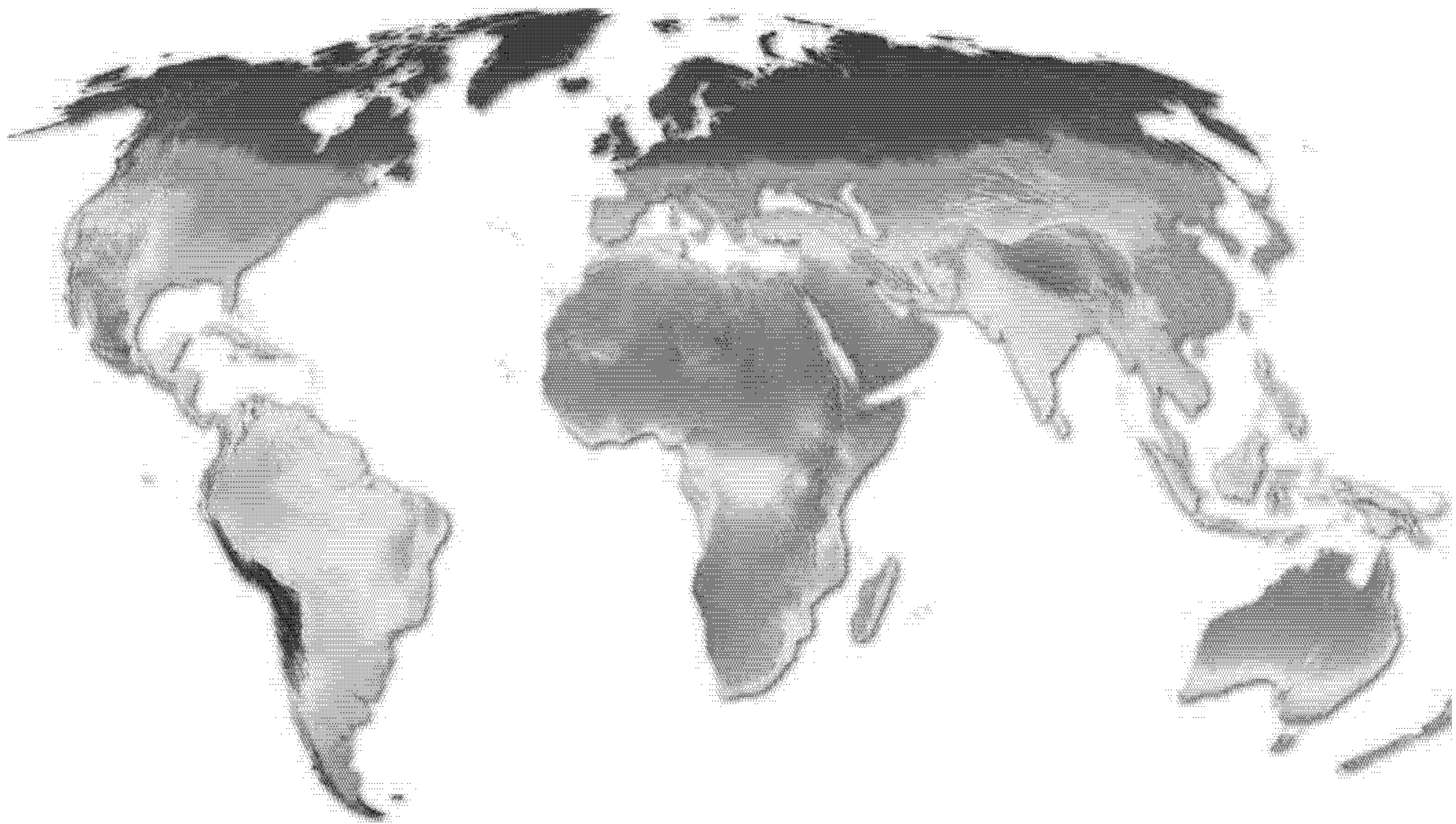
VALHALLA

ESPEJO DE TARAPACÁ

Solar PV + Central Hidráulica de Bombeo

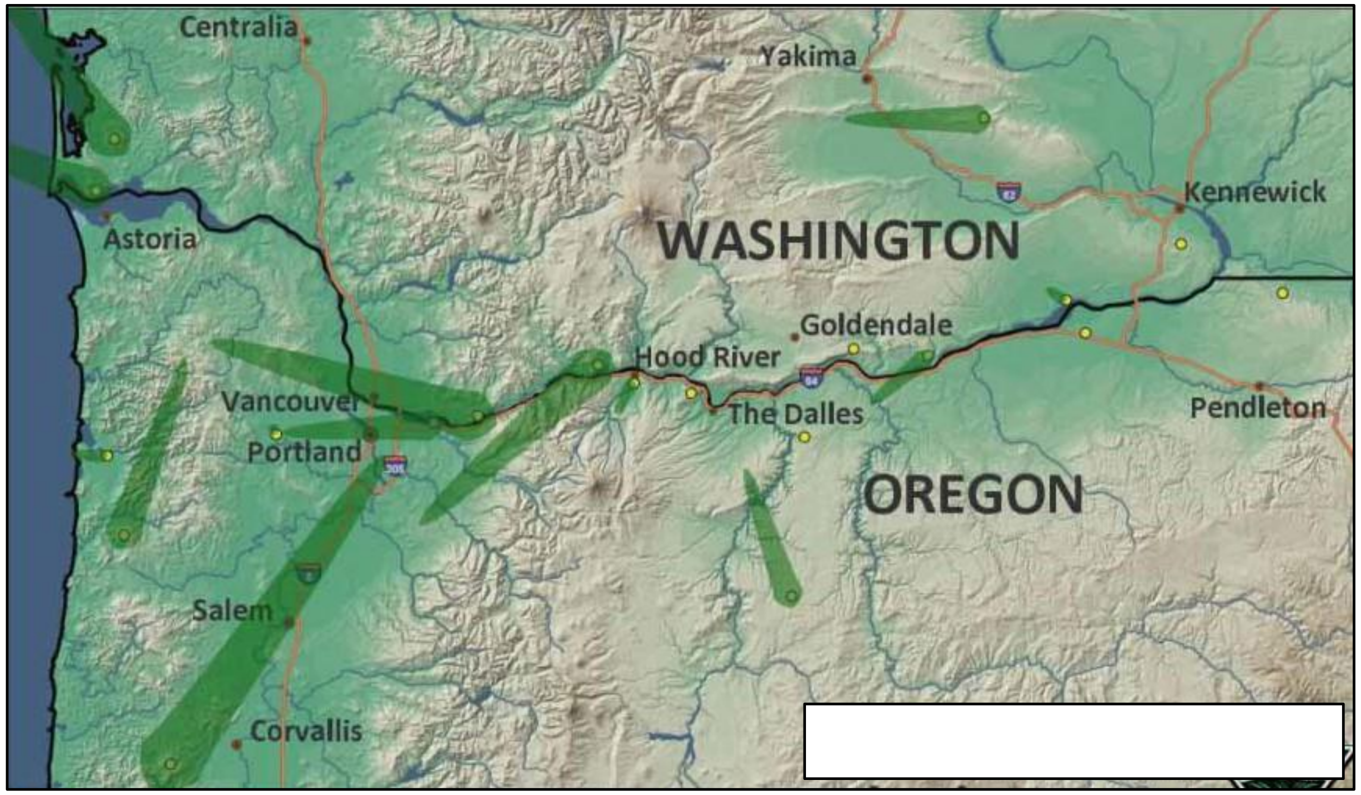
Global Solar rradiance

3TIE



VALHAL

EL DESAFIO: ESTABILIDAD SISTEMICA



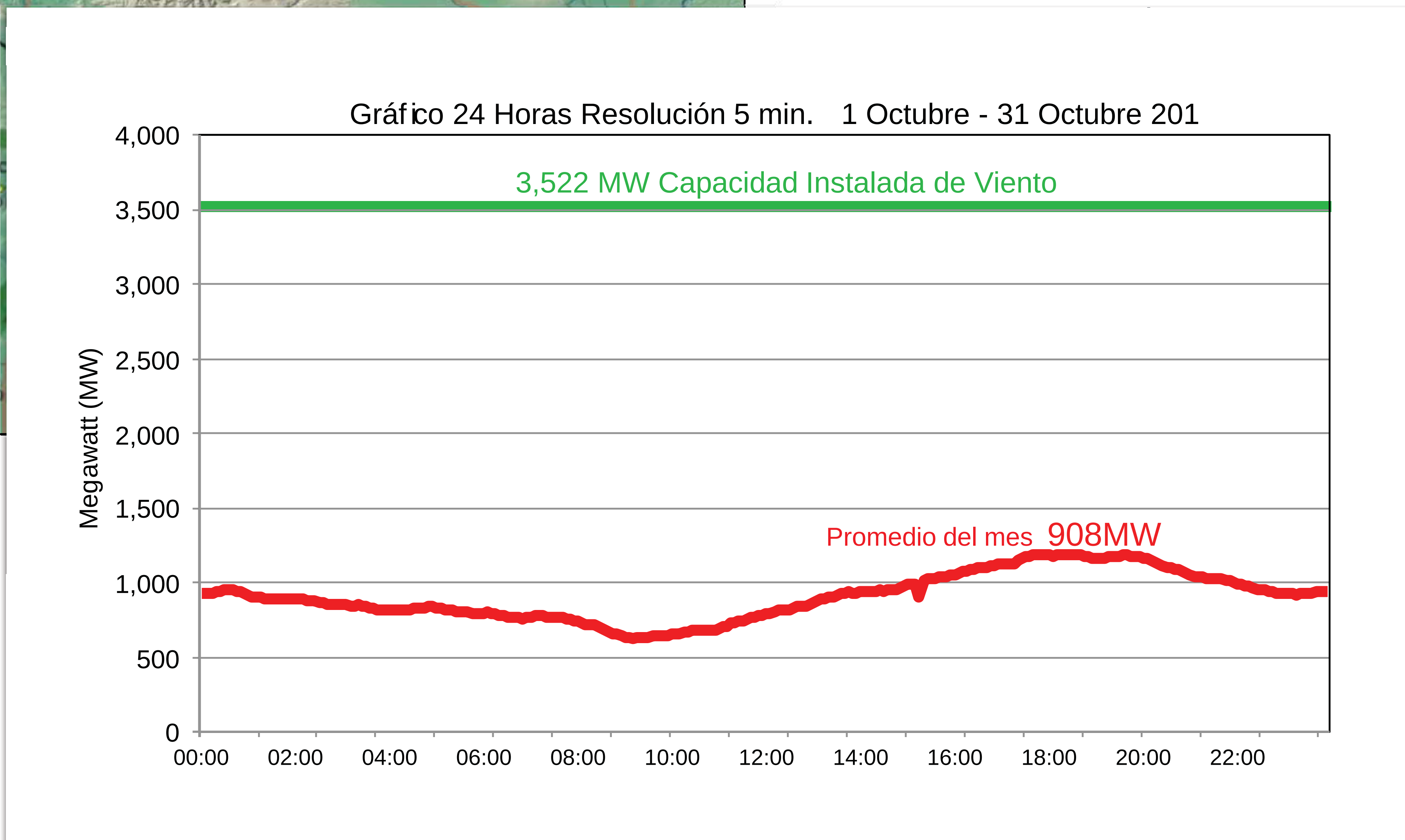
Fuente: Bonneville Power Administration (BPA)

Al 2011: 3.522MW de capacidad eólica instalada, con más de 2.500 turbinas repartidas en un área de 400 kilómetros de ancho por 280 kilómetros de alto

VALHALLA

EL DESAFIO: ESTABILIDAD SISTEMICA

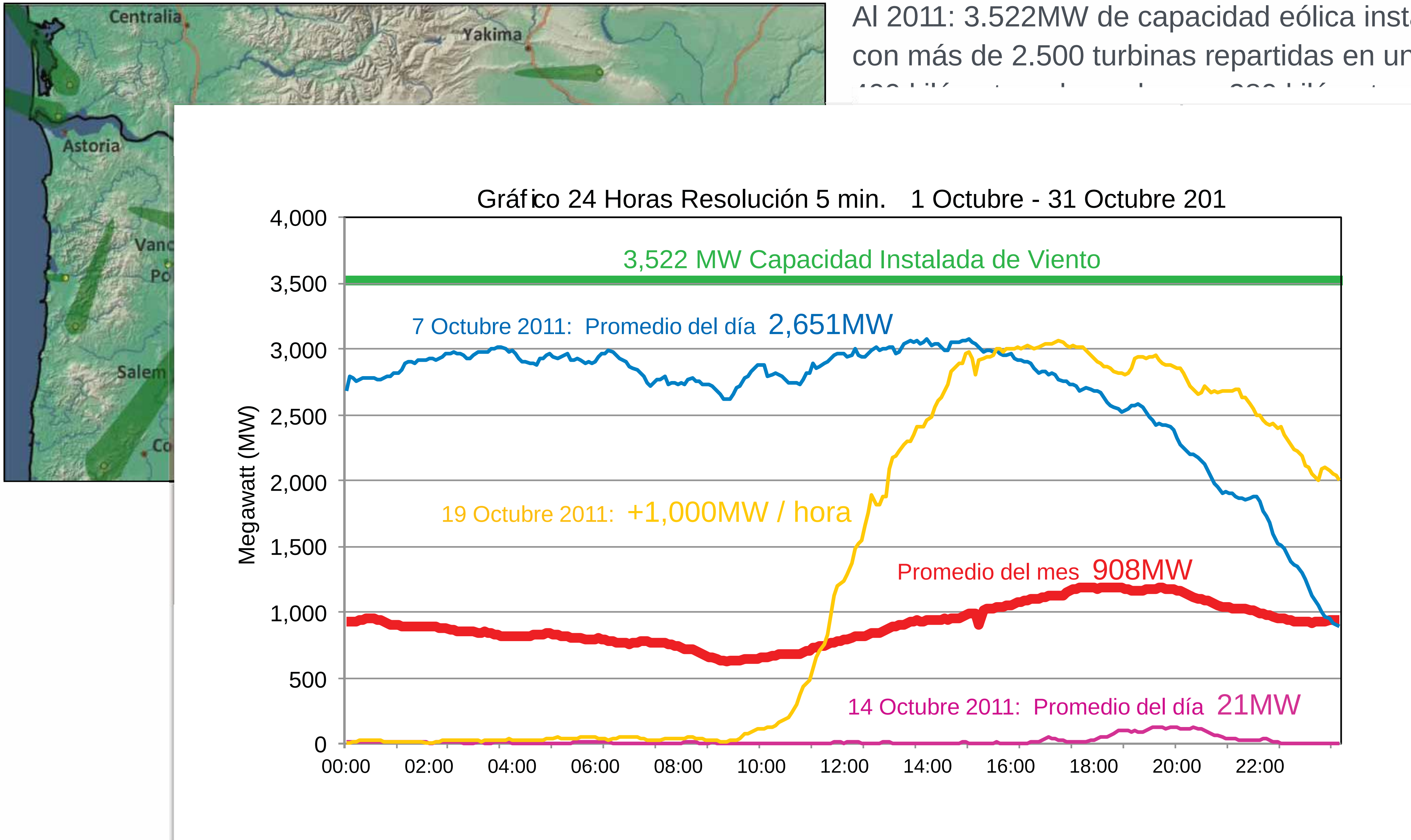
Al 2011: 3.522MW de capacidad eólica instalada, con más de 2.500 turbinas repartidas en un área de



Fuente: Elaboración Propia con info BPA

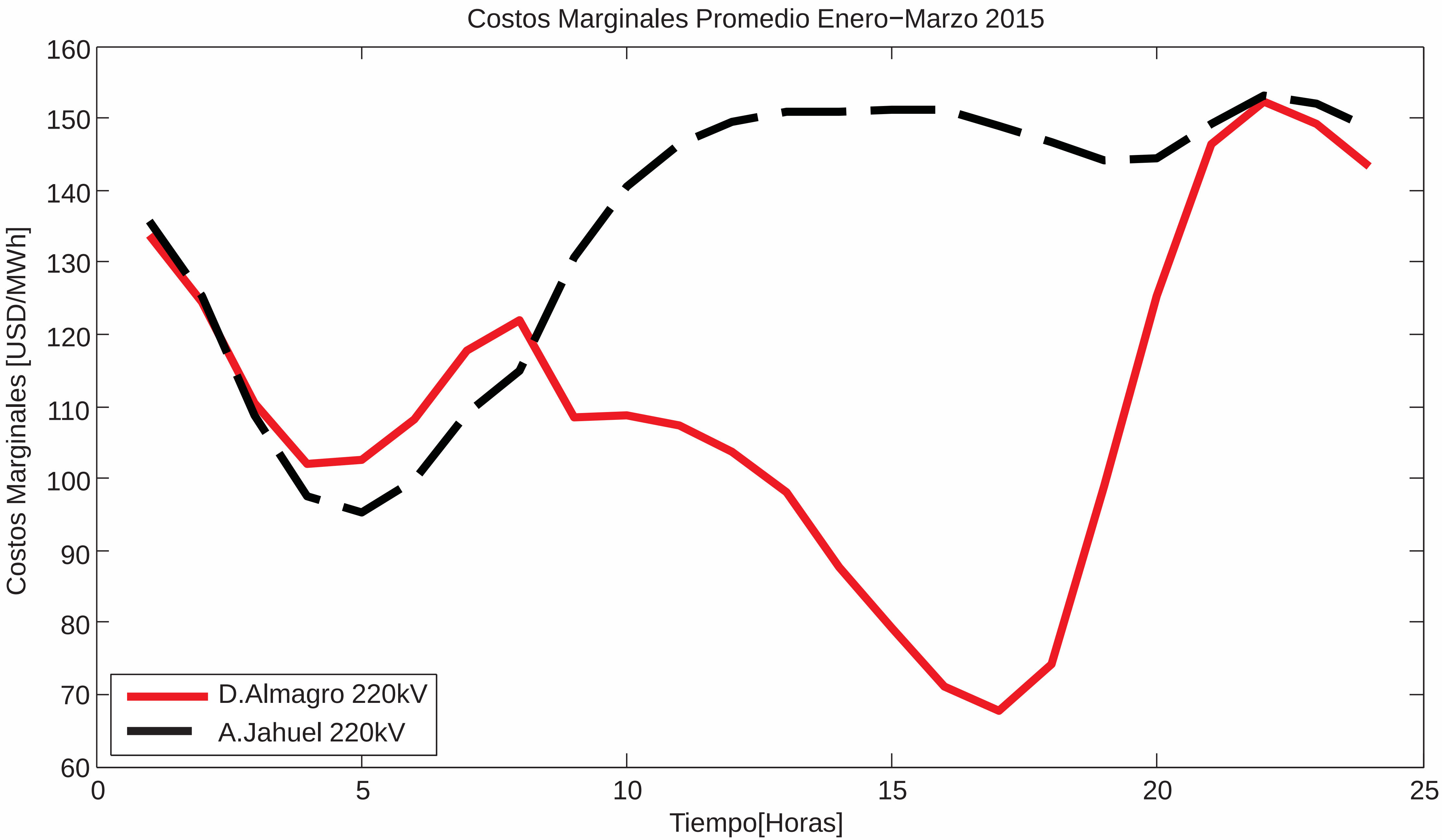
EL DESAFIO: ESTABILIDAD SISTEMICA

Al 2011: 3.522MW de capacidad eólica instalada, con más de 2.500 turbinas repartidas en un área de ... alto



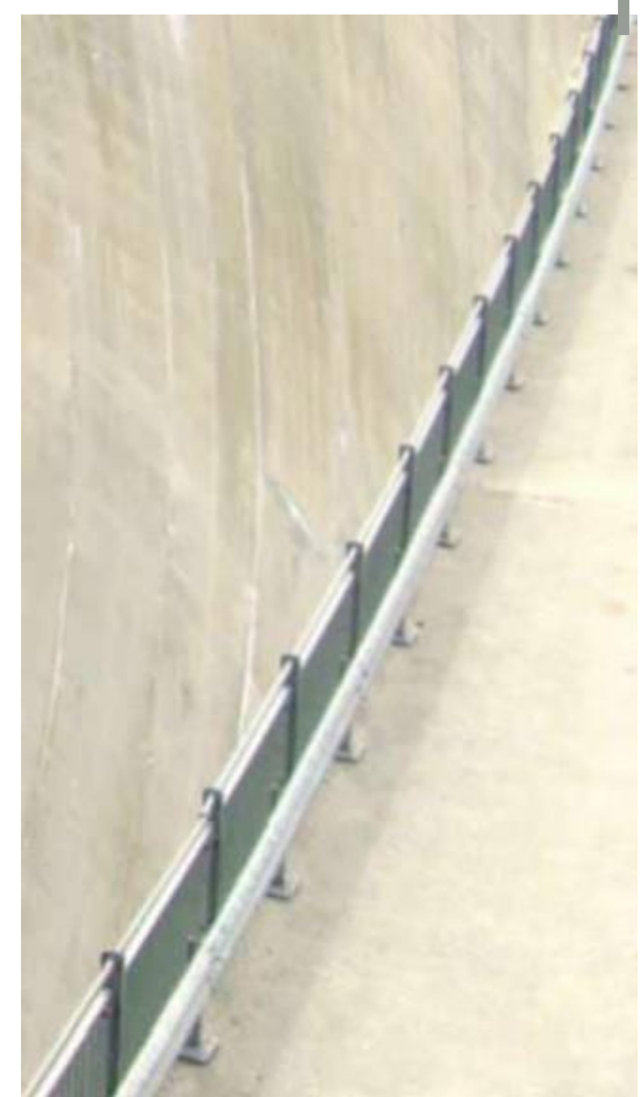
Fuente: Elaboración Propia con info BPA

EL DESAFIO: VIABILIDAD ECONOMICA

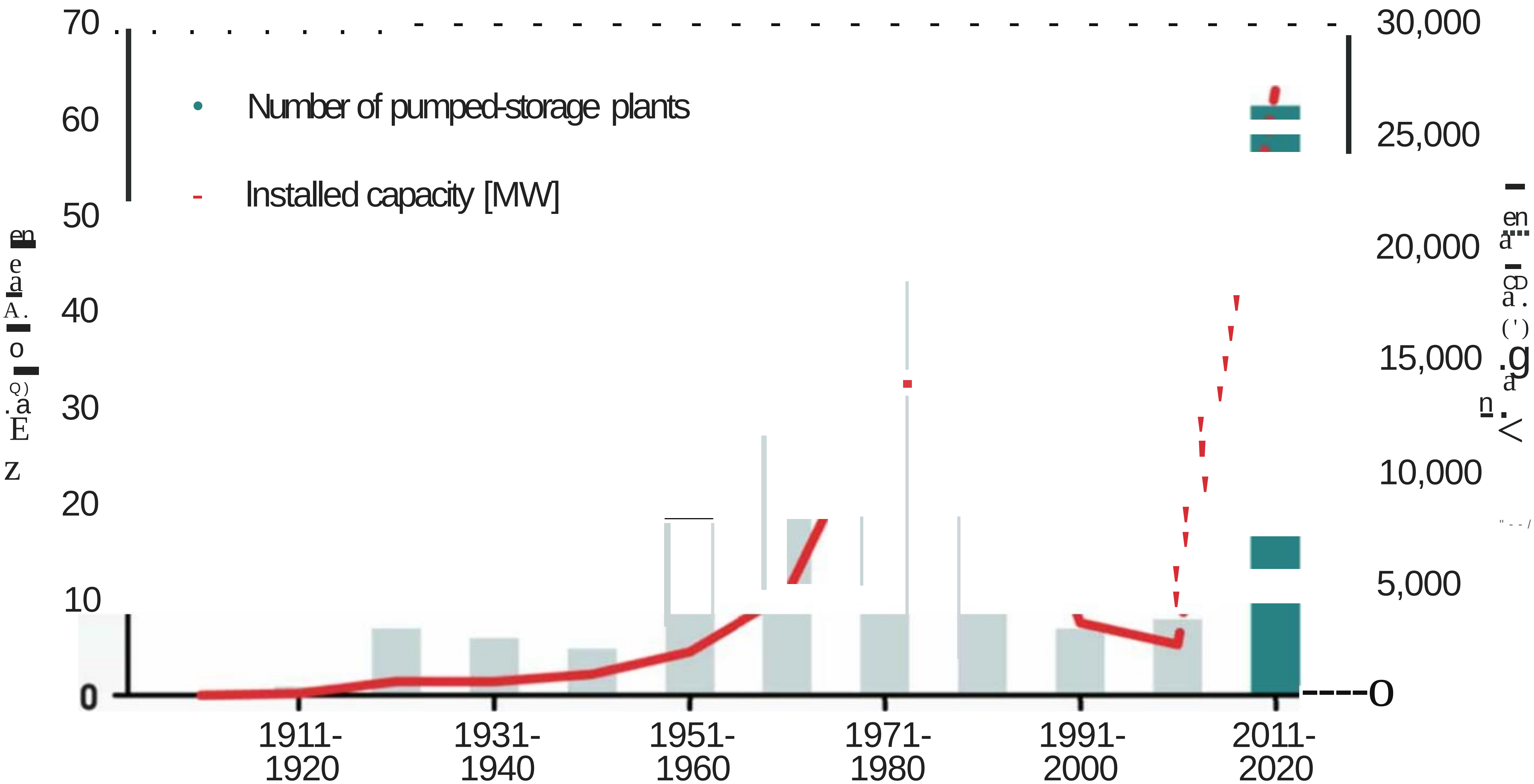


Fuente: Elaboración Propia con info CDEC-SIC

LA SOLUCION GLOBAL



LA SOLUCION GLOBAL



LA SOLUCION GLOBAL

Fuente: Elaboración Propia

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LA SOLUCION GLOBAL

China	**18.000**	**Hoy**
Qingyuan	1.280	2015
Hohhot	1.224	2015
Hongping	1.200	2015
Liyang	1.500	2016
Jixi	1.800	2018
Huanggou	1.200	2019
Fengning	3.600	2019

Fuente: Elaboración Propia

VALHALLA

LA SOLUCION LOCAL

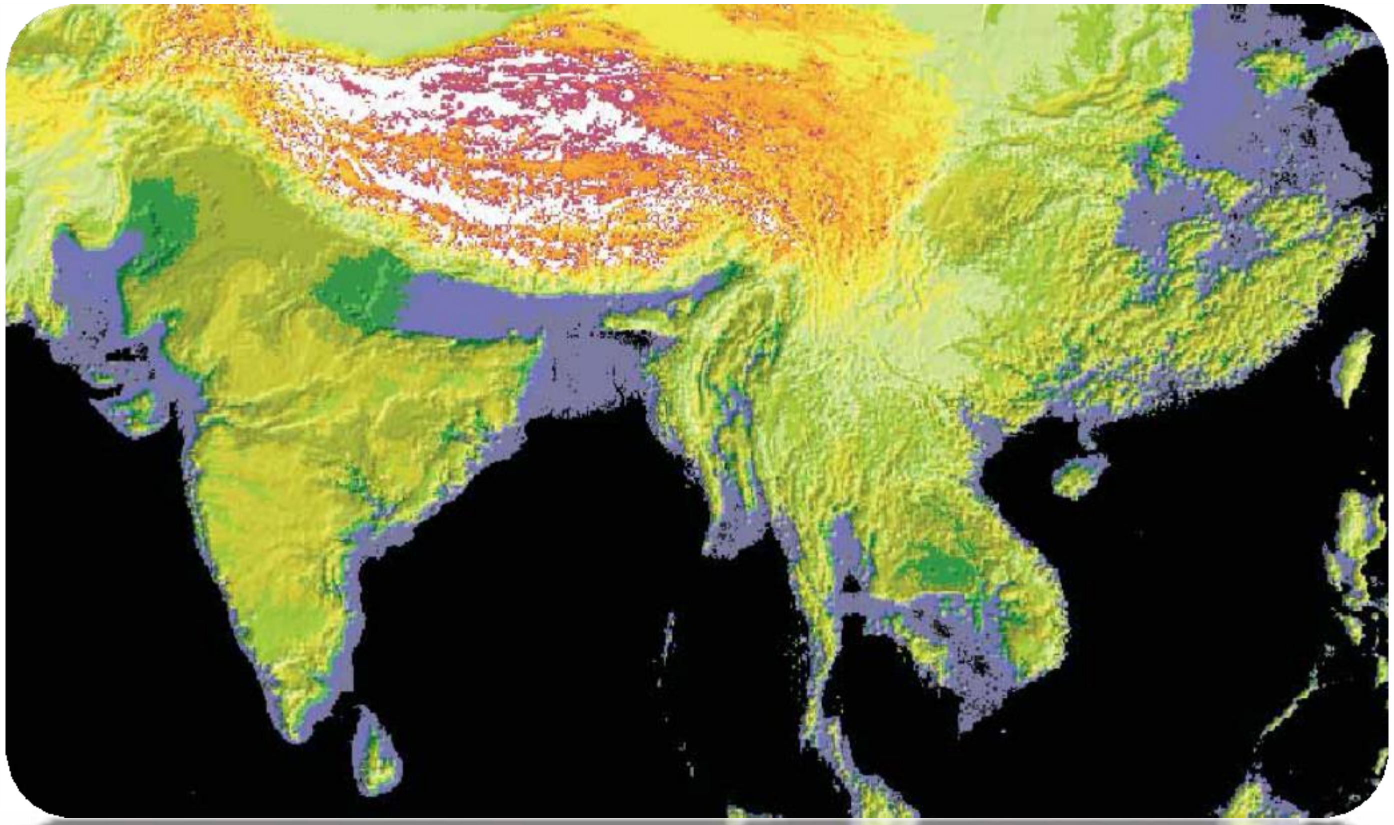
LA SOLUCION LOCAL

Maitenes Auxiliar (1926)

VALHALLA

LA SOLUCION LOCAL

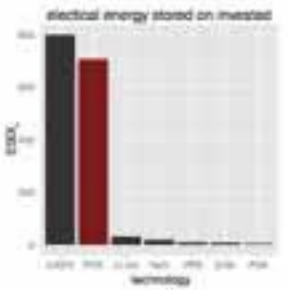
LA SOLUCION LOCAL



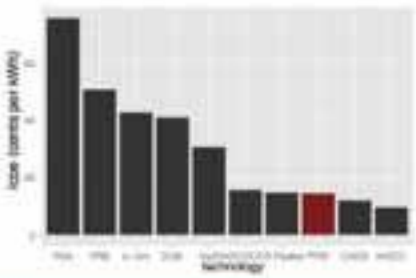
LA SOLUCION LOCAL

ENERGY STORAGE POTENTIAL ESTIMATES USING GIS-BASED TOPOGRAPHIC ANALYSIS

Pumped Hydro Storage (PHS)



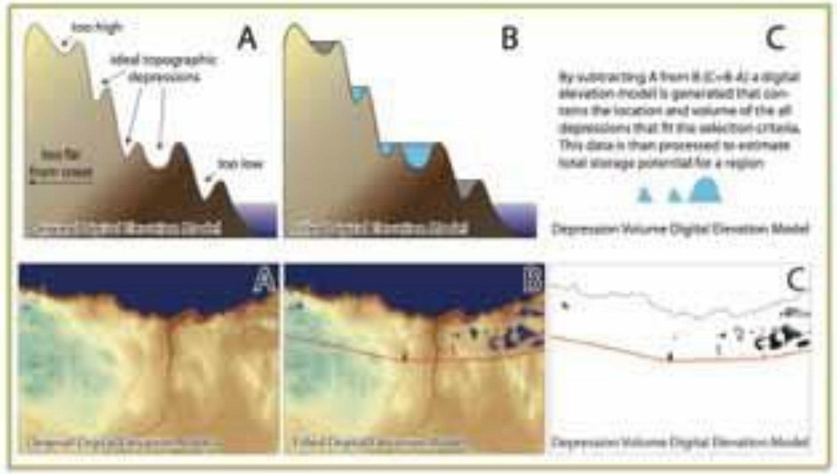
Over 99% of storage on the grid is PHS. This is not surprising because PHS combines high energetic performance (figure A) with low financial costs (figure B). It is however, geographically limited. Coastal PHS, which uses the ocean as the lower reservoir, may open vast new storage potential.



Yanbaru Power Station, Okinawa

Methods: Using GIS to identify topographic depressions in coastal locations

We employ ArcGIS and GRASS GIS to locate local topographic depressions in digital elevation models (DEM) obtained from NASA shuttle radar topography mission (SRTM) data. We then process the found depressions with a python script that records depression latitude, longitude, elevation, areal extent, and potential energy storage capacity.

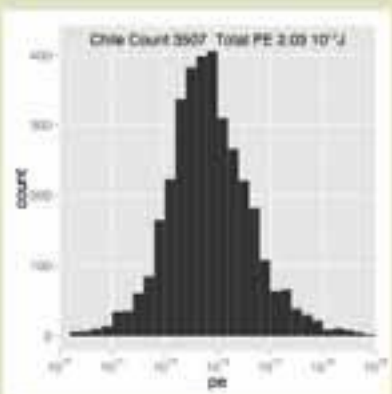


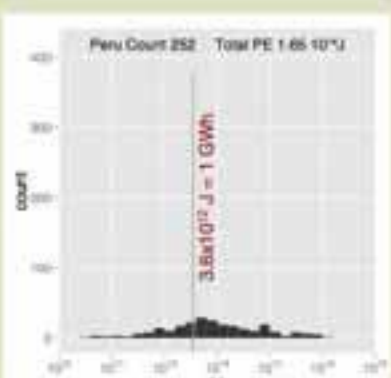
We bound our search with critiriea that make for good PHS: near the coast (<20km), not too high (<1500m), and not too low (>100m). We aggregate the results and produce a .kml file with pertinent data for use in Google Earth.

ABSTRACT: Large-scale electrical energy storage could accommodate variable, weather dependent energy resources such as wind and solar. Pumped hydroelectric energy storage (PHS) and compressed energy storage area (CAES) have life cycle energy and financial costs that are an order of magnitude lower than conventional electrochemical storage technologies. However PHS and CAES storage technologies require specific geologic conditions. Conventional PHS requires an upper and lower reservoir separated by at least 100 m of head, but no more than 10 km in horizontal distance. Conventional PHS also impacts fresh water supplies, riparian ecosystems, and hydrologic environments. A PHS facility that uses the ocean as the lower reservoir benefits from a smaller footprint, minimal freshwater impact, and the potential to be located near off shore wind resources and population centers. Although technologically nascent, today one coastal PHS facility exists. The storage potential for coastal PHS is unknown. Can coastal PHS play a significant role in augmenting future power grids with a high faction of renewable energy supply? In this study we employ GIS-based topographic analysis to quantify the coastal PHS potential of several geographic locations, including California, Chile and Peru. We developed automated techniques that seek local topographic minima in 90 m spatial resolution shuttle radar topography mission (SRTM) digital elevation models (DEM) that satisfy the following criteria conducive to PHS: within 10 km from the sea; minimum elevation 150 m; maximum elevation 1000 m. Preliminary results suggest the global potential for coastal PHS could be very significant. For example, in northern Chile we have identified over 3500 locations that satisfy the above criteria. 52 of these locations could store over 10 million cubic meters of water or several GWh of energy. We plan to report a global database of candidate coastal PHS locations and to estimate their energy storage capacity.

Key Result:

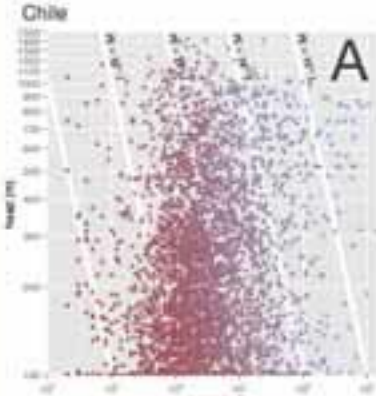
There is tremendous technical potential for coastal PHS in Chile and Peru.





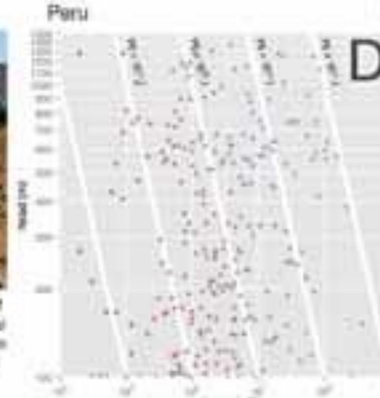
Detailed Results for Chile and Peru: Depression location, elevation and energy storage potential

Chile



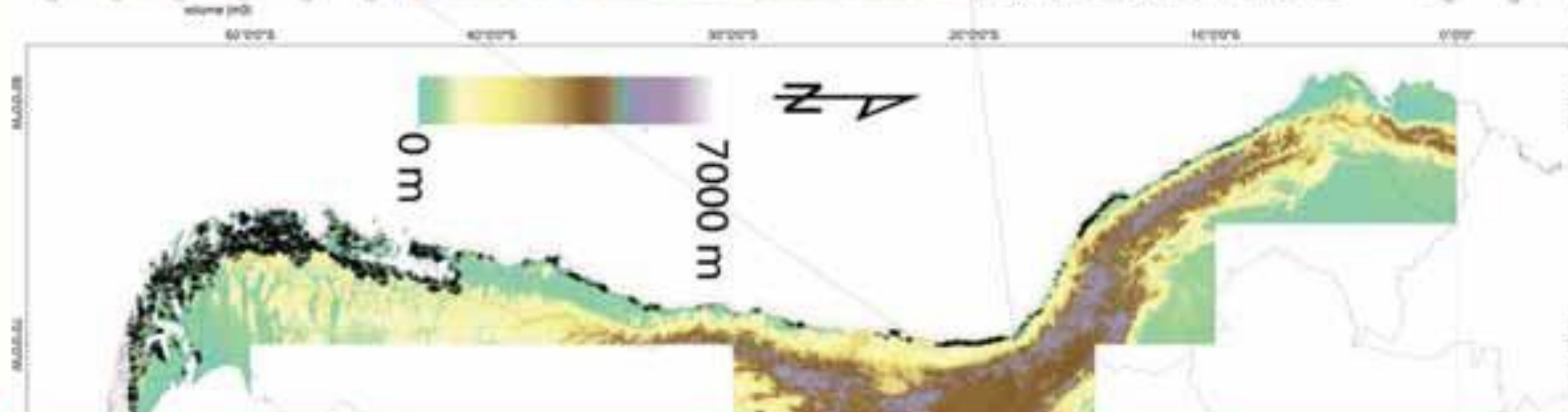
Panels A and D show head vs volume and contour lines of potential energy storage for depressions located in coastal Chile (A) and Peru (D). Panel B is a zoom of the Atacama in Northern Chile with an overlay of filled depressions. Panel C shows the dramatic coastal cliff of the Atacama.

Peru



Depressions with greatest storage potential

	head (m)	PE (GWh)
Chile	848	2450
	830	1910
	865	1710
	313	1260
	744	1258
Peru	1251	391
	1126	267
	569	246
	1251	239
	382	229



Future Work: We plan to continue to perform this analysis at coastal locations worldwide. Once an abundance of potential sites have been established for a region, focus needs to shift to secondary concerns that will determine project viability. We plan to further employ GIS analyses to quantify economically sensitive parameters like distance from cities, load centers, generation resources, and the ocean. Environmentally sensitive parameters are important too. We plan to filter out potential sites that reside in national parks, biological preserves and geologically hazardous locations like fault lines and arroyos.

LA SOLUCION LOCAL

VALHALLA

Espejo de Tarapacá

Cielos de Tarapacá

ESPEJO DE TARAPACA

Solución revolucionaria y altamente escalable. EDT es el primer paso de un concepto que combina tecnologías probadas (CHB y Solar), que puede ser replicado e integrado con todo tipo de renovables (i.e. Eólica), y que va a cambiar el mercado eléctrico chileno

Alternativa renovable competitiva. EDT es una solución competitiva con tecnologías convencionales - pero sin volatilidad de combustibles o variabilidad hidrológica -, que contribuye a destrabar penetración de renovables, a la independencia energética y a reducir la huella de carbono

Fundamentos económicos. El modelo de negocios se basa en ingresos provenientes de PPA con clientes finales, pagos por capacidad, trading y servicios complementarios. Este no requiere subsidios de ningún tipo

Relación con la comunidad. Valhalla ha desarrollado una relación temprana, transparente, participativa y permanente con la comunidad de Caleta San Marcos, la que viene desde antes del inicio de cualquier estudio en terreno

Equipo experimentado. Valhalla ha incorporado un equipo de especialistas con amplia experiencia en estructuración de proyectos energéticos a gran escala, cubriendo ámbitos de ingeniería, construcción, medioambiental, mercado, regulación económica, legal y Project Finance

VALHALLA

INTEGRACION COMERCIAL

Modelo Negocios 24/7

PROYECTO INTEGRADO COMERCIALMENTE

PLANTA SOLAR PV

Día

-

300 MW disponibles para generación (PPA & spot sistema).

-

300 MW disponibles para bombeo.

INTERCONNECTED ELECTRIC GRID

FINAL CUSTOMER
200 MW PPA

CENTRAL BOMBEO

Noche

-

300 MW disponibles para generación (PPA & spot sistema).

INGRESOS PRINCIPALES

PPA

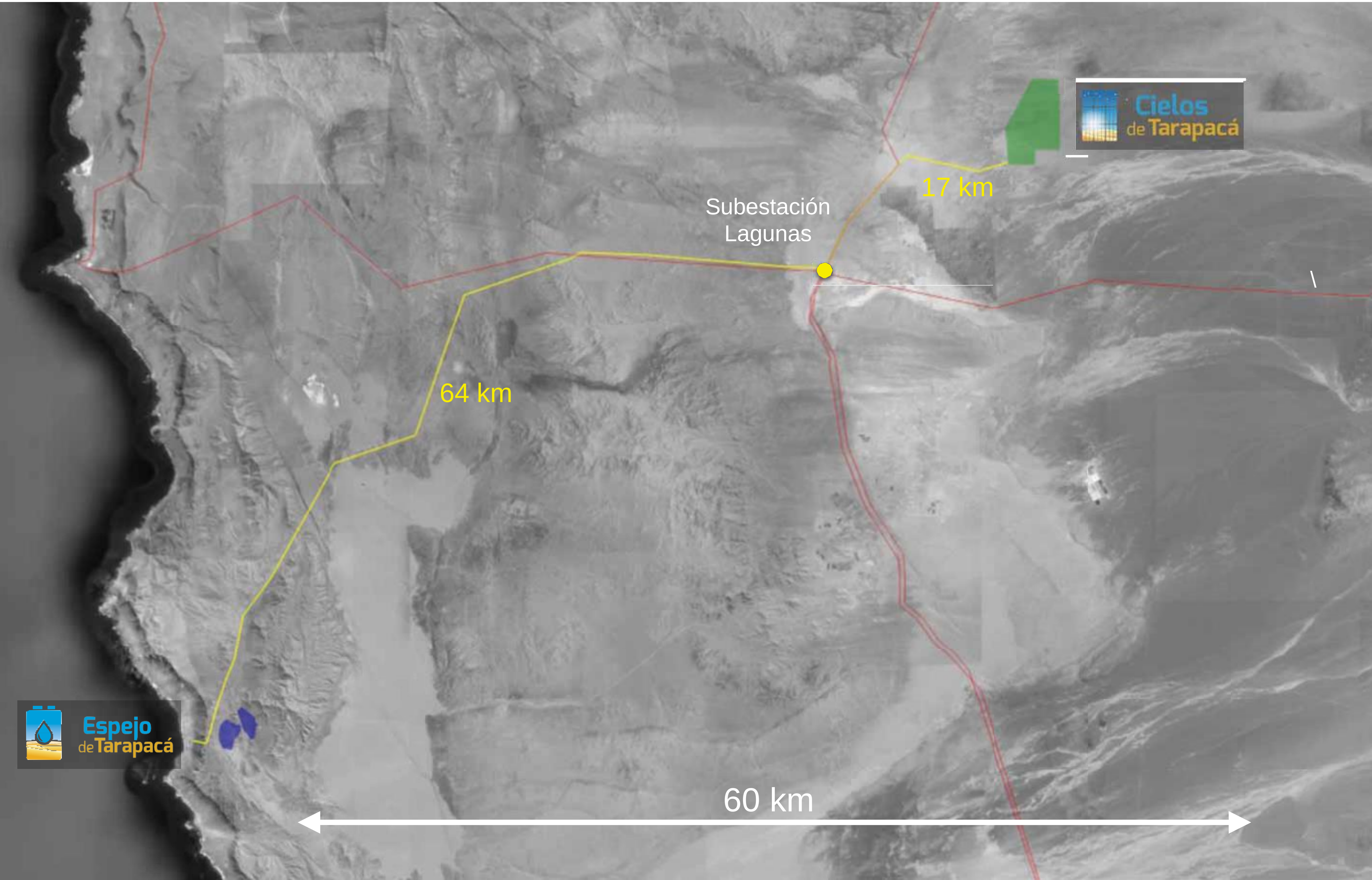
Pago por capacidad central bombeo

INGRESOS ADICIONALES

Ventas energía en spot

SS.CC.

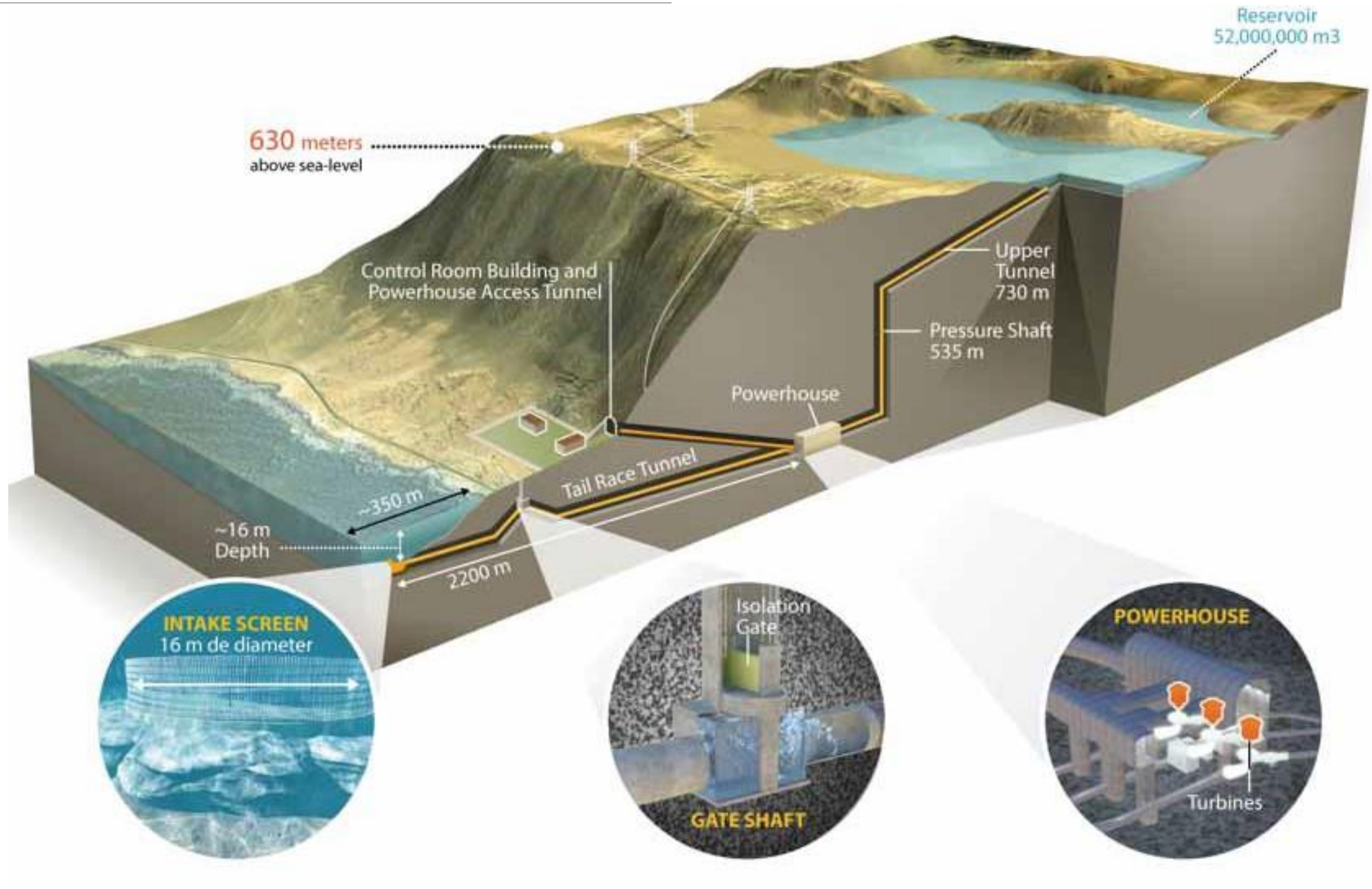
UBICACION GEOGRAFICA



ESPEJO DE TARAPACÁ

Pumped-Storage Hydro Plant

LAYOUT PUMPED-STORAGE HYDRO PLANT



UBICACIÓN PROYECTO

VALHALLA

ÁREAS PROYECTO

VALHALLA

VISTA FRONTAL

VALHALLA

VALHALLA