SYLLABLE TECHNOLOGY AND DESIGN

UNDERGROUND PUMPED HYDROELECTRIC STORAGE

REPORT SUMMARY, DRAFT 0.1.0

Full report can be found here: github.com/syllable-hq/uphs-feasibility-study

"We only get one home.
We only get one planet.
There's no plan B.

– President Barack Obama

Underground Pumped Hydro Storage

We must stop climate change.
This requires renewable energy.
Which also requires energy storage...
Trillions of dollars of it.

Underground Pumped Hydro Storage
could be 3-15 times cheaper than Li-ion batteries

Climate change damage is escalating

Annual climate damage cost to the United States one decade from now:

$360 billion a year

(That's half of the expected growth of the economy)

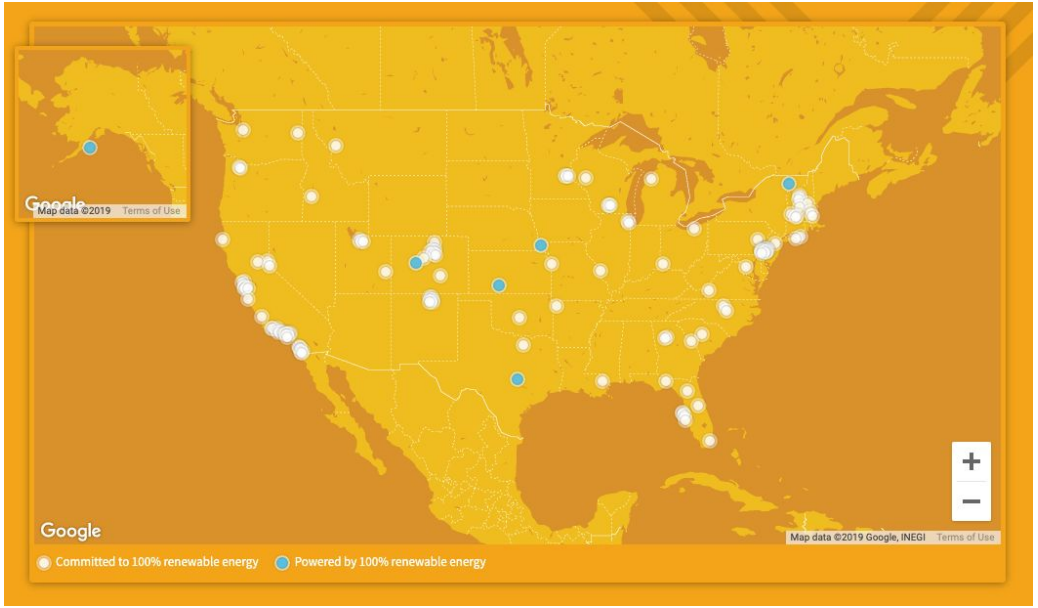
https://feu-us.org/case-for-climate-action-us/

What are we doing about it?

U.S. cities have pledged to become carbon neutral by 2050.

But 100% renewable energy won't work without another key ingredient:

We also need enormous volumes of Energy Storage.



https://thesolutionsproject.org/2018-impact-report/

Why do we need Energy Storage

The sun doesn't always shine & the wind doesn't always blow.

So, renewable energy increases our grid's supply variability…

which makes it hard to match our grid's real-time energy demands.

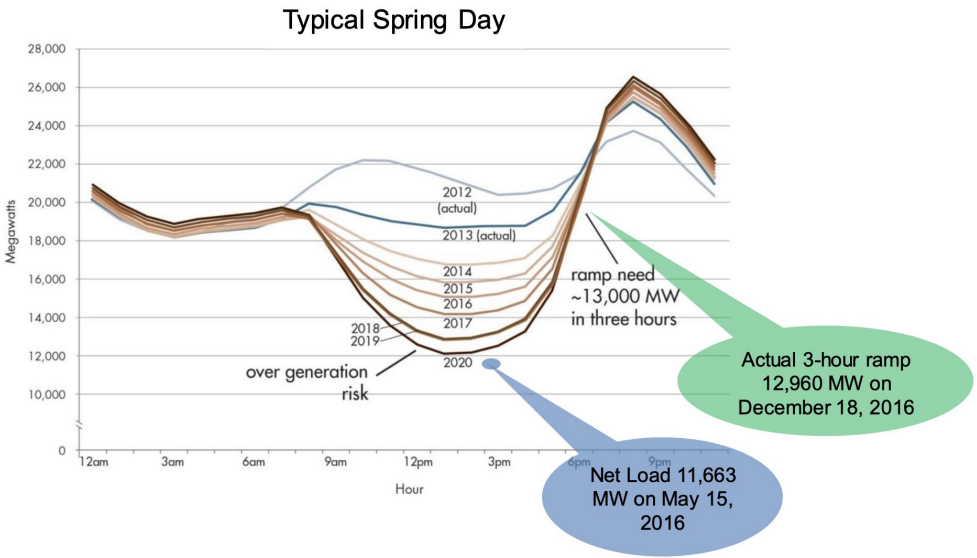


Figure 3. CAISO duck chart (source: CAISO)

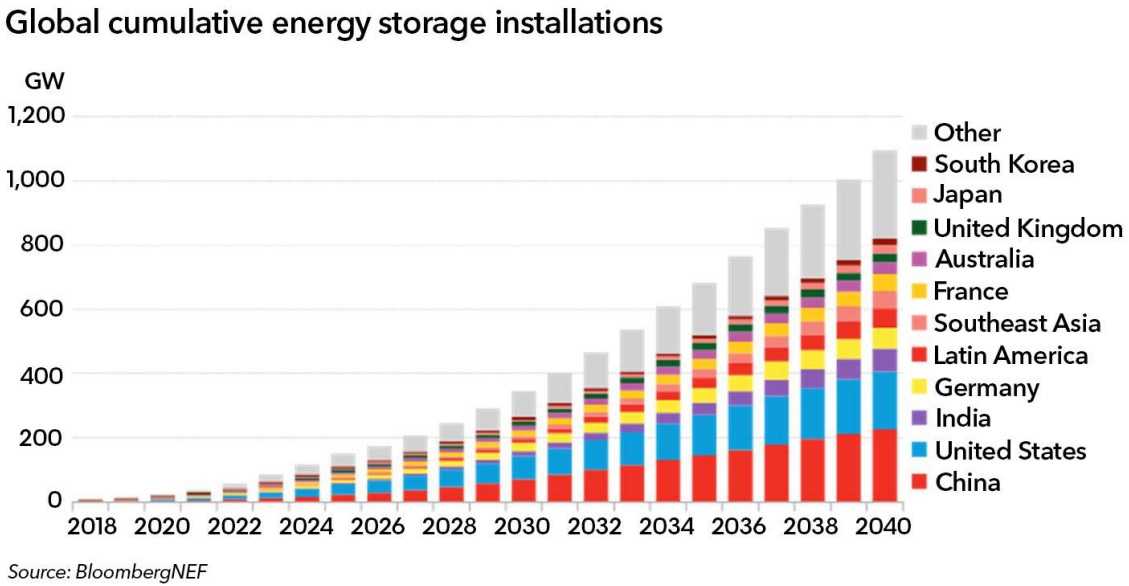
https://www.caiso.com/Documents/UsingRenewablesToOperateLow-CarbonGrid.pdf

How much energy storage do we need?

Getting to 100% wind and solar energy requires enormous volumes of energy storage.

Exponential growth is expected for the market.

~ 14x by 2024
~ 122x by 2040 *



* Not even including pumped hydro installations

https://bnef.turtl.co/story/neo2019

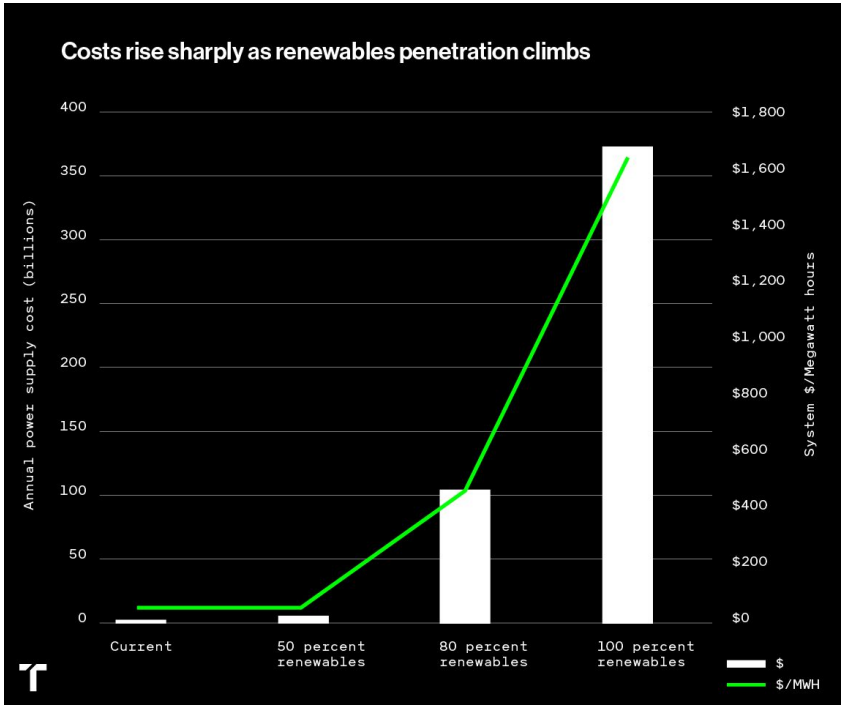
How much will this cost?

We need way more energy storage. Our current capacity is only 2.5% of our overall energy supply.

Li-ion batteries + 80% renewable energy sources would cost too much. How much?

$2.5 Trillion just for the U.S.

But we have a cheaper option...



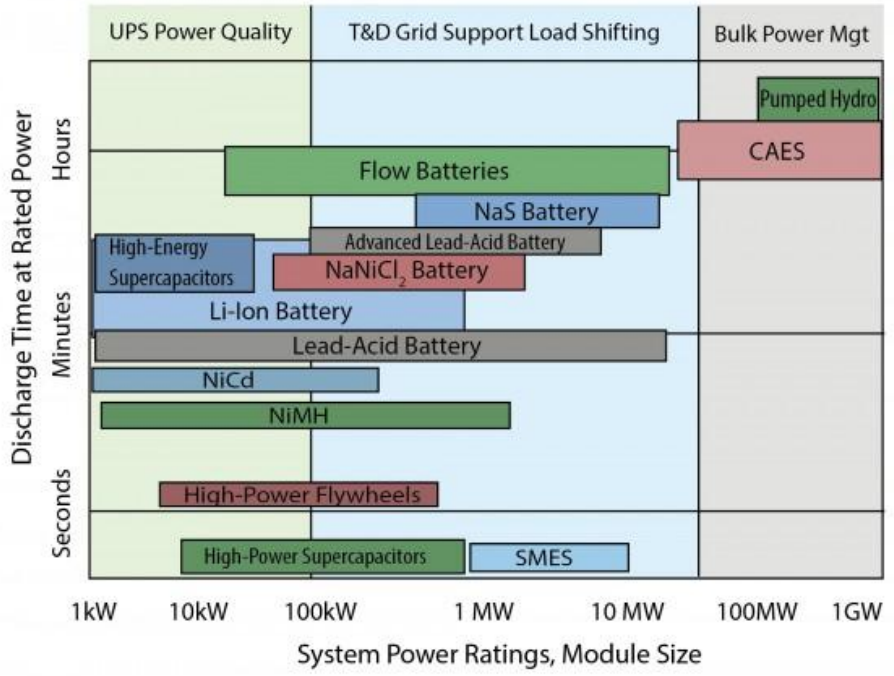
https://www.technologyreview.com/s/611683/the-25-trillion-reason-we-cant-rely-on-batteries-to-clean-up-the-grid

How can we build this energy storage?

There is only one cheap, proven, carbon-free, solution for bulk power management:

Pumped Hydro Energy Storage

Chemical battery solutions are not suitable for grid-scale storage.



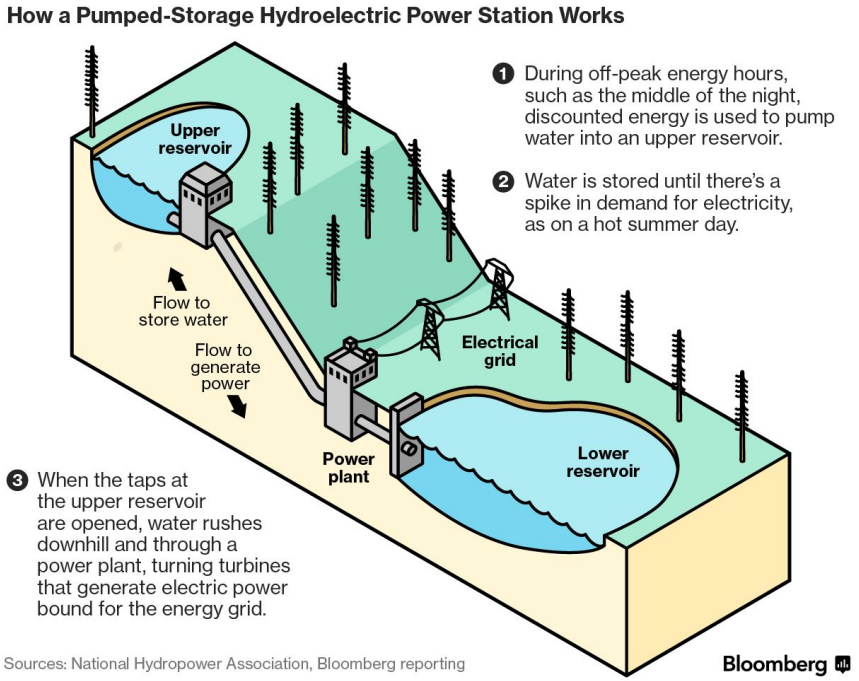
http://css.umich.edu/sites/default/files/U.S._Grid_Energy_Storage_Factsheet_CSS15-17_e2018.pdf

What is Pumped Hydro?

Pumped Hydro Storage is simple. It's just pumping water up and down a hill.

This is how we generate almost all of our energy storage.

Pumped hydro supplies 94% of our stored energy.



https://www.bloomberg.com/news/articles/2019-06-06/in-quest-for-bigger-batteries-california-mulls-century-old-idea

Why not Pumped Hydro?

Pumped Hydro Storage (PHS) is beautiful, simple, & efficient.

But it has disadvantages:

- New dams harm ecosystems
- Construction time is long
- Limited viable locations

PHS permits have spiked, but they are being blocked by eco concerns.

https://www.bloomberg.com/news/articles/2019-06-06/in-quest-for-bigger-batteries-california-mulls-century-old-idea

Better than Pumped Hydro?

What if we could improve Pumped Hydro?

Is there a PHS that is cheaper without disadvantages?

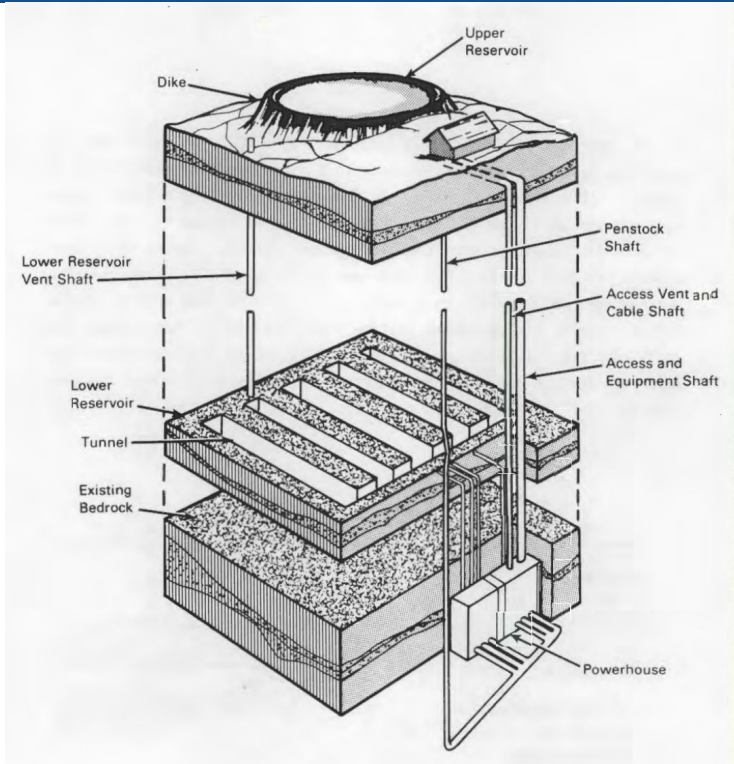
Underground Pumped Storage (UPHS)

Introducing: Underground Pumped Hydroelectric Storage (UPHS)

UPHS is just regular pumped storage, but with a lower reservoir dug out of bedrock.

"The UPHS concept is technically feasible and economically viable."

-- A U.S. Dept of Energy report from the 1980s



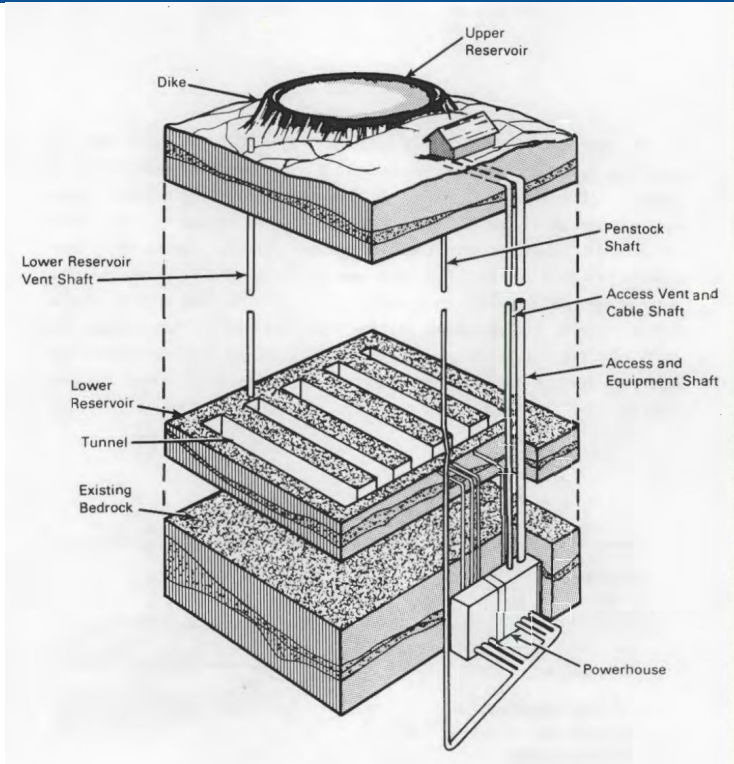
https://www.osti.gov/biblio/6517343

UPHS to the rescue?

A U.S. DOE report from 1984 determined that UPHS costs about the same as traditional pumped storage.

And UPHS avoids PHS disadvantages:

- No environmental concerns
- Shorter construction time (modular)
- Flexible location requirements



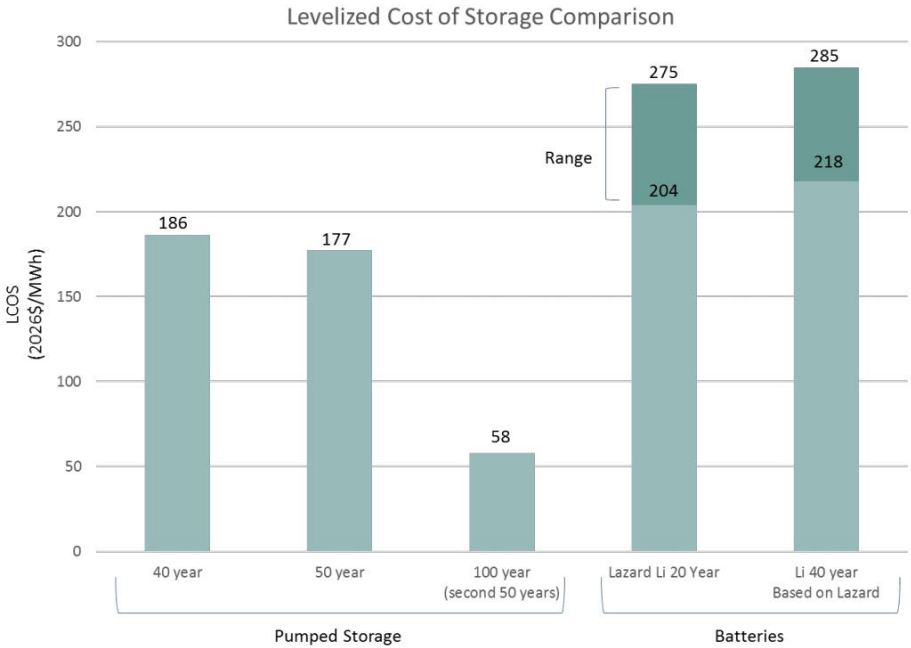
https://www.osti.gov/biblio/6517343

UPHS is cheaper than Li-ion batteries

Pumped Storage (PHS) is cheaper than Li-ion batteries.

UPHS could be the cheapest PHS.

Over 40 years, UPHS could be 3-15 times cheaper than Li-ion.



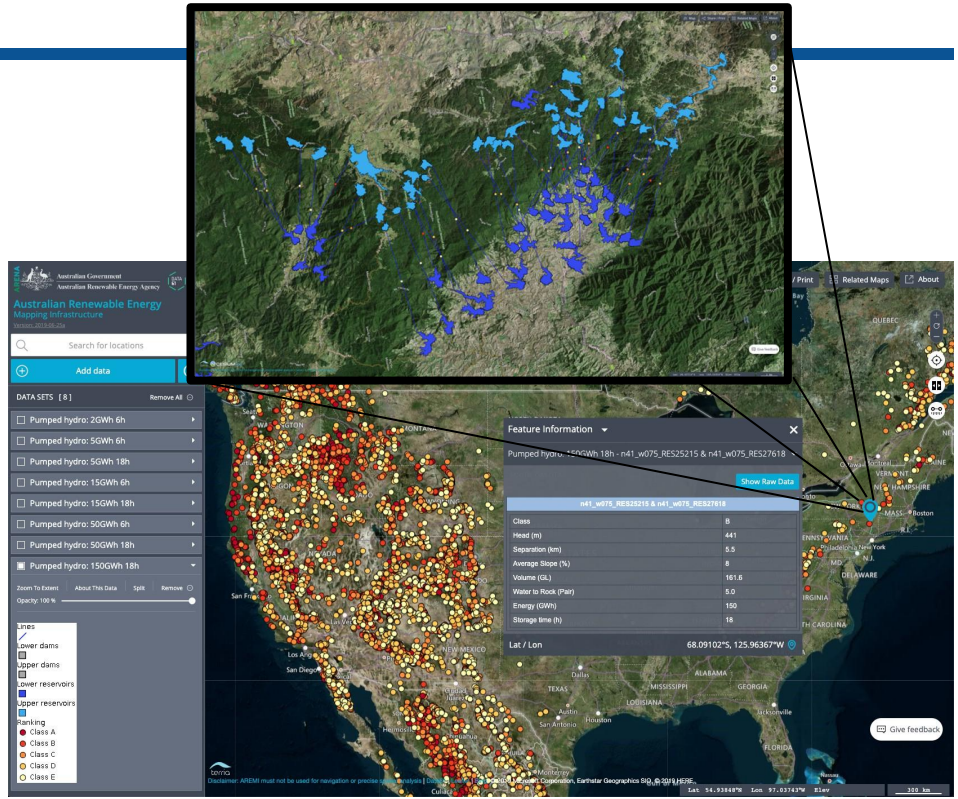
https://www.sdcwa.org/san-vicente-energy-storage-facility

So what's next?

What's next?

We can use mapping tools to discover optimal sites for pumped storage (PHS & UPHS).

We should immediately develop UPHS technology.



http://re100.eng.anu.edu.au/global/

Invest in this project

We are seeking:

- **Engineering Partners**
- **Investment Partners**

Full report at github.com/syllable-hq/uphs-feasibility-study
Contact us at hello@syllablehq.com.
Pitch deck coming soon.

"

We're the first generation to feel the impact of climate change.

We're the last generation that can do something about it.

– President Barack Obama