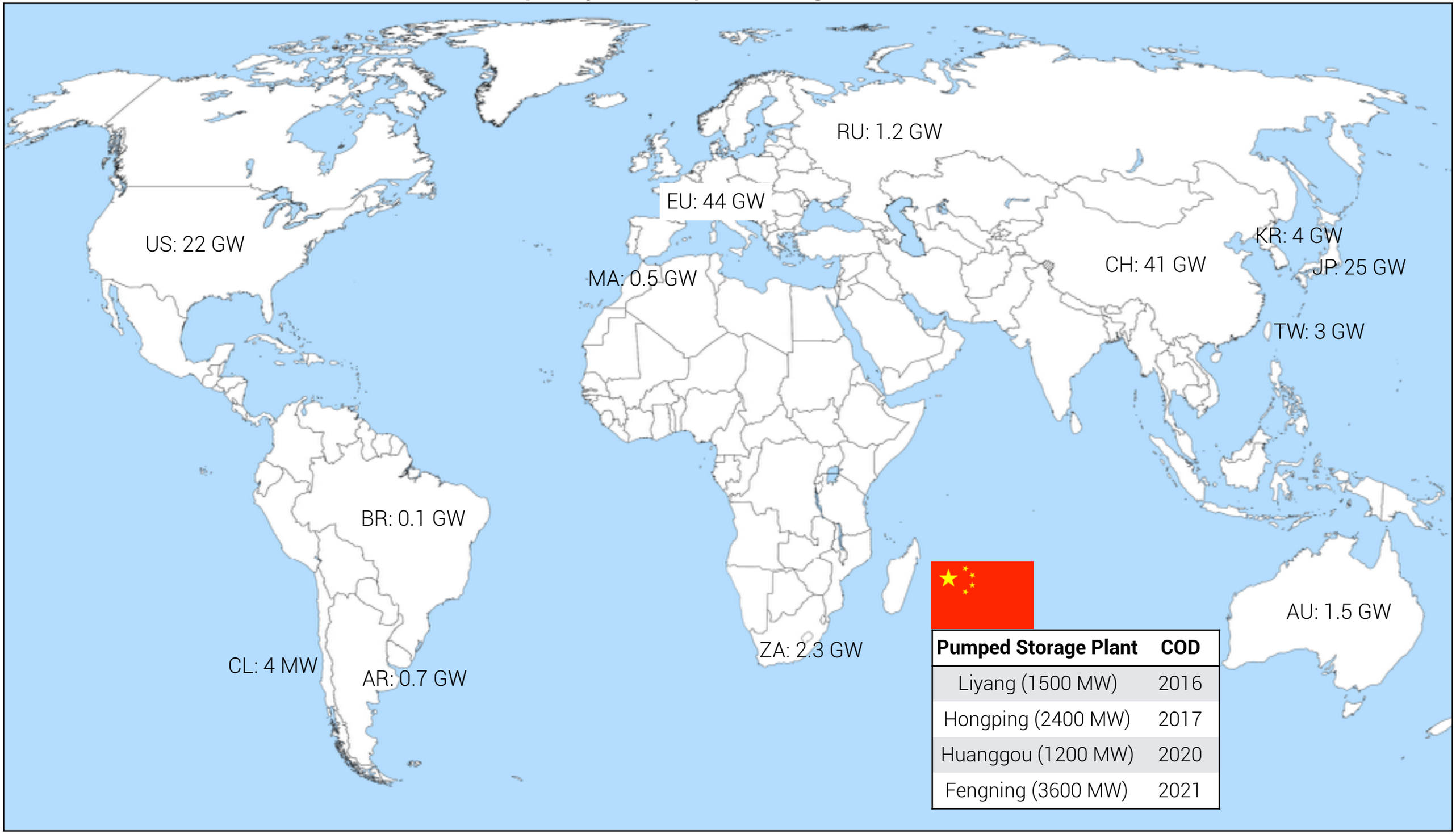
VALHALLA

April 2017

EdT CAPEX Breakdown

Installed Capacity of Pumped Storage Plants: ~145 GW



Pumped Storage Plant	COD
Liyang (1500 MW)	2016
Hongping (2400 MW)	2017
Huanggou (1200 MW)	2020
Fengning (3600 MW)	2021

Pumped Storage Plants – CAPEX

Historically, PSH CAPEX has ranged from USD 2,000/kW to USD 3,600/kW.
CAPEX of recent PSH projects including Espejo de Tarapacá (EdT) are shown below.

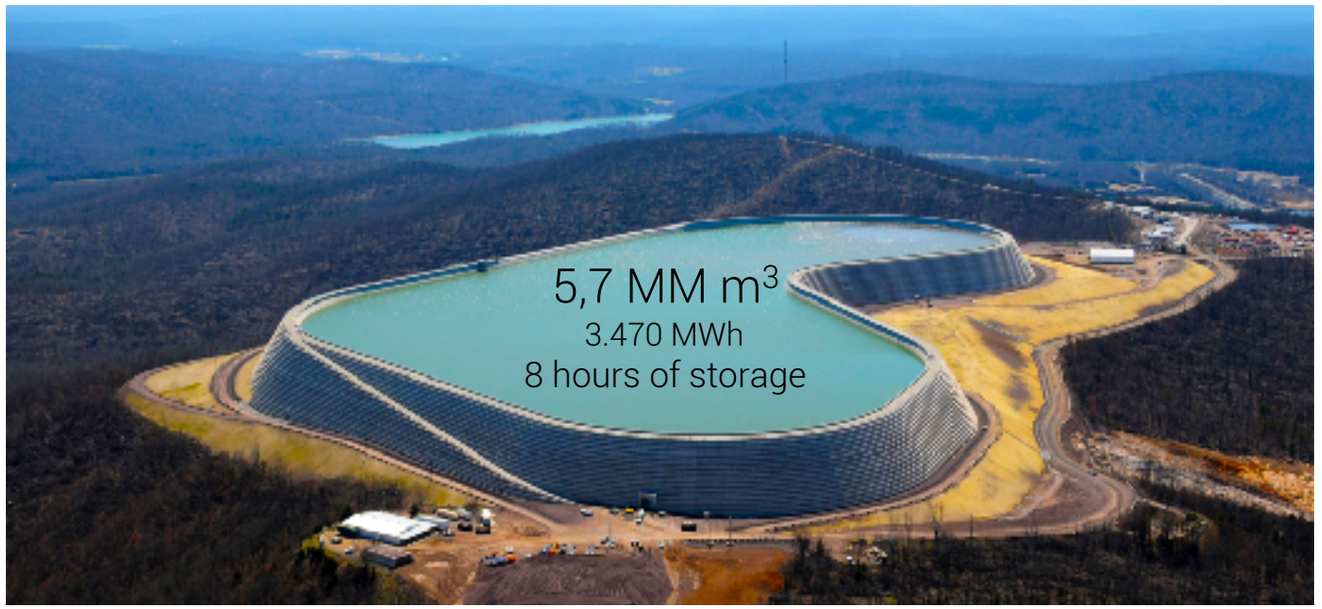
PSH	Country	Capacity (MW)	Cost (MM)	USD/kW	COD
Ingula	South Africa	1,332	3,500	**2,628**	2016
Nant de Drance	Switzerland	900	2,100	**2,333**	2018
Leningradskaya	Russia	1,560	3,025	**1,940**	Planned
Espejo de Tarapacá	Chile	300	471	**1,570**	2021

Why is the unit cost of EdT significantly lower than other PSH plants which are more than triple in size?

a. Large Natural Reservoir: Natural concavity serves as Upper Reservoir and Pacific Ocean serves as Lower Reservoir—avoiding construction of dams and contention infrastructure,
b. Minimal Distance: 3 km distance between upper and lower reservoirs minimizes construction costs and energy losses,
c. Optimal Elevation: Coastal site with cliff 600 m above sea-level provides hydraulic head with superior relationship between potential energy and the cost of civil & underground works,
d. Favorable Intake Conditions: Rocky ocean bed with steep drop-off (350 m from coast at depth of 16.5 m).

EdT – Natural Reservoir & Low Cost

The cost savings achieved with natural reservoirs (the ocean and existing concavities) can be understood by comparison to an existing PSH plant, Taum Sauk[1] (440 MW).



In December 2005, the upper reservoir suffered catastrophic damage (see photo below).
A new reservoir was constructed at a total cost of USD 450 million for a 440 MW PSH, which is equivalent to **USD 1,000/kW**, only for the upper reservoir.

[1] Located in Missouri (USA), commissioned in 1963.

EdT – Natural Reservoir & Capacity

In order to put in context EdT's enormous size[1], it can be compared to Bath County PSH, Virginia, USA.

Bath County is the largest PSH plant in the world with a capacity of 3,000 MW – 10 times larger than EdT. Bath County's reservoir is capable of storing **34 GWh**, equivalent to operating 11 hours at full capacity.

EdT has storage capacity of **76 GWh** – 2.2x Bath County. EdT's reservoir is capable of storing the equivalent to operating *253 hours at full capacity*.

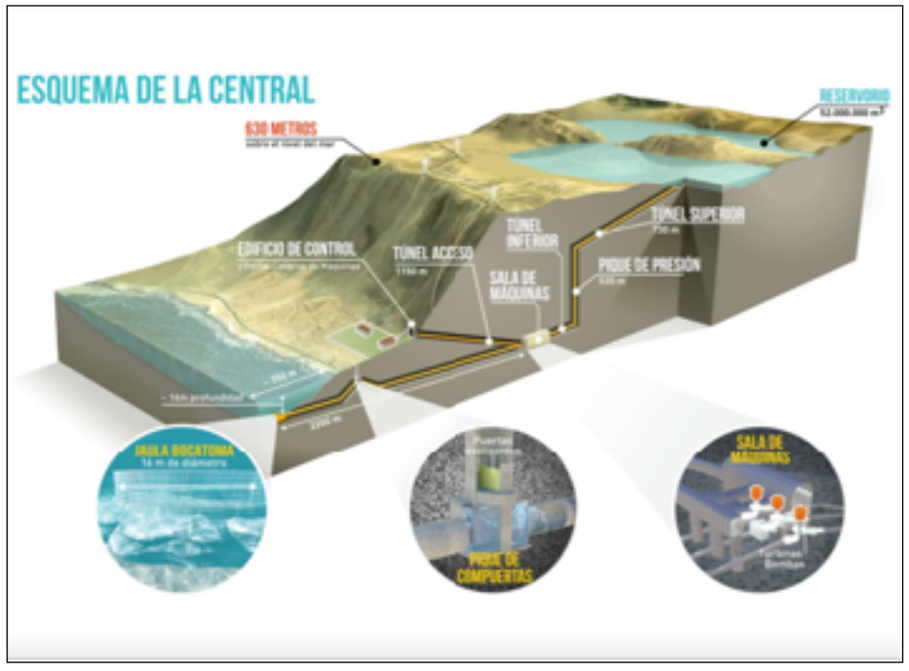
Standard PSH plants are typically capable of storing between 6 and 20 hours.

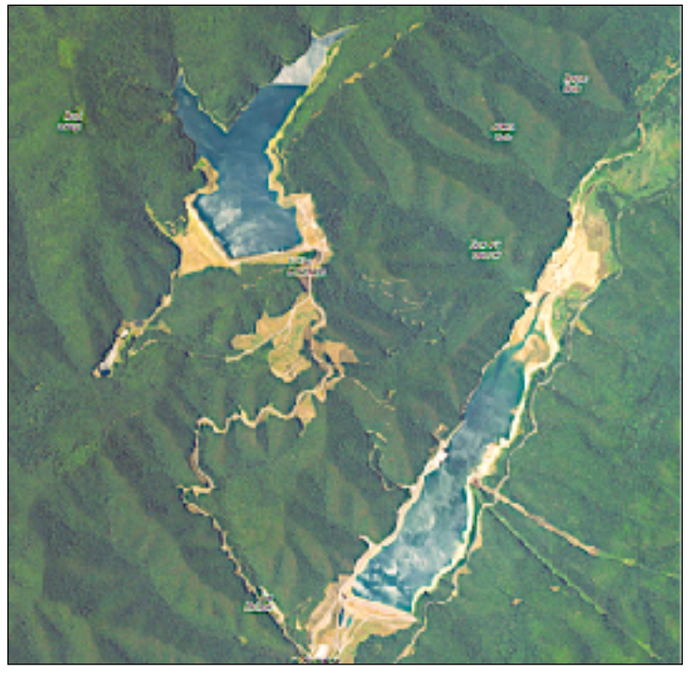
EdT (300 MW)

Maximum Reservoir Area	375	Ha.
Volumetric Capacity	52	MM m^3
Gross Hydraulic Head	608	m
Maximum Stored Energy	**76**	**GWh**

Bath County (3,003 MW)

Maximum Reservoir Area	220	Ha.
Volumetric Capacity	35	MM m^3
Gross Hydraulic Head	402	m
Maximum Stored Energy	34	GWh





[1] In colloquial terms, the volume of the reservoir is equivalent to 22,000 Olympic pools and the surface area to 500 football fields.

Iquique

Cielos de Tarapacá

Espejo de Tarapacá

18 km

Cielos de Tarapacá

Pacific Ocean

65 km

Espejo de Tarapacá

Lagunas Substation (interconnection point)

Dedicated Transmission Line

Existing Transmission Lines

Santiago

Espejo de Tarapacá

100 km al sur de Iquique

Parámetros Técnicos Centrales de Bombeo Valhalla

	Espejo de Tarapacá	Espejo de Antofagasta	Espejo de Antofagasta II
Capacidad (MW)	300	920	900
CAPEX Unitario (USD/kW)[1]	1,570	1,150	880
OPEX Unitario (USD/kW-año)[2]	38	29	23
Eficiencia Roundtrip[3]	76.5%	77.3%	77.3%
Período de Construcción	3.5 años	4.3 años	3.2 años
Comisionamiento	2021	2024	?
Subestación de Interconexión	Lagunas 220 kV	Seccionamiento Línea SIC-SING 500 kV	Seccionamiento Línea SIC-SING 500 kV
Configuración	3 unidades Francis reversibles	4 unidades Francis reversibles	4 unidades Francis reversibles
Caída Bruta	608 metros	940 metros	940 metros
Capacidad Almacenamiento (GWh)	76	61	61

[1] Incluye transmisión e interconexión a red eléctrica.
[2] Incluye gastos de Operación y Mantenimiento, gastos de administración, programas sociales, mantención línea de transmisión y S/E, monitoreo medioambiental.
[3] Medida desde retiro de subestación hasta reinyección en la misma subestación (incluye todas las pérdidas: transmisión, motor/generador, bomba/turbina, de carga, evaporación).

EdA savings as compared to EdT:

- EdA hydraulic head increase implies 55% more power than EdT at same water flow – i.e. savings in civil works/tunneling
- Civil works/tunneling costs are significantly less than proportional to scale – i.e. 1% more capacity implies < 1% higher cost
- Relevant fixed costs, such as roads, are independent to project size

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