CARS	Hybrid cars pair an electric motor and battery with an internal combustion engine. The combination makes them more efficient, improving fuel economy and lowering emissions.
ELECTRIC BIKES	Electric bikes get a boost from a small battery-powered motor. They are the most environmentally sound means of motorized transport in the world today.
ELECTRIC VEHICLES	Electric vehicles are the cars of the future. If powered by solar energy, their carbon dioxide emissions drop by 95 percent compared to gasoline-powered vehicles.
HIGH-SPEED RAIL	High-speed rail is the fastest way to travel distances between 100 to 700 miles. Compared to driving or flying, it reduces emissions up to 90 percent.
MASS TRANSIT	Riding a streetcar, bus, or subway—rather than driving a car or hailing a cab—averts greenhouse gases, relieves traffic congestion, and reduces air pollution.



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RIDESHARING	Ridesharing pairs drivers and riders who share common origins, destinations, or stops en route. When trips are pooled, people split costs, ease traffic, and curtail emissions.
SHIPS	Shipping produces 3 percent of global emissions. Fuel-saving ship design, onboard technologies, and practices can have a sizable impact, because of huge shipping volumes.
TELEPRESENCE	Telepresence integrates high-performance visual, audio, and network technologies to enable people who are geographically separated to interact. By reducing travel, it can reduce emissions.
TRAINS	Most trains are powered by diesel-burning engines. Technology and operations can improve fuel efficiency, and rail electrification has the potential to provide nearly emissions-free transport.
TRUCKS	Road freight is responsible for about 6 percent of global emissions. Increasing fuel efficiency in both new trucks and existing fleets can significantly reduce emissions.

COMING ATTRACTIONS	
ARTIFICIAL LEAF	The artificial leaf is technology inspired by photosynthesis. It combines solar energy, water, and carbon dioxide, to feed bacteria that synthesize energy-dense fuel.
AUTONOMOUS VEHICLES	Autonomous vehicles are on the rise. They have the potential to shrink the auto fleet and accelerate ridesharing and the adoption of electric vehicles.
BUILDING WITH WOOD	High-performance wood materials are transforming construction. They can reduce emissions by (1) sequestering and storing carbon and (2) avoiding emissions of cement and steel.
A COW WALKS ONTO A BEACH	Asparagopsis taxiformis, a species of seaweed, shows promise for reducing methane emissions from livestock—currently 4 to 5 percent of annual greenhouse gas emissions.
DIRECT AIR CAPTURE	Direct Air Capture systems are a nascent sequestration technology. Functioning like a chemical sieve and sponge, they capture carbon dioxide from air and release it in purified form.
ENHANCED WEATHERING OF MINERALS	Natural weathering of silicate rock sequesters carbon dioxide. Enhanced weathering aims to hasten that process by milling rock powder and applying it to landscapes.
HYDROGEN-BORON FUSION	Tri Alpha Energy has achieved one-half of the nuclear fusion equation. It could herald clean, safe, affordable energy to take the world beyond fossil fuels.
HYPERLOOP	The promise of Hyperloop is speed. The virtue is moving people and cargo with 90 to 95 percent less energy than planes, trains, or cars.
INDUSTRIAL HEMP	Hemp is a global warming solution primarily because of what it can replace: cotton. Cotton has high chemical use and depends on fossil fuel inputs.
INTENSIVE SILVOPASTURE	Intensive silvopasture intercrops a leguminous woody shrub with grasses and trees. Through rapid rotational grazing, livestock yields increase alongside carbon sequestration in soil.
LIVING BUILDINGS	The Living Building Challenge holistically defines how buildings can benefit both people and planet. One key criteria: Living buildings produce more energy than they use.
MARINE PERMACULTURE	Marine permaculture utilizes floating, latticed structures designed to grow rich kelp forests and foster marine life. It could sequester billions of tons of carbon dioxide.
MICROBIAL FARMING	Microbes have the potential to dramatically reduce the need for synthetic fertilizers, pesticides, and herbicides, while improving crop yields and plant health.
OCEAN FARMING	Small-scale ocean farms have the potential to provide sustainable food and biofuel, while oysters filter nitrogen pollution and seaweed sequesters carbon dioxide.
PASTURE CROPPING	In a pasture cropping system, annual crops are grown in a perennial pasture. Double-cropping grains and animals sequesters carbon and improves farm health and productivity.
PERENNIAL CROPS	Perennial crops sequester carbon because they leave the soil intact. Researchers are pursuing grain, cereal, and oilseed plants that are perennial food providers.
REPOPULATING THE MAMMOTH STEPPE	A vast ecosystem called the mammoth steppe once dominated the frozen north. Restoring grazers and grassland could prevent carbon-rich permafrost from thawing and releasing emissions.
SMART GRIDS	With two-way communication between suppliers and consumers, smart grids accommodate the fluctuations of wind and solar power. They also improve grid stability and overall efficiency.
SMART HIGHWAYS	The world's first sustainable highway is being pioneered south of Atlanta, Georgia, emphasizing electric vehicle infrastructure and solar power to reduce carbon emissions.
SOLID-STATE WAVE ENERGY	Solid-state wave energy technology converts the ocean's kinetic energy without external moving parts. It is more robust in marine environments, rich with untapped renewable energy.

