



California Water and Infrastructure Report

Formerly, the “California Drought (and Flood) Update”

For January 3, 2019

by Patrick Ruckert

Published weekly since July, 2014

An archive of all these weekly reports can be found at both links below:

<http://www.californiadroughtupdate.org>

<https://www.facebook.com/CaliforniaDroughtUpdate>

patruckert@hotmail.com

For the eyes of the world now look into space, to the moon and to the planets beyond, and we have vowed that we shall not see it governed by a hostile flag of conquest, but by a banner of freedom and peace. We have vowed that we shall not see space filled with weapons of mass destruction, but with instruments of knowledge and understanding.

President John F. Kennedy

A Note To Readers

This morning west coast time China landed a rover on the far side of the Moon. An accomplishment no other nation has ever done.

As I have often presented here, in these reports, it is an aggressive space and nuclear fusion development policy that must be the foundation of a new platform of scientific progress, and that in turn, must be the foundation for a new platform of infrastructure for the 21st Century. That is the subject of our Feature this week, and is the last item in this report.

So, this week we highlight the Chinese space program, while not neglecting to recall the great accomplishments of the U.S. space program put in motion by our last really great President, John Kennedy.

All that follows an array of items on the drought, the snowpack measurement of December 3, rain and

snow forecasts and related meteorological developments. Also included in this first section of the report is two studies worrying about a generally developing snow and winter deficit in the Rocky Mountains and the Sierras.

Of course, I cannot leave out a short item on our Governor who is about to leave office for the last time. And characteristic of Jerry Brown he leaves a real turd. In a farewell interview he warned that America and the rest of the world are falling behind in the fight against climate change and likened the challenge to fighting the Nazis in World War II.

Two other items in this report should be mentioned. First, that even somewhat flaky guys like Bill Gates are recognizing that the U.S. must return to an aggressive program of building fission nuclear power plants. Second, is a delightful report on President Trump's partner, the new President of Mexico Lopez Obrador. President Obrador in his New Year's address outlined an Franklin Roosevelt policy of how to put all of Mexico's young people to work.

While I include several pages on the China Moon landing, there is a broader concern about what the Hell is the U.S. doing. On January 31, an item on the LaRouche PAC website posed such a fundamental question:

Two 'Sputniks of 2019': What Will America Do?

<https://larouchepac.com/20191231/two-sputniks-2019-what-will-america-do>

The new year begins with the United States facing scientific and technological surprises from two great nations at once. Russia has tested and begun to deploy hypersonic weapons, against which, numerous U.S. defense and military officials acknowledge, the United States has no defense. And China may be days away from landing its Chang'e-4 mission on the far side of the Moon, a feat no spacefaring nation has attempted before.

How should the United States, and President Donald Trump, react? Well, perhaps, the following will aid your thinking about that question. I include here just a short excerpt from this article:

What the World Needs Now

<https://larouchepac.com/20190104/what-world-needs-now>

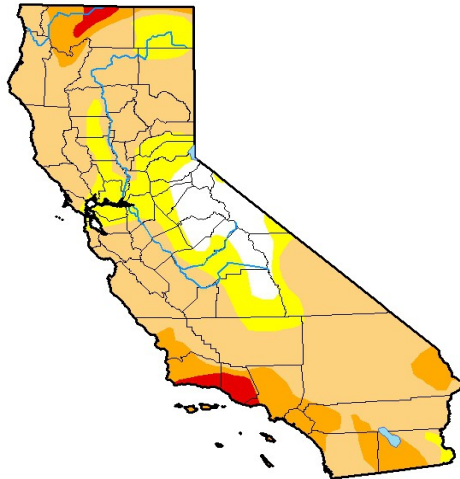
Jan. 3 (EIRNS)—As all the world now knows, Chang'e-4 touched down today on the far side of the Moon for mankind's first-ever controlled landing there. As EIR Founding Editor Lyndon LaRouche had correctly forecast even before the Chang'e-4 mission was formally announced in December 2015, a new era has opened for mankind. Ouyang Ziyuan, the chief scientist and father of the Chinese Lunar Exploration Program, was interviewed today on CGTN television, and discussed his discovery that the Moon's helium-3 will provide fusion energy to power mankind for the next 10,000 years. At the same moment, the great promise the lunar far side offers for low-frequency radio astronomy—of which LaRouche's Basement Science Team has written—was already being exploited as early as yesterday, when the Chinese lunar lander was coupled with their Queqiao relay satellite, to make a compound low-frequency radio telescope reaching out far beyond our galaxy, while sheltered by the body of the Moon from the Earth's interference.

But still more important is Chang'e-4's role in our species' historic progress from Earth, and out into the Solar System, the galaxy and beyond, which was begun, against tremendous odds, by heroic Germans, Russians and Americans of the 20th Century. But then it was cruelly shut down by Britain after the American manned Moon landings of 1969-72. Now at last, that great crusade of humanity has finally been resumed again after two lost generations.

Drought, Rain, Snow, Snowpack-- We Are Getting It All This Week

U.S. Drought Monitor

U.S. Drought Monitor California



January 1, 2019
(Released Thursday, Jan. 3, 2019)
Valid 7 a.m. EST

	Drought Conditions (Percent Area)					
	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	7.77	92.23	75.17	14.12	2.10	0.00
Last Week 12-25-2018	7.77	92.23	75.17	16.24	2.10	0.00
3 Months Ago 10-02-2018	12.18	87.82	47.97	22.82	4.93	0.00
Start of Calendar Year 01-01-2019	7.77	92.23	75.17	14.12	2.10	0.00
Start of Water Year 09-25-2018	12.18	87.82	47.97	22.82	4.94	0.00
One Year Ago 01-02-2018	55.70	44.30	12.69	0.00	0.00	0.00

Intensity:

D0 Abnormally Dry D3 Extreme Drought
D1 Moderate Drought D4 Exceptional Drought
D2 Severe Drought

The Drought Monitor focuses on broad-scale conditions.
Local conditions may vary. See accompanying text summary
for forecast statements.

Author:

David Miskus
NOAA/NWS/NCEP/CPC



<http://droughtmonitor.unl.edu/>

As you can see with the U.S. Drought Monitor, the state still has about 75 percent of the territory in Moderate, Severe or Extreme Drought. That may change in the coming week or two with a lot of precipitation expected, but it does take more than one storm or even a week of storms to budge that drought monitor to any significant degree.

And while the Fall was relatively dry and the talk of more drought was featured in some articles, as the meteorologists will say, no one really knows what the weather will be for the rest of the winter.

Just look at the Sacramento Bee article from December 27, below. The statement is made that, "And there's not a major storm in sight." Now on January 2, up to six days of precipitation begins tomorrow.

The largest reservoirs in the state do remain at a relatively low level for this time of year, and that does cause concern.

Finally, the Department of Water Resources (DWR) performed the first snow survey of 2019 today, and found that while the snowpack thus far is below normal, it is better than that of last year. But, a couple of studies find that over the past decade or so, overall the Sierra snowpack and the snowpack of the Rocky Mountain snowpacks are shrinking.

Rain is on the way: Bay Area to get soaked by series of storms

ABC7 News Meteorologist Mike Nicco says the entire Bay Area may get soaked with six consecutive days of rain, starting on Saturday.

By [Mike Nicco](#)

Thursday, January 03, 2019

SAN FRANCISCO (KGO)

<https://abc7news.com/weather/bay-area-to-get-soaked-by-series-of-storms/5010475/>

We are talking about potentially six days of consecutive rain, starting on Saturday.

ABC7 News [Meteorologist Mike Nicco](#) says the whole region will get soaked during a series of storms.

"The storms could leave anywhere from 2 to 6 inches of rain from the South Bay to the North Bay," said Nicco.

Expect blustery winds too.

"In fact, we will probably be under a wind warning by the time we get to Friday," said Nicco. "Gusts could get to 30 MPH to even 60 MPH from our valleys to our ridge tops."

Storm train to resume along US West Coast this weekend

By Renee Duff, AccuWeather meteorologist

January 2, 2019

<https://www.accuweather.com/en/weather-news/storm-train-to-resume-along-us-west-coast-this-weekend/70007033>

A storm poised to unleash rain and mountain snow across the western United States this weekend will be the start of an unsettled pattern lasting into next week.

Through Friday, the most impactful weather across the West will remain focused on Washington state, where rain will continue to soak coastal areas, while snow levels lower in the mountains.

A bit of wintry mix can lead to slippery travel in central and eastern Washington on Thursday.

The storm track will shift southward this weekend, allowing areas of heavy rain and mountain snow to move into California on Saturday, according to AccuWeather Long-Range Meteorologist Max Vido.

Yet another storm can crash onshore by the middle of next week. This storm may bring the chance for rain back to Southern California.

California weather remains dry. Is it too early to talk drought?

By [Ryan Sabalow](#) and Dale Kasler

December 27, 2018

<https://www.mercedsunstar.com/news/state/california/article223624085.html#storylink=cpy>

When it comes to California's water supply, 2018 will end with a whimper.

California's two largest reservoirs are not even half full. The Sierra Nevada snowpack, which functions as an additional set of reservoirs, is below normal for this time of year.

And there's not a major storm in sight.

"We'll ring in the new year with mild, quiet weather," Cory Mueller, a meteorologist with the National Weather Service in Sacramento, said Thursday.

That doesn't necessarily mean the state is heading [into another drought](#). While December has been relatively dry in much of California, private weather forecaster Jan Null said January and February can easily make up for the slow start to the rainy season.

Perhaps more ominously is the condition of California's two most important reservoirs, where much of the water for California's two big federal and state water projects is stored. Shasta Lake, the linchpin of the federal Central Valley Project, is just half full, and at 80 percent of historical average for late December. Lake Oroville, which serves the State Water Project, is 29 percent full, and at 47 percent of historical average.

Complicating matters is that the Department of Water Resources plans to run Oroville emptier than usual this winter so it can complete the last of the repairs to Oroville Dam's flood control spillways. DWR announced in October it plans to keep water levels 13 feet lower than normal to finish the work that's been under way since 2017, when the two spillways suffered near-disastrous failures.

That 13 feet difference could translate into at least 100,000 acre-feet of water that can't be stored this winter, possibly reducing supplies available to the State Water Project during the summer and fall. An acre-foot is 326,000 gallons, enough to supply an average California household for one to two years. The city of Sacramento's water utility provided its customers around 86,000 acre-feet in 2015.

2018 Another Dry Year for California

December 31, 2018 MATTHEW RENDA

<https://www.courthousenews.com/2018-another-dry-year-for-california/>

(CN) – As the Golden State moves into 2019, it will close the book on an abnormally dry year with hopes that a few rain storms can stave off the prospect of another drought.

The long-term outlook for wet weather in California isn't promising.

The Climate Prediction Center expects the high-pressure weather system currently hovering over much of Northern California to be there until at least mid-January.

The eight-state index, which measures rainfall in the Northern Sierra, reports about 12.9 inches have fallen since October. That's about 75 percent less than average.

First Snow Survey of the Year Reveals a Strong Start

January 3, 2019

http://agnetwest.com/first-snow-survey-strong-start/?fbclid=IwAR3Koh55-lmdHngXpApHUM_CvQ4IAwCX8NERgv54rlLcytcWcyIgM4Y0ChI

The Department of Water Resources (DWR) performed the first snow survey for 2019 today, about 90 miles east of Sacramento at Phillips Station in the Sierra Nevada. The readings found that while still below the average for this time of year, 2019 is still off to a significantly better start than the year prior.



“The snow depth is 25.5 inches and the snow water content is nine inches, which results in 80 percent of average-to-date, and 36 percent of the April 1 average at this location,” Water Resources Engineer with DWR's Snow Survey Section John King said during the press conference. “Despite some late-

November, early-December storms the statewide snow water content is 67 percent to-date, according to our statewide snow sensor network.”

Since 1964 the historic average for the snow water equivalent at Phillips Station has been 11.3 inches in early January. “While these results are below average, they are a stark contrast to where we were last year where there was just patches of snow at this location. The season’s still early, anything is possible from now until May,” King noted.

Winter is shrinking, Scripps study finds, posing new fire, water risks

By [Deborah Sullivan Brennan](#)

December 31, 2018

<https://www.sandiegouniontribune.com/communities/north-county/sd-no-20181221-story.html>

Across the mountains of the West, the landscape of winter is changing.

Deep snowpacks that held fast through winter, then melted in a torrent each spring, are instead seeping away earlier in the year. The period of winter weather is shrinking, too, with autumn lasting longer and spring starting earlier.

The findings by Amato Evan, a professor of atmospheric and climate science with [Scripps Institution of Oceanography](#), show changes to Western hydrology that could jeopardize water resources, flood control, fire management and winter recreation.

*His results were published this month in the *Journal of Applied Meteorology and Climatology*, and presented at the American Geophysical Union Fall Meeting in Washington, D.C.*

Western mountains have historically released their water after winter storms have passed, but with snow melt and storms occurring at the same time, the risk of floods increases. The near collapse of the [Oroville Dam](#) in February 2017 illustrates the kinds of dangers California could face with earlier runoff.

“We’re getting snow melt at a time when a big storm which has both rain and snow could happen, and could overwhelm the flood control capacity of a given reservoir in that earlier season,” he said. “So that’s a feature of climate change that is really a threat, that water managers are going to have to contend with.”

Catastrophic wildfires are another peril of the changing regimen. Snow melt dampens the risk of wildfire for [California’s forests](#) during spring and early summer. If it runs off sooner, that could leave those woodlands parched and fragile.

“When snow melts earlier in the year... that means the soils dry out earlier in the year,” Evan said. “That means those forest ecosystems become drier. So in a sense, we can lengthen the fire season.”

Snowpack has declined by an average of 41 percent in the Rocky Mountains over past 3 decades

Deepan Dutta / *Summit Daily News*

December 27, 2018

<https://www.skyhinews.com/news/snowpack-has-declined-by-an-average-of-41-percent-in-the-rocky-mountains-over-past-3-decades/>

It’s been a great winter in Summit County. Storms have been coming in regular and heavy, the fluffy

stuff has been sticking around and the metrics prove that this winter's snowfall is doing at least twice as well as last year's.

Unfortunately, the snow on the ground today is a pale shadow of what Summiters were seeing a few decades ago. Recently released research reveals that today's mountain snowpack is about 41 percent less than it was back then.

Researchers revealed their findings at the American Geophysical Union's annual meeting on Dec. 13. One of the research papers, conducted by University of Arizona researchers, found that snowpack had declined by 41 percent over 13 percent of Western land area — mainly in the Colorado River Basin mountain ranges — between 1982 and 2016.

The Governor, On His Way Out the Door, Goes Over the Edge

Jerry Brown: Climate change challenges as serious as those faced in World War II

The outgoing California Democratic governor joined "Meet the Press" for an in-depth discussion about climate change.

Dec. 30, 2018

By Ben Kamisar

<https://www.nbcnews.com/politics/meet-the-press/jerry-brown-climate-change-challenges-serious-those-faced-world-war-n952446>

WASHINGTON — California Democratic Gov. Jerry Brown warned that America and the rest of the world are falling behind in the fight against climate change and likened the challenge to fighting the Nazis in World War II.

"I would point to the fact that it took Roosevelt many, many years to get America willing to go into World War II and fight the Nazis. Well, we have an enemy, though different, but perhaps, very much devastating in a similar way. And we've got to fight climate change. And the president's got to lead on that."

Now For the Fun: China Lands Rover on the Far Side of the Moon, and More

What follows are some details of the spectacular achievement by China in being the first nation to land anything on the far side of the Moon. But first, just two weeks ago was the 50th anniversary of the Apollo 8 mission that arrived at the Moon on Christmas Eve and made ten orbits around the Moon before returning to Earth.

Reflecting on that great accomplishment by the U.S., two of the Apollo astronauts commented just the other day:

Apollo 8 Commander Frank Borman told Politico in an interview that since Apollo, "NASA hasn't been able to define a consistent mission." He explained that "every president since then has advocated for space exploration and none of them have (sic) funded it adequately." Both Borman and crew mate Jim

Lovell stressed that the Mars mission should be prepared for by working on the Moon first.

Lovell (also, 90 years old), responding to the question of whether we need something like the earthrise photo from Apollo to bring people together, said "something like that would be very helpful right now...It was sort of a gift from the Apollo 8 crew to the people of Earth... We might be a planet of many, many nations, but we're strictly a world of one."

Here is a video of that mission:

Apollo's Daring Mission

<https://www.pbs.org/video/apollos-daring-mission-ntnwii/>

China records historic first with moon landing

https://www.youtube.com/watch?time_continue=45&v=lyV-wQKs0Rw

China's Chang'e 4 lunar probe made a successful landing on the dark side of the moon on Thursday morning, which marked a milestone in the human exploration of space.

NASA Administrator Jim Bridenstine sent a tweet:

"Congratulations to China's Change'e-4 team for what appears to be a successful landing on the far side of the Moon. This is a first for humanity and an impressive accomplishment."

China lands spacecraft on 'dark' side of moon in world first (Update)

January 3, 2019

by Ken Moritsugu

<https://phys.org/news/2019-01-china-probe-side-moon-state.html#jCp>



In this Dec. 8, 2018, file photo, and released by Xinhua News Agency, the Chang'e 4 lunar probe launches from the the Xichang Satellite Launch Center in southwestern China's Sichuan province. The official China Central Television says Thursday, Jan. 3, 2019, the lunar explorer Chang'e 4 had touched down at 10:26 a.m to make first-ever landing on the far side of the moon. (Jiang Hongjing/Xinhua via AP, File)

"On the whole, China's space technology still lags behind the West, but with the landing on the far side of the moon, we have raced to the front," said Hou Xiyun, a professor at Nanjing University's school of astronomy and space science.

He added that China has Mars, Jupiter and asteroids in its sights: "There's no doubt that our nation will go farther and farther."

In 2013, Chang'e 3, the predecessor craft to the current mission, made the first moon landing since the former Soviet Union's Luna 24 in 1976. The United States is the only country that has successfully sent a person to the moon, though China is considering a crewed mission too.

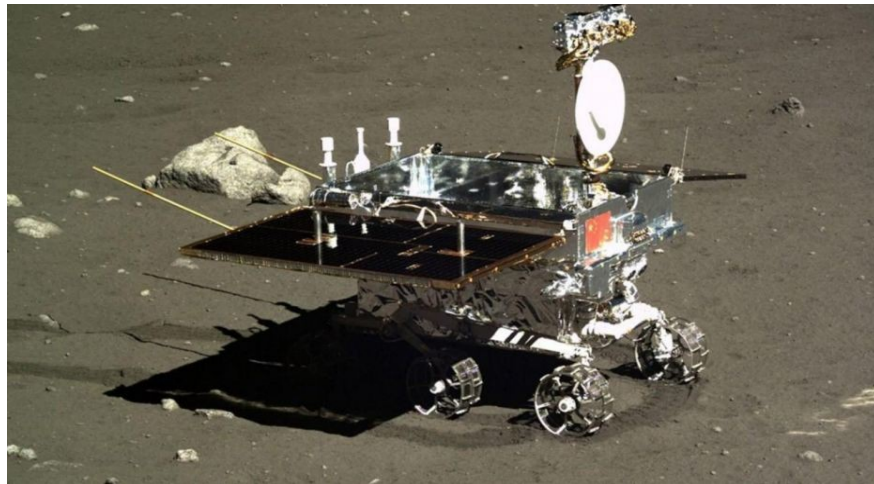
For now, it plans to send a Chang'e 5 probe to the moon next year and have it return to Earth with samples—also not done since the Soviet mission in 1976.

China Lands Spacecraft on Far Side of Moon

By [Steven Lee Myers](#) and Zoe Mou

Jan. 2, 2019

<https://www.nytimes.com/2019/01/02/world/asia/china-change-4-moon.html>



One small step for Chang'e-4, one giant leap for humankind!

https://www.youtube.com/watch?v=1_rCTxTSQn8&feature=share

One small step for Chang'e-4, one giant leap for humankind! How did the probe reach the far side of the moon? What is it looking for? [#XinhuaSpecial](#) explains all! A great 5 minute video.

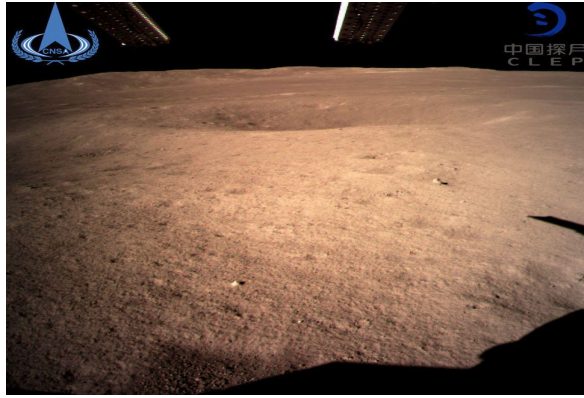
China's Chang'e 4 sends back first photos of moon's far side after historic landing

Going where no spacecraft has gone before, Chang'e 4 snaps photos on the surface on the far side of the moon.

by [Jackson Ryan](#)

January 3, 2019

<https://www.cnet.com/news/chinas-change-4-becomes-first-spacecraft-to-land-on-the-far-side-of-the-moon/>



In this photo provided Jan. 3, 2019, by China National Space Administration via Xinhua News Agency, the first image of the moon's far side taken by China's Chang'e-4 probe. (China National Space Administration/Xinhua News Agency via AP)

Helium-3: Fuel of the future on Earth's natural satellite

Tech & Sci

By Nayan Seth, Li Jingyi

2019-01-03 16:56 GMT+8

https://news.cgtn.com/news/3d3d674e31637a4e31457a6333566d54/share_p.html

No human has set foot on the lunar surface since America's Apollo missions ended in 1972. Almost five decades on, the Moon isn't just seen as the Earth's natural satellite.

Apart from technological missions, scientists over the years have researched the presence of precious minerals and untapped energy on the Moon which could be put to use on Earth.

But why did people keep working on exploring the Moon? Here might be the answer.

Apart from helping humans study the mystery of the solar system, the Moon has attracted global attention due to the presence of rich natural resources on its surface and the core.

Thus, it is sometimes referred to as the Persian Gulf of the solar system. Scientists believe the Moon is full of resources like rare earth elements, titanium, and uranium.

But the most important element is Helium-3.

The Helium-3 isotope is extremely rare on Earth but exists in abundance on the Moon.

It is emitted from the Sun and carried throughout the Solar System by solar winds, but is repelled by the Earth's magnetic field, with only a small amount penetrating the atmosphere.

But for the Moon where the magnetic field is weak and the atmosphere is extremely thin, Helium-3 is deposited in significant quantities.

The element is believed to be a critical component in developing controlled thermonuclear fusion power, a difficult but still possible process.

Looking at the potential of Helium-3, experts believe that 5,000 tons of coal could be replaced by just 40 grams of Helium-3.

And just eight tons of Helium-3 in fusion reactors would provide the equivalent energy of one billion tons of coal, dramatically reducing transportation costs and protecting the environment.

In an interview with the BBC in 2013, top Chinese scientist Ouyang Ziyuan estimated the Moon's Helium-3 resources could solve humans' energy demand for around 10,000 years at least.

Fireside Chat: "Chang'e Is Good" - Will America Join China In Returning Mankind to the Moon?

<https://larouchepac.com/20190103/fireside-chat-chang-e-good-will-america-join-china-returning-mankind-moon>

Humanity, in the form of China's Chang'e 4 spacecraft mission, is on its way back to the Moon! While some wonder whether this will spark a new space race between China and the United States, why not combine forces to return to the Moon faster? Why not include Russia, India and other powers, too?

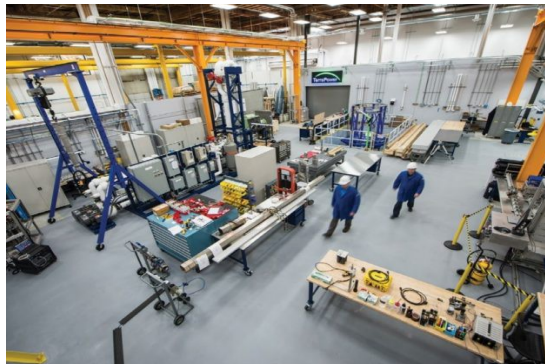
Space cooperation is the pathway out of senseless war on Earth. Why "space-race?" Win-Win" collaboration is what Presidents Donald Trump and Xi Jinping just proved is their agenda, in their pre-New Years' joint phone conversation to resolve differences on trade. War with China, Korea, Russia or others is over, if we choose to think the way astronauts are forced to think in space. Kesha Rogers & Mike Steger of the LaRouche Policy Committee will discuss how the Trump Presidency can use the LaRouche Four Laws to reawaken the United States, to develop a mass workforce and scientific cadre to rebuild our nation now. We can do this by exposing the lie of entropy and replacing the "green genocide" death culture, with a culture based on the beauty of the human mind.

Nuclear Power

As China option fades, Bill Gates urges U.S. to take the lead in nuclear power, for the good of the planet

by [Alan Boyle](#) on December 29, 2018

<https://www.geekwire.com/2018/china-option-fades-bill-gates-urges-u-s-take-lead-nuclear-power-good-planet/?fbclid=IwAR3DYHdGB5kZp1AJjZ5Pw1GZjT9nWxlGfRAUC6qbwV2RzBB3mqXmW10uEcA>



TerraPower, a venture co-founded by Bill Gates, conducts nuclear energy research at a 10,000-square-foot laboratory in Bellevue, Wash. (TerraPower Photo)

In his [year-end letter](#), Microsoft co-founder Bill Gates says his to-do list for 2019 includes persuading U.S. leaders to regain America's leading role in nuclear energy research and embrace advanced nuclear technologies such as the concept being advanced by his own TerraPower venture.

"The world needs to be working on lots of solutions to stop climate change," Gates wrote in [the wide-ranging letter](#), released Saturday night. "Advanced nuclear is one, and I hope to persuade U.S. leaders to get into the game."

Now Here Is Why President Trump Likes Working With the New Mexican President

Mexico's López Obrador Announces 'Every Young Person To Work' Program, Inspired by FDR

Jan. 2, 2018 (EIRNS)—In his New Year's Day message, Mexican President Andres Manuel López Obrador announced that "all youth, all of them, are going to have work and schooling," because the government is launching a new program to provide some 3,600 pesos a month (some US\$184), which will allow them to work as apprentices.

"They are going to work in workshops; they are going to work in factories, in businesses. They are going to be working in the countryside, in the cities; with their parents, with their relatives, but working, being educated, qualifying themselves for work—all youth,"

he said.

The goal of this Mexican President is to end in Mexico the acute problem throughout the West, where young people are being robbed of a future by neither being in school nor working.

López Obrador explained that this idea came from FDR:

"I have had this idea since I read how President Franklin Delano Roosevelt pulled the United States out of the 1930s' crisis. What did he do, in a tremendous economic crisis? He decided to put the whole U.S. people to work. And he decided to put young people to work, and he paid them a dollar a day, for every young person. But his idea was full employment. That is, a job for everyone. That idea stuck in my head, because Roosevelt lifted the United States out of the crisis, and for me, he was therefore, if not the best President, one of the best that the United States has had—Franklin Delano Roosevelt, by that action, by that decision. Now we are going to do something similar: All young people to work."

His message in this statement, on New Year's Eve, was one of optimism for the year 2019. He promised that he would not fail the Mexican people, he repeated.

"Some changes have been made, and more are coming."

Feature: LAROCHE'S FOUR LAWS FOR ECONOMIC RECOVERY-- The Fourth Law

With the potential now represented by China's Moon exploration policy, of which the landing of a rover on the far side of the Moon today is only one stage of, it is time for the U.S. to get back into a real space program-- one that President Kennedy would be proud of. LaRouche's Fourth Law presents what that would mean:

<http://media.larouchepac.com/larouche/documents/20180503-LPAC-2018-Campaign-web.pdf>

(1) The immediate re-enactment of the Glass-Steagall law instituted by U.S. President Franklin D. Roosevelt, without modification, as to principle of action.

(2) Return to a system of top-down, and thoroughly defined, National Banking.

(3) The purpose of the use of a Federal Credit-system, is to generate high-productivity trends in improvements of employment, with the accompanying intention, to increase the physical-economic productivity and the standard of living of the persons and households of the United States.

(4) A Crash Program for Fusion and an Expanded Space Program.

Progress exists so only under a continuing, progressive increase of the productive and related powers of the human species... A fusion economy is the presently urgent next step, and standard, for man's gains of power within the Solar system, and beyond.

Mankind, unlike all animal species, is capable of perpetual growth and progress. Realizing this potential, however, requires that we increase our power in and over nature, over time. Such increase does not happen at a steady pace and by continuation of one level of technologies and practices, but by revolutions—leaps upward—in the productive powers of each individual, revolutions which result from the introduction of new creative discoveries into mankind's applied practice. In this way, man creates his own future and evolves upward through discoveries of higher and more powerful principles.

Compared to mankind of the Middle Ages, or of the 18th century, we as a species are a mighty geological force, with powers to change nature, and to sustain human life in greater numbers and to broader geographical extent, than ever existed before. It is thus the role of economic policy to encourage and enable such crucial discoveries, and their application to our work and life.

The vital and unique role of the creative human mind just referenced is the principle underlying LaRouche's call for a "Fusion-Driver Crash Program" as the fourth of his Four Economic Laws. We must craft our economic program to effect the necessary next steps to be taken by mankind, in conjunction with a program for the colonization of nearby space. With such a commitment for the next several decades, we will re-assert our self-advancement towards a more powerful state of humanity.

Fusion: Mastery of the Cosmos

Throughout human history, our discoveries have put ever-higher forms of "fire" into our hands— from wood fire, charcoal, coal, and coke; to petrochemicals and natural gas; to the fire of the atomic nucleus. We use this "fire" to transform nature around us and to expand our reach both on and off the Earth. This succession of categories of fire has given us the means to cook food, melt and transform metals, invent new chemicals, travel faster than sound, reshape mountains, redirect rivers, create new elements of the periodic table, and send rockets to other planets.

The next step in our mastery of principles of nature lies in full mastery of the powers of the atomic nucleus: controlled nuclear fusion. Nuclear fission reactions, which have been under our control for many decades, release energy when a heavy nucleus (such as uranium) is split apart. Fusion reactions unite two light nuclei (such as hydrogen and helium), releasing an order of magnitude more energy (per fuel mass) than fission reactions. However, making fusion happen is not simply "fission backwards," and it has challenged our basic assumptions about the behavior of matter and energy. The potentials of controlled fusion are enormous. While the temperature inside a fission reactor can range from 300-1000°C, temperatures inside fusion reactors are in the tens of millions, to hundreds of millions of degrees. This means that we are interacting with matter in an entirely new way, since any material is vaporized at such high temperatures, and becomes a superheated charged gas, called a plasma.

The power of fusion is seen both in the sheer magnitude of power produced, and also in unique

qualitative properties of high temperature plasmas. Inside a tokamak—one type of fusion machine—when fusion occurs, energy is released in the form of electromagnetic radiation and charged particles. The heat and charged particles created can be used to produce abundant electricity very cheaply, and the full spectrum of products of fusion reactions have other applications in industry, medicine, mining, and other sectors of the economy. The resulting increase in the productivity of the labor force will support increased lifespans, population density and quality of life, both on and off the planet.

The advancements of a fusion economy are at our fingertips, and can be brought about by a firm commitment to an international crash program effort, within a new paradigm of international cooperation.

Fusion is a Space Platform

Applying the immense power of controlled fusion on Earth will transform our species' relationship to nature in an almost unimaginable way, but its full potential is extraterrestrial. Fission and fusion power will allow us to live and work in other places in the Solar System, and to transform them, in a way that is impossible with chemical power alone.

The process will begin on the Moon, our nearest planetary neighbor—and a rich depot for fusion fuel! For billions of years, the Sun has been depositing helium-3, an isotope of helium, via the solar wind onto the surface of the Moon, where it is held within the upper layers of the lunar soil. Helium-3 is very rare on Earth, but estimates are that there are 1 million tons of helium-3 on the Moon, which would be enough to power civilization on Earth at current levels of consumption for millions of years.

Helium-3 is an ideal fusion fuel. Fusion of deuterium and helium-3 releases more energy than any other fusion fuel regime (see diagram), and unlike other fuel combinations, the products of the reaction are almost entirely charged particles—which can be controlled with a magnetic field. This means that they can be used to produce electricity directly and efficiently, and also as thrust in fusion rockets. With nuclear power we can maintain our work and industries through the two-week-long lunar nights. Nuclear rockets can power flight to distant bodies like Mars in weeks, as opposed to months.

With fusion power, we will upshift our species to one which can extend and maintain its existence throughout the inner solar system, and perhaps beyond, and begin to fulfill our role as a creature from Earth with an extraterrestrial imperative.

A Great Upshift in Civilization

The development of space is a vehicle through which civilization can and must unify around the common aims of mankind. This fulfills the inspiration of President Kennedy, who said:

For the eyes of the world now look into space, to the moon and to the planets beyond, and we have vowed that we shall not see it governed by a hostile flag of conquest, but by a banner of freedom and peace. We have vowed that we shall not see space filled with weapons of mass destruction, but with instruments of knowledge and understanding.

We are looking at the immediate potential for international cooperation in the exploration and development of the Moon and the cosmic environment within the Moon's orbit (cislunar space). This could get going right away, and would produce amazing results. Such a program would require new discoveries in the domain of high-energy physics, biology in the space environment, fission and fusion power, and related fields. In this first stage of development, we will establish the technologies, resources and capabilities needed to expand beyond, to places such as Mars.

China has taken a leading role in lunar missions in the recent decade, and has invited cooperation from all other nations—including the U.S. In 2017, China will return a lunar sample to Earth for the first time in 41 years, and in 2018, they will place a lander and rover on the far side of the Moon. Mankind

has never landed anything—robotic or human—on the lunar far side, yet the unique geology of that location promises to tell us more about the history of the development of our Solar system than anything we can access on Earth; and by setting up a very low frequency radio astronomy observatory there, it will give us a glimpse into features of the Solar system, Milky Way galaxy and far distant galaxies which are simply impossible to see from Earth or Earth orbit.

The spinoff technologies generated by expanding the arena of human dominion to, first, cislunar space, then within the orbit of Mars, and then the entire heliosphere, have the ability to lift every nation out of poverty, cure every disease, feed every child, and render the tools and causes of war obsolete. For the reason, leaving the Earth will drive the greatest upshift in civilization on Earth in human history.

The commitment to space exploration will be the embodiment of the new paradigm, and must be based on the defense of the creative identity of the human mind. Human beings are a space-faring species, not meant to be confined to Earth: a species with a mission to discover and come to understand who we are as mankind in the Universe. We must bring about a unified human mission that establishes a completely new view of the Solar System, defined not by the compartmentalization of space, but by a unified galactic system.

The great German-American space pioneer Krafft Ehrlicke understood that the industrial development of the Moon and beyond is not just a worthwhile undertaking, but in fact is nothing less than an extra-terrestrial imperative:

Space opens new horizons beyond Earth and offers new beginnings in ways we can manage this precious planet. It offers noble aspirations, opportunities for creative action, for bringing the human family closer together and contributing to a better future for all.