Getting the US to Net Zero

on Climate Change

Proposal by Brighter Climate Futures

- **A Quantitative actionable, and timebound Energy, Climate & Ecosystem Transformation "Plan" for the US**

- **Resource Ideas for Implementation of the Biden Plan &**

- **Pathway for California**

By

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Based on the Book "Brighter Climate Futures"

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This document is based on Chapter 6 of the following book and includes extracts from other chapters in the book:

"Brighter Climate Futures – A Global Energy, Climate & Ecosystem Transformation"
By Dr. Hari Lamba
Regent Press, Berkeley, California

Book can be seen on Amazon and on Barnes & Noble Bookstore, and other bookstores (US)

Added information on the plan and book is available on the website

www.brighterclimatefutures.com

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"Our Climate Futures can be Brighter if we act effectively right away. Things can be much better. "

"What we have is a quantitative actionable doable time bound strategy, the global aspect of it which will keep global average temperature rise to 1.5 degrees Celsius "

"Things can be much better with plenty of renewable energy, effectively zero greenhouse gas emissions, restored land and ocean ecosystems, a healthier and more beautiful Earth, and a good life for all. But we have to get started and implement this nationally and then push for it to happen globally."

Introduction

The political prospects for implementation of climate change solutions have improved with the prospect of Mr. Joe Biden becoming the next president of the US. So, this booklet includes a brief description of the plan that Biden proposed for climate change during his presidential campaign. Then, based on the recent book "Brighter Climate Futures" a pathway is described which amounts a quantitative actionable plan for the US, which can provide ideas to the new administration, as well as inform active people and the public that that solutions are available that can be worked on to achieve success in solving climate change, in terms of keeping the global average temperature rise below 1.5 degrees Celsius. Of course, since climate change is a global problem, it does need global solutions, and so the US part can be first to make sure it can do its part and then get the rest of the world to come to the table and be part of global solutions. Next, since California has been a leader among the US states on climate change, a pathway is described on how that state can do its part in meeting its ambitions, as well as what the rest of the world can learn from it. It is hoped that this document will be a good resource to help the US make progress at all levels from the national to the local, and for the informed public to engage enough politically to overcome political opposition, so that the US becomes a global leader in climate change.

National Energy, Climate & Ecosystem Plan for the US

The US gross domestic product (GDP or size of its economy) in 2018 was about $ 20 trillion, or about 24% of the whole world's GDP of $ 84 trillion. In comparison, China's GDP in 2018 was about $ 15 trillion, making it the second largest national economy in the world. If one could count all the nations of the European Union together, their GDP was about $ 18 trillion. Out of the global military spending of $ 1.8 trillion in 2018, with the US increasing its spending to $ 649 billion and China to $ 250 billion. The twenty nine NATO (North Atlantic Treaty Organization) nations, including the US, spent $ 963 billion in 2018 (or more than 50% of global spending).

As of January 2020, the US was by far the biggest economy in the world and the strongest military, and if one takes its own spending and that of its allies, it is militarily the most powerful. It has been a leader in the past two centuries (along with the European nations) in fossil fuel development and in fueling its industrial and other growth by the use of fossil fuels. So much so, that, along with teaching the rest of the world how to base their "development" on fossil fuels, it has a very powerful lobby that dominates its political landscape, and has been effective in slowing the growth of alternative energy – especially clean renewable energy. Not only has this lobby been effective in stalling development of renewable energy in a big way, it is also not doing as much as other nations in the Research and Development of the technologies of the future – whether its renewable energy, "storage" fuels, or clean transportation (like high speed rail). Currently, Japan, Australia and some Scandinavian countries are outdoing the US in research in these areas.

In 1991, when I was in the Chicago area, I came to know about the Earth Summit. This was the United Nations Conference on Environment and Development (UNCED) that was scheduled for June 1992 in Rio de Janeiro, Brazil, to address the problems of environment and development faced by the world. In order to understand the process and to participate actively, we formed an informal group in Chicago called the Earth Summit Network (ESN), of which I was one of the founders and one of two main coordinators. The other coordinator was Tom Spaulding of the YMCA (Young Men's Christian Association). For about the period of the year, we organized several teleconferences and public events to educate the Chicago public about the issues at the Earth Summit. At the first teleconference that we held in Chicago, Al Gore (later vice-president of the US and author of the book, "An Inconvenient Truth"), who was then a young senator, spoke about the issues. We also tried to apply pressure on the senior US Bush administration to be more flexible at the global warming negotiations and sign the climate change treaty. We were certainly small so our effect was not much, but the US president George H.W. Bush did sign global warming treaty, the United Nations Framework Convention on Climate Change, UNFCCC, which was described in Chapter 1. Thereafter, I began a process of self-education through reading and writing that culminated in a book titled, "Rethinking Progress – Towards A

Creative Transformation of Global Society." By Harinder Lamba, Daanish Books, New Delhi, 2005, which is about the global environment and development crises (problems and solutions).

So, what is the effect of Climate Change on the US?

Global Warming IS ALREADY Devastating the USA

Global warming is not some distant future problem. It has already begun to devastate the US and the world. To understand that, one needs to understand that one of the key things that happen is that when air temperature rises, there is greater evaporation from the sea, and the air has more energy. This leads to two effects, it increases the energy and hence the wind velocity of weather related phenomenon like hurricanes, tornados and coastal storms, while increasing the amount of rain most of the time. We have seen both. The hurricanes are getting stronger and more devastating. Katrina ($ 75 billion losses), Superstorm Sandy ($ 75 billion losses), etc., the list continues to grow. Each time the devastation is greater and the hurricane leaves more damage and grief. Caused by a coastal storm, the catastrophic floods in South Carolina (October 2015) are now known to have given one of the highest levels of rainfall in US history, giving 15-19 inches of rain in a 24 hour period ("One in a 1,000 year storm"). Out of 59 sites recording rainfall, six sites set all-time records (NOAA data). In recent years, many rainfall events in the Chicago area have led to very high levels of rainfall – some to flash flooding. More and deadlier tornadoes, and severe rainfall events are likely to damage the region. **Global warming is not some future problem – its devastation has arrived!**

Some of the other symptoms in the US are that glaciers are melting and disappearing. All but a few of Alaska's more than a hundred glaciers are melting and receding. California is facing a persistent and prolonged drought. The dry conditions are leading to worse and worse wild fires every year – this could lead to a runaway greenhouse effect – more wild fires, more carbon dioxide in the atmosphere. With the mountainsides denuded of vegetation – any rain that follows can cause massive landslides, burying entire communities – this has already happened in the western US. The Mississippi Floods of 2005 – high levels of rain and a stationary weather front dumped so much rain that it led to massive flooding of the Mississippi river

What the future holds for the US is that the hurricanes and coastal storms will get stronger and stronger – devastating coastal areas. Tornadoes will get more severe and frequent, and will be felt further north as weather patterns shift – causing untold misery in the America's heartland. What is now known is that tornado cells are showing up with an increase in the number of tornadoes per cell. Floods will go from bad to worse – leading to massive floods as seen in Texas and South Carolina in 2017-2018.

US National Climate Assessments

The US Global Change Research Program (USGCRP) is legally required to look at the issue of Climate Change, and every four years publish its finding in a National Climate Assessment

(NCA), which is an interagency ongoing effort of the United States Government. The first NCA report was released in 2000. Between 2002 and 2009 they published several Synthesis and Assessment Products (SAPs), a second report in 2010, and a third report in 2014.

The Fourth National Climate Assessment (NCA4) Report was published in two volumes, the first in October 2017 (477 pages), and the second in November 2018 (1,524 pages). The US National Oceanic and Atmospheric Administration (NOAA) was the lead agency for this assessment in which a total of 13 US Federal Government agencies, 1,000 people, and about 300 scientists were involved, with about half of the scientists were from outside governments. **So, the fourth National Climate Assessment is a very thorough scientific assessment of the best scientific minds of the United States. Here is a summary of their findings from the November 2018 Report, some of which have been paraphrased to make them easier to understand. Some examples have been added. [18]**

Communities across the country are already experiencing the impacts of climate change with more frequent and intense extreme weather and climate related events, and changes in average climate conditions, which are affecting and are expected to continue to damage infrastructure, ecosystems, and their social situations. This is placing increasing challenges to human health and safety, quality of life and the rate of economic growth. Without significant reductions in global emissions and adaptation, extreme events will cause substantial losses to American infrastructure, labor productivity, reduction of the efficiency of power generation, and occurrences abroad will affect trade, and all of these will overall act to reduce economic growth. Climate change is affecting the quality and quantity of water available for use and is increasing risks and costs to agriculture, energy production, industry, recreation and natural areas. Powerplants that rely on a good supply of cooling water will be adversely affected, and water supply and drainage infrastructure, designed for past conditions, may not be adequate for the future.

In terms of health, extreme events are affecting air quality, and increasing the transmission of disease through insects and pests, food quality and water are threatening the health of Americans. Indigenous peoples (native Americans), the original dwellers of America are being increasingly affected by Climate Change as it threatens their livelihoods, economies, heath and cultural identities. The degradation of American ecosystems**,** and those on the continent, are having an adverse impact on the benefits and services these ecosystems provide. Coral reef, sea ice, coastal, water, mountain, glacier and forest ecosystems are already experiencing degradation. Agriculture is being hammered by rising temperatures, extreme heat, wildfires on rangelands and heavier than normal downpours. These are affecting and will increasingly affect livestock health, declines in crop yields and quality and lead to degradation of the lives of rural and small town folks throughout the country.

America’s infrastructure has been aging and deteriorating because of poor investments. However, climate change will further stress the infrastructure, by heavy rains, flooding, wildfires, mudslides and other extreme events, leading to adverse impacts on the economy,

national security, essential services and health. Climate Change will adversely affect energy and transportation systems, threatening fuel shortages, and power outages. Many coastal areas will be submerged or adversely affected by rising sea levels and increasing storm surges. The coastal areas are being threatened by rising water temperatures, ocean acidification (carbon dioxide dissolved in water gives carbonic acid), retreating arctic sea ice, sea level rise, high tide flooding, higher storm surges and extremely have rain events.

As it is for the rest of the world, the situation for the US is grim, unless this PLAN is acted upon.

History of US Actions & Plans Proposed by Others

The US did sign the global warming treaty in 1992, and was then quite active in bringing about the Kyoto Protocol in Kyoto, Japan in 1997, which was an agreement to take some actions. However, because of opposition in the US legislatures (Congress and Senate) by the Republican Party, US never ratified the protocol. Again, US leadership brought the world together to sign the Paris Agreement, in Paris, December 2015, which has been described in Chapter 1. Each nation who signed the agreement and the US also submitted its Intended Nationally Determined Contribution (INDC) plan, which was a voluntary submittal by each nation as to what it would do as its share of climate change solutions.

The INDC (Intended Nationally Determined Contribution), submitted by the United States agreed to reduce greenhouse emissions by 26-28% from 2005 to 2025 (from about 6,300 million metric tons of carbon dioxide equivalent in 2005). This was along with the intended effort (uncommitted) to reduce emissions by about 80% by 2050.This target included all gases covered in the US 2014 inventory of Greenhouse Gases and Sinks: carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), and other manmade chemicals. The US INDC included commitments to increase vehicle fuel efficiencies, building efficiencies, reduction in man- made chemicals used as refrigerants, the reduction of methane gas emissions from landfills and oil production facilities, and the Clean Power Plan (CPP).

The CPP aimed to reduce US carbon dioxide emissions from electrical power generation by 32 percent by 2030, from 2005 levels. The main focus of the CPP was on reducing emissions from coal-burning power plants, as well as increasing the use of renewable energy and energy conservation. It required individual states in the country to reduce their carbon dioxide emissions to given levels by various means, and the states had to submit emissions reduction plans by September 2016, extendable if approved to September 2018. If a state did not submit a plan, then the US EPA (Environmental Protection Agency) would impose their own plan on the state. However, Trump Administration, besides announcing that it was going to withdraw the US from the Paris Agreement, in October 2017 began the process of repealing the Clean Power Plan, although it takes two years to formally repeal a regulation. In 2013, the Obama Administration defined a national Climate Action Plan that laid out a number of domestic initiatives (including the CPP) and encouraged the other nations of the world to follow suit – it was this action that encouraged the other nations of the world to come up with their voluntary contributions at the Paris Agreement.

Then, in addition, politicians electioneering as candidates for the US 2020 presidential election came up with their own plans. The first one that was noteworthy was by the **Governor of the State of Washington, Jay Inslee,** that proposed that for the next ten years (2020-2029) about $ 9 trillion of investment, with about $ 300 billion per year in federal government spending that would encourage $ 600 billion per year in private investment, with a claim that this would create 8 million good jobs. His proposed "Evergreen Economy Plan" proposed five main strategies – renewable energy and electrification development, infrastructure and community resilience, clean manufacturing, research and development, and job growth.

Plan Proposed by US Senator Bernie Sanders

Another plan that proposed by US presidential candidate Bernie Sanders, is much more ambitious and comprehensive and proposed converting all of electricity generation and transportation 100% to renewable energy by 2030, and complete decarbonization of the rest of the entire economy by 2050. His plan proposes a direct public investment of $ 16.3 trillion during this period, and the creation of 20 million good paying union new jobs in renewable energy, energy efficiency, construction, transportation and industry. Also, the creation of a new Civilian Conservation Corps in agriculture, engineering and in preserving public lands. He would provide a just transition to all fossil fuel workers in terms of five years of salary, benefits and retraining or early retirement benefits so that these workers come out ahead after the transition. The plan proposes to save all families money by investing in energy efficiency, modern low carbon transportation, reduce the cost of changing to high efficiency electric vehicles and rebuilding the crumbling infrastructure. His plan would support the transition of agriculture to smaller family farms, to more regenerative and sustainable agriculture and maximize the growing of local foods, and a freeing farmers and ranchers from the strangle hold of corporate interests.

A major part of his plan has to do with a transformation of the energy sector. He proposes the replacement of all private electric utility companies with Power Marketing Administrations (or PMAs – some of which exist already), and get all PMAs to build enough wind, solar, energy storage and geothermal power plants to replace all fossil fuels in electric power. He proposes spending $ 1.52 trillion on renewable energy and $ 852 billion to build energy storage capacity. In order for this to happen reliably, he feels that the entire utility model for producing and delivering electricity needs to be changed from mainly corporate private ownership to mainly publicly owned utilities that behave responsibly, with a good combination of championing energy solutions to climate change, and responsiveness of electrical customer needs. He proposes that the renewable energy generation sources will be publicly owned, managed by federal PMAs, the Bureau of Reclamation and the Tennessee Valley Authority. This electricity will be sold to utilities that will distribute this electricity to consumers, with preference given to publicly, municipally or cooperatively owned utilities with democratically controlled pubic ownership.

Besides that, he proposes a modern smart electric transmission and distribution grid that is resilient (to disasters), and manages and transmits large amounts of renewable energy, has the capacity to rapidly charge electric vehicles, and is energy efficient. He proposes spending $ 526 billion on a smart, high voltage, underground, and direct current smart grid, that makes the transition to renewable energy smooth, safe and timely. At the same time, he proposes an investment of $ 2.18 trillion on vastly improving the energy efficiency of homes, business, organizational, and industrial buildings, and lowering their energy bills. The energy efficiency efforts would focus first on the leakiest and most energy inefficient structures, and housing for seniors, people with disabilities and low income families. The money would be invested as sliding scale grants for low and middle income families and small businesses. Federally mandated standards will ensure that new and existing buildings and wealthy landowners meet the same energy efficiency goals. A similar investment of $ 964 billion would help in all homes and buildings to transition to electrification, and end the use of fossil fuels for these needs. This would enable the added electricity to be met by expanded generation of renewable energy. In addition, he proposes to slowly get rid of unsustainable source of electricity like nuclear power, geoengineering, carbon capture and sequestration, and trash incinerators.

From the financing end he proposes ending all fossil fuel subsidies, and making the fossil fuel industry pay through litigation, fees and taxes. Revenues will be collected for certain periods of time, and thereafter only operations and maintenance costs. He proposes scaling back military spending that currently is spent in protecting oil supplies. Then there will be the income tax revenue from the new 20 million jobs created, as well as reduced spending on providing safety nets for people as more will be having good paying union jobs. In addition he proposes that wealthy and large corporations pay more in taxes. He claims that the US economy will lose $ 34.5 trillion in economic activity by the end of the century, while on the other hand, the benefits of his plan will be to save $ 2.9 trillion over 10 years, $ 21 trillion over 30 years and $ 70.4 trillion over 80 years.

Summary of Plan proposed by Joe Biden (added – not in the book)

The plan proposed by Biden during his presidential campaign aims at 100% of electrical power being from renewables by 2035, and for all of energy to be Net Zero emissions by 2050 – meaning that by 2050 all greenhouse gas emissions would be balanced by absorption or carbon capture and storage somewhere else. Overall, he states that he aims to build a climate resilient infrastructure (one that can better survive disasters – including that for the military), cooperate with the rest of the world, hold the fossil fuel companies accountable (especially in regard to environmental justice for disadvantaged communities and provide a just transition for fossil fuel workers (means significant support for them to transition with health, financial and educational benefits when they lose their jobs).

He would roll back the Trump tax cut, increase the corporate income tax rate and use stimulus money to pay for a $ 2 trillion investment over 10 years. Other details of his plan would invest in quality public transportation or mass transit in cities above a population of 100,000, establish

grid scale storage at a lower cost (lower cost utility scale battery systems), encourage zero net energy buildings (that on a net basis produce as much energy as they consume), support energy efficiency building retrofits, accelerate the introduction of electric vehicles, aim at establishing 500,000 electric vehicle charging points nationwide, and eliminate the heat trapping fluorinated gases still used in refrigeration and air conditioners. Further, on the transportation side, he will encourage high speed and passenger rail so as to reduce carbon emissions from transportation, and invest in the use of biofuels for aviation.

On the unconventional side, from the view of environmentalists, he would establish research projects in government research institutions to look at solving radioactive waste disposal and other issues that discourage nuclear reactors and encourage the introduction of small modular nuclear reactors and fund research on how to make nuclear energy safer and more efficient. Then, so as to continue to use some fossil fuels he will establish projects that invest in Carbon Capture, Use and Storage (CCUS) and advance the research, development and deployment of these technologies. His infrastructure investments would aim at removing disparities in access to clean air and water, transportation, high-speed internet, jobs, and education.

Biden's plan certainly aims at meeting the goals set forth by the IPCC for carbon and other greenhouse gas emissions so as to keep the global temperature rise below 1.5 degrees Celsius. The only major weakness in his plan is that carbon capture use and storage (CCUS) or even carbon capture and storage (CCS), from carbon dioxide emitted by the burning of fossil fuels, are as yet unproven technologies where there are no large scale demonstration projects showing that these technologies can work.

We now look at the pathway that is being proposed herein to help meet the goals of the Biden plan in electrical energy by 2035 and net zero emissions by 2050.

The United States of America, having been in the forefront of the Industrial Revolution, along with European nations and later Japan, based almost of all of its economy on fossil fuels, first coal, then adding oil and then adding natural gas. Because of its emphasis on fossil fuels and discouragement to renewable energy and low carbon technologies, with the exception of the state of California (described later), the US has fallen behind other nations in the development of green technologies. The US has now the opportunity to demonstrate in a big a way that it can transform its economy totally with renewable energy and green low carbon technologies. The overall plan that is described next shows how to do exactly that.

The Proposed Energy & Climate Plan for the US

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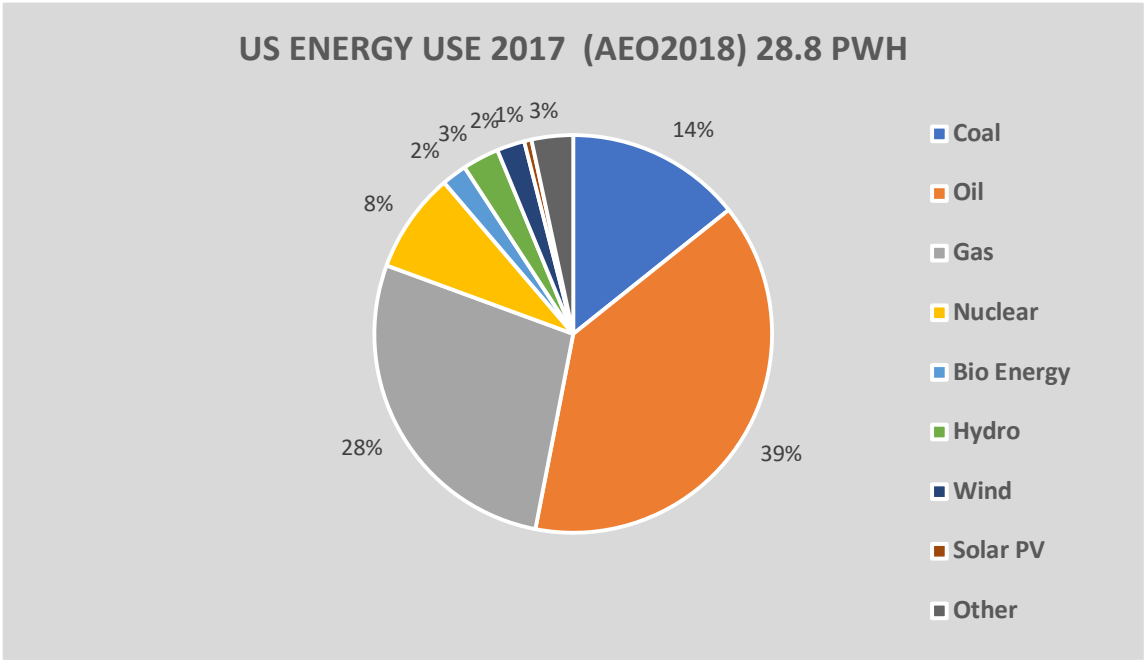
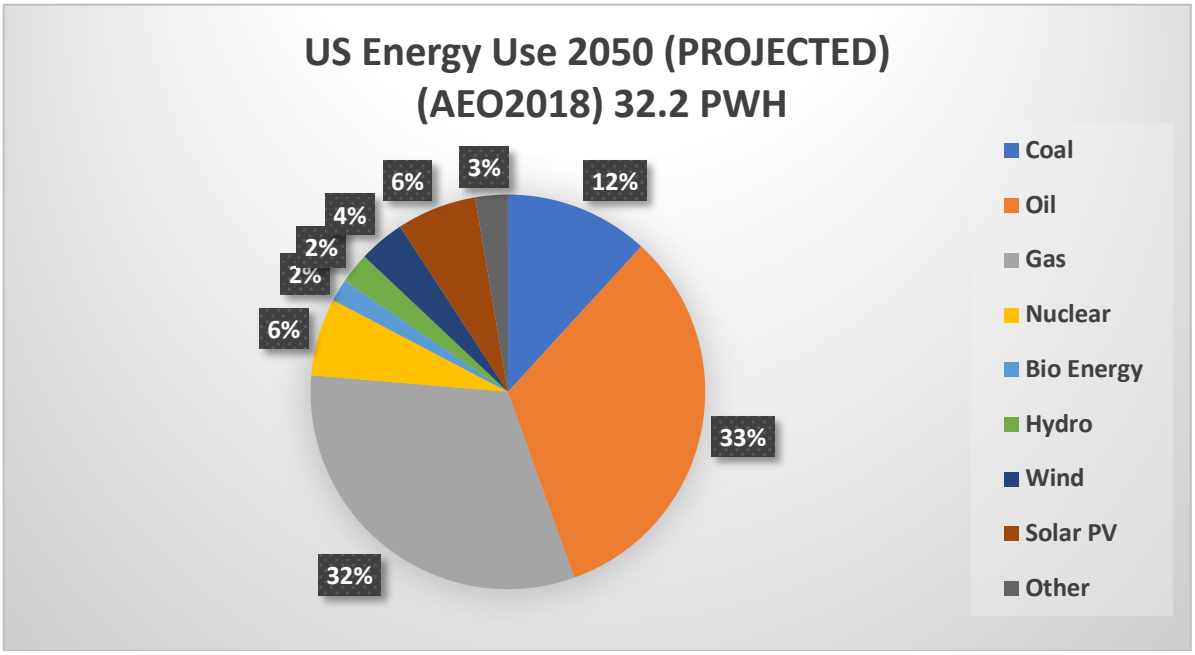
The pie chart below shows the current energy use by source, and then the projected energy use by 2050, and then what the Plan proposes for 2050. According to the AEO2018 Report (Annual Energy Outlook) by the US Energy Information Agency (EIA), the US consumed about 28.8 PWH (Peta Watt Hours) of energy in 2017. The following Pie Chart shows the details. One can see that the three fossil fuels provided 81 % of US total energy needs, while the four renewable energies (Bio energy, Hydro-electric, wind and solar) only produced about 8%. These three fossil fuels produced about 5 million Metric Tons of carbon dioxide, which is most of the US greenhouse gas emissions. Updated versions of the AEO2018 report have been published in the AEO2019 and the AEO2020 reports. **[19,20,21]**



ENERGY ACTUALLY CONSUMED BY THE US IN 2017
In 2017, the US consumed about 18% of the world's energy (162 PWH), but its reliance on fossil fuels was very high at 81%, with 14% of that being from coal.

The same AEO2018 Report makes the following projection for 2050 if current policies continue. Energy use in the US is projected to grow very little in about 30 years.



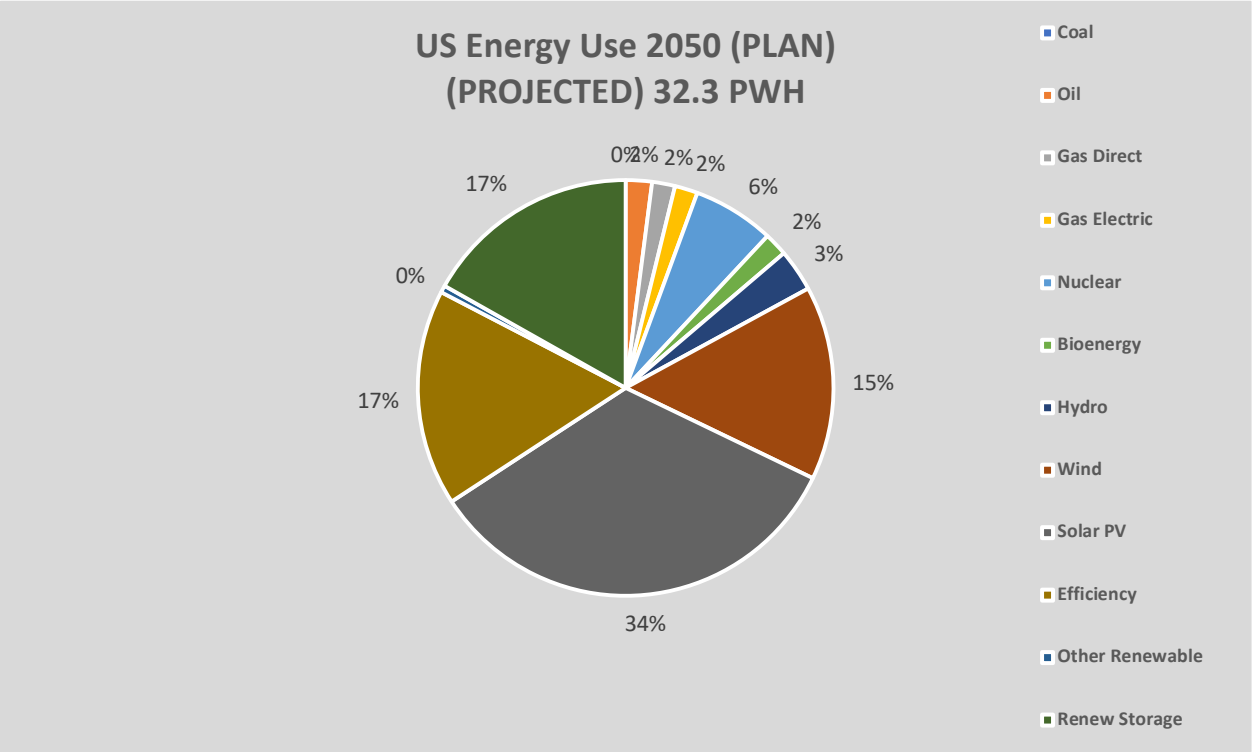
US ENERGY USE PROJECTED FOR 2050 BY THE US EIA (AEO2018) – BUSINESS AS USUAL

US energy use is projected to grow only about 12% from 2017 to 2050. However, the US Energy Information Agency projects that the US will still be 77% reliant on fossil fuels (about 12% on coal). Wind will have grown to 4% and Solar PV to 6% of the total. Clearly, this is not the path to climate solutions. So, here we present the proposed PLAN for the US.

Proposed Energy & Climate PLAN for the US

Because of its emphasis on fossil fuels and discouragement to renewable energy and low carbon technologies, the US has fallen behind other nations in the development of green technologies. The US has now the opportunity to demonstrate in a big a way that it can transform its economy totally with renewable energy and green low carbon technologies. The overall plan that is described next shows how to do exactly that, and then the rest of the chapter provides details on how to do it.

Basically, the US PLAN goes along with the Global PLAN described in Chapter 3, of the book.



US ENERGY USE PROJECTED FOR 2050 BY THE PLAN

The Book Plan for 2050 reduces fossil fuel consumption down to about 5% of the total (down from 77% of the total in the above Business As Usual scenario as projected in AEO2018 report). Coal is totally gone, oil is there in a small way, and most of the remaining small amount is natural gas. A small push for Wind Energy increases it to 15% of total, Solar PV to 34% of total, Energy Efficiency saves 17% of the total, and renewable energy based "storage" fuels like Hydrogen (that store renewable energy) at 17% of the total. The extent to which energy efficiency goals are not met, will need to be met with an expansion of Solar PV and Storage Fuels.

Here's a list of the proposed PLAN. Again RDD&D means Research, Development, Demonstration and Deployment, meaning the technology or hardware is taken from laboratory to prototype, to demonstration size project (means a large enough project that fully confirms that the technology succeeds on a big scale and establishes the numbers for the economics), and finally to all aspects of deployment (meaning production plants, storage, transportation, infrastructure and end use). In the case of end use technologies, this means the same thing, except that the fuel is simply taken and then the technology is used to power the machine or engine that uses it – so the technology RDD&D is centered around the machine or engine and its demonstration and final production, distribution and support.

1. Overall – **Transitioning Out of Coal and Natural Gas**
    a. Coal and natural gas power plants REPLACED by Solar PV + Battery + Natural gas for evenings and nights – latter replaced by replaced by Storage Fuels

2. Overall – Transitioning Out of Oil – **Solar-Electric Highway**s of the type described above to replace use of gasoline and diesel fuels
    a. Solar-Electric electric vehicle charging stations to supply "storage Fuels" like Hydrogen and Ammonia to fuel cell vehicles
3. **Storage fuels RDD&D (Research, Development, Demonstration & Deployment)**
    a. US to join other nations to do the RDD&D for the Green Production of non-carbon fuels that store renewable energy – storage and distribution of fuels
    b. Storage and Distribution of these fuels on a massive scale
    c. Also, RDD&D in regard to end user technologies for Storage Fuels used in Vehicle internal combustion Engines, Gas Turbines & Fuel Cells
4. **Electrification of buildings, homes and industry**
    a. Apply existing technologies, and do RDD&D to develop the rest – incentives
    b. What cannot be electrified, develop methods using "Storage Fuels" (RDD&D)
    c. Transmission Upgrades – Increased Capacity (about double), depending on location of Solar PV power plants – Smart Grid features
5. **Electrical Transmission Upgrades**
    a. Increased Capacity (about double) with more local location of Solar PV power plants near users (to reduce transmission costs), and democratic control by local governments, organizations and companies.
    b. Smart Grid features that enable the grid to manage the variability of renewable energy, as well as the demand and supply aspects to manage peak power and increase reliability of the grid (ability to satisfy demand reliably under all conditions)
6. **Expanded Carbon Sinks – Reforestation and Coastal Ecosystems**
    a. In all regions, add 80 Million Hectares of forests – with all of the aspects described in Chapter 4, including agroforestry and urban forestry.
    b. All designed so as to properly manage forest fires and their consequences
    c. Enhanced Carbon Sink Coastal Ecosystems – Atlantic, Pacific and Gulf coasts – entire coastline – Mangrove swamps, salt marshes, sea grasses and coral reefs
7. **Rejuvenated Agriculture**
    a. From agricultural universities to farmers and marketing, transform US agriculture to the Regenerative agriculture and Agroforestry described in Chapter 5 of book.
    b. Increased soil fertility and carbon absorption, by deliberate processes to increase the organic and carbon content of the soils
8. **Advanced Disaster Management – Disaster Risk Reduction**
    a. Wildfires, hurricanes, tornados, coastal storms - Before, during and after disasters
    b. Massive organization infrastructure to do Disaster Risk Reduction, prepare for disaster relief, and proper reconstruction (Build Back Better)
9. Implementation of all of the Mobilization Goals of the Green New Deal – described in detail below.

Overall for US - Transitioning Out of Coal

US coal consumption was at about 14 Quads (Quadrillion BTU) or about 4,110 Billion KWH in electrical energy terms in 2017, as per the AEO2018 report of the US Energy Information Agency. Then it was projected to be essentially flat at about 13 Quads or about 3,820 Billion KWH till 2050. For electric power, the capacity of coal power plants fell by about 60 Giga Watts (GW) mainly due to the US EPA enforcement of Mercury and Toxics standards. However, coal fired electric capacity is projected to further decrease by about 65 GW between 2017 and 2030, before levelling off at 190 GW by 2050. Coal is mainly used for electric power production, but is also used by the steel industry as Coking Coal, by the cement industry and in the making of many products. The US also has the world's largest proven reserves of coal, and according to the US EIA in 2008 had about 260.5 billion short tons of coal.

When one burns a million BTU (British Thermal Units) of a fuel the amount of carbon dioxide emitted are about 215 pounds (98 Kilograms) for Coal (an average for the different types of coal), about 160 pounds (73 Kilograms) for either gasoline or diesel, and about 117 pounds (53.2 Kilograms) for Natural Gas. **Clearly, the case for eliminating Coal from its use as for electric power and heat (by burning it) has come. It needs to be the first to go.**

The proposed plan will eliminate most coal fired power plants by 2030, and ALL by 2050. The overall plan needs replacing all of the coal fired power plants with a combination of Solar PV and Battery power plants – as described in Chapter 3. Where coal use cannot be electrified in the rest of the economy (as in industry), the RDD&D will be needed up front to replace coal with Storage Fuel based technologies. The plan is projecting that by 2050, all of the mining, use and export of coal will be gone.

Overall for US – Transitioning Out of Oil

As of early 2019, in terms of the daily production of oil (petroleum), out of the world's production of about 80 million barrels per day (mbl/day) the US was producing about 15 million barrels per day, Saudi Arabia about 12 mbl/day, Russia about 11 mbl/day, and the four nations of Iraq, Iran, China and Canada near about 4 mbl/day each. **By 2022, the US is forecast to become a net exporter of oil. The natural gas liquids production (liquids separated from natural gas during gas production) is growing and will increase to about 5 million barrels per day by 2023.** The natural gas liquids consist of mainly ethane, propane, isobutane, normal butane and natural gasoline. For what the US Energy Information Agency calls its Reference Case (AEO2018 Report), crude oil production could vary from 10 to 19 million barrels per day, and natural gas plant liquids production to about 5.5 million barrels per day, by 2050.

As of 2018, in terms of proportions, US oil consumption use was 46% for motor gasoline, 20% for distillate fuel (heating oil and diesel fuel), and 8% for jet fuel. Besides transportation fuels, oil or petroleum is used for fuel oils for heating and electricity generation, asphalt and road oil, and materials that are used in making chemicals, plastics and synthetic materials that are in

most products people use and consume. Most of the greenhouse gas emissions from fossil fuels come from burning them, and about 45% of the emissions come from oil or petroleum.

Clearly, for climate change solutions, we need to get out of this scenario. Here is how we can do it. We need to transition ALL highway transportation to electric and storage fuels. For transitioning out of gasoline and diesel use, the details for this are described in the section on Solar-Electric Highways. There will be a parallel program similar to a "cash for clunkers" program that the US has used in the past, that will then be used to get all fossil fuel cars off the roads by 2050 (that includes any added due to increase in the number of vehicles), and replace them with battery electric and storage fuel cars.

For the aviation segment, besides the use of bio-fuels, aviation will be replaced by a network of High Speed Rail crisscrossing the country from north to south along each of the west and east coasts, and for east-west – one northerly route going through Chicago, and the other going from Southern California to Florida. The plan proposes that all of the US be covered by a transformed transportation policy that emphasizes low carbon transportation between regions, and in cities and local areas. For this see the section on reducing the carbon footprint of transportation, including aviation, shipping and tourism in the book.

Overall for US - Transitioning Out of Natural Gas

US natural gas is about 28% of US energy use and contributes to about 28% of US carbon dioxide emissions. In 2017, the US produced about 28 trillion cubic feet of Natural gas and as per the AEO2018 Report, the production is projected to grow to about 42 trillion cubic feet by 2050, for what it calls the Reference case. The actual use of natural gas is projected to grow from about 28 trillion cubic feet in 2017 to about 34 trillion cubic feet in 2050 (the excess of production over consumption will lead to significant exports of natural gas from the US). The carbon dioxide (CO2) emissions from the burning of natural gas in the US are projected to grow from about 14 million metric tons of CO2 in 2017 to about 18 million metric tons of CO2 by 2050 for the Reference case.

When one burns a million BTU (British Thermal Units) of a fuel the amount of carbon dioxide emitted are about 215 pounds (98 Kilograms) for Coal (an average for the different types of coal), about 160 pounds (73 Kilograms) for either gasoline or diesel, and about 117 pounds (53.2 Kilograms) for Natural Gas. Natural gas is also cleaner burning and emits negligible amounts of sulfur, mercury and particulates (particulates cause smoke) when it is burned. Because of this, the US and many other nations have used this as an argument to substitute natural gas for coal or oil based fuels.

However, there are many damaging aspects resulting from the production and consumption of natural gas. During the drilling and extraction of natural gas from wells, methane gas leaks which is 34 times stronger than carbon dioxide in trapping heat over 100 years, and 86 times stronger over 20 years. Methane leakage needs to be no more than 1-2% for there to be any greenhouse gas emissions benefits of using natural gas. Although the burning of natural gas is

cleaner, within about a half mile of drilling sites there are increased emissions of particulates and ozone – both of which are not good for health. Hydraulic fracturing (or "Fracking") has been known to cause the contamination of ground water with the liquid used in fracking, and in poorly constructed wells to cause ground water to get contaminated with naturally occurring radioactive materials, methane and other gases, and volatile organic compounds. The large amount of water used in production can also result in local water shortages. The US Environmental Protection Agency (EPA) has identified about 1,000 chemical additives used in Fracking, although a particular well may use only about a dozen of these. Lastly, fracking has been linked significantly with the increased incidence of earthquakes. So, if we have to get to zero greenhouse gas emissions and avoid they above negative effects of natural gas production, we need to transition out of natural gas.

For electric power, the plan proposes replacing natural gas power plants with a combination of Solar PV and Battery storage. For industrial use, all technologies will transition to all electric energy and the increased electricity will again be met by a combination of Solar PV and Battery power plants, and Solar PV (or other renewable) producing and using non-carbon "Storage Fuels". As per above, all transportation will be transition to solar-electric highways and use of storage fuels. Generally, all commercial properties use natural gas for heating, cooling, cooking, and all appliances. These will all be switched to all-electric. The general strategy is to mandate and enable all NEW construction for power plants, industry, commercial and residential uses to a combination of all electric and storage fuels, and support this with all the research, development, demonstration and deployment actions needed. After successful demonstrations, all the technologies will then be applied and all sectors mandated to switch to the new energy sources by 2050.

SOLAR PV POWER PLANTS – THE TOTAL ENERGY SOLUTION

Solar PV Combined + Battery System + Storage Fuels

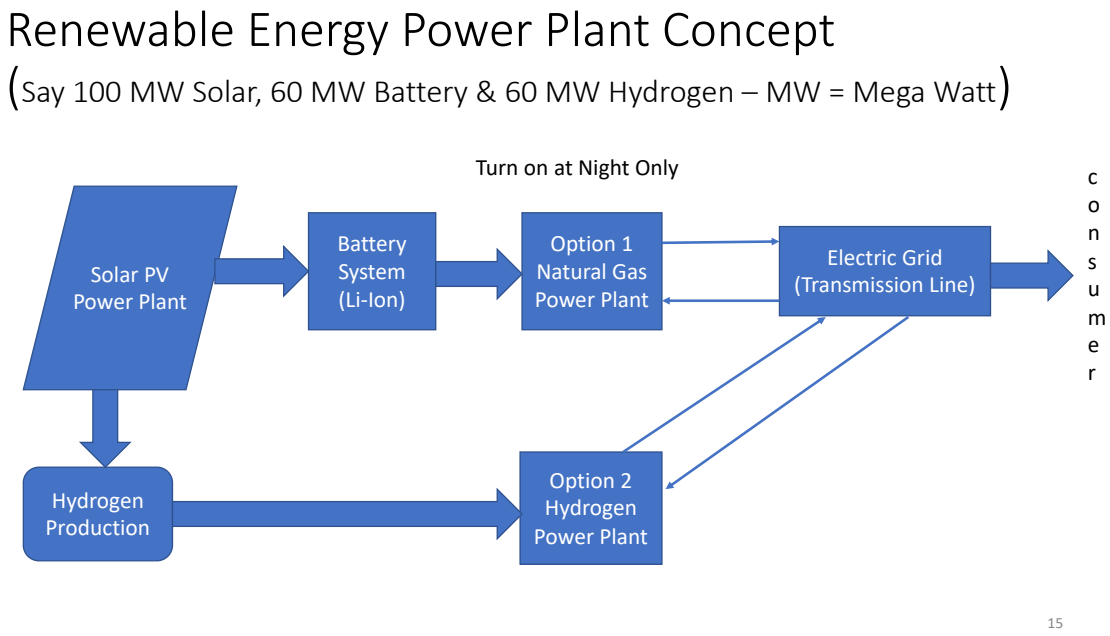
Small, medium and large utility scale Solar PV plants will be established throughout the world (except of course in nations such as Iceland that already have met all of their needs with other renewable energy). When the sun is shining there will be three loads that would be supplied: (1) Direct supply for electricity for immediate use through transmission lines, (2) The charging of a local battery system that would provide short term smoothing and backup, and (3) the production of a "storage" fuels such as Hydrogen or Ammonia (fuels that can store renewable energy), for reuse at the plant and for excess production and supply to the rest of the economy. When clouds come over, the battery system would kick in immediately to make sure the supply is smooth. If the sun stops shining for a longer period of time, in the early stages of the plan, a generator such as one based on natural gas would start up and kick in to provide electricity during that time and at night. At the later stage of the plan, when the storage fuel technology is well developed and storage fuel is being produced and stored during the day, the storage fuel generator would provide electricity when the sun is not shining or at night. When this happens, the natural gas generator would be retired and be no longer needed.

SUMMARY

The new Solar PV plants, from smaller community ones to larger state and regional utility scale plants would supply currently needed electricity, and the added electricity for battery charging and the production of storage fuels. The total electric capacity of all the new Renewable Energy Power Plants (in terms of power and energy) will be anywhere from two to five times the current electrical capacity, in order to meet the needs of the total electrification of the whole global economy.

LOCATIONS

To minimize the size and expense of the Transmission grid (covered in following pages), it is best that the Solar PV power plants be located near the end users and end user communities. In this way, the transmission line lengths will be much shorter. All Solar-Electric Charging Stations for vehicles will have the solar and battery systems located as close to the station as possible. Similarly, the Solar PV based "Storage Fuel" production stations will be as close to the end user locations as possible. Solar PV plus Battery Power plants that REPLACE Coal Fired Power Plants will be located very near the original plant so as to use the same transmission lines.



SOLAR PV PLUS BATTERY POWER PLANT

CAISO, the California Independent System Operator coined the term "Duck Curve" to point out the problem created for non-renewable power sources when Solar PV was added at mid-day in a big way.

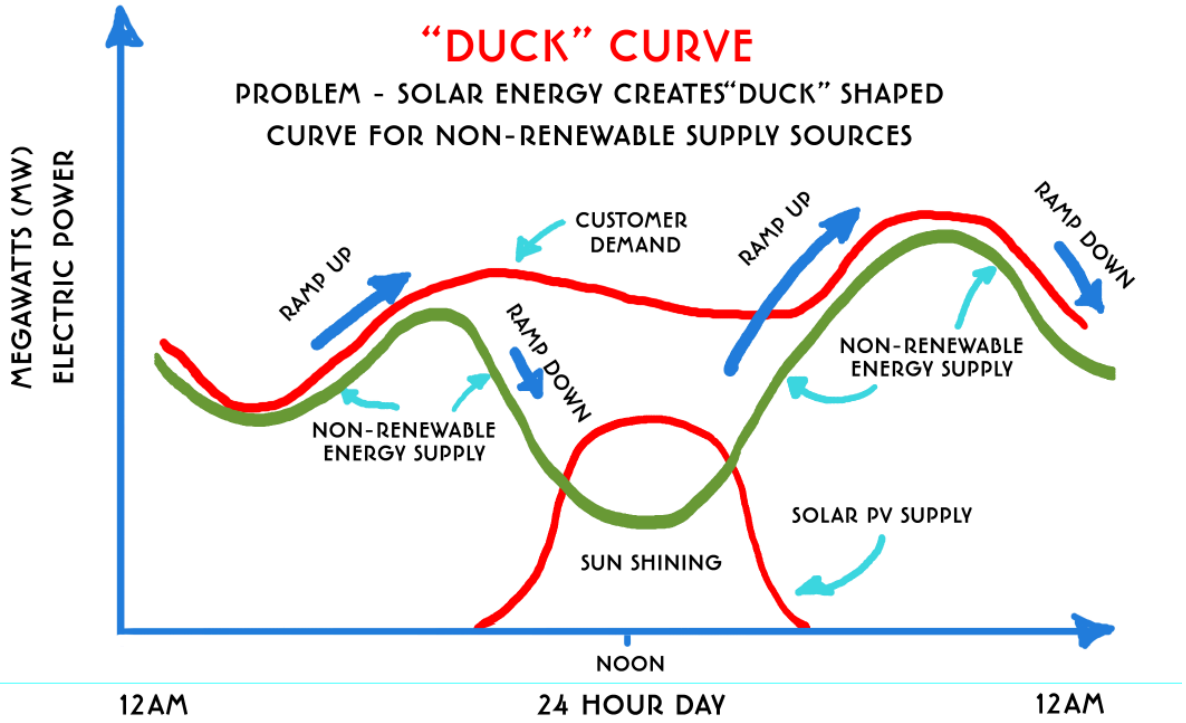


ILLUSTRATION OF THE "DUCK CURVE"
The customer demand over a 24 hour period is shown schematically above (This is not actual data, but the shapes of the curves represent what happens). Then, mid-day as solar energy kicks in, the other energy sources (currently mainly non-renewable energy sources – mainly natural gas power plants in California), have to ramp down very fast. Then, towards evening as the sun sets, these same sources have to ramp up fast. This is all in addition to what happens early morning and late at night as energy demand from customers fall.

The "HUMP CURVE" is proposed by the PLAN completely overcomes the problem if Solar PV is the only source of electric energy. The Solar PV plus Battery plus "Storage Fuel" Power plant is sized such that when Solar PV power is being generated, it is enough to not only meet the mid-day demand, but it fully charges the onsite Battery system, and produces adequate quantities of a non-carbon "Storage Fuel", which is stored for evening and night use. Then, as Solar PV power and energy are going down as the sun is setting, the Battery System cuts in and meets the late afternoon increased power demand. Then, after the Battery system has discharged to a defined level that is good for battery level, the "Storage Fuel" Electric Power Generator kicks in and produces power and energy for the rest of the evening, night and early morning, till the sun rises again.

Other major storage sources can also play a role here in providing the power – compressed air, water pumped storage, molten salts at CSP (Concentrated Solar Producer that use heat to generate power, but can also melt the salt) or other storage methods. For "Storage Fuels", the

maximum amount that might need to be produced in advance and stored would be, say 6-7 days' worth, in case there were a number of overcast or days with less sunshine. Also, before "Storage Fuel" green production and use is fully developed, natural gas power plants can be used from evening to early morning, or electricity can be imported by the grid from elsewhere (hydro, geothermal or wind).

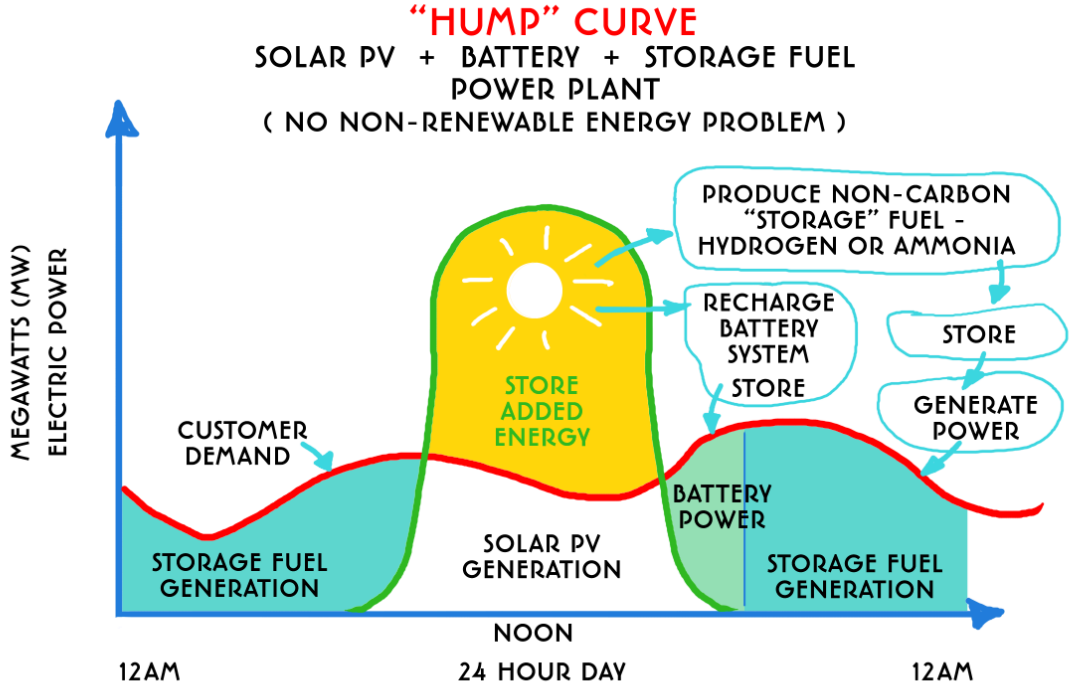


ILLUSTRATION OF THE "HUMP" CURVE TO OVERCOME THE VARIABILITY OF SOLAR ENERGY

The issues that occur with high levels of solar energy that occur in the US in states such as California, do not occur in the middle of the United States which are more dependent on Wind Energy. Wind Energy tends to be steadier and can blow at all times, so that it creates more of a flat curve during the day. Some have called it the "alligator" curve than actually is closer to consumer demand most of the day, and only causes a small hump during the day when nearby Solar PV power kicks in (utility scale or roof top solar). **So, it is important to encourage Wind and Geothermal energy that can provide power when the sun is not shining, and energy from Hydro-electric power plants can also add to this.** There are other good ways of managing the issues and that is by demand side management, or reducing the demand on the user side by various means (smart grid approaches).

The US state of California has developed about 40 retail hydrogen refueling stations, and one is located near Honolulu, Hawaii. These have been opened by a company to serve Toyota Mirai car drivers who lease their Fuel Cell Vehicle cars through Toyota. Most of these refueling stations are located near the Los Angeles area, but others are spread throughout the state. As of the time of the writing of this book (early 2020), there are about another 24 hydrogen stations that are at various stages of permit, planning, construction and commissioning. Other car manufacturers that have developed fuel cell vehicles are Honda (2018 Clarity Fuel Cell) and Hyundai (2019 Nexo) – the latter offers 5 passenger seating and a 380 mile (612 Kilometer) range. Hyundai says that it plans to build 500,000 fuel cell vehicles powered by hydrogen by 2030. The former Governor of California, Jerry Brown, had signed executive orders that that set targets of 200 hydrogen refueling stations by 2025 and 5 million Zero emission (electric or fuel cell) vehicles by 2030.

The main challenge of Hydrogen fuel is that they need to ALL be green, or use renewable energy sources to produce the fuel. The photo below shows a 100% green or renewable hydrogen station installed in 2019 in the city of San Francisco, that was developed by Shell and funded by the California Energy Commission (CEC), is open 24 hours a day, has a capacity of 513 Kilograms (about 1,130 pounds), has two refueling nozzles that supply hydrogen gas under pressure, to fill the vehicle tanks. The government of California requires that at least 33% of the hydrogen fuel supplied at each station comes from green sources, and that a station that supplies at least 40 % green hydrogen qualifies for its Low Carbon Fuel Standard ZEV (Zero Emission Vehicle) Infrastructure credit. **[California Fuel Cell Partnership]**


Shell
Hydrogen
2
Shell
Hydrogen
Shell
Hydrogen
1
START
STOP

Photo by Author: A 100% GREEN HYDROGEN REFUELING STATION IN SAN FRANCISCO, CALIFORNIA

Electrification of The Whole Global Economy

SOLAR-ELECTRIC HIGHWAYS – EXAMPLE OF THE USA

VARIATIONS OF THIS TO BE APPLIED GLOBALLY

- The Entire US Highway Transportation system can be electrified by Solar PV powered Electric Charging Stations throughout its entire highway and road network
- Indirect Electrification will be by Fuels that are produced by Solar Energy, and then stored for later use – we call these "Storage Fuels" – more on these in next few pages
    - These vehicles will use either fuel cells (like the Hydrogen fueled vehicles of today), or have internal combustion engines (like those used in vehicles today)
- Calculation for the US based on its energy use on Roads and Highways in 2017
    - The US used 27 Quads (Quadrillion BTUs) or 7,930 billion KWH of energy
    - Information from the US Energy Information Agency Report
    - On the average, vehicles consume this energy with only 40% efficiency
        - About 60% is wasted and leaves out of the muffler
    - So, for Electric Energy, we only need 3,172 Billion KWH (40% of 7,930)
    - For most latitudes of the US, this energy needs 2,115,000 MW of Power
    - **If Charging Stations are 10 MW is size we need 211,500 of these**
    - **At 0.015 square kilometers per MW, this needs 0.15 sq. Km. or 38 acres area.**
    - Each Solar-Electric Charging Station can also store and sell "Storage Fuels", produced onsite or transported from some other location
    - Each Station can also have an onsite unit that produces one or more "Storage" Fuels using Solar PV energy and sells it to vehicles, using the same solar panels
    - These "Storage Fuels" can either be Hydrogen or Ammonia
    - Since the US has 47,000 miles of Interstate Highways, one station each 20 miles means 2,350 of these stations on the Highways alone
    - The photo on the next page shows a Solar Powered Electric Charging Station
    - Or the Solar Panels Could be Elevated Construction along the Center Strip of the Highway
    - See the page after next for a Concept of such a Solar-Electric Charging, including "Storage Fuel" onsite production as an option
    - Over a period of 30 years (2021-2050), these Solar-Electric Charging Stations can replace the 111,000 "Gas" Stations currently in the US (for gasoline and diesel).

SOLAR-ELECTRIC ELECTRIC VEHICLE CHARGING STATION

In April 2019, Marin Clean Energy (MCE), a local non-profit organization in California, that was established for Community Choice Aggregation (CCA* – see below) completed a Solar PV Powered Electric Charging Station in cooperation with a company called American Solar Corporation, that is of 80 kW (kilo watt) capacity that powers 10 Level 2 Electric Vehicle (EV) Charging Stations next door to its office in San Rafael, California. The Station will generate about 120,000 kWh (kilo watt hour) of electric energy per year and power the 10 EV Charging Stations. When the sun is shining, the Solar energy directly charges the battery electric vehicles, and at other times will receive power from MCE's other California's renewable energy sources (mainly wind and solar). If there is excess solar energy, it will flow back into the grid and be used to offset the energy use of its nearby office building. MCE contributed funds to make required infrastructure upgrades, and received some financial support from local area California governmental organizations. The effort complimented MCE's Electric Vehicle Program where it has funded and supported 644 charging ports at mainly multifamily dwelling and workplace locations in their service area.

Photo: Courtesy of Marin Clean Energy, MCE, San Rafael, California

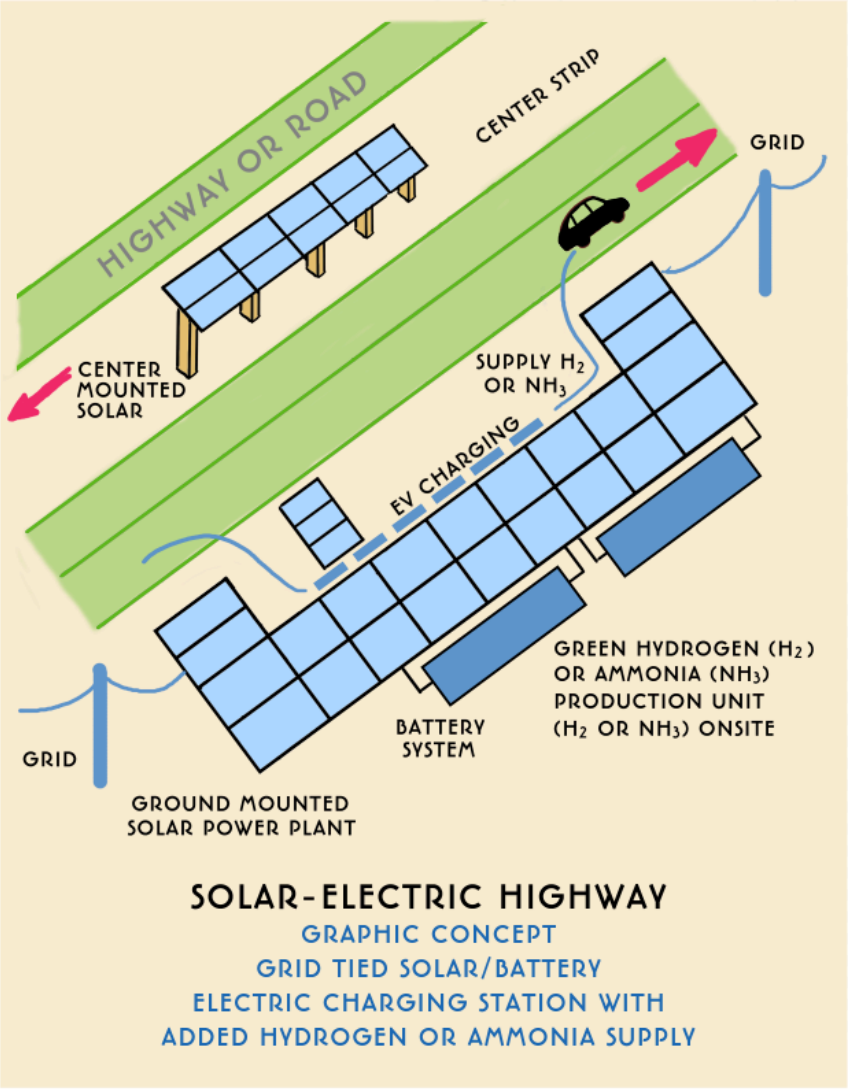
*Community Choice Aggregation or CCA, is a method that is being used in California and other states of the US. These are covered in more detail in the California Plan, but here is a summary. A CCA is a not-for-profit organization that provides an alternative to investor owned utilities, where the CCA provides alternative renewable energy supply, but the utility still handles transmission, metering and billing. Marin Clean Energy is the first of about 19 Community

Choice Aggregation organizations in California, and it began service in 2010 with the aim of providing stable electricity rates to customers and reducing greenhouse gas emissions.

CONCEPT OF GLOBAL SOLAR-ELECTRIC TRANSPORTATION SYSTEM

HIGHWAYS & ROADWAYS

- The US proposed plan is parallel to the global plan in that it proposes direct electrification of the world's highways and roadways
- The plan proposes concept of **Solar-Electric Highways and Roadways**. So the plan here is to have solar panel systems with raised structures covering highways, or where the space along the highways is available, ground mounted solar systems.



- As is proposed elsewhere for power plants, the solar system will be accompanied by battery backup system, so there is power at times other than when the sun is shining.

- At each location, there will be electric vehicle charging stations, so battery electric vehicles can be charged, some directly from solar panels, and later directly from the battery system.
- At other times (like at night), the Solar Charging Station can be on the transmission grid and powered by electric power from elsewhere.
- If the Solar-Electric Charging Station is stand-alone (not tied to the Grid or connected to the Utility), then its Battery System will need to be much larger and be capable of charging vehicles when the sun is not shining
- See the Concept of such a Solar-Electric Charging Station

The Development and use of Non-Carbon Storage Fuels in the US

In 1970, at a talk he gave at the General Motors Technical Center at Detroit, Michigan, John Bockris coined the term **"Hydrogen Economy"**. The concept of a "Hydrogen Economy" was popularized by a 1970 technical Report by Lawrence Jones of the University of Michigan. It was proposed to popularize the concept of generating non-carbon fuels that emit no carbon when burned.

The Proposed PLAN for "Storage" Fuels for the US

The US has usually been a leader in innovation and in showing the way to the future. However, it needs to stop its leadership in fossil fuels innovation and expansion and start to look at how it can be one of the leader nations in innovating for climate change solutions. Otherwise, it will get left behind. Other nations are pushing ahead with innovation in "Storage Fuels" – fuels that store the sun's and the wind's energy in a non-carbon way. Japan is leading the research in close cooperation with Australia, and China and the Scandinavian nations are proceeding too.

The biggest challenge here is to do the research to develop "Green" ways of producing "Storage Fuels", or how to produce these using Solar and Wind (or other renewable energy) on an economical and commercial scale. The next big challenge is to do the research that will develop that technologies (engines, fuel cells, turbines, etc.), that will consume these fuels and burn them without any carbon emissions. All aspects are important in RDD&D – Research, Development, Demonstration and Deployment.

The proposed plan is as follows:

1. Concentrate and expand its Energy **Research** in Universities and Research Laboratories into the technologies that succeed in producing Storage Fuels by green methods. Cooperate in this research with other nations that have a similar capability, or are leading the charge.
2. For the technologies that show promise through success in research, invest in and **Developing** them further and solving any technical problems that show up.

3. For the technologies that have succeeded in both the research and development phases, invest in larger scale **Demonstration** sites, that demonstrate all aspects of the technology on a mini-plant scale. This is where all involved can go and witness that all aspects of a particular technology will work on a reasonable scale, and to establish the information needed about the technical feasibility and economics of the technologies.
4. For the technologies that have been successfully demonstrated, take the steps to **Deploy** these technologies on a nationwide basis, and cooperate with other nations in terms of imports, exports and funding of technologies and plants in all nations that will enable the global strategy to succeed.

For successful Deployment of Green Storage Fuel Technologies, the US needs to take the following steps in the widespread deployment in terms of Regulations, Production, Transport, Storage and End-Use of these fuels:

1. Develop and Establish the **Regulations** and standards for the safe production, storage, transport and end use of these fuels.
2. Invest in and establish the **Production** facilities that will produce Storage Fuels for all applications: Electric Power, Industry, Buildings, Agriculture and Transportation.
3. If the Fuels have to be transported over large distances, establish the pipelines and tankers and ships to **Transport** these fuels safely and economically.
4. For the **Storage** of these fuels, invest in and develop the storage tanks that will safely store these until they can be used and consumed.
5. For the **End Use**, of these Storage Fuels (engines, fuel-cells, turbines, etc.), deploy the large scale electric power technologies, technologies for vehicle engines, and technologies for their use in buildings and homes, and in industry – replacing all fossil fuel technologies with either electric technologies or Storage Fuel technologies.

There will need to be special attention paid to the production, supply and end use of Storage Fuels that are produced in a distributed way using renewable energy (mainly solar) on all of the roadways and highways of the US (and globally), **so as to totally replace gasoline (petrol) and diesel in entire US and global transportation.** At the same time, there will need to be all of the efforts as per above RDD&D and actions needed for safe deployment of fuel cells, engines and turbines (end use) in vehicles. There can also be hybrid systems that combine Battery Systems with Storage Fuel prime movers (fuel cells and engines). Efforts on this front need to start in 2020. So, all investments in RDD&D on fossil fuels should stop and be diverted to efforts on Storage Fuels.

Solar-Electric Highways, Roadways & Trainways – PLAN for the US

The entire US transportation system needs to be electrified, directly or indirectly. Direct electrification that seems feasible but will still require a significant effort is for all cars to become battery electric. Two forms of indirect electrification, is to use “Storage Fuels” (Like Hydrogen or Ammonia) as fuel in fuel-cell cars. The other indirect electrification is that of the direct use of “Storage Fuels” in engines (either internal combustion engines or turbines) to burn

these fuels in vehicles. ALL of these non-Carbon Storage Fuels must be produced by renewable energy.

First, direct electrification. The Plan proposes Solar-Electric Highways and Roadways. So the plan here is to have solar panel systems with raised structures covering highways, or where the space along the highways is available, ground mounted solar systems. As is proposed for power plants, the solar system will be accompanied by battery backup system, so there is power at times other than when the sun is shining. At each location, there will be electric vehicle charging stations, so battery electric vehicles can be charged, some directly from solar panels, and later directly from the battery system. At other times (like at night), the Solar Charging Station can be on the transmission grid and powered by electric power from elsewhere.

The US consumed 27 Quads (Quadrillion BTUs) of energy in Transportation in 2017. The Quads of energy used in transportation are projected to stay about the same even up to 2050. Assuming that all of these 27 Quads are used in burning oil or petroleum based fluids, the energy used in electric energy terms is 7,930 Billion KWH (or Terra Watt Hours). Since on average, internal combustion engines used in vehicles are only about 40% efficient, only about 40% of this is actually used in operating the vehicles, or about 3,172 Billion KWH per year. To generate this much electricity every year would take Solar PV installations of a total of 2,115,000 MW of electric capacity. Assuming that all of the distributed Solar Charging Stations are 10MW stations, it will take 211,500 of these stations. These will replace the current number of 111,000 gas stations (providing both gasoline and sometimes diesel). Just like the gas stations, each of these locations could be locations where other commerce could flourish in terms of restaurants, shops, etc., where people can be while their cars are being charged.

Each 10 MW Electric charging station could have its Solar panels distributed along the length of the highways. For the 47,000 miles of Interstate Highways throughout the US, one station every 20 miles, will mean 2,350 of these stations on the Interstate highways alone. The rest could be distributed throughout the rural areas (where most of the roads are) and near or in town areas. Each of these 10 MW charging stations (which produce in the US 1,500 MWH for every MW), would produce 15,000 MWH of energy every year or about 41 MWH daily. Since 100 KW Solar System is known to be able to charge 12 electric cars at a time, a 10 MW solar station could charge about 1,200 cars at a time, although the number of charging stations may actually depend on the number of parking spots created. Each 10 MW station will either have its solar panels distributed along the length of the highway or roadway, or use a square area about 400 meters by 400 meters or 430 yards by 430 yards. If the solar panels are elevated (what is called a built-up environment or on an elevated structure), the cars will be parked underneath the panels while charging.

Similarly, light rail, bus systems and all railways will develop supporting systems for pure electric, battery and storage fuel use. Although the cost of adding pure electrification of mass transit type systems (such as electric trams) is high, wherever these make sense, these should be developed or expanded. For battery light rail vehicles, Solar PV charging stations will be developed that charge these vehicles throughout the day, and at night from stationary batteries

that have been charged. All Rail vehicles, especially diesel-electric locomotives will be converted to Hybrid battery electric and Storage Fuel turbine based engines. End-use engines, fuel cells and turbines that use Storage Fuels will need the RDD&D so that these achieve widespread use. The use of Diesel fuel in railway locomotives and other types of light rail systems will be phased out.

Each Solar Charging Station for road vehicles can also perform the following added functions:

1. Store and sell a "Storage" fuel to cars, trucks and other vehicles
2. Have an onsite "Storage" fuel production unit, powered by extra energy from the same Solar panels, that produces and stores the fuel, and sells it to vehicles

The storage fuel can be Hydrogen that is produced and consumed quickly onsite, or Ammonia, that is produced and stored and consumed over longer periods. The size of the Storage Fuel production unit can vary depending on local demand. The Storage fuel production unit will only need water that is split to provide the Hydrogen, and Nitrogen that is drawn from the air – both resources that are available everywhere – although water will need to be supplied. Since these fuels can be produced locally, they do not need to be transported over large distances. However, globally, if some nations that specialize in producing large quantities of Storage Fuels, produce these fuels, then these can be transported in ships and tankers that use the same transport fuels they transport!

Electrification of Buildings & Homes & Supply With Renewable

A significant number of homes and buildings in the US use propane, fuel oil and natural gas for heating and other appliances (water heaters, clothes dryers, cooking stoves, and cooking ovens). There seems to be general agreement that for new homes and buildings, especially if the cost of infrastructure for the supply of natural gas is eliminated, that the structures can be fully electrified and that this will be totally economical. In July of 2019, the city of Berkeley, which is on the East Bay area of San Francisco, adopted an ordinance that there be no Gas hook ups in new homes, apartments and commercial buildings. This will essentially require all of these new buildings to be all-electric. For the US, and for California, this is a great beginning! However, new buildings are only about 1% of the buildings and this does not affect the rest of the existing stock to begin with. California now also requires all new homes to have Solar PV systems (essentially solar panels on the roof). This is a good beginning.

If the US has to be able to reduce its Greenhouse Gas emissions from homes, apartments and all buildings, besides having a plan for new structures, the nation needs a strategy for full electrification of all new and existing structures. Currently, where natural gas infrastructure is already in place and gas is being provided and at low prices, the costs of electrification can be high. For a home, replacing an existing gas furnace with a higher efficiency gas furnace is much easier and saves much money. But replacing it with, say an air source Heat Pump (or even with a ground source Heat Pump, or one that exchanges heat with the ground), requires a much higher capital cost. Even though less energy is used, and the excess electricity is say offset with

the home getting solar panels (Solar PV system), the high capital cost and the absence of rebates and incentives for switching to the electric mode make that a difficult choice for home owners. The same is currently true for most apartments and buildings.

So, here is the plan for the electrification of homes & buildings:

1. Require that all new structures of all kinds have no fossil fuel options (natural gas, fuel oil or propane), and that they be fully electrified, have battery electric vehicle charging stations, have solar panels, and they meet mandated efficiency standards that are technically feasible.
2. Change all laws and regulations, and building codes in order to make it easier for any retrofits of existing structures to switch to the all-electric modes.
3. Engage in a nation-wide program that is a combination of incentives, rebates, tax credits, and education in regard to the all-electric technologies needed. These should include heating, clothes drying, water heating and cooking modes. This should include the encouragement for Solar Thermal panels for water and space heating, that help reduce the energy load. In addition to air source heat pumps that can be used in milder climate regions (like California), there will be encouragement for ground source heat pumps (that use the fact that the ground temperatures below about 10 feet or three meters remain constant throughout the year).

Electrification of industry & supply with renewable energy

Studies have indicated that there is considerable potential for electrification in Industry, but that this is a very specialized area that needs individual attention. Studies indicate that the potential for electrification is high in manufacture of metal products, machinery production, iron and steel mills, wood products, and plastic and rubber products, just because of the processes they use. The potential is medium or low in industries for food and beverages, chemicals, paper, non-metallic minerals, and in the making of petroleum and coal based products. It is assumed that the last of these will be eliminated, although petroleum and coal products not involving the burning of these (and hence high emissions) would still continue.

There are several end-use electrical technologies that are already growth areas that can grow more. These are cryogenics, direct arc melting, induction heating, resistance heating and melting, ultraviolet curing and infrared processing. Other promising areas are water supply reverse osmosis (desalination), induction melting, membrane processes, and electro-slag, vacuum and plasma (combined). All of these areas have grown much in the 2015-2020 period and will need to grow further up to 2050.

The proposed plan for the direct use of Renewables and the electrification of Industry are as follows:

1. The Expansion of known technologies and methods for electrification must be made universal. All industries will need to switch to these if they can use them. For this, all the encouragement, incentives and standards will be needed.
2. Locally, on industrial sites, all of industry will maximize the use of renewable energy (mainly Solar PV) to produce electricity for ALL of their electric needs (existing and expanded).
3. Produce and use Storage Fuels – help with RDD&D on end use technologies for this
4. Develop end-use technologies that will enable them to substitute coal, oil and natural gas use with the use of either direct electric or the use of Storage fuels.
5. The industrial sector will be invested in in terms of all of the RDD&D needed for establishing new methods and technologies or improving on existing ones, or furthering either electrification or the use of Storage Fuels.
6. All industry will produce as much of their own Storage Fuels as they need, or for other nearby industries. If no Solar PV space is available, then they can import the Storage Fuel.

ENHANCEMENT OF THE SIZE, QUALITY, RELIABILITY, SMARTNESS & EFFICIENCY OF THE US ELECTRIC GRID

Transmission System Expansion and Upgrade

As the overall plan for the US above indicates, the electricity production will need to grow from the current 38% to at least 60%. This means a doubling in the size of the transmission grid (77%/38%) at least, if the Storage Fuels (17%) are produced locally right next to the Solar PV (or other renewable energy source). If not, then the size of the transmission grid will grow to be about double the size (77/38).

Whenever one considers an electrical energy system, there is the generator, the spur transmission (that gets the electricity to the main or bulk transmission line), the Point of Interconnection (POI), that interconnects the spur to the bulk transmission line. “Brownfield” sites are those where an existing power plant is simply being replaced. In such Brownfield cases, where say an existing coal, oil or natural gas generating station is being replaced by a Solar PV plus Battery Generating station, one can use the existing transmission line if enough land is available locally for the Solar PV plant. **Hence, in most cases where fossil fuel power plants are being replaced by renewable energy power plants (Brownfield Sites), little or no expansion of the Spur Transmission grid may be required.**

However, in case of expanded electrification, where additional renewable energy generating capacity is being added (these new ones are called Greenfield Sites), there will be need for new spur lines, points of interconnection and a large expansion of the Bulk Transmission lines. Many substations will also be needed at the points where the electricity is distributed at the end of a bulk transmission line to a consumer location, whether it be an urban area, a transportation hub (solar electric charging station) or an industrial location. The size of the expansion of the

bulk transmission hub will be reduced by locating the Solar PV plus battery generating station near the end-user locations.

The cost of Bulk Transmission expansions are affected by land and construction costs, overhead versus buried cable transmission, extent of transmission upgrade on the spur line, the length of the upgrades or expansion needed, and the economies of scale. In the transmission study by the University of Texas at Austin compared the transmission upgrade costs of an upgrade in Texas and California, and found that the costs were much higher in California because of the higher land and construction costs in California, and the need to bury the cables in California because of environmental impact aspects. Greenfield sites may need new or upgraded lines in order to get the electric power to the load centers, which will either be urban or industrial sites that are recently electrified. The length of new transmission lines will be higher for wind generation if it is far from load centers, but can be very short for Solar PV stations as these can be located right next to the load centers. **[22]**

The overall Structure, Organization and Economics of the whole electricity system needs to be revisited. It is crucial that this meet the following criteria:

1. It should enable a fast transition from fossil fuels to renewable energy based electricity and storage fuels
2. It should represent the joint interests of consumers (for savings and convenience), the need of city and state governments (for sustainability) the federal government to meet the transition goals, and the interests of those who operate the transmission grid, electricity generators and storage fuel providers.
3. In terms of income, control, jobs, and community owned or cooperative businesses, it should produce the widest possible distribution of earning benefits, and meet the criteria of energy democracy and a just transition.
4. In terms of the financing aspects, it should make sure that there are enough finances through various forms of taxes as described in Chapter 3, and public investment through government budgets, and that the rest of the unfulfilled needs be met through private financing, with a maximum empowerment of community banks through the accumulated savings of all actors in the whole system.

Presidential candidate Bernie Sanders, in his own version of the Green New Deal has made some sweeping recommendations of his own. He points out that already four federal Power Marketing Administrations (PMAs) and the Tennessee Valley Authority generate power and distribute it to 33 states. He proposes to create one more PMA to cover the remaining states, and expand the existing PMAs and empower them to add as much renewable energy as is needed. He proposes investing $ 1.52 trillion on renewable energy electricity production and $ 852 billion on the accompanying battery storage capacity.

He further indicates that rather than a private utility system that only responds to shareholder returns and profits for financiers, he proposed a system as follows, “The renewable energy generated by the Green New Deal will be publicly owned, managed by the Federal Power

Marketing Administrations, the Bureau of Reclamation and the Tennessee Valley Authority and sold to distribution utilities with a preference for public power districts, municipally- and cooperatively-owned utilities with democratic, public ownership, and other existing utilities that demonstrate a commitment to the public interest. The Department of Energy will provide technical assistance to states and municipalities that would like to establish publicly owned distribution utilities or community choice aggregation programs in their communities. Electricity will be sold at current rates to keep the cost of electricity stable during this transition."

An example of a utility that meets these criteria is Arizona's Salt River Project (SRP), because it is a public utility company with elected boards, and it operates with minimal supervision by the state's public utilities commission that allows it to itself prioritize based on long term (like sustainability) and short term (like savings) needs of residents. Since there are no shareholders to satisfy, all of the revenue is reinvested in the grid.

Another major innovation that has come recently in the US is **Community Choice Aggregation** (CCA), although it goes by some other names too. This provides electricity consumers with an alternative to investor owned electric utilities, in which local not-for-profit organizations provide alternative energy supply, but the transmission and billing is still done by the investor owned utilities (who still own the transmission and distribution infrastructure, metering and billing)**. CCAs are capable of being a big part of the solution to Climate Change, providing their mandate is to supply only green renewable energy, with little or no greenhouse gas emissions.** The CCA can then go and develop contracts with renewable energy suppliers, including new projects, and then supply it to the customers in the jurisdiction or areas the CCA serves. Customers in that area then have the option of getting part or all of their electricity from green sources.

The government entity setting up the CCA sets up a governing board, usually consisting of local elected politicians, who often lack the expertise and often hire consultants that advise them on the complex technical and contractual issues. Because of their not-for-profit status they are often challenged in terms of ability to access credit. Nonetheless, CCAs throughout the US have set records in terms of their performance in providing green power and climate protections, while providing renewable energy power at electricity rates that are competitive with fossil fuel and nuclear power plants. Only 13% of CCAs in the US offer green power, although all CCAs in California offer it as they are required by law to do so, although in California they are not called utilities by electric service providers.

CCAs can only be set up in States where legislation allows them to operate, and the electricity market is deregulated in terms of separating the functions of electricity generation from transmission and distribution. At this time, only 17 states and the district of Columbia have deregulated markets, and in the remaining 33 states, the utilities have a monopoly of generation, transmission and distribution. If the new Plan proposed in this book is to succeed, deregulation should be legislated at the national level, so that in all the state's electricity generation is deregulated. Only such legislation will enable everything to be electrified, and the

three or five fold growth of electrical energy, all powered by renewable energy, will be empowered. CCAs in California will be described in greater detail in the special section on California later in this chapter, that described what that state is doing on the Climate Change and clean energy fronts.

Based on the criteria listed above and the need to expand the transmission grid and account for the renewable production of non-carbon storage fuels and create a smart and reliable transmission grid that minimizes losses, **here is the proposed PLAN for the US:**

1. Up front, the situation the US faces is that because of the worn out and aging condition of the US power plants and grid, the University of Texas at Austin study estimated that the needed replacements of aging power plants already need an investment of $ 2.7 trillion and the replacements of the transmission infrastructure about $ 2.1 trillion, for a total of about $ 4.8 trillion. That's before we start talking about climate change solutions as per this book. **[22]**
2. Brownfield sites where all the fossil fuel generating plants are replaced by Solar PV plus Battery Storage generators located close by, will need little or no expansion, can use most of the existing grid, and be modernized and replace the aging parts as per Item 1.
3. Renewable Energy resources that are far from load centers (like wind and geothermal) have two options: (a) Lay long new greenfield lines to the load centers, or (b) Locate substantial production facilities for making storage fuels close to these sources, but then way storage and transport facilities for the fuels to carry the fuels to other use centers.
4. Renewable energy sources that can be located close to load centers (like Solar PV plus Battery Storage) also have two options: (a) They will need very short spur transmission lines, but will need to be interconnected with the build transmission grid, to carry the energy to the load center, or (b) They can also have storage fuel production facilities very onsite, so the transmission line can be very short, but again there will need to be facilities for the storage and transport of these fuels to use centers.
5. As has been emphasized by others, even otherwise, the whole US electrical system from generators to transmission lines to users, needs to be made smart, which for the overall system means, "a grid with digital technology that allows and enables two way communications between utilities (or electricity providers) and customers. It involves using this information in an automated way so that supply and demand are regulated so as improve reliability, availability and economics". A simple example may be a home air conditioner unit that can be cycled on and off by the utility company on very hot days in order to manage peak demand and not lead to a failure of the system with a brownout or blackout.
6. For the Plan, there needs to be an overall Smart Grid that can manage the variable energy flows coming from renewable energy (Variable Renewable Energy or VRE). For this, the following Green Smart Grid needs the following additions: (a) At the Solar Power Plant, in case of cloud cover, the Battery system with a four hour energy capacity will need to automatically kick in, and when the sunlight returns be recharged by the Solar System, (2) When the Wind Power or Solar system are producing excess energy, redirect this energy to the production of Storage fuels and store these for later

electricity generation, (3) When Wind Power and Solar PV are producing less than needed power, the power plant will fire up Storage Fuel electricity generators, or in the short term before this technology is fully developed, import electric energy from other parts of the grid or fire up small natural gas generators, and (4) When roof top solar is generating full power in a given area, cut back on other parts of the system.

7. **Community Choice Aggregation (CCA) is a powerful model** for the existing electrical energy to be provided by them, but by law they should be mandated to provide green power, and then should receive preferential finance from the public sector and community banks, so they can better access private finance. In their efforts to encourage and develop renewable energy projects, they should favor the principles of Energy Democracy, and favor community and worker cooperative owned renewable energy providers.
8. The Financial and economic aspects of the whole electricity system will need to be revisited. Investor and shareholder controlled private corporations have a role to play, but they should also favor the principles of Energy Democracy, and favor local community and worker owned cooperative type enterprises in their selections of vendors for goods and services, and in renewable energy providers.

A Beautiful Carbon Sink - Reforesting and Afforesting the US

In about the year 1600, at the start of European settlement, it is estimated that the US had about 46% forest cover. By about the year 1907, the forest cover had reduced to about 33%, due to is use as fuel, and timber for housing, industry, railroads, and clearing the land for farming. As of 2010, the US had about 304 million hectares (about 750 million acres) of forest cover, of which 25% was old growth forest, 67% is secondary forest, and 8% is tree farms and plantations. In terms of regions the northeast had 42%, the southeast had 40% and the west had 28%. In the 20 years (1990-2010), the US lost 0.4 million hectares, but added about 7.7 million hectares due to reforestation. So, for the last century or so, the US forest cover had mostly stabilized. However, since the start of European migration, the nation has lost about 120 million Hectares (about 300 million acres) of forest cover.

In the Global Plan described in Chapter 4, the reforestation and afforestation target for the world is One Billion Hectares (1,000 Million Hectares). **The part of this Plan for the US is to reforest and afforest the US with 80 million Hectares. This is only reforesting 60% of what was lost since the year 1600.** It will need reforesting and afforesting of Temperate areas (continental US), Boreal areas (Alaska) and Tropical areas (Hawaii and Puerto Rico). In the New Deal in 1933, the Civilian Conservation Corps planted 3 billion trees and employed 3 million people. This plan is similar to that but can be conducted a lot differently.

First, it is important to point out that there are many organizations who have been doing this activity or encouraging it. Most of the reforestation in the 1990-2010 period of about 7.7 million hectares (about 19 million acres) has been done by organizations such as the US Forest Service and Arbor Day Foundation. Other organizations that have been active trying to encourage reforestation are Nature Conservancy and American Forests. However, most of

these organizations advocate reforestation and afforestation on like 40-50 million acres (16-20 million hectares). However, the Book Plan is proposing the much larger area of 80 million hectares (175 million acres), which considering the US total land area of 983 million Hectares (2,430 million acres), is only about 7% of the land area. Over a 31 year period (2020-2050) this amounts to only 2.3 million hectares (or about 5.7 million acres added every year). If, on the average, a hectare has 1,800 trees (an approximate average, which will vary with the type of tree) this means a little over about 4 billion trees per year or about 128 billion trees in a 31 year period.

The main criteria that this reforestation and afforestation effort need to meet are:

1. That they provide the needed carbon sink
2. That they provide the needed habitats for all forms of species
3. That they provide livelihoods, incomes and products on a distributive basis

The first criteria means that the total tree area continuously expand. The second criteria means that there be certain areas that are not disturbed (like old growth forests), or that when activities are done, they account for the health of all species and they provide them with enough habitat. The third criteria means that people have to have a central role in owning, managing and using a major part of the expanded forests for their livelihoods based on sustainable forestry extractive methods, that allow them to use enough of the forests for their livelihoods, businesses and usable products – with the central rule that they plant more than they harvest, and that they pay attention to the first two criteria.

PLAN for The US – Blue Carbon
Rejuvenation of US Coastal Ecosystems along Entire Non-Ice Coastline

As documented and described in the global Plan for Coastal Ecosystems in Chapter 4, these ecosystems have a very large potential for absorbing carbon, comparable to forests. Out of the global non-ice coastline of 1.2 to 1.6 million kilometers (0.75 to 1 million miles), the US has about 95,000 miles (or about 153,00 kilometers) according to the US National Oceanic and Atmospheric Administration (NOAA), although this includes the northern shoreline of Alaska and the shores of the freshwater Great Lakes in the middle of the country.

So what has happened with coastal ecosystems or wetlands as they are sometimes called. The US has lost more than half of its coastal wetlands, or about 110 million acres (about 45 million Hectares), since the early settlers came from Europe. California lost about 91% of its coastal wetlands since 1780. American Samoa has lost 25% of its coastal wetlands to development and most of the wetlands of the Commonwealth of the Northern Mariana Islands have gone. Most mangrove forests, seagrass beds and coral reefs have not done well. Shallow water reefs have been damaged by hurricanes, fishing, coastal development, runoff and sedimentation (soil from water erosion of soils). Seagrass cover has been lost in Tampa Bay (more than 50%), Mississippi Sound (76%), and Galveston Bay (90%). This has also happened in Chesapeake Bay, Puget

Sound, San Francisco Bay, and Florida's coast. Global temperature rise and sea level rise have also been degrading coastal habitats (Ref: NOAA, "Conserving and Restoring Coastal Habitat").

However, there have been many US government agencies and organizations that have engaged in preserving and restoring coastal ecosystems and wetlands. Significant efforts exist in the US Department of the Interior, the NOAA, the US Fish and Wildlife Service, the US environmental Protection Agency, the US Department of Agriculture and the US Army Corps of Engineers. Significant actions have taken place at coastal Louisiana, and in the Florida Everglades (which are actually an example of a very large assembly of coastal type ecosystems). **The administration of US president George H.W. Bush (about 1990) put forward significant wetlands protections for all inland wetlands, so much so that in many states of the US, no inland wetland can be destroyed, on public or private lands.**

The American Recovery and Reinvestment Act (ARRA) of 2009 was signed by the US president Barack Obama, which included the restoration of 50 coastal areas through the US National Oceanic and Atmospheric Administration (NOAA). Three of these restoration efforts that were evaluated were the oyster reef and seagrass areas of the Seaside Bays of Virginia, the oyster reef project in Mobile Alabama and the salt marsh restoration in the San Francisco Bay, California. **A study that was done by Abt Associates, of Cambridge Massachusetts, and reported on by the Center for American Progress and Oxfam America, showed that the economic and environmental benefits of the Virginia and California projects by far exceeded the amounts spend on them.** In the San Francisco Bay project the $ 8 million spent provided and estimated lifetime benefit of more than $ 69 million and the $ 2.5 million spent on the Virginia project yielded and estimated lifetime benefit of more than $ 35 million. The Mobile, Alabama project could not be fully evaluated, and it was hard hit by the financial crisis of 2009 and the British Petroleum Deepwater Oil Spill of 2010, but it provided significant employment to low-income, natural resource dependent workers. The study showed that overall, the total benefits including the ecosystem benefits exceeded the initial investments in a ratio of 15 to 1. **[23]**

Because of the crucial aspect of their ability to absorb large amounts of Carbon and the need to restore habitats, and provide some increased protection against coastal storms, the Book Plan proposes a massive Rejuvenation of Coastal Ecosystems, that will be part of the global plan described in Chapter 4. The plan for the US is as follows:

1. The US plan will go beyond just restoration to a national program to introduce coastal ecosystems along its entire coastline.
2. For the 95,500 miles (about 153,000 Kilometers) of US coastline, the coastal ecosystems will be introduced an average or 1 Kilometer (0.625 miles) width, that will give a total coastal ecosystem growth of about 38 million acres (or about 15 million hectares), about 38% of what has been lost since about the year 1620.
3. Finally, the plan includes a national level inventory of carbon absorption and evaluation, to estimate and evaluate the entire coastline of projects and activities in terms of the

carbon absorbed. This will estimate the greenhouse gas sequestration taking place in these ecosystems.

Besides the main benefit of acting as a massive carbon sink, and all of the benefits that this will provide in terms of environment and economics, the addition and restoration of US coastal ecosystems will create a beautiful coastline the like of which many have never seen. It will add to the beauty and wildlife of coastal areas.

Advanced Climate Change Disaster Management for the US

To begin with, it is important to point out that FEMA (the Federal Emergency Management Agency) has excellent resources on their website and provide very good information in regard to all kinds of disasters. They also have a high level of experience and expertise in managing all kinds of disasters. However, the US needs to increase its Disaster Risk Reduction activities and preparedness many fold and work with all of the local states, communities and people in regard to resources, training, awareness and implementation. **Because of the increasing probability and devastation that can be caused by climate change, the resources, efforts and visibility of these efforts needs to be many multiples greater.**

Common to all the major disaster types covered below are that

1. The US needs to prepare in advance to reduce the damage caused by disasters.
2. To prepare resources in advance for the evacuation of people
3. To prepare in advance for the relief of displaced people
4. To prepare in advance for the recovery and reconstruction
5. To continue to improve capabilities, resources, and organization to better respond to and recover from climate change disasters.

The major climate change related disasters that the US needs to prepare for are hurricanes and coastal storms, flooding, tornadoes and wildfires.

Hurricanes & Coastal Storms

First and foremost, it will really help all coastal areas is the action plan in regard to coastal ecosystems is implemented. The coastal ecosystems will help better withstand the effects of hurricanes, coastal storms and storm surges, although in each case the damage to the ecosystems may need some restoration. Then, nationally, the needs to organize and prepare resources in advance, and store them at inland locations that will escape the wind and water effects of the storms, and which can be quickly pulled in after the disaster has passed to provide rescue, and relief. These will include resources as follows:

1. Mobile housing units that can provide temporary housing for the displaced population
2. Food, medicine and water supply for the displaced people
3. Mobile Solar PV energy supply stations that provide energy for lighting, cooking and for operating facilities.

4. Mobile medical units that help provide medical relief as well as act to contain any diseases and medical problems (diarrhea, infectious diseases, etc.
5. Build better back
6. Build only where less damage and then whatever is built must be resilient

Mobile housing units should be assembled, with like ten mini-houses per truck trailer, complete with solar panels. If a hundred of these are ready, they will be able to travel to a location needed and be able to set up temporary housing for about a thousand people in a matter of days. Other truck trailers can be medical units, sanitary units, supplies units and water purification units. Prior to a disaster, locations near a disaster zone should be selected in advance are the land either purchased or rented in advance, so that it can be used speedily. If possible, these land locations can already be equipped with electrical and sewer connections. The provision and preparation of such materials and resources in advance, and located near expected disaster zones will make the tasks of relief and restoration much easier for the displaced people and emergency management organizations like FEMA.

Tornadoes

It has been found that with climate change, the number of tornadoes in a cell have been increasing. So, all areas which a have a high probability of tornadoes, the following actions should be taken in advance:

1. ALL NEW housing and buildings will need to be built to withstand the higher wind velocities of tornadoes (both in terms of shape and structure), and it be mandatory that the they still have tornado proof shelters.
2. All homes and buildings will construct a tornado shelter that will survive the tornado, or there should be enough in a community where people can rush to. All schools, medical facilities and government buildings will be retrofitted to have these shelters as well as retrofits to make them more resilient to high winds

Wildfires

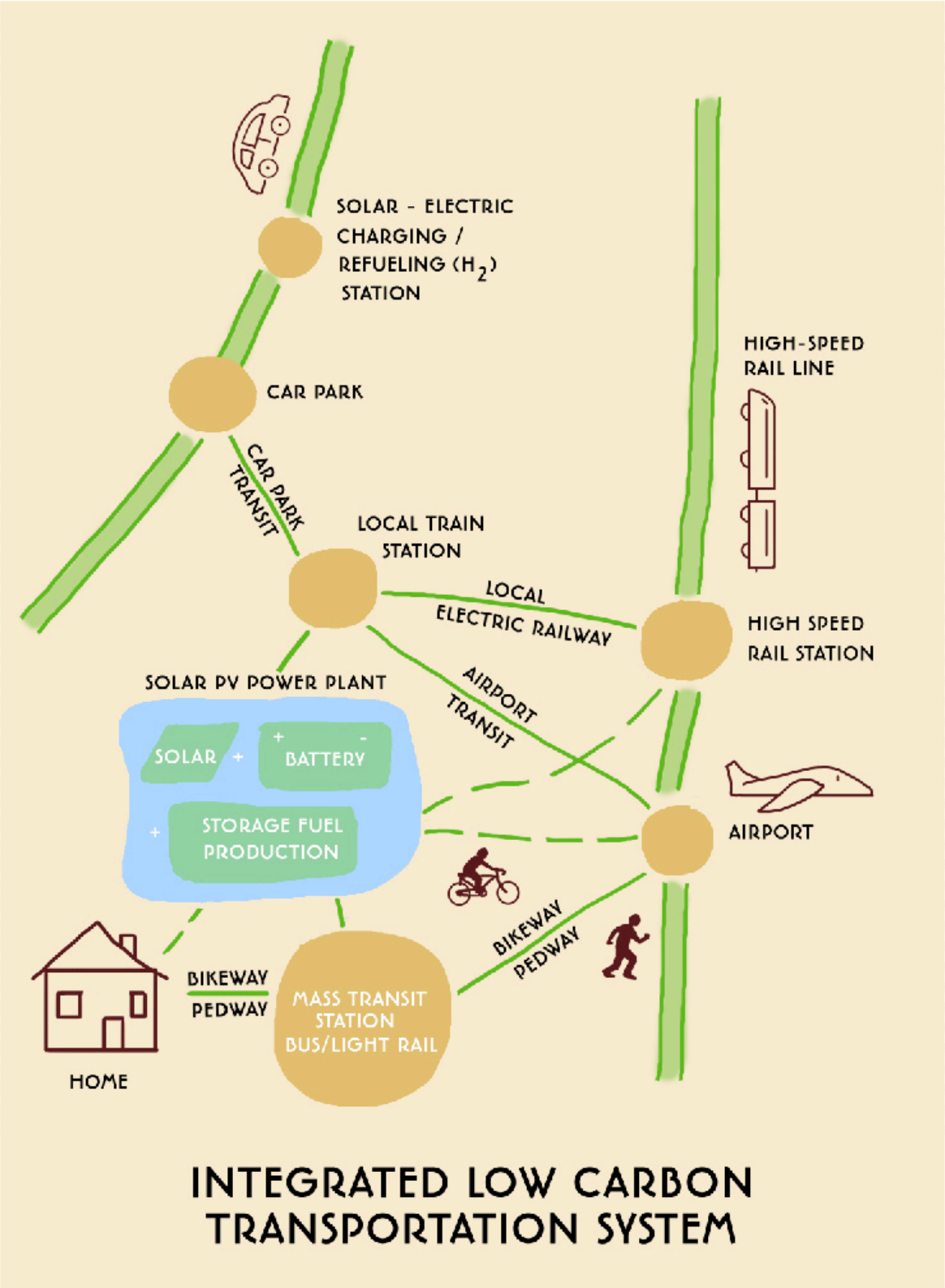
These are becoming more and more frequent and devastating, especially in the western US and Colorado. These regions and states need, with federal help, begin to start making their forest areas less prone to wildfires, and there be measures in place, such as breaks in the forest, that make the wildfires easier to control. Then, after the wildfires have burnt an area, there needs to be advance preparation for stabilizing the burnt out hillsides, to ensure that there are no mudslides caused by the rains that follow, and that they begin to prepare to reforest these areas with suitable tree varieties. In the recovery and reconstruction part of this, new codes and regulations are needed to ensure that homes not be built adjacent to reforested areas, and that there be fire defensible spaces around any home developments that are constructed.

Eco-Cities & Low Carbon Transportation

It has become quite obvious that the mode of highway and urban development is not very energy efficient, and has contributed in a big way to high energy consumption and high emissions from fossil fuels. Urban sprawl in particular, with far flung suburbs with single family homes force everyone to use a car, and even the homes are designed for cars (car garages). **To make them energy efficient and low carbon, cities need to be designed to Reduce transportation distances, so that that there is much more thought given to the colocation of homes, businesses (where people work), grocery stores, shopping centers, entertainment locations, etc.** So, for new developments, housing developments must be required to be denser, and laws, regulations and codes changed to make urban sprawl very difficult.

Next, the forms of transportation that will need to be encouraged are all the low carbon modes, so that people have a lot more choices. Entire communities should be redesigned to make walking and biking and mass transit easier, and local travel by car more expensive and difficult. Then, all of the transportation modes will need to be inter-connected so that one can easily go from walking and biking to taking the train, to taking a high speed train, to taking a flight, to taking a bus, to taking a taxi, to renting a car (the last inter-connecting mode is the only one available today – that is not enough).

See below for a concept of such a low carbon transportation system.


SOLAR - ELECTRIC
CHARGING /
REFUELING (H_2)
STATION
CAR PARK
CAR PARK
TRANSIT
LOCAL TRAIN
STATION
HIGH-SPEED
RAIL LINE
LOCAL
ELECTRIC RAILWAY
HIGH SPEED
RAIL STATION
SOLAR PV POWER PLANT
AIRPORT
TRANSIT
SOLAR
BATTERY
STORAGE FUEL
PRODUCTION
AIRPORT
BIKEWAY
PEDWAY
BIKEWAY
PEDWAY
MASS TRANSIT
STATION
BUS/LIGHT RAIL
HOME
INTEGRATED LOW CARBON
TRANSPORTATION SYSTEM

The Energy, Climate and Ecosystem Plan for California

Impact of Climate Change on California

California has taken good steps in the areas of car fuel emissions standards, battery electric cars, renewable energy electricity generation, and tighter standards on environmental and pollution standards. However, California also has been suffering from the effects of Climate Change through droughts and wildfires, and some effects of heat waves, increased air pollution, ocean acidification and sea level rise. There was an extreme drought in 2014 that covered almost all of California, and in 2015 the drought cost agriculture about $ 2.7 billion and more than 20,000 jobs, and in 2016 was followed by heavy rains that led to flooding that damaged highways, threatened rural areas and isolated coastal communities.

California has become increasingly subject to wildfires due to increased temperatures, and drought (dry times), often accompanied by high winds. From 1979-2013, the length of the fire season increased by about 19%, and since 1985, more than 50% of the wildfires have been thought to have been caused by climate change. Since 1990, the average annual number of homes lost to wildfires has increased by 300%, and the number of homes at risk from wildfires was estimated to be about 900,000 in 2017, and about 35% of the wildfires have started in high risk areas. Matters have been made worse by people building homes in forested areas. In 2017, 2018 and 2019 California has suffered from catastrophic wildfires in many of its forests. In 2017 there was a catastrophic wildfire in Sonoma County and in 2018 a catastrophic wildfire that essentially burned down the town of Paradise, both in Northern California. In 2019, the northern Kincade wildfire, again in northern California has been devastating. In 2019, till early November there were about 6,400 wildfires, that burned about 250,000 acres and about $ 163 million was spent in fire suppression.

The other bad news in relation to California wildfires is that in 2018, the estimated carbon dioxide emissions were 45 million metric tons, that wiped out some of the benefits of decreasing emissions down to 424 MMTCO2e (hence doing better than the 431 MMTCO2e goal for 2020), that were being tracked and are described above. This is also bad, because it points to one of the possible scenarios of a runaway greenhouse effect – that climate change makes things happen that increase carbon dioxide emissions.

Status of Energy and Climate Change Efforts in California

While there has been foot dragging and often outright opposition at the national or federal level for solutions to Climate Change, the state of California located on the west coast of the US has forged ahead. There are three aspects of California's Energy and Climate situation: (a) California has achieved much in the past decades, both in energy and emissions (b) There is much the world can learn from California (as it has led in many actions), (c) California still faces immense challenges, especially in transportation, electrification, high jet fuel use and in fossil

fuel based electric power generation. Because of the energy and emissions challenges that remain, and challenges in the forestation/wildfire and coastal ecosystems front, a Plan is proposed for California that will help it in achieving the ambitious goals it has set for itself (which parallel what we are trying to do globally here).

California Achievements & State Government Goals

- If California was a country, it would be the fifth largest economy in the world. In 2006, California passed legislation (SB32) to reduce Greenhouse Gas Emissions by 2020 to the state's 1990 levels (431 MMTCO2e – million metric tons of Carbon dioxide equivalent). It achieved that in 2017, when the emissions were 424 MMtCO2e) – California was serious about the **Kyoto Protocol goals**, and was one of the few "countries" to achieve its commitments as per Kyoto. Inspired by the state, many of the cities in California, including the city of El Cerrito, California that also set targets and achieved them as per the Kyoto targets.
- Utility Scale Solar and Wind electric power generation increased from 3% in 19% in 2018 – in the later stages, spurred by legislation (SB350) passed by the previous Governor, Jerry Brown, in 2015 which had mandated 33% of electric energy come from renewable sources by 2020, and 50% by 2030 (**Renewable Portfolio Standard – RPS**). This is monitored and enforced by the California Energy Commission (CEC)
- California was one the first to establish a **Cap & Trade Program**, which is market based approach. In summary, it assesses the total carbon emission by the big emitters, issue allowances which later were auctioned. Over time the allowances are decreased so that the large emitters have to decrease their emissions or purchase allowances from those who have done more than their allowance. The program is a very complicated one that is described in detail in the accompanying website. To date, most emissions reductions have come from renewable energy increases, and not from Cap and Trade. However, the California Air Resources Board (CARB) reported that as of 2018, the Auctions from the sales of allowances to companies had gone to the Greenhouse Gas Reduction Fund (GGRF), the legislature had appropriated $ 6.1 billion, out of which $ 3 billion had been selected and $ 2 billion implemented in Green" projects intended to reduce greenhouse gas emissions.
- **Goal of Carbon Neutrality by 2045**: In 2016, the previous Governor Jerry Brown, signed legislation (SB100) that mandated that ALL (100%) electric energy in the state be carbon neutral by 2045 (meaning that all sources were admissible in this number as long as it did not emit carbon dioxide). This differed from previous legislation and requirements that a certain percentage be from only renewable energy (like solar and wind). However, Governor Brown went one bold step further – he signed an executive order mandating ALL energy (not just electric energy which is only about 10% of all energy consumed) be "carbon neutral" by 2045. The details of the law allow many options, because of which the energy mix can include nuclear, large hydro and natural gas with Carbo Capture and Storage (CCS).

- **Accompanying Increase in Renewable Energy:** For Electric Energy only, the bill (SB100) also increased the requirement that 50% electric energy be from renewables by 2026 (that does not include nuclear), and 60% renewables by 2030.
- Here are the achievements and goals in the **Transportation Sector:** California has always led the US in terms of established Corporate Average Fuel Economy Standards (CAFE) for vehicles, that require higher fuel efficiency for vehicles. California already has more electric cars than the other states. Governor Brown had also signed an executive order that established the **goal of having 5 million electric vehicles in California by 2030, and to establish 250,000 zero-emission vehicle chargers (that provide a slower charge), including 10,000 DC fast chargers by 2025** (which charge in a much shorter time, but need higher power). Initially, the California Energy Commission (CEC) is funding about **100 Hydrogen refueling stations throughout the state**, which are required to have at least 33% renewable hydrogen, with those supplying more than 40% renewable hydrogen eligible for a credit.

Efforts of the Government of California

The four agencies of the Government are the California Energy Commission (CEC), the California Air Resources Board (CARB), the California Public Utilities Commission (CPUC), and California Independent System Operator (CAISO). These organizations are engaged in different aspects of energy and climate change solutions activities. Efforts are being implemented that are aimed at Building Decarbonization – mainly electrification

Challenges faced by California: California will have a much easier time achieving the energy and emissions reductions goals in electric energy. But California faces big challenges in the energy and climate sectors by the way of Decarbonization (mainly electrification) in the areas of transportation (with a large number of fossil fuel vehicles on the road that are increasing their vehicle miles travelled), in residential and commercial buildings, and in Industry.

So here is the Proposed Plan for California

The Current and Proposed Energy Plan pie charts are shown below. The Plan for California will mirror that proposed for the US above, as well as draw on the global plan, with the following added notes:

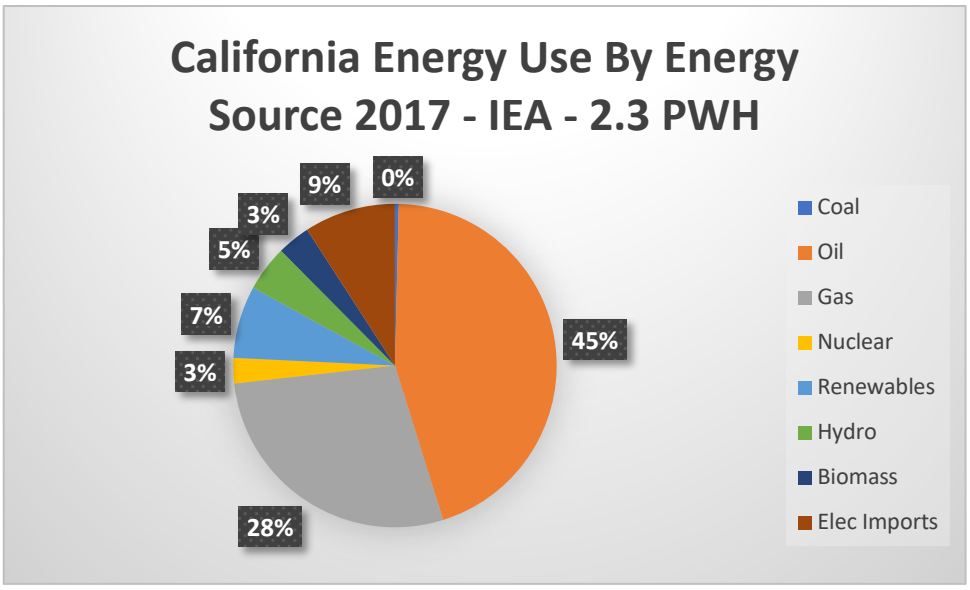
- **California needs a phased and Time bound program to REPLACE its Natural Gas Power Plants with Solar plus Battery Storage units** – keeping only a few operational to deal with the variability of renewables until such time as other alternatives are developed.
- California is well poised to **develop Solar Electric Highway**s that vastly expand its electric charging stations throughout the state. Adopting the concept of Solar-electric highways and roadways will make it much easier for California to blanket all land areas with solar-electric charging and green hydrogen refueling stations.

- **Vehicle Replacement:** California had 31 million vehicles on the road as of 2010. If 5 million electric vehicles are on the road by 2030 (California's current goal), assuming that they have replaced fossil fuel vehicles, then there still will be 26 million mostly fossil fuel vehicles on the road (assuming no growth in numbers). So from 2031 and 2050, the combined growth in battery electric vehicles and Fuel Cell Vehicles (Using Hydrogen) and a "Cash for Clunker's" type program, will need to be about 1.3 million vehicles a year. With this, there will be NO fossil fuel vehicles on the road by 2050. PLAN calls for all fossil fuel vehicle sales to end by 2035, so that the replacements for those can begin in 2045.
- With significant capabilities for clean energy research and development, the state should undertake the **RDD&D (Research, Development, Demonstration & Deployment) of the green production of "Storage Fuels" like Hydrogen and Ammonia**, and in their end use in electricity generation, transportation, shipping, and industry. The state is leading the US in establishing Hydrogen refueling stations for cars, especially encouraging "green" hydrogen produced from renewable energy. The State needs to up its ambition considerably so that by 2050 it has about 9% of its energy coming from hydrogen and ammonia.
- The State can also pioneer in the US in terms of the **full scale electrification of homes, commercial buildings, industry, and agriculture** – transitioning what cannot be electrified with innovative technologies for "Storage" Fuels.
- With Electrification, the electric energy demand will be 3 to 5 times what it is today. The State needs to build as much Solar PV generation within cities of near cities, so as to reduce the need and expense for transmission lines. Still, with the **expansion of renewable energy based generation the transmission grid expansion** needs to be undertaken, and significant storage capacity developed locally (such as large battery systems) in order to deal with the variability of renewable energy.
- With the massive wildfires that have occurred in recent years, the State needs to undertake at a very high level, **Disaster Risk Reduction in regard to preparing for wildfires**, of the type described above by building fire breaks in existing forests, and designing new afforested areas with fire breaks so fires are easy to control. Massive programs need to be undertaken.
- **Carbon Sinks - Forests**: California should take up its share of the 80 million Hectares that is the goal for the US in terms of reforestation and afforestation, with the areas designed to enable ease in control of wildfires, as described above. The reforestation of wildfires needs to be specially designed on these principles, with special paid to the locations of buildings and homes, and building fire defensible spaces around them.
- **Carbon Sinks - Coastal Ecosystems**: California is well poised to establish all types of coastal ecosystems along its entire Pacific coastline, coordinating with fishery experts to enhance the habitats for all kinds of fish and ocean life.
- **Low Carbon Transportation**: California has begun its investment in **High Speed Rail** along the coast – it should review the whole process and design and see how this can be expedited so as to establish this early – this will cut down vehicular traffic. California needs a statewide plan for low carbon transportation that will parallel that of the US –

pedways, bikeways, mass transit, rail transit, solar-electric roadways, high speed rail and airports all integrated.

- **Just Transition**: The Oil and Natural Gas industry is quite active in the state. California and the US (and other fossil fuel dependent nations) need programs and policies in place that help the companies, workers and communities involved in fossil fuel activities to transition to the new clean energy renewable economy. More on this follows.
- California needs to begin **enforcing its rules for its Cap and Trade Program**, so that the allowances of all polluting sources covered by the program are reduced to zero by 2045, and most of its auction proceeds are invested in implementing the above PLAN. It is estimated that if the Cap and Trade program succeeds, it will reduce its greenhouse gas emissions by 15-20%.
- California needs to coordinate with national US policies in beginning the shut-down of its oil refineries and the possible conversion of these facilities to the making of "Storage Fuels" using renewable energy sources. The import of oil and the export of refined oil products need to be coordinated along with a Just Transition for all of its oil industry and natural gas industry workers.

We now present a snapshot of California's Energy Consumption during 2017.

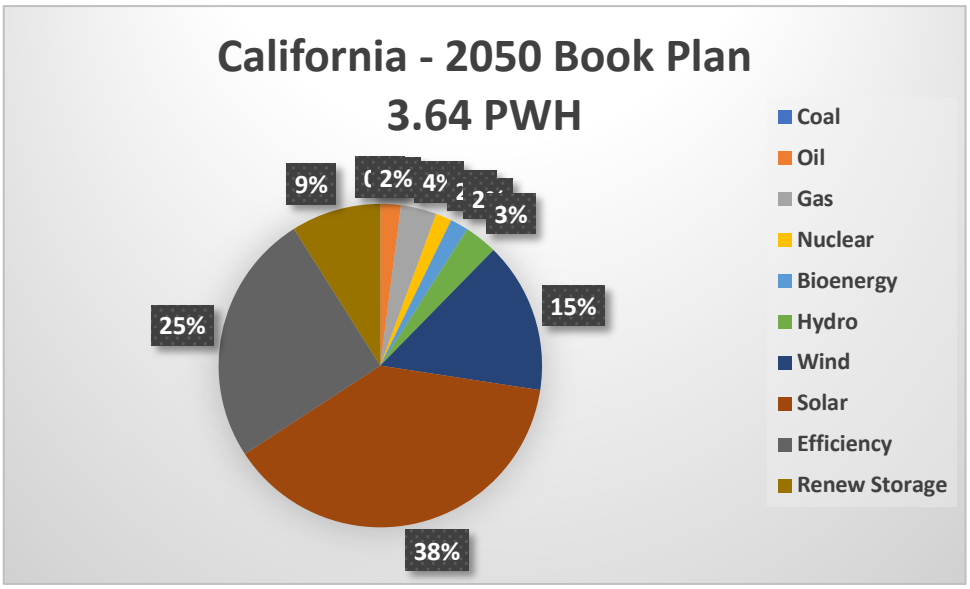


CALIFORNIA ACTUAL ENERGY USE IN 2017

This information is from the US Energy Information Agency – profile for California. Coal use is very small, essentially zero, but oil use is 45% and Natural Gas is 28%. Combined, dependence on fossil fuels is at 73%. Note that imported electricity is about 9% of total energy use. PWH = Peta Watt Hours (10E15 Watt Hours, or 10E12 Kilo Watt Hours).

The proposed plan for California is essentially to achieve Carbon Neutrality by 2050 totally by fossil fuels. This can certainly be speeded up to achieve this by 2045, if the state wishes to meet its time bound goal by 2045. The reforestation and afforestation, and coastal ecosystems expansion are treated as bonuses because of their uncertainty, but they can be significant

insurance that California more than meets its goals of reducing carbon and greenhouse gas emissions. California has very good record of implementing energy efficiency activities, so the goal set is at 25%. Storage fuels are estimated at 9% of the increased energy. However, if energy efficiency does not achieve the necessary reductions, then Storage fuels production and use can correspondingly expand. Here is the PLAN for 2050.



CALIFORNIA ENERGY PLAN FOR 2050

Fossil fuels are down to about 5-6% (essentially gone) with the gas component larger. Solar PV has a big expanded role at 38%, with Wind coming in next at 15%. If efficiency is excluded, California's actual energy use grows from about 2.3 PWH in 2017 to about 2.7 PWH by 2050.

Along with the European Union, California has always led the world in Energy and Climate Change Solutions. It is time for the state to up its ambitions in line with what is needed to achieve the 1.5 C goals and implement a PLAN such as described above. There is much that the US and the world can learn from California as they begin to implement their national and global PLANS and this can provide the motivation and information that will lead to effective global treaties, effective actions by other nations, and an effective implementation of a US national plan.

We now turn to the US Green New Deal that has received a lot of public attention in the US.

US Green New Deal (GND) – Aspirations and Practical Implementation

The Proposed US Green New Deal

The original New Deal was a whole package of measures that were pushed and implemented by US president Franklin Roosevelt from 1933 to 1936 to get the country out of a really big depression, at a time when most of the rest of the world was also in a depression. The New

Deal was a number of programs, public works projects, financial reforms and regulations that helped lift the US out of the Depression and provided some protections against having the problems again. At a time when many of the nations of Europe were either going towards communism or fascism, he was successful in helping the US to remain a liberal capitalist democracy, that avoided going to the extremes.

Regardless of the politics, and regardless of which political persuasion you are, on the one hand the New Deal dealt with the excesses of the misbehavior by financial institutions and banks (by establishing Federal Deposit Insurance Corporation, FDIC and the Securities and Exchange Commission, SEC, and legislation that separated banking from speculative investments), and on the other hand provided the people with a minimum level of income, employment, healthcare, retirement (Social Security), working conditions (hours of work) and labor protection, and on the other hand helped agriculture pull out of the environmental degradation (like the dust bowl years where agricultural soil was being blown away) by conservation, did a major reconstruction of the infrastructure, and helped manufacturing recover from the depression. The big problem then was the Depression and the New Deal helped solve the big Depression, but also gave a new deal to the people and the environment.

The Green New Deal (GND) of the US is a good list of aspirations or desirable outcomes, and does lay out a bold plan for change that has been put forward in the US Congress by Congresswoman Alexandria Occasio-Cortez, who has sponsored it in cooperation with others and has been the principal champion of it in US politics and argued for it very eloquently.

However, what the Green New Deal does need is a concrete plan of how, what and where, to solve climate change. As written, the two aspects – climate change solutions and better living conditions appear to be part of the GND package but items like wages and healthcare are mainly political aspects that are not directly related to climate change. The US Green New Deal is, however, the most ambitious political plan that has been proposed for the country to start to be part of the major global solution to climate change, while addressing the massive inequality and bad living conditions of much of the population.

The author and activist Naomi Klein provides a strong case for the Green New Deal. She emphasizes that it will be a massive job creator, lead to a fairer economy, increase pressure for action, be implemented even in times of recession, draw a lot of enthusiasm, help overcome opposition, and its an idea whose time has come. She is an accomplished author who has come at climate change from many directions, from the environmental, political and spiritual ends. **[24]**

However, what it will really needs is a lot of specific plans, programs, financing, regulations, new or revitalized organizations, and incentives, as well as comprehensive new industrial, transportation, urban development, energy transition, agricultural and ecosystem policies. This and other comprehensive actions are what the Book Plan lays out in the rest of this Chapter.

The Green New Deal draws its inspiration from the US New Deal that the US used to recover from the Depression in the 1930s, where the big problem now is Climate Change, and the solutions will give a new deal to the people and the environment. The Plan shows how to practically implement the US Green New Deal, but also to expand it to a Global Green New Deal. Some aspects, like Unionization laws and programs are strictly public policy, but the Plan goes beyond what the US Green New Deal hopes to achieve.

How the PLAN helps Effective Implementation of the Green New Deal

Here are the Green New Deal "Mobilization" Goals and Objectives (as shown within quotation marks), as stated in the Resolution passed by the House of Representatives, and how the PLAN satisfies them - as a sub-note to each goal.

(A) "Building Resiliency against climate change-related disasters"
    a. The PLAN proposes an advanced Disaster Risk Reduction (DRR) strategy for preparing for and dealing with hurricanes, typhoons, cyclones, coastal storms, massive floods, wildfires, and tornadoes, which is both high level and enables and empowers local communities to prepare and deal with these.

(B) "Repairing & Upgrading Infrastructure"
    a. The PLAN presents infrastructure upgrades that do repair existing infrastructure, but emphasizes investments in new types of infrastructure that help mitigate climate change – renewable energy, electrification and ecosystem related

(C) "Meeting 100 percent of power demand in the US through clean, renewable and zero-emission sources"
    a. The PLAN not only shows how to do that for all fossil fuel power plants, but it also demonstrates how to overcome the variability aspect of renewable energy. But the plan shows how to achieve the maximum amount of electrification, and then how to meet the expanded demand through more renewable energy. A significant complement is the production of Non-Carbon "Storage Fuels" such as Hydrogen and Ammonia, that are produced only with renewable energy, and then used throughout to massively supplement electrification.

(D) "Building and upgrading to energy efficient and distributed "smart" power grids"
    a. The plan shows how to achieve this, but the primary smartness up front that's needed is the "Smartness" of how to deal with the variability aspects of Renewable Energy (be able to shift energy dynamically around the grid), have local community micro-grids that can function autonomously if the main grid supply fails or is disconnected, and local smartness that better manages supply and demand by turning things off and on as needed – to save energy and manage peak demand.

(E) "Upgrading all existing buildings … and new buildings to achieve maximum energy efficiency"
    a. The PLAN proposes the maximum achievable electrification of buildings and homes, the research into and use of energy efficient technologies, and the

maximum level of local production of Renewable Energy in or around the buildings and homes

(F) "Spurring Massive Growth of Clean Manufacturing"
   a. The PLAN proposes the maximum level of the electrification of all industrial processes. What cannot be electrified will be switched to new technologies using the renewable energy based production and use of non-carbon "Storage Fuels". The proposed plan proposes the establishment of a major Industrial policy that is pro-employment, pro-environment and establishes net zero industries in all aspects of the new energy and ecosystem plans.

(G) "Working Collaboratively with farmers and ranchers to remove pollution and greenhouse gas (GHG) emissions"
   a. The proposed plan addresses the electrification aspect of Agricultural machinery, and the use of Ammonia as a fuel for agricultural uses (the farmers already use Ammonia as a fertilizer and store it in tanks on the farm for this). Further, the PLAN addresses the methane emissions from cows and livestock manure, which is another greenhouse gas that traps heat more than carbon dioxide.

(H) "Overhauling transportation systems… to remove pollution and GHG emissions"
   a. The PLAN proposes a novel concept "Solar Electric Highways" that will electrify all the highways and roadways by establishing Solar powered Electric Charging Stations everywhere, and enable them to supply (and occasionally produce locally) non-carbon "Storage fuels" like Hydrogen. The PLAN proposes the maximum level of electrification of transportation that is powered by renewable energy and the laying of high speed rail networks throughout the US and globally, to reduce the number of short haul flights that use jet fuel. Also, all of the green ways of transportation will be interconnected – walking and biking to mass transit, mass transit to regional and high speed rail and to air and road transportation – and added, the total encouragement of small electrified vehicles for local travel.

(I) "Mitigating and managing the long-term adverse health, economic and adverse effects of pollution and climate change"
   a. The PLAN addresses the whole aspect of adaptation to climate change related changes, and how the switch out of coal will be better for the health of local communities, and how local efforts can be supported and funded to help communities adapt to heat waves, floods, sea level rise and high winds. At the same time, the PLAN proposes a major transformation of agriculture toa regenerative kind./

(J) "Removing Greenhouse gases from the atmosphere…"
   a. The plan proposes a massive reforestation and afforestation of about 80 million Hectares (1 billion hectares for the world) of Boreal and Temperate forests and the design of newly reforested areas to deal better with wildfires, encourage biodiversity, and also provide local benefits and incomes

(K) "Restoring and protecting threatened, endangered and fragile ecosystems"
   a. The plan proposes a massive restoration and expansion of coastal ecosystems along the entire coastlines of Atlantic, Gulf of Mexico and Pacific coasts.

Mangrove swamps, salt marshes and sea grasses, already do, but when expanded and established will store large amounts of carbon, will help restore ocean life and restore fisheries – all of which means much more beautiful coastlines and better incomes and benefits to coastal communities.

(L) "Cleaning up hazardous waste and abandoned sites"
   a. These were US "Superfund" sites that industries and companies left behind when they polluted and dumped. These were called "superfund" sites as they were identified and a fund was established by the government a few decades back to clean them up – not all the sites have been cleaned up. The PLAN does not address this issue, but what can be said here is that after the sites are cleaned up, these will be ideal sites for Solar PV power plants as well as restored parks.

(M) "Identifying other emissions and pollution sources and creating solutions to remove them"
   a. The answer to this will be the same as (L) above

(N) "Promote the International exchange of technology….help other nations achieve a Green New Deal"
   a. The plan does all of that and more. It actually lays out a full strategy consisting of the aspects of global organization, taxes, financing, global agreement, technology development and sharing, transitioning out of fossil fuels, just transitions for oil producing nations, and assistance to the developing nations. **The proposed plan lays out a Global Green New Deal,** and a detailed plan for meeting a 1.5 degree Celsius goal by 2050. Detailed plans are also laid out for all the big emitters – USA, China, India, European Union and even a plan for California.

The Green New Deal (GND) of the US is more a list of aspirations or desirable outcomes to simultaneously solve climate change and improve people's lives. It does combine the need to solve climate change with a vast improvement in living conditions for all of the population. It is the national version of a global climate action plan and the United Nations Sustainable Development Goals (that aim at improvements in the living conditions of people).

Part 4 of the Resolution written by the US Congress addresses issues that are important for the implementation of the GND. Many of the issues in this part are more addressed through effective public policy and programs, not having directly to do with climate change – these are the issues such as the support workers and their right to unionize, wages, healthcare, public ownership, workplace safety, trade negotiations, the protection of public lands, protection of the rights and interests of indigenous people, protections of businesses from monopoly capitalism, high quality health care, affordable and safe housing, and clean water, air, healthy and affordable food, and access to nature.

However, the proposed plan does the following that addresses the goals of Part 4 in an effective way:

1. An industrial development policy and reindustrialization programs that are pro-employment and pro-environment.
2. Tax reform that favors the human factor and employment by implementing depreciation for human capital investments, and decreasing depreciation for machine and other capital investments not relating to renewable energy or electrification.
3. Direct economic development policies and programs that favor local production for local use, using forest and agricultural raw materials grown locally.
4. Direct business development and employment in all of the tasks of Energy, Climate Change and Ecosystem development laid out in the PLAN.
5. Just Transition for all of the workers and companies (if the latter are favorable) which means that the workers will get financial and healthcare benefits for a few years, providing they sign up for the education and training planned for them, and then assistance with alternative employment (preferably in renewable energy jobs, but they can take other employment if they choose). The issues for companies will be taken up in talking about investment.
6. Application of the principles of Energy Democracy: In terms of income, control, jobs, and community owned or cooperative businesses, the PLAN will produce the widest possible distribution of earning benefits, and meet the criteria of energy democracy – which means that the process should favor local community and worker owned cooperative type enterprises in their selections of vendors for goods and services, and in local utilities that produce renewable energy and supply it to the electric grid.

The proposed plans for the US, California and the Green New Deal, will put the US in a good position to implement its part of the global plan, and to help other nations that need help. The lessons that are learned from California (as well as other nations that are leading), will help convincing all of the nations of the world to agree to the global plan and model their own national plans accordingly.

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For appendices – see below.

APPENDICES

Appendix I

To see how much land area would be needed if ALL of the energy were to be produced by Solar photovoltaic power plants, here is the calculation – first for the global level.

SOLAR ENERGY FACT CHECK

- World Total Energy Consumption in 2017 (WEO 2018 Report – IEA)
    - 13,972 Mtoe (Millions of Metric Tons of Oil Equivalent)
    - 162,494 TWH (Terra Watt Hours, 1 TWH = 1,000,000 MWH) = 162.5 PWH
    - **All fossil fuels only use 35% of their share (Efficiency) – Rest is wasted**
- Area Needed to Make This Energy with Solar PV (Photo-Voltaic)
    - MW – Mega Watts, and MWH – Mega Watt Hours (or 1,000 KWH)
    - **KWH or Kilo Watt Hours is what shows up on your electric bill (units)**
    - 1 MW of POWER produced for 1 hour gives 1 MWH of ENERGY
    - 1MW Solar Panels typically generate 2,000 MWH of energy in a whole year
    - So 162,494 TWH/2,000 – Needs 81.25 TW, or 81,250,000 MW capacity size
    - So, 81,250,000 MW worth of Solar PV panels could generate ALL of the world's energy for the year 2017
    - Typical Utility Scale Solar PV system, 1 MW needs 0.0154 Square Kilometers area
    - So Solar Panels of 81,250,000 MW size need 1.25 million square kilometers
    - At 35% efficiency, 162.5 PWH of fossil fuel energy only generates 0.35 x 162.5 PWH worth of electric energy (56.8 PWH), which only needs 28,500,000 MW
    - Which in turn only needs 0.43 million square kilometers
    - Even if the numbers are off a little bit, that's about what we need
- The Total Land Area of the World is
    - 148.9 Million Sq. Km. (58 Million Square Miles)
- **SUMMARY**

WE ONLY NEED 0.4% TO 1.25% LAND AREA TO MAKE <u>ALL</u> OF THE WORLD'S ENERGY WITH SOLAR ENERGY

Appendix II

Biden Climate Plan compared to Lamba plan, GND and Sanders plan

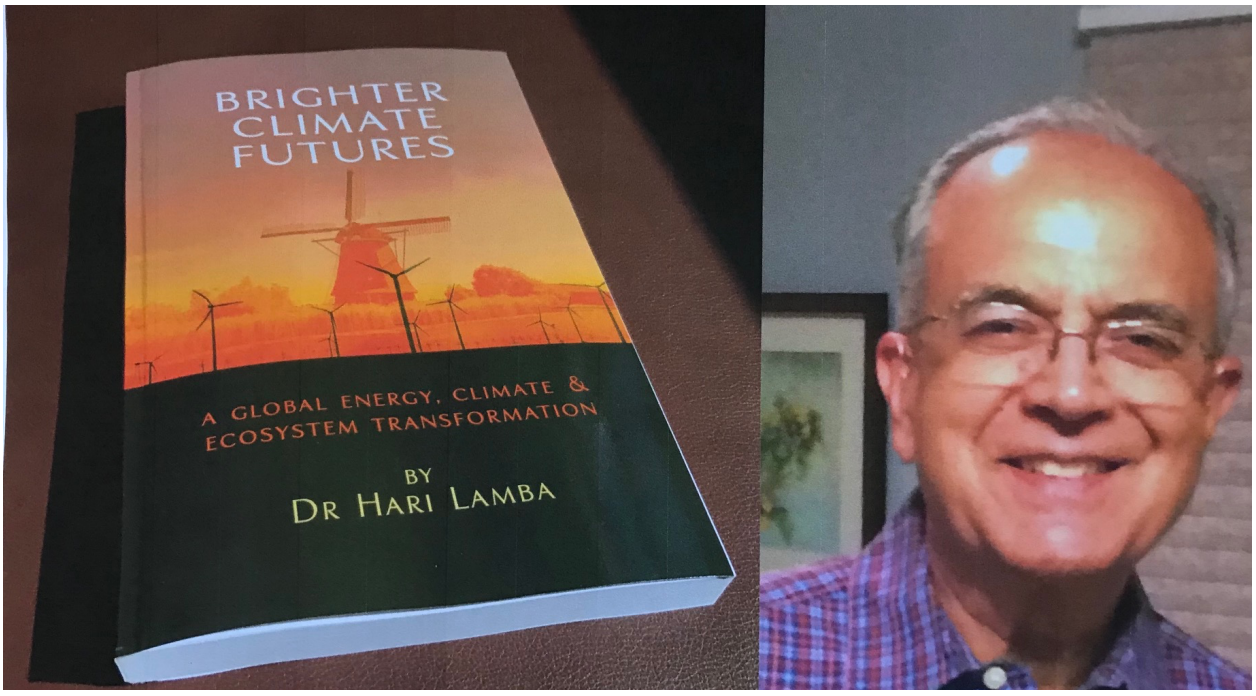
Biden Plan	**Lamba Plan**	**GND**	**Bernie Sanders –Pres Campaign**
Clean Energy Revolution	ECE Transformation (BCF)	Green New Deal	
!00% Renewable power by 2035. Net Zero Emissions by 2050	Same – but near zero emissions from fossil fuels by 2050 – a difference	100% renewable power (Cl. 3)	100% RE power generation & Transp. By 2030, and complete decarb by 2050
Build Climate Resilient Infrastructure	Similar but emphasize new green infrastructure (non-fossil fuel)	Build resilience – yes (Cl. 1). Rebuild infrastructure but emphasize new green(Cl. 2)	
Cooperate with Rest of the world – foreign policy	Cooperate yes, but also strengthen global orgs Global GND	Promote International exchange of technology - help other nations with GND (Cl. 14)	
Accountability of fossil companies and clean water	Yes. Biggest – companies must set aside remediation funds	Cleaning up hazardous waste and abandoned sites (Cl. 12)	
Just Transition for fossil workers	Yes – full support to transition		
	A Full energy transition-Quantitative to Renewable energy		$ 1.52 trillion investment in Renewable Energy
	Major expansion of battery systems in electric grid		$ 852 billion investment in energy storage or batteries.
	Electrification of all sectors		$ 526 billion in smart, underground grid.
	“Storage” Fuels RDD&D – Green Hydrogen and ammonia		
	Electric grid expansion, modernization and reform – more distributed – smart grid	100% energy efficient and smart grid (Cl. 4)	Replace private investor owned utilities with PMAs like the Tennessee Valley Auth.

Quality public transportation in cities above 100,000 population	Solar-Electric-Hydrogen Highways - Transportation	Overhaul Transportation System to reduce GHG (Cl. 8)	
	Massive investment in Energy Efficiency – 25% of total		$ 2.18 trillion EE of buildings
	Afforestation 80 Million Hectares	Carbon absorption, but from forests (Cl. 10)	
	Coastal ecosystems all coast	Restoring fragile ecosystems (Cl. 11)	
	Regenerative agriculture		
	Organized Disaster Risk Reduction- Before, during, after		
	Adaptation to heat, drought, floods and sea level rise	Mitigating adverse effects of climate change (Cl. 9)	
	Transition out of Coal, oil, NG – fossil fuels gone		
	Energy Democracy		
Roll back Trump polluting regulation changes & reverse the Trump Tax cut	Yes - end fossil fuel subsidies		
Cost $ 2 trillion over 10 years	Cost $ 3.3 Trillion over 10 years		$ 16.3 trillion over 30 years
Investment in climate R&D and Innovation – global too	Invest in RDD&D		
Establish special ARPA-C (cross)			
Grid scale storage at lower cost			
Small modular nuclear reactors - So nuclear, yes			
F-gases gone			
Zero net energy buildings	All buildings to become net zero and free of fossil fuel use	Upgrading all bldgs. To achieve max energy efficiency (Cl. 5)	
Decarbonize agriculture	Reduce GHG from farming, but also total transf. to a Regenerative	Working collaboratively with farmers to reduce GHG emissions (Cl. 7)	

	agriculture that also serves as a carbon sink		
CCS from power plants	Afforestation 80 Million Hectares	Carbon absorption, but from forests (Cl. 10)	
Accelerate CCUS, RDD&D			
Efficiency Bldg Retrofits	Yes		$ 2.18 trillion EE of buildings
Accel EVs, 500K charging points – tax credits			
Funding clean transportation	Zero carbon integrated transportation		
Better Ag practices – Fund bio-gas	Regenerative Agriculture		
Low Carbon Manufacturing – Energy Transition	Clean manufacturing and renew energy based manufacturing	Clean manufacturing and renew energy based manuf. (Cl. 6)	
Re-invigorate AmeriCorps for sustainability			A New Civilian Conservation Corps for ag, engrg and lands
Reducing other GHG emissions - qualitative	Yes. 50% reduction for Methane and 25% for N2O by 2050	Identify other GHG sources and remove them (Cl. 13)	
High Speed & Passenger Rail	Yes – E – W & N – S (2 each). Low carbon integrated and linked transportation	Yes and transit	
Use trade measures if needed	Yes – but convince nations		
Clean energy exports, financing			
Green Climate Fund			
Climate Resilience of Military			
Biofuels applied to planes			
Quotes 4th NCA – Trump ignores			
WHAT HE DID BEFORE			
Debt for Nature swaps ARRA – Coastal Ecosystems (50)			
Banning oil and gas exploration			

Reduce Urban Sprawl - denser			
CAFÉ & Paris Agreement			
No Carbon tax, and does not move fast enough to eliminate fossil fuels			US economy will lose $34 trillion, but gain $ 70 trillion over 80 years
Raise corp. income tax rate, increase taxes and use stimulus money			

Others:
Tom Goldtooth, Indigenous Environmental Network, criticizes CCS as a “false solution” and calls for US and Canada to keep 80% of the fossil fuel reserves in the ground.
Bob Inglis, Exec Director of RepublicEn, a conservative climate policy group, calls for a carbon tax that is border adjustable and carbon neutral (fee on imports from nations w/o a carbon tax and US Govt would not keep the money).



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