

How to Fulfill Chile's \$100 billion/year Solar Export Potential

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IEEE, Millennium Project, Lifeboat...

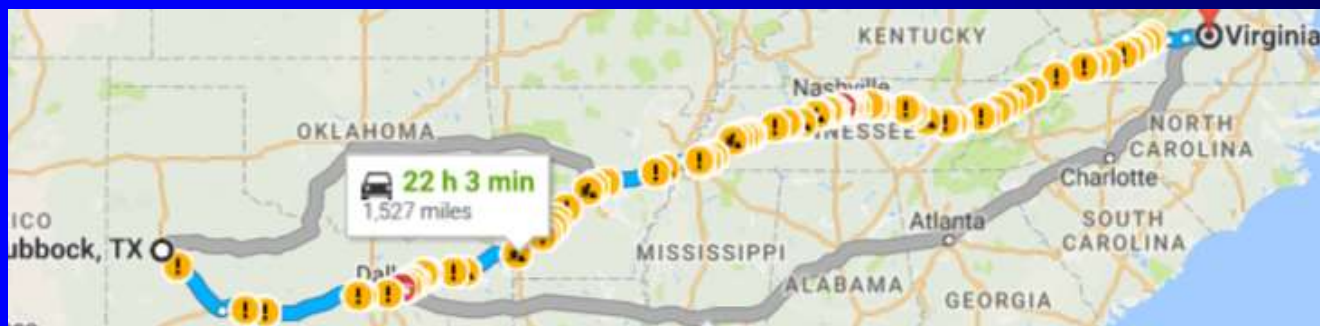
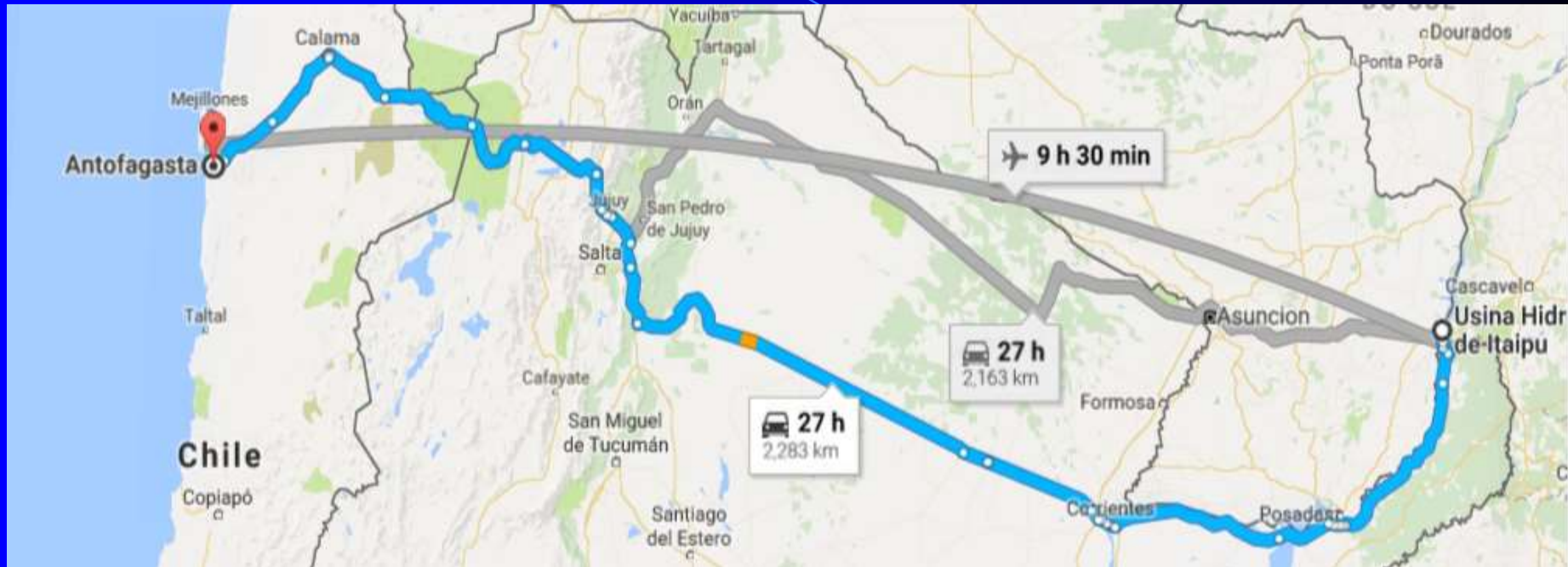
www.werbos.com

Review of Enersol 2016 *

- New generation needed by 2024 in Latin America beyond Chile: 1000TWH per year
 - 10¢/kwh at Itaipu from Chile = **\$100 billion/year**
 - 10¢ - 5¢ (solar PPA) - 2¢(HVDC)→**\$30b/year surplus**
 - **More surplus possible:** storage not needed to Brazil
- 3 Actions Needed to Get Cash Flowing ASAP:
 - Clear Chile/Brazil legal framework, deal rules
 - 1st phase business plan: \$3b, 10 gigawatt, \$1.4/yr profit
 - R&D huge risk reduction solar options
- Global climate risks also demand new action

***www.werbos.com/Atacama.pdf**

Proposed Start: 10 gigawatts on new line as long as TX→PJM 2¢/kwh



1gw→2.8TWH/year. With $(10¢-3¢-2¢)*28TWH$,
\$1.5 billion/year extra profit on \$3b investment

Funding the First Phase

- Large investors prefer predictable benefits. They have few large projects with profits as predictable as this (with Dr. Palma-Behnke's data used in plan). Brazil has had problems scaling up, hydro no longer enough.
- Many funds would fear politics and nationalization but IADB, IAAB, CTG able to risk it, when global development and environment so big a part.
- After a Chile-Brazil deal, the **5¢/kwh cost of solar in Atacama** is what most needs proving. Different funds face different hedging needs, and cost estimates.

2016: 3¢/kwh PPAs based on solar cells probably safe at 10 gigawatts, but need hedge to secure the path to \$100 billion/year (i.e. be sure of <8¢/kwh)

- Power towers have offered 12¢/kwh technology with hope of lower:
 - little mirrors focus on “eye in the sky+storage (liquid fuel option?)
- Unproven leadership opportunity, solar orchards:
 - Each “tree” stands on its own, moving reflector points to small

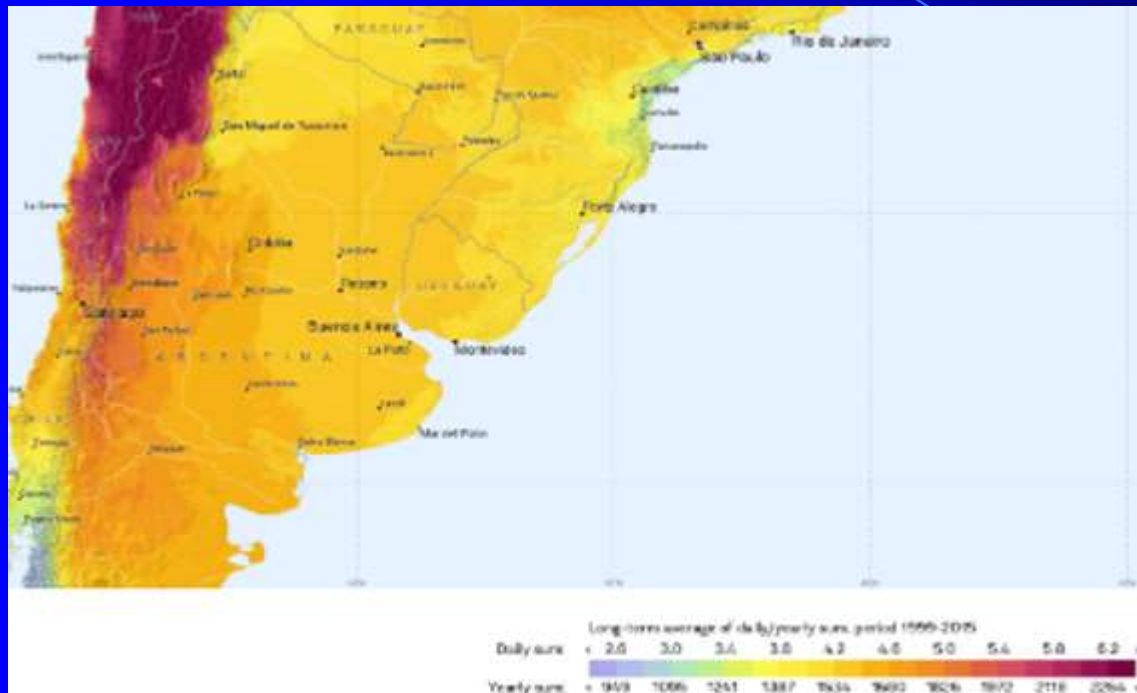


How can we be certain we can get $\leq 5\text{¢/kwh}$ PPAs up to 30gw?

- Atacama already had 3¢/kwh in 2006, with PV farms, and storage not needed to Brazil. But:
 - Trump claims panel costs will go up, $9\text{-}10\text{¢/kwh}$, after China stops dumping solar panels*.
 - China-based funds may disagree, and may like to create a big new market for their solar panels
- Solar Reserve soon bids 5¢/kwh for Atacama CSP, with storage, simply by advances studied in DOE/NREL sunshot program. But not proven yet.
- As in 2016, major **new unmet** technology options worth \$30 million hedge in a \$3 billion investment, updated*.

*www.werbos.com/E/GridIoT.pdf

CTG Already Invests in Renewables in Brazil. Why Go to Chile?



Source:
SolarGIS

- Because cost per kwh is half as much when sun is more than twice as strong, for any technology.
 $5¢/\text{kwh} + 2¢/\text{kwh} < 10¢/\text{kwh}$, difference worth \$30 billion on \$100 billion. (Add 2¢ in Brazil anyway.)

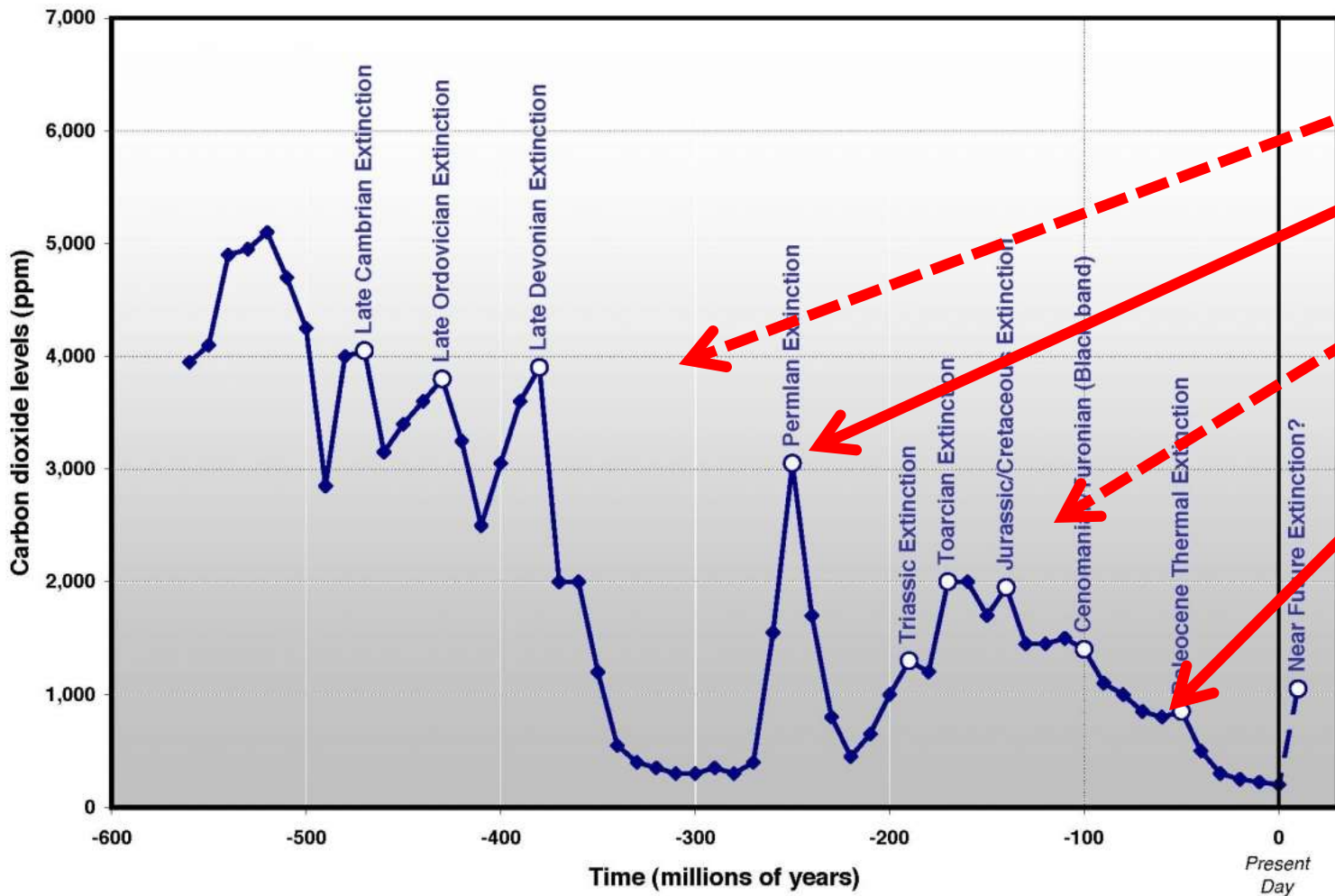
Brazil can Also Benefit From Other New Power Technologies, But Solar from Chile Is Most Important

- P. Werbos, “AI Intelligence for the Grid 16 Years Later: Progress, Challenges and Lessons for Other Sectors,” in Proc. International Joint Conference on Neural Networks, IEEE, 2018: Rio, July 2018.
- Reviews intelligent grid work led by NSF, new cybersecurity issues, global markets, larger issues of internet of things.
- www.Werbos.com/E/GridIOT.pdf (semifinal)

US Senate skeptics 2009: “CO2 was >2000 ppm for millions of years in earlier earth. Didn't life just go on as usual? How bad could it be?”



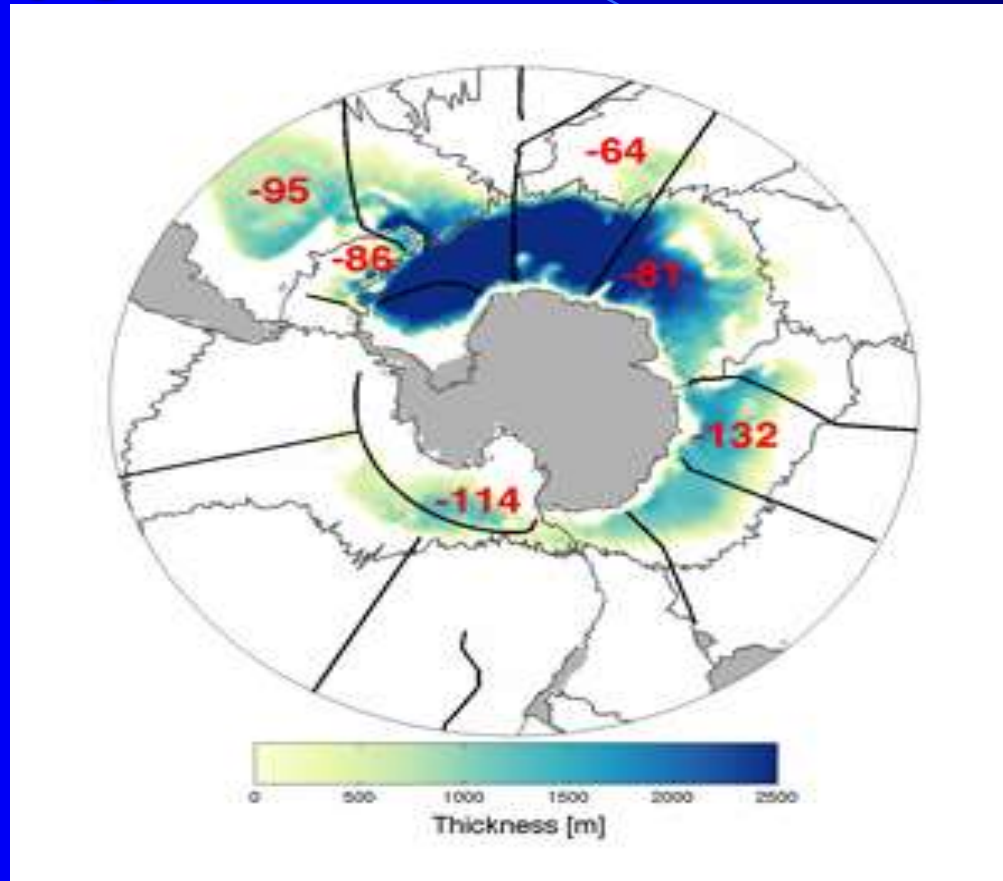
No one in the room knew,
but I decided to find out



H2S in air
And
Radiation
Enough
To kill
All humans

- NSF Geosciences sponsored best data on past:
- Graph from Peter Ward, Under a Green Sky, adapted by Englander. Ward theory half right.

Could global warming cut off the flow of oxygen to the Pacific Ocean?



It already has! Best NOAA data suggest 40 years left, maybe better, maybe worse, but we need more data – and should face up to what we see.

Given Current US Blinders, New International Efforts Also Needed (as Big as Antarctic Work) in:

- RD&D to develop/improve best options for geoengineering to try to restore Antarctic THC
- Aquarium-sized R&D with modern assay to assess just what ocean conditions cause proliferation of H₂S-producing archaea
- Technology to improve fertilizer efficiency and reduce runoff to Pacific waters

http://drpauljohn.blogspot.com/2018/03/which-environmentalists-are-working-for_30.html