ANGELIKA JAKOB/LUZ/EYEVINE

We've joined oceans and tunnelled under the sea. But some engineers have much grander plans, as ***Michael Marshall*** *reports*

WORLD CHANGING

THEY said it would never happen. Yet by the time you read this, work should have begun on a massive new canal to link the Atlantic and Pacific oceans. Building the 278-kilometre-long canal through Nicaragua will require moving billions of tonnes of earth and cost at least $50 billion. If it is eventually completed, it will be wider, deeper and three times as long as the Panama Canal. Its backers claim it will be the biggest engineering project in history. But it is certainly not the biggest ever suggested. "All of us live in places that are engineered and designed," says mega-engineering expert Stanley Brunn of the University of Kentucky in Lexington. So it's natural to dream even bigger, he says.

That may be true. But some of the schemes sound like the plans of Bond villains, such as flooding California's Death Valley or nuking the isthmus of Panama. Others, like damming entire seas to generate hydroelectricity, are on a mind-boggling scale. Here are seven of the world's biggest schemes. Could we really go ahead with any of them? And should we?


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Join Asia and North America
Unfeasibility
Benefits
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Unfeasibility
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Unfeasibility
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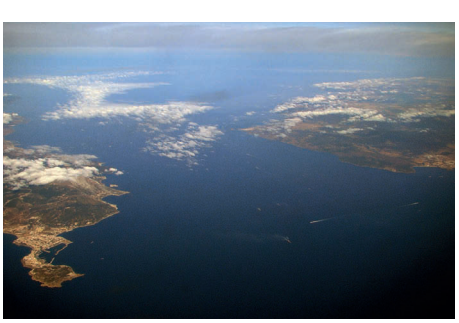
1 Damming the Atlantic

It doesn't get much bigger than this. We could build a barrier across the Strait of Gibraltar (below), effectively turning the Atlantic into a huge dam reservoir. This was first proposed in the 1920s by German architect Herman Sörgel. With the flow of water into the Mediterranean reduced, the sea would begin to evaporate. Allowing it to fall by 200 metres would create 600,000 square kilometres of new land.

The environmental impacts of Atlantropa, as this plan is known, would of course be gargantuan. Perhaps most, er, damning of all, lowering the Med by 200 metres would raise sea level in the rest of the world by 1.35 metres. "It's impossible in terms of the politics," says Richard Cathcart, a real-estate adviser in Burbank, California, and a mega-projects enthusiast who has written several articles and books. "Academics are actually afraid to talk about big ideas," Cathcart says.

With sea level set to rise tens of metres over the coming centuries because of global warming, Cathcart thinks the idea of a dam across the Strait of Gibraltar is worth revisiting. Instead of lowering the Med, a dam could maintain it at its current level, saving low-lying farmland from the sea as well as cities such as Venice and Alexandria. Egypt in particular would benefit. As things stand, rising waters will swamp large parts of the Nile delta and displace millions of people by 2100.



LTCE/GETTY

2 Trans-Atlantic Aqueduct

Northern Africa could do with some more fresh water. The nearest potential source is the world's second largest river, the Congo, but it flows through a volatile, dangerous region. So why not tap the world's largest river, the Amazon, instead? All you'd need is a pipe. A very long pipe.

The idea of piping water all the way across the Atlantic has been around since at least 1993, when Heinrich Hemmer put it forward in a journal devoted to flights of fancy (*Speculations in Science and Technology*, vol 16, p 65). He envisaged a pipe 4300 kilometres long, carrying 10,000 cubic metres of water per second, enough to irrigate 315,000 square kilometres.

There the matter rested until 2010, when Viorel Badescu, a physicist at the Polytechnic University of Bucharest in Romania, revisited the idea with

"Underground nuclear explosions would do the trick"

Cathcart. They proposed to submerge a pipeline 100 metres below the surface, and anchor it to the seabed at regular intervals (*Water Resources Management*, vol 24, p 1645). The pipe would have to be at least 30 metres wide, and have up to 20 pumping stations to keep the water flowing. It would start offshore in the plume of fresh water from the Amazon – "water that has been discarded by the continent of South America", as Cathcart puts it. All in all, he estimates that the pipeline would cost about $20 trillion. Residents of the Sahara, start saving now.

It might be wise to start a bit smaller – perhaps by piping fresh water 2000 kilometres from lush Papua New Guinea to Queensland in Australia. In 2010, businessman Fred Ariel announced plans for a feasibility study into a $30 billion pipeline. This year, the PNG government approved the idea in principle, but Queensland has said the plan is not under "active consideration".

3 Flood the depressions

In 1905, irrigation engineers in California accidentally flooded a depression that lay below sea level. The result was the Salton Sea, the largest lake in the state. There have been many proposals over the decades for flooding other low-lying areas.

The prime candidate is the Qattara depression in north-west Egypt, which lies as deep as 130 metres below sea level. It consists of 19,000 square kilometres of sand dunes, salt marshes and salt pans. The idea is to flood it with seawater from the Mediterranean, just 50 kilometres to the north. Generating electricity is the main motive: if water flows in at the same rate as it evaporates, generation could continue indefinitely. The "Qattara Sea" would become ever more saline, but surrounding areas might benefit from cooler, wetter weather (*Climatic Change*, vol 5, p 73).

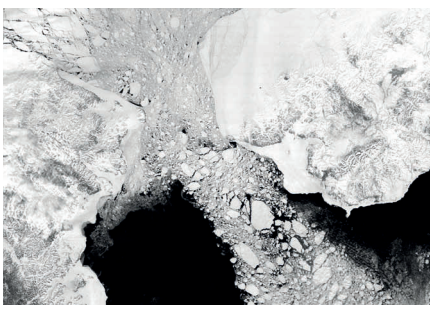
The idea has been around since at least 1912, and the Egyptian government looked into it in the 1960s and 1970s. Few people live in the Qattara, so politically it is doable. The biggest problem is the sheer scale of the construction, which would require tunnels to go under a range of hills between the Mediterranean and the depression. One construction plan involved nuclear bombs. You may not be surprised that Egypt abandoned the idea.

Interest in the idea has revived recently thanks to Desertec – a plan to build a vast solar power plant in North Africa. Magdi Ragheb, a nuclear engineer at the University of Illinois at Urbana-Champaign, has proposed storing energy from Desertec by pumping seawater through a pipeline to storage facilities on top of the hills. When more electricity is needed, this water would be allowed to run down into the depression, turning turbines as it went. There would be no need for tunnels.

Flooding areas like California's Death Valley would also help offset sea level rise caused by climate change. But it is not worth doing for this reason alone: even if we flooded all of the world's major depressions, it would barely make a difference.

The Salton Sea, meanwhile, is not a great advert. It did thrive for decades, but it is now drying out and dying. Most fish can no longer survive in the ever-saltier water, and frequent foul smells and toxic dust are driving human residents away.

4 Join Asia and North America



GEORGE RIGGS, NASA GSFC

The obvious place to link Asia and North America is at the Bering Strait (above), in between Russia's north-east corner and Alaska. At its narrowest point, the strait is just 82 kilometres across, and never more than 50 metres deep.

The idea of a bridge has been around since the 1890s. It would be the longest bridge over water, but not by a silly amount: the current record holder is the Qingdao-Haiwan bridge in China, which spans a 26-kilometre-wide stretch of water. But the Arctic conditions, especially the sea ice, pose a huge challenge. Oil drilling companies like Shell have struggled to even explore in the area.

That may be why Russia is more interested in a tunnel. In 2007, its government announced the TKD-World Link, a railway that would link Siberia to Alaska by way of a tunnel. Seven years later, there is still no sign of the tunnel being dug, and relations between Russia and the US have soured. But perhaps China will take the lead: this year the *Beijing Times* reported that engineers there are hatching plans for a high-speed railway that would run from China to the contiguous US, via Russia, the Bering Strait, Alaska and Canada.

It may not be a recipe for more harmonious relationships, however. Twenty years after the Channel Tunnel physically linked it to the continent, the UK is considering breaking its political union with Europe.

5 Dam the Indian Ocean

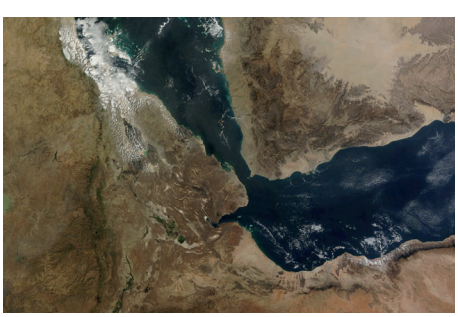
Wherever there's a narrow bit of sea, someone has suggested installing concrete. The idea is usually to build a dam in a place where the water level on one side will drop because of evaporation. The resulting difference in height could be used to generate electricity.

There have been various proposals over the years but two stand out. In 2005, mega-engineering enthusiast Roelof Schuiling, a retired geochemist at Utrecht University in the Netherlands, suggested damming the Gulf in the Middle East where it opens into the Indian Ocean. At one point, the Strait of Hormuz, it narrows to just 39 kilometres across.

The idea is not to do this anytime soon, because it is an important shipping route for oil tankers. But when this trade declines, Schuiling says, damming the Indian Ocean and allowing the level of the Gulf to fall up to 35 metres could generate 2500 megawatts of electricity (*Marine Georesources & Geotechnology*, vol 23, p 25).

There is an even bigger proposal out there: a dam across the Red Sea just before it joins the Indian Ocean, across the Bab-el-Mandeb Strait (below). That would require a dam wall 100 kilometres long, from Yemen in the north to either Eritrea or Djibouti in the south. Even Cathcart calls this "a little more wild". In 2007, he, Schuiling and their colleagues estimated it could generate around 50,000 megawatts of electricity (*International Journal of Global Environmental Issues*, vol 7, p 341).

These projects would lower local sea level and create more land. However, as with Atlantropa, they would cause sea level to rise even faster elsewhere. What's more, without any exchange with the Indian Ocean the water in the seas would become steadily saltier, eventually destroying their entire ecosystems.



EOSNAP/CHELYS

6 Creating land

Building artificial islands or peninsulas has become routine, with some astounding ones being made in Dubai, for example. But existing methods require deep quarries and deep pockets. Schuiling thinks there is a cheaper way to create land. He has shown that injecting sulphuric acid into limestone turns it into gypsum, causing it to swell to up to twice its original size. So where there is limestone close to the surface of the sea, new land could be created.

One such place is Adam's bridge, a narrow and shallow strip of shoals stretching for 35 kilometres between India and Sri Lanka. Schuiling thinks a land bridge could be created using his method for far less than the cost of a conventional bridge (*Current Science*, vol 86, p 1351).

7 Relink the Pacific and Atlantic oceans

Destroying the Isthmus of Panama, the slender strip of land that joins North and South America, would reunite the Pacific and Atlantic oceans. Underground nuclear explosions would do the trick. With the land gone, the ocean current that once flowed around the equator would restart and, allegedly, stabilise the climate (*i-manager's Journal on Future Engineering & Technology*, vol 5, p 74).

This idea is unlikely to be popular in Panama. What's more, some climate scientists think the closure of the gap 3 million years ago forced warm water in the tropical Atlantic to flow north, increasing humidity and snowfall in the Arctic and leading to the formation of the great northern ice sheets. If so, nuking the isthmus would hasten the loss of the Greenland ice sheet. ■

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