

United States Sourced Clean Green Energy

Sustainable and affordable food and clean energy, represents the most critical challenge of the 21st Century, not just for America but for all nations. Half the 6.6 people on our planet are hungry and food insecure.

The U.S. has 60 million citizens on government food support – one in five Americans. This life support system is necessary because poor families cannot afford food. America's poor cannot afford energy either and must make do with public transit, public housing and public heating support.

Imports for Transportation

60% of U.S. energy

Liquid transportation fuel – fossil

- 65% imported
- \$400 B in 2008
- Dirty, CO2

Drilled crude oil
Expensive
Dirty, CO2
Security challenge
Long supply chain

40%

Electrical grid – fossil, US sourced

- Coal
- Natural gas
- Hydro
- Nuclear

Expensive
Dirty, CO2
Distribution challenge

Zero Carbon Future

Green Independence strategy to replace imported oil and zero carbon.

1. **Develop Green Solar** — algal energy replaces imported and domestic petroleum and fossil fuels
2. **Use wind to displace natural gas** for the electrical grid — 20% of grid
3. **Use natural gas for cars** as a bridge to truly clean and sustainable energy
4. Use other **carbon neutral energy** sources to displace coal and crude oil

American Green Independence Sustainable and Affordable Food and Energy

Survival Risks for Human Societies

Reserves go dry

The depletion of fossil fuel reserves will leave people very hungry, thirsty, and stuck without transportation, cold and in the dark.

Political instability

The geopolitical strife from competition for declining fossil resources will lead to economic and energy disturbances, political destabilization and war.

Mass migration

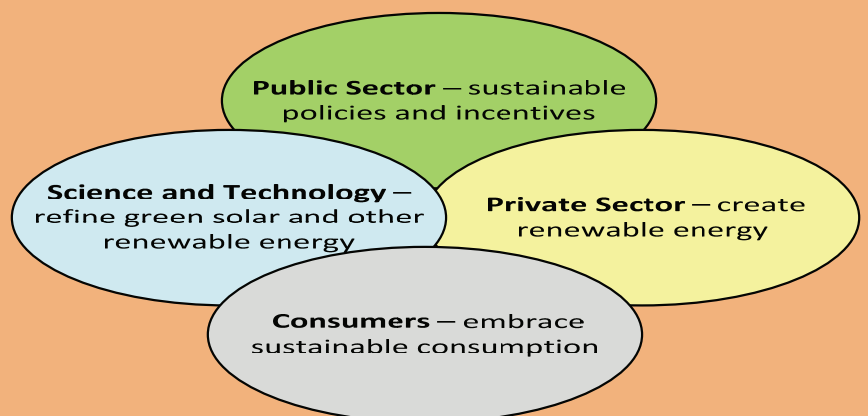
Lack of affordable energy to pump, clean and transport water will force entire populations to migrate to diminishing freshwater sources. Future wars will be fought over water, the proxy for food and available in many places only at a high energy cost. Climate change brings rising oceans, salt invasion and drought so millions will have nowhere to migrate.

Climate change

Global climate change caused by increases in atmospheric CO2, nitric oxides and soot particulates due to combustion of the fossil fuels threatens entire species with extinction, severe weather disturbances and water insecurity.

Green Independence aligns public and private sector actions with advances in biotechnology to make all citizens secure from high food and energy prices. Green Independence will mobilize the energy and ingenuity of all Americans to:

1. End dependence on energy imports in 3600 days (about 10 years)
2. Displace all fossil fuel burning in 20 years with clean green energy
3. Create food, energy and transportation security for all Americans
4. Move to net zero carbon emissions; end ecological degradation
5. Build a stronger economy that refreshes and strengthens rather than extracts and weakens our ecosystems
6. Enhance our exports with sustainable foods and other products
7. Create useful new sources of food, energy, pollution solutions and novel products with green solar, algae.
8. Shift culture from a disposable society to sustainable consumption



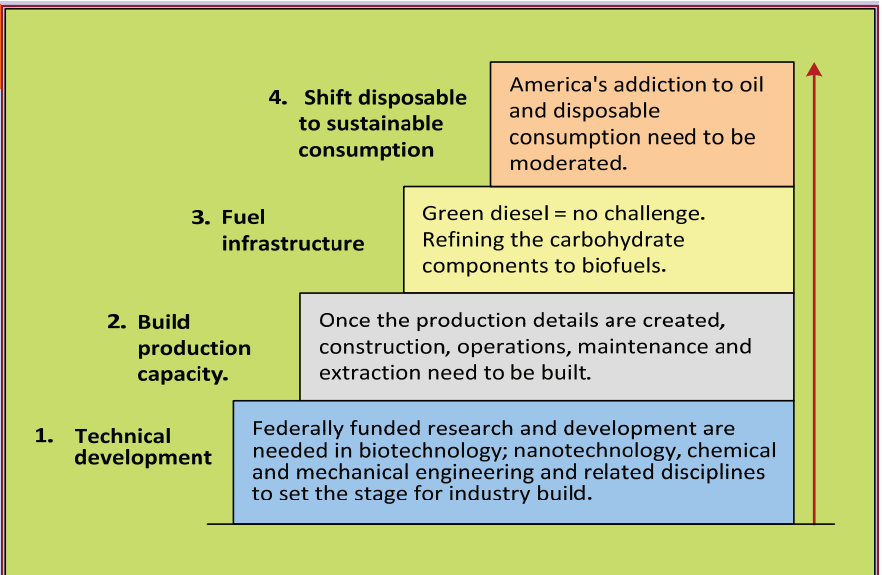
| | Fossil Fuel Impacts to the United States | Green Solar |
|--|--|---|
| Food security | Escalating energy costs will devastate U.S. food production that is heavily dependent on fossil fuels for farming and crop inputs. In 2008, over 60 million Americans are already on food support. A recession or further food price increases could push 120 million Americans to food support – 40% of U.S. citizens. | Photosynthetic microorganisms, algae and cyanobacteria, use low-cost and plentiful inputs– sunshine, wastewater and CO ₂ to convert solar energy to lipids. The lipids, oils, may be pressed from the biomass and used as biofuel. |
| Exports | Higher fuel costs combined with fresh water scarcity will diminish agricultural exports significantly. In 2008, over a dozen countries ceased food exports due to food shortages. Many of the 155 countries that currently buy food, mostly food grains, from the U.S. will not be able to afford the prices American farmers and exporters will have to charge. | Water-based plants called algae are 30 to 100 times more productive in producing biomass than land plants. The microalgae biomass may be 20% to 60% lipids, called algal oil and common vegetable oil that can fuel diesel engines directly without conversion. The carbohydrate component of the biomass may also be refined to other biofuels such as methane or gasoline.. |
| National security | As fuel scarcity becomes more severe, the threat of disruption in production, supply, refining or distribution due to nature, politics, terrorist, weather or other factor threaten American’s health and welfare, food, transportation and the US military’s access to strategic fuel. | Green solar or algaculture applies a seemingly novel but actually nature’s ancient strategy for growing biomass; the use of water-based plants with special characteristics. Algae are among the oldest, tiniest yet fastest growing plants on Earth. Algae form the bottom of the food chain and are eaten by many herbivores from the tiniest shrimp to the largest animals on Earth; the great blue whales. |
| Foreign debt | The \$9.5 trillion US foreign debt is currently being supported by foreign countries that have the expectation the robust American economy will service the debt. America cannot afford the severe growth in the balance of payments deficit. In the past, agricultural exports partially offset oil imports. | Green solar produces energy in a variety of ways for: <ul style="list-style-type: none"> • People – protein in food • Animals – protein in fodder • Fowl – protein for birds • Fish – protein in fish feed • Plants – organic nitrogen fertilizer • Fire – high energy algal oil for cooking and heating • Cars – carbohydrates refined to gasoline for transportation • Trucks and tractors – high energy green diesel • Planes – high energy jet fuel |
| Water security | The distribution of water for agriculture, industry and cities consumes roughly 20% of America's energy. Higher energy costs will reduce water availability for all users – especially for farmers and food production. | Green solar also produces other coproducts such as low cost organic fertilizer and fine medicines, vaccines and pharmaceuticals. Algae also provide a wide range of pollution diagnostics, measures and air and water pollution solutions. |
| Consumer prices | Consumers know that fuel price increases create a rising tide of prices for nearly all consumer goods, especially food and transportation. Fossil fuels represent the largest cost in food production. A diesel guzzling tractor gets about six miles per gallon and often travels each row in the field seven times to raise a single crop. In addition, 80% of the cost of synthetic fertilizer comes from the fossil fuel used to manufacture the fertilizer. | |
| <p>Black solar. The petroleum used in today’s vehicles is derived from prehistoric biomass which captured solar energy in antiquity. Many fossil fuels came from algae blooms in ancient wetlands and oceans. Ancient animals such as fish and dinosaurs, whose biomass is also in crude oil, derived their energy from algal protein.</p> | | |
| <p>Brown solar. Trees, bushes and grasses absorb sunlight through photosynthesis and store the energy in their cellulosic structure that can be burned to release energy. Our ancestors have harvested woody biofuels for thousands of years to burn for heat and cooking fires. Brown solar has all the ecological disadvantages associated with fossil fuels except that to some degree, it is renewable.</p> | | |
| <p>Grey solar. Land plants such as food grains absorb sunlight through their leaves and use photosynthesis to store energy in their fruit which is also called seeds, nuts or grains. Agriculture uses grey solar with freshwater and fuels to produce food.</p> | | |
| <p>Yellow solar. Traditional or yellow solar energy production employs panels with photovoltaic cells that absorb photons in sunlight directly with semiconductor materials such as silicon. Electrons are knocked loose from their atoms and flow through the semiconductor to produce electricity, are relatively efficient, 33% solar capture and are carbon neutral.</p> | | |

Actions to Green Independence

Steps to Green Independence

Technical development needs to be well under way before phase two can begin building production capacity. Systems built to maximize energy may use a variety of strategies to grow algae that can be harvested for lipids, carbohydrates and protein.

Phases three and four may start immediately because they are not dependent on the design for production systems. The most difficult challenge will be changing disposable consumer behavior to sustainable consumption.



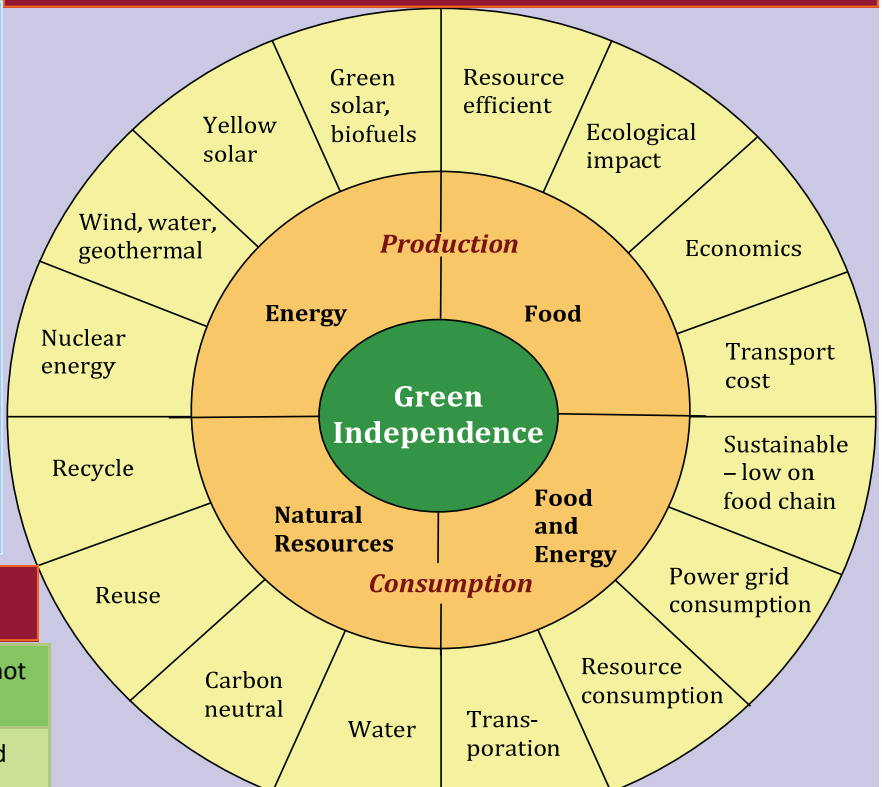
Production and Consumption

Focus on energy supplies alone will only create more energy addiction. Production will take the whole slate of renewable sources.

America needs a Cabinet Level **Chief Sustainability Officer** who:

- Coordinates production and minimizes non-sustainable actions
- Leads the shift from disposable to sustainable consumption
- Creates and monitors metrics to minimize unintended consequences
- Leads with recognition and rewards for innovators and green champions

Sustainable Energy Production and Consumption



Key Terms

Renewable energy was produced recently and not mined from fossil sources 250 million years old.

Sustainable energy can continue to be produced for decades and is not limited by the size of the fossil pool. Corn ethanol production for example, is renewable in the sense that it can be grown with rotation, every two years. However corn production is not sustainable because it costs too much to grow and consumes too many non-renewable resources – cropland, freshwater and fossil fuels. Corn is also too self-destructive because farming it causes extraordinary pollution.

Carbon neutral means that any CO₂ released was taken from the atmosphere recently, creating a short-term carbon cycle, not a net addition of CO₂ from sources sequestered in antiquity.

Clean energy avoids the production of black soot particulates, nitric oxides and other greenhouse gases that add smog to the air, cause human health problems, reduce crop production and create the heat retention that increases global warming.

Secure energy does not have the long and precarious supply chain problems associated with imported fossil fuels.

Affordable assures that low production and transportation costs price energy within the means of normal consumers. Public policy may decide to tax energy in order to discourage wasteful consumption.

Ecologically positive energy sequesters CO₂ and produces positive net oxygen while not polluting air, soils or water.

Why initiate American Green Independence now?

We need a solution that will reduce gas prices for all Americans quickly. Failure to act now will force the U.S. to spend \$10 trillion over the next ten years for oil imports.

Drilling for new fossil sources will not give consumers relief for 10 years, add to our carbon footprint and not break our oil addiction. The rising cost of fuel pushes up the cost of many consumer products, especially food because agriculture is fossil fuel intensive. We intend to shift our fossil dependence to independence with clean, carbon neutral fuels. Over 60 million Americans are on food support because they are poor and hungry. Food riots are occurring in 33 countries, 11 million children will starve this year and some countries have banned food exports. It makes no sense to burn 85 tons of U.S. food in gas tanks while replacing less than 3% of our imported oil. Each year ethanol production takes:

- **Cropland** – 40 million acres for growing corn
- **Freshwater** – about 2 trillion gallons for irrigation
- **Fossil fuels** – about 5 billion gallons for farming and transportation

Ethanol is a zero sum game and takes nearly as much energy as it creates. Green solar, algae farms, on 2 million desert acres would produce more energy than ethanol and save all the cropland, freshwater and fossil fuels for food. Green solar can use solar panels to move and mix the water. We can replace 100% of our imported oil in 10 years without using cropland, freshwater or fossil fuels and significantly reduce pollution.

Are you betting the ranch on algae?

Algae will not be the silver bullet that singularly resolves America's energy independence. Truly renewable technologies that meet increasing world demand for food and energy will be solved by a portfolio approach that will include a set renewable energy sources including wind, waves, solar, geothermal, nuclear energy and other biofuels such as cellulosic ethanol, methane and hydrogen. We will tap energy sources that do not compete for our precious croplands, fresh water or fossil fuels. Algae are poised to provide innovative, high value and engaging solutions for liquid transportation fuels.

Please see the Defense Advanced Research Projects Agency (DARPA), RFP to develop and commercialize algae production for \$4 a gallon near military bases for aviation fuels and JP-8, which is used by U.S. and NATO militaries. <http://www.darpa.mil/sto/solicitations/BioFuels/>

What will American Independence cost?

Shifting away from ecologically destructive subsidies will save money and our environment. We will also save money by avoiding the high cost of imported oil. Those dollars should go to American farmers and green collar jobs. Naturally, there will be R&D and start-up costs for renewable fuel sources but they will cost less than the current ethanol subsidies.

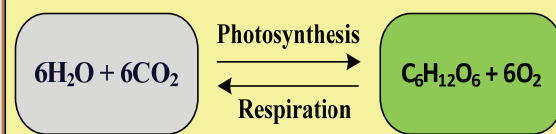
Why now?

Recent advances in biotechnology, nanotechnology and chemical and mechanical engineering have changed the production landscape for algae from dismal to terrific. *Green Algae Strategy* lays out a roadmap for the challenge of the 21st C: solutions for sustainable food, water, pollution solutions, energy and transportation.

Why hasn't algae (green solar) been used before?

After the 1973 oil crisis, excellent research began called the Algae Species Project, www.nrel.gov/docs/legosti/old/5726.pdf. Unfortunately, political decisions by both parties led policy makers to kill all research funding for algae in 1993 in order to focus on corn ethanol. We will to change that.

Photosynthesis — takes CO₂; gives off O₂



Water + carbon dioxide

glucose + oxygen



It sounds too easy.

Algae consume nearly free inputs – sunshine, wastewater, CO₂ and nutrients. Green solar simply does in a matter of days what nature took 200 million years to do in making black solar — petroleum, coal and coal shale.

Algae are nature's oldest and tiniest yet fastest growing biomass. Green solar does not make gold out of lead. It simply taps the most efficient growing system on Earth, that captures solar energy in plant bonds. Of course, there is a cost in building large-scale algal-oil farms.

What about our addiction to oil?

Will independence feed that addiction?

The Office of Sustainability will work on both the supply and demand for energy. We will transform our disposable culture to one that is sustainable and green. Americas will take pride in public transportation, car pools and eating low ecological impact foods taken home in reusable shopping bags.

We will create a sustainable culture for all of our precious natural resources including water, air, soils, forests and ecosystems. Together we can create an environment that we will be proud to hand over to our children.

What about the farmers?

We will assemble a blue-ribbon committee to find sensible and equitable solutions to provide a security net for farmers. Many farmers will grow green solar.

What about unintended consequences?

We will create metrics and monitoring systems that are carefully analyzed by government, university and environmental groups. American Independence will have transparency.

Will I be able to put algae fuel in my car?

Yes. Much of the algal production will go to clean diesel for trucks, tractors, trains and ships which will increase energy supply and lower prices. We will also refine algal biomass to gasoline for our cars. The same refineries we use for crude can process algae. We will not need new refinery infrastructure.