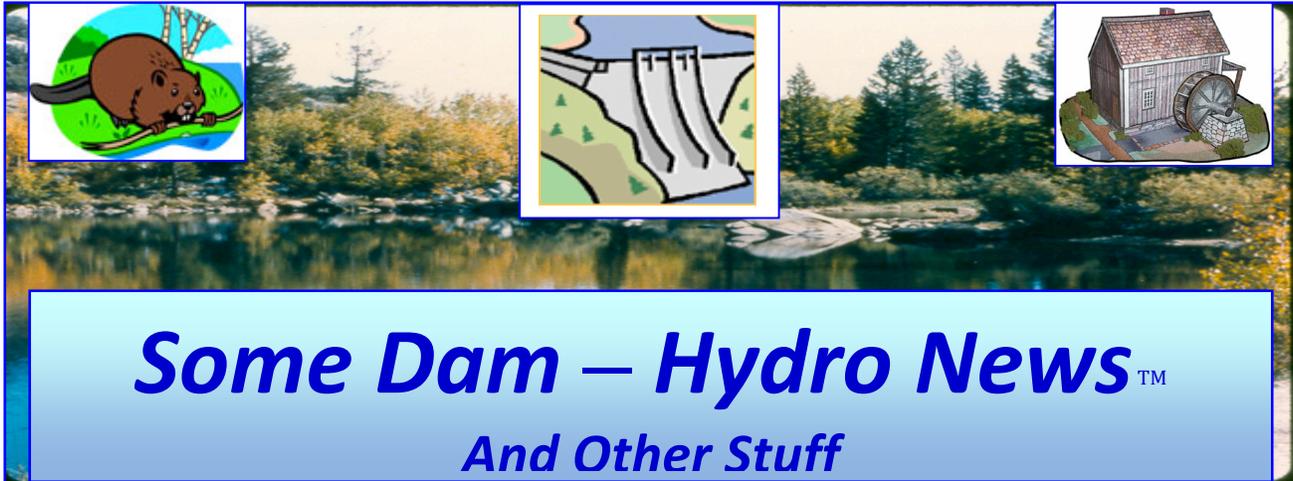


3/8/2019



Some Dam – Hydro News™

And Other Stuff



Quote of Note: *“Never give up on something that you can't go a day without thinking about.” - Winston Churchill*

Some Dam - Hydro News → Newsletter Archive for Current and Back Issues and Search:
(Hold down Ctrl key when clicking on this link) <http://npdp.stanford.edu/>. After clicking on link, scroll down under Partners/Newsletters on left, click one of the links (Current issue or View Back Issues).

“Good wine is a necessity of life.” - -Thomas Jefferson
Ron’s wine pick of the week: 2016 Seghesio Zinfandel "Sonoma County"
“No nation was ever drunk when wine was cheap.” - - Thomas Jefferson



Dams:

(Sometimes regulation is a good thing.)

Fox16 Investigates: How many dams are unregulated? Who is responsible?

By: Ashlei King, Feb 08, 2019, fox16.com

SALINE COUNTY, Ark. - Walking hand in hand, Mike Oglesby, his wife and their dog, Killer, enjoyed all of nature's beauty. The two have only lived on a property along Lake Sandy in Saline County for about two years, but it quickly became a special place. **"I love being on water and being able to have my own dock and canoe and fish," Oglesby said.** Recently while on a walk, Oglesby discovered something alarming at the Lake Sandy Dam. **"Started noticing water running from beneath the dam in some places and several seeps," he said.** Oglesby started investigating and even put his own camera inside of a pipe to get a better view. **"It looks as if there was failure happening in one of the pipes that leads**



under the dam," Oglesby said. He called the Arkansas Natural Resources Commission to check out the dam. ANRC shared a letter about the inspection with FOX16. It said the Lake Sandy Dam has "internal erosion and voids could cause the dam to collapse." Even though collapsing was a possibility, Engineering Supervisor Bill Ruck told FOX16 he does not consider this dam as a "high hazard" dam, meaning it won't cause a significant amount of damage. Ruck also said it was clear there was a lack of maintenance of the dam, but the state cannot do anything to fix the problem. He said the ANRC is simply designed to assist owners.

"The Arkansas Natural Resources Commission did not know about the dam until I brought it up," Oglesby said.

The ANRC said a dam must be 25 feet high in order to be regulated. The Lake Sandy Dam falls just below that requirement at 23 feet; therefore, no one regulates it. It is also privately owned, likely by the Lake Sandy Property Owners Association, which Oglesby said has been nonexistent for the last 20 year. This was not just a problem in Saline County. According to the Federal Emergency Management Agency, the majority of dams in the United States were privately owned. A search on the National Inventory of Dams showed there were 1,263 dams reported in Arkansas, but the state only regulates 410 of those and could not tell FOX16 the condition of those dams. However, the ANRC said it feels the dams in Arkansas are all in good shape. "Getting the dam fixed is a top priority and how to do that? I haven't a clue at this point." In the meantime, Oglesby will continue warning his neighbors downstream about the potential danger. For a complete list of the dams that are on the National Inventory of Dams' list, click here: <https://nid-test.sec.usace.army.mil/ords/f?p=105:113:13515988950769::NO::>

(Bigger spillway.)

Public meeting for Success Dam enlargement project set for Feb. 4

portervillerecorder.com, Feb 2, 2019

The U.S. Army Corps of Engineers (USACE) Sacramento District, CA will host a public meeting Feb. 4 to discuss the re-initiation of the Tule River Spillway Enlargement Project, which received \$74 million in appropriations in 2018 to raise Success Dam's spillway up to 10 feet higher. "This meeting is kind of a kick off so the public can be advised of the program that we will be starting back up at Success Dam for the spillway raise project," said Calvin Foster, a member of the USACE. Previously known



as the Success Reservoir Enlargement Project, the effort to reduce the flood risk to downstream communities such as Porterville, while also increasing reservoir storage, has been a stop-and-go effort as the Corps looked into potential deficiencies associated with Success Dam. Now that those studies have concluded, the Corps is ready to re-start the enlargement project.

Success Dam provides flood risk management for the City of Porterville and surrounding communities. There is currently a 1-in-50 chance in any given year that flooding will occur in Porterville from Tule River flows. The spillway enlargement project is expected to further reduce that flood risk by nearly half. Construction is scheduled to begin in 2022 and would be complete by 2024. The public meeting is scheduled for Monday, Feb. 4, from 4 to 7:30 p.m. at the Porterville Veterans Hall, and will be an open house format, meaning there will be no formal presentation given. Attendees can arrive anytime during the meeting to get an overview of the project, view maps and conceptual designs for the enlarged spillway, and ask questions of Corps team members. Attendees can also submit public comments during the meeting. "It is an open house format, so it's not a public meeting per se," said Foster. "We will have our team members there to answer questions, and we will have different maps to look at to see what the project will look like and how it may impact the surrounding property." Success Dam and Lake, which was constructed by the Corps in 1961, is operated by the Corps for flood control and storage of irrigation water. Recreational facilities at the lake were added after the dam was completed. The

dam is located on the Tule River about 6 miles east of the City of Porterville. *The Porterville Veterans Hall is located at 1900 W. Olive Ave. For more information about the Tule River Spillway Enlargement Project or the upcoming public meeting, please contact Tyler Stalker, deputy chief of public affairs, at 916-557-5107 or via email at tyler.m.stalker@usace.army.mil, or Katie Charan, project manager, at 916-694-8780 or via email at katie.j.charan@usace.army.mil.*

(Most people don't think about the benefits dams provide.)

Our Water: Twin Buttes special report conclusion

By: Victor Glenn, Feb 14, 2019, conchovalleyhomepage.com

San Angelo, TX - The Twin Buttes Dam is a complex and vital mass of engineering. As years of available water supply continue to add up behind the dam, it's worth keeping in mind that as with all dams, there is also a stream management and flood control component to it. "Behind me you'll see the spillway for the Twin Buttes Reservoir," said Allison Strube, Water Utilities Director for the City of San Angelo. "Any water going over the spillway would be at a much, much higher level than the conservation pool (the elevation that the reservoir is considered to be 100% full). There is a flood control component to Twin Buttes — it is designed to capture more than twice the water it is now holding before breaching the spillway."



With these important elements of the structure in mind, we spoke to several of the city staff responsible for overseeing the health and function of the Twin Buttes Dam and Reservoir. The importance and extent of the constant monitoring procedures came into focus. A lot rides on the health of this infrastructure. The community that depends on it has shown their care for Twin Buttes, and care for the relationship between it and Nasworthy. Release of water from the Twin Buttes gates keeps the Lake Nasworthy — an important recreational asset for the city — water level constant. It's an old joke that San Angelo has the most miles of dams to hold back the least amount of water than any other place in the world. While the joke is rooted in some accurate observation during drought, that may change as Twin Buttes is continuing to climb beyond the 60% full mark. This milestone is due to more than just recent rains or the presence of the dam itself. The cut off wall installed at the end of the last century has proven to be holding, stopping the major seepage that plagued the dam for decades.

It is likely that when summer comes and Lake Nasworthy needs water from Twin Buttes, there will be less public concern about releasing water into the lake. While it is of course hoped that the reservoir is never so full to make the spillway necessary, San Angelo can rest easy knowing that their much-needed water is not slowly bleeding away, and that all of its water infrastructure is performing as-designed in safety, and will continue to serve for many, many years to come.

(People are getting nervous as they should.)

AI Gedicks: Brazilian tailings dam disaster: Is Wisconsin next?

By AI Gedicks | Wisconsin Resources Protection Council, 2/20/19, madison.com

The recent collapse of a mine tailings dam in southeastern Brazil has already resulted in 169 fatalities, leaving an estimated 200 people still missing, according to rescue workers. The spill flooded nearby homes, submerging cars and buses under a river of reddish-brown sludge. This environmental disaster should raise red flags for Michigan regulators and the communities downstream from Aquila Resources' proposed open pit metallic sulfide mine and tailings dam next to the Menominee River on the Wisconsin-Michigan border.



On Jan. 25, 2019, a 40-year-old, 280-foot high tailings dam in Brumadinho, Brazil, failed, releasing almost 12 million cubic meters of mine waste. The dam is owned by the mining giant Vale, the same company responsible for a tailings dam failure three years earlier in Mariana that buried three communities, killing 19 people, leaving hundreds homeless and contaminating hundreds of miles of river valleys with toxic sludge. It was one of the worst environmental disasters in Brazil's history.

Tailings dams are some of the largest human-made structures on earth. Tailings are the waste material left over from the crushing, grinding and chemical (including cyanide) processing of mineral ores. Tailings often contain residual minerals — including lead, mercury and arsenic — that can be toxic if released to the environment. The Brazilian dam failures offer lessons for the proposed mine on the Wisconsin-Michigan border. The Brazilian tailings dam that failed was built in 1976 using the “upstream” dam construction method, which is the riskiest method of dam construction. Upstream dam construction has a track record of causing dam collapses around the world, including the catastrophic Mount Polley tailings dam collapse in Canada in August 2014, the largest environmental disaster in Canada's mining history. This failed upstream dam construction method is now being proposed for Aquila's tailings dam at the Back Forty project next to the Menominee River, which eventually drains into Lake Michigan, providing drinking water to millions in the Upper Midwest. Despite Aquila's claim that mining technology and regulation have made modern mining safer, a recent study by the Center for Science in Public Participation found that nearly half of all recorded serious tailings dam failures happened in modern times, between 1990 and 2010. “These failures,” according to the report, “are a direct result of the increasing prevalence of tailings storage facilities with greater than a 5 million cubic meter total capacity necessitated by lower grades of ore and the higher volumes of ore production required to attain or expand a given tonnage of finished product.”

In Aquila's original mine permit application, the company proposed to store 5.1 million cubic meters of tailings. In their revised application, they propose to store 4.9 million cubic meters of tailings. Whether it is 5.1 or 4.9 million cubic meters, the large volume of tailings poses a serious risk for a tailings dam failure, which is not addressed in the 900 pages of Aquila's revised permit. To address this regulatory failure, the Front 40 Environmental Group and the Mining Action Group of the Upper Peninsula Environmental Coalition have just contracted with the Center for Science in Public Participation for a scientific review of Aquila's tailings dam design. Al Gedicks is the executive secretary of the Wisconsin Resources Protection Council in La Crosse, Wisconsin

(I'm ready!)

DWR doesn't expect to use Oroville Dam spillway anytime soon — but it's preparing if necessary

By RISA JOHNSON | chicoer.com | Chico Enterprise-Record, February 22, 2019

OROVILLE, CA — The state Department of Water Resources does not expect to need to operate the Oroville Dam spillway anytime soon but is preparing in the event that it is necessary. Lake Oroville, currently at 773-foot elevation, could rise to 780-785 feet by the end of the month based on current projections. DWR and crews with Kiewit Infrastructure West Co., the contractor for the spillways construction project, would remove equipment from the main spillway if the lake elevation reached 780 feet. The spillway can't be used until the water reaches its gates at 813 feet. If water does reach that level, it doesn't necessarily mean the structure will be used, DWR said in a press release sent Thursday. “Releases are based on available flood storage, environmental needs, and water deliveries,” the release reads. DWR has said the main spillway



was ready to use since Nov. 1, 2018, though some minor work continues there and construction on the emergency spillway is ongoing. Lake Oroville is expected to reach average levels for this time of year, according to the department. If the spillway is used, DWR will be following its 2018/2019 Lake Oroville Flood Operations Plan.

More water allocations

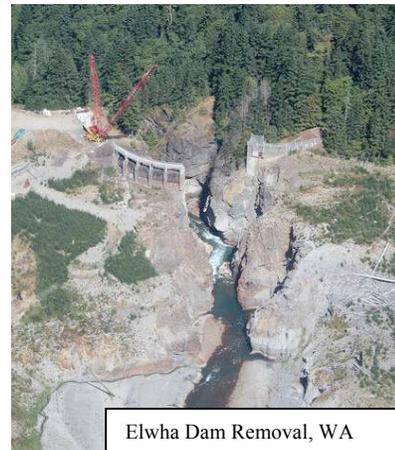
Meanwhile, the department just announced it was increasing State Water Project allocations from 15 percent, decided last month, up to 35 percent. This means that State Water Project contractors south of the Sacramento-San Joaquin Delta may receive 35 percent of their requests for the 2019 calendar year. Allocations are reviewed monthly and finalized typically by May. "Recent storms boosted California's snowpack and total precipitation well above average, which allows us to have a more abundant water supply allocation," said DWR Director Karla Nemeth in a press release. "Although we've got more water in the system now, we must always manage our precious resources with tomorrow's climate uncertainties in mind." Lake Oroville, the largest reservoir of the State Water Project, has been managed conservatively with public safety in mind as work continues on the spillways, according to DWR. It is at 53 percent of capacity and 78 percent of average. Most state reservoirs are at or above their average capacity for this time of year and the Sierra Nevada snowpack statewide is around 146 percent of average.

(Dam removal marches on. They're now in control.)

Ecosystem responses to dam removal complex, but predictable

February 21, 2019, USDA Forest Service, phys.org

In the United States, the removal of dams now outpaces the construction of new ones—with more than 1,400 dams decommissioned since the 1970s—and a new study suggests that the ecosystem effects of dam removal can be predicted. Published in the journal *BioScience*, the study identifies a consistent set of physical and biological processes that control ecological responses to dam removal. These processes, combined with the unique environmental conditions found at each dam, ultimately determine how the ecology of the river will respond. "We found that each dam removal is unique because of the location, size, and history of the watershed," said Ryan Bellmore, a Juneau, Alaska-based research fish ecologist with the U.S. Forest Service's Pacific Northwest Research Station who is lead author of the study. "Nevertheless, we found that ecological responses generally follow similar patterns."



Although dams are primarily removed because they are aging and are costly to repair or upgrade, ecosystem recovery also is a common objective, particularly for fish species such as salmon that are culturally and economically important.

Bellmore and 14 other government, university, and nonprofit organization colleagues synthesized more than 125 dam removal studies and ecological theory into conceptual models. These models reveal the key physical and biological factors responsible for driving ecological responses to dam removal and show that these factors—and associated ecological responses—are distinctly different upstream and downstream of removed dams. Upstream of former dams, the major driver involves aquatic species recolonizing habitats that they were not able to access with the dam in place. Downstream of former dams, the river often receives a surge of sediment that had accumulated in the former reservoir, which can lead to major—although temporary—effects on aquatic organisms. Finally, in the former reservoir itself, species that are adapted to slower, deeper water are replaced by those adapted to shallower, faster moving water. Managers and dam-removal practitioners can use the study's models to gauge the potential range of ecological responses to dam removal and the most likely future conditions, helping generate more realistic expectations for ecological recovery. "This research expands our conceptual understanding and

improves our ability to predict response to future dam removals," said Jill Baron, co-director of the U.S. Geological Survey's John Wesley Powell Center for Analysis and Synthesis, which sponsored the work.

(Here's the numbers.)

82 dams removed to restore rivers, improve public safety in 2018

By American Rivers, February 21, 2019, yubanet.com

Washington February 21, 2019 – Eighty-two outdated dams were removed in 2018, restoring rivers, improving public safety and recreation opportunities, and revitalizing fish and wildlife in communities nationwide, American Rivers announced today.

Communities in 18 states, working in partnership with non-profit organizations and state and federal agencies, removed the dams last year to restore more than 1,230 miles of streams. Dams were removed in the following states: California, Connecticut, Georgia, Illinois, Indiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New York, North Carolina, Ohio, Oregon, Pennsylvania, and Wisconsin.



In 2018, with the removal of 33 dams on the Cleveland National Forest alone, California had the highest number of dam removals, for the first time surpassing Pennsylvania, the leading dam removal state for the past 15 years. The top three states removing outdated dams in 2018 were:

- California: 35 dams removed
- Pennsylvania: 7 dams removed
- Michigan: 7 dams removed

"The river conservation movement in our country is stronger than ever," said Bob Irvin, President of American Rivers. "Twenty years ago this summer, Edwards Dam was removed from Maine's Kennebec River, sparking a river restoration movement nationwide. Today, not only is the Kennebec thriving, but rivers nationwide are coming back to life thanks to the removal of harmful and outdated dams."

When a dam is removed, a river can again flow naturally, which has benefits for water supply, flood protection, wildlife habitat and ecosystem health. The American Society of Civil Engineers gives the nation's dams a D grade in its report card on the nation's infrastructure. One of the most cost-effective ways to deal with outdated, unsafe dams is to remove them. 2018 was the second-best year for removing unsafe, outdated dams in the U.S. 2017 was the top year, with 89 dams removed. "The growing number of dam removal projects across the country shows that there is strong demand from communities for clean, free-flowing rivers which are vital to our health, economy and future," said Irvin.

American Rivers is the only organization maintaining a record of dam removals in the United States. The database includes information on 1,578 dams that have been removed across the country since 1912. Most of those dams (1,355) were removed in the past 30 years. American Rivers played a role in 13 of the dam removals on this year's list. The complete list includes all known dam removals, regardless of the extent of American Rivers' involvement. Factors that contributed to successful dam removal and river restoration projects in 2018 include increased awareness about the benefits of removing outdated, unsafe dams; efforts by American Rivers and others to train organizations and increase capacity to manage dam removal projects; and the cost of maintaining aging dams, which pose liability and safety hazards for their owners.

HIGHLIGHTS OF DAM REMOVAL AND RIVER RESTORATION EFFORTS IN 2018 INCLUDE: Bloede Dam, Patapsco River, Maryland

The Bloede Dam was removed in 2018 as part of a larger plan— which included removal of the Union and Simkins dams in 2010— to restore more than 65 miles of spawning habitat for blueback herring, alewife, American shad, hickory shad, and more than 183 miles for American

eel in the Patapsco River watershed. Originally built by a private company in the early 1900s to supply electricity to the cities of Catonsville in Baltimore County and Ellicott City in Howard County, the 34-foot high by 220-foot long dam, located in Patapsco Valley State Park, was most recently owned by the Maryland Department of Natural Resources. At the time of demolition, it no longer produced power or any other economic benefit, but contributed to numerous injuries and deaths, including at least nine dam-related drownings since the 1980s. Its removal reconnects habitat for one of the highest runs of river herring in the Chesapeake Bay.

Cleveland National Forest, California

The Cleveland National Forest removed 33 dams in total—18 dams from Holy Jim Creek, four in upper San Juan Creek, 10 in lower San Juan Creek and one from Trabuco Creek—in 2018. The dams were originally constructed for varying uses, including to create pools for a stocked rainbow trout fishery and provide water for fire suppression. However, years of disuse and, in some instances, a 40-year maintenance backlog resulted in the decision to remove these structures as a way to improve stream conditions and provide adequate fish passage and wildlife habitat. The efforts of the Cleveland National Forest demonstrate the power of coupling smart management of outdated water infrastructure with the potential re-establishment of extirpated species like the southern California steelhead trout

Columbia Lake Dam, Paulins Kill, New Jersey

The 18-foot tall and 330-foot long Columbia Lake Dam was originally built in 1909 and, at the time of removal, owned by New Jersey Department of Environmental Protection Division of Fish and Wildlife. The project consisted of the removal of Columbia Lake Dam and a downstream remnant dam on Paulins Kill. These two dams were physical barriers to fish migration and negatively impacted river flow. The removal of the Columbia Lake Dam restored access to more than 10 miles of historic habitat for migratory fish including American shad, restored 32 acres of floodplains, and provided safe and new recreational opportunities. The project is anticipated to increase abundance and diversity of macroinvertebrates, including freshwater mussels, that are indicative of good water quality

(They don't want to be left in the dust by American Rivers.)

Nature Conservancy removes first dam in Litchfield County

By Katrina Koertin, February 22, 2019, newstimes.com

NEW MILFORD, CT — An excavator chipped away at the old Paper Mill dam Friday morning, allowing the East Aspetuck River to once again flow free. The project is part of a larger effort to remove old dams to restore river ecosystems and fish habitats. It is the first one The Nature Conservancy has done in Litchfield County. "Taking out Old Papermill Pond Dam will provide multiple benefits for nature and people," said Sally Harold, the project manager for The Nature Conservancy in Connecticut. By removing the dam, the fish will not only be able to swim through the river better but it will also prevent the water from getting too hot for the trout, which was happening with the impoundment above the dam. It will also allow the sediment to flow downstream again. All of the man-made materials will be hauled away and the bulk of the sediment will be stored in three areas, allowing the rest to travel downstream and restore the river to its natural state. This can be done because the sediment isn't contaminated and The Nature Conservancy will continue to monitor what travels downstream.



Removing this dam has been in the works for about 10 years because sediment was building up behind it, said John Deluca, committee chairman for the Ousatonic Fish & Game Protective Association, which owns the site. "It got to the point where the spot was unusable and it was deteriorating the river," he said, adding it was almost surreal to see the dam finally coming out

after all of the group's work. **The dam also presented safety concerns and was a liability.** The whole project is expected to cost about \$350,000. It is funded by the U.S. Fish and Wildlife Service as part of the compensation fund General Electric had to establish to remedy its release of polychlorinated biphenyls, or PCBs, into the Housatonic River. Once the group received a grant five years ago, they began working with Princeton Hydro to determine the best way to address the dam and decided to remove it. They then brought The Nature Conservancy on board to oversee the project. The state Department of Energy and Environmental Protection and the National Oceanic and Atmospheric Administration are also involved.

The dam was built in 1855 and originally was designed to power the mill down the road. At some point, a wall was built, redirecting the river as it runs now and providing a swimming hole. The Ousatonic Fish & Game Protective Association acquired it about 15 years ago and uses the site for seminars, fishing and teaching children about the outdoors. "There's little dams like this all over the place," said Becky Cohn, the project coordinator with SumCo Eco-contracting, the firm removing the dam and restoring the river. "You probably don't realize they're there until you're the one driving up to and taking it out." **There are more than 4,400 dams in Connecticut, most of which are privately owned,** Harold said. She said she appreciates any chance to work with these owners to restore the rivers and help the fish. Harold said the bulk of their dam removals happen along the coast because the grant funding is generally available to help migratory species. Because the Housatonic River has a lot of hydroelectric dams, the river is generally not selected for these grants because it's hard for the fish to get through.

Laura Wildman, the engineer on the project with Princeton Hydro, said the dams that are removed are obsolete and generally aren't properly maintained. She said they won't take one out if it has a reservoir, or if it's still used to generate power or floodplain control. She said this particular project is pretty standard. The spillway will be removed, but the earthen part will remain, keeping a part of the industrial history there. Rocks will also be added to the retaining wall to create a habitat. **"It's a low hanging fruit," Wildman said. "It's not complicated."** Cohn said they actually expect to finish up in two weeks, the lower end of the estimated timetable, as long as there isn't a lot of rain or melted snow to raise the water level.

[\(Here's a really dumb thing to do! Don't try this.\)](#)

French mountain biker in hot water after riding down dam in Australia

By Alex Bowden, February 23 2019, road.cc

French mountain biker Kilian Bron has been strongly criticised for riding down the wall of the Mundaring Weir near Perth. The Water Corporation has referred the matter to Western Australia Police. **"Not only is this act illegal, it is extremely dangerous and stupid,"** said a Water Corporation spokesman to the Hills Gazette ([link is external](#)). "At around 40 metres, the wall is very high. While it is unlikely to cause any damage to the wall itself, trespassing onto the wall would be an extreme risk to personal safety."

Bron was not, on the face of it, unduly troubled by the risks.

He posted a photo of himself riding down the dam to Instagram.



Hydro:

[\(There's an app for everything.\)](#)

IHA launches online community and app for hydro professionals

Hydropower professionals from Africa, the Americas, Europe, Asia and the Pacific will be able to exchange experiences and collaborate with one another using a new online community and mobile app launched by the International Hydropower Association (IHA).

Exclusively available to members of IHA, Hydropower Pro gives users access to more than 20 online groups focused on specialist topics, along with access to essential and exclusive downloadable resources.

It is home to IHA's 11 knowledge networks covering topics such as asset management, finance and investment, river basin development, regional interconnections, communications, clean energy systems, climate mitigation, climate resilience and sediment management.



Hydropower Pro provides a hive of news and information from IHA's team of analysts. Users can discover opportunities, discuss new trends and common challenges, and stay updated with instant and weekly email alerts. Hydropower Pro is available to IHA individual members and corporate representatives from member organisations. Existing members can request an invitation to join Hydropower Pro by contacting communications@hydropower.org. The platform is available as a website – hydropower.org/pro – and as a mobile app for Apple iPhone and Google Android devices

(Hydro is the only energy source than can claim all of this. You forgot flood control, navigation, water supply and irrigation, navigation, and recreation. Probably left some out too.)

Chasing Waterfalls: 7 Benefits of Hydropower

By Melissa Thompson, January 31, 2019, accessnews.com

Melissa is a mother of 2, lives in Utah, and writes for a multitude of sites. She is currently the EIC of HarcourtHealth.com and writes about health, wellness, and business topics.

What would you change if you were told you had 12 years left to live? While that might sound dramatic, it's the exact question leading climate scientists are asking about the Earth. A research report released by the UN states that we have 12 years to slow our effect on global warming. After that, we could suffer catastrophic environmental consequences. **The biggest difference we can make is switching to clean energy.** Fossil fuels contribute the bulk of greenhouse gasses into the environment. One of the benefits of hydropower, wind energy, and other alternative energy sources is that they can help turn back the clock on the demise of our planet. **Ready to learn why we need to invest in green energy like hydropower? Read on!**



Benefits of Hydropower

Hydropower, or the power of water, is an infinite resource. Producing electricity via water power doesn't use up water. Rather, it utilizes the running flow to generate energy. Any type of hydropower is always replenished by rains and melting snows. This resource is earth-friendly and carries many benefits!

1. COMBATS CLIMATE CHANGE

Hydropower produces smaller and far less significant amounts of greenhouse gas compared to gas, coal, and oil. **Switching to hydroelectric power would immediately begin to reduce the GHGs released into the atmosphere.** Only 33% of hydropower's available potential has been utilized and developed. Even so, what does exist is already offsetting 4 billion metric tons worth of greenhouse gas emissions.

2. IMPROVES USE OF RENEWABLE ENERGY SOURCES

Reservoirs for hydropower create a flexible energy source. The storage and harnessing of hydroelectric energy means it is a perfect supplement to other methods like solar or wind. Should those common methods fail to meet demand? Hydropower can be a failsafe that immediately offers more energy to the power grid. This flexibility makes it safer and more economical to rely on renewable energy as a whole. Even a string of cloudy or windless days would not tax the available reserve of energy, as hydropower creates an auxiliary system. Hydroelectricity is more readily utilized than any other source. Because of this, hydropower can assist at moderating fluctuations in demand. In a blackout scenario, the rapid generation of waterpower can help recover service right away.

3. STABILIZES THE WATER TABLE

Hydropower plants assist with collecting rainwater, which protects against drought. These reservoirs can help prevent flooding and prevents local water table depletion. Water reservoirs can serve as intermediary sources for irrigation or drinking water.

4. STABILITY AND DOMESTIC AVAILABILITY

Unlike fossil fuels, water is a readily available domestic resource. Utilizing running rivers has no risk of pricing spikes due to market changes. Reducing the reliance on foreign imports of fuels creates an optimal environment for cost reduction and energy availability.

5. INEXPENSIVE TO MAINTAIN

After the initial plant production costs, maintenance and operation of hydropower plants is very inexpensive. Hydropower water sources don't need purification, alternation, or frequent replacement. Because water is not being used up, production costs are virtually zero. There is no market price, so the costs do not fluctuate to shifts in demand the way barrels of oil might. The water supply replenishes naturally, for free, as rains come and snows melt. Hydroelectric plants last for many decades and can be upgraded as technology advances. The oldest power plants in the country are over a hundred years old.

6. IMPACT ON AIR AND WATER QUALITY

Hydropower plants are free of air and water pollutants like the ones generated in fossil fuel production. Reducing the byproducts and toxins from power generation mitigates smog production, air pollution, and acid rain. In combination with water treatment, water reservoirs can double as potable water and resources for hydroelectricity. One of the disadvantages of hydro plants is that they can compromise the water oxygen levels, which can harm local aquatic habitats. Fortunately, technological advancements are allowing environmental scientists to develop solutions to this and other issues that can develop through hydropower use. The Money Map Press goes into greater detail on the advantages and disadvantages of hydroelectric energy in this helpful article.

7. TIME-TESTED PRODUCTION

Hydropower is the predominant renewable energy source in the world, accounting for about 16% of energy production. This technology has been in use for thousands of years. Hydroelectricity is always upgrading and evolving to be more efficient and reliable. Many states already rely on hydroelectricity for the majority of their energy needs. Over 70% of the energy produced in Washington state is hydroelectric. Washington, Vermont, Idaho, and Oregon use hydropower for over 50% of their utility power. Hydropower plants make up the oldest electricity-generating resources in the US. All 50 of the oldest plants in the country have been in service since 1908.

Go Green to Protect Our Future

Humans have done some major damage to the planet we call home. The clock is ticking on our ability to recover from irreversible climate change. Investing in the benefits of hydropower and other renewable energies can help. Engage with your representatives and lawmakers to let them know how important sustainable energy is to your community. Unless we all start pitching in for a

responsible future, we won't have much of a planet left to protect. Scientists have given us 12 years to clean up our act, so it's everyone's job to invest in a greener tomorrow. Want to know how you can make a difference in your own home? Big change starts in small ways. Check out our guide on how you can do your part for the environment and save some money at the same time

(Bet things will get simpler when they have a power sales agreement.)

Proposed hydroelectric plant plans still developing

FEB 15, 2019, by MIRANDA SEBROSKI, timesleaderonline.com

YORKVILLE, IL — Plans for an estimated \$200 million hydroelectric plant at Pike Island Locks and Dam in the Ohio River continue to develop.

Alan Skelly, CEO of Pike Island Energy, attended a Yorkville Council meeting Tuesday, seeking feedback on his plans to build a 48-megawatt plant, which he said would generate enough electricity for about 22,000 homes. Skelly said the proposed six-turbine plant at Pike Island would be located on the portion of the dam closest to Ohio to allow river vessels to pass through the locks portion of the facility. The project has been discussed with Tiltonsville and Yorkville officials since 2017. Skelly said the current state of the project is in the licensing process that will take two years to complete. He said after that is complete, there will be the construction process that will take another two years



"We started talking to folks and we talked to a couple universities from Ohio and one from West Virginia who are interested in power from Pike Island because they are looking at renewable power," Skelly said. "The whole thing is moving along, but it feels like it is at a snail's pace some days." "I have been thinking, does it make sense to make a co-op, so that we are not just selling the power to universities, but instead selling the power here locally and passing on those savings to the residents?" he asked. "Everyone would be saving pretty close to 20 percent on their electric bill with all of this. I had a chance to stop over in Wheeling and talked to the mayor over there about it. He said that they would consider and look at it. I think that is the answer that we are going to get from a lot of people." Skelly said the village would need to examine its options, find out the cost of such a venture and whether any laws would prohibit it. He added that he was considering pursuing a grant to conduct this study.

Skelly also told council that money could be saved while building the power house. "By using the sheet rock panels that are there and building up dirt on our copper walls, that saves us about a half a million dollars," Skelly said. "Just that one thing saves us that money." In 2017, Skelly said he would provide a new fishing area for anglers and will work to improve the fishing conditions for those on the Ohio side of the Pike Island Locks and Dam. This was due to the concerns from residents who said they love to fish at this location. He added that the construction phase of his project could cause "fish strandings," which occurs when aquatic life is found dead on the beach or shore, or floating in the water. Skelly said he has been to the location multiple times to get opinions from fishermen who favor that location. He wants to continue to make sure the site would be a destination for the community. The Pike Island Locks and Dam has been in place since 1963 and spans the Ohio River between Ohio and West Virginia. Its West Virginia terminal is just north of the Warwood section of Wheeling, while the Ohio side reaches Yorkville. In 2014, American Municipal Power considered building a hydroelectric power plant at the Pike Island Locks and Dam but eventually dropped the project. However, that company opened generating units at the Willow Island Lock and Dam in Pleasants County, W.Va., last year.

(Hydro & global warming.)

Hydropower dams can help mitigate the global warming impact of wetlands

Manage methane emissions and produce clean, cheap energy at the same time, argues Mike Muller.

By Mike Muller, 19 FEBRUARY 2019, nature.com

Every few years, a cyclone hits Mozambique's Sofala province. The Pungwe River floods and severs road connections between Zimbabwe and coastal ports, sometimes for months. After a few weeks, the standing water starts to bubble as flooded vegetation decays. This 'marsh gas' is methane, a greenhouse gas that is some 20 times more potent than carbon dioxide.



Elsewhere in Mozambique, such devastation is a thing of the past. Since two hydropower dams started operating on the Zambezi River in the 1960s and 1970s, floods no longer kill hundreds of people and destroy thousands of hectares of crops. Although they were criticized for their environmental impacts (see go.nature.com/2wpjh4y), these dams generate 3,500 megawatts of clean electricity, supplying most of the needs of Mozambique, Zambia and Zimbabwe. Methane emissions from downstream floodplains have also been curbed, an effect that goes largely unnoticed.

Methane is responsible for one-fifth of the rise in average global temperatures over the past century. Approximately half of the roughly 600 million tonnes released every year comes from natural sources — mainly wetlands. In tropical regions such as the Amazon and Africa, fresh water releases almost as much carbon to the atmosphere as forests and agriculture mop up¹. Because aquatic carbon sources and sinks are poorly understood and hard to measure, they are given limited attention in climate policies. Worse, because such policies address the impacts mainly of human activities, some researchers focus disproportionately on emissions from artificial lakes, and neglect those from other waters and wetlands. Many scientists maintain the view that 'natural' emissions are good and 'artificial' ones bad. What really matters is how much carbon enters the atmosphere, not how it got there². Politics is filling the void. Hydropower projects, already controversial for their social and environmental impacts, are now routinely opposed because they are said to add to greenhouse-gas emissions and aggravate global warming. Yet dams that are well planned, constructed and managed can deliver decades of clean, cheap energy and help to mitigate climate change (see 'Life-cycle emissions'). Hydropower dams account for 97% of electricity storage worldwide, and can reach full power in less than a minute. They thus help in the integration of other renewable sources, such as solar and wind, into supply grids³.

These wider benefits are seldom acknowledged. And in a rapidly warming world, we cannot afford blind spots. Researchers need to take a systems approach to carbon emissions and sequestrations from fresh waters. And the roles of dams and other water-management interventions need to be reassessed from the perspective of climate change: in some places, they might help communities and the environment more than they damage them. Carbon follows Rivers function as both pipes and reactors. Carbon washed from river catchments is transported downstream. On the way, some organic material reacts to produce methane and CO₂, which escape to the atmosphere. Solids can settle along river banks, in lakes and on floodplains. The remainder reaches the sea, from which some is recycled into the atmosphere and the rest is locked in sediment and rocks. The amounts vary from place to place. Earth scientists have mapped carbon flow in some rivers, but global estimates of freshwater emissions and sequestration are still too uncertain to produce the robust carbon budgets needed to guide mitigation strategies. Methane is especially hard to follow, because emissions can vary by factors of hundreds across regions and seasons.

It is therefore understandable that lakes are often used to provide a baseline — their areas are well defined and gases emitted from their surfaces are easy to measure. But studying a lake alone paints a partial picture. In my view, this has encouraged anti-dam campaigners to misrepresent the science. Many early studies of reservoirs started with the premise that newly

flooded vegetation would decay and emit methane. High levels of methane were then used to infer that hydroelectricity is not a carbon-free source of energy. This argument was taken up by lobbyists who opposed dam construction. However, other work reveals that most of the methane emanating from dam reservoirs actually comes from carbon sources elsewhere in the catchment. Damming a river blocks the flow of organic material that might otherwise have ended up on floodplains or in the oceans. As in a natural lake, that carbon is either stored in sediments or decomposes. But some methane would have been emitted anyway had the dam not been there. To determine the impact of a dam on overall sequestration and emissions, the carbon balance of the whole catchment needs to be analysed. Yet some researchers persist in studying reservoirs in isolation. Excited reports of high methane emissions from tropical reservoirs still frequently neglect to mention that their main source is the carbon flowing in from upstream wetlands and forests. = So far, the Intergovernmental Panel on Climate Change (IPCC) has resisted calls to include reservoirs as a specific source of greenhouse-gas emissions and to downgrade hydropower from classification as a clean source of energy, citing a lack of evidence. But the panel fails to address the overall dynamics of freshwater carbon and could be missing mitigation opportunities.



Water:

(Too much water, but flood control.)

Wolf Creek Dam increasing releases to historic levels

By Bill Peoples, U.S. Army Corps of Engineers, Nashville District, dvidshub.net

JAMESTOWN, Ky. (Feb. 22, 2019) – With Lake Cumberland approaching its pool of record, the U.S. Army Corps of Engineers Nashville District is planning to step up releases at Wolf Creek Dam to historic levels, with potential flooding in low-lying areas downstream.



Water managers at the Nashville District headquarters in Nashville, Tenn., said Wolf Creek Dam is currently discharging water at a rate of 36,200 cubic feet per second, but plan to increase to 40,000 cfs as early as Sunday, and 45,000 cfs 24 to 48 hours after that. The largest amount of water ever released from the dam is 40,000 cfs in January 1974. “We are working directly with state officials to inform the public downstream that a significant amount of water will be released in a controlled manner from Lake Cumberland to lower the pool,” said Lt. Col. Cullen Jones, Nashville District commander. “The ground is saturated and the heavy rainfall upstream has led to a much greater inflow into the lake than we’ve been releasing at the dam. These increases are necessary because the lake is quickly filling up, and increasing releases in a controlled manner now reduces the likelihood of even greater releases being required in the future.”

Minor impacts to low lying areas near the river, especially in the Cumberland River reach in Kentucky from Rowena to Burkesville are expected from these record high releases from Wolf Creek Dam. The designated downstream control point for Wolf Creek Dam is Celina, Tenn. Wolf Creek, in conjunction with Dale Hollow Dam, is operated to maintain the river stage in Celina at or below 25 feet. Action stage at Celina is 35 feet and flood stage is 40 feet. Despite zero releases from Dale Hollow Dam on the Obey River near Celina, Tenn., the stage at Celina is currently forecast to reach 32.9 feet this weekend. The Corps is pursuing a deviation from its authorized water control plan to temporarily raise this control flow target of 25 feet at Celina because of the

pressing need to regain storage in Lake Cumberland. The Corps will carefully balance downstream flooding concerns with storage remaining in Lake Cumberland, but the stage at Celina will remain elevated and above its control flow target for many weeks.

Following the impacts from this weekend's rainfall leading to the projected crest of 32.9 feet, the stage will stay elevated around 29 or 30 feet. The Ohio River Forecasting Center of the National Weather Service is the agency responsible for issuing river stage forecasts. The forecast for Celina is available at <https://water.weather.gov/ahps2/hydrograph.php?gage=clat1&wfo=ohx>. Jerry Breznican, Nashville District Emergency Management chief, said the Corps of Engineers is working with state officials to communicate with land owners downstream and to get the word out about these increases for public safety. "We are coordinating with the Louisville District Emergency Management Operations Center and they are in turn communicating with Kentucky Emergency Management," Breznican said. Residents can contact emergency managers for Russell County at 270-343-1408, Clinton County at 606-387-9163, Campbell County at 859-635-1111, and Wayne County at 606-348-3302 for more information about the increased releases at Wolf Creek Dam.

Michael Dossett, director of Kentucky Emergency Management, said, "Kentucky officials are asking that everyone remain vigilant during these flooding conditions and continue to monitor the developing high water issues." The current elevation of the lake is 748.26 feet. A total of 66 percent of the flood control pool is currently being utilized. Anthony Rodino, Nashville District Water Management Section chief, explained that the Nashville District has to increase releases at this point in an effort to regain storage in the reservoir.

The flood control pool at Lake Cumberland spans elevations 723 to 760, which allocates 2,094,000 acre feet of storage in the pool and allows for storage of 6.78 inches of rainfall runoff from the 5,789 square-mile watershed. The current elevation at Lake Cumberland is the highest observed since the pool of record of 751.69 in May 1984. The water management plan designates Celina, Tenn., as the downstream control point. The flow at Celina, which is made up of discharges from Wolf Creek Dam and Dale Hollow Dam, as well as the 583 square miles of uncontrolled watershed below the dams, is normally maintained at or below 40,000 cfs. However, current circumstances require the Corps of Engineers to go beyond normal operating levels and make the necessary larger releases. For more information about how the Nashville District operates the Cumberland River Reservoir System, see the Water Management Education Series at <http://www.lrn.usace.army.mil/Missions/WaterManagement/EducationSeries.aspx>. A little more, as necessary, news and information regarding water management and flood operations will be made available on the district's website at www.lrn.usace.army.mil, on Facebook at <http://www.facebook.com/nashvillecorps>, and on Twitter at <http://www.twitter.com/nashvillecorps>

(In case you wondered, 2 million gallons per second is bit over 267,000 cfs.)

Watch water spill over Wilson Dam at 2 million gallons per second

By Leada Gore | al.com, 2/21/19

Heavy rains have resulted in massive flows at the Tennessee Valley Authority's Wilson Dam on the Tennessee River near Florence. The dam is releasing some 2 million gallons per second using all available generating units and 43 spillway gates, TVA said. Heavy rainfall has resulted in very high levels along the entire 652-mile river, so water is being stored at dams in the tributary and main stem reservoirs to help reduce downstream flood levels.





Currently, the Tennessee River in Florence is at 21.33 feet, more than 3 feet over flood stage. A flood warning remains in place at the Tennessee River at Florence through today. Minor flooding is expected and, once water reaches 21.5 feet, it will cover the parking lot of the marina at McFarland Park with extensive flooding expected at the soccer fields and golf course within the park. Water is also beginning to cover the road that goes underneath highways 43 and 72 at the playground. The road and bridge at Wilson Dam are closed. According to the National Weather Service, the current crest compares to the 23.7 feet experienced on Dec. 29, 2015. Incredible site! Wilson Dam near Florence AL, is releasing 2 million gallons per second. Heavy rainfall has resulted in high river conditions along the Tennessee River. We are storing water at tributary and main stem reservoirs to help reduce downstream flood levels. Click this link to see the video: #ALWX #TNWX



Other Stuff:

(Think about how many wind farms this will take! Excluding hydro is a mistake! Wind and solar can never approach the efficiency of hydro. And, it's always cheaper.)

SLOWLY GREEN SPECTATOR

BY STEPHEN TUTTLE | FEB. 23, 2019, northernexpress.com

We are determined to get ourselves some “green” energy. There is legislation in Congress and in various state legislatures. Cities and states are setting goals for percentages of power generated from renewable sources by certain times. Noble objectives all. But it won't be that easy to replace fossil fuels or the infrastructure and economy they drive. The country might be thinking green, but the fossil fuel industry continues to be a powerful economic force and political player. Not to mention millions of employees being paid more than \$1 trillion annually — and paying billions in taxes. The industry has a vast infrastructure to which federal, state, and local governments have contributed significantly in the form of various incentives. There are somewhere between 115,000 and 150,000 gas stations here (no one seems to know for sure) and more than two million miles of various oil and gas pipelines, the most extensive such network in the world.

While we talk about going green, we've reduced environmental regulations, expanded areas available for oil/gas exploration, and continue expanding production. We're now the leading oil producer in the world. So, no, it won't be easy breaking a stranglehold more than a century old. But even if we ignore climate science, we already know extracting, transporting, and processing fossil fuels are dangerous and environmentally destructive. Burning those fuels creates tiny particulates that are harmful to our health. The World Health Organization (WHO) attributes 7 million deaths annually to particulate pollution, including 71,000 here in the U.S. That leaves us with solar and wind as viable options — hydroelectric having lost its pollution-free charm. Both come with their own issues that will slow down their progress.

Solar, for all its appeal, isn't so clean prior to installation. The manufacture of solar panels and solar cells — China makes 60 percent of the panels and 71 percent of the cells — utilizes a cocktail of toxic chemicals, including acids, solvents, and known carcinogens. Breathing the inevitable silicon dust isn't so good for the workers, either. The manufacturing, material transportation, installation, and maintenance all come with their own carbon footprint. And solar panels have a shelf life and need to be decommissioned, dismantled, and replaced, adding to that footprint. There is also a land-use issue associated with large-scale solar. The largest solar

array in the world, in India, will produce enough electricity to power 150,000 homes when at full capacity. **But the array covers nearly six square miles.** We'll need way more land, and that means environmental concerns like habitat degradation, migratory corridors, flood plains ... anything covering many square miles is going to have issues. **Despite all of that, the Union of Concerned Scientists (UCS) puts solar's overall contribution to pollution at less than a third that of natural gas and barely 10 percent of coal.**

Which brings us to wind power, **which is even cheaper and greener than solar but has been far more controversial.** Those turbines and towers produce their own pollutants during manufacturing, transportation, and installation. (We've not yet found any power source that doesn't somehow contribute to air, water, or land pollution.) **Wind turbines have another issue; they don't exactly fit into the landscape on which they're placed.** Almost every location proposed has encountered opposition based on their appearance, intrusion into the landscape, shadow casting, noise, and bird strikes. But, once operational, they produce the cheapest energy of all. **Maine, despite a relative handful of fervent opponents, including ex-governor Paul LePage, now gets about 17 percent of its power from wind.** But Maine's power needs are relatively small, and the country's are enormous. The temptation is to think in terms of huge projects, and that could be an impediment to going green. Massive solar arrays and wind farms aren't the only solution. Those technologies work just as well, and maybe better on smaller scales.

Smaller communities don't necessarily need to be grid-dependent. They can make huge inroads in their renewable energy goals by encouraging smaller solar and wind farms designed to power a few thousand, or tens of thousands of homes, instead of millions. Even better would be each home with its own solar, wind, geothermal, hydrogen fuel cell — or some combination — built into new construction, so no grid is needed at all. The economies of scale are nearing a point at which that will be entirely possible. **Both solar and wind technologies continue improving, becoming more efficient and producing more power, greener and cheaper.** Their use, or a yet-developed renewable source, is inevitable and will save lives and, perhaps, the planet. But it will require patience, political will, leadership that understands science, and likely a couple generations rather than a couple decades. **The steps we now take, while critical, are just the first miles of a marathon. Fossil fuels' days are numbered, but it's still a very big number.**

(Jumping on the wagon before the “green new deal” does.)

Climate hedgehogs and foxes

By Armond Cohen and Steve Brick, Opinion Contributors — 02/21/19, thehill.com

The views expressed by contributors are their own and not the view of The Hill

The Democratic take-back of House of Representatives and the recent introduction of the “Green New Deal” Congressional resolution have reinvigorated discussion of action on climate change. The Green New Deal resolution calls for meeting 100 percent of U.S. power demand through “clean, renewable, and zero-carbon electricity” – a recognition that it will take all of the **technologies in the toolkit, including nuclear and carbon-scrubbed fossil, to fully decarbonize the power sector.** **Despite pressure from those seeking an end to fossil use within 10 years and power the electric grid solely with wind and solar, coupled with batteries and other forms of energy storage, the Green New Deal resolution does not exclude any zero-carbon technologies.** As the Senate sponsor, Sen. Ed Markey Edward (Ed) John Markey Climate hedgehogs and foxes Overnight Energy: Trump ends talks with California on car emissions | Dems face tough vote on Green New Deal | Climate PAC backing Inslee in possible 2020 run AOC's green deal isn't new — **it's been a flop in Germany** MORE (D-Mass.), said in announcing the introduction of the resolution: “While the resolution does not mention any specific technology, it talks about any technology that can dramatically reduce greenhouse gases. . . .We are open to



whatever works." That is the wise approach. The Intergovernmental Panel on Climate Change, many leading environmental organizations and the last Obama White House report, argue for the broadest possible set of approaches – the use of wind and solar energy, as well as increased use of nuclear energy, scrubbing carbon out of fossil fuels, and, in some cases, the expanded use of hydropower and biomass energy.

Moreover, the most motivated states on climate issues have adopted the technology-inclusive approach. New York Gov. Andrew Cuomo recently committed the state to 100 percent carbon-free electricity by 2040. Last fall, California set a target of carbon-free energy by 2045. Earlier, Massachusetts set a technology-inclusive goal of an 80 percent reduction in carbon emissions by 2050. While these state plans include a large minimum share of renewable power, they allow other technologies to provide the balance. The philosopher Isaiah Berlin once proposed a distinction between two kinds of thinking, quoting an aphorism that "[t]he fox knows many things, but the hedgehog knows one big thing." Berlin elaborated that hedgehog thinkers embrace single, pure explanations of the world, while foxes see complexity, contingency, and the potential for unintended consequences. The "100% renewable energy" vision is a Big Hedgehog Idea, consistent, attractive and highly marketable. But when it comes to solving climate change, the evidence favors the Foxes.

We've reviewed dozens of power sector studies and concluded that having a diverse set of technologies beyond wind and solar substantially reduces the cost of cutting carbon because the wind does not always blow and the sun does not always shine. Worse, wind and sun vary dramatically over weeks and months, not just days, providing the needed power in some weeks and months, but virtually no power in others. At high levels of renewables you need to build three to eight times more wind and solar capacity to ensure that they can produce enough energy at times of low wind and sun – the rest of the time much of that energy would be wasted. Some argue that batteries or other energy storage can solve this problem. But batteries typically store and discharge power over periods of 4-10 hours, not the weeks and months that are needed. Balancing wind and sun with firmer technologies such as nuclear, carbon-scrubbed fossil plants, and "firm" renewables such as hydroelectric, geothermal and biomass – can avoid the high cost of wasted excess, or massive storage.

Additionally, tens of thousands of large wind and solar farms would need to be sited, along with tens of thousands of miles of transmission lines. And we would also need massive flexibility in demand – where residential, commercial, and industrial customers would have to curtail their electric use frequently and for long periods. To be sure, nuclear energy has its own challenges and risks, some of which are being addressed by advanced reactor designs and cost containment strategies, and carbon-scrubbed fossil fuels and advanced geothermal energy are still at an early commercial stage. But this argues for more effort to diversify – not less – through research and development, demonstration, and commercial incentives for early scale-up, as we successfully did for wind and solar in the past few decades. So this is the time not to close off climate options but to cultivate them, as New York, California and Massachusetts have. Other states are considering this approach, and The Green New Deal resolution suggests the federal government may eventually follow. Single-bet, Hedgehog strategies might work, but bring all-or-nothing risks. Foxes, on the other hand, are known for their ability to adapt and survive. Armond Cohen is Executive Director of the Clean Air Task Force. Steve Brick is an Adjunct Energy and Climate Lecturer at the Kellogg School of Management at Northwestern University.



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