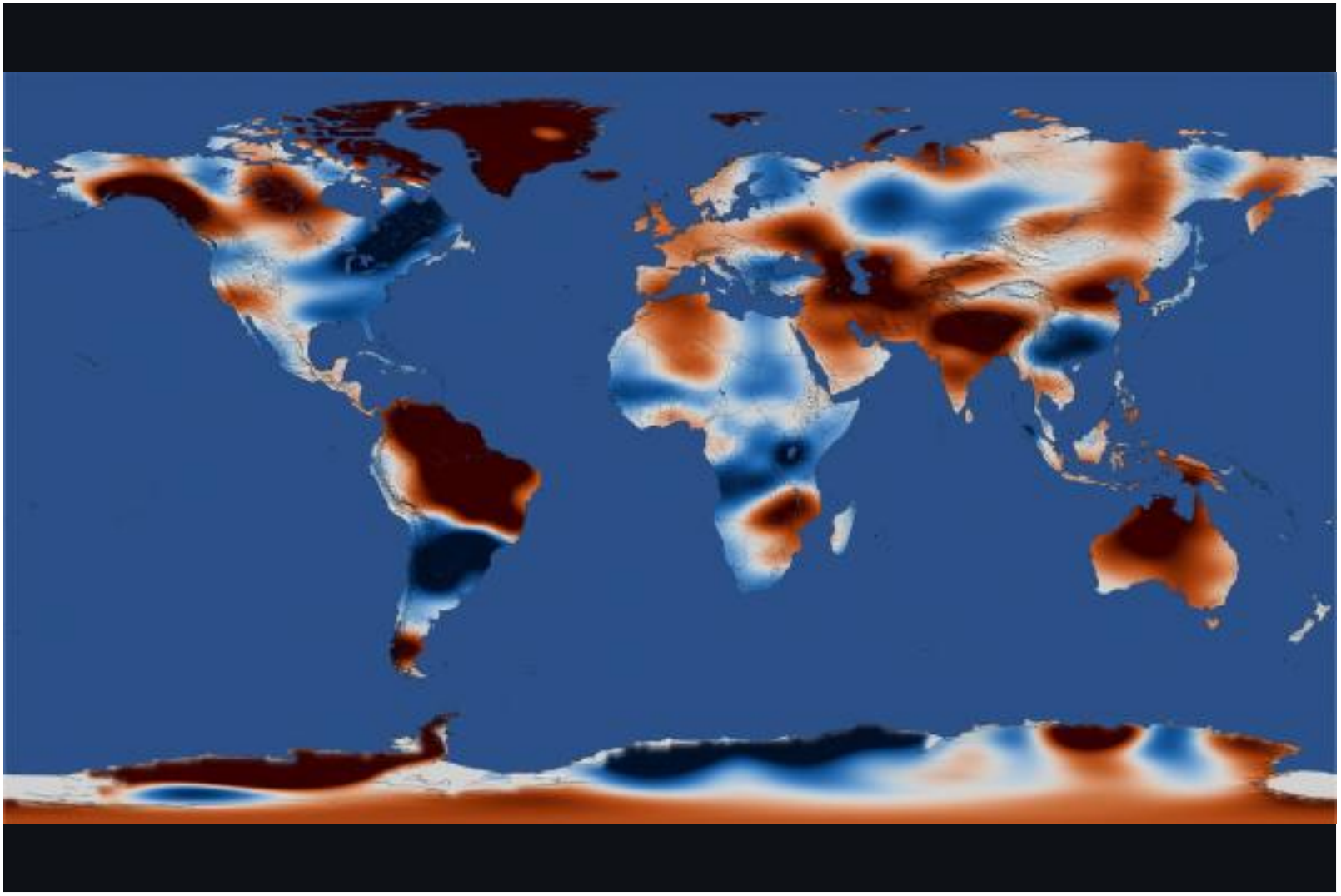
Off Grid Rainwater Harvesting

Can it delay the Day Zero of the water crisis?

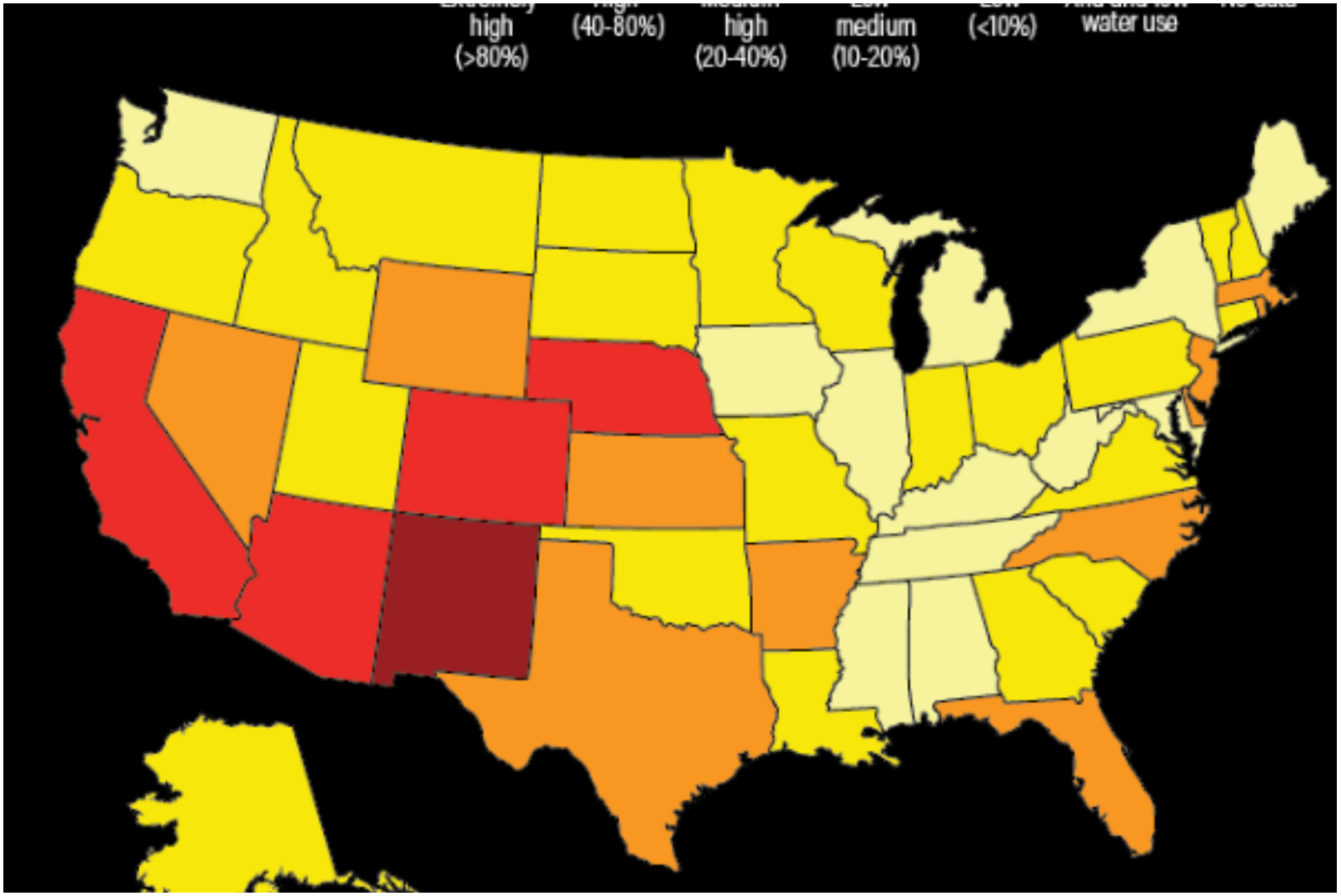
Rhea Rawat

August 7, 2022

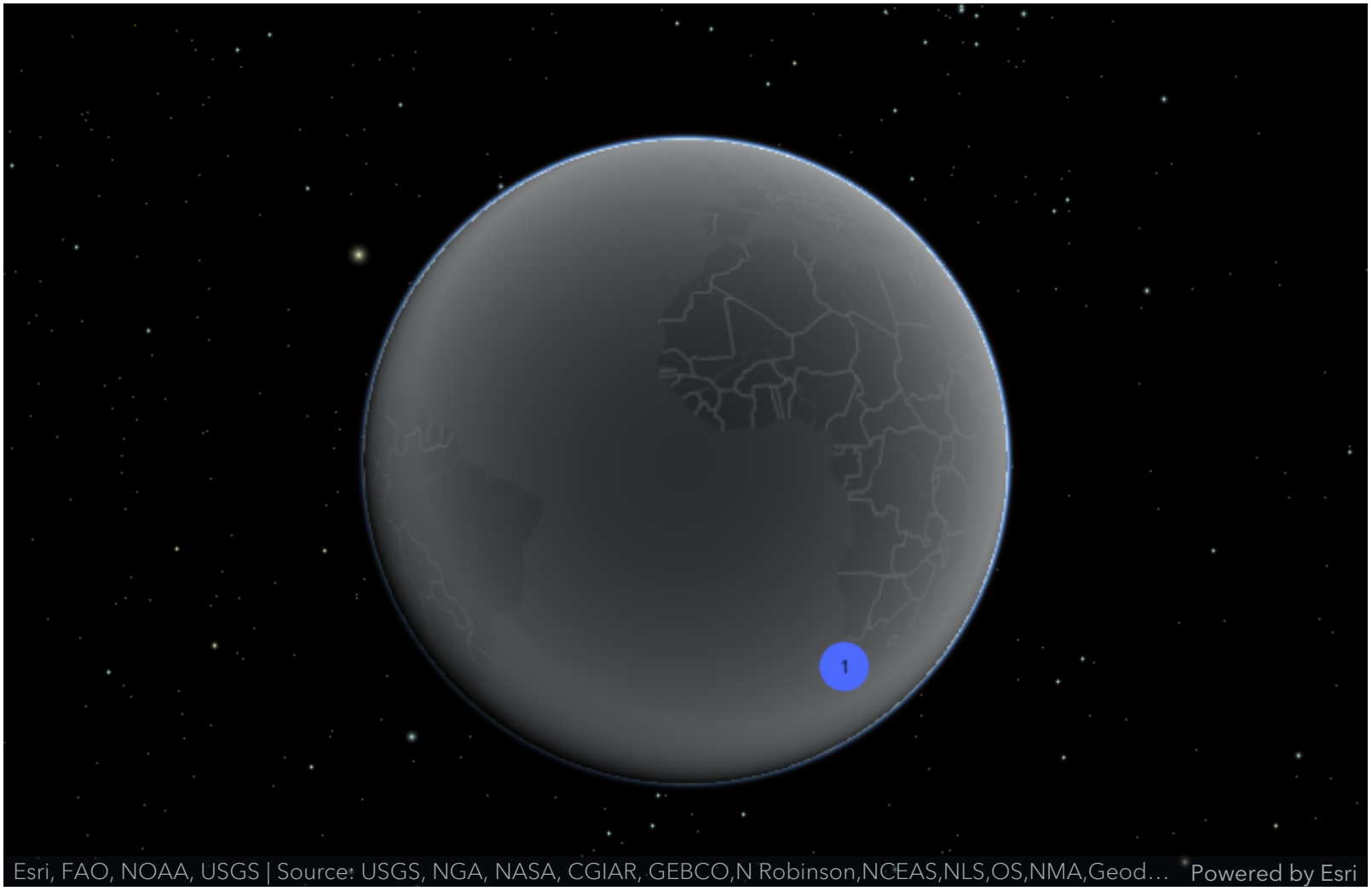
A Global Water Crisis



The availability of fresh water is rapidly changing all over the world. This NASA freshwater map captures changing freshwater availability over 14 years. What the map shows is deeply troubling: Water security—a phrase that means having access to sufficient quantities of safe water for our daily lives—is at a greater risk than most people realize.



Even in countries with medium or low overall water stress, communities may still be experiencing extremely stressed conditions. According to the World Resources Institute New Mexico, USA has extremely high-stress levels at par with Cape Town, South Africa.



1 Cape Town, Africa

Cape Town is a prosperous metropolis, a global tourist destination, full of multimillion-dollar beachfront properties responsible for 9.9% of South Africa's GDP. It will be known to be the first modern major city in the world, to reach its Day Zero. Day Zero is defined to be the day the residents living in the area will no longer have access to municipal water. Residents are now limited to using 13 gallons of water per person per day. That's enough for a 90-second shower, a half-gallon of drinking water, a sinkful to hand-wash dishes or laundry, one cooked meal, two hand washings, two teeth brushings, and one toilet flush. Day Zero, though delayed, is still lurking ahead. On D day the majority of residents will have

to line up at communal water points to collect their daily allotment of 6.6 gallons. The Cape Town crisis starts from a combination of poor planning, three years of drought, and bad crisis management. The burden of making sure it doesn't happen rests largely on the resident's ability to cut water usage dramatically.(credit: *TIME.com)*

2 Chennai, India

In Chennai, it rains more than twice the amount in London. It surprisingly hit headlines for running out of water forcing the government to truck in 2.6 Million Gallons of water for its residents. Rapid urbanization including housing and factories caused lakes and ponds to disappear. More recently the IT corridor was built on its large area of wetland reducing the capacity of the city's last remaining urban wetland to recharge the groundwater. Rainfall is uneven with 90% during

monsoon and with reduced areas to hold precipitation, flooding has increased. Chennai continues to add a quarter of a million people a year, making it a race against time to curb the floods and water shortages.

3 New Mexico, USA

While the United States of America as a country is not yet in a water crisis, the stats tell a different story. New Mexico as a state is reported to have high water stress. 87% of New Mexico's public water supply comes from groundwater. Severe declines in groundwater levels have occurred in some parts of the state. New Mexico and several other states also draw water from the Colorado River Basin, and demand for water from that river exceeded supply more than a decade ago. With the drought, some farms were allotted just 10 inches of water from the Rio Grande, compared to the normal 36 inches. With no grass to feed their herds, ranchers sold cattle to pay for hay.

A Potential Solution to Make Every Drop Count - Case Study

Prestige Garden Bay: A condominium complex in Bengaluru, India.

How policy mandates can bring about change: The government mandated self-sufficiency of water for the approval of the condominium complex. The complex would only be approved

if it took no water from the municipal water system and the complex could not dump sewage or wastewater in the municipal sewage system.

The government also mandated rainwater harvesting and sewage treatment for multistory building communities.

In order to secure permits, the builder built 4 borewells sourcing 5.3 thousand gallons of water and a rainwater harvesting capacity of 21.1 thousand gallons, leaving a deficit to be purchased from tankers by the residents. A water treatment plant was added to treat the borewell water before supplying it for drinking. Additionally, each home has a reverse osmosis system.

However, how do you meet the requirement of passing no sewage back to the municipal sewage pipes? The builder installed a sewage treatment plant for water to recycle back into toilets and gardens.

The community swimming pool is supported by high efficient filtration system requiring only 10% of new water a month. Additionally, a dual flush is installed in each bathroom of the complex. Composting facility for the complex encourages waste segregation with biodegradable waste going into the composting bins.

PROPERTY PLUS

Water it down

Rajnish Ohri

CHENNAI SEPTEMBER 27, 2013 18:37 IST
UPDATED: JUNE 02, 2016 15:35 IST

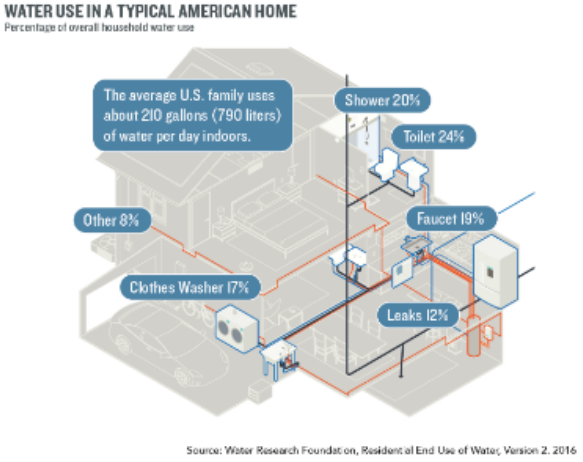
The average individual uses up to 70 gallons of water in a day. You could save 25 gallons of this with a few smart moves, says Rajnish Ohri

The homeowner association took further steps to upgrade the capacity of the sewage treatment plant, increase the rainwater harvesting capacity to 660 thousand gallons to replace water brought from the tankers, and address future consumption increases. Additional capacity can be shared with agriculture and nearby construction projects.

In advocacy, the homeowner association has bought aerators and kept them in a local shop. Any resident can buy these and the society plumber will install them on the faucets. Residents are urged to reduce water consumption by limiting showers and using buckets to limit water used for showering. Many residents are removing bathtubs. Biodegradable detergents that use less water are also encouraged.

America what are we waiting for?

An average US family uses about 300 Gallons of water out of which 210 gallons or 70% is used indoors and 30% outdoors. Compare this to Italy where the average daily consumption is 58 gallons or Canada where it is 86 gallons. When do we wake up to the fact that a water crisis is coming to our backyard and squandering away water like an abundant resource is no longer an option?

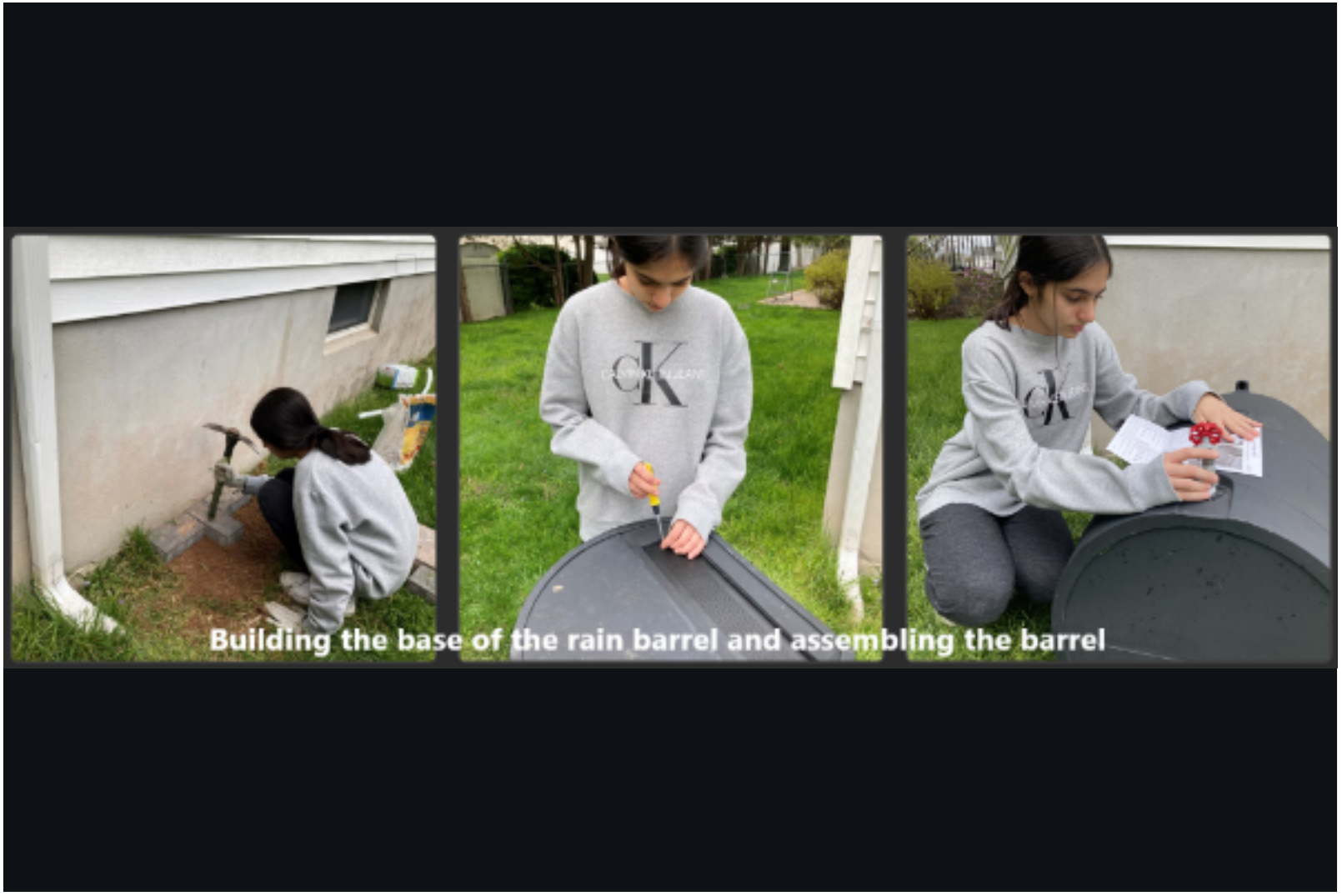


Average American water consumption

Creating your own off-grid rainwater harvesting system

Rainwater harvesting, also known as rainwater collection, is the process in which water is captured and stored for later use. So what is the point of this?

Water crises all over the world, are nothing but human causes. Many people use sprinklers to water their lawns. Nonetheless, this water is nothing but tap water that has been purified for our daily activities. Plants also benefit from the rainwater minerals, that our purified water lacks. Purified water won't harm the grass in any way, but it will slow down the growth of your plants. This got me thinking about why we are throwing drinking water onto our lawns when we are headed towards a drinking water crisis.



Step 1: The Rain Barrel

First, I had to find a rain barrel and decide its size. I ended up buying a rain barrel that could sustain 50 gallons of water to start with. I can easily add more barrels by attaching a pipe between them. I also didn't want insects or debris falling into the barrel, so I

made sure that a protectant screen came with the purchase. The screen is placed directly above the barrel. The small holes allow water to pour, and ensure that leaves and other debris don't fall in.

Step 2: The Diverter

The second thing I need is a diverter to pipe the water from the downspout to the rain barrel. There are different types of diverters. Some diverters channel the water in the direction of the barrel. When the rain barrel is full, the diverter will shut off, and the water will continue its regular path down the pipe. But how does the diverter know when to shut off? The diverter uses the backpressure of the entire rain barrel, and it prevents more water from entering. However, when I read the reviews, many people said that the water was leaking and the backpressure wasn't working. So I decided to go for a simple diverter that will channel the water into the rain barrel and the barrel will have an overflow spout.

Overflow

The rain barrel actually fills up faster than you'd think. This results in "overflow". On the front of the barrel, I stuck a thin white pipe (called an overflow pipe), which led underground to the downspout. Using some tools, we were able to create an opening

in the downspout to attach the overflow pipe inside. This way, any excess water that the rain barrel doesn't have space to store, will just resume its way down the downspout.

After the rain is over, I attached a hose from the rain barrel to the sprinkler and switched it on. But the water is barely coming out of the sprinkler. After realizing that not much water had been coming out of the sprinkler, I started searching for ways to create water pressure. Water pressure is created by a pump. We need the minimum sprinkler pressure, which is around 30 psi (per square inch).

I came across two potential pumps to buy:

Submersible Pump:

This pump submerges under the water, so it isn't much of a hassle to maintain. It has a float switch, which rises to the top of

the barrel as the rainwater fills it up. However, I realized that this would become a problem because as soon as the float switch reaches the top, the pump will turn on. The sprinkler would end up throwing water as it is still raining. The pump will continue to run until there is no water left in the barrel, and the float has reached the bottom.

Water Transfer Pump:

These pumps work by pushing water from the inlet to the outlet. A small, motor inside the pump runs at massive speeds. As water comes in through the inlet, the motor runs, increasing the speed of the water. It exits through the outlet hose. The pump is attached to the barrel from one end (through a hose). As the water comes through the hose, it goes through the pump and quickly comes out from the other side into another hose (which leads to the sprinkler). Although the pump is small, it can throw the water a far distance.

Just like the submersible pump, there were some flaws to this one. The pump doesn't stop running until you unplug it. The sump pump can tell when the barrel is empty, but the transfer pump will still keep running. This can cause it to burn out, destroying the entire pump. In order to make sure this doesn't happen, I will have to stand and watch the sprinklers run until I hear a loud sound

coming from the transfer pump. As soon as you hear this, you unplug it.

Conclusion:

After some debating, I ended up buying the **water transfer pump** because I didn't want the water to be pumping while it is still raining. With the pump that I bought, I choose when to turn it on. The pump resulted in the water coming out of the sprinkler at a much higher rate, and it can now water a great portion of my lawn.

Solar Panel

With the intention of making this project with completely renewable energy (off-grid), I decided that a solar panel would work best with the water transfer pump used to water the lawn. Initially, there was a power outlet, and I used electricity to power

the whole thing. However, currently, our house electricity is being generated by nonrenewable sources. I wanted to see if I can get completely off-grid and use everything from nature.

Understanding Solar Panels: What Are They?

When photons (light) hit the panel's surface, it is absorbed by PV (Photo Voltaic) cells and creates an electric field. This electricity that the panel generated is sent through a conductive wire to the solar power bank. The solar power bank stores this energy in its LiFePO4 battery. This type of battery is more stable and safe than a LiOn Lithium Ion battery. The battery can only supply DC power but my water transfer pump needs AC power. So the battery bank I need to choose should have an inbuilt inverter to convert DC to AC.

Finding the right solar panel to buy for this off-grid project was essential. There are four different kinds of panels I could get:

- Polycrystalline: $0.70 – $1 per cell
- Monocrystalline: $1 – $1.50 per cell
- Amorphous silicon (a-Si): $0.43 – $0.50 per cell
- Cadmium telluride (CdTe): $0.50 – $0.60 per cell

After some research, I ended up buying the Monocrystalline Silicon solar panel with high efficiency. It can provide an average

of 400-500 watt-hours of electricity/day (depending on sunlight availability). The panel has Grade A+ solar cells, meaning that it is the best in its material type (Grade B and C solar cells are inferior to Grade A+). You can expect these solar panels to last up to 40 years or longer before buying a new one.

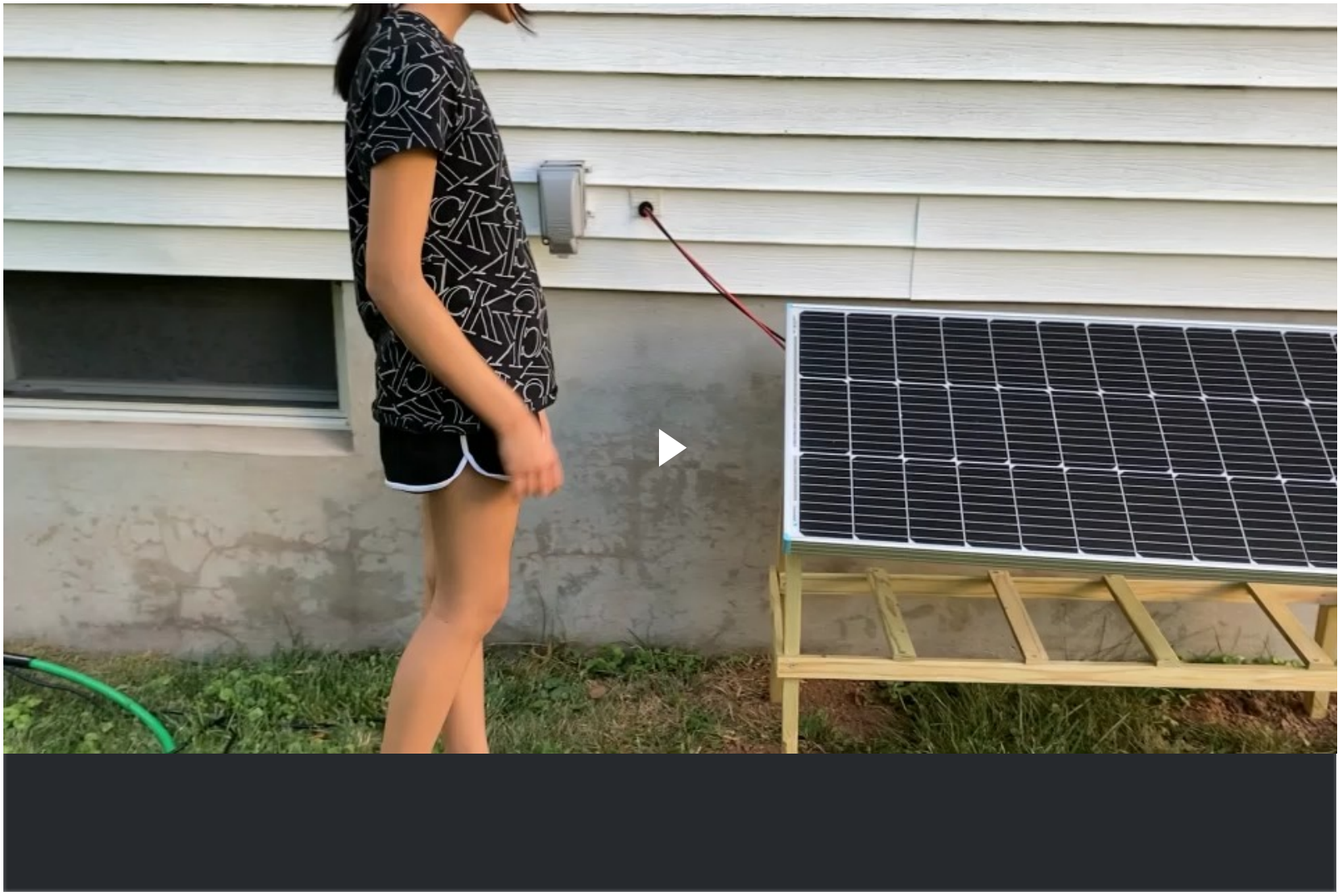
The Solar Power Battery Bank

The solar power battery bank stores the energy from the sunlight via the solar panel. I wanted to use solar power with my pump that requires AC. So I began searching for a battery bank that has an inverter to do this conversion. In this project, the role of the solar power battery bank is to provide the correct type of energy for the pump to function.

There are three kinds of batteries to choose from:

- Lead Acid
- Lithium-Ion
- Nickel Cadmium

The one I ended up chosing was Lithium-Ion (LioN). Within this, there are another 6 main types of lithium batteries. And the one that works best in this situation, is called the Lithium Iron Phosphate battery. This is a popular option for most applications because there are many benefits. The LFP batteries have a long lifespan of 2000 cycles or more. While most LFP batteries have an 80% depth of discharge, this one is rated with a 100% depth of discharge (DoD). And even after this, the battery is not harmed. This battery has excellent thermal stability. The materials are also low resistance, making the battery one of the safest even when fully charged.



Solar-powered rainwater harvesting system

Now we have finally achieved our goal of using solar energy to power the water pump while using the water collected from the rain. This is a completely green solution where we are not using

any resource that is nonrenewable. Now let us see how everything is finally hooked up.

Should we wait till the last drop or lead with innovation?

“Without earth, there is no rain; without rain, the earth cannot endure, and without either, humanity cannot exist” (Genesis, Rabbah 13:3)

A new World Bank reports finds that water scarcity, exacerbated by climate change, could hinder economic growth, spur migration, and spark confl[illegible]*. However, most countries can neutralize the adverse impacts of water scarcity by taking action to allocate and use water resources more efficiently.*